Final Program Environmental Impact Report

Expansion of Ferry Transit Service in the San Francisco Bay Area

Prepared by:

URS Corporation

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Prepared for:

WATER TRANSIT AUTHORITY

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This section summarizes the public involvement process and the list of preparers of this document. In general, this section describes the public and agency outreach activities that have taken place since the release of the Draft EIR in August 2002.

6.1 PUBLIC INVOLVEMENT AND SCOPING

6.1.1 Public Involvement

In addition to the preparation of this Program EIR, WTA developed a parallel public involvement strategy and process that includes coordination with many other organizations, project stakeholders, and government agencies. Working under the direction of the WTA's enabling legislation, the project team structure was created to allow for continuous and substantive input from the various interests and stakeholders. The structure includes:

- **WTA** – WTA Board of Directors and supporting staff serve as the Lead Agency under CEQA and the sponsors of this project. The WTA Board of Directors has held regularly scheduled meetings that are open to the public.
- **Technical Advisory Committee (TAC)** – Technical review group including various interest groups such as affected public agencies, recreational, environmental, business, ferry vessel operators, organized labor, and the public at large. The group discusses technical issues related to the environmental review. The following subcommittees provided input to the IOP and EIR development process:
  - The **Agency Ad-Hoc Committee** was created as a TAC subcommittee to focus specifically on the environmental concerns and regulatory issues of partner and future permitting agencies. This group met several times throughout the environmental process, providing early feedback on the environmental technical studies and resource issues.
  - The **Clean Marine Ad-Hoc Work Group** was created as a TAC subcommittee to examine current and future ferry vessel technologies.
  - The **SOS Ad-Hoc Work Group** was created as a TAC subcommittee to provide a forum for discussion of ferry operations safety methods and technologies.
  - The **Clean Marine Ad-Hoc Committee** was created as a TAC subcommittee to examine current and future ferry vessel technologies.
  - The **Environmental Organizations Ad-Hoc Committee** was created as a TAC subcommittee to provide environmental organizations such as the Bluewater Network and the Sierra Club an opportunity to discuss environmental concerns.
  - The **Intermodal Design Ad-Hoc Committee** was created as a TAC subcommittee with transit providers and current ferry operators to provide input on efficient transit connections to ferry terminals.
  - The **Operators Ad-Hoc Committee** was created as a TAC subcommittee to provide input on efficient terminal/system design and operations.

- **Community Advisory Committee (CAC)** – Forum for representatives appointed by their local governments to raise issues of local concern and learn about the project. Members represent local jurisdictions around San Francisco Bay with potential ferry terminal expansion or new terminal sites. The group, composed primarily of elected officials, serves as a conduit for information to the larger community.

- **Interest Groups, the Public, and Other Public Agencies** – Information channeled through a comprehensive public outreach plan. The TAC and CAC members serve as a conduit of information to their larger constituencies. Input is provided through direct communication, information flyers, project website, public meetings/presentations, and public hearings. Informational project presentations were provided to local/regional governments, civic organizations, and the public at large. A listing of the meetings held through August 2002 was provided in the Draft EIR.

The Public Involvement process aims to keep stakeholders involved through the CAC, TAC, open public forums, and project updates. The following provides a comprehensive list of meetings and other outreach methods convened by the WTA to educate stakeholders throughout the environmental process.

- **TAC Meetings (Metropolitan Transportation Commission, 101 8th Street, Oakland)**

- May 1, 2001
- September 13, 2001
- December 13, 2001
- March 12, 2002
- June 11, 2002
- July 9, 2002

- **Agency Ad-Hoc Meetings – TAC Subcommittee (Bay Conservation and Development Commission, 50 California Street, San Francisco)**

- August 31, 2001
- March 1, 2002
- May 29, 2002

- **Clean Marine Ad-Hoc Work Group – TAC Subcommittee (Port of San Francisco, Pier 1, San Francisco)**

- June 29, 2001
- August 13, 2001
- November 16, 2001
- March 5, 2002
- May 7, 2002

- **SOS Ad-Hoc Work Group – TAC Subcommittee (Port of San Francisco, Pier 1, San Francisco)**

- October 19, 2001
- March 8, 2002
- April 18, 2002
- June 04, 2002
- July 12, 2002

- **Environmental Organizations Ad-Hoc Committee – TAC Subcommittee (WTA, 120 Broadway, San Francisco)**
  - August 16, 2001
- **Intermodal Design Ad-Hoc Committee – TAC Subcommittee (ARUP, 901 Market Street Suite 260, San Francisco)**
  - April 10, 2002
  - May 7, 2002
- **Operators Ad-Hoc Committee – TAC Subcommittee (WTA, 120 Broadway, San Francisco)**
  - January 28, 2002
  - March 25, 2002
  - April 17, 2002
- **CAC Meetings (425 Market Street, 26th Floor, SFSU Extension, San Francisco)**
  - May 2, 2001
  - September 5, 2001
  - December 12, 2001
  - March 27, 2002
  - July 10, 2002
- **Public Information Presentations (Various locations)** – Approximately 60 public information meetings and presentations were conducted by WTA staff with local governments, civic organizations, and interest groups. These presentations were held throughout the Bay Area to educate the public and decision-makers on the environmental process.
- **Project Website** – The project website at **www.watertransit.org** provides detailed and current information on the project. Many draft technical documents and presentations are available on the project website.

- **Project Update** – Distributed to a database of approximately 850 contacts, the project mailer provides stakeholders with a schedule and status report on the overall project. The Project Update is also distributed with information packets for the media and at stakeholder meetings.
- **Project Brochure** – The project brochure was developed to provide stakeholders with an overview of the entire program, including the environmental process. This is a full color, glossy, tri-fold brochure distributed at stakeholder meetings, conferences, presentations, and other public venues.

6.1.2 Public Hearings

The DEIR was released on August 26, 2002 and a public comment period was initially open until October 31, 2002. It was later extended to January 30, 2003. The Draft Implementation and Operations Plan (IOP) was submitted to the Legislature on December 12, 2002. The public comment period was open until October 31, 2002. During the public comment period, two public hearings were held on the DEIR and nine on the IOP. The hearings were a chance for members of the public to learn more about the program and to comment on the two documents. The following provides a comprehensive list of these hearings:

DEIR Hearings

- **September 10, 2002 – Oakland**

  Metropolitan Transportation Commission Auditorium
  101 8th Street, Oakland

- **September 17, 2002 – San Francisco**

  Port of San Francisco
  Bayside Conference Room
  Pier 1, San Francisco

IOP Hearings

- **September 26, 2002 – Contra Costa County**

  Senior Center
  818 Green Street, Martinez

- **October 1, 2002 – San Mateo County**

  The Municipal Services Building
  33 Arroyo Drive, South San Francisco

- **October 3, 2002 – Alameda County**

  Metropolitan Transportation Commission Auditorium
  101 8th Street, Oakland

- **October 8, 2002 – Marin County**

  Council Chambers
  1400 5th Street, San Rafael

- **October 10, 2002 – San Francisco County**

  Port of San Francisco
  Pier 1, San Francisco

- **October 15, 2002 – Sonoma County**

  Community Center
  320 N. McDowell Boulevard, Petaluma

- **October 17, 2002 – Solano County**

  JFK Library
  505 Santa Clara Street, Vallejo

- **October 21, 2002 – Santa Clara County**

  City Hall Council Chamber
  456 W. Olive Avenue, Sunnyvale

- **October 24, 2002 – Napa County**

  County Library
  Coombs Street, Napa

6.1.3 Public Comments

The project's public involvement process included public comment periods for both the DEIR and the Revised DEIR. During the comment periods, project stakeholders and the public had the opportunity to review the documents and provide the WTA with comments.

The WTA then considered and responded to the comments received and developed the FEIR. Comments on both the DEIR and the Revised DEIR are addressed together as a separate volume to this FEIR.

6.2 LIST OF PREPARERS AND CONTRIBUTORS

Water Transit Authority – Lead Agency

Manager of System Planning	Steve Castleberry
Chief Executive Officer	Tom Bertken
Manager of Marine Engineering	Mary Frances Culnane
Secretary to the Board and Executive Administrator	Lisa Klairmont
Public Affairs Officer	Heidi Machen
Project Manager IOP	Steve Morrison
Manager Communications and Gov.	Veronica Sanchez
WTA Administrative Assistant	Tristen Bettencourt

URS Corporation – EIR Authors

Project Manager	Jeff Zimmerman
Project Principal	Ian Austin
Air Quality	Cheri Velzy, Geoff Thornton, Dan Kringle
Biological Resources	Bill Martin, Minji Kim, Corinna Lu
Wake Wash	Ian Austin, Susan Zielinski
Dredging	Sergio Feld, Suzanne Loadholt
Navigation	Sergio Feld
Water Resources	Sergio Feld, Suzanne Loadholt
Aesthetics	Suzanne Eastridge
Community and Land Use	Orion Fulton, Minji Kim
Energy	Geoff Thornton
Cultural Resources	Bryon Bass
Geology	Clark Fenton, Jennifer Benton
Noise	Joe Czech
Report Coordination and Management	Geoff Thornton, Susan Zielinski
Technical Editors	Reinhold Dillon, Lynn McIntyre, Jay Plano, Jean Lewis, Pam Cory
Peer Review & CEQA Expertise	Fritts Golden
Graphics	Suzanne Loadholt, Cheri Velzy, Vivien Arnold

Urban Alternatives – Scoping Meetings

Meeting Organization, Notification, Mailing, Scoping Report	Gary Robbins, Jim Marks

Cambridge Systematics – Transportation Modeling Input

Maren Outwater
Vamsee Modugula

Pacific Transit Management – System Feasibility and Operation Input

Tony Bruzzone
Michael Fajans

Ken Fox & Associates – Wake Wash

Ken Fox

ARUP – Conceptual Planning and Design Input

Aiden Hughs
John Lucas

John J. McMullen Associates, Inc. (JJMA) – Vessel Design and Operation Input

Chris McKesson

Parsons Brinckerhoff – Terminal Design Input

Reece Shaw

CH2M Hill – Consultant Coordination

Chris Proud
Steve Smith
Loretta Meyer
Dan Johnson

Jones & Stokes – Review and CEQA Process Input

Mike Davis
Kim Avila
Ken Bogden

5.15 SIGNIFICANT IRREVERSIBLE CHANGES

Significant irreversible changes are considered to involve the use of nonrenewable resources, which from implementation of the WTA program could create an irreversible commitment of resources or irreversible damage to the environment. These impacts can fall within three categories:

- The irretrievable commitment of resources, such as energy and construction materials, expended from the expansion of ferry service
- The irreversible loss of resources due to a direct or indirect impact
- An increase in the use of natural resources because of growth

5.15.1 Irretrievable Commitment of Resources

Natural resources such as fossil fuel energy will be used for the construction of new or expanded facilities as well as for the operation of an expanded fleet of vessels. This EIR evaluates the use of energy for the alternatives, based on the use of diesel fuel. This EIR also identifies and evaluates possible alternative means of minimizing the use of this fuel. However, expansion of ferry service would likely result in an increase in the use of fossil fuels in comparison to nonferry travel. WTA has investigated the feasibility and application of alternative propulsion systems and fuel that can be considered as ferry transit service is expanded.

Construction of new or expanded facilities would require natural resources such as gravel, sand, asphalt, etc. These materials are generally not retrievable, but they are also generally available and not in limited supply.

5.15.2 Loss of Resources from Direct or Indirect Impacts

The implementation of the program may lead to impacts that adversely affect natural resources. The potential for these impacts is addressed in each of the appropriate sections in this EIR. It is not envisioned that new terminal sites or other facilities that have substantial impacts to areas such as sensitive habitat, aquatic, or community resources would advance very far in the planning process. Specific projects that go forward for consideration will undergo additional review, and avoidance and mitigation measures will have to be applied.

5.15.3 Increase in the Use of Resources from Growth

The potential for growth inducement is addressed earlier in this section. The implementation of the WTA program would affect shifts in commuting patterns, but growth changes are not expected at a regional scale. If growth occurred, it would likely be limited to localized areas around some potential terminals. Although some changes in the regional use of natural resources could take place, they are not expected to be substantial.

5.14 GROWTH INDUCEMENT

The San Francisco Bay Area is attractive not only for its geographic setting, but also for its relatively strong and diverse economy. The Association of Bay Area Governments (ABAG) estimates that the population of the nine-county Bay Area region will increase by 1.4 million people in the next 25 years, from approximately 6.8 million in the year 2000 to 8.2 million in the year 2025. During the same time period, 252,800 acres would be available for development (residential and commercial/industrial), which is about 5.7 percent of the region's total area. This population growth rate is not as dramatic as in the late 1990s and early 2000s (ABAG 2001).

According to the General Plans of the nine counties, only San Francisco and Marin counties are not projected to have a housing shortage over the next 25 years. Over the same time period, these two counties are also projected to have the smallest increase in population and number of households. Based on general plan projections at the city and county level, the other seven counties will experience housing shortages. Those shortages will range from 5,450 housing units in Alameda County to 26,480 housing units in Santa Clara County in the year 2025. The average number of persons per household is expected to remain at approximately 2.7 for the Bay Area as a whole. The mean household income for the Bay Area is expected to rise from $93,800 in the year 2000 to $116,400 by the year 2025 (ABAG 2001).

The housing crisis in the Bay Area is negatively affecting the regional transportation system because the centers of population growth (i.e., where people are living or moving to) are not located where the most economic activity is occurring (i.e., where the employment opportunities are). Between the years 2000 and 2025, the projected increase in jobs will exceed the number of employed residents by approximately 149,000 people (ABAG 2001). This trend is expected to continue because Bay Area cities and counties seek to maximize job production without commensurate emphasis on housing production (ABAG 2001).

Impact GRO-1 **The expansion of ferry service and the placement of new ferry terminals in communities around the Bay Area could induce growth in the region.**

Alternatives 1, 2, and 3 all have the potential to induce growth that is not currently planned for at the local level. Individually, local growth impacts may not be significant on the regional level. However, if a number of terminals are found to be growth inducing, the combined impact may be potentially significant. Furthermore, when growth inducement impacts are considered in conjunction with the impacts of other planned development in the area, cumulative impacts could be significant. Given that Alternative 3 would not establish new terminals, the unplanned growth that could occur as a result of terminal enhancement would be minimal at the regional level, and is therefore not considered to be significant.

New Development

According to Table 5.7.1, Alternatives 1 and 2 propose to build new terminals in the following locations that are currently undeveloped:

Facility	Land Use Designation	Local Planning Agency
Candlestick Park	Parks and Open Space; Public Facilities	San Francisco Planning Department
Coyote Point	Parks and Open Space	City of San Mateo Planning Department
Fort Baker	Public Institutional	Golden Gate National Recreation Area (GGNRA)
Fort Mason	Public Open Space	GGNRA
Gnoss Field / Port Sonoma	Data not available	Sonoma County Permit & Resource Management Department
Point Molate	Open Space Recreation	Richmond Planning Department
Presidio	Public Open Space	GGNRA

In the case of Candlestick Park, Coyote Point, Gnoss Field/Port Sonoma, and Point Molate, the placement of ferry terminals would require compliance with local planning policies as contained in the applicable local general plan, which usually has specific policies to protect open space land uses. It is likely that a proposed ferry terminal within GGNRA jurisdiction would need to be located in accordance with the findings of GGNRA's independent ferry terminal location analysis.

Of the proposed terminal locations above, Coyote Point, Gnoss Field/Port Sonoma, and Point Molate are the three locations where no identified local planning efforts are currently underway to establish ferry terminals. Unlike the other potential sites listed above, the lack of current planning at these three locations would result in Alternative 1 or 2 proposing ferry terminals that could induce unplanned growth. Candlestick Park, Fort Baker, Fort Mason, and the Presidio are all being analyzed independent of the Water Transit Initiative by their local agencies.

Coyote Point is composed mostly of open space park, Bay shoreline wetlands and wildlife habitat, a marina, public museum, and a golf course (City of San Mateo 2002). Gnoss Field/Port Sonoma is a large agricultural area with a lot of ecological importance, which makes any form of development difficult (Sonoma County 2002). Point Molate is a closed Navy brownfield with limited shoreline development, and the City of Richmond's redevelopment agency is tentative to approve any development there due to difficult access to the site, minimal public services/infrastructure, and the high cost of site cleanup (City of Richmond 2002).

Out of all the proposed terminal locations in Alternatives 1 and 2, these three locations represent the areas where there is little or no urban development, and the local planning agencies are not planning for new development. As discussed above, land use designations and zoning ordinances dictate the type and location of development to ensure compatibility of adjoining land uses. However, it is possible that through a general plan amendment or a Conditional Use Permit (or other form of local variance), a local jurisdiction could place a ferry terminal in an area where current policy says it is incompatible. A general plan amendment would require review under the California Environmental Quality Act (CEQA) at a site-specific level, at which time the significance of a conversion of agricultural land, parkland, recreational land, or other open space would need to be addressed. However, a Conditional Use Permit may or may not, in which case the conversion of an open space, agriculture, recreation, or parkland use designation may not receive adequate environmental review. In other words, by proposing ferry terminals in open space locations where no ferry terminal planning is currently occurring, Alternatives 1 and 2 may induce growth in undeveloped or otherwise protected areas. This would constitute a significant impact.

Public Services

Most of the new ferry terminals identified in Alternatives 1 and 2 would be located in an urban setting. By proposing to build the majority of ferry terminals in already built-up areas, the proposed project would minimize impacts to open space resources and limit the expansion of the urban environment. However, redevelopment of an urban area can carry its own set of environmental impacts, such as creating a demand for additional public services and infrastructure, causing the displacement of people or businesses, or physically dividing a community or neighborhood. For community impacts related to the displacement of people or businesses and the division of community, refer to the discussions of Impacts LU-1 and LU-2 in Section 3.7 (Land Use).

A new ferry terminal or a major expansion of an existing terminal in an urban area can have a significant adverse affect on local public services such as police, fire, sewer, and water if the demand is great enough to require the expansion of those services. Likewise, the increase of ferries on the Bay could result in impacts to regional public services provided by the U.S. Coast Guard (see the Navigation Report for a discussion on impacts to U.S. Coast Guard operations). Typically, all public services are designed to provide adequate services for the growth planned in the local general plan or management plan. However, the exact size and nature of future planned development is not always known, so the capacity of public services is often determined by the maximum development allowed by the local zoning ordinance. Therefore, although many of the proposed ferry terminal locations are not identified in local planning documents, new terminals may not adversely impact public services.

Each terminal location will have a different set of impacts on the existing public services and infrastructure of a city or county, depending on the current capacity of local sewer and water infrastructure and the capabilities of the existing public safety workforce. Therefore, it is important that each potential ferry terminal site be considered in light of the local conditions. This is especially true of ferry terminals that are being considered by local agencies as part of a larger project to provide amenities adjacent to the terminal, such as retail or commercial centers (see Cumulative Growth Inducement Impacts, below, for more discussion on adjacent land uses).

Population/Employment

If implemented, the proposed project could cause an unanticipated increase in population in the Bay Area that could result in an increased demand for public services, housing, and other services that could induce growth. Specifically, people may move into the areas due to a perceived increase in the regional quality of life here or job opportunities afforded by the proposed increase in ferry services. However, a population increase as a result of either of these would not be significant relative to the number of people projected to move to the Bay Area in the next 25 years overall (see Section 3.7.1.1).

In regard to population increases in Bay Area communities due to quality of life, the number of people that actually move here because of the proposed project is unpredictable. In reality, people moving into communities from outside the Bay Area to improve their quality of life would require more than just a regional ferry service, such as availability of affordable housing, climate, and cultural amenities beyond the scope of the project.

With regard to an unplanned population increase due to new jobs created by the project, Alternatives 1, 2, and 3 would all create new employment opportunities in the ferry industry to some degree. Alternative 1 would create the most jobs out of all the alternatives considered, with Alternatives 2 and 3 increasing job opportunities to a lesser degree. On a regional scale, the increase in job opportunities related to Alternatives 1 and 2 is potentially significant, considering the number of new terminals and ferries proposed. However, while the actual number of employment positions is unknown, it is reasonable to assume that most if not all of the positions would be filled by people currently residing in the Bay Area. Furthermore, job opportunities that are created as a result of the project would occur incrementally, as opposed to all at once, which would make any immigration to the Bay Area as a result of jobs in the ferry industry insignificant. Therefore, the potential impacts due to creating employment opportunities would be less than significant.

Cumulative Growth Inducement Impacts

Cumulative growth inducement impacts would involve the implementation of other projects adjacent to a ferry terminal that are not associated with the proposed WTA initiative. Cumulative growth inducement impacts due to unplanned development may occur in communities where ferry terminals are proposed because: (1) terminals function as transportation hubs where the transit riders condense, creating a potential real estate market; or (2) ferry service would increase accessibility to communities.

As a transportation nexus, a ferry terminal attracts people using a variety of transportation modes, including cars, buses, bicycles, walking, and potentially rail. The placement of a new terminal facility or the enhancement of an existing terminal could change the local transportation patterns in a community, resulting in a potentially significant impact. Furthermore, ferry terminals can also become destinations for tourists or Bay Area residents, given their accessibility and location along the shoreline. This concentration of transit-users as well as destination-seekers represents a potential market for real estate development or redevelopment that could result in a potentially significant impact on the existing community beyond the presence of the terminal itself.

Changes at the local level as a result of providing new or enhanced ferry service could also occur as a result of making local communities more accessible. The benefits of ferry service may be perceived by many as an improvement to their current quality of life, making these communities attractive for commuters to live in. This could have more significant impacts in more suburban or rural areas, such as Gnoss Field/Port Sonoma, where undeveloped land could be put at risk as a result of a demand for more adjacent services (see discussion above under New Development). Conversely, increased accessibility to a suburban community, such as San Leandro or Benicia, may benefit the people already living there due to increased economic activity from tourists and commuters.

Although it is quite possible that a ferry terminal would operate independent of services provided by adjacent development indefinitely, the potential for a terminal to lead to additional development may cause cumulative growth inducement impacts. Therefore, as discussed above, it is important that each potential ferry terminal site be considered in light of the local conditions and the potential for additional growth to occur. Without proper planning, cumulative growth associated with the proposed project and other currently unplanned development could lead to significant environmental impacts on communities, public services, or open space resources, depending on the location.

Summary of Impact GRO-1

- Alternative 3 would not result in significant growth inducing impacts.
- Alternatives 1 and 2 may result in potentially significant impacts due to development in areas where growth is unplanned. Specifically, by proposing ferry terminals at Coyote Point, Gnoss Field/Port Sonoma, and Point Molate, the proposed project would encourage growth where there is little urban development and the local planning agencies are not planning to develop there.

Depending on the capacity of local infrastructure and public safety services, some ferry terminals may increase the demand for services, which would result in a significant impact.

The increase in population due to a perceived increase in quality of life or employment opportunities provided by the expanded ferry services of Alternatives 1, 2, or 3 would not result in a significant impact.

Unplanned development beyond the scope of the proposed project could, in conjunction with the implementation of Alternatives 1, 2, or 3, result in cumulative growth inducement impacts.

Mitigation GRO-1.1: Implement Mitigation LU-1.1.

Mitigation GRO-1.2: The California Legislature has given local governments the primary responsibility to make land use decisions. As such, growth inducement impacts should be considered by planning staffs at the local level because growth can be considered a negative or positive impact depending on the objectives of the local government and the community. If growth is an objective of an applicant for new or expanded ferry service, then the applicant must clearly demonstrate to WTA how the growth has been addressed and planned for. Appropriate documentation includes but is not limited to an adopted Specific Plan, Master Plan, or other local plan, or an adopted amendment of a land use designation in a general plan. If a ferry terminal is proposed independently of any other growth, then the applicant must clearly demonstrate to WTA how unplanned growth will be prohibited.

WTA shall be responsible for ensuring the adopted alternative does not induce unplanned growth. To do so, adequate CEQA environmental review or other comprehensive planning process for the waterfront must be prepared by or presented to WTA on a project-by-project basis that clearly defines how planned growth will be managed or how unplanned growth will be avoided.

Mitigation GRO-1.3: Without the implementation of Mitigations LU-1.1 and GRO-1.2, Alternatives 1 or 2 shall not be implemented with ferry terminals proposed for Coyote Point, Gnoss Field/Port Sonoma, or Point Molate, so as to not encourage growth in areas where there is little urban development and to protect open space resources.

Impact After Mitigation: Impact GRO-1 would be less than significant after implementation of Mitigations GRO-1.1, GRO-1.2, and GRO-1.3.

References

Association of Bay Area Governments (ABAG). 2001. Projections 2002. Oakland, California. December.

City of Richmond. 2002. Personal Correspondence between M. Kim of URS Corporation and Richmond Planning Department. May.

County of San Mateo. 2002. Personal Correspondence between M. Kim of URS Corporation and San Mateo County Environmental Services Agency, Planning and Building Division. May.

County of Sonoma. 2002. Personal Correspondence between M. Kim of URS Corporation and Sonoma County Permit and Resource Management Department. May.

5.13 ENERGY

5.13.1 Significance Criteria

According to Appendix F of the CEQA Guidelines, project "alternatives should be compared in terms of overall energy consumption and in terms of reducing wasteful, inefficient, and unnecessary consumption of energy." For the purposes of this EIR, an impact would be considered significant if:

- A proposed alternative results in a substantial increase in energy consumption per passenger miles traveled; or
- A proposed alternative would result in a wasteful, inefficient, or unnecessary consumption of energy.

5.13.2 Method of Analysis

This energy analysis addresses the changes in energy consumption by the transportation sector in the nine-county Bay Area for the year 2025 between the four project alternatives. Forecasted energy consumption per PMT was calculated for automobiles, trucks, public buses, transit rail vehicles, and ferries. Ferry energy consumption was calculated using the projected schedule of routes, types of ferries to be used, and passenger volumes. Energy calculations for all other transportation modes were calculated using vehicle miles traveled (VMT) and passenger volume forecasts based on the transportation modeling performed for this project (Outwater 2002).

Comparisons of energy consumption were made between Alternative 4 (No Project) and the other project alternatives to determine the change in total Bay Area-wide transportation energy use with Alternatives 1, 2, and 3. Appendix ENRG-B presents details on the energy consumption per PMT value calculation methodology used for this report.

For this analysis, consumption of energy by ferry vessels was estimated based on engine power output. Engine power output is generally referred to in kilowatts (kW). Power is converted to energy, in the unit of kilowatt-hours (kW-hrs), by applying a factor of engine running time. The energy unit of kW-hrs can directly be converted to a Btu value.

For the no project alternative, average power outputs were assumed for each route, based on the current ferries in use on these routes[1]. Characteristics of the current ferries are available in the working document, *New Technologies and Alternative Fuels*, prepared for Water Transit Authority by JJMA (JJMA 2002). For Alternatives 1, 2, and 3, two ferry fleets were assumed. One fleet would consist of 400-passenger ferries with a maximum power output of 5,966 kW. The other fleet would have 149-passenger ferries with a maximum power output of 2,163 kW (Hutchison 2002). Daily energy consumption per PMT was calculated by dividing the average daily energy consumption by the average daily PMT.

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[1] For the Larkspur ferry route, only the newer catamaran vessels used on this route were assumed to be used for the no project alternative. The monohull boats used on this route were constructed in the 1970's and will be taken out of commission by 2025.

5.13.3 Impacts and Mitigation

The following section addresses energy consumption for all transit modes in the Bay Area for all project alternatives and potential mitigation measures.

Impact E-1 **Enhancing or expanding ferry service in the Bay Area would result in more energy consumed per passenger mile traveled for all transit modes in the Bay Area. This increase is relatively small on the regional scale.**

Compared to Alternative 4 (No Project), total daily energy consumption and energy consumption per PMT for all transit modes in the Bay Area would increase for Alternatives 1, 2, and 3. This increase can be summarized as follows:

	Total Energy Consumption (Btu)	Percent Increase in Energy Over Alternative 4	Energy/PMT (Btu/PMT)	Percent Increase in Energy/PMT over Alternative 4
Alternative 1	1,209,281,802,398	0.43%	4,385	0.97
Alternative 2	1,202,356,703,160	0.32%	4,362	0.45
Alternative 3	1,203,393,344,245	0.10%	4,342	0
Alternative 4	1,203,428,264,995	NA	4,342	NA

Alternative 1 would have the largest increase in total transit energy consumption and energy consumption per PMT in comparison to Alternative 4. For all project alternatives, the totals for energy consumption and energy consumption per PMT values are primarily determined by automobiles. Automobiles consume 92 percent of the total energy consumed by the transportation sector in 2025 and 75 percent of the total PMT. Ferries would consume between 0.6 percent and 0.05 percent (depending on the alternative) of the total energy consumed by the transportation sector and between 0.4 percent and 0.09 percent of the total PMT. Although there is an increase in energy use, it is not a substantial or significant increase regionally, as shown above.

Summary of Impact E-1

- Alternative 1 would result in a 0.97 percent increase over Alternative 4 in energy consumption per passenger mile traveled for all transit modes in the Bay Area. This would be a less-than-significant impact.
- Alternative 2 would result in a 0.45 percent increase over Alternative 4 in energy consumption per passenger mile traveled for all transit modes in the Bay Area. This would be a less-than-significant impact.
- Alternative 3 would result in no increase over Alternative 4 in energy consumption per passenger mile traveled for all transit modes in the Bay Area. This would be a less-than-significant impact.
- Alternative 4 would have no impacts.

Mitigation E-1.1: Energy consumption by the ferries under Alternatives 1, 2, and 3 would be further reduced by elimination of routes with low ridership, such that the following routes would remain:

- Alameda to San Francisco
- Oakland to San Francisco
- Tiburon to San Francisco
- Richmond to San Francisco
- Martinez to San Francisco
- Hercules to San Francisco
- Harbor Bay to San Francisco
- Sausalito to San Francisco
- Berkeley to San Francisco
- Larkspur to San Francisco
- Vallejo to San Francisco
- Pittsburg to San Francisco

The table below shows the energy consumption for a ferry service using the above routes:

Total Energy Consumption (Btu)	Percent Increase In Energy Over Alternative 4	Energy/PMT (Btu/PMT)	Percent Increase In Energy/PMT over Alternative 4
1,209,865,172,223	0.53	4,353	0.25

As shown above, this mitigated Alternative 2 ferry service would still result in an increase in energy consumption per PMT over Alternatives 3 and 4, but this mitigated alternative would result in improved passenger service over these two alternatives and improved energy consumption per PMT value over Alternative 1 and an unmitigated Alternative 2. This mitigated alternative demonstrates an improved efficiency in energy use based by focusing proposed new ferry service on routes predicted to have the most passenger demand.

Impact After Mitigation: Energy consumption per PMT values would be improved but remain slightly greater under the above-described mitigated alternative than with Alternative 4. This impact is less than significant as the difference in energy use is not measurably different between Alternative 4 (4,343 Btu/PMT) and Alternative 2 as mitigated above (4,353 Btu/PMT).

Impact E-2 The proposed enhancement or expansion of ferry service in the Bay Area could result in a wasteful, inefficient, and unnecessary consumption of energy without mitigation.

The design and purpose of enhancing or expanding the ferry services in the Bay Area is to increase and improve transportation mobility, service, and choice in the Bay Area, provide a service to regional commuters, and provide an additional mode of regional transit in the Bay Area. As discussed in Section 3.12 of this report (Transportation), the major areas of traffic congestion are at the transbay crossings. Alternatives 1, 2, and 3 would result in decreases in daily trips across all the transbay routes for all modes of transbay transit (i.e., BART, AC Transit, highways, etc.). However, ridership at full service is projected to be fairly low in comparison to the potential numbers of people that could be utilizing the ferries (i.e., filling every ferry run at or near the capacity of each ferry). Low average ridership volumes per ferry run would contribute to a high rate of energy consumption per PMT. Comparison of the forecasted average passengers per run and daily PMT values for the ferries to other modes of mass transit in the Bay Area (see Table 5.13.1) shows that Alternatives 1, 2, and 3 would result in a slightly less energy-efficient mode of mass transit.

Summary of Impact E-2

- Alternatives 1, 2, and 3 could result in low passengers per run and PMT values when compared to other forms of regional mass transit in the Bay Area and compared to Alternative 4 (No Project). As shown in Table 5.13.1, the passengers per run and the PMT values are lower for ferries than for the other four modes of mass transit analyzed. Comparison of the passengers per run and PMT values for Alternatives 1, 2, and 3 are lower than Alternative 4. These low passenger per run values are a primary factor for the high energy consumption per PMT values for Alternatives 1, 2, and 3. Therefore, these alternatives could result in potentially significant impacts.
- Alternative 4 would result in vessels averaging approximately 42 percent of their maximum capacity. This alternative represents current conditions. No impact would occur.

Mitigation E-2.1: Energy consumption for the alternatives can be improved by focusing service on the routes with greatest demand, as shown in Mitigation E-1.1.

Mitigation E-2.2: The WTA would continue to investigate the feasibility and applicability of using energy sources other than fossil fuels. The WTA has investigated the use of alternative fuels for ferries in the working document, *New Technologies and Alternative Fuels Working Document*, (JJMA 2002), which is available on the WTA website, www.watertransit.org.. Alternative energy sources would become incorporated and used by the WTA as they become feasible for use with the WTA ferries.

Impact After Mitigation: Consumption of energy is a factor of achieving high-speed ferry service. This transit mode has the potential to approximately match energy consumption per PMT values as other mass transit modes. By implementing Mitigations E-2.1 and E-2.2, this impact would be a less-than-significant impact and would avoid the potential for wasteful or inefficient consumption of energy.

References

Hutchison, B. 2002. Personal communication between Bruce Hutchison of Glosten, Inc. with URS. June.

John J. McMullen Associates, Inc. (JJMA). 2002. New Technologies and Alternative Fuels. Prepared for Water Transit Authority. May 2.

Outwater, Maren. 2002. Personal Communication between Maren Outwater of Cambridge Systematics and URS. June and July.

Table 5.13.1
Comparison of Passenger Data for Mass Transit Modes – Alternatives 1 Through 4

		Passengers/Run	PMT
Alternative 1	Buses	53	17,671,965
	Light Rail	108	2,087,013
	BART	1,041	32,668,803
	Commuter Rail	964	8,199,995
	Ferries	17	984,023
Alternative 2	Buses	56	18,604,195
	Light Rail	110	2,125,606
	BART	1,053	33,052,084
	Commuter Rail	971	8,263,327
	Ferries	21	630,431
Alternative 3	Buses	58	18,927,393
	Light Rail	111	2,129,149
	BART	1,061	33,312,983
	Commuter Rail	981	8,342,568
	Ferries	38	430,074
Alternative 4	Buses	59	18,974,168
	Light Rail	111	2,132,620
	BART	1,062	33,322,155
	Commuter Rail	952	8,099,280
	Ferries	164	236,461

Source: JJMA 2002; Outwater 2002

5.12 TRANSPORTATION

5.12.1 Significance Criteria

According to California Environmental Quality Act (CEQA) guidelines, a project would have a significant impact if it would cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system. This assessment was performed at a regional level and impacts are identified in terms of their potential to substantially change traffic volumes, and hence a specific numerical criterion was not applied.

5.12.2 Impacts and Mitigation

The proposed enhancement of the ferry system would expand transportation options for Bay Area commuters. In general, this may result in lower use of the automobile and or nonferry transit as commuters shift to ferries. Table 5.12.1 presents the Vehicle Miles Traveled (VMT) breakdown by county for the different project alternatives. There are very few differences (0.1 percent overall reduction) in VMT, at this regional scale of analysis, between the 2025 No Project Alternative (Alternative 4) and the project alternatives. The largest reductions in VMT occur in counties where ferries are competing with congested highway facilities, such as San Francisco, San Mateo, and Marin. However, an increase in drive access to transit VMT is expected due to increases in drive access to ferry ridership at new terminals (as discussed in Impact T-1). Similarly, there would be small increases in bus VMT associated with access to ferry terminals.

Table 5.12.2 shows the effect of the project alternatives on the vehicle trips by purpose and vehicle type. As expected, only auto trips would be affected because they are the greatest transportation mode affected by commute improvements. Truck trips would remain constant for 2025 regardless of the project alternative. Among the auto trips, the addition of ferry routes and vessels would mostly affect trips to work and for recreation, where ferry travel presents a real option for Bay Area residents. However, as Table 5.12.3 indicates, the percentage change in total vehicle trips from Alternative 4 is minimal for all project alternatives.

Changes in nonferry transit ridership due to expansion of ferry system, both increases and decreases, could result from the different project alternatives. As Table 5.12.3 indicates, these changes would be minimal and insignificant (below 0.1 percent).

Focusing the scale of transportation analysis to the screenline areas mentioned in Section 3.12.1 shows that ferry expansion would facilitate a greater reduction in auto VMT over Alternative 4. Table 5.12.4 presents daily person trips across Bay Area screenlines for the different project alternatives. The table shows that screenlines may experience relatively small increases or decreases in the number of person trips. For example, under Alternative 1, an overall small increase in the number of daily person trips across both the Bay Bridge and Golden Gate Bridge corridors is predicted, while at the same time ferries would divert some passengers from other transit and highways. The introduction of ferry service across screenlines that do not currently have ferry service, such as the San Francisco-San Mateo County Line and the San Mateo Bridge, would have a greater effect of diverting passengers from other modes, primarily from highways.

The screenline analysis included a $2 parking charge at ferry terminals for all alternatives. This reduces overall ridership for the alternatives compared to the 2025 No Project Alternative, which does not include a parking charge at ferry terminals. This effect is on all ferry routes, but improvements in service outweigh this effect, yielding more riders in the alternatives than in the base, except for the Carquinez/Benicia Bridge Corridor screenline, where a slight ridership reduction is observed.

This diversion is more evident when considering daily auto trips across screenlines for the different project alternatives. As shown in Table 5.12.5, while the total number of daily vehicle trips in Bay Area screenlines would experience the greatest reduction (0.8 percent) under Alternative 1, Alternative 2 would result in the largest decreases in vehicular movement along the Bay Bridge and Golden Gate Bridge corridors.

Impact T-1 **New and existing ferry terminals would require access by car or transit. This could result in potential localized increases in traffic in the vicinity of the terminals.**

Existing and new terminals would be accessed by ferry riders by foot, car and/or transit. Expanded ferry service would require additional access to terminals by car or transit. Table 5.12.6 shows the ridership access mode for the most aggressive ferry expansion alternative (Alternative 1). Of a total daily ridership of 49,210, 66 percent would access the terminals by car, 16 percent by bus or rail, and 18 percent on foot. Ridership would be lower for the other alternatives: 46,295 for Alternative 2, 25,385 for Alternative 3, and 23,238 for Alternative 4 (No Project). Similar percentages of mode of access are expected for these alternatives.

Table 5.12.7 indicates that VMT to access ferry terminals would increase by 155 percent from the 1998 baseline to the 2025 No Project conditions. Implementation of the project alternatives would increase the ridership and, consequently, the daily driving to and from those terminals by commuters, resulting in higher VMT. This increase holds true for all terminals except for some of the existing terminals (i.e., Larkspur, Vallejo, Jack London Square, and Tiburon) where decreases in drive access VMT are expected. Such decreases are the result of a potential introduction of parking fees and additional transit service to terminals (included in the alternatives but not in the No Project calculations) that may coax some commuters into transit.

There is a potential that traffic impacts could be significant on a site-specific level, where access and circulation are not adequate to accommodate riders attracted to the terminal and system.

Summary of Impact T-1

- Alternative 1 could result in increased car and bus traffic to and from existing ferry terminals, depending on local access and traffic conditions. This impact could be potentially significant on a site-specific level.
- Alternative 2 could result in increased car and bus traffic to and from existing ferry terminals, depending on local access and traffic conditions. This impact could be potentially significant on a site-specific level.

- Alternative 3 could result in increased car and bus traffic to and from existing ferry terminals, depending on local access and traffic conditions. This impact could be potentially significant on a site-specific level.
- Alternative 4 would not involve additional ferry terminals and would not require additional car or bus access to new terminals. Therefore, there would be no impact.

Mitigation T-1.1: Traffic mitigation measures would depend on site-specific conditions, including design of vehicular access to terminal, major access routes, parking availability, and traffic patterns. For some cases, where access is problematic or presents serious community concerns, the viability of the terminal would need to be further evaluated.

Impact After Mitigation: Impacts after mitigation must be determined on a case-by-case basis after mitigation measures are considered. Impact T-1 could be potentially significant.

Impact T-2 **Additional car drive access to existing and new ferry terminals would require parking. This could result in potential localized parking problems and conflicts in the vicinity of the terminals.**

Ridership increases would result from new and expanded ferry service. It is expected that more commuters would drive their cars to access ferry terminals. As discussed in Impact T-1, up to 66 percent of the ferry riders, under the most aggressive ferry service enhancement (Alternative 1), are expected to drive to the terminals. While some of the additional cars may be accommodated in terminal parking structures, it is the intention of the WTA to limit parking in an effort to encourage transit use to access existing and new terminals. The demand for parking as a percentage of available parking is listed in Table 5.12.8. Generally, it is expected that parking availability will exceed demand. In some locations, due to lack of sufficient space or desire to avoid paying parking fees, commuters would chose to park off-site, along local streets in the vicinity of the ferry terminals. This can lead to enforcement of restrictions on local street parking, which can inconvenience local residents and businesses.

Summary of Impact T-2

- Alternative 1 would result in increased car traffic to and from new ferry terminals and lead to an increased demand for parking. The WTA would seek to encourage and increase transit access to terminals. The impact would be localized and site-specific, and its significance cannot be determined at the programmatic level. Therefore it is potentially significant.
- Alternative 2 would result in increased car traffic to and from new ferry terminals and lead to an increased demand for parking. Parking demand would exceed parking availability for all project alternatives, as the WTA would seek to encourage and increase transit access to terminals. The impact would be localized and site-specific, and its significance cannot be determined at the programmatic level. Therefore it is potentially significant.
- Alternative 3 would result in increased car traffic to and from new ferry terminals and lead to an increased demand for parking. Parking demand would exceed parking availability for all project alternatives, as the WTA would seek to encourage and increase transit access to terminals. The impact would be localized and site-specific, and its significance cannot be determined at the programmatic level. Therefore it is potentially significant.

- Alternative 4 (No Project) would involve additional ferry terminals or expanded service and would not require additional parking. Therefore, there would be no impact.

Mitigation T-2.1: The WTA and ferry terminal authorities, in conjunction with local and regional transit agencies, should study and develop a terminal-specific plan to ensure that potential driving ferry patrons can be adequately served by transit in locations with limited parking and currently insufficient transit access.

Mitigation T-2.2: Non-drive access could be encouraged through measures such as charging fees for parking, provision of preferential parking for carpools and vanpools, comprehensive shuttle access, land use scenarios that encourage non-drive access, and encouraging bicycle and pedestrian access.

Impact After Mitigation: Traffic access impacts can typically be mitigated through design or operational improvements. Mitigation improvements would be defined with each proposed new terminal or terminal improvement. This is a potentially significant impact.

Table 5.12.1
Vehicle Miles Traveled (VMT) Under the WTA Ferry Expansion Project Alternatives

County	1998 Vehicle Miles Traveled	2025 No-Project Vehicle Miles Traveled	2025 Alt 1 Vehicle Miles Traveled	Percentage Change from No Project	2025 Alt 2 Vehicle Miles Traveled	Percentage Change from No Project	2025 Alt 3 Vehicle Miles Traveled	Percentage Change from No Project
San Francisco	8,017,759	9,075,385	9,008,509	-0.007	9,015,828	-0.007	9,066,584	-0.001
San Mateo	18,458,290	20,838,110	20,704,505	-0.006	20,733,300	-0.005	20,793,944	-0.002
Santa Clara	33,671,029	45,696,564	45,675,552	0.000	45,677,089	0.000	45,683,006	0.000
Alameda	30,534,137	40,021,231	39,981,340	-0.001	39,975,671	-0.001	40,013,094	0.000
Contra Costa	17,249,251	23,702,339	23,680,594	-0.001	23,693,740	0.000	23,706,802	0.000
Solano	9,320,419	16,317,037	16,320,101	0.000	16,320,363	0.000	16,322,159	0.000
Napa	3,085,129	5,038,273	5,036,882	0.000	5,038,031	0.000	5,037,252	0.000
Sonoma	7,785,717	11,045,667	11,034,889	-0.001	11,033,789	-0.001	11,050,163	0.000
Marin	7,335,401	8,539,503	8,480,530	-0.007	8,480,453	-0.007	8,535,238	0.000
Intrazonal VMT	1,347,897	2,112,613	2,112,531	0.000	2,112,544	0.000	2,112,558	0.000
Transit Drive Access VMT	984,344	1,892,977	1,966,608	0.039	1,965,901	0.039	1,918,770	0.014
Bus VMT	268,239	323,225	333,497	0.032	333,497	0.032	333,497	0.032
TOTAL BAY AREA	**138,057,611**	**184,602,925**	**184,335,538**	**-0.001**	**184,380,207**	**-0.001**	**184,573,066**	**0.000**

Table 5.12.2
Vehicle Trips by Purpose and Vehicle Type Under the Project Alternatives

Purpose/Vehicle Type	1998 Vehicle Trips	2025 No-Project Vehicle Trips	2025 Alt 1 Vehicle trips	Percent Change from No Project	2025 Alt 2 Vehicle trips	Percent Change from No-Project	2025 Alt 3 Vehicle trips	Percent Change from No Project
Car								
Home Based Work	3,707,297	5,103,132	5,094,566	-0.2%	5,096,452	-0.1%	5,100,121	-0.1%
Home Based Shop	3,277,781	4,030,835	4,030,399	0.0%	4,030,347	0.0%	4,030,072	0.0%
Home Based Social/Recreation	1,302,011	1,607,989	1,605,341	-0.2%	1,605,594	-0.1%	1,607,596	0.0%
Non-Home Based	3,610,424	4,738,388	4,737,265	0.0%	4,737,488	0.0%	4,738,077	0.0%
Internal-External	458,523	913,203	913,203	0.0%	913,203	0.0%	913,203	0.0%
Truck								
Small Truck	192,446	264,732	264,732	0.0%	264,732	0.0%	264,732	0.0%
Medium Trucks	18,633	25,580	25,580	0.0%	25,580	0.0%	25,580	0.0%
Large Trucks	40,851	56,647	56,647	0.0%	56,647	0.0%	56,647	0.0%
TOTAL	12,607,967	16,740,507	16,727,733	-0.1%	16,730,045	-0.1%	16,736,029	0.0%

Source: Cambridge Systematics (2002)

Table 5.12.3

Ridership Changes in Non-Ferry Transit Under the Project Alternatives

Transit Mode	2025 No Project Riders (Alt 4)	2025 Alt 1 Riders	Percentage Change from No Project	2025 Alt 2 Riders	Percentage Change from No Project	2025 Alt 3 Riders	Percentage Change from No Project
Bus	1,728,641	1,628,111	-0.06	1,713,997	-0.01	1,732,195	0.00
Light Rail (Muni, SCVTA)	240,818	235,668	-0.02	240,026	0.00	240,426	0.00
BART	890,084	872,632	-0.02	882,870	-0.01	889,839	0.00
Commuter Rail (Caltrain, ACE, Amtrak)	133,896	135,561	0.01	136,608	0.02	137,918	0.03

Source: Cambridge Systematics (2002)

Note: Cambridge Systematics modified the MTC model to allow for expanded catchment of drive access to commuter rail terminals for the project alternatives. This modification was performed to make drive access to non-ferry transit equivalent to the drive access allowed for ferry transit in the model. This modification has resulted in project alternatives (Alternatives 1 through 3) showing an increase in ridership over the no project alternative (Alternative 4). However, as the ferry ridership expands from Alternative 3 to Alternative 2 and Alternative 1, the commuter rail ridership is shown to decrease.

Table 5.12.4
Daily Person Trips Across a Screenline

Screenline		Screenline 2025 No Project	2025 Alternative 1	Difference from No Project	Percent Change from Total	2025 Alternative 2	Difference from No Project	Percent Change from Total	2025 Alternative 3	Difference from No Project	Percent Change from Total
Bay Bridge	BART	262,671	256,073	-6,598	-0.9%	256,073	-6,598	-0.9%	256,073	-6,598	-0.9%
	AC Transit	3,812	3,682	-130	0.0%	3,682	-130	0.0%	3,682	-130	0.0%
	Ferry Transit	3,058	15,212	12,154	1.7%	15,053	11,995	1.7%	4,367	1,309	0.2%
	Highway	451,521	446,498	-5,023	-0.7%	446,168	-5,353	-0.7%	451,659	137	0.0%
	Subtotal	***721,062***	***721,465***	***403***	***0.1%***	***720,976***	***-86***	***0.0%***	***715,781***	***-5,282***	***-0.7%***
Golden Gate	Golden Gate Transit	14,055	13,471	-584	-0.3%	13,471	-584	-0.3%	13,471	-584	-0.3%
	Ferry Transit	14,247	17,432	3,185	1.6%	17,364	3,117	1.6%	16,083	1,836	0.9%
	Highway	168,637	166,476	-2,162	-1.1%	166,307	-2,331	-1.2%	167,720	-917	-0.5%
	Subtotal	***196,939***	***197,379***	***439***	***0.2%***	***197,142***	***202***	***0.1%***	***197,274***	***335***	***0.2%***
SF/San Mateo County Line	Caltrain, BART and Samtrans	99,129	98,099	-1,030	-0.2%	98,099	-1,030	-0.2%	98,099	-1,030	-0.2%
	Ferry Transit	0	4,544	4,544	0.9%	2,006	2,006	0.4%	-	0	0.0%
	Highway	380,252	375,745	-4,507	-0.9%	377,223	-3,029	-0.6%	379,788	-464	-0.1%
	Subtotal	***479,381***	***478,388***	***-993***	***-0.2%***	***477,328***	***-2,053***	***-0.4%***	***477,887***	***-1,494***	***-0.3%***
San Mateo Bridge	Ferry Transit	0	1,214	1,214	0.0%	617	617	0.0%	-	0	0.0%
	Highway	161,611	161,208	-403	-0.2%	161,271	-340	-0.2%	161,590	-21	0.0%
	Subtotal	***161,611***	***162,422***	***811***	***0.5%***	***161,888***	***277***	***0.2%***	***161,590***	***-21***	***0.0%***
Dumbarton Bridge	Highway	***161,796***	***161,643***	***-153***	***-0.1%***	***161,765***	***-30***	***0.0%***	***161,912***	***117***	***0.1%***
Richmond-San Rafael Bridge	Highway	***90,986***	***90,579***	***-407***	***-0.4%***	***91,103***	***117***	***0.1%***	***90,941***	***-44***	***0.0%***
Carquinez/Benicia Bridges	Ferry Transit	5,933	5,555	-378	-0.2%	4,319	-1,614	-0.9%	4,935	-998	-0.6%
	Highway	*176,634*	176,484	-151	-0.1%	176,471	-163	-0.1%	176,667	33	0.0%
	Subtotal	***182,567***	***182,039***	***-529***	***-0.3%***	***180,790***	***-1,777***	***-1.0%***	***181,602***	***-965***	***-0.5%***
TOTAL		***1,994,342***	***1,992,700***	***-1,642***	***-0.1%***	***1,990,375***	***-3,967***	***-0.2%***	***1,986,987***	***-7,355***	***-0.4%***

Table 5.12.5
2025 Daily Vehicle Trips (Auto Modes only) Across a Screenline

Screenline	2025 No Project	2025 Alternative 1	Difference from No Project	Percent Change from Total	2025 Alternative 2	Difference from No Project	Percent Change from Total	2025 Alternative 3	Difference from No Project	Percent Change from Total
Bay Bridge	383,245	379,296	-3,950	-1.0%	379,009	-4,236	-1.1%	383,430	185	0.0%
Golden Gate	143,510	141,626	-1,884	-1.3%	141,493	-2,017	-1.4%	142,646	-864	-0.6%
SF/SM County line	327,759	324,050	-3,709	-1.1%	325,264	-2,496	-0.8%	327,359	-400	-0.1%
San Mateo Bridge	137,838	137,495	-343	-0.2%	137,547	-291	-0.2%	137,808	-30	0.0%
Dumbarton Bridge	133,989	133,857	-132	-0.1%	133,971	-18	0.0%	134,073	84	0.1%
Richmond-San Rafael Bridge	78,984	78,640	-344	-0.4%	79,101	117	0.1%	78,960	-24	0.0%
Carquinez/Benecia Bridges	157,122	156,994	-129	-0.1%	156,975	-147	-0.1%	157,161	39	0.0%
TOTAL	***1,362,447***	***1,351,958***	***-10,490***	***-0.8%***	***1,353,359***	***-9,088***	***-0.7%***	***1,361,438***	***-1,010***	***-0.1%***

Table 5.12.6

Daily Ridership According To Access Mode To Terminals By Ferry Corridor For Alternative 1

Corridor	Ferry Route	Walk Access	Drive Access	Transit Access
Solano	Vallejo to San Francisco	327	3,589	367
Solano	Benicia/Martinez to San Francisco	98	1,131	43
Contra Costa	Antioch/Pittsburg to San Francisco	19	976	5
Contra Costa	Hercules/Rodeo to San Francisco	177	613	104
Contra Costa	Richmond-San Francisco	263	1,449	133
Alameda	Berkeley-SF-Mission Bay	57	2,048	645
Alameda	Alameda Point-Mission Bay-SF	543	904	733
Alameda	Oakland to San Francisco	126	1,467	681
Alameda	Harbor Bay to San Francisco	487	903	34
Alameda	San Leandro to San Francisco	98	1,185	66
Alameda	Oakland Army Base to San Francisco	10	296	68
Peninsula	Harbor Bay to So. San Francisco	23	418	22
Peninsula	Harbor Bay to Redwood City	5	70	3
Peninsula	Harbor Bay to Moffett Field	4	31	3
Peninsula	Harbor Bay to Hunters Pt	48	339	13
Peninsula	Harbor Bay to Coyote Pt	6	37	6
Peninsula	Harbor Bay to Foster City	8	64	1
Peninsula	Harbor Bay to East Palo Alto	15	95	3
Marin	Sausalito to San Francisco	2,651	2,442	241
Marin	Tiburon to San Francisco	1,402	1,092	328
Marin	Larkspur to San Francisco	845	5,453	1,523
Sonoma	Port Sonoma to San Francisco	5	1,382	68
San Mateo	South San Francisco to San Francisco	91	1,449	123
San Mateo	Redwood City to San Francisco	74	973	47
San Mateo	Coyote Point to San Francisco	1	1,484	19
San Mateo	Foster City to San Francisco	28	712	58
Santa Clara	Moffett Field to San Francisco	15	475	15
Santa Clara	East Palo Alto to San Francisco	16	569	58
Treasure Island	Berkeley to Treasure Island	19	378	148
Treasure Island	Oakland to Treasure Island	73	293	212
Treasure Island	San Francisco to Treasure Island	1,467	0	2,123
	TOTAL	**9,000**	**32,317**	**7,893**

Source: Cambridge Systematics (2002)

Table 5.12.7

Drive Access VMT for Project Alternatives

Terminal	1998	2025 No Project	2025 Alternative 1	2025 Alternative 2	2025 Alternative 3
Berkeley			3,814	3,817	
Martinez			2,009	2,009	
Benicia			1,502	1,457	
Redwood City			3,878	5,361	
Moffett Field			1,540	1,599	
Port Sonoma			8,519	7,972	
San Leandro			3,451	3,522	
South SF			5,048	8,651	
Alameda Point			864	836	
Pittsburg			5,366	5,366	
Hercules			1,500	1,511	
Richmond			4,038	4,070	
Larkspur	12,458	25,943	23,000	23,003	22,975
Sausalito	5,098	10,385	13,469	13,469	13,479
Alameda	278	413	-	-	411
JLS	1,114	1,980	2,535	2,859	1,675
Vallejo	12,851	42,518	33,483	33,057	35,982
Tiburon	483	1,472	1,378	1,378	1,384
Harbor Bay	409	638	2,470	2,510	2,605
Oakland Army Base			390	-	
Coyote Point			3,979	-	
Foster City			1,580	-	
East Palo Alto			1,540	-	
San Leandro for South SF routes			-	-	
Harbor Bay for South SF Routes			5,353	2,935	
Alameda Point for South SF Routes			-	-	
Berkeley for TI routes			1,930	1,512	
Oakland for TI routes			900	901	
Grand Total	32,691	83,349	133,536	127,795	78,511

Table 5.12.8
Potential Parking Availability and Parking Demand for Project Alternatives

Corridor	Route	Potential Available Parking	Alternative 1 Parking Demand Percentage	Alternative 2 Parking Demand Percentage	Alternative 3 Parking Demand Percentage
Transbay	Vallejo - SF	1,600	64%	63%	75%
	Benicia/Martinez - SF	500	64%	64%	
	Antioch/Pittsburg SF	300	93%	93%	
	Hercules/Rodeo - SF	500	35%	35%	
	Richmond-San Francisco	1,000	41%	42%	
	Berkeley-SF-Mission Bay	1,000	58%	59%	
	Alameda Point-Mission Bay-SF	1,000	32%	31%	
	Oakland Army Base -SF	1,000	9%		
	Oakland - SF	500	88%	102%	80%
	Harbor Bay - SF	400	80%	82%	85%
	Harbor Bay - Hunters Point	100	60%		
	San Leandro to San Francisco	250	96%	99%	
	Harbor Bay to So. San Francisco	250	59%	59%	
	East Bay (San Leandro) to Coyote Point	200	7%		
	East Bay (San Leandro) to Foster City	200	11%		
	East Bay (San Leandro) to Redwood City	200	12%	15%	
	East Bay (San Leandro) to East Palo Alto	200	17%		
	East Bay (San Leandro) to Moffett Field	200	5%		
	Subtotal Transbay Corridor	***9,350***			
Golden Gate	Sausalito-San Francisco	100	287%	287%	
	Tiburon-San Francisco	100	158%	158%	158%
	Larkspur-San Francisco	2,000	80%	80%	80%
	Port Sonoma-San Francisco	300	136%	129%	
	Subtotal Golden Gate Corridor	***2,500***			
Peninsula	South San Francisco to San Francisco	300	69%	94%	
	Coyote Point to San Francisco	200	211%		
	Foster City to San Francisco	300	68%		
	Redwood City to San Francisco	500	55%	77%	
	East Palo Alto to San Francisco	300	54%		
	Moffett Field to San Francisco	500	27%	29%	
	Subtotal Peninsula Corridor	***2,100***			
Treasure Island	Berkeley to Treasure Island	*300*	*36%*	31%	
	Oakland to Treasure Island	*100*	*88%*	86%	
	San Francisco to Treasure Island				
	Subtotal Treasure Island Service	***400***			

Source: Cambridge 2002

5.11 NOISE

5.11.1 Significance Criteria

The CEQA Guidelines environmental checklist includes the following criteria for determining potentially significant impacts:

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinances, or applicable standards of other agencies.
- Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels.
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.
- Exposure of people residing or working in the project area to excessive noise levels for a project located within an airport land use plan, or where such a plan has not been adopted, within 2 miles of a public airport or public use airport, or for a project within the vicinity of a private airstrip.

Based on these guidelines and relevant local, state, and federal standards, this EIR applies the following thresholds of significance. A noise impact is considered significant if it would:

- Expose ferry passengers and crew to noise levels greater than OSHA standards,
- Expose noise-sensitive (to humans) land use to "impacts" as defined by FTA,
- Expose terrestrial wildlife to 60 dBA CNEL (or greater) per the USFWS, and
- Expose aquatic wildlife to underwater sound pressure levels at or above 160 dB (re: 1 uPa) per the NMFS.

5.11.2 Impacts and Mitigation

Four impact topics have been identified and are discussed in this section.

Impact NOI-1 **Passengers and crew would be exposed to shipboard noise from proposed enroute ferry operations.**

Most existing fast ferries have large, powerful diesel engines and complex systems that produce high volumes of noise. Because of the relatively short time that passengers spend onboard the ferries (e.g., 20 to 40 minutes), they are unlikely to be at risk for hearing damage. However, these noise levels can damage crew hearing if not controlled. Compliance with Cal/OSHA regulations will ensure that ferry crews are adequately protected from potential noise hazards. The time-averaged noise exposure level to protect hearing of workers is regulated at 90 dBA over an 8-hour work shift. Areas above 85 dBA will be posted as high-noise level areas, and hearing protection will be required. The ferry operators would have to implement a hearing conservation program for applicable employees as outlined in Cal/OSHA regulations.

Summary of Impact NOI-1

- Alternative 1 would result in ferry passenger and crew exposure to engine noise. It is expected to be at acceptable levels for passengers due to limited time exposure and existing regulations that control noise level exposure. Existing and proposed ferries have to incorporate necessary noise and vibration controls to comply with USCG guidelines and Cal/OSHA limits to avoid adverse noise effects to crew members.
- Alternatives 2 and 3 would also have a potential for impact but the number of people exposed (and thus the degree of potential impact) would be lower for each alternative.
- Alternative 4 does not include expansion. Therefore, no impacts over existing conditions would occur.

Impact After Mitigation: Compliance with existing guidelines already mandates noise exposure controls for crew members. Impacts to passengers are not expected to be significant.

Impact NOI-2 **Exposure of human noise-sensitive land use to significant noise from proposed enroute ferry operations.**

Noise impacts would be considered significant if the project resulted in a determination of “impact” per the FTA guidelines described in Section 3.11.1.4. The use of the FTA’s “sliding scale” is appropriate because where ambient/background levels are low, an increase of up to 10 dB would not cause annoyance or activity interference. In contrast, if the ambient/background noise levels were high (above 65 dBA in residential areas), any perceptible increase in noise could cause an increase in annoyance, nuisance, and inability to have a conversation without raising voices.

At this stage of the environmental impact process, i.e., a programmatic EIR, it is difficult to predict the degree of noise impact from future fast ferry operations. However, limitations on the average SEL, with fairly broad assumptions, can be made to avoid an exceedance of an (FTA) “impact” criteria.

To estimate the average SEL, assumptions regarding receptor type, location and ambient noise environment are required in addition to frequency of operations experienced during daytime (7 a.m. to 7 p.m.), evening (7 p.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.) periods. Distance from the ferry to the receptor also is variable due to the regional nature of this assessment. The following bullets contain assumptions that were applied to determine the applicable SEL.

- No FTA Category 1 (e.g., outdoor amphitheaters, concert pavilions, National Historic Landmarks with significant outdoor use) receptors exist along the shoreline.
- Dense urban FTA Category 2 (e.g., residential) receptors exist along the shoreline and have an ambient sound level of 70 dBA (L_{dn} or CNEL). These receptors would experience the noise from 50 percent of all ferry trips.
- Suburban and low-density urban FTA Category 2 (e.g., residential) receptors also exist along the shoreline and have an ambient sound level of 55 dBA (L_{dn} or CNEL). These receptors would experience the noise from 10 percent of all ferry trips.

- The ferries would pass by these receptors at a distance of no less than 1/3 mile (1,760 feet) while operating at typical cruise power and speed, their assumed mode of maximum noise output in terms of SEL.
- The remaining 40 percent of all enroute ferry trips would not influence this evaluation because they were assumed to only be experienced by Category 3 (e.g., institutional) receptors. Category 3 receptors' criterion level of impact is 5 dB higher (not as conservative) than that of Category 2 receptors.
- 85 percent of ferry trips (pass-by events) would occur during the daytime (7 a.m. to 10 p.m.), 10 percent during the evening (7 p.m. to 10 p.m.) period and 5 percent during the nighttime (10 p.m. to 7 a.m.) period.

At a distance of 1/3 mile, the sound equivalent level from ferry operations would have to exceed the thresholds listed in Table 3.11-6 for each alternative to result in a significant noise impact, as defined by the FTA in Figure 3.11-6. These thresholds vary by land use due to their differences in relative sensitivity to noise levels. For dense urban receptors, sound equivalent levels at 1/3 mile distance would have to exceed 79 dBA, 80 dBA, and 86 dBA for Alternatives 1, 2, and 3, respectively. Alternative 1 has the most limiting SEL of the three alternatives because it has the most proposed trips. For suburban receptors, the SEL would have to exceed 78 dBA, 79 dBA, and 85 dBA for Alternatives 1, 2, and 3, respectively.

A calculation of the noise output from existing and proposed ferry vessels shows that maximum noise levels are well under the significance criteria discussed above. The WTA has developed initial draft specifications for new vessels. These include "owner-imposed noise level limits" of 60 dBA (L_{max}) at 1,000 feet. A vessel designed and built to meet this specification is estimated to generate noise levels that would be about 10 dBA below the SEL criteria described above. In addition, noise measurements of an existing Golden Gate Ferry vessel in operation reported a maximum noise level up to 110 dBA on the exterior main aft deck (see Section 3.11.1.2). Comparison of this noise level to the SEL criteria shows that it would be about 15 dBA below the criteria. This indicates that the existing and proposed new vessels can achieve a less than significant noise impact.

Summary of Impact NOI-2

The determination of significant impact of this topic depends on many factors. The primary factor is the pass-by noise level generated by the proposed ferries. Other important factors include numbers of trips experienced by various categories of land use and the period of day in which those trips occur.

For ferries approaching noise-sensitive land uses by no less than 1/3 mile, dense urban residential-type receptors would be impacted if the ferry's average SEL were higher than 79 dBA, 80 dBA and 86 dBA for Alternatives 1, 2 and 3, respectively. Suburban receptors would be impacted if the ferry's average SEL were higher than 78 dBA, 79 dBA and 85 dBA for Alternatives 1, 2 and 3, respectively. If the ferry's point of closest approach was 1 mile from these receptors instead of 1/3 mile, the maximum allowable SELs would increase by 5 dBA. Calculation of vessel noise output, based on existing noise measurements a vessel and a maximum noise level specification discussed above, indicate that noise levels would be well within these criteria.

- Alternatives 1, 2, 3, and 4 could result in proposed ferry operations that result in noise levels at noise-sensitive land uses. Calculated noise levels for an existing vessel and proposed vessel specifications shown above indicates that noise levels would be well within (below) calculated noise levels that would result in "impacts" as defined by FTA, 1/3 mile or greater from a sensitive receptor. At closer distances or with the use of vessels with higher noise output than applied in this calculation, specific analysis would be required to determine if the noise levels are maintained below these criteria. For this reason, this impact is considered potentially significant.

Mitigation NOI-2.1: This study provides an evaluation of noise levels at which the ferry alternatives would exceed the significance criteria summarized earlier. Maintaining the operation of the alternative fleet below the SEL levels calculated above would avoid exceeding the significance thresholds. Mitigation measures to maintain the average noise levels below the threshold could include:

- Reduction of the noise output from the individual vessels through design measures
- Reduction of the number of trips per day (average noise levels would decrease)
- Reduction of trips during the more noise-sensitive evening hours
- Operation restrictions nearest noise-sensitive receptors. This example evaluation specifies average noise output levels at which an exceedance occurs, based on trip frequency and noise output. This methodology can be repeated for site-specific situations to determine rate specific limits.

Impact After Mitigation: This evaluation indicates that existing and proposed vessels should not exceed acceptable noise impact thresholds within 1/3 mile distance, based on the parameters used in this evaluation. The measures listed above can maintain noise levels at acceptable limits depending upon vessel type, operation, and site-specific conditions. Mitigation NOI-2.1, if needed, can provide effective noise control and reduction, but its success depends on site and route conditions and operation. Therefore, this impact remains potentially significant.

Impact NOI-3 **Sensitive land uses could be exposed to increases in ambient noise from proposed ferry terminal operations.**

Ferry terminals, like terminals of other modes of mass transit, can bustle with activity—arriving and departing ferries, automobile, and bus and truck traffic. Some existing ferry terminals in the Bay Area have Park-and-Ride lots for auto and bus commuters. Proposed ferry terminals may include rail (Amtrak and/or BART) links.

Ferry whistles or horns used in proximity to terminals for safety reasons create impulsive and directional sound. At a distance of 1,000 feet in front of, abeam, and behind a typical ferry horn, a small sample of maximum A-weighted sound levels of approximately 90 dBA, 83 dBA and 77 dBA, respectively, have been measured (BKL Consultants 2002). Horn blowing usually consists of one or two blows, which last less than 10 seconds per event.

A study of noise from ferry terminals in the State of Washington yielded anecdotal daytime hourly L_{eq} values of 55 to 60 dBA at residential locations varying from approximately 500 feet to 2,500 feet from terminal operations. These noise levels occurred during normal scheduled ferry service. Nighttime levels when ferries were not operating yielded hourly L_{eq} near 45 dBA except at the site that was 2,500 feet away (approximately 35 dBA hourly L_{eq}). The range of DNL derived from these 24-hour measurements resulted in levels from 51 dBA at the farther site to 63 dBA at the closer sites (Magnoni 2002).

Summary of Impact NOI-3

- Alternatives 1 and 2 would introduce new terminals that could create impacts to nearby noise sensitive land use, such as adjacent residential areas. This impact is potentially significant if the exposure and noise levels exceed applicable noise thresholds
- Alternative 3 only involves existing terminal sites. Alternative 3 adds vessels and traffic to existing routes; this impact is potentially significant only if the changes exceed local noise level thresholds.
- Alternative 4 would not have any additional noise impacts to nearby land uses, as no changes would occur.

Mitigation NOI-3.1: Siting and planning of new or expanded ferry terminals should include planning to separate terminal areas away from noise-sensitive land uses. Compliance of existing or proposed ferry terminals with existing zoning ordinances should be sufficient to mitigate any potential impacts of ferry terminal operations.

Impact After Mitigation: After implementation of Mitigation NOI-3.1, no significant impact is expected.

Impact NOI-4 Exposure of wildlife to noise from proposed ferry operations.

The proposed project would generate noise both in air and underwater; therefore, there is a potential impact to wildlife in both media. Potential in-air and underwater environmental impacts to wildlife are addressed separately in the following section.

Mammals. Mammalian hearing varies, although abilities are fairly consistent within families (Fay 1988). In general, mammals can hear in the bandwidth from below 10 Hz to over 150 kHz. Small terrestrial mammals, small odontocetes (toothed whales), and bats hear best at high frequencies; mysticetes (baleen whales) hear best at low frequencies; and most other mammals have similar hearing to humans (20 Hz to 20 kHz). Noise-induced hearing loss usually results from inner ear hair-cell loss, which is typically permanent in mammals.

Airborne sounds as a result of the proposed project would contribute to the ambient noise to which small terrestrial mammals and marine mammals are exposed (when at the surface or when hauled out). However, little data are available on the overall sound level from specific sources. The small terrestrial mammals of particular interest to this project are the salt marsh harvest mouse and the salt marsh wandering shrew (see Section 3.5, Biological Resources). These mammals would be exposed to noise from the ferries as they pass by salt marsh habitat. The auditory sensitivity of these small mammals is at higher frequencies (Fay 1988) and the noise from the ferry would be in the low to mid-frequency range. Therefore, masking of biologically significant sounds is highly unlikely. Due to the transient nature of ferries passing by, the proposed project would likely instigate increased alertness, but not habitat avoidance or hearing loss. Furthermore, small mammals inhabiting the area are already exposed to airborne ship noise within San Francisco Bay and are presumably habituated. These small mammals would not be impacted by underwater noise generated as a result of the project.

The marine mammals of particular interest to this project are the gray whale, Pacific harbor seal, California sea lion, and sea otter. No research has been conducted on the effects of airborne noise on the behavior of gray whales. The response of gray whales to underwater vessel noise depends on several factors, including location of vessel (i.e., breeding/calving grounds, migration route, and summering grounds), behavior of the vessel, and behavior of the whale. Gray whales are frequently attracted to vessels in the breeding/calving lagoons of Baja California (Dahlheim et al. 1981; Wisdom 2000), but often change course or stay underwater longer in the presence of vessels while migrating (Schulberg et al. 1991). Because gray whales rarely utilize the Bay, no impacts are expected as a result of the project.

Harbor seals utilize haul-out sites throughout the Bay and are of particular concern to the staff at Point Reyes National Seashore (BAC 1998). In California, small boats that approach a haul-out site often displace the seals; less severe disturbances can cause alert reactions without departure (Stewart et al. 1988; Allen 1991). In places with many boats, harbor seals may become habituated to the noise (Johnson et al. 1989). Detailed studies regarding locations of haul-out sites in relation to specific ferry routes would need to be completed in association with the Point Reyes National Seashore staff.

California sea lions also utilize the Bay, but the only known haul-out site is Pier 39. In the water, sea lions tolerate close and frequent approaches by vessels and often congregate around fishing vessels. Sea lions hauled out on land (or piers) are more responsive, but rarely react unless a boat approaches very closely (Bowles and Stewart 1980). The sea lions that utilize Pier 39 are extremely habituated to human presence and would therefore not be affected by the proposed project.

Little data are available on reactions to vessels by sea otters. However, since they rarely utilize habitat within the Bay, no significant impact as a result of the project is expected.

As stated in Section 3.11.1.4, the NMFS currently considers, as a guideline, received underwater sound pressure levels at or above 160 dB (re 1 μPa) as constituting harassment of marine mammals. NMFS has suggested that underwater sound pressure levels above 180 dB (re 1 μPa) could cause temporary hearing impairment in marine mammals.

Birds. Birds have more uniform hearing abilities than mammals and hear best from 100 Hz to 10 kHz. Hearing loss in birds is difficult to characterize because they appear to regenerate inner ear hair cells even after substantial loss (Corwin and Cotanche 1988). Domestic fowl sometimes experience declines in productivity after continuous exposure to noise at high levels, but laying rates did not change in wild waterfowl after exposure to continuous noise from a compressor station (reviewed in Bowles 1994). Persistent human disturbance or harassment by predators causes declines in productivity of colonies of birds (Anderson and Keith 1980). Birds exhibit behavioral responses to noise similar to those of mammals. At the lowest level, they become alert to the noise; at the highest level, they abandon the area. In the long term, nesting birds become more habituated and less responsive in the presence of human disturbance if they are not deliberately harassed (Burger and Gochfeld 1981). After habituation, loss rates are too low to be detected.

Noise impacts on wintering birds in the South Bay will need to be studied on specific routes (BAC 1998). Personnel associated with the Point Reyes Bird Observatory have identified sensitive foraging and breeding habitats for residential and migratory birds, including eelgrass beds. A preliminary list of birds that need further consideration in reference to specific routes has been developed, including Caspian terns (Brooks Island), least terns, phalaropes (salt ponds), cormorants on Alcatraz, and rails (black and clapper) in marshes. Wintering ducks appear to be somewhat tolerant of boat traffic, but its effect has to be assessed and minimized.

The USFWS has determined a significance criterion of 60 dBA CNEL at the line of habitat as an impact. Specific studies of each ferry route would need to determine where this 60 dBA CNEL contour line falls and develop mitigation accordingly. Mitigation would likely be constrained to the moving of ferry routes away from the lines of habitat.

Fish. Fish also use sound to obtain information about their environment and for communication (reviewed in Tavolga et al. 1981). Every species of fish has a different auditory system and therefore different hearing sensitivity. Generally, fish hear sounds at frequencies between 50 Hz and 2,000 Hz. Loud sounds may cause damage to auditory systems of fish, ranging from morphological damage to stunning and even death (Hastings 1991). Intense sound pressure levels may also cause morphological damage to other parts of the body, such as the air bladder, that plays an important role in acoustic detection and production in some fish.

A review of scientific literature and experiments summarized that several species of fish exposed to underwater sound levels of 180 dB re 1 µPa or higher for 2 hours or less were adversely affected (Finneran et. al. 1995). Little or no data exist for fish exposed to sound levels between 149 and 180 dB re 1 µPa. Therefore, it is difficult to determine the potential impacts as a result of the project to fish in the area. Fish may avoid the area while a ferry is in transit, but it is unlikely that it would cause fish to completely abandon the area.

Summary of Impact NOI-4

- Alternatives 1 through 3 would have the following impacts:
  - Small mammals such as the salt marsh harvest mouse would not be impacted by project-generated underwater noise.
  - No noise impacts to gray whales are expected.
  - The potential for significant impact to harbor seals at their haul-out sites and to birds depends on the specific location of ferry routes. Placement or design of specific routes is not within the scope of this document. Although it is unlikely that fish would completely abandon ferry transit areas, available data preclude determination of impact. Wintering birds have a higher potential for disturbance from fast ferries than from conventional ferries but, like harbor seals, their impact depends on choice of specific ferry routes. The potential for significant impacts to fish and birds from noise is considered unlikely.
  - No impact is expected for sea lions and sea otters from ferry operations.
- Alternative 4 would not have increased ferry operations. Therefore, no impacts would occur.

Mitigation NOI-4.1: Existing NMFS requirements require avoidance of marine mammals (see Biology Mitigation B-14.1). For other wildlife (birds and fish), consultation with federal and state resource agencies will be a part of development of specific routes. If additional mitigation is necessary, it would be identified and applied to specific projects through that process.

Impacts After Mitigation: It is anticipated that impacts would be less than significant with implementation of Mitigation NOI-4.1.

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5.10 GEOLOGY

5.10.1 Significance Criteria

Impacts would be considered significant if they:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving surface fault rupture, earthquake ground shaking, liquefaction, subsidence, uplift, expansive soils, mass wasting, erosion and tsunami or seiche;
- Situate terminals on a geologic unit or soil that is unstable, or that could become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse; or
- Prevent future access to geologic features and resources of economic or scientific value.

The following section discusses potential impacts to the geologic environment from the proposed WTA alternatives. Geologic hazards considered include surface fault rupture, earthquake ground shaking, liquefaction and lateral spreading, uplift and subsidence, expansive soils, mass wasting, erosion, and tsunamis. Major active faults in the Bay Area are summarized in Table 3.10.1. The potential exposure of transit terminals to geologic hazards is summarized in Table 3.10.2. Mitigation measures required to overcome the various geologic hazards are also presented. Lastly, the impacts of the program on the geologic environment are discussed.

5.10.2 Impacts and Mitigation

Impact G-1 **Potential new terminals and facilities could be exposed to surface faulting. There is a potential for substantial damage and risk of injury or loss of life at facilities located on or near active faults.**

The state of California delineates zones around active faults under the AP Earthquake Fault Zone Act (Hart 1994) to mitigate for the effects of surface faulting. Any development within an AP Zone requires detailed geologic investigation to accurately delineate active fault strands such that they can be avoided. Fault rupture beneath engineered structures can, if the fault displacement is large enough, lead to damage and in extreme conditions catastrophic collapse. Even minor fault displacements can cause significant structural damage.

With the exception of the potential for a Half Moon Bay terminal location (Alternative 1), none of the potential shore-based facilities are located within an AP Zone. Therefore, the potential for surface faulting is low for all other terminals (Table 3.10.2). The San Gregorio fault comes onshore at Pillar Point, near the potential Half Moon Bay transit terminal location. The San Gregorio fault poses a potential surface faulting hazard, therefore the potential for surface faulting at Half Moon Bay is considered high (Table 3.10.2).

<u>Summary of Impact G-1</u>

- For Alternative 1, the Half Moon Bay terminal could be within or near the AP Zone for the San Gregorio fault and could be exposed to potential surface fault rupture effects. Other terminal locations have a low likelihood of exposure. This is a potentially significant impact for Half Moon Bay.

- Alternative 2 has no new terminal locations within AP Zones. The potential for this impact is low and considered not significant.
- Alternatives 3 and 4 would not include new terminals. No impact would occur.

Mitigation G-1.1: Significant risk of exposure to surface faulting for Alternative 1 can be avoided if the Half Moon Bay terminal location is dropped from further consideration.

Mitigation G-1.2: Any potential development at Half Moon Bay would have to be carried out in accordance with the regulations detailed in the Alquist-Priolo Act. This will involve detailed, site-specific subsurface geologic investigations to accurately locate the active trace(s) of the fault and adoption of a suitable setback distance in order to mitigate for the effects of potential future fault rupture.

Based on the information above and the generalized locations of WTA facilities presented in this EIR, the hazard from surface faulting rupture is negligible at all potential transit terminal localities except for Half Moon Bay. Therefore, no mitigation measures are recommended for other locations. The proximity of terminals to active fault zones should, however, be verified when specific terminals and routes are proposed.

Impact After Mitigation: The impact from surface faulting after mitigation is low and considered not significant.

Impact G-2 **Potential new terminals and other facilities could be exposed to strong ground shaking. There is a potential for substantial damage to facilities and risk of injury or loss of life at incorrectly designed or constructed facilities.**

The Bay Area is seismically active and all sites have a reasonably high potential of experiencing significant strong earthquake shaking in the future (Working Group on California Earthquake Probabilities 1999).

A number of attenuation relationships have been developed from recordings of earthquake shaking that relate earthquake size, distance from the earthquake source, and geologic conditions to the amount of shaking that can be expected at a site. The amount of shaking is expressed in terms of “Peak Horizontal Acceleration” measured in percent of acceleration of gravity (g) (approximately 9.81 feet per second per second or 10 m/s^2). However, because no specific projects are proposed at this time, no site-specific ground motions were calculated for any sites during this study. Rather, relative levels of earthquake shaking were estimated based on the proximity of each terminal site to known active faults (Table 5.10.1). Sites located less than 5 km from an active fault could experience “very high” shaking. Sites located 5 to 10 km from an active fault could experience “high” levels of shaking. Sites located 10 to 20 km from active faults could experience “moderate” shaking. In cases where ground conditions are likely to amplify the effects of earthquake shaking (deep, soft sediment), there is an increase in the likely shaking hazard ranking (i.e., a site on soft Bay Mud located 7 km from an active fault would likely experience “very high” levels of earthquake shaking).

The levels of earthquake shaking expected from a large earthquake on any of the Bay Area faults would likely result in structural damage and possible injury or loss of life at poorly constructed structures. Areas where foundation conditions have not been sufficiently engineered could experience a loss of bearing capacity, leading to significant structural damage and even collapse.

Summary of Impact G-2

- Alternatives 1 and 2 include new terminals. If the new structures and facilities are not properly designed or constructed for site-specific conditions, they could suffer substantial damage from seismic activity and pose potential risk of injury or loss of life to occupants.
- Alternative 3 could involve expansion of existing terminals. If the expansion was not properly designed, substantial damage could occur from seismic activity.
- Alternative 4 does not include new structures. No impacts would occur.

Mitigation G-2.1: Terminal facilities should be designed and constructed at a minimum to the seismic design requirements for ground shaking specified in the Uniform Building Code for Seismic Zone 4. Additionally, to satisfy the provisions of the 1998 California Building Code, these facilities must be designed to withstand ground motions equating to approximately a 500-year return period (10 percent probability of exceedence in 50 years). For design purposes, site-specific ground motions will have to be calculated for all project sites.

Impact After Mitigation: Impact G-2 would be less than significant with implementation of Mitigation G-2.1.

Impact G-3 **Potential new terminals are in areas of potentially liquefiable soils. There is a potential risk for destruction of structures.**

A map of liquefaction susceptibility in the seven-county Bay Area, prepared by Knudsen et al. (2000), was used to assess risk for the potential ferry terminal locations (Table 5.10.1). The majority of the terminal locations around the Bay Area are in areas of soft, potentially liquefiable soils (Knudsen et al. 2000). Liquefaction is likely to be triggered by strong shaking from an earthquake on one of the Bay Area's active faults. When liquefaction occurs, the strength of the soil decreases and, the ability of soil to support building foundations is reduced. Liquefied soil also exerts higher pressure on retaining walls, which can cause them to tilt or slide. This movement can cause settlement of the retained soil and destruction of structures on the ground surface. Increased water pressure can also trigger landslides. Liquefaction can be minimized or even prevented by adopting appropriate ground improvement techniques, such as soil densification and dewatering, or designing foundations that will accommodate differential ground movement during liquefaction.

Summary of Impact G-3

- Alternatives 1 and 2 would involve potential new terminals located within areas ranked with high to very high susceptibility to liquefaction. The only terminal that might not include soils with these conditions is Fort Baker (Table 5.10.1). This is a potentially significant impact.

- Alternative 3 could involve expansion of existing facilities. This is a potentially significant impact only if building foundations are not designed correctly for potentially liquefiable conditions.
- Alternative 4 involves existing terminals and service. Therefore, there would be no impacts.

Mitigation G-3.1: A program of site-specific exploratory borings and accompanying laboratory testing will be required to delineate any potentially liquefiable materials underneath potential terminal sites. These geotechnical investigations will also be required for consideration prior to foundation design. Potentially liquefiable deposits will either have to be removed or engineered (dewatered or densified) to reduce their liquefaction potential.

Impact After Mitigation: Impact G-3 would be reduced to less than significant with implementation of Mitigation G-3.1 for potential new terminals.

Impact G-4 **Subsidence is ongoing in portions of the Bay Area. The potential geohazard presented by subsidence to potential new terminals is likely low to moderate.**

Although subsidence is ongoing in areas of the Bay (Ogden Beeman and Associates 1992), it does not appear to pose a significant hazard during the lifetime of the project. Significant land level changes generally occur on geologic time scales (>10^3 years). There may be some localized settlement associated with liquefaction (Impact G-3), however, this can be avoided if appropriate mitigation measures (Mitigation G-3.1) are implemented.

Summary of Impact G-4

- Alternatives 1 and 2 would involve potential new terminals located in areas of low to moderate potential for subsidence. The potential for this impact is low and not considered significant.
- Alternatives 3 and 4 involve only existing terminals. Therefore, there would be no impacts from these alternatives.

Mitigation G-4.1: Based on the information above, the hazard from subsidence is likely negligible at potential transit terminal localities. Verification of this condition should be verified when site-specific exploratory investigations are performed.

Impact After Mitigation: Impact G-4 can be avoided or reduced to less-than-significant levels with implementation of Mitigation G-3.1, above.

Impact G-5 **Expansive soil behavior is associated with wetting and drying of soils containing mixed-layer clays. Expansive soils can lead to structural damage.**

The high groundwater table along the margins of the Bay and along the coast at Half Moon Bay indicate that soils at these localities are permanently saturated, therefore there is a very low risk of expansive soil behavior.

Summary of Impact G-5

- Alternatives 1 and 2 would involve potential new terminals located along the shore, where soils are permanently saturated. Alternative 3 could involve expansion of existing facilities. The hazard of expansive soils is considered negligible, and no mitigation is required.
- Alternative 4 involves an existing terminal, and no changes would occur under the WTA program. Therefore, there would be no impacts.

Based on the information above, the hazard from expansive soils is negligible at potential transit terminal localities and, therefore, no mitigation measures are identified.

Impact G-6 **Slope movements have the potential to cause a range of impacts from minor structural damage (building impacts from rock fall) to major damage and injury/loss of life from building collapse.**

Project sites located adjacent to any areas of steep topography are potentially prone to slope instability, depending on source materials, when subject to a triggering mechanism such as heavy rainfall or seismic shaking. Slope instability ranging from rock falls to block sliding is possible on any steep slope around the Bay Area. Particularly prone areas are underlain by rocks of the Great Valley Group or the Franciscan Complex (Table 5.10.1).

Summary of Impact G-6

- Alternatives 1 and 2 include terminals that are not on relatively flat topography (Sausalito, Angel Island, and Fort Baker). These three terminal locations could present potential impacts depending on the actual siting of terminal facilities with regard to slope and source materials.
- Alternative 3 includes Sausalito, which is not on relatively flat topography. Any expansion of the terminal could present potential impacts.
- Alternative 4 does not include new or expanded terminals. Therefore, no impacts would occur.

Mitigation G-6.1: The hazard from mass wasting can be reduced by siting facilities away from steep and unstable slopes. For sites located adjacent to areas of steep topography, site-specific geologic and geotechnical investigations and laboratory testing will determine the stability of slopes and their parent material. Using these data, appropriate slope strengthening and stabilizing designs can be developed.

Impact After Mitigation: Impact G-6 would be considered less than significant after implementation of Mitigation G-6.1.

Impact G-7 **Erosion due to wind and water action could lead to the deterioration of terminal structures.**

Wind and water are the primary agents of erosion, leading to the weathering and subsequent transportation of rock and soils. In coastal and shoreline environments, both agents work in conjunction, often augmented by tidal and current action, to cause removal and/or redeposition of sediments and soft, easily erodable rock. In addition, erosion of soils and soft rock along the margins of river channels can be significant due to high velocity flows.

Comparison of pre-1900 and post-1900/pre-fill topographic maps of San Francisco Bay indicates that the greatest amount of erosion has occurred along the East Bay shoreline in the area south of the Bay Bridge (http://anchor.ncd.noaa.gov/states/ca.htm). This erosion is the result of wave action, driven by the prevailing winds that cross the Bay from the west. The western shoreline, in the lee of the Peninsula Hills and San Bruno Mountain, has remained essentially unchanged during this period. Thus, potential terminal facilities located along the eastern shoreline of the South Bay at San Leandro Marina may be subject to some degree of erosion.

Other areas that may be subject to erosion are located along the banks of rivers, including Pittsburg, Antioch, Martinez, and Benicia along the main channel of the Sacramento River through Suisun Bay, where relatively high velocity flows are achieved during flood stage.

Coastal localities, including those at the entrance to San Francisco Bay, may be subject to tidal and wave erosion. The amount of erosion at these, or any other sites, is essentially unknown at this time. Erosion potential will have to be calculated from detailed site-specific sedimentologic and hydrodynamic studies.

Significant erosion could result in undermining of seawalls, foundations, and other constructed facilities located adjacent to the affected coast or river channel.

Summary of Impact G-7

- Alternatives 1 and 2 would involve potential new terminals. Alternative 3 could involve expansion of existing terminals. Some of these terminals, particularly those located in the East Bay shoreline of the South Bay, could be subjected to a high degree of erosion, which could affect terminal structures. This is a potentially significant impact.
- Alternative 4 involves existing terminals, and no changes would occur under the WTA program. Therefore, there would be no impacts.

Mitigation G-7.1: As stated above, the erosion potential of each site will have to be determined by detailed, site-specific studies. Once this has been determined, appropriate mitigation measures can be adopted.

In general terms, erosion can be prevented by armoring the coastline with rip-rap or concrete seawalls. Defensive measures such as groins that modify or deflect flow and circulation patterns are not desirable as they merely transfer the erosion problem elsewhere.

Impact After Mitigation: Impact G-7 would be less than significant after implementation of Mitigation G-7.1.

Impact G-8 **Tsunami- and seiche-generated waves have the potential to inundate shoreline sites and damage terminal facilities. This potential impact would range from potentially significant at oceanside terminals (Half Moon Bay) to low and or not significant at most of the Bay terminals.**

Ritter and Dupre (1972) show that for a tsunami originating outside San Francisco Bay, the amount of inundation based on tsunami run-up decreases to 50 percent of its maximum at the

Golden Gate by the time it passes the Bay Bridge to the south and the Richmond-San Rafael Bridge to the north. By the time the tsunami reaches the Carquinez Strait to the north or Alviso in the south, the run-up would only be approximately 10 percent of its maximum at the Golden Gate. This model was used to assess hazards related to tsunamis and seiche in San Francisco Bay.

Tsunami-generated waves have the potential to inundate low-lying coastal areas and cause extensive erosion and/or deposition of sediment. Poorly constructed facilities can also be damaged by both the incoming and outgoing waves. As stated above, by the time a tsunami enters the Bay, its impacts will be dramatically reduced compared to those on the open coast. Therefore, the impact of a tsunami to facilities along the Bay shoreline would be minimal, possibly involving a meter or so of potential inundation. The terminal site at Half Moon Bay could be subject to larger tsunami waves from distant sources, including subduction zones surrounding the northern Pacific. Such tsunamis have inundated coastal California on numerous occasions. Most notably, the tsunami generated by the 1964 Alaska earthquake caused damage along the coast of northern California.

Summary of Impact G-8

- Alternative 1 would involve a potential new terminal in Half Moon Bay. This impact would be potentially significant.
- Alternatives 2, 3, and 4 do not involve oceanside terminals. No impact is anticipated.

Mitigation G-8.1: The impacts of future tsunamis can be lessened or mitigated completely by the application of appropriate engineering design. Detailed hydrodynamic modeling may be necessary for coastal locations in order to determine the likely extent of potential inundation. The behavior of tsunami waves is dependent on local bathymetry. Optimal siting of shoreline facilities and breakwaters would lessen the impact of incoming waves. The placement of concrete seawalls and rip-rap will assist in minimizing erosion during wave incursion and withdrawal.

Impact After Mitigation: Impact G-8 would be reduced to a less-than-significant level after implementation of Mitigation G-8.1.

Impact G-9 **The WTA ferry expansion program could potentially impact the geologic environment, including energy or mineral resources. At a program level of review, none of these issues present any potentially significant impacts.**

Hydrocarbon Resources. There are no known hydrocarbon (oil and gas) resources within the immediate area of the project with the exception of a gas field located adjacent to the Antioch Ferry Terminal location (DOGG 2001). However, the WTA project is not expected to have an impact on this resource.

Geothermal Resources. There are no known geothermal resources within the immediate area of the program expansion (DOGG 2001). The WTA project would have no impact on geothermal resources.

Crushed Rock Aggregate Resources. The majority of the terminal locations are classified by California Division of Mines and Geology (now California Geological Survey) as being Mineral

Resource Zone (MRZ)-1 or MRZ-4 areas (Stinson et al. 1987). MRZ-1 describes "areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence." MRZ-4 describes "areas where available information is inadequate for assignment to any other MRZ zone." Based on this information, the majority of potential terminal locations would have no impact on economic mineral resources. However, Rodeo and Crockett were classified as MRZ-3 areas containing crushed aggregate resources. MRZ-3 describes "areas containing mineral deposits, the significance of which cannot be evaluated from available data." Therefore, there is a possibility that the Rodeo and Crockett sites may impact future use of these crushed aggregate resources.

Activities involved in the ferry terminal construction would likely require crushed rock aggregate for the manufacture of concrete elements (e.g., piles, retaining wall structures, surface facilities). Considerations of transportation cost mean that this material will have to come from local sources. This will result in increased production of crushed rock aggregate at local source sites, but this has not been a major constraint for other Bay Area projects.

Sand and Gravel Resources. Half Moon Bay and Antioch are classified as MRZ-3 areas containing sand and gravel resources. This indicates that the siting of shore facilities at these locations could restrict future development of these sand and gravel resources. The Bay Area has other available sources for these materials.

Unique or Outstanding Geologic and Geomorphic Features. The area of San Francisco Bay surrounding potential terminal sites does not contain any unique geological formations, geological features, or geomorphological features that would be adversely impacted by the various WTA project alternatives.

Summary of Impact G-9

- Alternatives 1 and 2 would not have regionwide significant impacts to other mineral or energy resources. There is potential for terminal locations, once selected or determined, to potentially affect these resources.
- Alternative 3 does not include new terminals. No impact would occur.
- Alternative 4 would not impact these resources or features.

Mitigation G-9.1: The presence of geologic, energy, or mineral resources would be identified in the course of site investigations performed for selected terminal or facility features. Avoidance or design measures can mitigate these impacts and can be defined at that time.

Impact After Mitigation: These impacts are not considered significant on a regionwide basis. They can also be avoided during specific terminal planning and design.

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Table 5.10.1
Geohazard Exposure for Potential WTA Terminal Sites

Terminal Site	Alt. 1	Alt. 2	Alt. 3	Potential Geohazards							
				Earthquake Shaking[1]	Fault Rupture[2]	Liquefaction[3]	Subsidence / Uplift[4]	Landsliding[5]	Erosion[6]	Expansive Soils[7]	Seiche / Tsunami[8]
Vallejo	X	X	X	Very High	Low	High – Very High	Low	Low	Moderate	Low	Low
Larkspur	X	X	X	High	Low	Very High	Low	Low	Low	Low	Low
Tiburon	X	X	X	High	Low	Very High	Low	Low	Low	Low	Low
Sausalito	X	X	X	High	Low	Very High	Low	Moderate	Low	Low	Low
Pier 41/43	X	X	X	High	Low	Very High	Low	Low	Low	Low	Low – Moderate
Ferry Building	X	X	X	High	Low	Very High	Low	Low	Low	Low	Low – Moderate
Jack London Square	X	X	X	High	Low	Very High	Low	Low	Low	Low	Low
Alameda	X	X	X	High	Low	Very High	Low	Low	Low	Low	Low
Harbor Bay Isle	X	X	X	High	Low	Very High	Low	Low	Low	Low	Low
Pittsburg	X	X		High	Low	High	Low	Low	Moderate	Low	Low
Martinez	X	X		High	Low	Very High	Low	Low	Moderate	Low	Low
Benicia	X	X		High	Low	Very Low	Low	Low	Moderate	Low	Low
Port Sonoma / Gnoss Field / North Bay	X	X		Very High	Low	High	Moderate	Low	Moderate	Low	Low
Richmond	X	X		High or Very High**	Low	Very Low or Very High**	Low	Low	Low	Low	Low
Berkeley / Albany	X	X		Very High	Low	Very High	Low	Low	Low	Low	Low
Angel Island	X	X		Moderate	Low	Very Low	Low	Low or Moderate**	Low	Low	Low
Treasure Island	X	X		High	Low	Very High	Low	Low	Low	Low	Low - Moderate
Ft. Baker	X	X		High	Low	Moderate or Very Low**	Low	Moderate	Low	Low	Moderate
Alameda Point	X	X		Very High	Low	Very High	Low	Low	Low	Low	Low
Oakland International / Coliseum	X	X		Very High	Low	Very High	Low	Low	Low	Low	Low
East Bay / San Leandro Marina	X	X		Very High	Low	Very High	Low	Low	Moderate	Low	Low
Moffett Field	X	X		Very High	Low	High – Very High	Moderate	Low	Low	Low	Low
Redwood City	X	X		High	Low	High	Low	Low	Low	Low	Low
San Francisco Airport	X	X		Very High	Low	Very High	Low	Low	Low	Low	Low
Oyster Point	X	X		Very High	Low	Very High	Low	Low	Low	Low	Low
Mission Bay	X	X		High	Low	Very High	Low	Low	Low	Low	Low
China Basin / PacBell Park	X	X		High	Low	Very High	Low	Low	Low	Low	Low
Ft. Mason	X	X		Moderate or High**	Low	Very High or Very Low**	Low	Low	Low	Low	Moderate
Antioch	X			High	Low	Moderate – Very High	Low	Low	Moderate	Low	Low
Mare Island	X			Very High	Low – Moderate	High – Very High	Low to Moderate	Low	Moderate	Low	Moderate
Crockett	X			Very High	Low	Very High	Low	Low	Low	Low	Moderate
Rodeo	X			High	Low	High	Low	Low	Low	Low	Moderate
San Rafael	X			High	Low	High – Very High	Low	Low	Low	Low	Low
Bay Model	X			Very High	Low	Very High	Low	Low	Low	Low	Low
Point Molate	X			High or Very High**	Low	Very Low or Very High**	Low	Low or Moderate**	Low	Low	Low
Oakland Army Base	X			Very High	Low	Very High	Low	Low	Low	Low	Low
East Palo Alto	X			High	Low	High or Very High**	Low	Low	Low	Low	Low
Foster City	X			High	Low	High or Very High**	Low	Low	Low	Low	Low
Coyote Point	X			Very High or High**	Low	Very High or Very Low**	Low	Low	Low	Low	Low
Candlestick Park	X			Very High	Low	Very High	Low	Low	Low	Low	Low
Hunters Point	X			High	Low	Very High	Low	Low	Low	Low	Low
Pier 43	X			High	Low	Very High	Low	Low	Low	Low	Moderate
Presidio	X			Very High	Low	Very High	Low	Low	Low	Low	Moderate
Half Moon Bay	X			Very High	High to Moderate	Low to Very High**	Moderate	Low	Moderate	Low	High

[1]Earthquake Shaking: Site-specific earthquake ground motions were not calculated. Ranking is based on proximity to major active faults. Very High – located 5 km or less from active fault; High – located 5-10 km from from active fault; Moderate – located 10-20 km from an active fault.
[2]Fault Rupture: High – located within and Alquist-Priolo (AP) Earthquake Fault Zone; Moderate – Located adjacent to an AP Zone; Low – Located away from known AP Zones.
[3]Liquefaction: Hazards designations based on ranking of Knudsen *et al.* (2000).
[4]Subsidence/Uplift: Ranking relates to potential for tectonic uplift/subsidence during lifetime of the project. Subsidence due to liquefaction and/or lateral spreading is not considered. High – Area of known ongoing subsidence/uplift; Moderate – Area of historical uplift/subsidence; Low – Area with no history of geologically recent uplift/subsidence.
[5]Landsliding: High – History of landsliding/debris flows; Moderate – Area of steep slopes with landslide-prone materials; Low – Flat or relatively flat topography.
[6]Erosion: High – Are of significant active erosion; Moderate - Site located adjacent to river channel, open ocean, or coastline exposed to wind/wave fetch; Low – Site sheltered from agents of erosion.
[7]Expansive Soils: the expansive soil hazard at all localities is considered low as the coastal location of these sites ensures that the soils will almost always be saturated and, therefore, not subject to shrink/swell wetting and drying.
[8]Seiche/Tsunami: High – exposed to open ocean tsunami waves; Moderate – exposed to reduced height tsunami waves or smaller local tsunamis; Low – sheltered from potential tsunami waves.
** Actual hazard ranking is dependent on the exact location of the shore based facility.

5.9 CULTURAL RESOURCES

5.9.1 Significance Criteria

5.9.1.1 Federal and State Evaluation Criteria

The criteria for eligibility for the California Register of Historic Resources (CRHR) are very similar to those that qualify a property for the National Register of Historic Properties (NRHP), which is the significance assessment tool used under the National Historic Preservation Act (NHPA). The criteria of the NRHP apply when a project has federal involvement. The development and adaptation of a ferry expansion plan by the WTA falls under the California Environmental Quality Act (CEQA). Federal cultural resources significance criteria would apply when resources or project actions fall under the jurisdiction of a federal agency. This could apply when actions:

- Occur inside the Monterey Bay National Marine Sanctuary or Gulf of the Farallones National Marine Sanctuary;
- Occur on the outer continental shelf (i.e., deep water dredge disposal sites);
- Require a U.S. Army Corps of Engineers (USACE) 404 permit;
- Occur on lands administered by the U.S. Navy, U.S. Coast Guard (USCG) (other federal agency); or
- Require nation-to-nation consultation between a federally recognized Native American tribe or individual and the federal government.

A property that is eligible for the NRHP is also eligible to the CRHR. All potential impacts to significant resources under a federal agency must be assessed and addressed under the procedures of Section 106 of the NHPA, set forth at 36 CFR 800. All resources encountered when implementing a specific ferry expansion project, with the exception of isolate artifacts and isolate features that appear to lack integrity or data potential, will have to be evaluated for significance vis-à-vis Section 106.

<u>**Federal Significance Criteria**</u>

The four evaluation criteria to determine a resource's eligibility to the NRHP, in accordance with the regulations outlined in 36 CFR 800, are identified at 36 CFR 60.4. These evaluation criteria, listed below, are used to help determine what properties should be considered for protection from destruction or impairment resulting from project-related activities (36 CFR 60.2).

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

- Resources that are associated with events that have made a significant contribution to the broad patterns of our history; or
- Resources that are associated with the lives of persons significant in our past; or

- Resources that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
- Resources that have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

State Significance Criteria

In considering impact significance under CEQA, the significance of the resource itself must first be determined. At the state level, consideration of significance as an "important archaeological resource" is measured by cultural resource provisions considered under CEQA Sections 15064.5 and 15126.4, and the draft criteria regarding resource eligibility to the CRHR.

Generally under CEQA, a historical resource (these include built-environment historic and prehistoric archaeological resources) is considered significant if it meets the criteria for listing on the CRHR. These criteria are set forth in CEQA Section 15064.5 and defined as any resource that:

- Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;
- Is associated with lives of persons important in our past;
- Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or
- Has yielded, or may be likely to yield, information important in prehistory or history.

Section 15064.5 of CEQA also assigns special importance to human remains and specifies procedures to be used when Native American remains are discovered. These procedures are detailed under PRC Section 5097.98.

Impacts to "unique archaeological resources" and "unique paleontological resources" are also considered under CEQA, as described under PRC Section 21083.2. A unique archaeological resource implies an archaeological artifact, object, or site about which it can be clearly demonstrated that—without merely adding to the current body of knowledge—there is a high probability that it meets one of the following criteria:

- The archaeological artifact, object, or site contains information needed to answer important scientific questions, and there is a demonstrable public interest in that information; or
- The archaeological artifact, object, or site has a special and particular quality, such as being the oldest of its type or the best available example of its type; or
- The archaeological artifact, object, or site is directly associated with a scientifically recognized important prehistoric or historic event or person.

A non-unique archaeological resource indicates an archaeological artifact, object, or site that does not meet the above criteria. Impacts to non-unique archaeological resources and resources which do not qualify for listing on the CRHR receive no further consideration under CEQA.

Under CEQA Section 15064.5, a project potentially would have significant impacts if it caused substantial adverse change in the significance of one of the following:

- A historical resource (i.e., a cultural resource eligible for the CRHR);
- An archaeological resource (defined as a unique archaeological resource which does not meet CRHR criteria);
- A unique paleontological resource or unique geologic feature (i.e., where the project would directly or indirectly destroy a site or resources);
- Human remains (i.e., where the project would disturb or destroy burials).

A non-unique archaeological or paleontological resource is given no further consideration, other than the simple recording of its existence by the lead agency.

5.9.2 Impacts and Mitigation

As previously noted, the proposed project actions are primarily located in onshore, Bay shoreline, and offshore environments. As detailed in Appendix CUL-A, cultural resources have been recorded in these settings or have the potential to be located in these geographic locations.

As specific projects move forward for evaluation, detailed record searches, archival reviews, field reconnaissance, and consultation with Native American groups/individuals and local historical societies will be conducted, as appropriate. These tasks, in conjunction with related research and consultations, will further establish the cultural resources data baseline and facilitate assessments of potential impacts to significant cultural resources. It will be the responsibility of the project proponent to direct these activities in a manner consistent with Section 106 and CEQA guidelines, as applicable.

5.9.2.1 Construction and Operation (Dredging)

Impact CUL-1 **Dredging of new channels, maintenance dredging, dredging for pier retrofit or installation, or dredging/related activities for buoy placement could impact submerged and sub-bottom cultural resources in San Francisco Bay.**

Submerged and sub-bottom resources are known within the San Francisco Bay and California coastal submarine environments. Prehistoric resources, such as submerged shellmounds, settlement sites, ceremonial artifacts, and possibly watercraft, are known to exist in these settings. Known historic resources in these environs could include maritime vessels, wharf or pier remnants, shrimp farm remnants, refuse dumps, ammunition dumps, airplane fuselages, and materials related to these or other historical activities. Previously unknown resources could also be encountered.

Summary of Impact CUL-1

- Alternatives 1 and 2 involve expansion of ferry service to new terminals. If all routes that are considered in those alternatives were implemented, considerable dredging would be required, for both channels and ancillary project components. The chances of encountering and adversely disturbing buried sites could inadvertently destroy the cultural value of the resource. Other dredging and construction activities are already underway, or will occur, within the San Francisco Bay environs, such as construction of the east span of the Bay Bridge and construction related to the runway reconfiguration at San Francisco International Airport. These project actions, combined with dredging and related constructions for new ferry terminals, could have potentially significant impacts to cultural resources if they are eligible for, or listed on, either the NRHP/CRHR, or resources that qualify as a "unique archaeological resource" under CEQA. This is a potentially significant impact.

- Alternative 3 would not require dredging of new ferry channels. This alternative would use existing channels that are already maintained. However, Alternative 3 might require minor dredging near the existing ferry terminal to retrofit, expand, or otherwise improve a facility. The resulting impacts could be cumulative and potentially significant for cultural resources eligible for, or listed on, either the NRHP/CRHR, or resources that qualify as a "unique archaeological resource" under CEQA.
- Alternative 4 would not require dredging of new ferry channels. This alternative would utilize existing channels that are already maintained. No impacts are anticipated under the alternative.

Mitigation CUL-1.1: To avoid or mitigate impacts to cultural resources, they must be evaluated against the federal and state significant criteria previously described. Prior to project construction, a focused literature search should be conducted to identify any known resources for sites that cannot be adequately characterized by existing literature or available site history information, marine archaeological surveys may be necessary to detect any previously unknown submerged or sub-bottom resources. Depending on the proposed project undertaking and the geographic or bathymetric setting, appropriate remote sensing field survey could include deployment of a side scan sonar, sub-bottom profiler, and magnetometer to help detect these resources. Follow-up diver survey, high-resolution sidescan sonar, sub-bottom profiler, magnetometer survey, or Remote Operated Vehicle (ROV) investigations might be required to positively identify the targets.

If resources are detected, they should be identified and evaluated against the NRHP/CRHR significance criteria, and as a "unique archaeological resource" under CEQA. If the resources are not eligible for—or already on—the NRHP/CRHR and do not qualify as a "unique archaeological resource" under CEQA, then no further consideration of these resources is required. If the resources are eligible for—or currently on—the NRHP/CRHR or qualify as a "unique archaeological resource" under CEQA, then impacts would occur to those resources. If a resource is found significant, then the resource will be avoided through alterations in project design, when feasible.

Under CEQA, preservation in place is the preferred manner of mitigating impacts to archaeological sites. Preservation in place for archaeological resources may be accomplished by, but not necessarily limited to, a suite of approaches such as:

- Planning construction activities to avoid archaeological sites;
- Incorporation of sites within parks or other open spaces;
- Covering the site with a layer of chemically stable soil before building facilities on top of the archaeological site;

- Deeding the site into a permanent conservation easement.

In the event that avoidance of cultural resources is not possible via project design modifications, appropriate mitigation, which could include a record of the wharf, pier, building or structure in a Historic American Building Survey/Historic American Engineering Record (HABS/HAER) at a level compatible with National Park Service standards. Adequate recordation of a built environment resource would include the following:

- The development of site-specific history and appropriate contextual information regarding the particular resource, in addition to archival research and comparative studies;
- Accurate mapping of the noted resources, scaled to indicated size and proportion of the structures;
- Architectural descriptions of the structures;
- Photo documentation of designated resources;
- Recordation utilizing measured architectural drawings.

Mitigation of a built environment resource may also take place in the form of preservation or reuse of a wharf, pier, building or structure. It should be anticipated that the preservation and/or reuse of an eligible structure would include abiding by the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation. If the building is considered a historic resource under CEQA, the local building inspector must grant code alternatives under the State Historic Building Code.

In some cases, HABS/HAER documentation might not provide an adequate mitigation measure to reduce impacts to a less-than-significant level and might not be an appropriate mitigation measure for some resources. Mitigation should capture the history of a resource and share it with the public so that the public can continue to feel a connection with common heritage. If the pier/building/structure cannot physically be retained, then it is incumbent on the lead agency to pursue ways that the memory of the resource is retained and made easily available. To this end, educational resources such as web media, static displays, interpretive signs, use of on-site volunteer docents, or informational brochures can supplement HABS/HAER. Often, it might be possible to incorporate the resource into the project as one means of resource mitigation.

The lead CEQA agency will be responsible for coordinating all necessary mitigation measures. This might include coordination with a lead federal agency, where federal permitting, land ownership, or other federal-level issues prevail over a specific project action.

Mitigation CUL-1.2: In the event that avoidance of cultural resources is not possible via project design modifications, appropriate mitigation, which could include further recordation and/or data recovery, in accordance with Section 106 of the NHPA, will be conducted.

Under CEQA, preservation in place is the preferred manner of mitigating impacts to archaeological sites. Preservation in place may be accomplished by, but not necessarily limited to:

- Planning construction activities to avoid archaeological sites
- Incorporation of sites within parks or other open spaces

- Covering the archaeological site with a layer of chemically stable soil before building facilities on top of the site
- Deeding the site into a permanent conservation easement

For built environment resources, mitigation may take place in the form of preservation or reuse of a wharf, pier, building, or structure. It should be anticipated that the preservation and/or reuse of an eligible structure would include abiding by the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation. If the building is considered a historic resource under CEQA, the local building inspector must grant code alternatives under the State Historic Building Code.

In some cases, HABS/HAER documentation might not provide an adequate mitigation measure to reduce impacts to a less-than-significant level and might not be an appropriate mitigation measure for some resources. Mitigation should capture the history of a resource and share it with the public so that the public can continue to feel a connection with common heritage. If the building/structure cannot physically be retained, then it is incumbent on the lead agency to pursue ways that the memory of the resource is retained and made easily available. To this end, educational resources such as web media, static displays, interpretive signs, use of on-site volunteer docents, or informational brochures can supplement HABS/HAER. Often, it might be possible to incorporate the resource into the project as one means of resource mitigation.

As the lead CEQA agency, the WTA will be responsible for coordinating all necessary mitigation measures. This might include coordination with a lead federal agency, where federal permitting, land ownership, or other federal-level issues prevail over a specific project action.

Impact After Mitigation: According to CEQA Section 15126.4(b)(1), in certain cases with built environment resources, the mitigation steps outlined in CUL 1.1 and CUL 1.2 might not reduce the impacts on a resource to less than significant. In some circumstances, documentation of a historical resource by way of historic narrative, photographs, or architectural drawings—as mitigation for demolition of the resource—might not mitigate the effects to a point where no significant effect on the environment would occur. In these cases, there could be potentially significant impacts to the resource after mitigation.

Impact CUL-2 Deposition of dredge spoils for upland reuse or wetland restoration could impact submerged or terrestrial cultural resources.

Dredging would result in spoils that would have to be deposited in various locations. Only finer-grained materials (Bay Mud and sand) are suitable for aquatic disposal or upland reuse. Rock, coarse gravel, or materials such as concrete, steel, and other construction debris found in the submarine environment are not suitable for aquatic disposal/upland wetland reuse and must be taken to appropriate locations for disposal or recycling. Depending on volume and suitability of dredged materials, dredging projects may consider a range of options including in-Bay disposal, ocean disposal, upland reuse, wetland restoration, upland landfill disposal, and reuse as fill material for construction projects. It is assumed that deep-ocean disposal would be done at a previously designated disposal site, in-Bay disposal would not be allowed for new dredging projects, and upland disposal would be done at an existing landfill. Therefore, only upland reuse or wetland restoration activities could impact terrestrial and marine cultural resources.

Summary of Impact CUL-2

The impact for CUL-2 is the same as for CUL-1.

Mitigation CUL-2.1: The mitigation for CUL-2.1 is the same as for CUL-1.1.

Mitigation CUL-2.2: The mitigation for CUL-2.2 is the same as for CUL-1.2.

Impact After Mitigation: Impact CUL-2 would be less than significant after implementation of Mitigations CUL-2.1 or 2.2.

Impact CUL-3 **Project actions such as retrofitting, expansion, or improvement on existing facilities, or construction of new facilities, could impact terrestrial historic and prehistoric cultural resources and historic built environment resources.**

On-shore project constructions could include expansion of existing ferry terminals or construction of new facilities. Some of these existing structures, or components thereof, are more than 50 years in age. Project actions have the potential to impact historic built environment structures and districts (including historic terminal structures), and prehistoric and historic (nonbuilt) archaeological sites.

Summary of Impact CUL-3

The impact for CUL-3 is the same as for CUL-1.

Mitigation CUL-3.1: The mitigation for CUL-3.1 is the same as for CUL-1.1.

Mitigation CUL-3.2: The mitigation for CUL-3.2 is the same as for CUL-1.2.

Impact After Mitigation: Impact CUL-3 would be less than significant after implementation of Mitigations CUL-3.1 or 3.2.

Impact CUL-4 **Project actions such as construction and related activities could impact previously unknown resources.**

During project construction and related activities, the potential always exists to encounter previously unknown cultural resources. This would include prehistoric and historic submarine and terrestrial resources.

Summary of Impact CUL-4

- Alternatives 1 and 2 would require construction in numerous areas. These alternatives could have the potential to significantly impact previously unknown resources during construction.
- Alternative 3 could require expansion and retrofitting of existing ferry terminals. This alternative is unlikely to impact previously unknown resources during construction. Therefore, impacts are considered less than significant.
- Alternative 4 would not require expansion of new ferry terminals. No impacts are anticipated under the alternative.

Mitigation CUL-4.1: Same as CUL-1.1. As the lead CEQA agency, the WTA will be responsible for coordinating all necessary mitigation measures. This might include coordination with a lead federal agency, where federal permitting, land ownership, or other federal-level issues prevail over a specific project action.

Impact after Mitigation: Impact CUL-4 would be less than significant after implementation of Mitigation CUL-4.1.

5.8 AESTHETICS

This programmatic assessment of visual and aesthetic impacts due to proposed WTA water transit service expansion is a qualitative analysis. It is broad-based and regional in nature and does not provide detailed local visual and aesthetic impact assessment. Broad types of visual and aesthetic impacts were assessed because they could occur at any location throughout San Francisco Bay due to increased ferry services.

The issues considered in the analysis include views to and from the Bay, the visual quality of new or enhanced structures, light and glare, and the aesthetic quality of construction or ferry activity along the shoreline. The assumption was made that visual and aesthetic impacts of increased ferry services would be most prominent at the existing and potential terminal locations. Therefore the assessment focused more heavily on these areas.

5.8.1 Significance Criteria

Impacts would be considered significant if they:

- Would have a substantial adverse effect on a scenic vista or degrade the existing visual character or quality of the site and its surroundings;
- Would substantially damage scenic resources, including but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway; or
- Would create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area.

5.8.2 Impacts and Mitigation

Impact V-1 **The construction and operation of new and enhanced ferry terminals along the Bay shoreline could potentially impact land and water views of San Francisco Bay or degrade the visual character of the Bay.**

The types of impacts that could occur through construction of terminals, enhancement of existing terminals, and expansion of ferry service are summarized below. These impacts would be localized; regionwide, these structures would affect a relatively small portion of the 1,000 miles of Bay shoreline. For example, even if new terminals under Alternative 1 were implemented, they would represent less than 1 percent of the existing shoreline. Most of these terminals would be at already developed shoreline areas. Localized site-specific visual impact analysis of potential terminal locations was not performed for this program-level EIR.

- Block Bay views: New shoreline development could result in new structures or docked vessels. It is possible that in some instances these structures could be visible or even block or restrict existing views of the Bay.
- Construct unsightly buildings: Without careful planning and design, new terminals could result in unattractive development that negatively affects shoreline views.
- Create light and glare: Safety lighting for facilities, walkways, and parking lots could create a new source of light and glare that negatively affects the surrounding community.

- Construct a building that is inappropriate to a waterfront location: Inappropriate terminal designs could result in parking areas or other inappropriate structures along the waterfront.

Proposed ferry service expansion may also result in positive impacts to visual resources and the aesthetics of the Bay:

- Enhance Bay views: New terminal designs could provide new or enhanced opportunities to view the Bay from piers, platforms, and the ferries themselves.
- Improve the aesthetics of shoreline development: New terminal development could revitalize areas of the shoreline that currently do not take advantage of the Bay setting. Improving areas that currently have debris, contamination, or inappropriate development through the construction of terminals designed to visually complement the Bay and provide public access to the waterfront could result in an enhancement of public views to and from the Bay.

Planning of any development or change in or near the shoreline of the San Francisco Bay is subject to considerable regulatory review by local, state, and federal resource and permitting agencies. Site and terminal planning and its associated regulatory review process for all proposed ferry terminal projects would follow the San Francisco Bay Conservation and Development Commission (BCDC) San Francisco Bay Plan (Bay Plan) policies on appearance, design, and scenic views (BCDC 2002). The policies provide guidelines for enhancing the visual quality of development around the Bay while preserving views of the Bay and shoreline. In addition, the BCDC Design Review Board would review all proposed development that affect the appearance of the Bay in accordance with the Bay Plan. Local city and county ordinances, regulations, and policies would also apply on a project-by-project basis.

Summary of Impact V-1

- Alternatives 1 and 2 could result in the construction of new terminals and/or the improvement of existing terminals, which could have potentially significant impacts to views of the Bay or the visual character of waterfront areas.
- Alternative 3 could require enhancements to existing terminals, which would not result in significant impacts to views of the Bay or the visual character of waterfront areas.
- Alternative 4 would not require new construction or expansion of service. No impact would occur.

Mitigation V-1.1: The WTA established Intermodal and Architectural Design Guidelines that should be considered in the planning and design of new and enhanced ferry terminals (WTA 2002). The design objectives may include, but are not limited to, making the ferry system more attractive, integrating terminals with the local urban context, and taking advantage of waterfront views. The ideal terminal facility will serve as a catalyst to ferry service expansion in the Bay Area.

The physical design objectives focus on terminal layouts that prioritize use by pedestrians, bicycles, and other transit modes rather than individual vehicles. A seamless and efficient transfer between modes of transport will be emphasized through a logical progression of facilities, signs, and boarding points as well as a pedestrian network connecting adjacent amenities such as businesses, transit stops, and public spaces. The specific design of each terminal facility should be developed at a local level to ensure compatibility with the surrounding visual environment.

Impact After Mitigation: The WTA design guidelines will promote aesthetic planning criteria that guide the initial development of projects in a manner consistent with preservation of views and scenic resources. In addition, future development of projects will not proceed without the prospect of meeting BCDC and local planning requirements. Impact V-1 could still be potentially significant after implementation of Mitigation V-1.1.

Impact V-2 **An increase in the number of ferryboats operating on San Francisco Bay could impact views of the Bay or degrade the visual character of the Bay.**

The current ferry services use 15 boats systemwide, with over 80,000 trips annually. Ferries share the Bay with commercial, military, and recreational boats making their way to and from the eight ports and 21 marine terminals throughout the Bay. Views of the Bay therefore include many types of shipping vessels.

The proposed expansion of ferry service under Alternative 1 could result in 160 ferryboats operating on the Bay if all routes and frequencies of service are provided. Ferry activity on the Bay would more than double to potentially 243,440 annual trips if Alternative 3 is implemented. If the most comprehensive service were provided, it would potentially increase the current activity level by more than 10 times, resulting in up to 1,182,980 trips annually.

The potential visual impact of additional ferryboats making trips across the Bay is subjective in nature. It could be seen as an enhancement of the maritime atmosphere and Bay views similar to existing views, which include ferry services, shipping activity, and recreational boating. It could also be seen as a detriment to views of the Bay. There are no established significance criteria that provide a framework to determine if increased ferry vessels on the Bay would be considered a significantly detrimental impact. Increases in service may be relatively unnoticeable to most Bay Area residents and travelers. However, full implementation of service, such as for Alternative 1, could compromise some existing views.

Summary of Impact V-2

- Alternatives 1 and 2 would result in an increase in the number of vessels operating on San Francisco Bay. This could have an adverse impact on scenic views of the Bay. Under full implementation of service routes and frequency of service, this could represent a significant impact to views of the Bay or the visual quality of waterfront areas.
- Alternative 3 would result in a minor increase in the number of vessels operating on San Francisco Bay. The minor increase in the number of boats and the lack of new terminal facilities would not represent a significant impact to views of the Bay or the visual quality of waterfront areas.
- Alternative 4 would not require additional boats or increased services. No impact would occur.

Mitigation V-2.1: This impact is partially minimized by the concentration of routes along some common alignments. It would be further reduced by implementation of other mitigation measures for air quality and energy that describe route and ferry vessel trip reductions. These measures would reduce services considerably from those described for full implementation of Alternatives 1 and 2. No mitigation is required.

Impact After Mitigation: This impact would be mitigated to less-than-significant levels through implementation of mitigation measures for air quality. Mitigation A-1 describes a reduction of route service. No further mitigation is proposed.

Impact V-3 Visible exhaust from current or modern ferries is minimal or nonexistent due to improvements in engine propulsion and operation. Visible exhaust plumes would not occur under normal ferry operation.

Visible smoke plumes exhausting from an engine are a result of various conditions, but can indicate that an engine is not completely burning the fuel. Incomplete combustion results in unwanted pollutant emissions. These emissions can include particulates that may be visible in the exhaust, resulting in darkened plumes. Internal combustion engine emissions also include a large proportion of water vapor, a normal product of combustion, which may also be visible under certain conditions (such as very cold temperatures or an engine that is not completely warmed up).

Expansion of ferry service on existing or new routes would be based on engine and fuel technology that is current or state-of-the-art. Visible exhaust plumes would not occur. Modern ferry vessels on current routes are well maintained on a regular basis and would continue to be maintained with expansion of service.

Summary of Impact V-3

- Alternatives 1, 2, and 3 would increase the number of ferryboats and trips on the Bay, but all boats would continue to be maintained on a regular basis and would not result in visible exhaust plumes. No impact would occur.
- Alternative 4 would not require additional ferryboats or increased services and existing vessels would continue to be maintained on a regular basis. No impact would occur.

Impact V-4 Expanded and enhanced ferry services, including terminals and additional ferry boats, would not impact scenic resources within a State Scenic Highway.

Sections of Bay Area Highways 280, 580, and 680 have been designated as scenic corridors under the State Scenic Highway program but do not provide motorists with expansive or continuous views of the Bay. Therefore, these corridors would not be affected by an increase in visible ferries on the Bay or the construction of new terminals along the shoreline.

Summary of Impact V-4

- Alternatives 1 and 2 would result in additional terminals and an increase in the number of vessels operating on San Francisco Bay. This development and boating activity would not be highly visible to motorists and it does not represent a visual impact to scenic resources within a State Scenic Highway.

- Alternative 3 would increase ferry trips on the Bay, but would not result in the development of new terminals. This boating activity would not be highly visible to motorists and it does not represent a visual impact to scenic resources within a State Scenic Highway.
- Alternative 4 would not require new ferry vessels or increased services. No impact would occur to scenic resources within a State Scenic Highway.

Impact V-5 **Expanded and enhanced ferry terminals and services throughout San Francisco Bay could result in light and glare impacts.**

Ferry terminal facilities could include structures, parking lots, roadways, and pedestrian and bicycle facilities that would be lit for public safety. Terminals proposed within or adjacent to existing marinas, ports, or shoreline development would add to existing light and glare, but may not necessarily create a substantial new source. Potential terminal facilities in parkland or less developed areas would be more likely to create a new source of light and glare, and this impact could be adverse and significant. New light sources may represent a potentially significant impact to light-sensitive land uses such as nearby residential areas.

Increased ferry trips on the Bay would add to the existing vessels that already cross Bay waters. Early morning or late day/evening vessel trips would show navigation as well as cabin and deck lighting. The increase in frequency of trips and new routes to terminals not currently serviced would increase and introduce these sources of light on the Bay and at terminals, but it would be transitory and the lighting would not be a substantial source of glare to light-sensitive land uses. Therefore, this vessel lighting would not be considered adverse or significant.

Summary of Impact V-5

- Alternatives 1 and 2 could result in the construction of new terminals and/or the improvement of existing terminals, which would result in potentially significant light and glare impacts.
- Alternative 3 could require enhancements to existing terminals. This would not create new sources of light or glare and does not represent a significant impact.
- Alternative 4 would not require new construction or expansion of services. No light or glare impacts would occur.

Mitigation V-5.1: Ferry terminal designs will be required to develop site-specific lighting plans. Outdoor lighting should be focused and directed to the specific location (e.g., roads, walkways), be shielded to avoid the production of glare, and minimize up-light and light spill. Fixtures should be located, aimed or shielded to minimize stray light to or across property boundaries. Light design should use down-cast, low glare, shields, or equivalent design to minimize light and glare on surrounding land uses.

Impact After Mitigation: Impact V-5.1 would be minimized through application of Mitigation V-5.1, but the potential remains for significant impacts depending on site-specific locations and settings. This impact remains potentially significant.

References

San Francisco Bay Conservation and Development Commission (BCDC). 2002. San Francisco Bay Plan. October.

5.7 LAND USE

5.7.1 Significance Criteria

Impacts would be considered significant if they would:

- **Cause community displacement.** Implementation of the project would have a potentially significant impact if an alternative could result in the displacement of existing houses or businesses, either directly or indirectly.
- **Disrupt community cohesion.** Implementation of the project would have a potentially significant impact if an alternative physically divides, or otherwise substantially disrupts, a community, either directly or indirectly.
- **Result in disproportionate physical impacts to low-income or minority communities.** Implementation of the project would have a potentially significant impact if an alternative disproportionately causes adverse physical impacts to low-income or minority persons. Following criteria were used for determining low-income and minority communities:
  - ***Low Income*:** A community is defined as low income when the median household income of a census tract is below the 2002 California Department of Housing and Community Development (HCD) low-income limit for the parent county.
  - ***Minority Community*:** A minority community is defined as a having at least 70 percent of the population share be one or more minority group (as compared to a 50 percent average for the Bay Area as a whole) (MTC 2001).

Because formal federal environmental review and compliance is not required at this program EIR stage, these definitions are not based strictly on federal guidelines. In terms of low income, the most recent HCD data was used, which are based on federal (HUD) standards for determining low income. The definition of a minority community was used from the Metropolitan Transportation Commission (MTC) EIR for their 2001 Regional Transportation Plan (RTP), which is the most recent analysis of potential adverse environmental impacts to minority communities conducted by a regional transportation agency in the Bay Area.

5.7.2 Impacts

5.7.2.1 Construction and Operational Impacts

Potential WTA ferry terminal locations can be divided into locations that have existing, operating terminals, and locations that do not currently have operating terminals. The expansion and enhancement of ferry services would affect a wide range of land uses and communities along the Bay shoreline. The majority of the potential terminal locations for Alternatives 1 and 2 would require construction of new ferry terminals. Brief descriptions of potential local settings for new or enhanced terminal locations are provided below. The descriptions note when planning departments have identified potential changes in land use for a particular area, as some areas may have changed by the time a ferry terminal site is considered. The numbers in parentheses correspond to terminal locations shown in Figures 2.1, 2.2, and 2.3. More detail on each potential ferry terminal site is contained in Tables 5.7.1 through 5.7.3.

Alameda – Harbor Bay (14)	The existing ferry terminal at Harbor Bay Parkway and Mecartney Road on the northwest side of Bay Farm Island, Alameda, is located within a single-family residential area. The terminal was built as a requirement of the part of the Harbor Bay Business Park development, an employment center for 85 companies located approximately one-half mile south of the terminal site.
Alameda Main Street (15)	The existing ferry terminal is located on Main Street along the Oakland Estuary. The site is between the former U.S. Naval Air Station Alameda and the Alameda Gateway site. Due to redevelopment plans for these areas, significant changes will occur including mixed-use business park development with office, commercial, and light industrial uses.
Alameda Point (13)	A ferry could be located on the decommissioned Naval Air Station Alameda, which is under redevelopment as a mixed-use residential/commercial neighborhood. The area will include residential units, industrial/office space, retail businesses, and cultural/institutional facilities.
Alcatraz Island (38)	The existing ferry terminal is on the northeast side of Alcatraz Island. The terminal is next to a visitor's center and visitor amenities and is downhill from the cellblock buildings of the penitentiary. The island retains its historic buildings and appearance as a former prison, and the ferry terminal facilities and surroundings are the first facilities that visitors see when approaching the island.
Angel Island (5)	There is existing ferry service to Angel Island—the largest island in San Francisco Bay and a California State Park. The terminal is located at Ayala Cove on the north side of the island in Marin County. The island is composed of hilly grasslands and forest with recreational facilities, trails, and sites of historical interest including the Immigration Station, Fort McDowell, and the West Garrison.
Antioch (46)	A potential ferry terminal could be located at the marina in Antioch. The site is surrounded by a parking lot, boat slips, restaurants, and commercial uses. Adjacent to the marina is a downtown setting with commercial, office, and residential land uses.
Benicia (40)	The potential terminal site would be located adjacent to the downtown area. It would be near the commercial core as well as single- and multi-family housing.
Berkeley/Albany (7)	This terminal site would be located south of Golden Gate Fields, or at the foot of University Avenue. A hotel and conference center is proposed just north of the terminal location, and retail space is proposed to the south. The remaining shoreline would be part of the Eastshore State Park.

Candlestick Park (34)	The San Francisco Planning Department stated that a new marina complex with space for a ferry landing and concessions is planned near Candlestick (3Com) Park. The football stadium is surrounded by a large parking lot and nearby mudflats that are planned for restoration to natural salt marsh habitat. An interpretive center is proposed to promote environmental education.
China Basin/ Pac Bell Park (11)	A potential location is just south of the ballpark in the South of Market neighborhood of San Francisco, a light industrial area of the city with numerous high-technology firms and multiple-unit residential buildings. This highly developed and active area of San Francisco includes the Moscone Convention Center, the San Francisco Museum of Modern Art, and the Yerba Buena Center for the Arts.
Coyote Point (35)	This ferry terminal would be in San Mateo at Coyote Point. There is an existing marina, open space park, public museum, and golf course at this location. The nearest residential units are to the south of East Poplar Avenue.
Crockett (27)	Railroad tracks run along the entire shoreline of Crockett, and uses along the waterfront include residential, industrial, and commercial. Downtown Crockett has many historical buildings and narrow streets. The City of Crockett discourages cars downtown.
East Palo Alto (37)	Although there is currently no marina in East Palo Alto, a potential location for a new terminal in this area is Cooley Landing. The area is currently a junkyard/scrap yard with wetland habitat nearby. Extensive redevelopment is proposed for this area, which would include residential, retail, commercial, and office uses.
Fort Baker (8)	The proposed ferry terminal would be located at Fort Baker, on Horseshoe Bay just east of the Golden Gate Bridge in Sausalito. The site is within the Golden Gate National Recreation Area and the scenic Marin Headlands. The ferry would service the proposed conference and retreat center in the rehabilitated historic structures.
Fort Mason (31)	Ferry service is proposed to Fort Mason Center in San Francisco. The site is a converted military base with a variety of nonprofit organizations and activities including arts, education, ecology, and recreation. It is part of the Golden Gate National Recreation Area, near major tourist attractions like Ghirardelli Square, and surrounded by dense urban neighborhoods.
Foster City (36)	The waterfront in the vicinity of a potential Foster City terminal site includes a park that is currently closed and used as staging area for work on the San Mateo Bridge, a residential area, and office uses.
Gnoss Field (44)	A potential ferry terminal could be located northeast of Novato along the Petaluma River. The site is on a slough near the Marin County Gnoss Field general aviation airport, the Northwestern Pacific railroad tracks, and Highway 101.

Half Moon Bay (43)	The Half Moon Bay terminal would be located at an existing harbor that is surrounded by a golf course, beaches, and natural reserves along the coastline. Recent real estate development has made Half Moon Bay into a new bedroom community serving San Francisco and the Peninsula.
Hercules/Rodeo (28)	Hercules is a rapidly growing city stretching from San Pablo Bay to the rolling coastal hills. The City of Hercules has proposed mixed-use development along the waterfront, primarily single-family residential and commercial. The Rodeo Marina is surrounded by a retail, commercial, and residential area and the Lone Tree Regional Shoreline.
Hunters Point (33)	This potential ferry terminal site could be at the decommissioned Hunters Point Shipyard in the southeast corner of San Francisco. The shipyard consists primarily of abandoned industrial and residential buildings, which are being used in limited capacities. The proposed redevelopment of the former U.S. naval base is conversion to civilian use as a waterfront mixed-use, live-work community.
Larkspur (1)	The existing ferry terminal complex in Larkspur, Marin County, includes four vessel slips, a parking lot, bus parking, fuel storage, and maintenance and administration offices. Across the street is Larkspur Landing, an outdoor shopping complex with retail businesses and restaurants.
Mare Island (25)	A ferry terminal is proposed for service to Mare Island, a former naval shipyard. The island currently has many old military buildings, some of which are occupied by businesses and some are of which are vacant or closed. Reuse plans call for creating a job center with mixed land uses such as industrial and office as well as residential units, a regional park, expansion of the golf course, and the construction of a bridge at the southern end of the island.
Martinez (24)	A ferry terminal is proposed in the vicinity of the Martinez Yacht Harbor at the end of North Court Street. The harbor extends into the Carquinez Strait and is surrounded by the Martinez Regional Shoreline Park to the east and west and the Martinez Waterfront Park to the south. The parks form a half-mile buffer between downtown Martinez and the harbor. Other potential sites could include areas near the Martinez Intermodal Station.
Mission Bay (12)	Ferry service is proposed to the Mission Bay Redevelopment Area, approximately 1 mile southeast of downtown San Francisco. The site is currently an industrial area and former rail yard proposed for redevelopment as a dense urban neighborhood with housing, offices, retail, parks, and a school.
Moffett Field (22)	Ferry service is proposed for Moffett Field in Mountain View/Sunnyvale, Santa Clara County. This decommissioned base along the South Bay shore includes two runways, barracks, administrative buildings, aircraft hangars, military housing, and the NASA/Ames research center. Reuse plans are being developed and may include a NASA Research Park, a California Air and Space Center, and other intensified land uses.

Oakland Army Base (OARB) (32)	The former OARB is currently a mix of maritime, industrial, and former army base facilities. A redevelopment plan is being prepared for this area which would include business parks, light industrial, maritime support, new marine terminals, and public parks. A new terminal to serve this area would be located along the Inner Harbor.
Oakland International Airport/Coliseum (42)	A potential ferry terminal could be located either on the west side of San Leandro Bay adjacent to the Oakland International Airport or on the east side near the Oakland Coliseum. The area is a mix of industrial, business parks, airport-related services, and low-density commercial/office.
Oakland/Jack London Square (16)	The existing ferry terminal is at the end of Clay Street within the commercial/retail district of Jack London Square. This active area includes restaurants, small shops, entertainment, residential units, and office space and is within walking distance of downtown Oakland.
Oyster Point (19)	A ferry terminal is proposed at the end of Oyster Point Boulevard in the Oyster Point Marina/Park. The marina is surrounded by a shoreline park extending north and south along the Bay. The area inland of this park includes primarily low-density offices, technology parks, and light industrial areas with very few housing units.
Pittsburg (26)	A ferry terminal could be located at the Pittsburg Marina/Central Harbor, Contra Costa County. The waterfront area is immediately adjacent to the downtown core of Pittsburg with urban commercial and residential areas. There are few visual and physical connections between downtown and the water.
Point Molate (29)	A ferry terminal could be located at Point Molate, a decommissioned Navy contaminated site (brownfield). The area is currently vacant with some shoreline recreational uses.
Port Sonoma (45)	A ferry terminal could be located at the existing Port Sonoma Marina, along the Petaluma River in Sonoma County. The surrounding area is under agricultural use (some of which has conservation easements) and provides important wildlife habitat. The site is also near Route 37 and the former Northernwestern Pacific Railroad, but it is miles away from urban centers.
Presidio (10)	A former military base, the Presidio is now part of the Golden Gate National Recreation Area. It includes public open space, residential uses, historic buildings, and office space. New construction at the Presidio is limited to maintain the significant open space and preserve natural, historic, scenic, and recreational features.
Redwood City (21)	The proposed ferry terminal site in Redwood City is on a narrow spit of land adjacent to Redwood Creek and surrounded by wetlands and salt evaporation beds. Commercial development is the primary land use planned for the area, including a large existing development at Pacific Shores. The Port of Redwood City is serving a growing industrial role for the delivery of bulk construction materials to the South Bay.

Richmond (4)	Given Richmond's extensive waterfront, there are a variety of potential locations for a ferry terminal, including the existing decommissioned terminal at the end of Harbor Way South. The shoreline in the vicinity of the existing terminal includes a vacant parking lot, debilitated historical industrial factory, the Port of Richmond shipping yard, a small park, and R&D office facilities. Redevelopment of this area may include new land uses such as office, research and development, residential, mixed-use development, parks, promenades, and open space.
San Rafael (30)	A ferry terminal could be located at the marina in San Rafael. The area surrounding area includes a supermarket, a neighborhood shopping/ commercial area, and residential units (including houseboats).
Sausalito (3)	The existing ferry terminal is located in the middle of downtown Sausalito, Marin County, and is easily accessible from the shopping area of central downtown. The picturesque town includes boutiques, restaurants and public parks. Multifamily housing dominates the nearby residential area.
Sausalito/ Bay Model (3)	A second ferry in Sausalito could serve the Bay Model, a public museum of the Bay Ecosystem. The area surrounding the museum is industrial. The location is within the Marinship Specific Plan Area (1983), the intent of which is to preserve water-oriented areas and prevent large-scale development.
San Francisco Ferry Building (20)	The historic San Francisco Ferry Building is currently being redeveloped as a major retail/commercial structure. The project will result in new and improved ferry terminal facilities and enhanced public access and aesthetic character. The surrounding area includes high-rise buildings with offices, retail, and restaurants.
San Francisco, Pier 41-43 (9)	Ferry service is currently provided from Pier 41 in San Francisco, which is a major tourism center due to its location next to Pier 39, a year-round festival marketplace. The neighborhood adjacent to the terminal includes tourist and residential uses including retail, restaurants, other services, and single-family and multifamily housing.
San Francisco International Airport (18)	A ferry terminal could directly serve San Francisco International Airport in Millbrae, San Mateo County. The airport has seen rapid growth in air traffic and is continuing to explore means for expanding services, such as potential runway expansion.
San Leandro Marina/East Bay (17)	The City of San Leandro's marina is a potential location for a new ferry terminal. The waterfront in San Leandro is primarily devoted to open space in the form of parks and golf courses. The city has identified the marina as the focus of future development activity, including a potential hotel development.
Tiburon (2)	The existing Tiburon ferry terminal is located on the west end of Tiburon near the Belvedere border and looks directly across to Angel Island. Main Street, the downtown retail area with boutiques, restaurants, and other small-scale retail, is directly adjacent to the terminal. An adjoining

multiple-unit residential area quickly gives way to lower-density residential as the distance from downtown increases.

Treasure Island (6)	A ferry terminal is proposed on Treasure Island, in San Francisco Bay between San Francisco and Oakland. The island is composed of the natural island of Yerba Buena and the artificial Treasure Island. The site is a decommissioned military base with offices, housing, warehouses, and other structures. The Draft Reuse Plan emphasizes publicly oriented uses such as recreation, entertainment, retail, and hospitality.
Vallejo (25)	The existing Vallejo ferry terminal provides service from Mare Island Way in Memorial Park. The terminal is adjacent to Vallejo's city hall, main post office, and library and is close to downtown Vallejo. In addition, the redevelopment of Mare Island may generate increased ferry ridership. Buildout of the former base will include a variety of uses including residential, wetland research center, regional park, an 18-hole golf course, dredge ponds, schools, and light industrial.

Alameda, Candlestick Park, and Treasure Island are the only locations identified that have already adopted plans for developing a new ferry terminal. In most cases, however, the development of a new terminal would not be compatible with local land use policies such as land use designations and zoning ordinances. Although Alternative 3 would only result in terminal enhancement, some activities may result in the need to change a land use designation or require a Conditional Use Permit.

As discussed in Section 3.7.1.4, analysis under the California Environmental Quality Act (CEQA) is required for general plan amendments to change a land use designation, or Conditional Use Permits (or similar permit) needed by local zoning ordinances. Therefore, any impact to an existing land use that may occur as a result of constructing a new ferry terminal or other facility would require additional CEQA review. As such, the development and implementation of a specific route(s) would require site-specific CEQA review for most of the new terminals proposed.

Based on the land use data collected and analyzed for the project, it appears that the large majority of proposed terminal locations would not be consistent with local land use policies. However, until such time that parcels are identified for potential ferry terminals, the compatibility of each proposed terminal with existing land uses and zoning ordinances remains unknown.

Any potential terminal site must be identified using some level of analysis or waterfront planning process with consideration to the surrounding land uses in order to adequately ensure the terminal will be a compatible use. This can be accomplished under CEQA or conducted as an independent analysis. This requirement for the WTA and local proponents of specific ferry expansion projects to comply with CEQA is not identified herein as a formal "impact." These projects could not proceed without complying with this already required process.

Impact LU-1 **Many of the ferry terminal locations are proposed in developed urban areas that do not currently have ferry terminal facilities. The development of new ferry terminals in urban locations could result in the displacement of existing residential, commercial, or industrial buildings.**

Water transit facilities in areas without existing operational ferry terminals that are already developed may result in the displacement of residences, offices, or industrial facilities. The possible expansion of existing terminal facilities as a result of the proposed enhancement could also result in displacement impacts; however, it is anticipated that this would occur in limited circumstances. As discussed below, planning for terminals would be performed in conjunction with local planning to minimize these effects. It is also noted that the area needed for new or expanded transit terminals is not a substantial amount at a regional level. For example, the maximum total affected shoreline for Alternative 1, if fully implemented, is less than 1 percent of the Bay Area shoreline area.

Because the specific size, type, and location of each proposed new terminal proposed is unknown, the significance of displacement impacts that occur as a result of the proposed project cannot be determined. In other words, the conceptual nature of the ferry expansion plan prevents the assessment of the significance of potential displacement impacts at a regional scale. However, it is important to note how displacement impacts might occur generally, and clearly identify the considerations that the WTA and local agencies will need to incorporate into site-specific environmental review under CEQA.

Significant displacement impacts to people or businesses can be minimized by locating new terminals in areas that are already identified by a local redevelopment agency, or need to be removed for safety reasons (e.g., that are known to be structurally deficient or contain hazardous materials that need to be removed). The installation of water transit facilities could also take advantage of the older, derelict industrial areas that occur in some locations throughout Bay shoreline communities to avoid impacting residential areas and minimize the number of business relocations. Note that planning for facilities in industrial areas, or for any location, will be performed with evaluations of each site for potential existing soil or water contamination. The presence of these site conditions can be addressed through avoidance, construction methods, or site remediation.

Some ferry terminals could be developed as an amenity to or in conjunction with other developments that have displacement impacts, such as a Specific Plan or Redevelopment Plan. If the construction of a ferry terminal is adopted as part of a larger development, it will be the responsibility of the local city or county to consider displacement impacts for that entire project including the terminal. The potential impacts associated with these larger development projects may require partial analysis as part of an environmental review process. Specific displacement impacts would be considered at that time.

Although property acquisition impacts could occur for ferry services, they could also occur as an indirect or cumulative impact due to street widening or reconfiguration to provide better access to a terminal.

If people and businesses do not own the property or unit they live or work in (i.e., renters), they may not be able to obtain the benefits afforded to displaced property owners. When required to move out of a rental property as a result of a redevelopment project, relocation can be made difficult by the high cost of living in the Bay Area or an increase in time spent traveling to and from a job. When considering a terminal location, specific project proponents would have to take into account the potential impacts to renters that can result from displacing homes and businesses, especially in low-income neighborhoods.

Summary of Impact LU-1

- Alternatives 1, 2, and 3 could involve acquisition of property necessary to expand or create ferry passenger terminals or other facilities. This action could potentially include residential or business properties. Although the significance of displacement impacts cannot be quantified at the regional due to a lack of site-specific information, it remains a potentially significant impact.
- The decision to displace homes or businesses must be made in participation with local city and county governments.
- Displacement impacts most often result from redevelopment or property acquisition requirements.

Mitigation LU-1.1: Site-specific projects should consider project alternatives that avoid displacement of homes or businesses. Displacement impacts to homes and businesses should be addressed as part of the terminal site selection process and avoided through design measures to the extent feasible. Proposals for terminals with potentially significant impacts due to the displacement of homes and/or businesses will likely not be approved without proper mitigation.

If a displacement is unavoidable, project proponents will be required to prepare and execute mitigation in the form of a relocation assistance plan or equivalent. If federal transportation funds will be used for a ferry terminal project, compliance with the Uniform Relocation Assistance and Real Property Acquisition Act of 1970, as amended, shall be required. Relocation plans typically consider:

- Criteria for replacement housing
- Reimbursement criteria for moving costs and/or differential housing costs (including rents)
- Reimbursement criteria for businesses, including costs associated with searching for a new space, and business (i.e., patronage) lost due to the relocation

Impacts After Mitigation: Relocation of a resident or business can be a significant impact to those affected, and sometimes to the community. Required relocation assistance and compensation has typically offset this impact. It is not significant at a regional level due to the expected low number of people and businesses likely affected. However, it is identified here as a potentially remaining significant effect until site-specific locations are identified and conceptually defined.

Impact LU-2 **Installation of new ferry terminals could disrupt or divide already established neighborhoods. This impact has the potential to be significantly negative or positive, depending on how much the community supports or opposes the location of the terminal.**

The construction and operation of a ferry terminal where one does not currently exist could, in some cases, result in potentially significant impacts as a result of disrupting or dividing an already established neighborhood. It is unlikely that Alternative 3 would have regionally significant impacts due to a permanent disruption or division of an established neighborhood because the ferry terminals are already integrated into the community. An expansion of ferry service or terminal facilities could have significant impacts on the neighborhoods adjacent to the existing terminals, however this would not be a significant impact at the regional level.

Construction-related impacts could disrupt existing neighborhoods due to construction noise, dust, and traffic. Examples of these impacts include trucks driving through neighborhoods on the way to a construction site, noise increases related to pile driving or other noisy construction activity, or particulate matter blowing into neighborhoods from a project site. These potentially disruptive impacts will be analyzed on a project-by-project basis as part of the environmental review under CEQA. Although potentially significant, these impacts are most often minimized to less-than-significant level through project design features or best management practices. Furthermore, construction-related impacts are temporary and would not result in permanent change in an established community.

Operational impacts that could permanently disrupt or divide existing neighborhoods are potentially significant. Alternatives 1 and 2 have the greatest potential to permanently alter already established neighborhoods in communities around the Bay, especially in terminal locations proposed in urban or suburban settings where terminals do not currently exist. Divisions could occur primarily due to potential roadway expansion that may be required in order to accommodate anticipated changes in traffic patterns to and from a new terminal. Disruption could occur as a result of changes in land use and development adjacent to a new ferry terminal in a neighborhood where this growth would not have otherwise occurred (see discussion under Impact LU-2 for potential growth inducement impacts). The project could also disrupt an established community by displacing a community center, place of worship, or other gathering place, however this impact is unlikely to occur nor would it be regional significant. Because most of the ferry terminals will be "origin" terminals (they will be places where trips originate), people from around the Bay Area will need access to and from the terminals by vehicle, bus, or other from of transit.

For purposes of this analysis, new terminal locations were identified that would potentially require vehicles to utilize roads through established residential areas to access the site. The following locations were identified:

Facility	**Nearest Highways**	**Approx. Driving Distance to Nearest Highway (mi)**	**Approx. % of Driving Distance in Residential Area**
Antioch	SR 4	1.5	50
Benicia	I-780	> 1	75
Crockett	I-80	> 1	75
East Palo Alto	US 101; SR 84	1.5; 1.5	75; 50
Half Moon Bay	SR 1	> 1	50
Hercules/Rodeo	I-80	1 – 1.5	100
Hunters Point	US 101	2	75
Mare Island	I-80, SR29; SR 37	3.5; 3; 3	50; 50; 50
Martinez	SR 4; I-680	3; 2.5	100; 25
Mission Bay	I-280; US 101	> 1	75
Pittsburg	SR 4	1.5	50
Richmond	I-580	1	50
San Leandro	I-880	1.5	75
Sausalito/Bay Model	US 101/SR 1	1.5	75

These locations could result in significant community impacts if it is determined that existing roadways must be widened to accommodate an increase in traffic due to the installation of a ferry terminal. Roadway widening could result in the relocation of homes or businesses. The result of larger roadways with more traffic could potentially impact community cohesion by increasing noise, light, glare, and aesthetic impacts in the community; could make it less desirable to live there; and may adversely affect property values. Due to the speculative nature of these impacts, adequate analysis cannot be conducted at this time. Therefore, as stated above, it is important that local planning agencies consider implementing new ferry service only after environmental review under CEQA and/or some comprehensive planning has been conducted to analyze these potential impacts.

Localized impacts that result in the disruption or division of established neighborhoods due to the implementation of Alternatives 1 or 2 could cumulatively result in a potentially significant impact at the regional level. It is possible that many terminals could be constructed simultaneously. Also, the permanent changes that occur as a result of implementing Alternative 1 or 2 could be considered potentially significant at the regional level if many of the adopted plans result in changes that are considered disruptive or divisive of an established neighborhood.

Summary of Impact LU-2

- Impacts that disrupt or divide established communities could take place during the construction and operation of a ferry terminal.
- Cumulatively, local projects that result from the implementation of Alternatives 1 or 2 could result in potentially significant impacts at the regional level.
- Implementation of Alternative 3 may potentially disrupt or divide an established neighborhood; however, these impacts would be less-than-significant at the regional level.
- As with Impact LU-1, community impacts must be considered at the local level when a city of county adopts plans to construct and operate a ferry terminal.

Mitigation LU-2.1: Local agencies desiring ferry service should identify parcels along their waterfronts that would facilitate a ferry terminal through a waterfront planning process or other type terminal location study. Any potential terminal site must be identified using some level of analysis with consideration to the surrounding land uses in order to adequately ensure the terminal will be a compatible use and will minimize land use impacts, as is required under CEQA. Site-specific projects should consider project design elements that improve terminal accessibility while maintaining community cohesion.

Impacts After Mitigation: Although the implementation of Mitigation LU-2.1 would reduce Impact LU-2 to a less-than-significant level, until further study at the local level is conducted to identify site-specific criteria or standards for identifying and mitigating disruptive or divisive community impacts, Impact LU-2 remains a potentially significant impact.

Impact LU-3 **The implementation of the program alternatives could result in disproportionate adverse impacts to low-income and minority communities. These impacts would occur primarily as a result of the displacement of homes or businesses in low-income and minority communities or substantial disruption of established low-income or minority neighborhoods.**

As the regional transportation agency, MTC identified low-income and minority neighborhoods (referred to as Disadvantaged Communities) in the Bay Area to determine if funding for the 2001 RTP would result in an inequitable allocation of funds to non-disadvantaged communities. MTC's Equity Analysis found that the 2001 RTP would increase spending in disadvantaged communities as compared to the previous plan. Like MTC, the WTA analyzed the potential for the proposed project to result in disproportionate adverse impacts to low-income and minority neighborhoods in the Bay Area.

Community impacts that result from implementing the WTA Initiative could result in negative or positive impacts. Positive impacts could potentially occur in every community, where a new terminal is proposed, as a result of increased transit opportunities. More specifically, site-specific terminal projects, if constructed and operated carefully, could greatly benefit low-income and minority communities by providing economic opportunity locally as well as greater access to the region. By integrating with other forms of transportation at new and existing terminal locations, the proposed program could improve the mobility of low-income and minority communities.

These positive impacts could be offset by adverse impacts that disproportionately affect low-income and minority communities. Although displacement of homes and businesses or community disruption by a site-specific ferry project may be a significant impact to any community, such impacts could potentially have a greater adverse impact on low-income and minority communities. As MTC points out in their 2001 RTP EIR, "[P]ersons in these communities may be more constrained in finding appropriate new living situations, paying for the costs of relocation, getting to businesses that are relocated, or establishing new businesses" (MTC 2001).

Alternatives 1 and 2 could result in disproportionate adverse impacts to low-income and minority communities if discretion is not taken to avoid the displacement of homes and businesses or substantial disruption of these communities. Disproportionate adverse impacts could occur if a large portion of an alternative's total displacement impacts occurred in low-income or minority neighborhoods. This is also true if a disproportionate number of the total community disruption impacts occur in these communities. As discussed under Impacts LU-2 and LU-3, there is a potential for these community impacts to be significant, regardless of income or race/ethnicity. Alternative 3 would not cause disproportionate adverse impacts to low-income or minority communities because it would only enhance existing terminals.

The following shows those census tracts considered to be minority and/or low-income communities that could be potentially affected by the proposed project either directly by the terminal or indirectly by the growth that could occur as a result of installing a terminal. "Yes" means that the census tract data indicated that the community met or exceeded the criteria for defining a low-income and/or minority community. "No" means that the community did not meet the criteria.

As shown in Table 5.7.3, the proposed project would not disproportionately impact low-income or minority communities. Because it cannot be determined at this time where physical impacts would occur as a result of implementing the project, disproportionate adverse impacts cannot be assessed at this time. However, the following proposed terminal locations should be recognized not only for their potential to adversely impact low-income or minority neighborhoods, but for their potential to positively impact the local community by creating a new form of accessible regional transportation:

Alameda/Main Street	Oakland (Ninth Ave)
Antioch	Oakland (Jack London Square)
Berkeley/Albany	PacBell/China Basin
Candlestick	Pittsburg
East Palo Alto	Presidio
Ferry Building	Redwood City
Hercules/Rodeo	Richmond
Hunters Point	San Francisco (Pier 41-43)
Martinez	San Rafael
Mission Bay	Sausalito
Moffett Field	Vallejo

Summary of Impact LU-3

- Impacts to low-income and minority communities could be positive or adverse.
- The physical displacement of homes and/or businesses or the substantial disruption of an established neighborhood could have a greater adverse effect when it occurs in a low-income or minority neighborhood.
- Implementing Alternatives 1, 2, or 3 could potentially result in a locally significant impact to low-income and minority neighborhoods. However, impacts to low-income and/or minority communities would be considered adverse only if they would result in a physical adverse impact such as the displacement of a home or business, or the division of an established community.

Mitigation LU-3.1: The terminal site selection process should consider project alternatives to avoid adverse physical impacts to the low-income and minority neighborhoods identified in this EIR.

If federal money will be used for the construction of a ferry terminal, compliance with NEPA will be required, and the federal lead agency's guidelines for addressing Environmental Justice shall be adhered to. If required, the federal Environmental Justice process will supersede the requirement to comply with adopted WTA criteria.

Mitigation LU-3.2: Implement Mitigations LU-1.1 and LU-2.1.

Impacts After Mitigation: Although the implementation of Mitigations LU-1.1, LU-2.1, and LU-3.1 would reduce Impact LU-3 to a less-than-significant level, until further study at the local level is conducted to identify site-specific criteria or standards for identifying and mitigating impacts to low-income and minority communities, Impact LU-2 remains a potentially significant impact.

References

Metropolitan Transportation Commission (MTC). 2001. Draft Environmental Impact Report for the 2001 Regional Transportation Plan.

Table 5.7.1
Land Use and Community Matrix – Alternatives 1 Through 4

Facility	Local Agency	Location	G.P. Designation(s)	Pertinent Policies	Zoning	Existing Port? (Y/N)	Existing Ferry Service? (Y/N)	Mixed Uses? (Y/N)	Predominant Use(s)	Redevelopment Plan?	Pertinent Visual/Aesthetic Policies
Alameda	Alameda Planning and Building Department	Alameda	Public Institutional	Expansion of the ferry is proposed in the Transportation Plan, including relocation to the Seaplane Lagoon at Alameda Point to avoid Estuary marine traffic and provide a better connection with the Mission Bay development area	M-2 Manufacturing	Y	Y	Y	Parking; Maritime uses; small manufacturing buildings	This location is adjacent to the Alameda Point redevelopment area, and significant changes are expected here as a result. Tentative plans include a business park, residential, community and mixed-use land uses	None Identified
Alameda Harbor Bay Isle	Alameda Planning and Building Department	Alameda	Residential; Commercial Retail	Ferry service required for business park	R-1-PD Residential, Planned Development	Y	Y	Y	Harbor Bay Business Park; Residential; Commercial	There are still vacant areas where new office buildings could be built	All new developments have to adhere to Harbor Bay Business Park Association's guidelines for signage, height, size, etc.
Alameda Point	Alameda Planning and Building Department	Alameda	Public Institutional	1996 NAS Reuse Plan identifies a number of priorities for land use, employment, economic development, housing, public use, and social service.	M-2-G Manufacturing and special government district	Y	N	Y	Decommissioned naval station. Currently, little activity on site. Least tern colony on runway portion of site.	Under redevelopment as mixed-use, residential, and commercial neighborhood. A golf course, hotel, and convention center are being considered.	Most of the older Navy buildings are in the art-deco style, so this theme/core would be preserved. Keep historically significant buildings, keep old runway as a wildlife refuge
Alcatraz Island	GGNRA	San Francisco	Park and Open Space	Maintain as public open space for rec. use. Preserve historic structures. Protect bird and marine wildlife habitats.	Park/Public Land	Y	Y	N	Tourist Attraction	None Identified.	None Identified.
Angel Island	California State Parks	San Francisco	Park and Open Space	Data not available	Park/Public Land	Y	Y	Y	Tourist Attraction/ Recreation	None Identified.	
Antioch	Antioch Community Development Department	Antioch	Rivertown	Upgrade the Marina area for better connection between people and commercial areas	M2 – Industrial District (in the process of trying to change zoning in the City)	Y	N	Y	Parking lot, boat slips, restaurants, commercial uses at the Marina. Adjacent downtown with commercial, office, and residential land uses	Focus Policy Area in the General Plan to bring more commercial uses to the area. An application for a 2-story office building in downtown was approved.	Design Review Board reviews all new buildings. General Plan design guidelines are very generic. Design requirements are site dependent, usually takes in elements from the surrounding area.
Benicia	Benicia Planning Department	Benicia	Residential	See the General Plan	E - Light Industrial; Residential	Y	N	Y	Light Industrial area is vacant. Wastewater treatment plant on 5th/G Streets. Along the waterfront is Rancho Benicia Mobile Home Park and Portside Village (condos)	Proposed 10-acre development east of wastewater treatment plant, but no applications yet.	Many policies regarding conformance with existing architectural characteristics.
Berkeley/ Albany	Berkeley Planning and Development Department	Berkeley	Waterfront/ Marina	Policy 9 – ferry service	SP – Specific Plan (from 1986 Waterfront Specific Plan)	Y	N	Y	Golden Gate Fields Parking	None Identified	None Identified
Candlestick	San Francisco Planning Department	San Francisco	Parks and Open Space; Public Facilities	Enhance wildlife habitat and develop water-oriented and recreational uses.	M-2 Industrial	N	N	Y	Stadium, previously for baseball, now for football. Large parking lot.	Natural marsh to be restored near the mudflat. Indigenous vegetation will be recreated by planting native trees, shrubs, and ground cover. Construction of an interpretive center to promote environmental education. A marina complex is planned with space for ferry landing and concessions.	Preserve wildlife habitat and waterfront environment.
Coyote Point	City of San Mateo Planning Department	San Mateo	Parks and Open Space	None Identified specific to Coyote Point. Bay shoreline policy goals are to enhance wildlife habitats and promote public awareness of the environment with on-site programs and presentations.	S - Shoreline District (allows for parks facility)	Y	N	Y	A marina, open space park, public museum, and golf course. Residential units to the south of E. Poplar Ave.	No plans	City design review guidelines.
Crockett	Contra Costa County, Community Development Agency	Contra Costa County	Heavy Industrial, Commercial Recreation, Low-Density Residential	New development cannot encourage cars to use downtown. Mixed uses encorged along Loring Ave.	Data not available.	Y	N	Y	Railroad tracks run along the entire shoreline. Waterfront has mixed uses; residential, industrial and commercial	Mixed uses encouraged along Loring Ave (near shoreline).	Many Victorian structures in downtown.

Table 5.7.1 - Continued
Land Use and Community Matrix – Alternatives 1 Through 4

Facility	Local Agency	Location	G.P. Designation(s)	Pertinent Policies	Zoning	Existing Port? (Y/N)	Existing Ferry Service? (Y/N)	Mixed Uses? (Y/N)	Predominant Use(s)	Redevelopment Plan?	Pertinent Visual/Aesthetic Policies
East Palo Alto	East Palo Alto Community Development Department, Planning Division	East Palo Alto	Industrial	Currently, there are no marinas in EPA. Cooley Landing is being considered for one, with extensive redevelopment in the surrounding area.	Will require rezoning to allow for residential, commercial, office land uses	N	N	Y	Junkyard, scrap yard, wetlands	Urban Design Plan has been adopted and will be going through an EIR process. Redevelopment in the area will include residential, retail, commercial and office land uses.	City has design review policies.
Ferry Building (SF)	San Francisco Planning Department	San Francisco	General Commercial/ Public Trust	Reinforce recreational use of this area as terminus of Market St. and terminal for commuter and recreational ferries. Improve physical access to the waterfront.	C2 – Community Business District	Y	Y	Y	Facilities for ferry service; Golden Gate Transit operates from north of the BART ventilation structure behind the Ferry Building. Adjacent is Pier One, a commercial development that also houses the Port of SF office. Across the Embarcadero is Justin Herman Plaza, a major public gathering spot and open space.	Currently undergoing renovations and redevelopments to include major retail/ commercial uses. New facilities for ferry passengers will include covered and accessible landing facilities and newly designed structures. Also, new promenades for public access and new terminals for increased commuter ferry service capacity are planned.	Create a plaza with a strong urban design setting for the Ferry Building.
Fort Baker	GGNRA	Sausalito	Public Institutional	Promote the continued recreational and educational uses and preservation of existing facilities in East Fort Baker within the GGNRA area	Park/Public Land	Y	N	Y	Public, commercial, and some historical buildings	Limited redevelopment plans	Majority of lands are to remain open space; preservation of the environment
Fort Mason	GGNRA	San Francisco	Public Open Space	Protect natural vegetation and marine wildlife habitat. Encourage continued programming of special events and activities.	Public	N	N	Y	Public, residential, some historical buildings	Large redevelopment unlikely, however Lucas Company's commercial development is to the west of the Fort.	None Identified.
Foster City	Foster City Community Development Department	Foster City	General Commercial, Office Park	None Identified	None Identified	Y	N	Y	Park facilities currently closed; used as staging area for work on the San Mateo Bridge. Mostly residential area across Beach Park Blvd, with office uses to the west	None Identified	None Identified
Gnoss Field/Port Sonoma	Sonoma County Permit & Resource Management Department	Sonoma County	Data not available.	Environmental and ecological importance of this area makes it difficult for any kind of development in this area.	Data not available.	Y	N	N	Agricultural use that supports a large wildlife habitat. Adjacent to Route 37 and the Northwestern Pacific Railroad.	None Identified.	None Identified.
Half Moon Bay	Half Moon Bay Planning Department	Half Moon Bay	Data not available.	Data not available	Data not available	Y	N	Y	Data not available	Data not available	Data not available
Hercules/ Rodeo	Contra Costa County, Community Development Agency	Contra Costa County	Mixed-Use (downtown), Commercial Recreation, Parks and Recreation, Industrial, Commercial	Rodeo: Establish mixed uses along waterfront and downtown to make it a community "focal point"	Data not available	N	N	Y	Railroad tracks run along the entire shoreline. Waterfront has mixed uses; residential, industrial and commercial.	Hercules: New Town Center, Rodeo: redevelopment of the mixed-use area downtown.	Development along the shoreline must improve access. Shoreline is Rodeo's most prominent natural resource.
Hunters Point (Shipyard)	San Francisco Planning Department	San Francisco	Industrial/ Support Facilities, Naval Shipyard	Environmental remediation req'd (in progress)	Not yet determined	N	N	Y	Abandoned residential and industrial buildings.	Convert from naval to civilian uses	Increase public access to the shipyard without interfering with maritime use.
Larkspur	Larkspur Planning Department	Larkspur	Ferry Terminal; Public Facilities; Commercial; Shoreline/Marsh conservation	None Identified	Terminal; Study District; PD – Planned Development	Y	Y	Y	Commercial, office buildings	Mixed-use redevelopment proposal for hotel, offices, residential unit, and corporation yard for the City Sanitary District	None Identified

Table 5.7.1 - Continued
Land Use and Community Matrix – Alternatives 1 Through 4

Facility	Local Agency	Location	G.P. Designation(s)	Pertinent Policies	Zoning	Existing Port? (Y/N)	Existing Ferry Service? (Y/N)	Mixed Uses? (Y/N)	Predominant Use(s)	Redevelopment Plan?	Pertinent Visual/Aesthetic Policies
Mare Island	Vallejo City Hall Planning Department	Vallejo	Reuse Plan – Planned District	Will be built out according to the Reuse Plan; emphasis on making Mare Island primarily a job center, an economic engine for the City of Vallejo.	Planned District	N	N	Y	Currently there are many old military buildings, some of which are occupied by businesses. Some buildings vacant, or closed.	Reuse Plan focuses on creating a job center with mixed land uses (i.e. industrial and office uses). The Plan also calls for development of a regional park, expansion of the golf course to 18 holes, relocation of the rifle range, reactivation of the dredge pond, and the construction of a bridge at the southern end of the island. New residential development and marina built nearby.	Focus is on making this an economic center, not a bedroom community of Vallejo. Preserve waterfront areas.
Martinez	Martinez Community Development Department	Martinez	Park and Recreation, Special Study Area	General Plan 30.721: Contains policies pertaining to the waterfront. Highest priority placed on conservation, park, and recreational uses along the waterfront.	M-OS/RF Mix Use Open Space and Rec. Facilities. Surrounding area is Light Industrial, Institutional, Single-Family Residential, Medium Density Residential, and Central Commercial	Y	N	Y	Martinez Waterfront Park and the Martinez Regional Shoreline Park form a 0.5-mile buffer between downtown Martinez and the Yacht Harbor. Nearby urban land use is mostly commercial and some residential with some light industrial parcels to the southwest of the possible terminal site.	A Marina Development Area is being contemplated (i.e., the Special Study Area land use designation), but no redevelopment plans have been adopted.	Any waterfront development must be consistent with the recreational and park land uses promoted within the Waterfront Park and Marina area.
Mission Bay	San Francisco Planning Department	San Francisco	Residential/ Commercial	This site must incorporate walkable, bikeable, and transit-friendly elements.	Low-, medium- and high-density residential, office, commercial-industrial, neighborhood shopping, and open space.	Y	N	Y	Currently in transition from an industrial area and former rail yard into a mix-use community with housing, jobs, retail, open space, parks, and a school	First of the development blocks currently under construction, including housing units, corporate science and technical campus, health science campus for UCSF, retail space, hotel, and a public school.	Public access to the shoreline and adequate parks and public open space.
Moffett Field	Federal Military Property	Moffet Field	Data not available.	Data not available	Data not available		N		Data not available	Data not available	Data not available
Oakland Airport/ Coliseum	City of Oakland Community and Economic Development Agency	Oakland	Business Mix and General Industrial/ Transportation (for airport)	Busi ness Mix – Broad mix of commercial, light industrial, R&D, office, air & rail transportation services. General Industrial/ Transportation: industrial and manufacturing, transportation, warehousing	Most of area is regulated by the Port of Oakland, with no zoning regulations imposed by the city; ;some development along Hegenberger Road is within city's zoning jurisdiction	N	N	Y	Oakland International Airport, business park, and travel-related commercial land uses along Hegenberger Rd.	Continued airport and business development with improved public access along the Estuary. The Proposed BART Coliseum-Airport connector with 2 interim stations near Hegenberger will increase intermodal access in area.	City and Port design review policies for new development. Airport proximity issues (i.e. height).
Oakland Army Base	City of Oakland Community and Economic Development Agency	Oakland	General Industrial / Transportation	The Oakland Army Base is subject to a Re-Use Plan that is not yet finalized. The Oakland Base Reuse Authority (OBRA) maintains authority over future redevelopment of the base	M-40 General/Heavy Industrial (redevelopment as per the Re-Use Plan may require rezoning)	Y	N	Y	Currently a mix of maritime, industrial, and former army base facilities. Future plans for redevelopment are not finalized.	Subject to Oakland Army Base Re-Use Plan, under authority of OBRA. Re-Use Plan not yet finalized.	Subject to Army Base Re-Use Plan, and potential historic preservation issues with certain base structures.
Oakland/ 9th Avenue	City of Oakland Community and Economic Development Agency	Oakland	Planned Waterfront Development	The Estuary Policy Plan calls for the transformation of this area from maritime and marine industrial uses to a public-oriented waterfront district with significant open space	M-40 General/Heavy Industrial (redevelopment will require rezoning to mixed use district)	Y	N	Y	Currently, this area is dominated by the Ninth Ave. Terminal, a break-bulk maritime facility. Other uses include light industrial land uses, furniture sales, and trucking companies.	A specific plan will be prepared within the next 12-18 months for the Oak to Ninth District	The Ninth Ave. Terminal is a potentially designated historic property. Water views and significant public access to the waterfront is required with new development
Oakland/ Jack London Square (Alice St.)	City of Oakland Community and Economic Development Agency	Oakland	Waterfront Commercial Recreation	Public-oriented waterfront activities are encouraged, including retail, restaurant, hotel, and commercial recreation uses, with significant public access and open space along the estuary.	R-80 High Density Residential (may be changed to a mixed-use/commercial district as part of the Jack London Sq. II development)	Y	Y	Y	Previously Jack London Village – now demolished; future commercial and hotel uses as part of Jack London Square II development; nearby are several restaurants, Barnes & Noble bookstore, other retail and hotels	Future redevelopment as part of Jack London Square II includes approx 300,000 sq. ft. office space; 119,000 sq.ft. retail and a 240-room hotel w/ conference facilities; Port of Oakland owns this land	The Estuary Policy Plan requires preservation and enhancement of view corridors to the estuary; and sensitive treatment along the water's edge
Oyster Point	South San Francisco Planning Department	South San Francisco	Coastal Commercial	The City would like new developments to include uses that generate high revenues (i.e., hotels) that can help pay for maintenance of the Marina area and its debts. The City is supportive of introducing ferry service to this area.	Surrounding area is Coastal Commercial.	Y	N	Y	Shoreline park, small hotel, restaurants, office park, R&D buildings, and some parking lots	Part of the City's "East of 101" planning area, where significant potential growth is expected. Permit has been approved for 2 small office buildings, and plan underway for full service hotel. New developments will require adequate parking, especially if water transit services are introduced.	Policies allude to enhancement of waterfront shoreline and its accessibility. The City does not have specific details about design guidelines such as waterfront view preservation.
PacBell Park/China Basin	San Francisco Planning Department	San Francisco	Ballpark, Heavy Industrial/ Public Trust	Create a new public park and small boat marina east of the Embarcadero Roadway. Include a public boat launching ramp if possible.	Public	Y	Y	Y	Recreational, commercial, residential, light industrial.	Mission Bay redevelopment plans	Provide broad lawn areas and landscaped grounds. Provision for bike trail and pedestrian promenade linking open space along the waterfront.

Table 5.7.1 - Continued
Land Use and Community Matrix – Alternatives 1 Through 4

Facility	Local Agency	Location	G.P. Designation(s)	Pertinent Policies	Zoning	Existing Port? (Y/N)	Existing Ferry Service? (Y/N)	Mixed Uses? (Y/N)	Predominant Use(s)	Redevelopment Plan?	Pertinent Visual/Aesthetic Policies
Pier 41 - 43 (SF)	San Francisco Planning Department	San Francisco	General Commercial/ Public Trust	Develop a new fishing harbor in the vicinity of Hyde St, create a cenral open space, and maintain/create opportunities for new water-oriented commercial recreational development.	M-1 Light Industrial, 40- foot height limit	Y	Y	Y	Mixed tourist uses including retail, restaurants, and other attractions	None Identified	Public Plaza
Pittsburg	Pittsburg Community Development Department	Pittsburg	Marine Commercial; Residential	5-P-13 to 16 of the General Plan: Undertake efforts to develop a waterfront activity center featuring a cluster of Marine Commercial uses with pedestrian amenities, focus on visitor attractions and traditional marine services, and provide access to the waterfront and open space at the center of the new Marine Commercial center	Downtown Medium and High Density Residential; Marine Commercial facilities	Y	N	Y	Mainly residential at the harbor, waterfront downtown is mostly commercial, office, residential. Across the slough from the waterfront area is Brown's Island Regional Shoreline Preserve.	A proposed marine/waterfront commercial village may feature marine-oriented repair and sales, restaurants, professional offices, industrial incubators, and specialty retail activities	Development standards (Floor Area Ratios, max building heights, etc.) in Table 5-2 of General Plan; Preservation and enhancement of historic structures unique to downtown
Point Molate	Richmond Planning Department	Richmond	Open Space Recreation	None.	CRR - Community Regional Recreation	N	N	N	Vacant, with some shoreline recreational uses	This is a closed down Navy brown field. City's redevelopment office may have some plans, but viable implemention of any plans is unlikely. Very narrow one-lane road makes access difficult and redevelopment would require great financial resources. There are also issues with accessibility to public services.	None Identified.
Presidio	GGNRA	San Francisco	Public Open Space	Attractively maintain the significant open space. Permit more intensive recreational uses without significantly altering the character of its open landscape (e.g. Crissy Field)	Park/Public Land	N	N	Y	Public open space, residential, some historic buildings		Preserve open space and natural historic, scenic and recreational features of the Presidio. No new structures with adverse effects on natural characteristics of the Presidio; limited new construction
Redwood City	Redwood City Planning and Redevelopment Agency	Redwood City	R&D office uses; light and heavy industrial	A future Waterfront Plan is under consideration	IP – Industrial Park, GI – General Industrial	Y	N	Y	Seaport Conference Center, wetlands, salt evaporation beds, delivery of bulk construction materials and bulk recycling for the Port of Redwood City	Waterfront Plan is the only redevelopment plan under consideration.	None Identified
Richmond	Richmond Planning Department	Richmond	Industrial; Commercial, Residential; Recreation	Richmond Redevelopment Agency will consider new direction for waterfront land use, will likely recommend denser development than has been considered previously	None Identified	Y	N	Y	Vacant parking lot, debilitated historical industrial factory. Nearby, Port of Richmond shipping yard, small park, and R&D office facilities in the 0.25 mi radius, but isolated from waterfront.	Focus of extensive revitalization and planning effort by the City. Plan includes significant increase of R&D/office, residential and mixed-use land uses, as well as parks, promenades, open spaces, a Westshore business park, and historical preservation.	Focus of waterfront amenities
San Francisco Int'l Airport (SFO)	San Francisco Planning Department	San Francisco	Airport	Various FAA regulations, safety	Self- Permitting	N	N	Y	Airport uses	Considering runway expansion or other means of expanding services at the airport.	Airport-related issues and regulations
San Leandro Marina/ East Bay	San Leandro Planning Division	San Leandro	General Commercial (Marina); Parks and Recreation and Garden Density Residential in the surrounding areas	Policy 15.09 of General Plan: Support continued study of the feasibility of ferry service from SL to other destinations around SF Bay. Policy 9.01-09 of General Plan: enhance the Marina area and support water-oriented development.	CR - Commercial Recreation	Y	N	Y	Mix of active recreational and commercial uses, including a 466-slip public marina, two yacht clubs, a hotel, and two large restaurants. Nearby, two golf courses and the 30-acre Marina Park.	No formal applications for redevelopment. City is supportive of new developments in this area that include full service hotel, conference center, and more commercial uses that will encourage more people to use the Marina.	Due to the Marina's unique status in the City's park system, high design standards will be required for future developments; new building and landscape design will tie together the commercial and recreational uses and reinforce the sense of the Marina.
San Rafael (Loch Lomond Marina)	San Rafael Community Development Department	San Rafael	Marina	New General Plan coming out in the next 1-2 years. No current pertinent policies.	Marina. Nearby is Neighborhood Commercial.	Y	N	Y	Marina uses (boat slips, etc.), supermarket, neighborhood shopping/ commercial area, surrounded by residential units across the streets.	No plans	City design review guideline criteria, and conformance with neighborhood plans.

Table 5.7.1 - Continued
Land Use and Community Matrix – Alternatives 1 Through 4

Facility	Local Agency	Location	G.P. Designation(s)	Pertinent Policies	Zoning	Existing Port? (Y/N)	Existing Ferry Service? (Y/N)	Mixed Uses? (Y/N)	Predominant Use(s)	Redevelopment Plan?	Pertinent Visual/Aesthetic Policies
Sausalito	Sausalito Community Development Department	Sausalito	Public Institutional	CP-3.2.1-2 of General Plan: Promote increase patronage of ferries while protecting the area from overuse, support ferry providers for better service and efficient loading area, increase ferry information provided to passengers as alternatives to automobiles	Public	Y	Y	Y	Small park/plaza (open space) on either side of the ferry terminal, parking lot, commercial downtown across the street. Residential units beyond commercial downtown.	Possible proposal for building restroom facilities near the ferry terminal/downtown, but no applications yet.	Any new development will have to go through the design review; generally preserve waterfront views; and fit with existing architectural characteristics.
Sausalito/ Bay Model	Sausalito Community Development Department	Sausalito	Public Institutional	Part of Marine Ships Specific Plan Area (1983). Major policy of Specific Plan is to preserve water-oriented areas. Any development here has to be done in parcels (no large developments).	Public	N	N	Y	Location is a public museum of Bay Area Ecosystem. Industrial uses in the area.	None Identified	Similar to Sausalito
Tiburon	Tiburon Planning and Building Department	Tiburon	VC (Village Commercial) and P (Public/ Quasi-Public)	Office use not allowed on ground floor of Main Street in this area	VC – typical comm. uses w/ a conditional use permit; P- allows public parks and open space	Y	Y	Y	Restaurants and retail stores (small); Public park		Downtown Design Handbook provides specific guidelines for all private and public improvements in the downtown area. A ferry access project was constructed in Spring 2002. The project improved pedestrian and bike access to the existing ferry landing.
Treasure Island	San Francisco Planning Department	San Francisco	Public/Marina	1996 Draft Reuse Plan emphasizes publicly oriented recreational, entertainment, retail, and hospitality uses that can take advantage of the island's location. Goal is to make island accessible to urban residents by ferry	Marina	Y	N	Y	Closed Naval Station, some historic buildings	New ferry terminal, waterfront promenades, bike and pedestrian paths, recreational and entertainment facilities, and residential community.	Preserve historic structures and island's waterfront views; public promenade and open area around the entire island with parks and plazas to help connect the island to the bay setting
Vallejo	Vallejo City Hall Planning Department	Vallejo	Waterfront Commercial	Waterfront Downtown Plan (under EIR process) would increase the intensity of development, connect waterfront area with downtown, and make the waterfront area more accessible to the walking public	CW – Waterfront shopping and service. If Waterfront Downtown Plan is approved, rezoning to Planned Development Zoning.	Y	Y	Y	Surface parking for ferry passengers; Public facilities; commercial; high- density residential	The Waterfront Downtown Plan would result in a multi-level parking structure, 1,400 residential units, commercial uses, hotel, office space, new open space, emphasis on new walkable business district. Georgia St. would go from downtown to waterfront.	Reopening old grid of streets (e.g., opening Georgia St.) and establishing new street corridors; keeping waterfront view open for hill residents; make sure new developments (e.g., large parking structure) are visually attractive

Notes: 1) A new terminal would be located at Pittsburg or Antioch.

Table 5.7.2
Race/Ethnicity Analysis for Alternatives 1 Through 4

Facility	Census Tract No. [1]	Top Four Ethnicities (%)[1]				Minority Community?[3]
		African American	Asian[2]	Caucasian	Hispanic	
Alameda Point	4277.00	0.00	29.30	54.00	9.20	No.
Alameda Point	4286.00	0.00	34.70	49.00	8.30	No.
Alameda/Harbor Bay Isle	4283.01	0.00	32.00	52.00	6.50	No.
Alameda/Harbor Bay Isle	4283.02	0.00	40.00	51.00	3.80	No.
Alameda/Main St.	4274.00	10.00	0.00	66.70	14.20	No.
Alameda/Main St.	4275.00	4.70	0.00	67.50	12.20	No.
Alameda/Main St.	4276.00	30.60	33.40	20.80	0.00	Yes.
Alcatraz Island	No Data	0.00	0.00	0.00	0.00	No.
Angel Island	No Data	0.00	0.00	0.00	0.00	No.
Antioch	3050.00	6.00	0.00	63.00	35.00	No.
Antioch	3060.01	5.30	0.00	76.60	20.80	No.
Antioch	3060.02	4.10	0.00	73.70	20.60	No.
Benicia	2520.00	0.00	0.00	85.70	8.00	No.
Benicia	2521.02	4.80	0.00	81.10	11.70	No.
Benicia	2521.07	5.50	0.00	81.90	8.30	No.
Berkeley/Albany	4204.00	0.00	47.80	27.30	13.80	Yes.
Berkeley/Albany	4219.00	13.20	15.00	61.50	0.00	No.
Berkeley/Albany	4220.00	26.80	0.00	46.80	13.50	No.
Berkeley/Albany	4221.00	25.60	0.00	42.40	25.20	No.
Berkeley/Albany	4222.00	16.60	15.20	55.50	0.00	No.
Candlestick	610.00	19.00	54.20	15.70	9.00	Yes.
Coyote Point	6054.00	0.00	10.40	65.50	16.40	No.
Coyote Point	6061.00	0.00	12.00	53.10	33.30	No.
Crockett	3570.00	2.90	0.00	85.70	11.90	No.
East Palo Alto	6018.00	0.00	20.30	58.70	23.70	No.
East Palo Alto	6019.00	0.00	26.00	45.30	30.90	No.
East Palo Alto	6119.00	29.30	0.00	24.10	54.60	Yes.
Ferry Building	105.00	0.00	17.10	77.90	3.20	No.
Ferry Building	106.00	0.00	62.20	33.50	3.00	No.
Ferry Building	115.00	0.00	69.40	21.70	3.40	Yes.
Ferry Building	179.01	8.20	16.30	67.30	0.00	No.
Fort Baker	1310.00	0.00	3.00	89.80	6.10	No.
Fort Mason	126.00	8.80	0.00	87.50	3.30	No.
Fort Mason	127.00	0.00	9.40	87.20	3.50	No.
Fort Mason	129.00	0.00	10.90	84.10	4.80	No.

Table 5.7.2 - Continued
Race/Ethnicity Analysis for Alternatives 1 Through 4

Foster City	6081.00	0.00	29.30	61.00	6.90	No.
Foster City	6082.00	0.00	28.40	61.60	5.90	No.
Foster City	6083.00	0.00	34.60	56.80	5.20	No.
Foster City	6103.03	0.00	35.30	58.30	4.30	No.
Gnoss Field/Point Sonoma	1011.00	0.00	3.10	91.60	3.40	No.
Gnoss Field/Point Sonoma	1330.00	0.00	1.00	87.90	14.40	No.
Gnoss Field/Point Sonoma	1506.06	0.00	5.40	84.60	13.10	No.
Half Moon Bay	6135.01	0.00	8.00	69.00	29.00	No.
Hercules/Rodeo	3580.00	0.00	14.60	62.50	17.00	No.
Hercules/Rodeo	3591.01	17.70	27.70	43.00	0.00	No.
Hercules/Rodeo	3592.03	20.20	38.60	29.20	0.00	Yes.
Hercules/Rodeo	3592.04	15.60	53.70	21.60	0.00	Yes.
Hunters Point	231.01	46.80	23.70	0.00	20.50	Yes.
Hunters Point	231.02	73.60	0.00	8.90	11.60	Yes.
Hunters Point	232.00	58.20	10.90	0.00	22.50	Yes.
Hunters Point	234.00	46.10	14.00	0.00	25.30	Yes.
Hunters Point	606.00	59.60	20.10	0.00	12.60	Yes.
Larkspur	1192.00	0.00	4.00	92.00	2.90	No.
Larkspur	1200.00	0.00	2.90	93.10	3.70	No.
Larkspur	1211.00	0.00	4.30	89.00	5.40	No.
Larkspur	1212.00	0.00	7.10	85.70	5.50	No.
Mare Island	2508.00	20.10	20.10	42.20	0.00	No.
Martinez	3160.00	22.50	0.00	56.70	15.60	No.
Martinez	3170.00	0.00	2.40	83.40	11.10	No.
Martinez	3200.01	0.00	2.30	76.10	2.40	No.
Mission Bay	226.00	11.50	9.60	71.80	0.00	No.
Mission Bay	607.00	10.60	24.20	56.30	0.00	No.
Moffett Field	5046.01	0.00	10.10	66.20	15.40	No.
Moffett Field	5046.02	0.00	11.30	60.60	16.00	No.
Moffett Field	5047.00	0.00	3.30	41.70	75.30	No.
Oakland (9th Ave)	4060.00	0.00	44.00	19.70	30.20	Yes.
Oakland (Airport)	No Data	0.00	0.00	0.00	0.00	No.
Oakland (Army Base)	No Data	0.00	0.00	0.00	0.00	No.
Oakland (Jack London Square)	4020.00	25.00	0.00	25.00	35.70	Yes.
Oakland (Jack London Square)	4032.00	15.80	19.00	47.60	0.00	No.
Oakland (Jack London Square)	4033.00	8.40	77.40	8.70	0.00	Yes.
Oyster Point	6023.00	0.00	16.90	46.60	43.50	No.

Table 5.7.2 - Continued
Race/Ethnicity Analysis for Alternatives 1 Through 4

PacBell/China Basin	180.00	29.30	0.00	45.70	18.40	No.
Pittsburg	3090.00	32.70	0.00	42.10	19.20	No.
Pittsburg	3100.00	15.90	0.00	38.60	59.00	No.
Point Molate	No Data	0.00	0.00	0.00	0.00	No.
Presidio	601.00	0.00	7.50	76.40	9.40	No.
Redwood City	6102.00	0.00	0.00	0.00	0.00	No.
Redwood City	6102.02	14.00	0.00	51.00	40.00	No.
Redwood City	6103.02	5.00	0.00	71.00	24.00	No.
Richmond	3780.00	8.10	0.00	80.60	9.10	No.
Richmond	3790.00	68.00	0.00	11.00	23.00	Yes.
Richmond	3800.00	31.80	0.00	35.50	18.90	No.
Richmond	3820.00	68.00	0.00	11.60	10.90	Yes.
San Francisco (Airport)	6043.00	0.00	0.00	0.00	0.00	No.
San Francisco (Pier 41-43)	101.00	0.00	26.00	57.00	7.00	No.
San Francisco (Pier 41-43)	102.00	0.00	9.00	83.00	3.00	No.
San Francisco (Pier 41-43)	103.00	0.00	35.00	58.00	3.00	No.
San Leandro (Marina)	4324.00	0.00	20.40	37.00	29.60	No.
San Leandro (Marina)	4333.00	0.00	26.70	45.60	20.60	No.
San Leandro (Marina)	4334.00	0.00	46.00	32.90	9.10	No.
San Rafael	1101.00	0.00	1.50	87.30	6.30	No.
San Rafael	1102.00	0.00	4.10	91.90	3.50	No.
San Rafael	1122.00	0.00	8.30	16.40	70.10	Yes.
Sausalito	1290.00	45.90	0.00	36.40	8.20	No.
Sausalito (Bay Model)	1302.00	0.00	3.90	91.70	3.30	No.
Tiburon	1230.00	0.00	1.80	94.90	2.10	No.
Tiburon	1242.00	0.00	3.20	89.50	4.00	No.
Treasure Island	No Data	0.00	0.00	0.00	0.00	No.
Vallejo	2507.01	33.20	0.00	30.90	32.30	No.
Vallejo	2509.00	35.50	0.00	31.20	19.90	No.
Vallejo	2515.00	25.20	0.00	41.30	25.70	No.
Vallejo	2516.00	23.20	0.00	42.60	27.50	No.
Vallejo	2517.01	23.70	0.00	40.70	18.10	No.
Total Average:		**10.89**	**13.07**	**50.23**	**13.44**	

Notes:
1) 2000 US Census Data
2) Includes Pacific Islander and Other
3) Based on MTC Equity Analysis. A minority community is defined as a having at least 70 percent of the population share be one or more minority group (as compared to a 50 percent average for the Bay Area as a whole). (MTC 2001).

Table 5.7.3
Low Income Analysis – Alternatives 1 Through 4

Facility	County	Census Tract No.	Median Household Income ($)[1]	County Low Income Limit ($)[2]	Potentially Low Income?
Alameda Point	Alameda	4277.00	77,047	52,200	No
Alameda Point	Alameda	4286.00	82,873	52,200	No
Alameda/Harbor Bay Isle	Alameda	4283.01[*]	121,754	52,200	No
Alameda/Harbor Bay Isle	Alameda	4283.02[*]	121,754	52,200	No
Alameda/Main St.	Alameda	4274.00	42,804	52,200	Yes
Alameda/Main St.	Alameda	4275.00	52,197	52,200	Yes
Alameda/Main St.	Alameda	4276.00	43,993	52,200	Yes
Alcatraz Island	San Francisco	No Data	No Data	No Data	No Data
Angel Island	San Francisco	No Data	No Data	No Data	No Data
Antioch	Contra Costa	3050.00	47,798	52,200	Yes
Antioch	Contra Costa	3060.01	58,974	52,200	No
Antioch	Contra Costa	3060.02	88,818	52,200	No
Benicia	Solano	2520.00	90,245	41,200	No
Benicia	Solano	2521.02	63,255	41,200	No
Benicia	Solano	2521.07[&]	63,255	41,200	No
Berkeley/Albany	Alameda	4204.00	36,383	52,200	Yes
Berkeley/Albany	Alameda	4219.00	69,081	52,200	No
Berkeley/Albany	Alameda	4220.00	44,588	52,200	Yes
Berkeley/Albany	Alameda	4221.00	49,106	52,200	Yes
Berkeley/Albany	Alameda	4222.00	56,359	52,200	No
Candlestick	San Francisco	610.00	66,703	73,300	Yes
Coyote Point	San Mateo	6054.00	76,572	73,300	No
Coyote Point	San Mateo	6061.00	76,928	73,300	No
Crockett	Contra Costa	3570.00	69,675	52,200	No
East Palo Alto	San Mateo	6018.00	78,593	73,300	No
East Palo Alto	San Mateo	6019.00	73,718	73,300	No
East Palo Alto	San Mateo	6119.00	71,935	73,300	Yes
Ferry Building	San Francisco	105.00	160,753	73,300	No
Ferry Building	San Francisco	106.00	52,554	73,300	Yes
Ferry Building	San Francisco	115.00	32,698	73,300	Yes
Ferry Building	San Francisco	179.01	86,916	73,300	No
Fort Baker	San Francisco	1310.00	121,873	73,300	No
Fort Mason	San Francisco	126.00	108,199	73,300	No
Fort Mason	San Francisco	127.00	101,541	73,300	No
Fort Mason	San Francisco	129.00	82,873	73,300	No
Foster City	San Mateo	6081.00	103,681	73,300	No
Foster City	San Mateo	6082.00	129,720	73,300	No
Foster City	San Mateo	6083.00	120,446	73,300	No
Foster City	San Mateo	6103.03[&]	143,631	73,300	No

Table 5.7.3 – Continued
Low Income Analysis – Alternatives 1 Through 4

Gnoss Field/Point Sonoma	Marin	1011.00	148,387	73,300	No
Gnoss Field/Point Sonoma	Marin	1330.00	92,029	73,300	No
Gnoss Field/Point Sonoma	Sonoma	1506.06[&]	83,706	73,300	No
Half Moon Bay	San Mateo	6135.01[&]	107,248	73,300	No
Hercules/Rodeo	Contra Costa	3580.00	53,981	52,200	No
Hercules/Rodeo	Contra Costa	3591.01	81,565	52,200	No
Hercules/Rodeo	Contra Costa	3592.03	91,553	52,200	No
Hercules/Rodeo	Contra Costa	3592.04	93,337	52,200	No
Hunters Point	San Francisco	231.01[*]	41,258	73,300	Yes
Hunters Point	San Francisco	231.02[*]	41,258	73,300	Yes
Hunters Point	San Francisco	232.00	58,618	73,300	Yes
Hunters Point	San Francisco	234.00	48,868	73,300	Yes
Hunters Point	San Francisco	606.00	62,660	73,300	Yes
Larkspur	Marin	1192.00	133,049	73,300	No
Larkspur	Marin	1200.00	118,068	73,300	No
Larkspur	Marin	1211.00	101,422	73,300	No
Larkspur	Marin	1212.00	89,056	73,300	No
Mare Island	Solano	2508.00	48,273	41,200	No
Martinez	Contra Costa	3160.00	41,972	52,200	Yes
Martinez	Contra Costa	3170.00	46,728	52,200	Yes
Martinez	Contra Costa	3200.01	76,096	52,200	No
Mission Bay	San Francisco	226.00	67,179	73,300	Yes
Mission Bay	San Francisco	607.00	55,526	73,300	Yes
Moffett Field	Santa Clara	5046.01	59,688	66,800	Yes
Moffett Field	Santa Clara	5046.02	61,234	66,800	Yes
Moffett Field	Santa Clara	5047.00	84,776	66,800	No
Oakland (9th Ave)	Alameda	4060.00	41,021	52,200	Yes
Oakland (Airport)	Alameda	No Data	No Data	No Data	No Data
Oakland (Army Base)	Alameda	No Data	No Data	No Data	No Data
Oakland (Jack London Square)	Alameda	4020.00	80,852	52,200	No
Oakland (Jack London Square)	Alameda	4032.00	50,651	52,200	Yes
Oakland (Jack London Square)	Alameda	4033.00	50,889	52,200	Yes
Oyster Point	San Mateo	6023.00	76,334	73,300	No
PacBell/China Basin	San Francisco	180.00	36,621	73,300	Yes
Pittsburg	Contra Costa	3090.00	60,639	52,200	No
Pittsburg	Contra Costa	3100.00	48,155	52,200	Yes
Point Molate	Contra Costa	No Data	No Data	No Data	No Data
Presidio	San Francisco	601.00	66,822	73,300	Yes
Redwood City	San Mateo	6102.00	57,191	73,300	Yes
Redwood City	San Mateo	6102.02[&]	57,191	73,300	Yes
Redwood City	San Mateo	6103.02	64,682	73,300	Yes

Table 5.7.3 – Continued
Low Income Analysis – Alternatives 1 Through 4

Richmond	Contra Costa	3780.00	108,199	52,200	No
Richmond	Contra Costa	3790.00	38,880	52,200	Yes
Richmond	Contra Costa	3800.00	64,325	52,200	No
Richmond	Contra Costa	3820.00	57,904	52,200	Yes
San Francisco (Airport)	San Francisco	6043.00	No Data	No Data	No Data
San Francisco (Pier 41-43)	San Francisco	101.00	71,459	73,300	Yes
San Francisco (Pier 41-43)	San Francisco	102.00	147,079	73,300	No
San Francisco (Pier 41-43)	San Francisco	103.00	111,766	73,300	No
San Leandro (Marina)	Alameda	4324.00	63,374	52,200	No
San Leandro (Marina)	Alameda	4333.00	74,194	52,200	No
San Leandro (Marina)	Alameda	4334.00	80,139	52,200	No
San Rafael	Marin	1101.00	127,104	73,300	No
San Rafael	Marin	1102.00	171,097	73,300	No
San Rafael	Marin	1122.00	60,758	73,300	Yes
Sausalito	Marin	1290.00	60,758	73,300	Yes
Sausalito (Bay Model)	Marin	1302.00	148,625	73,300	No
Tiburon	Marin	1230.00	280,842	73,300	No
Tiburon	Marin	1242.00	218,657	73,300	No
Treasure Island	San Francisco	No Data	No Data	No Data	No Data
Vallejo	Solano	2507.01	51,959	41,200	No
Vallejo	Solano	2509.00	26,515	41,200	Yes
Vallejo	Solano	2515.00	46,847	41,200	No
Vallejo	Solano	2516.00	44,706	41,200	No
Vallejo	Solano	2517.01	92,504	41,200	No

Notes:
ABAG data. Median Income based on 1995 dollars. Projection to 2000 dollars was made using a 1.189 multiplier.
Low Income Limit for a 3-person household published February 2002 by the California Department of Housing and Community Development. Since the average persons per household in every county potentially affected by the project was between 2 and 3 persons, a 3-person household low income limit was used. HUD bases their low income limits on a 4-person household, and uses a factor of 0.9 to determine low income limits for 3-person households.
* Census tracts that were split up into two tracts for the 2000 US Census from one 1990 US Census tract.
& Partial census tracts. Data presented is from larger tract from the 1990 US Census.

5.6 AIR QUALITY

5.6.1 Impact Assessment Methodology

The air quality study addresses impacts from both vehicle and ferry emissions sources for the different alternatives and modes of travel. The evaluation is based on a calculation of the total emissions from all modes of travel (ferry, car, bus) that might be affected by implementation of the WTA program. The different types of travel modes generate different rates of emissions.

The overall impacts from the system as a whole, i.e., ferries, passenger cars, and buses, were evaluated to obtain a regional, cumulative emissions estimate for each of the project alternatives and for the No Project alternative. For purposes of evaluating the significance of impacts, the estimated emissions from all these modes were summed for each alternative. The total emissions were then compared among the alternatives to determine if any would result in an overall decrease or increase in emissions. This is discussed in more detail under "Significance Criteria" below. This comparative evaluation was done instead of examining the emissions from each individual source alone and comparing them to a threshold level. Nevertheless, in addition to a discussion of the regional emissions impacts under the "Project Impacts" section, each individual impact is broken out for discussion to fully disclose all anticipated environmental impacts.

The ferry and vehicle emissions are presented for the criteria pollutants, which include oxides of nitrogen (NO_x), reactive organic gases (ROG), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter (PM_{10}).

5.6.1.1 Vehicle Emissions

Vehicle emissions (passenger cars and buses) were calculated using forecasts of total vehicle miles traveled for the year 2025, and ferry emissions were calculated using the projected schedule of routes and frequencies for that same year. The emissions calculations were performed for the three project alternatives and the No Project alternative. The year 2025 is consistent with the MTC travel forecast model that was used as a basis for the vehicle forecasts.

Vehicle emissions were modeled using EMFAC2000, which incorporates anticipated emissions changes for future years, i.e., emissions decrease due to expected improvements in engine and fuel technology and the retirement of older vehicles from the fleet. For example, year 2025 passenger car emissions of ROG, CO, and NO_x are anticipated to decrease from 1.5, 10.8, and 1.0 grams per mile, respectively, in 2002 to 0.3, 1.5, and 0.2 grams per mile, respectively, in 2025. PM_{10} emissions are not expected to change significantly in the future. Emissions from cold starts were included in the total vehicle emissions. Cold starts occur after a vehicle has been off for more than four hours, and cold-start emissions represent a major portion of the total trip emissions for a vehicle.

5.6.1.2 Ferry Emissions

Ferry emissions were estimated assuming that EPA Tier 2 standards would be in effect, which require new diesel engines manufactured after the year 2007 to meet lower emissions than current diesel engines. The assumption was that all ferries in the year 2025, with or without the project, would use engines that would at least meet the EPA Tier 2 standards. This emission level was used as the “baseline” level, i.e., the level at which the highest emissions from ferries would be expected by the time the year 2025 comes. The ferry emissions for the WTA program were developed for the future projected year 2025, using a combination of site-specific data, readily available emission factors, and current and projected operating conditions. Existing data for each ferry system were reviewed and analyzed. Initially, future baseline emissions were based upon peak and off-peak conditions, where peak hours represented 6 hours per day and non-peak hours represented 6.5 hours per day. Baseline emissions for each period were calculated by multiplying together the total travel time from all ferries, the average horsepower rating, and the emission factors for marine diesels. Total travel time was computed for both peak and non-peak periods by: (1) dividing the total time within each period by the frequency of visits by each ferry to obtain the number of trips; (2) multiplying the number of trips for each ferry by the estimated time per trip; and (3) summing the trip times for all ferries. For the No Project alternative the average horsepower rating was calculated as the mean rating for all of the existing ferries (Hutchison 2002). The ferry system schedules for each of the alternatives is presented in Appendix AIR-A.

The significance criteria used for this study and a discussion of each of the impacts follows.

5.6.2 Significance Criteria

The significance criterion used in this EIR is as follows:

- Emissions that are higher for the proposed project than for the No Project alternative (Alternative 4) would have a significant impact.

As applied to the WTA program, this involved calculation of total emissions by criteria pollutant, and by alternative, for each mode of travel: ferry, bus, and passenger car. These are compared to Alternative 4 to determine whether an alternative results in overall higher or lower regional emissions. This criterion was used because it allows comparison of alternatives on a regional scale, consistent with the WTA program. This type of significance criterion was used in the 2001 Regional Transportation Plan (RTP) EIR issued by the Metropolitan Transportation Commission.

In addition, since the impact from each travel mode is discussed separately under “Project Impacts,” an increase in emissions from a particular mode by itself (e.g. ferry) over those for the No Project Alternative for that mode is considered a significant impact.

5.6.3 Impacts and Mitigation

Impact A-1 **Regional cumulative emissions from passenger cars, buses, and ferries together would increase under Alternatives 1, 2, and 3 over those under the No Project Alternative (Alternative 4). The increase of Alternative 1, 2, and 3 cumulative emissions (unmitigated) represents the following percentage increase over total, current Bay Area emissions:**

	Alternative 1 (percent)	Alternative 2 (percent)	Alternative 3 (percent)
NO_x	4	4	0.1
SO_2	1	1	0.2
PM_{10}	0.7	.6	0.1
CO	0.04	.04	.01
ROG	0.02	0.2	.05

The evaluation of significance is based on the sum of vehicle (passenger car and bus) emissions plus ferry emissions for a given alternative. If the emissions sum of vehicles plus ferries for a given project alternative (Alternative 1, 2, or 3) is less than the emissions sum of vehicles plus ferries for the No Project Alternative (Alternative 4), the impact is considered less than significant. If, however, the sum of vehicles plus ferry emissions from any of the project alternatives is greater than the sum of passenger car plus ferry emissions from the No Project Alternative, then the impact is considered significant. This comparison is done for each of the pollutants.

Tables 5.6.1 through 5.6.3 summarize emissions from ferries, passenger cars, and buses for each of the alternatives. Tables in Appendix AIR-C present the route information (e.g. frequencies, number of vessels, sailing times) for each alternative, as well as the per-route emissions.

Summary of Impact A-1

- Alternative 1 emissions from vehicles (passenger cars and buses) plus ferries are greater than those for the No Project Alternative, resulting in a significant impact.
- Alternative 2 emissions from vehicles plus ferries are greater than those for the No Project Alternative, resulting in a significant impact.
- Alternative 3 emissions from vehicles plus ferries are greater than those for the No Project Alternative, resulting in a significant impact.

Mitigation A-1.1: Emissions from ferries under Alternatives 1, 2, and 3 could be reduced by elimination of routes with low ridership to consolidate ridership on the most effective service routes. For example, an evaluation of only the following routes was performed:

- Alameda to San Francisco
- Harbor Bay to San Francisco
- Oakland to San Francisco
- Sausalito to San Francisco
- Tiburon to San Francisco
- Berkeley to San Francisco
- Richmond to San Francisco
- Larkspur to San Francisco
- Martinez to San Francisco
- Vallejo to San Francisco

- Hercules to San Francisco
- Pittsburg to San Francisco

Impact after Mitigation: Providing full service on only the routes listed above reduces the net pollutant increase by half. Thus, emissions from ferries and vehicles (cars and buses) would be reduced but would remain greater under Alternatives 1, 2, and 3 than they are under the No Project Alternative. This impact would remain potentially significant.

Mitigation A-1.2: NO_x and PM_{10} emissions from ferries would be reduced by using SCR and particulate traps. The WTA evaluation considered a range of vessel types, fuels, and propulsion systems (in JJMA 2002) that could be potentially used on the projected service routes. These different technologies result in various levels of emissions of NO_x, ROG, CO, SO_2, and $PM_{10.}$ Some examples of the technologies include diesel engines fueled with natural gas, gas turbines fueled with diesel or natural gas, and diesel engines fueled with diesel with selective catalytic reduction (SCR) and particulate traps. The WTA's evaluation of vessel technology involved a comprehensive investigation of emerging technologies and their relative suitability to Bay Area passenger service. Section 2.5 summarizes the evaluation that was performed in coordination with the "Clean Marine Ad Hoc" Work Group. The use of SCR and particulate traps is examined here as mitigation of emissions from ferries.

Impact after Mitigation: Ferry emissions from diesel engines with SCR and particulate traps would be less under Alternatives 1, 2, and 3 than those for the No Project Alternative for NO_x and PM_{10}, resulting in a less-than-significant impact for those two pollutants. ROG, CO, and SO_2 emissions would remain greater than those for the No Project Alternative, resulting in a significant impact for those pollutants. It should be noted that the sum of NO_x and ROG emissions decreases under Alternative 2 with this mitigation. This is important because NO_x and ROG are precursors to ozone, and the Bay Area does not attain the ozone standard. Therefore, the project serves to decrease the contribution to this non-attainment pollutant. The reduction of PM_{10} is also important because it is a nonattainment (state standards) pollutant in the Bay Area. The Bay Area is in attainment for both SO_2 and CO. The residual emissions of SO_2, CO, and ROG represent the following percentage increase over total current Bay Area emissions (there is a net decrease of NO_x and PM_{10}):

Reduced Alternative 2 with Mitigation A-1.2	
NO_x	Net decrease
SO_2	0.6 percent
PM_{10}	Net decrease
CO	0.007 percent
ROG	0.04 percent

In conclusion, after application of these emission reduction measures, there remains a small regionwide increase in SO_2, CO, and ROG. ROG is primarily of concern because it is an ozone precursor, and as noted above this mitigation measure results in a net decrease in ozone precursors. The remaining pollutants of concern, SO_2 and CO, are currently in attainment in the Bay Area, but because they show a small regionwide increase, this impact is identified as potentially significant.

Impact A-2 **Total vehicle miles traveled are reduced with Alternatives 1, 2, and 3 as commuters use ferries for all or a portion of their commute. This results in a beneficial reduction in overall passenger car pollutant emissions in comparison to Alternative 4 (No Project).**

The California Air Resources Board (CARB) model EMFAC2000 was used to calculate regional emissions based on vehicle miles traveled (VMTs) for each alternative. EMFAC2000 is the latest in a series of California emission factor models that calculates emissions of CO, NO_x, ROG, and PM_{10} for current and future years. This is the model accepted by the CARB and most local air pollution control districts for analysis of motor vehicle emissions in California. The EMFAC2000 model reflects the emissions decreases from motor vehicles in future years due to anticipated improvements in engine and fuel technology.

Emission factors from the EMFAC2000 model were used to estimate emissions for the No Project Alternative and Alternatives 1 through 3. In addition, emissions from cold starts based on trip purpose were also calculated for each of the alternatives, using factors from the EMFAC2000 model. The cold-start emissions were incorporated into the daily total emissions presented in Tables 3.6-5 through 3.6-7.

Daily vehicle miles traveled (VMTs), total vehicle trips, and trip purpose for each of the alternatives (including No Project) were obtained from the traffic analysis performed by Cambridge Systematics for the WTA.

Summary of Impact A-2

- Alternative 1 emissions from passenger cars are less than those for the No Project Alternative, resulting in a less-than-significant impact.
- Alternative 2 emissions from passenger cars are less than those for the No Project Alternative, resulting in a less-than-significant impact.
- Alternative 3 emissions from passenger cars are less than those for the No Project Alternative, resulting in a less-than-significant impact.

Impact A-3 **Motor vehicles leaving ferry terminals during the evening commute period would produce cold-start emissions that could lead to a localized violation of the short-term carbon monoxide standard.**

As vehicles in a parking area leave a ferry terminal, there could be a concentration of cold-start emissions at those locations, instead of the emissions being dispersed throughout the Bay Area at people’s homes, as during the morning commute. This “clustering” of cold-start emissions during the evening commute hour could produce a violation of the one-hour carbon monoxide standard at locations near the terminal parking lots. This is a potentially significant impact.

Summary of Impact A-3

- Alternatives 1, 2, and 3 could result in cold-start emissions during the evening commute period that would lead to a violation of the short-term carbon monoxide standard, leading to a potentially significant impact.

Mitigation A-3.1: Cold-start emissions would be reduced by restricting the number of cars parking at the ferry terminals. This could be accomplished by limiting the amount of parking at the ferry terminals to a level less than full ridership. Parking management strategies could also be implemented, such as fees for parking and provision of preferential parking for carpools and vanpools In addition, feeder shuttle buses could be equipped with zero emission or ultra-low emission engines.

Impact after Mitigation: The effectiveness of Mitigation A-3 cannot be quantified, as the design and exact number of ferry terminals is not defined at this time. Therefore, the impact remains potentially significant.

Impact A-4 **Criteria pollutant emissions from ferries would increase under Alternatives 1, 2, and 3 over those from the No Project Alternative. Emissions from NO_x would be less than 5 percent of total Bay Area emissions for Alternatives 1 and 2, and less than 1 percent of total Bay Area emissions for Alternative 3. Emissions of SO_2 would be 1 percent or less of total Bay Area emissions for the three project alternatives. Emissions of PM_{10}, CO, and ROG would all be less than 1 percent of Bay Area total emissions for each of the three alternatives.**

Ferries would be a source of CO, NO_x, ROG, and PM_{10} emissions. NO_x and ROG are of major concern due to their photochemical reactions downwind of specific sources and are considered regional emission concerns. Since the majority of the emissions occur during transport, emissions from the ferry exhaust are mobile and therefore dispersed over a significant spatial region. PM_{10} emissions are a concern due to the toxicity of PM_{10} emissions from diesel exhaust.

Summary of Impact A-4

- Alternative 1 emissions from ferries would be greater than those for the No Project Alternative, resulting in a significant impact.
- Alternative 2 emissions from ferries would be greater than those for the No Project Alternative, resulting in a significant impact.
- Alternative 3 emissions from ferries would be greater than those for the No Project Alternative, resulting in a significant impact.

Mitigation A-4.1: See Mitigations A-1.1 and A-1.2.

Impact After Mitigation: Ferry emissions of NO_x and PM_{10} would be less under Alternatives 1, 2, and 3 than for the No Project Alternative, resulting in a less-than-significant impact for those two pollutants, but ROG, CO, and SO_2 emissions would remain greater than those for the No Project Alternative, resulting in a significant impact for those pollutants. However, the project with this mitigation decreases ozone precursors, as discussed in Impact After Mitigation A-1.2, above.

Impact A-5 **Ferries would emit toxic pollutants in the exhaust in the form of particulate matter from the combustion of diesel fuel. Emissions from Alternatives 1, 2, and 3 would be greater than those from the No Project Alternative.**

In 1998, the California Air Resources Board (CARB) formally identified particulate matter emitted by diesel-fueled engines as a toxic air contaminant (TAC). Diesel engines emit TACs in both gaseous and particulate forms. The particles emitted by diesel engines are coated with chemicals, many of which have been identified by the EPA as hazardous air pollutants (HAPs), and by the CARB as TACs. Because by weight, the vast majority of diesel exhaust particles are very small (94 percent of their combined mass consists of particles less than 2.5 microns in diameter), both the particles and their coating of TACs are inhaled into the lung. While the gaseous portion of diesel exhaust also contains TACs, the CARB's August action was specific to diesel particulate emissions which, according to supporting CARB studies, represent 50 to 90 percent of the mutagenicity of diesel exhaust (CARB 1998).

Diesel particulate emissions were calculated as described above under "Ferry Emissions." For the purposes of characterizing potential air toxic impacts, the entire mass of estimated particulate matter emissions from diesel engines is considered toxic.

Since the majority of diesel particulate matter is in the fine fraction (less than 2.5 micrometers in diameter, or $PM_{2.5}$), it can remain airborne for several days. The area of impact will depend on meteorological conditions. If light to moderate wind conditions prevail in the project area, diesel particulate is likely to be dispersed widely and have its impact on a regional scale. During periods of very light wind speeds, low inversion heights, and atmospheric stability, diesel particulates may remain in the project area and have a relatively larger local impact. Because health risks relate to long-term, lifetime exposure, it is long-term average exposure to diesel particulate that is of most concern. Due to the prevailing meteorological conditions in the project area and the distance of the closest residential areas from the emissions sources, levels of particulate in the area of local impact are expected to be well dispersed. Nevertheless, any substantial increase in such emissions could be potentially significant.

Summary of Impact A-5

- Alternative 1 $PM_{2.5}$ emissions from ferries would be greater than those for the No Project Alternative, resulting in a significant impact.
- Alternative 2 $PM_{2.5}$ emissions from ferries would be greater than those for the No Project Alternative, resulting in a significant impact.
- Alternative 3 $PM_{2.5}$ emissions from ferries would be greater than those for the No Project Alternative, resulting in a significant impact.

Mitigation A-5.1: See Mitigations A-1.1 and A-1.2. Those mitigation measures include the use of Selective Catalytic Reduction (SCR) and particulate traps on ferry engines to reduce emissions.

Impact after Mitigation: Ferry $PM_{2.5}$ emissions from Alternatives 1, 2, and 3 would be less than those for the No Project Alternative, resulting in a less-than-significant impact.

Impact A-6 **Buses traveling to and from the ferry terminals would emit criteria pollutants in the exhaust. The emissions increases for NO_x, PM_{10}, and ROG would be less than 10 pounds per day. Emissions increases of CO would be 50 pounds per day for Alternatives 1 and 2 and less than 30 pounds per day for Alternative 3.**

Bus mileage traveled was obtained for each of the alternatives from Cambridge Systematics. Alternatives 1, 2, and 3 would increase bus service to the ferry terminals, and there would be an associated increase in criteria pollutant emissions. This would lead to a significant impact.

Summary of Impact A-6

- Alternative 1 would increase emissions from buses over those of the No Project, resulting in a significant impact.
- Alternative 2 would increase emissions from buses over those of the No Project, resulting in a significant impact.
- Alternative 3 would increase emissions from buses over those of the No Project, resulting in a significant impact.

Mitigation A-6.1: Emissions would be reduced by decreasing or not providing bus service to new terminals.

Mitigation A-6.2: Bus emissions would be reduced by fueling buses servicing the new terminals with compressed natural gas (CNG), propane, fuel cells, or other low-emission technology that could become practicable in the future.

Impact after Mitigation: Emissions from buses for Alternatives 1, 2, and 3 would be equal to or less than those for the No Project Alternative, and the impact would be less than significant.

Impact A-7 **Air pollutants would be deposited on the bay, increasing the levels of nitrates and sulfates in the water.**

A fraction of airborne pollutant emissions from ferry fuel combustion would be deposited on the Bay. Emissions of nitrogen and sulfur oxides would be deposited as nitrates and sulfates, respectively. A portion of the particulate matter in the diesel exhaust, mostly in the fine fraction ($PM_{2.5}$) would also be deposited. Not all of the exhaust emissions would be deposited on the Bay; some would be transported over land by winds.

The amount of pollutants deposited on land versus on the Bay depends on several factors including the proximity of the ferry to land, the distance the ferry travels over water, the amount of wind transporting the pollutants, and the location of the exhaust port on the ferry. The most pollutant deposition would likely occur from ferries traveling the longest routes, e.g. San Francisco to Redwood City and San Francisco to Port Sonoma.

Summary of Impact A-7

- Deposition of nitrates and sulfates on the Bay from ferry emissions would increase under Alternative 1, leading to a potentially significant impact.

- Deposition of nitrates and sulfates on the Bay from ferry emissions would increase under Alternative 2, leading to a potentially significant impact.
- Deposition of nitrates and sulfates on the Bay from ferry emissions would increase under Alternative 3, resulting in a potentially significant impact.

Mitigation A-7: See Mitigations A-1.1 and A-1.2.

Impact after Mitigation: Deposition of nitrates and sulfates from ferry emissions from Alternatives 1, 2, and 3 would be less than those for the No Project Alternative, and the residual impact is less than significant.

Impact A-8 **Construction of ferry terminals would create emissions of fugitive dust from excavation and grading, and emissions of ROG, NO_x, CO, SO_2, and PM_{10} in construction equipment exhaust.**

Construction-related pollutant emissions have not been quantified because the specific plans for each terminal are not defined at this time. Furthermore, the BAAQMD does not require quantification of construction emissions, but does require a discussion of construction mitigation measures. As for any construction project, there can be occasional concentrations of emissions from construction activities that temporarily approach or exceed air quality standards.

Summary of Impact A-8

- Construction impacts under Alternatives 1, 2, and 3 could be potentially significant.

Mitigation A-1.1: The BAAQMD CEQA Guidelines contain a list of mitigation measures to control fugitive dust emissions from construction activities. These measures involve activities such as watering and covering exposed soil surfaces to minimize dust emissions. The BAAQMD considers construction impacts to be less than significant if the recommended mitigation measures are used. Each individual ferry expansion project should employ the current BAAQMD-recommended construction emissions control measures to reduce impacts.

Impact after Mitigation: Construction impacts under Alternatives 1, 2, and 3 would be less than significant.

References

Bay Area Air Quality Management District (BAAQMD) 2001. Clean Air Plan 2000.

Hutchison, Bruce. 2002. Personal communication regarding power output of ferry engines.

John J. McMullen Associates, Inc. (JJMA). 2002. New Technologies and Alternative Fuels: Working Paper on Alternative Propulsion and Fuel Technology Review. May.

Table 5.6.1
Emission Estimates for Year 2025 No Project vs. Alternative 1 (lbs/day)

FERRIES

	Year 2025 No Project	**Year 2025 Alternative 1**	**Project Increase over No Project (difference)**
NO_x	3394	62627	59233
SO_2	117	2156	2039
PM_{10}	202	3733	3531
CO	194	3609	3415
ROG	179	3306	3127

PASSENGER VEHICLES

Vehicle Miles Traveled

2025 No Project	**177,851,516**
2025 Alternative 1	**177,573,856**

		Year 2025 No Project				**Year 2025 Alternative 1**				
	EMFAC2000 Emission Factors (g/mi) - Year 2025	Running Emissions (lb/day)	AM Cold Start Emissions (lb/day)	PM Cold Start Emissions (lb/day)	Total Vehicle Emissions (lb/day)	Running Emissions (lb/day)	AM Cold Start Emissions (lb/day)	PM Cold Start Emissions (lb/day)	Total Vehicle Emissions (lb/day)	**Alt 1 Decrease (lb/day**
NO_x	0.152	59598	6346	2885	68829	59504	6341	2880	68726	-102
PM_{10}	0.015	5881	70493	33141	109516	5872	70442	33086	109400	-116
CO	1.544	605385	2752	1480	609617	604440	2750	1477	608668	-950
ROG	0.158	61950	153	74	62177	61853	153	74	62080	-97

BUSES

Alternative 3 Shuttles to Ferry Terminals
Vehicle Miles Traveled 10272

	EMFAC2000 Emission Factors (g/mi) -	**Year 2025 Alternative 1** Emissions (lb/day)
NO_x	0.325	7
PM_{10}	0.038	1
CO	2.203	50
ROG	0.368	8

Table 5.6.2

FERRIES

	Year 2025 No Project	Year 2025 Alternative 2	Project Increase over No Project (difference)	Year 2025 "Reduced Routes" Alternative 2	Project Increase over No Project (difference)	Year 2025 "Reduced Routes Alt. 2 with SCR and Particulate Traps	Project Increase over No Project (difference)
NO_x	3394	54459	51065	25459	22065	2665	-729
SO_2	117	1875	1758	876	759	1172	1055
PM_{10}	202	3246	3044	1518	1316	80	-122
CO	194	3126	2932	1459	1265	1459	1265
ROG	179	2873	2694	1343	1164	721	542

PASSENGER VEHICLES

<u>Vehicle Miles Traveled</u>

2025 No Project	**177,851,516**
2025 Alternative 2	**177,618,525**

		Year 2025 No Project				Year 2025 Alternative 2				
	EMFAC2000 Emission Factors (g/mi) - Year 2025	Running Emissions (lb/day)	AM Cold Start Emissions (lb/day)	PM Cold Start Emissions (lb/day)	Total Vehicle Emissions (lb/day)	Running Emissions (lb/day)	AM Cold Start Emissions (lb/day)	PM Cold Start Emissions (lb/day)	Total Vehicle Emissions (lb/day)	**Alt 2 Decrease (lb/day)**
NO_x	0.152	59598	6346	2885	68829	59519	6342	2881	68743	-86
PM_{10}	0.015	5881	70493	33141	109516	5874	70452	33097	109422	-94
CO	1.544	605385	2752	1480	609617	604592	2751	1478	608821	-797
ROG	0.158	61950	153	74	62177	61869	153	74	62096	-81

BUSES

Alternative 3 Shuttles to Ferry Terminals

Vehicle Miles Traveled 10272

		Year 2025 Alternative 2
	EMFAC2000 Emission Factors (g/mi) -	Emissions (lb/day)
NO_x	0.325	7
PM_{10}	0.038	1
CO	2.203	50
ROG	0.368	8

Table 5.6.3
Emission Estimates for Year 2025 No Project vs. Alternative 3 (lbs/day)

FERRIES

	Year 2025 No Project	**Year 2025 Alternative 3**	**Project Increase over No Project (difference)**
NO_x	3394	14850	11456
SO_2	117	511	394
PM_{10}	202	885	683
CO	194	849	655
ROG	179	783	604

PASSENGER VEHICLES

Vehicle Miles Traveled	
2025 No Project	**177,851,516**
2025 Alternative 3	**177,811,385**

		Year 2025 No Project				**Year 2025 Alternative 3**				
	EMFAC2000 Emission Factors (g/mi) - Year 2025	Running Emissions (lb/day)	AM Cold Start Emissions (lb/day)	PM Cold Start Emissions (lb/day)	Total Vehicle Emissions (lb/day)	Running Emissions (lb/day)	AM Cold Start Emissions (lb/day)	PM Cold Start Emissions (lb/day)	Total Vehicle Emissions (lb/day)	**Alt 3 Decrease (lb/day)**
NO_x	0.152	59598	6346	2885	68829	59584	6344	2884	68812	**-17**
PM_{10}	0.015	5881	70493	33141	109516	5880	70473	33125	109477	**-39**
CO	1.544	605385	2752	1480	609617	605249	2752	1479	609479	**-138**
ROG	0.158	61950	153	74	62177	61936	153	74	62163	**-14**

BUSES

Alternative 3 Shuttles to Ferry Terminals

Vehicle Miles Traveled **5825**

		Year 2025 Alternative 3
	EMFAC2000 Emission Factors (g/mi) -	Emissions (lb/day)
NO_x	0.325	4
PM_{10}	0.038	0
CO	2.203	28
ROG	0.368	5

5.5 BIOLOGY

The following section describes the potential impacts that expanded ferry service could have on the biological environment. It is organized by each major biological habitat or species type (e.g., overall Bay habitat, benthic environment, fish, marine mammals, etc.). Where applicable, impacts are distinguished between construction of ferry facilities and operation of vessels. This section is an evaluation of impacts from the overall ferry service expansion program alternatives and, therefore, the discussion addresses the overall potential for impacts and, where applicable, the mitigation measures that can be adopted to avoid or minimize these effects. Where differences in the magnitude or type of effect occur between alternatives, the differences are broken out per alternative. Otherwise, the impacts are discussed and evaluated for all of the program alternatives.

5.5.1 Significance Criteria

Impacts would be considered significant if they would:

- Substantially affect threatened, endangered, or protected species;
- Alter or diminish designated critical habitat[1] or special aquatic sites, including eelgrass beds, mudflats, and wetlands;
- Result in the reduction of protected wetland habitat as defined in Section 404 of the Clean Water Act and/or in Section 6610 of the San Francisco Bay Conservation and Development Commission (BCDC) McAteer-Petris Act or result in alteration of desirable functions and values through direct removal, filling, hydrological interruption, or other means;
- Cause the introduction or substantial spread of invasive nonnative plants or wildlife;
- Interfere substantially with the movement of resident or migratory fish or wildlife species;
- Cause substantial or sustained impact to spawning habitat of commercially important species (e.g., Pacific herring); and/or
- Cause underwater sound pressure levels during construction or operation that exceed National Marine Fisheries Service (NMFS) guidelines for protection of marine mammals (i.e., 160 decibels [dB] referenced to 1 micropascal [160 dB re 1 μPa]).

5.5.2 Impacts and Mitigation

5.5.2.1 Potential Impacts on Habitat

This section identifies impacts that could potentially affect biological habitat types. These habitat types include tidal marshes (including salt and brackish marshes), mudflats, agricultural baylands, salt ponds, and sandy or rocky shorelines.

[1] Habitat, whether occupied by listed species or not, that has been determined to be essential for the conservation and management of a listed species and has been formally described in the Federal Register.

Impact B-1 **Loss of jurisdictional wetland habitat could occur as a result of dredging and construction of terminal facilities if these facilities are located in or near wetland habitats.**

Construction of terminal facilitates and access channels under Alternatives 1 and 2 could result in the loss or disturbance of jurisdictional wetlands. The impact would be site-specific and would depend ultimately on the design and specific location of terminal facilities and access channels. Loss of jurisdictional wetland habitat would be considered a significant impact.

Habitat types in the vicinities of existing and potential terminals are shown on Figures 5.5.1 though 5.5.5. The following describes mapped wetland areas that occur in proximity to some of the sites and routes that could potentially be added or expanded with each alternative. New terminal sites, associated landside facilities, and access routes have not been specifically located or evaluated for the program EIR and, therefore, the following is a description of known wetland habitats in the general area that should be avoided if facilities are advanced for further consideration.

- Alternative 1 – Comprehensive System: Several Alternative 1 potential terminal locations could be located near large wetland areas, including Gnoss Field, Port Sonoma, East Palo Alto, and Moffett Field. Other locations near smaller wetland areas include Benicia, Martinez, SFO, Coyote Point, and Foster City.
- Alternative 2 – Expanded System: New terminal locations that could potentially result in wetland impacts include (from north to south) Pittsburg, Benicia, Martinez, Port Sonoma, Gnoss Field, SFO, and Moffett Field. As noted above, the latter three sites are located near large wetland areas.
- Alternative 3 – Enhanced System: Tidal marsh occurs near the Larkspur terminal; however, no new construction would be implemented for Alternative 3 (or Alternative 4, the No Project Alternative).

Summary of Impact B-1

- Alternatives 1 and 2 could potentially result in significant impacts to wetlands due to new construction.
- Alternatives 3 and 4 would not involve construction of new facilities and therefore would not result in direct removal of jurisdictional habitat. No impacts would occur.

Mitigation B-1.1: The above-mentioned locations, while having the potential for wetland impacts, have not been specifically surveyed for wetland habitat occurrence with respect to project features because no specific improvements are proposed. Existing mapping of wetlands, discussed in Section 3.5.1, was used to identify areas of known wetland presence, but these maps and databases are of a regional nature. As part of the environmental studies and documentation for specific projects, wetland areas should be delineated on a site-specific basis. Disturbance of wetlands should be avoided in the design of project features.

Mitigation B-1.2: In cases where wetland impacts are unavoidable, suitable compensatory mitigation should be designed and implemented in consultation with the appropriate regulatory agencies.

The Goals Project (1999) has described habitat restoration goals and 115 potential restoration sites around the Bay, representing tens of thousands of acres of potential habitat restoration. While not all of these sites may be available or suitable for the types of mitigation necessary for impacts from terminal construction, there are large amounts of area that could potentially be used by the WTA for compensatory mitigation. Total area of wetland impacts, though not calculated for this document, is expected to be minimal compared to the areas potentially available for mitigation.

Impact after Mitigation: Impact B-1 would be significant if loss of wetlands could not be substantially avoided and/or successfully mitigated. The residual impact cannot be quantified until site-specific mitigation measures are designed and, thus, could be significant.

Impact B-2 Construction of terminals could result in increased potential for the spread of invasive nonnative plant species in disturbed habitats.

Construction activities such as dredging in tidal wetland areas could result in the spread of nonnative invasive plant species that are of concern in San Francisco Bay. Of particular concern is the nonnative smooth cordgrass, *Spartina alterniflora*. This species has the ability to invade and exclude and/or hybridize with the native Pacific cordgrass, alter native northern saltmarsh habitat, colonize tidal mudflats, and reduce open-water areas, potentially resulting in reduced habitat for foraging shorebirds, fish, and invertebrates. Most smooth cordgrass occurs in the South Bay (SFEISP 2002).

Dredging in areas of nonnative cordgrass infestations could increase the spread of this species by creating root fragments and rhizomes that could disperse with the tides. Erosion from ferry operations, which could disperse root fragments and rhizomes, is not expected to be significant when using the prescribed measure discussed under Wake Wash Impact WW-1.

Summary of Impact B-2

- Alternatives 1 and 2 could involve construction of new facilities, several of which are in the South Bay where smooth cordgrass is most widely distributed. According to mapping by the Invasive Spartina Project, this species may occur in areas near the potential San Leandro, Oakland Airport/Coliseum, Oyster Point, SFO, Coyote Point, Foster City, Redwood City, East Palo Alto, and Moffett Field terminal locations. Spread of this species due to project construction would be considered significant.
- Alternatives 3 and 4 would not involve new dredging; thus, no impacts are expected.

Mitigation B-2.1: Preconstruction surveys by a qualified biologist/botanist should be conducted to identify and map areas of smooth cordgrass within potential terminal locations where this species could potentially occur. Identified areas of nonnative cordgrass should be removed to the extent feasible prior to dredging activities. The methods of removal should be developed in coordination with the U.S. Army Corps of Engineers (USACE). Eradication of this species at a site should be done well in advance of construction.

Impact after Mitigation: Impact B-2 would be less than significant after successful implementation of Mitigation B-2.1.

Impact B-3 **Project construction could result in the removal of or disturbance of "Special Aquatic Sites" including eelgrass beds, mudflats, and wetlands.**

Eelgrass beds, mudflats, and wetlands are considered special aquatic sites and are subject to USACE jurisdiction under Section 404 of the Clean Water Act and BCDC jurisdiction under Section 66605 of the McAteer-Petris Act. Eelgrass in the Bay provides spawning habitat for herring, serves as a nursery ground, and provides shelter for juvenile fish, among other functions. Mudflats serve as important foraging areas for shorebirds species and provide shallow-water habitat for juvenile fish.

Eelgrass and mudflats could be impacted directly by removal or disturbance during dredging. Deepening areas to create channels could result in the permanent loss of these habitat types. In addition, eelgrass beds may be impacted indirectly during construction by sedimentation of areas adjacent to dredging operations. Potential removal or other disturbance causing degradation to eelgrass beds or mudflats would be considered a significant impact.

For Alternatives 1 and 2, any of the potential terminal locations that would require dredging could result in the removal of mudflat habitat in nearshore areas. Though site-specific surveys have not been conducted, for Alternative 2, locations that have the potential to include mudflats to varying degrees include Moffett Field, SFO, Oakland International Airport/Coliseum, Berkeley/Albany, Port Sonoma, and Martinez. Alternative 1 would include these as well as Crockett, Hercules/Rodeo, San Rafael, Coyote Point, Foster City, East Palo Alto, and Moffett Field.

Known eelgrass beds are located near the entrance to the potential Richmond terminal and at Coyote Point. Coyote Point would not be affected by Alternative 2. Routes that could use low or no-draft vessels (e.g., approaching Moffett Field, East Palo Alto) may avoid or substantially minimize the direct permanent loss of mudflat habitat.

In addition to potential impacts from dredging, eelgrass may also be affected by ferry operations (e.g., wake and prop wash) if vessels pass in close proximity to eelgrass beds. As noted above, known eelgrass beds occur in proximity to Richmond and Coyote Point.

Potential wetland impacts are addressed under Impact B-1.

Summary of Impact B-3

- Alternatives 1 and 2 would require dredging to access potential terminal locations. This dredging may impact mudflats and/or eelgrass beds. Impacts to these special aquatic sites would be considered significant.
- Alternatives 3 and 4 would not involve new construction; thus, no impacts are expected.

Mitigation B-3.1: Disturbance of eelgrass beds and mudflats should be avoided in the design of project features and routing of ferries.

Mitigation B-3.2: As part of the environmental studies and documentation for specific projects, specific areas of eelgrass beds and mudflats that could be impacted should be specifically determined.

The general locations of eelgrass beds in the Bay were mapped in the late 1980s (Figures 3.5.15 through 3.5.17). However, recent comprehensive mapping of eelgrass beds in the Bay has not been conducted. If any project construction were to occur in the vicinity of any of these known beds, updated mapping of the extent of the beds should be conducted. Methods include use of side-scan sonar techniques, possibly in conjunction with other techniques such as visual surveys. In addition, areas that are less than 3 meters deep may have a reasonable potential to support eelgrass while areas less than 1.5 meters deep have a moderate potential to support eelgrass. Areas such as these should be surveyed to determine the current status of eelgrass prior to design and construction, and this information should be used to avoid or substantially minimize impacts.

In cases where impacts to eelgrass beds or mudflats are unavoidable, suitable compensatory mitigation should be designed in consultation with the appropriate state and federal agencies such as the USACE, the U.S. Environmental Protection Agency (USEPA), California Department of Fish and Game (CDFG), BCDC, and the San Francisco Bay Regional Water Quality Control Board (RWQCB). However, it should be noted that very little eelgrass mitigation has been done in San Francisco Bay and that mitigation of eelgrass impacts may not be feasible or successful in all cases.

If eelgrass is unavoidable or impacts cannot be reduced to an acceptable level, compensation or offsetting mitigation options could be further investigated. Mitigation should provide enhanced functions and values relative to the impacted special aquatic sites. A mitigation plan should be prepared that identifies the specific habitat restoration methods, the criteria to be used for monitoring and evaluating the success of the mitigation effort, and a contingency plan if the mitigation fails.

Mitigation B-3.3: Indirect impacts to eelgrass beds from sedimentation may be avoided or reduced through the use of silt curtains to protect the beds from sedimentation or other methods that would otherwise protect the eelgrass from turbidity plumes generated during dredging. Mitigation for indirect effects would need to be evaluated on a case by case basis as the techniques used may differ from site to site. For example, at a given location, the specific dredging requirements and the potential for sediment plume generation and specific areas that may be impacted by the sediment plume should be evaluated. If it appears eelgrass could be affected by sedimentation, site-specific conditions (depth, etc.) and local tidal currents would be assessed to determine the best way to deploy mitigation such as silt curtains.

Impact after Mitigation: The applicability and potential for success of eelgrass impact mitigation should be determined on a site-specific basis. For some sites, impacts would be less than significant after implementation of Mitigations B-3.1 through B-3.3. However, for some sites, impacts could still be potentially significant.

5.5.2.2 Potential Effects on Plankton/Productivity

Impact B-4 **Turbidity caused by dredging would reduce light penetration in the water column and could locally reduce phytoplankton production.**

Increased sediment concentrations in the upper water column reduce sunlight penetration, which in turn can reduce the depth of the zone in which phytoplankton are productive. Phytoplankton productivity is reduced at suspended sediment concentrations that may occur in estuaries during periods of high runoff or when wind and currents agitate sediments.

The Port of Oakland evaluated turbidity plumes associated with clamshell dredging operations for its 50-foot deepening project (Port of Oakland 1998). The results indicated that increases in turbidity tended to be localized, with the most concentrated portion of the plume located near the bottom and with decreasing concentrations nearer the surface. The studies showed that light transmissivity in a 13-meter (42-foot) water column decreased by approximately 5 percent (from 40 to 35 percent transmissivity) in near-surface waters, while transmissivity near the bottom decreased by as much as 35 percent (to only 5 percent transmissivity at the bottom).

Turbidity plumes are anticipated to dissipate quickly after dredging activities are completed. Sand settles very rapidly, in a matter of minutes. Silts settle more slowly, on the order of approximately 1.2 meters (4 feet) per day. Very fine clay particles can remain suspended in the water column for longer periods of time.

The impact of dredging and dredge material disposal on phytoplankton is anticipated to be localized to the dredging areas (within 100 to 200 meters) and short-lived because the material dissipates and settles relatively quickly out of the upper water column.

Due to the relatively small scale of dredging operations for most projects (and assuming that not all dredging for all potential locations would occur simultaneously), it is unlikely that any of the dredging necessary for construction of new terminals, access channels, or maintenance dredging would result in a reduction in phytoplankton productivity that would significantly affect Bay-wide production at other trophic levels (e.g., benthos, fish, etc.). However, each individual project should be reviewed with respect to dredging needs, sediment types, and local current conditions to evaluate the potential dredge plume at a given location.

No established threshold of significance exists for this impact; however, the impact of increased suspended solids on estuary zooplankton is not expected to be significant for the same reason stated above for phytoplankton: primarily because turbidity plumes are expected to be localized and short-lived.

Summary of Impact B-4

- Alternatives 1 and 2 would require dredging to access potential terminal locations. This dredging could cause turbidity plumes that could locally reduce phytoplankton productivity during the period that dredges are operating. This impact to productivity in the Bay is expected to be local and short-lived. This impact is expected to be less than significant.
- Alternatives 3 and 4 would not involve new construction; thus, no impacts are expected.

No long-term impacts to plankton and productivity are expected from implementation of the ferry system alternatives.

5.5.2.3 Potential Effects on Benthos

Potential impacts to benthic communities that could occur during construction of new terminals or dredging new channels include:

- Removal of benthic organisms during dredging operations and sedimentation in adjacent areas;
- Temporary loss of benthic prey items for larger animal species such as fish, birds, and mammals; and
- Potential reduction of native benthic species and increases or spread of nonnative species during the recolonization of bottom habitat disturbed by construction activities.

Impact B-5 **Disturbance of benthic habitat from dredging could result in the temporary loss of benthic (bottom dwelling) organisms.**

Dredging of sediments for creation of channels, which would be necessary under Alternatives 1 and 2, could result in the temporary loss of benthic (bottom dwelling) organisms in dredged sediments. Some benthic species serve as sources of food for diving birds, fish, and mammals such as harbor seals and, thus, the loss of organisms could temporarily and locally decrease food resources.

In addition to the direct loss of organisms, additional organisms could be impacted by the settling of suspended sediments in areas adjacent to the dredging operations. This increased sedimentation could potentially bury fauna or clog feeding and respiration structures. The potential impacts of sedimentation would be dependent on the amount of dredging, current patterns, rate of accumulation, and the types of benthic organisms present. For example, burrowing organisms would likely be less impacted or could withstand deeper burial than surface and suspension feeding organisms, which do not possess a strong ability to burrow upward through newly deposited sediments. Studies reported by the Port of Oakland (1998) suggested that average critical burial depths ranged from 5 centimeters maximum for surface feeders to 30 centimeters for active burrowers.

Effects on adjacent areas could be minimized through the use of physical containment systems such as silt curtains. Feasibility of the use of silt curtains would need to be evaluated on a site-specific basis. Silt curtains tend to be logistically difficult to deploy and ineffective in areas of high current velocity.

Following dredging, disturbed areas are anticipated to recolonize, first with opportunistic species. These species, characterized by rapid growth and reproduction, may not be the same species that were present in the area prior to the disturbance. Marine benthic invertebrates usually colonize disturbed sedimentary habitats via pelagic larvae that settle from the water column. Early colonists are often polychaete worms with opportunistic life histories, which includes short generation times, high number of larvae, and high mortality rates (Oliver et al. 1977; Lenihan and Oliver 1995; Conlan et al. 1998).

Routine maintenance dredging would continue to periodically disturb the benthic community.

Summary of Impact B-5

- Alternatives 1 and 2 would require dredging to access potential terminal locations. This dredging could result in the removal of benthic organisms from the dredged areas. In addition, some loss or degradation of the benthos in areas immediately adjacent to the dredged areas is anticipated due to increased sedimentation. The disturbed areas are expected to recolonize with organisms once the dredging is complete; thus, benthic prey items would return. The temporary loss of benthic organisms is considered less than significant given the total areas of potential dredging under Alternatives 1 and 2 relative to the available benthic habitat in the Bay and assuming that not all dredging for all locations would occur simultaneously. Total dredging for the project, assuming full buildout of Alternative 1, would disturb approximately 0.1 percent of shallow benthic habitat in the Bay.
- Alternatives 3 and 4 would not involve new construction; thus, no impacts are expected.

Impact B-6 **Disturbance of habitat from dredging may result in the spread of nonnative benthic invertebrate species.**

San Francisco Bay has been disturbed by a wide variety of human activities, including the introduction of nonnative benthic invertebrates (Cohen and Carlton 1995; Cohen 1996). Among the benthic infauna, the average number of introduced species is highest throughout the main estuary and into fresh-brackish water habitats (34-79 percent); is lower in the Central and South Bay marine muddy habitats (23 percent), and is lowest in the Central Bay sandy habitats (11 percent) (Lee et al. 1999). The opportunistic life histories of many introduced species are widely recognized; they are similar to early colonists in a natural succession. However, unlike early native colonists, some nonnative species can be strong competitors that persist and are not replaced by less opportunistic native species later in succession (Nichols et al. 1985). Certain nonnative species such as *Potamocorbula* appear to have a greater impact on the ecosystem than other species. Lee et al. (1999) indicate that although the Bay has been invaded by more than 200 species, only a small subset, such as *Potamocorbula*, mitten crabs, and green crabs, are considered to pose a threat to ecosystem sustainability. Many of the nonnative species inhabiting the Bay serve ecological functions similar to native species.

Disturbance of sediments from dredging operations could lead to recolonization of the disturbed areas by increased densities of nonnative species. However, given the areas that could be dredged under Alternatives 1 and 2 relative to the available benthic habitat in the Bay (0.1 percent under full buildout of Alternative 1), this impact is not considered significant. In addition, as mentioned, many nonnative species serve ecological functions (e.g., prey items) similar to native species. The project would not result in the introduction of any new species to the Bay.

Summary of Impact B-6

- Alternatives 1 and 2 would require dredging to access potential terminal locations. Recolonization after dredging could result in an increase in the number of nonnative species in the disturbed areas. However, based on the small areas that could be dredged relative to the available benthic habitat in the Bay (0.1 percent under full buildout of Alternative 1), and given that most nonnative species serve ecological functions similar to native species, this impact is considered less than significant.
- Alternatives 3 and 4 would not involve new dredging; thus, no impacts are expected.

5.5.2.4 Potential Effects on Fish

Impact B-7 **Dredging could adversely affect fish species near the construction activities.**

Increased turbidity levels caused by dredging can adversely affect dissolved oxygen levels in the water and oxygen uptake by fish in the immediate vicinity of the plume due to clogged or lacerated gills. Studies cited by the Port of Oakland indicated that juvenile Chinook salmon showed damage to the gill tissues after exposure to suspended solids concentrations of 1,547 mg/L for 96 hours. Because fish tend to avoid areas of high turbidity and return when concentrations of suspended solids are lower, impacts are generally expected to be minimal. Nevertheless, dredging in areas where fish migrate or otherwise could not avoid the sediment plume could be potentially significant. Impacts due to dredging are discussed further under Impact D-4.

Summary of Impact B-7

- Alternatives 1 and 2 would require dredging that could adversely affect fish species and movements. This impact is considered potentially significant.
- Alternatives 3 and 4 would not involve new construction; thus, no impacts are expected.

Mitigation B-7.1: Mitigation for Impact B-7 is the same as discussed under Impact D-4.

Impact after Mitigation: Impact B-7 would be reduced after implementation of Mitigations D-4.1 and D-4.2, and D-4.3 (Section 3.1). Implementation of site specific mitigation measures at the project level would further reduce Impact B-7 to less-than-significant levels.

Impact B-8 **Dredging and associated turbidity could affect spawning by Pacific herring.**

Increased turbidity and sedimentation could adversely affect Pacific herring (*Clupea harengus*), a commercially important species which spawns in the Bay. The herring attach their eggs to hard substrates (rock, pilings, etc.) and vegetation, including eelgrass, in areas primarily located in the Central Bay (see Figure 3.5.6). If dredging occurred during spawning season (December through March) in areas where spawning has occurred, eggs attached to these substrates could be impacted by sedimentation. Herring could also be excluded from areas where they might otherwise spawn if construction activity were occurring and turbidity levels were high. Since this species is commercially important, impacts to herring spawning would be considered significant.

Herring spawning generally occurs in the central portion of the Bay (Figure 3.5.6). Alternative 1 terminal locations within known herring spawning boundaries that could require dredging include the Presidio, Candlestick Point, Mission Bay, SFO, Coyote Point, Harbor Bay Island, Berkeley/Albany, and Richmond. Alternative 2 would include the Presidio, Mission Bay, SFO, Harbor Bay Island, and Berkeley/Albany.

Summary of Impact B-8

- Alternatives 1 and 2 would require dredging at some locations in the Bay used by herring to spawn. Turbidity and sedimentation could adversely affect herring eggs. This impact would be considered potentially significant.
- Alternatives 3 and 4 would not involve new construction; thus, no impacts are expected.

Mitigation B-8.1: Dredging should be avoided in known herring spawning areas during the spawning season. If dredging must occur during this time period, qualified biological monitors should be present to monitor spawning in the work area. If spawning is noted in the construction area, dredging operations should be halted in areas where high turbidity could affect the attached eggs. The dredging should be halted until the eggs have hatched. In San Francisco Bay, this is typically 10 to 15 days (average = 10.5 days) (Goals Project 2000).

Mitigation B-8.2: The use of silt curtains while dredging may reduce turbidity adjacent to the dredging area. The use of silt curtains, however, would need to be evaluated on a site-specific basis to determine feasibility for a given area. Silt curtains can to be logistically difficult to deploy and can be ineffective in areas of high current velocity.

Impact after Mitigation: Impact B-8 would be less than significant after implementation of Mitigations B-8.1 and B-8.2.

Impact B-9 **Underwater noise from pile driving and other construction activities could affect nearby fish.**

Fish could be temporarily displaced by noise from construction activities (barges, workboats, etc.), but would return once the construction activities ceased.

Construction activity associated with pile driving will result in increased underwater noise and acoustic pressure waves. Underwater noise and acoustic pressure resulting from pile driving could affect aquatic resources by causing both behavioral avoidance of the construction area and/or sublethal or lethal effects on sensitive species. Fish mortality resulting from pile-driving activities could be considered a significant impact, particularly if the activity results in take of listed species such as winter-run chinook.

The severity of adverse effects on fish (e.g., behavioral avoidance) is dependent upon a number of factors, including the concentration and location of fish within the area, species-specific differences in sensitivity to acoustic pressures, the depth of water, bottom- and surface-water characteristics, and the type of pile (steel, concrete, and hammer size). Exposure to sound pressure levels associated with pile driving also decreases in water exponentially as a function of the distance from the source.

Sound pressure levels of 180 dB re 1 μPa are known to cause permanent injury to the lateral line and inner ear of fishes (Hastings et al. 1996). Damage to these organs results in disorientation and the inability to locate food and avoid predators. Delayed mortality may also occur. Exposure to low-frequency underwater sound may also result in reduced hatching rates of fish eggs and reduced larval fish survival. Fish eggs are known to be especially vulnerable to vibration and acoustic pressure waves during the first few days after fertilization. Fish larvae and small juvenile fish have been found to be much more vulnerable to elevated sound pressure levels than adult fish (Yelverton et al. 1975).

Although specific designs are not available, it is assumed that any piles needed to construct terminal facilities would likely be small (24- to 36-inch diameter) and would likely be concrete as is typically used in these applications. Concrete piles tend to generate lower underwater sound pressure levels than steel piles. In addition, smaller piles need much smaller hammers, resulting in lower underwater sound pressure levels than large piles. Pile driving for terminal facilities would be very unlikely to generate sound pressure levels even close to those referenced above. Therefore, it is not expected that significant fish mortalities would result from driving small concrete piles. However, further analysis would be needed once specific designs and specifications for individual projects are known.

Recent experience in San Francisco Bay during a pile installation test for the Bay Bridge East Span indicated that the use of large pile drivers can result in the mortality of fish with swim bladders (Caltrans 2001). Pile driving for the Bay Bridge East Span test resulted in fish mortalities. The Bay Bridge project, however, is using large (8-foot-diameter, approximately 300-foot-long) steel piles and some of the largest pile-driving hammers available. Pile driving for terminal facilities would include much smaller concrete piles and would be unlikely to have the same sorts of impacts as the much larger-scale Bay Bridge project.

Summary of Impact B-9

- Alternatives 1 and 2 could require pile driving. Fish mortality from this activity could potentially be a significant impact.
- Alternatives 3 and 4 would not involve new construction; thus, no impacts are expected.

Mitigation B-9.1: Mitigation for this potential impact would need to be evaluated on a site-specific basis. Once specific designs and construction specifications are know for a particular site, sound pressure levels should be estimated to the extent possible. Underwater sound monitoring should be conducted if estimated sound pressure levels could approach those that may harm fish (e.g., 180 dB). Measures to reduce sound pressure levels in surrounding waters, such as bubble jackets surrounding the piles, may need to be deployed if sound pressure levels exceed those that could harm fish.

Impact after Mitigation: Impact B-9 would be less than significant with successful implementation of Mitigation B-9.1.

5.5.2.5 Potential Effects on Birds

Impact B-10 Construction could result in loss of habitat for waterfowl, shorebirds and other birds.

Construction in tidal wetlands and dredging of mudflats could result in the loss of foraging, roosting, and possibly nesting habitat for various bird species. The impact would be site specific and would depend on the design and specific location of terminal facilities and access channels. Loss of habitat could be considered a potentially significant impact. The impacts to general habitat are further discussed under Impacts B-1 and B-3.

Summary of Impact B-10

- Alternatives 1 and 2 could potentially result in significant habitat impacts due to new construction.
- Alternatives 3 and 4 would not involve construction of new facilities and therefore would not impact habitat.

Mitigation B-10.1: Mitigation for Impact B-10 is the same as for Impacts B-1 and B-3.

Impact after Mitigation: Impact B-10 would be less than significant with successful implementation of Mitigation B-1.1 and/or Mitigations B-3.1 through B-3.3.

Impact B-11 Ferry traffic (primarily in South Bay) could disturb roosting and foraging waterfowl in shallow areas of the Bay.

San Francisco Bay is an important stopover for many species of migratory waterfowl in the Pacific Flyway. Waterfowl are sensitive to the noise level, speed, size, and visual effects of travelling vessels, and generally react to this disturbance by flushing (taking flight away from the area of disturbance). Huffman (1999) noted that after repeated disturbance events, the number of birds in an area would decrease and subsequent disturbances resulted in greater proportions of birds leaving the area. Birds generally returned to an area after a 10- to 35-minute period of no disturbance. The degree of tolerance to disturbance from vessel traffic varies greatly depending upon the species, tide, flock characteristics, location, and season (Davidson and Rothwell 1993; Mori et al. 2001; Keopff and Dietrich 1986 in Hockin et al. 1992). Surf scoters, canvasback, and lesser scaup appear to be more sensitive than other species (Goals Project 2000; Korschgen and Dahlgren 1992; Korschgen et al. 1985; Huffman 1999).

When waterfowl flush or take flight when disturbed, they often circle several times before landing (Huffman 1999). Flying is a high-energy activity for waterfowl (Korschgen and Dalhgren 1992) and frequent flying due to human disturbance may take away from the energy reserves that would normally be used to complete migration. Large flocks appear to be more susceptible to disturbance than small flocks and canvasback and scaup are especially vulnerable (USFWS 1992; Mori et al. 2001).

The projected ferry routes for full buildout of Alternatives 1 and 2 would bisect areas of the Bay that are used as foraging and roosting areas for diving birds, particularly surf scoter, canvasback, lesser and greater scaup, and ruddy duck. Other waterfowl, such as dabbling ducks, typically utilize habitat such as salt ponds and marshes more frequently than open-water habitat in the Bay (Accurso 1992), and may be less impacted by disturbance from ferries.

Disturbance to waterfowl would be greatest with Alternatives 1 and 2 in the South Bay (from approximately the San Mateo Bridge south) due to the relative number of ferry routes and proposed frequency of trips that bisect the Bay in areas where vessel traffic frequency is now relatively low. South Bay routes (particularly those that cross areas less than about 6 meters in depth), in combination with the frequency of ferry traffic, could disturb roosting and foraging waterfowl more often (than existing conditions) and leave less undisturbed open-water habitat for the birds. Figures 3.5.7 and 3.5.8 indicate use of the shallow areas by waterfowl and show potential ferry routes. If it is assumed that waterfowl within 100 meters of a ferry route would be disturbed as a ferry passes, then approximately 6,326 and 5,061 acres of shallow, open-water habitat would be routinely disturbed by passing ferries for Alternatives 1 and 2, respectively. These acreages represent approximately 6 (Alternative 1) and 7.5 (Alternative 2) percent of the available shallow bay habitat. This disturbance does not represent a permanent loss of habitat, but rather the area of habitat where disturbance may take place. Waterfowl may use these when ferries are not present.

A terminal at Port Sonoma would add a route across San Pablo Bay that would increase vessel traffic frequency over current usage in this area; however, large areas of San Pablo Bay would remain undisturbed by ferry traffic, leaving undisturbed shallow open-water roosting and foraging habitat. This impact is considered potentially significant for routes in the South Bay.

Alternative 3 would increase vessel frequency on existing routes. These routes are generally within the deeper portions of Central Bay and the shipping channel to the north where waterfowl densities are lowest. Therefore, potential impacts are not considered to be significant.

Summary of Impact B-11

- Alternatives 1 and 2 would add ferry routes that would bisect areas of waterfowl roosting and foraging habitat. Large portions of San Pablo Bay in the north would remain undisturbed by ferry traffic. In the South Bay, however, the number of routes and frequency of ferry traffic, particularly shallow areas south of SFO, could increase the frequency that flushing of waterfowl flocks occurs and reduce the amount of undisturbed open-water habitat. This impact would be considered potentially significant.

- Alternative 3 would increase vessel frequency on existing routes where roosting and foraging waterfowl densities are lowest. This impact would be less than significant.
- Alternative 4 would not result in changes to existing service and no new impacts are expected.

Mitigation B-11.1: Ferry routes, particularly in the South Bay, should be consolidated within common corridors to leave as much undisturbed shallow open-water habitat as possible. Alternatively (or in addition to route consolidation) the frequency of ferry traffic could be reduced, thereby reducing the frequency of disturbance to waterfowl. Reduction in ferry traffic would likely be done as part of other resource issues (e.g., air quality).

Impact after Mitigation: The residual impact to waterfowl after Mitigation B-11.1 is implemented would depend on the amount of route consolidation or vessel frequency reduction that is feasible. The residual impact cannot be quantified and, thus, could be potentially significant.

5.5.2.6 Potential Effects to Marine Mammals

Impact B-12 **Increased turbidity and activity from dredging operations could affect marine mammal foraging.**

Increased turbidity during dredging may disturb foraging activities by decreasing visibility and removing benthic prey. Figure 3.5.14 shows haul-out and feeding areas. The effects of localized turbidity plumes during dredging are not expected to be significant as marine mammals typically are well adapted to low light levels because they feed deep in the water column often at night, and in areas with decreased visibility. It is likely that most dredging would take place during daylight hours.

Dredging could also temporarily remove or displace benthic prey species for marine mammals (e.g., small bottom fish such as gobies fed on by seals or amphipods fed on by gray whales). This impact is not expected to be significant due to the localized nature of the dredging impacts and the relatively large feeding ranges of marine mammals in the Bay.

Summary of Impact B-12

- Alternatives 1 and 2 would require dredging at some locations, causing localized increases in turbidity. For the reasons stated above, this impact would be considered less than significant to marine mammal populations in the Bay.
- Alternatives 3 and 4 would not involve new dredging; thus, no impacts are expected.

Impact B-13 **Underwater pile driving noise could disturb marine mammals.**

If pile driving in aquatic environments is required under any of the alternatives, construction could result in temporary disturbance to foraging or migrating marine mammals. Under the Marine Mammal Protection Act of 1972 (amended in 1994), it is forbidden to intentionally harass marine mammals. Harassment is defined under the Act as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption to migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment)." Pile driving activities would be considered Level B harassment.

NMFS considers, as a guideline, underwater sound pressure levels at or above 160 dB re 1 μPa as constituting harassment to marine mammals. Studies have suggested that sound pressure levels above 180 dB re 1 μPa can cause temporary hearing impairment in marine mammals. Caltrans (2001a) measured sound pressure levels exceeding this guideline in areas near the installation of a test pile for the Bay Bridge East Span Project. It should be noted that these were very large piles, using some of the largest pile-driving hammers available. Pile driving of this magnitude is not expected for the WTA project.

Several studies have been conducted on the behavioral reactions of marine mammals to underwater sounds. As reported in a summary of these studies by Richardson et al. (1995), reactions often involved cessation of feeding, resting, or social interaction, and increased alertness or avoidance behaviors. Avoidance reactions in pinnipeds (seals and sea lions) often involved movement from haul-out sites to water (or vice versa).

The potential for adverse underwater sound pressure levels during construction would depend largely on whether in-water piles are necessary for terminal or docking facilities, the types and sizes of piles necessary, the substrate and depth of the area where piles are needed, and the proximity of pile-driving activities to sensitive areas such as haul-out and feeding locations. Any work that could result in sound pressure levels exceeding NMFS guidelines would be considered significant. However, as discussed in Impact B-9, pile driving for terminal facilities would involve much smaller (24- to 36-inch diameter) piles than the piles used for the Bay Bridge project, and sound pressure levels are unlikely to be above the NMFS guideline values.

Summary of Impact B-13

- Alternatives 1 and 2 could require in-water pile driving for some potential terminal locations. Impacts to marine mammals would be considered significant if sound pressure levels exceeded NMFS guidelines.
- Alternatives 3 and 4 would not involve new construction; thus, no impacts are expected.

Mitigation B-13.1: An Incidental Harassment Authorization from NMFS may be needed for pile-driving activities, particularly if activities are to occur near sensitive areas such as haul-out sites. Known haul-out sites are shown on Figure 3.5.14. Most potential new construction would not occur near major haul-out sites. Potential terminals nearest haul-out sites include Coyote Point and Foster City (near Bair Island). Pre-construction surveys should be conducted to determine use of the area by marine mammals before pile driving begins. Marine mammal monitoring should be conducted during construction in conjunction with underwater noise monitoring. A “safety zone” should be established based on the initial monitoring. Pile-driving activities should not commence until marine mammals are not sighted within the safety zone for approximately 15 to 30 minutes.

Impact after Mitigation: Impact B-13 would be less than significant after implementation of Mitigation B-13.1.

Impact B-14 Transiting ferries could disturb marine mammals resting at haul-out sites.

Haul-out sites are areas where seals and sea lions pull themselves from the water to rest. Some of the sites are also used for breeding and raising pups. Known haul-out locations around the Bay are shown on Figure 3.5.14. Ferries passing near sensitive areas such as haul-out sites could potentially disturb seals using these areas. Human activities have been shown to adversely affect the behavioral patterns of marine mammals. Seals react to both visual and acoustic disturbances (Richardson et al. 1995). According to Green et al. (2001), the primary sources of disturbance for harbor seals in San Francisco Bay are boats, kayaks, jet skis, aircraft, foot traffic, and dogs in the vicinity of haul-out sites. Disturbance sources that occur closer to the animals tend to provoke a stronger negative response. Long-term disturbances in close proximity to haul-out sites have resulted in documented abandonment of sites.

Green et al. (2001) found that watercraft, especially those that exhibit erratic movements, are a common disturbance to seals on San Francisco Bay. Green et al. conducted studies of disturbances at Castro Rocks and Yerba Buena Island. They found that the average distance at which watercraft caused animals to flee the site (flush) was approximately 183 meters at Castro Rocks and approximately 133 meters at Yerba Buena Island. Larger boats, such as tugboats and ferries, tended to cause a flush at greater distance than smaller watercraft such as jet skis and kayaks. For example, at Castro Rocks, larger watercraft caused a flush at an average of approximately 264 meters (range 121 to 511 meters) while jet skis and kayaks caused a flush at an average of approximately 150 meters (range 10 to 500 meters). Watercraft that exhibit erratic movements such as sudden changes in speed or direction were more likely to cause a disturbance than those traveling at steady speeds, at slow speeds, and in a constant direction (Green et al. 2001; Kopec and Harvey 1995).

Ferry routes for Alternatives 1, 2, and 3 are generally well away from most haul-out sites in the Bay. Existing routes pass near Yerba Buena Island and Castro Rocks, two major haul-out sites in the Bay.

Summary of Impact B-14

- Alternatives 1, 2, and 3 all have routes that pass near seal haul-out sites, in particular Yerba Buena Island and Castro Rocks. Passing too close and disturbing marine mammals at these locations would be considered significant.
- Alternative 4 would not involve changes over existing conditions. No new impacts are expected.

Mitigation B-14.1: Although NMFS does not regulate normal watercraft operations or require Incidental Harassment Authorizations for regular shipping and pleasure craft operations (Fahy 2002), NMFS does have guidelines, outlined below, for avoidance of marine mammals to reduce disturbance.

NMFS Guidelines

Animal or Sensitive Site	Minimum Distance
Whales	91 meters (100 yards)
Pinnipeds (seals and sea lions)	46 meters (50 yards) in water 91 meters (100 yards) from haul-out sites
Dolphins	46 meters (50 yards)

This guidance, however, does not take potential boat speeds and related wake effects into account. Distances discussed in the literature indicate that, in general, seals tend to flush at greater distances than those in the NMFS guidelines. Site-specific information available for San Francisco Bay (Castro Rocks) showed average disturbance from larger vessels occurring at distances of about 250 meters. Therefore, ferry routes should be at least 100 to 250 meters from the Castro Rocks and Yerba Buena Island haul-out sites to reduce disturbance to the animals at these locations.

Impact after Mitigation: Impact B-14 would be less than significant after implementation of Mitigation B-14.1.

Impact B-15 High-speed ferries could potentially strike gray whales in San Francisco Bay.

Because of the increase in gray whale sightings in San Francisco Bay over the last several years, concern exists about collisions between whales and vessels during normal operations. As discussed in Section 3.5.1, as the gray whale population in the Pacific has returned to historic levels, the number of whales entering San Francisco Bay during their migration has increased. Since this phenomenon, the frequent of use of the Bay by whales, is relatively recent, the length of time whales stay in the Bay and the average number of whales in the Bay at a given time are not well known.

An attempt to statistically estimate the probability of a vessel making contact with whales was made using an unpublished whale strike model and a Monte Carlo simulation. The whale strike model was developed by Tregenza et al. (www.chelonia.demon.co.uk) to predict the probability of a pilot whale being struck in the Canary Islands where ferries cross perpendicularly to a whale migration route. Both models assume whale behavior is random, that is, the whales can statistically be at any location at any given time.

The Monte Carlo model was developed because initial runs of the whale strike model predicted a certainty (probability of 1) of a whale collision in a test case where a significant probability of no collision should have resulted. The Monte Carlo model was tested (calibrated) against known whale observations along the Larkspur ferry route. Again, a certainty of a whale collision was predicted in a situation where no collisions have actually occurred. Discussions of the models with ecological modeling specialists indicated the weakness of both models is that whale behavior in the Bay is not random. Whales are not migrating perpendicularly to ferry routes but are probably feeding at preferred locations and likely are actively avoiding ferry vessel routes. For a meaningful statistical prediction of a collision between a ferry and a whale to be made, it will be necessary to develop a greater understanding of whale behavior and movements in the Bay. As alluded to above, no documented collisions between gray whales and any type of vessel have occurred in San Francisco Bay (Cordero 2001). Whales have been stranded in the Bay and areas just offshore. However, it is often difficult to determine the exact cause of death. The fact that gray whales are sighted in the Bay, however, suggests that at least the potential exists for a ferry to strike a whale at some point. Any whale strike would be considered a significant impact.

Summary of Impact B-15

- Alternatives 1, 2, and 3 include increased numbers of vessel transits across the Bay. Every transit represents a potential for a whale strike. The potential would be greatest with Alternative 1 because it would have the largest number of ferries traveling on the Bay. Although the likelihood of a whale strike is very low, such a strike would be a significant impact.
- Alternative 4 would not increase the number of vessel transits. Therefore, no impact would occur above existing conditions.

Mitigation B-15.1: Ferry operators should be aware of the potential for whales entering the Bay and should be familiar with spotting whales at the surface. The USCG reports whale sightings and distance to vessels when they receive a report of a whale sighting. Ferry captains should be made aware of these reports and exercise diligence when a whale sighting has been reported.

The ferry system should implement a program of informing ferry operators of whale sightings and locations. For example, if one captain sights a whale, it should be reported through a network to all other captains. Operators should be informed or reminded during seasonal periods of heightened whale activities or presence. If whale sightings continue to increase in the Bay, having dedicated lookouts on board or other detection equipment could be warranted. Devices (such as sound-generating equipment) used to scare whales from the area may be considered intentional harassment by NMFS and would not likely be allowed.

Mitigation B-15.2: Ferries could be equipped with a whale detection system such as forward-looking sonar. Such a system is currently under development and being tested on a NOAA vessel in Cape Cod Bay.

Impact after Mitigation: Implementation of Mitigations B-15.1 and B-15.2 would reduce the chances of a whale strike; however, some probability, though small, would still remain of an accident occurring. One gray whale represents approximately 0.004 percent of the total estimated population of 26,000 whales along the Pacific coast, and the rare occurrence of a whale strike would not likely have an effect on long-term regional gray whale populations. However, the possibility of a whale strike is still considered potentially significant.

5.5.2.7 Potential Effects on Special-Status Species

Impact B-16 **Project construction and/or operation could result in the "take" of state or federally listed species or loss or degradation of their habitat.**

Activities that could affect listed species or their habitat include construction of ferry terminals, dredging or excavation near wetland habitats, or operational impacts such as wake effects on species such as California clapper rail. Alternatives 1 and 2 would have the greatest likelihood of impacting listed species or their habitat since these alternatives involve construction of new facilities.

"Incidental take" permits of fully protected species cannot be authorized by CDFG. Fully protected species that may be affected by this project include salt marsh harvest mouse, California clapper rail and California black rail. Table 3.5.4 provides a comprehensive list of special status species in the Bay Area. Figures 3.5.10 through 3.5.12 show the known distributions of salt marsh harvest mouse, black rail, and clapper rail. Potential impacts to special status species would be addressed on a site specific basis.

Summary of Impact B-16

- Alternatives 1 and 2 could potentially result in the take of listed species due to new construction. The greater potential for impacts to listed species would be in or near wetland areas and primarily in the North and South Bay areas.
- Alternative 3 would not involve construction of new facilities and therefore would not likely result in the take of listed species or loss of their habitat.

- Alternative 4 would not involve changes over existing conditions. No new impacts are expected.

Mitigation B-16.1: Table 3.5.4 lists threatened, endangered, and other special-status species that could occur around the Bay Area. Construction sites should be reviewed for potential occurrence of listed species and critical habitat using the literature and tools such as the CNDDB. Field surveys by qualified biologists should be conducted in areas of potential occurrence or with suitable habitat for listed species. Areas with listed species should be avoided.

In areas where construction is likely to result in a take of a listed species, consultation should be initiated with USFWS, NMFS, and CDFG as required by the Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA). Specific mitigation measures will likely be required as a result of that consultation and must be incorporated into the specific project design or mitigation plan. Measures may include redesign of project features to avoid impacts to listed species or their habitat or include restoration or creation of replacement habitat.

Impact after Mitigation: The significance of impacts after implementation of project-specific mitigation measures would need to be evaluated after design of those specific measures. Impacts could still be potentially significant.

5.5.2.8 Potential Water Quality Effects on Biological Resources

Impact B-17 **Construction and operation of terminal facilities could increase stormwater pollutant discharges and affect receiving water quality, which could, in turn, affect local biological resources.**

This impact is potentially significant and is discussed, along with mitigation, under Wake Wash Impact W-1.

Impact B-18 **Contaminated sediments could potentially become resuspended during construction and dredging operations and could cause toxicity to Bay organisms.**

Contaminated sediments exist at various locations in the Bay. Dredging of these sediments could release chemicals to the water column that could result in toxicity to Bay organisms. The potential release of sediment contaminants and mitigation measures are discussed in detail in Dredging Impact D-2.

Impact B-19 **Increased numbers of ferry transits could bring an increased potential for fuel spills and water quality degradation in the Bay.**

Fuel spill could expose Bay fish and wildlife to toxic pollutants in fuels and oils. This impact is potentially significant and is addressed in Impact W-3.

5.5.2.9 Potential Wake Effects

Impact B-20 **Vessel wakes could potentially cause erosion and loss of wetland habitats, impact special-status species such as the clapper rail and salt marsh harvest mouse, and impact marine mammals through disturbance at or erosion of haul-out sites.**

These potential impacts and mitigation measures are addressed in Section 3.3, Wake.

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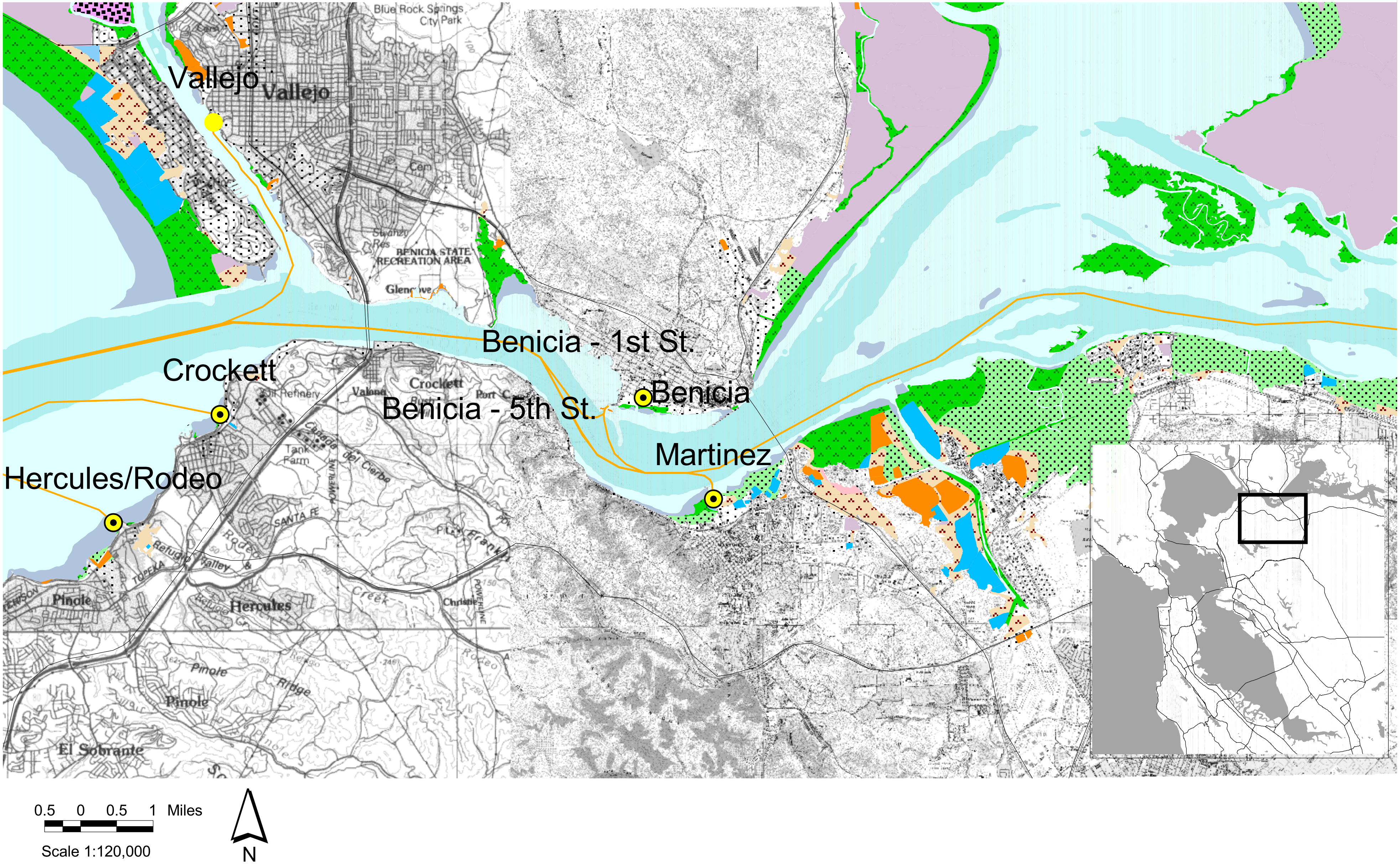


Lagoon
Muted Tidal Marsh
Bay Flat
Tidal Marsh
Diked Marsh
Developed Island or Fill
Managed Marsh
Ruderal Bayland
Undeveloped Fill
Deep Bay
Shallow Bay

Terminal Locations
Existing
Proposed

URS

Water Transit Authority Program EIR

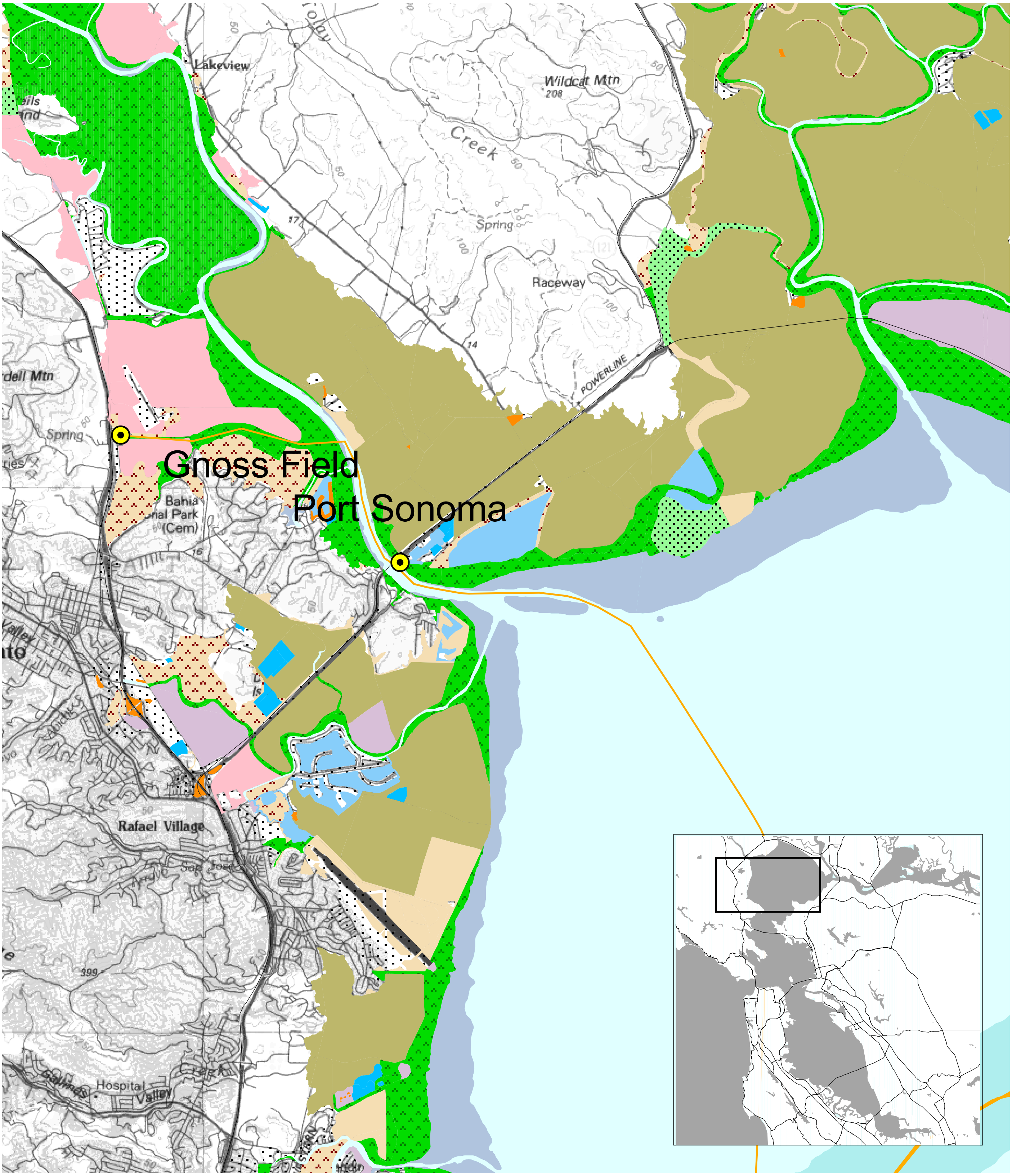
Project No. 43-00066890

HABITAT TYPES FOR EXISTING AND POTENTIAL TERMINAL LOCATIONS - CARQUINEZ STRAIT

Source: Goals Project 1999

Figure 5.5.1

L:GIS/projects/wta/apr/habitat_types.apr



Lagoon
Muted Tidal Marsh
Bay Flat
Tidal Marsh
Farmed Bayland
Grazed Bayland
Diked Marsh
Shallow Bay
Undeveloped Fill
Managed Marsh
Ruderal Bayland
Developed Island or Fill

Terminal Locations
Existing
Proposed

N

0.5 0 0.5 Miles

Scale 1:100,000

URS

Water Transit Authority
Program EIR

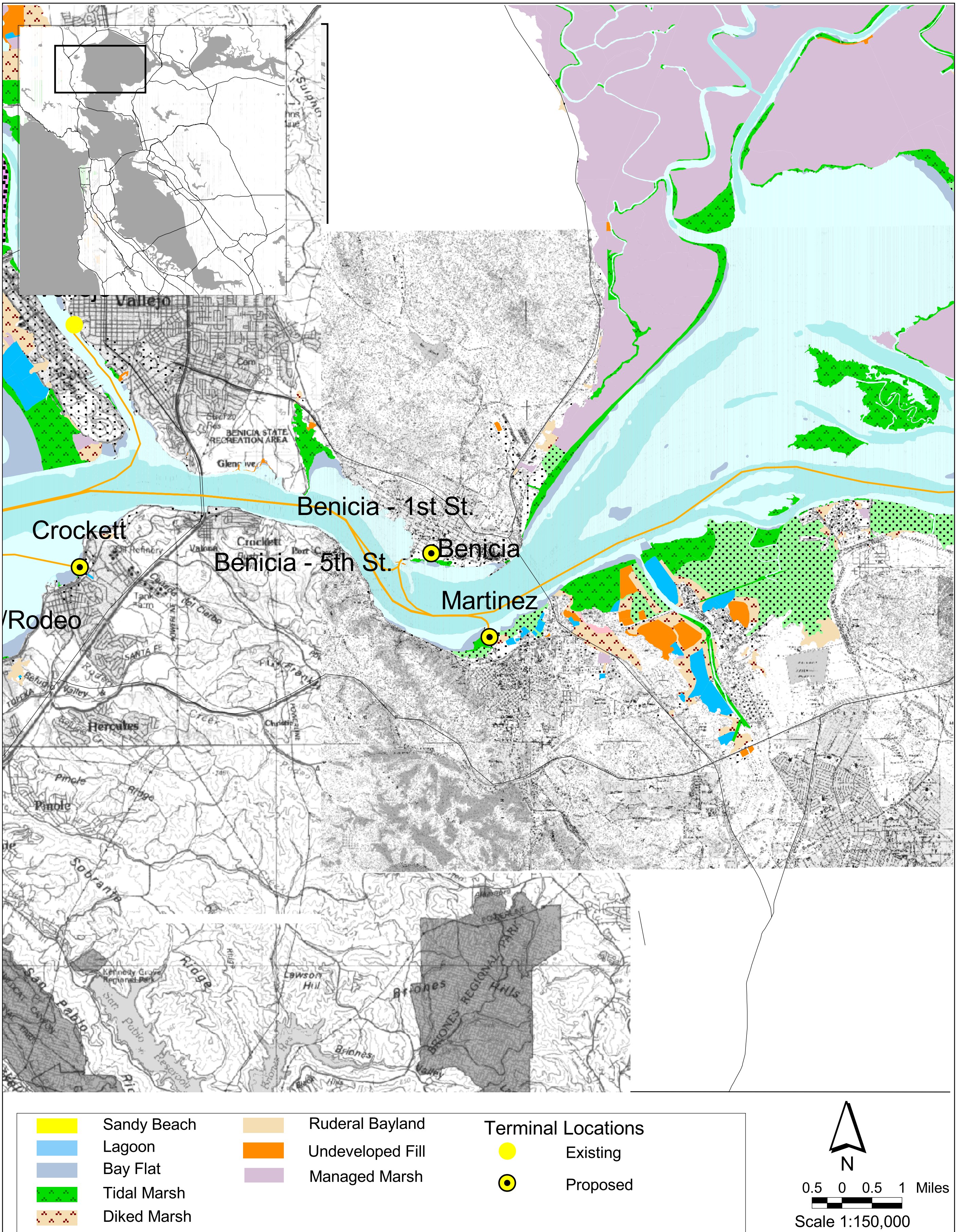
Project No. 43-00066890

Habitat Types for Existing and Potential Terminal Locations - Port Sonoma

Source: Goals Project 1999

Figure 5.5.2

L:GIS/projects/wta/apr/habitat_types.apr



URS

Water Transit Authority
Program EIR

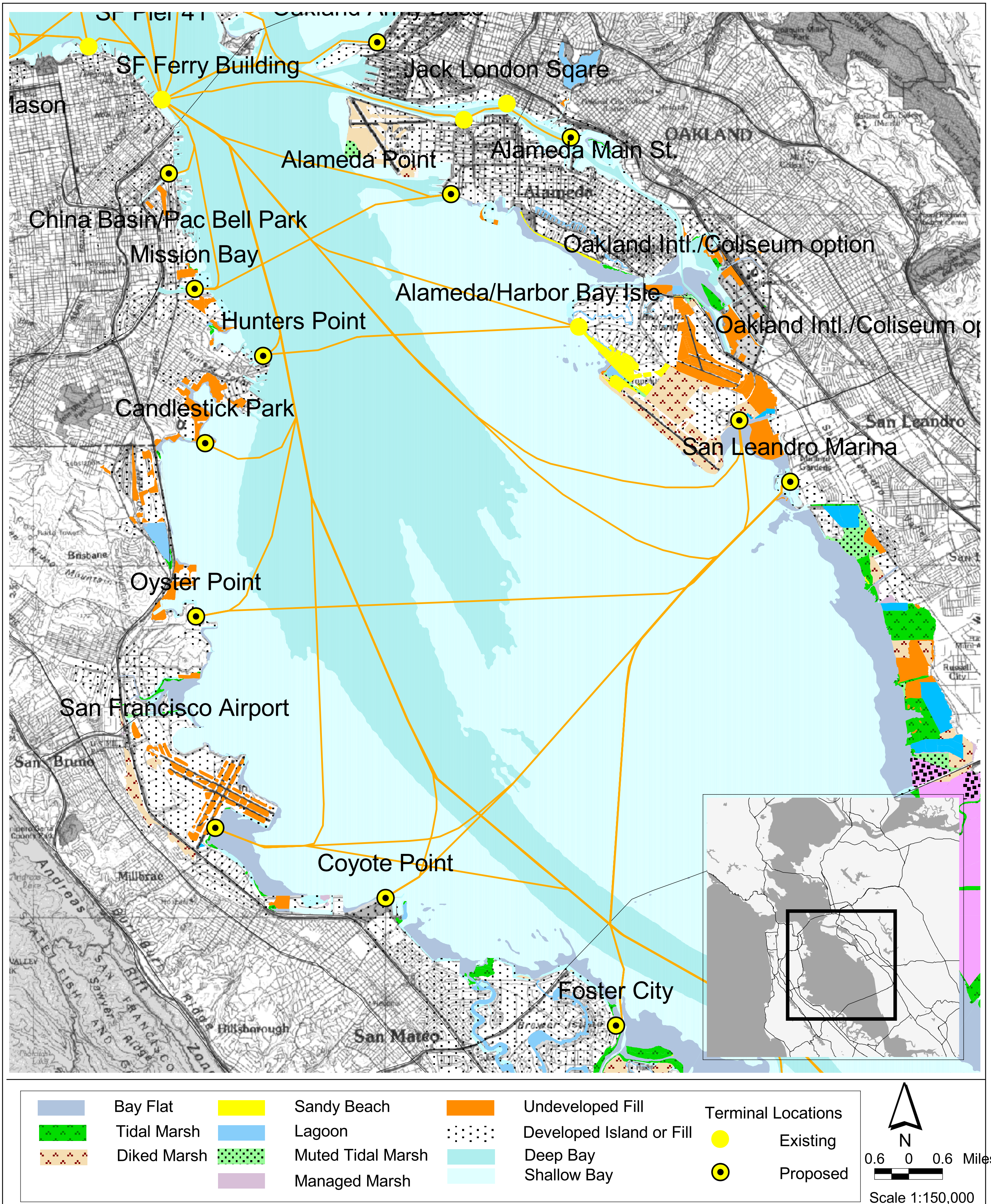
Project No. 43-00066890

Habitat Types for Existing and Potential Terminal Locations - Central Bay

Source: Goals Project 1999

5.5.3

L:GIS/projects/wta/apr/habitat_types.apr



URS

Water Transit Authority Program EIR

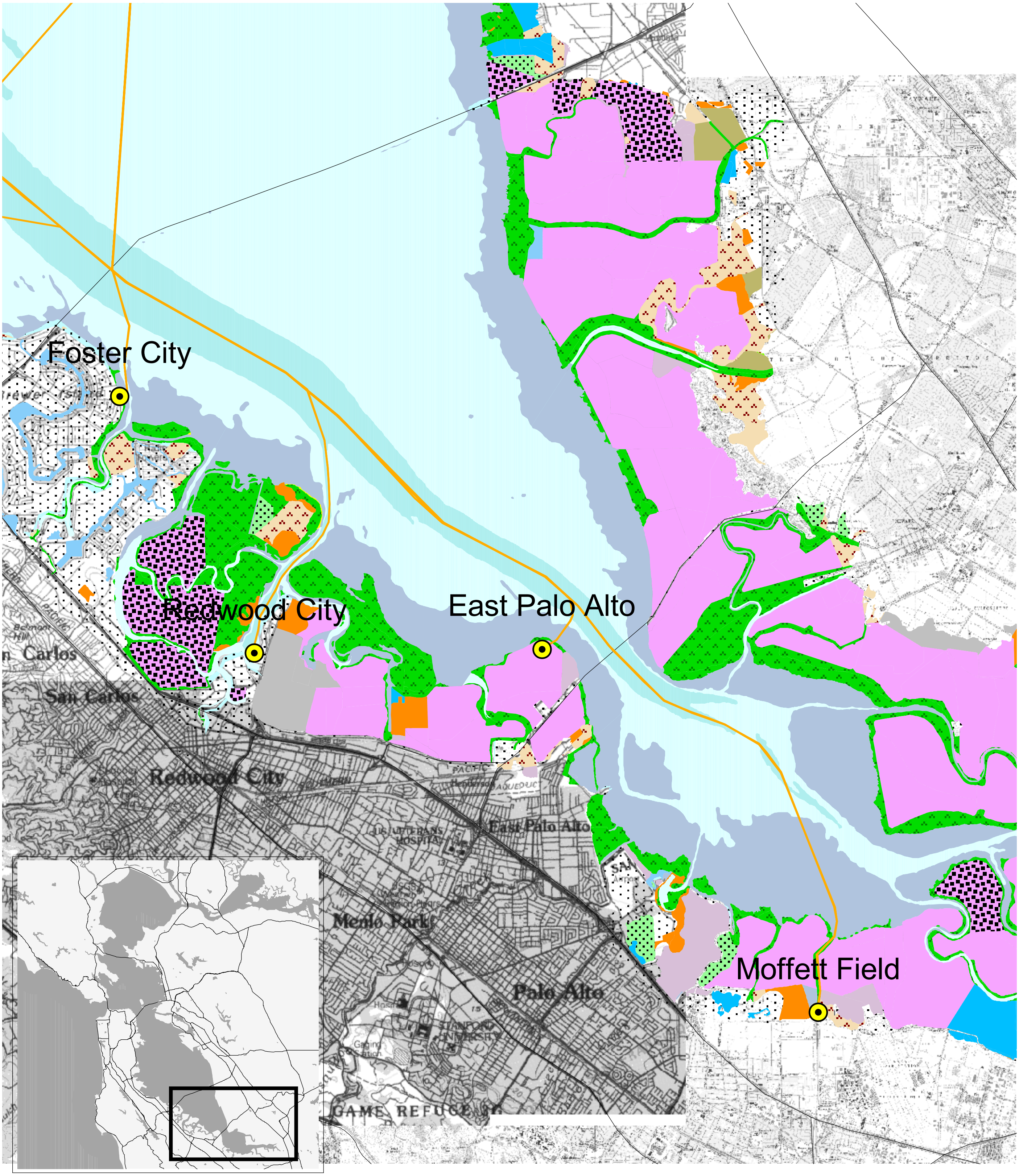
Project No. 43-00066890

HABITAT TYPES FOR EXISTING AND POTENTIAL TERMINAL LOCATIONS - SOUTH BAY

Source: Goals Project 1999

Figure 5.5.4

L:GIS/projects/wta/apr/habitat_types.apr



Lagoon	Managed Marsh	Farmed Bayland	**Terminal Locations**		
Muted Tidal Marsh	Diked Marsh	Storage Basin	Existing		
Salt Pond	Deep Bay	Ruderal Bayland	Proposed		
Inactive Salt Pond	Shallow Bay	Undeveloped Fill			
Tidal Marsh	Bay Flat	Developed Island or Fill			

N

0.5 0 0.5 Miles

Scale 1:125,000

URS

Water Transit Authority
Program EIR

Project No. 43-0006689

HABITAT TYPES FOR EXISTING
AND POTENTIAL TERMINAL
LOCATIONS - EXTREME SOUTH BAY

Source: Goals Project 1999

Figure
5.5.5

L:GIS/projects/wta/apr/habitat_types.apr

5.4 WATER RESOURCES

5.4.1 Significance Criteria

Impacts to water resources would be considered significant if they would:

- Substantially reduce ability to achieve water quality objectives consistent with improved habitat conditions;
- Cause a degradation in water quality from on-site stormwater discharges due to construction of new terminal facilities, including buildings, roads, parking lots, and associated structures;
- Cause substantial flood hazards to human safety and property damage due to construction of new terminal facilities within a floodplain; or
- Result in a substantial increase in the incidence of fuel spills from ferries.

5.4.2 Impacts and Mitigation

5.4.2.1 Construction and Operation

Impact W-1 **Construction and operation of terminal facilities including parking lots, access roads, and buildings, would increase the amount of impervious surface area at terminal sites causing an increase in stormwater discharge. If the stormwater came in contact with pollutants or eroded disturbed soil, discharge of the runoff could impact the quality of the receiving water.**

Stormwater pollution occurs when rainwater comes into contact with materials on-site and washes contaminants into storm drains, creeks, or directly into the Bay. Sources of pollution during project construction could include oil leaked from heavy equipment and vehicles, grease, hydraulic fluid or fuel, construction materials and products, waste materials, landscaping runoff containing fertilizers, pesticides or weed killers, and erosion of disturbed soil.

Stormwater discharges associated with project construction activities are regulated according to CCR Section 402(p) under the National Pollutant Discharge Elimination System (NPDES) Permitting System. Under the NPDES construction permit, owners of the proposed terminal locations where construction would disturb more than 1 acre of land would have to submit a Notice of Intent (NOI), develop a stormwater pollution prevention plan (SWPPP), conduct monitoring and inspections, retain records of the monitoring, report incidences of noncompliance, and submit annual compliance reports by July 1st of each year.

Summary of Impact W-1

- Alternatives 1 and 2 would involve construction activities and operation of new terminal facilities that could reduce water quality due to stormwater discharges. These impacts could be potentially significant.

- Alternatives 3 and 4 would not involve construction of new facilities and therefore would not result in increased stormwater discharges. No impact would occur.

Mitigation W-1.1: Adoption of measures during construction to prevent, minimize, and clean up spills and leaks from construction equipment would reduce the potential for impacts to water quality. Any equipment with a gas tank or other oil tank, such as heavy excavation machinery, must be considered as a potential source of released oil. Storage and parking of such equipment must take into account oil spill prevention regulations to ensure that the area is free of drains or other venues though which spills may escape containment. These measures must cover construction in new terminals and should to be included by the WTA in the development of an Implementation and Operations Plan.

Mitigation W-1.2: New terminal facilities should be designed such that stormwater runoff would be controlled and discharged in an appropriate manner. Construction and industrial stormwater NPDES permits would be required, and Best Management Practices (BMPs) should be used to reduce the chance of pollutants entering surface and groundwater and therefore reduce the potential for impacts to water quality. Typical pollution control measures include BMPs designed to reduce quantities of materials used that may produce pollutants, change the way various products and materials are handled or stored, employ various structural devices to catch and restrict the release of pollutants from the site, and set out appropriate responses to spills and leaks. The WTA should include BMPs in the development of its Implementation and Operations Plan. Some examples of BMPs include temporary silt fencing, protection devices such as rock aprons at pipe outlets, stabilized pads of aggregate at points where construction traffic would be entering or leaving an unimproved construction site to or from a public street, temporary drain inlet protection devices such as filter fabric and sand bags, concrete washouts for cement mixers, preservation of existing vegetation, vehicle and equipment cleaning, etc.

Impact After Mitigation: Impact W-1 would be less than significant after implementation of Mitigations W-1.1 and W-1.2.

Impact W-2 **Some shoreline areas of the Bay where terminals may be planned are within 100-year floodplains. Construction of new terminal facilities within a 100-year floodplain could expose people to the hazard of flooding and terminal facilities to flood damage.**

Some areas of the Bay along the shoreline and drainage areas leading to the Bay are potential floodplains. Risks associated with building in a floodplain include threats to life and property. The level of risk depends on the type facility; i.e., parking lots, ticket purchase stations, access roads, docks, etc., its location, and appropriate mitigation measures specific to each water transit terminal facility. Local city or county government agencies regulate floodplain construction, management, and mitigation through land use controls, based on determinations of flood elevations. The Federal Emergency Management Agency (FEMA) maintains maps of 100-year flood zones in the Bay counties, which are areas where a flood level have a 1 percent or greater probability of being equaled or exceeded in any given year.

Existing and proposed water transit terminal locations, not including access roads, have been evaluated for their location within the FEMA 100-year flood boundary, based on published FEMA maps (Figure 5.4.1). Two of the potential terminal sites, East Palo Alto and Moffett Field, lie within the 100-year floodplain as mapped by FEMA and may be subject to flooding depending on exactly where the terminal and associated facilities (parking lots, access roads) could eventually be located. All other potential terminal sites appear outside of the FEMA floodplain areas, as currently mapped.

Summary of Impact W-2

- If all terminals considered in Alternatives 1 and 2 were implemented, construction of terminal facilities in areas within the 100-year floodplain that are subject to the risk of flooding would occur. Impacts at sites within the 100-year floodplain could be potentially significant.
- Alternatives 3 and 4 would not involve construction of new terminal facilities. Existing terminals are outside flood risk areas. Therefore, no impacts would occur.

Mitigation W-2.1: Base flood elevations in the area of the proposed facilities should be verified or determined from FEMA Flood Insurance Rate Maps (FIRMs) when specific sites are chosen. If construction within the 100-year floodplain cannot be avoided, new terminal facilities should be designed to minimize flooding (including retaining walls, levees, construction on fill), post flood hazard warnings, and develop flood evacuation plans. Construction and design should also account for the maximum flood level so that facilities are built above that mark. Terminal design and flood mitigation measures should be presented for approval to the local city or county governmental agency charged with flood control regulations.

Impact After Mitigation: Impact W-2 would be less than significant after implementation of Mitigation W-2.1.

5.4.2.2 Operation

Impact W-3 **Increased numbers of ferry transits could bring an increased potential for fuel spills and water quality degradation in the Bay.**

Marine oil spills can result from leaks or breaks in vessel fueling equipment, vessel accidents, mechanical or structural failures, or human errors such as valves left open or misaligned. Ferry refueling and other operations involving the handling of potentially harmful products and materials are carried out under strict U.S. Army Corps of Engineers (USACE) and U.S. Environmental Protection Agency (USEPA) regulations prohibiting water pollution. Existing regulations and codes treat large vessels, including transit ferries, like major industrial facilities sited on land. They are recognized as potential "point specific" sources of water pollution. Detailed procedures and engineering requirements have been written into public law to prohibit harmful spills and discharges.

Data for water pollution from ferries in San Francisco Bay are presented in Table 3.4.1. Six incidents of pollution occurred from ferries from 1998 to 2001; the largest spill size was 15 gallons. The total number of ferry transits during the four years of record was 317,335, which means that approximately two one-thousandths of one percent of transits (0.002 percent) resulted in an incident of pollution. While statistics for the existing ferry system indicate a low-probability and low-volume situation, spills may continue to happen. Spills could occur in transit, as a result of a navigational incident, such as collision or grounding, or due to equipment failure or malfunction. Spills can also take place at the refueling station as a result of accidental releases or malfunctions.

Currently, each of the three Bay Area ferry operators has concentrated its fueling operations at a single company location (i.e., Larkspur, Mare Island and Pier 41). Current Bay Area ferry service requires approximately 77,000 gallons of fuel weekly to operate. Expansion of ferry service would require additional fuel storage and transfer capacity. This will require the expansion of existing fueling operations at the three centralized locations and/or the construction and operation of new fueling facilities at other locations to be determined. Both the expansion of existing facilities and the construction of new facilities would require permits according to relevant regulations and codes.

The National Oceanographic and Atmospheric Administration's (NOAA) Hazardous Materials Response and Assessment Division and Office of Response and Restoration have issued a fact sheet on small diesel spills, that is, in the range between 500 and 5,000 gallons (www.response.restoration.noaa.gov). This would be the general range of potential spills from vessels in the current and proposed ferry fleet. Diesel fuel is a light, refined petroleum product with a relatively narrow boiling range, meaning that, when spilled on water, most of the oil will evaporate or naturally disperse within a few days or less. According to the NOAA fact sheet, this is particularly true for small spills, even in cold water. Consequently, after a few days there is rarely any oil on the surface for oil spill responders to recover.

After spilling on water, diesel oil spreads very quickly to a thin film. Even when the oil is described as a heavy sheen, it is 0.0004 inches thick and contains about 1,000 gallons per square nautical mile of continuous coverage. Diesel has a very low viscosity and is readily dispersed into the water column when winds reach 5-7 knots.

Diesel oil is much lighter than water (specific gravity is about 0.85, compared to 1.03 for seawater). It is not possible for this oil to sink and accumulate on the seafloor as pooled or free oil. However, it is possible for the oil to be physically mixed into the water column by wave action, forming small droplets that are carried and kept in suspension by the currents. Oil dispersed in the water column can adhere to fine-grained suspended sediments, which would eventually settle on the estuary bottom. However, this process is not likely to result in measurable sediment contamination for small spills.

Diesel oil is not very sticky or viscous, compared to black oils. When small spills do strand on the shoreline, the oil tends to penetrate porous sediments quickly, but also tends to be washed off quickly by waves and tidal flushing. Shoreline cleanup is usually not needed. Diesel oil is readily and completely degraded by naturally occurring microbes, under time frames of one to two months.

Diesel is considered to be one of the most acutely toxic oil types. Fish, invertebrates and seaweed that come in direct contact with a diesel spill may be killed. However, according to the NOAA fact sheet, small spills in open water are so rapidly diluted that fish kills have never been reported. Fish kills have been reported for small spills in confined, shallow water. Crabs and shellfish can be tainted from small diesel spills in shallow, nearshore areas. Small diesel spills can affect marine birds by direct contact, though the number of birds affected is usually small because of the short time the oil is on the water surface. Mortality is caused by ingestion during preening as well as to hypothermia from matted feathers. According to NOAA's experience with small diesel spills, few birds are directly affected. However, small spills could result in serious impacts to birds under the "wrong" conditions, such as grounding of a vessel next to a large nesting colony or transport of diesel sheens into areas of high bird concentrations.

Summary of Impact W-3:

- Alternatives 1, 2, and 3 would involve expansion of ferry service and increased numbers of ferry transits. Alternatives 1 and 2 introduce new routes across the Bay, with the potential to impact areas not currently served by water transit. Alternative 3 utilizes existing ferry routes, but increased the frequency of trips. Based on the historic record, spills associated with ferry operations have an extremely low probability of occurrence. This has likely been due to the procedures followed by the ferry operators. Alternatives 1, 2, and 3 will not result in a substantial increase in the incidence of spills assuming continued use of similar procedures. This impact will likely not be significant in terms of its low probability and past record. However, a potentially significant spill could still occur.
- Alternative 4 would not increase the number of ferry transits in the Bay. Therefore, no impacts would occur above present conditions.

Mitigation W-3.1: Although this impact is considered a low probability, a spill still has the potential to occur and safety and avoidance measures are prudent. The Harbor Safety Committee of the San Francisco Bay Region adopted a Harbor Safety Plan in 1992 for San Francisco, San Pablo, and Suisun Bays. The plan, as mandated by the California Oil Spill Prevention and Response Act (OSPRA) of 1990, is aimed at improving the prevention, removal, abatement, response, containment, and cleanup and mitigation of oil spills in the state's waters. OSPRA also requires an annual review of the harbor safety plans to be submitted to the state Oil Spill Prevention and Response Administrator for comment and approval. The Bay Area ferry operators participate in the Harbor Safety Committee. The safety issues raised by expansion of ferries in the San Francisco Estuary and relevant recommendations and modifications will need to be incorporated into the annual plan review. A strengthened Harbor Safety Plan would reduce the potential for impacts to water resources resulting from expansion of ferry operations.

Mitigation W-3.2: Ferry operators need to update their contingency plans and continue to utilize emergency response services for pollution incidents. Several Oil Spill Response Organizations (OSROs) operate in the Bay and collaborate with the U.S Coast Guard (USCG), California Office of Spill Prevention and Response (OSPR), and other organizations in the Unified Command System during drills and spill responses. Ferry operators have retained OSRO services and maintain response equipment on board vessels and at ferry terminals. As part of the WTA ferry expansion program, the contingency plans, drill exercises, and emergency response service agreements would be reviewed, and modified if necessary, to reduce potential impacts to water resources resulting from spills. Such modifications would include ensuring that all the spill response equipment required at new terminals is made available. Review of updates and modifications to plans will be done under the USCG's regular oversight of oil spill contingency plans. The work of updating and expanding the spill response plans should be based on NOAA's Environmental Sensitivity Index (ESI). The ESI involves the systematic compilation in a standardized format of information related to coastal shoreline sensitivity, biological resources and human uses. ESI maps have been prepared for San Francisco Bay and are useful tool for setting protection priorities and cleanup strategies before a spill occurs (NOAA No Date).

Mitigation W-3.3: Development and maintenance of a regular program to train fueling operators on correct fueling methods to minimize spills due to human error or improper use of equipment would decrease the potential for spills. The WTA should sponsor such training and incorporate it as part of its Implementation and Operations Plan.

Mitigation W-3.4: New vessels to be adopted in a ferry expansion program and the equipment to service any new fleets should include technological designs to avoid fuel spills. The WTA Implementation and Operations Plan should require review of new vessels and equipment to be introduced to new routes and or for existing route service expansion

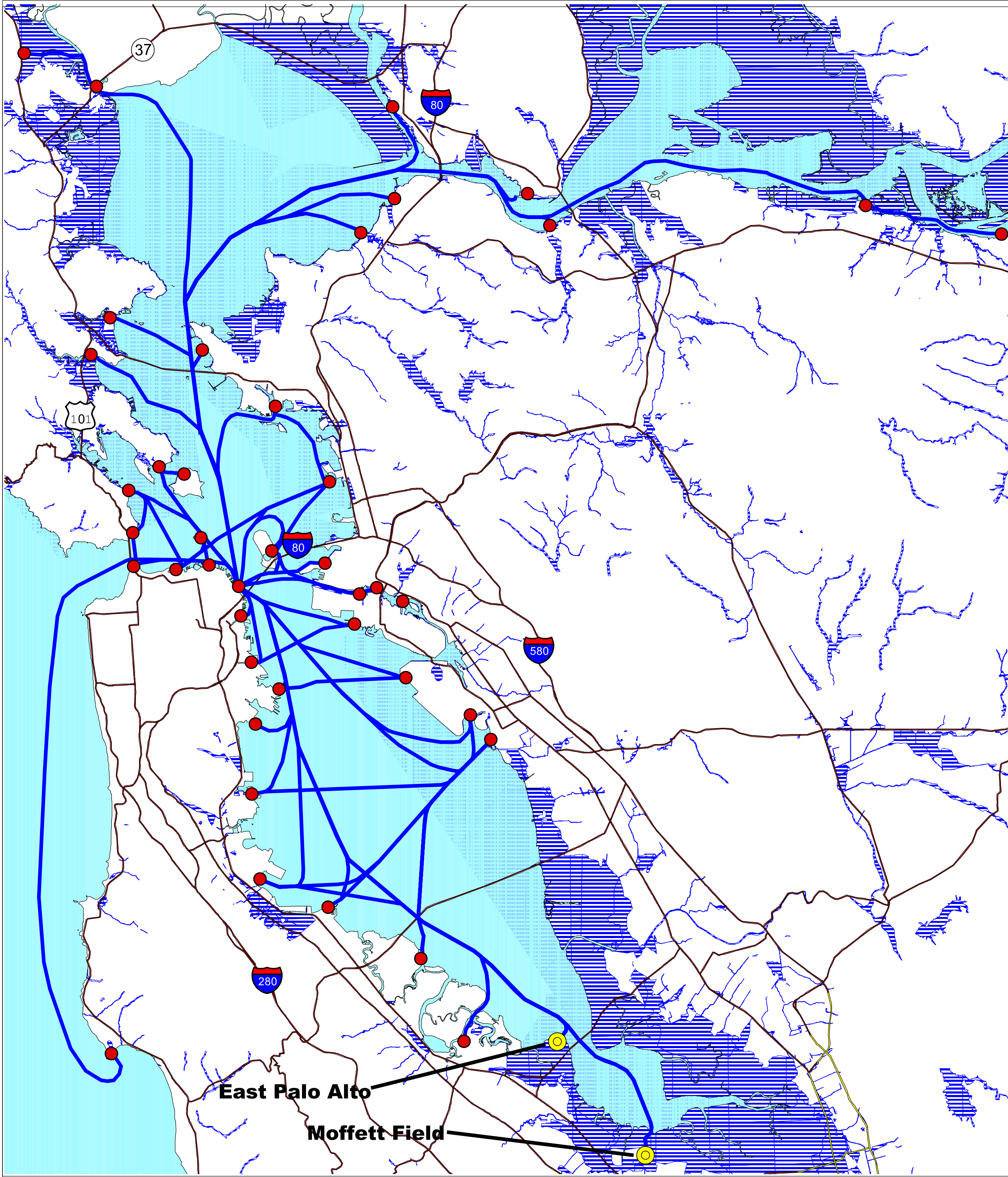
Mitigation W-3.5: Adoption of applicable measures recommended by the Ferry Safety Plan under preparation (ABS Consulting 2002) would minimize safety risks and prevent navigational incidents with the potential for spills. Ferry operators must take those new measures into account by ferry operators in their updates to contingency plans and OSRO service agreements.

Impact after Mitigation: The potential for Impact W-3 would be significantly reduced after implementation of Mitigations W-3.1 through W-3.5. Nonetheless, unintentional fuel releases may take place despite those measures. Site-specific emergency response and cleanup measures would be applied to address any actual spills and mitigate their impacts. Although there is a small chance of a fuel release, the potential to occur remains and could lead to a potentially significant impact.

References

ABS Consulting. 2002. Ferry Operations Safety Plan Kickoff Meeting Presentation, Pier One, San Francisco. Prepared by ABS Consulting Risk Consulting Division. March 8.

National Oceanographic and Atmospheric Administration (NOAA). No Date. www.mapfinder.nos.noaa.gov/ mapfinderHTML3/surround/esi/atlas.html



LEGEND

Primary Roads

FEMA 100-yr Floodplain

Proposed Ferry Terminal Within FEMA 100-yr Floodplain

Existing or Proposed Ferry Terminal Outside of FEMA 100-yr Floodplain

3 0 3 6 Miles

Scale 1:385,000

N

URS

Water Transit Authority Program EIR

Project No. 43-00066890

FERRY TERMINALS WITHIN FEMA 100-YR FLOOD ZONE

Figure 5.4.1

L:/projects/wta/apr/water_resources.apr

5.3 WAKE WASH

The following section describes the potential impacts that wake wash from expanded ferry service could have on the environment. This is an evaluation of impacts from the overall ferry service expansion program alternatives, and therefore the discussion addresses the overall potential for impacts, and, where applicable, the mitigation measures that can be adopted to avoid or minimize these effects.

5.3.1 Significance Criteria

Qualitatively, impacts to the shoreline from wake wash resulting from new ferry service would be considered significant if they would:

- Cause a significant increase in wave height (energy) at a shoreline receptor over that of natural wind-driven waves and existing wake; or
- Cause a significant increase in shoreline erosion or loss of wetland habitat; or
- Impact special-status species such as California clapper rail (threatened species) or Pacific harbor seal (protected species).

5.3.1.1 Quantitative Shoreline Significance Criteria

To enable quantitative assessment of potential impacts to shorelines, specific criteria for San Francisco Bay were developed as described in Appendix Wake-D. The significance criteria developed include a 16-cm wake wash wave height at the shoreline and a 1,500-meter distance from sensitive shorelines to ferry routes. Potentially sensitive shorelines include mudflats, salt marshes, narrow channels, and sandy beaches. Potential impacts from increased ferry service would not be significant for rocky or armored shorelines. Erosion at rocky shorelines is a consequence of cumulative extreme storm events and armored shorelines are designed to resist the waves occurring during extreme storm events. The 16-cm criterion is based on an analysis of daily average wind waves. The 1,500-meter criterion is based on distance required for the wake from a vessel's design wake wave height of 27 cm (measured at 300 meters) to attenuate to the 16 cm shoreline criterion. (The 27-cm vessel design criterion is based on the largest anticipated vessel that would be used for the increased ferry service – a 350-passenger, 35+ knot vessel.) The rationale for these criteria is described in detail in Appendix Wake-D.

However, even if the 16-cm and 1,500-meter criteria are not met, wake wave impacts may not be significant at the shoreline and comparison with site-specific data would be necessary to make such a determination. If predicted wake waves at the shoreline are less than 50 percent of the average sustained wind wave height on a monthly basis, significant impacts are not anticipated because the wake wash waves would be indistinguishable from the natural variation of the wind driven waves.

With these criteria, impacts to the shoreline would be considered significant if:

- A ferry route passes within 1,500 meters of a potentially sensitive shoreline and the predicted wake wash wave at the shoreline is greater than the 16 cm shoreline wave height criterion; and

- Predicted wake waves at the shoreline are greater than 50 percent of the average sustained wind wave height on a monthly basis.

To aid in the impact assessment for individual ferry routes and shoreline areas, a Decision Tree was developed. It is shown on Figure 3.3.2 in Wake Section 3.3 for the Proposed Project. The Decision Tree includes the steps required to determine if impacts to shorelines would be significant and potential mitigation measures that could be utilized to reduce potential impacts to less than significant levels.

5.3.1.2 Qualitative Significance Criterion for Clapper Rail Nest Inundation

Impacts to California clapper rail nesting sites could be considered significant if:

- Ferry routes were within 50 meters of known nesting sites.

It is important to note that a clapper rail nest within 50 meters of the route will not necessarily be impacted but only potentially impacted.

5.3.2 Impacts and Mitigation

5.3.2.1 Potential Impacts to Shorelines

Impact WW-1 **New routes and increased frequency of ferry trips across the Bay could increase the wave height (energy) at some shorelines, potentially causing increased erosion.**

Shorelines tend to be in dynamic equilibrium with the "typical" or average wind wave energy reaching them. Erosion could be increased or altered due to additional ferry service if wake wave heights and energy were significantly greater than those of existing wind-driven waves (see Appendix Wake-D for discussion.)

For shorelines at a distance greater than 1,500 meters from a proposed ferry route, impacts are not anticipated to be significant. Impacts could potentially be significant for sensitive shorelines (tidal marshes and mudflats) that are within 1,500 meters of a ferry route. Impacts are not anticipated at rocky or armored shorelines as these shorelines can withstand extreme weather events, which subject them to conditions only experienced every 50 or 100 years. Figures 5.3.1 through 5.3.3 show areas of sensitive shoreline that are within 1,500 meters of a ferry route for Alternatives 1 through 3, respectively. If a potentially sensitive shoreline is within 1,500 meters of a route, it does not indicate there would be impacts, only that there is a potential for significant impacts.

The highlighted shoreline areas are based on an approximate 1,500-meter measurement from the proposed routes. When exact routes are identified, they will need to be accurately plotted on navigational charts. Potential sensitive shoreline areas within 1,500 meters of those routes could then be identified.

A Decision Tree (Figure 3.3.2 in Wake Section 3.3) was developed to help evaluate whether impacts to shorelines would be significant. It includes potential mitigation measures to reduce potential impacts to less-than-significant levels.

For Alternative 1, potentially sensitive shoreline areas within 1,500 meters of proposed ferry routes are highlighted on Figure 5.3.1. Potential sensitive shoreline areas within 1,500 meters of those routes could then be identified. For Alternative 1, potentially impacted shorelines include south of Point Pinole, areas near Port Sonoma, areas in the Carquinez Strait, and Suisun Bay in the North Bay, areas of shoreline adjacent to potential terminal locations in the Central Bay, and areas near potential terminal locations and shorelines near narrow portions of the Bay in the South Bay.

For Alternative 2, potentially sensitive shoreline areas within 1,500 meters of ferry routes are highlighted on Figure 5.3.2. Potentially impacted shorelines include south of Point Pinole, areas near Port Sonoma, and areas in the Carquinez Strait and Suisun Bay in the North Bay, areas of shoreline adjacent to potential terminal locations in the Central Bay, and areas near potential terminal locations and shorelines near narrow portions of the Bay in the South Bay.

For Alternative 3, potentially sensitive shoreline areas within 1,500 meters of proposed ferry routes are highlighted on Figure 5.3.3. Potentially impacted shorelines include south of Point Pinole and areas in the Carquinez Strait in the North Bay, and areas of shoreline adjacent to potential terminal locations in the Central Bay.

Summary of Impact WW-1

- Alternatives 1 and 2 would involve expansion of ferry service and increased numbers of ferry transits. The alternative also includes new routes across the Bay, with the potential to impact areas not currently served by water transit. Different routes could result in larger wave heights from wake wash reaching the shoreline than existing wind-driven waves. Potentially impacted shorelines include south of Point Pinole, areas near Port Sonoma, in the Carquinez Strait, and Suisun Bay in the North Bay, areas of shoreline adjacent to potential terminal locations in the Central Bay, and areas near potential terminal locations and shorelines near narrow portions of the Bay in the South Bay. This is a potentially significant impact.
- Alternative 3 uses existing ferry routes but includes increased frequency of trips. Because the vessels used would have the same or lower design wash heights as those currently in use, impacts are not anticipated to be significant. Potentially impacted shorelines include areas in the Carquinez Strait and south of Point Pinole in the North Bay, and areas of shoreline adjacent to potential terminal locations in the Central Bay.
- Alternative 4 would not increase the number of ferry transits in the Bay. Therefore, no impacts would occur above present conditions.

Potential implementation of the following mitigation measures is shown as a Decision Tree on Figure 3.3.2 in Wake Section 3.3. Appendix Wake-E presents example analyses for representative shoreline types.

Mitigation WW-1.1: To meet the criteria evaluated for this impact, ferry routes and service may need to be modified such that:

- The route alignments are maintained at more than 1,500 meters from potentially sensitive shorelines (e.g., mudflats, unprotected tidal marshes). This should maintain wake impacts to a less-than-significant level.

- Operation of the vessels (primarily speed) should be maintained such that predicted wake wave heights at the shoreline would be less than 16 cm. This would also reduce this impact to a less-than-significant level.
- Operation of vessels maintained such that predicted wake waves at the shoreline would be less than 50 percent of the average sustained wind wave height on a monthly basis.

If resulting ferry routes meet one or more of the above criteria, impacts should be less than significant.

Mitigation WW-1.2: New ferry routes could potentially be modified to redirect energy away from sensitive habitats, to reduce or eliminate increased wake energy. Adjustment to routes can be used to focus wave energy on rocky or armored shorelines or to direct energy away from sensitive areas. Detailed wave refraction, diffraction, and reflection analysis would be required to predict the efficacy of wave energy focussing. This mitigation measure would only be feasible and effective on portions of routes where the operation of the vessel can incorporate these adjustments. For example, the approach routes to terminals near sensitive areas could be designed (directed) such that wake wash is away from sensitive tidal marsh environments, and turning movements are not permitted at a speed and/or direction that exceeds criteria 2 or 3, listed above.

Mitigation WW-1.3: Use of existing low wake vessel technology could reduce both the total wake wash energy and heights of individual waves. As shown in Figure Wake-D-2 (in Appendix Wake-D) existing light-weight high-speed vessels have 25 percent or better wave height and wave energy characteristics than the 350-passenger high-speed vessels presently operating on the Bay.

Mitigation WW-1.4: Use of advanced or state-of-the-art technologies such as low or no-draft vessels, which have almost no wake wash, could be considered.

Mitigation WW-1.5: Operational adjustments, such as slowing vessels down, could be implemented to reduce wake energy near sensitive tidal marsh habitat. Note, as shown in Figure Wake-D-2 (in Appendix Wake-D), a considerable reduction in vessel speed is required with an efficient high-speed vessel before the wake wash height is less than that at design operational speeds. Since this could have a substantial impact to high-speed routes, this measure would only be practicable in specific areas that cannot be mitigated with any of the other measures.

To ensure that ferries do not exceed any slow speed limits that are set, a monitoring and enforcement program should be developed to ensure compliance with routes and speeds. This mitigation could provide funding for the Department of Fish and Game to monitor routes and speeds on a random basis.

Mitigation WW-1.6: If it is not possible to reduce impacts to less than significant levels using the previous mitigation measures, the proposed routes with potentially significant erosional wake wash impacts could be removed from consideration or terminal locations could be changed.

The routes that are most likely to have unmitigable wake wash impacts are those from San Francisco to Pittsburg and Antioch. These routes are within 1,500 meters of the shoreline beside long stretches of tidal marsh.

Impact after Mitigation: Impact WW-1 would be less than significant after successful implementation of one or more of the above mitigation measures. However, these mitigation measures could involve compromises in service and cost, which would need to be evaluated on a route-by-route basis.

5.3.2.2 Potential Impacts to Marinas

Impact WW-2 **Increased frequency of ferry trips across the Bay could increase the wave heights at surrounding marinas, potentially damaging moored vessels and interfering with recreational users.**

Individual wave height is the primary factor of concern for impacts at unprotected marinas, due to the potential for damage of moored vessels, docks, etc., or potential safety issues for users of the marina.

For Alternatives 1 and 2, unprotected marinas could potentially be impacted throughout the Bay if individual wave heights from wake due to additional ferry service were significantly higher than existing waves.

For Alternative 3, unprotected marinas could potentially be affected, primarily in the Central Bay. However, because the vessels used would have the same or lower design wash heights as those currently in use, no significant impacts are anticipated to marinas.

Summary of Impact WW-2

- Alternatives 1 and 2 would involve expansion of ferry service and an increased number of ferry transits thereby potentially increasing wave heights impacting nearby marinas. They also include new routes across the Bay, with the potential to impact areas not currently served by water transit. Different routes or vessels could result in larger wave heights from wake wash reaching the shoreline. Unprotected marinas could potentially be impacted throughout the Bay if individual wave heights from wake due to additional ferry service were significantly higher than existing waves. Therefore, this impact is potentially significant.
- Alternative 3 uses existing ferry routes but includes increased frequency of trips. For Alternative 3, unprotected marinas could potentially be impacted primarily in the Central Bay. However, because the vessels used would have the same or lower design wash heights as those currently in use, no significant impacts are anticipated to marinas.
- Alternative 4 would not add new routes or increase the number of ferry transits in the Bay. Therefore, no impacts would occur above present conditions.

Mitigation WW-2.1: The mitigation measures for impacts to marinas are the same as for Mitigations WW-1.1 through WW-1.6.

Impact after Mitigation: Impact WW-2 would be less than significant after successful implementation of one or more of the above mitigation measures.

5.3.2.3 Potential Impacts on Indicator Species

Impact WW-3 **Wake wash impacts from increased ferry service could have an adverse effect on California clapper rail, a listed species, by inundating nests.**

California clapper rail, an endangered species, was used to represent shoreline habitat impacts from vessel wake. As discussed in Section 3.5.1.1, clapper rail are yearlong residents of emergent salt and tidal marshlands in the Bay Area, primarily in marshes south of San Mateo

Bridge and in San Pablo Bay. The known distribution of California clapper rail in the Bay Area is shown on Figure 3.5.12 in Section 3.5 (Biology).

Nests are typically constructed with their bases 10 to 20 cm above the ground and their tops 25 to 30 cm above the ground. Inundation of nests by wake wash has the potential to cause a significant negative impact on the endangered species' survivability during the nesting season (between February 15 and June 15). The nests are generally located at least 100 meters inland from the marshland shoreline.

Wake from passenger ferries near clapper rail nesting sites would not be likely to have detrimental impacts on nests located more than 50 meters from a healthy marsh fringe (see Appendix Wake-D). Wake wash could have significant impacts on nest sites located within 50 meters of the marsh fringe. It is also possible that wake wash could impact nesting areas less than 50 meters from a marsh fringe, under conditions of high wake energy and no wake attenuation (degraded marsh habitat).

Summary of Impact WW-3:

- Alternatives 1 and 2 would involve expansion of ferry service and an increased number of ferry transits thereby potentially increasing wake wash impacts to California clapper rail nesting sites. The alternative also includes new routes across the Bay, with the potential to impact areas not currently served by water transit. Nesting sites could be within 50 meters of ferry routes in areas of Suisun Bay, and near Port Sonoma in the North Bay, and along the shoreline near the Redwood City and Moffett Field terminals in the South Bay. This impact could be potentially significant.
- Alternative 3 utilizes existing ferry routes, but includes increased frequency of trips. Because the vessels used would have the same or lower design wash heights as those currently in use, no significant impacts are anticipated to California clapper rail nesting sites. For Alternative 3, no nesting sites are within 50 meters of ferry routes.
- Alternative 4 would not increase the number of ferry transits or have new routes. Therefore, no impacts would occur above present conditions.

Mitigation WW-3.1: For any shoreline areas that have potential clapper rail nesting habitat within 50 meters of the edge of a marshland (or within marshland that does not appear healthy and could limit attenuation of wave energy as a result) and are along a proposed ferry route, habitat surveys should be conducted to determine if nesting sites exist. If nesting sites do exist within 50 meters of the edge of the marshland, site-specific measurements of wake attenuation should be performed at the potential site to determine if wash will be an issue. An analysis such as that provided as part of the documentation for the Wave Height Analysis for Flood Insurance Studies (WHAFIS) model could be used to predict wave propagation and decay at high water (FEMA 1988). If the measurements/calculations indicate that nest inundation could potentially occur, one of the following additional mitigation measures may be necessary. For nesting sites more than 50 meters from the edge of the marshland, no significant impacts would occur.

Mitigation WW-3.2: Use of existing low wake vessel technology could reduce both the total wake wash energy and heights of individual waves. Use of this mitigation in areas where clapper rail nests are within 50 meters of the shoreline could reduce impacts to less-than-significant levels.

Mitigation WW-3.3: New ferry routes could be adjusted to redirect energy away from sensitive habitat or to reduce or eliminate increased wake energy. Use of this mitigation in areas where clapper rail nests are within 50 meters of the shoreline could reduce impacts to less than significant levels.

Mitigation WW-3.4: Operational adjustments, such as slowing the vessel down near sensitive areas, could be performed during ferry operation to reduce wake energy. Use of this mitigation in areas where clapper rail nests are within 50 meters of the shoreline could reduce impacts to less-than-significant levels.

Mitigation WW-3.5: If no other mitigation could reduce impacts to less than significant, the proposed route could be removed from consideration or the terminal location could be changed.

Impact after Mitigation: Impact WW-3 would be less than significant after successful implementation of one or more of the above mitigation measures. Mitigation for any final specific routing that may cause a potentially significant impact should require a Biological Opinion from the U.S. Fish and Wildlife Service under the federal Endangered Species Act.

Impact WW-4 **Wake wash impacts from increased ferry service could have an adverse effect on Pacific harbor seals at haul-out sites.**

Pacific harbor seals (*Phoca vitulina*) are common year-round in San Francisco Bay and are protected by the Marine Mammal Protection Act of 1972. Harbor seals haul out in groups ranging in size from a few individuals to several hundred seals. As discussed in the Biology Section, harbor seal habitats used as haul-out sites include tidal rocks, bay flats, sandbars, and sandy beaches and tend to be relatively consistent from year to year. Known locations of haul-out sites are shown on Biology Section Figure 3.5.14. Haul-out sites that support some of the largest concentrations of seals include Corte Madera Marsh and Castro Rocks in the Central Bay, Mowry Slough south of the Dumbarton Bridge, and Yerba Buena Island.

Ferries passing near sensitive areas such as haul-out sites could potentially disturb seals using these areas. As discussed in the Biology Section, seals react to both visual and acoustic disturbances from boats, kayaks, jet skis, aircraft, foot traffic, and dogs in the vicinity of haul-out sites. Disturbances that occur closer to the animals tend to provoke a stronger negative response.

Green et al. (2001) found that watercraft, especially those that exhibit erratic movements, are a common disturbance to seals on San Francisco Bay. Green et al. (2001) conducted studies of disturbances at Castro Rocks and Yerba Buena Island. They found that the average distance at which watercraft caused animals to flee the site (flush) was approximately 183 meters at Castro Rocks and approximately 133 meters at Yerba Buena Island. Larger boats such as tugboats and ferries tended to cause a flush at greater distance than smaller watercraft such as jet skis and kayaks. For example, at Castro Rocks, larger watercraft caused a flush at an average of approximately 264 meters (range 121-511 meters) while jet skis and kayaks caused a flush at an average of approximately 150 meters (range 10-500 meters). Watercraft that exhibit erratic movements such as sudden changes in speed or direction were more likely to cause a disturbance than those traveling at steady speeds, slow speeds and constant direction (Green et al. 2001; Kopec and Harvey 1995).

Ferry routes for Alternatives 1, 2, and 3 are generally well away from most haul-out sites in the Bay. Existing routes pass near Yerba Buena Island and Castro Rocks, two major haul-out sites in the Bay.

Because seal haul-out sites tend to be in rocky areas that experience significant natural wave action, and individual wake wash wave heights are smaller than those generated by average or normal winds, it is unlikely that wake wash from ferries would significantly impact seals. As described in the Biology Section, a greater concern for seals is the startle effect caused by sudden changes in vessel direction or location.

Summary of Impact WW-4

- Alternatives 1 and 2 would involve expansion of ferry service and an increased number of ferry transits thereby potentially increasing wake wash impacts to seal haul-out sites. It includes routes that pass near seal haul-out sites, in particular Yerba Buena Island and Castro Rocks. Passing too close and disturbing marine mammals at these locations would be considered significant. The alternative also includes new routes across the Bay, with the potential to impact areas not currently served by water transit. This impact could potentially be significant.
- Alternative 3 includes routes that pass near seal haul-out sites, in particular Yerba Buena Island and Castro Rocks. However, this alternative utilizes existing ferry routes and vessels used would have the same or lower design wash heights as those currently in use. Therefore no significant impacts are anticipated.
- Alternative 4 would not increase the number of ferry transits in the Bay or include new routes. Therefore, no new impacts are anticipated.

Mitigation WW-4.1: As discussed in Mitigation B-14.1 in the Biology Section (5.5), the National Marine Fisheries Service (NMFS) currently has guidelines for avoidance of marine mammals to reduce disturbance. For seals and sea lions, the minimum avoidance distance for haul-out sites is 30 meters (this distance, however, does not take vessel speed or wash into account).

Distances discussed from the literature show that, in general, seals tend to flush at greater distances than those in the NMFS guidelines. Given the site specific information available for San Francisco Bay (Castro Rocks) it is recommended that ferry routes should be at least 100 to 250 meters from the Castro Rocks and Yerba Buena Island haul-out sites to reduce disturbance to the animals at these locations (see Biology Mitigation B-14.1 in Section 5.5).

Impact after Mitigation: Impact WW-4 would be less than significant after successful implementation of the above mitigation measure.

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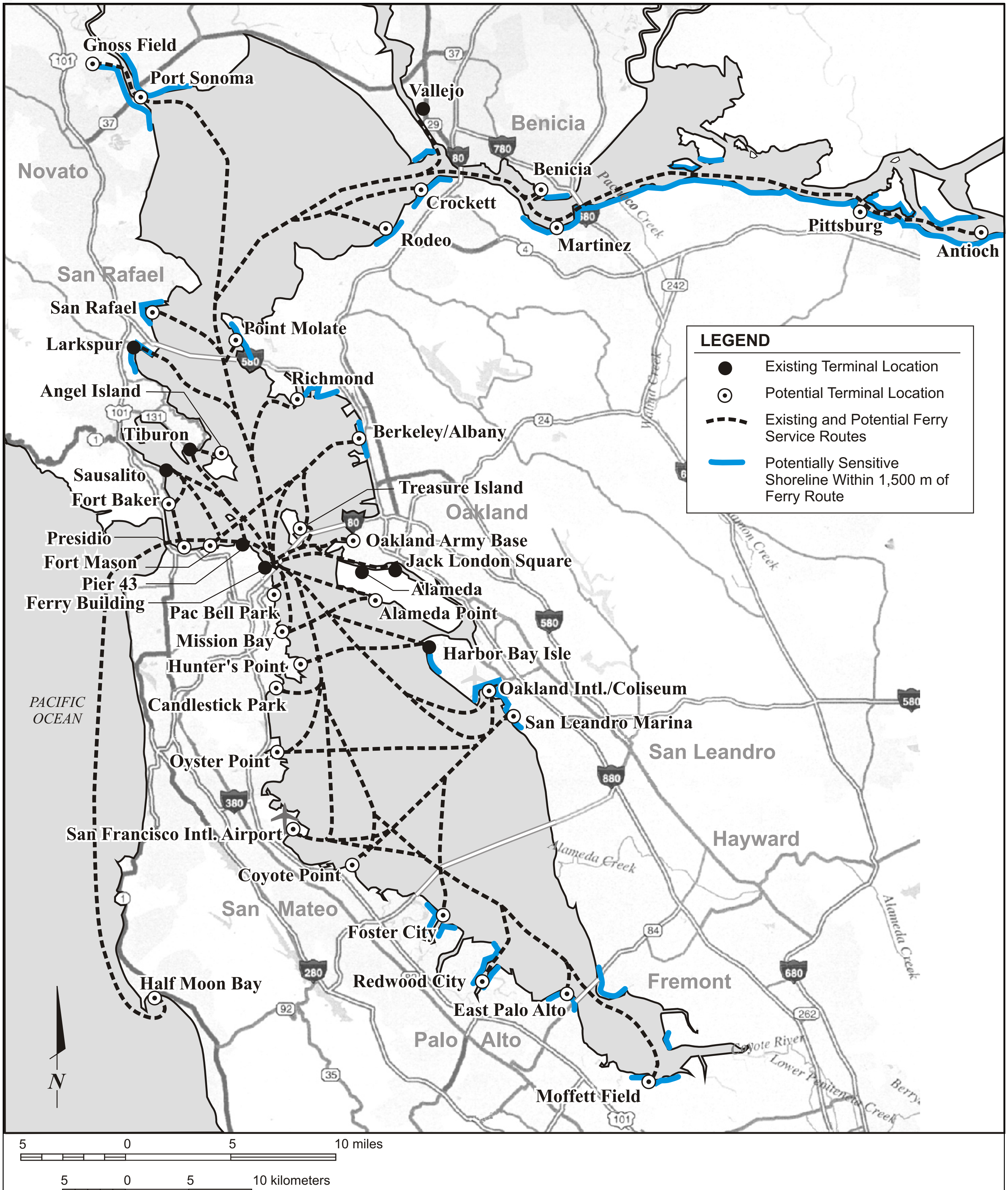

URS	Water Transit Authority Program EIR Project No. 28066519	Potentially Wake Sensitive Shoreline Based on 1,500 m Criterion - Alternative 1	Figure 5.3.1

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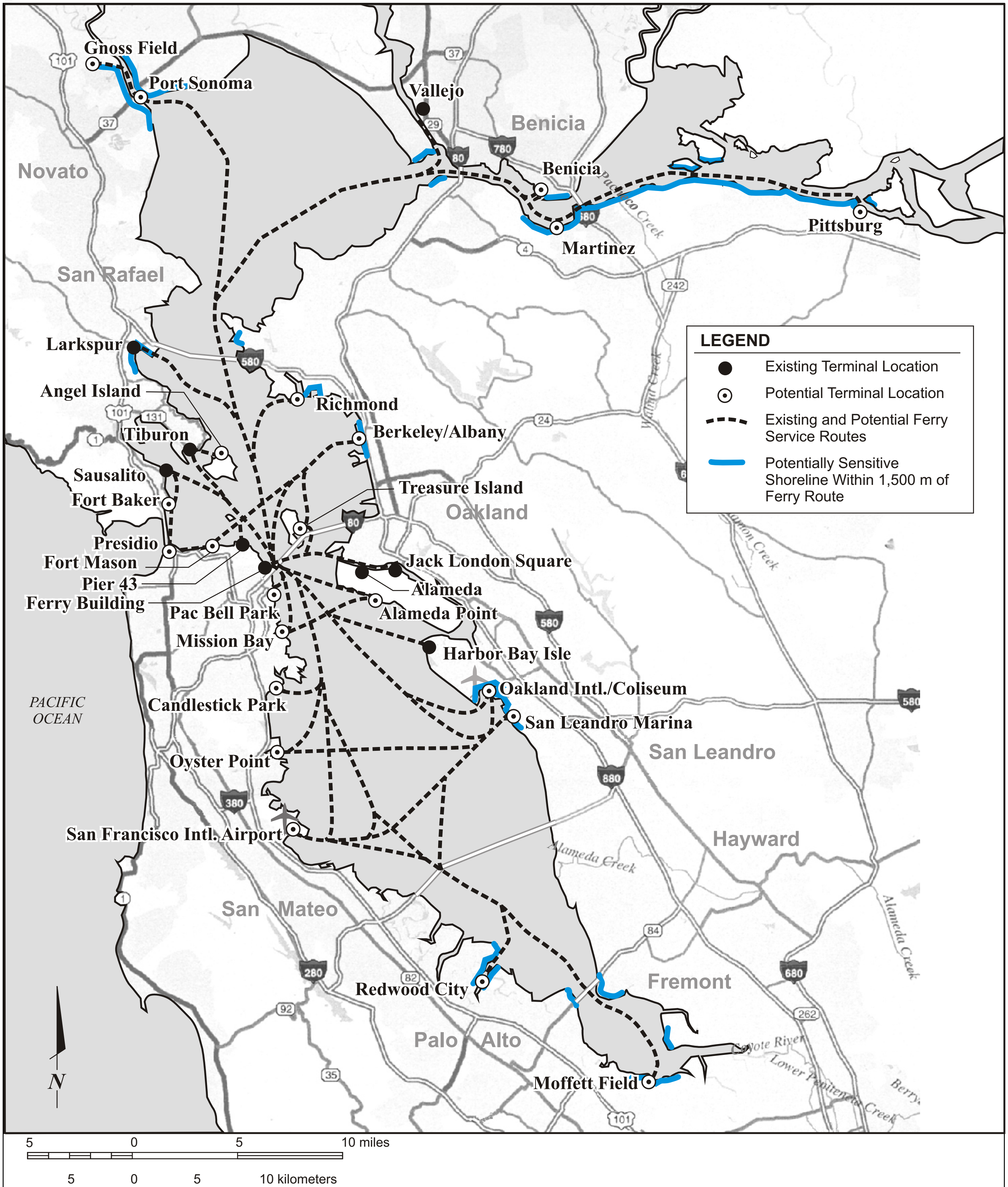

URS	Water Transit Authority Program EIR Project No. 28066519	Potentially Wake Sensitive Shoreline Based on 1,500 m Criterion - Alternative 2	Figure 5.3.2

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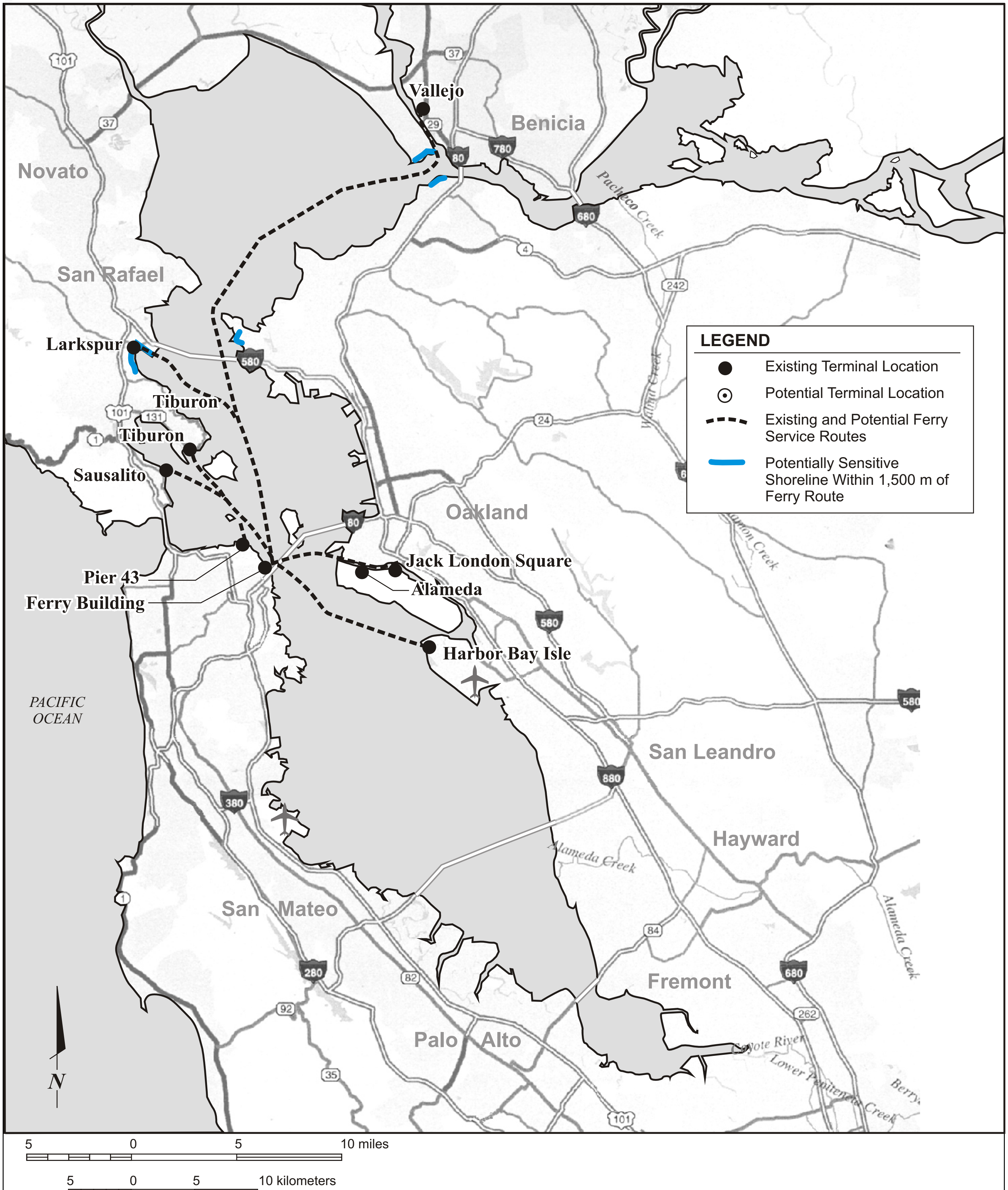

URS

Water Transit Authority
Program EIR

Project No. 28066519

Potentially Wake Sensitive Shoreline Based on 1,500 m Criterion - Alternative 3

Figure 5.3.3

5/14/03 vsa ...28066519 WTA\F5.3.3_wakeshore_ALT3.cdr

5.2 NAVIGATION

5.2.1 Significance Criteria

Impacts would be considered significant if they would:

- Affect the safe navigation of the Bay (including commercial shipping), resulting in substantial increases in the number of incidents reported by the Vessel Traffic Service (VTS); and/or
- Interfere substantially with the recreational water uses in San Francisco Bay through increases in the number of accidents involving the interaction of ferries and recreational vessels.

5.2.2 Impacts and Mitigation

Impact NAV-1 **Existing ferry service results in some navigational incidents, including accidents involving collisions, allisions, and groundings. There is a potential for an increase in these incidents with expansion of water transit service.**

Bay Area ferry service currently serves terminals in San Francisco Bay. Most ferry trips are within the Central Bay. Expanded ferry service could add ferry traffic throughout the Bay, depending on the chosen alternative, involving new trips to and from terminals in localities not currently accessed by ferries. This could lead to a potential increase in navigational incidents.

Three passenger service companies currently provide daily service from 5:30 a.m. to 12:30 a.m. In 2000, ferry traffic reached a volume of 88,469 trips, or approximately 68 percent of the total vessel trips reported by the U.S. Coast Guard (USCG) Vessel Traffic Service (VTS) in San Francisco Bay for that year. Alternatives 1, 2, and 3 involve expansion of ferry service and would increase the number of ferry transits in the Bay. Table 5.2.1 shows the number of ferry trips projected for the year 2025 under each alternative. The year 2025 ferry trips for Alternatives 1 through 3 were derived from projections prepared for the WTA as of April 2002. Ferry traffic projections are calculated through modeling and testing of different assumptions and are subject to revision (Bruzzone 2002). For Alternative 4, the No Project Alternative, the number of trips is assumed to remain constant at the levels reported in 2000.

Available data for San Francisco Bay and other heavily used harbor areas in the United States (presented in Table 3.2.4) suggest that there is no direct correlation between the number of vessel transits and the number of reported incidents. This lack of correlation is also depicted on Figure 3.2.4. For example, despite having the lowest number of transits compared to other U.S. ports, Los Angeles/Long Beach had the highest number of reported collisions per 1,000 transits. Similarly, there appears to be no relationship between higher traffic and reports of near misses, groundings, allisions, or other vessel casualties for the main U.S. harbors.

The comparison of number of transits and number of navigational incidents between different harbors could indicate that some harbors are more navigationally dangerous than others, regardless of the number of trips. However, evaluation of navigational incidents within San Francisco Bay over time also does not show a clear correlation of any increase in incidents with an increase in transits. USCG incident statistics for the Bay for 1996-2001 are presented in Table 3.2.6. The trend indicated is that both ferry and total transit trips by all vessel types generally increase over time. However, over the same period, the number of incidents does not change in a consistent pattern.

This comparison of recorded navigational incidents and vessel traffic statistics does not appear to associate an increase in trips with an increase in the probability of incidents. Other factors appear to affect the occurrence of navigational incidents for any given volume of harbor transits. These may include the condition of mechanical equipment, navigational aids, and training of pilots for safety. It is important to note that Puget Sound and San Francisco Bay are among the harbors with the lowest number of incidents. Ferries represent approximately 80 and 70 percent, respectively, of Puget Sound and San Francisco Bay annual vessel trips. This could imply that ferry pilots familiarity with the navigational conditions and procedures in those harbors account for fewer incidents.

To evaluate the significance of the increased ferry traffic within the overall vessel traffic in San Francisco Bay, two extreme scenarios were evaluated, as represented in Figures 5.2.1 and 5.2.2. The purpose of this evaluation was to capture the possible range of the contribution of passenger ferry transits to the overall vessel traffic in the Bay. In the conservatively low scenario, all non-ferry traffic would remain at year 2000 levels. This scenario does not consider any further expansion in waterborne traffic that would naturally occur in response to regional economic demand. Alternatively, in the conservatively high scenario, non-ferry traffic would continue to grow steadily based on the rates of increase shown in recent years. This scenario does not consider any logistical constraints or infrastructure limitations on the capacity of the Bay to accommodate waterborne traffic. The number of vessel trips in the Bay in each vessel traffic growth scenario is presented in Table 5.2.2.

Under either scenario, the proportion of ferry transits as part of the total vessel transits would increase from the current level of 69 percent corresponding to Alternative 4. This increase indicates that ferries would account for between 92 and 97 percent of the total vessel transits in the Bay under Alternative 1, between 90 and 96 percent under Alternative 2, and between 70 and 86 percent under Alternative 3. That is, under all alternatives, ferry trips would represent the overwhelming majority of all the vessel transits within the Bay.

Incidents such as collisions and near misses involve the interaction of two vessels. A model was developed by ABS Consulting as part of a preliminary risk assessment for the WTA that counts vessel interactions (ABS 2002). Any vessel (i.e., VTS-monitored vessel, recreational boater, or another ferry) within 0.5 miles of a ferry was considered an interaction. An interaction also includes situations in which a vessel is within 5 minutes of crossing track, and the crossing occurs either within 1 mile ahead or within 0.5 mile behind the ferry. The counting does not define the level of risk related to collision. It only provides a measure of hazardous exposure. The ABS model was used to simulate navigational conditions and produce geospatial distribution of vessels for the year 2000 with the ferry fleets and routes corresponding to Alternatives 1 through 3 and Alternative 4 as the base case. The model results shown in table below indicate that as ferry transits expand compared to the base case, interactions between vessels would grow exponentially.

Alternative	Ferry Transits (percent)*	Total Vessel Interactions (percent)*
Alternative 4 (base case)	100	100
Alternative 3	365	620
Alternative 2	1,228	4,600
Alternative 1	1,559	8,400

Data presented as a percentage of the base case results.
Source: ABS (2002)

The increase in the relative number of ferry transits under Alternatives 1, 2, and 3 imply that the potential interactions between ferries would continue to predominate over the interactions between ferries and non-ferry vessels as well as over those between two non-ferry vessels. Consequently, this comparison indicates that proper maintenance of fleets, ferry pilot training, and the use of appropriate navigation aids will be the most important factors in addressing any potential navigation risks created by the additional transits and the increased hazardous exposure created by the increased interactions. As stated before, increased vessel traffic does not correlate with increased navigational incidents in the nation's harbors. Procedures will continue to be more significant than the number of vessel interactions in determining the level of risk.

The WTA ferry expansion will involve different ferry routes, some of which are common to the four alternatives considered. These routes may pose varying degrees of navigational challenge and location-specific navigational concerns. However, ABS modeling results indicate that the majority of the increased interactions will take place within a square grid northeast of the San Francisco cityfront.

Summary of Impact NAV-1

- Alternatives 1 and 2 could have potentially significant impacts on navigational incidents resulting from the increase in the number of ferry transits and service to and from new terminal locations. The level of significance of such impacts is difficult to determine.
- Alternative 3 could have potentially significant impacts on navigational incidents resulting from the increase in the number of ferry transits. The level of significance of such impacts is difficult to determine.
- Alternative 4 would not involve expansion of ferry transits and would therefore have no impact.

Mitigation NAV-1.1: Implementation of best practices as recommended by the preliminary risk assessment prepared by ABS (2002) will serve to minimize navigation-related risk. These practices (ABS 2002) are listed below:

1. Design and implement a preventive maintenance system that meets or exceeds manufacturer's service requirements.
2. Require a licensed master to complete an extended familiarization training program aboard the hull and route before being qualified as master-in-charge. (Note: Program training should meet or exceed the requirements in the USCG National Maritime Center Policy Letter 06-01 subj.: "Qualification for Issuance of Type Rating Endorsements Authorizing Service on High-Speed Craft.")

3. Design the terminal to facilitate docking under both prevailing and seasonal environmental conditions.
4. When conditions make it difficult for the master-in-charge to effectively maintain situational awareness, assign another person to the bridge watch (i.e., another licensed master or a senior deckhand) to share the workload and serve as a safety double check.
5. Design and install gangway systems (1) that help steady the ferry and hold it firmly to its dock, (2) that can be adjusted to accommodate changing environmental forces, and (3) that can be manipulated by crew having different physical abilities.
6. Install, operate, and maintain technology (e.g., portable pilot units, and/or automatic identification system tracking and display) to facilitate communication of intent and to audit conformance with navigational protocols.
7. Install, operate, and maintain a backup radar and separate power supplies for radars.
8. Train/certify all bridge watchstanders in radar operation.
9. Periodically survey the water depth in vicinity of a terminal to identify shoaling, and set and maintain private markers to identify shoal water.
10. Conduct periodic electrical safety inspections and daily check of ground faults. Install a bridge alarm/indicator that alerts the licensed master of the location of electrical shorts.
11. Install and maintain a fixed fire suppression system that has sufficient capacity to flood the engine room twice with CO_2 or equivalent fire suppression agent.
12. Eliminate or minimize hazardous materials used in maintenance and repair.
13. Use a closed gauging system for checking fuel levels.
14. Develop company policy and standard procedures for emergencies and adverse weather and normal operating conditions. Implement and enforce procedures through training and company communications. Audit conformance. Provide job aids for critical procedures.

    Note: Policy and procedures manual and an operational training program should be developed using the guidance in the USCG Navigation and Vessel Inspection Circular 5-01 subj.: "Guidance for Enhancing the Operational Safety of Domestic High-speed Vessels."

    14a. Develop, communicate, and enforce standard operating procedures for ferry startup and shutdown.

    14b. Develop, communicate, and enforce navigational protocols for routes.

    14c. Identify areas/conditions in which meeting, crossing, or overtaking may significantly increase the risk of collision and develop/enforce a "no passing" policy for those areas.

    14d. Develop and exercise vessel mutual assistance plans.

    14e. Develop and exercise emergency response protocols to facilitate communication and ferry traffic control during emergencies.

    14f. Determine with emergency care providers (e.g., ambulance services) locations along a route at which the ferry can transfer people in medical distress.

14g. Develop, communicate, and enforce a hot work permit program.

14h. Develop, communicate, and enforce lock-out/tag-out program.

14i. Develop, communicate, and enforce a safe lifting program for deckhands.

14j. Develop and enforce standards for emergency training. Establish a frequency for emergency drills that meets or exceeds USCG requirements. Establish criteria for measuring drill performance. Require all shifts and all crew on each shift to participate. Document training.

Impact After Mitigation: Impact NAV-1 would be reduced after implementation of Mitigation Measure NAV-1.1. Ferry transit has operated safely on the Bay, and expansion of service with these measures would minimize risks. However, no system can ensure risk-free navigation conditions in the Bay. This impact is potentially significant because of the remaining risk.

Impact NAV-2 **Increased numbers of ferry transits in the Bay may increase the risk of incidents (such as collision and near misses) between recreational water users and ferries. This raises concerns for public safety, especially where windsurfers launch and sail in close proximity to ferry vessels.**

Windsurfers typically do not use the Bay marinas. Rather, different launching facilities have developed in the Bay Area because of the need for particular site amenities for that sport, such as shore accessibility and parking, and to take advantage of particular wind and water conditions. The desire to avoid conflicts with other user groups also plays a role in the selection of launch sites. No accidents involving windsurfers and ferries have been documented to date.

Figure 3.2.3 presents the location of existing launch sites relative to existing and proposed ferry terminals. The figure also shows the season during which best windsurfing conditions prevail at each location and, therefore, when these locations are most heavily used. The following proposed terminals would be located in the vicinity of an existing launch site: Benicia, Martinez, Crissy Field, Oyster Point, San Francisco International Airport, and Coyote Point.

Larkspur is the only existing ferry terminal located close to a windsurf launch site. No windsurfing accidents have been reported by ferry operators at the Larkspur terminal even though windsurfing has been a popular recreational activity in the area for many years. This may be attributed to the fact that ferries travel at slow speeds (10 knots) near the terminal and can quickly stop if a windsurfer falls along their path (Clark 2002). No written navigational rules exist for windsurfers, but windsurfers are reported to honor the ferries' approach and departure route since ferries are restricted to the dredged channel. Depending on wind and tide conditions, windsurfers generally sail within a 1-2 mile radius from their launch sites. Windsurfers require a minimum wind speed of 9 knots and typically sail with winds ranging from 15 to 30 knots. Consequently, in the areas where interaction between windsurfers and ferries might occur, windsurfers may be sailing at higher speeds than ferries. On occasion, ferries pick up windsurfers who drift too far from shore and are unable to return. The navigational situation and relationship between ferry operators and windsurfers is reportedly agreeable, and each group is said to "look out for each other" (Clark 2002).

That view of the situation was corroborated by Tom Lloyd, owner of Boardsports Marin located at Larkspur Landing and an experienced windsurfer in the Larkspur channel. Mr. Lloyd noted that "ferries usually honk their horn to alert a windsurfer who has either not noticed the ferry is approaching or who has lost control of their board so that they can get out of the ferry's way. As long as the two groups communicate and stay aware of their surroundings, there shouldn't be any problems." (Lloyd 2002). The North Bay Chapter of the San Francisco Boardsailing Association monitors the activities between windsurfers and other vessels, including ferries, near Larkspur Landing to ensure a safe recreational environment for their members.

Summary of Impact NAV-2

- Alternatives 1 and 2 would increase the number of ferry transits in the Bay and expand service to and from new terminal locations. Some of those proposed terminals could be located in the vicinity of windsurf launch sites. The impact of increased ferry traffic on windsurfers could be potentially significant.
- Alternative 3 would increase the number of ferry transits in the Bay but would not require new terminals in locations close to launch sites. The impact of increased ferry traffic on windsurfers could be potentially significant.
- Because Alternative 4 does not involve an increase in ferry traffic or new terminals, there would be no significant impact.

Mitigation NAV-2.1: Appropriate training of ferry crew in new terminals located near existing windsurfing launch sites could reduce the risk of incidents involving ferries and windsurfers. The San Francisco Boardsailing Association should participate in the development and delivery of such training.

Mitigation NAV-2.2: Designation of specific ferry employees to stand watch on the bridge of ferries at select routes to watch for navigational hazards (i.e., during periods of high use by windsurfers within the vicinity of selected terminal locations) could reduce the risk of incidents involving ferries and windsurfers.

Impact After Mitigation: Impact NAV-2 would be reduced after implementation of Mitigations NAV-2.1 and NAV-2.2. As exemplified by the case of the Larkspur terminal, windsurfers and ferry crews will "look out for each other" and develop a relationship that will serve to minimize incidents. No system can ensure risk-free navigation conditions in the Bay, and this impact remains potentially significant for Alternatives 1 through 3.

Impact NAV-3 **Increased numbers of ferry transits in the Bay may lead to an increased risk of collision between recreational boaters and ferries.**

As the population of the Bay region increases, more people are expected to use their leisure time in water-oriented recreational activities. According to USCG information, California has 904,863 registered boats in 2000 and ranks second (after Michigan) among the states in the number of registered recreational vessels (motor and non-motor watercraft). Accident statistics indicate that in 2000 there were a total of 900 boat accidents in California, involving 49 deaths and 519 injuries and totaling $3 million in property damages. One third of all California boat accidents that year involved collisions with other recreational vessels. A similar proportion was observed nationwide, with 2,706 accidents out of a total 7,740 involving collision with other vessels (USCG No Date). The majority of accidents between recreational boats are caused by improper control of the vessels due to operator recklessness. National and state statistics of boating accidents do not indicate that there were any accidents involving ferries and recreational boats. The 1996-2001 record of ferry accidents indicates only one collision during that period and it did not involve a recreational boat.

Figure 3.2.1 presents the locations of marinas along the San Francisco Bay shoreline, where local recreational water users berth or store their vessels. While most marinas are concentrated in the Central Bay, once vessels are launched, they can travel virtually anywhere in San Francisco Bay, San Pablo Bay, and the Sacramento River Delta, depending on the capabilities of the vessel and the operator. Therefore, there is potential for interaction between ferries and recreational boaters along any of the existing and potential future ferry routes.

Requirements for the safe interaction between power-driven vessels and between power-driven and sailing vessels are delineated in the International Regulations for Preventing Collision at Sea, Inland Navigation Rules Part B – Steering and Sailing, Rule 18. These regulations govern open bodies of water in which foreign shipping traffic is possible and provide a set of statutory requirements designed to promote navigational safety. These rules include requirements for navigation lights, dayshapes, and steering, as well as sound signals for both good and restricted visibility.

General public education and specific boat operator training in regard to safe operation of boats, appropriate rescue and life-saving equipment, boating under the influence of drugs and alcohol, and other key topics is widely recognized as an important tool to prevent and reduce watercraft accidents. The Federal Boating Safety Act of 971 (recodified under Title 46 of the United States Code) gave the USCG authority to administer two separate grant programs aimed at recreational boating safety. These are a State Grant Program to assist U.S. states and territories and an award program for nonprofit public service organizations to support recreational boating safety activities.

Boating activities in the Bay Area are well organized. Sail races are scheduled and planned well in advance of the events. USCG, the California Department of Boating and Waterways, marina associations, yacht clubs, and community-based entities such as Boat U.S. Foundation have collaborated extensively in matters of boating education and improving recreational navigation safety in Northern California.

Summary of Impact NAV-3

- Alternatives 1 and 2 would increase the number of ferry transits in the Bay and expand service to new terminal locations. Alternative 3 would increase the number of ferry transits in the Bay. The increase in the potential for incidents between recreational vessels and increased ferry traffic is potentially significant.
- Because Alternative 4 does not involve an increase in ferry traffic or new terminals, there would be no impact.

Mitigation NAV-3.1: Additional training, education, and public advisory programs for recreational watercraft users related to navigation safety requirements could reduce the risk of incidents associated with expanded ferry service in the Bay. The WTA could fund or sponsor new education and advisory training programs and strengthen existing ones. Potentially affected recreational users, especially those docking at marinas located in the vicinity of proposed new ferry terminals, could be reached through public notices on ferry routes and schedules.

Mitigation NAV-3.2: Designation of specific ferry employees to stand watch on the bridge of selected ferries to watch for navigational hazards (i.e., during periods of high recreational use, such as weekends or race events, or when weather hazards exist) could reduce the risk of navigational incidents.

Impact After Mitigation: Impact NAV-3 would be reduced after implementation of Mitigations NAV-3.1 and NAV-3.2. No system can ensure risk-free navigation conditions in the Bay. This could be a potentially significant impact.

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Lloyd, Tom. 2002. Boardsports Marin. Personal Communication. April.

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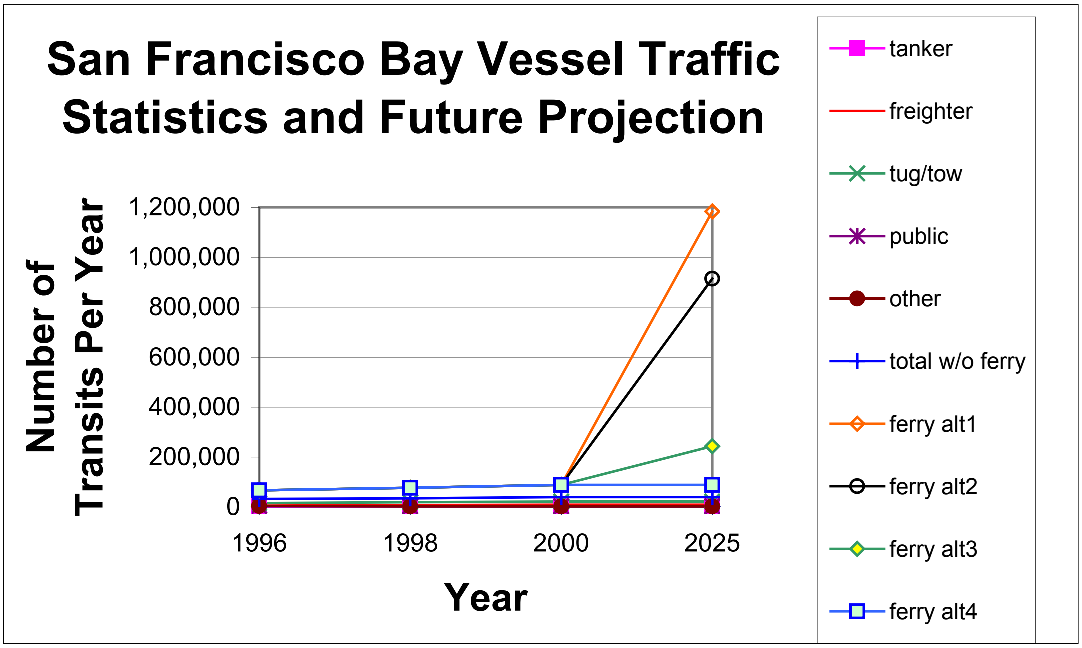
Table 5.2.1
Projected Ferry Trips in 2025

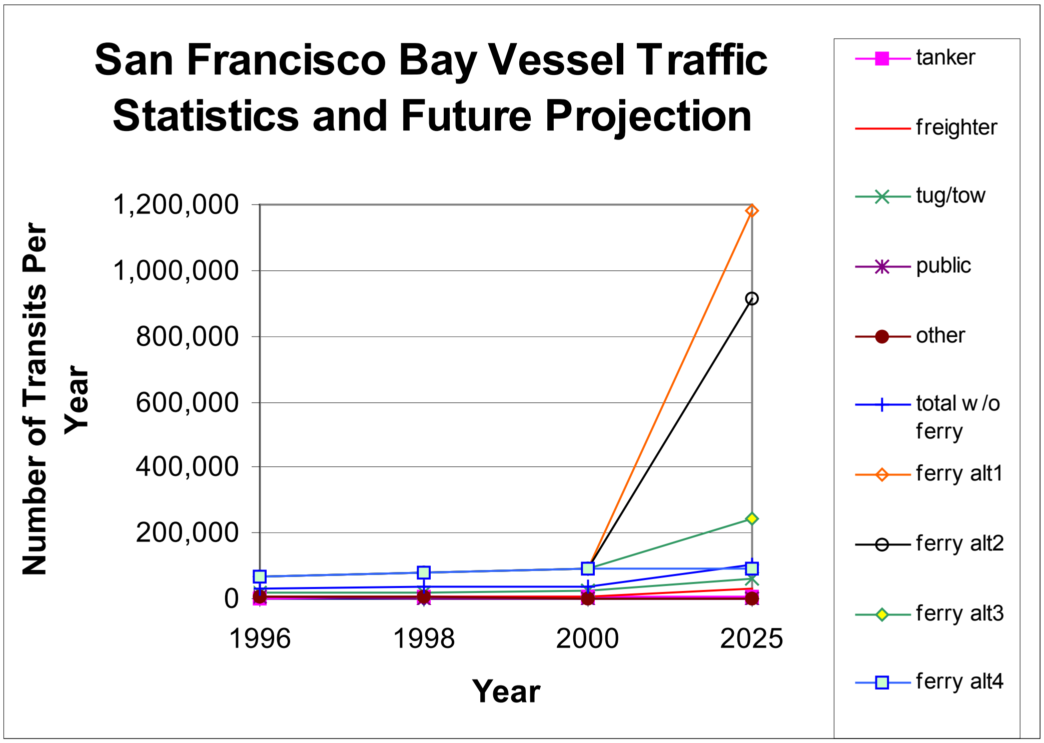
	Number of Projected Annual Ferry Transits
Alternative 1	1,182,980
Alternative 2	914,180
Alternative 3	243,440
Alternative 4	88,469

Table 5.2.2
Projected 2025 Annual Vessel Transits in San Francisco Bay

		2025 Non-Ferry No Growth			2025 Sustained Non-Ferry Growth		
	Ferry Transits	Non-Ferry Transits	Total Transits	% Ferry Transits	Non-Ferry Transits	Total Transits	% Ferry Transits
Alternative 1	1,182,980	39,235	1,222,215	97	103,962	1,286,942	92
Alternative 2	914,180	39,235	953,415	96	103,962	1,018,142	90
Alternative 3	243,440	39,235	282,675	86	103,962	347,402	70



URS	Water Transity Authority Program EIR Project No. 28066519	2025 FERRY TRANSIT PROJECTIONS AND NO GROWTH IN NON-FERRY VESSEL TRIPS	Figure 5.2.1



URS	Water Transity Authority Program EIR Project No. 28066519	2025 FERRY TRANSIT PROJECTIONS AND SUSTAINED GROWTH IN NON-FERRY VESSEL TRIPS	Figure 5.2.2

28066519.00200/051503/gos

5.1 DREDGING

5.1.1 Dredging Significance Criteria

Impacts would be considered significant if they would:

- Hinder achievement of the Long Term Management Strategy (LTMS) goals for allocation of dredged materials to in-Bay, ocean, and upland reuse sites;
- Result in a substantial adverse impact on water quality;
- Affect threatened, endangered, or protected species in a manner that results in a take under the Endangered Species Act; or
- Result in the reduction of protected wetland habitat as defined in Section 404 of the Clean Water Act or result in alteration of desirable functions and values established in applicable regulations through direct removal, filling, hydrological interruption, or other means.

Potential impacts to habitats due to dredging are addressed in Biology Section 3.5.2, specifically in Biology Impacts B-1 through B-3.

5.1.2 Impacts

<u>**Construction and Operation (Maintenance Dredging)**</u>

Impact D-1 **Dredging of new channels and maintenance dredging, which would be conducted on a periodic basis in shallow areas, would add to the total annual volume of dredged materials in San Francisco Bay. The increase in dredged volume could hinder achievement of LTMS goals for allocation of dredged materials to in-Bay disposal, ocean disposal, and upland reuse sites.**

Dredging in San Francisco Bay includes dredging for new projects and maintenance dredging for existing navigational channels. The U.S. Army Corps of Engineers (USACE) San Francisco District conducts most of the dredging in the Bay. The long-term dredging and disposal need for the Bay Area is estimated as approximately 300 million cubic yards (mcy) over a 50-year period, or an average of 6 mcy per year (USACE 1998). This is a conservatively high estimate based on historic dredge volumes as well as on proposed projects foreseen during the period of LTMS EIR/EIS preparation. Some of the new projects included in the estimates, such as a round-the-bay channel, have since been eliminated from consideration. There is great variability in dredge volume from year to year, depending on new projects as well as the level of dredging maintenance required, which appears to have declined in recent years. In 2001, for example, total dredging and disposal in the Bay Area was only 2.0 mcy according to USACE data (Dwinell 2002).

The goals of the LTMS include a reduction of in-Bay disposal volumes and increased emphasis on beneficial reuse of dredged material. The most likely beneficial reuses are wetland restoration and levee maintenance and repair. The long-term goal is to reduce disposal at in-Bay sites from approximately 50 percent of recent dredged volumes to approximately 20 percent by the year 2013. Volume targets have been established for each in-Bay disposal site, based on sediment-dispersive dynamics and historical information. A transition schedule with overall volume targets for in-Bay disposal has been established, as shown on Table 3.1.3. In addition to the target volumes, the LTMS contemplates a contingency volume of 0.25 mcy per year, which would be allowed for emergency situations or for years when sedimentation or other factors result in unanticipated volumes of deposited sediment to be dredged. The remainder of dredged material generated each year should be disposed of at the San Francisco Deep Ocean Disposal Site (SF-DODS) or at any of the existing or potential beneficial reuse and upland sites (Figure 3.1.2).

Figure 5.1.1 presents a Geographic Information System (GIS) map of San Francisco Bay showing the bathymetry and the potential WTA ferry routes and channels that would potentially require dredging. To calculate the potential dredging volumes, three-dimensional segments were delineated on the GIS map for each channel that could require dredging. These segments were defined to allow safe passage of ferries; with a buffer zone 300 feet wide (150 feet to each side of the center line to enable two vessels to pass with sufficient separation) and depth of 7 feet, which is conservative for ferry navigation (i.e., 5 feet maximum navigational draft and 2 feet of required keel clearance). Layer depth to be dredged was derived from bathymetric data.[1]

Potential dredging volumes associated with access to individual ferry terminals were calculated for Alternatives 1 and 2 and are presented in Tables 5.1.1 and 5.1.2, respectively. Alternatives 3 and 4 would not require dredging of new ferry channels as new routes are not proposed for those alternatives. The potential dredging requirements for construction (approach channels for new terminals) are 5.05 mcy for Alternative 1 and 4.70 mcy for Alternative 2. These totals reflect the estimated increase in dredging volumes to create new navigational channels for those alternatives.[2]

Potential construction dredging volumes are considerable when compared to current dredging activities in the Bay. The potential dredge volume for construction of Alternatives 1 and 2 exceeds the total average volume dredged for annual maintenance of USACE channels in the Bay (4.5 mcy). Construction dredging, however, would not occur all at one time. Table 5.1.3 presents the average annual dredging volumes when construction activities are spread over 3-, 5-, or 10-year periods. Actual annual volumes would depend on which new channels were dredged in any given year. In addition to construction dredging, channels would also require maintenance dredging. Although the long-term dredging maintenance requirements cannot be determined without location-specific sedimentation rates and hydrodynamic conditions, they would not exceed the construction dredging volumes, and they would likely recur on 3- to 5-year periods, as is the case for other channels in the Bay. Therefore, the dredging volumes presented

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[1] The GIS map was developed using National Oceanographic and Atmospheric Administration (NOAA) National Ocean Service Bathymetric Digital Elevation Models (DEM) that were generated from original point soundings collected during hydrographic surveys conducted by the National Ocean Service and its predecessors. Mean High Water shoreline as defined by NOAA nautical charts was used as a constraining boundary and assigned its local elevation relative to the local datum (typically Mean Low Water) (NOAA-National Ocean Service 1998). Bathymetric data for the John Black Slough was not available from the DEM. Instead, an approximation of average depth within the slough was derived from 1997 and 1998 surveys of San Francisco Bay (National Geophysical Data Center, no date).

[2] In some cases, such as for Harbor Bay where a ferry channel currently exists, some dredging may be required to create the 300-foot-wide and 7-foot-deep channel applied to all terminals in this analysis.

in Table 5.1.3 also represent the maximum potential annual maintenance dredging requirements associated with Alternatives 1 and 2.

As indicated in Table 5.1.3, channel maintenance dredging for Alternative 1 could lead to a maximum increase of 37 percent over average annual USACE maintenance channel dredging. This potential dredging volume would represent 28 percent of the Bay Area's long-term annual dredging requirements of 6.0 mcy estimated by the LTMS. Under Alternative 2, maintenance dredging could potentially lead to a maximum increase of 35 percent over average annual USACE channel maintenance volumes. This volume would represent 26 percent of the estimated LTMS long-term average annual dredging and disposal needs. Should longer maintenance cycles be appropriate, annual dredging volumes would decrease.

Expansion of water transit was not considered as part of the long-term dredging and disposal needs estimate for the LTMS. Given the facts that the LTMS estimate of 6.0 mcy is conservatively high and it includes dredged volumes for projects that will not happen, such as proposed tourism navigation channel ring around the Bay, volumes generated by the WTA ferry expansion may not result in the average annual estimate being significantly exceeded in the long-term. However, the LTMS dictates that only 20 percent of the dredged materials annual volume may be disposed of at in-Bay disposal sites by the year 2013. In-Bay sites are generally reserved for disposal of USACE maintenance dredging materials. Therefore, during project implementation, the WTA would have to ensure that new ferry channel dredged materials could be accommodated in any given year at either the ocean disposal site or at beneficial reuse sites while observing annual and/or total capacity restrictions at those sites.

Summary of Impact D-1

- Alternatives 1 and 2 involve expansion of ferry service to new terminals. If all routes considered in those alternatives were implemented, considerable channel dredging would be required. The resulting cumulative volumes of dredged materials required for construction and maintenance of new channels could hinder achievement of LTMS goals for reduction of in-Bay disposal. Impacts could be potentially significant.
- Alternatives 3 and 4 would not require dredging of new channels. These alternatives would utilize existing channels that are already maintained. Therefore, no impacts are expected.

Mitigation D-1.1: The total amount of dredging required could be minimized by avoiding dredging in those proposed channels that would require removal of the largest sediment volumes. Dredging would not be required if low or no-draft vessels are used. As indicated in Tables 5.1.1 and 5.1.2, four of the potential new ferry terminals, Gnoss Field, Moffett Field, San Francisco International Airport, and Oakland International Airport/Coliseum, together would account for approximately 4.59 mcy of dredged materials. This volume represents 91 percent of the total potential dredging requirements under Alternative 1 and 98 percent of the total under Alternative 2. Tables 5.1.4 and 5.1.5 present the dredging requirements for Alternatives 1 and 2, respectively, recalculated without channel access to the four terminals.

Avoidance of dredging along the identified four major channels, either through elimination of routes associated with those four terminals or use of shallow draft vessels, to and from them would reduce the total dredging requirement for construction under Alternatives 1 or 2 by approximately 4.59 mcy. Consequently, annual maintenance dredging requirements would also be reduced. Under Alternative 1, if zero-draft vessels were used or the above-mentioned routes eliminated, the potential construction dredging could be reduced from 5,048,630 cy to 460,540 cy. After construction, annual maintenance dredging requirements (assuming a 5-year maintenance cycle) would also be reduced from 1,009,726 cy to 92,108 cy. These average annual volumes represent 1.6 percent of the total long-term average annual volumes projected by LTMS (6.0 mcy). Under Alternative 2, potential construction dredging would be reduced from 4,698,670 cy to 110,580 cy and maximum maintenance dredging requirements would be reduced from 110,580 cy to approximately 22,116 cy, which represents 0.4 percent of the total long-term average annual volumes projected by LTMS. The potential increases in dredging and disposal associated with Alternatives 1 and 2 after mitigation would be small enough to be considered as part of the uncertainty in the estimation of the LTMS long-term needs. More importantly, it would be easier to accommodate these smaller volumes at the ocean disposal site or at existing reuse sites.

Mitigation D-1.2: Consultation with the Dredge Materials Management Office (DMMO) and associated permitting agencies would be required before proceeding with dredging and disposal plans in order to comply with regulatory requirements. At that time, DMMO will advise on available opportunities for the creation of new upland and wetland reuse areas for disposal of dredged materials associated with the proposed ferry routes. Fostering such opportunities would facilitate achievement of LTMS goals for reduction of in-Bay disposal. Potential beneficial dredged sediment reuse sites have been identified throughout the Bay Area by the LTMS (Figure 3.1.2). Those sites and other sites that may be eventually identified should be evaluated in terms of logistics, availability and capacity to accommodate the disposal needs of the WTA ferry expansion.

Impact After Mitigation: In-Bay dredge disposal will be restricted by permit conditions for each individual project and is unlikely to be very much. The LTMS target for the amount of annual in-Bay disposal will vary on timing of when the disposal would occur, based on other scheduled or proposed dredging projects. Mitigations D-1.1 and D-1.2, either separately or in combination, show a means of achieving the LTMS goals by minimizing in-Bay disposal. Adherence to the LTMS goals would yield a less-than-significant impact.

Impact D-2 **Dredging of new channels to accommodate expanded ferry service could locally reduce water quality by exposing and suspending contaminated sediment.**

Bay sediments have been influenced by natural and anthropogenic influxes of toxic chemicals over time, with a significant increase since the 1800s, when mining and industrial activities in the Northern California watersheds became widespread. Dredging and the disposal of sediments directly relate to the health of the Bay because these activities can remobilize previously deposited particulate-bound pollutants. For this reason regulatory controls greatly restrict new activities that might require dredging.

Contaminated sediments are not distributed evenly in the Bay, but tend to be in localized areas of high contamination. Trace metals, pesticides, and numerous organic contaminants are monitored for Bay sediments through the Regional Monitoring Program (RMP). Pollutant concentrations in sediments tend to be highest in harbors, harbor entrances, marinas, and industrial waterways and lowest in the central portions of the embayments.

Sediment "toxic hot spots", where sediment dredging could result in the degradation of water quality, have been identified in San Francisco Bay by the Bay Protection and Toxic Cleanup Program (BPTCP) and are shown in Figure 3.1.4. Areas of particular concern for the WTA expansion are those where ferry terminals coincide with or are in the vicinity of candidate toxic hot spots. Accordingly, dredging in China Basin, Mission Bay, and Richmond may present the potential for disturbance and remobilization of contaminated sediments, and require their eventual safe disposal. Oakland Inner Harbor was also identified by the BPTCP, but no additional dredging would be required for the purposes of the WTA's program. Other channels to be dredged may also contain contaminated sediments. Before dredging, proposed channel bottom sediments would be sampled and tested for contamination in accordance to DMMO guidelines.

Dredging impacts to water quality can be minimized through the use of best management practices (BMPs) including:

- Use of silt curtains, which prevent suspended sediment from migrating out of the immediate project area;
- Dredging only on the incoming tide;
- Hydraulic or closed clamshell dredging to reduce the generation of suspended sediments;
- Shunting, which involves pumping of the free water in a barge to the bottom of the water body which reduces turbidity; and
- Employment of an independent, certified, on-board dredging inspector to ensure compliance with permit conditions.

Monitoring should be conducted during dredging to allow for the following:

- Measurement of contaminated sediment removal efficiency;
- Determination dredged volumes;
- Measurement of sediment resuspension at the dredge site; and
- Checking performance of barriers and other controls.

Summary of Impact D-2

- Alternatives 1 and 2 would require dredging in areas that may contain contaminated sediments. If proposed channel bottom sediments are found to be contaminated after testing, a potentially significant impact to water quality could occur if contaminants were substantially resuspended or contaminated dredged material were not disposed of properly.
- Alternatives 3 and 4 would not require additional dredging. Therefore no impacts would occur.

Mitigation D-2.1: As part of the dredging permit requirements, proposed dredging locations will need to be sampled and tested to determine the extent of contamination, if any. Whenever contaminated materials are to be dredged, negative impacts on water quality could be minimized through the use of the most appropriate dredge type and dredging techniques for each site. Engineering included in the plans and permits for dredging projects should include the use of BMPs described above to reduce potential impact to a non-significant level.

If terminal sites with dredging requirements are selected for development, the Implementation and Operations Plan should include specifications and allocation of responsibility to the entities implementing new channel dredging to adopt adequate dredging techniques and BMPs. Individual project proponents should incorporate appropriate BMPs for dredging plans and specifications. In addition, dredging activities for a proposed terminal or route will require permits. The DMMO will issue a recommendation regarding preferred dredged material management options presented by the WTA, while individual agencies must issue specific regulatory approvals. As part of the permit application and permit conditions, implementation of BMPs will be required by the regulatory agencies.

Mitigation D-2.2: Depending on the logistics and passenger considerations of the terminal or routes being evaluated, the WTA may opt for the use of low or no-draft vessels in proposed channels where channel bottom sediments are contaminated. Avoidance of dredging would eliminate potential impacts.

Mitigation D-2.3: Whenever dredging is considered, sampling and testing will be required by the permit conditions. Depending on sediment testing results, actual amounts of suitable and unsuitable materials for aquatic disposal could be identified.

Impact After Mitigation: Impact D-2 would be less than significant after implementation of Mitigation Measures D-2.1, D-2.2, and D-2.3

Impact D-3 **There is a low probability that dredging new channels could remove bottom sediments that could result in a salinity intrusion into groundwater basins.**

Maintaining groundwater quality is of concern near ferry terminals or where dredging could impact a groundwater basin's water quality. Groundwater quality can be degraded through the intrusion of saltwater. Saltwater intrusion would reduce the groundwater basin yield, diminishing production from existing activities and limiting future groundwater development. Deep dredging of Bay mud could strip the "cover" from the top of a freshwater reservoir under the Bay, allowing the saltwater to contaminate the fresh water, or allowing fresh water (if artesian) to escape in large quantities, thus causing land to sink. However, the precise location of groundwater reservoirs under the Bay is not yet well known. Dredging Policy 9 of the Amendments to the Bay Plan, found in Chapter 10 of the Final LTMS Management Plan, specifies that "to protect fresh water reservoirs (aquifers): (a) all proposals for the dredging or construction work that could penetrate the mud 'cover' should be reviewed by the San Francisco Bay Regional Water Quality Control Board and the State Department of Water Resources; and (b) dredging or construction work should not be permitted that might reasonably be expected to damage an underground water reservoir Applicants for permission to dredge should provide additional data on groundwater conditions in the area of construction to the extent necessary and reasonable in relation to the proposed project" (USACE 2001).

With the exception of terminals proposed in the San Francisco and Oakland Bay front areas, where groundwater is not used as a fresh water reservoir since it is not considered fit for consumption, other future terminals may be located in the vicinity of aquifers that are subject to protection. Dredging for the purpose of terminal access would not be sufficiently deep to strip the freshwater reservoir cover. Furthermore, in most cases, dredging will be used to rehabilitate former dredged channels. However, following DMMO procedures, the WTA may be required to document aquifer depth and conditions at proposed terminal locations.

Summary of Impact D-3

- Alternatives 1 and 2 could require channel dredging in areas underlain by freshwater aquifers. Dredging would not extend to depths where protective layers may be damaged. The maximum dredging depth would be approximately -7 feet MLLW, which is well above the top elevations of known aquifers (see Section 3.4.1.6 in Water Resources). Groundwater pollution is not expected to occur as a result of dredging. This would be a less-than-significant impact.
- Alternatives 3 and 4 would not require dredging. No impact would occur.

Mitigation D-3.1: As part of the dredging permit application, individual projects would need to be evaluated for potential threats to groundwater basins in accordance to the Bay Plan requirements. Although this is not expected given the shallow ferry channels, the DMMO may determine whether there is a need for localized studies of groundwater basins and sediment layers to support regulatory permits.

Impact After Mitigation: Impact D-3 would be less than significant after implementation of Mitigation D-3.1.

Impact D-4 Dredging activities could adversely impact threatened, endangered, or protected species.

Dredging and the disposal of dredged material temporarily increases turbidity, which could influence bottom-feeding communities at and near dredge and disposal sites, and may affect the behavior and physiology of fish and other organisms. Increased suspended sediment concentrations are an unavoidable consequence of dredging and disposal of dredged material. During dredging, sediments are suspended as the cutting device excavates material from the bottom. Clamshell dredges also release sediments into the water column as the bucket is raised from the bottom, and hopper dredges release suspended sediments during barge dewatering. Regardless of the dredging method, the aquatic disposal of material increases suspended sediment concentrations at the disposal site. Increased turbidity can cause acute and chronic effects in adult fishes. Direct mortality results from impaired oxygen exchange caused by the laceration, irritation, or clogging of the gills. Even at suspended sediment concentrations adjacent to disposal barges or in the water column immediately following disposal, fish would have to be exposed for several hours in order for death to occur, while plumes of highly concentrated suspended solids last only for minutes.

Potential impacts to endangered species will require reviews and concurrence by federal and state agencies.

Summary of Impact D-4

- Alternatives 1 and 2 require dredging that may adversely affect threatened, endangered, or protected species. This could be a potentially significant impact.
- Alternatives 3 and 4 do not require dredging. No impact would occur.

Mitigation D-4.1: Use of dredge types and techniques and implementation of BMPs as described in Mitigation D-2.1 would minimize negative impacts on threatened, endangered, or protected species. Use of BMPs and appropriate dredging techniques for each dredging project will be part of the DMMO recommendation and incorporated as conditions for regulatory approval of the permit application.

Mitigation D-4.2: Depending on the passenger and logistics considerations of the routes and terminals, the WTA may have the option to use low or no-draft vessels in specified shallow areas. As described in Mitigation D-1.1, this option would reduce the need for extensive dredging and minimize turbidity and potential harmful impacts to biota.

Mitigation D-4.3: Individual projects would undergo consultation with the resource agencies. Several mitigation measures have been proposed by previous projects to reduce or avoid impacts to biological resources related to dredging operations. These include: the use of physical barriers such as silt curtains to contain the turbidity plume; selection of dredging equipment to reduce suspended materials; and, if construction sequencing permits, dredging in shallow water would be restricted to a window between June 1 and November 30.

During the preparation of the LTMS EIS/EIR, the LTMS agencies consulted with U.S. Fish and Wildlife Service, National Marine Fisheries Service and the California Department of Fish and Game regarding potential impact of dredging and dredged material disposal to sensitive biological resources. These resource agencies, in conjunction with LTMS agencies, developed a list of restrictions specific for San Francisco Bay to protect critical habitat for special status and important commercial and recreational species. Figure 3.1.5 shows areas and times of restricted dredging activity related to these species. Conformance to seasonal restrictions as conditions of the dredging permit will minimize impacts to biological resources.

Impact After Mitigation: Impact D-4 would be reduced after implementation of Mitigations D-4.1, D-4.2, and D-4.3. Implementation of site-specific mitigation measures at the project level would further reduce Impact D-4 to less than significant levels.

Impact D-5 **Dredging for construction of access channels to new ferry terminals could result in the loss or disturbance of jurisdictional wetlands.**

Dredging of access channels would be conducted under Alternatives 1 and 2. This impact is addressed in Section 3.5 (Biology), Impact B-1.

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Table 5.1.1
Alternative 1 Potential Construction Dredging Requirements

Ferry Terminal Location	Transit Routes Associated with Dredging	Potential Dredge Volume (cubic yards)	% Contribution to Total
Gnoss Field*	Gnoss Field – S.F. Ferry Building	2,945,000*	58.33
Moffett Field	San Francisco Intl. Airport - Moffett Field Moffett Field – S.F. Ferry Building East Bay/San Leandro Marina - Moffett Field	960,940	19.03
San Francisco Intl. Airport	San Francisco Intl. Airport - Moffett Field San Francisco Intl. Airport - Ferry Building	364,400	7.22
Oakland Intl. Airport/Coliseum	Oakland Intl. Airport/Coliseum – S.F. Ferry Building	317,750	6.29
San Rafael	San Rafael – S.F. Ferry Building	85,270	1.69
Foster City	Foster City - S.F. Ferry Building East Bay/San Leandro Marina - Foster City	78,470	1.55
Mission Bay	Mission Bay - S.F. Ferry Building	77,320	1.53
East Palo Alto	East Palo Alto - S.F. Ferry Building East Bay/San Leandro Marina - East Palo Alto	63,240	1.25
Crockett	Crockett - S.F. Ferry Building	51,910	1.03
Hercules/Rodeo	Hercules/Rodeo - S.F. Ferry Building	49,830	0.99
Candlestick Point	Candlestick Point - S.F. Ferry Building	15,040	0.30
Berkeley/Albany	Berkeley/Albany - Treasure Island Berkeley/Albany - S.F. Ferry Building Richmond - Berkeley/Albany Fort Mason - Berkeley/Albany	13,260	0.26
Port Sonoma	Port Sonoma - S.F. Ferry Building	12,130	0.24
Presidio	Presidio - Fort Baker Fort Mason - Presidio - Fort Baker - Sausalito	7,870	0.16
Coyote Point	Coyote Point - S.F. Ferry Building East Bay/San Leandro Marina - Coyote Point	6,200	0.12
	Total Cubic Yards	**5,048,630**	**100.00**

*Ferry access to Gnoss Field Terminal would require dredging of Black John Slough. Bathymetry data within the slough is partially available. Estimate of dredging based on conservative assumption that the average of existing survey soundings (2 MLLW) is uniform thorough the slough. A total length of 2.5 miles would require dredging to access proposed ferry terminal location. Channel width of 300 feet is assumed as for all other terminals

Table 5.1.2
Alternative 2 Potential Construction Dredging Requirements

Ferry Terminal Location	Transit Routes Associated with Dredging	Potential Dredge Volume (cubic yards)	% Contribution to Total
Gnoss Field*	Gnoss Field – S.F. Ferry Building	2,945,000	62.68
Moffett Field	San Francisco Intl. Airport - Moffett Field Moffett Field - Ferry Building East Bay/San Leandro Marina - Moffett Field	960,940	20.45
San Francisco Intl. Airport	San Francisco Intl. Airport - Moffett Field San Francisco Intl. Airport – S.F. Ferry Building	364,400	7.76
Oakland Intl. Airport/Coliseum	Oakland Intl. Airport/Coliseum – S.F. Ferry Building	317,750	6.76
Mission Bay	Mission Bay – S.F. Ferry Building	77,320	1.65
Berkeley/Albany	Berkeley/Albany – Treasure Island Berkeley/Albany – S.F. Ferry Building Fort Mason – Berkeley/Albany	13,260	0.28
Port Sonoma	Port Sonoma – S.F. Ferry Building	12,130	0.26
Presidio	Presidio - Fort Baker Fort Mason – Presidio - Fort Baker - Sausalito	7,870	0.17
	Total Cubic Yards	**4,748,500**	**100.00**

*Ferry access to Gnoss Field Terminal would require dredging of Black John Slough. Bathymetry data within the slough is partially available. Estimate of dredging based on conservative assumption that the average of existing survey soundings (2 MLLW) is uniform thorough the slough. A total length of 2.5 miles would require dredging to access proposed ferry terminal location. Channel width of 300 feet is assumed as for all other terminals

Table 5.1.3
Potential Annual Average Construction Dredging Requirements and Maximum Recurring Maintenance Dredging Associated with Alternatives 1 and 2

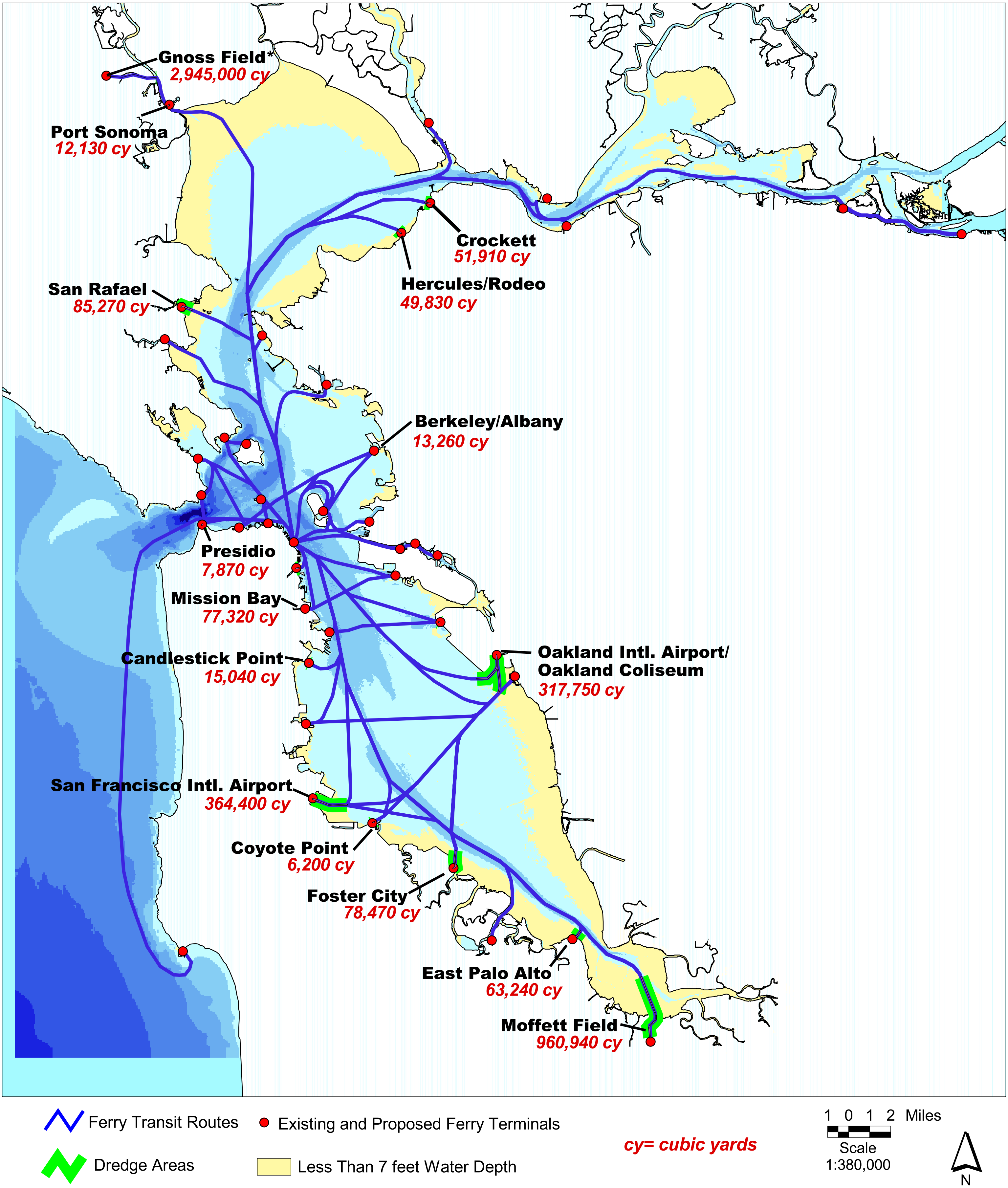
	Total Channel Construction Dredging Requirements (mcy)	3-Year Basis			5-Year Basis			10-year Basis		
		Average Annual Requirements (mcy)	Average % Increase Over Current Annual USACE Projects Volume	% of Projected Long-Term Annual Dredge and Disposal Volume	Average Annual Requirements (mcy)	Average % Increase Over Current Annual USACE Projects Volume	% of Projected Long-Term Annual Dredge and Disposal Volume	Average Annual Requirements (mcy)	Average % Increase Over Current Annual USACE Projects Volume	% of Projected Long-Term Annual Dredge and Disposal Volume
Alternative 1	5.05	1.68	37	28	1.01	22	17	0.50	11	8.5
Alternative 2	4.70	1.57	35	26	0.94	21	15	0.47	10	7.8

Table 5.1.4
Potential Construction and Maximum Recurring Maintenance Dredging Requirements Associated with Alternative 1 with and without Use of Zero-Draft Vessels to Selected Terminals

Ferry Terminal	Total Construction Dredge Volume (cubic yards)	Annual Maintenance Dredge Volume (over 5 years)	Total Construction Dredge Volume Without Major Channels	Annual Maintenance Dredge Volume, Without Major Channels (over 5 years)
Gnoss Field	2,945,000	589,000	0	0
Moffett Field	960,940	192,188	0	0
San Francisco Intl. Airport	364,400	72,880	0	0
Oakland Intl. Airport/Coliseum	317,750	63,550	0	0
San Rafael	85,270	17,054	85,270	17,054
Foster City	78,470	15,694	78,470	15,694
Mission Bay	77,320	15,464	77,320	15,464
East Palo Alto	63,240	12,648	63,240	12,648
Crockett	51,910	10,382	51,910	10,382
Hercules/Rodeo	49,830	9,966	49,830	9,966
Candlestick Point	15,040	3,008	15,040	3,008
Berkeley/Albany	13,260	2,652	13,260	2,652
Port Sonoma	12,130	2,426	12,130	2,426
Presidio	7,870	1,574	7,870	1,574
Coyote Point	6,200	1,240	6,200	1,240
Total	**5,048,630**	**1,009,726**	**460,540**	**92,108**

Table 5.1.5
Potential Construction and Maximum Recurring Maintenance Dredging Requirements Associated with Alternative 2 with and without Use of Zero-Draft Vessels to Selected Terminals

Ferry Terminal	Total Construction Dredge Volume (cubic yards)	Annual Dredge Volume for Maintenance (over 5 Years)	Total Construction Dredge Volume Excluding Zero-Draft Terminals	Annual Maintenance Dredge Volume Excluding Zero-Draft Terminals (over 5 Years)
Gnoss Field	2,945,000	589,000	0	0
Moffett Field	960,940	192,188	0	0
San Francisco Intl. Airport	364,400	72,880	0	0
Oakland Intl. Airport/Coliseum	317,750	63,550	0	0
Mission Bay	77,320	15,464	77,320	15,464
Berkeley/Albany	13,260	2,652	13,260	2,652
Port Sonoma	12,130	2,426	12,130	2,426
Presidio	7,870	1,574	7,870	1,574
Total	**4,698,670**	**939,734**	**110,580**	**22,116**



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Water Transity Authority
Program EIR

Project No. 43-00066890

DREDGING AREAS AND
DREDGING VOLUMES

Figure
5.1.1

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As described in Section 2.1, the WTA completed and circulated a Draft EIR (DEIR) in August 2002 for review and comments. The DEIR evaluated three project alternatives for expanding ferry service in the Bay Area as well as a fourth alternative representing the No Project Alternative. The alternatives were analyzed at the same level of detail in the initial DEIR. Each consisted of a set of ferry transit routes and terminals. Together, the alternatives represent a broad range of investment in water transit service expansion. The initial DEIR did not contain a Proposed Project or Preferred Alternative. The alternatives are described in detail in Section 2.2.2.

The Draft Implementation and Operations Plan (IOP) was also circulated for review, describing expansion of service and the additional new routes. Based partially on the technical information included in the environmental document, the Draft IOP made recommendations for phased implementation. All of the routes and terminals identified in the IOP were included as elements of the various alternatives evaluated in the DEIR.

Partly as a result of public comment and review, the Program DEIR was revised to specifically address the expansion of existing service and the new routes as described in the IOP. This recirculated EIR investigated the potential environmental impacts associated with implementation of the IOP. This Revised DEIR was circulated in April 2003. It addressed only the Proposed Project as described in the IOP. The background and analysis for the Proposed Alternative are presented in Section 3.0.

The following sections present the analysis of three ferry alternatives (Alternatives 1 through 3) and the No Project Alternative (Alternative 4) that were presented in the DEIR, but are not being considered for implementation. While public comments were considered and changes have been made to much of the text in Section 3.0, the analyses presented in this section have not been substantially changed from those presented in the DEIR. These analyses are presented here for completeness.

4.1 GROWTH INDUCEMENT

The San Francisco Bay Area is attractive not only for its geographic setting, but also for its relatively strong and diverse economy. The Association of Bay Area Governments (ABAG) estimates that the population of the nine-county region will increase by 1.4 million people in the next 25 years, from approximately 6.8 million in the year 2000 to 8.2 million in the year 2025. During the same time period, 252,800 acres would be available for development (residential and commercial/industrial), which is about 5.7 percent of the region's total area. This population growth rate is not as dramatic as in the late 1990s and early 2000s (ABAG 2001).

According to the General Plans of the nine counties, seven will experience housing shortages over the next 25 years. Those shortages will range from 5,450 housing units in Alameda County to 26,480 housing units in Santa Clara County in the year 2025. The average number of persons per household is expected to remain at approximately 2.7 for the Bay Area as a whole. The mean household income for the Bay Area is expected to rise from $93,800 in the year 2000 to $116,400 by the year 2025 (ABAG 2001).

The housing crisis in the Bay Area is negatively affecting the regional transportation system because the centers of population growth (i.e., where people are living or moving to) are not located where most employment opportunities are. Between the years 2000 and 2025, the projected increase in jobs will exceed the number of employed residents by approximately 149,000 people (ABAG 2001). This trend is expected to continue because Bay Area cities and counties seek to maximize job production without commensurate emphasis on housing production (ABAG 2001).

Impact GRO-1 **The Proposed Project would expand ferry service at existing terminals and add new ferry terminals primarily at developed waterfront areas. This could be growth inducing for areas near the terminals.**

The Proposed Project includes expansion of service at existing terminal locations and at new sites selected because they have attributes and public support that indicate that ferry service will be successful in terms of ridership and cost effectiveness. All of the new terminal locations, with the exception of Hercules/Rodeo, would serve areas that are already generally developed with maritime or urban uses. The Hercules/Rodeo site is forecast (in their General Plan) for urban uses.

Growth can be considered negative or positive, depending on the objectives of the local government and the community. Local governments have the responsibility to make land use decisions. Potential growth inducement impacts should be considered by planning staffs at the local level to ensure that specific projects do not induce unplanned or unwanted growth. For these reasons, the Proposed Project is not anticipated to have a significant effect on unplanned growth. However, until site specific analyses are performed, this impact remains potentially significant.

Public Services

With the exception of Hercules/Rodeo, all of the ferry terminals in the Proposed Project are in built-up areas. Therefore, the Proposed Project would minimize impacts to open space resources and limit the expansion of the urban environment. However, redevelopment of an urban area can carry its own set of environmental impacts, such as creating a demand for additional public services and infrastructure, causing the displacement of people or businesses, or physically dividing a community or neighborhood. For discussions of community impacts related to the displacement of people or businesses and the division of community, refer to Impacts LU-1 and LU-2 in Section 3.7 (Land Use).

A new ferry terminal or expansion of an existing terminal in an urban area could have an adverse effect on local public services such as police, fire, sewer, and water if the demand is great enough to require the expansion of those services. Likewise, the increase of ferries on the Bay could result in impacts to regional public services provided by the U.S. Coast Guard (USCG) (see Navigation Section 3.2 for a discussion on impacts to USCG operations). Typically, all public services are designed to provide adequate services for the growth planned in the local general plan or management plan. However, the exact size and nature of future planned development is not always known, so the capacity of public services is often determined by the maximum development allowed by the local zoning ordinance. Therefore, although many of the proposed ferry terminal locations are not identified in local planning documents, new terminals may not adversely impact public services.

Each terminal location would have a different set of potential impacts on the existing public services and infrastructure of a city or county, depending on the current capacity of local sewer and water infrastructure and the capabilities of the existing public safety workforce. Therefore, it is important that each potential ferry terminal site be considered in light of the local conditions. This is especially true of ferry terminals that are being considered by local agencies as part of a larger project to provide amenities adjacent to the terminal, such as retail or commercial centers (see Cumulative Growth Inducement Impacts, below, for more discussion on adjacent land uses).

Population/Employment

Implementation of the Proposed Project could increase demand for public services, housing, and other services. Specifically, people may move into the areas due to a perceived increase in the regional quality of life or job opportunities afforded by the proposed increase in ferry services. However, a population increase as a result of either of these would not likely be significant relative to the number of people projected to move to the Bay Area in the next 25 years overall (see Section 3.7.1.1). People moving into communities from outside the Bay Area to improve their quality of life would be attracted by the availability of affordable housing, and the climate, and not just by improved ferry service.

New jobs created by the project would create new employment opportunities in the ferry industry. However, the existing ferry operators are not significant employers in the context of overall Bay Area employment, or even when considered within a single community where a terminal might be located. New positions would include additional ferry operators, and on-board and landside support for operation, passenger assistance, ticketing, maintenance, etc. However, while the actual number of employment positions is unknown, it is reasonable to assume that most if not all of the positions would be filled by people currently residing in the Bay Area. Furthermore, job opportunities that are created as a result of the project would occur incrementally, which would make any inmigration to the Bay Area as a result of increased jobs in the ferry industry insignificant. Therefore, the potential impacts due to creating employment opportunities are anticipated to be less than significant.

Cumulative Growth Inducement Impacts

Cumulative growth inducement impacts would involve the implementation of other projects adjacent to ferry terminals that are not associated with the proposed WTA initiative. Cumulative growth inducement impacts due to unplanned development may occur in communities where ferry terminals are proposed because: (1) terminals function as transportation hubs where transit riders congregate, creating a potential real estate market; or (2) ferry service would increase accessibility to communities.

As a transportation nexus, a ferry terminal attracts people using a variety of transportation modes, including private cars, buses, bicycles, walking, and potentially rail. The placement of a new terminal facility or enhancement of an existing terminal could change the local transportation patterns in a community, resulting in a potentially significant impact. Furthermore, ferry terminals could also become destinations for tourists or Bay Area residents, given their accessibility and locations along the shoreline. This concentration of transit users as well as destination-seekers represents a potential market for real estate development or redevelopment that could result in a potentially significant impact on the existing community.

Changes at the local level as a result of providing new or enhanced ferry service could also occur by making local communities more accessible. The benefits of ferry service may be perceived by many as an improvement to their current quality of life, making these communities attractive for commuters to live in. This effect is primarily of concern at terminal locations in relatively undeveloped or less accessible areas (Hercules/Rodeo). Increased accessibility to the relatively urban and suburban communities that would be served by the Proposed Project is expected to benefit the people currently living there.

As discussed above, it is important that each potential ferry terminal site be considered in light of the local conditions and the potential for additional growth to occur. Without proper planning, cumulative growth associated with the Proposed Project and other currently unplanned development could lead to potentially significant impacts on communities, public services, or open space resources, depending on the location.

Summary of Impact GRO-1

- With the exception of Hercules/Rodeo, all of the ferry terminals in the Proposed Project are in developed areas. The Proposed Project is not expected to result in significant growth inducing impacts. However, until site specific analyses are performed, this impact is considered potentially significant.

Mitigation GRO-1.1: Implement Mitigation LU-1.1.

Impact After Mitigation: Impact GRO-1 would be less than significant after implementation of Mitigation GRO-1.1.

4.2 SIGNIFICANT IRREVERSIBLE CHANGES

Significant irreversible changes are considered to involve the use of nonrenewable resources, which from implementation of the Proposed Project could create an irreversible commitment of resources or do irreversible damage to the environment. These impacts fall within three categories:

- The irretrievable commitment of resources, such as energy and construction materials, expended from the expansion of ferry service;
- The irreversible loss of resources due to a direct or indirect impact; or
- An increase in the use of natural resources due to growth.

4.2.1 Irretrievable Commitment of Resources

Natural resources such as fossil fuel energy would be used for the construction of new or expanded facilities as well as for the operation of an expanded fleet of vessels. This EIR evaluates the use of energy for the Proposed Project, based on the use of diesel fuel. It also identifies and evaluates possible alternative means of minimizing the use of this fuel. However, as noted in Section 3.13 (Energy) the Proposed Project would result in a 0.42 percent increase over the No Project Alternative in energy consumption per passenger mile traveled for all transit modes in the Bay Area. The WTA has investigated the feasibility and application of alternative propulsion systems and fuel that can be considered as ferry transit service is expanded.

Construction of new or expanded facilities would require natural resources such as gravel, sand, asphalt, etc. These materials are generally not retrievable, but they are generally not in limited supply.

4.2.2 Loss of Resources from Direct or Indirect Impacts

The implementation of the Proposed Project may lead to adverse impacts on natural resources. The potential for these impacts is addressed in each of the appropriate sections in this EIR. It is not envisioned that new terminal sites or other facilities that would have substantial impacts to areas such as sensitive habitat, aquatic, or community resources would advance very far in the planning process. Specific projects that go forward for consideration will undergo additional site specific environmental review, and avoidance and/or other mitigation measures will have to be applied.

4.2.3 Increase in the Use of Resources from Growth

The potential for growth inducement was addressed earlier in this section. The implementation of the Proposed Project would affect shifts in commuting patterns, but growth changes are not expected on a regional scale. If growth occurred, it would likely be limited to localized areas around some potential terminals. Although some changes in the regional use of natural resources could take place, they are not expected to be significant.

4.3 CUMULATIVE IMPACTS

CEQA requires analysis of cumulative impacts of the Proposed Project and other projects that are planned and that could produce related cumulative impacts. The Proposed Project is treated as a program, and therefore the impact analyses evaluate the whole of the action. This allows for consideration of cumulative project impacts for each subject area. Cumulative impacts could potentially occur regionally or locally. Local cumulative impacts cannot be evaluated in a program EIR as the analyses are not site specific. Site specific analyses of cumulative impacts (such as site specific traffic impacts, noise, light/glare, etc.) may be required when specific locations and routes are determined.

Regionally, cumulative impacts are included in the analyses for several potential impact areas:

- Section 3.1 describes dredge management for the entire San Francisco Bay area, including existing dredge and disposal activities, current dredging projects, and the LTMS program for dredge management in future years. This includes estimates from the LTMS (USACE 1998) for future baywide (cumulative) dredging volumes. The LTMS program was used as a basis for comparison in the impact assessment, to provide an understanding of the quantity of dredge volumes against the anticipated regional quantities. The WTA Proposed Project would not affect achievement of the LTMS goals.
- The navigation analysis (Section 3.2) includes projected increases in other vessel traffic on the Bay. Cumulative growth in regional vessel traffic was estimated using two extreme scenarios, one low and one high, to which the proposed ferry transits were added. These cumulative scenarios were then used to evaluate the increase in potential ferry interactions between ferries, and between non-ferry vessels.
- The air quality analysis includes projections of Bay Area-wide emissions for cars, busses, and ferries for the pollutants NO_x, PM_{10}, CO, SO_2, and ROG. The total estimated Proposed Project emissions were then compared against the no project alternative, providing an indication of how the cumulative regional pollutant emission "burden" changes with and without the Proposed Project.
- The transportation analysis includes transit forecasts from the Regional Transportation Plan (MTC 2001) and projections from ABAG.
- The energy analysis is based on the same region-wide travel forecasts used for the air quality assessment, and evaluated in terms of energy consumption per passenger mile traveled (PMT) for vehicles and vessels. The total emissions for the Proposed Project were also compared against the No Project Alternative, to show the change in cumulative regional transportation energy consumption with and without the Proposed Project in place.

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3.13 ENERGY

This section discusses energy consumption and addresses the issue of potential for wasteful, inefficient, or unnecessary use of energy from implementation of the Proposed Project.

3.13.1 Environmental Setting

3.13.1.1 National Setting

In the year 2000, transportation activity accounted for 27 percent of the total energy consumed in the US. Between 1990 and 2000, energy use for transportation increased 1.7 percent annually. Petroleum was the source of 96.4 percent of the energy for transportation in 2000. This accounts for the majority of petroleum used in the United States (USDE 2001). In 1999, automobiles accounted for 9,126 trillion British thermal units (Btu)[1], personal trucks accounted for 4,702 trillion Btu, buses 207 trillion Btu, aviation passenger transportation 2,176 trillion Btu, and rail passenger transportation 78 trillion Btu (ORNL 2001). For public transit in 1999, diesel buses accounted for 72.2 percent, diesel commuter rail 8.52 percent, and ferries 3.35 percent of the total fossil fuel (petroleum, gas, and coal) consumed by this transit sector (APTA 2002).

3.13.1.2 California and Bay Area Setting

In California, the vast majority of energy consumed originates from fossil fuel sources. Approximately 60 percent of the state's energy is derived from petroleum, while 27 percent is from natural gas; 10 percent from hydroelectric, geothermal, nuclear, and other sources; and 3 percent from coal. Consumption of petroleum for transportation is the primary use of fossil fuel energy in the state. Of all energy consumed, 48 percent is used for transportation, 31 percent for industrial use, 12 percent for residential use, and 9 percent for commercial use (CEC 1993).

In 1998, the Bay Area accounted for the consumption of 22.98 percent of the state's total gasoline motor fuel (CEC 1999a). Electricity and natural gas are the other two major forms of energy consumed for transportation. Table 3.13.1 presents an estimate of the 2000 transportation energy consumption in California and the Bay Area.

In the Bay Area, as in most other places in the United States, automobiles and commercial vehicles (composed of small, medium, and large trucks) are the largest energy consumers in the transportation sector. Automobiles and commercial vehicles are generally fueled by diesel or gasoline. Other transit modes in the Bay Area include ferries, buses, light rail (San Francisco MUNI and SCVTA rail cars), BART, and commuter rail (Caltrain, Amtrak, and ACE). These transit modes consume gasoline, diesel, and electricity.

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[1] A common unit of energy used when discussing transportation energy is the British thermal unit (Btu). This is the unit of energy used in this report. A Btu is the quantity of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit at sea level. Other common units of energy are kilowatt-hours (kWh), therms, and gallons.

Energy Used By Ferries

Energy consumption by ferries in the Bay Area varies, because several different ferry vessel models are used. For example, three different types of ferries run the existing route between San Francisco and Larkspur:

- One monohull, built in 1976, with a capacity for 725 passengers, powered by two 1216 kilowatt (kW) engines;
- A catamaran, built in 1998, with a 325-passenger capacity, powered by four 1194 kW engines; and
- A catamaran, built in 2001, with a 408-passenger capacity, powered by four 1193 kW engines (JJMA 2002).

The two catamarans perform a one-way crossing in 30 minutes, and the monohull does the same crossing in 45 to 50 minutes (GGF 2002). In terms of energy consumption (energy per run and energy per passenger miles traveled [PMT])[2], the two newer catamarans require more energy for a single run than the older monohull vessel, assuming the vessels are running under full passenger capacity. Table 3.13.2 lists the energy consumption for these three ferry vessels.

In terms of ferry usage in the Bay Area, it is evident that the trend in the past 25 years is for the ferries to achieve greater speeds and passenger service. For example, ferry service between Larkspur and San Francisco is now 33-40 percent faster than with the older monohull design. However, as shown in Table 3.13.2, the increase in speed is at a cost of greater energy use.

3.13.1.3 Regulatory Setting

Regulations for transportation energy consumption are generally directed toward fuel efficiency of motor vehicles. The federal Energy Policy and Conservation Act of 1992 established fuel economy standards for on-road vehicles in the United States. This law places responsibility to the National Highway Traffic and Safety Administration (a part of the U.S. Department of Transportation) for establishing vehicle standards and for revising existing standards. The U.S. Environmental Protection Agency (USEPA) administrates the Corporate Average Fuel Economy (CAFE) program, which determines vehicle manufacturers' compliance with existing fuel economy standards. The "California Greenhouse Bill" (AB 1493) signed into law in July 2002 is intended to reduce production of "greenhouse gases," and its implementation may also result in use of more energy-efficient vehicles. There are no federal or state requirements for energy efficiency of vessels.

The California Environmental Quality Act (CEQA) requires that a discussion of the potential energy impacts of a proposed project be addressed, with particular emphasis on avoiding or reducing inefficient, wasteful, and unnecessary consumption of energy.

[2] When discussing energy consumption by mass transit, it is appropriate to analyze energy expenditures by the proportion of energy consumed and the estimated number of passengers traveling by a specific form of transit. Though mass transit vehicles use more energy per mile traveled than many automobiles, energy consumption often may be less when considering the average energy consumed per passenger mile traveled (PMT). For example, in the U.S. in 1999, personal automobiles used 5,815 Btu/VMT and averaged 3,635 Btu/PMT, while the transit rail system used 69,746 Btu/VMT and averaged 3,075 Btu/PMT (ORNL 2001) Therefore, nationally, rail systems were more energy efficient than personal automobiles when factoring in energy consumed per passenger PMT.

3.13.2 Impacts and Mitigation

3.13.2.1 Significance Criteria

According to Appendix F of the CEQA Guidelines, environmental impacts may include "the project's projected transportation energy use requirements and its overall use of efficient transportation alternative". For the purposes of this analysis, an impact would be considered significant if the Proposed Project would result in:

- A substantial increase in overall energy consumption per passenger miles traveled; or
- A wasteful, inefficient, or unnecessary consumption of energy.

3.13.2.2 Method of Analysis

This energy analysis addresses the changes in energy consumption in the transportation sector in the nine-county Bay Area for the year 2025 between the Proposed Project and the No Project Alternative. Forecasted energy consumption per passenger mile traveled (PMT)[3] was calculated for automobiles, trucks, public buses, transit rail vehicles, and ferries. Ferry energy consumption was calculated using the projected schedule of routes, types of ferries to be used, and passenger volumes. Energy calculations for all other transportation modes were calculated using vehicle miles traveled (VMT) and passenger volume forecasts based on the transportation modeling performed for this project (Cambridge Systematics 2002; Outwater 2002).

For this analysis, consumption of energy by ferry vessels was estimated based on engine power output. Engine power output is generally referred to in kilowatts (kW). Power is converted to energy, in the unit of kilowatt-hours (kW-hrs), by applying a factor of engine running time. The energy unit of kW-hrs can directly be converted to a British thermal unit (Btu)[4] value.

For the No Project Alternative, average power outputs were assumed for each route, based on the current ferries in use on these routes[5]. Characteristics of the current ferries are available in the working document, *New Technologies and Alternative Fuels*, prepared for the WTA by JJMA (JJMA 2002). For the Proposed Project, two ferry fleets were assumed, which is consistent with the Implementation and Operation Plan (IOP). One fleet would consist of 350-passenger ferries with a maximum power output of 8,000 horsepower (5,966 kW). The other fleet would have 149-passenger ferries with a maximum power output of 2,900 horsepower 2,163 kW (Hutchison 2002). Daily energy consumption per PMT was calculated by dividing the average daily energy

[3] When discussing energy consumption by mass transit, it is appropriate to analyze energy expenditures by the proportion of energy consumed and the estimated number of passengers traveling by a specific form of transit. Though mass transit vehicles use more energy per mile traveled than many automobiles, energy consumption often may be less when considering the average energy consumed per passenger mile traveled (PMT). For example, in the U.S. in 1999, personal automobiles used 5,815 Btu/VMT and averaged 3,635 Btu/PMT, while the transit rail system used 69,746 Btu/VMT and averaged 3,075 Btu/PMT (ORNL 2001) Therefore, nationally, rail systems were more energy-efficient than personal automobiles when factoring in energy consumed per passenger PMT.

[4] A common unit of energy used when discussing transportation energy is the British thermal unit (Btu). A Btu is the quantity of heat required to raise the temperature of 1 pound of water 1 degree Fahrenheit at sea level. Other common units of energy are kilowatt-hours (kWh), therms, and gallons.

[5] For the Larkspur ferry route, only the newer catamaran vessels used on this route were assumed to be used for the No Project Alternative. The monohull boats used on this route were constructed in the 1970s and will be taken out of commission by 2025.

consumption by the average daily PMT.

3.13.2.3 Impacts and Mitigation

The following section addresses energy consumption for all transit modes in the Bay Area for the Proposed Project and the No Project Alternative.

Impact E-1 **The Proposed Project could result in more transportation-related energy consumed.**

Compared to the No Project Alternative, the Proposed Project would result in an increase in total daily energy consumption and energy consumption per PMT for all transit modes in the Bay Area. This increase is summarized below.

Alternative	Total Energy Consumption all Transit Modes (Btu)	Percent Increase in Energy Over No Project Alternative	Energy/PMT (Btu/PMT)	Percent Increase in Energy/PMT over No Project Alternative
Proposed Project	1,205,158,328,459	0.09	4,360	0.41
No Project Alternative	1,204,064,104,267	NA	4,342	NA

Automobile usage primarily determines the totals for energy consumption and energy consumption per PMT values. For the two analyzed alternatives, automobiles are predicted to use approximately 92 percent of the total energy consumed by the transportation sector in 2025, and 75 percent of the total PMT. Ferries would consume between 0.22 percent and 0.05 percent of the total energy consumed by the transportation sector and between 0.15 percent and 0.09 percent of the total PMT for the Proposed Project and the No Project Alternative, respectively. Although there is an increase in energy use, it is not a substantial increase regionally, as shown above.

Additional passengers using the planned service routes can increase passenger miles traveled without requiring additional vessels, which would increase the passenger mile traveled measure of efficiency discussed in this impact. As routes and service are implemented, project proponents will make adjustments in service that will have the effect of improving the efficiency of the system, both from energy consumption and cost effectiveness criteria.

Summary of Impact E-1

The Proposed Project would result in a 0.41 percent increase over the No Project Alternative in energy consumption per passenger mile traveled for all transit modes in the Bay Area. This would be a less than significant impact.

Impact E-2 **The Proposed Project could result in higher energy per passenger miles traveled value than other transit modes.**

The design and purpose of the Proposed Project is to have ferry service in the Bay Area increase and improve transportation mobility, service, and choice; provide a service to regional commuters; and provide an additional mode of regional transit in the Bay Area. As discussed in other sections of this document, the Proposed Project would achieve these goals. In terms of energy consumption, ferries, under the Proposed Project, would have higher energy consumption compared to the other modes of mass transit in the Bay Area, as shown in Table 3.13.3. Part of this higher value of energy consumption is due to the energy efficiency for each mode of transit, passenger capacity of the individual transit vehicles, and the service area of the transit vehicles.

Summary of Impact E-2

- The Proposed Project would result in a higher energy per passenger miles traveled value than other transit modes. This higher energy consumption ratio occurs as a result of the WTA meeting its design and purpose as an effective transportation alternative in terms of service and routes. The difference in energy consumption per passenger mile traveled between ferries and automobiles is greater for ferries but not significantly different (Table 3.13.3). The difference between ferries and other modes is more substantial, and therefore this impact is considered potentially significant.

Mitigation E-2.1: The WTA is planning to continue investigating the feasibility and applicability of using energy sources other than fossil fuels and different engine technologies. One promising technology is the use of fuel cells. The WTA has investigated the use of alternative fuels for ferries in: *New Technologies and Alternative Fuels Working Document* (JJMA 2002). Alternative energy sources and engine technologies will become available and will be incorporated as they become feasible and cost-effective.

Impact After Mitigation: This impact could be less than significant with implementation of Mitigation E-2.1. However, the effectiveness of the mitigations cannot be quantified at this time. Therefore, this impact remains potentially significant.

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Table 3.13.1

Transportation Energy Use in California and the Bay Area (2000)

Fuel Type	Units	State	Bay Area	Bay Area % of Statewide Demand
Gasoline/ Diesel	Million gallons	14,378	3,159	22%
Electricity	Million kW-hr	505	416	82%
Natural Gas	Million therms	34	5	15%

Source: Caltrans 2000; CEC 1999b; MTC 2001.

Table 3.13.2

Comparison of Energy Usages of Three Ferries Currently in Use on San Francisco Bay

Boat	Time for Run (minutes)	Energy per Run (Btu/run)	Passenger Miles Traveled per Run (miles)	Energy/PMT (Btu/PMT)
1976 Monohull	45-50	$6.225x10^6$ $6.918x10^6$	9207.5	676.1-751.4
1998 Catamaran	30	$8.150x10^6$	4127.5	1975
2001 Catamaran	30	$8.143x10^6$	5181.6	1572

Source: JJMA 2002
Note*:* Assumes ferries are running under maximum capacity

Table 3.13.3
Comparison of Passenger Data for Mass Transit Modes

	Transit Mode	Passengers/Run	Energy/PMT (Btu/PMT)	Total PMT
Proposed Project	Automobile	1.17	5,321	207,919,595
	Buses	56	660	18,083,990
	Light Rail	110	91	2,125,739
	BART	1,056	68	33,151,135
	Commuter Rail	971	102	8,263,795
	Ferries	67	6,297	415,612

Sources: JJMA 2002; Outwater 2002; Cambridge Systematics 2002

3.12 TRANSPORTATION

This section provides an overview of transportation in the Bay Area and its importance from environmental and regional planning perspectives. Existing transportation modes and primary routes and corridors crossing and accessing key Bay Area destinations are described. Current and future challenges for regional transportation are also discussed.

Bay Area traffic conditions will change over time. Both the Metropolitan Transportation Commission (MTC) and Association of Bay Area Governments (ABAG) develop and share projections and planning information for forecasted growth and transportation conditions in the region. For this report, existing traffic refers to conditions at the present time. "Projected traffic" is the anticipated traffic conditions which is projected to exist at the time of project buildout (2025) without the WTA ferry expansion program (i.e., the 2025 No Project Alternative). These conditions are described to provide the basis for comparison to changes with the ferry expansion alternatives, discussed in Section 3.12.2.

3.12.1 Environmental Setting

3.12.1.1 Transportation Within the San Francisco Bay Area

Transportation is vital to the nine-county Bay Area and its economy. Work commutes, shipping and distribution, and routine daily tasks rely on a dependable and safe transportation system. The region is also a global gateway for international trade. The Port of Oakland, one of the busiest on the West Coast, and the three international airports in the area serve as hubs for commerce and transportation. The Bay Area also includes dense urban cores with suburban and rural peripheries. It is connected to the rest of the region through a system of federal and state highways, while a network of local major and arterial roads provide internal circulation. In addition to surface roads and freeways, the region is served by an extensive transit network including rail and ferry systems. Bay Area residents make about 21 million person trips per day. Bay Area-wide, 82.2 percent of those trips are completed by car, 6.2 percent by public transit, 1.3 percent by bike, and 10.3 percent on foot (MTC 2001).

Road System

Bay Area residents depend on automobiles for the majority of their local and regional transportation needs. The Bay Area has 19,600 miles of local streets and roads. The region is served by numerous interstate and U.S. freeways. On the west side of San Francisco Bay, I-280 and U.S. 101 run north-south. U.S. 101 continues north of San Francisco into Marin County. I-880 and I-680 run north-south on the east side of the Bay. I-80 starts in San Francisco, crosses the Bay Bridge, and runs northeast toward Sacramento. SR 92 and SR 84, both highways that allow at-grade crossings, in certain parts of the region become freeways that run east-west and cross the Bay. I-580 starts in San Rafael, crosses the Richmond-San Rafael Bridge, joins with I-80, runs through Oakland, and then runs eastward toward Livermore.

The California Department of Transportation (Caltrans) is responsible for the design, construction, and maintenance of the California State Highway System, in addition to the portion of interstate highways within California's boundaries. The U.S. Department of Transportation Federal Highway Administration (FHWA) provides oversight of projects involving federal highways or projects that are funded through the Department of Transportation. The MTC is the nine-county transportation planning and coordinating agency for the region. Local government, (such as county or city public works departments) and regional transportation planning agencies are responsible for the design, construction, and maintenance of county and local roads.

Mass Transit

Public transportation is managed by private, public, and quasi-governmental agencies at the local, county, or regional level. Bay Area transit system components include buses, rail systems (including light rail, rapid rail, and commuter rail), and ferries. Historically, the Bay Area's transit systems have developed independently of one another, which has resulted in geographic gaps in service and limited direct connections between different transit modes.

MTC encourages the integration of expansion of existing systems in the Bay Area Regional Transportation Plan (RTP). Figure 3.12.1 shows the different transit systems in the region. Table 3.12.1 lists transit systems by county. Appendix Tran-A describes those systems. Ferries are part of this Bay Area transit system. Existing ferry service is summarized in Table 3.12.2.

The existing and forecast future transit supply of each transit component is presented in Table 3.12.3. Transit supply can be expressed in terms of passenger-seat miles per hour. Based on that measure, the ferries currently carry the least number of passengers when compared to other transit modes. The 2025 forecast increases in transit supply take into account planned expansions in bus, BART, light rail and train service. While increases in ferry patronage are expected, they will likely be outpaced by supply increases in other transit, and the proportion of ferry supply from the total transit supply will drop without enhancements in ferry service.

Transportation Challenges in the Bay Area

Almost 7 million people live in the Bay Area's nine counties and 101 cities. According to ABAG, this number is projected to grow to 8 million by 2020. Imbalances in area employment and available affordable housing have resulted in mounting traffic congestion. Reliance on the automobile is illustrated by the vehicle ownership statistics. In the 1940s growth in vehicle ownership began to outpace the growth in the number of households. According to ABAG's figures, in 1980 there were approximately 1.5 vehicles per household. By 2010, the ratio is projected to reach approximately 2 cars per household, with almost 6 million vehicles in the nine-county region (Figure 3.12.2). The number of people driving alone to work every day grew by 35 percent, from 1.6 million to 2.1 million, between 1980 and 1990. With the growth in the number of cars, there has been a growth in highway congestion.

Current Highway Bottlenecks

Traffic performance of the freeway system within the nine counties of the San Francisco Bay Area has been the subject of study by the Caltrans District 4 Office of Highway Operations. The Highway Congestion Monitoring Program (HICOMP) was established to compile data on locations and magnitude of recurrent traffic congestion. With the exception of 1985 and 1997, HICOMP reports were issued by Caltrans from 1981 until 2001, when funding was discontinued.

Congestion is measured as Level of Service (LOS), which reflects the ease with which one can drive on a roadway. There are six LOS gradations, from A to F. LOS A represents free flow, unimpeded travel (at maximum posted speed). LOS F represents bumper-to-bumper or very congested conditions. Congestion becomes a problem when it affects the capacity for movement. Congestion on Bay Area freeways has been increasing steadily. The 1988 HICOMP reported 58,600 vehicle-hours of delay (the combined amount of time cars and trucks spend idling on freeways), costing commuters an estimated $548,000 daily in lost productivity. By 1998 Bay Area commuters were spending an estimated 112,000 vehicle-hours in congestion, costing approximately $1,249,000 per day. All counties in the region experienced an increase in congestion, with the greatest increases occurring in Alameda and Santa Clara Counties. The 1998 HICOMP reported congestion regularly occurring at 145 different freeway locations each day, affecting 327 directional miles of freeway (a one-mile length of freeway has two directional miles, irrespective of the number of lanes.)

One of the more apparent effects of increased congestion is the expanded duration of commute periods. In many locations, peak commute periods now last up to 5 hours. Commutes have stretched both in time and distance as people move farther from their workplaces. In Alameda County, for example, the average commute time has increased from 17 minutes in 1993 to 35 minutes in 2000. During that same period, according to the Alameda County Congestion Management Agency (ACCMA), the average one-way commute length increased from 15.3 to 17.1 miles (ACCMA 2001). Congestion occurs at distinct locations in the freeway system, depending on commute patterns and the ability of the system to accommodate traffic flow. Table 3.12.4 shows the main Bay Area bottlenecks, by county, recorded by the 1998 HICOMP. Noted on Table 3.12.4 are those congested areas associated with Bay Area bridges. Figure 3.12.3 illustrates congested and heavily congested highway locations.

Bay Area Crossings

Some of the Bay Area's most congested corridors are associated with the three principal transbay crossings: Oakland-San Francisco, San Mateo-Hayward, and the Dumbarton Bridge corridor. Of these three corridors, only the Oakland-San Francisco crossing is currently served by ferries. These corridors are currently filled to capacity much of the time and, according to MTC projections, transbay travel is expected to increase 40 percent by 2025. To address the situation, MTC launched the San Francisco Bay Crossings Study in 2000 to update a 1991 study (http://www.mtc.ca.gov/projects/bay_crossing/bay_crossing.htm). The Crossings Study is attempting to answer questions regarding more efficient use of existing corridors, as well as the need for construction of new transbay bridge or tunnel crossings. One of the study's first activities consisted of the preparation of a forecast of travel patterns, traffic volumes, and trip times for the year 2025 if no major improvements are made in the three principal transbay corridors. This forecast is known as the 2025 baseline. The first phase of the study included identification of the possible range of improvements in each transbay corridor, including:

- Carpool facilities and other operational improvements on existing highway bridges;
- New highway, BART, commuter rail, or multimodal crossings;
- Express bus services;
- BART services; and
- Water-based transportation services.

While the Bay Crossings Study is not focusing on expanded ferry service, the San Francisco Bay Area Water Transit Authority (WTA) is studying several alternatives, which are the subject of this program EIR, to improve mobility for transbay travelers.

Screenlines

A useful tool to consider traffic conditions in the Bay Area is a "screenline" analysis. Screenlines are representative geographic lines that provide a measurement point of people making trips either by public transit or private car. Cambridge Systematics analyzed daily person trips made across screenlines that correspond to important bottlenecks in the Bay Area, as shown in Table 3.12.5.

The Cambridge Systematics screenline analysis indicates that public transit accounted for 215,458 person trips across Bay Area screenlines in 1998 (i.e., 13.5 percent of the baseline year total). Ferry trips accounted for 5.5 percent of person trips by transit and 0.7 percent of the total person trips across the screenlines considered. By the year 2025, without any expansion or enhancement of the ferry service, the number of public transit person trips across screenlines would almost double, according to the modeling, reaching 402,905 or 20 percent of that year's total. Ferry transit is also expected to increase and will make up 5.7 percent of transit person trips and 1.1 percent of the total person trips in 2025 across the screenlines.

Bay Area Vehicle Trips

Although most instances of congestion are related to work commutes, fewer than one in three automobile trips made by Bay Area residents are to work. The vast majority of daily trips are less than 5 miles. According to ABAG, "they are trips to the grocery store, gym, daycare center, or a child's soccer practice" (ABAG 2002). Table 3.12.6 shows the number of Bay Area trips by purpose. Commuter trips, approximately 3.7 million in 1998, were outnumbered by trips in the other categories. Table 3.12.6 also indicates that 98 percent of the private vehicle trips in the Bay Area are made by automobile and the remaining 2 percent by truck. The total number of trips made during the 1998 baseline year was 12.6 million. While the number of trips is expected to increase by 33 percent in 2025, the proportion of trips made by car and truck will remain the same.

Table 3.12.7 shows the number of vehicle miles traveled (VMT) by vehicle type in the nine-county area during the 1998 baseline year. Santa Clara and Alameda are the two counties with the greatest traffic volumes.

3.12.2 Impacts and Mitigation

3.12.2.1 Significance Criteria

According to CEQA guidelines, a project would have a significant impact if it would cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system. This assessment was performed at a regional level and impacts are identified in terms of their potential to substantially change traffic volumes; hence a specific numerical criterion was not applied.

3.12.2.2 Impacts and Mitigation

The proposed enhancement of the ferry system would expand transportation options for Bay Area commuters. In general, this may result in lower use of the automobile and non-ferry transit as commuters shift to ferries. Table 3.12.8 shows VMT for year 2025, without any expansion of ferry service (No Project Alternative) and for the Proposed Project and compares them to the 1998 data. As shown in Table 3.12.8, the total regional VMT for the No Project Alternative will increase by 33.7 percent over the baseline, while the total regional VMT for the Proposed Project would increase by 33.6%. All nine counties will experience traffic increases, with the highest relative percent changes in the North Bay counties. Notably, Solano County will experience a 75 percent increase over baseline conditions. The largest reductions in VMT occur in counties where ferries are competing with congested highway facilities, such as San Francisco, San Mateo, and Marin. However, an increase in drivers accessing transit is expected due to increases in VMT in the vicinity of terminals to ferry ridership at new terminals (as discussed in Impact T-1). The Proposed Project would have a total regional VMT of 0.07% less than the No Project Alternative. While the overall percentage reduction may seem small, it may reduce peak hour volumes on the Bay Bridge by almost a lane's worth of traffic.

Table 3.12.9 shows the effect of the Proposed Project on vehicle trips by purpose and vehicle type. As expected, only auto trips would be affected because they are the transportation mode most affected by commute improvements. Truck trips would remain constant for 2025. Among the auto trips, the addition of ferry routes and vessels would mostly affect trips to work and recreation, where ferry travel presents a real option for Bay Area residents. However, as Table 3.12.9 indicates, the percentage change in total vehicle trips from the Proposed Project to the No Project Alternative is minimal.

Table 3.12.10 shows total ridership in non-ferry transit for the No Project Alternative and the Proposed Project. As shown, the modeling for the Proposed Project predicts small decreases in ridership for busses (0.6%), light rail (0.3%), and BART (0.5%), and 2.0% increase in ridership for commuter rail. It is important to note, however, that this modeling result is similar to the modeling results from other transit expansion. For example, the WTA's ridership model showed that expansion of express buses or BART also forecast shifts from one mode to another. It is important to note that the MTC regional model does not use capacity constraints for transit systems. This likely causes an overestimation of shifts from BART to ferries. In addition, it is unclear whether the capacity constraints are in BART terminal access or in the trains themselves. BART has indicated that capacity of the trains could be expanded by eliminating seats and shifting to 3-door cars. It is also not clear how increased crowding would affect BART ridership. Based on these uncertainties, it is expected that there would be little effect on BART revenues from ferry expansion.

The Proposed Project would result in a reduction in automobile trips across the Bay Area bridge screenlines, as shown in Table 3.12.11. The Bay Area screenlines would experience a 0.7 percent reduction in automobiles. The Bay Bridge and Golden Gate Bridge corridors would experience more than 1 percent reductions in automobile trips.

Impact T-1 **At the regional level, expansion of the ferry service would result in a decrease of the total automobile VMT. At the local level, expansion of the ferry service could facilitate changes in traffic patterns at new and existing ferry terminals. This could potentially result in localized increases in traffic in the vicinity of the terminals.**

As shown in Table 3.12.8, the Proposed Project would result in a 0.07 percent reduction in automobile VMT for the nine-county Bay Area. Reductions in automobile VMT would occur in all counties.

Due to the increase in ferry riders of 13,736 under the Proposed Project, the expanded ferry service would facilitate an increase in access to terminals by riders. As shown in Table 3.12.12, of the 36,974 daily riders under the Proposed Project, 65 percent would access the terminals by car, 15 percent by bus or rail, and 20 percent on foot. With a 65 percent total access to terminals by car and a 13,736 increase in total daily riders, 8,928 new riders could be accessing ferry terminals in automobiles. There could also be an increase in bus access to ferry terminals. The increase in riders accessing the ferry terminals in cars could alter traffic circulation patterns in localized areas near the ferry terminals. In locations where terminals would only exist under the Proposed Project, traffic could be expected to increase. Localized traffic could likely increase and decrease, depending on the location, between the Proposed Project and the No Project Alternative at existing terminal locations due to shifts in local traffic movements related to the implementation of the Proposed Project.

Therefore, there is a potential that traffic impacts could be significant on a site specific level, where access and circulation are not adequate to accommodate riders attracted to the terminal and system

Summary of Impact T-1

- The Proposed Project would result in an overall decrease in regional auto VMT. At a more localized level, the Proposed Project could result in increased car and bus traffic to and from existing ferry terminals, depending on local access and traffic conditions. This impact could be potentially significant on a site specific level.

Mitigation T-1.1: Once terminal locations are narrowed down, site specific traffic analyses shall be conducted to compare predicted traffic with applicable local LOS standards. Traffic mitigation measures would depend on site specific conditions, including design of vehicular access to terminals, major access routes, parking availability, and traffic patterns. For example, impacts that were predicted to occur at intersections could be mitigated by addition of turning lanes. For some cases, where access is problematic or presents serious community concerns, the viability of the terminal location would need to be further evaluated.

Impact After Mitigation: Impacts after mitigation must be determined on a case-by-case basis after mitigation measures are considered. Impact T-1 could be potentially significant.

Impact T-2 **Additional automobiles accessing existing and new ferry terminals would require parking. This could result in potential localized parking problems and conflicts in the vicinity of the terminals.**

Ridership increases would result from new and expanded ferry service. It is expected that more commuters would drive their cars to access ferry terminals. As discussed in Impact T-1, up to 65 percent of the ferry riders, under the Proposed Project, are expected to drive to the terminals. While some of the additional cars may be accommodated in terminal parking structures, it is the intention of WTA to limit parking in an effort to encourage transit use to access existing and new terminals. The demand for parking as a percentage of available parking is listed in Table 3.12.13. Approximately 40 percent of the ferry terminals under the Proposed Project could have parking demands exceeding parking availability. In some locations, due to lack of sufficient space or desire to avoid paying parking fees, commuters would choose to park offsite, along local streets in the vicinity of the ferry terminals. This can lead to enforcement of restrictions on local street parking, which can inconvenience local residents and businesses. It is important to note, however, that the potential parking at each site was estimated based on limited knowledge of the potential sites. Actual parking would be based on the demand and site specific constraints. Actual parking would likely vary from the estimates of available parking included in Table 3.12.13.

Summary of Impact T-2

- Implementation of the Proposed Project would result in increased car traffic to and from new ferry terminals and lead to an increased demand for parking. Parking demand would exceed parking availability at some locations. The project proponent(s) should seek to encourage and increase transit access to terminals. The impact would be localized and site specific. Its significance cannot be determined at the program level. Therefore this is a potentially significant impact.

Mitigation T-2.1: The project proponent(s) and ferry terminal authorities, in conjunction with local and regional transit agencies, shall study and develop terminal-specific plans to ensure that potential driving ferry patrons can be adequately served by transit in locations with limited parking and currently insufficient transit access.

Mitigation T-2.2: Non-drive access could be encouraged through measures such as charging fees for parking, provision of preferential parking for carpools and vanpools, comprehensive shuttle access, land use scenarios that encourage non-drive access, and encouraging bicycle and pedestrian access.

Impact After Mitigation: Traffic access and parking impacts can often be mitigated through design or operational improvements. Mitigation improvements would be defined with each proposed new terminal or terminal improvement. This is a potentially significant impact.

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Table 3.12.1
Bay Area Regional and County Transit Systems

	Local Service	Connecting Service
Regional	Alameda/Oakland Ferry Service BART Blue & Gold Fleet Caltrain Dumbarton Express Golden Gate Ferry Harbor Bay Ferry Red and White Fleet Vallejo Baylink Ferry	
Alameda	AC Transit Air-BART BART Broadway Shuttle CSUH Hill Hopper Emery Go-Round UC Berkeley Campus Shuttle Union City Transit WHEELS (LAVTA) West Berkeley Shuttle	Alameda/Oakland Ferry Service Altamont Commuter Express County Connection Dumbarton Express Harbor Bay Ferry Modesto MAX SamTrans San Joaquin Regional Transit (SMART) Santa Clara VTA
Contra Costa	AC Transit BART Brentwood Dimes-A-Ride County Connection Tri Delta Transit WestCAT	Benicia Transit Fairfield-Suisun Transit Golden Gate Transit
Marin	Angel Island - Tiburon Ferry Golden Gate Transit	Blue & Gold Fleet Golden Gate Ferry
Napa	American Canyon Transit Calistoga Handy Van Napa Downtown Trolley Napa Valley Commute Club St. Helena VINE VINE VINE Go Yountville Shuttle	Lake Transit
San Francisco	BART Caltrain San Francisco Muni	AC Transit Alameda/Oakland Ferry Service Blue & Gold Fleet Golden Gate Ferry Golden Gate Transit Harbor Bay Ferry Napa Valley Commute Club SamTrans Vallejo Baylink Ferry
San Mateo	BART BART Employer Shuttles Burlingame Free Bee Shuttle Caltrain Caltrain Shuttles Foster City Sunshine Shuttle Menlo Park Midday Shuttle SamTrans	Dumbarton Express San Francisco Muni Santa Clara VTA

Table 3.12.1 - Continued
Bay Area Regional and County Transit Systems

Santa Clara	Caltrain Caltrain Shuttles Palo Alto Shuttle Santa Clara BEE Santa Clara VTA Stanford Marguerite Shuttle VTA Light Rail Shuttles	AC Transit Altamont Commuter Express Menlo Park Midday Shuttle SamTrans San Benito County Transit San Joaquin Regional Transit (SMART)
Solano	Benicia Transit Fairfield-Suisun Transit Rio Vista Transit Vacaville City Coach Vallejo Transit	Vallejo Baylink Ferry
Sonoma	Cloverdale Transit Healdsburg In-City Transit Petaluma Transit Santa Rosa CityBus Sonoma County Transit	Golden Gate Transit Mendocino Transit
Outside the Bay Area	Altamont Commuter Express Amtrak California / Capitol Corridor Greyhound Lake Transit Mendocino Transit Modesto MAX Monterey/Salinas Transit Sacramento Regional Transit (RT) San Benito County Transit San Joaquin Regional Transit (SMART) Santa Cruz Metro Unitrans (Davis) Yolobus	

Source: www.transitinfo.org/county.html

Table 3.12.2
Existing Ferry Service

Corridor	Route	Operator	Number of Vessels	Annual Patronage
Transbay	Vallejo –S.F. Ferry Bldg.	Blue and Gold	2	736,000
	Oakland-Alameda-S.F. Ferry Bldg.	Blue and Gold	2	496,000
	Harbor Bay- S.F. Ferry Bldg.	Harbor Bay Maritime	1	114,000
Golden Gate	Sausalito - San Francisco	GGBH&TD*	1	454,000
	Tiburon - San Francisco	Blue and Gold	1	125,000
	Larkspur – San Francisco	GGBH&TD	4	1,400,000
Sub-Total Commuter Ferry				3,325,000
GGNRA Service	Alcatraz	Blue and Gold	1	2,720,000
TOTAL			12	6,045,000

(*) Golden Gate Bridge Highway and Transportation Department
Source: WTA

Table 3.12.3
Transit Supply for 1998 and 2025 During Morning Peak Hours

Mode	1998 passenger-seat miles per hour	Percentage of 1998 total	2025 passenger-seat miles per hour[a]	Percentage of 2025 total	Percentage increase between 1998 and 2025
Bus	1,365,270	43.53	1,470,102	36.95	7.68
Light rail	143,011	4.56	268,134	6.74	87.49
BART	1,058,138	33.74	1,452,045	36.50	37.23
Train	473,046	15.08	672,602	16.90	42.19
Ferry	96,720	3.08	115,860	2.91	19.79
Total	3,136,185	100.00	3,978,743	100.00	26.87

Source: MTC 2001
[a] 2025 data is the forecasted data under the No Project Alternative, i.e. the forecasted 2025 passenger seat miles per hour data if the project were to not occur.

Table 3.12.4
Highway Congestion Locations in the Bay Area

County	Congestion Location
Alameda	• Southbound Route 680 over the Sunol Grade • Westbound Route 92 over the San Mateo Bridge * • Route 84 over the Dumbarton Bridge * • Westbound Route 80 approaching the Bay Bridge Toll Plaza (morning)* • Eastbound Route 80 (afternoon) • Northbound Route 880 approaching the Bay Bridge toll plaza.*
Contra Costa	• Route 4 in Pittsburg (morning and afternoon commutes) • Route 680 in Concord/Walnut Creek (morning)
Marin	• Southbound Route 101 from Novato to central San Rafael (morning peak) • Westbound Route 580 approaching Route 101 (evening)
Napa	• There is no significant freeway congestion in this county.
San Francisco	• Route 101 in the vicinity of Hospital Curve (at the Cesar Chavez Street interchange) in both directions (morning)* • Bay Bridge approach (afternoon commute)*
San Mateo	• Eastbound on the San Mateo-Hayward Bridge (evening)* • Southbound Route 101 between San Bruno and Burlingame (morning) • Southbound Route 280 from Daly City to Route 380 (morning)
Santa Clara	• Southbound Route 101 between Great America Parkway and Tully Road (evening) • Northbound Route 101 from Route 237 to University Avenue (evening) • Several locations on Route 87 and Route 680 (evening peak) • Southbound Route 280 from Page Mill Road to Magdalena (evening)
Solano	• Northbound Route 680 near the 80/680 interchange (evening peak period) • Approaches to the toll plazas at the Carquinez and Benicia-Martinez Bridges (evening).*
Sonoma	• Route 101 north of the Route 101/12 interchange in Santa Rosa (evening) • Northbound Route 101 north of Route 12/101 interchange (morning) • Southbound Route 101 south of Route 12/101 interchange (morning) • Southbound Route 101 near Lakeville Highway in Petaluma (morning)

(*) indicates congested area associated with bridge approaches and crossings.
Source: Caltrans District 4, HICOMP 1998

Table 3.12.5
Daily Person Trips Across Bay Area Screenlines

	Screenline	Daily Person Trips 1998	Daily Person Trips 2025[a]
Bay Bridge	BART	143,958	262,671
	AC Transit	2,089	3,812
	Ferry Transit	1,801	3,058
	Highway	408,851	451,521
	Bay Bridge Total	***556,699***	***721,062***
Golden Gate	Golden Gate Transit	9,298	14,055
	Ferry Transit	8,118	14,247
	Highway	151,926	168,637
	Golden Gate Total	***169,342***	***196,939***
SF/San Mateo County Line	Caltrain, BART and Samtrans	48,204	99,129
	Highway	318,955	380,252
	SF/SM County line Total	***367,159***	***479,381***
San Mateo Bridge	Highway	***145,258***	***161,611***
Dumbarton Bridge	Highway	***129,638***	***161,796***
Richmond-San Rafael Bridge	Highway	***78,058***	***90,986***
Carquinez/Benicia Bridges	Ferry Transit	1,990	5,933
	Highway	157,224	176,634
	Carquinez/Benicia Bridges Total	***159,214***	***182,567***
TOTAL		**1,605,368**	**1,994,342**

Source: Cambridge Systematics, 2002
[a] 2025 data is the forecasted data under the No Build alternative, i.e. the forecasted 2025 daily person trips data if the project were to not occur.

Table 3.12.6
Daily Number of Trips in the Bay Area by Vehicle Type

Purpose	1998 trips	2025 trips[a]	Percentage Change
Car			
Home-Based Work	3,707,297	5,103,132	38
Home-Based Shop	3,277,781	4,030,835	23
Home-Based Social/Rec.	1,302,011	1,607,989	24
Non-Home Based	3,610,424	4,738,388	31
Internal- External	458,523	913,203	99
Total cars	12,356,037	16,393,547	33
Trucks			
Small Truck	192,446	264,732	38
Medium Truck	18,633	25,580	37
Large Truck	40,851	56,647	39
Total trucks	251,930	346,959	38
TOTAL	**12,607,967**	**16,740,507**	**33**

Source: Cambridge Systematics (2002)
[a] 2025 data is the forecasted data under the No Build alternative, i.e. the forecasted 2025 trips if the project were to not occur.

Table 3.12.7
Daily Vehicle Miles Traveled (VMT) by County and Vehicle Type in 1998

County	Auto	Small Truck	Medium Truck	Large Truck	TOTAL
San Francisco	7,755,334	183,804	14,900	63,721	8,017,759
San Mateo	17,850,190	402,968	29,657	175,474	18,458,290
Santa Clara	32,754,307	651,396	53,770	211,556	33,671,029
Alameda	29,345,683	809,450	61,280	317,724	30,534,137
Contra Costa	16,701,084	376,108	27,912	144,147	17,249,251
Solano	9,057,951	181,832	12,131	68,505	9,320,419
Napa	2,978,750	73,024	4,656	28,699	3,085,129
Sonoma	7,509,204	187,843	13,405	75,265	7,785,717
Marin	7,084,922	164,598	11,112	74,768	7,335,401
INTRAZONAL VMT	1,347,897	-	-	-	1,347,897
TRANSIT DRIVE ACCESS VMT	984,344	-	-	-	984,344
TOTAL BAY AREA	**133,369,665**	**3,031,024**	**228,824**	**1,159,859**	**137,789,372**

Source: Cambridge Systematics (2002)

Table 3.12.8
Vehicle Miles Traveled for the Proposed Project for Automobiles, Trucks, and Buses

		2025 No Project Alternative		2025 Proposed Project		
County	**1998 Vehicle Miles Traveled**	**Vehicle Miles Traveled**	**% Change from 1998 Baseline**	**Vehicle Miles Traveled**	**% Change from 1998 Baseline**	**% Change from No Project**
San Francisco	8,017,759	9,075,385	13.19	9,035,662	12.70	-0.4
San Mateo	18,458,290	20,838,110	12.89	20,743,861	12.38	-0.5
Santa Clara	33,671,029	45,696,564	35.71	45,688,423	35.69	-0.02
Alameda	30,534,137	40,021,231	31.07	40,007,689	31.03	-0.03
Contra Costa	17,249,251	23,702,339	37.41	23,693,094	37.36	-0.04
Solano	9,320,419	16,317,037	75.07	16,331,542	75.22	0.09
Napa	3,085,129	5,038,273	63.31	5,044,401	63.51	0.1
Sonoma	7,785,717	11,045,667	41.87	11,041,454	41.82	-0.04
Marin	7,335,401	8,539,503	16.41	8,505,155	15.95	-0.4
Intrazonal VMT	1,347,897	2,112,613	56.73	2,112,563	56.73	-0.002
Transit Drive Access VMT	984,344	1,892,977	92.31	1,933,395	96.41	2.1
Bus VMT	268,239	323,225	20.50	333,167	24.21	3.1
TOTAL BAY AREA	**138,057,611**	**184,602,925**	**33.71**	**184,470,407**	**33.62**	**-0.07**

Source: Cambridge Systematics (2002)

Table 3.12.9
Vehicle Trips by Purpose and Vehicle Type for the Proposed Project

Purpose/Vehicle Type	1998 Vehicle Trips	2025 No Project Vehicle Trips	2025 Proposed Project Vehicle trips	Percent Change from No Project
Car				
Home-Based Work	3,707,297	5,103,132	5,096,452	-0.131%
Home-Based Shop	3,277,781	4,030,835	4,030,347	-0.012%
Home-Based Social/Recreation	1,302,011	1,607,989	1,605,594	-0.149%
Non-Home-Based	3,610,424	4,738,388	4,737,488	0.019%
Internal-External	458,523	913,203	913,203	0%
Truck				
Small Truck	192,446	264,732	264,732	0%
Medium Trucks	18,633	25,580	25,580	0%
Large Trucks	40,851	56,647	56,647	0%
TOTAL	**12,607,967**	**16,740,507**	**16,730,045**	**-0.062%**

Source: Cambridge Systematics (2002)

Table 3.12.10
Total Ridership in Non-Ferry Transit under the Proposed Project

Transit Mode	2025 No Project Riders	2025 Proposed Project Riders	Percent Change from No Project
Bus	1,728,641	1,719,018	-0.6%
Light Rail (Muni, SCVTA)	240,818	240,041	-0.3%
BART	890,084	885,524	-0.5%
Commuter Rail (Caltrain, ACE, Amtrak)	133,896	136,613	2.0%

Source: Cambridge Systematics (2002)

Table 3.12.11
2025 Daily Vehicle Trips (Auto Modes Only) Across a Screenline

Screenline	2025 No Project	2025 Proposed Project	Difference from No Project	Percent Change from Total
Bay Bridge	383,245	379,009	-4,236	-1.1
Golden Gate	143,510	141,493	-2,017	-1.4
SF/SM County line	327,759	325,264	-2,496	-0.8
San Mateo Bridge	137,838	137,547	-291	-0.2
Dumbarton Bridge	133,989	133,971	-18	0.0
Richmond-San Rafael Bridge	79,000	79,000	0	0.0
Carquinez/Benecia Bridges	157,000	157,000	0	0.0
TOTAL	**1,362,348**	**1,353,290**	**-9,058**	**-0.7%**

Source: Cambridge Systematics (2002)

Table 3.12.12
Daily Ridership According To Access Mode to Terminals by Ferry Corridor for the Proposed Project

Corridor	Ferry Route	Walk Access	Drive Access	Transit Access
Solano	Vallejo - San Francisco	257	3,805	349
Contra Costa	Pittsburg/Antioch – Martinez - San Francisco	24	1,995	19
Contra Costa	Hercules/Rodeo - San Francisco	172	619	142
Contra Costa	Richmond - San Francisco	219	1,435	126
Alameda	Berkeley – San Francisco - Mission Bay	24	1,789	544
Alameda	Oakland – San Francisco	107	1,695	525
Alameda	Harbor Bay - San Francisco	314	345	20
Alameda	Alameda – San Francisco	410	746	549
Marin	Sausalito - San Francisco	2,520	2,201	397
Marin	Tiburon - San Francisco	1,288	988	373
Marin	Larkspur - San Francisco	693	4,888	995
San Mateo	Oyster Point (South San Francisco) - San Francisco	128	2,159	209
San Mateo	Redwood City - San Francisco	76	1,286	58
Treasure Island	San Francisco - Treasure Island	1,074	0	1,411
TOTAL		**7,306**	**23,951**	**5,717**

Source: Cambridge Systematics (2002)

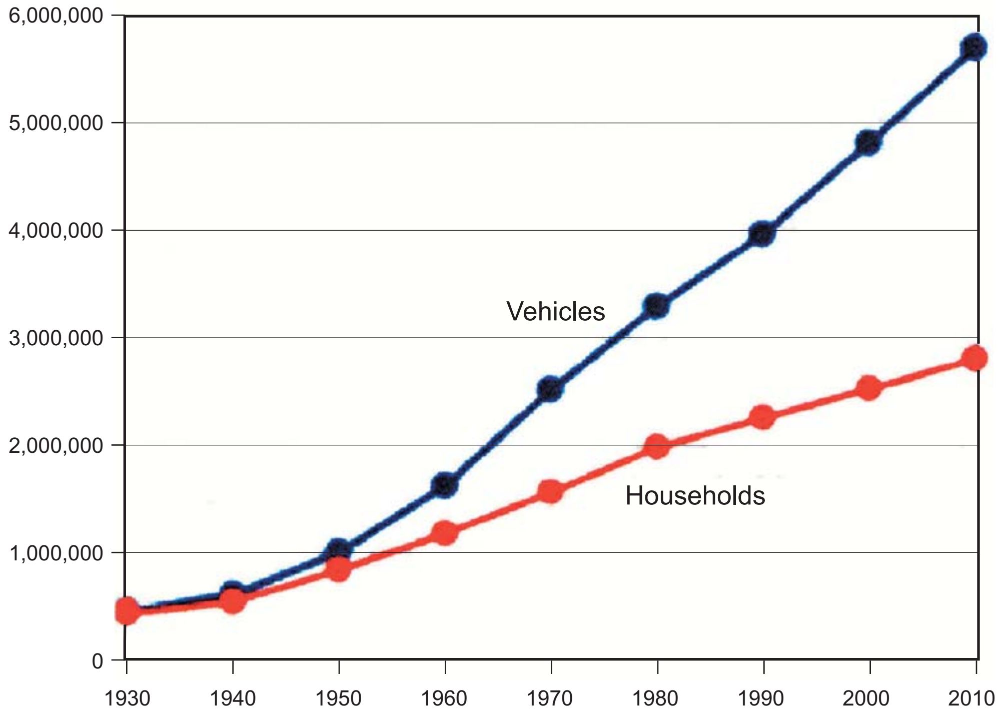
Table 3.12.13
Potential Parking Availability and Parking Demand for the Proposed Project

Corridor	Route	Potential Available Parking	Proposed Project Parking Demand
Transbay	Vallejo - San Francisco	1,600	1,084
	Pittsburg /Antioch – Martinez - San Francisco	300	568
	Hercules/Rodeo - San Francisco	500	176
	Berkeley – San Francisco – Mission Bay	1,000	510
	Alameda - San Francisco	1,000	263
	Richmond - San Francisco	1,000	409
	Jack London Square (Oakland) - San Francisco	500	509
	Harbor Bay - San Francisco	400	122
	Subtotal Transbay Corridor	***6,300***	***3,641***
Golden Gate	Sausalito - San Francisco	100	259
	Tiburon - San Francisco	100	143
	Larkspur - San Francisco	2,000	1,438
	Subtotal Golden Gate Corridor	***2,200***	***1,840***
Peninsula	Oyster Point (South San Francisco) - San Francisco	600	615
	Redwood City - San Francisco	500	366
	Subtotal Peninsula Corridor	***1,100***	***981***

Source: Cambridge Systematics (2002)

URS	Water Transity Authority Program EIR Project No. 28066519	REGIONAL TRANSIT SYSTEMS	Figure 3.12.1

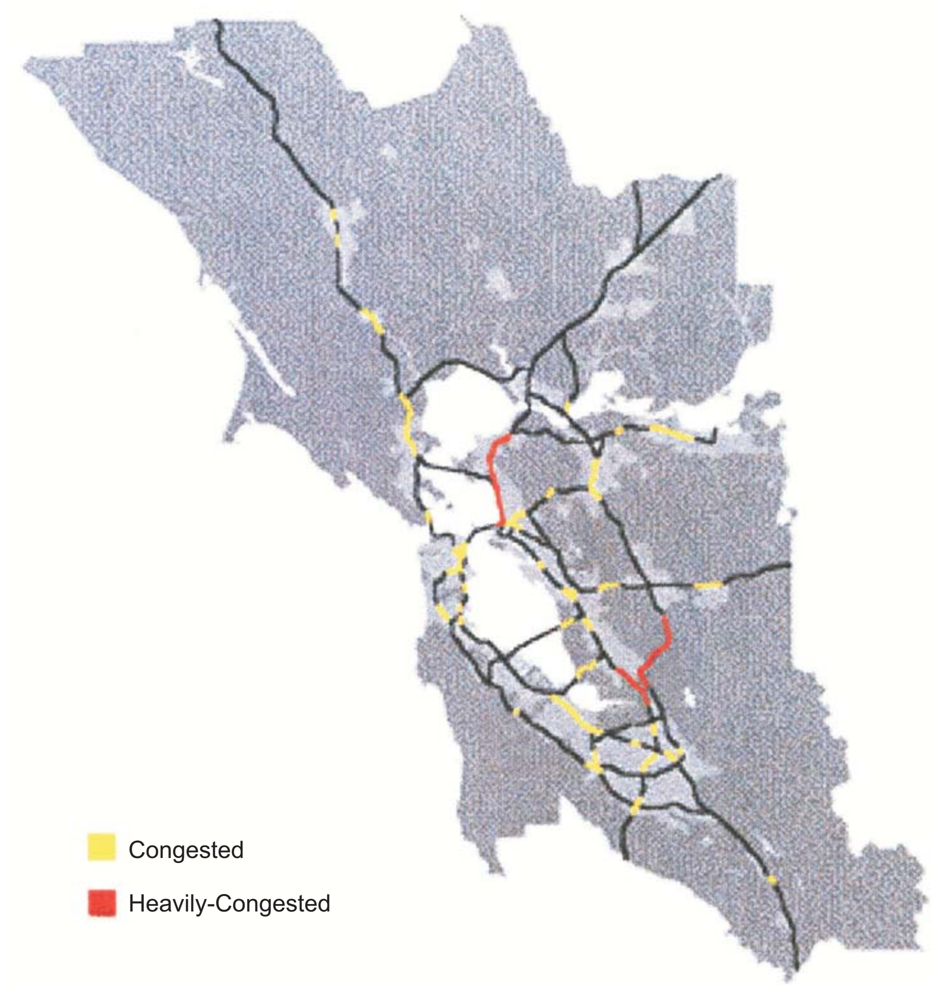
28066519.00200/051503/gos



Source: www.abag.ca.gov

URS	Water Transity Authority Program EIR Project No. 28066519	SAN FRANCISCO BAY AREA VEHICLE OWNERSHIP 1930-2010	Figure 3.12.2

28066519.00200/051503/gos



Source: www.abag.ca.gov

URS	Water Transity Authority Program EIR Project No. 28066519	LOCATIONS OF FREEWAY CONGESTION	Figure 3.12.3

28066519.00200/051503/gos

3.11 NOISE

Noise is defined as unwanted sound. The perception of sound requires three components – a sound source, a pathway for the sound to travel, and a receiver. A sound source generates minute vibrations (pressure waves) that affect the medium surrounding it. The medium and the course of the vibrations traveling through the medium describe the sound pathway. The receiver is a person or animal hearing and perceiving the sound.

The perception of a sound or noise depends on two physical characteristics – amplitude and frequency – both of which can be measured. Amplitude is the measure of the acoustic energy of sound vibrations. Although amplitude can be expressed in terms of linear sound pressure (in units called Pascals (Pa)), the range of audible sound pressures is very large and is difficult to comprehend on a linear (Pa) scale. Therefore, sound amplitude is measured on a logarithmic scale in units called decibels (dB). When expressed in decibels, sound pressure is referred to as sound pressure level (SPL). SPL in air is referenced to 20 microPascals (μPa). SPL in water is referenced to 1 μPa. Because they have unique reference pressures, SPLs in air and water cannot be readily compared.

Frequency, also referred to as pitch or tone, is the rate at which the medium (e.g., air or water) vibrates or oscillates and is expressed in terms of cycles per second, or Hertz (Hz). The distribution of frequency content of any sound or noise is known as its spectrum.

Two relevant characteristics of sound (or noise) behavior are propagation and attenuation. Propagation refers to the manner in which sound energy travels outward from its source. The pattern of propagation is related to the type of sound source.

There are many mechanisms for attenuation of sound. Typical mechanisms include absorption, geometrical divergence[1], terrain, wind, and topography. For example, absorption is the reduction of acoustic energy as a result of conversion of acoustic energy to heat as sound propagates through a medium. Geometrical divergence is the term associated with the reduction of acoustic energy with increasing distance from the sound source. The emitted energy is assumed to spread uniformly away from the source.

The perception of noise depends heavily on the medium involved. Because ferries generate sound in air and under water, the propagation of sound and its descriptors (or metrics) in both media are presented.

3.11.1 Environmental Setting

3.11.1.1 Noise Metrics

The common measure for environmental sound in air is the "A"-weighted sound level (dBA) relative to 20 μPa. The "A" scale weighting is an adjustment to measured sound that takes into account how the human ear responds to sound.

[1] Also called "spreading loss" or "distance attenuation."

The “ambient” noise level is the steady noise level that exists in the absence of all identifiable, sporadic, individual noise events, such as automobile pass-bys, aircraft over-flights, intermittent dog barking, etc. The ambient noise level comprises the sum of all noise sources, both near and far. It includes indistinguishable noise from roads, machinery, aircraft, and other sources. The ambient level varies slowly during the day, as these sources increase or diminish.

Because noise by its nature varies with time, it is beneficial to define certain measurement terms, also called “metrics,” used to characterize this fluctuation. The study of environmental noise has led to many noise metrics. The energy-average level over a specific time period is defined as the Equivalent Sound Level (L_{eq}). For a given time interval, L_{eq} is a constant sound level whose acoustic energy is the same as the acoustic energy of the (actual) time-varying sound level. Thus, L_{eq} provides a measure of the true energy-average sound level in an area, and includes the sound from all constant, sporadic or transient events. L_{eq} is usually measured in hourly intervals over long periods in order to develop 24-hour energy-average noise levels. L_{eq} is generally used to describe levels of noise affecting sensitive receptors where the noise source itself is not of special concern during evening and nighttime hours, or where the noise is only generated during daytime hours such as with construction activities.

Other descriptors of noise are commonly used to predict noise/land use compatibility, as well as community reaction to daytime and nighttime environmental noise. These descriptors include the Day-Night Average Sound Level (abbreviated L_{dn} or DNL), and California’s Community Noise Equivalent Level (CNEL). Each of these descriptors has units of dBA. Both L_{dn} and CNEL represent 24-hour periods, and both apply a penalty to noise events that occur during evening or nighttime hours, when relaxation and sleep disturbance is usually of more concern. In the case of CNEL, noise occurring during the daytime hours, between 7:00 a.m. and 7:00 p.m., receives no penalty. Noise occurring between 7:00 p.m. and 10:00 p.m. (denoted “evening”) is penalized by adding 5 dB to the measured noise level, while noise occurring from 10:00 p.m. to 7:00 a.m. (nighttime) is penalized by adding 10 dB to the measured level. L_{dn} differs from CNEL by not adding a penalty in the evening period. Both CNEL and L_{dn} are the predominant metrics used by local governments to describe noise environments within their jurisdictions and for land use compatibility planning purposes. The U.S. Environmental Protection Agency (USEPA) recommends their use.

Other metrics presented in this report include Maximum A-weighted Sound Level (L_{max}), Sound Exposure Level (SEL), and statistical sound levels such as L_{10}, L_{50} and L_{90} (L_x) in dBA. L_{max} is the A-weighted maximum instantaneous sound level measured during a specified time interval or for an individual noise event. SEL is a composite metric that represents the amplitude of a sound and its duration. SEL is a logarithmic measure of the total acoustic energy transmitted to the listener during an event. L_x is the (measured) level that is exceeded “x” percent of the time during a given interval.

3.11.1.2 Airborne Noise Propagation

Environmental noise sources are typically characterized as one of two source types – point source or line source. Examples of a point source would be a horn or a single piece of machinery or construction equipment relatively close to a receptor (or a single ferryboat) or an entire construction site that is relatively far away from a receptor. Examples of a line source would be a very busy (nearly continuous stream and densely populated) highway or a long railroad train.

In general, for a point source, the rate of distance attenuation is 6 dB for every doubling of distance (DD) relative to the source's level at a reference distance (usually 50 feet). This attenuation rate is appropriate for intermittent ferryboat traffic. For an infinite line source, the rate of distance attenuation is 3 dB per DD. An in-between condition exists called a quasi-line-source (e.g., automobiles spaced apart on a road) that attenuates with distance at the approximate rate of 4.5 dB per DD.

Besides distance, other factors cause changes in sound levels. Sound waves can be "carried" by the wind if the wind is blowing away from the sound source. Conversely, sound waves can be bent up and away from receptors by the wind if the wind is blowing toward the sound source.

Other sound attenuators include intervening terrain or barriers between the source and the receptor that block the direct line-of-sight, and for distances greater than 1,000 feet, the atmosphere itself. Grassy ground or plowed earth is usually referred to as "soft ground" whereas asphalt/concrete or water surfaces such as San Francisco Bay are usually referred to as "hard ground." Soft ground attenuates sound more than hard ground. Attenuation, especially that due to terrain, is dependent on the spectrum, i.e., the frequency content, of the source. At 1,000 feet from the source, the difference between hard ground and soft ground attenuation could be on the order of 3 to 4 dBA. The difference would increase with distance. Atmospheric attenuation (also called "air absorption") is dependent on the source spectrum, the relative humidity and temperature of the air through which the sound is travelling. Air absorption increases linearly with distance.

Figure 3.11.1 shows an example of overall sound attenuation for a line source and for a point source demonstrating the effect of different ground types (soft and hard ground). The magnitudes of attenuation in the figure account for spreading loss, air absorption and ground/water attenuation. The spectrum chosen for this figure is low-frequency dominant, like that of a diesel-engine ferry.

3.11.1.3 Underwater Noise Propagation

Sound levels in air are not comparable to underwater sound levels because a different reference level is used to calculate the decibel level. The reference level for underwater acoustics is 1 μPa.

Propagation of sound in air is very different than propagation in water. Although the speed of sound in water is greater than the speed of sound in air, the former is dependent on water temperature, pressure, salinity and bubble population. For the temperature range of interest to this project, the speed of sound increases with increased temperature. The speed of sound in water also increases with increased salinity. However, bubbles found in breaking waves ("white caps") tend to decrease the speed of sound in water.

In air, sound pressure amplitude from a point source is proportional to the inverse of the distance from the source. For comparison with underwater sound, at long distances from the source, the geometrical divergence or spreading can be characterized as a line source radiating as a cylinder of constant depth whose surface area increases with distance. In this case, the sound pressure amplitude is proportional to the inverse of the square root of the distance from the source. This is one reason why sound propagates farther in water than in air. Figure 3.11.2 shows the difference in spreading loss for sound propagation in air and in water.

The attenuation losses due to absorption in water are much less than those in air. This is another reason why sound in water travels greater distances than sound in air. The rate of absorption increases with frequency.

Sound is also reflected from the surface and the bottom. The composition of the bottom material affects the reflection loss. Multilayered bottoms consisting of sand, mud and rock would give multiple reflections. The bottom roughness also affects the reflection losses.

Figure 3.11.3 shows typical underwater noise sources and their frequency range and levels. The ambient noise in shallow water environments such as San Francisco Bay is highly variable in space and time. Sources would include existing boat traffic (industrial, commercial and pleasure craft), rain noise, breaking waves induced by the wind or shore breaks, and biological noise. Boat noise can be of very high levels, especially below 1 kHz. As the wind speed increases, the wave height increases and so do the number of breaking waves. The frequency range of wind-induced wave noise is between about 500 to 20,000 Hz.

3.11.1.4 Noise Perception and Effects

This section is divided into two subsections, human and wildlife.

Human

Human response to noise varies among individuals and is dependent upon the ambient environment in which the noise is perceived. The same noise that would be highly intrusive to a sleeping person or someone in a quiet park might be barely perceptible at an athletic event or in the middle of the freeway at rush hour. Therefore, planning for an acceptable noise exposure must take into account the types of activities and corresponding noise sensitivity in a specified location for each particular set of land use. Some general guidelines for noise levels are sleep disturbance, speech interference, and workplace hearing loss. Sleep disturbance begins to occur when the indoor Sound Exposure Level rises above 35 dBA (FICAN 1997). Interference with human speech begins to occur when the L_{eq} rises above 60 dBA (USEPA 1974). Hearing loss can result from prolonged exposure (in the workplace, for example) to a time-averaged noise level of 90 dBA for 8 hours or more (OSHA).

Some representative sources and their sound levels are shown in Figure 3.11.4. An evaluation of differences between the existing and total predicted future noise environments usually assesses potential responses of persons to changes in the noise environment. The following relationships of perception and response to quantifiable noise increases are used as a basis for assessing potential effects of changes in environmental noise level:

- Except in a carefully controlled laboratory condition, a change of 1 dBA is very difficult to perceive.
- In the outside environment, a 3 dBA change is considered just perceptible.
- An increase of 5 dBA is considered readily perceptible and would generally result in a change in community response.
- A 10 dBA increase is perceived as a doubling in loudness and would likely result in a widespread community response.

Because of their logarithmic scale, sound levels must be logarithmically added and subtracted and cannot be arithmetically added or subtracted. For example, two sources each producing 60 dB would yield 63 dB (not 120 dB) when added. Note that the result (63 dB) is only 3 dB greater than the sound level of each of the sources (60 dB). This provides insight into the degree of perception when a noise source is doubled. For example, a doubling of boat traffic represents a doubling of sound energy yielding a 3 dB increase. Thus, for an environment dominated by boat noise, the number of boats must double for a noise level increase to be just perceived.[2]

Wildlife

Anthropogenic (i.e., human-generated) noise impacts wildlife in a variety of ways and under certain circumstances can be damaging. In general, noise has the potential to impact wildlife via three methods: masking of acoustic signals, affecting behavior, and affecting the animal's physiology (auditory or non-auditory). Each method is described below.

Masking

Animals use sound for a variety of purposes, including communication, detection of predators/prey, and navigation. Masking occurs when noise interferes with the perception of the sound of interest. The specific animal's physics, behavior, anatomy, and physiology determines whether masking will occur as a result of noise due to the proposed project. Animals may compensate for masking through behavioral adaptation, by avoiding the noise, or shift frequency and/or level of the signal.

Behavioral Effects

Noise has the potential to disrupt animal behavior. Extensive research has been conducted on observed behavioral changes due to anthropogenic sounds (aircraft, ships, boats, construction, etc.) with a variety of animals. Observed reactions include a cessation of feeding, resting, socializing, and an onset of alertness or avoidance. The disturbance may not be biologically significant if it causes a temporary change in behavior or habitat use. In contrast, the disturbance may be biologically significant if it causes animals to avoid critical habitat for an extended time period, or hinders foraging or mating.

Excessive noise may cause an animal to frequent a hazardous area (as a result of humans or other predators) due to motivation to find food. For example, pelicans and sea lions are known to be attracted to fishing vessels and bait barges due to the presence of an "easy meal." Animals may also exhibit "habituation" to noise, which can also have positive and negative impacts. For example, animals that habituate to traffic noise are vulnerable to oncoming vehicles, but also may have the choice of better habitat if it can adapt to the louder noise environment. Habituation to noise is affected by the frequency of the noise event (how many times it occurs), the motivation of the animal to habituate (i.e., easy meal), and many other factors.

Physiological Effects

Any type of noise above some level has the capability to damage hearing. The resulting damage determines whether the resulting threshold shift is temporary (temporary threshold shift [TTS])

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[2] This example assumes all other factors (e.g., boat type, engine type, etc.) remain constant.

or permanent threshold shift (PTS). Repeated exposure to TTS in marine animals is thought to cause a PTS, but no long-term studies offer empirical proof. Hearing loss affects the animal's ability to navigate, communicate, and detect predators and prey. The extent to which a noise may damage an animal's hearing ability depends on the animal's auditory sensitivity.

3.11.1.5 Ferry Noise Sources

The major source of airborne noise from existing ferries operating at full power is their engine exhaust. Other sources of airborne noise, especially for fast ferries, include the main propulsion engines and water (or wake) noise. Fluid dynamic noise in fast-moving slender catamaran hulls is often a major contributor of shipboard noise. Other shipboard noise sources include gearbox(es), ventilation fans and cabin heating, and ventilation and air conditioning (HVAC) systems. Most fast ferries are driven by waterjets, which are normally not a major source of airborne noise. In terminal areas, diesel generators and horns replace the idling main engines as the primary airborne noise generators (J. & A. Enterprises 2002). As the engines and exhaust of fast ferries are the primary airborne noise components, the low-frequency regime (up to approximately 125 Hz) dominates their spectra (Danish EPA 2002). Low-frequency noise generated by older diesel engines was the greatest concern in European studies (BAC 1998).

Most of the existing fast ferry data is anecdotal and is focused on shipboard noise. One such data point is on the deck of a 40 knot (kt) experimental catamaran with two Caterpillar 3516 diesel engines with waterjet propulsion – 96 dBA (Noise Control Engineering Inc. 2002). Another data point is from an existing high-speed catamaran ferry in the San Francisco Bay Area. The operator recorded sound levels between 71 and 73 dBA in the passenger lounge, 84 to 86 dBA on the main deck and levels up to 110 dBA on the exterior main aft deck (Courtois 2002). Note that these shipboard levels may not be representative of all vessels in the existing ferry fleet. Future methods of propulsion via fuel cells (diesel-electric or hydrogen fuel, for example) or those running on natural gas or solar and wind energies may prove quieter (TR News 2000; Solar Sailor Holdings 2001).

Underwater noise data of existing ferries throughout the world is virtually nonexistent, especially for the types of fast ferries proposed for this project. Therefore, the expected range of underwater noise levels is unknown. However, a range of underwater source sound levels of vessels while underway is provided in Richardson et al. (1995) and was used to estimate underwater sound levels that may be generated by the ferry. Sound levels range from 152 dB (*re* 1 µPa at 1 meter) at 6,300 Hz for a 5-meter inflatable Zodiac to 177 (*re* 1 µPa at 1 meter) at 125 Hz. Although the acoustic characteristics of ferries and tankers vary, the source level of ferries would most likely be less than that of the tanker. Therefore, an estimate of 177 dB (re 1 µPa at 1 meter) would be considered a worst-case condition.

3.11.1.6 Regional Setting

Exterior noise measurements of fast ferries operating on San Francisco Bay were made in April 2003 with the purpose of obtaining maximum sound pressure levels (L_{max}) at a common distance from the vessels (Stumbo, 2003). Measurements were taken from an observation boat positioned 100 to 200 meters from ferries operating at service speed under normal full power. Sound levels (dBA) were measured with a calibrated sound level meter interfaced to a laptop computer running data acquisition software. The distance to vessels was measured with a laser rangefinder accurate to ±1 meter.

The results of the noise measurements are shown in the table below. The measured values were converted to L_{eq} at a closest point of approach (CPA) distance of 100 meters, and L_{max} at the same distance. Because engine and exhaust noise is the largest contributor to exterior vessel noise, the sound levels are usually highest directly behind a vessel. Hence, the maximum noise levels do not occur at the CPA, but rather, after the vessel has passed. The measured data show this effect for all vessels except the Intintoli, which calls the Intintoli data into question. The Mare Island (sister ship of the Intintoli) and Del Norte data shows the expected pattern and multiple measurements of the Del Norte show very consistent results. Hence the Mare Island and Del Norte results are considered representative of exterior noise levels for 325-passenger vessels using existing technology.

The table below shows L_{max} at various distances including 2/3 mile and 1,500 meters. Background (ambient) noise levels on the Bay were measured to range between 58 and 63 dBA (average 60 dBA) which means that at a distance of 2/3 mile, exterior vessel noise is at ambient (except for the Peralta). At a distance of 1,500 m (the distance from the shoreline recommended to minimize wake impacts), the maximum vessel noise is below ambient and not detectable.

Exterior Vessel Noise Measurements, April 2003

VESSEL	L_{EQ} @ CPA	L_{max} @ 100 m (328 ft)	L_{max} @ 1000 ft	L_{max} @ 2/3 mi. (3520 ft)	L_{max} @ 1500 m (4922 ft)
INTINTOLI	72.1	72.1	62.4	51.5	48.6
MARE ISLAND	72.3	79.5	69.8	58.8	56
DEL NORTE*	66.8 - 69.1	79.0 - 80.5	69.3 – 70.8	58.4 - 59.9	55.5 - 57.0
PERALTA	63.6	87	77.3	66.4	63.5

Note: * multiple measurements

The existing noise on-land environment in the study area ranges from quiet and serene rural to a noisy urban center. Generalized characterizations of ambient sound level are shown on Figure 3.11.5. The figure shows the ranges of L_{dn} for seven environments. A rural setting could be 40 dBA L_{dn} or lower. The L_{dn} for a downtown metropolis ranges from approximately 72 dBA to 80 dBA. Table 3.11.1 provides Federal Transit Administration (FTA) guidance on estimating existing noise exposure. Existing noise exposure is estimated by first looking at a site's proximity to major roads and railroad lines. If the site's noise environment is not thought to be dominated by the closest major roads or railroad lines, then population density determines the level. If the noise environment could be a combination of roads, railroads and/or general community noise, the highest level of the combination would be used (FTA 1995).

Population density for Congressional District 8 (primarily the City of San Francisco) is approximately 18,000 people per square mile (U.S. Census Bureau 2000). Table 3.11.1 yields an L_{dn} of 60 dBA as an estimate of the District's ambient noise level. This level is consistent with the 60 dBA average of background noise measured on the Bay as described above.

3.11.1.7 Regulatory Setting

Federal, state and local settings are discussed in the following subsections.

Federal

The Noise Control Act of 1972

The Noise Control Act (42 United States Code [USC] Chapter 4901 et seq.) directs the EPA to develop noise level guidelines, which would protect the population from the adverse effects of environmental noise. The EPA published a guideline (USEPA 1974) containing recommendations for acceptable noise level limits affecting residential land use of 55 dBA L_{dn} for outdoors and 45 dBA L_{dn} for indoors. The agency is careful to stress that these recommendations contain a factor of safety and do not consider technical or economic feasibility issues, and therefore should not be construed as standards or regulations.

Noise Emission Standards for Transportation Equipment

Federal regulations establish noise limits for medium and heavy trucks (more than 4.5 tons, gross vehicle weight rating) under 40 Code of Federal Regulations (CFR) Part 205, Subpart B. The federal truck pass-by noise standard is 80 dBA at 15 meters (approximately 50 feet) from the vehicle pathway centerline (Crocker 1997). Vehicle noise limits are implemented through regulatory controls on vehicle manufacturers.

The federal regulations for railroad noise are contained in 40 CFR, Part 201, and 49 CFR, Part 210. Noise limits for locomotives manufactured during or after 1980 are as follows: stationary (idle throttle setting)—70 dBA at 15 meters from the track pathway centerline; stationary (all other throttle settings)—87 dBA at 15 meters; and moving—90 dBA at 15 meters (Crocker 1997). These noise limits are implemented through regulatory controls on vehicle manufacturers.

Department of Housing and Urban Development (HUD) Standards

Department of Housing and Urban Development standards define L_{dn} below 65 dBA as acceptable for residential use. Levels up to 75 dBA L_{dn} can be made acceptable through the use of insulation in buildings.

FTA Guidelines

The FTA has no specific guidelines for ferries. However, it has published a guidance manual for assessment of rail and bus mass transit projects. As ferries are another mode of mass transit, and in lieu of any specific guidance, it would be expected that the FTA would apply its “transit project” impact criteria described below.

Table 3.11.2 describes the three “sensitive” land use categories used by the FTA to evaluate the compatibility of predicted noise levels. Category 1 includes land where quiet is an essential element such as outdoor amphitheaters; Category 2 includes residences where people sleep; and Category 3 includes institutional buildings where quiet is important such as schools, libraries and churches. Note that Categories 1 and 3 utilize the Hourly Equivalent Sound Level (L_{eq}(h)) whereas Category 2 utilizes L_{dn}. Such criteria recognize the heightened community annoyance caused by late-night or early-morning train operations, and to respond to the varying sensitivities of communities to projects under different ambient noise conditions. The noise criteria is to be applied *outside of building locations* for residential land use and at the *property line* for parks and other significant outdoor use (FTA 1995).

The FTA noise impact criteria for a transit project are shown in Figure 3.11.6. It considers the existing (ambient) noise, the noise from the proposed project, the change in overall noise level due to the project and the type of land use receiving the noise. Use of the figure results in three determinations of impact to human annoyance: No Impact, Impact, and Severe Impact to Land Use Categories 1 through 3. “Impact” is associated with the minimum measurable change in community reaction whereas “Severe Impact” is associated with the change in community reaction from an acceptable to an unacceptable noise environment (FTA 1995).

U.S. Fish and Wildlife Service

Regarding impacts to birds, the U.S. Fish and Wildlife Service (USFWS) has determined a significance criterion of 60 dBA CNEL at the line of habitat as an impact.

Marine Mammal Protection Act

See Section 3.5 (Biological Resources) for a brief description. With regard to noise, the National Marine Fisheries Service (NMFS) currently considers, as a guideline, received underwater sound pressure levels at or above 160 dB (re 1 μPa) as constituting harassment of marine mammals. NMFS has suggested that underwater sound pressure levels above 180 dB (re 1 μPa) could cause TTS in marine mammals.

Shipboard Noise

The regulation of shipboard noise is not very clear. The United States Coast Guard (USCG) regulates all affairs regarding licensed commercial vessels. The applicable USCG document is Navigation & Vessel Inspection Circular (NVIC) No. 12-82, dated June 2, 1982. However, the NVIC 12-82 only provides guidelines and recommendations for vessel noise, not shipboard noise. Away from seaways, OSHA actively regulate noise in industrial environments under the Department of Labor (Bahtiarian 2002).

The OSHA regulations are similar to the USCG requirements. The governing regulations for “Occupational Noise Exposure” are found in 29 CFR 1910.15. The California Department of Industrial Relations, Division of Occupational Safety and Health (Cal OSHA) (8 California Code of Regulations [CCR], General Industry Safety Orders, Article 105, Control of Noise Exposure, Section 5095) requires that the time-averaged noise level of any work environment during an 8-hour period be limited to 90 dBA.

In many cases, shipboard and exterior noise limits for all types of ships including ferries are specified prior to ship construction. For example, Table 3.11.3 contains the noise limits imposed by Alaska for their Fast Vehicle Ferry (FVF). For this vessel, shipboard levels are limited to 55 dBA due to HVAC noise up to 120 dBA in the engine room. FVF exterior noise is limited to 60 dBA at 1,000 feet with engines developing their maximum fast ferry power rating (The Glosten Associates 2002).

State

Noise Insulation Standards

Relevant state regulations are contained in the California Code of Regulations. Part 2 of Title 24 establishes the limit for interior community noise level for multifamily dwellings, hotels, motels, dormitories and long-term care facilities of 45 dBA L_{dn}. The state's regulation may be extended by local legislative action to include single-family dwellings.

California Governor's Office of Planning and Research (OPR) Guidelines

Section 65302(f) of the CCR establishes the requirement that local land use planning jurisdictions prepare a General Plan. In 1998, the OPR published its most recent edition of their *General Plan Guidelines* (GPG). The GPG advise local jurisdictions in preparing their comprehensive long-term general plans. The Noise Element is a mandatory component of the General Plan and includes general community noise guidelines and specific planning guidelines for noise/land use compatibility developed by the local jurisdiction.

The OPR guidelines are presented in Figure 3.11.7. Selected relevant levels are:

- CNEL below 60 dBA—acceptable for low-density residential use.
- CNEL below 65 dBA—normally acceptable for high-density residential use.
- CNEL of 60 to 70 dBA—conditionally acceptable for churches, educational and medical facilities.
- CNEL below 70 dBA—normally acceptable for playgrounds and neighborhood parks.

See Figure 3.11.7 for definitions of the word "acceptable."

Other

The State of California also establishes noise limits for vehicles licensed to operate on public roads. For heavy trucks, the state pass-by noise standard is consistent with the federal limit of 80 dBA. The state pass-by noise standard for light trucks and passenger cars (less than 4.5 tons, gross vehicle weight rating) is also 80 dBA at 15 meters from the centerline (California Vehicle Code Sections 23130, 23130.5, 27150 et seq., 27204, and 27206). Vehicle noise limits are implemented through regulatory controls on vehicle manufacturers and by legal sanction of vehicle operators enforced by state and local peace officers. Other state standards exist, such as Caltrans and FHWA's criteria for noise assessment and abatement, but these are focused on situations unique to their authority, such as control of freeway noise, and are not necessarily applicable to WTA's actions.

Local

Regulatory noise standards employed by local jurisdictions generally fall into two categories: noise control ordinances and noise/land use compatibility guidelines. Noise produced by sources not related to transportation is usually regulated using ordinances that limit the amount of noise such sources may produce, as measured at the nearest sensitive receptor or at property lines. Standards in local noise ordinances may be in the form of quantitative noise performance levels, or they may simply be in the form of a qualitative prohibition against creating a nuisance. Many ordinances employ both approaches.

Because local jurisdictions are preempted from regulating noise emissions from transportation noise sources such as cars, trucks, trains, airplanes and ferries, such jurisdictions also typically implement noise controls through adoption and implementation of noise/land use compatibility guidelines. Noise/land use compatibility guidelines identify the range of noise levels with which various land uses are deemed compatible. This permits local jurisdictions to achieve noise/land use compatibility for the land uses exposed to noise, even if the noise sources themselves cannot be regulated.

Jurisdictions in the study area (along the shorelines) have published Noise Elements of their General Plan. Some of the Noise Elements contain specific guidelines for noise and land use planning. Some of the jurisdictions default to the HUD guidelines.

Tables 3.11.4 and 3.11.5 identify exterior operational noise standards according to noise ordinances of two of the cities affected by the project – San Francisco (San Francisco Municipal Code [SFMC], Title 8, Chapter 8.32.030) and Oakland (Oakland Municipal Code [OMC], Title 17, Chapter 17.120.050). As evidenced by these two tables, ordinances in the region typically specify daytime and nighttime limits of statistical noise levels for various land use or zoning. Nighttime limits are usually lower than daytime limits accounting for the lower ambient noise levels at night and people's increased sensitivity to or annoyance about nighttime noise events.

3.11.2 Impacts and Mitigation

3.11.2.1 Significance Criteria

The CEQA Guidelines environmental checklist includes the following criteria for determining potentially significant noise impacts:

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinances, or applicable standards of other agencies;
- Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels;
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project; and/or
- Exposure of people residing or working in the project area to excessive noise levels for a project located within an airport land use plan, or where such a plan has not been adopted, within 2 miles of a public airport or public use airport, or for a project within the vicinity of a private airstrip.

Based on these guidelines and relevant local, state, and federal standards, this EIR applies the following thresholds of significance. A noise impact is considered significant if it would:

- Expose ferry passengers and crew to noise levels greater than Occupational Safety and Health Administration (OSHA) standards;

- Expose residents and noise-sensitive land use to "impacts" as defined by the Federal Transit Administration (FTA) (FTA 1995);
- Expose terrestrial wildlife to 60 A-weighted dB (dBA) Community Noise Equivalent Level (CNEL) (or greater) per the U.S. Fish and Wildlife Service (USFWS); and/or
- Expose aquatic wildlife to underwater sound pressure levels at or above 160 dB (re: 1 uPa) per the National Marine Fisheries Service (NMFS).

3.11.2.2 Impacts and Mitigation

Four impact topics have been identified and are discussed in this section.

Impact NOI-1 **Passengers and crew would be exposed to shipboard noise from proposed enroute ferry operations.**

Because of the relatively short time that passengers spend onboard ferries (e.g., 20 to 40 minutes per trip), they are unlikely to suffer hearing loss or damage. However, the noise levels on ferries could damage crew hearing if not controlled. Compliance with Cal/OSHA regulations would ensure that ferry crews are adequately protected from potential noise hazards. A time-averaged noise exposure level less than or equal to 90 dBA over an 8-hour work shift protects hearing of workers. Areas above a time-averaged noise level of 85 dBA would be posted as high-noise level areas, and hearing protection would be required. The ferry operators would have to implement a hearing conservation program for applicable employees as outlined in Cal/OSHA regulations.

Summary of Impact NOI-1

- Implementation of the Proposed Project would result in ferry passenger and crew exposure to engine noise. Shipboard noise is expected to be at acceptable levels for passengers due to limited exposure time. Existing and proposed ferries are required to incorporate necessary noise and vibration controls to comply with USCG guidelines and Cal/OSHA limits to avoid adverse noise effects to crew members. Because compliance with existing guidelines already mandates noise exposure controls for crew members, no further mitigation is required. Impacts to passengers are expected to be less than significant.

Impact NOI-2 **Noise-sensitive human receptors could be exposed to significant noise from proposed enroute ferry operations.**

Noise impacts would be considered significant if the project resulted in a determination of an "impact" per the FTA guidelines (Figure 3.11.6). The FTA guidelines consider noise levels at the outside of buildings or property boundaries for 3 categories of noise-sensitive land use. The guidelines are described in Section 3.11.1.4. The use of the FTA's "sliding scale" is appropriate because it responds to the varying sensitivity of communities to projects under different ambient noise conditions. For example, for an ambient sound level of 45 dBA Day-Night Average Sound Level (DNL), a project generating 52 dBA DNL or more would cause impact (e.g., annoyance or activity interference). In contrast, for an ambient noise level of 65 dBA DNL, a project generating 61 dBA DNL or more would result in a noise impact.

The determination of noise impacts depends on many factors. The primary factor is the noise level generated by a single pass-by of a proposed ferry, often expressed as the Sound Exposure Level (SEL). Other important factors include the number of trips per day, the category of land use that would experience the ferry pass-bys, existing ambient noise levels, and the time of day in which those trips occur. In California, noise assessments divide the day into: daytime (7 a.m. to 7 p.m.), evening (7 p.m. to 10 p.m.) and nighttime (10 p.m. to 7 a.m.).

Measurements of exterior noise from fast ferries operating at full service speed recorded an L_{max} (or SEL) of 70 dBA at a distance of 1,000 feet. This level is representative of the existing class of 350-passenger high-speed vessels operating at between 34 and 36 knots. The measurements also indicate that the ferry L_{max} noise levels would drop to the measured ambient level of 60 dBA at a distance of 2/3 mile. Therefore, ferry operations on routes greater than 2/3 of a mile from the shoreline would not be heard under typical ambient conditions.

The numbers of weekday pass-bys estimated by the WTA are listed in Table 3.11.6, which includes pass-bys for Peak period, Off-Peak, and Total. The distribution of trips over a one-day period assumes that 85 percent of the total trips would be during the daytime, 10 percent during the evening, and 5 percent during the nighttime for all routes.

At the regional level, this programmatic noise impact assessment assumes that the most noise-sensitive land use potentially affected would be FTA Category 2 receptors (e.g., residential, places where people sleep). Furthermore, it was assumed that the existing ambient sound level at all potentially affected FTA Category 2 receptors is 55 dBA DNL or CNEL. With an ambient sound level of 55 dBA DNL, an FTA impact would result if the sound level from proposed ferry operations would be 55 dBA DNL or CNEL.

Using these criteria and assumptions, a ferry-to-shoreline distance was determined beyond which no adverse noise impact would occur. For existing fast ferries with an SEL of 70 dBA at 1,000 feet, there would be no adverse noise impact from ferry operations or routes at a distance of 130 feet or more from noise-sensitive land uses along the shoreline. Because of terminal approach and departure safety procedures, no service-speed operations occur within 130 feet of a terminal site. Existing and proposed ferry routes are located at least 5,000 feet (1.5 km) from the shoreline except in areas with narrower passages and no service-speed operations along routes occurs within 130 of the shoreline due to safety and other considerations (such as wake wash). The 130-foot estimate applies to the most frequently traveled segment and assumes:

- FTA Category 2 residential receptors are located on the shoreline; and
- Sound attenuates as it propagates over the Bay's surface at a rate of 3 dB per doubling of distance.

Summary of Impact NOI-2

- It is unlikely that the Proposed Project would cause significant noise impacts to noise-sensitive land use. Measured fast ferry pass-by noise levels indicate that a maximum stand-off distance of 130 feet for a fast ferry at service power and speed avoids the FTA's "impact" designation at residential-type land use on the shoreline. Service-speed operations will not occur within 130 feet of the shoreline for safety, wake wash and other considerations. Because the WTA has adopted new vessels specifications with noise level limits that are more severe than those on existing high-speed vessels, new vessels could have an L_{max} (at

1,000 feet) up to 10 dBA quieter than existing vessels. This impact is considered less than significant.

Impact NOI-3 **Noise-sensitive human receptors could be exposed to significant increases in ambient noise from proposed ferry terminal operations.**

Ferry terminals, like other mass transit terminals, can bustle with activity, including arriving and departing ferries, automobiles, and bus and truck traffic. Some existing ferry terminals in the Bay Area have Park-and-Ride lots for auto and bus commuters. Proposed ferry terminals may include rail (Amtrak and/or BART) links.

Ferry whistles or horns used in proximity to terminals for safety create impulsive and directional sound. A small sample of measured maximum A-weighted sound levels at a distance of 1,000 feet in front of, abeam, and behind a typical ferry horn yielded approximate sound levels of 90 dBA, 83 dBA, and 77 dBA, respectively (BKL Consultants 2002). Horn use usually consists of one or two blows, lasting 2 to 5 seconds per event.

A study of noise from ferry terminals in the State of Washington yielded anecdotal daytime hourly equivalent sound level (L_{eq}) values of 55 to 60 dBA at residential locations varying from approximately 500 feet to 2,500 feet from terminal operations. These noise levels occurred during normal scheduled ferry service. Nighttime levels, when ferries were not operating, yielded hourly L_{eq} near 45 dBA except at a site that was 2,500 feet away (approximately 35 dBA hourly L_{eq}). The range of DNL derived from these 24-hour measurements resulted in levels from 51 dBA at the farther site to 63 dBA at the closer sites (Magnoni 2002).

Summary of Impact NOI-3

- Implementation of the Proposed Project would involve new and existing terminals that could create impacts to noise-sensitive land uses, such as adjacent residential areas. This impact is potentially significant if the exposure and noise levels exceed applicable noise thresholds.

Mitigation NOI-3.1: Siting and planning of new ferry terminals shall include planning to locate terminal areas away from noise-sensitive land uses. Compliance with existing zoning ordinances should be sufficient to mitigate any potential impacts of ferry terminal operations.

Impact After Mitigation: After implementation of Mitigation NOI-3.1, the impact would be less than significant.

Impact NOI-4 **Wildlife could be exposed to noise from proposed ferry operations.**

The proposed project would generate noise both in air and underwater. Therefore, there is a potential impact to wildlife in both media. Potential in-air and underwater environmental impacts to wildlife are addressed separately in the following section.

Mammals. Mammalian hearing varies, although abilities are fairly consistent within families (Fay 1988). In general, mammals can hear in the bandwidth from below 10 Hz to over 150 kHz. Small terrestrial mammals, small odontocetes (toothed whales), and bats hear best at high frequencies; mysticetes (baleen whales) hear best at low frequencies; and most other mammals have similar hearing to humans (20 Hz to 20 kHz). Noise-induced hearing loss usually results from inner ear hair-cell loss, which is typically permanent in mammals.

Airborne sounds as a result of the proposed project would contribute to the ambient noise exposure for small terrestrial mammals and marine mammals (when at the surface or when hauled out). However, little data are available on the overall sound level from specific sources. The small terrestrial mammals of particular interest to this project are the endangered salt marsh harvest mouse and the salt marsh wandering shrew (see Section 3.5, Biological Resources). These mammals would be exposed to noise from the ferries as they pass salt marsh habitat. The auditory sensitivity of these small mammals is at higher frequencies (Fay 1988) and the noise from ferries is in the low to mid-frequency range. Therefore, masking of biologically significant sounds is highly unlikely. Due to the transient nature of noise from passing ferries, the proposed project would likely instigate increased alertness, but not habitat avoidance or hearing loss. Furthermore, small mammals inhabiting the area are already exposed to airborne ship noise within San Francisco Bay and are presumably habituated to such noise. These small mammals would not be impacted by underwater noise generated as a result of the Proposed Project.

The marine mammals of particular interest to this project are the gray whale, Pacific harbor seal, California sea lion, and sea otter. No research has been conducted on the effects of airborne noise on the behavior of gray whales. The response of gray whales to underwater vessel noise depends on several factors, including location of the vessel, behavior of the vessel, and behavior of the whale (i.e., whether the whale is in breeding/calving grounds, migration route, or summering grounds). Gray whales are frequently attracted to vessels in the breeding/calving lagoons of Baja California (Dahlheim et al. 1981; Wisdom 2000), but often change course or stay underwater longer in the presence of vessels while migrating (Schulberg et al. 1991). Because gray whales rarely use the Bay, no impacts are expected as a result of the Proposed Project.

Harbor seals use haul-out sites throughout the Bay (BAC 1998). Small boats that approach haul-out sites often displace seals; less severe disturbances can cause alert reactions without departure (Stewart et al. 1988; Allen 1991). In places with many boats, harbor seals may become habituated to the noise (Johnson et al. 1989). The National Marine Fisheries Service (NMFS) currently has guidelines for avoidance of marine mammals to reduce disturbance. For seals and sea lions, the minimum avoidance distance for haul-out sites is 30 meters (this distance, however, does not take vessel speed or wake wash into account). Distances discussed from the literature show that, in general, seals tend to flush at greater distances than those in the NMFS guidelines. Given the site-specific information available for San Francisco Bay (Castro Rocks), it is recommended that ferry routes should be at least 300 meters from haul-out sites to reduce disturbance to the animals. Figure 3.5.14 in the Biology Section presents seal and sea lion haul-out sites in relation to the ferry routes in the Proposed Project. As shown on the figure, the only haul-outs within 300 meters of a proposed route are on the eastern side of Treasure Island and near Redwood City. Detailed studies regarding the specific location of this haul-out site in relation to specific ferry routes will need to be completed to determine the significance of impacts.

California sea lions also use the Bay, but the only known haul-out site is Pier 39. In the water, sea lions tolerate close and frequent approaches by vessels and often congregate around fishing vessels. Sea lions hauled out on land (or piers) are more responsive, but rarely react unless a boat approaches very closely (Bowles and Stewart 1980). The sea lions that use Pier 39 are habituated to human presence and, therefore, should not be affected by the Proposed Project.

Little data are available on reactions of sea otters to vessels. However, since they rarely use habitat within the Bay, no significant impact as a result of the Proposed Project is expected.

As stated in Section 3.11.1.4, NMFS currently considers, as a guideline, received underwater sound pressure levels at or above 160 dB (re 1 μPa) as constituting harassment of marine mammals. NMFS has suggested that underwater sound pressure levels above 180 dB (re 1 μPa) could cause temporary hearing impairment in marine mammals. As discussed in Section 3.11.1.2, no underwater noise level data for ferries are available. However, based on the worst-case estimate of 177 dB re 1 μPa at 1 meter for a tanker ship pass-by, marine mammals would experience sound levels of 160 dB at a distance of approximately 7 meters and would not experience sound levels greater than 180 dB. Seals and sea lions show high levels of tolerance to vessel traffic and would more than likely remain beyond 7 meters of the ferry due to the high speed of the vessel; therefore, they would not be exposed to underwater noise levels greater than 160 dB.

Birds. Birds have more uniform hearing abilities than mammals and hear best from 100 Hz to 10 kHz. Hearing loss in birds is difficult to characterize because they appear to regenerate inner ear hair cells even after substantial loss (Corwin and Cotanche 1988). Domestic fowl sometimes experience declines in productivity after continuous exposure to noise at high levels, but laying rates did not change in wild waterfowl after exposure to continuous noise received at the nest from a compressor station (reviewed in Bowles 1994). Persistent human disturbance or harassment by predators causes declines in productivity of colonies of birds (Anderson and Keith 1980). Birds exhibit behavioral responses to noise similar to those of mammals. At the lowest level, they become alert to the noise; at the highest level, they abandon the area. In the long term, nesting birds become more habituated and less responsive in the presence of human disturbance if they are not deliberately harassed (Burger and Gochfeld 1981). After habituation, loss rates are too low to be detected.

The USFWS has determined a significance criterion of 60 dBA CNEL at the edge of habitat as an impact. Birds in San Francisco Bay use a variety of habitats, including wetlands, shoreline, sandbars, and the Bay itself; hence it is difficult to determine the sound level received at all bird habitat. Therefore, the distance of the 60 dBA CNEL contour from the ferry operations or routes was calculated using the criteria and assumptions discussed in Impact NOI-2. For an average fast ferry with a pass-by noise rating (or level) of 70 dBA at 1,000 feet, there would be no adverse noise impact from ferry operations or routes at a distance of 34 feet or more from the edge of the noise-sensitive habitat. Mitigation would likely mean moving ferry routes so that the sound level received at the edge of habitat does not exceed 60 dBA CNEL by ensuring that routes are at least 35 feet from sensitive habitat.

Fish. Fish use sound to obtain information about their environment and for communication (Tavolga et al. 1981). Every species of fish has a different auditory system and therefore different hearing sensitivity. Generally, fish hear sounds at frequencies between 50 Hz and 2,000 Hz. Loud sounds may cause damage to auditory systems of fish, ranging from morphological damage to stunning and even death (Hastings 1991). Intense sound pressure levels may also cause morphological damage to other parts of the body, such as the air bladder, that play an important role in acoustic detection and production in some fish.

A review of scientific literature and experiments concluded that several species of fish exposed to underwater sound levels of 180 dB re 1 µPa or higher for 2 hours or less were adversely affected (Finneran et al. 1995). Aversive responses were detected in some fish at levels as low as 161 dB (Hawkins 1973).

As noted in Section 3.11.1.2, underwater noise data for ferries is not available. However, based on the worst-case estimate of 177 dB re 1 µPa at 1 meter for a tanker ship pass-by, fish would experience sound levels of 160 dB at a distance of approximately 7 meters and would not experience sound levels greater than 180 dB. Fish may avoid the area while a ferry is in transit, but it is unlikely that it would cause fish to completely abandon the area.

The worst-case estimate of 177 dB re 1 µPa at 1 meter for a tanker ship pass-by is considered to be very conservative. Whereas tanker propulsion is provided by large propellers, most high-speed vessels use water jet propulsion systems. While non-classified data comparing water jet and propeller noise could not be identified, water jets are considered to produce less underwater noise than propellers. Anecdotal evidence is provided in military citations of the use of water jets in "stealth" vessels to reduce underwater noise (see http://www.memagazine.org/backissues/jan01/features/stealth/stealth.html "They also equipped the Smyge with a quiet propulsion system consisting of two water jets made by KaMeWa Group of Kristinehamn, Sweden. KaMeWa's jets are used on fast ferries, catamarans, and other high-speed marine craft.").

Summary of Impact NOI-4

- **Terrestrial Mammals.** Implementation of the Proposed Project would be unlikely to impact small mammals, such as the salt marsh harvest mouse.
- **Marine Mammals.** No noise impacts to gray whales are expected. No impact is expected for sea lions and sea otters from ferry operations. There is a potential for impacts to seals at the haul-out site on the eastern side of Treasure Island.
- **Birds.** Noise impacts to birds are difficult to determine because of the variety of habitats birds use within San Francisco Bay. There is a potential for impacts if noise levels exceed 60 dBA CNEL at the edge of sensitive habitat.
- **Fish.** Although it is unlikely that fish would completely abandon ferry transit areas, available data preclude determination of impact. Therefore, impacts to fish could be potentially significant for some routes.

Mitigation NOI-4.1: The exact routes from San Francisco to Treasure Island and to Redwood City shall be determined in consultation with federal and state resource agencies. These agencies may require site-specific studies to determine whether impacts to the seals at the nearby haul-outs or to other wildlife (birds and fish), could be significant.

Impacts After Mitigation: It is anticipated that impacts would be less than significant with implementation of Mitigation NOI-4.1, except for the seal haul-outs at Treasure Island and Redwood City. The impact could be potentially significant regarding the seal haul-outs.

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Table 3.11.1
Estimating Existing Noise Exposure

Distance from Major Noise Source [1] (feet)				Noise Exposure Estimates (dBA)			
Interstate Highways [2]	Other Roadways[3]	Railroad Lines [4]	Population Density (people per sq. mile)	L_{eq} (day)	L_{eq} (evening)	L_{eq} (night)	L_{dn}
10 - 49				75	70	65	75
50 - 99				70	65	60	70
100 - 199				65	60	55	65
200 - 399				60	55	50	60
400 - 799				55	50	45	55
800 and up				50	45	40	50
	10 - 49			70	65	60	70
	50 - 99			65	60	55	65
	100 - 199			60	55	50	60
	200 - 399			55	50	45	55
	400 and up			50	45	40	50
		10 - 29					75
		30 - 59					70
		60 - 119					65
		120 - 239					60
		240 - 499					55
		500 - 799					50
		800 and up					45
			1 - 99	35	30	25	35
			100 - 299	40	35	30	40
			300 - 999	45	40	35	45
			1,000 - 2,999	50	45	40	50
			3,000 - 9,999	55	50	45	55
			10,000 - 29,999	60	55	50	60
			30,000 and up	65	60	55	65

Notes:

1. Distances do not include shielding from intervening rows of buildings. General rule for estimating shielding attenuation in populated areas: Assume 1 row of buildings every 100 ft; -4.5 dB for the first row, -1.5 dB for every subsequent row up to a maximum of -10 dB attenuation.
2. Roadways with 4 or more lanes that permit trucks, with traffic at 60 mph.
3. Parkways with traffic at 55 mph, but without trucks, and city streets with the equivalent of 75 or more heavy trucks per hour and 300 or more medium trucks per hour at 30 mph.
4. Main line railroad corridors typically carrying 5 to 10 trains per day at speeds of 30 to 40 mph.

Source: FTA, 1995 (Table 5-7)

Table 3.11.2
Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA) *	Description of Land Use Category
1	Outdoor L_{eq}(h) **	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals, and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor L_{eq}(h) **	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Buildings with interior spaces where quiet is important, such as medical offices, conference rooms, recording studios and concert halls fall into this category, as well as places for meditation or study associated with cemeteries, monuments, and museums. Certain historical sites, parks and recreational facilities are also included.

* Onset-rate adjusted sound levels (L_{eq}, L_{dn}) are to be used where applicable.
** L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.
Source: FTA, 1995 (Table 3-2)

Table 3.11.3
Owner-Imposed Noise Level Limits

Areas of Measurement	Noise Levels Not to Exceed	Applicable Notes
Interior Noise		
Passenger & Crew Spaces	75 dBA	Notes 1, 2, 4, 5
HVAC Noise	55 dBA	Notes 1, 2, 4, 7
Offices	70 dBA	Notes 1, 2, 5
Food Services	75 dBA	Notes 1, 2, 5
Solarium	82 dBA	Notes 1, 2, 5
Wheelhouse	65 dBA	Notes 1, 2, 5
Bridge Wings	65 dBA	Notes 1, 2, 5
Boat Embarkation Station	75 dBA	Notes 1, 2, 6
Line Handling Station	75 dBA	Notes 1, 2, 6
Engine room	120 dBA	Notes 1, 2, 5
Vehicle Deck	75 dBA	Notes 1, 2, 3
Exterior Noise	60 dBA at 1,000 ft distance from the FVF and at elevations of sea level and 100 ft above sea level	
In Harbor	Notes 1, 2, 6	
At Sea	Notes 1, 2, 5	

Source: The Glosten Associates, 2002

Notes:

1. dBA ref: 20 microPascals
2. Criteria do not apply to operation of portable appliances, but do apply to operation of machinery that is operated intermittently or automatically cycles on and off, such as elevators and compressors. The criteria apply with the windlasses, capstans and boat davits secured.
2. Measured at 5 feet above the vehicle deck with fans running at 20 air changes per hour with either loading door open, and all engines running at an rpm and loading reflective of temporary tie-up. (Main engines will not be shut down and shore power will not be connected.)
3. Applies to all passenger spaces, crew spaces and normal work areas throughout the vessel, except the vehicle space and stairwells leading from the vehicle space to these areas.
4. Applies to main propulsion engines operating at maximum fast ferry rating, and all ship systems in normal operation.
5. Measured with the main propulsion engines operating at the maximum harbor maneuvering power without causing waterjet cavitation, and the vehicle deck ventilation system operating at 20 air changes/hour.
7. Applies to all passenger and crew spaces with HVAC equipment operating at the maximum capacities required to achieve the heating or cooling requirements, the auxiliary diesel gensets operating as required to supply the electrical load, and the main engines shut down.

Table 3.11.4
City of San Francisco Operational Noise Standards at Receiving Property Line, dBA[a]

Receiving Zoning/Land Use[a]	Cumulative Number of Minutes in a 1-Hour Period[b]	Maximum Allowable Noise Level (dBA)		
		Daytime 7 a.m.-10 p.m.	Nighttime 10 p.m.-7 a.m.	Notes
Residential (R-E, R-1 and R-2 zones) or single-family or duplex in a specific plan district	30 (L_{50})	60	50	c
	15 (L_{25})	65	55	d
	5 ($L_{8.3}$)	70	60	d
	1 ($L_{1.7}$)	75	65	f
	0 (L_{max})	80	70	g
Residential (R-3 and D-C zones) or multi-family or mixed residential/commercial in any specific plan district	30 (L_{50})	60	55	c
	15 (L_{25})	65	60	d
	5 ($L_{8.3}$)	70	65	e
	1 ($L_{1.7}$)	75	70	f
	0 (L_{max})	80	75	g
C-1, P-C zoning and Gateway and Oyster Point Marina districts or any commercial use in any specific plan district	30 (L_{50})	65	60	c
	15 (L_{25})	70	65	d
	5 ($L_{8.3}$)	75	70	e
	1 ($L_{1.7}$)	80	75	f
	0 (L_{max})	85	80	g
		Anytime		
M-1and P-1 zones	30 (L_{50})	70		c
	15 (L_{25})	75		d
	5 ($L_{8.3}$)	80		e
	1 ($L_{1.7}$)	85		f
	0 (L_{max})	90		g

Source: City of San Francisco — San Francisco Code Section 8.32.030.
Notes:
a: Apply lowest of two zones plus 5 dB if on boundary
b: L_x is the noise level exceeded x percent of a given period. L_{max} is the maximum instantaneous noise level.
c: Apply ambient if it is higher
d: Apply 5 dB above ambient if ambient is higher than L_{50} standard
e: Apply 10 dB above ambient if ambient is higher than L_{50} standard
f: Apply 15 dB above ambient if ambient is higher than L_{50} standard
g: Apply 20 dB above ambient if ambient is higher than L_{50} standard

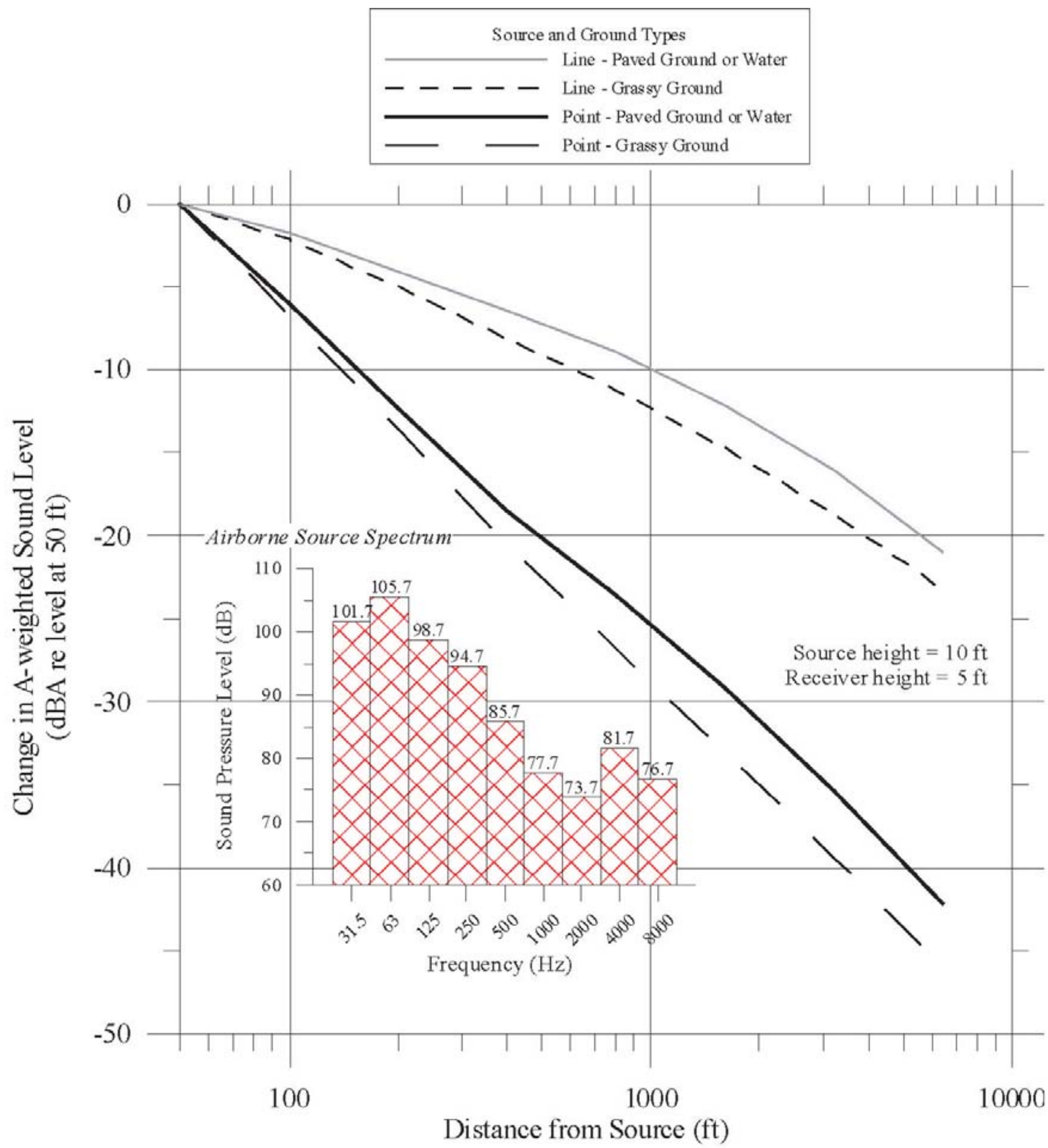
Table 3.11.5
City of Oakland Operational Noise Standards at Receiving Property Line

Receiving Land Use	**Cumulative Number of Minutes in a 1-Hour Period**[a]	**Maximum Allowable Noise Level (dBA)**[b]	
		Daytime 7 a.m.-10 p.m.	**Nighttime 10 p.m.-7 a.m.**
Residential and Civic[c]	20 (L_{33})	60	45
	10 ($L_{16.7}$)	65	50
	5 ($L_{8.3}$)	70	55
	1 ($L_{1.7}$)	75	60
	0 (L_{max})	80	65
		Anytime	
Commercial	20 (L_{33})	65	
	10 ($L_{16.7}$)	70	
	5 ($L_{8.3}$)	75	
	1 ($L_{1.7}$)	80	
	0 (L_{max})	85	
Manufacturing, Mining, and Quarrying	20 (L_{33})	70	
	10 ($L_{16.7}$)	75	
	5 ($L_{8.3}$)	80	
	1 ($L_{1.7}$)	85	
	0 (L_{max})	90	

Source: City of Oakland 1996b—Oakland Planning Code Section 17.120.050.
Notes:
a: Lx is the noise level exceeded x percent of a given period. Lmax is the maximum instantaneous noise level.
b: These standards are reduced 5 dBA for simple tone noise, noise consisting primarily of speech or music, or recurring impact noise. If the ambient level exceeds these standards, the standard shall be adjusted to equal the ambient noise level.
c: Legal residences, schools, childcare facilities, health care facilities, public open space, or similarly sensitive land uses.

Table 3.11.6
Weekday Ferry Pass-bys by Route

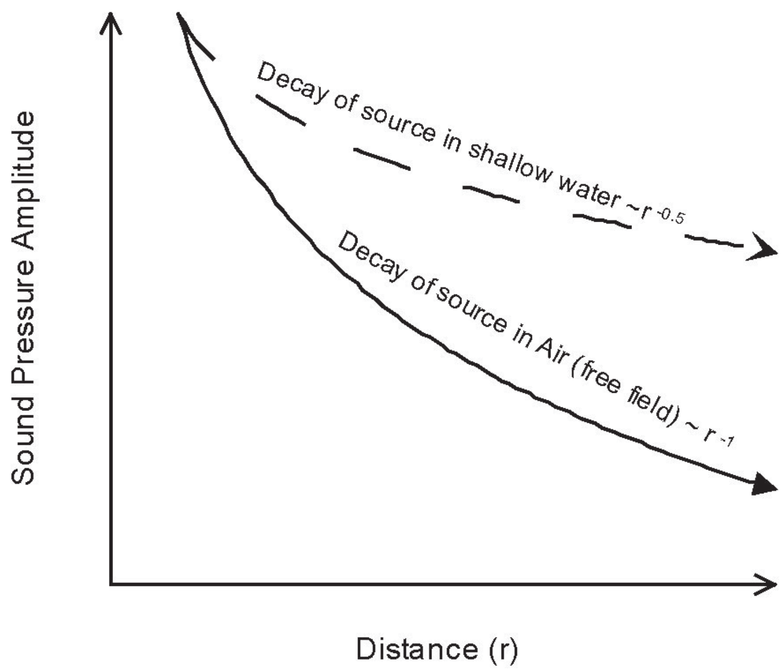
Route	Total Weekday Pass-bys		
	Peak	**Off-Peak**	**Total**
Existing Routes			
Alameda/Harbor Bay Isle - Ferry Bldg.	12	0	12
Jack London Sq.& Alameda Main St.- Ferry Bldg.	24	18	42
Sausalito - Ferry Bldg.	24	18	42
Tiburon - Ferry Bldg.	24	18	42
Larkspur - Ferry Bldg.	36	18	54
Vallejo - Ferry Bldg.	24	18	42
New Routes			
Berkeley/Albany - Ferry Bldg.	24	18	42
Mission Bay – Ferry Bldg.	24	18	42
Redwood City - Ferry Bldg.	12	18	30
Richmond - Ferry Bldg.	24	18	42
Oyster Point (SSF) - Ferry Bldg.	24	18	42
Treasure Island - Ferry Bldg.	24	36	60
Hercules/Rodeo - Ferry Bldg.	12	4.5	16.5
Pittsburg/Antioch & Martinez - Ferry Bldg.	12	5.4	17.4



SOURCE: ISO 9613 3 (1996)

L:/WATER TRANSIT AUTHOR/fig1.fh10 5/03

URS	Water Transit Authority Program EIR Project No. 28066519	EXAMPLE OF OVERALL AIRBORNE SOUND ATTENUATION	Figure 3.11.1



URS

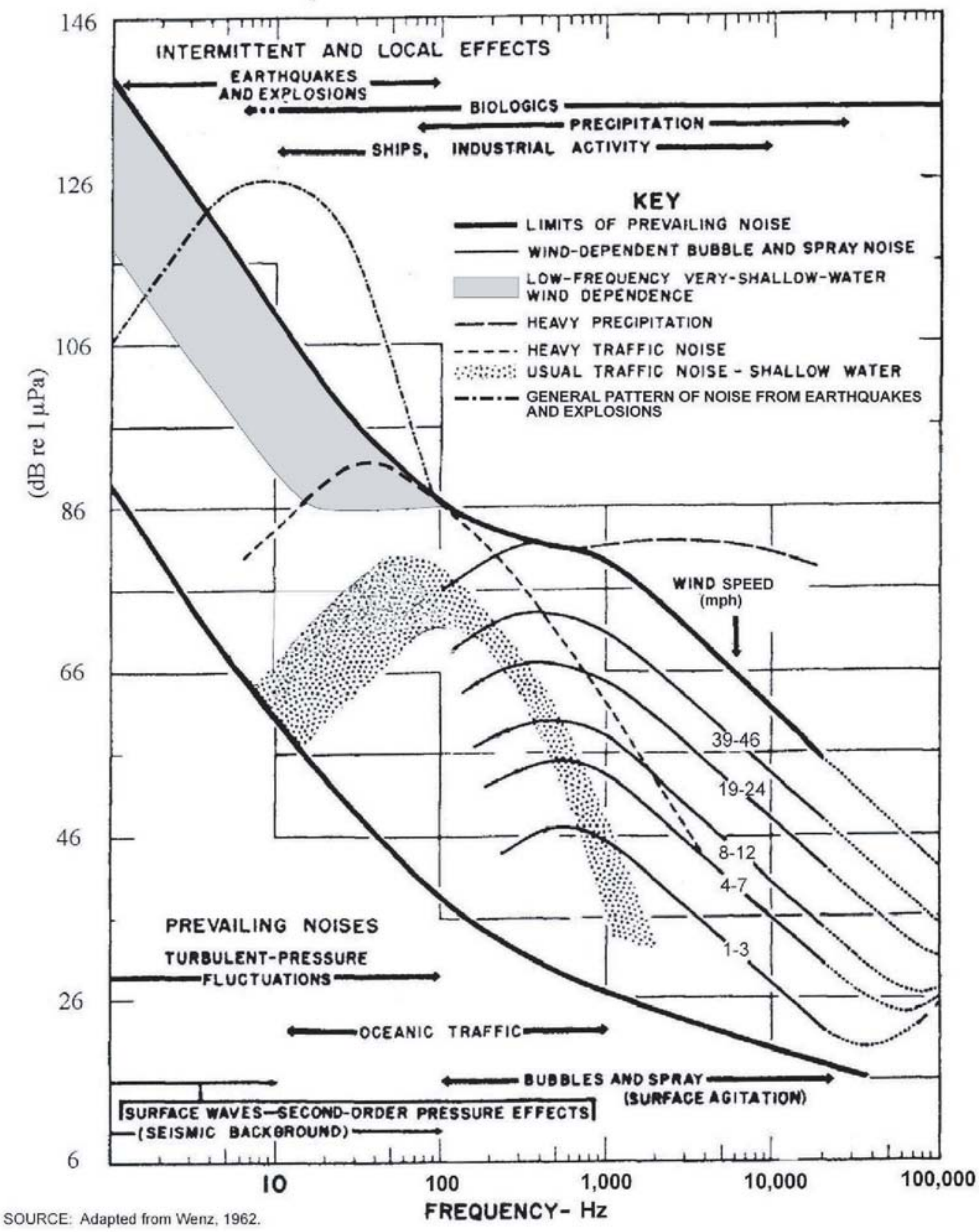
Water Transit Authority
Program EIR

Project No. 28066519

DIFFERENCE IN SPREADING LOSS FOR SOUND PROPAGATING IN AIR AND IN WATER

Figure 3.11.2

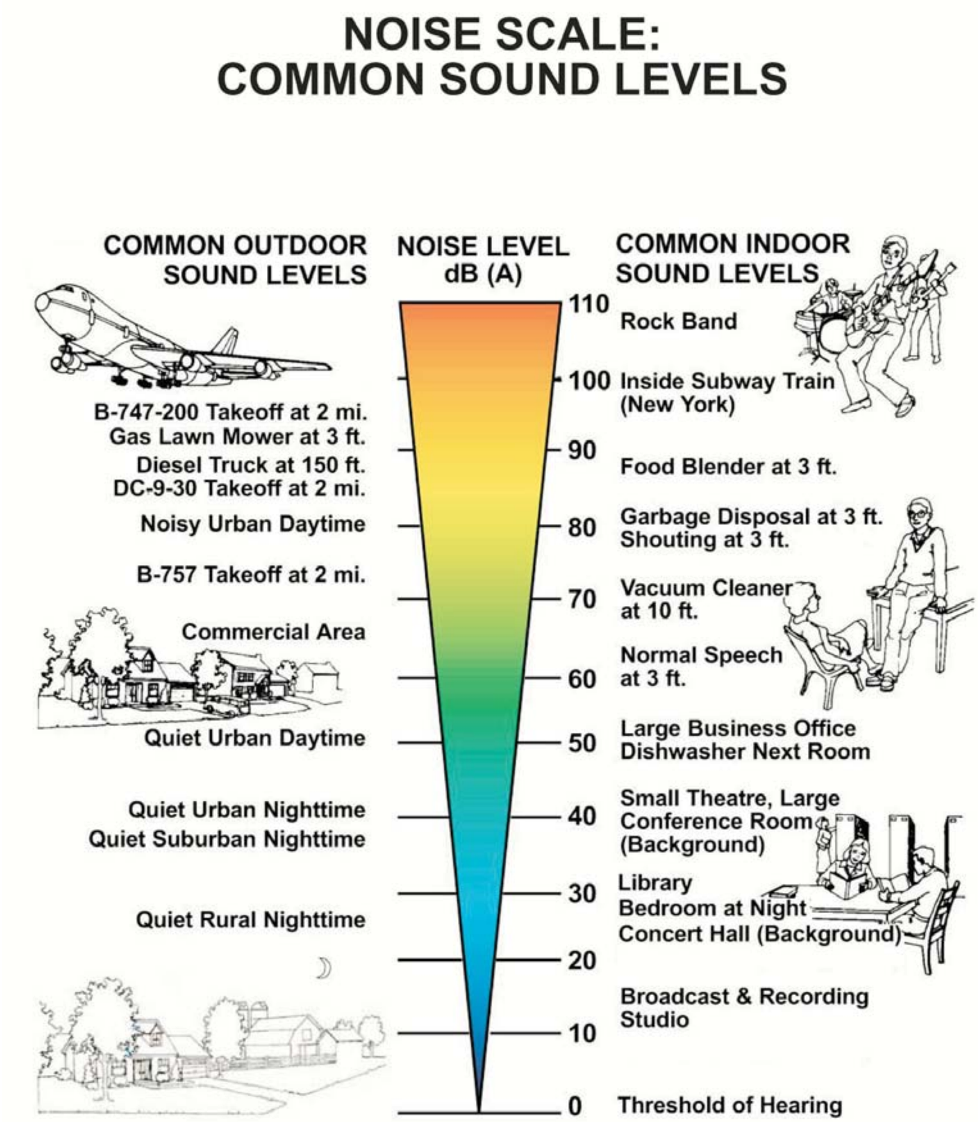
L:/WATER TRANSIT AUTHOR/fig1.fh10 5/03



SOURCE: Adapted from Wenz, 1962.

L:/WATER TRANSIT AUTHOR/fig1.fh10 5/03

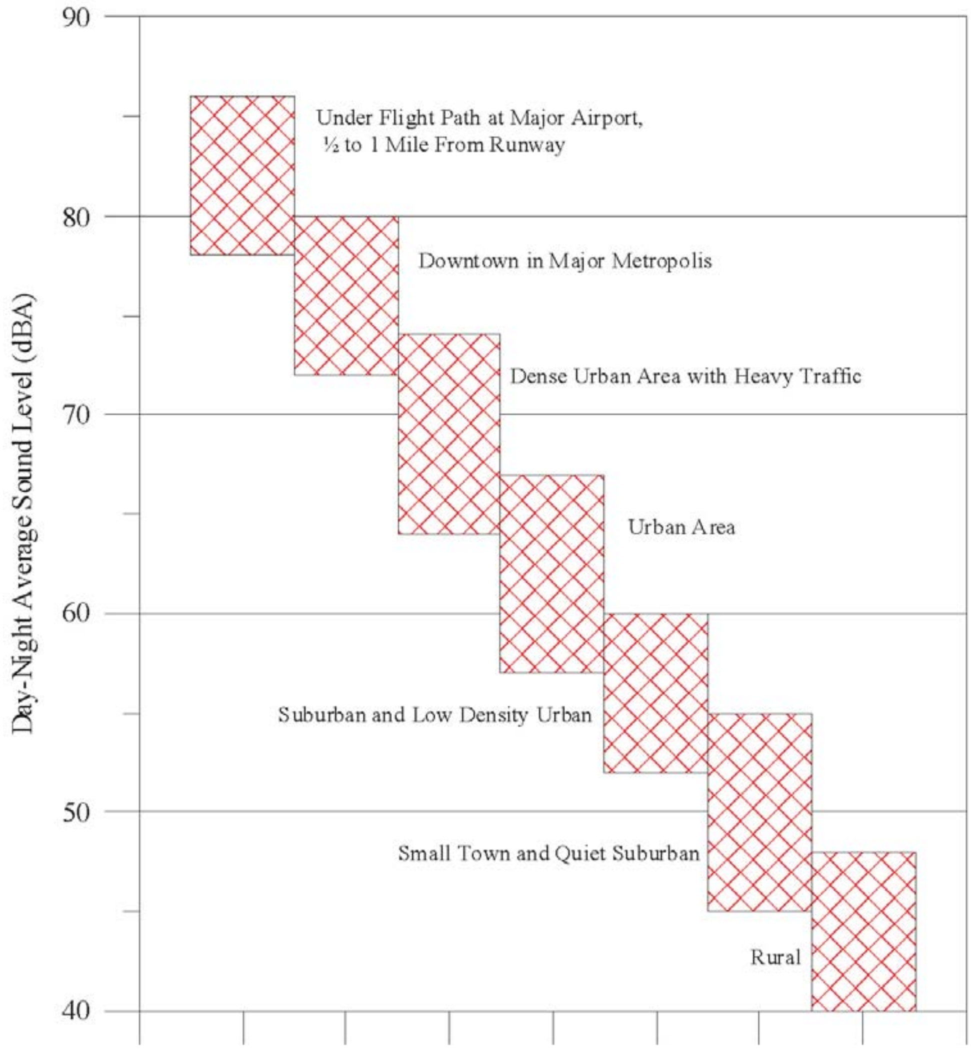
URS	Water Transit Authority Program EIR Project No. 28066519	SUMMARY OF UNDERWATER AMBIENT NOISE	Figure 3.11.3



Source: Draft EIS/EIR LAX Proposed Master Plan Improvements, Los Angeles, CA
U.S. Dept. of Transportation, FAA
January 2001

L:/WATER TRANSIT AUTHOR/fig1.fh10 5/03

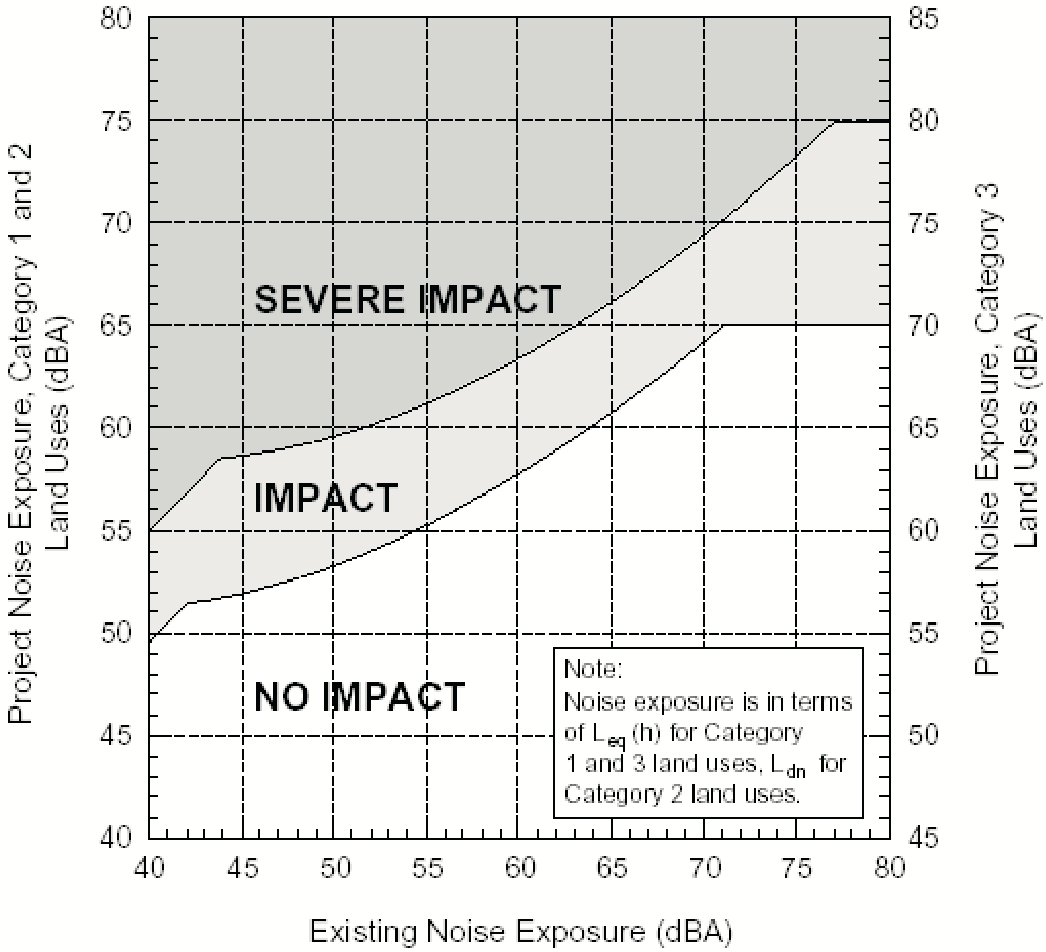
URS	Water Transit Authority Program EIR Project No. 28066519	COMMON INDOOR AND OUTDOOR SOUND LEVELS	Figure 3.11.4



SOURCE: Carver, 1978

L:/WATER TRANSIT AUTHOR/fig1.fh10 5/03

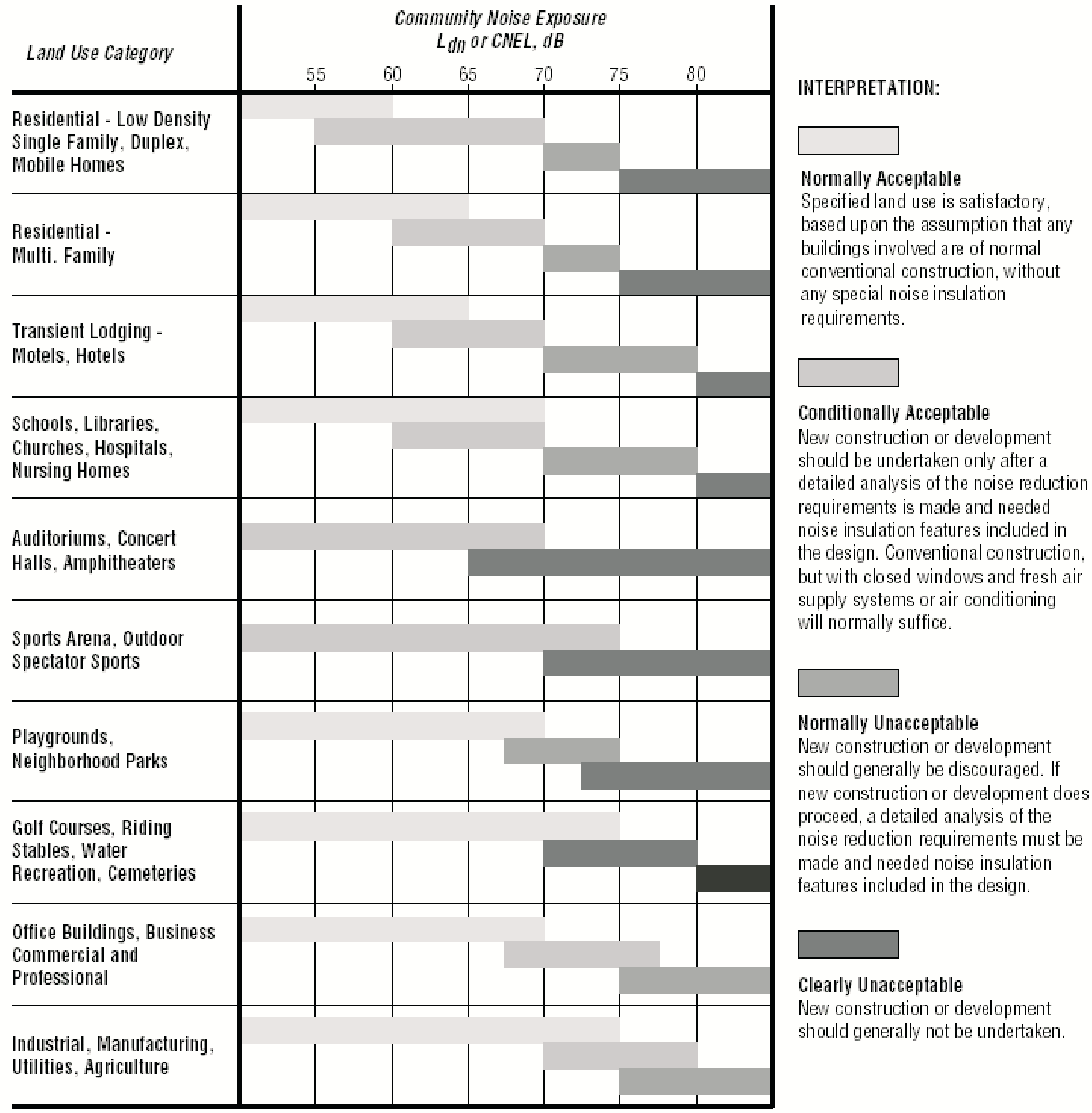
URS	Water Transit Authority Program EIR	TYPICAL RANGE OF OUTDOOR COMMUNITY DAY-NIGHT AVERAGE SOUND LEVELS	Figure 3.11.5
	Project No. 28066519		



SOURCE: Federal Transit Administration, 1995 (Figure 3-1)

L:/WATER TRANSIT AUTHOR/fig1.fh10 5/03

URS	Water Transit Authority Program EIR	NOISE IMPACT CRITERIA FOR TRANSIT PROJECTS	Figure 3.11.6
	Project No. 28066519		



SOURCE: State of California, 1998

L:/WATER TRANSIT AUTHOR/fig1.fh10 5/03

URS

Water Transit Authority
Program EIR

Project No. 28066519

GUIDELINES FOR NOISE COMPATIBLE LAND USE

Figure 3.11.7

3.10 GEOLOGY

This section addresses the geologic environment and the potential geologic and seismic hazard impacts related to the Proposed Project. It includes the baseline geologic, geomorphic, and seismic conditions for the San Francisco Bay Area. Potential geologic and seismic hazards are also discussed, as they might pertain to implementation of the Proposed Project.

3.10.1 Environmental Setting

3.10.1.1 Study Area

The study area for geology and seismic hazards for the Proposed Project is essentially the overall geologic and tectonic setting of the San Francisco Bay Area. The study area is a broad geographic area because of the potential for regional geologic features to affect the Proposed Project. It extends from the edge of the continental shelf, near the Farallon Islands inland to the western margin of the Sacramento-San Joaquin Valley, and from the southern end of the Santa Clara Valley northward to the northern end of the Sonoma Valley. This region incorporates all the major tectonic elements that define the structure and geologic characteristics of or affecting the San Francisco Bay Area.

3.10.1.2 Information Sources

The analyses and conclusions presented in this report were based on the review of U.S. Geological Survey (USGS) and California Division of Mines and Geology (now Geological Survey of California) maps and reports; published and peer-reviewed scientific literature; seismicity catalogs; and other available, non-proprietary geologic and seismologic data.

3.10.1.3 Regional Seismic Setting

The San Francisco Bay region is located on the boundary between the North American and Pacific tectonic plates. The Pacific plate is moving northwest relative to North America across a plate boundary oriented in a north-northwest direction that is approximately 100 kilometers (km) wide. This zone encompasses all the major faults in Northern California (Figure 3.10.1). The relative motion across this plate boundary amounts to 35 to 38 millimeters (mm) per year, with the majority of this motion occurring during large earthquakes (Working Group on California Earthquake Probabilities 1999). Geologically, this region is one of the most active in the world, highlighted by the number of large, damaging earthquakes that have occurred in the past. Major earthquakes have occurred along the margins of the Bay on the San Andreas and Hayward faults in 1836, 1838, 1868, and 1906 (Bakun 1999). Some slip also occurs as aseismic fault creep (i.e., fault movement that does not generate earthquakes) on the Hayward, Concord, and Calaveras faults (Galehouse 1992).

Historical seismicity for the Bay region is primarily associated with the strike-slip faults of the San Andreas system (Figure 3.10.1, Table 3.10.1). Fourteen earthquakes of magnitude (M) 6.0 or greater have occurred in the Bay Area in historical times. Earthquakes of this magnitude pose significant ground-shaking hazard to the study area. Of these, some of the most significant events were:

- **October 21, 1868.** This Richter Local magnitude[1] (M_L) 6.8 earthquake occurred on the southern Hayward fault. Heavy damage was sustained in towns along the Hayward fault in the eastern Bay Area, as well as in San Francisco and San Jose. Reported damage extended from Gilroy and Santa Cruz in the south to Santa Rosa in the north.

- **March 31, 1898.** The San Francisco Bay region was shaken by an earthquake that appeared to be centered near Mare Island in San Pablo Bay. This earthquake caused disturbances in the Bay that were reported as a "tidal wave."

- **April 18, 1906.** The Great San Francisco Earthquake of 1906, Moment magnitude[2] (M_w) 7.9, centered near Olema, was arguably the most destructive earthquake to have occurred in Northern California in historical times. It ruptured the San Andreas fault from San Juan Bautista to the Cape Mendocino. Damage was widespread in Northern California and injury and loss of life was particularly severe. Ground shaking and fire caused the deaths of more than 3,000 people and injured approximately 225,000. Damage from shaking was most severe in areas of saturated or loose, young soils. Liquefaction was reported throughout the Bay Area.

- **October 17, 1989.** The M_w 6.9 Loma Prieta earthquake at 5:04 p.m. local time occurred on or adjacent to the southern Santa Cruz segment of the San Andreas fault. The cities of Los Gatos, Watsonville, and Santa Cruz were hard hit with damage, as were San Francisco and Oakland. Shaking was felt throughout the Bay Area. Damage to major transportation facilities included the collapse of the I-880 Cypress structure, liquefaction and settlement damage to Port facilities in Oakland, and the runway apron at Oakland International Airport, and temporary closure of the Oakland-Bay Bridge. As in the 1906 earthquake, the worst damage from shaking occurred at structures on unconsolidated or saturated soils.

The majority of contemporary seismicity in the Bay Area is associated with the major faults, namely, the Hayward, Rodgers Creek, San Gregorio, Calaveras, and San Andreas faults (Figure 3.10.1; Table 3.10.1), or related secondary structures located within about 5 km of the major faults (Zoback et al., 1999).

3.10.1.4 Physiographic Setting

The San Francisco Bay Area has a structurally controlled topography that consists primarily of north to northwest trending mountain ranges and intervening valleys that are characteristic of the Coast Range geomorphic province (Figure 3.10.2). This fabric is subparallel to the San Andreas fault. The Coast Ranges consist of the Mendocino Range to the north of the San Francisco Bay, the Santa Cruz Mountains west of the Bay, and the Diablo Range to the east of the Bay. The Coast Ranges are composed of a thick sequence of late Mesozoic (200 to 70 million years old)

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[1] Measurement of earthquake size used for relatively small, shallow earthquakes in California. Measures the maximum amplitude traced on seismogram by a seismometer located at a distance of 100 miles (62 km) from the earthquake epicenter.

[2] Measurement of earthquake size based on the energy released. The amount of energy released during an earthquake is a function of the surface area of the fault that has slipped, the amount of slip, and the rigidity of the rock through which the fault passes.

and Cenozoic (less than 70 million years old) sedimentary strata. The northern part of the Coast Range is dominated by the landslide-prone Franciscan Formation.

San Francisco Bay is a topographic trough formed by combination of warping and faulting and is underlain by a down-dropped or tilted block (the Bay Block) (Olson and Zoback 1998). This gap in the Coast Ranges to allow the San Joaquin and Sacramento Rivers to drain to the ocean. The Bay is about 90 km long and from 5 to 8 km wide. Constrictions divide the Bay into Suisun, San Pablo and the North and South San Francisco Bays. The Bay is relatively shallow with depths of less than 3 meters except in locations of drowned drainage channels. The deepest point is within the main channel through the Golden Gate, at a depth of approximately 105 meters below sea level.

To the east, the Coast Ranges are bounded by the Great Valley geomorphic province. The Great Valley comprises two elongate northwest to southeast-trending basins, the Sacramento basin to the northwest and the San Joaquin basin to the southeast located between the Coast Ranges to the west and the Sierra Nevada to the east. The province is approximately 700 km long and 70 to 90 km wide. It is characterized by a thick, relatively undeformed sequence of alluvium and volcanic deposits overlying older sediments. The western margin of the Great Valley, the Coast Ranges-Great Valley geomorphic boundary, is underlain by a system of folds and seismically active thrust faults (Wakabayashi and Smith 1994). This separates the relatively undeformed strata of the Great Valley from the highly deformed rocks of the Coast Ranges.

3.10.1.5 Regional Geology

The geology of the Bay Area is made up primarily of three different geologic provinces: the Salinian block, the Franciscan complex, and the Great Valley sequence (Figure 3.10.3). The Salinian block is located west of the San Andreas fault. It is composed primarily of granitic plutonic rocks, which are similar to those found in the Sierra Nevada and are believed to be rocks of the Sierra Nevada Batholith that have been displaced along the San Andreas fault. To the east of the San Andreas fault and bounded on the west by the Hayward fault is the Mesozoic Franciscan complex. The Franciscan rocks represent pieces of former oceanic crust that have accreted to North America by subduction and collision. These rocks are primarily deep marine sandstone and shale. However, chert and limestone are also found within the assemblage. The rocks of the Franciscan complex are prone to landslides. To the east of the Hayward fault is the Great Valley sequence. This is composed primarily of Cretaceous and Tertiary marine sedimentary rocks in the Bay Area. These rocks are also prone to landsliding.

3.10.1.6 Recent Geologic History

San Francisco Bay is California's largest estuarine environment, and its configuration and the surrounding landscape has been shaped by a combination of tectonic activity, recent sea level changes, and human activities since 1850.

Since the formation of the Sacramento-San Joaquin drainage outlet through the Bay approximately 400,000 years ago, the environment of deposition has fluctuated between estuarine (periods of high sea level resulting from a warm global climate) and alluvial (periods of low sea level during periods of cold global climate) (Sloan 1992).

The present Bay estuary formed less than 10,000 years ago as the global climate warmed and sea levels rose. Marine water re-entered the Bay approximately 10,000 years ago and by about 4,000 years ago had reached its present level. With the establishment of true estuarine conditions, sedimentation in the Bay changed from alluvial sands and silts to dark-colored estuarine clays and silts, commonly called Bay Mud. Deposition of sandier sediment was confined to channels.

Since about 1850, human activities have made enormous modifications to the Bay, causing changes in the patterns of circulation and sedimentation. Between 1856 and about 1900, hydraulic mining in the Sierra foothills deposited several feet of sediment throughout the Bay. Starting in the 1800s, the construction of levees and dykes altered the patterns of drainage and annual flooding in the Sacramento River Delta. Also, the placement of fill at numerous localities around the Bay margins has dramatically altered the shoreline profile during historic time.

3.10.1.7 Geologic and Seismic Hazards

The geologic environment of the greater San Francisco Bay Area comprises a number of potential geologic hazards. These are discussed in the following sections. The specific hazards at each potential terminal locality are summarized in Table 3.10.2.

Surface Fault Rupture

Surface fault rupture is defined as slip on a fault plane that has propagated upward to, and offsetting or disturbing, the earth's surface. Offset on a fault intersecting the ground surface can create a discrete step or fault scarp if fault slip occurs on a single fault plane or within a narrow fault zone. If fault slip is accommodated over a broader area, then the deformation may manifest as a zone of fracturing and ground cracking with minor amounts of offset on individual fractures. However, the cumulative offset across the entire zone may be significant. Surface faulting may also arise as a secondary effect from other geologic processes. Secondary surface faulting can be triggered by aquifer compaction and subsidence or by the effects of strong ground shaking triggering slip on neighboring faults. Surface fault rupture has occurred on a number of faults within the study region during the last 10,000 years (Table 3.10.1). The San Andreas, Hayward, Calaveras, and Greenville faults have all experienced surface rupture associated with large, damaging earthquakes during historical time (Figure 3.10.1).

The Alquist-Priolo (AP) Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy in California. Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that potential buildings will not be constructed across active faults. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 50 feet).

Fault rupture hazard was assessed at each potential terminal locality and ranked as follows: High (located within an AP Earthquake Fault Zone), Moderate (located adjacent to an AP Zone), and Low (located away from known AP Zones). Table 3.10.2 presents a summary of surface fault rupture hazards for each potential terminal locality.

Earthquake Ground Shaking

Strong earthquake ground shaking is probably the most important seismic hazard that can be expected anywhere in the San Francisco Bay Area. The amount of earthquake shaking at a site is a function of earthquake magnitude; the type of earthquake source (i.e., type of fault); distance between the site and the earthquake source; the geology of the site; and how the earthquake waves decrease or attenuate as they travel from their source to the site in question. The larger the earthquake and the shorter the distance between the earthquake source and the site, the greater the amount of shaking. The geologic materials through which the earthquake energy travels toward the site act to decrease, or attenuate, the amount of shaking. The San Francisco Bay Area has experienced a number of large, damaging earthquakes during historical time (see Section 3.10.1.3).

Site-specific earthquake ground motions were not calculated as part of the Program EIR. Because of the overview nature of this evaluation a ranking was developed based on proximity to major active faults, defined as Very High (located 5 km or less from an active fault), High (located 5-10 km from an active fault), and Moderate (located 10-20 km from an active fault). Ground shaking hazards are further discussed under Impacts and Mitigation (Impact G-2). Ground shaking hazards at each potential terminal locality are summarized in Table 3.10.2.

Liquefaction

Liquefaction is a phenomenon in which the strength and stiffness of a soil is reduced by earthquake shaking. Liquefaction and related phenomena have been responsible for tremendous amounts of damage by historical earthquakes around the world.

Liquefaction is the transformation of a granular material from a solid state into a liquefied state as a consequence of increased pore pressure and decreased effective stress (Youd 1973). Increased pore pressures in unconsolidated sediment, especially in western California, are most typically seismically induced deformation. Observed types of ground failure resulting from liquefaction can include sand boils, lateral spreads, ground settlement, ground cracking, and ground warping (Youd and House 1978). Liquefaction occurs in saturated soils.

Lateral Spread is the lateral displacement of surficial blocks of sediment as the result of liquefaction in a subsurface. Once liquefaction transforms the subsurface layer into a fluidized mass, gravity may cause the mass to move downslope toward a cut slope or free face (such as a river channel or a canal). Lateral spreads most commonly occur on gentle slopes that range between 0.3 degrees and 3 degrees. When liquefaction occurs, the strength of the soil decreases and the ability of a soil deposit to support foundations for buildings or other structures is reduced. Liquefied soil also exerts higher pressure on retaining walls, which can cause them to tilt or slide. This movement can cause settlement of the retained soil and destruction of structures on the ground surface. Extensive liquefaction was triggered by the 1906 M_w 7.9 San Francisco earthquake, resulting in widespread damage in areas of soft, saturated soils. Liquefaction also resulted in major damage during the 1989 M_w 6.9 Loma Prieta earthquake.

A map of liquefaction susceptibility in seven counties of the Bay Area, prepared by Knudsen et al. (2000), was used to assess risk for the potential ferry terminal locations (Table 3.10.2). The majority of the terminal locations around the Bay Area are in areas of soft, potentially liquefiable soils (Knudsen et al. 2000). Liquefaction is likely to be triggered by strong shaking from an earthquake on one of the Bay Area's active faults.

Subsidence

Land surface subsidence can result from both natural and man-made phenomena. Natural phenomena include subsidence resulting from tectonic deformations and seismically induced settlements (see liquefaction); soil subsidence due to consolidation; subsidence due to oxidation or dewatering of organic-rich soils: and subsidence related to subsurface cavities. Subsidence or settlement related to human activities includes subsidence caused by decreased pore pressure due to the withdrawal of subsurface fluids, including water and hydrocarbons. Ogden Beeman and Associates (1992) investigated changes in the bathymetry[3] of San Francisco Bay as a result of sedimentation and land level changes. The potential for subsidence hazard was assessed using historically recorded subsidence/uplift behavior in the Bay Area (Table 3.10.2). Ranking of subsidence hazard relates to potential for tectonic subsidence during lifetime of the project. Subsidence due to liquefaction and/or lateral spreading is not considered. Subsidence hazard rankings are as follows: High (area of known ongoing subsidence/uplift), Moderate (area of historical uplift/subsidence), and Low (area with no history of geologically recent uplift/subsidence). The northern shoreline of San Pablo Bay is experiencing contemporary subsidence, probably as a result of a combination of compaction of sediments with a high organic content and ongoing tectonic subsidence.

Expansive Soils

Expansive soils contain mixed-layer clay minerals that increase and decrease in volume upon wetting and drying, respectively. Expansive soils are common throughout California and can cause damage to foundations and slabs unless properly treated during construction. Most fine-grained deposits along the margins of San Francisco Bay contain mixed clay layer and exhibit expansive or potentially expansive behavior. However, the hazard for expansive behavior is considered a low risk for coastal locations in and around the Bay Area because these areas are permanently saturated. Expansive soils hazards at each potential terminal locality are summarized in Table 3.10.2.

Mass Wasting

Mass wasting is downward movement of soils and rock under gravity. This includes landslides, rock falls, and debris flows. Mass wasting requires source materials, a slope, and a triggering mechanism. Source materials include fractured and weathered bedrock and loose soils. Triggering mechanisms include earthquake shaking, heavy rainfall, and erosion.

Slides and earth flows are landslides that can pose serious hazard to property in the hillside terrain of the San Francisco Bay region. They tend to move slowly and thus rarely threaten life directly. When they move (in response to such changes as increased water content, earthquake shaking, addition of load, or removal of downslope support) they deform and tilt the ground surface. The result can be destruction of foundations, offset of roads, and breaking of underground pipes within and along the margins of the landslide, as well as overriding of property and structures downslope. Landslide hazards for the Bay Area have been mapped by the USGS (San Francisco Bay Landslide Mapping Team 1997) and more recently by California Geological Survey (http://gmw.consrv.ca.gov/shmp/) under the Seismic Hazard Mapping Program. Mass wasting hazards at each potential terminal locality are summarized in Table 3.10.2. Ranking of mass wasting hazard is based on the presence of suitable topography, source material (soil or weak rock), and the presence of previous slope movement. Rankings are as

[3] Bathymetry is the water depth relative to sea level. Depth values may be either negative or positive, but should all be understood to be negative.

follows: High (history of landsliding/debris flows), Moderate (area of steep slopes with landslide-prone materials), and Low (flat or relatively flat topography).

Tsunami and Seiche

A tsunami (Japanese word meaning "harbor wave") is a water wave or a series of waves generated by an impulsive displacement of the surface of the ocean or other body of water. Tsunamis can travel across oceanic basins and cause damage several thousand miles from their sources. Most tsunamis are caused by a rapid vertical movement along a break in the Earth's crust, i.e., a tectonic fault rupture on the bottom of the ocean resulting in displacement of the column of water directly above it. The majority of tsunamis are triggered by earthquake rupture along subduction zones. The 1964 Alaska earthquake generated a tsunami that caused widespread damage along the coastline of northern California. Paleoseismic investigations have also shown that tsunamis resulting from earthquakes on the subduction zone beneath Japan and the Cascadia subduction zone in the Pacific northwest have also inundated the Pacific coast states (Atwater et al. 1995).

A seiche is a periodic oscillation or "sloshing" of water in an enclosed basin such as the San Francisco Bay. The period of oscillation can range from minutes to hours. The 1898 "Mare Island" earthquake is reported to have caused a seiche in the northern part of the Bay (Toppozada et al. 1992). There are no reports of damage associated with this event.

Ritter and Dupre (1972) show that for a tsunami originating outside San Francisco Bay, the amount of inundation based on tsunami run-up decreases to 50 percent of its maximum at the Golden Gate by the time it passes the Bay Bridge to the south and the Richmond-San Rafael Bridge to the north. By the time the tsunami reaches the Carquinez Strait to the north or Alviso in the south, the run-up would only be approximately 10 percent of its maximum at the Golden Gate. Tsunami run-up results in inundation and flooding of low-lying areas, and in locations where the waves have sufficient energy cause significant erosion. The inundation model of Ritter and Dupre (1972) was used to assess hazards related to tsunamis and seiche in San Francisco Bay (Table 3.10.2). The ranking of tsunami hazard is based on the exposure of each terminal locality to the open ocean, where: High – exposed to open-ocean tsunami waves; Moderate – exposed to reduced-height tsunami waves or smaller local tsunamis; Low – sheltered from potential tsunami waves.

3.10.1.8 Regulatory Setting

Regulatory requirements potentially applicable to geology and geologic hazards are summarized below:

1998 California Building Code

The California Building Code (CBC) contains the minimum standards for design and construction in California. Local standards other than the CBC may be adopted if those standards are stricter. Some design considerations associated with seismic hazards will have to address the appropriate building codes for each ferry expansion facility location. The CBC involves the standards associated with seismic engineering detailed in the Uniform Building Code of 1997.

California Public Resources Code Section 25523(a); 20 CCR 1752(b) and (c); 1972 Alquist-Priolo Earthquake Fault Zoning Act (amended 1994)

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. The Alquist-Priolo Earthquake Fault Zoning Act's main purpose is to prevent the construction of buildings used for human occupancy on the surface trace of active faults.

Before a project can be permitted, cities and counties must require a geologic investigation to demonstrate that potential buildings will not be constructed across active faults. An evaluation and written report of a specific site must be prepared by a licensed geologist. If an active fault is found, a structure for human occupancy cannot be placed over the trace of the fault and must be set back from the fault (generally 50 feet).

California Public Resources Code Chapter 7.8, 1990 Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act of 1990 allows the lead agency to withhold permits until geologic investigations are conducted and mitigation measures are incorporated into plans. The Seismic Hazards Mapping Act addresses not only seismically induced hazards but also expansive soils, settlement, and slope stability. The Seismic Hazards Mapping Act will be relevant to soil conditions at some future facility sites.

3.10.2 Impacts and Mitigations

3.10.2.1 Significance Criteria

Impacts would be considered significant if they would:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving surface fault rupture, earthquake ground shaking, liquefaction, subsidence, uplift, expansive soils, mass wasting, erosion, and tsunami or seiche;
- Expose people or structures to on-site or off-site landslides, lateral spreading, ground subsidence, liquefaction, or collapse because terminals were situated on unstable geologic units or soil, or soil that could become unstable as a result of the project;
- Prevent future access to geologic features and resources of economic or scientific value.

The following section discusses potential impacts to and from the geologic environment for the Proposed Project. Geologic hazards considered include surface fault rupture, earthquake ground shaking, liquefaction and lateral spreading, uplift and subsidence, expansive soils, mass wasting, erosion, and tsunamis. Major active faults in the Bay Area are summarized in Table 3.10.1. The potential exposure of transit terminals to geologic hazards is summarized in Table 3.10.2. Mitigation measures to overcome the various geologic hazards are also presented. The potential impacts of the program on the geologic environment are discussed.

3.10.2.2 Impacts

Impact G-1 **Potential new terminals and facilities could be exposed to surface faulting. There is a potential for substantial damage and risk of injury or loss of life at facilities located on or near active faults.**

The State of California delineates zones around active faults under the Alquist-Priolo (AP) Earthquake Fault Zone Act (Hart 1994). Any development within an AP Zone requires detailed geologic investigation to accurately delineate active fault strands such that they can be avoided. Fault rupture beneath engineered structures can, if the fault displacement is large enough, lead to damage and in extreme conditions catastrophic collapse. Even minor fault displacements can cause significant structural damage.

None of the ferry terminal locations for the Proposed Project are within an AP Zone. Therefore, the potential for exposure and damage from surface fault displacement is low (Table 3.10.2).

Summary of Impact G-1

- The Proposed Project does not include new terminal locations within AP Zones. Therefore, the potential for impacts from surface faulting is low and is considered less than significant.

Impact G-2 **Potential new terminals and other facilities could be exposed to strong ground shaking. There is a potential for substantial damage to facilities and risk of injury or loss of life at incorrectly designed or constructed facilities.**

The Bay Area is seismically active and all sites have a reasonably high potential of experiencing significant strong earthquake shaking in the future (Working Group on California Earthquake Probabilities 1999). This is true for most transportation facilities and public buildings in and around the Bay Area.

A number of attenuation relationships have been developed based on recordings of earthquake shaking. These relate earthquake size, distance from the earthquake source, and geologic conditions to the amount of shaking that can be expected at a site. The amount of shaking is expressed in terms of "Peak Horizontal Acceleration" measured in percent of acceleration of gravity (g) (approximately 9.8 m/s^2). However, because no specific projects are proposed at this time, no site-specific ground motions were calculated for any sites during this study. Rather, relative levels of earthquake shaking were estimated based on the proximity of each terminal site to known active faults (Table 3.10.2). Sites located less than 5 km from an active fault could experience "very high" shaking. Sites located 5 to 10 km from an active fault could experience "high" levels of shaking. Sites located 10 to 20 km from active faults could experience "moderate" shaking. In cases where ground conditions are likely to amplify the effects of earthquake shaking (deep, soft sediment), there is an increase in the likely shaking hazard ranking (i.e., a site on soft Bay Mud located 7 km from an active fault would likely experience "very high" levels of earthquake shaking). As shown on Table 3.10.2, all of the proposed terminal sites for the Proposed Project could experience "high" to "very high" earthquake shaking.

The levels of earthquake shaking expected from a large earthquake on any of the Bay Area faults would likely result in structural damage and possible injury or loss of life at poorly constructed structures. Areas where foundation conditions have not been sufficiently engineered could experience a loss of bearing capacity, leading to significant structural damage and even collapse.

Summary of Impact G-2

- The Proposed Project includes new terminals. If the new structures and facilities are not properly designed or constructed for site-specific conditions, they could suffer substantial damage from seismic activity and pose potential risk of injury or loss of life to occupants. This impact is potentially significant.

Mitigation G-2.1: Terminal facilities shall be designed and constructed at a minimum to the seismic design requirements for ground shaking specified in the Uniform Building Code for Seismic Zone 4. Additionally, to satisfy the provisions of the 1998 California Building Code, these facilities shall be designed to withstand ground motions equating to approximately a 500-year return period (10 percent probability of exceedence in 50 years). For design purposes, site-specific ground motions shall be calculated for all project sites.

Impact After Mitigation: Impact G-2 would be less than significant with implementation of Mitigation G-2.1.

Impact G-3 **Potential new terminals are in areas of potentially liquefiable soils. There is a potential risk for destruction of structures.**

A map of liquefaction susceptibility in the seven-county Bay Area, prepared by Knudsen et al. (2000), was used to assess risk for the potential ferry terminal locations (Table 3.10.2). The majority of the terminal locations around the Bay Area are in areas of soft, potentially liquefiable soils (Knudsen et al. 2000). Liquefaction is likely to be triggered by strong shaking from an earthquake on one of the Bay Area's active faults. When liquefaction occurs, the strength of the soil decreases, and the ability of soil to support building foundations is reduced. Liquefied soil also exerts higher pressures on retaining walls, which can cause them to tilt or slide. This movement can cause settlement of the retained soil and destruction of structures on the ground surface. Increased water pressure can also trigger landslides. Liquefaction can be minimized or even prevented by adopting appropriate ground improvement techniques, such as soil densification and dewatering, or by designing foundations that will accommodate differential ground movement during liquefaction.

Summary of Impact G-3

- The Proposed Project includes new terminals located within areas ranked as having high to very high susceptibility to liquefaction. This is a potentially significant impact only if soil improvement techniques are not implemented or building foundations are not designed correctly for potentially liquefiable conditions.

Mitigation G-3.1: A program of site-specific exploratory borings and accompanying laboratory testing will be required to delineate any potentially liquefiable materials underneath potential terminal sites. These geotechnical investigations will also be required for consideration prior to foundation design. Potentially liquefiable deposits will either have to be removed or engineered (dewatered or densified) to reduce their liquefaction potential.

This has been performed with success within areas of liquefaction risk in the Bay Area. For example, densified fill material in areas of Foster City and Redwood Shores survived the 1989 M_w 6.9 Loma Prieta earthquake without liquefying (Benuska 1990). The commercial and residential developments situated on these areas of engineered fill suffered no major structural damage during the earthquake.

Impact After Mitigation: Impact G-3 would be reduced to less than significant levels with implementation of Mitigation G-3.1 for potential new terminals.

Impact G-4 **Subsidence is ongoing in portions of the Bay Area. Damage from subsidence is a potential geohazard.**

Although subsidence is ongoing in areas of the Bay (Ogden Beeman and Associates 1992), it does not appear to pose a significant hazard during the lifetime of the project. Significant land level changes generally occur on geologic time scales (more than a thousand years). The geohazard presented by subsidence to potential new terminals is low (Table 3.10.2). Therefore, the hazard from subsidence is likely negligible at potential transit terminal localities and the potential for impacts is considered less than significant.

Summary of Impact G-4

The Proposed Project includes new terminals located in areas of low potential for subsidence. Therefore, the hazard from subsidence is likely negligible at potential transit terminal localities and the potential for impacts is considered less than significant. No mitigation is required.

Impact G-5 **Expansive soil behavior is associated with wetting and drying of soils containing mixed-layer clays. Expansive soils can lead to structural damage.**

The high groundwater table along the margins of the Bay indicates that soils at these localities are permanently saturated; therefore, there is a very low risk of expansive soil behavior and this impact is considered less than significant.

Summary of Impact G-5

- The Proposed Project includes new terminals located along the shore, where soils are permanently saturated. The hazard of expansive soils is considered less than significant, and no mitigation is required.

Impact G-6 **Slope movements have the potential to cause a range of impacts from minor structural damage (building impacts from rock fall) to major damage and injury/loss of life from building collapse.**

Project sites located adjacent to any areas of steep topography are potentially prone to slope instability, depending on source materials, when subject to a triggering mechanism such as heavy rainfall or seismic shaking. Slope instability ranging from rock falls to block sliding is possible on any steep slope around the Bay Area. Particularly prone areas are underlain by rocks of the Great Valley Group or the Franciscan Complex. However, for the Proposed Project, all localities of proposed new terminals are on relatively flat topography. Therefore the potential hazard from mass wasting is considered less than significant.

Summary of Impact G-6

- All localities of proposed new terminals are in relatively flat topography. Therefore the potential hazard from mass wasting is considered less than significant.

Impact G-7 Erosion due to wind and water action could lead to the deterioration of terminal structures.

Wind and water are the primary agents of erosion, leading to the weathering and subsequent transportation of rock and soils. In coastal and shoreline environments, both agents work in conjunction, often augmented by tidal and current action, to cause removal and/or redeposition of sediments and soft, easily erodable rock. In addition, erosion of soils and soft rock along the margins of river channels can be significant due to high velocity flows.

Comparison of pre-1900 and post-1900/pre-fill topographic maps of San Francisco Bay indicates that the greatest amount of erosion has occurred along the East Bay shoreline in the area south of the Bay Bridge (NOAA no date). This erosion is the result of wave action, driven by the prevailing winds that cross the Bay from the west. The western shoreline, in the lee of the Peninsula Hills and San Bruno Mountain, has remained essentially unchanged during this period.

Other areas that may be subject to erosion are located along the banks of rivers, where relatively high velocity flows can occur during flood stage.

Erosion can result in undermining of seawalls, foundations, and other constructed facilities located adjacent to the coast or river channel.

As shown in Table 3.10.2, Vallejo, Pittsburg/Antioch, and Martinez have moderate potential for erosion. All other proposed terminals have low potential. However, the majority of landside portions of terminals would either be on piles or set back from the shoreline. Erosion would not be an issue for ferry floats. While it is unlikely that erosion would lead to significant impacts, until site-specific conditions are known, this remains a potentially significant impact.

Summary of Impact G-7

- The Proposed Project includes new terminals (Pittsburg/Antioch and Martinez) along narrow portions of the North Bay, where relatively high velocity flows can occur during flood stage. These terminals could be subjected to erosion. While it is unlikely that erosion would lead to significant impacts, until site-specific conditions are known, this remains a potentially significant impact.

Mitigation G-7.1: The erosion potential of each site will have to be determined on a site-specific basis. Once this has been determined, appropriate mitigation measures, if necessary, could be adopted.

If erosion is determined to be a significant threat at a terminal location, the specific location of the terminal could be changed and/or terminal design could be changed to minimize the potential for impacts from erosion. As a last resort, the shoreline could be armored with rip-rap or concrete seawalls. Defensive measures such as groins that modify or deflect flow and circulation patterns are not desirable as they can merely transfer erosion problems elsewhere.

Impact After Mitigation: Impact G-7 would be less than significant after implementation of Mitigation G-7.1.

Impact G-8 Tsunami- and seiche-generated waves have the potential to inundate shoreline sites and damage terminal facilities.

Ritter and Dupre (1972) show that for a tsunami originating outside San Francisco Bay, the amount of inundation, based on tsunami run-up, decreases to 50 percent of its maximum at the Golden Gate by the time it passes the Bay Bridge to the south and the Richmond-San Rafael Bridge to the north. By the time the tsunami reaches the Carquinez Strait to the north or Alviso in the south, the run-up would only be approximately 10 percent of its maximum at the Golden Gate. This model was used to assess hazards related to tsunamis and seiche in San Francisco Bay.

Tsunami-generated waves have the potential to inundate low-lying coastal areas and cause extensive erosion and/or deposition of sediment. Poorly constructed facilities can also be damaged by both the incoming waves and outgoing return flow. By the time a tsunami enters the Bay, its impacts will be dramatically reduced compared to those on the open coast. Therefore, the impact of a tsunami to facilities along the Bay shoreline would be minimal, possibly involving a meter or so of potential inundation. The Proposed Project does not include any oceanside terminals and the potential for impacts from tsunamis to facilities along the Bay shoreline is minimal. Therefore, the impact is less than significant.

Summary of Impact G-8

- The Proposed Project does not include any oceanside terminals and the potential for impacts from tsunamis to facilities along the Bay shoreline is minimal. Therefore, the impact is less than significant.

Impact G-9 The ferry expansion program could potentially impact the geologic environment, including energy or mineral resources.

Hydrocarbon Resources. No known hydrocarbon (oil and gas) resources are within the immediate area of the project with the exception of a gas field located near Antioch (DOGG 2001). However, the Proposed Project is not expected to have an impact on this resource.

Geothermal Resources. No known geothermal resources are within the immediate area of the program expansion (DOGG 2001). The Proposed Project would have no impact on geothermal resources.

Crushed Rock Aggregate Resources. The majority of the terminal locations are classified by California Division of Mines and Geology (now California Geological Survey) as being Mineral Resource Zone (MRZ)-1 or MRZ-4 areas (Stinson et al. 1987). MRZ-1 describes “areas where adequate information indicates that no significant mineral deposits are present, or where it is judged that little likelihood exists for their presence.” MRZ-4 describes “areas where available information is inadequate for assignment to any other MRZ zone." Based on this information, the majority of potential terminal locations would have no impact on economic mineral resources. However, Rodeo was classified as MRZ-3 areas containing crushed aggregate resources. MRZ-3 describes "areas containing mineral deposits, the significance of which cannot be evaluated from available data". Therefore, there is a possibility that the Hercules/Rodeo site could locally affect future use of these crushed aggregate resources.

Activities involved in the ferry terminal construction would likely require crushed rock aggregate for the manufacture of concrete elements (e.g., piles, retaining wall structures, and surface facilities). Considerations of transportation cost mean that this material would have to come from local sources. This would result in increased production of crushed rock aggregate at local source sites, but this has not been a major constraint for other Bay Area projects.

Sand and Gravel Resources. Antioch is classified as an MRZ-3 area containing sand and gravel resources. This indicates that the siting of shore facilities at these locations could restrict future development of these sand and gravel resources. However, the terminal would be located in the Rivertown district, which does not permit the types of uses involved in extracting or processing sand and gravel resources (Albro 2002). In addition, the Bay Area has other available sources for these materials. Therefore, the Proposed Project would not have a significant impact on these resources.

Unique or Outstanding Geologic and Geomorphic Features. The area of San Francisco Bay surrounding potential terminal sites does not contain any unique geological formations, geological features, or geomorphological features that would be adversely impacted by the Proposed Project.

Summary of Impact G-9

- The Proposed Project does not appear to have a significant potential to impact energy or geologic resources. Therefore, impacts are anticipated to be less than significant.

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Table 3.10.1
Major Active Faults in the San Francisco Bay Area

Fault Name	Maximum Length (km)	Maximum Magnitude (M_w)	Dip (°)	Approximate Age of Most Recent Rupture Event	Slip Rate (mm/yr)
San Gregorio	175	7.7	90	Holocene	7 ± 3
San Andreas	474	7.9	90	1906	24 ± 5
Rodgers Creek	63	7.1	90	Holocene	9 ± 2
Hayward	87	7.1	90	1868 (Currently creeping)	9 ± 2
Calaveras	123	7.5	90	Holocene (Part in 1851)	15 ± 3
Concord	20	6.6	90	Holocene (Currently creeping)	4 ± 2
Green Valley	36	7.0	90	Holocene (Currently creeping)	5 ± 3
Coast Range-Sierra Block	41	6.6	15 WSW	Holocene	1.5 ± 0.5
Greenville	73	7.2	90	Holocene (Part in 1980)	2.0 ± 1.0
Ortigalita	92	7.2	90	Holocene	1.0 ± 0.5
West Napa	33	6.8	90	Holocene	1.0 ± 0.5
Mount Diablo	25	6.7	20 NE	Holocene	3.0 ± 1.0

Sources: Working Group on California Earthquake Probabilities (1999); Working Group on Northern California Earthquake Potential (1996)

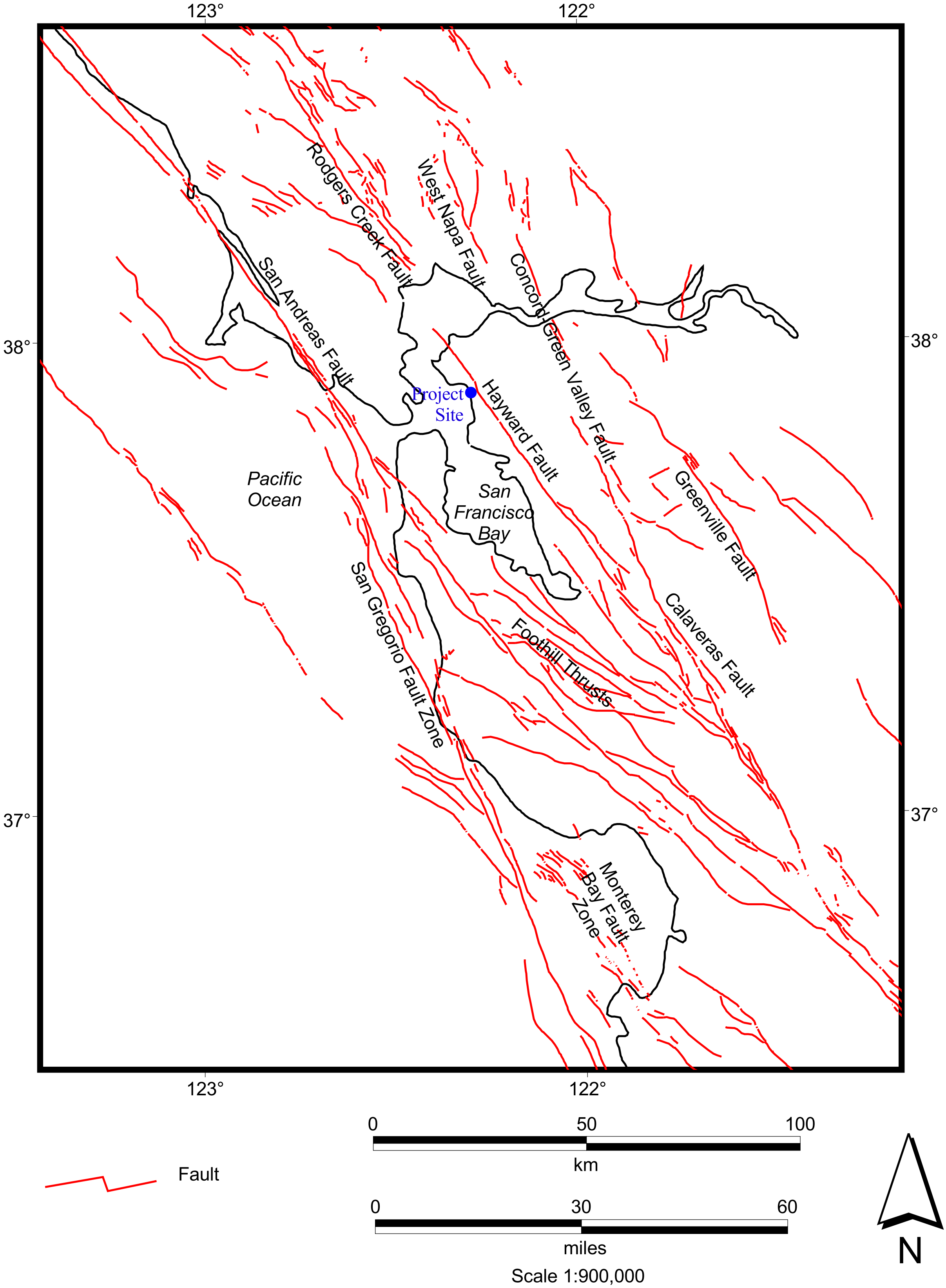
Table 3.10.2
Geohazard Exposure for Potential Terminal Sites

	Terminal Site	Potential Geohazards							
		Earthquake Shaking[1]	Fault Rupture[2]	Liquefaction[3]	Subsidence / Uplift[4]	Landsliding[5]	Erosion[6]	Expansive Soils[7]	Seiche / Tsunami[8]
Existing Terminals	Vallejo	Very High	Low	High to V. High	Low	Low	Moderate	Low	Low
	Larkspur	High	Low	Very High	Low	Low	Low	Low	Low
	Tiburon	High	Low	Very High	Low	Low	Low	Low	Low
	Sausalito	High	Low	Very High	Low	Moderate	Low	Low	Low
	SF Ferry Building	High	Low	Very High	Low	Low	Low	Low	Low to Moderate
	Jack London Square	High	Low	Very High	Low	Low	Low	Low	Low
	Alameda	High	Low	Very High	Low	Low	Low	Low	Low
	Harbor Bay Isle	High	Low	Very High	Low	Low	Low	Low	Low
Proposed Terminals	Pittsburg/Antioch	High	Low	Moderate to V. High*	Low	Low	Moderate	Low	Low
	Martinez	High	Low	Very High	Low	Low	Moderate	Low	Low
	Richmond	High or V. High*	Low	V. Low or V. High*	Low	Low	Low	Low	Low
	Berkeley / Albany	Very High	Low	Very High	Low	Low	Low	Low	Low
	Treasure Island	High	Low	Very High	Low	Low	Low	Low	Low to Moderate
	Redwood City	High	Low	High	Low	Low	Low	Low	Low
	Oyster Point (SSF)	Very High	Low	Very High	Low	Low	Low	Low	Low
	Hercules/Rodeo	High	Low	High	Low	Low	Low	Low	Moderate

Notes:

1) Earthquake Shaking: Site-specific earthquake ground motions were not calculated. Ranking is based on proximity to major active faults. Very High = 5 km or less from active fault; High = 5-10 km from active fault; Moderate = 10-20 km from an active fault.
2) Fault Rupture: High = within an Alquist-Priolo (AP) Earthquake Fault Zone; Moderate = adjacent to an AP Zone; Low = away from known AP Zones.
3) Liquefaction: Hazards designations based on ranking of Knudsen et al. (2000).
4) Subsidence/Uplift: Ranking relates to potential for tectonic uplift/subsidence during lifetime of the project. Subsidence due to liquefaction and/or lateral spreading is not considered. High – Area of known ongoing subsidence/uplift; Moderate – Area of historical uplift/subsidence; Low – Area with no history of geologically recent uplift/subsidence.
5) Landsliding: High – History of landsliding/debris flows; Moderate – Area of steep slopes with landslide-prone materials; Low – Flat or relatively flat topography.
6) Erosion: High – Area of significant active erosion; Moderate – Site located adjacent to river channel, open ocean, or coastline exposed to wind/wave fetch; Low – Site sheltered from agents of erosion.
7) Expansive Soils: The expansive soil hazard at all localities is considered low as the coastal location of these sites ensures that the soils will almost always be saturated and, therefore, not subject to shrink/swell wetting and drying.
8) Seiche/Tsunami: High – exposed to open ocean tsunami waves; Moderate – exposed to reduced-height tsunami waves or smaller local tsunamis; Low – sheltered from potential tsunami waves.

* Actual hazard ranking is dependent on the exact location of the shore-based facility.



URS

Water Transit Authority Program EIR

Project No. 43-00066890

MAJOR ACTIVE FAULTS

Figure 3.10.1

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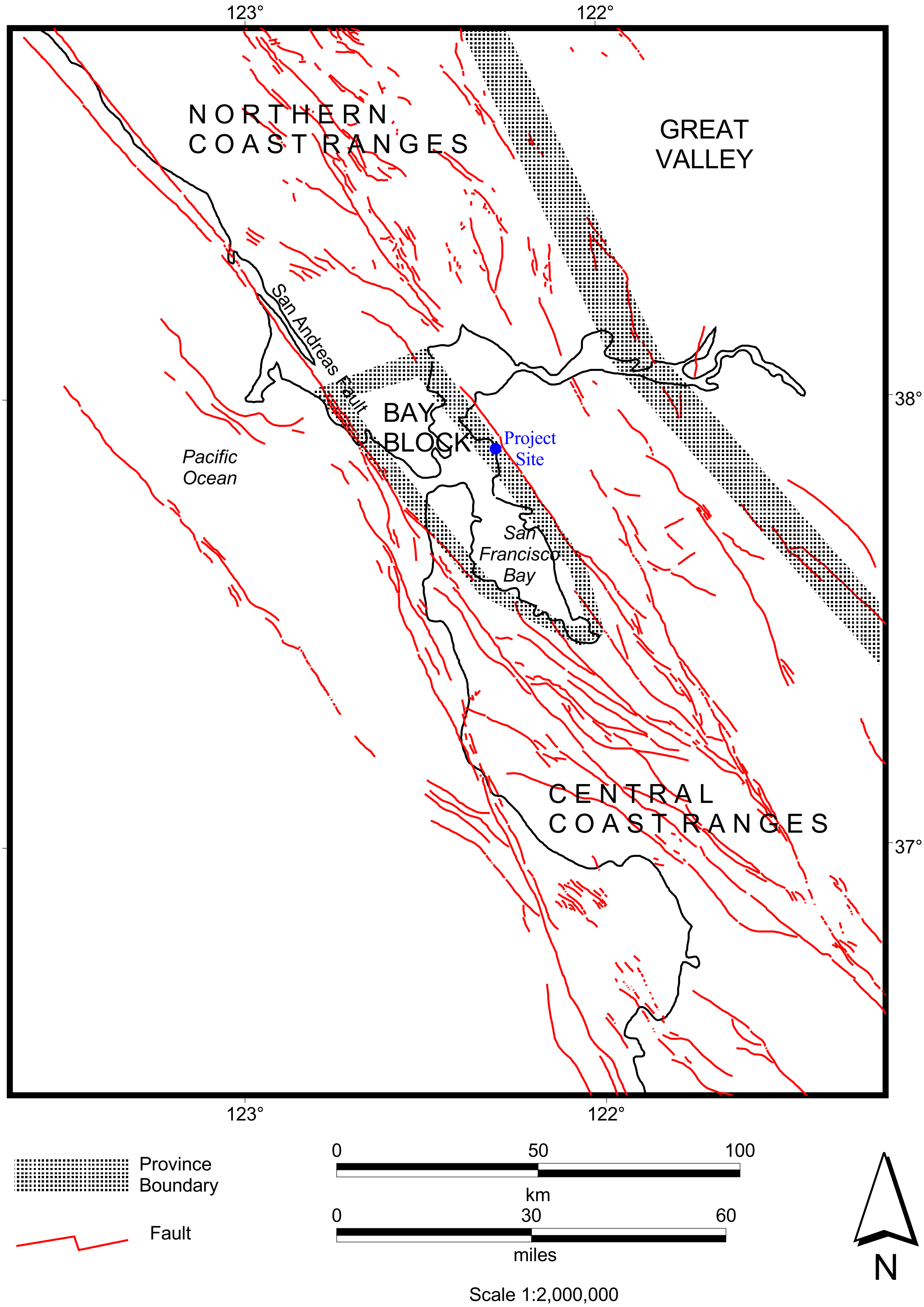

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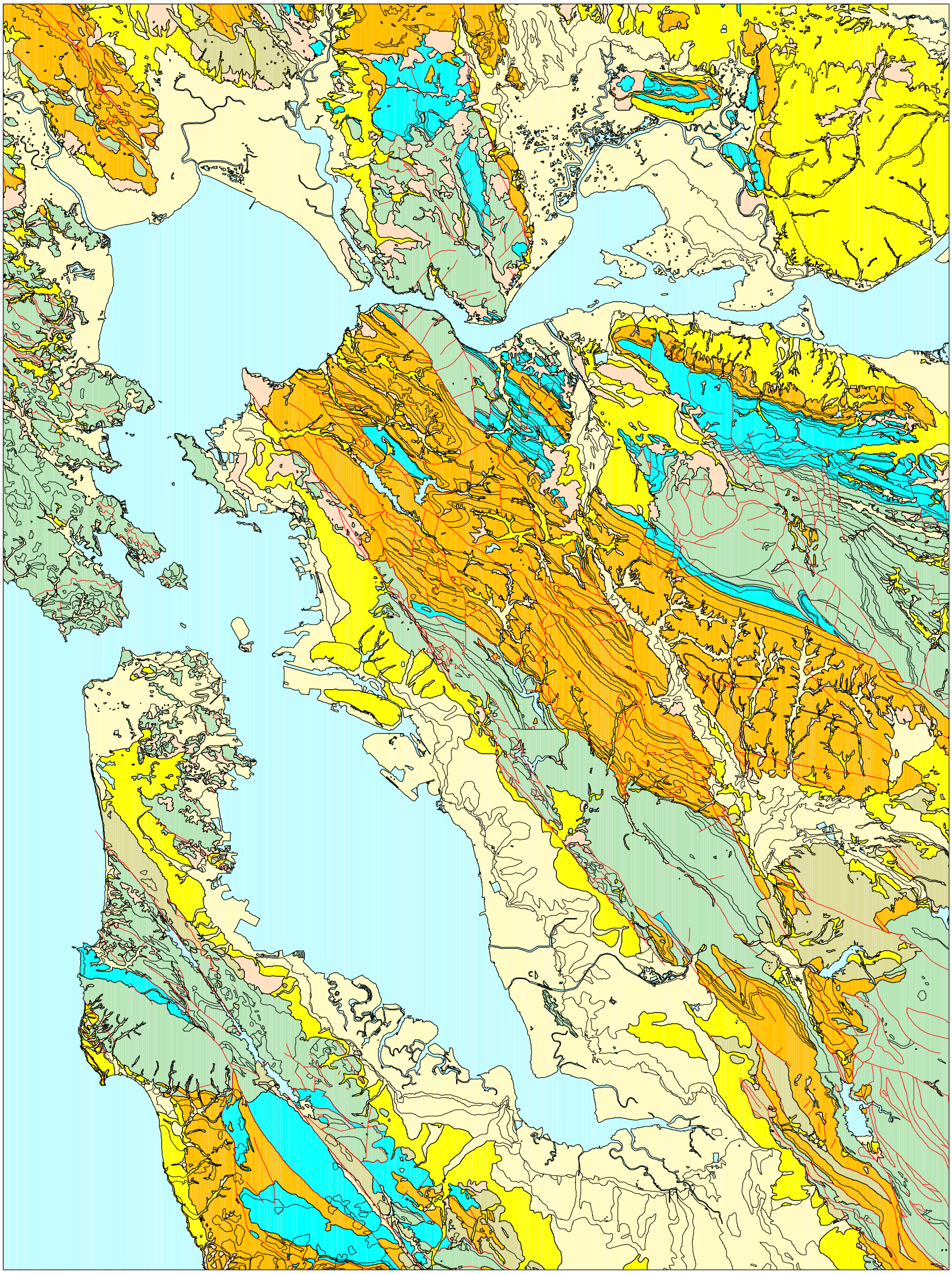
Water Transit Authority Program EIR

Project No. 43-00066890

PHYSIOGRAPHIC PROVINCES

Figure 3.10.2



Legend

Holocene	Upper Tertiary
Pleistocene	Lower Tertiary
Quaternary Undivided	Mesozoic
Pliocene and/or Quaternary	Water
	Geologic Contact
	Fault

N

5 0 5 10 15 Kilometers

Scale 1:600,000

URS

Water Transit Authority
Program EIR

Project No. 43-00066890

REGIONAL GEOLOGY

Figure
3.10.3

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3.9 CULTURAL RESOURCES

Cultural resources can be the material artifacts of past human activity or historic buildings and structures. These nonrenewable resources may be found in both onshore and nearshore locations (marine and terrestrial settings) throughout the San Francisco Bay area. Land and marine cultural resources often include, but are not limited to:

- Prehistoric and historic archaeological sites
- Historic sites or districts
- Important or exemplary buildings or structures
- Culturally modified landscapes
- Locations of culturally important events
- Shipwrecks or other maritime resources

This technical report includes limited prehistoric and historic site locational information. Generally, the documents and data related to prehistoric sites are considered confidential and are only made available to qualified cultural resource specialists, project managers, or other pertinent individuals on a need-to-know basis.

3.9.1 Environmental Setting

3.9.1.1 Study Area

The study area for cultural resources included the San Francisco Bay and its embayments, the Carquinez Strait and Suisun Bay to Antioch at the San Joaquin River, and Half Moon Bay. This project does not have a defined Area of Potential Effect (APE), which is a formal study area defined in concurrence with a lead federal agency under NEPA. Within the study area defined for this program, a bibliographic survey was conducted to provide an overview of classes of resources known to the Bay Area, to establish a general baseline for known cultural resources within the project study area, and to anticipate the types of resources that might be potentially encountered with implementation of each project alternative.

3.9.1.2 Native American Consultation

No locations of Traditional Cultural Properties (TCPs) are known within the programmatic project area. As a professional courtesy, Native American communications are considered confidential and should only be made available to qualified cultural resource specialists, pertinent project managers, or other Native Americans on a need-to-know basis. The TCPs recognized by the California Native American Heritage Commission (NAHC) are also considered confidential. Native American correspondence at this programmatic level was limited to a TCP search conducted by the NAHC.

3.9.1.3 Bibliographic Survey

A screening-level research study was conducted at the Northwest Information Center (NWIC) of the California Historic Resources Information Service (CHRIS). The following USGS 7.5' Series quadrangle maps were also reviewed: Petaluma River, Petaluma Point, Mare Island, San Quentin, Richmond, Benicia, Vine Hill, Honker Bay, Antioch North, San Francisco North, San Francisco South, Oakland West, Hunters Point, San Leandro, Montara Mountain, San Mateo, Redwood Point, Half Moon Bay, Woodside, Palo Alto, and Mountain View.

Known site locations recorded in the general vicinity of the various project areas were noted. This overview is the first step in the identification of known resources. Once defined projects moves forward and project actions are refined, detailed records searches would be conducted. This work should be conducted in conjunction with appropriate marine and terrestrial archaeological field reconnaissance to identify areas of low sensitivity or potential areas of sensitivity where mitigation or other actions many be required.

Typical Settings for Cultural Resources within the San Francisco Bay Environs

The Proposed Project actions are primarily located in a coastal marine setting. The Proposed Project include terminal and routes that fall within the following geographic settings:

The Onshore Environment

Project actions in an onshore environment might include expansion of existing ferry terminal facilities, construction of new terminal facilities, or construction or repair/maintenance facilities. The onshore environment is defined here as "dry land" and does not include facilities located on piers.

The Bay Shoreline Environment

Project actions in the Bay shoreline environs might include expansion of existing piers, construction of new piers, expansion of terminal facilities located on piers, or construction of terminal facilities on piers

The Offshore Environment that Extends Out from the Bay or Coastal Shoreline

Project activities in the offshore environment are primarily related to underwater activities that include dredging, dredge spoil disposal, buoy placement, and related maintenance of ferry corridors through shallow draft waters

Cultural resources that have been recorded in the above environments, or have the potential to be located in the aforementioned geographic settings, include:

- Wharves
- Piers
- Shipwrecks
- Prehistoric sites
- Other (resources such as airplane wrecks, historic dump or disposal sites, historic structures, etc.).

Prehistory

General information concerning the regional prehistory and chronology has been primarily synthesized from Moratto (1984) and Chartkoff and Chartkoff (1984). Ethnohistoric information has been gathered from Levy (1978b; 1978a), Johnson (1978), and Kelly (1978).

Controversial Early Evidence from the Region

Although it cannot be ruled out that sites or evidence might exist in the Bay Area dating to extremely early human occupation, none has been identified to date. Some investigators have postulated hominid occupation in other regions of California (e.g., Leakey, Simpson, and Clements 1968, 1969; Leakey et al. 1972; Schuiling 1972, 1979) but no corroborative cultural or skeletal evidence of a similar age exists in the Americas.

Regional Overview

This section provides a regional overview of the prehistoric and historic periods relevant to the San Francisco Bay Area.

Paleoindian – Early Holocene Period

Early Holocene finds are typologically attributed to a Western Pluvial Lakes Tradition, often recognized as the Lake Mojave Stemmed Tradition or simply the Stemmed Point Tradition (Moratto 1984). In Central California, a number of isolated finds are attributed to the Fluted Point or Stemmed Point Traditions. These sites typically contain chipped stone crescents, gravers, scrapers, choppers, perforators, expedient ground stones and various fluted/stemmed points, and geographically appear along paleo-shorelines, piedmont zones of former grasslands, and in mountain pass areas associated with fossil lakes. Sites from this period are not known within the study area, although they could be present within these environs.

Early Period and Millingstone Horizon

Millingstone Horizon sites are found in both coastal and inland settings (Wallace 1955; Leonard 1971). The Millingstone period, also called the Millingstone culture, extends to at least 6000 B.P. and probably as far back as 8500+ B.P. (cf. Warren 1968; Wallace 1955). The stone tool assemblage during this cultural period trends toward core/cobble tools and an abundance of ground stone implements (manos and metates), while projectile points appear less frequently. Hard-seed processing became one of the major components of subsistence during this period. Overall, the economy appears to have been based on plant collecting supplemented by fishing and hunting.

In the Bay Area, archaeological localities such as the Scotts Valley site, SCr-177 (Cartier 1982; 1993; cf. Erlandson 1994; and Moratto 1984), and SCl-178, situated in the Santa Clara Valley (Moratto 1984; Erlandson 1994), provide evidence for early Holocene activities in the broader San Francisco Bay Area. The immediate San Francisco Bay environs have not yielded extensive Early Period evidence. This occurrence can be attributed to a combination of factors including fluctuating shorelines, eustatic sea level changes, extensive and dynamic wetlands which can preclude resource preservation, and anthropogenic activities such as extensive coastal marine development around San Francisco Bay. Although resources from this period are not common around San Francisco Bay, their presence cannot be ruled out by mere lack of current evidence.

The Intermediate Period

The Intermediate period (Wallace 1955) has also been called the Hunting period or Middle Horizon (Beardsley 1948). About 5,000 years ago, the Millingstone culture began to gravitate toward animal proteins and marine resources. A higher percentage of projectile points and smaller chipped stone tools are present during the Intermediate period.

In the Bay Area, this period of occupation is often referred to as the Ellis Landing Facies (Beardsley 1954), named for a shellmound situated in a salt marsh in Richmond. Excavated by Nels Nelson in the early 1900s (e.g., Nelson 1910), the Ellis Landing mound (Cco-295) yielded stratified cultural materials that allowed Nelson to identify an "upper" and "lower" cultural sequence. The upper component contained perforate charmstones, incised bone tubes, saucer-shaped *Olivella* beads, stemmed projectile points, and mortars with flared sides (Moratto 1984). The lower level contained spatulate bone objects, rectilinear and triangular *Haliotis* pendants, *Olivella* saucer and saddle-shaped beads, red ochre, cobble mortars, grooved sinker stones, and large non-stemmed points (Moratto 1984). Sites from this period are known within the project area.

The Late Prehistoric Period

Meighan (1954) originally characterized the Late Prehistoric period in California, although this work pertained mainly to cultures from the Southern California area. The period began sometime around the B.C./A.D. transition and expanded culturally around 500 A.D. This cultural expansion was roughly coeval with the introduction of bow-and-arrow technology. The end of the period is recognized at the close of the 18th century, when the Spanish mission system had its greatest effect on the native Californian populations.

Much of what is known of the later prehistory of the San Francisco Bay Area has been gleaned from numerous excavations at the Emeryville Shellmound (Ala-309). The mound's estimated size was at least 100 meters by 300 meters, with a maximum depth of almost 10 meters (Moratto 1984). Max Uhle's excavations at the site in the early 1900s (Uhle 1907) revealed a stratified deposit with numerous cultural sequences. The lower levels contained flexed burials associated with artifacts such as pointed bone implements, chert bifaces, perforate charmstones, red ochre, and a predominance of bay oyster shells (Moratto 1984). Upper levels appeared to have cremation burials, polished stone artifacts, flaked obsidian tools, and an abundance of clam (Moratto 1984). In 1924, Schenck "rescued" materials, including approximately 700 burials, most interred in a flexed position, as the site was being prepared for construction of a paint factory (Schenck 1926).

<u>Ethnography</u>

The ethnographic or ethnohistoric period generally refers to the time from initial contact between the European cultures and local Native American groups to the present. Initial references to Native Americans during this period are often sketchy references found in expeditionary diaries or church baptismal records. Descriptions of Native American lifeways were later refined, frequently via informant interviews, by anthropologists, ethnographers, historians, and archaeologists (e.g., Milliken 1995). However, in most cases the decimation of Native American cultures occurred at a much faster rate than these research and recordation efforts.

Costanoan

The name Costanoan is derived from the Spanish *Costaños* or *Costeños*, or coast people (Swanton 1952). The Costanoan group designates a linguistic family consisting of eight different yet related languages (Levy 1978b). The Costanoan languages, together with Miwok, compose the Utian language family of the Penutian stock. Native Americans from the area also use the term Ohlone, which means "the Abalone people," when referring to their ancestors.

The arrival of Costanoan groups into the Bay Area appears to be temporally consistent with the appearance of the Late Period artifact assemblage in the archaeological record, as documented at sites such as the Emeryville Shellmound or the Ellis Landing mound. The cultural territory of the Costanoan groups extended along the coast from San Francisco Bay in the north to just beyond Carmel in the south.

Linguistic evidence suggests that the Costanoans' ancestors probably moved into the San Francisco and Monterey Bay areas approximately 1,500 years ago. The various groups subsisted as hunter-gatherers and relied on local terrestrial and marine flora and fauna. Their predominant plant food was the acorn, but they exploited a wide range of other foods, including various seeds, buckeye, berries, roots, land and sea mammals, waterfowl, reptiles, and insects (Levy 1978b). The Costanoans constructed watercraft from tule reeds and possessed bow and arrow technology. They fashioned blankets from sea otter pelts, fabricated basketry from twined reeds of various types, and assembled a variety of stone and bone tools in their assemblage. Costanoan villages consisted of dwelling structures, sweathouses, dance enclosures, and assembly houses constructed from thatched tule reeds and a combination of wild grasses, wild alfalfa, ferns, and carrizo. Before European contact, the Costanoans were politically organized into autonomous tribelets that had distinct cultural territories.

The first European contact with the Costanoans was probably in 1602, when Sebastian Vizcaíno's expedition moored in Monterey. The estimated Costanoan population in 1770—when the first mission was established in Costanoan territory—was approximately 10,000. By 1832, the population had declined to fewer than 2,000, mainly due to diseases introduced by the Europeans. When the Spanish mission system rapidly expanded across California, the Costanoan traditional way of life was irreversibly altered. The pre-contact hunter-gatherer subsistence economy was replaced by an agricultural economy, and the Spanish missionaries prohibited traditional social activities (Levy 1978b).

The Karkin, Chochenyo, and Ramaytush Costanoan Groups

The Karkin, Chochenyo, and Ramaytush were tribelets belonging to the larger cultural group recognized as the Costanoan Indians. The environs around Carquinez Strait were primarily tidal marsh and open water during the ethnographic period. At the time of European contact, an estimated 2000 Chochenyo ranged from Richmond to Mission San Jose, and out into the Livermore Valley. Ramaytush, also known as San Francisco Costanoan, was spoken among tribelets living in what are now San Mateo and San Francisco counties. At the time of European contact, the Ramaytush had about 1,400 speakers of their distinct language.

The cultural identity of the entire Costanoan group rapidly disappeared after the European contact. In the literature, the Karkin, Chochenyo, and Ramaytush populations are usually referred to in a larger cultural context within the Ohlone or Costanoan tradition, and except for anecdotal or extrapolated information, specific data on these small tribelet communities is sparse in the academic literature. In 1971, descendents of the various Costanoan tribelets, including possible descendents of the Karkin, Chochenyo, and Ramaytush tribelets, formed a "corporate entity" known as the Ohlone Indian Tribe (Levy 1978b).

Coast Miwok

Potential and existing North Bay terminal sites are located in the territory of the Coast Miwok, who together with the Lake and Eastern Miwok, comprise the larger ethnic group termed *Miwok* by ethnographers. Coast Miwok territory extended from Duncan's Point north of Bodega Bay along the coast and interior of Sonoma and Marin Counties to San Pablo Bay on the south. Coast Miwok territory extended east as far as midway between the Sonoma and Napa Rivers (Kelly 1978; Figure 3.9.1).

Coast Miwok villages were in most cases located near major watercourses and, less commonly, on the coast. The villages were composed of several structure types, such as dwelling houses, a sweathouse (in larger villages), and secret society dance houses (in larger villages). Dwelling houses were built on conical frames of willow or driftwood poles, with bunches of grass, tule, or rush covering the structure.

Coast Miwok subsistence strategy focused on the coast and adjacent inland areas for much of the year, where salmon and other fish, deer, crab, kelp, seeds, mud hens, geese, eels, mussels, and clams were available. Acorns were pounded into meal, leached, and boiled with hot stones to make mush. Bread was made by mixing leached acorn meal with water and red earth and then baking it in an earth oven. Fishing was performed in a variety of ways: bay fish were caught in a seine strung between two tule balsas (rafts), and surf fish were captured with circular dip nets.

Early contact between the Coast Miwok and Europeans first occurred on the Marin County coast as early as 1579, when Sir Francis Drake spent five weeks on the coast to repair his damaged ship (Kroeber 1925). Spanish explorers made contact with the Coast Miwok in the late 1700s. By 1776, the Franciscan fathers of the San Francisco mission began forced conversions and brought Coast Miwok to mission lands, initiating a partial abandonment of native settlement. Subsequent ranching and settlement by Mexicans and Americans further displaced Coast Miwok from their homes and subjected the group to intense depredations of homicide and epidemic diseases (Cook 1976).

Eastern Miwok

Some of the potential and existing terminals are located within the territory of the Eastern Miwok, who together with the Lake and Coast Miwok, comprise the larger ethnic group termed *Miwok* by ethnographers. There were many distinct linguistic groups within the Eastern Miwok, including the Plains, Northern Sierra, Southern Sierra, Central Sierra, and Bay language areas. The project locations in this area are exclusively assigned to traditional Bay Miwok territories.

The Bay Miwok ranged from the environs near Mount Diablo into the delta of the Sacramento-San Joaquin river system. The Bay Miwok were the first tribelet of the Eastern Miwok to succumb to missionization by the Spanish. The first Bay Miwok, deriving from the Saclan tribelet, were converted at the Mission San Francisco in 1794 (Levy 1978a). The baptisms continued through 1827, with most apparently occurring between 1805 and 1812 (op cit. 401). The primary Miwok political unit was the tribelet. Each tribelet was considered an independent and sovereign nation with control over a specified territory.

The Gold Rush brought further disease to the native inhabitants. By then, nearly all of the Eastern Miwok had adapted in some way or another to economies based on cash income. Hunting and gathering activities continued to decline and were rapidly replaced with economies based on ranching and farming.

Patwin

The Montezuma Slough area is in the homeland of the Patwin. Patwin territory included the lower portion of the west side of the Sacramento Valley west of the Sacramento River from about the location of the town of Princeton in the north to Benicia in the south. In this larger territory, the Patwin have traditionally been divided into River, Hill, and Southern cultural/geographic groups, although in actuality a more complex set of linguistic and cultural differences existed than is indicated by these three divisions (Johnson 1978).

The tribelet represented the basic social and political unit. Patwin villages contained four types of permanent structures, which were earth covered, semi-subterranean, and either elliptical or circular in shape included the dwelling house, the ceremonial dance house, the sweathouse, and the menstrual hut (Johnson 1978).

Patwin subsistence consisted of hunting and gathering from a village base. Acorns were a staple food and were pulverized with a long river cobble pestle (Merriam 1967) in wooden mortars (Johnson 1978). The acorns were then leached in a sand basin and made into a bread or soup. Individuals or small groups undertook hunting and fishing. The Patwin produced numerous basketry implements that included cooking baskets, scoop trays, winnowing trays, fish baskets, baby carriers, and burial accompaniments.

The Patwin probably first encountered Europeans during Spanish domination of California. At least by 1800, Spanish missionaries from Mission Dolores (San Francisco de Asís) recruited neophytes from the Patwin villages for mission labor (Bennyhoff 1977). Under Mexican rule in California, the Patwin suffered from numerous military incursions and attacks from Mexican and American settlers who occupied Patwin territory. The Patwin also suffered from epidemic diseases, such as malaria and smallpox, which led to a decline in the Patwin population (Johnson 1978). Finally, to facilitate the development of ranching, agriculture, mining, and large settlements after the U.S. conquest of California, the U.S. government called for removal of remnant Patwin descendents to reservations.

<u>Historic Setting</u>

The summarized historic period represents the modern settlement California and the Bay Area from the time of the first European explorations and settlements to the present. This overview focuses on events important to San Francisco Bay and the associated historical activities that occurred in and near the shoreline environment. The following historic setting is essentially a compilation of two recent Bay Area reports completed under the aegis of URS.[1]

[1] *Underwater Cultural Resources Survey for the Proposed SFO Runway Reconfiguration Project by Ecosystems Management Associates, Inc*. (2001) for URS Corporation and *Final Cultural Resources Inventory Report for the Habitat Migration Planning Sites, San Francisco International Airport Proposed Runway Reconfiguration Project*, (2001) by Jones & Stokes for URS Corporation.

Spanish Period

Jose de Ortega located the entrance to the San Francisco Bay in 1769, but formal entry into the bay occurred a few years later with Juan Manuel de Ayala. In Contra Costa County Spanish contact was made was in 1772 by Pedro Fages while in Marin County, the first coastal exploration was in 1579 by Englishman Francis Drake. His exact anchoring continues to be debated. The first Spanish overland expedition into the San Francisco Bay region was led by Juan Bautista de Anza, who reached San Francisco in 1776 and located the sites of Mission Dolores and the Presidio. All of these expeditions were augmented with military support and the ecclesiastical presence of Franciscan priests who were responsible for establishing mission authority and converting California's Native American inhabitants to Christianity (Bean and Rawls 1983; Hoover et al. 1990; Merrit 1928.) By 1823, the Spanish network of missions, presidios, and pueblos extended from San Diego to Sonoma, enabling the Spanish to gain control of Alta California.

British, Russian, French, and American Exploration

The Spanish were extremely protective of the California territory and found outside influences difficult to control. The Spanish viewed the San Francisco Bay as a remote outpost and established the area as a buffer zone to protect the more densely inhabited areas to the south. Despite this they were unable to retain San Francisco as an isolated outpost because governments of England, France, Russia, and Prussia all became interested in California. Once the abundant natural resources were found profitable and steam power became available for ships, interest in the area dramatically increased.

Mexican Period

In 1821, Mexico achieved independence from Spain, and the following year, California was declared a territory of the Mexican republic. Apart from sending in new governors and small numbers of soldiers, Mexican intervention in California was minimal over the next several years.

The Mexican government's order for the secularization of the missions would have a major impact on the subsequent historical development of California. The 1834 secularization order downgraded the missions to the status of parish churches and divided their vast holdings into individual land grants, or ranchos. The secularization of the missions opened the door for approximately 700 private land grants and the rise of family ranchos. The ranchos raised cattle for the hide and tallow trade, sheep, horses, grain, and wine grapes. Most of these ranchos were involved in trade, specifically hides and tallow in exchange for New England goods. The advent of this trade mobilized interest of people from around the globe and increasingly more ships entered the bay. Missions and military installations in the San Francisco Bay environs included: Mission Delores (San Francisco de Asis), Presidio (Presidio de San Francisco), Mission Santa Clara (Santa Clara de Asis), Mission San Jose (San Jose de Asis), Mission San Rafael (San Rafael Arcangel), Mission Sonoma (San Francisco Solano).

American Period

Commercial activity between the United States and Mexican California increased during the Mexican period, with an influx of fur trappers and individuals in search of resources. The influx of settlers and pioneers crossing the Sierra Nevada range into Mexican California brought internal conflicts that lead to the 1846 war between Mexico and the United States. The conflict formally ended with the signing of the Treaty of Guadalupe Hidalgo in February 1848. Alta California was ceded to the United States and was admitted as a state in 1850.

The discovery of gold led to the Gold Rush (1848–1852), which attracted a tremendous influx of prospectors and settlers. A thousand people called San Francisco home by 1848, but the news of gold hunting near Sacramento nearly emptied the growing community as mariners, hide processors and tradesmen deserted for the new gold diggings. Soon some of the prospectors found that hauling freight and gold-hunting passengers was more profitable than panning for gold. The discovery of gold at Sutter's Mill and the American control of California ended the hide trade. Within a year and a half, thousands of immigrants came to San Francisco and completely changed the lifestyle of the San Francisco community.

Maritime trade arrived through three major shipping channels approaching San Francisco. These lanes converge outside the Golden Gate to form the single channel entering San Francisco Bay. Lumber schooners came through this channel from the Mendocino coast, along with sealers, whalers, fishermen, traders, and passenger ferries. San Francisco became a major city and port almost overnight and grew at a phenomenal rate replacing Monterey as the coast's principal port. Large docks were built in order to discharge cargo directly onto the wharves instead of being ferried by rowboats to shore. From those docks, the cargo was distributed and sometimes reloaded onto smaller vessels to transport to various settlements. By July 1850, more vessels entered the bay then departed. Some 500 ships lay abandoned inside and outside the anchorage by their crews, who had deserted them in hopes of finding a better life, mostly in the gold fields. Sometimes ships, surrounded by other vessels, became landlocked. Unable to depart, they were more valuable as dock space than as a means for transport. In relation to San Francisco, development on the peninsula south of San Francisco was much different. This region remained rural with sparsely populated villages. Oakland remained a quiet suburb of busy San Francisco until 1863 when the San Francisco-Oakland railroad was built. Six years later, western Oakland became the terminus of the transcontinental railroad in 1869. This transportation role molded Oakland's future development.

Maritime Transportation

Before development of transcontinental and regional railroads, maritime transportation of agricultural products played a principal role in the economy of the San Francisco Bay Area. In the South Bay, the Port of Alviso was created to replace the Embarcadero de Santa Clara/Alviso, and is one of the oldest ports (1840s) in the western United States. In the North Bay, Mexican ranchers began using the rivers to transport hides and tallow out of the bay and into ships for export. Petaluma and the Petaluma River became a major shipping depot and agricultural center. Other development in this area included the Sausalito waterfront, which developed into an anchorage and supply point for whaling vessels and other commercial ships.

Ferry enterprises traveling to Oakland, San Pablo Bay, and San Francisco flourished during the late 19th century and the first half of the 20th century. The Bay was a transportation corridor for both local and international traffic. During the early part of the American period, the ferries united the sparsely populated rural communities and ranches with San Francisco. By the early 1870s, the railroad companies owned the ferries operating on the Bay. As communities in the area grew larger, local trade produced a demand for more frequent ferry schedules and for inter-urban lines to feed the ferry terminals. Despite all this success, the needs of the Bay Area were rapidly changing. Most ferry service ceased in 1939 with the completion of several bridges spanning the Bay and the opening of the Bay Bridge to electric trains.

Fishing Industry

In the 1850s, commercial fishing in the San Francisco Bay began with whaling and salmon fishing. Chinese immigrants turned to shrimp fishing in the years following the Gold Rush. Throughout California's coastal waters, shrimp were harvested and sold. By 1855 over fifty Chinese shrimping vessels, mostly sampans and junks, operated on the San Francisco Bay. After 1870, shrimp fishing evolved into a major industry along the shores of San Pablo and San Francisco Bays. Approximately 26 fishing camps or villages have been recorded in this region. During the 1870s, a significant expansion of the fishing industry occurred due to the increased immigration of fisherman from Italy, Greece, China, and Portugal. By the beginning of the 20th century, the staple yields of the fishing industry were salmon, crabs, cod, and oysters (Hart 1978).

Shipbuilding

In the mid-1840s, San Francisco relied heavily upon East Coast boat builders for ship manufacturing. These builders constructed prefabricated river and delta boats and sent them around Cape Horn. It was not until after the Gold Rush that large numbers of boat builders arrived. They emigrated from New England, the British Isles, Scandinavia, the Mediterranean, and China. Due to the deep water and easy access and good storage, Hunters Point became a principal shipbuilding location, particularly during the advent of World War I. Soon after, other South Bay ports were being established as shipyards and others were enlarged for construction of steamers.

3.9.1.4 Cultural Resources Baseline Information

For this programmatic EIR, a screening level survey was conducted of archaeological and historic information to gain an understanding of resources that might be present at or near existing or proposed terminal locations. This functions as one step in the identification of potential issues and constraints as ferry transit facilities are advanced and defined. Many of the ferry sites lacked specific location information; therefore, a search was performed of the general area as opposed to specific street locations or addresses.

General Review of Ferry Terminal Locations

Many of the potential new ferry terminals are not specifically sited, and even at known ferry terminal locations, new facilities or changes to existing facilities and improvements have not been defined. An initial review of literature and record sources for the vicinity of the terminal locations was performed to generally identify types of historic and prehistoric resources, as well as the nature and type of resources present in the general area (i.e., wharves, piers, structures, listed prehistoric sites, etc.). This review was not a formal search of resource record databases, such as would be completed for a specified project and its final proposed locations, but it is intended to provide an initial identification of sites and resources that could be affected by an overall alternative.

The results of this review are listed in Appendix CUL-A. A brief overview of each site is described. In general, many of the terminal sites are located in communities having a history of maritime development and activities, where piers or wharves were located which in some cases may still be in use. A few terminal locations are in the general vicinity of potentially significant archaeological sites such as shell mounds or possible Native American occupation sites. All of these sites and resources would be evaluated as specific terminals and routes are proposed.

Marine Cultural Resources

There is a significant potential for subsurface marine cultural resources in San Francisco Bay. The sedimentation process in the San Francisco Bay Estuary has been affected by 150 years of regional anthropogenic activity. Changes in tributary runoff, alterations of the Bay shoreline wetlands and marshes, and sediment dredging and redeposition activities have all contributed to recent Bay sedimentation patterns.

Since the time of initial European contact, numerous cultural resources have been wrecked, dumped, abandoned, deposited or otherwise lost within the Bay and its environs. Likewise, prehistoric and protohistoric sites are known within the Bay environs, specifically the numerous shell mounds that have been recorded along the Bay margins (Appendix CUL-A).

3.9.1.5 Dredging and Archaeological Resources

Since 1824, the U.S. Army Corps of Engineers (USACE) has planned, built, and maintained federal navigation and flood control projects in the Bay. The U.S. Navy is also responsible for current dredging activities, including those at Mare Island and the Alameda Naval Air Station. Other dredging activities are conducted by both public and private marine operators, ports, refineries, and flood control and reclamation districts around the Bay.

In many locations, recent maintenance dredging or a continuum of dredging history could preclude the requirement for cultural resources survey. This was noted in a recent marine archaeology report that examined various nearshore and offshore sites throughout the San Francisco Bay (Ecosystems 2001), in which it was assumed that constant maintenance dredging would have obliterated any marine cultural resources in the project Area of Potential Effect.

Dredged material currently disposed within the Bay is limited to four state and federally designated sites in the Carquinez Strait, San Pablo Bay, Suisun Bay, and off Alcatraz island. Depending on volume and suitability of dredged materials, dredging projects may consider a range of reuse/disposal sites within the counties surrounding the Bay region. Options include:

- In-Bay disposal;
- Deep ocean disposal;
- Upland/wetland reuse;
- Upland landfill disposal; and
- Reuse as fill material for construction projects.

These possible locations of dredge spoils disposal could contain cultural resources.

3.9.1.6 Regulatory Setting

Regulatory requirements applicable to cultural resources are summarized in the following sections.

Federal Regulations

A number of federal regulations address the protection of cultural resources, which are summarized below. The WTA program does not have federal involvement at this time, but these requirements will likely apply at later stages when federal funding or authorizations are required.

Executive Order 11593 (1971)

Executive Order 11593 provides federal protection and enhancement of the "cultural environment," in support of the Antiquities Act, Historic Sites Act, the National Historic Preservation Act, and the National Environmental Policy Act.

Executive Order 13007 (1996)

Executive Order 13007 requires that all Executive Branch agencies that have responsibility for the management of Federal lands will, where practicable, permitted by law, and not clearly inconsistent with essential agency functions, provide access to and ceremonial use of Native American sacred sites by Native American religious practitioners. Likewise, agencies will avoid adversely affecting the integrity of such sacred sites. The order also requires that federal agencies, when possible, maintain the confidentiality of sacred sites.

Executive Order 13175 (1990)

Executive Order 11593 provides that each federal agency must have an accountable process to ensure regular and meaningful consultation and collaboration with Native American tribal governments, or their representative organizations, in the development of regulatory policies that have tribal implications.

Antiquities Act (1906)

The federal government formally recognized the importance of some cultural resources with passage of the 1906 Antiquities Act, 16 United States Code (USC) 431-433. This act, with its applicable regulation in 43 CFR 3, protects all historic and prehistoric sites on federal lands and prohibits excavation or destruction of such antiquities unless a permit (Antiquities Permit) is obtained from the secretary of the federal agency that has the jurisdiction over those lands. It also authorizes the President to declare areas of public lands as National Monuments and to reserve or accept private lands for that purpose.

Historic Sites Act (1935)

The Historic Sites Act, codified at 16 USC 461 et seq., declares a national policy to preserve historic sites, buildings, antiquities, and objects of national significance, including those located on refuges. The Historic Sites Act provides procedures for designation, acquisition, administration, and protection of such sites.

National Historic Preservation Act, as amended (1966)

The National Historic Preservation Act (NHPA) declares federal policy to protect historic sites and values in cooperation with other nations, states, and local governments. The NHPA establishes a program of grants to assist states for historic preservation activities. Subsequent amendments designated the State Historic Preservation Officer (SHPO) as the individual responsible for administering state-level programs. The act also created the President's Advisory Council on Historic Preservation (ACHP). Federal agencies are required to consider the effects of their undertakings on historic resources and to give the ACHP a reasonable opportunity to comment on those undertakings.

National Environmental Protection Act, as amended (1969)

Under the National Environmental Policy Act (NEPA), 42 USC 4321–4327, federal agencies are required to consider potential environmental impacts and appropriate mitigation measures for projects with federal involvement. If the project has federal involvement (e.g., a 404 permit), the lead federal agency will be responsible for project compliance with Section 106 of the NHPA and its implementing regulations, set forth by the Advisory Council on Historic Preservation (ACHP) at 36 CFR 800.

Archaeological and Historic Preservation Act (1974)

Under 16 USC 469-469c, the Archaeological and Historic Preservation Act (AHPA) requires Federal agencies to provide notice to the Secretary of the Interior of any dam constructions and, if archeological resources are found, for recovery or salvage of those resources. The law also applies to any agency whenever it received information that a direct or federally assisted activity could cause irreparable harm to prehistoric, historic, or archaeological data. Up to one percent of project funds could be used to pay for salvage work. The NHPA also authorized additional funding to be availed for this purpose.

American Indian Religious Freedom Act (1978)

The American Indian Religious Freedom Act, 42 USC 1996 et seq., regulated under 43 CFR 7, has been established to protect religious practices, ethnic heritage sites, and land uses of Native Americans. The act makes it a policy to protect and preserve for American Indians, Eskimos, Aleuts, and Native Hawaiians their inherent right of freedom to believe, express, and exercise their traditional religions. The act allows them access to sites, use and possession of sacred objects, and freedom to worship through ceremonial and traditional rights. It further directs various federal departments, agencies, and other instrumentalities responsible for administering relevant laws to evaluate their policies and procedures in consultation with Native American traditional religious leaders to determine changes necessary to protect and preserve Native American cultural and religious practices.

Archaeological Resources Protection Act (1979)

The Archaeological Resources Protection Act (ARPA) supplements the provisions of the Antiquities Act of 1906, and declares it illegal to excavate or remove from federal or Native American lands any archeological resources without a permit from the land manager (or federal agency with jurisdiction over those lands). Permits may be issued only to educational or scientific institutions and only if the resulting activities will increase knowledge about archeological resources.

Native American Graves Protection and Repatriation Act (1990)

The Native American Graves Protection and Repatriation Act (NAGPRA), 25 USC 3001 et seq., defines cultural items, sacred objects, and objects of cultural patrimony, and establishes ownership hierarchy for remains found on federal lands. It also provides for specific case review, allows excavation of human remains, and stipulates return of the remains according to ownership. NAGPRA also sets penalties for violations of the act, calls for cultural resource inventories, and has provisions for the return of specified cultural items to the appropriate Native American tribe(s) and/or Native Hawaiian organization(s). NAGPRA is initiated when the project and the finds are situated on federal lands.

State Regulations

In California, cultural resources include archaeological and historical objects, sites and districts, historic buildings and structures, cultural landscapes, and sites and resources of concern to local Native American and other ethnic groups. Compliance procedures are set forth in the California Environmental Quality Act (CEQA) Sections 15064.5 and 15126.4. The primary applicable state laws and codes pertinent to the proposed project are presented below.

California Native American Graves Protection and Repatriation Act (2001)

In the California Health and Safety Code, Division 7, Part 2, Chapter 5 (Sections 8010-8030), broad provisions are made for the protection of Native American cultural resources. The act sets the state policy to ensure that all California Native American human remains and cultural items are treated with due respect and dignity. The act also provides the mechanism for disclosure and return of human remains and cultural items held by publicly funded agencies and museums in California. Likewise, the act outlines the mechanism with which California Native American tribes not recognized by the federal government may file claims to human remains and cultural items held in agencies or museums.

California Public Resources Code Section 5020

This California Code created the California Historic Landmarks Committee in 1939 and authorizes the Department of Parks and Recreation to designate Registered Historical Landmarks and Registered Points of Historical Interest.

California Public Resources Code Section 5097.9

Procedures are detailed under California Public Resources Code (PRC) Section 5097.9 for actions taken whenever Native American remains are discovered. No public agency, and no private party using or occupying public property, or operating on public property, under a public license, permit, grant, lease, or contract made on or after July 1, 1977, shall in any manner whatsoever interfere with the free expression or exercise of Native American religion as provided in the United States Constitution and the California Constitution; nor shall any such agency or party cause severe or irreparable damage to any Native American sanctified cemetery, place of worship, religious or ceremonial site, or sacred shrine located on public property, except on a clear and convincing showing that the public interest and necessity so require. The commission, pursuant to Sections 5097.94 and 5097.97, shall enforce the provisions of this chapter.

California Public Resources Code Section 7050.5

Every person who knowingly mutilates or disinters, wantonly disturbs, or willfully removes any human remains in or from any location other than a dedicated cemetery without authority of law is guilty of a misdemeanor, except as provided in Section 5097.99 of the Public Resources Code. In the event of discovery or recognition of any human remains in any location other than a dedicated cemetery, there shall be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent remains until the coroner of the county in which the human remains are discovered has determined. If the coroner determines that the remains are not subject to his or her authority and if the coroner recognizes the human remains to be those of a Native American, or has reason to believe that they are those of a Native American, he or she shall contact, by telephone within 24 hours, the Native American Heritage Commission.

California Public Resources Code Section 7051

Every person who removes any part of any human remains from any place where it has been interred, or from any place where it is deposited while awaiting interment or cremation, with intent to sell it or to dissect it, without authority of law, or written permission of the person or persons having the right to control the remains under Section 7100, or with malice or wantonness, has committed a public offense that is punishable by imprisonment in the state prison.

14 California Code of Regulations 4308

Under this state preservation law, no person shall remove, injure, disfigure, deface, or destroy any object of archaeological, or historical interest or value.

Underwater Cultural Resources

It is important to note that federal-level mandates also cover underwater cultural heritage, such as shipwrecks and related historic maritime resources and submerged prehistoric sites. These legislative acts would be pertinent in instances where near-shore, intertidal, or offshore cultural resources are detected during project constructions or related activities. Although originally intended to address terrestrial resources, the Antiquities Act of 1906 and the ARPA of 1976 cover underwater cultural heritage to certain extents. The ARPA of 1976, which superseded the Antiquities Act of 1906, is applicable only if the underwater cultural resources are found on lands owned by the federal government.

The acts cited below, although federal-level, also apply to resources in state waters. As such, these acts are concurrently relevant for both federal and/or state-level projects.

Submerged Lands Act (1953)

This act is largely superseded by the Abandoned Shipwreck Act but has been used by states to protect abandoned historic shipwrecks by citing various state-level historic preservation laws. The Submerged Lands Act established state jurisdiction over offshore lands within 3 miles of shore (or 3 marine leagues for Texas and the Gulf coast of Florida). The Act did reaffirm the federal claim to the Outer Continental Shelf, which consists of those submerged lands seaward of state jurisdiction. However, the act limited states' claims to the submerged lands inside the landward boundary of the Outer Continental Shelf. Several federal courts rejected state positions on historic preservation laws, for various reasons, that pertained to shipwrecks within this 3-mile zone. Judicial conclusions from cases involving the Submerged Lands Act were inconsistent and confusing, yet shipwrecks in state waters were still at risk from damage and destruction. These circumstances provided the momentum for the passage of the Abandoned Shipwreck Act.

Abandoned Shipwreck Act (1987)

The Abandoned Shipwreck Act, 43 USC 2101–2106, is a federal-level legislative act but it does protect shipwrecks found in state waters. The Abandoned Shipwreck Act also states that the laws of salvage and finds do not apply to abandoned shipwrecks protected by the Act. Under the Abandoned Shipwreck Act, the United States asserts title to abandoned shipwrecks located within state waters that are either:

- Embedded in state-submerged lands,
- Embedded in the coralline formations protected by a state on submerged lands, or
- Resting on state-submerged lands and either included in or determined eligible for the National Register of Historic Places.

The Abandoned Shipwreck Act also has a provision for the simultaneous transfer, by the federal government, of title for those abandoned shipwrecks to the state(s) in whose waters the wrecks are located.

National Marine Sanctuaries Act

National Marine Sanctuaries Act, 16 USC 1431 et seq., is also known as Title III of the Marine Protection, Research and Sanctuaries Act of 1972. The National Marine Sanctuaries Act provides for the establishment of national marine sanctuaries in waters extending to the outer limits of the 200-nautical-mile Exclusive Economic Zone of the United States. The act has provisions for civil judicial actions and administrative penalties against persons damaging, removing, or destroying natural resources within the sanctuary. This protection also extends to submerged cultural resources. The sanctuaries are protected and managed by the Sanctuaries and Reserves Division of the National Oceanographic and Atmospheric Administration. The National Marine Sanctuaries Act would apply in instances where project actions might affect resources in a designated national marine sanctuary. National marine sanctuaries near San Francisco Bay include (Figure 3.9.2):

- The Gulf of the Farallones National Marine Sanctuary, established in 1981, which covers a 1,255 square mile area (948 square nautical miles) just north of San Francisco Bay
- The Monterey Bay National Marine Sanctuary, established in 1992, which covers 400 miles (348 nautical miles) along the California coast, extends an average of 35 miles (30 nautical miles) offshore, and covers over 5,300 square miles (4,024 square nautical miles). Proposed project components are within this sanctuary.

3.9.2 Impacts and Mitigation

3.9.2.1 Significance Criteria

Conformity of Federal and State Evaluation Criteria

The criteria for eligibility for the California Register of Historic Resources (CRHR) are very similar to those that qualify a property for the National Register of Historic Places (NRHP), which is the significance assessment tool used under NHPA. The criteria of the NRHP apply when a project has federal involvement. The development and adaptation of a ferry expansion plan by the WTA is a CEQA-level project, and federal cultural resources significance criteria would apply when resources or project actions fall under the jurisdiction of a federal agency. This could apply when actions:

- Occur on the outer continental shelf (e.g., deep water dredge disposal sites);
- Require a USACE 404 permit;
- Occur on lands administered by the U.S. Navy, Coast Guard (other federal agency); or
- Require nation-to-nation consultation between a federally recognized Native American tribe or individual and the federal government.

A property that is eligible for the NRHP is also eligible to be listed on the CRHR. All potential impacts to significant resources under a federal agency must be assessed and addressed under the procedures of Section 106 of the NHPA, set forth at 36 CFR 800. All resources encountered when implementing a specific ferry expansion project, with the exception of isolate artifacts and isolate features that appear to lack integrity or data potential, will have to be evaluated for significance vis-à-vis Section 106.

Federal Significance Criteria

The four evaluation criteria to determine a resource's eligibility for the NRHP, in accordance with the Code of Federal Regulations (CFR) outlined in 36 CFR 800, are identified at 36 CFR 60.4. These evaluation criteria, listed below, are used to help determine what properties should be considered for protection from destruction or impairment as a result of project-related activities (36 CFR 60.2).

The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

(a) Resources that are associated with events that have made a significant contribution to the broad patterns of our history;

(b) Resources that are associated with the lives of persons significant in our past;

(c) Resources that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) Resources that have yielded, or may be likely to yield, information important in prehistory or history (36 CFR 60.4).

State Significance Criteria

In considering impact significance under CEQA, the significance of the resource itself must first be determined. At the state level, consideration of significance as an "important archaeological resource" is measured by cultural resource provisions considered under CEQA Sections 15064.5 and 15126.4, and the draft criteria regarding resource eligibility to the CRHR.

Generally under CEQA, a historical resource is considered significant if it meets the criteria for listing on the CRHR. These criteria are set forth in CEQA Section 15064.5, and defined as any historical resource that:

(a) Is associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage;

(b) Is associated with lives of persons important in our past;

(c) Embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or

(d) Has yielded, or may be likely to yield, information important in prehistory or history.

Section 15064.5 of CEQA also assigns special importance to human remains and specifies procedures to be used when Native American remains are discovered. These procedures are detailed under Public Resources Code (PRC) Section 5097.98.

Impacts to "unique archaeological resources" and "unique paleontological resources" are also considered under CEQA, as described under PRC Section 21083.2. A unique archaeological resource is an archaeological artifact, object, or site about which it can be clearly demonstrated that—without merely adding to the current body of knowledge—there is a high probability that it meets one of the following criteria:

(a) The archaeological artifact, object, or site contains information needed to answer important scientific questions, and there is a demonstrable public interest in that information; or

(b) The archaeological artifact, object, or site has a special and particular quality, such as being the oldest of its type or the best available example of its type; or

(c) The archaeological artifact, object, or site is directly associated with a scientifically recognized important prehistoric or historic event or person.

A non-unique archaeological resource is an archaeological artifact, object, or site that does not meet the above criteria. Impacts to non-unique archaeological resources and resources that do not qualify for listing on the CRHR receive no further consideration under CEQA.

Under CEQA Section 15064.5, a project potentially would have significant impacts if it caused substantial adverse change in the significance of one of the following:

(a) A historical resource (i.e., a cultural resource eligible for the CRHR);

(b) An archaeological resource (defined as a unique archaeological resource that meets CRHR criteria);

(c) A unique paleontological resource or unique geologic feature (i.e., where the project would directly or indirectly destroy a site or resources); or

(d) Human remains (i.e., where the project would disturb or destroy burials).

A non-unique archaeological or paleontological resource is given no further consideration, other than the simple recording of its existence by the lead agency.

3.9.2.2 Impacts and Mitigation

As previously noted, the Proposed Project actions are located in onshore, Bay shoreline, and offshore environments. As detailed in Appendix CUL-A, cultural resources have been recorded or have the potential to be located in these settings.

As specific projects move forward for evaluation, detailed record searches, archival reviews, field reconnaissance, and consultation with Native American groups/individuals and local historical societies will be conducted as appropriate. These tasks, in conjunction with related research and consultations, will further establish the cultural resources data baseline and facilitate assessments of potential impacts to significant cultural resources. It will be the responsibility of the project proponent to direct these activities in a manner consistent with Section 106 and CEQA guidelines, as applicable.

Construction and Operation (Dredging)

Impact CUL-1 **Dredging of new channels or for pier retrofit or installation could impact submerged and sub-bottom cultural resources in San Francisco Bay.**

Additional dredging may be required for pier retrofits or related activities at other locations, but is likely to be minor in extent and would affect areas where previous construction has taken place. The Proposed Project includes only one terminal location, Hercules/Rodeo, which would require new construction dredging. Submerged and sub-bottom resources are known to exist within the San Francisco Bay and California coastal submarine environments. Prehistoric resources, such as submerged shellmounds, settlement sites, ceremonial artifacts, and possibly watercraft, are known to exist in these settings. Known historic resources in these environs could include maritime vessels, wharf or pier remnants, shrimp farm remnants, refuse dumps, ammunition dumps, airplane fuselages, and materials related to these or other historical activities. Previously unknown resources could also be encountered.

Summary of Impact CUL-1

- The Proposed Project involves expansion of ferry service to new terminals. This expansion would require dredging at only one location, Hercules/Rodeo. Additional dredging could be required for pier retrofits, but is likely to be minor in extent and would affect areas where previous construction has taken place. Encountering and adversely disturbing buried sites could inadvertently destroy the cultural value of the resource. Dredging and related constructions for the new terminal could have potentially significant impacts to cultural resources if they are eligible for, or listed on, either the NRHP/CRHR, or resources that qualify as a "unique archaeological resource" under CEQA. This is a potentially significant impact.

Mitigation CUL-1.1: To avoid or mitigate impacts to cultural resources, they must be evaluated against the federal and state significance criteria previously described. Prior to project construction, a focused literature search shall be conducted to identify any known resources. For sites that cannot be adequately characterized by existing literature or available site history information, marine archaeological surveys may be necessary to detect any previously unknown submerged or sub-bottom resources. Depending on the Proposed Project undertaking and the geographic or bathymetric setting, appropriate remote sensing field surveys could include deployment of a side-scan sonar, sub-bottom profiler, and magnetometer to help detect these resources. Follow-up diver survey, high-resolution side-scan sonar, sub-bottom profiler, magnetometer survey, or Remote Operated Vehicle (ROV) investigations might be required to positively identify the targets.

If resources are detected, they shall be identified and evaluated against the NRHP/CRHR significance criteria, and as a "unique archaeological resource" under CEQA. If the resources are not eligible for—or already on—the NRHP/CRHR and do not qualify as a "unique archaeological resource" under CEQA, then no further consideration of these resources is required. If the resources are eligible for—or currently on—the NRHP/CRHR or qualify as a "unique archaeological resource" under CEQA, then impacts could occur to those resources. If a resource is found to be significant, then the resource shall be avoided through alterations in project design, when feasible.

Under CEQA, preservation-in-place is the preferred manner of mitigating impacts to archaeological sites. Preservation in place for archaeological resources may be accomplished by, but not necessarily limited to, a suite of approaches such as:

- Planning construction activities to avoid archaeological sites;
- Incorporation of sites within parks or other open spaces;
- Covering the archaeological site with a layer of chemically stable soil before building facilities on top of the site; and/or
- Deeding the site into a permanent conservation easement.

In the event that avoidance of cultural resources is not possible via project design modifications, appropriate mitigation shall be required. This could include further recordation or data recovery, in accordance with Section 106 of the NHPA. This could include a record of the resource, such as a wharf, pier, building or structure in a Historic American Building Survey/Historic American Engineering Record (HABS/HAER) at a level compatible with National Park Service standards. Adequate recordation of a built-environment resource shall include the following:

- The development of site specific history and appropriate contextual information regarding the particular resource, in addition to archival research and comparative studies;
- Accurate mapping of the noted resources, scaled to indicated size and proportion of the structures;
- Architectural descriptions of the structures;
- Photographic documentation of designated resources; and
- Recordation using measured architectural drawings.

Mitigation of impacts to a built-environment resource may also take place in the form of preservation or reuse of a wharf, pier, building, or structure. The preservation or reuse of an eligible structure would include abiding by the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation. If the building is considered a historic resource under CEQA, the local building inspector must grant code alternatives under the State Historic Building Code.

In some cases, HABS/HAER documentation might not provide an adequate mitigation to reduce impacts to a less than significant level, and might not be a sufficient mitigation measure for some resources. Mitigation should capture the history of a resource and share it with the public so that the public can continue to feel a connection with common heritage. If the pier/building/structure cannot physically be retained, then it is incumbent on the lead agency to pursue ways that the memory of the resource is retained and made easily available. To this end, educational resources such as web media, static displays, interpretive signs, use of on-site volunteer docents, or informational brochures can supplement HABS/HAER. Often, it might be possible to incorporate the resource into the project as one means of resource mitigation.

The CEQA lead agency will be responsible for coordinating all necessary mitigation measures. This might include coordination with a federal lead agency, where federal permitting, land ownership, or other federal-level issues affect a specific project action.

Impact After Mitigation: The proposed mitigation may be adequate to avoid significant impacts. This condition applies to the Hercules/Rodeo location, which would require new construction dredging, and to any ancillary dredging at other locations. Further evaluations would be needed when final locations and designs are known in order to fully evaluate the significance of potential impacts. However, according to CEQA Section 15126.4(b)(1), in certain cases with built-environment resources, the mitigation steps outlined in CUL-1.1 might not reduce the impacts on a resource to a less than significant level. In some circumstances, documentation of a historical resource by way of historic narrative, photographs, or architectural drawings—as mitigation for demolition of the resource—might not mitigate the effects to a point where no significant effect on the environment would occur. In these cases, there could be potentially significant impacts to the resource after mitigation.

Impact CUL-2 **Deposition of dredge spoils for upland reuse or wetland restoration could impact submerged or terrestrial cultural resources.**

Dredging would result in spoils that would require disposal. Only finer-grained materials (Bay Mud and sand) are suitable for aquatic disposal or upland reuse. Rock, coarse gravel, or materials such as concrete, steel, and other construction debris found in the submarine environment are not suitable for aquatic disposal/upland wetland reuse and must be taken to appropriate locations for disposal or recycling. Depending on the volume and suitability of dredged materials, dredging projects may consider a range of disposal options, including in-Bay disposal, ocean disposal, upland reuse, wetland restoration, upland landfill disposal, and reuse as fill material for construction projects. It is assumed that deep-ocean disposal would occur at a previously designated disposal site, that in-Bay disposal would not be allowed for new dredging projects, and that upland disposal would occur at an existing landfill. Therefore, only upland reuse or wetland restoration activities could impact terrestrial and marine cultural resources. Construction dredging would occur at only one location, Hercules/Rodeo. The estimated volume of dredged material at this location is less than 50,000 cubic yards (cy). Disposal of this dredged material at locations that have cultural resources could have a potentially significant impact on those resources.

Summary of Impact CUL-2

- The Proposed Project involves expansion of ferry service to new terminals. This expansion would require dredging at some terminals, for both channels and ancillary project components. Construction dredging at Hercules/Rodeo would result in approximately 50,000 cy of spoils that would require disposal. Upland reuse or use for wetland restoration activities could impact terrestrial and marine cultural resources. Disposal at sites that have not previously been evaluated for cultural resources could pose a potentially significant impact to resources, should they exist.

Mitigation CUL-2.1: Same as CUL-1.1.

Mitigation CUL-2.2: Impacts could be mitigated by avoidance of the particular disposal site.

Impact After Mitigation: Impact CUL-2 would be less than significant after implementation of Mitigation CUL-2.1 or CUL-2.2.

Impact CUL-3 **Project actions such as retrofitting, expansion, or improvement of existing facilities, or construction of new facilities, could impact terrestrial historic and prehistoric cultural resources and historic built environment resources.**

On-shore project construction would involve construction of new facilities and could include expansion of existing ferry terminals. While some of the existing structures, or components thereof, are more than 50 years of age (e.g., the Ferry Building), the majority of terminals are significantly more recent (less than 25 years). Impacts at most sites are anticipated to be less than significant. However, project actions have the potential to significantly impact historic built environment structures and districts (including historic terminal structures), or prehistoric and historic (nonbuilt) archaeological sites.

Summary of Impact CUL-3

- The Proposed Project would involve construction of new terminals and expansion of ferry service. In addition, existing terminals could require renovation or expansion of facilities. While impacts at most sites are anticipated to be less than significant because the buildings at most terminal locations are less than 25 years old, these activities could potentially significantly impact historic built environment structures and districts (including historic terminal structures), or prehistoric and historic (nonbuilt) archaeological sites. These impacts could be potentially significant.

Mitigation CUL-3.1: Same as CUL-1.1.

Impact After Mitigation: Impact CUL-3 would be less than significant after implementation of Mitigation CUL-3.1.

Impact CUL-4 **Project actions such as construction and related activities could impact previously unknown resources.**

During project construction and related activities, the potential always exists to encounter previously unknown cultural resources. This would include prehistoric and historic submarine and terrestrial resources.

Summary of Impact CUL-4

- The Proposed Project would require construction in several areas. Such construction could potentially significantly impact previously unknown resources. Until final locations and designs are known, the impact on unknown cultural resources cannot be determined. Therefore, this remains a potentially significant impact.

Mitigation CUL-4.1: Same as CUL-1.1.

Impact After Mitigation: Impact CUL-4 could be potentially significant after implementation of Mitigation CUL-4.1.

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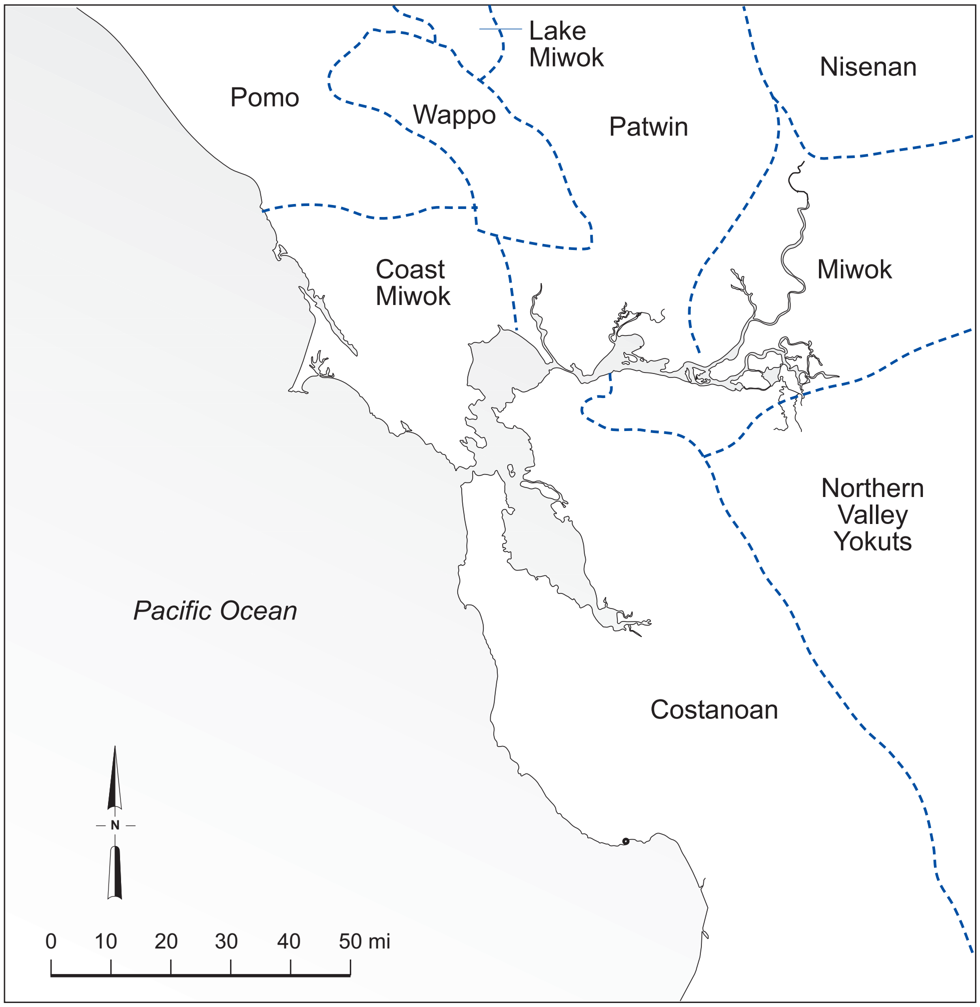

Source: Handbook of North American Indians, Vol. 8, 1978

URS

Project No.43-00066890

Water Transit Authority
Program EIR

TRIBAL TERRITORIES OF THE
SAN FRANCISCO BAY AREA

Figure
3.9.1

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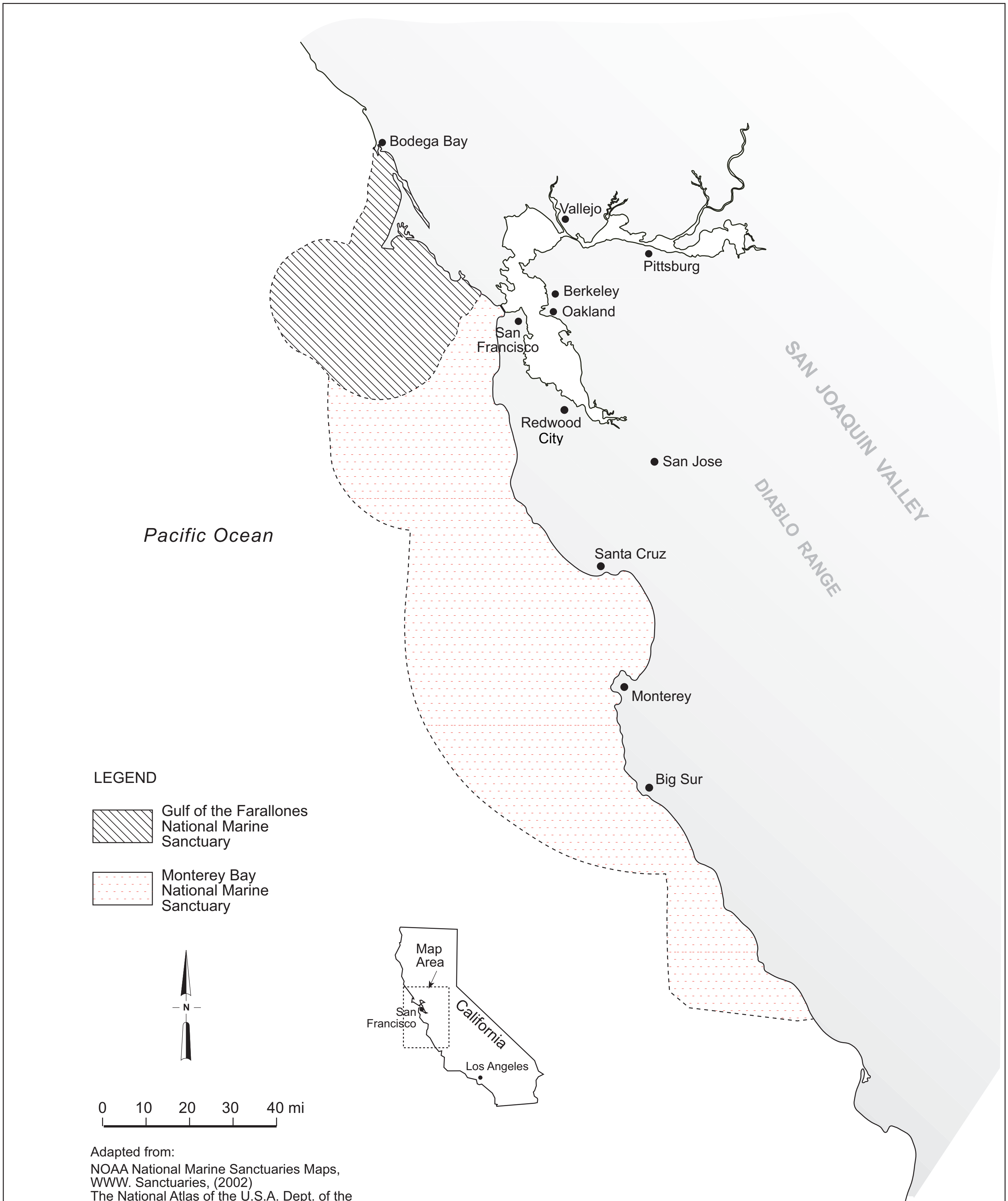

Adapted from:
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URS	Project No.43-00066890 Water Transit Authority Program EIR	NATIONAL MARINE SANCTUARIES NEAR SAN FRANCISCO BAY	Figure 3.9.2

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3.8 AESTHETICS

This section describes the visual and aesthetic resources setting potentially affected by the expansion and enhancement of ferry service throughout the Bay Area.

3.8.1 Environmental Setting

San Francisco Bay is a world-renowned scenic resource, combining water, islands, urban skylines, bridges, and mountains in picturesque and impressive vistas. San Francisco Bay extends from the Sacramento River Delta to the marshlands of Santa Clara County, a total of 548 square miles and 1,000 miles of shoreline. The shoreline of the Bay is lined with commercial, industrial, and residential land uses; points of historic, natural, and cultural interest; recreational areas such as beaches, fishing piers, boat launches; and over 130 parks and wildlife preserves. It is viewed and appreciated from many locations throughout the region. As stated in the San Francisco Bay Plan (BCDC 2002), "Probably the most widely enjoyed 'use' of the Bay is simply viewing it – from the shoreline, from the water, and from afar".

Hills and mountains surround San Francisco Bay. The north-south Coastal Range runs just east of San Francisco and the famously rugged coast is in full dramatic character along the Marin Coast and the Golden Gate. The East Bay hills frame the cities of Oakland and Berkeley and the topography of San Francisco is also famously hilly, providing a dynamic city skyline contrasted against the water and coastal hills.

Islands such as the hilly and forested Angel Island, the historic Alcatraz Island, and the man-made Treasure Island help define the visual character of the Central Bay. They are a dramatic landscape viewable throughout the Central Bay. They also provide spectacular views of San Francisco, the Marin coastline, the hills of the East Bay, and Bay waters extending north and south.

Other unique visual features of the Bay Area include the salt ponds of the South Bay and Suisun Marsh in the North Bay, which contribute to the natural and visual diversity of the area. Wildlife is also a highlight of the Bay's visual character. People can watch seals, shorebirds, and deer in regional parks. In the spring, after mild but wet winters, the Bay is surrounded by colorful displays of native wildflowers.

The cities, towns, and industry along the Bay are evidence of the large population of people living and working around the Bay. The built environment heavily defines the visual character of the Bay shoreline. For example, residential areas along or within the nearby hills of Marin County, Point Richmond, or the Marina District of San Francisco are noted by many as memorable skylines. Along the Carquinez Strait, the views are a mix of industrial and petro-chemical refiners and tanker wharves, interspersed with open shoreline and marsh.

3.8.1.1 Local Visual Setting

The expansion and enhancement of ferry services would affect a wide range of visual settings along the Bay shoreline. Section 3.7.1.2 (Land Use) summarizes land uses around each existing and potential terminal location, which provides additional understanding of the local visual settings. The potential settings range from highly urban landscapes to undeveloped shoreline parks. General types of visual settings are described below to provide context to potential and existing terminal locations that may be included in the WTA plan.

Urban Environment

Ferry terminals in San Francisco and Oakland are surrounded by dense development including warehouses, high-rise buildings, commercial, and housing. The urban environment provides a unique visual resource and views to and from the Bay, including skylines and shoreline development. Historic structures, such as the Ferry Building in San Francisco or more modern developments such as Jack London Square in Oakland, are examples of the varied urban context behind new or enhanced terminals.

Suburban Environment

Waterfront communities around the Bay provide varied visual settings for potential ferry terminals. These areas are generally less densely developed and have open Bay views due to lower buildings, waterfront promenades, and marinas. Existing terminal facilities at Larkspur, Vallejo, and Alameda are transportation and commuter hubs and are surrounded by retail, business, and residential land uses. Potential terminal locations identified in this EIR, such as Antioch or Pittsburg may utilize existing ports or marinas to develop similar transportation hubs. In some locations, such as the Berkeley marina, the local marina or shoreline is separated from the city center and neighborhoods by freeways, railroads, and/or undeveloped lands.

3.8.1.2 Regulatory Setting

McAteer-Petris Act

Under the McAteer-Petris Act, the Bay Conservation and Development Commission (BCDC) regulates development within the first 100 feet inland from the Bay. One of BCDC's primary roles is to review proposed development or changes to the shoreline for their aesthetic and visual impact. BCDC has appointed a Design Review Board that evaluates projects and makes recommendations in light of the San Francisco Bay Plan Part IV, Appearance, Design, and Scenic Views, Policies 1-15 (BCDC 2002). Some of the criteria relevant to the WTA program include the following:

- To enhance the visual quality of development around the Bay and to take maximum advantage of the attractive setting it provides, the shores of the Bay should be developed in accordance with the Public Access Design Guidelines.
- All bay front development should be designed to enhance the pleasure of the user or viewer of the Bay. Maximum efforts should be made to provide, enhance, or preserve views of the Bay and shoreline, especially from public areas, from the Bay itself, and from the opposite shore.
- Structures and facilities that do not take advantage of or visually complement the Bay should be located and designed so as not to impact visually on the Bay and shoreline. In particular, parking areas should be located away from the shoreline.

- To enhance the maritime atmosphere of the Bay Area, ports should be designed, whenever feasible, to permit public access and viewing of port activities by means of (a) view points (e.g., piers, platforms, or towers), restaurants, etc., that would not interfere with port operations, and (b) openings between buildings and other site designs that permit views from nearby roads.

Local Regulations

Aesthetic and visual resource regulations vary from location to location based upon the City and County General Plans, Ordinances, and Policies. These local regulations must be identified on a project-by-project basis. Pertinent local aesthetic policies currently in place are listed in Table 3.7.1 of the Section 3.7 (Land Use).

State Scenic Highway Program

The State Scenic Highway Program, created by the State Legislature in 1963, was established to preserve and protect scenic highway corridors from change that would diminish the aesthetic value of lands adjacent to highways. A highway is officially designated under this program when a local jurisdiction adopts a scenic corridor protection program, applies to the California Department of Transportation for scenic highway approval, and receives notification from Caltrans that the highway has been designated as a Scenic Highway.

When a city or county nominates an eligible scenic highway for official designation, it defines the scenic corridor, which is land generally adjacent to and visible to a motorist on the highway. The agency then must adopt or document ordinances to preserve the scenic quality of the corridor.

3.8.2 Impacts and Mitigation

3.8.2.1 Methods

This programmatic assessment of visual and aesthetic impacts due to proposed water transit service expansion is a qualitative analysis. It is broad-based and regional in nature and does not provide a detailed local visual and aesthetic impact assessment. Broad types of visual and aesthetic impacts were assessed because they could occur at any location throughout the Bay due to increased ferry services.

The issues considered in the analysis include views to and from the Bay, the visual quality of new or enhanced structures, light and glare, and the aesthetic quality of construction or ferry activity along the shoreline. The assumption was made that visual and aesthetic impacts of increased ferry services would be most prominent at the existing and potential terminal locations. Therefore, the assessment focused more heavily on these areas.

3.8.2.2 Significance Criteria

Impacts would be considered significant if they:

- Would have a substantial adverse effect on a scenic vista or degrade the existing visual character or quality of the site and its surroundings;

- Would substantially damage scenic resources, including but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway; or
- Would create a new source of substantial light or glare that would adversely affect daytime or nighttime views in the area.

3.8.2.3 Impacts

Impact V-1 **The construction and operation of new and enhanced ferry terminals along the Bay shoreline could potentially impact land and water views of San Francisco Bay or degrade the visual character of the Bay.**

The types of impacts that could occur through construction of terminals, enhancement of existing terminals, and expansion of ferry service are summarized below. These impacts would be localized. Region-wide, these structures would affect a relatively small portion of the 1,000 miles of Bay shoreline. The Proposed Project represents only nine potential new terminals. All but one of these terminals (Hercules/Rodeo) would be at already developed shoreline areas. Localized site-specific visual impact analyses of potential terminal locations were not performed for this program-level EIR.

- Block Bay views: New shoreline development could result in new structures or docked vessels. It is possible that in some instances these structures could be visible or even block or restrict existing views of the Bay.
- Construct unsightly buildings: Without careful planning and design, new terminals could result in unattractive development that negatively affects shoreline views.
- Create light and glare: Safety lighting for facilities, walkways, and parking lots could create a new source of light and glare that negatively affects the surrounding community and/or wildlife.
- Construct a building that is inappropriate to a waterfront location: Inappropriate terminal designs could result in parking areas or other inappropriate structures along the waterfront.

Proposed ferry service expansion may also result in positive impacts to visual resources and the aesthetics of the Bay:

- Enhance Bay views: New terminal designs could provide new or enhanced opportunities to view the Bay from piers, platforms, and the ferries themselves.
- Improve the aesthetics of shoreline development: New terminal development could revitalize areas of the shoreline that currently do not take advantage of the Bay setting. Improving areas that currently have debris, contamination, or inappropriate development could result in an enhancement of public views to and from the Bay through the construction of terminals designed to visually complement the Bay and provide public access to the waterfront.

Planning of any development or change in or near the shoreline of the San Francisco Bay is subject to considerable regulatory review by local, state, and federal resource and permitting agencies. Site and terminal planning and its associated regulatory review process for all proposed ferry terminal projects would follow the BCDC Bay Plan policies on appearance, design, and scenic views (BCDC 2002). The policies provide guidelines for enhancing the visual quality of development around the Bay while preserving views of the Bay and shoreline. In addition, the BCDC Design Review Board would review all proposed development that affects the appearance of the Bay in accordance with the Bay Plan. Local, city, and county ordinances, regulations, and policies would also apply on a project-by-project basis.

Summary of Impact V-1

- The Proposed Project would involve the construction of new terminals and could involve the improvement of existing terminals. These could have potentially significant impacts on views of the Bay or the visual character of waterfront areas. Light and glare could also have potentially significant impacts on wildlife. Potential impacts to wildlife are addressed in Impact B-21 in the Biology Section (3.5).

Mitigation V-1.1: When feasible, the following shall be included in ferry terminal design:

- Locate terminal facilities so as not to obstruct or detract from views of the Bay from nearby public thoroughfares;
- Design terminals and layout to integrate with the surrounding landscape and historical structures to preserve, and take advantage of, existing views of the Bay and shoreline.
- Design terminal facilities to provide new or enhanced point access areas or view areas such as piers, platforms and walkways;
- Design and site terminals so as to maintain and enhance the visual quality of the shoreline and visual public access to the Bay; and
- Vessels should be standardized to support system-wide operations and to work interchangeably at all terminals. Vessel berthing should be configured so as to allow maximum feasible visual access to the Bay.

Mitigation V-1.2: The WTA established Intermodal and Architectural Design Guidelines (ARUP 2001) that shall be considered in the planning and design of new and enhanced ferry terminals (Parsons Brinckerhoff 2002). The design objectives may include, but are not limited to, making the ferry system more attractive, integrating terminals with the local urban context, and taking advantage of waterfront views. The ideal terminal facility will serve as a catalyst to ferry service expansion in the Bay Area. The specific design of each terminal facility should be developed at a local level to ensure compatibility with the surrounding visual environment. In addition, site-specific studies on the potential impacts of light and glare on wildlife may be necessary to determine appropriate mitigations. This would be most relevant for the Hercules/Rodeo site, which is the only proposed new terminal site that would not be in an area having existing maritime uses.

Impact After Mitigation: The WTA design guidelines would promote aesthetic planning criteria that guide the initial development of projects in a manner consistent with preservation of views and scenic resources. In addition, future development of projects will not proceed without meeting BCDC and local planning requirements. At some sites, Impact V-1 could still be potentially significant after implementation of Mitigations V-1.1 and V-1.2.

Impact V-2 **An increase in the number of ferryboats operating on San Francisco Bay could impact views of the Bay or degrade the visual character of the Bay.**

The current ferry services use 15 boats systemwide, with over 80,000 trips annually. Ferries share the Bay with commercial, military, and recreational boats making their way to and from the eight ports and 21 marine terminals throughout the Bay. Views of the Bay therefore include many types of vessels.

The proposed expansion of ferry service under the Proposed Project would expand service by approximately four times. Ferry activity on the Bay would increase from approximately 85 daily trips to a projected 336 daily trips.

The potential visual impact of additional ferryboats making trips across the Bay is subjective. It could be seen as an enhancement of the maritime atmosphere and Bay views similar to existing views, which include ferry services, shipping activity, and recreational boating. It could also be seen as a detriment to views of the Bay. There are no established significance criteria that provide a framework to determine whether increased ferry vessels on the Bay would be considered a significantly detrimental impact. Increases in service may be relatively unnoticeable to most Bay Area residents and travelers. In addition, the visual impact would be partially minimized by the concentration of routes along some common alignments. Given the total volume of boat traffic on the Bay, and the maritime history of the Bay, the impact on visual resources of expanded ferry service is expected to be less than significant.

Summary of Impact V-2

- The Proposed Project would result in an increase in the number of vessels operating on San Francisco Bay. This could have an adverse impact on scenic views of the Bay or the visual quality of waterfront areas. Given the variety of vessels plying the Bay and the frequency of their passage, it is expected that additional ferries would have a less than significant impact on scenic views.

Impact V-3 **Increased ferry operations could increase the amount of visible exhaust over the Bay.**

Visible exhaust plumes from existing ferry engines are the result of various conditions, but can indicate that an engine is not completely burning the fuel. Incomplete combustion results in unwanted pollutant emissions. These emissions can include particulates that may be visible in the exhaust, resulting in darkened plumes. Internal combustion engine emissions also include a large proportion of water vapor, a normal product of combustion, which may also be visible under certain conditions (such as very cold temperatures or an engine that is not completely warmed up).

For the Proposed Project, all ferries proposed for new routes would be based on state-of-the-art engine and fuel technology that would have minimal or nonexistent plumes. The modern ferry vessels on current routes would also use the clean technology (SCR and particulate traps). This technology goes beyond U.S. Environmental Protection Agency (USEPA) Tier 2 standards in reducing emissions. By the year 2025, it is assumed that all ferries operating on the Bay will be based on the cleaner technology and visible exhaust plumes would be significantly reduced or nonexistent. Therefore, visual impacts from exhaust plumes are considered to be less than significant.

Summary of Impact V-3

- The Proposed Project would increase the number of ferries and trips on the Bay, but all boats would use clean technologies. As a result, visible exhaust plumes would be minimal or nonexistent. Therefore, visual impacts from exhaust plumes are considered to be less than significant. No mitigation is required.

Impact V-4 **Expanded and enhanced ferry services, including terminals and additional ferry boats, would not impact scenic resources within a State Scenic Highway.**

Sections of Bay Area Highways 280, 580, and 680 have been designated as scenic corridors under the State Scenic Highway program but do not provide motorists with expansive or continuous views of the Bay. Therefore, these corridors would not be affected by an increase in visible ferries on the Bay or the construction of new terminals along the shoreline.

Summary of Impact V-4

- The Proposed Project includes additional terminals and an increase in the number of vessels operating on San Francisco Bay. This development and boat activity would not be highly visible to motorists and it does not represent a visual impact to scenic resources within a State Scenic Highway.

Impact V-5 **Expanded and enhanced ferry terminals and services throughout San Francisco Bay could result in light and glare impacts.**

Ferry terminal facilities could include structures, parking lots, roadways, and pedestrian and bicycle facilities that would be lit for public safety. Terminals proposed within or adjacent to existing marinas, ports, or shoreline development would add to existing light and glare, but may not necessarily create a substantial new source. Potential terminal facilities in parkland or less developed areas would be more likely to create a new source of light and glare, and this impact could be adverse and significant. New light sources may represent a potentially significant impact to light-sensitive land uses such as nearby residential areas.

Increased ferry trips on the Bay would add to the existing vessels that already cross Bay waters. Early morning or late day/evening vessel trips would show navigation lighting as well as cabin and deck lighting. The increase in frequency of trips and new routes to terminals not currently serviced would increase and introduce these sources of light on the Bay and at terminals, but it would be transitory and the lighting would not be a substantial source of glare to light-sensitive land uses. Therefore, this vessel lighting would not be considered adverse or significant.

Summary of Impact V-5

- The Proposed Project would include the construction of new terminals and possibly the improvement of existing terminals. These could result in potentially significant light and glare impacts.

Mitigation V-5.1: Ferry terminal designs will be required to develop site-specific lighting plans. Outdoor lighting shall be focused and directed to the specific location (e.g., roads, walkways), be shielded to avoid the production of glare, and minimize up-light and light spill. Fixtures shall be located, aimed or shielded to minimize stray light to or across property boundaries. Light design shall use down-cast, low glare, shields, or equivalent designs to minimize light and glare on surrounding land uses.

Impact After Mitigation: Impact V-5 would be minimized through Mitigation V-5.1, but the potential remains for significant impacts depending on site-specific locations and settings, and applicable local regulations. This impact remains potentially significant.

References

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San Francisco Bay Conservation and Development Commission (BCDC). 2002. San Francisco Bay Plan. October.

3.7 LAND USE

This section describes the existing land uses and communities around the Bay Area potentially involved with the project. The environmental setting of this report is divided into four sections: (1) the regional setting of the Bay Area; (2) the existing land use setting of each potential ferry terminal site; (3) a description of the land use and community resources potentially affected; and (4) the regulatory setting.

The regional setting is based largely on the data provided by the Association of Bay Area Governments (ABAG) in their publication *Projections 2002* (ABAG 2001). The existing land use setting of each proposed terminal location is based on a summary review of city and county general plans, regional census data, and other terminal site information already gathered by ARUP (ARUP 2001) for the WTA ferry expansion project. The data collection process focused primarily on the local settings.

A variety of land use and community attributes were identified for each community within which a potential ferry terminal facility is proposed or would be expanded as a result of the project. Most of the land use information was acquired from general plans. Existing land uses as well as planned future developments were identified. To expedite the data gathering process, a questionnaire was developed and mailed out to the planning department of each local jurisdiction (see Appendix LU-A). Planning agencies were requested to respond to the questionnaire. Follow-up phone calls were made to gather missing information.

Census data from the 2000 Census were reviewed to help describe the potentially affected communities with respect to race/ethnicity and income. Specifically, low-income and minority communities were identified to evaluate whether the proposed project could result in disproportionate adverse effects on these communities.

Table 3.7.1 contains a summary of the land use data collected for each potential terminal location. Table 3.7.2 contains the racial summary of each community potentially affected by the project. Table 3.7.3 compares the median income of each community potentially affected by the project to the low-income threshold for the county. Table 3.7.4 presents the census tracts considered to be minority and/or low-income communities.

3.7.1 Environmental Setting

3.7.1.1 Regional Setting

The San Francisco Bay Area consists of nine counties that cover roughly 4.5 million acres. According to ABAG, approximately 17 percent of this total acreage had been developed by the year 2000. Most of the Bay Area's population and economy is situated along the perimeter of San Francisco Bay (the Bay) in the older, larger cities such as San Francisco, Oakland, and San Jose. However, the majority of new residential and commercial land use development is occurring in the peripheral cities located in the valleys surrounding the Bay, such as Santa Rosa, Fairfield, and Livermore (ABAG 2001).

The communities in the Bay Area situated along the waterfront, such as those that could be involved with the proposed project, were historically focused on industrial and commercial land use. Many of the rail lines that serviced these areas still run along large stretches of Bay shoreline, and large areas of cities still have active industrial areas on the waterfront. More recently, portions of the Bay shoreline have been the focus of redevelopment projects and recreational projects to renew people's connection to the Bay. ABAG is working on the San Francisco Bay Trail, which will one day provide a continuous recreational trail around the Bay. Industrial and commercial land uses have also continued to develop, but in more select areas around the Bay.

3.7.1.2 Existing Land Uses at Proposed Terminal Sites

The expansion and enhancement of ferry services would affect a wide range of land uses and communities along the Bay shoreline. Brief descriptions of potential local settings for new or enhanced terminal locations are provided below. The descriptions note when planning departments have identified potential changes in land use for a particular area, as some areas may have changed by the time a ferry terminal site is considered. The numbers in parentheses correspond to terminal locations shown on Figure 2.1. More detail on each potential ferry terminal site is contained in Tables 3.7.1 through 3.7.3.

Alameda – Harbor Bay (14)	The existing ferry terminal at Harbor Bay Parkway and Mecartney Road on the northwest side of Bay Farm Island, Alameda, is located within a single-family residential area. The terminal was built as a requirement of the part of the Harbor Bay Business Park development, an employment center for 85 companies located approximately one-half mile south of the terminal site.
Alameda Main Street (15)	The existing ferry terminal is located on Main Street along the Oakland Estuary. The site is between the former U.S. Naval Air Station Alameda and the Alameda Gateway site. Due to redevelopment plans for these areas, significant changes will occur including mixed-use business park development with office, commercial, and light industrial uses.
Pittsburg/Antioch (46)	A potential ferry terminal could be located at the marina in Antioch. The site is surrounded by a parking lot, boat slips, restaurants, and commercial uses. Adjacent to the marina is a downtown setting with commercial, office, and residential land uses. Alternatively, a ferry terminal could be located at the Pittsburg Marina/Central Harbor, Contra Costa County. The waterfront area is immediately adjacent to the downtown core of Pittsburg with urban commercial and residential areas. There are few visual and physical connections between downtown and the water.
Berkeley/Albany (7)	This terminal site would be located at the foot of University Avenue. The area includes a marina, restaurants, and a hotel, as well as recreational uses.
Hercules/Rodeo (28)	Hercules is a rapidly growing city stretching from San Pablo Bay to the rolling coastal hills. The City of Hercules has proposed mixed-use development along the waterfront, primarily single-family residential and commercial. The Rodeo Marina is surrounded by a retail, commercial, and residential area and the Lone Tree Regional Shoreline.

Larkspur (1) The existing ferry terminal complex in Larkspur, Marin County, includes four vessel slips, a parking lot, bus parking, fuel storage, and maintenance and administration offices. Across the street is Larkspur Landing, an outdoor shopping complex with retail businesses and restaurants.

Vallejo/Mare Island (25) A ferry terminal is proposed for service to Mare Island, a former naval shipyard. The island currently has many old military buildings, some of which are occupied by businesses and some of which are vacant or closed. Reuse plans call for creating a job center with mixed land uses such as industrial and office as well as residential units, a regional park, expansion of the golf course, and the construction of a bridge at the southern end of the island.

Martinez (24) A ferry terminal is proposed in the vicinity of the Martinez Yacht Harbor at the end of North Court Street. The harbor extends into the Carquinez Strait and is surrounded by the Martinez Regional Shoreline Park to the east and west and the Martinez Waterfront Park to the south. The parks form a half-mile buffer between downtown Martinez and the harbor. Other potential sites could include areas near the Martinez Intermodal Station.

Mission Bay (12) Ferry service is proposed to the Mission Bay Redevelopment Area, approximately 1 mile southeast of downtown San Francisco. The site is currently an industrial area and former rail yard proposed for redevelopment as a dense urban neighborhood with housing, offices, retail, parks, and a school.

Oakland/Jack London Square (16) The existing ferry terminal is at the end of Clay Street within the commercial/retail district of Jack London Square. This active area includes restaurants, small shops, entertainment, residential units, and office space and is within walking distance of downtown Oakland.

Oyster Point (19) A ferry terminal is proposed at the end of Oyster Point Boulevard in the Oyster Point Marina/Park. The marina is surrounded by a shoreline park extending north and south along the Bay. The area inland of this park includes primarily low-density offices, technology parks, and light industrial areas with very few housing units.

Redwood City (21) The proposed ferry terminal site in Redwood City is on a narrow spit of land adjacent to Redwood Creek and surrounded by wetlands and salt evaporation beds. Commercial development is the primary land use planned for the area, including a large existing development at Pacific Shores. The Port of Redwood City is serving a growing industrial role for the delivery of bulk construction materials to the South Bay.

Richmond (4) Given Richmond's extensive waterfront, there are a variety of potential locations for a ferry terminal, including the existing decommissioned terminal at the end of Harbor Way South. The shoreline in the vicinity of the existing terminal includes a vacant parking lot, debilitated historical industrial factory, the Port of Richmond shipping yard, a small park, and R&D office facilities. Redevelopment of this area may include new land uses such as office, research and development, residential, mixed-use development, parks, promenades, and open space.

Sausalito (3) The existing ferry terminal is located in the middle of downtown Sausalito, Marin County, and is easily accessible from the shopping area of central downtown. The picturesque town includes boutiques, restaurants and public parks. Multifamily housing dominates the nearby residential area.

San Francisco Ferry Building (20) The historic San Francisco Ferry Building is currently being redeveloped as a major retail/commercial structure. The project will result in new and improved ferry terminal facilities and enhanced public access and aesthetic character. The surrounding area includes high-rise buildings with offices, retail, and restaurants.

Tiburon (2) The existing Tiburon ferry terminal is located on the west end of Tiburon near the Belvedere border and looks directly across to Angel Island. Main Street, the downtown retail area with boutiques, restaurants, and other small-scale retail, is directly adjacent to the terminal. An adjoining multiple-unit residential area quickly gives way to lower-density residential as the distance from downtown increases.

Treasure Island (6) A ferry terminal is proposed on Treasure Island, in San Francisco Bay between San Francisco and Oakland. The island is composed of the natural island of Yerba Buena and the artificial Treasure Island. The site is a decommissioned military base with offices, housing, warehouses, and other structures. The Draft Reuse Plan emphasizes publicly oriented uses such as recreation, entertainment, retail, and hospitality.

Vallejo (25) The existing Vallejo ferry terminal provides service from Mare Island Way in Memorial Park. The terminal is adjacent to Vallejo's city hall, main post office, and library and is close to downtown Vallejo. In addition, the redevelopment of Mare Island may generate increased ferry ridership. Buildout of the former base will include a variety of uses including residential, wetland research center, regional park, an 18-hole golf course, dredge ponds, schools, and light industrial.

3.7.1.3 Potentially Affected Land Uses and Communities

This section describes the range of identified land use and community attributes potentially affected by the Proposed Project. The discussions of the first three sections on land use designations, zoning, and future developments summarize the data presented in Table 3.7.1. The discussion on race and ethnicity is supported by Table 3.7.2, and the discussion on income is supported by Table 3.7.3.

Land Use Designations

The Proposed Project would potentially affect a wide range of land use designations. Most of the terminals that already exist are designated as Public Institutional, Public Facility, Public Trust, or Parks and Open Space, and are compatible with the policies of the local general plan.

The land use patterns along the waterfronts of the various cities and counties was generally consistent, with the Industrial and Open Space/Recreational land use designations being the most common. This is consistent with the historical uses and present goals for use along the Bay shoreline. Interestingly, many of the areas surrounding the existing ferry terminals had these same designations, which may be attributed to the fact that many city and county planning agencies consider ferry terminals to be consistent land uses in industrial and open space/recreation areas.

The exact locations of many of the proposed new ferry terminal sites are unknown at this time. These sites could be located in a variety of places along the shoreline within each city or county. However, most of the proposed new terminal locations are in areas with existing maritime characters and can be considered "mixed-use," as more than one type of land use is designated along the waterfront. Most of the mixed uses are dominated by industrial uses, which are mixed with commercial and residential land uses.

Although most of the locations where new ferry service is proposed are defined by the presence of a population center, residential land uses are not common directly on the shoreline.

Zoning

Zoning ordinances support the land use designations in a local general plan. Zoning details the allowable use of a parcel, to ensure that it is used consistently with the general plan. Just as the proposed project would involve a large range of land use designations, it would also require compliance with a large range of related zoning regulations. As stated above, the existing ferry terminal facilities tend to be compatible with industrial and open space/recreation land uses. This may be attributed to the fact that ferry terminals are considered allowable uses in these areas by the local zoning ordinances. The zoning regulations that support commercially designated areas may also state ferry terminals as an allowable use.

Future Developments

Some of the proposed new ferry terminal sites would be located in areas where a Specific Plan, Master Plan, Management Plan, or other proposed local development plan has been proposed or adopted. When a large development or redevelopment project is proposed, involving more than one type of land use, the city or county responsible for adopting the development will usually require that a Specific Plan be prepared for incorporation into the local general plan. These types of local plans are opportunities for ferry services and terminals to be incorporated into the future land uses of an area.

It appears that some of the locations identified for potential new ferry terminals would be compatible with redevelopment plans that are currently being considered or have already been adopted by various city and county planning agencies. The Naval Air Station in Alameda is an example of a proposed redevelopment project that could incorporate a ferry terminal.

Other potential ferry terminal sites that could be incorporated into a local planning process under way include but are not limited to Richmond, whose planning department is currently considering plans to redevelop a part of the waterfront; Pittsburg, whose community development department is considering a new marine/waterfront commercial village; South San Francisco, whose planning department is expecting significant growth in the area east of U.S. 101 near Oyster Point; Antioch, whose community development department is currently overseeing the development of a large mixed-use waterfront development called Rivertown; and Redwood City, whose planning and redevelopment agency is developing a new Waterfront Plan.

The GGNRA is conducting a separate study to address access to the various areas under their jurisdiction, including potentially increasing ferry services and creating new ferry terminals. Potential terminal sites, including existing piers, are being identified, along with encumbrances to landside access and potential transit linkages to support visitor flow. As part of the analysis, GGNRA is also examining the carrying capacity of the terminal sites and the natural resources which would be affected by water transit, along with the need for landside facilities once visitors arrive (GGNRA 2002). The exact sites being considered by GGNRA are still under study at this point. Although future GGNRA ferry terminals are still under study at this time, they may be compatible with three proposed ferry terminal locations, such as at Fort Mason, Fort Baker, and the Presidio. Federal environmental review and site-specific management planning is required before any development project is undertaken on GGRNA property. The GGNRA project is further described in Section 2.6.

In a few cases, such as at Alameda and Treasure Island, a new ferry terminal has been specifically proposed as part of an adopted Specific Plan or similar local plan. The City of Alameda Transportation Plan identifies the relocation of the existing ferry terminal to Seaplane Lagoon and the 1996 Reuse Plan for Treasure Island emphasizes the goal of making the island accessible to urban residents by ferry.

The proposed terminals at Alameda and Treasure Island are notable because the local agencies are already considering new ferry terminal facilities that may lead to a change in a land use designation and/or the construction of a ferry terminal facility independent of the WTA process.

Race and Ethnicity

The Bay Area is a diverse region in terms of race and ethnicity. According to the 2000 Census, the largest percentage (50 percent) of people in the nine-county Bay Area consider themselves white and not of Hispanic lineage. Twenty percent consider themselves Hispanic, 20 percent consider themselves Asian/Pacific Islander/Other, 7 percent consider themselves African American, and 3 percent consider themselves a mix of more than one race/ethnicity (U.S. Census Bureau 2001).

Race and ethnicity data were collected to determine whether the Proposed Project would have a disproportionate adverse impact on minority communities. Because the racial composition of a community or neighborhood can change drastically over small distances within one city's jurisdiction, racial and ethnic data were collected at the census tract level. Table 3.7.2 lists the 54 potentially affected census tracts and the top races/ethnicities for each census tract. In some instances, census tract information overlapped two potential ferry terminal sites; however, census tracts were only counted once. The Oakland Army Base and Treasure Island had no census data.

Although demographic surveys such as the U.S. Census categorize people generally and may not completely describe the level of diversity of a community, demographic data on race and ethnicity are important to consider in the analysis of potential impacts (both positive and negative) that may result from selecting the location of a transportation facility such as a ferry terminal.

Income

Income data are important to the environmental review process because, like race/ethnicity data, they help describe the community that could be served or adversely affected by constructing and operating a ferry terminal. Low-income neighborhoods are of particular concern because they tend to be more susceptible to redevelopment projects that deem these neighborhoods "blighted." Although the decision to redevelop a low-income neighborhood can only be made by the city or county government, it can be encouraged by regional projects such as the Proposed Project.

Income data by census tract were collected to determine whether the Proposed Project could have a disproportionate adverse impact on low-income communities. For the purposes of this analysis, one census tract was considered to be one neighborhood/community. As stated above, in some instances census tract information overlapped two potential ferry terminal sites; however, census tracts were only counted once in the analysis.

The California Department of Housing and Community Development (HCD) recently published income limits for the year 2002 (HCD 2002). HCD establishes income limits by household for the U.S. Department of Housing and Urban Development (HUD) programs in the state of California. These limits are published by county, which administers federal and state housing programs at the local level.

Table 3.7.3 presents a comparison of median household income to the county low-income limit for all of the communities potentially affected. For the purposes of this analysis, when the median household income in a census tract is below the low-income limit for the county, the community is considered low income. Because the average household size in all of the counties potentially affected is between 2 and 3 persons, the low-income limit used is based on a 3-person household. As stated above, the Oakland Army Base and Treasure Island had no census data.

3.7.1.4 Regulatory Setting

National Environmental Policy Act of 1972

Although the Proposed Project does not currently have federal involvement, it is possible that future actions at the local level may require compliance with the National Environmental Policy Act of 1972 (NEPA). NEPA is the federal process through which environmental effects are analyzed. It is required when a proposed action requires a federal permit or entitlement, is jointly carried out by a federal agency, will be federally funded, or will occur on federal land. For example, potential routes and terminals may be funded in part by a federal grant or agency, which would require the local project sponsor to comply with NEPA. Construction of new docks could require permits from the U.S. Army Corps of Engineers (USACE). Such permits could trigger environmental review under NEPA.

Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations, was issued to all federal departments on February 11, 1994. This order requires federal lead agencies to ensure rights established under Title IV of the Civil Rights Act of 1964 are considered as part of analyzing environmental effects. Therefore, any proposed action under NEPA requires an Environmental Justice analysis to determine impacts to low income and minority communities.

California Environmental Quality Act

At the state level, the California Environmental Quality Act (CEQA) (California Public Resources Code Sections 21000-21178) and the CEQA Guidelines (14 California Code of Regulations [CCR] 15000-15387) are the primary policies that require projects to analyze potential impacts to land uses and communities. Essentially, CEQA requires that projects identify all potential impacts to environment and reduce their significance to a less-than-significant level. Unlike NEPA, however, CEQA does not require an environmental impact analysis to consider potential community impacts that are not physical in nature. In particular, land use impacts must be considered under CEQA; however, consideration of impacts to low-income or minority populations is not required.

CEQA requires that every project determine its consistency with local plans. Consistency with the adopted local general plan is one of several criteria for determining whether a project will have a significant effect under the provisions of CEQA. Specifically, an Initial Study must contain an examination of whether the project would be consistent with existing zoning, plans, and other applicable land use controls (Section 15063(d)(5) of the CEQA Guidelines). Please refer to City and County General Plans and Ordinances, below, for more discussion on the local land use controls.

San Francisco Bay Plan

Development in or within 100 feet of the San Francisco Bay is subject to the jurisdiction of the San Francisco Bay Conservation and Development Commission (BCDC) and would require BCDC approval. The goals and policies of BCDC are described in the San Francisco Bay Plan (Bay Plan), which was adopted in 1968 and incorporated by the California Legislature into the McAteer-Petris Act in 1969 (BCDC 2002). The Bay Plan contains findings about the value of the Bay, policies to guide future uses of the Bay, and maps that apply these policies to the Bay and its shoreline. Part Four of the Bay Plan contains findings and policies pertinent to development of the Bay and shoreline. Policies from the “Recreation” and “Public Access” subsections are described below.

Recreation (last amended October 2002)

This section states that as the population of the Bay region increases, more people are expected to use their leisure time in water-oriented recreational activities. It predicts that many more water-oriented recreational facilities will be needed to accommodate the needs of Bay Area residents and visitors. The Bay Plan maps include about 5,800 acres of potential new parks along the approximately 1,000-mile shoreline, as well as 4,400 acres of parkland that could be created if military use of the properties ceases (particularly near the Golden Gate). The Bay Plan states that water-oriented recreational facilities should be well distributed around the shores of the Bay, to the extent consistent with criteria specified elsewhere in the Bay Plan. Recreational facilities should not, however, preempt sites needed for ports, waterfront industry, or airports, but efforts should be made to integrate recreational uses into these facilities to the extent that they might be compatible. The Bay Plan also advises that waterfront land needed for parks and beaches by the year 2020 should be reserved now to preserve them from being used for other purposes. These facilities need not be built all at once, however.

Public Access (last amended March 2001)

This section states that, although public access to the Bay shoreline has increased since adoption of the Bay Plan in 1968, additional public access is still needed. Public agencies have limited funds for providing or improving shoreline access, but private capital can provide public access in association with a wide variety of shoreline developments. Any proposed fill project should enhance public access to the Bay to the maximum extent feasible in accordance with Bay Plan policies. In addition to the public access provided by waterfront parks, beaches, marinas, and fishing piers, maximum feasible access to and along the waterfront and on any permitted fills should be provided in and through every new development in the Bay or on the shoreline, including airport development. In those cases where public access is inconsistent with the project because of public safety considerations or significant use conflicts (such as significant adverse effects on wildlife), in-lieu public access should be provided, preferably near the project site.

Public access as a condition of development should be permanently guaranteed and should be consistent with the development project, as well as with the physical environment of the Bay and shoreline. Access to and along the waterfront should be provided by walkways or trails and should be convenient to parking and/or public transit. In addition, the BCDC, special districts, and federal, state, regional, and local jurisdictions should cooperate to provide new public access areas, especially to link the entire series of shoreline parks, regional trail systems, and existing public access areas to the extent feasible, without additional Bay filling or adversely affecting natural resources. BCDC's *Public Access Design Guidelines* (BCDC 2001) should be used in siting and designing public access associated with a proposed project. The Design Review Board should advise the BCDC on the adequacy of the public access proposed.

City and County General Plans and Ordinances

The California State Legislature, pursuant to Government Code Section 65300, requires each city and county jurisdiction in the state to prepare a local general plan. The general plan is the primary planning document that establishes policies to regulate the development, function, and use of land within the boundaries of each city or county jurisdiction. With respect to the proposed project, the enhancement of an existing terminal or the development of a new one must conform to the policies of the local general plan.

General plans are required to contain the following elements or chapters: land use, circulation, housing, conservation, open space, noise, and safety. Although all seven elements carry equal weight, the land use element is integral to carrying out local planning because it designates the pattern and scope of development. Land use designations are one of the primary tools cities and counties use to establish a comprehensive plan that is used to guide development. Examples of land use designations include Low Density Residential, Open Space, General Agriculture, and Light Industrial. Land use designations are supported by general plan policies that generally define how land can and cannot be used.

General plan policies are supported by local ordinances, such as zoning ordinances, which describe the specific requirements for developing a parcel within an identified land use designation. Zoning ordinances are important to the planning process because they define the specific allowable uses for each type of land use designation. Land uses may be classified in the zoning ordinance as principally permitted, conditionally permitted, or permitted under other special circumstances. Under most zoning ordinances, principally permitted land uses require a simplified land use permitting process, whereas Conditional Use Permits and other special circumstance use permits have additional criteria for being considered allowable.

When a city or county desires to amend its general plan to make a change to an existing land use designation, it must go through an environmental review under CEQA to address the potential impacts that may occur as a result. More specifically, if any aspect of a general plan, element, or amendment, either individually or cumulatively, may lead to a significant impact on the environment, regardless of whether the overall impact of a project is adverse or beneficial, the city or county must prepare a draft Environmental Impact Report (EIR) (14 CCR 15063(b)). Furthermore, even if a proposed project is consistent with the land use designation, if it requires a Conditional Use Permit or similar special circumstance permit under the zoning ordinance, then CEQA compliance is required. These CEQA entitlements are an important step in the local planning process because they require local agencies to comply with state environmental regulations when making changes to the pattern or scope of planned development within their jurisdiction.

The local policies regarding either a Conditional Use Permit for allowing an otherwise noncompatible designation, or CEQA compliance due to a change in land use designations, could influence the local planning process with respect to the Proposed Project. This is especially true in areas where new ferry terminals are proposed because they may not be compatible with the existing land use designations.

3.7.2 Impacts and Mitigation

3.7.2.1 Significance Criteria

Impacts would be considered significant if they would:

- **Cause community displacement.** Implementation of the Proposed Project would have a potentially significant impact if it would result in the displacement of existing houses or businesses, either directly or indirectly.
- **Disrupt community cohesion.** Implementation of the Proposed Project would have a potentially significant impact if it would physically divide or otherwise substantially disrupt a community, either directly or indirectly.
- **Result in disproportionate physical impacts to low-income or minority communities.** Implementation of the project would have a potentially significant impact if the Proposed Project would cause adverse physical impacts to low-income or minority persons. The following criteria were used for determining low-income and minority communities:
  - ***Low-income:*** A community is defined as low-income when the median household income of a census tract is below the 2002 California Department of Housing and Community Development (HCD) low-income limit for the parent county.
  - ***Minority Community:*** A minority community is defined as having at least 70 percent of the population belong to of one or more minority groups (as compared to a 50 percent average for the Bay Area as a whole) (MTC 2001).

Because formal federal environmental review and compliance is not required at this Program EIR stage, these definitions are not based strictly on federal guidelines. In terms of low-income, the most recent HCD data were used, based on federal (HUD) standards for determining low-income. The definition of a minority community was taken from the Metropolitan Transportation Commission (MTC) EIR for their 2001 Regional Transportation Plan (RTP), which is the most recent analysis of potential adverse environmental impacts to minority communities conducted by a regional transportation agency in the Bay Area.

3.7.2.2 Impacts

Construction and Operational Impacts

Proposed Project ferry terminal locations are primarily located at existing port or maritime facilities. Nine of the proposed new terminal locations for the Proposed Project would require construction of new ferry terminals. Treasure Island is the only location identified that has already adopted plans for developing a new ferry terminal. In most cases the development of a new terminal would require revising or amending local land use policies, such as land use designations and zoning ordinances.

As discussed in Section 3.7.1.4 (Environmental Setting), CEQA review is required for general plan amendments to change a land use designation, or to issue Conditional Use Permits (or similar permits) required under local zoning ordinances. Therefore, any impact to an existing land use that may occur as a result of constructing a new ferry terminal or other facility would require additional CEQA review. The development and implementation of a specific terminal would require site-specific CEQA review for proposed new terminals.

Of the seventeen ferry terminal locations included in the Proposed Project, eight currently have ferry service (Table 3.7.1). All but one of the potential new terminal locations (Hercules/Rodeo) already have port or maritime land uses at the site. Depending on the specific land uses and the objectives for land use planning at and near each terminal location, a waterfront planning process should be used to consider surrounding land uses and local objectives to ensure that terminals will be a compatible use.

Impact LU-1 **The Proposed Project includes ferry terminal locations in developed urban areas that primarily have port or maritime land uses, but do not currently have ferry terminal facilities. The development of new ferry terminals in urban locations could result in the displacement of existing land uses.**

New water transit facilities in developed areas without existing operational ferry terminals may result in the displacement of residences, offices, or industrial facilities. The possible expansion of existing terminal facilities as a result of the Proposed Project could also result in displacement impacts; however, it is anticipated that this would occur in limited circumstances. As discussed below, planning for terminals would be performed in conjunction with local planning to minimize these effects.

As noted previously, eight of the seventeen terminal locations already have ferry terminals and service, and all but one of the seventeen have existing port or maritime facilities that may be relatively compatible for adding new service. One example is the Richmond location, where previous ferry service has been provided and there are plans for the revitalization of the waterfront area, which could be compatible and potentially enhanced with ferry service. It is also noted that the area needed for new or expanded ferry transit terminals is not substantial, on a regional level. For example, the maximum total affected shoreline area for the Proposed Project is less than one half of one percent of the Bay Area shoreline.

Because the specific size, type, configuration, and location of each proposed new terminal and its associated facilities are unknown, potential displacement impacts cannot be determined. However, in the event it is necessary, it is important to note how displacement impacts might occur generally, and to identify the considerations that the project proponent(s) and local agencies would need to incorporate into future site-specific environmental review under CEQA.

The terminal locations included in the Proposed Project were selected based on favorable ridership projections, cost effectiveness, potential for local support, and/or potential for implementation related to existing or planned land uses. Implementation of the Proposed Project would have a very low potential for displacement impacts to people or businesses.

Some ferry terminals could be developed as an amenity to or in conjunction with other developments that have displacement impacts of their own, such as a Specific Plan or Redevelopment Plan. If the construction of a ferry terminal is adopted as part of a larger development, it will be the responsibility of the project sponsor to consider displacement impacts for that entire project, including the terminal. The potential impacts associated with these larger development projects may require analysis as part of an environmental review process. Specific displacement impacts would be considered at that time.

Although property acquisition impacts could occur for ferry services, they could also occur as an indirect or cumulative impact due to street widening or reconfiguration to provide better access to a terminal.

If people and businesses do not own the property or unit where they live or work (i.e., renters), they may not be able to obtain the benefits afforded to displaced property owners. When required to move out of a rental property as a result of a redevelopment project, relocation can be made difficult by the high cost of living in the Bay Area or an increase in time spent traveling to and from a job. When considering a terminal location, proponents of specific projects would have to take into account the potential impacts to renters that can result from displacing homes and businesses, especially in low-income neighborhoods.

Summary of Impact LU-1

- The Proposed Project minimizes land use conflicts and potential displacement issues by focusing expansion on only the most promising new terminal locations, which are primarily in existing port or maritime areas. However, its implementation could still involve acquisition of property necessary to expand or create ferry passenger terminals or other facilities. This action could potentially include residential or business properties. Although the significance of displacement impacts cannot be quantified at the regional level due to a lack of site-specific information, it remains a potentially significant impact. The decision to displace homes or businesses must be made with the participation of local governments. Displacement impacts most often result from redevelopment or property acquisition requirements. While at this time, no information indicates that any displacements will be required, until site-specific analysis is conducted, this remains a potentially significant impact.

Mitigation LU-1.1: Site-specific projects shall consider project alternatives that avoid displacement of homes or businesses. Displacement impacts to homes and businesses shall be addressed as part of the terminal site selection process, and be avoided through design measures. Proposals for terminals with potentially significant impacts due to the displacement of homes and/or businesses will likely not be approved without appropriate mitigation.

In the unusual circumstance that displacement is unavoidable, project proponents shall prepare and execute mitigation in the form of a relocation assistance plan or equivalent. If federal transportation funds will be used for a ferry terminal project, compliance with the Uniform Relocation Assistance and Real Property Acquisition Act of 1970, as amended, shall be required. Relocation plans typically consider:

- Criteria for replacement housing;
- Reimbursement criteria for moving costs and/or differential housing costs (including rents); and
- Reimbursement criteria for businesses, including costs associated with searching for a new space, and business (i.e., patronage) lost due to the relocation.

Impact After Mitigation: With implementation of Mitigation Measure LU-1.1, this impact is considered less than significant.

Impact LU-2 **Construction of new ferry terminals and associated landside facilities could disrupt or divide established neighborhoods. This impact has the potential to be significantly adverse or beneficial, depending on how much the community supports or opposes the location of the terminal.**

The Proposed Project terminal locations are primarily within existing port, maritime, and waterfront areas. Therefore, disruption to existing neighborhoods should be avoidable or minimal. Nine proposed new terminals are included with the Proposed Project. It is anticipated that significant neighborhood or community disruption or division impacts would not occur at Proposed Project terminal locations. These types of impacts would still have to be determined or verified with each local terminal planning process. At a regional level, they are not expected to be significant.

Construction may also disrupt existing neighborhoods due to noise, dust, and traffic. These potentially disruptive impacts will be analyzed on a project-by-project basis as part of the environmental review under CEQA, but are most often minimized to a less than significant level through project design features and best management practices. Furthermore, construction-related impacts are temporary and would not result in permanent changes in an established community.

Because most of the ferry terminals will be “origin” terminals (they will be places where trips originate), people from around the Bay Area will need access to the terminals by private vehicle, bus, or other forms of transit. The following locations were identified where trips might travel through residential areas:

Facility	Nearest Highways	Approximate Driving Distance to Nearest Highway (miles)	Approximate Percent of Driving Distance in Residential Area
Hercules/Rodeo	I-80	1 – 1.5	100
Martinez	SR 4; I-680	3; 2.5	100; 25
Mission Bay	I-280; US 101	> 1	75
Pittsburg/Antioch	SR 4	1.5	50
Richmond	I-580	1	50

The volume of riders, the dispersed locations of the existing and planned ferry terminals, and the frequency of ferry transits are not expected to result in any substantial change to the regional highways listed above. In the event that existing local roadways must be widened or modified for access to a terminal or parking facilities are planned, there is a potential need for right-of-way acquisition. In some cases, this may involve impacts to existing local land uses. The need for property acquisition would be determined at the time each terminal is advanced for specific planning and further environmental and community review. At a regional level, it is not anticipated that significant right-of-way or property acquisition would be required for the Proposed Project, and planning and implementation of the Proposed Project terminals and any needed access improvements are unlikely to occur simultaneously.

Summary of Impact LU-2

- The Proposed Project includes nine new ferry terminals located within South San Francisco and Treasure Island, the Peninsula, and the East Bay. With the exception of one terminal (Hercules/Rodeo), all are within existing ports or maritime areas. At a regional level, the implementation of these terminals is not considered a significant impact to existing communities. Specific community impacts may occur at a local level related to some necessary property acquisition and land use changes, depending on each terminal site. These effects must be evaluated when each of the terminal plans is advanced for further review. Based on the terminals included in the Proposed Project, these impacts are not anticipated to be significant, but should be considered at the time each route and terminal are advanced for implementation. This is a potentially significant impact.

Mitigation LU-2.1: Local agencies desiring ferry service should identify parcels along their waterfronts that would facilitate a ferry terminal through a waterfront planning process or other type of terminal location study. Any potential terminal site must be analyzed with consideration to the surrounding land uses in order to ensure the terminal will be a compatible use and will minimize land use impacts. Projects should include project design elements that improve terminal accessibility while maintaining community cohesion.

Impact After Mitigation: With implementation of Mitigation Measure LU-2.1, this impact is considered less than significant.

Impact LU-3 **Implementation of the Proposed Project could result in disproportionate adverse impacts to low-income and minority communities. These impacts would occur primarily as a result of the displacement of homes or businesses in low-income and minority communities, or substantial disruption of those neighborhoods.**

As the regional transportation agency, MTC identified low-income and minority neighborhoods (referred to as "Disadvantaged Communities") in the Bay Area to determine whether funding for the 2001 RTP would result in an inequitable allocation of funds to non-disadvantaged communities. MTC's Equity Analysis found that the 2001 RTP would increase spending in disadvantaged communities as compared to the previous plan. As did the MTC, the WTA analyzed the potential for the Proposed Project to result in disproportionate adverse impacts to low-income and minority neighborhoods in the Bay Area.

Community impacts from implementation of the Proposed Project could be beneficial or adverse. Increased transit opportunities would be a positive impact to a community, especially if ferry service were integrated with other transportation modes. In addition, if a new terminal was constructed, low-income and minority communities could benefit from increased local economic opportunity. Potential adverse impacts to low-income and minority communities include displacement of homes and businesses, or community disruption.

The Proposed Project could result in disproportionate adverse impacts to low-income and minority communities if care is not taken to minimize or avoid the displacement of homes and businesses or substantial disruption of these communities. As discussed under Impacts LU-2 and LU-3, there is a potential for these community impacts to occur.

Table 3.7.4 presents the census tracts considered to be minority and/or low-income communities. These could potentially be affected by the Proposed Project, either directly by the construction of a new terminal or expansion of an existing terminal, or indirectly by growth that could occur as a result of installing a terminal. Of the 54 census tracts potentially affected by the Proposed Project, 23 (42.6 percent) are considered low-income communities and 9 (16.6 percent) are considered minority communities. Information on income and poverty levels are only reported by the U.S. Census at the tract level, making further assessment of the type of communities potentially affected near the terminal locations difficult at this program EIR level of evaluation without further site-specific information gathering.

As shown, the Proposed Project could impact low-income or minority communities. Because at this time it cannot be determined where physical impacts would occur as a result of implementing the project, disproportionate adverse impacts cannot be assessed at this time. However, new terminal locations should be recognized not only for the potential to adversely impact low-income or minority neighborhoods, but also for the potential to positively impact the local community by creating a new form of accessible regional transportation. Locations where there is a potential beneficial impact include Berkeley/Albany, Hercules/Rodeo, Martinez, Mission Bay, Pittsburg/Antioch, Redwood City, and Richmond.

Summary of Impact LU-3

- Implementation of the Proposed Project could result in positive or adverse impacts to low-income and minority communities. Specific site location characteristics have not yet been analyzed for this program-level analysis, although some of the overall communities where new terminals are included in the Proposed Project are identified as low-income. The physical displacement of homes and/or businesses (if any) or the substantial disruption of an established neighborhood could have an adverse impact, while increased transportation options and potential for greater economic opportunities would be positive impacts.

Mitigation LU-3.1: The terminal site selection process shall consider project alternatives to avoid adverse physical impacts to the low-income and minority neighborhoods. This would include site and terminal access design that minimizes residential acquisition. Terminal planning shall also involve local community input to help identify opportunities to avoid adverse impacts and enhance local planning efforts. Depending on the specific site and local land use planning, the project proponent may work with the local, city, or county to develop specific plans that address appropriate land use designations in the vicinity of the terminals.

If federal money will be used for the construction of a ferry terminal, compliance with NEPA will be required, and the federal lead agency's guidelines for addressing Environmental Justice shall be adhered to. If required, the federal Environmental Justice process will supersede the requirement to comply with adopted WTA criteria.

Mitigation LU-3.2: Implement Mitigations LU-1.1 and LU-2.1.

Impact After Mitigation: Implementation of Mitigations LU-1.1, LU-2.1, and LU-3.1 would reduce Impact LU-3 to a less than significant level. However, until further study at the local level is conducted to identify site-specific criteria or standards for identifying and mitigating impacts to low-income and minority communities, this impact remains potentially significant.

Impact LU-4 **New or modified ferry terminals would be located along the shoreline, and could affect and/or enhance existing public use and access to and along the Bay shoreline.**

Policies to protect and enhance public and recreational use and access to and along the Bay shoreline are included in the Bay Plan (BCDC 2002) and BCDC's *Public Access Design Guidelines* (BCDC 2001), as well as some local and general plans. New and expanded ferry terminal facilities could provide public access to the shoreline, and would impact shoreline access only where it would interfere with existing pathways, trails, parking, viewpoints, or other access locations along the shoreline. As each terminal is advanced forward for local approval and development, public access will be evaluated and included to meet the requirements of the Bay Conservation and Development Commission and local land use authorities.

Summary of Impact LU-4

- Adverse impacts to existing shoreline access and recreational uses from expansion or development of ferry terminal facilities is not considered a significant impact at the regional level, as no direct impacts to parks or trails are identified at this stage of evaluation. Terminal plans will potentially have to include measures for public access to gain regulatory permit approvals from BCDC or local authorities, depending on individual site conditions. This impact is not considered significant, but should be evaluated as terminal planning is advanced. Any public access would have to be appropriate and compatible with safe ferry operations.

Mitigation LU-4.1: Incorporate public access to and/or along the Bay shoreline in the planning for terminal locations or expansion. This may include trails, parking set aside for shoreline users, viewpoints, disabled access, etc.

Mitigation LU-4.2: Incorporate the shoreline access guidelines described in The *Terminal Architecture and Engineering – Terminal Design Guidelines* prepared for the WTA (Parsons Brinkerhoff 2002). The guidelines include Shoreline Access for pedestrians and bicycles, and viewpoints to provide views of the shore, bay, and the loading/ unloading of the ferries

Impacts After Mitigation: With implementation of Mitigation Measure LU-4.1, this impact is considered less than significant.

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Please refer to Appendix LU-A for a comprehensive list of planning departments contacted for this report.

Table 3.7.1
Land Use and Community Matrix

Facility	Local Agency	Location	G.P. Designation(s)	Pertinent Policies	Zoning	Existing Port? (Y/N)	Existing Ferry Service? (Y/N)	Mixed Uses? (Y/N)	Predominant Use(s)	Redevelopment Plan?	Pertinent Visual/Aesthetic Policies
Alameda	Alameda Planning and Building Department	Alameda	Public Institutional	Expansion of the ferry is proposed in the Transportation Plan, including relocation to the Seaplane Lagoon at Alameda Point to avoid Estuary marine traffic and provide a better connection with the Mission Bay development area	M-2 Manufacturing	Y	Y	Y	Parking; Maritime uses; small manufacturing buildings	This location is adjacent to the Alameda Point redevelopment area, and significant changes are expected here as a result. Tentative plans include a business park, residential, community and mixed-use land uses	None Identified
Alameda Harbor Bay Isle	Alameda Planning and Building Department	Alameda	Residential; Commercial Retail	Ferry service required for business park	R-1-PD Residential, Planned Development	Y	Y	Y	Harbor Bay Business Park; Residential; Commercial	There are still vacant areas where new office buildings could be built	All new developments have to adhere to Harbor Bay Business Park Association's guidelines for signage, height, size, etc.
Antioch	Antioch Community Development Department	Antioch	Rivertown	Upgrade the Marina area for better connection between people and commercial areas	M2 – Industrial District (in the process of trying to change zoning in the City)	Y	N	Y	Parking lot, boat slips, restaurants, commercial uses at the Marina. Adjacent downtown with commercial, office, and residential land uses	Focus Policy Area in the General Plan to bring more commercial uses to the area. An application for a 2-story office building in downtown was approved.	Design Review Board reviews all new buildings. General Plan design guidelines are very generic. Design requirements are site dependent, usually takes in elements from the surrounding area.
Berkeley/ Albany	Berkeley Planning and Development Department	Berkeley	Waterfront/ Marina	Policy 9 – ferry service	SP – Specific Plan (from 1986 Waterfront Specific Plan)	Y	N	Y	Marina, restaurants, hotel, and recreational uses	None Identified	None Identified
Ferry Building (SF)	San Francisco Planning Department	San Francisco	General Commercial/ Public Trust	Reinforce recreational use of this area as terminus of Market St. and terminal for commuter and recreational ferries. Improve physical access to the waterfront.	C2 – Community Business District	Y	Y	Y	Facilities for ferry service; Golden Gate Transit operates from north of the BART ventilation structure behind the Ferry Building. Adjacent is Pier One, a commercial development that also houses the Port of SF office. Across the Embarcadero is Justin Herman Plaza, a major public gathering spot and open space.	Currently undergoing renovations and redevelopments to include major retail/ commercial uses. New facilities for ferry passengers will include covered and accessible landing facilities and newly designed structures. Also, new promenades for public access and new terminals for increased commuter ferry service capacity are planned.	Create a plaza with a strong urban design setting for the Ferry Building.
Hercules/ Rodeo	Contra Costa County, Community Development Agency	Contra Costa County	Mixed-Use (downtown), Commercial Recreation, Parks and Recreation, Industrial, Commercial	Rodeo: Establish mixed uses along waterfront and downtown to make it a community "focal point"	Data not available	N	N	Y	Railroad tracks run along the entire shoreline. Waterfront has mixed uses; residential, industrial and commercial.	Hercules: New Town Center, Rodeo: redevelopment of the mixed-use area downtown.	Development along the shoreline must improve access. Shoreline is Rodeo's most prominent natural resource.
Larkspur	Larkspur Planning Department	Larkspur	Ferry Terminal; Public Facilities; Commercial; Shoreline/Marsh conservation	None Identified	Terminal; Study District; PD – Planned Development	Y	Y	Y	Commercial, office buildings	Mixed-use redevelopment proposal for hotel, offices, residential unit, and corporation yard for the City Sanitary District	According to City of Larkspur staff, there could be visual and aesthetic issues at this site.
Martinez	Martinez Community Development Department	Martinez	Park and Recreation, Special Study Area	General Plan 30.721: Contains policies pertaining to the waterfront. Highest priority placed on conservation, park, and recreational uses along the waterfront.	M-OS/RF Mix Use Open Space and Rec. Facilities. Surrounding area is Light Industrial, Institutional, Single-Family Residential, Medium Density Residential, and Central Commercial	Y	N	Y	Martinez Waterfront Park and the Martinez Regional Shoreline Park form a 0.5-mile buffer between downtown Martinez and the Yacht Harbor. Nearby urban land use is mostly commercial and some residential with some light industrial parcels to the southwest of the possible terminal site.	A Marina Development Area is being contemplated (i.e., the Special Study Area land use designation), but no redevelopment plans have been adopted.	Any waterfront development must be consistent with the recreational and park land uses promoted within the Waterfront Park and Marina area.
Mission Bay	San Francisco Planning Department	San Francisco	Residential/ Commercial	This site must incorporate walkable, bikeable, and transit-friendly elements.	Low-, medium- and high-density residential, office, commercial-industrial, neighborhood shopping, and open space.	Y	N	Y	Currently in transition from an industrial area and former rail yard into a mix-use community with housing, jobs, retail, open space, parks, and a school	First of the development blocks currently under construction, including housing units, corporate science and technical campus, health science campus for UCSF, retail space, hotel, and a public school.	Public access to the shoreline and adequate parks and public open space.

Table 3.7.1 -Continued
Land Use and Community Matrix

Facility	Local Agency	Location	G.P. Designation(s)	Pertinent Policies	Zoning	Existing Port? (Y/N)	Existing Ferry Service? (Y/N)	Mixed Uses? (Y/N)	Predominant Use(s)	Redevelopment Plan?	Pertinent Visual/Aesthetic Policies
Oyster Point	South San Francisco Planning Department	South San Francisco	Coastal Commercial	The City would like new developments to include uses that generate high revenues (i.e., hotels) that can help pay for maintenance of the Marina area and its debts. The City is supportive of introducing ferry service to this area.	Surrounding area is Coastal Commercial.	Y	N	Y	Shoreline park, small hotel, restaurants, office park, R&D buildings, and some parking lots	Part of the City's "East of 101" planning area, where significant potential growth is expected. Permit has been approved for 2 small office buildings, and plan underway for full service hotel. New developments will require adequate parking, especially if water transit services are introduced.	Policies allude to enhancement of waterfront shoreline and its accessibility. The City does not have specific details about design guidelines such as waterfront view preservation.
Pittsburg	Pittsburg Community Development Department	Pittsburg	Marine Commercial; Residential	5-P-13 to 16 of the General Plan: Undertake efforts to develop a waterfront activity center featuring a cluster of Marine Commercial uses with pedestrian amenities, focus on visitor attractions and traditional marine services, and provide access to the waterfront and open space at the center of the new Marine Commercial center	Downtown Medium and High Density Residential; Marine Commercial facilities	Y	N	Y	Mainly residential at the harbor, waterfront downtown is mostly commercial, office, residential. Across the slough from the waterfront area is Brown's Island Regional Shoreline Preserve.	A proposed marine/waterfront commercial village may feature marine-oriented repair and sales, restaurants, professional offices, industrial incubators, and specialty retail activities	Development standards (Floor Area Ratios, max building heights, etc.) in Table 5-2 of General Plan; Preservation and enhancement of historic structures unique to downtown
Redwood City	Redwood City Planning and Redevelopment Agency	Redwood City	R&D office uses; light and heavy industrial	A future Waterfront Plan is under consideration	IP – Industrial Park, GI – General Industrial	Y	N	Y	Seaport Conference Center, wetlands, salt evaporation beds, delivery of bulk construction materials and bulk recycling for the Port of Redwood City	Waterfront Plan is the only redevelopment plan under consideration.	None Identified
Richmond	Richmond Planning Department	Richmond	Industrial; Commercial, Residential; Recreation	Richmond Redevelopment Agency will consider new direction for waterfront land use, will likely recommend denser development than has been considered previously	None Identified	Y	N	Y	Vacant parking lot, debilitated historical industrial factory. Nearby, Port of Richmond shipping yard, small park, and R&D office facilities in the 0.25 mi radius, but isolated from waterfront.	Focus of extensive revitalization and planning effort by the City. Plan includes significant increase of R&D/office, residential and mixed-use land uses, as well as parks, promenades, open spaces, a Westshore business park, and historical preservation.	Focus of waterfront amenities
Sausalito	Sausalito Community Development Department	Sausalito	Public Institutional	CP-3.2.1-2 of General Plan: Promote increase patronage of ferries while protecting the area from overuse, support ferry providers for better service and efficient loading area, increase ferry information provided to passengers as alternatives to automobiles	Public	Y	Y	Y	Small park/plaza (open space) on either side of the ferry terminal, parking lot, commercial downtown across the street. Residential units beyond commercial downtown.	Possible proposal for building restroom facilities near the ferry terminal/downtown, but no applications yet.	Any new development will have to go through the design review; generally preserve waterfront views; and fit with existing architectural characteristics.
Tiburon	Tiburon Planning and Building Department	Tiburon	VC (Village Commercial) and P (Public/ Quasi-Public)	Office use not allowed on ground floor of Main Street in this area	VC – typical comm. uses w/ a conditional use permit; P- allows public parks and open space	Y	Y	Y	Restaurants and retail stores (small); Public park		Downtown Design Handbook provides specific guidelines for all private and public improvements in the downtown area. A ferry access project was constructed in Spring 2002. The project improved pedestrian and bike access to the existing ferry landing.
Treasure Island	San Francisco Planning Department	San Francisco	Public/Marina	1996 Draft Reuse Plan emphasizes publicly oriented recreational, entertainment, retail, and hospitality uses that can take advantage of the island's location. Goal is to make island accessible to urban residents by ferry	Marina	Y	N	Y	Closed Naval Station, some historic buildings	New ferry terminal, waterfront promenades, bike and pedestrian paths, recreational and entertainment facilities, and residential community.	Preserve historic structures and island's waterfront views; public promenade and open area around the entire island with parks and plazas to help connect the island to the bay setting
Vallejo	Vallejo City Hall Planning Department	Vallejo	Waterfront Commercial	Waterfront Downtown Plan (under EIR process) would increase the intensity of development, connect waterfront area with downtown, and make the waterfront area more accessible to the walking public	CW – Waterfront shopping and service. If Waterfront Downtown Plan is approved, rezoning to Planned Development Zoning.	Y	Y	Y	Surface parking for ferry passengers; Public facilities; commercial; high- density residential	The Waterfront Downtown Plan would result in a multi-level parking structure, 1,400 residential units, commercial uses, hotel, office space, new open space, emphasis on new walkable business district. Georgia St. would go from downtown to waterfront.	Reopening old grid of streets (e.g., opening Georgia St.) and establishing new street corridors; keeping waterfront view open for hill residents; make sure new developments (e.g., large parking structure) are visually attractive

Notes: 1) A new terminal would be located at Pittsburg or Antioch.

Table 3.7.2
Race/Ethnicity Analysis

Facility	Census Tract #[1]	Top Four Ethnicities (%)[1] African American	Asian[2]	Caucasian	Hispanic	Minority Community?[3]
Alameda Point	4277.00	0.00	29.30	54.00	9.20	No
Alameda Point	4286.00	0.00	34.70	49.00	8.30	No
Alameda/Harbor Bay Isle	4283.01	0.00	32.00	52.00	6.50	No
Alameda/Harbor Bay Isle	4283.02	0.00	40.00	51.00	3.80	No
Alameda/Main St.	4274.00	10.00	0.00	66.70	14.20	No
Alameda/Main St.	4275.00	4.70	0.00	67.50	12.20	No
Alameda/Main St.	4276.00	30.60	33.40	20.80	0.00	Yes
Antioch	3050.00	6.00	0.00	63.00	35.00	No
Antioch	3060.01	5.30	0.00	76.60	20.80	No
Antioch	3060.02	4.10	0.00	73.70	20.60	No
Berkeley/Albany	4204.00	0.00	47.80	27.30	13.80	Yes
Berkeley/Albany	4219.00	13.20	15.00	61.50	0.00	No
Berkeley/Albany	4220.00	26.80	0.00	46.80	13.50	No
Berkeley/Albany	4221.00	25.60	0.00	42.40	25.20	No
Berkeley/Albany	4222.00	16.60	15.20	55.50	0.00	No
Ferry Building	105.00	0.00	17.10	77.90	3.20	No
Ferry Building	106.00	0.00	62.20	33.50	3.00	No
Ferry Building	115.00	0.00	69.40	21.70	3.40	Yes
Ferry Building	179.01	8.20	16.30	67.30	0.00	No
Hercules/Rodeo	3580.00	0.00	14.60	62.50	17.00	No
Hercules/Rodeo	3591.01	17.70	27.70	43.00	0.00	No
Hercules/Rodeo	3592.03	20.20	38.60	29.20	0.00	Yes
Hercules/Rodeo	3592.04	15.60	53.70	21.60	0.00	Yes
Larkspur	1192.00	0.00	4.00	92.00	2.90	No
Larkspur	1200.00	0.00	2.90	93.10	3.70	No
Larkspur	1211.00	0.00	4.30	89.00	5.40	No
Larkspur	1212.00	0.00	7.10	85.70	5.50	No
Martinez	3160.00	22.50	0.00	56.70	15.60	No
Martinez	3170.00	0.00	2.40	83.40	11.10	No
Martinez	3200.01	0.00	2.30	76.10	2.40	No
Mission Bay	226.00	11.50	9.60	71.80	0.00	No
Mission Bay	607.00	10.60	24.20	56.30	0.00	No
Oakland (Jack London Square)	4020.00	25.00	0.00	25.00	35.70	Yes
Oakland (Jack London Square)	4032.00	15.80	19.00	47.60	0.00	No
Oakland (Jack London Square)	4033.00	8.40	77.40	8.70	0.00	Yes
Oyster Point	6023.00	0.00	16.90	46.60	43.50	No
Pittsburg	3090.00	32.70	0.00	42.10	19.20	No
Pittsburg	3100.00	15.90	0.00	38.60	59.00	No
Redwood City	6102.00	0.00	0.00	0.00	0.00	No
Redwood City	6102.02	14.00	0.00	51.00	40.00	No
Redwood City	6103.02	5.00	0.00	71.00	24.00	No
Richmond	3780.00	8.10	0.00	80.60	9.10	No
Richmond	3790.00	68.00	0.00	11.00	23.00	Yes
Richmond	3800.00	31.80	0.00	35.50	18.90	No
Richmond	3820.00	68.00	0.00	11.60	10.90	Yes

Table 3.7.2 - Continued
Race/Ethnicity Analysis

Facility	Census Tract #[1]	Top Four Ethnicities (%)[1]				Minority Community?[3]
		African American	Asian[2]	Caucasian	Hispanic	
Sausalito	1290.00	45.90	0.00	36.40	8.20	No
Tiburon	1230.00	0.00	1.80	94.90	2.10	No
Tiburon	1242.00	0.00	3.20	89.50	4.00	No
Treasure Island	No Data	0.00	0.00	0.00	0.00	No
Vallejo	2507.01	33.20	0.00	30.90	32.30	No
Vallejo	2509.00	35.50	0.00	31.20	19.90	No
Vallejo	2515.00	25.20	0.00	41.30	25.70	No
Vallejo	2516.00	23.20	0.00	42.60	27.50	No
Vallejo	2517.01	23.70	0.00	40.70	18.10	No
Total Average:		**13.40**	**13.50**	**50.79**	**12.76**	

Notes: 1) 2000 US Census Data
2) Includes Pacific Islander and Other
3) Based on MTC Equity Analysis. A minority community is defined as a having at least 70 percent of the population share be one or more minority group (as compared to a 50 percent average for the Bay Area as a whole). (MTC 2001)
4) A new terminal would be located at Pittsburg or Antioch.

Table 3.7.3
Low Income Analysis

Facility	County	Census Tract No.	Median Household Income ($)[1]	County Low Income Limit ($)[2]	Potentially Low Income?
Alameda Point	Alameda	4277.00	77,047	52,200	No
Alameda Point	Alameda	4286.00	82,873	52,200	No
Alameda/Harbor Bay Isle	Alameda	4283.01	121,754	52,200	No
Alameda/Harbor Bay Isle	Alameda	4283.02	121,754	52,200	No
Alameda/Main St.	Alameda	4274.00	42,804	52,200	Yes
Alameda/Main St.	Alameda	4275.00	52,197	52,200	Yes
Alameda/Main St.	Alameda	4276.00	43,993	52,200	Yes
Antioch[4]	Contra Costa	3050.00	47,798	52,200	Yes
Antioch[4]	Contra Costa	3060.01	58,974	52,200	No
Antioch[4]	Contra Costa	3060.02	88,818	52,200	No
Berkeley/Albany	Alameda	4204.00	36,383	52,200	Yes
Berkeley/Albany	Alameda	4219.00	69,081	52,200	No
Berkeley/Albany	Alameda	4220.00	44,588	52,200	Yes
Berkeley/Albany	Alameda	4221.00	49,106	52,200	Yes
Berkeley/Albany	Alameda	4222.00	56,359	52,200	No
Ferry Building	San Francisco	105.00	160,753	73,300	No
Ferry Building	San Francisco	106.00	52,554	73,300	Yes
Ferry Building	San Francisco	115.00	32,698	73,300	Yes
Ferry Building	San Francisco	179.01	86,916	73,300	No
Hercules/Rodeo	Contra Costa	3580.00	53,981	52,200	No
Hercules/Rodeo	Contra Costa	3591.01	81,565	52,200	No
Hercules/Rodeo	Contra Costa	3592.03	91,553	52,200	No
Hercules/Rodeo	Contra Costa	3592.04	93,337	52,200	No
Larkspur	Marin	1192.00	133,049	73,300	No
Larkspur	Marin	1200.00	118,068	73,300	No
Larkspur	Marin	1211.00	101,422	73,300	No
Larkspur	Marin	1212.00	89,056	73,300	No
Martinez	Contra Costa	3160.00	41,972	52,200	Yes
Martinez	Contra Costa	3170.00	46,728	52,200	Yes
Martinez	Contra Costa	3200.01	76,096	52,200	No
Mission Bay	San Francisco	226.00	67,179	73,300	Yes
Mission Bay	San Francisco	607.00	55,526	73,300	Yes
Oakland (Jack London Square)	Alameda	4020.00	80,852	52,200	No
Oakland (Jack London Square)	Alameda	4032.00	50,651	52,200	Yes
Oakland (Jack London Square)	Alameda	4033.00	50,889	52,200	Yes
Oyster Point	San Mateo	6023.00	76,334	73,300	No
Pittsburg	Contra Costa	3090.00	60,639	52,200	No
Pittsburg	Contra Costa	3100.00	48,155	52,200	Yes

Table 3.7.3 - Continued
Low Income Analysis

Facility	County	Census Tract No.	Median Household Income ($)[1]	County Low Income Limit ($)[2]	Potentially Low Income?
Redwood City	San Mateo	6102.00	57,191	73,300	Yes
Redwood City	San Mateo	6102.02[3]	57,191	73,300	Yes
Redwood City	San Mateo	6103.02	64,682	73,300	Yes
Richmond	Contra Costa	3780.00	108,199	52,200	No
Richmond	Contra Costa	3790.00	38,880	52,200	Yes
Richmond	Contra Costa	3800.00	64,325	52,200	No
Richmond	Contra Costa	3820.00	57,904	52,200	Yes
Sausalito	Marin	1290.00	60,758	73,300	Yes
Tiburon	Marin	1230.00	280,842	73,300	No
Tiburon	Marin	1242.00	218,657	73,300	No
Treasure Island	San Francisco	No Data	No Data	No Data	No Data
Vallejo	Solano	2507.01	51,959	41,200	No
Vallejo	Solano	2509.00	26,515	41,200	Yes
Vallejo	Solano	2515.00	46,847	41,200	No
Vallejo	Solano	2516.00	44,706	41,200	No
Vallejo	Solano	2517.01	92,504	41,200	No

Notes:

1) ABAG data. Median Income based on 1995 dollars. Projection to 2000 dollars was made using a 1.189 multiplier.
2) Low Income Limit for a 3-person household published February 2002 by the Calif. Dept. HCD. Since the average persons per household in every county potentially affected by the project was between 2 and 3, a 3-person household low income limit was used. HUD bases low income limits on a 4-person household, and uses a factor of 0.9 to determine low income limits for 3-person households.
3) Census tracts that were split up into two tracts for the 2000 US Census from one 1990 US Census tract. Partial census tracts. Data presented are from larger tract from the 1990 US Census.

Table 3.7.4
Minority and/or Low-Income Communities

Facility	Census Tract No.	Low-Income Community?	Minority Community?
Alameda Point	4277.00	No	No
Alameda Point	4286.00	No	No
Alameda/Harbor Bay Isle	4283.01	No	No
Alameda/Harbor Bay Isle	4283.02	No	No
Alameda/Main St.	4274.00	Yes	No
Alameda/Main St.	4275.00	Yes	No
Alameda/Main St.	4276.00	Yes	Yes
Antioch	3050.00	Yes	No
Antioch	3060.01	No	No
Antioch	3060.02	No	No
Berkeley/Albany	4204.00	Yes	Yes
Berkeley/Albany	4219.00	No	No
Berkeley/Albany	4220.00	Yes	No
Berkeley/Albany	4221.00	Yes	No
Berkeley/Albany	4222.00	No	No
Ferry Building	105.00	No	No
Ferry Building	106.00	Yes	No
Ferry Building	115.00	Yes	Yes
Ferry Building	179.01	No	No
Hercules/Rodeo	3580.00	No	No
Hercules/Rodeo	3591.01	No	No
Hercules/Rodeo	3592.03	No	Yes
Hercules/Rodeo	3592.04	No	Yes
Larkspur	1192.00	No	No
Larkspur	1200.00	No	No
Larkspur	1211.00	No	No
Larkspur	1212.00	No	No
Martinez	3160.00	Yes	No
Martinez	3170.00	Yes	No
Martinez	3200.01	No	No
Mission Bay	226.00	Yes	No
Mission Bay	607.00	Yes	No
Oakland (Jack London Square)	4020.00	No	Yes
Oakland (Jack London Square)	4032.00	Yes	No
Oakland (Jack London Square)	4033.00	Yes	Yes
Oyster Point	6023.00	No	No
Pittsburg	3090.00	No	No
Pittsburg	3100.00	Yes	No
Redwood City	6102.00	Yes	No
Redwood City	6102.02	Yes	No
Redwood City	6103.02	Yes	No
Richmond	3780.00	No	No
Richmond	3790.00	Yes	Yes
Richmond	3800.00	No	No
Richmond	3820.00	Yes	Yes
Sausalito	1290.00	Yes	No
Tiburon	1230.00	No	No
Tiburon	1242.00	No	No
Treasure Island	No Data	No Data	No
Vallejo	2507.01	No	No
Vallejo	2509.00	Yes	No
Vallejo	2515.00	No	No
Vallejo	2516.00	No	No
Vallejo	2517.01	No	No
TOTALS		23 = Yes	9 = Yes
PROJECT TOTALS	54 Project Tracts	42.6% of project total	16.6% of project total

3.6 AIR QUALITY

This section describes the environmental setting of the Bay Area with respect to air quality and the regulatory controls applicable to emissions from vessels and vehicular traffic. Federal, state, and regional regulations apply to Bay Area air quality and set controls and goals for air quality criteria for the regional area. These criteria and the regional compliance with established air quality standards are summarized below. A list of acronyms and technical terms is provided at the end of this section.

3.6.1 Environmental Setting

3.6.1.1 Study Area

The proposed project area covers the entire San Francisco Bay Area Air Basin. Although ferry terminals would only be located along the perimeter of the Bay, people would be traveling from many areas within the air basin to use the ferries. Motor vehicles and vessels would be a source of air pollutants associated with the project. The project area and the air basin are under the jurisdiction of the Bay Area Air Quality Management District (BAAQMD). The air basin covers all or part of nine counties surrounding San Francisco Bay: all of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, and Santa Clara; and portions of Solano and Sonoma.

3.6.1.2 Project Setting

The Bay Area Air Basin consists of seven regions with varying meteorological, climatological, and air pollution characteristics. This section summarizes these characteristics and differences. This project is regional in nature, and there could be potential impacts from motor vehicles throughout the region. Therefore, the climate and air quality for the entire Bay Area is described, as ferry commuters could be driving from the farthest reaches of the Bay Area.

Meteorology, Climatology, and Air Quality of the Bay Area Region

The BAAQMD operates a regional air quality monitoring network for criteria pollutants, including ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter less than 10 micrometers in diameter (PM_{10}). Table 3.6.1 presents a 4-year summary of ambient air quality measured at seven monitoring stations throughout the Bay Area. This table also shows the number of exceedances of the state and national ambient air quality standards at each station, for pollutants for which there were exceedances. Monitoring data from the BAAQMD network are used by the U.S. Environmental Protection Agency (USEPA) and the California Air Resources Board (CARB) to designate the attainment status of the area and to classify the severity of nonattainment problems.

The Bay Area is in attainment of most pollutant standards. The exceptions are O_3 and particulate matter, the standards for which are exceeded periodically. As shown in Table 3.6.1, monitoring stations throughout the different meteorological subregions of the Bay Area reflect the same pattern: only the state O_3 and PM_{10} standards are exceeded.

In addition to criteria pollutants, both the BAAQMD and the CARB operate toxic air contaminant (TAC) monitoring networks in the San Francisco Bay Area. These stations measure

10 to 15 TACs, depending on the specific station. The TACs selected are those that have traditionally been found in the highest concentrations in ambient air, and therefore tend to produce the most significant risk.

The climate of the San Francisco Bay Area is diverse and varies widely from region to region. In general, the Bay Area is classified as having a Mediterranean climate, with warm, dry summers and mild, wet winters. In the summer, air flow generally approaches the Bay Area from the Pacific Ocean (from the west or northwest). This air, which is generally cool and moisture-laden from its movement across the Pacific Ocean, is further cooled as it flows across a cold bank of water existing off the coast of the Bay Area. This cooling often produces condensation, resulting in fog and stratus clouds along the Bay Area coast. In winter, storms are frequent. Ninety percent of the Bay Area's precipitation occurs between November and April. During winter rainy periods, inversions are weak or nonexistent, winds are often moderate, and air pollution potential is very low. During winter dry periods, inversions become strong, winds are light, and pollution potential is high. During these dry, winter periods, winds can flow out of the Central Valley into the Bay Area, bringing tule fog into the region.

The Bay Area is characterized by terrain consisting of coastal mountain ranges, inland valleys, and bays. Elevations of 1,500 feet are common in the higher terrain of this area. Normal wind flow is often distorted in many areas.

Due to the topographical diversity of the Bay Area, it is appropriate to describe the meteorology and climate of the Bay Area in more detail by discussing several of the Bay Area subregions and their microclimates. Table 3.6.1 provides a 4-year summary of ambient air quality measured at seven different air quality monitoring stations throughout the Bay Area, providing an overview of the ambient air quality of many of the Bay Area microclimates.

Carquinez Strait Region

The Carquinez Strait area is the only major sea level pass through California's Coast Range. Prevailing winds flow from west to east. During the summer and fall months, air pressure patterns become established, drawing marine air eastward through Carquinez Strait almost every day. Afternoon wind speeds of 15 to 20 mph are common throughout the straits region. Occasionally, pressure patterns will reverse, causing an east to west air flow through the strait, elevating pollutant levels in the Bay Area. This air flow pattern has low wind speeds and shallow mixing depths, thereby allowing localized emissions to build up. Also, this air mass is generally warm and contains more pollutants than the marine air flow, thereby increasing photochemical activity.

Many industrial facilities within the strait region have significant emissions. The general west-to-east flow of the winds in the straits tends to move pollutants east. Receptors to the east of the industrial facilities in the strait generally have longer term exposure to pollutants than other receptors in the region.

Average daily maximum temperatures (in degrees Fahrenheit) are in the mid to high 50s in the winter and the high 80s in the summer. Average minimum temperatures are in the high 30s to low 40s in the winter and the mid-50s in the summer. Rainfall amounts in the region vary from 13 inches annually in Antioch to 22 inches annually in Fairfield. In Table 3.6.1, the data presented for Pittsburg is representational of average ambient air quality in the Carquinez Strait region.

Diablo Valley–San Ramon Valley Region

East of the Coast Range lie the Diablo and San Ramon Valleys. The Diablo Valley is a broad valley, approximately 5 miles wide and 10 miles long. The Carquinez Strait is at its north end and the south tapers into the San Ramon Valley. The San Ramon Valley is long and narrow, approximately 12 miles long and one mile wide. Its southern end opens to the Amador Valley. The Coast Range on the west side of these valleys blocks much of the marine air from reaching the valleys. The wind speeds in these valleys are generally the lowest in the Bay Area. During the daytime, there are two weakly predominant air flow patterns: an upvalley flow and a westerly flow across the lower elevations of the Coast Range. On clear nights, a surface inversion sets up and separates the surface flow from the upper layer flow. When this occurs, the terrain channels the flow downvalley toward the Carquinez Strait. Crow Canyon gap, which is near the town of San Ramon, allows polluted air from cities near the Bay to travel into the San Ramon Valley during the summer months.

These valleys are cooler in the winter and warmer in the summer than areas closer to Bay waters. High temperatures range from the 50s in the winters to the 90s in the summers. Low temperatures in the winter are in the low to mid-40s. Tule fogs are common on clear winter nights. Rainfall averages approximately 19 inches annually.

Pollution potential is high in these valleys. In the winter, light winds at night, inversion, and terrain blocking to the east and west does not allow much dispersion of pollutants. In the summer, ozone can be transported into the valleys from both the Central Valley and the central Bay Area. Due to the narrowness of the San Ramon Valley, winter pollution buildups can be high due to automobile emissions from Interstate 680 (which runs down the center of the valley) and emissions from fireplaces and woodstoves. The data presented for Concord in Table 3.6.1 are representational of average ambient air quality in the Diablo Valley–San Ramon Valley region.

Livermore Valley Region

The Livermore Valley is a northwest-to-southeast running, sheltered inland valley bound by 1,000- to 1,500-foot hills on its east and west sides. On the western side of the valley, two gaps connect it to San Francisco Bay. The eastern side of the Livermore Valley has one major passage to the San Joaquin Valley. The valley connects to the Diablo Valley–San Ramon Valley at its northwest point and the south side of the valley terminates at the 3,000-foot Diablo range.

During winter dry periods, a weak pressure pattern exists in the valley. At night and during the early morning, cool air flows down the valley from its hills, gaps, and passes. Solar heating, which occurs during the day, can reverse this air flow. A weak temperature inversion can be present during the summer, causing afternoon winds to flow from the Bay. When a strong temperature inversion is present during the summer, air flow is minimal. Winter high temperatures range from the high 50s to the low 60s and low temperatures range from the mid- to high 30s, with extremes in the high teens and low 20s. Summer high temperatures range from the 80s to the low 90s, with extremes in the 100s, and minimum temperatures are in the low 50s. Average annual precipitation is 14 inches.

The potential for air pollution in the Livermore Valley is high, especially for photochemical pollutants. The valley traps locally generated pollutants and can be the receptor of ozone and ozone precursors from San Francisco, Alameda, Contra Costa, and Santa Clara Counties.

Occasionally in the fall, northeasterly winds flow in the area, allowing ozone to enter the valley from the San Joaquin Valley. The strong temperature inversion that often occurs in the winter allows local pollutants from automobiles, fireplaces and agricultural burning to concentrate, raising carbon monoxide and particulate levels. The data presented for Livermore in Table 3.6.1 are representative of average ambient air quality in the Livermore Valley region.

Marin County Basins Region

The Marin County Basins region is bound on the west by the Pacific Ocean, on the east by San Pablo Bay, on the south by the Golden Gate, and on the north by the Petaluma Gap. The area is mostly hilly. Most of the population lives in small, sheltered valleys on the eastern side of the hills. The western, coastal side of the region is subjected to cool marine air; often with fog in the summer and relatively warm, clear skies in the winter. The eastern side of the region has generally warmer weather and less fog than the western side. The low terrain of 800 to 1,000 feet allows for marine air to flow through the area. However, due to the wedge shape of the region, the northern sections of the area are farther from the ocean, allowing the marine air mass to be heated before it arrives.

Temperatures vary throughout the region. In the coastal area, temperatures range from the high 50s in the winter to the low 60s in the summer. San Rafael, which is near the Bay, experiences average maximum winter temperatures in the high 50s to low 60s, average minimum winter temperatures in the low 40s, average maximum summer temperatures in the high 70s to low 80s, and average minimum summer temperatures in the 50s. Inland areas generally experience temperature fluctuations a few degrees warmer and a few degrees cooler from the average temperatures along the Bay. Rainfall averages between 25 and 50 inches annually, depending on location, with some of the more mountainous regions experiencing more rainfall than most locations in the Bay Area.

The potential for air pollution is highest on the eastern side of Marin County, where the sheltered valleys and largest population centers are located. The data presented for San Rafael in Table 3.6.1 are representational of average ambient air quality in the Marin County Basins region.

East Bay Region

The East Bay region stretches from Richmond in the northwest to Milipitas in the southeast. Its western boundary is defined by San Francisco Bay and its eastern boundary by the East Bay Hills. The area is generally flat, with most of its population living between the Bay and an elevation of 500 feet.

Maritime intrusion through the Golden Gate is a dominant weather factor. Winds that enter the Golden Gate diverge as a result of the East Bay Hills in the Oakland/Berkeley area, with south-southwesterly winds in the Richmond area and northwesterly winds in the rest of the East Bay. During periods of little or no wind, the Bay can generate its own circulation system. During the winter, winds from the east or southeast are common.

Temperatures in the southern parts of the East Bay region are generally cooler in the winter and warmer in the summer than in the northern parts of the region. Summer temperatures vary from the mid-50s to the low 70s. Winter temperatures vary from the mid-30s to the mid- to high 50s. Annual rainfall averages between 14 inches in the south and 22 inches in the north.

In the northern areas, the potential for air pollution is minor. Occasionally, these areas experience light winds at night and early in the morning, which may allow elevated pollutant levels. In the southern areas, the air pollution potential is relatively high during the summer and fall months. When high pressure dominates the weather, low mixing depths and marine wind patterns can concentrate and carry pollutants from other cities to the southern part of this region, adding to the locally emitted pollutants. This polluted air is then pushed up against the East Bay Hills. Winter pollution levels are generally moderate. The data presented for Oakland in Table 3.6.1 are representative of average ambient air quality in the East Bay region.

Peninsula Region

The Peninsula region of the Bay Area extends from the area northwest of San Jose to the Golden Gate. The Santa Cruz Mountains extend up the center of the peninsula, with elevations exceeding 2,000 feet at the south end, and gradually decreasing to 500 feet in South San Francisco, where the mountain range terminates. The west side of these mountains experiences a high incidence of cool, foggy weather in the summer. The southeastern area of the peninsula experiences warmer temperatures and few foggy days. At the north end of the peninsula lies San Francisco. Because most of the topography of San Francisco is below 200 feet, the marine layer is able to flow across most of the city, making its climate cool and windy.

The coastal area has relatively high wind speeds, out of the west. Low-lying areas in the mountain range, at San Bruno Gap and Crystal Springs Gap, commonly allow the marine layer to pass across the peninsula. On mornings without a strong pressure gradient, areas on the east side of the peninsula often experience an eastern flow in the surface air layer, induced by upslope flow on the east-facing slopes and by the bay breeze.

Due to the blocking effect of the Santa Cruz Mountains, summertime maximum temperatures along the ocean coast and San Francisco are 62 to 64 degrees, while on the eastern side of the mountains, the maximum summer temperatures are in the low 80s. Daily maximum temperatures throughout the peninsula during the winter months are in the high 50s. Rainfall amounts range from 19.5 inches annually on the east side of the peninsula to 25 inches annually on the west side. The western slopes of the Santa Cruz Mountains have significantly higher annual rainfall amounts.

The potential for air pollution is highest along the southeastern portion of the peninsula because this area is protected from the high winds and fog of the marine layer, the emission density is relatively high, and pollutant transport from upwind sites is possible. In the northern areas of the Peninsula, pollutant emissions are high, but winds are generally fast enough to carry the pollutants away before they can accumulate. The data presented for San Francisco in Table 3.6-1 are representative of average ambient air quality in the Peninsula region.

Santa Clara Valley Region

The northwest/southeast-oriented Santa Clara Valley is bounded by the Santa Cruz Mountains to the west, the Diablo Range to the east, San Francisco Bay to the north and the convergence of the Gabilan Range and the Diablo Range to the south.

The wind patterns roughly parallel to the valley's northwest-southeast axis with a north-northwesterly sea breeze extending up the valley during the afternoon and early evening and a light south-southeasterly drainage flow occurring during the late evening and early morning. In summer, air flowing northward from Monterey Bay through the Pajaro Gap at the southern end of the valley forms a convergence zone in the southern end of the valley with the prevailing north-northwesterly winds.

At the northern end of the valley, the mean maximum temperatures range from the high 70s to the low 80s during the summer and from the high 50s to the low 60s during the winter. Mean minimum temperatures range from the low 40s during the winter to the high 50s during the summer. Farther inland, where the moderating effect of the Bay is not as strong, temperature extremes are greater. Summer highs are more than 10 degrees warmer and winter nights greater than 10 degrees cooler. Annual rainfall ranges from 13 inches in the lowlands to 20 inches in the hills.

The air pollution potential of the Santa Clara Valley is high. The valley has a large population and the largest complex of mobile sources in the Bay Area, making it a major source of carbon monoxide, particulate and photochemical air pollution. In addition, photochemical precursors from San Francisco, San Mateo, and Alameda Counties can be carried along by the prevailing winds to the Santa Clara Valley, making it a major ozone receptor. Geographically, the valley tends to channel pollutants to the southeast. Meteorologically, on high-ozone/low-inversion summer days, the pollutants can be re-circulated by the prevailing northwesterly winds in the afternoon and the light drainage flow in the late evening and early morning, significantly increasing the impact of emissions. On days with high concentrations of particulates and carbon monoxide during late fall and winter, clear, calm, and cold conditions associated with a strong surface-based temperature inversion prevail. The data presented for San Jose in Table 3.6.1 are representative of average ambient air quality in the Santa Clara Valley region (BAAQMD 1999).

Existing Bay Area Pollution Sources

The BAAQMD maintains an inventory of point, area, and mobile sources within the San Francisco Bay Area air basin. Point sources include industrial plants and refineries; area sources include numerous small sources such as dry cleaners, gas stations, and paint and solvent use; and mobile sources include on-road and off-road vehicles and marine sources. The year 2000 BAAQMD emission inventory is summarized in Table 3.6.2. This is a planning inventory from the ozone attainment plan for the Bay Area, and it itemizes sources within a given source category.

Impacts of Existing Ferry Services on Bay Area Air Quality

Emissions from ferries are included in the BAAQMD planning inventory under the category of Commercial Boats, which includes ferries, fishing boats, tugs, towboats, and dredges. The year 2000 emissions from ferries alone are 0.13 tons per day of ROG and 2.42 tons per day of NO_x. Emissions from ferries represent 0.03 percent of the total Bay Area ROG emissions and 0.45 percent of total Bay Area NO_x emissions. Comparable emissions inventory data for the other pollutants, CO, SO_2, and PM_{10}, are unavailable in the planning inventory.

3.6.1.3 Regulatory Setting

The project area is subject to major air quality planning programs required by both the federal Clean Air Act, which was last amended in 1990 (42 United States Code [USC] 7401 et seq.), and the California Clean Air Act of 1988 (California Health and Safety Code Section 39600 et seq.).

Both the federal and state statutes provide for ambient air quality standards to protect public health, timetables for progressing toward achieving and maintaining ambient standards, and the development of plans to guide the air quality improvement efforts of state and local agencies. The federal plan, which is referred to as the State Implementation Plan (SIP), must contain control strategies that demonstrate attainment with national ambient air quality standards by deadlines established in the federal Clean Air Act. The state plan is called the Clean Air Plan (CAP). The CAP must show satisfactory progress in attaining state ambient air quality standards. Deadlines are not fixed for attaining state standards. The SIP and the CAP overlap and generally contain the same emissions control measures.

Both the SIP and the CAP rely on the combined emission control programs of the USEPA, the CARB, and the BAAQMD. The role of each agency in controlling emissions in the project area is described below.

Federal

The USEPA oversees state and local implementation of federal Clean Air Act requirements. They set emission standards for many of the mobile sources, such as new on-road motor vehicles, including transport trucks that are sold outside of California. The USEPA also sets emission standards for various classes of new off-road mobile sources, including locomotives that are sold throughout the country. The USEPA is also working with the International Maritime Organization to begin the process of setting international standards to lower emissions from new marine vessels that operate under that organization's protocol.

In 1999 the USEPA issued a final rule to reduce emissions from new large marine diesel engines. These emission reduction requirements take place from 2004 through 2007. This program will reduce emissions of NO_x (an ozone precursor) and PM_{10} generated by marine diesel engines larger than 50 horsepower. This rule would affect new ferry vessels and vessels with engines replaced after 2004.

State and Local

Under California law, the responsibility to carry out air pollution control programs is split between the CARB and local or regional air pollution control agencies. In the project area, the BAAQMD regulates stationary sources. The BAAQMD can require stationary sources to obtain permits, as well as impose emission standards, set fuel or material specifications, or establish operational limits to reduce air emissions.

The CARB shares the regulation of mobile sources with the USEPA. The CARB has the authority to set emission standards for on-road motor vehicles and for some classes of off-road mobile sources that are sold in California. The emission standards with the largest effect in the project area are those set for automobile, light- and medium-duty truck, California heavy-duty truck, and other diesel engines. The CARB also regulates vehicle fuels, with the intent to reduce emissions. The CARB has set emission reduction performance requirements for gasoline (California reformulated gasoline) and has limited the sulfur and aromatic content of diesel fuel to make it burn more cleanly. The CARB also sets the standards used to pass or fail vehicles in the smog check and heavy-duty truck inspection programs.

The federal, state, and regional control programs described above are directed primarily toward criteria pollutants—the pollutants for which ambient air quality standards exist. Programs are also in place to reduce public exposure to other pollutants, such as those that present a potential hazard to public health. These pollutants are called "hazardous air pollutants" (HAPs) in federal law and "toxic air contaminants" (TACs) under California law. TACs are pollutants "which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health" (BAAQMD 1997). The federal and state programs are currently directed toward reducing TAC emissions from stationary sources. Unlike criteria pollutants, TACs have no ambient standards; however, BAAQMD regulates new or expanding stationary sources of TACs.

Transportation Conformity

Transportation projects receiving federal funding must be found to conform with the current State Implementation Plan (SIP). The SIP is a plan that describes how a state will reduce air emissions such that ambient pollutant concentrations will decrease and the state will achieve attainment of ambient air quality standards. Each region in the state submits its emissions budgets and strategies for reducing air emissions to the California Air Resources Board (CARB), which prepares the SIP.

Transportation planning is coordinated with this "conformity" process. The Regional Transportation Plan (RTP) contains a long-range plan for transportation projects and emissions budgets for those projects. The RTP must conform to the SIP by having an emissions budget from its planned projects that does not exceed the emissions budget in the SIP. For an individual project to conform to the SIP, it must be contained in a conforming RTP.

The WTA program must eventually be included in a conforming RTP if it is found to conform to the SIP. The legislation that created the WTA and mandated preparation of this EIR and IOP (refer to Section 1) did not fund specific projects. As funding is identified for water transit expansion, further review (including air quality evaluations) will have to take place to advance a more defined set of the projects to the RTP.

National and State Ambient Air Quality Standards

Criteria Pollutants

National and state ambient air quality standards have been established for CO, O_3, NO_2, SO_2, and particulate matter 10 micrometers or less in diameter (PM_{10} and $PM_{2.5}$).[1] Ambient standards specify the concentration of these "criteria pollutants" that the public can be exposed to without adverse health effects. Since individuals vary widely in their sensitivity to air pollutants, standards are set to protect more sensitive populations (i.e., children and the elderly). National and state standards are reviewed and updated periodically based on new health studies. California ambient standards tend to be at least as protective as national ambient standards and are often more stringent. National and state ambient air quality standards are listed in Table 3.6.3. The criteria pollutants and associated adverse health effects are summarized below:

- **Carbon Monoxide.** Exposure to high concentrations of CO reduces the oxygen-carrying capacity of the blood, and therefore can cause dizziness and fatigue, impair central nervous system functions, and induce angina in persons with serious heart disease. The most

[1] Other pollutants (e.g., lead) also have ambient standards, but they are not discussed in this document because emissions of these pollutants from cars and marine vessels are expected to be minimal.

important sources of high CO levels in the ambient air are passenger cars, light-duty trucks, and residential wood burning.

- **Ozone.** While O_3 serves a beneficial purpose in the upper atmosphere (stratosphere) by reducing potentially harmful ultraviolet radiation, when it reaches elevated concentrations in the lower atmosphere it can be harmful to the human respiratory system and to sensitive species of plants. O_3 concentrations build to peak levels during periods of light winds, bright sunshine, and high temperatures. Short-term O_3 exposure can reduce lung function in children, make persons susceptible to respiratory infection, and produce symptoms that cause people to seek medical treatment for respiratory distress. Long-term exposure can impair lung defense mechanisms, and lead to emphysema and chronic bronchitis. Sensitivity to O_3 varies among individuals. About 20 percent of the population is sensitive to O_3, with exercising children being particularly vulnerable. O_3 is formed in the atmosphere by a complex series of photochemical reactions that involve "ozone precursors." Ozone precursors are categorized into two families of pollutants: oxides of nitrogen (NO_x) and reactive organic gases (ROGs). NO_x and ROGs are emitted from a variety of stationary and mobile sources. While NO_x is considered a criteria pollutant, ROGs are not in this category, but are included in this discussion as O_3 precursors.
- **Nitrogen Dioxide.** The major health effect from exposure to high levels of NO_2 is the risk of acute and chronic respiratory disease. NO_2 is a combustion by-product, but it can also form in the atmosphere by chemical reaction. It is a reddish-brown gas often observed during the same conditions that produce high levels of O_3. NO_2 is a precursor to O_3.
- **Sulfur Dioxide.** The major health effect from exposure to SO_2 is acute and chronic respiratory disease. Asthmatics are particularly sensitive. SO_2 can also react with water in the atmosphere to form acids (or so-called "acid rain"), which can cause damage to vegetation and man-made materials. The main source of SO_2 is the combustion of fuels containing sulfur, chiefly coal and fuel oil. California has very low levels of SO_2 because most large combustion sources burn natural gas, which contains only trace quantities of sulfur. California regulations also limit the sulfur content of gasoline and diesel fuel.
- **Particulate Matter.** Particulate matter is regulated as PM_{10} (particulate matter less than 10 micrometers in diameter). More recently it has been subdivided into coarse and fine fractions, with particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) constituting the fine fraction. The health effects from long-term exposure to high concentrations of particulate matter are increased risk of chronic respiratory disease like asthma and altered lung function in children. Short-term exposure to high levels of particulate matter has been shown to increase the number of people seeking medical treatment for respiratory distress, and to increase mortality among those with severe respiratory problems. Particulate matter also results in reduced visibility. Ambient particulate matter has many sources. It is emitted directly by combustion sources like motor vehicles, industrial facilities, and residential wood burning, and in the form of dust from ground-disturbing activities such as construction and farming. It also forms in the atmosphere from the chemical reaction of precursor gases.

For planning purposes, regional areas like the San Francisco Bay Area are given an air quality status "label" by the federal and state regulatory agencies. Areas with monitored pollutant concentrations that are lower than ambient air quality standards are designated as "attainment areas" on a pollutant-by-pollutant basis. When monitored concentrations exceed ambient standards (the national and state standards are presented in Table 3.6.3), areas are designated as “nonattainment areas.” An area that recently exceeded ambient standards, but is now in attainment, is designated as a “maintenance area.” Nonattainment areas are further classified based on the severity and persistence of the air quality problem as “moderate” “severe” or “serious.” Classifications determine the applicability and minimum stringency of pollution control requirements. In general, the more serious the air quality classification, the more stringent are the control requirements that must be contained in the regional air quality plans (see discussion above of the SIP and CAP).

Toxic Air Contaminants

As noted above, no ambient air quality standards exist for TACs. Many pollutants are identified as TACs because of their potential to increase the risk of developing cancer. For TACs that are known or suspected carcinogens, the CARB has consistently found that there are no levels or thresholds below which exposure is risk free. Individual TACs vary greatly in the risk they present; at a given level of exposure one TAC may pose a hazard that is many times greater than another. Where data are sufficient to do so, a “unit risk factor” can be developed for cancer risk. The unit risk factor expresses assumed risk to a hypothetical population, the estimated number of individuals in a million who may develop cancer as the result of continuous, lifetime (70-year) exposure to 1 microgram per cubic meter ($\mu g/m^3$) of the TAC. Unit risk factors provide a standard that can be used to establish regulatory thresholds for permitting purposes. However, this is not a measure of actual health risk because actual populations do not experience the extent and duration of exposure that the hypothetical population is assumed to experience. For noncancer health effects, a similar factor called a Hazard Index is used.

New Air Quality Standards

In July 1997, the USEPA adopted a number of changes to national ambient air quality standards for O_3 and particulate matter (USEPA 1997a,b,c,d). These new standards are discussed separately because from a regulatory standpoint they have a different status than previously adopted standards. None of the new standards is in full effect at this time because the data and information needed to develop control programs will require several years to collect.

Ozone

The USEPA adopted a new 8-hour standard that will eventually replace the existing 1-hour standard. For particulate matter, the USEPA adopted a 24-hour standard and an annual average standard for the fine fraction of particulate matter, $PM_{2.5}$ (USEPA 1997a). The USEPA retained the existing PM_{10} standards, but slightly changed the form of the 24-hour standard (USEPA 1997b).

The new O_3 standard was adopted after the USEPA found that the previous national 1-hour standard of 0.12 part per million (ppm) did not adequately protect the public from adverse health effects. Of particular concern is evidence that exposure to O_3 levels below 0.12 ppm is associated with increased hospital admissions for people with respiratory ailments, including asthma, and with reductions in lung function in children and adults who are active outdoors (USEPA 1997c). Evidence also exists that long-term exposure can cause repeated inflammation of the lung, impairment of lung defense mechanisms, and irreversible damage in lung structure, leading to premature aging of the lungs and chronic respiratory illnesses (USEPA 1997c).

Particulate Matter

The USEPA's review of its particulate standard showed "coarse" respirable particles (2.5 to 10 micrometers in size) can be inhaled and aggravate health problems such as asthma. Therefore, the USEPA chose to retain PM_{10} standards. The USEPA also reviewed studies providing epidemiological evidence that exposure to particulate matter at levels well below the existing PM_{10} standards were associated with increased hospital admissions and premature mortality (USEPA 1997b). In addition, the USEPA found that finer particles (less than 2.5 micrometers in diameter) can penetrate more deeply into lungs, and are more likely than coarser particles to contribute to more severe health effects (USEPA 1997b). Therefore, the USEPA established new standards for $PM_{2.5}$.

The USEPA has not yet designated any areas of the country as being in attainment or nonattainment for the new O_3 and $PM_{2.5}$ standards. In May 1999, a federal appeals court remanded both the new ozone and the new particulate ambient standards back to the USEPA for failing to articulate adequately its authority to set the standards. The new standard was upheld by the federal D.C. Circuit Court of Appeals on February 27, 2001. The CARB is currently in the process of evaluating the attainment status of the state's air basins with respect to the USEPA's $PM_{2.5}$ standards.

Revision of Existing Standards

California Senate Bill 25, Escutia 1999, established the Children's Environmental Health Protection Act and commissioned a report to assess health-based ambient air quality standards. This report concluded that the standards for particulate matter, ozone, and nitrogen dioxide are inadequate to protect public health. The standards for particulate matter were found to have the highest priority for revision (CARB 2000). The staff of the CARB will present a final particulate matter standards report, containing recommendations for revising particulate matter standards, to the CARB for review in May 2002. Similar reports will be written by the CARB staff for ozone and nitrogen dioxide standards are tentatively scheduled to be presented to the CARB on December 2003 and December 2004, respectively. The CARB staff is also investigating the establishment of a California standard for $PM_{2.5}$.

Diesel Particulate Matter

On August 27, 1998, the CARB formally identified particulate matter emitted by diesel-fueled engines as a TAC. Diesel-fueled engines emit TACs in both gaseous and particulate forms. The particles emitted are coated with chemicals, many of which have been identified by the USEPA as HAPs and by the CARB as TACs. Since by weight, the vast majority of diesel exhaust particles are very small (94 percent of their combined mass consists of particles less than 2.5 micrometers in diameter), both the particles and their coating of TACs are inhaled into the lungs. While the gaseous portion of diesel exhaust also contains TACs, the CARB's August action was specific to diesel particulate emissions which, according to supporting CARB studies, represent 50 to 90 percent of the mutagenicity of diesel exhaust (CARB 1998). The CARB action was taken at the end of a lengthy process that considered dozens of health studies, extensive analysis of health effects and exposure data, and public input collected over the last 9 years. The CARB's Scientific Advisory Committee has recommended a unit risk factor of 300 in a million for diesel particulate.[2] This action will lead to additional control by CARB of diesel emissions in coming years. The USEPA has also begun an evaluation of both the cancer and noncancer health effects of diesel exhaust.

3.6.2 Impacts and Mitigation

Impact Assessment Methodology

This evaluation addresses impacts from both vehicle and ferry emissions sources for the Proposed Project and the No Project Alternative. The evaluation is based on a calculation of the total emissions from all modes of travel (ferry, car, bus) that might be affected by implementation of the Proposed Project. The different travel modes generate different rates of emissions.

The overall impacts from the system (i.e., ferries, passenger cars, and buses) were evaluated to obtain a regional, cumulative emissions estimate for the Proposed Project and the No Project Alternative. For the purposes of evaluating the significance of impacts, the estimated emissions from all travel modes were summed for each alternative. The total emissions were then compared between the Proposed Project and the No Project Alternative to determine whether the Proposed Project would result in an overall decrease or increase in emissions. This is discussed in more detail under “Significance Criteria” below. This comparative evaluation was done instead of examining the emissions from each individual source alone and comparing them to a threshold level.

Ferry and vehicle emissions are presented for criteria pollutants, which include oxides of nitrogen (NO_x), reactive organic gases (ROG), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter (PM_{10}).

Vehicle Emissions

Vehicle emissions (passenger cars and buses) were calculated using forecasts of total vehicle miles traveled for the year 2025. Ferry emissions were calculated using the projected schedule of routes and frequencies for that same year. The emissions calculations were performed for the Proposed Project and the No Project Alternative. The year 2025 is consistent with the Metropolitan Transportation Commission (MTC) travel forecast model that was used as a basis for the vehicle forecasts.

The California Air Resources Board (CARB) model "San Francisco Bay Area EMFAC 2000" (EMFAC2000) was used to calculate regional emissions based on vehicle miles traveled (VMTs) for each alternative. At the time of the modeling, EMFAC2000 was the latest in the series of California emission factor models that calculate emissions of CO, NO_x, ROG, and PM_{10} for current and future years. This model is accepted by the CARB and most local air pollution control districts for analysis of motor vehicle emissions in California. The EMFAC2000 model reflects emissions decreases from motor vehicles in future years due to anticipated improvements in engine and fuel technology and retirement of older vehicles from the fleet. For example, year 2025 passenger car emissions of ROG, CO, and NO_x are anticipated to decrease from 1.5, 10.8,

[2] The Scientific Review Committee findings are Attachment A to CARB Resolution 98-35, August 27, 1998.

and 1.0 grams per mile, respectively, in 2002 to 0.3, 1.5, and 0.2 grams per mile, respectively, in 2025. PM_{10} emissions are not expected to change significantly.

In addition, emissions from cold-starts based on trip purpose were calculated for each alternative, using factors from the EMFAC2000 model. The cold-start emissions were incorporated into the daily total emissions calculated for passenger vehicles. Cold-starts occur after a vehicle has been off for more than four hours, and cold-start emissions are important because they represent a major portion of the total trip emissions for a vehicle. The traffic analysis included information on the number of daily trips based on the purpose of the trip (e.g. shopping, work, recreation, etc.). All home-based work trips were assumed to be in cold-start mode (i.e., the vehicle would have been off for more than four hours). Cold-start emissions were calculated by multiplying the number of cold-start trips by an emission factor of pounds of pollutant per cold-start. This calculation was done for both the morning and evening commutes to yield a total pounds-per-day emissions from cold-starts.

Ferry Emissions

Ferry emissions were estimated assuming that USEPA Tier 2 standards would be in effect. These standards require that new diesel engines manufactured after the year 2007 meet lower emissions requirements than current diesel engines. The assumption was that all ferries in the year 2025, with or without the project, would have engines that would at least meet the USEPA Tier 2 standards. With the Proposed Project, the ferries would also have control devices to reduce the levels of NO_x and PM_{10}. Selective catalytic reduction (SCR) and particulate traps would reduce NO_x emissions to 10 percent of Tier 2 levels and PM_{10} emissions to 5 percent of Tier 2 levels. Therefore, for the Proposed Project emissions were assumed to be at least 85% below Tier 2 standards. These standards are included in the WTA Vessel Specifications.

The WTA evaluation considered a range of vessel types, fuels, and propulsion systems (JJMA 2002) that could be potentially used on the projected service routes. These different technologies result in various levels of emissions of NO_x, ROG, CO, SO_2, and PM_{10}. Some examples of the technologies include diesel engines fueled with natural gas, gas turbines fueled with diesel or natural gas, and diesel engines fueled with diesel with SCR and particulate traps. The WTA's evaluation of vessel technology involved a comprehensive investigation of emerging technologies and their relative suitability to Bay Area passenger service. Section 2.5 (Vessel Technology) summarizes the evaluation that was performed in coordination with the "Clean Marine Ad Hoc" Work Group. The use of SCR and particulate traps was found to currently be the most effective combination of control measures.

The ferry emissions for the WTA program were developed for the projected year 2025 using a combination of site-specific data, readily available emission factors, and current and projected operating conditions. Existing data for each ferry system were reviewed and analyzed. Future baseline emissions were based upon peak and off-peak conditions, where peak hours represented 6 hours per day and non-peak hours represented 6.5 hours per day. Baseline emissions for each period were calculated by multiplying together the total travel time from all ferries, the average horsepower rating, and the emission factors for marine diesels. Total travel time was computed for both peak and non-peak periods by: (1) dividing the total time within each period by the frequency of visits by each ferry to obtain the number of trips; (2) multiplying the number of trips for each ferry by the estimated time per trip; and (3) summing the trip times for all ferries.

For the No Project Alternative, average power outputs were assumed for each route, based on the current ferries in use on these routes. Characteristics of the current ferries are available in the working document, *New Technologies and Alternative Fuels*, prepared for the WTA (JJMA 2002). For the Proposed Project, two ferry vessel types were assumed, which is consistent with the Implementation and Operations Plan (IOP). One type would be 350-passenger with a maximum power output of 8,000 horsepower (5,966 kW). The other would be 149-passenger with a maximum power output of 2,900 horsepower (2,163 kW) (Hutchison 2002).

For the Larkspur ferry route, only the newer catamaran vessels used on this route were assumed for the No Project Alternative. The monohull boats used on this route were constructed in the 1970s and will be taken out of commission by 2025.

The ferry system schedules are presented in Appendix AIR-A. Tables 3.6.4 through 3.6.6 present the data used for the ferry emissions calculations: ferry power rating, ferry power usage, hours of operation, pollutant emission factors, and calculated emissions in pounds per day.

The significance criteria used for this study and a discussion of each of the impacts follow.

3.6.2.1 Significance Criteria

The significance criterion used in this EIR is as follows:

- Higher cumulative emissions from all travel modes for the Proposed Project than for the No Project Alternative would be considered a significant impact.

As applied to the WTA program, this involved calculation of total emissions by criteria pollutant, for each mode of travel: ferry, bus, and passenger car. These were compared to the No Project Alternative to determine whether the Proposed Project would result in overall higher or lower regional emissions. This criterion was used because it allows comparison of alternatives on a regional scale, consistent with the WTA program. This type of significance criterion was used in the 2001 Regional Transportation Plan (RTP) EIR issued by the Metropolitan Transportation Commission (MTC 2001).

3.6.2.2 Impacts

Impact A-1 **Regional cumulative emissions of NO_x, PM_{10}, CO, SO_2, CO_2, and ROG could increase as a result of the implementation of the Proposed Project.**

The evaluation of significance is based on the sum of vehicle (passenger car and shuttle bus) emissions plus ferry emissions for the Proposed Project versus vehicle emissions plus ferry emissions for the No Project Alternative. If the emissions sum of vehicles plus ferries for the Proposed Project is less than the emissions sum of vehicles plus ferries for the No Project Alternative, the impact would be considered less than significant. If, however, the sum of vehicles plus ferry emissions from the Proposed Project is greater than the sum of passenger car plus ferry emissions from the No Project Alternative, then the impact would be considered significant. This comparison was done for each of the pollutants.

The Bay Area emissions inventory is summarized in Table 3.6.7. Table 3.6.8 summarizes emissions from ferries, passenger cars, and shuttle buses for the Proposed Project and the No

Project Alternative. Tables in Appendix AIR-A present route information (frequencies, number of vessels, sailing times) for each alternative, as well as the per-route emissions.

Regional cumulative emissions of NO_x, PM_{10}, and CO from passenger cars, buses, and ferries would decrease with the Proposed Project below those for the No Project Alternative. Emissions of SO_2 and ROG would increase with the Proposed Project, by 0.3 percent and 0.02 percent respectively. The sum of ROG plus NO_x emissions (ozone precursors) would be less with the Proposed Project than for the No Project Alternative.

Greenhouse gas emissions include carbon dioxide (CO_2), methane, and chlorofluorocarbons. The predominant greenhouse gas from fossil fuel combustion is CO_2. Operation of the Proposed Project would result in an increase in CO_2 emissions.

CO_2 is not a priority pollutant and currently, there are no State or Federal standards that apply to the emissions of greenhouse gases. Therefore, there is no standard of significance against which to compare emissions increases.

CO_2 emissions from ferries were calculated using fuel consumption rates, hours of usage, and the amount of carbon in diesel fuel, which when combusted converts to CO_2. In addition, there would be a decrease in passenger vehicle miles traveled due to the proposed project. The decrease in CO_2 emissions from passenger cars was calculated using the decrease in vehicle miles traveled and the CO_2 emission factor from EMFAC2000.

The increase/decrease of emissions of various constituents for the Proposed Project (compared to the No Project Alternative) are summarized below:

Constituent	Proposed Project Emission Compared to No Project
NO_x	Net Decrease
SO_2	0.3% Increase
PM_{10}	Net Decrease
CO	Net Decrease
CO_2	Net Increase
ROG	0.02% Increase

In conclusion, small region-wide increases in SO_2 and ROG would remain with implementation of the Proposed Project. ROG is primarily of concern because it is one of the precursors of ozone. However, as noted above, the Proposed Project would result in a net decrease in both ozone precursors (NO_x and ROG combined). The Proposed Project would result in a net increase in CO_2 emissions. The remaining pollutant of concern, SO_2, is currently in attainment in the Bay Area. However, as the analysis indicates a small region-wide increase for the Proposed Project, this impact is identified as potentially significant.

Summary of Impact A-1

- Proposed Project emissions from vehicles (passenger cars and buses) plus ferries would be less than those for the No Project Alternative for NO_x, PM_{10}, and CO, resulting in a less than significant impact.
- Proposed Project emissions from vehicles plus ferries would be greater than those for the No Project Alternative for SO_2 and ROG, resulting in a significant impact.
- The sum of ozone precursors ROG plus NO_x would be less with the Proposed Project than with the No Project Alternative.
- There would be a net increase in CO_2 from the Proposed Project, resulting in a significant impact.

Future engine fuel and/or pollution control technologies that are not at present commonly used could have an effect on future emission levels. One such engine technology is the use of fuel cells instead of combustion of fossil fuels. While the 2025 emissions are based on current or 2007 technology, it is expected that by 2025, other technologies will be available and cost effective and will further reduce emissions. Emissions could be reduced or eliminated through use of these engine technologies..

The WTA is planning to continue investigating the feasibility and applicability of using energy sources other than fossil fuels and different engine technologies. One promising technology is the use of fuel cells. The WTA has investigated the use of alternative fuels for ferries in: *New Technologies and Alternative Fuels Working Document* (JJMA 2002). Alternative energy sources and engine technologies will become available and will be incorporated as they become feasible and cost-effective. However, as future technology cannot be predicted, this impact remains potentially significant

Impact A-2 **Motor vehicles leaving ferry terminals during the evening commute period would produce cold-start emissions that could lead to localized violations of the short-term carbon monoxide standard.**

As vehicles in a parking area leave a ferry terminal, there could be a concentration of cold-start emissions at those locations, instead of the emissions being dispersed throughout the Bay Area at people's homes, as during the morning commute. This "clustering" of cold-start emissions during the evening commute hour could produce a violation of the one-hour carbon monoxide standard at locations near the terminal parking lots. This is a potentially significant impact.

Summary of Impact A-2

- The Proposed Project would result in cold-start emissions during the evening commute period that could lead to a violation of the short-term carbon monoxide standard, leading to a potentially significant impact.

Mitigation A-2.1: Cold-start emissions shall be reduced by encouraging non-drive access at the ferry terminals. Techniques for encouraging non-drive access could include fees for parking, provision of preferential parking for carpools and vanpools, comprehensive shuttle access, land use scenarios that encourage non-drive access, and encouraging bicycle and pedestrian access. In addition, feeder shuttle buses could be equipped with zero emission or ultra-low emission engines.

Impact After Mitigation: The effectiveness of Mitigation A-2 cannot be quantified, as the design and exact number of ferry terminals are not defined at this time. Therefore, this impact remains potentially significant.

Impact A-3 Ferries would emit toxic pollutants in the exhaust in the form of particulate matter from the combustion of diesel fuel.

In 1998, the CARB formally identified particulate matter emitted by diesel-fueled engines as a toxic air contaminant (TAC). Diesel engines emit TACs in both gaseous and particulate forms. The particles emitted by diesel engines are coated with chemicals, many of which have been identified by the USEPA as hazardous air pollutants (HAPs), and by the CARB as TACs. The vast majority of diesel exhaust particles are very small (94 percent of their combined mass consists of particles less than 2.5 microns in diameter), and both the particles and their coating of TACs can be inhaled into the lungs. While the gaseous portion of diesel exhaust also contains TACs, the CARB's 1998 action was specific to diesel particulate emissions, which, according to supporting CARB studies, represent 50 to 90 percent of the mutagenicity of diesel exhaust (CARB 1998).

Diesel particulate emissions were calculated as described above under "Ferry Emissions." For the purposes of characterizing potential air toxic impacts, the entire mass of estimated particulate matter emissions from diesel engines is considered toxic.

Since the majority of diesel particulate matter is in the fine fraction (less than 2.5 micrometers in diameter, or $PM_{2.5}$), it can remain airborne for several days. The area of impact will depend on meteorological conditions. If light to moderate wind conditions prevail in the project area, diesel particulate is likely to be dispersed widely and have its impact on a regional scale. During periods of very light wind speeds, low inversion heights, and atmospheric stability, diesel particulates may remain in the project area and have a relatively larger local impact. Because health risks relate to long-term, lifetime exposure, it is long-term average exposure to diesel particulate that is of most concern. Due to the prevailing meteorological conditions in the project area and the distance of the closest residential areas to the emissions sources, particulates in the area of local impact are expected to be well dispersed.

Emissions from the Proposed Project would be less than those for the No Project Alternative, resulting in a less than significant impact.

Summary of Impact A-3

- Proposed Project $PM_{2.5}$ emissions from ferries would be less than those for the No Project Alternative, resulting in a less than significant impact.

Impact A-4 Air pollutants would be deposited in the Bay, which could increase the levels of nitrates and sulfates in the water.

A fraction of the airborne pollutant emissions from ferry fuel combustion would be deposited on the Bay. The rest would be transported over land by winds. The amount of pollutants deposited on land versus on the Bay depends on several factors including the proximity of the ferry to land, the distance the ferry travels over water, the amount of wind transporting the pollutants, and the location of the exhaust port on the ferry.

Emissions of nitrogen and sulfur oxides would be deposited as nitrates and sulfates. A portion of the particulate matter in the diesel exhaust, mostly in the fine fraction ($PM_{2.5}$), would also be deposited.

The level of nitrates would decrease with the Proposed Project below those for the No Project Alternative. However, the level of sulfates would increase with the Proposed Project.

Summary of Impact A-4

- Deposition of nitrates on the Bay from ferry emissions would decrease with the Proposed Project, resulting in a less than significant impact.
- Deposition of sulfates on the Bay from ferry emissions would increase under the Proposed Project, leading to a potentially significant impact.

Mitigation A-4.1: Use of a fuel technology that lowers SO_2 emissions would reduce sulfate emissions and subsequent deposition.

Impact After Mitigation: The effectiveness of such mitigation cannot be reasonably quantified, due to the variability of the factors affecting deposition levels. This impact would remain potentially significant.

Impact A-5 Construction of ferry terminals would create emissions of fugitive dust from excavation and grading, and emissions of ROG, NO_x, CO, SO_2, and PM_{10} from construction equipment exhaust.

Construction-related pollutant emissions have not been quantified because the specific plans for each terminal are not defined at this time. Furthermore, the BAAQMD does not require quantification of construction emissions, but does require a discussion of construction mitigation measures. As for any construction project, there can be occasional concentrations of emissions from construction activities that temporarily approach or exceed air quality standards.

Summary of Impact A-5

- Construction emission impacts under the Proposed Project could be potentially significant.

Mitigation A-5.1: The project proponent(s) shall implement the mitigation measures contained in the BAAQMD CEQA Guidelines (BAAQMD 1999) to control fugitive dust emissions from construction activities. These measures include activities such as watering and covering exposed soil surfaces to minimize dust emissions.

Mitigation A-5.2: Measures to reduce emissions from vehicles and heavy equipment shall include: 1) Use alternative fueled construction equipment when possible; 2) Minimize idling time, for example, 5-minute maximum; 3) Properly maintain equipment; and 4) Limit the hours of operation of heavy-duty equipment and/or the amount of equipment in use.

Impact After Mitigation: The BAAQMD considers construction impacts to be less than significant if the recommended mitigation measures are used. Each individual ferry expansion project should employ the current BAAQMD-recommended construction emissions control measures to reduce impacts.

Impact A-6 The Proposed Project could result in concentrations of nitrogen dioxide and particulate matter above state and federal standards at the Ferry Building.

Based on the independent analysis by the BAAQMD (Appendix AIR-B), the increased ferry service to and from the San Francisco Ferry Building could add between 6 and 55 percent to the existing concentration values of nitrogen dioxide and particulate matter. The magnitude of the increases would depend on vessel design (particularly the location of the vessel exhaust in relation to passenger and public areas) and dockside idle time. Localized pollutant concentrations are highly dependent upon the height of the engine exhaust pipes.

Summary of Impact A-6

- Under the Proposed Project, local concentrations of nitrogen dioxide and particulate matter could exceed state and federal standards at the Ferry Building. This would be a significant impact.

Mitigation A-6.1: Engine exhaust pipes shall be located sufficiently high to reduce localized impacts. During their analysis, BAAQMD staff hypothesized that the location of the exhaust points was an important factor in local concentrations of air pollutants. This was tested with a model scenario wherein all future vessels would have exhaust heights at 20 feet above the waterline.

While the BAAQMD's choice of modeling the exhaust location at 20 feet above the waterline was somewhat arbitrary, the results indicate that this height would reduce the potential for unhealthy concentrations of air pollutants[3] (Murphy 2003). Therefore, exhaust points shall be located at least 20 feet above the waterline unless future modeling indicates that lower heights would reduce concentrations of pollutants to acceptable levels.

Mitigation A-6.2: Project proponents shall minimize dockside idling time at the Ferry Building.

Impact After Mitigation: Impact A-6 would be less than significant after implementation of Mitigations A-6.1 and A-6.2.

Impact A-7 The Proposed Project could result in increases of pollutants from ferry exhaust deposited directly into the Bay.

The amount of pollutants from exhaust that would be deposited in the Bay depends upon the height of the exhaust port. If the exhaust ports are located high, the predominant wind patterns in the Bay Area would transport much of the pollutants emitted from the ferries over land such that only a small amount is deposited into the Bay. However, if the exhaust ports on the new ferries are close to the water, the turbulent eddies in the boat wake could capture some of the emissions, resulting in an increased amount of pollutants deposited into the Bay.

[3] BAAQMD notes, however, that this result may only be valid if ferry service equals or is less than the frequency proposed in the December 2002 IOP.

Summary of Impact A-7

- Under the Proposed Project, pollutants from exhaust could be deposited in the Bay due to turbulent eddies in the vessel wake if the exhaust ports are located near the waterline. This could be a potentially significant impact.

Mitigation A-7.1: Implement Mitigation A.6-1, which is to locate exhaust pipes at least 20 feet above the waterline.

Impact After Mitigation: Impact A-7 would be less than significant after implementation of Mitigation A-7.1.

Impact A-8 **Equipment and boats used for dredging of the harbor at the Hercules/Rodeo terminal would emit criteria air pollutants. These emissions would exceed the significance thresholds of 80 pounds per day for NO_x, ROG, and PM_{10} listed in the BAAQMD CEQA Guidelines.**

Air pollutant emissions associated with dredging activities were estimated assuming that just less than 50,000 cubic yards (yd^3) of material would need to be dredged. Due to the nature of the project, a number of assumptions were made in order to estimate the air emissions. It was assumed that the dredging would occur on a barge with a capacity of 4,000 yd^3 of dredge material. One 800 hp engine was assumed to power the dredging operation and one tugboat was assumed to be required to move the barge to the release point in the Bay. There are a number of areas in the Bay where dredge material can be dumped. It was assumed that there would be a four hour round trip between the dredging point and the release point. The entire process was assumed to take twelve and a half 10-hour days. One round trip to the release point would be completed each day. The emissions and emission factors used are summarized in Table 3.6.9.

Summary of Impact A-8

- Dredging for the Proposed Project would emit criteria air pollutants. These emissions would exceed the significance thresholds of 80 pounds per day for NO_x, ROG, and PM_{10} listed in the BAAQMD CEQA Guidelines. The exceedences would occur for approximately 12 days every 3 to 6 years. This is a potentially significant impact.

Mitigation A-8.1: Minimize required dredging for construction and maintenance, both in terms of dredge volume and maintenance dredging interval.

Mitigation A-8.2: Utilize dredging contractors with the best available emission controls on their equipment.

Impact After Mitigation: With implementation of Mitigations A-8.1 and A-8.2, Impact A-8 would be less than significant.

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Table 3.6.1

Ambient Air Quality (1997-2000)

	1997	1998	1999	2000
Ambient Ozone levels (ppm)				
Concord-2975 Treat Blvd.				
Highest 1-hour Concentration	0.099	0.147	0.156	0.138
Measured days>State standard	2	13	8	2
Measured days>National standard	0	2	2	1
Highest 8-hour Concentration	0.081	0.109	0.122	0.094
Measured days>National standard	0	6	6	1
Livermore-Old 1st Street				
Highest 1-hour Concentration	0.114	0.146	0.146	0.137
Measured days>State standard	3	21	14	5
Measured days>National standard	0	6	2	2
Highest 8-hour Concentration	0.084	0.11	0.116	0.11
Measured days>National standard	0	10	5	2
Oakland-Alice Street				
Highest 1-hour Concentration	0.079	0.056	0.081	0.072
Measured days>State standard	0	0	0	0
Measured days>National standard	0	0	0	0
percent year coverage	99	79	98	98
Highest 8-hour Concentration	0.062	0.045	0.059	0.048
Measured days>National standard	0	0	0	0
Pittsburg-10th Street				
Highest 1-hour Concentration	0.087	0.097	0.098	0.107
Measured days>State standard	0	4	2	1
Measured days>National standard	0	0	0	0
Highest 8-hour Concentration	0.067	0.089	0.087	0.08
Measured days>National standard	0	1	1	0
San Francisco-Arkansas Street				
Highest 1-hour Concentration	0.068	0.053	0.079	0.058
Measured days>State standard	0	0	0	0
Measured days>National standard	0	0	0	0
Highest 8-hour Concentration	0.059	0.046	0.057	0.043
Measured days>National standard	0	0	0	0
San Jose-4th Street				
Highest 1-hour Concentration	0.094	0.147	0.109	0.073
Measured days>State standard	0	4	3	0
Measured days>National standard	0	1	0	0
Highest 8-hour Concentration	0.068	0.091	0.084	0.061
Measured days>National standard	0	1	0	0
San Rafael-4th Street				
Highest 1-hour Concentration	0.106	0.074	0.102	0.071
Measured days>State standard	1	0	2	0
Measured days>National standard	0	0	0	0
Highest 8-hour Concentration	0.073	0.058	0.08	0.058
Measured days>National standard	0	0	0	0

Table 3.6.1 - Continued

Ambient Air Quality (1997-2000)

	1997	1998	1999	2000
Ambient CO levels (ppm)				
Concord-2975 Treat Blvd.				
Highest 8-hour Concentration	3.03	3.75	3.11	2.7
Livermore-Old 1st Street				
Highest 8-hour Concentration	2.53	2.36	2.91	--
Oakland-Alice Street				
Highest 8-hour Concentration	3.58	4.58	5.23	3.43
Pittsburg-10th Street				
Highest 8-hour Concentration	3.19	2.65	3.27	2.68
San Francisco-Arkansas Street				
Highest 8-hour Concentration	3.45	3.96	3.68	3.19
San Jose-4th Street				
Highest 8-hour Concentration	6.11	6.27	6.28	7.03
San Rafael-4th Street				
Highest 8-hour Concentration	2.64	3.3	2.92	2.26
Ambient NO_2 levels (ppm)				
Concord-2975 Treat Blvd.				
Highest 1-hour Concentration	0.076	0.066	0.079	0.074
Annual Average	0.016	0.016	0.018	0.016
Livermore-Old 1st Street				
Highest 1-hour Concentration	0.082	0.071	0.094	0.073
Annual Average	0.018	0.019	0.02	0.017
Oakland-Alice Street				
Highest 1-hour Concentration	--	--	--	--
Annual Average	--	--	--	--
Pittsburg-10th Street				
Highest 1-hour Concentration	0.07	0.064	0.087	0.054
Annual Average	0.014	0.014	0.015	0.013
San Francisco-Arkansas Street				
Highest 1-hour Concentration	0.067	0.08	0.103	0.074
Annual Average	0.02	0.02	0.021	0.02
San Jose-4th Street				
Highest 1-hour Concentration	0.118	0.083	0.128	0.114
Annual Average	0.025	0.025	0.026	0.025
San Rafael-4th Street				
Highest 1-hour Concentration	0.067	0.062	0.087	0.057
Annual Average	0.016	0.017	0.018	0.016
Ambient SO_2 levels (ppm)				
Concord-2975 Treat Blvd.				
Highest 24-hour Concentration	0.008	0.007	0.012	0.005
Annual Average	0.001	0.002	0.002	0.002
Livermore-Old 1st Street				
Highest 24-hour Concentration	--	--	--	--
Annual Average	--	--	--	--
Oakland-Alice Street				
Highest 24-hour Concentration	--	--	--	--
Annual Average	--	--	--	--

Table 3.6.1 - Continued

Ambient Air Quality (1997-2000)

	1997	1998	1999	2000
Pittsburg-10th Street				
Highest 24-hour Concentration	0.008	0.016	0.01	0.009
Annual Average	0.002	0.003	0.002	0.002
San Francisco-Arkansas Street				
Highest 24-hour Concentration	0.007	0.005	0.007	0.008
Annual Average	0.001	0.001	0.002	0.002
San Jose-4th Street				
Highest 24-hour Concentration	--	--	--	--
Annual Average	--	--	--	--
San Rafael-4th Street				
Highest 24-hour Concentration	--	--	--	--
Annual Average	--	--	--	--
Ambient PM_{10} levels (micrograms/cubic meter)				
Concord-2975 Treat Blvd.				
Highest 24-hour Concentration	75.6	65.9	63.8	53.8
Measured days>State standard	2	1	3	1
Measured days>National standard	0	0	0	0
State annual geometric mean	17.4	16.5	18.1	16.1
National annual arithmetic mean	19.4	17.9	20.8	17.8
Livermore-Old 1st Street				
Highest 24-hour Concentration	61.6	62.3	86.6	67.5
Measured days>State standard	2	2	3	2
Measured days>National standard	0	0	0	0
State annual geometric mean	22	19.4	22.6	19.1
National annual arithmetic mean	24.3	21.3	25.6	21.2
Oakland-Alice Street				
Highest 24-hour Concentration	--	--	--	--
Measured days>State standard	--	--	--	--
Measured days>National standard	--	--	--	--
State annual geometric mean	--	--	--	--
National annual arithmetic mean	--	--	--	--
Pittsburg-10th Street				
Highest 24-hour Concentration	--	--	72	55.5
Measured days>State standard	--	--	2	1
Measured days>National standard	--	--	0	0
State annual geometric mean	--	--	20.9	13.8
National annual arithmetic mean	--	--	28.9	16.3
San Francisco-Arkansas Street				
Highest 24-hour Concentration	81	52.4	77.9	63.2
Measured days>State standard	3	1	6	2
Measured days>National standard	0	0	0	0
State annual geometric mean	22.4	20.2	22.6	21.6
National annual arithmetic mean	24.9	21.7	26.4	24

Table 3.6.1 - Continued

Ambient Air Quality (1997-2000)

	1997	1998	1999	2000
San Jose-4th Street				
Highest 24-hour Concentration	78	92	114.4	76.1
Measured days>State standard	3	3	5	7
Measured days>National standard	0	0	0	0
State annual geometric mean	23.7	22.5	25.4	23.7
National annual arithmetic mean	25.8	25	28.7	26.7
San Rafael-4th Street				
Highest 24-hour Concentration	72	52.4	75.6	39.5
Measured days>State standard	2	1	2	0
Measured days>National standard	0	0	0	0
State annual geometric mean	20.2	18.7	19.5	18.1
National annual arithmetic mean	21.9	20.1	22	19.5

Notes:

1. Data obtained from the California Air Resources Board Internet Site.
2. CO, NO_2, and SO_2 levels did not exceed state or federal standards during this period.
3. Annual data capture of PM_{10} for Pittsburg in 1999 was 52% and for San Rafael in 2000 was 88%.
4. Annual data capture of CO for Livermore in 1999 was 73% and for Oakland in 1998 was 84%.
5. Annual data capture of ozone for Oakland in 1998 was 79%.

Table 3.6.2
2000 Planning Inventory for the Bay Area

Source Category	VOC (tpd)	NO_z (tpd)
INDUSTRIAL COMMERCIAL PROCESSES		
Petroleum Refining Facilities:		
Basic Refining Processes	0.10	6.49
Wastewater (Oil-Water) Separators	3.53	--
Wastewater Treatment Facilities	0.09	--
Cooling Towers	2.35	--
Flares and Blowdown Systems	0.08	1.36
Other Refining Processes	0.54	--
Fugitives	8.93	--
Subtotal	***15.6***	***7.9***
Chemical Manufacturing Facilities:		
Sulfur Manufacturing	0.03	0.07
Coatings and Inks Manufacturing	0.70	--
Resins Manufacturing	0.02	--
Other Chemicals Manufacturing	0.74	2.20
Fugitives (all manufacturing) – Valves and Flanges	1.70	--
Subtotal	***3.2***	***2.3***
Other Industrial Commercial Processes:		
Bakeries	1.30	--
Cooking	1.07	--
Wineries	0.88	--
Other Food and Agricultural Processes	0.26	--
Metallurgical	0.04	0.01
Asphalt Concrete Plants	0.03	0.03
Glass and Related Products Manufacturing	0.02	0.87
Stone, Sand and Gravel	0.04	--
Oil Production Fields	0.05	--
Gas Production Fields	0.19	--
Waste Management	4.22	0.25
Semiconductor Manufacturing	0.78	--
Flexible and Rigid Discs Manufacturing	0.02	--
Fiberglass Products Manufacturing	0.52	--
Rubber Products Manufacturing	0.22	--
Plastic Products Manufacturing	0.72	0.03
Contaminated Soil Aeration	3.06	--
Soil Vapor Extraction and Air Stripping	0.30	
Other Industrial Commercial	0.90	0.23
Subtotal	***14.6***	***1.4***
PETROLEUM PRODUCTS/SOLVENT EVAPORATION		
Petroleum Refinery:		
Storage Tanks	7.48	--
Loading Operations	2.74	--
Subtotal	***10.2***	***--***

Table 3.6.2 - Continued
2000 Planning Inventory for the Bay Area

Source Category	VOC (tpd)	NO_z (tpd)
Fuels Distribution:		
Natural Gas Distribution	0.45	--
Bulk Plants (Gasoline Only)	0.70	--
Bulk Plants and Terminals (Non-gasoline)	0.06	--
Loading Trucks	0.41	--
Trucking	0.15	--
Gasoline Filling Stations	9.80	--
Aircraft Fueling	2.82	--
Recreational Boat Fueling	0.93	--
Ferry and Fishing Boats Fueling	0.20	--
Other Fueling	0.20	--
Subtotal	***15.7***	***--***
Other Organic Compound Evaporation:		
Industrial Degreasing	3.33	--
Commercial Degreasing	2.26	--
Dry cleaners	0.15	--
Printing	6.75	--
Adhesives and Sealants	8.98	--
Structures Coating	26.00	--
Industrial/Commercial Coating	30.70	--
Storage Tanks	1.51	--
Lightering	0.09	--
Ballasting	1.85	--
Marine Vessel Cleaning and Gas Freeing	0.72	--
Sterilizers	--	--
Marine Loading (Non-refinery)	0.22	--
Asphalt Paving	0.33	--
Other Organics Evaporation	0.67	--
Subtotal	***83.6***	***--***
COMBUSTION – STATIONARY SOURCES		
Fuels Combustion:		
Domestic	2.10	12.00
Cogeneration	0.76	6.16
Power Plants	0.17	30.20
Oil Refineries External Combustion	0.40	32.90
Glass Melting Furnaces – Natural Gas	--	4.21
Reciprocating Engines	0.34	4.83
Turbines	0.14	2.37
Other External Combustion	1.18	21.80
Subtotal	***5.1***	***114.5***
Burning of Waste Material:		
Incineration	0.75	1.30
Planned Fires	0.10	0.01
Subtotal	***0.9***	***1.3***

Table 3.6.2 - Continued
2000 Planning Inventory for the Bay Area

Source Category	VOC (tpd)	NO_z (tpd)
COMBUSTION – MOBILE SOURCES		
Off-Highway Mobile Sources:		
Lawn, Garden, and Other Utility Equipment	6.57	1.29
Transportation Refrigeration Units	0.23	1.84
Farm Equipment	1.28	6.55
Heavy Duty Industrial/Construction Equipment	2.37	22.40
Light Duty Industrial/Construction Equipment	22.20	72.10
Locomotive Operations	0.48	10.60
Off-Road Motorcycles	1.18	0.12
All Terrain Vehicles	0.46	0.02
Four-Wheel Drive Vehicles	0.10	0.08
Ships Maneuvering	0.11	3.28
Ships Berthing	0.29	1.73
Ships In-Transit	0.15	5.70
Commercial Boats	0.69	4.33
Recreational Boats	16.40	1.71
Subtotal	***52.5***	***131.8***
Aircraft:		
Commercial Aircraft	3.16	15.00
General Aviation	0.91	0.21
Military Aircraft	6.06	4.55
Agricultural Aircraft	--	--
Airport Ground Support Equipment	0.17	0.49
Subtotal	***10.3***	***20.2***
On-Road Motor Vehicles:		
Light Duty Passenger	116.8	106.5
Light Duty Trucks	44.10	62.00
Medium Duty Trucks	7.98	13.20
Light Heavy Duty Trucks	2.09	14.40
Medium Heavy Duty Trucks	1.68	14.20
Heavy Heavy Duty Trucks	2.79	31.00
Heavy Duty Buses	0.52	4.82
Motorcycles	1.78	0.99
Subtotal	***177.7***	***247.1***
Further Reductions due to Reformulated Gasoline	2.5	--
Subtotal	***175.3***	
MISCELLANEOUS OTHER SOURCES		
Construction Operations	--	--
Farming Operations	--	--
Entrained Road Dust	--	--
Accidental Fires	0.41	0.13
Animal Waste	4.00	--
Wind Blown Dust	--	--
Agricultural Pesticides	2.95	--
Non-Agricultural Pesticides	1.53	--
Consumer Products (No pesticides)	41.70	--
Other Miscellaneous Sources	0.19	0.07
Subtotal	***50.8***	***0.2***
TOTAL	**438**	**527**
Banking Emissions:	7.56	7.69
GRAND TOTAL:	**445**	**534**

Source: BAAQMD. 1999. SF Bay Area Ozone Attainment Plan

Table 3.6.3
State and Federal Ambient Air Quality Standards
(as of January 2002)

Pollutant	Averaging Time	California Standards	National Standards	Bay Area State Status/ Classification	Bay Area National Status/Classification
Photochemical Oxidants	8 hour	--	0.08 ppm	--	Unclassified/Not Designated
	1 hour	0.09 ppm	0.12 ppm	Nonattainment	Nonattainment/ Unclassified
Carbon Monoxide	8 hour	9.0 ppm	9 ppm	Attainment	Attainment
	1 hour	20 ppm	35 ppm	Attainment	Attainment
Nitrogen Dioxide	Annual Mean	--	0.053 ppm	--	Attainment
	1 hour	0.25 ppm	--	Attainment	--
Sulfur Dioxide	Annual Mean	--	0.03 ppm	--	Attainment
	24 hour	0.04 ppm	0.14 ppm	Attainment	Attainment
	1 hour	0.25 ppm	--	Attainment	--
Fine Particulate Matter (PM_{10})	Annual Arithmetic Mean	--	50 $\mu g/m^3$	--	Attainment
	Annual Geometric Mean	30 $\mu g/m^3$	--	Nonattainment	--
	24 hour	50 $\mu g/m^3$	150 $\mu g/m^3$	Nonattainment	Unclassified/Not Designated
Fine Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	--	15 $\mu g/m^3$	--	Unclassified/Not Designated
	24 hour	--	65 $\mu g/m^3$	--	Unclassified/Not Designated

Notes:

1. California standards for ozone, carbon monoxide (except Lake Tahoe), sulfur dioxide (1-hour and 24-hour), nitrogen dioxide, suspended particulate matter - PM_{10}, and visibility reducing particles are values that are not to be exceeded. The standards for sulfates, lead, hydrogen sulfide, and vinyl chloride are not to be equaled or exceeded. If the standard is for a 1-hour, 8-hour or 24-hour average (i.e., all standards except for lead and the PM_{10} annual standard), then some measurements may be excluded. In particular, measurements are excluded that CARB determines would occur less than once per year on the average.
2. National standards other than for ozone, particulates, and those based on annual averages are not to be exceeded more than once a year. The 1-hour ozone standard is attained if, during the most recent three-year period, the average number of days per year with maximum hourly concentrations above the standard is equal to or less than one. The 8-hour ozone standard is attained when the 3-year average of the 4th highest daily concentrations is 0.08 ppm or less. The 24-hour PM_{10} standard is attained when the 3-year average of the 99th percentile of monitored concentrations is less than 150 µg/m3. The 24-hour $PM_{2.5}$ standard is attained when the 3-year average of 98th percentiles is less than 65 µg/m3. Except for the national particulate standards, annual standards are met if the annual average falls below the standard at every site. The national annual particulate standard for PM_{10} is met if the 3-year average falls below the standard at every site. The annual $PM_{2.5}$ standard is met if the 3-year average of annual averages spatially-averaged across officially designed clusters of sites falls below the standard.
3. National air quality standards are set at levels determined to be protective of public health with an adequate margin of safety. Each state must attain these standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency.
4. A 1999 federal court ruling blocked the implementation of the 8-hour ozone standard. Its status is unclear as of January 2002.
5. In August 1998, the Bay Area was redesignated to nonattainment-unclassified for the national 1-hour ozone standard.
6. In April 1998, the Bay Area was redesignated to attainment for the national 8-hour carbon monoxide standard.
7. Statewide VRP Standard (except Lake Tahoe Air Basin): Particles in sufficient amount to produce an extinction coefficient of 0.23 per kilometer when the relative humidity is less than 70 percent. This standard is intended to limit the frequency and severity of visibility impairment due to regional haze and is equivalent to a 10-mile nominal visual range.

Table 3.6.4

Summary of Ferry Power Usage

FERRY POWER RATING AND HOURS OF OPERATION

Year 2025 No Project	
Ferry Power Rating (kW) - Service Speed	
Larkspur	4,296.9
Alcatraz	2,147.7
Sausalito	872.5
Tiburon	2,148
Vallejo	3,548
Alameda	2,148
Oakland	2,148
Harbor Bay	1,383
Ferry Power Rating (kW) - Slow Speed	
Larkspur	339
Alcatraz	170
Sausalito	127
Tiburon	170
Vallejo	280
Alameda	170
Oakland	170
Harbor Bay	202
Total Transit Hours (hr/day)	
Larkspur	19.6
Alcatraz	4.4
Sausalito	15.7
Tiburon	10.3
Vallejo	19.4
Alameda	8.7
Oakland	7.2
Harbor Bay	4
Total Daily Power Usage (kW-hr)	
Larkspur	65,680
Alcatraz	7,389
Sausalito	10,889
Tiburon	17,178
Vallejo	53,674
Alameda	14,502
Oakland	12,046
Harbor Bay	4,929
SUM:	186,288
Total Idle Hours (hr/day)	22.6

Year 2025 Proposed Project		
Large Ferry Power Rating (kW)		
	- Service Speed	5,369.1
	- Slow Speed	424.2
Small Ferry Power Rating (kW)		
	- Service Speed	1,946.3
	- Slow Speed	284.2
Total Transit Hours (hr/day)		
	large ferry	115.0
	small ferry	180.0
Total Power Usage (kW-hr)		
	large ferry	480,800
	small ferry	278,515
Total Idle Hours (hr/day)		68.7

Notes: Power at service speed is 90% of rated power. Slow speed power is between 8% and 14% of service speed power.

Table 3.6.5

Criteria Pollutant Emission Factors for Ferries

Running Emission Factors (lb/kW-hr)	Year 2025 No Project[1]	Year 2025 Proposed Project[2]
NO_x Emission Factor	0.0157	0.0016
SO_2 Emission Factor	0.0005	0.0007
PM Emission Factor	0.0009	0.0000
CO Emission Factor	0.0009	0.0009
VOC Emission Factor	0.0008	0.0004
Idle Emission Factors		
NO_x Emission Factor	0.1250	0.0131
PM Emission Factor	0.0057	0.0003
CO Emission Factor	0.2086	0.2086
VOC Emission Factor	0.0278	0.0149

Notes:
1) EPA Tier II
2) With SCR and Particulate Traps

Table 3.6.6

Summary of Criteria Pollutant Emissions from Ferries

Emissions (lb/day)	Year 2025 No Project	Year 2025 Proposed Project	Increase in Emissions from Future Baseline (lb/day)
NO_x Emissions (lb/day)	2,929	1,249	**-1,680**
SO_2 Emissions (lb/day)	101	550	**449**
PM Emissions (lb/day)	175	37	**-137**
CO Emissions (lb/day)	169	684	**515**
VOC Emissions (lb/day)	155	338	**183**

Note: Transit Hours (hrs/day) x Ferry Power (kW) x Emission Factor (lb/kW-hr) + Idle Hours (hrs/day) x Idle Emission Factor (lb/hr) = Pollutant Emissions (lbs/day)

Table 3.6.7
Existing (Year 2000) Bay Area Emissions Inventory-
Total Bay Area Summer Average Emissions (tons/day)

Source	Year 2000[1]					Predicted Year 2006[2]				
	PM_{10}	**ROG**	**NO_x**	**SO_2**	**CO**	**PM_{10}**	**ROG**	**NO_x**	**SO_2**	**CO**
Petroleum Refining Processes	1	25	3	36	--	1	14	1	N/A	N/A
Other Industrial/Commercial Processes	18	13	3	9	--	16	12	3	N/A	N/A
Organic Compounds Evaporation	--[3]	121	--	--	--	--	132	--	N/A	N/A
Combustion	9	5	82	10	72	44	6	56	N/A	N/A
Off-Highway Mobile Sources[4]	12	70	179	25	541	9	54	154	N/A	N/A
Aircraft	2	11	21	1	57	3	12	25	N/A	N/A
On-Road Motor Vehicles	10	238	353	2	2,317	9	176	207	N/A	N/A
Other Miscellaneous Sources	173	70	8	4	15	103	49	--	N/A	N/A
Total	**225**	**553**	**648**	**88**	**3,002**	**185**	**455**	**446**		

Notes:
1) Source: BAAQMD Website http://www.baaqmd.gov
2) Source: BAAQMD 2001
3) "--" means less than 0.1%
4) Construction and farming operations, entrained road dust, and wind-blown dust.

Table 3.6.8

Emission Estimates for Year 2025 No Project vs. Proposed Project (lbs/day)

FERRIES			
Emission	**Year 2025 No Project**	**Year 2025 Proposed Project**	**Increase over No Project (difference)**
NO_x	2,929	1,249	**-1,680**
SO_2	101	550	449
PM_{10}	175	37	**-137**
CO	169	684	515
CO_2	226,000[a]	796,000[a]	570,000
ROG	155	338	183
PASSENGER VEHICLES			
Emission	**Year 2025 No Project**	**Year 2025 Proposed Project**	**Decrease over No Project (difference)**
NO_x	63,830	63,779	**-51**
SO_2	N/A	N/A	
PM_{10}	6108	6,104	**-5**
CO	709,019	708,449	**-570**
CO_2	N/A	N/A	**-144,000**[b]
ROG	71,181	71,123	**-58**
BUSES TO NEW FERRY TERMINALS			
Emission	**Year 2025 No Project**		**Emissions Increase over No Project (lb/day)**
NO_x	N/A		7
SO_2	N/A		
PM_{10}	N/A		1
CO	N/A		48
CO_2	N/A		
ROG	N/A		8
FERRY + PASSENGER VEHICLES + BUSES NET INCREASE/DECREASE OVER NO PROJECT (lbs/day):			
	NO_x	**-1,723**	
	SO_2	449	
	PM_{10}	**-141**	
	CO	**-7**	
	CO_2	426,000	
	ROG	134	

[a] Based on fuel consumption rates of 340 gal/hr at service speed for large ferries and 123 gal/hr at service speed for small ferries. Fuel consumption decreases at slow speed and idle.
[b] Based on a vehicle mile traveled reduction of 142,460 miles per day

Table 3.6.9

Criteria Pollutant Emissions from Dredging at Hercules/Rodeo

Diesel Engine Emission Factors (g/hp-hr)					
	HC	NOx	CO	PM_{10}	SO_2
Tug Engine	0.3	5.3	0.3	0.3	0.2
Dredging Engine	1.0	6.9	8.5	0.4	0.2

Tug emission factors the same as those used in the EIR.
Dredging engine factors from CARB Off-Road Engine Standards for engines
larger than 750 hp. (http://www.arb.ca.gov/msprog/offroad/offroadstandards.pdf)

Pollutant Emissions Associated with Dredging					
	HC	NOx	CO	PM10	SO2
Tug Engine (lb/day)	9.5	187.3	10.7	10.7	6.0
Dredging Engine (lb/day)	17.6	121.7	149.9	7.1	3.5
TOTAL (lb/day)	**27.2**	**309.0**	**160.7**	**17.8**	**9.5**
Tug Engine (ton)	0.06	1.17	0.07	0.07	0.04
Dredging Engine (ton)	0.11	0.76	0.94	0.04	0.02
TOTAL (ton)	**0.17**	**1.93**	**1.00**	**0.11**	**0.06**

Tug engine assumed to be 4,000 hp, and the dredging engine 800 hp.
Tug will operate 4 hours per day round trip and the dredge assumed to operate 10 hours per day.
Total dredging operation assumed to last for 12.5 days.

3.5 BIOLOGY

This section provides an overview description of the biological resources that may be affected by implementation of the Proposed Project. The Proposed Project could potentially affect a variety of habitat types, supporting a diverse assemblage of species. This section first describes the general nearshore and tidal habitat types found around the Bay and provides general locations of these habitat types and the species commonly found in them. The open-water community of the Bay is described and has been organized by resource area based on the following broad categories:

- Plankton
- Benthos (bottom dwelling organisms)
- Fish
- Birds
- Marine mammals

Species and habitats (e.g., eelgrass beds, etc.) protected under the state and federal endangered species acts and other regulations are also described.

3.5.1 Environmental Setting

3.5.1.1 Study Area

The biological resources of San Francisco Bay are discussed in the following sections by location and type. Figure 3.5.1 shows the biological resources study area. For purposes of this report, the Bay is categorized into three subregions, which are defined as the following:

- **North Bay** – North of the Richmond Bridge extending to Suisun Bay and the west Sacramento-San Joaquin River Delta (the Delta)
- **Central Bay** – Richmond Bridge to the Bay Bridge
- **South Bay** – South of the Bay Bridge

3.5.1.2 Habitat Types

Habitat types range from marshes and bayflats to agricultural and developed lands, some of which are specific to regional areas. These habitat types, as used in this report, include the broad categories described below.

Habitats around San Francisco Bay include those that fringe the Bay such as tidal marsh, salt ponds, and bayflats as well as the open Bay itself. The habitats types around the Bay often blend with one another in transition zones called ecotones. Species found in these areas often overlap habitat types.

Potential project features (e.g., potential ferry terminal locations) are shown on habitat maps (Figures 3.5.2 through 3.5.4) based on the Bay Area EcoAtlas, managed by the San Francisco Estuary Institute (SFEI 1999). The descriptions of habitats provided below combine similar habitat types, such as muted tidal marsh and tidal marsh, described in the Bay Area EcoAtlas because the majority of species occur in both habitats. The habitats and common species associated with those habitat types discussed below have the potential to occur within the project boundaries.

Tidal Marsh

Two classifications of tidal marsh occur in San Francisco Bay: salt marsh and brackish marsh. In areas with a predominantly marine influence, tidal salt marsh is present. In areas with significant freshwater influence, especially at the mouths of streams such as in Suisun Bay and the Petaluma and Napa rivers, the water is less saline and the marshes are more brackish (Goals Project 1999). The vegetation in these marsh types differs due to the variation in salinity, and is described in more detail below. Vegetation zones and the distance from the shore characterize the gradations in tidal salt marsh and tidal brackish marsh. Low tidal marsh occurs between the lowest margin of marsh and mean high water (MHW). Middle tidal marsh occurs between MHW and mean higher high water (MHHW).

High tidal marsh occurs between MHHW and the highest margin of the marsh. Tidal marshes can be referred to as young or old. Younger marshes are more recently established, often due to shoreline fill development, which can cause sediments to accumulate in surrounding areas where marsh vegetation eventually grows. These marshes tend to be dominated by low-diversity plant composition, whereas older marshes tend to have a more complex plant composition (Goals Project 2000). The total acreage of tidal marsh area in the Bay has been consistently declining over the past years, with more than 80 percent of the tidal marshes around the Bay already filled or converted to other wetland uses. Today, the few remaining tidal marshes in the Bay exist in the following parts of the Bay (Goals Report 1999):

- **North Bay** – near Port Sonoma; around San Pablo Bay
- **Central Bay** – near Larkspur
- **South Bay** – at the mouth of San Bruno Creek; small patches at the fringe of the Burlingame shoreline south of SFO; near Redwood City

Salt Marsh

Salt marsh occurs throughout the entire San Francisco Bay, primarily in the North and South Bays (Figures 3.5.2 through 3.5.4). Pacific cordgrass (*Spartina foliosa*) and pickleweed (*Salicornia virginica*) dominate salt marshes in the Bay. The low salt marsh zone consists mainly of these species, although it is rapidly being colonized by the invasive smooth cordgrass (*Spartina alterniflora*). Pacific cordgrass and smooth cordgrass frequently hybridize and are slowly outcompeting the native Pacific cordgrass. The middle salt marsh zone, or the salt marsh plains in the Bay, tend to be dominated by pickleweed, but are also characterized to a lesser extent by saltgrass (*Distichilis spicata*), dodder (*Cuscuta salina*), fleshy jaumea (*Jaumea carnosa*), and alkali heath *(Frankenia salina*). Species such as marsh gumplant (*Grindelia stricta* var. *angustifolia*), saltgrass, pickleweed, dodder, and alkali heath characterize the high salt marsh zone (Goals Project 2000).

Common fish and insects in salt marshes include: California killifish (*Lucania parva),* bay goby (*Lepidogobius lepidus*), striped bass (*Morone saxatilis*), topsmelt (*Atherinops affinis*), starry flounder (*Platichthys stellatus),* water boatman (*Trichocorixa reticulata*), and wandering skipper (*Panoquina errans*). Common wildlife species in salt marshes include Belding's savannah sparrow (*Passerculus sandwichensis beldingi*), white-crowned sparrow (*Zonotrichia leucophrys*), sora (*Porzana carolina*), marsh wren (*Cistothorus palustris*), northern harrier (*Circus cyaneus*), and deer mouse (*Peromyscus maniculatus*).

Special-status animal species found in salt marsh habitat include salt marsh harvest mouse (*Reithrodontomys raviventris*), clapper rail (*Rallus longirostris obsoletus*), black rail (*Laterallus jamaicensis*), Suisun shrew (*Sorex ornatus sinuosus*), salt marsh wandering shrew (*Sorex vagrans halicoetes*), San Pablo vole (*Microtus californicus sanpabloensis*), and salt marsh common yellowthroat (*Geothlypis trichas sinuosa*).

Special-status plant species include soft bird's beak (*Cordylanthus mollis* ssp. *mollis*), Point Reyes bird's beak (*Cordylanthus maritimus* ssp. *palustris*), California seablite (*Suaeda californica*), and Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*). These species are discussed in more detail in Section 3.5.1.4, Protected Species and Habitats.

In addition to full tidal salt marshes, several different types of tidal marshes are present within the Bay: diked marsh, managed marsh, and muted tidal marsh. They provide slightly different habitats since they differ hydrologically from traditional salt marshes and from each other.

Diked Marsh

Diked marshes are present in low areas or behind dikes that have poor drainage. These areas are not farmed, and since they receive annual rainfall and runoff, they still retain many wetland features and often have seasonal sections of shallow ponded water. They are not typically managed for wildlife. Diked marshes typically resemble tidal salt marsh, tidal brackish marsh, and seasonally wet grasslands in vegetation composition. Diked marshes are used frequently by wintering waterfowl, especially dabbling ducks, and shorebirds.

Managed Marsh

Managed marshes are also diked but are managed for waterfowl. Timing, length, depth and area of ponding are regulated to maximize foraging potential for these birds. Fresh or brackish slough water is the primary source of water for these marshes. The dominant vegetation in these marshes are alkali-bulrush (*Scirpus maritimus*), and brass buttons (*Cotula coronopifolia*).

Muted Tidal Marsh

In muted tidal marshes, some, but not all, natural tidal action has been cut off from the site. The vegetation in these marshes is similar to full tidal marshes but not as varied and diverse since the hydrological range is not as great. Similarly, wildlife species present in full tidal marshes occur in this habitat, although the diversity is also restricted.

Brackish Marsh

Typical brackish marsh species in San Francisco Bay include alkali-bulrush, tules (*Scirpus californicus* and *S. acutus*), and cattails (*Typha angustifolia* and *T. latifolia*) in areas that have more freshwater. The middle brackish zone is frequently dominated by saltgrass, although pickleweed, fleshy jaumea, and fathen (*Atriplex triangularus)* are also present. The high brackish marsh zone is characterized by perennial peppergrass (*Lepidium latifolium*), fennel (*Foeniculum vulgare*), and exotic grasses (Goals Project 2000). American bittern (*Botaurus lentiginosus*) and wildlife species commonly found in salt marshes also often occur in brackish marshes.

Brackish marsh is present in northern San Pablo Bay within the sloughs connecting to the Bay, the sloughs in the South Bay, and Suisun Marsh. Within the project area, it is present in the vicinity of the Pittsburg, Antioch, Martinez, and Benicia proposed ferry terminals. Special-status species in freshwater marshes include all of the species found in salt marshes listed above except Suisun thistle, San Pablo vole, and salt marsh wandering shrew. These species are discussed in more detail in Section 3.5.1.4.

Bayflats

Bayflats are sparsely vegetated intertidal areas that occur from approximately mean lower low water (MLLW) to mean tide level (MTL). They provide protection to banks and upland shoreline from wave energy and sediment. Bayflats around San Francisco Bay provide habitat for many species of invertebrates, including diatoms, polychaetes, oligochaetes, amphipods, isopods, and crustaceans.

During low tide, bayflats provide crucial foraging and roosting areas for almost one million shorebirds that utilize the Bay during the spring migration. Shorebirds frequently found on bayflats in the Bay include western sandpiper (*Calidris mauri*), least sandpiper (*Calidris minutilla*), dunlin (*Calidris alpina*), long- and short-billed dowitcher (*Limnodromus griseus,* and *L. scolopaceus,* respectively), long-billed curlew (*Numenius americanus*), whimbrel (*Numenius phaeopus*), and American avocet (*Recurvirostra americana*).

During high tide, bayflats provide foraging habitat for fish, including longfin smelt (*Spirinchus thaleichthys)*, staghorn sculpin (*Leptocottus armatus*), starry flounder, and leopard shark *(Triakis semifasciata).* One of the few mammals that are occasionally present on bayflats is the Pacific harbor seal (*Phoca vitulina*).

Agricultural Bayland

As noted in the *Baylands Ecosystem Habitat Goals Report* (Goals Project 1999), agricultural bayland is a type of land use rather than a type of wetland or related habitat. They are diked areas of former tidal marsh that are used for agricultural production or are ruderal areas that are fallow. Many of these areas are flooded in the winter. These areas represent a major part of the ecosystem and provide foraging and roosting habitat for a variety of species in San Francisco Bay. Agricultural baylands, located predominantly along San Pablo Bay, are diked, former tidal marshes that are used in agricultural production or as grazing lands. In some cases, agricultural production has stopped and the land is fallow. Upland vegetation is dominant in many of these agricultural baylands, although they also support seasonal wetlands. During the wet season, large areas of bayland are waterlogged or inundated, so these areas are heavily managed to grow crops. If the land were no longer intensively managed for agriculture, the area could support more wetland habitat. Common bird species utilizing agricultural baylands include long-billed curlew, least sandpiper, dunlin, northern harrier, snowy egret (*Egretta thula*), horned lark (*Eremophila alpestris*), and black-crowned night heron (*Nycticorax nycticorax*). Mammal species occurring in these areas include black-tailed deer (*Odocoileus hemionus*), striped skunk (*Mephitis mephitis*), coyote (*Canis latrans*), and California ground squirrel (*Spermophilus beecheyi*). Common upland plant species in these areas include wild mustard (*Brassica kaber*), fennel, and poison hemlock (*Conium maculatum*).

Developed Areas

Developed areas are already paved and have landscaped or ruderal vegetation. They typically support wildlife species associated with disturbed or urban areas, such as red-winged blackbird (*Agelaius phoeniceus*), mourning dove (*Zenaida macroura*), American crow (*Corvus brachyrhynchos*), European starling (*Sturnus vulgaris*), rock dove (*Columba livia*), house cat (*Cattus domesticus*), and black rat (*Rattus rattus*).

Salt Ponds

Artificial salt ponds are present in both the North and South bays. The salt ponds, a series of connected hypersaline basins of varying degrees of salinity within which seawater was evaporated and the salt harvested, were first constructed in the latter half of the 19th century and displaced existing tidal marsh. The ponds in the South Bay are still functioning as commercially producing salt evaporation ponds, although those in the North Bay are not. The California Department of Fish and Game (CDFG) purchased these ponds from Cargill Salt Division in 1994 and have since been working to restore them to a more sustainable system.

Due to the hypersaline nature of the ponds, the salt ponds support a distinct flora of halotolerant (salt tolerant) and halophilic (species adapted to a high saline environment) species, the most dominant of which is the algal species *Dunaliella salina.*

Halotolerant and halophilic fauna, such as the black-necked stilt (*Himantopus mexicanus*), American avocet, and eared grebe (*Podiceps nigricollis*) also inhabit the salt ponds of the area. The ponds are also used by many species of waterfowl, primarily canvasbacks (*Aythya valisineria*) and greater and lesser scaup (*Aythya marila* and *A. affinis*), for loafing. Special-status species utilizing the salt ponds include the western snowy plover (*Charadrius alexandrinus*) and occasionally the brown pelican (*Pelecanus occidentalis*).

Open Bay

The Goals Report (Goals Project 1999) subdivides the open Bay into two habitat subunits: deep bay/channel and shallow bay. Deep bay/channel habitat, which accounts for approximately one-third of the area of San Francisco Bay, is defined as those portions of the Bay deeper than 18 feet below MLLW, including the deepest portions of the Bay and the largest tidal channels. Shallow bay is defined as that portion of the Bay between 18 feet below MLLW and MLLW. The shallow bay habitat accounts for two-thirds of the Bay's area (Goals Project 1999).

Species that use the deep bay habitat include several species of free swimming invertebrates such as California bay shrimp (*Crangon franciscorum*), and fishes such as brown rockfish (*Sebastes auriculatus*), halibut (*Paralichthys californicus)*, and sturgeon (*Asipenser* sp.). This habitat provides important feeding, foraging, roosting, and "loafing" habitat for waterbirds, especially in areas protected from intense wind fetch or wave action. Waterbirds, such as surf scoter (*Melanitta perspicillata*), scaup, brown pelican, and terns, and marine mammals, such as harbor seal and California sea lion (*Zalophus californianus*), can be found utilizing this habitat type. Anadromous fish use the deep bay habitat as migratory pathways to and from upstream spawning areas.

The shallow bay habitat is a feeding area for Pacific herring (*Clupea harengus*), northern anchovy (*Engraulis mordax*), bat ray (*Myliobatis californica*), and jacksmelt (*Catherinops californiensis*), as well as at least 40 other species of fish, crabs, and shrimp. The shallow bay is also a nursery area for juvenile halibut and sanddab (*Citharichthys stigmaeus*), leopard shark, shiner perch (*Cymatogaster aggregata*), herring, and other fishes. Anadromous fish use the shallow bay area as migratory pathways to and from upstream spawning areas. This habitat is within the depth range of many diving birds and, therefore, provides important avian foraging habitat. Marine mammals such as harbor seals also forage in this habitat type. Eelgrass (*Zostera marina L.),* San Francisco Bay's only rooted seagrass, is present in some areas of this habitat type. Eelgrass is particularly important to many species of fish such as Pacific herring (which spawn in the blades of this plant) and the endangered least tern (*Sterna antillarum browni*), which can forage on small fishes associate with the eelgrass.

3.5.1.3 Biological Resources

Plankton

The three major components of plankton are phytoplankton, zooplankton, and ichthyoplankton (fish larvae and eggs), all of which free-float in open water. Representing the lower levels of the food chain, plankton are important to many marine community members, including benthic organisms, fish, and mammals.

Phytoplankton

Phytoplankton are small, floating simple plants that represent the base of the marine food web. Consisting of single cells or chains of cells, phytoplankton are usually microscopic in size and reproduce asexually through cellular division. Much of San Francisco Bay's productivity of other organisms, including clams, worms, mussels, and zooplankton, depends on the growth of phytoplankton (SFEP 1992). Major phytoplankton groups in the Bay include diatoms, dinoflagellates, and cryptomonads (Herbold et al. 1992). In the Bay Area, abundance and distribution of phytoplankton vary seasonally and are affected by water column height, benthic grazing, and availability of light or turbidity (Lucas et al. 1999; Cole and Cloern 1984). Phytoplankton population in the North Bay has generally suffered since the early 1970s, and especially since the 1976-1977 drought (SFEP 1992).

In the North Bay, most phytoplankton occur in the shoals between the deeper channels and the shoreline where light is adequate. In San Pablo Bay, phytoplankton abundance generally peaks in the spring when river flows are high. In Suisun Bay, peak phytoplankton abundance occurs in the spring and summer, sometimes as early as February and as late as November, depending on river flow (SFEP 1992). Phytoplankton abundance, which has been on the decline since the late 1970s, has suffered dramatically, by a factor of almost ten, since the accidental introduction of the nonnative Asian marine filter-feeding clam *Potamocorbula amurensis* in 1986 (SFEP 1992).

In the Central Bay where habitats are mostly open and deep water, the high degree of tidal water exchange and mixing generally keep phytoplankton levels very low.

Under conditions in the South Bay, phytoplankton reach their peak concentrations in the spring when tides and winds are at their weakest and freshwater outflow is at its highest. These conditions create water stratification, resulting in separation of fast growing phytoplankton in the upper waters of adequate light from the benthic filter-feeding organisms, which graze on the phytoplankton (SFEP 1992).

Zooplankton

Zooplankton consist of microscopic and macroscopic animals that either free-float or feebly swim in open water. Zooplankton provide an ecologically important food source for many types of fish such as anchovies, smelt, and striped bass. Two different types of zooplankton exist. Zooplankton that are permanent members of the plankton during their life cycle are known as holoplankton. Other zooplankton, consisting of eggs, larvae, and juveniles of benthic or nektonic organisms, are temporary members of the plankton only during early life stages, and they are known as meroplankton. Common zooplankton found in the Bay include species of copepods, tintinnids, larval forms of gastropods, bivalves, barnacles, polychaetes, and crustaceans such as the Dungeness crab (*Cancer magister*) (Ambler et al. 1985).

Zooplankton abundance can vary seasonally and is affected by factors including temperature or photoperiod, coastal hydrography, seasonal cycles of phytoplankton, and river discharge. River discharge also determines zooplankton distribution by influencing residence time and salinity distribution, which is a determinant for copepod habitat.

Ichthyoplankton

Ichthyoplankton are the eggs and larval forms of marine fishes, such as Pacific herring, northern anchovy, goby (family *Gobiidae*), white seabass (*Cynoscion nobilis*), staghorn sculpin, and diamond turbot (*Hypsopsetta guttulata*). Seasonal abundance and distribution of individual ichthyoplankton species are dependent on the reproductive cycles of the adult fish species and their circulation within the Bay. In return, the dynamics of the adult fish populations are closely related to annual recruitment success rates of individuals from the larval stage. Generally, fish larvae are in the plankton community coinciding with peaks of phytoplankton and zooplankton abundance in the winter and spring (Ambler et al. 1985).

Benthos

Benthos are bottom-dwelling organisms that generally live nonmobile lifestyles, though some mobile species such as crabs do exist. Epibenthos are benthos that live on the substrate surfaces, while infauna are benthos that live within the sediment. Because many infauna species live a year or more in the same bottom area, they serve as one of the best biological indicators of impacts from human disturbances, as well as general indicators of ecosystem health in aquatic environments. The benthos also provide an important food source for many species of fish, birds, and mammals in the marine environment.

In the Bay Area, many benthic invertebrates live within sedimentary or soft-bottom habitats, usually within the top 2 to 3 centimeters of the soft sediment. Some benthic invertebrates also live on hard substrates, which are much less common in the Bay compared to sedimentary habitats.

Three major benthic species assemblages are present in the Bay Area: fresh-brackish, estuarine, and marine assemblages. Fresh-brackish assemblages are found in the Delta, with a transition assemblage extending into Suisun Bay. Estuarine assemblages are prevalent in San Pablo Bay. The Central and South Bays harbor marine assemblages. The term assemblage refers to a group of organisms that inhabit a location or locations at a certain time or over a period of time. Assemblage characteristics such as species composition and abundance are affected by many physical factors, including salinity and sediment grain size, or by biological factors such as competition and predation (Thompson et al. 2000). Changes in these factors can influence individual benthic species differently.

Many of the more common benthic species in San Francisco Bay today are accidentally or intentionally introduced species (SFEP 1992). Most of these nonnative species were transported here in ballast water of ships or on the oyster shells brought from the east coast for commercial farming purposes in the late 19th century (Carlton 1979). Some of these nonindigenous species serve ecological functions similar to those of the native species that they have displaced. Examples of these include the eastern oyster (*Crassostrea virginica*), the Japanese littleneck clam (*Tapes philippinarum)*, and the soft-shelled clam (*Mya arenaria*), all of which have supported commercial or sport fisheries. However, other species, such as *Potamocorbula amurensis*, have a negative effect on phytoplankton and zooplankton populations and organisms that depend on them. Though *Potamocorbula* may serve as a food source for diving ducks and sturgeon, their high feeding rates can remove much of the phytoplankton from the water column and may have an adverse effect on zooplankton and other organisms in the food chain that feed on them (SFEP 1992).

In Suisun Bay and the western part of the Delta, the benthos found are mostly fresh-brackish assemblages, with a transition assemblage extending into Suisun Bay. Fresh-brackish water species include oligochaetes, chironomids, soft-shelled clams, Asian clams (*Corbicula sp.*), and amphipods (SFEP 1992; Thompson et al. 2000). Farther west into San Pablo Bay, more estuarine conditions exist and intertidal bayflats and marshes are extensive. Here, estuarine assemblages are prevalent. Common benthic species include ribbed mussels (*Ischadium demissum),* Baltic clams *(Macoma balthica*), *Potamocorbula*, California hornsnails (*Cerithidea californica*), yellow shore crabs (*Hemigrapsus oregonensis*), amphipods, polychaete worms, and Bay mussels.

In the Central and South Bays, marine conditions exist. Benthic species common in these areas consist of clams (including *Potamocorbula*), amphipods such as *Monocorophium* and *Ampelisca*, polychaete worms, and Bay mussels (SFEP 1992).

Fish

More than 100 species of fish inhabit the San Francisco Bay system. The majority of species are native, but there are also many introduced species. A large portion complete all life stages within the Bay. A smaller portion, anadromous fish, migrate from ocean waters, through the Bay-Delta Estuary (the Estuary), and into a series of freshwater streams where they spawn. As adults or young-of-the-year (YOY), they migrate through the Estuary back to the ocean. A small portion of these remain in the Bay year-round. Whether spawned offshore and carried into the

Bay by currents or spawned directly in the Bay, most of the anadromous species spend 4 to 8 months in the Bay before entering the ocean. Common fish species found in the Bay are shown in Table 3.5.1, and include northern anchovy, topsmelt, jacksmelt, striped bass, white croaker (*Genyonemus lineatus*), Pacific herring, and English sole (*Parophrys vetulus*).

Fish population trends can be determined by analyzing the data resulting from the monitoring efforts of the CDFG. An analysis of these data from a monitoring study between 1981 and 1988 suggests a general distribution of fishes in the Bay as follows (SFEP 1992):

- **North Bay** – Fish species typically found in the North Bay include sharks, rays, longfin smelt, staghorn sculpin, starry flounder, topsmelt, arrow goby (*Clevelandia ios*), yellowfin goby (*Acanthogobius flavimanus*), stickleback (*Gasterosteus* sp.), mosquitofish (*Gambusia affinis*), green sunfish (*Lepomis cyanellus*), Pacific herring, Chinook salmon (*Oncorhynchus tshawytscha*), and steelhead trout (*Oncorhynchus mykiss*).
- **Central Bay** – Typical fish species occurring in the Central Bay include Chinook salmon, striped bass, American shad (*Alosa sapidissima*), green sturgeon, Pacific herring, and northern anchovy.
- **South Bay** – Typical fish species in the South Bay include sharks, rays, longfin smelt, starry flounder, topsmelt, rainwater killifish (*Lucania parva*), yellowfin goby, staghorn sculpin, Pacific herring, and sturgeon.

Because of the large number of fish species that could potentially be present, not all are discussed in detail here. The more ecologically, commercially, and/or recreationally important species are discussed below. A discussion of fish species with either federal or state protection status is included in Section 3.5.1.4. Fish species in the Bay can be divided into several groupings. Common species are described briefly below and are organized by group.

Pelagic Fish

Pelagic species are generally small fish distributed in the mid- and upper water column and include species such as Pacific herring, anchovy, and topsmelt.

Pacific Herring (*Clupea pallasi*). Pacific herring are the largest commercial fishery in the Bay Area, and the Bay is this species' only significant spawning area south of Puget Sound (Alderdice and Velsen 1971 in Baxter et al. 1999). Pacific herring migrate into the Bay to spawn from November through March, and spawn adhesive eggs on subtidal and intertidal substrates, preferably eelgrass (*Zostera* spp.). Herring in San Francisco Bay regularly spawn on other marine algal species, as well as substrates such as sand, natural rock, riprap, and pilings.

Surveys of Pacific herring spawning activity in the Bay have been conducted since the 1973-1974 reproductive season (Griffin and Cherr 2001). Data on natural spawn sites show intertidal and nearshore habitat in the northern Central Bay receiving the predominant proportion of herring spawn (Griffin and Cherr 2001). This area includes San Mateo Point to Fort Point on the west side of the Bay, Alameda to Richmond along the East Bay, and the north tower of Golden Gate Bridge to Paradise Cove in the northern Central Bay. Since 1980, spawns have been primarily restricted to the northern Central Bay from Sausalito to Paradise Cove and on the San Francisco shore from just inside the Golden Gate to Hunters Point. In years when the northern Central Bay has not predominated as spawn habitat, the southern Central Bay or

Oakland/Alameda have been the major recipients of spawn. The western South Bay is considered a minor spawn habitat for herring, receiving spawns in association with a decrease in water quality or an increase in salinity in the southern Central Bay (Griffin and Cherr 2001). Figure 3.5.6 shows common herring spawning locations within San Francisco Bay.

Northern Anchovy (*Engraulis mordax*). Anchovy are found in highest abundance in the Central Bay and in less abundance in the North and South bays. Their primary residence is along California coastal waters, but they migrate into the Bay in late spring for feeding (USEPA et al. 1996). Although most of anchovy spawning sites are located outside of the Bay, eggs and larvae are commonly found in abundance in the Bay (USEPA et al. 1996). In the Bay, anchovy larvae develop rapidly in the productive shallow habitat before migrating out of the Bay in winter with other adult anchovy. The northern anchovy provide an important food resource for other fish species such as salmon, smelt, and striped bass (Baxter et al. 1999).

Topsmelt (*Atherinops affinis*). Topsmelt are among the most abundant fish found in shallow water sloughs in the South Bay (Goals Project 2000). Common topsmelt spawning sites are located on bayflats, which are also used for breeding and nursery areas.

Elasmobranchs

Members of this fish guild include sharks, rays, and skates. Common species in the Bay include the leopard shark, brown smoothhound (*Mustelus henlei*), bat ray, and spiny dogfish (*Raja bionocula*) (Baxter et al. 1999). Leopard sharks and bat rays extensively use shallow subtidal habitats in the Bay, mostly in the South Bay. The recreational value of these fish makes them important to the charter boat industry, recreational fishing, and public and private aquariums.

Anadromous Fish

Most of the anadromous fish use the Bay as corridors to migrate up to freshwater stream spawning. Most anadromous fish species are rare in the South Bay, and are most abundant in the North Bay, especially in the Sacramento-San Joaquin River Delta area.

Chinook Salmon (*Oncorhynchus tshawytscha*) and Steelhead Trout (*Oncorhynchus mykiss*). San Francisco Bay's Chinook salmon stocks have declined significantly from an annual average of about 850,000 fish at the turn of the century to only about 285,000 fish in the recent years (SFEP 1992). Most of these fish spawn in the Sacramento River drainage in the fall. Found mostly in the North Bay, very little is known about salmon and steelhead trout migration routes through the Bay (Maragni 2000; Leidy 2000). These species are discussed in more detail in Section 3.5.1.4, because of their listed status.

Striped Bass (*Morone saxatilis*). Striped bass can be found throughout the Bay, but may be most abundant and spend most time in Suisun Bay, the Delta, and surrounding freshwater areas (Goals Project 2000). Striped bass spawn between May and June in tributaries to the Bay (USEPA et al. 1996). They can tolerate a wide range of environmental conditions including low oxygen and high turbidity (Goals Project 2000). Young-of-the-year show the highest abundance in the "entrapment zone" of the Estuary, the area where freshwater and saltwater mix. Striped bass were once part of the commercial fishery from 1879 to 1935, and now they are managed exclusively as a recreational fishery (McGinnis 1984). Adult abundance in the Bay has declined over the years (CDFG 1992 in Goals Project 2000), but striped bass remain a very important fish resource for the recreational fishermen, mostly in the North Bay.

Sturgeon (*Acipenser sp.*). Sturgeon are native fish common in the South Bay and they feed on several species of bay shrimp, benthic invertebrates, and herring eggs. The white sturgeon (*Acipenser transmontanus*) is more abundant than the green sturgeon (*Acipenser medirostris*) and is thus an important part of the fishery resource in the Bay. The green sturgeon is discussed in more detail in Section 3.5.1.4. Sturgeon populations are declining (Saltzman 2003).

Rocky Substrate Species

Consisting mainly of various surfperch species (family *Embiotocidae*) and brown rockfish, these fish depend exclusively on rocky substrates and structures with irregular vertical habitat such as natural rocky outcroppings, sunken boats, bridge piers, and pilings supporting boat docks. These species serve an important role for the shore-based recreational fishery.

Small Demersal Fish

The main fish of this group include gobies (family *Gobiiae*), sculpin (family *Cottidae*), and midshipman (*Porichthys* sp.). These are primarily small fish that spend most of their lives on the bottom of the Bay, generally in shallow waters of the Bay. All of these small demersal fish species provide an important food source for harbor seals and wading birds.

Flatfish

Flatfish comprise fish species that metamorphose from bilaterally symmetrical pelagic larvae (free swimming, "upright" larvae) to asymmetrical bottom-dwelling juveniles (flat and bottom-dwelling) (Baxter et al. 1999). The main flatfish species found in the Bay are California halibut, English sole, and speckled sanddab.

California Halibut (*Paralichthys californicus*). Halibut is both a commercially and recreationally important species in the Bay. Its abundance in the Bay has increased corresponding to a general increase in the Bay water temperature over the last 2 decades (Baxter et al. 1999). Halibut juveniles use the shallow Bay subtidal habitat for feeding and rearing (Moser and Watson 1990).

English Sole (*Pleuronectes vetulus*). These fish are very common in the South Bay. Adult English sole spawn from November to May in the shallow coastal areas, mostly in the Central Bay, with some in the South Bay (Wang 1986 in USEPA et al. 1996).

Shrimp and Crabs

The Bay is home to many species of shrimp and crab that are important for their recreational value in the fishery, and ecological value in the aquatic food web.

Bay shrimp (*Crangon* spp.) is the most common shrimp reported by the CDFG in the Bay (Baxter et al. 1999). Bay shrimp, along with other shrimp species, are an important food source for virtually all species of fish, marine mammals, and water birds.

While distributed widely throughout the Bay, the various species of shrimp found in the Bay do have differing centers of distribution. For example, *C. franciscorum* are more commonly collected in the northern reach of the Bay (San Pablo to the west Delta) than in the Central or South Bays, while *C. nigromaculata* are usually found in the Central and South Bays, and to a lesser extent, in San Pablo Bay (Baxter et al. 1999).

Crabs are both recreationally and ecologically important in the Bay. The most common species in the Bay is the Dungeness crab, which supports an important commercial fishery. Other commonly found species in the Bay include C. *productus*, C. *antennarius*, and C. *gracilis*. These species are typically abundant in the more marine waters of the Central Bay but are also found in the South Bay and San Pablo Bay (Baxter et al. 1999).

Birds

San Francisco Bay provides diverse habitat for many species of waterfowl, shorebirds, and tidal marsh birds. Open water, bayflats, and tidal marsh are just some of these habitats.

The Bay serves as an important staging and wintering ground on the Pacific Flyway for numerous species of waterbirds, both common and uncommon. The Pacific Flyway is a bird migration corridor along the Pacific Coast that stretches as far north as northern Canada and Alaska, and as far south as the southern tip of South America (SFEP 1992). In the Bay, the greatest waterbird abundance and species diversity is seen in winter, as birds migrate along the flyway. Each year, nearly one million waterfowl and more than one million shorebirds pass through this area. San Francisco Bay, particularly the North Bay, supports the largest population of canvasback along the Pacific coast, 46 percent of the midwinter population in the Pacific Flyway (Goals Project 2000). Additionally, San Francisco Bay provides crucial wintering habitat for surf scoter (Goals Project 2000). It is the most important inshore habitat in the eastern Pacific, south of the Straits of Georgia and Puget Sound (Small 1994), for this species. Scoters (primarily surf scoters, but also white-winged scoters [*Melanitta fusca*]) are the second most abundant waterfowl in the Bay, and between 1998 and 2000 accounted for 25 percent (South Bay) to 29 percent (Central Bay) of total wintering waterfowl numbers counted during annual surveys (USFWS, unpublished data).

Roughly 120 waterbird species from 16 avian families occur in the Bay. Of these birds, approximately two-thirds are represented by three families: *Anatidae* (waterfowl), *Laridae* (gulls and terns), and *Scolopacidae* (sandpipers and phalaropes). Individual waterbird species may reach their peak abundance during different periods throughout the fall and spring migration.

San Francisco Bay is also recognized as a site of hemispheric importance for shorebirds by the Western Hemisphere Shorebird Reserve Network (WHSRN). A site has been designated of hemispheric importance if it is utilized by at least 500,000 shorebirds annually. Between 1988 and 1995, the Bay supported 41.4 to 96.5 percent of the key species of shorebirds surveyed along the Pacific Flyway in the fall, 37.8 to 90.1 percent in the winter, and 24 to 85.6 percent in the spring. No other site within the Pacific Flyway supported more than 16.1 percent of these species in the fall, 32.9 percent in the winter, and 27.5 percent in the spring (Page et al. 1999). Tidal bayflats in particular offer important habitat and a migratory staging area for shorebirds.

Tidal marshes in the Bay also provide foraging, nesting, and roosting habitat for many tidal marsh species endemic to the area. Many of these species are listed as threatened or endangered by the state or federal governments or are recognized as species of special concern. A discussion of the distribution of these species is included in the species accounts in Section 3.5.1.4, along with a discussion of all of the bird species with either federal or state protection status.

Waterbirds

Each year, typically in January, the U.S. Fish and Wildlife Service (USFWS) conducts a mid-winter survey of the distribution and number of waterfowl present in the San Francisco Bay. Accurso (1992) analyzed the species and distribution of waterfowl in the Bay from 1988 to 1990. These data, while 10 years old, still provide the most detailed information available concerning the distribution of waterfowl species in the Bay.

Forty-eight and 68 percent of all waterfowl in San Francisco Bay utilized the open Bay in 1988-1989 and 1989-1990, respectively (not including Suisun Bay) (Accurso 1992). Table 3.5.2 shows the percentage of all waterfowl by region.

The most predominant birds in the open Bay are diving ducks. Dabbling ducks such as mallard (*Anas platyrhynchos*), northern pintail (*Anas acuta*), and American widgeon (*Anas americana*) are also present in the open Bay, but in smaller numbers, as they tend to prefer seasonal wetlands, salt ponds, and managed marshes surrounding the Bay. Ruddy ducks (*Oxyura jamaicensis*) and bufflehead (*Bucephala albeola*), also diving ducks, are found predominately in the North and South Bay salt ponds (Goals Project 2000).

Mid-winter surveys from 1998 to 2000 (USFWS, unpublished data) found scaup comprise 43.2 percent of all waterfowl in the entire Bay, 64 percent of all waterfowl in the South Bay open water, and 67 percent of waterfowl in the Central Bay open water. Scoters, the second most abundant waterfowl in the Bay, accounted for 25 percent in the South Bay and 29 percent in the Central Bay.

A comprehensive survey and analysis of waterbirds in the Bay was conducted between 1988 and 1990 by Accurso and published in a report (Accurso 1992). Between 1988 and 1990, diving ducks consisted of between 52 to 75 percent of the Bay's waterfowl, depending on the month. Greater and lesser scaup were the most abundant species in 1989-90, accounting for 47 percent of all species. Surf scoter was the second most abundant species in the Bay, making up 19 to 20 percent of all waterfowl in the Bay. Canvasback, another diving bird, accounted for 7 percent of all waterfowl species in the Bay (Accurso 1992). Table 3.5.3 shows the percentages of each of these species as they are distributed throughout the North, Central, and South Bays. The North Bay is an especially important area for wintering waterfowl, due in part to its relative shallowness compared with the rest of the Bay. More than 62 percent of the diving ducks were observed in depths less than 4 meters, or at the perimeter of the Bay. Figures 3.5.7 and 3.5.8 illustrate the distribution of surf scoter and canvasback in the Bay, based on data from 1982 to 1989.

Tidal Marsh Birds

Tidal flats are a primary foraging habitat for shorebirds within the Bay. The North Bay supports approximately 20 percent of shorebirds in San Francisco Bay, while the South Bay supports approximately 60 percent (SFEP 1992), primarily due to the extensive tidal flats and salt ponds present in the South Bay. The South Bay is a particularly sensitive and important area to shorebirds, because San Francisco Bay supports between 26 and 96 percent of all shorebirds along the Pacific Flyway and the majority of these birds forage in the South Bay. Figure 3.5.9 shows the locations and relative densities of foraging shorebirds in the Bay.

North Bay. North Bay is the most important habitat for many waterfowl species that utilize the Bay's open-water and wetland habitats. As the amount of wetlands in other parts of the state declines, Suisun Marsh and farmed wetlands in the Delta become increasingly more valuable to many waterfowl species in the Bay. In addition, the North Bay, more specifically San Pablo Bay, is home to about 20 percent of shorebirds in San Francisco Bay (SFEP 1992).

Central Bay. Some of the few remaining rocky shore habitats in the Bay occur in the Central Bay at the edges of Yerba Buena, Angel, and Alcatraz islands. This area is used by several shorebird species, brown pelicans, cormorants, and gulls (SFEP 1992). Other waterbirds representative of Central Bay are supported by its deepwater habitat, and include western grebe (*Aechmophorus occidentalis*), scaup, canvasback, and surf scoter.

South Bay. About 60 percent of shorebirds use the South Bay, which has are extensive bayflats and salt ponds (SFEP 1992). The shorebird species abundance and diversity is greatest in the spring, when these birds stop en route to northern breeding grounds in Canada and Alaska, and in the fall upon their return to South America. Some common waterbirds in the South Bay's intertidal bayflats and salt ponds include western sandpiper, dunlin, marbled godwit (*Limosa fedoa)*, willet (*Catoptrophorus semipalmatus*), American avocet, bufflehead, snowy plover, Caspian tern (*Sterna caspia*), eared grebe, Forster's tern (*Sterna forsteri*), Wilson's phalarope (*Phalaropus tricolor*), and black-necked stilt.

Marine Mammals

San Francisco Bay supports several common marine mammal species that include the Pacific harbor seal, California sea lion, and more recently, the gray whale (*Eschrichtius robustus*). All marine mammals are protected by the Marine Mammal Protection Act of 1972, with additional laws protecting species with very low population levels (e.g., sea otter). Other marine mammal species that have been seen occasionally in the Bay include the humpback whale (*Megaptera noveangliae*), harbor porpoise (*Phocoena phocoena*), northern elephant seal (*Mirounga angustirostris*), Steller sea lion (*Eumetopius jubatus*), northern fur seal (*Callorhinus ursinus*), and less frequently, the southern sea otter (*Enhydra lutris*). Due to their protected status, individual marine mammal species are discussed in greater detail in Section 3.5.1.4.

3.5.1.4 Protected Species and Habitats

Special-status species that occur, or have the potential to occur, in the project vicinity were identified from several sources, including the following: California Natural Diversity Data Base (CNDDB), California Native Plant Society (CNPS) Electronic Inventory records (Skinner and Pavlik 1994), and USFWS special-status species lists. Information was reviewed for the following U.S. Geological Survey 7.5-minute quadrangles:

Denverton	San Quentin	Newark
Birds Landing	Petaluma Point	Redwood Point
Antioch North	Sears Point	Palo Alto
Antioch South	Petaluma River	Mountain View
Clayton	Novato	Niles
Honker Bay	San Rafael	Milpitas
Fairfield South	Point Bonita	San Jose West
Vine Hill	San Francisco South	Cupertino
Walnut Creek	San Francisco North	Mindego Hill
Cordelia	Oakland West	La Honda
Benicia	Oakland East	Woodside
Briones Valley	San Leandro	San Mateo
Cuttings Wharf	Las Trampas Ridge	Montara Mountain
Mare Island	Hayward	Half Moon Bay
Richmond		

The resulting species list gathered from these sources has been formatted into a table showing the common and scientific names, federal and state status, and a general description of suitable habitat for each species (Table 3.5.4). Due to the preliminary nature of the potential ferry terminal locations, the potential for each species to occur in an area is based upon habitat. Habitat maps for the proposed sites are shown on Figures 3.5.2 through 3.5.4. Species with a strong potential to occur in one or more of the potential ferry terminal areas are discussed in more detail in the text. If no suitable habitat exists in the vicinity of any of the potential ferry terminals for a species listed on these tables, the species is not discussed further in this document.

Threatened and Endangered Species

Mammals

Salt Marsh Harvest Mouse (*Reithrodontomys raviventris*). The salt marsh harvest mouse is listed as endangered under both the Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA) and is a state fully protected species. Salt marsh harvest mice are endemic to tidal and brackish marsh habitats of the Bay, where they occur in areas of dense cover, preferably where pickleweed constitutes 60 percent or more of the vegetation (Shellhammer 1984). These mice are most commonly associated with large tidal marshes of the both the North and South bays that have extensive high marsh zones. Smaller marshes do not usually provide adequate cover for mice during periods of high tide.

Known populations of these mice in the South Bay include Hayward Marsh, New Chicago Marsh, Palo Alto Baylands, and Crescent March. In the North Bay, they have been found in the marshes bordering San Pablo Bay, as well as at Mare Island (Goals Project 2000). They have also been recorded in Suisun Bay. Figure 3.5.10 shows current locations and suitable habitat within the Bay.

Southern Sea Otter (*Enhydra lutris*). The southern sea otter is considered a threatened population under FESA and is protected by the Marine Mammal Protection Act of 1972. Approximately 16,000 to 18,000 sea otters were formerly distributed along the California coastline. After extensive harvesting in the 18th and 19th centuries, less than a hundred sea otters remained off the isolated coastline of Big Sur, California. After years of protection, the population increased to 500 to 600 individuals by 1950 and, thereafter, increased by approximately 5 percent annually until 1976, when the increase slowed (Estes 1990). Currently, about 2,200 individuals exist in the southern sea otter range, and they have expanded their range to north of Santa Cruz (about Half Moon Bay), and are only occasionally seen in the Bay.

For example, in March 2001, a sea otter was observed within the Bay near Sausalito (Oliver 2001). This and other recent observations of sea otters within the Bay confirm that sea otters may be taking up residence in the Bay.

Birds

California Black Rail (*Laterallus jamaicensis coturniculus*). State listed as threatened, the California black rails reside in larger tidally influenced marshes of the Bay region. They require high-elevation emergent tidal marsh for nesting and breeding. Most, if not all, nesting occurs in the northern portions of the Estuary; however, they have been recorded in the South Bay during the breeding season (Evens et al. 1991). Black rails occur in the Central and South bays in the nonbreeding season, with known populations at Dumbarton Marsh and Palo Alto Baylands. They are of low to moderate abundance along the coast of San Pablo Bay, from China Camp State Park to Mare Island. Populations are more concentrated along the Petaluma and Napa rivers. Rails have also been found in low to moderate abundance along Carquinez Strait between Martinez and Baypoint, and in Suisun Slough (Evens et al. 1991). The distribution and abundance of black rails in San Francisco Bay is shown on Figure 3.5.11.

California Brown Pelican (*Pelecanus occidentalis californicus*). The California brown pelican is a state and federally listed endangered species. This species breeds on the California Channel Islands between March and August (Zeiner et al. 1990) and is present in Northern California from June to November. In the Bay, pelicans forage over deep-water habitats and roost on structures such as breakwaters, pilings, and to a lesser extent, salt-pond dikes (USFWS 1992). Brown pelicans feed almost exclusively on fish in either shallow or deep waters. Brown pelicans are fairly common throughout waters of the Central Bay and San Pablo Bay.

California Clapper Rail (*Rallus longirostris obsoletus*). The California clapper rail is a listed as endangered under FESA and CESA and is a state fully protected species. Clapper rails are yearlong residents of emergent salt and tidal marshlands of the Bay (Goals Project 2000; Zeiner et al. 1990). California clapper rail nest between February 15 and June 15, building their nests in marsh vegetation such as bullrush (*Scirpus robustus*) and *Spartina* sp. at the maximum water level for the nest period (Collins et al. 1994; Avocet Research 1992). The whole breeding season for California clapper rail is February 1 through August 31, including courtship, nesting and renesting (Floerke 2002). Loss and degradation of wetland habitat, predation by nonnative red foxes (*Vulpes vulpes*), and sewage effluent in the South Bay have contributed to the population decline of this species (Steinhart 1990). In the Bay, clapper rails are most abundant in marshes south of San Mateo Bridge and in San Pablo Bay. The known distribution of clapper rails in the Bay is shown on Figure 3.5.12.

California Least Tern (*Sterna antillarum browni*). The California least tern is a state and federally listed endangered species. It is migratory, breeds in California from April to August, and ranges from southern Baja California and Mexico north to San Francisco Bay. Breeding colonies are generally located in abandoned salt ponds and along estuarine shorelines that are free of predators. California least terns are ground-nesters and nest in colonies on sandy beaches and fine gravel with sparse vegetation (Goals Project 2000). Due to degradation of more natural nesting habitat, they occasionally nest on dredge-spoil islands, open areas adjacent to airport runways, and industrial ports. Known San Francisco Bay nesting locations of this species include areas in the city of Alameda, Pittsburg Power Plant, and Oakland Airport (Goals Project 2000).

Western Snowy Plover (*Charadrius alexandrinus nivosus*). The western snowy plover is listed by the federal government as a threatened species and by the State of California as a species of special concern. This small shorebird typically occupies sandy beaches and intertidal areas of marine and estuarine habitats, but is known to occur in some inland areas. In San Francisco Bay, it is commonly found on salt pond levees. Western snowy plovers are known to winter in the San Francisco Bay Area. Approximately 250 individuals have been recorded in the Bay during the breeding season (Port of Oakland 1998). They have been found nesting primarily in the salt ponds south of San Mateo Bridge in the South Bay, although they have also been observed in San Pablo Bay at the Napa-Sonoma salt ponds, and in the Central Bay at Alameda Naval Air Station.

Fish

Steelhead (*Oncorhynchus mykiss*). Steelhead are federally listed as threatened. Steelhead historically ranged throughout the north Pacific Ocean from Baja California to Kamchatka Peninsula. Currently, their range extends from Malibu Creek in southern California to Kamchatka Peninsula (Busby et al. 1996). The Bay and its tributary streams support migrating steelhead populations. Trout can be either anadromous (migrating from freshwater to the ocean and returning to spawn in freshwater) or can complete their entire life cycle in freshwater. Those fish that remain in fresh water are referred to as rainbow trout. Steelhead, the anadromous form of *O. mykiss*, can spend several years in freshwater prior to smoltification and can spawn more than once before dying, unlike most other salmonids (Busby et al. 1996). Spawning runs in the Bay occur from December through May.

Individuals from two Evolutionary Significant Units (ESUs[1]) can be found in San Francisco Bay: Central California Coast steelhead and Central Valley steelhead. The Central California Coast ESU includes river basins between the Russian River and Aptos Creek and all of the Bay and its tributaries. Steelhead found east of San Pablo Bay are included in the Central Valley ESU. Central Valley steelhead may migrate through the project area. NMFS has issued a 4(d) rule for steelhead, which prohibits activities and institutes restrictions on all activities that will likely result in harm or take of steelhead and/or their habitat.

Chinook Salmon (*Oncorhynchus tshawytscha*). The species historically ranged from the Ventura River in California to Point Hope, Alaska, on the eastern edge of the Pacific and in the western portion of the Pacific Ocean from Hokkaido, Japan, to the Anadyr River in Russia

[1] An ESU is a distinctive group of steelhead or salmon

(Healey 1991). Chinook salmon consist of four distinct breeding populations or ESUs that are endemic to the Sacramento-San Joaquin River system. Factors used in determining ESUs include spatial, temporal, and genetic isolation, maturation rates, and other life history traits. Chinook salmon have been categorized into fall/late fall, winter, and spring ESUs. Each ESU is considered a distinct race and has been given its own management status. Winter-run Chinook salmon has been state and federally listed as endangered, the fall/late fall-run salmon has been state and federally listed as threatened and is federally proposed as endangered, and spring-run salmon is federally proposed as threatened and is a CDFG species of concern.

Three Chinook salmon ESUs migrate through the Bay: Sacramento River winter-run, Central Valley spring-run, and Central Valley fall/late fall-run. The winter-run, a state and federally listed endangered species, spawns in the upper Sacramento River below Keswick Dam. The fall/late fall-run, a proposed endangered species, spawns in the Sacramento and San Joaquin River basins (Myers et al. 1998). Spring-run Chinook salmon, state and federally listed as threatened, spawn in the Sacramento River Basin. All three runs are most commonly found migrating through the northern and central portions of the Bay (CDFG 1987).

Coho Salmon (*Oncorhynchus kisutch*). Coho salmon are listed as threatened under FESA and endangered under CESA. This species ranges from Baja California, Mexico, north to Alaska, and southwest to Japan (McGinnis 1984). This species exhibits a simple 3-year anadromous life cycle (Federal Register 1999), rearing in freshwater for up to 15 months before migrating to the ocean. Coho salmon typically spend two growing seasons in the ocean before returning to their natal streams to spawn (Federal Register 1996). The Central California Coast Coho Salmon evolutionarily significant unit (ESU) occurs from Punta Gorda in Northern California south to, and including, the San Lorenzo River in central California, including tributaries to the Bay, but excluding the Sacramento-San Joaquin River system (Weitkamp et al. 1995). Coho generally return to their natal streams between November and December.

Coho no longer spawn in Bay tributaries and are not expected to occur within the Bay.

Delta Smelt (*Hypomesus transpacificus*). Delta smelt is listed as threatened under FESA and CESA. This fish is primarily an annual species and is endemic to the Estuary. Spawning occurs in shallow freshwater in tidally influenced rivers and sloughs. Spawning sites include (among others) the lower Sacramento and San Joaquin rivers and Georgiana Slough, and in sloughs of Suisun Marsh, with a significant portion of spawning taking place in the northern and western Delta. Juvenile and adult Delta smelt occur in the surface and shoal waters of the lower reaches of the Sacramento River below Mossdale, through the Delta, and into Suisun Bay. The species inhabits a salinity range of less than 2 parts per thousand, and tolerates a wide range of water temperatures (<8ºC to >25ºC). Delta smelt had a sharp decline in abundance in the 1980s. Declines have been attributed to restricted habitat and increased losses through entrainment by Delta diversions. Competition with nonnative inland silversides may have also contributed to their decline (Goals Project 2000).

Sacramento Splittail (*Pogonichthys macrolepidotus*). The Sacramento splittail is listed as a federally threatened species and is a CDFG California Species of Special Concern. Splittail historically lived in all low-gradient portions of all major tributaries to the Sacramento and San Joaquin rivers, and some other freshwater tributaries to San Francisco Bay. Currently, they are most common in the brackish water of Suisun Bay, Suisun Marsh, and the Delta. Adults and young are abundant in the Napa and Petaluma rivers, along with Peyton, Hastings, and Pacheco sloughs, tributaries of Suisun Bay. Migration barriers have contributed to much of the loss of splittail habitat, along with loss of floodplain and wetlands due to diking. The upstream spawning migration occurs November through May, with a peak from January to March, and the preferred spawning habitat is shallow, seasonally flooded vegetation. Despite a reduction in their range, splittails are hardy fish that tolerate low dissolved oxygen levels, strong water currents, and a wide range of temperatures (Goals Project 2000).

Tidewater Goby (*Eucyclogobius newberryi*). Tidewater goby is a federally endangered small fish, rarely exceeding 5 centimeters. It prefers semiclosed estuaries or lagoons of small coastal streams that are low in salinity. Optimal habitat has fairly still but not stagnant water and high oxygen levels. Populations are found along the entire California coast (McGinnis 1984). Tidewater gobies are rare in San Francisco Bay, but nearby populations are located in coastal San Gregorio Creek and Pescadero Creek in San Mateo County. In 1980, it was found at the mouth of Novato Creek of San Pablo Bay (Swift 1980). It has been found in Rodeo Lagoon, Estero de San Antonio, and Estero Americano (Wang 1986). This study also searched for this species at other sites within the Sacramento-San Joaquin Estuary but did not find any more specimens. Historically, they have also occurred in Corte Madera Creek and Novato Creek (CDFG 2001). The USFWS has proposed to delist all California populations north of Orange County, California.

Plants

California Sea Blite (*Suaeda californica*). This FESA listed endangered species occupies coastal saltwater marshes and the upper margins of salt flats. Today, this species is known primarily to inhabit the relatively well-drained marshy beach ridges along Morro Bay. The last known specimen collected in San Francisco Bay was in 1943 (Goals Project 2000).

Soft Bird's Beak (*Cordylanthus mollis* ssp. *mollis*). Soft bird's beak is an annual herb listed as endangered under FESA and state-listed as rare. This plant occurs in the high brackish marsh zone, typically in the lower end of a well-drained high marsh gradient, on slight topographic relief above the marsh plain. It is often found in association with high marsh vegetation such as pickleweed (*Salicornia virginica*), saltgrass (*Distichlis spicata*), fleshy jaumea (*Jaumea carnosa*), and alkali seaheath (*Frankenia salina*). Soft bird's beak is hemiparasitic, and its numbers fluctuate from year to year. The plant may disappear for a year or more and then regenerate from dormant seed banks. Threats to the species include erosion and marsh drainage. Soft bird's beak is currently found in tidal brackish marshes around the Napa River, Carquinez Strait tidal marsh, and Suisun Marsh area (Goals Project 2000).

Suisun Thistle (*Cirsium hydrophilum* var. *hydrophilum*). Suisun thistle is listed as a federally endangered species. A perennial herb, it is endemic to the Delta and exists only in Solano County. It grows with bulrush and salt grass near small watercourses in saltmarshes, and blooms from July to September. Current occurrences have been recorded on Grizzly Island in the Suisun Marsh area (CDFG 2001). This plant is threatened by altered hydrology and competition from native and nonnative plants (CNPS 2001).

Other Special-Status Species

Mammals

California Sea Lion (*Zalophus californianus*). The California sea lion is protected under the Marine Mammal Protection Act. California sea lions breed in Southern California and along the Channel Islands. After the breeding season, males migrate up the Pacific Coast and enter the Bay. In the Bay, sea lions are known to haul out at Pier 39 in the Fisherman's Wharf area of the San Francisco Marina. An estimated 600 animals were observed in January and February 1991 at that haul-out site (USFWS 1992). In addition to that site, California sea lions have the potential to haul out on buoys and similar structures throughout the Bay. No other repeatedly used haul-out site for California sea lions, other than Pier 39, has been observed in the Bay (Allen 1999). During anchovy and herring runs, approximately 400 to 500 sea lions (mostly immature males) feed almost exclusively in the North and Central bays (USFWS 1992).

Gray Whale (*Eschrichtius robustus*). Gray whales are protected by the Marine Mammal Protection Act of 1972 (as are all marine mammals including seals and sea lions), and were recently delisted as an endangered species. Gray whales migrate each year along the west coast of North America, typically passing off the coast of San Francisco heading south from December through February and heading north from mid-February through July. The population has recently reached a level thought to be near carrying capacity (approximately 26,000 animals), which may explain why more gray whales have been observed feeding off of the coasts of British Columbia, Washington, Oregon, and California rather than migrating the entire way to Alaska.

Gray whales consume benthic prey (primarily amphipods) in North America (e.g., Bering, Beaufort, and Chukchi seas) during summer and migrate south along the west coast of North America to calve and breed off the coast of Mexico. During the migration, gray whales will occasionally enter rivers and bays (such as San Francisco Bay) along the coast either because they are disoriented or to forage. Recently, small numbers of gray whales (presumably juveniles and post-weaning females) have been observed foraging along the nearshore coastline of California, Oregon, Washington, and British Columbia during summer and are remaining there instead of migrating northward as do the bulk of the population (Sumich 1985).

In the past, gray whales have been seen irregularly in the Bay. These whales may be individuals that meandered off during the migration, although it is unknown specifically why they are entering the Bay. Most of these individuals eventually make their way out of the Bay. The number of gray whales sighted in the Bay has increased recently. The Sea Training Institute reported two gray whales in the Bay during 1999 and six in 2000, although some of these may be repeat sightings. The Oceanic Society has observed and recorded reported gray whales in the Bay. During spring 2000, most of the whales were seen near the mouth of the Bay as shown on Figure 3.5.13. Note that this figure shows reported gray whale sightings and not the actual number of whales in the Bay at a given time.

The Oceanic Society has also reported increased numbers of sightings recently. Concurrent with the increased sightings of gray whale in the Bay during 2000, approximately 29 gray whales stranded dead within the Bay from April through July (Moore et al. 2001). About a third of these individuals were adults, and some appeared to be in good shape (e.g., not emaciated with a thick blubber layer). Although some may have been killed by encounters with passing ships, the cause of death for most was undetermined.

Pacific Harbor Seal (*Phoca vitulina*). The harbor seal is protected by the Marine Mammal Protection Act. Harbor seals are nonmigratory and can be found along shorelines and in estuaries throughout North America. Pacific harbor seals use the Bay year-round where they engage in limited seasonal movements associated with foraging and breeding activities (Kopec and Harvey 1995). They are the only marine mammals that permanently reside in the Bay. Harbor seals haul out in groups ranging in size from a few individuals to several hundred seals. Habitats used as haul-out sites include tidal rocks, bayflats, sandbars, and sandy beaches (Zeiner et al. 1990). Haul-out sites are relatively consistent from year to year and are important habitats for harbor seals (Kopec and Harvey 1995). They are used for resting, breeding, and raising of pups. Harbor seal haul-out sites are shown on Figure 3.5.14. In the Bay, pupping occurs from March to May, and molting in June and July (Kopec and Harvey 1995). These activities correspond to the greatest number of harbor seals counted at major haul-out sites in the Bay (Kopec and Harvey 1995). Haul-out sites that support some of the largest concentrations of seals include Corte Madera Marsh and Castro Rocks in the Central Bay, Mowry Slough south of Dumbarton Bridge, and Yerba Buena Island.

The total population of harbor seals in the Bay is estimated to be approximately 700 animals (USFWS 1992). Aerial counts by CDFG (1999) indicate that the harbor seal population has remained relatively constant in the Bay from 1982 through 1995, with an average increase in the population of 60 individuals over all years. However, harbor seal populations in other areas off the West Coast have been increasing by a much larger percentage since the late 1970s than that observed in the Bay (Kopec and Harvey 1995). Factors such as pollution and human disturbance at haul-out sites in the Bay may be factors contributing to this population difference.

Harbor seals forage in shallow, intertidal waters on a variety of fish, crustaceans, and a few cephalopods (e.g., octopus). They also consume benthic organisms as well as schooling fishes. The most numerous prey items identified in harbor seal fecal samples from haul-out sites in the Bay include yellowfin goby, northern anchovy, Pacific herring, staghorn sculpin, plainfin midshipman, and white croaker (Harvey and Torok 1994).

Salt Marsh Wandering Shrew (*Sorex vagrans haliocoetes*). The salt marsh wandering shrew is a Special Concern Species under FESA and a CDFG California Species of Special Concern. The salt marsh wandering shrew is located in salt marshes of the South Bay and exists in a narrow band of tidal marsh. It is not present in diked marshes. This insectivorous mammal prefers wet, medium-high salt marshes that provide dense cover, abundant invertebrates, suitable nesting sites, and fairly continuous ground moisture. Suitable sites have abundant driftwood and debris scattered among pickleweed 1 to 2 feet in height (Goals Project 2000).

Birds

American Bittern (*Botaurus lentiginosus*). The American bittern is a federal species of concern and is distributed widely in the Bay in fresh emergent wetlands. This bird feeds in tall, fresh or saline, emergent wetlands; less often in adjacent shallow water of lakes, backwaters of rivers, or estuaries; and occasionally along adjacent shores. It relies on tall, dense, emergent vegetation for resting and roosting. The American bittern declined due to draining of marshes, pesticides, and overgrazing of emergent vegetation (Zeiner et al. 1990).

American Peregrine Falcon (*Falco peregrinus anatum*). The American peregrine falcon is federally delisted but was formerly a federally listed endangered species. It is still state-listed as endangered. The historic range of the American peregrine falcon extends throughout North America from the boreal forests south into Mexico (USFWS 1992). Peregrines generally nest on protected ledges of high cliffs in woodland, forest, and coastal habitats; however, pairs are also known to nest on human-made structures such as bridges and buildings.

Caspian Tern (*Sterna caspia*). Nesting colonies of Caspian tern are of concern; however, this species is listed as "demonstrably secure; commonly found throughout its historic range" (CDFG 2000). Active South Bay and Central Bay colonies are located at Coyote Hills (west levee), Alviso Pond A7, Hayward Shoreline, Ravenswood Slough, Brooks Island, and Naval Air Station Alameda (Goals Project 1999). It also nests within the Napa-Sonoma salt ponds complex (Lu 2000).

Common Loon (*Gavia immer*). The common loon is listed as a California Special Concern species (CDFG) with a 'demonstrably secure' population. The common loon is observed in the Bay, but their nesting sites, which do not occur in the Bay region, are of primary concern (Zeiner et al. 1990).

Double-Crested Cormorant (*Phalacrocorax auritus*). The double-crested cormorant is a CDFG species of special concern and is a permanent resident along the coast of California and within the Bay. It roosts beside water on offshore rocks, islands, steep cliffs, and trees, as well as wharves and bridges.

Elegant Tern (*Sterna elegans*). The elegant tern is a CDFG species of special concern, and its nesting colonies are protected. Elegant terns are post-nesting visitors to coastal California north of San Diego, generally between June and October (Zeiner et al. 1990). In the Bay, this species is most often observed foraging or roosting near breakwaters and marinas in the Central Bay.

Long-Billed Curlew (*Numenius americanus*). Long-billed curlew is a federal and CDFG species of special concern. Long-billed curlews commonly winter in the Central Valley, where they occupy seasonal wetland habitats. Smaller numbers of curlews also winter in San Francisco Bay. This species breeds within the northeastern portion of the state in grassland or wet meadow habitats that are usually adjacent to lakes or marshes. Conversion of these breeding grounds to agricultural areas is believed to be the primary cause for the decline of this species in the state (Zeiner et al. 1990).

Northern Harrier (*Circus cyaneus*). The northern harrier is a state species of concern. It occurs throughout the state except for the Sierra Nevada and the Cascade Ranges. Breeding usually occurs in shrubby vegetation within marshes, although nesting may also occur in grasslands or other dry habitats away from water. Harriers forage primarily on small mammals that inhabit a variety of wet and dry habitats.

Salt Marsh Common Yellowthroat (*Geothlypis trichas sinuosa*). The salt marsh common yellowthroat is a California Special Concern species (CDFG 2000). The salt marsh common yellowthroat is mostly a resident in the fresh and brackish marsh habitat surrounding the Bay, moving into saline tidal marshes in winter. The salt marsh common yellowthroat population has been reduced by 80 to 90 percent in the past 100 years due to loss of suitable habitat, with this diminution most exacerbated in the South Bay (Goals Project 2000).

Song Sparrow (*Melospiza melodia*). Three subspecies of song sparrow reside year-round in marshlands of San Francisco Bay: Alameda song sparrow (*Melospiza melodia pusillula*), San Pablo song sparrow (*M. m. samuelis*), and Suisun song sparrow (*M. m. maxillaris*). All three subspecies are federal species of concern and CDFG species of special concern. The Alameda and San Pablo song sparrows are found predominantly in tidal salt marsh, which provides optimum habitat for all life needs as long as the marsh contains numerous small channels and complex vegetation structure. Tidal brackish marsh dominated by tall hardstem bulrush (*Scirpus acutus)*, salt marsh bulrush (*S. robustus)*, and concentrated areas of pickleweed and gumplant provides habitat for the Suisun song sparrow. The birds generally forage along the banks of sinuous tidal channels and utilize gumplant bushes for nest sites and song perches. The San Pablo song sparrow ranges from San Pablo Bay and northern San Francisco Bay (south to Sausalito and north Richmond), with the most suitable habitat in Petaluma Marsh. The Alameda song sparrow is found in the San Francisco Bay shores, breeding from San Francisco and southeast Richmond south to Alviso. Their highest-quality habitat is located in Dumbarton Marsh, Greco Island, and Outer Bair Island. The Suisun song sparrow is found within the Suisun Bay marsh complex and west to include Southhampton Bay (Goals Project 2000).

Densities of all of the song sparrow species (Alameda song sparrow, San Pablo song sparrow, and Suisun song sparrow) are lower in the Central/South Bay, with a median of 3.7 birds/hectare for the tidal marshes surveyed, than in San Pablo Bay (18 birds/hectare) and Suisun Bay (26 birds/hectare) (Nur et al. 1997). Densities in San Pablo Bay range from 3.7 to 94 birds/hectare. They range from 7.6 to 46 birds/hectare in Suisun Bay. Highly channeled marshes were directly correlated to higher song sparrow density for this species.

Fish

Green Sturgeon (*Acipencer medirostris*). Green sturgeon are a federal and state species of concern. Green sturgeon are not abundant in any estuaries along the Pacific Coast but are known to exist in the Estuary (Pycha 1956; Skinner 1962; Moyle 1976). Green sturgeon are anadromous fish that spend most of their lives in saltwater and return to spawn in freshwater. Green sturgeon rely on streams, rivers, and estuarine habitat as well as marine waters during their lifecycle. They spawn in the lower reaches of large rivers with swift currents and large cobble. Juveniles remain in the estuaries for a short time and migrate to the ocean as they grow larger. Green sturgeon are found throughout the Bay and are native to the Sacramento-San Joaquin River system. Spawning occurs in the lower reaches of the Sacramento-San Joaquin River system; however, feeding occurs throughout the Bay. Sturgeon often feed on invertebrates and small fish and are common in areas where herring spawn.

Pacific Lamprey (*Lampetra tridentata*). Pacific lamprey are a federal species of special concern. Pacific lampreys range from Baja California to the Bering Sea in Alaska and Asia. In California, the species is more abundant from Monterey northward (Wang 1986). Pacific lamprey are a parasitic anadromous species that enter freshwater streams from July to October, and spawn the following spring. Adults migrate to the ocean between January and April and remain there for about 2 to 3 years before returning to freshwater to spawn (Pacific States Marine Fisheries Commission 1997). Within the Estuary, Pacific lamprey spawn primarily in the San Joaquin, American, Sacramento, and Napa rivers and Sonoma and Walnut creeks (Wang 1986).

Plants

Coastal Marsh Milk-Vetch (*Astragalus pycnostachyus* var. *pychnostachyus*). The coastal marsh milk-vetch is a CNPS List 1B plant. The coastal marsh milk-vetch is a perennial herb that blooms from April to October. It occurs at the high edges of mesic coastal dunes, coastal salt marshes, and streamsides. Associated species include coyote brush (*Baccharis pilularis*) and mule fat (*Baccharis salicifolia*). Known from fewer than 10 occurrences, it is possibly threatened by cattle trampling and erosion (CNPS 2001).

Delta Tule Pea (*Lathyrus jepsonii var. jepsonii*). Delta tule pea is a federal species of special concern. Delta tule pea is a perennial herb that occurs in high brackish marshes, which today are primarily associated with diked habitats dominated by nonnative grasses and herbs. Within this habitat, Delta tule pea occurs in the lower end of well-drained high marsh gradients, often on slight topographic relief above the marsh plain (Goals Project 2000). Historically, this species has occurred in Alameda, Contra Costa, Marin, Napa, and Santa Clara counties (Skinner and Pavlik 1994). The current distribution of Delta tule pea is believed to occur in Suisun Marsh and in tidal brackish marshes along the Napa River (Goals Project 2000). Threats to the species include agriculture and erosion.

Mason's Lilaeopsis (*Lilaeopsis masonii*). Mason's lilaeopsis is state-listed as rare and is found generally in marshes and swamps. It is a minute perennial plant that spreads by rhizomes and produces narrow, jointed leaves. The plant extends from the margins of the Napa River in Napa County, east to the channels and sloughs of the Delta in Contra Costa, Solano, Sacramento, Yolo, and San Joaquin counties. Associated vegetation includes pickleweed, alkali heath, salt grass, and sea lavender. Currently, approximately 130 occurrences of this plant are recorded, although CDFG does not know how many of these still exist. It is threatened by levee maintenance and construction, widening of Delta channels for water transport, dredging and dumping of spoils, recreation, erosion, and, potentially, changes in water quality in the Delta (CDFG 2000).

Point Reyes Bird's-Beak (*Cordylanthus maritimus* ssp. *palustris*). Point Reyes bird's-beak is a federal species of special concern. This species is a hemiparasitic annual herb that occurs in high sandy salt marshes (Goals Project 2000). Associated plants include marsh gumplant (Grindelia stricta var. *stricta),* seaside lavender *(Limonium californicum),* and sandspurry *(Spergularia sp.).* The known range of Point Reyes bird's-beak extends from northern Oregon to Marin and Sonoma counties in the North Bay with small remnant populations known both from Petaluma Marsh and near Gallinas Creek in Marin County. Historically, this species was also known to occur as far south as Santa Clara and San Mateo counties (Skinner and Pavlik 1994). Threats to the species includes development, competition from invasive species, and cattle grazing.

Suisun Marsh Aster (*Aster lentus).* The Suisun Marsh aster is a CNPS List 1B plant. The Suisun Marsh aster is a rhizomatous perennial herb that blooms from May to November. It is endemic to the Delta, occurring in brackish and freshwater marshes and swamps. Most often, it is associated with common reed, bulrush, blackberry, and cattail. Populations occur in Suisun Slough, Van Sickle Island in Suisun Marsh, Barker Slough, the San Joaquin River shoreline in Antioch, Brannon Island, and Sherman Island (CDFG 2001). The Suisun Marsh aster is seriously threatened by marsh habitat alteration and loss (CNPS 2001).

Special Aquatic Sites

Under Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers (USACE) regulates the disposal of dredged and fill materials into "waters of the United States." Waters of the U.S. include intrastate lakes, rivers, streams (including intermittent streams), bayflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, and wetlands adjacent to any water of the U.S. (33 Code of Federal Regulations [CFR] Part 328). In areas subject to tidal influence, Section 404 jurisdiction extends to the high tide line or to the boundary of any adjacent wetlands. Certain waters of the U.S. are considered "special aquatic sites" because they are generally recognized as having unique ecological value. Such sites include sanctuaries and refuges, mudflats, wetlands, vegetated shallows, eelgrass bed, coral reefs, and riffle and pool complexes. Special aquatic sites are defined by the U.S. Environmental Protection Agency (USEPA), and may be afforded additional consideration in the permit process for a project. The following describes eelgrass, wetlands, and tidal marshes that were previously discussed in Section 3.5.1.2.

Eelgrass (*Zostera marina*) is a native marine vascular plant indigenous to the soft-bottom bays and estuaries of the Northern Hemisphere. It has been afforded special management considerations by CDFG, USFWS, National Marine Fisheries Service (NMFS), and the Golden Gate Audubon Society. The species is found from middle Baja California and the Sea of Cortez to northern Alaska along the west coast of North America, and is common in healthy, shallow bays and estuaries. The depth at which this species grows is a function of light penetration. At greater depths, light is reduced to a level below which photosynthesis is unable to meet the metabolic demands of the plant to sustain net growth (the photocompensation depth).

Eelgrass beds perform multiple functions within an estuarine ecosystem. For example, they provide a nursery area for many species of fish, including Pacific herring, halibut, and English sole. Detritus from eelgrass is not only used by animals immediately adjacent to the beds, but also is transported further into the estuary, making it an important part of the detrital-based food web. As substrate for the epiphytic algae, invertebrates, and crustaceans on which these species feed, eelgrass beds also contribute to the ecosystem at multiple trophic levels. Eelgrass beds are also foraging areas for wintering waterfowl such as American wigeon (*Anas americana*) that feed on the roe and invertebrates.

In addition to being refugia for young fish, eelgrass beds stabilize shorelines by dampening wave energy, collecting sediments transported to the shore, and preventing erosion. They also improve water quality by collecting and filtering organic matter and sediments. This filtering also acts as a nutrient pump, transferring waterborne nutrients to the sediments and invertebrates.

Eelgrass is easily affected by changes in water quality and turbidity. Eelgrass beds are extremely dynamic, expanding and contracting by as much as several hectares per season depending on the quality of the site. Consequently, they serve as an indicator community for the overall health of an estuary.

A 1987 NMFS survey of San Francisco Bay documented 128 hectares (316 acres) of eelgrass, covering less than 0.1 percent of the total Bay bottom. Table 3.5.5 lists the location and acreage of all the beds located. Eelgrass beds are scattered throughout the Bay, and approximately one-third of all beds are in San Pablo Bay (Wyllie-Echeverria and Rutten 1989). Although there have been a number of site specific surveys for eelgrass over the years, a more recent comprehensive survey of the Bay has not been conducted. Figures 3.5.15 through 3.5.17 show known locations of eelgrass beds in the North Bay, Central Bay, and South Bay, respectively. The water tends to get more turbid and brackish in Northern San Pablo Bay and Suisun Bay and eelgrass generally does not grow in areas of high turbidity or brackish water. No known beds are located in these areas.

3.5.1.5 Regulatory Setting

Federal

Federal Endangered Species Act (16 USC 1531-1544)

FESA provides protection for endangered and threatened species and requires conservation of such species' critical habitats in the ecosystem. An "endangered" species is a species in danger of extinction throughout all or a significant portion of its range. A "threatened" species is one that is likely to become "endangered" in the foreseeable future without further protection. Other special-status species include "proposed" and "candidate" species, and "species of concern." Proposed species are those that have been officially proposed (in the Federal Register) for listing as threatened or endangered. Candidate species are those for which enough information is on file to propose listing as endangered or threatened. "Species of concern" are species for which not enough information is on file to support a listing proposal, but still may be appropriate for listing in the future after further study. A "delisted" species is one whose population has reached its recovery goal and is no longer in jeopardy.

The FESA is administered by the USFWS and the NMFS. In general, NMFS is responsible for protection of FESA-listed marine species and anadromous fishes, while other species are under USFWS jurisdiction.

FESA Section 9 prohibits the "take" of listed species, while Section 7 of this act provides a means of authorizing the "take" of listed species. Taking is defined by FESA [Section 3(19)] to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." Section 7 requires formal consultation with USFWS or NMFS for projects that may affect those species that are either listed as or proposed for listing as endangered or threatened, to ensure that the proposed action will not jeopardize listed species or destroy or adversely modify designated critical habitat. "Take" of fully protected species can only be authorized for necessary scientific research. "Incidental take" permits cannot generally be issued for fully protected species. Fully protected species in the project area include salt marsh harvest mouse, California clapper rail and California black rail.

A proposed project may address federally listed species in one of two ways: (1) a nonfederal government entity may resolve potential adverse impacts to protected species or (2) a federal lead agency may regulate a proposed project and develop mitigation for any significant impacts to federally listed species. Both cases require consultation with the USFWS and/or NMFS, which ultimately issues a final opinion determining whether the federally listed species will be adversely impacted by a proposed project.

Fish and Wildlife Coordination Act (16 USC 661-667e)

The original act of March 10, 1934, authorized the Secretaries of Agriculture and Commerce to assist and cooperate with federal and state agencies to protect, rear, stock, and increase the supply of game and fur-bearing animals, as well as to study the effects of domestic sewage, trade wastes, and other polluting substances on wildlife.

The amendments to this act, enacted in 1946, require consultation with the USFWS, NMFS, and state agencies responsible for fish and wildlife resources for all proposed federal undertakings and nonfederal actions needing a federal permit or license that would impound, divert, deepen, or otherwise control or modify a stream or waterbody, and to make mitigation and enhancement recommendations to the involved federal agency.

Additionally, the act requires that wildlife conservation be coordinated with other features of water resource development programs. Determination under this authority for specific projects located in estuarine areas constitute compliance with the provisions of the Estuary Protection Act, as discussed below.

Estuary Protection Act (16 USC 1221–1226)

This act highlights the value of estuaries and the need for conservation of their valuable natural resources. It authorizes the Secretary of the Interior, in cooperation with other federal agencies and the states, to study and inventory estuaries of the United States and to determine whether any areas should be acquired by the federal government for future protection.

Under this act, the Secretary of the Interior is required to review all project plans and reports for land and water resource development affecting estuaries and make an assessment of likely impacts and related recommendations for conservation, protection, and enhancement of estuaries.

Magnuson-Stevens Fisheries Act (16 USC 1801-1882)

The original act was passed in 1976, and its primary purposes were conservation and management of U.S. fishery resources, development of U.S. domestic fisheries, and phasing out foreign fishing activities within federal waters, the 200-mile limit extending from the edge of state waters. This area become known as the Exclusive Economic Zone (EEZ), and the Magnuson Act achieved its goal of eliminating foreign fisheries and enhancing domestic fisheries in the EEZ.

The Amended Magnuson-Stevens Fishery Conservation and Management Act of 1996, also known as the Sustainable Fisheries Act (Public Law 104-297), requires all federal agencies to consult with the Secretary of Commerce on proposed projects authorized, funded, or undertaken by that agency that may adversely affect Essential Fish Habitat (EFH). The main purpose of the EFH provisions of the Sustainable Fisheries Act is to avoid loss of fisheries due to disturbance and degradation of the fisheries habitat.

The act requires that EFH must be identified for all species federally managed under the Pacific Fisheries Management Council (PFMC). The PFMC is responsible for managing commercial fisheries resources along the coasts of Washington, Oregon, and California. Managed species are covered under three fisheries management plans:

- Coastal Pelagic Fishery Management Plan;
- Pacific Groundfish Fishery Management Plan; and
- Pacific Salmon Fishery Management Plan.

Migratory Bird Treaty Act (16 USC 703-712)

This act established special protection for migratory birds by regulating hunting or trade in migratory birds. Furthermore, this act prohibits anyone to take, possess, buy, sell, purchase, or barter any migratory bird listed in 50 CFR 10, including feathers or other parts, nests, eggs, or products, except as allowed by implementing regulations (50 CFR 21). Definition of "take" includes any disturbance that causes nest abandonment and/or loss of reproductive effort (e.g., killing or abandonment of eggs or young), and such activity is potentially punishable by fines and/or imprisonment.

Marine Mammal Protection Act (16 USC 1361-1421h)

The Marine Mammal Protection Act, adopted in 1972, makes it unlawful to take or import any marine mammals and/or their products. Under Section 101(a)(5)(D) of this act, an incidental harassment permit may be issued for activities other than commercial fishing that may impact small numbers of marine mammals. An incidental harassment permit covers activities that extend for periods of not more than 1 year and that will have a negligible impact on the impacted species. Amendments to this act in 1994 statutorily defined two levels of harassment. Level A harassment is defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal in the wild. Level B harassment is defined as harassment having potential to disturb marine mammals by causing disruption of behavioral patterns including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.

Executive Order 13112: Invasive Species

The purpose of this order is to prevent the introduction of invasive species and to provide control for the spread of any invasive species that have already been introduced. This law prohibits the federal government to "authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions."

Additionally, this order requires federal agencies to consult with the Invasive Species Council, consistent with the Invasive Species Management Plan.

Section 404/10 Jurisdiction (33 USC 1251-1376)

Under Section 404 of the Clean Water Act, the USACE regulates the disposal of dredged and fill materials into "waters of the United States," which include intrastate lakes, rivers, streams (including intermittent streams), bayflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, and wetlands adjacent to any water of the U.S. [33 CFR

328]. In areas subject to tidal influence, Section 404 jurisdiction extends to the high tide line or boundary of any adjacent wetlands.

The USACE also regulates navigable waters under Section 10 of the Rivers and Harbors Act. Navigable waters are defined as "those waters of the United States that are subject to the ebb and flow of the tide shoreward to the mean high water mark and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce" [33 CFR 322.2].

In San Francisco Bay, waters of the U.S. include open waters of the Bay, seasonal and tidal wetlands, and intertidal habitats. Any dredge or fill activities required as a part of ferry implementation and/or operation require a permit from the USACE.

California Endangered Species Act (California Fish and Game Code 2050-2116)

Similar to FESA, CESA, along with the Native Plant Protection Act, authorizes the California Fish and Game Commission to designate, protect, and regulate the taking of special-status species in the state of California. CESA defines "endangered" species as those whose continued existence in California is jeopardized. State-listed "threatened" species are those not presently threatened with extinction, but which may become endangered if their environments change or deteriorate. Any proposed projects that may adversely impact state-listed threatened or endangered species must formally consult with the CDFG. In addition to listed species, the CDFG also maintains a list of "Species of Special Concern," most of which are species whose breeding populations in California may face extirpation. To avoid the future need to list these species as endangered or threatened, the CDFG recommends consideration of these species, which do not as yet have any legal status, during analysis of the impacts of proposed projects.

3.5.2 Impacts and Mitigation

The following section describes the potential impacts that expanded ferry service could have on the biological environment. It is organized by major biological habitat or species type (e.g., overall Bay habitat, benthic environment, fish, marine mammals, etc.). Where applicable, a distinction is made between impacts from construction of ferry facilities and operation of vessels. This section is an evaluation of impacts from the overall ferry service expansion and, therefore, the discussion addresses the overall potential for impacts and the mitigation measures that can be adopted to avoid or minimize these effects.

3.5.2.1 Significance Criteria

Impacts would be considered significant if they would:

- Substantially affect threatened, endangered, or protected species;
- Alter or diminish designated critical habitat[2] or special aquatic sites, including eelgrass beds, mudflats, and wetlands;

[2] Habitat, whether occupied by listed species or not, that has been determined to be essential for the conservation and management of a listed species and has been formally described in the Federal Register.

- Result in the reduction of protected wetland habitat as defined in Section 404 of the Clean Water Act and/or in Section 6610 of the San Francisco Bay Conservation and Development Commission (BCDC) McAteer-Petris Act or result in alteration of desirable functions and values through direct removal, filling, hydrological interruption, or other means;
- Cause the introduction or substantial spread of invasive nonnative plants or wildlife;
- Interfere substantially with the movement of resident or migratory fish or wildlife species;
- Cause substantial or sustained impact to spawning habitat of commercially important species (e.g., Pacific herring); and/or
- Cause underwater sound pressure levels during construction or operation that exceed National Marine Fisheries Service (NMFS) guidelines for protection of marine mammals (i.e., 160 decibels [dB] referenced to 1 micropascal [160 dB re 1 μPa]).

3.5.2.2 Potential Impacts on Habitat

This section identifies impacts that could potentially affect biological habitat types. These habitat types include tidal marshes (including salt and brackish marshes), mudflats, agricultural baylands, salt ponds, and sandy or rocky shorelines.

Impact B-1 **Loss of jurisdictional wetland habitat could occur in areas of dredging and construction at terminal facilities.**

The need for dredging of channels has been minimized with the Proposed Project, with only the Hercules/Rodeo site predicted to potentially require new dredging of an access channel. There is an unknown potential for minor incidental dredging for installation or upgrading of facilities. The Hercules/Rodeo site has not been regionally identified as an area of wetland habitat, and therefore impacts to wetlands are not expected from any needed dredging activity. This would have to be verified once this terminal site has been specifically selected and advanced for further evaluation.

At the regional level of evaluation, mapped wetland areas could potentially occur at the Pittsburg/Antioch and Martinez vicinity. Areas of tidal marsh are located in the vicinity of the existing Larkspur terminal. These resources could potentially be affected by new construction of water transit terminal facilities, if wetland resources are specifically present at these or any of the Proposed Project sites.

Summary of Impact B-1

- Regionally mapped wetlands are present in the vicinity of the Pittsburg/Antioch and Martinez terminals. New terminal construction could impact wetlands at these or other Proposed Project terminals if the resources are present. This impact could be potentially significant.

Mitigation B-1.1: Terminal locations, while having the potential for wetland impacts, have not been specifically surveyed for wetland habitat occurrence with respect to project features because no specific improvements are proposed at this time. Existing mapping of wetlands, discussed in Section 3.5.1 (Environmental Setting), was used to identify areas of known wetlands, but these maps and databases are regional in nature. As part of the environmental studies and documentation for specific projects, wetland areas should be delineated on a site-specific basis. Specific wetland boundary determinations shall be used to avoid disturbance of these resources when specific terminal layout plans are defined. For example, parking lot facilities, typically the largest part of a terminal footprint, could be located in areas away from the shore and associated wetlands.

Mitigation B-1.2: In cases where wetland impacts are unavoidable, suitable compensatory mitigation shall be designed within the same subarea and implemented in consultation with the appropriate regulatory agencies.

The Goals Project (1999) has described habitat restoration goals and 115 potential restoration sites around the Bay, representing tens of thousands of acres of potential habitat restoration. While not all of these sites may be within the same subarea, available, or suitable for the types of mitigation necessary for impacts from terminal construction, a substantial amount of area could potentially be used by the project proponent for compensatory mitigation. The total area of wetland impacts, though not calculated for this document, is expected to be minimal compared to the areas potentially available for mitigation.

Impact After Mitigation: Impact B-1 would be potentially significant if loss of wetlands could not be substantially avoided and/or successfully mitigated. The residual impact cannot be quantified until site-specific mitigation measures are designed and thus is considered potentially significant.

Impact B-2 **Construction of terminals could result in increased potential for the spread of invasive nonnative plant species in disturbed habitats.**

Construction activities in tidal wetland areas could result in the spread of nonnative invasive plant species that are of concern in San Francisco Bay. Of particular concern is the nonnative smooth cordgrass, *Spartina alterniflora*. This is the most widespread of the nonnative cordgrass species and has the ability to invade and exclude and/or hybridize with the native Pacific cordgrass, alter native northern saltmarsh habitat, colonize tidal mudflats, and reduce open-water areas, potentially resulting in reduced habitat for foraging shorebirds, fish, and invertebrates. Most smooth cordgrass occurs in the South Bay (SFEISP 2002). Other species in the Bay include *S. anglica*, *S. densiflora*, and *S. patens.*

Dredging in areas of nonnative cordgrass infestations could increase the spread of this species by creating root fragments and rhizomes that could disperse with the tides. However, as discussed for impact B-1, dredging is limited within the Proposed Project to Hercules/Rodeo, and regional-level information does not identify this as a site of concern for nonnative cord grass. Erosion from ferry operations, which could disperse root fragments and rhizomes, is not expected to be significant when using the prescribed measure discussed under Impact WW-1.

Summary of Impact B-2

- The Proposed Project would involve construction of new facilities, including in the South Bay where smooth cordgrass is most widely distributed. According to mapping by the San Francisco Estuary Invasive Spartina Project (SFEISP), this species may occur in areas near the potential Oyster Point and Redwood City terminal locations. Spread of this species due to project construction would be considered significant. Therefore, this impact is considered potentially significant.

Mitigation B-2.1: Preconstruction surveys by a qualified biologist/botanist shall be conducted to identify and map areas of smooth cordgrass within potential terminal locations where this species could potentially occur. Identified areas of nonnative cordgrass, if falling within areas of disturbance, shall be removed to the extent feasible prior to construction activities. The methods of removal shall be developed in coordination with the USACE and consultation with the SFEISP. Eradication of this species at a site shall be done well in advance of construction. However, depending upon the extent, complete removal may be infeasible. In this case, funding of an area-wide cordgrass eradication program would be used as mitigation.

Impact After Mitigation: Impact B-2 would be less than significant after successful implementation of Mitigation B-2.1.

Impact B-3 Project construction could result in the removal or disturbance of "Special Aquatic Sites", including eelgrass beds, mudflats, and wetlands.

Eelgrass beds, mudflats, and wetlands are considered special aquatic sites and are subject to USACE jurisdiction under Section 404 of the Clean Water Act and to BCDC jurisdiction under Section 66605 of the McAteer-Petris Act. Eelgrass in the Bay provides spawning habitat for herring, serves as a nursery ground, and provides shelter for juvenile fish, among other functions. Mudflats serve as important foraging areas for shorebird species and provide shallow-water habitat for juvenile fish.

Wetlands, eelgrass and mudflats could be impacted from vessel wake if it is severe enough to cause shoreline erosion. This issue is addressed and mitigated in Section 3.3. Deepening areas to create channels could result in the permanent loss of these habitat types. In addition, eelgrass beds may be impacted indirectly during construction by sedimentation in areas adjacent to dredging operations. Potential removal or other disturbance causing degradation to eelgrass beds or mudflats would be considered a significant impact.

For the Proposed Project, locations that have the potential to include mudflats to varying degrees include Berkeley/Albany, Martinez, and Hercules/Rodeo. Hercules/Rodeo is the only location where dredging of an access channel would be required.

Known eelgrass beds are located near the entrance to the potential Richmond terminal and at the Harbor Bay location. Eelgrass may be affected by ferry operations (e.g., wake and prop wash) if vessels pass in close proximity to eelgrass beds. While known eelgrass beds have not been identified near other proposed terminals or near new routes, new sidescan sonar survey techniques have been identifying eelgrass in areas previously thought not to have eelgrass.

Potential wetland impacts are addressed under Impact B-1.

Summary of Impact B-3

- Impacts to Special Aquatic Sites could occur from dredging operations, construction of facilities, or severe erosion from wake wash. Any impacts to special aquatic sites would be considered significant. Special aquatic sites are identified on a regional level at Berkeley/Albany, Martinez, Richmond, and Hercules/Rodeo. However, Hercules/Rodeo is the only location where dredging of an access channel would be required. Without site-specific study, this impact is considered potentially significant.

Mitigation B-3.1: Disturbance of eelgrass beds and mudflats shall be avoided in the design of project features and routing of ferries. Site specific sidescan sonar surveys would be required prior to implementation of new routes or construction of new terminals to verify that eelgrass is not present.

Mitigation B-3.2: As part of the environmental studies and documentation for specific projects, specific areas of eelgrass beds and mudflats that could be impacted shall be specifically determined.

The general locations of eelgrass beds in the Bay were mapped in the late 1980s (Figures 3.5.15 through 3.5.17). Recent comprehensive mapping of eelgrass beds in the Bay has not been conducted. If any project construction were to occur in the vicinity of any of these known beds, updated mapping of the extent of the beds should be conducted. Methods include use of side-scan sonar techniques, possibly in conjunction with other techniques such as visual surveys. In addition, areas that are less than 3 meters deep may have a reasonable potential to support eelgrass while areas less than 1.5 meters deep have a moderate potential to support eelgrass. Areas such as these should be surveyed to determine the current status of eelgrass prior to design and construction, and this information shall be used to avoid or substantially minimize impacts.

In cases where impacts to eelgrass beds or mudflats are unavoidable, suitable compensatory mitigation shall be designed in consultation with the appropriate state and federal agencies such as the U.S. Army Corps of Engineers (USACE), the U.S. Environmental Protection Agency (USEPA), the California Department of Fish and Game (CDFG), the San Francisco Bay Regional Water Quality Control Board (RWQCB), and BCDC. However, it should be noted that very little eelgrass mitigation has been done in San Francisco Bay and that mitigation of eelgrass impacts may not be feasible or successful in all cases.

If impacts to eelgrass are unavoidable or impacts cannot be reduced to an acceptable level, compensation or offsetting mitigation shall be further investigated. Mitigation shall provide enhanced functions and values relative to the impacted special aquatic sites. A mitigation plan shall be prepared that identifies the specific habitat restoration methods, the criteria to be used for monitoring and evaluating the success of the mitigation effort, and a contingency plan if the mitigation fails.

Mitigation B-3.3: Indirect impacts to eelgrass beds from sedimentation shall be avoided or reduced through the use of silt curtains to protect the beds from sedimentation or other methods that would otherwise protect the eelgrass from turbidity plumes generated during dredging. Mitigation for indirect effects would need to be evaluated on a case-by-case basis as the techniques used may differ from site to site. For example, at a given location, the specific dredging requirements and the potential for sediment plume generation and specific areas that may be impacted by the sediment plume should be evaluated. If it appears eelgrass could be affected by sedimentation, then site-specific conditions (depth, etc.) and local tidal currents shall be assessed to determine the best way to deploy mitigation, such as silt curtains.

Impact After Mitigation: The applicability and potential for success of eelgrass impact mitigation should be determined on a site-specific basis. For some sites, impacts would be less than significant after implementation of Mitigations B-3.1 through B-3.3. However, for some sites, impacts could still be potentially significant.

3.5.2.3 Potential Effects on Plankton/Productivity

Impact B-4 **Turbidity caused by dredging would reduce light penetration in the water column and could locally reduce phytoplankton production.**

Dredging activity at the Hercules/Rodeo site or minor incidental dredging of other locations could cause increased sediment concentrations in the upper water column, reducing sunlight penetration, which in turn can reduce the depth of the zone in which phytoplankton are productive. Phytoplankton productivity is reduced at suspended sediment concentrations that may occur in estuaries during periods of high runoff or when wind and currents agitate sediments.

The Port of Oakland evaluated turbidity plumes associated with clamshell dredging operations for its 50-foot deepening project (Port of Oakland 1998). The results indicated that increases in turbidity tended to be localized, with the most concentrated portion of the plume located near the bottom and with decreasing concentrations nearer the surface. The studies showed that light transmissivity in a 13-meter (42-foot) water column decreased by approximately 5 percent (from 40 to 35 percent transmissivity) in near-surface waters, while transmissivity near the bottom decreased by as much as 35 percent (to only 5 percent transmissivity at the bottom).

Turbidity plumes are expected to dissipate quickly after dredging activities are completed. Sand settles very rapidly, in a matter of minutes. Silts settle more slowly, on the order of approximately 1.2 meters (4 feet) per day. Very fine clay particles can remain suspended in the water column for longer periods of time.

The impact of dredging and dredge material disposal on phytoplankton is expected to be localized to the dredging areas (within 100 to 200 meters) and to be short-lived because the material dissipates and settles relatively quickly out of the upper water column.

Due to the relatively small scale of dredging operations for the Proposed Project (Hercules/Rodeo only), with the potential for minor incidental dredging at other locations, it is unlikely that any of the necessary dredging would result in a reduction in phytoplankton productivity that would significantly affect Bay-wide production at other trophic levels (e.g., benthos, fish, etc.). However, each individual project should be reviewed with respect to dredging needs, sediment types, and local current conditions to evaluate the potential of a dredge plume at a given location.

No established threshold of significance exists for this impact; however, the impact of increased suspended solids on estuary zooplankton is not expected to be significant for the same reason stated above for phytoplankton: primarily because turbidity plumes are expected to be localized and short-lived.

Summary of Impact B-4

- The Proposed Project would require dredging at one potential known terminal location (Hercules/Rodeo). This dredging could cause turbidity plumes that could locally reduce phytoplankton productivity during the period that dredges are operating. This impact to productivity in the Bay is expected to be local and short-lived. No long-term impacts to plankton and productivity are expected from implementation of the Proposed Project. Therefore, this impact is anticipated to be less than significant. No mitigation is required.

3.5.2.4 Potential Effects on Benthos

Potential impacts to benthic (bottom dwelling) communities that could occur during construction of new terminals or dredging new channels include:

- Removal of benthic organisms during dredging operations and sedimentation on adjacent areas;
- Temporary loss of benthic prey items for larger animal species such as fish, birds, and mammals; and/or
- Potential reduction of native benthic species and increases or spread of nonnative species during the recolonization of bottom habitat disturbed by construction activities.

Impact B-5 **Disturbance of benthic habitat from dredging could result in the temporary loss of benthic (bottom dwelling) organisms.**

The Proposed Project would require construction dredging only for access at Hercules/Rodeo. Minor amounts of incidental dredging could be needed at other locations during installation or upgrading of existing facilities. Dredging of sediments for creation of channels could result in the temporary loss of benthic (bottom dwelling) organisms in dredged sediments. Some benthic species serve as sources of food for diving birds, fish, and mammals such as harbor seals. The loss of organisms could temporarily and locally decrease food resources.

In addition to the direct loss of organisms, additional organisms could be impacted by the settling of suspended sediments in areas adjacent to the dredging operations. This increased sedimentation could potentially bury fauna or clog feeding and respiration structures. The potential impacts of sedimentation would depend on the amount of dredging, current patterns, rate of accumulation, and the types of benthic organisms present. For example, burrowing organisms would likely be less impacted or could withstand deeper burial than surface and suspension feeding organisms, which do not possess a strong ability to burrow upward through newly deposited sediments. Studies reported by the Port of Oakland (1998) suggested that average critical burial depths ranged from 5 centimeters maximum for surface feeders to 30 centimeters for active burrowers.

Following dredging, disturbed areas are anticipated to recolonize first with opportunistic species. These species, characterized by rapid growth and reproduction, may not be the same species that were present in the area prior to the disturbance. Marine benthic invertebrates usually colonize disturbed sedimentary habitats via pelagic larvae that settle from the water column. Early colonists are often polychaete worms with opportunistic life histories, which includes short generation times, high number of larvae, and high mortality rates (Oliver et al. 1977; Lenihan and Oliver 1995; Conlan et al. 1998).

Routine maintenance dredging, if needed, would continue to periodically disturb the benthic community.

Summary of Impact B-5

- The Proposed Project would require construction dredging only at Hercules/Rodeo. The dredging would disturb approximately 9.8 acres, representing 0.003 percent of shallow benthic habitat in the Bay. This dredging would result in the removal of benthic organisms from the dredged areas. In addition, some loss or degradation of the benthos in areas immediately adjacent to the dredged areas is anticipated due to increased sedimentation. The disturbed areas are expected to recolonize with organisms once the dredging is complete; thus, benthic prey items would return. The temporary loss of benthic organisms is considered less than significant. No mitigation is required.

Impact B-6 **Disturbance of habitat by dredging may result in the spread of nonnative benthic invertebrate species.**

San Francisco Bay has been disturbed by a wide variety of human activities, including the introduction of nonnative benthic invertebrates (Cohen and Carlton 1995; Cohen 1996). Among the benthic infauna, the average number of introduced species is highest throughout the main estuary and into fresh-brackish water habitats (34-79 percent); is lower in the Central and South Bay marine muddy habitats (23 percent), and is lowest in the Central Bay sandy habitats (11 percent) (Lee et al. 1999). The opportunistic life histories of many introduced species are widely recognized; they are similar to early colonists in a natural succession. However, unlike early native colonists, some nonnative species can be strong competitors that persist and are not replaced by less opportunistic native species later in succession (Nichols and Thompson 1985). Certain nonnative species such as *Potamocorbula* appear to have a greater impact on the ecosystem than other species. Lee et al. (1999) indicate that although the Bay has been invaded by more than 200 species, only a small number, such as *Potamocorbula*, mitten crabs, and green crabs, are considered to pose a threat to ecosystem sustainability. Many of the nonnative species inhabiting the Bay serve ecological functions similar to native species.

Disturbance of sediments from dredging operations could lead to recolonization of the disturbed areas by increased densities of nonnative species. However, *Potamocorbula* is already widespread in the North Bay and may already be found in relatively high densities in areas that would be disturbed by the project (Peterson 1996). This, in addition to the fact that the areas that could be dredged under the Proposed Project are small relative to the available benthic habitat in the Bay (0.003 percent), this impact is not considered significant. The project would not result in the introduction of any new species to the Bay.

Summary of Impact B-6

The Proposed Project would require dredging to access a potential terminal location at Hercules/Rodeo. Recolonization after dredging could result in an increase in the number of nonnative species, or an increase in the number if individuals of a particular nonnative species, in the disturbed areas. Many nonnative species serve ecological functions similar to native species, though some species, such as *Potamocorbula*, can have a greater impact on the ecosystem. *Potamocorbula* however, is already relatively widespread in North Bay areas that would be likely disturbed. The areas that could be dredged are small relative to the available benthic habitat in the Bay and this impact is considered less than significant.

3.5.2.5 Potential Impacts on Fish

Impact B-7 **Dredging could adversely impact fish species near the construction activities.**

Construction dredging would only be potentially necessary at the Hercules/Rodeo terminal site. Increased turbidity levels caused by dredging can adversely affect dissolved oxygen levels in the water and oxygen uptake by fish in the immediate vicinity of the plume due to clogged or lacerated gills. Studies cited by the Port of Oakland indicated that juvenile Chinook salmon showed damage to the gill tissues after exposure to suspended solids concentrations of 1,547 mg/L for 96 hours. Because fish tend to avoid areas of high turbidity and return when concentrations of suspended solids are lower, impacts are generally expected to be minimal. Nevertheless, dredging at the Hercules/Rodeo location, where fish might migrate or could not avoid the sediment plume, could be potentially significant. Impacts due to dredging are discussed further under Impact D-4 (Section 3.1). Similar impacts could result during maintenance dredging.

Summary of Impact B-7

- The Proposed Project would require dredging at one terminal location, and this action has the potential to adversely affect fish species and movements. This impact is considered potentially significant.

Mitigation B-7.1: Mitigation for Impact B-7 is the same as discussed under Impact D-4.

Impact After Mitigation: Impact B-7 would be reduced after implementation of dredging Mitigations D-4.1 and D-4.2 (Section 3.1). Implementation of site-specific mitigation measures at the project level would further reduce Impact B-7 to less than significant levels.

Impact B-8 **Dredging and associated turbidity could affect spawning by Pacific herring.**

Increased turbidity and sedimentation could adversely affect Pacific herring (*Clupea harengus*), a commercially important species that spawns in the Bay. However, herring spawning generally occurs in the central portion of the Bay (Figure 3.5.6). Proposed Project terminals within known herring spawning boundaries include Mission Bay, Harbor Bay Island, Berkeley/Albany, and Richmond. No new dredging would be required for access channels any of these terminals.

Summary of Impact B-8

- The Proposed Project would not require dredging at locations in the Bay used by herring to spawn. This impact would be considered less than significant.

Impact B-9 **Underwater noise from pile driving and other construction activities could impact nearby fish.**

Fish could be temporarily displaced by noise from construction activities (barges, workboats, etc.), but would return once the construction activities ceased.

Construction activity associated with pile driving would result in increased underwater noise and acoustic pressure waves. Underwater noise and acoustic pressure resulting from pile driving could affect aquatic resources by causing behavioral avoidance of the construction area and/or sublethal or lethal effects on sensitive species. Fish mortality resulting from pile driving activities could be considered a significant impact, particularly if the activity results in take of listed species such as winter-run chinook.

The severity of adverse effects on fish (e.g., behavioral avoidance) depends upon a number of factors, including the concentration and location of fish within the area, species-specific differences in sensitivity to acoustic pressures, the depth of water, bottom- and surface-water characteristics, and the type of pile (steel, concrete, and hammer size). Exposure to sound pressure levels in water associated with pile driving also decreases exponentially as a function of the distance from the source.

Sound pressure levels of 180 dB re 1 μPa are known to cause permanent injury to the lateral line and inner ear of fish (Hastings et al. 1996). Damage to these organs results in disorientation and the inability to locate food and avoid predators. Exposure to low-frequency underwater sound may also result in reduced hatching rates of fish eggs and reduced larval fish survival. Fish eggs are known to be especially vulnerable to vibration and acoustic pressure waves during the first few days after fertilization. Fish larvae and small juvenile fish have been found to be much more vulnerable to elevated sound pressure levels than adult fish (Yelverton et al. 1975).

Although specific designs are not available, it is assumed that any piles needed to construct terminal facilities would likely be small (24 to 36 inches in diameter) and would likely be concrete as is typically used in these applications. Concrete piles tend to generate lower underwater sound pressure levels than steel piles. In addition, smaller piles need much smaller hammers, resulting in lower underwater sound pressure levels than large piles. Pile driving for terminal facilities would be very unlikely to generate sound pressure levels even close to those referenced above. Therefore, it is not expected that significant fish mortalities would result from driving small concrete piles. However, further analysis would be needed once specific designs and specifications for individual projects are known.

Recent experience in San Francisco Bay during a pile installation test for the Bay Bridge East Span indicated that the use of large pile drivers can result in the mortality of fish that have swim bladders (Caltrans 2001). Pile driving for the Bay Bridge East Span test resulted in fish mortalities. The Bay Bridge project, however, is using large (8-foot diameter, approximately 300-foot) steel piles and some of the largest pile driving hammers available. Fish mortality has also occurred at the construction site of the new Benicia-Martinez Bridge on the Carquinez Strait, again using relatively large-diameter steel piles. Widening of the San Mateo Bridge required the driving of 900-1,200 concrete piles with 2- to 3-foot diameters. No fish kills were reported during this pile driving operation (Morrow 2003). Pile driving for terminal facilities would likely include small diameter concrete piles and would be unlikely to have the same sorts of impacts as much larger-scale bridge projects.

Summary of Impact B-9

- The Proposed Project could require pile driving. Fish mortality from this activity is unlikely, although it could be a potentially be a significant impact if it were to occur.

Mitigation B-9.1: Mitigation for this potential impact shall be evaluated on a site-specific basis. Once specific designs and construction specifications for a particular site are known, sound pressure levels shall be estimated to the extent possible. During initial pile driving efforts, the area around the in-water pile driving activities shall be monitored for signs that fish are being injured (e.g., floating on the surface, birds moving in to prey on dead or injured fish). Measures to reduce sound pressure levels in surrounding waters, such as placing bubble jackets surrounding the piles, shall be deployed if sound pressure levels exceed those that could harm fish.

Impact After Mitigation: Impact B-9 would be less than significant with successful implementation of Mitigation B-9.1.

3.5.2.6 Potential Impacts on Birds

Impact B-10 **Construction could result in loss of habitat for waterfowl, shorebirds and other birds.**

Construction in tidal wetlands and dredging of mudflats could result in the loss of foraging, roosting, and possibly nesting habitat for various bird species. The impact would be site-specific and would depend on the design and specific location of terminal facilities and access channels. Loss of habitat could be considered a potentially significant impact. The impacts to general habitat are further discussed under Impacts B-1 and B-3.

Summary of Impact B-10

- The Proposed Project could potentially result in significant habitat impacts due to new construction.

Mitigation B-10.1: Mitigation for Impact B-10 is the same as for Impacts B-1 and B-3.

Impact After Mitigation: Impact B-10 would be less than significant with successful implementation of Mitigation B-1.1 and/or Mitigations B-3.1 through B-3.3.

Impact B-11 **Ferry traffic could disturb roosting, rafting, and foraging waterfowl in the Bay.**

San Francisco Bay is an important stopover for many species of migratory waterfowl in the Pacific Flyway. Waterfowl are sensitive to the noise level, speed, size, and visual effects of travelling vessels, and generally react to this disturbance by flushing (taking flight away from the area of disturbance). Huffman (1999) noted that after repeated disturbance events, the number of birds in an area would decrease and subsequent disturbances resulted in greater proportions of birds leaving the area. Birds generally returned to an area after a 10- to 35-minute period of no disturbance. The degree of tolerance to disturbance from vessel traffic varies greatly depending upon the species, tide, flock characteristics, location, and season (Davidson and Rothwell 1993; Mori et al. 2001; Keopff and Dietrich 1986 in Hockin et al. 1992). Surf scoters, canvasback, and lesser scaup appear to be more sensitive than other species (Goals Project 2000; Korschgen and Dahlgren 1992; Korschgen et al. 1985; Huffman 1999).

When waterfowl flush or take flight when disturbed, they often circle several times before landing (Huffman 1999). Flying is a high-energy activity for waterfowl (Korschgen and Dalhgren 1992) and frequent flying due to human disturbance may take away from the energy reserves that would normally be used to complete migration. Large flocks appear to be more susceptible to disturbance than small flocks and canvasback and scaup are especially vulnerable (USFWS 1992; Mori et al. 2001).

The projected ferry routes for the Proposed Project would bisect shallow areas of the Bay that are used as foraging and roosting areas for diving birds, particularly surf scoter, canvasback, lesser and greater scaup, and ruddy duck. Other waterfowl, such as dabbling ducks, typically use habitat such as salt ponds and marshes more frequently than open-water habitat in the Bay (Accurso 1992), and may be less impacted by disturbance from ferries.

Most routes for the Proposed Project would be in deeper channel areas and areas where ship traffic routinely travels. The largest number of transects would occur in the Central Bay, where large rafts of birds do not generally occur due to the deeper waters found there. Most of the Proposed Project routes are located in areas where existing ferry and other ship traffic occurs. Figures 3.5.7 and 3.5.8 indicate use of the shallow areas by waterfowl relative to potential ferry routes. Only the Hercules/Rodeo terminal location would cross a shallow area not routinely used by vessel traffic. Routes to Oyster Point and Redwood City would also cross shallow areas used by waterfowl. These areas currently experience relatively light vessel traffic, and under the Proposed Project would experience more routine disturbance. This disturbance would not result in a permanent loss of habitat, but rather the area of habitat where disturbance may take place. Waterfowl may use these areas when ferries are not present.

There is evidence that waterfowl habituate to repeated disturbances and avoid areas that experience routine disturbance. For example, studies in Denmark showed that waterfowl annually redistributed themselves to areas of lesser routine disturbance, depending on which areas of a lake were set up as refuges (Madsen 1994). This suggests that waterfowl may become accustomed to the ferry traffic and avoid the direct path of the vessel routes. If birds avoided the vessel corridors, this would potentially reduce the frequency of disturbance to the birds and lessen the likelihood that birds would be struck by the vessels.

Increasing the frequency of flushing of waterfowl could be potentially significant.

Summary of Impact B-11

- The Proposed Project would add ferry routes that would bisect some areas of waterfowl roosting and foraging habitat. Large portions of roosting and foraging habitat in San Pablo Bay in the North and the South Bays would remain undisturbed by ferry traffic. An increase in the frequency of flushing of waterfowl flocks would be considered potentially significant.

Mitigation B-11.1: Ferry routes shall be consolidated within common corridors, travel down deeper channel areas as much as possible, and choose the shortest routes across shallow areas to leave as much undisturbed shallow open-water habitat as possible.

Mitigation B-11.2: Response of waterfowl to new ferry routes in shallow North and South Bay roosting, rafting, and foraging habitat shall be evaluated. Evaluation could include observations of ferry operations and waterfowl responses by an authority such as the Point Reyes Bird Observatory (PRBO).

Impact After Mitigation: This impact would be considered less than significant after implementation of Mitigations B-11.1 and B-11.2.

3.5.2.7 Potential Effects to Marine Mammals

Impact B-12 **Increased turbidity and activity from dredging operations could affect marine mammal foraging.**

Increased turbidity during dredging may disturb foraging activities by decreasing visibility, and removing benthic prey. Figure 3.5.14 shows haul-out and feeding areas. Dredging would only occur for the Hercules/Rodeo Terminal in a total area slightly less than 10 acres. Marine mammals typically are well adapted to low light levels because they feed deep in the water column, often at night, and in areas with decreased visibility. The effects of localized turbidity plumes during dredging are not expected to be significant. It is likely that most dredging would take place during daylight hours.

Dredging could also temporarily remove or displace benthic prey species for marine mammals (e.g., small bottom fish such as gobies fed on by seals or amphipods fed on by gray whales). This impact is not expected to be significant due to the localized nature of the dredging impacts and the relatively large feeding ranges of marine mammals in the Bay.

Summary of Impact B-12

- The Proposed Project would require construction dredging at only one location (Hercules/Rodeo), causing localized increases in turbidity. Because this location is not near any known haul-out or feeding locations, this impact is considered less than significant to marine mammal populations in the Bay.

Impact B-13 **Underwater pile driving noise could disturb marine mammals.**

If pile driving in aquatic environments is required under the Proposed Project, construction could result in temporary disturbance to foraging or migrating marine mammals. Under the Marine Mammal Protection Act of 1972 (amended in 1994), intentional harassment of marine mammals is forbidden. Harassment is defined under the Act as "any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption to migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment)." Pile driving activities would be considered Level B harassment.

NMFS considers, as a guideline, underwater sound pressure levels at or above 160 dB re 1 μPa as constituting harassment to marine mammals. Studies have suggested that sound pressure levels above 180 dB re 1 μPa can cause temporary hearing impairment in marine mammals. Caltrans (2001a) measured sound pressure levels exceeding this guideline in areas near the installation of a test pile for the Bay Bridge East Span Project. It should be noted that these were very large piles, using some of the largest pile driving hammers available. Pile driving of this magnitude is not expected for the Proposed Project.

Several studies have been conducted on the behavioral reactions of marine mammals to underwater sounds. As reported in a summary of these studies by Richardson et al. (1995), reactions often involved cessation of feeding, resting, or social interaction, and increased alertness or avoidance behaviors. Avoidance reactions in pinnipeds (seals and sea lions) often involved movement from haul-out sites to water (or vice versa).

The potential for adverse underwater sound pressure levels during construction would depend largely on whether in-water piles are necessary for terminal or docking facilities, the types and sizes of piles necessary, the substrate and depth of the area where piles are needed, and the proximity of pile driving activities to sensitive areas such as haul-out and feeding locations. Any work that could result in sound pressure levels exceeding NMFS guidelines would be considered significant. However, as discussed in Impact B-9, pile driving for terminal facilities would involve much smaller (24- to 36-inch-diameter) piles than the piles used for the Bay Bridge project, and sound pressure levels are unlikely to be above the NMFS guideline values.

Known haul-out sites are shown on Figure 3.5.14. Most potential new construction would not occur near major haul-out sites. Redwood City, however, is near a haul-out site.

Summary of Impact B-13

- The Proposed Project could require in-water pile driving for potential new and existing terminal locations. Most potential new construction would not occur near major haul-out sites. Redwood City, however, is near a haul-out site. The need, extent, and location of any pile driving is unknown at this time. Impacts to marine mammals from this activity, however, would be considered potentially significant if sound pressure levels exceeded NMFS guidelines.

Mitigation B-13.1: An Incidental Harassment Authorization from NMFS may be required for pile driving activities, particularly if activities are to occur near sensitive areas such as haul-out sites. Redwood City is near a haul-out site. Pre-construction surveys shall be conducted to determine use of the area by marine mammals before pile driving begins. Marine mammal monitoring shall be conducted during construction in conjunction with underwater noise monitoring. A "safety zone" shall be established based on the initial monitoring. Pile driving activities shall not commence until marine mammals are not sighted within the safety zone for approximately 15 to 30 minutes.

Impact After Mitigation: Impact B-13 would be less than significant after implementation of Mitigation B-13.1.

Impact B-14 Transiting ferries could disturb marine mammals resting at haul-out sites.

Haul-out sites are areas where seals and sea lions pull themselves from the water to rest. Some of these sites are also used for breeding and raising pups. Known haul-out locations around the Bay are shown on Figure 3.5.14.

Ferry routes for the Proposed Project are generally well away from most haul-out sites in the Bay. However, existing routes pass near Yerba Buena Island and Castro Rocks, two major haul-out sites in the Bay.

Ferries passing near sensitive areas such as haul-out sites could potentially disturb seals using these areas. Human activities have been shown to adversely affect the behavioral patterns of marine mammals. Seals react to both visual and acoustic disturbances (Richardson et al. 1995). According to Green et al. (2001), the primary sources of disturbance for harbor seals in San Francisco Bay are boats, kayaks, jet skis, aircraft, foot traffic, and dogs in the vicinity of haul-out sites. Disturbance sources that occur closer to the animals tend to provoke a stronger negative response. Long-term exposure to disturbance can result in separation of mothers and pups and the potential for outright abandonment on a haul-out site (Lowe 2002).

Green et al. (2001) found that watercraft, especially those that exhibit erratic movements, are a common disturbance to seals on San Francisco Bay. Green et al. conducted studies of disturbances at Castro Rocks and Yerba Buena Island. They found that the average distance at which watercraft caused animals to flee the site (flush) was approximately 183 meters at Castro Rocks and approximately 133 meters at Yerba Buena Island. Larger boats, such as tugboats and ferries, tended to cause a flush at greater distance than smaller watercraft such as jet skis and kayaks. For example, at Castro Rocks, larger watercraft caused a flush at an average of approximately 264 meters (range 121 to 511 meters) while jet skis and kayaks caused a flush at an average of approximately 150 meters (range 10 to 500 meters). Watercraft that exhibit erratic movements such as sudden changes in speed or direction were more likely to cause a disturbance than those traveling at steady speeds, at slow speeds, and in a constant direction (Green et al. 2001; Kopec and Harvey 1995).

Summary of Impact B-14

- The Proposed Project includes existing routes that pass near seal haul-out sites, in particular Yerba Buena Island and Castro Rocks. Passing too close and disturbing marine mammals at these locations would be considered potentially significant.

Mitigation B-14.1: Although NMFS does not regulate normal watercraft operations or require Incidental Harassment Authorizations for regular shipping and pleasure craft operations (Fahy 2002), NMFS does have guidelines, outlined below, for avoidance of marine mammals to reduce disturbance.

NMFS Guidelines

Animal or Sensitive Site	Minimum Distance
Whales	91 meters (100 yards)
Pinnipeds (seals and sea lions)	46 meters (50 yards) in water 91 meters (100 yards) from haul-out sites
Dolphins	46 meters (50 yards)

This guidance, however, does not take potential boat speeds and related wake effects into account. Distances discussed in the literature indicate that, in general, seals tend to flush at greater distances than those in the NMFS guidelines. Site-specific information available for San Francisco Bay (Castro Rocks) showed average disturbance from larger vessels occurring at distances of about 250 meters. Therefore, ferry routes shall be at least 100 to 250 meters from the Castro Rocks and Yerba Buena Island haul-out sites to reduce disturbance to the animals at these locations.

Impact After Mitigation: Impact B-14 would be less than significant after implementation of Mitigation B-14.1.

Impact B-15 **High-speed ferries could potentially strike gray whales in San Francisco Bay.**

Because of the increase in gray whale sightings in San Francisco Bay over the last several years, concern exists about collisions between whales and vessels during normal operations. As discussed in Section 3.5.1 (Environmental Setting), as the gray whale population in the Pacific has returned to historic levels, the number of whales entering San Francisco Bay during their migration has increased. Since this phenomenon of more frequent use of the Bay by whales is relatively recent, the length of time whales stay in the Bay and the average number of whales in the Bay at a given time are not well known.

An attempt to statistically estimate the probability of a vessel making contact with whales was made using an unpublished whale strike model as well as a Monte Carlo simulation. The whale strike model was developed by Tregenza et al. (www.chelonia.demon.co.uk) to predict the probability of a pilot whale being struck in the Canary Islands where ferries cross perpendicularly to a whale migration route. Both models assume that whale behavior is random, that is, the whales can statistically be at any location at any given time.

The Monte Carlo model was developed because initial runs of the whale strike model predicted a certainty (probability of 1) of a whale collision in a test case where a significant probability of no collision should have resulted. The Monte Carlo model was tested (calibrated) against known whale observations along the Larkspur ferry route. Again, a certainty of a whale collision was predicted in a situation where no collisions have actually occurred. Discussions of the models with ecological modeling specialists indicated the weakness of both models is that whale behavior in the Bay is not random. If whales were not actively avoiding ferries, and were traversing the Bay randomly, the statistical models predict there would be a large history of whale strikes. Since there have been no recorded whale strikes, whales are likely not migrating perpendicularly to ferry routes but are probably feeding at preferred locations and likely are actively avoiding ferry vessel routes. For a meaningful statistical prediction of a collision between a ferry and a whale to be made, it will be necessary to develop a greater understanding of whale behavior and movements in the Bay. As alluded to above, no documented collisions between gray whales and any type of vessel have occurred in San Francisco Bay (Cordero 2001). Whales have been stranded in the Bay and areas just offshore. However, it is often difficult to determine the exact cause of death. The fact that gray whales are sighted in the Bay, however, suggests that the potential exists for a ferry to strike a whale at some point. Any whale strike would be considered a significant impact.

Summary of Impact B-15

- The Proposed Project includes increased numbers of vessel transits across the Bay. Every transit represents a potential for a whale strike. Although the likelihood of a whale strike is very low, such a strike would be a significant impact.

Mitigation B-15.1: Ferry operators shall be aware of the potential for whales entering the Bay and should know hot to spot whales at the surface. The USCG reports whale sightings and distance to vessels when they receive a report of a whale sighting. Ferry captains shall be made aware of these reports and exercise diligence when a whale sighting has been reported.

The ferry system shall implement a program of informing ferry operators of whale sightings and locations. For example, if one captain sights a whale, it should be reported through a network to all other captains. Operators should be informed or reminded during seasonal periods of heightened whale activities or presence. If whale sightings continue to increase in the Bay, having dedicated lookouts on board or other detection equipment could be warranted, especially during certain times of the year. Devices (such as sound-generating equipment) used to scare whales from the area may be considered intentional harassment by NMFS and would not likely be allowed.

Mitigation B-15.2: Ferries shall be equipped with a whale detection system such as forward-looking sonar. Such a system is currently under development and being tested on a NOAA vessel in Cape Cod Bay.

Impact After Mitigation: Implementation of Mitigations B-15.1 and B-15.2 would reduce the chances of a whale strike; however, some probability, though small, would still remain of an accident occurring. One gray whale represents approximately 0.004 percent of the total estimated population of 26,000 whales along the Pacific coast, and the rare occurrence of a whale strike would not likely have an effect on long-term regional gray whale populations. However, the possibility of a whale strike is still considered potentially significant.

3.5.2.8 Potential Effects on Special-Status Species

Impact B-16 **Project construction and/or operation could result in the "take" of state or federally listed species or loss or degradation of these species' habitat.**

Activities that could affect listed species or their habitat include construction of ferry terminals, dredging or excavation near wetland habitats, or operational impacts such as wake effects on species such as California clapper rail. Wake effects are addressed in Impact B-20. Table 3.5.4 provides a comprehensive list of special status species in the Bay Area. Figures 3.5.10 through 3.5.12 show the relationship of the Proposed Project to known distributions of salt marsh harvest mouse, black rail, and California clapper rail.

"Incidental take" permits of fully protected species cannot be authorized by DFG. Fully protected species that may be affected by this project include salt marsh harvest mouse, California clapper rail and California black rail. Known distributions of salt marsh harvest mouse and/or suitable habitat include locations near the following proposed terminal locations: Antioch/Pittsburg, Martinez, and Redwood City. Black rail occur near Martinez. Clapper rail have known distributions near Martinez, Richmond, and Redwood City. Potential impacts to special status species would be addressed on a site specific basis.

Summary of Impact B-16

- The Proposed Project could potentially result in the take of listed species or loss of habitat due to new construction. The greater potential for impacts to listed species would be in or near wetland areas and primarily in the North and South Bay areas. This would be a potentially significant impact.

Mitigation B-16.1: Table 3.5.4 lists threatened, endangered, and other special-status species that could occur around the Bay Area. Terminal locations shall be reviewed for potential occurrence of listed species and habitat using the literature and tools such as the CNDDB. Field surveys by qualified biologists shall be conducted in areas of potential occurrence or with suitable habitat for listed species. Areas with listed species should be avoided.

In areas where construction of a terminal is could impact a listed species, either through construction disturbance or loss of resting, foraging, or breeding habitat, consultation shall be initiated with the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), and CDFG as required by the Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA). Specific mitigation measures will likely be required as a result of that consultation and must be incorporated into the specific project design or mitigation plan. Measures may include redesign of project features to avoid impacts to listed species or habitat or include restoration or creation of replacement habitat.

Mitigation B-16.2: Fully protected species that may be affected by this project include salt marsh harvest mouse, California clapper rail and California black rail. Proposed terminals and routes would be designed or located to avoid take of these species.

Impact After Mitigation: The significance of impacts after implementation of project-specific mitigation measures would need to be evaluated after design of those specific measures. Impacts could still be potentially significant.

3.5.2.9 Potential Water Quality Effects on Biological Resources

Impact B-17 **Construction and operation of terminal facilities could increase stormwater pollutant discharges and affect receiving water quality, which could, in turn, affect local biological resources.**

This impact is potentially significant and is addressed, along with mitigation, under Impact W-1.

Impact B-18 **Contaminated sediments could potentially become resuspended during construction and dredging operations and could cause toxicity to Bay organisms.**

Contaminated sediments exist at various locations in the Bay. Dredging of these sediments could release chemicals to the water column that could result in toxicity to Bay organisms. The potential release of sediment contaminants and mitigation measures are discussed in detail in Impact D-2 (Section 3.1). This is considered a potentially significant impact.

Impact B-19 **Increased numbers of ferry transits could bring an increased potential for fuel spills and water quality degradation in the Bay.**

Fuel spill could expose Bay fish and wildlife to toxic pollutants in fuels and oils. This potentially significant impact is addressed in Impact W-3.

3.5.2.10 Potential Wake Effects

Impact B-20 **Vessel wakes could potentially cause erosion and loss of wetland habitats, impact special-status species such as the clapper rail and salt marsh harvest mouse, and impact marine mammals through disturbance at or erosion of haul-out sites.**

These potentially significant impacts and mitigation measures are addressed in Section 3.3, Wake Analysis.

3.5.2.11 Potential Effects on Terrestrial Wildlife

Impact B-21 **Wildlife behavior and susceptibility to predation may be adversely influenced by an increase in lighting from terminal facilities and associated vehicle parking areas.**

New terminals could potentially be constructed in areas where new sources of light or glare could adversely impact wildlife. The Proposed Project includes nine new terminals. With the exception of one terminal (Hercules/Rodeo), all are within existing ports or developed maritime areas, and therefore would not likely have significant impacts.

Summary of Impact B-21

- The Proposed Project could potentially adversely impact wildlife through new sources of light or glare, especially at Hercules/Rodeo, where the terminal would not be in an area of existing maritime use. This impact could be potentially significant.

Mitigation B-21.1: New lighting should be directed on intended project areas and avoid surrounding wildlife habitat.

Impact After Mitigation: The impact is anticipated to be less than significant with implementation of Mitigation Measure B-21.1.

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Table 3.5.1
Common San Francisco Bay Fish Species Found in California Department of Fish and Game Beach Seine and Otter Trawl Catches

Scientific Name	Common Name
Acanthogobius flavimanus	yellowfin goby
Allosmerus elongatus	whitebait smelt
Alosa sapidissima	American shad
Amphistichus argenteus	barred surfperch
Amphistichus koelzi	calico surfperch
Atherinops affinis	topsmelt
Atherinopsis californiensis	jacksmelt
Citharichthys stigmaeus	speckled sanddab
Clevelandia ios	arrow goby
Clupea pallasi	Pacific herring
Cymatogaster aggregata	shiner surfperch
Dorosoma petenense	threadfin shad
Embiotoca jacksoni	black surfperch
Engraulis mordax	northern anchovy
Gasterosteus aculeatus	threespine stickleback
Genyonemus lineatus	white croaker
Hyperprosopon argenteum	walleye surfperch
Hypomesus pretiosus	surf smelt
Hypsopsetta guttulata	diamond turbot
Ilypnus gilberti	cheekspot goby
Lepidogobius lepidus	bay goby
Leptocottus armatus	Pacific staghorn sculpin
Menidia beryllina	inland silverside
Micrometrus minimus	dwarf surfperch
Morone saxatilis	striped bass
Mustelus henlei	brown smoothhound
Myliobatis californica	bat ray
Oncorhynchus tshawytscha	Chinook salmon
Ophiodon elongatus	lingcod
Paralichthys californicus	California halibut
Parophrys vetulus	English sole
Peprilus simillimus	Pacific pompano
Phanerodon furcatus	white seaperch
Platichthys stellatus	starry flounder
Pleuronichthys decurrens	curlfin turbot
Porichthys notatus	plainfin midshipman
Psettichthys melanostictus	sand sole
Raja binoculata	big skate
Rhacochilus toxotes	rubberlip seaperch
Rhacochilus vacca	pile perch
Sebastes auriculatus	brown rockfish
Spirinchus thaleichthys	longfin smelt
Symphurus atricauda	California tonguefish
Syngnathus leptorhynchus	bay pipefish
Triakis semifasciata	leopard shark
Tridentiger trigonocephalus	chameleon goby

Source: California Department of Fish and Game, Bay-Delta Monitoring Project, unpublished data.

Table 3.5.2
Percentage of All Waterfowl in San Francisco Bay by Region

Region	Percentage of all waterfowl	
Year	**1988-89**	**1989-90**
North Bay	20	42
Central Bay	17	17
South Bay	11	9

Source: Accurso 1990

Table 3.5.3
Percentages of Scaup, Canvasback, and Surf Scoter in the Overall Waterfowl Abundance in San Francisco Bay From 1988-1990

	Species					
	Scaup		Canvasback		Surf Scoter	
Year	**1988-1989**	**1989-1990**	**1988-1989**	**1989-1990**	**1988-1989**	**1989-1990**
North Bay	35	69	9.5	25.5	19	35
Central Bay	16	13	0.4	0.4	47	50
South Bay	18	13	1.9	1.7	16	14

Source: Accurso 1990

Table 3.5.4
Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
Mammals					
Guadalupe fur seal	*Arctocephalus townsendi*	T	T	NA	Coastal waters, islands, isolated, rocky haul-outs.
Right whale	*Balaena glacialis*	E	None	NA	Near shore in shallow waters, large bays
Sei whale	*Balaenoptera borealis*	E	None	NA	Temperate open seas, nearshore and offshore, from Gulf of Alaska to Baja California
Blue whale	*Balaenoptera musculus*	E	None	NA	Open waters, occasional inshore waters
Finback whale	*Balaenoptera physalus*	E	None	NA	Open waters, occasional inshore waters
Pacific western big-eared bat	*Corynorhinus townsendii townsendii*	SC	SC	NA	Humid coastal regions; roosts include caves, mines, and buildings
Berkeley kangaroo rat	*Dipodomys heermanni berkeleyensis*	SC	None	NA	Annual grassland, coastal scrub, chaparral, hardwood-conifer habitats (not specific to subspecies)
Southern sea otter	*Enhydra lutris nereis*	T	None	NA	Pacific Ocean nearshore marine waters; historically in San Francisco Bay
Gray whale	*Eschrichtius robustus*	D		NA	Open waters, occasional inshore waters
Right whale	*Eubalaena glacialis*	E	None	NA	Near shore in shallow waters, large bays
Steller sea lion	*Eumetopias jubatus*	T	None	NA	Isolated shoreline and rocky islands from San Mateo County north
Greater western mastiff bat	*Eumops perotis californicus*	SC	SC	NA	Chaparral-type areas with rock walls and low-growing vegetation, or trees
Harbor seal	*Phoca vitulina*	MMPA	None	NA	Shallow water; in and near mouths of rivers; sand bars
Sperm whale	*Physeter catodon*	E	None	NA	Temperate and tropical oceans, near continental shelf, from Bering Sea to equator
Long-eared myotis bat	*Myotis evotis*	SC	None	NA	Brush, woodland and forest habitats
Fringed myotis bat	*Myotis thysanodes*	SC	None	NA	Piñon-juniper forest, valley and foothill hardwood woodlands and hardwood-conifer forest
Long-legged myotis bat	*Myotis volans*	SC	None	NA	Woodlands, forests, chaparral, coastal scrub
Yuma myotis bat	*Myotis yumanensis*	SC	SC	NA	Open forests and woodlands near water
San Francisco dusky-footed woodrat	*Neotoma fuscipes annectens*	SC	SC	NA	Riparian woodland, hardwood forest, chaparral (not specific to subspecies)
Riparian woodrat	*Neotoma fuscipes riparia*	E	SC	NA	Brushy habitats with scattered trees

Table 3.5.4
Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
San Joaquin pocketmouse	*Perognathus inornatus*	PE	SC	NA	Dry, open grasslands or scrub areas, mostly on ridges or hillsides
Salt Marsh Harvest Mouse	*Reithrodonyomys raviventris*	E	E	NA	Coastal salt marsh, dense stands of pickleweed
Alameda Island mole	*Scapanus latimanus parvus*	SC	None	NA	Grassland, pasture, montane and valley foothill riparian, cropland, wet meadow, open forest (not specific to subspecies).
Salt-Marsh Wandering Shrew	*Sorex vagrans halicoetes*	SC	SC	NA	Salt marshes 6-8 feet above sea level where abundant driftwood is scattered throughout pickleweed.
California Sea Lion	*Zalophus californicus californianus*	MMPA	None	NA	Shallow water; on offshore rocks, sand bars, bays
Point Reyes jumping mouse	*Zapus trinotatus orarius*	SC	SC	NA	Riparian, grassland, and wet meadow habitats, also prefers habitat near coniferous forest (not specific to subspecies)
Birds					
Tricolored blackbird	*Agelaius tricolor*	SC	SC	NA	Open valleys and foothills in streamside timber, alfalfa and rice fields, blackberry thickets, tules and cattails on and around marshes and reservoirs
Grasshopper sparrow	*Ammodramus savannarum*	SC	None	NA	Grasslands, meadows, fields, pastures
Bell's sage sparrow	*Amphispiza belli belli*	SC	SC	NA	Chaparral, coastal scrub
Tricolored blackbird	*Agelaius tricolor*	SC	SC	NA	Open valleys and foothills in streamside timber, alfalfa and rice fields, blackberry thickets, tules and cattails on and around marshes and reservoirs
Golden Eagle	*Aquilla chrysaetos*	None	SC	NA	Mountainous areas, canyons, shrub-land and grasslands
Short-eared owl	*Asio flammeus*	SC	SC	NA	Meadows, grasslands, wetlands, irrigated land
Burrowing Owl	*Athene cunicularia*	None	SC	NA	Short-grass prairie and open space; associated with burrowing mammals such as ground squirrels
American bittern	*Botaurus lentiginosus*	SC	None	NA	Fresh and salt water marshes and wet meadows with tall emergents such as cattail and bulrush
Marbled murrelet	*Brachyramphus marmoratus*	T	E	NA	Mature Douglas fir and redwood forest within 56km (35mi) of the coast

Table 3.5.4
Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
Aleutian Canada goose	*Branta canadensis leucopareia*	D	None	NA	Streams, marshes, lagoons, and sea cliffs are used for breeding; winter habitat includes agricultural croplands and pastures.
Ferruginous hawk	*Buteo regalis*	SC	SC	NA	Undisturbed grassland and agricultural areas (winter)
Costa's hummingbird	*Calypte costae*	SC	None	NA	Desert scrub
Lawrence's goldfinch	*Carduelis lawrencei*	SC	None	NA	Valley foothill hardwood, valley foothill hardwood-conifer
Vaux's swift	*Chaetura vauxi*	SC	SC	NA	Redwood and Douglas fir forests with hollow trees and snags
Western Snowy Plover	*Charadrius alexandrinus nivosus*	T	None	NA	Sandy coastal beaches, salt pans, coastal dredges spoils sites, dry salt ponds, salt pond levees
Lark sparrow	*Chondestes grammacus*	SC	None	NA	Grazed grasslands, fields, pastures, city parks
Northern Harrier	*Circus cyaneus*	None	SC	NA	Nests and forages in salt marsh, freshwater marsh, and grassland habitats.
Olive-sided flycatcher	*Contopus borealis* (*cooperi*)	SC	None	NA	Mixed conifer, montane hardwood-conifer, Douglas fir, redwood, red fir, lodgepole forest
Black swift	*Cypseloides niger*	SC	SC	NA	Mountains and coastal cliffs
Hermit warbler	*Dendroica occidentalis*	SC	None	NA	Mature pine and coniferous forests
Short-tailed albatross	*Diomedea albatrus*	C	None	NA	Open ocean; majority of the species is found off the coast of Japan
White-tailed kite	*Elanus leucurus*	SC	FP	NA	Nests among dense-topped trees; forages in open grasslands, meadows or marshes
Little willow flycatcher	*Empidonax trailii brewsteri*	None	E	NA	Riparian habitat, dense willow thickets edging wet meadows or ponds (not specific to subspecies)
Horned Lark	*Eremophila alpestris*	None	SC	NA	Grasslands, meadows, fields, pastures and deserts
Pacific-slope flycatcher	*Empidonax difficilis*	SC	None	NA	Valley foothill and montane riparian, hardwood, and hardwood-conifer woodlands
Little willow flycatcher	*Epidonax traillii brewsteri*	None	E	NA	Riparian habitat, dense willow thickets edging wet meadows or ponds (not specific to subspecies)
American peregrine falcon	*Falco peregrinus anatum*	D	E	NA	Cliff ledges, particularly near shores and marshes

Table 3.5.4
Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
Common loon	*Gavia immer*	SC	SC	NA	Estuaries and subtidal marine habitats from September through May
Saltmarsh common yellowthroat	*Geothylpis trichas sinuosa*	None	SC	NA	San Francisco Bay region in fresh and saltwater marshes with thick continuous cover to water surface, tall grasses, tule patches and willows for nesting.
Bald Eagle	*Haliaeetus leucocephalus*	PD	E	NA	Seacoast, islands, sea cliffs, large lakes, large rivers, coastal lagoons
Harlequin duck	*Histrionicus histrionicus*	SC	SC	NA	coastal marine environments; breeds near fast-flowing rivers
Western least bittern	*Ixobrychus exilis hesperis*	SC	SC	NA	Emergent wetlands of cattail and tule
Loggerhead shrike	*Lanius ludovicianus*	SC	SC	NA	Open canopied valley and foothill hardwood, riparian; urban areas
California black rail	*Laterallus jamaaciensis coturniculus*	SC	SC	NA	Tidal salt marshes, freshwater and brackish marshes.
Lewis' woodpecker	*Melanerpes lewis*	SC	None	NA	Open pine-oak woodlands, coniferous forests, and riparian woodlands. Prefers burned and logged woodlands.
Suisun song sparrow	*Melospiza melodia maxillaris*	SC		NA	Intermixed stands of bulrush (*Scirpus* spp.), cattail (*Typha* spp.), and other emergent vegetation
San Pablo song sparrow	*Melospiza melodia samuelis*	SC		NA	Intermixed stands of bulrush (*Scirpus* spp.), cattail (*Typha* spp.), and other emergent vegetation
Alameda song sparrow	*Melospiza melodia pusillula*	SC	SC	NA	Salient emergent wetland
Long-billed curlew	*Numenius americanus*	SC	SC	NA	Intertidal mudflats of large estuaries, upland herbaceous areas, and cropland (winter)
Ashy storm-petrel	*Oceanodroma homochroa*	SC	SC	NA	Isolated coast and island nester
Brown pelican	*Pelecanus occidentalis*	E	E	NA	Nests on coastal islands, lacking ground predators; roost on piers, buys and other structures
Double-crested cormorant (rookery)	*Phalacrocorax auritus*	None	SC	NA	Coastal cliffs, offshore islands, and inland along lake margins; nests on ground or in tall trees.
California clapper rail	*Rallus longirostric obsoletus*	E	E	NA	Salt marshes dominated by pickleweed and cord grass
Bank swallow	*Riparia riparia*	SC	T	NA	Riparian vegetation, vertical banks or cliffs near streams, rivers, lakes, and

Table 3.5.4
Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
					oceans
Rufous hummingbird	*Selasphorus rufus*	SC	None	NA	Valley and foothill woodland, hardwood-conifer forest, riparian woodland, and chaparral during migration
Allen's hummingbird	*Selasphorus sasin*	SC	None	NA	Brushy slopes, chaparral, thickets and open coniferous forests
Red-breasted sapsucker	*Spyrapicus ruber*	SC	None	NA	Winters in lowland, cismontane habitats
California least tern	*Sterna antillarum*	E	E	NA	Flat, open areas along the coast near inshore estuaries, river mouths, or shallows, sandy ground with little or no vegetation, bays, freshwater ponds, channels, lakes1
Elegant tern	*Sterna elegans*	SC	SC	NA	Inland coastal waters, bays, estuaries, and harbors
Xantus' murrelet	*Synthliboramphus hypoleucus*	SC	SC	NA	Breeds on Channel Islands; winters in Monterey Bay and other coastal waters
Bewick's wren	*Thryomanes bewickii*	SC	None	NA	Chaparral, riparian forest, woodlands and conifer forest with brush understory
California thrasher	*Toxostoma redivivum*	SC	None	NA	Cismontane woodland, chaparral, and riparian woodland
Fish					
Green sturgeon	*Acipenser medirostris*	SC	SC	NA	Rivers and estuaries
Tidewater goby	*Eucyclogobius newberryi*	E	SC	NA	Upper end of lagoons in salinities less than 10 parts per thousand.
Delta smelt	*Hypomesus transpacificus*	T	T	NA	Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, river channels and sloughs
River lamprey	*Lampetra ayresi*	SC	SC	NA	Sacramento and San Joaquin Rivers and Delta; estuaries, rivers and creeks with fine gravel substrates
Pacific lamprey	*Lampetra tridentata*	SC	None	NA	Estuaries, rivers and creeks with fine gravel substrates
Central California Coho salmon	*Oncorhynchus kisutch*	T	E	NA	Between Punta Gordo and San Lorenzo River
Central Coast and Central Valley steelhead ESUs	*Oncorhynchus mykiss*	T	None	NA	Delta, Suisun Bay and associated marshes, San Francisco Bay west to the Golden Gate bridge is designated as suitable habitat.

Table 3.5.4
Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
Sacramento Valley winter-run Chinook salmon	*Oncorhynchus tshawytscha*	E	E	NA	Sacramento River from Keswick Dam (near Redding) south to Chipps Island, then west through Carquinez Strait, San Pablo Bay and San Francisco Bay
Central Valley spring-run Chinook salmon	*Oncorhynchus tshawytscha*	T	T	NA	Central Valley rivers and their tributaries, west to the Pacific Ocean
Central Valley fall/late-fall Chinook salmon	*Oncorhynchus tshawytscha*	C	SC	NA	Central Valley rivers and their tributaries, west to the Pacific Ocean
Sacramento splittail	*Pogonichthys macrolepidotus*	T	SC	NA	Fresh water from lower Sacramento and San Joaquin rivers down to Montezuma Slough (may extend to the mouth of Napa River at San Pablo Bay)
Longfin smelt	*Spirinchus thaleichthys*	SC	SC	NA	Moderately saline estuaries and lower reaches of rivers
Invertebrates					
Opler's longhorn moth	*Adela olplerella*	SC	None	NA	Serpentine soils, open grasslands, sandy soils; host plant is cream cups (*Platystemon californicus*)
Vernal pool fairy shrimp	*Branchinecta lynchi*	SC	None	NA	Vernal pools
Tomales isopod	*Caecidotea tomalensis*	SC	None	NA	Localized freshwater ponds or streams with still or nearly still water
Edgewood blind harvestman	*Calicina* (*Sitalcina*) *minor*	SC	None	NA	Open grassland with serpentine bedrock; seeps
Sandy beach tiger beetle	*Cicindela hirticollis gravida*	SC	None	NA	Sandy areas adjacent to non-brackish water along coast; found in dry sand of upper zone
Globose dune beetle	*Coelus globosus*	SC	None	NA	Coastal sand dunes; foredunes and sand hummocks with dune vegetation
Bay checkerspot butterfly	*Euphydryas editha bayensis*	T	None	NA	Grasslands containing native forbs where host plant dwarf plantain (*Plantago erecta*) is present, frequently on serpentine soils.
Black abalone	*Haliotes cracherodii*	C	None	NA	Mid to low rocky intertidal
White abalone	*Haliotes sorenseni*	E	None	NA	Rocky pinnacles and deep reefs in southern California; especially those off the channel islands. Lives at depths of a least 80 feet to over 200 feet
Ricksecker's water	*Hydrochara rickseckeri*	SC	None	NA	Freshwater habitats, restricted to the San Francisco Bay Area

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Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
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scavenger beetle					
Leech's skyline diving beetle	*Hydroporus leechi*	SC	None	NA	Freshwater predacious diving beetle
Bridges' Coast Range shoulderband snail	*Helminthoglypta nicklinianan bridgesi*	SC	None	NA	Grasslands of Alameda and Contra Costa counties
Mission blue butterfly	*Icaricia icariodoides missionensis*	E	None	NA	Coastal scrub, grassland; host plants are perennial lupines: *Lupinus albifrons, L. variicolor,* and *L. formosus*; preferred nectar plants of adults are coast buckwheat (*Eriogonum latifolium*) and golden aster (*Heterotheca sessiliflora*)
Marin elfin butterfly	*Incisalia mossii*	SC	None	NA	Coastal scrub with cliffs or rock outcrops; host plant is stonecrop (*Sedum spathulifolium*)
San Bruno elfin butterfly	*Incisalia mossii bayensis*	E	None	NA	Coastal scrub with cliffs or rock outcrops, north facing slopes; host plant is stonecrop (*Sedum spathulifolium*)
Bumblebee scarab beetle	*Lichnanthe ursina*	SC	None	NA	Coastal sand dunes from Sonoma County to San Mateo County
California linderiella fairy shrimp	*Linderiella occidentalis*	SC	None	NA	Vernal pools
Tiburon microblind harvestman	*Microcina tiburona*	SC	None	NA	Serpentine soils
San Francisco lacewing	*Nothochrysa californica*	SC	None	NA	Freshwater streams
Unsilvered fritillary butterfly	*Speyeria adiaste adiaste*	SC	None	NA	Redwood forest; food plant is Western heart's ease (*Viola ocellata*)
Callippe silverspot butterfly	*Speyeria callippe callippe*	E	None	NA	Grassy hillsides, chaparral, and oak woodland with native forbs; host plant a native violet (*Viola pedunculata)*
Mimic tryonia (California brackishwater snail)	*Tryonia imitator*	SC	None	NA	Coastal lagoons, estuaries, and salt marshes.
Reptiles and Amphibians					
California tiger salamander	*Ambystoma californiense*	C	SC	NA	Annual grassland and valley-foothill hardwood habitats, vernal pools and other seasonal water sources adjacent to underground refuges.

Table 3.5.4
Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
Silvery legless lizard	*Anniella pulchra pulchra*	SC	SC	NA	stabilized dune areas with coastal shrubs
Loggerhead turtle	*Caretta caretta*	T	None	NA	Open ocean, seldom California coast
Green (sea) turtle	*Chelonia mydas* (including *agassizi*)	T	None	NA	Warm-water bays and lagoons
Northwestern pond turtle	*Clemmys marmorata marmorata*	SC	SC	NA	Permanent or nearly permanent water with basking sites and upland for nest sites; can tolerate seawater for short periods of time, but prefer freshwater
Southwestern pond turtle	*Clemmys marmorata pallida*	SC	SC	NA	Permanent or nearly permanent water with basking sites and upland for nest sites; can tolerate seawater for short periods of time, but prefer freshwater
Leatherback turtle	*Dermochelys coriacea*	E	None	NA	Open ocean, California coast, bays and estuaries
Olive (Pacific) Ridley sea turtle	*Lepidochelys olivacea*	T	None	NA	Bay and lagoons, seldom in California
Alameda whipsnake	*Masticophis lateralis euryxanthus*	T	T	NA	Chaparral and other scrubland habitats
California horned lizard	*Phrynosoma coronatum frontale*	SC	SC	NA	Lowlands along sandy washes with scattered low bushes and open areas for sunning
California red-legged frog	*Rana aurora draytonii*	E	SC	NA	Lowlands and foothills with deep water remaining for at least 11 weeks; water source is usually associated with abundant emergent and/or shoreline vegetation
Foothill yellow-legged frog	*Rana boylii*	SC	SC	NA	Partly shaded, shallow streams and riffles with cobble size or larger rocky substrate
Western spadefoot toad	*Scaphiopus hammondii*	SC	SC	NA	Quiet streams and temporary pools in grassland, open chaparral, and pine-oak woodlands
San Francisco garter snake	*Thamnophis sirtalis tetrataenia*	E	E,FP	NA	Wetlands or grasslands near ponds, marshes, sloughs, and canals, and associated upland
Plants					
San Mateo thornmint	*Acanthomintha duttonii*	E	E	1B	Chaparral, grassland; serpentinite; Apr-Jun

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Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
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Franciscan onion	*Allium peninsulare* var. *franciscanum*	None	None	1B	Cismontane woodland, valley and foothill grassland; May-Jun
Napa false indigo	*Amorpha californica* var. *napensis*	None	None	1B	Chaparral, cismontane woodland; Apr-Jul
Large-flowered fiddleneck	*Amsinckia grandiflora*	None	None	1B	Cismontane woodland, valley and foothill grassland; Apr-May
Bent-flowered fiddleneck	*Amsinckia lunaris*	None	None	1B	Coastal bluff scrub, cismontane woodland, valley and foothill grassland; Mar-Jun
Santa Cruz manzanita	*Arctostaphylos andersonii*	SC	None	1B	Broadleafed upland forest, chaparral, coniferous forest; Nov-Apr
Mount Diablo manzanita					Chaparral; Jan-Mar
San Francisco manzanita	*Arctostaphylos hookeri* ssp. *franciscana*	SC	None	1B	Coastal scrub, chaparral, coastal prairie, coastal scrub, grassland; sandy; Mar-Aug
Presidio manzanita	*Arctostaphylos hookeri* ssp. *ravenii*	E	E	1B	Chaparral, coastal prairie, coastal scrub; serpentinite outcrop; Feb-Mar
San Bruno Mountain manzanita	*Arctostaphylos imbricata*	SC	E	1B	Chaparral, coastal scrub; rocky; Feb-May
Contra Costa manzanita	*Arctostaphylos manzanita* ssp. *laevigata*	None	None	1B	Chaparral; Jan-Feb
Montara manzanita	*Arctostaphylos montaraensis*	SC	None	1B	Chaparral, coastal scrub; Jan-Mar
Pacific manzanita	*Arctostaphylos pacifica*	SC	E	none	Chaparral, coastal scrub; sandstone outcrops
Pallid manzanita	*Arctostaphylos pallida*	T	E	1B	Chaparral, Foothill Woodland, Mixed Evergreen Forest; Dec-Mar
Kings Mountain manzanita	*Arctostaphylos regismontana*	None	None	1B	Chaparral, north coast coniferous forest; Jan-Apr
Marin manzanita	*Arctostaphylos virgata*	None	None	1B	Chaparral, north coast coniferous forest, closed cone coniferous forest; Jan-Mar
Marsh sandwort	*Arenaria paludicola*	E	E	1B	Freshwater marsh; May-Aug
Suisun Marsh aster	*Aster lentus*	None	None	1B	Brackish and freshwater marshes and swamps; May-Nov
Coastal marsh milk-vetch	*Astragalus pycnostachyus var. pycnostachyus*	None	None	1B	Coastal dunes, coastal salt marshes; Apr-Oct

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Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
Adobe milk-vetch	*Astragalus tener* var. *tener*	None	None	1B	Playas, adobe clay grasslands, vernal pools; Mar-Jun
Heartscale	*Atriplex cordulata*	None	None	1B	Chenopod scrub, saline or alkaline meadows; Apr-Oct
Britlescale	*Atriplix depressa*	None	None	1B	Chenopod scrub, meadows, playas, vernal pools, valley and foothill grassland; May-Oct
San Joaquin spearscale	*Atriplex joaquiniana*	None	None	1B	Alkaline meadows, playas, chenopod scrub, valley and foothill grassland; Apr-Oct
Big-scale balsamroot	*Balsamorhiza macrolepis* var. *macrolepis*	None	None	1B	Chaparral, cismontane woodland, valley and foothill grassland; Mar-Jun
Sonoma sunshine	*Blennosperma bakeri*	E	E	1B	Valley foothill grassland, vernal pools; Mar-May
Big tarplant	*Blepharizonia plumosa* ssp. *plumosa*	None	None	1B	Valley foothill grassland; Jul-Oct
Mount Diablo fairy-lantern	*Calochortus pulchellus*	None	None	1B	Chaparral, cismontane woodland, valley foothill grassland; Apr-Jun
Tiburon mariposa lily	*Calochortuns tiburonensis*	T	T	1B	Serpentine soils; Mar-Jun
Chaparral harebell	*Campanula exigua*	None	None	1B	Chaparral; May-Jun
Tiburon paintbrush	*Castilleja affinis* ssp. *neglecta*	E	T	1B	Serpentine soils; Apr-Jun
Holly-leaved ceanothus	*Ceanothus purpureus*	None	None	1B	Chaparral, cismontane woodland, often on volcanic substrates;Feb-Jun
Congdon's tarplant	*Centromadia parryi* ssp. *congdonii*	None	None	1B	Valley foothill grassland; Jan-Nov
San Francisco Bay spineflower	*Chorizanthe cuspidata var. cuspidata*	SC	None	1B	Coastal bluff scrub, coastal dunes, coastal prairies, coastal scrub; Apr-Aug
Robust spineflower	*Chorizanthe robusta var. robusta*	E	None	1B	Cismontaine woodland, coastal dunes, coastal scrub; Apr-Sep
Sonoma spineflower	*Chorizanthe valida*	E	E	1B	Sandy coastal prairie; Jun-Aug
Franciscan thistle	*Cirsium andrewsii*	None	None	1B	Broadleaved upland forest, coastal bluff scrub, sometimes serpentite soils; Mar-Jul
Fountain thistle	*Cirsium fontinale* var. *foninale*	E	E	1B	Chaparral, grassland; serpentinite seeps; Jun-Oct

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Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
Suisun Thistle	*Cirsium hydrophilum* var. *hydrophilum*	E	None	1B	Salt marshes and swamps; Jul-Sep
Mt. Tamalpais thistle	*Cirsium hydrophilum* var. *vaseyi*	None	None	1B	Broadleaved coniferous forest, chaparral, serpentite seeps; May-Aug
Compact cobwebby thistle	*Cirsium occidentale* var. *compactum*	SC	None	1B	Chaparral, coastal dunes; Apr-Jun
Presidio clarkia	*Clarkia franciscana*	E	E	1B	Coastal scrub, grassland; serpentine; May-Jul
South Bay clarkia	*Clarkia concinna* ssp. *automixa*	SC	None	1B	Cismontane woodlands; Apr-Jul
Round-headed Chinese houses	*Collinsia corymbosa*	None	None	1B	Coastal dunes; Apr-Jun. Believed by the CNPS to be extirpated from the San Francisco North USGS quadrangle.
San Francisco collinsia	*Collinsia multicolor*	None	None	1B	Closed cone coniferous forest, coastal scrub, sometimes serpentite soils; Mar-May
Point Reyes bird's-beak	*Cordylanthus maritimus* ssp. *palustris*	SC	None	1B	Coastal salt marshes; Jun-Oct
Hispid bird's-beak	*Cordylanthus mollis* ssp. *hispidus*	None	None	1B	Alkaline meadows, playas, valley foothill grassland; Jun-Sep
Soft bird's-beak	*Cordylanthus mollis* ssp. *mollis*	E	Rare	1B	Coastal salt marsh; Jul-Nov
Mount Diablo bird's-beak	*Cordylanthus nidularius*	None	Rare	1B	Serpentite soils in chaparral; Jul-Aug
Hoover's cryptantha	*Cryptantha hooveri*	None	None	1B	Valley foothill grassland; Apr-May
Santa Cruz cypress	*Cupressus abramsiana*	E	E	1B	Coniferous forest, chaparral, lower montane coniferous forest; sandstone or granitic
Clustered lady's-slipper	*Cypripedium fasciculatum*	SC	None	4	Coniferous forest; usually serpentinite seeps, streambanks; Mar-Jul
Hospital Canyon larkspur	*Delphinium californicum* ssp. *interius*	None	None	1B	Chaparral, cismontane woodland; Apr-Jun
Western leatherwood	*Dirca occidentalis*	None	None	1B	Broadleaved coniferous forest, closed cone coniferous forest, chaparral, cismontane woodland; Jan-Apr
San Mateo woolly	*Eriophyllum latilobum*	E	E	1B	Cismontane woodland; serpentinite; May-Jun

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Special-Status Species Potentially Occurring Within the WTA Ferry Service Expansion Area

Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
		Federal	State	CNPS	
sunflower					
Ben Lomond buckwheat	*Eriogonum nudum* var. *decurrens*	None	None	1B	Chaparral, cismontane woodland, lower montane coniferous forest; Jun-Oct
San Mateo woolly sunflower	*Eriophyllum latilobum*	E	E	1B	Serpentite soils in cismontane woodlands; May-Jun
Hoover's button celery	*Eryngium aristulatum* var. *hooveri*	SC	None	4	Vernal pools; Jul
Coast wallflower	*Erysimum ammophilum*	SC	None	1B	Chaparral, coastal dunes, coastal scrub; sandy, openings; Feb-Jun
Contra Costa wallflower	*Erysimum capitatus* ssp. *angustatum*	E	E	1B	Inland dunes; Mar-Jul
San Francisco wallflower	*Erysimum fransiscanum*	SC	None	4	Coastal dunes, coastal scrub, grassland; often serpentinite or granitic; Mar-Jun
Diamond-petaled California poppy	*Eschscholzia rhombipetala*	None	None	1B	Alkaline soils in valley foothill grasslands; Mar-Apr
N/A	*Fissidens pauperculus*	None	None	1B	North coast coniferous forest; moss
Hillsborough chocolate lily	*Fritillaria biflora* var. *ineziana*	None	None	1B	Cismontane woodland, grassland; serpentinite; Mar-Apr
Marin checker lily	*Fritillaria lanceolata* var. *tristulis*	None	None	1B	Coastal bluff scrub, prairie scrub; Feb-Apr
Fragrant fritillary	*Fritillaria liliacea*	SC	None	1B	Coastal prairie, coastal scrub, grassland; often serpentinite; Feb-Apr
Dune gilia	*Gilia capitata ssp. chamissonis*	None	None	1B	Coastal dunes, coastal scrub; Apr-Jul
Woolly-headed gilia	*Gilia capitata* ssp. *tomentosa*	None	None	1B	Rocky outcrops in coastal bluff scrub; May-Jul
Dark-eyed gilia	*Gilia millefoliata*	None	None	1B	Coastal dunes; Apr-Jul
San Francisco gumplant	*Grindelia hirsutula* var. *maritima*	SC	None	1B	Coastal bluff scrub, coastal scrub, grassland; sandy, serpentinite; Aug-Sept
Marsh gumplant	*Grindelia stricta* var. *angustifolia*	None	None	4	Coastal salt marsh, northern coastal scrub; Aug-Sep
Diablo helianthella	*Helinathella castanea*	SC	None	1B	Broadleafed upland forest, chaparral, cismontane woodland, coastal scrub,

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Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
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					riparian woodland, grassland; Apr-Jun
Tiburon tarplant	*Hemizonia multicaulis* ssp. *vernalis*	SC	None	None	Annual grassland
Pappose spikeweed	*Hemizonia parryi* ssp. *congdonii*	SC	None	1B	Grasslands; alkaline
Brewer's western flax	*Hesperolinon breweri*	None	None	1B	Chaparral, cismontane, serpentite soils in valley foothill grassland; May-Jul
Marin dwarf flax	*Hesperolinon congestum*	T	T	1B	Chaparral, grassland; serpentinite; Apr-Jul
Loma Preita hoita	*Hoita strobilina*	None	None	1B	Chaparral, serpentite soils in cismontane woodland; May-Oct
Santa Cruz tarplant	*Holocarpha macradenia*	T	E	1B	Coastal prairie, grasslands; often clay; Jun-Oct
Kellogg's (wedge-leaved) horkelia	*Horkelia cuneata* ssp. *sericea*	SC	None	1B	Coniferous forest, chaparral, coastal scrub; Apr-Sep
Point Reyes horkelia	*Horkelia marinensis*	SC	None	1B	Coastal dunes, coastal prairie, coastal scrub; sandy; May-Sept
Thin-lobed horkelia	*Horkelia tenuiloba*	None	None	1B	Broad leaved forest, chaparral; May-Jul
Carquinez goldenbush	*Isocoma arguta*	None	None	1B	Alkaline valley foothill grassland; Aug-Dec
Northern California black walnut	*Juglands hindsii*	None	None	1B	Riparian forest and woodland; Apr-May
Contra Costa goldfields	*Lasthenia conjugens*	E	None	1B	Grasslands, vernal pools; Mar-Jul
Delta tule pea	*Lathyrus jepsonii* var. *jepsonii*	SC	None	1B	Freshwater and brackish water marshes; May-Jun
Beach layia	*Layia carnosa*	E	E	1B	Coastal dunes, coastal scrub; Mar-Jul
Legenere	*Legenere limosa*	SC	None	1B	Vernal pools; Apr-Jun
Crystal Springs lessingia	*Lessingia arachnoidea*	SC	None	1B	Cismontane woodland, coastal scrub, grassland; serpentinite; Jul-Oct
San Francisco lessingia	*Lessingia germanorum*	E	E	1B	Coastal scrub, remnant dunes; Jun-Nov
Tamalpais lessingia	*Lessingis micradenia* var. *micradenia*	None	None	1B	Chaparral, serpentite soils in valley foothill grassland; Jun-Oct
Mason's lilaeopsis	*Lilaeopsis masonii*	None	Rare	1B	Brackish and freshwater marshes and swamps; Apr-Nov
Coast yellow linanthus	*Linanthus croceus*	None	None	1B	Coastal bluff scrub, prairie; May

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Common Name	Scientific Name	Status			Supporting Habitat/Flowering Period
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San Mateo tree lupine	*Lupinus arboreus* var. *eximius*	SC	None	3	Chaparral, coastal scrub; Apr-Jul
Showy madia	*Madia radiata*	None	None	1B	Cismontane woodland, valley foothill grassland; Mar-May
Arcuate bush mallow	*Malacothamnus arcuatus*	None	None	1B	Chaparral; Apr-Sep
Hall's bush mallow	*Malacothamnus hallii*	None	None	1B	Chaparral, coastal scrub; May-Sep
Oregon meconella	*Meconella oregana*	None	None	1B	Coastal prairie, coastal scrub; Mar-Apr
Marsh microseris	*Microseris paludosa*	None	None	1B	Closed cone coniferous forest, cismontane woodland; Apr-Jun
Baker's navarretia	*Navarretia leucocephala* ssp. *bakeri*	None	None	1B	Cismontane woodland, lower montane woodland; May-Jul
Prostrate navarretia	*Navarretia prostrata*	None	None	1B	Coastal scrub, alkaline valley foothill grassland, coniferous forest; Apr-Jul
Marin County navarretia	*Navarretia rosulata*	None	None	1B	Coastal scrub, alkaline valley foothill grassland; Apr-Jun
Colusa grass	*Neostapfia colusana*	T	E	1B	Vernal pools; Mar-Aug
Antioch Dunes evening-primrose	*Oenothera deltoides* ssp. *howellii*	E	E	1B	Inland dunes; Mar-Sep
Dudley's lousewort	*Pedicularis dudleyi*	SC	R	1B	Chaparral, cismontane woodland, coniferous forest, grassland; Apr-Jun
White-rayed pentachaeta	*Pentachaeta belliciflora*	E	E	1B	Valley and foothill grassland; often serpentinite; Mar-May
Mount Diablo phacelia	*Phacelia phacelioides*	None	None	1B	Chaparral, cismontane woodland; Apr-May
Choris's popcornflower	*Plagiobothrys chorisianus* var. *chorisianus*	None	None	1B	Chaparral, coastal prairie; Mar-Jun
San Francisco popcornflower	*Plagioobothrys diffusus*	None	E	1B	Coastal prairie, valley and foothill grasslands; Apr-Jun
North Coast semaphore grass	*Pleuropogon hooverianus*	None	None	1B	Broadleaved upland forest, meadows, freshwater marshes and swamps; May-Aug
Hickman's potentilla (cinquefoil)	*Potentilla hickmanii*	E	E	1B	Coastal bluff scrub, coniferous forest, vernally mesic meadows, freshwater marsh; Apr-Aug
Tamalpais oak	*Quercus parvula* var. *tamalpaisensis*	None	None	1B	Lower montane coniferous forest; Mar-Apr
Adobe sanicle	*Sanicula maritima*	None	None	1B	Chaparral, coastal prairie, meadows, grassland; serpentine soils; Feb-May

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Rock sanicle	*Sanicula saxatilis*	None	Rare	1B	Broadleaved coniferous forest, chaparral, valley foothill grassland; Apr-May
Point Reyes checkerbloom	*Sidalcea calycosa* ssp. *rhizomata*	None	None	1B	Freshwater marshes and swamps near coast; Apr-Sep
Marin checkermallow	*Sidalcea hickmanii* ssp. *viridis*	SC	None	1B	Chaparral; serpentinite; May-Jun
Mission Dolores campion	*Silene verecunda* ssp. *verecunda*	SC	None	1B	Open, grassy areas in sandy or rocky soils; Mar-Aug
Pacific cordgrass	*Spartina foliosa*	SC	None	None	Coastal salt marshes
Santa Cruz microseris	*Stebbinsoseris decipiens*	None	None	1B	Broadleaved coniferous forest, closed cone coniferous forest, chaparral; Apr-May
Most beautiful jewelflower	*Streptanthus albidus* ssp. *peramoenus*	SC	None	1B	Chaparral, grassland; serpentinite; Apr-Jun
Tamalpais jewelflower	*Steptanthus batrachopus*	None	None	1B	Closed cone coniferous forest, serpentite chaparral; Apr-Jun
Mt. Tamalpais jewelflower	*Streptanthus glandulosus* ssp. *pulchellus*	None	None	1B	Chaparral, serpentite valley foothill grassland; May-Jul
Mt. Diablo jewelflower	*Streptanthus hispidus*	None	None	1B	Chaparral, valley foothill grassland; Mar-Jun
Tiburon jewelflower	*Streptanthus niger*	E	E	1B	Serpentine soils; May-Jun
California sea blite	*Suaeda californica*	E	None	1B	Coastal salt marshes and swamps; Jul-Oct
Showy Indian clover	*Trifolium amoenum*	E	None	1B	Wet swales, grasslands and grassy hillsides; occasionally found on serpentine soils; Apr-Jun
Saline clover	*Trifolium depauperatum* var. *hydrophilum*	None	None	1B	Vernal pools, valley grassland, mixed evergreen forests; Apr-Jun
San Francisco owl's clover	*Triphysaria floribunda*	None	None	1B	Coastal prairie, coastal scrub, serpentite grassland; Apr-Jun
N/A	*Triquetrella californica*	None	None	1B	Coastal bluff scrub, coastal scrub; moss
Capper-fruited tropidocarpum	*Tropidocarpum capparideum*	SC	None	1A	Grasslands, alkaline hills; Mar-Apr

Notes:
Federal Status Codes:
E= Endangered. Species in danger of extinction throughout all or a significant portion of its range.
T = Threatened. Species likely to become endangered within the foreseeable future.
PE = Proposed for listing as endangered.
PT = Proposed for listing as threatened.
PD = Proposed for delisting.
C = Candidate for listing.
SC = Species of Concern

California Status Codes:
E= Endangered. Species whose continued existence in California is in jeopardy
T = Threatened. Species likely to become endangered within the foreseeable future.
SC = Species of Concern566
R = Rare. Plant species, although not presently threatened with extinction, that may become endangered in the foreseeable future.

California Native Plant Society Status Codes:
1A = Plants presumed extinct in California
1B = Plants that are rare, threatened or endangered in California and elsewhere.
2 = Plants that are rare, threatened or endangered in California, but more common elsewhere.
3 = Plants about which more information is needed.
4 = Plants of limited distribution.

Table 3.5.5
Acreage of Individual Eelgrass Beds in San Francisco/San Pablo Bay in 1989

Location	*Acres*
San Pablo Bay	124
Point Orient	3
Naval Supply Depot	12
Point Molate Beach	26
Toll Plaza, East	0.5
Toll Plaza, West	0.5
Point Richmond, North	7
Point Richmond, South	4
Richmond Breakwater, North	18
Richmond Breakwater, South	7
Emeryville	13
Alameda	55
Bay Farm, North	2
Bay Farm, South	4
Coyote Point	1
Richardson Bay	13
Angel Island	3
Belvedere Cove	5
Point Tiburon	1
Keil Cove	10
Paradise Cove, North	4
Paradise Cove, South	3
TOTAL ACRES	**316**

Source: NMFS SW Region. Wyllie-Echeverria and Rutten 1989 Administrative Report SWE-89-05

The study area was limited to the Bay and near-shore environments.

5 0 5 10 Kilometers

Scale 1:400,000

N

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Project No. 43-00066890

Biological Resources Study Area

Figure 3.5.1

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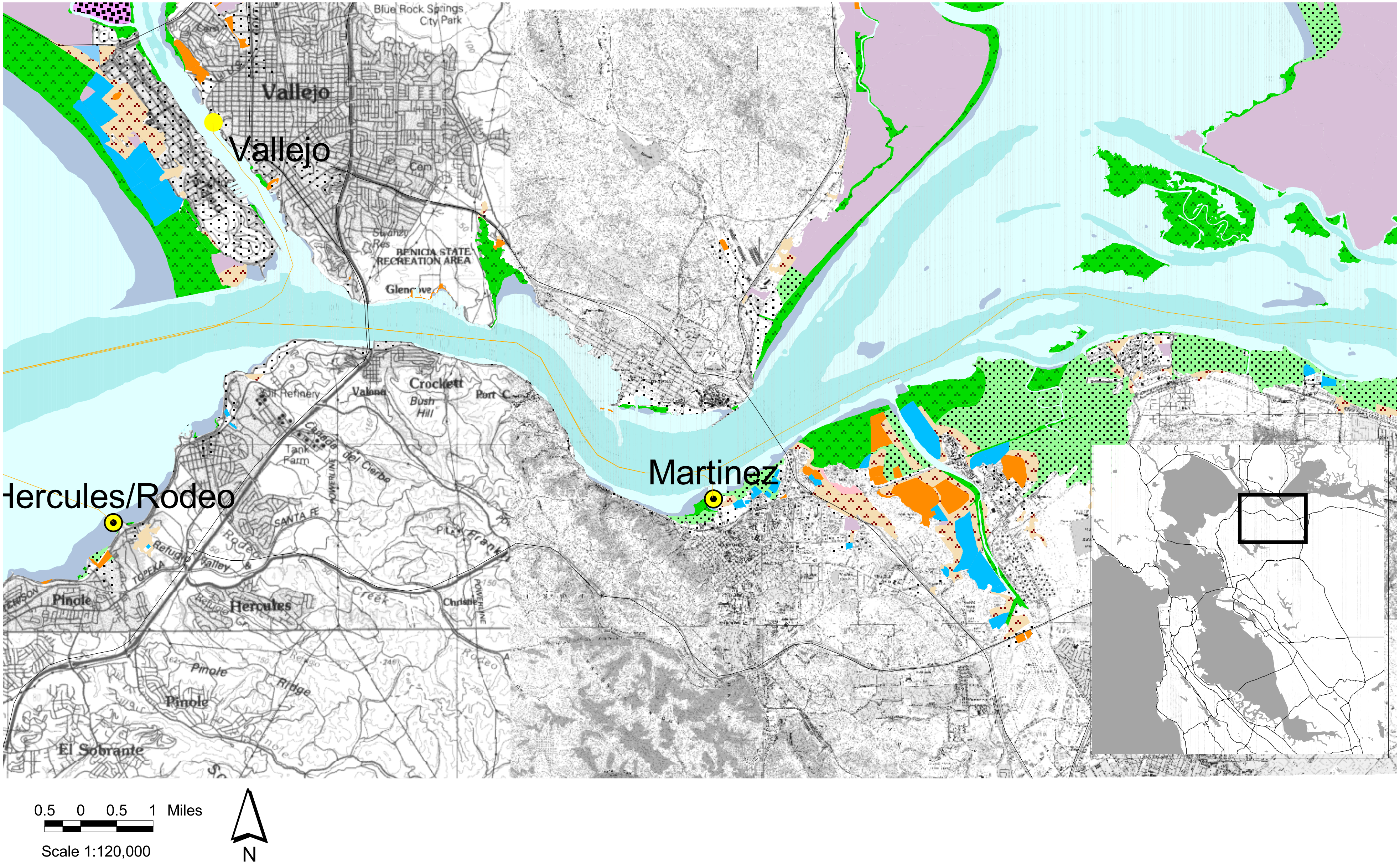

Lagoon
Muted Tidal Marsh
Bay Flat
Tidal Marsh
Diked Marsh
Developed Island or Fill
Managed Marsh
Ruderal Bayland
Undeveloped Fill
Deep Bay
Shallow Bay

Terminal Locations
Existing
Proposed

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HABITAT TYPES FOR EXISTING AND POTENTIAL TERMINAL LOCATIONS - CARQUINEZ STRAIT

Source: Goals Project 1999

Figure 3.5.2

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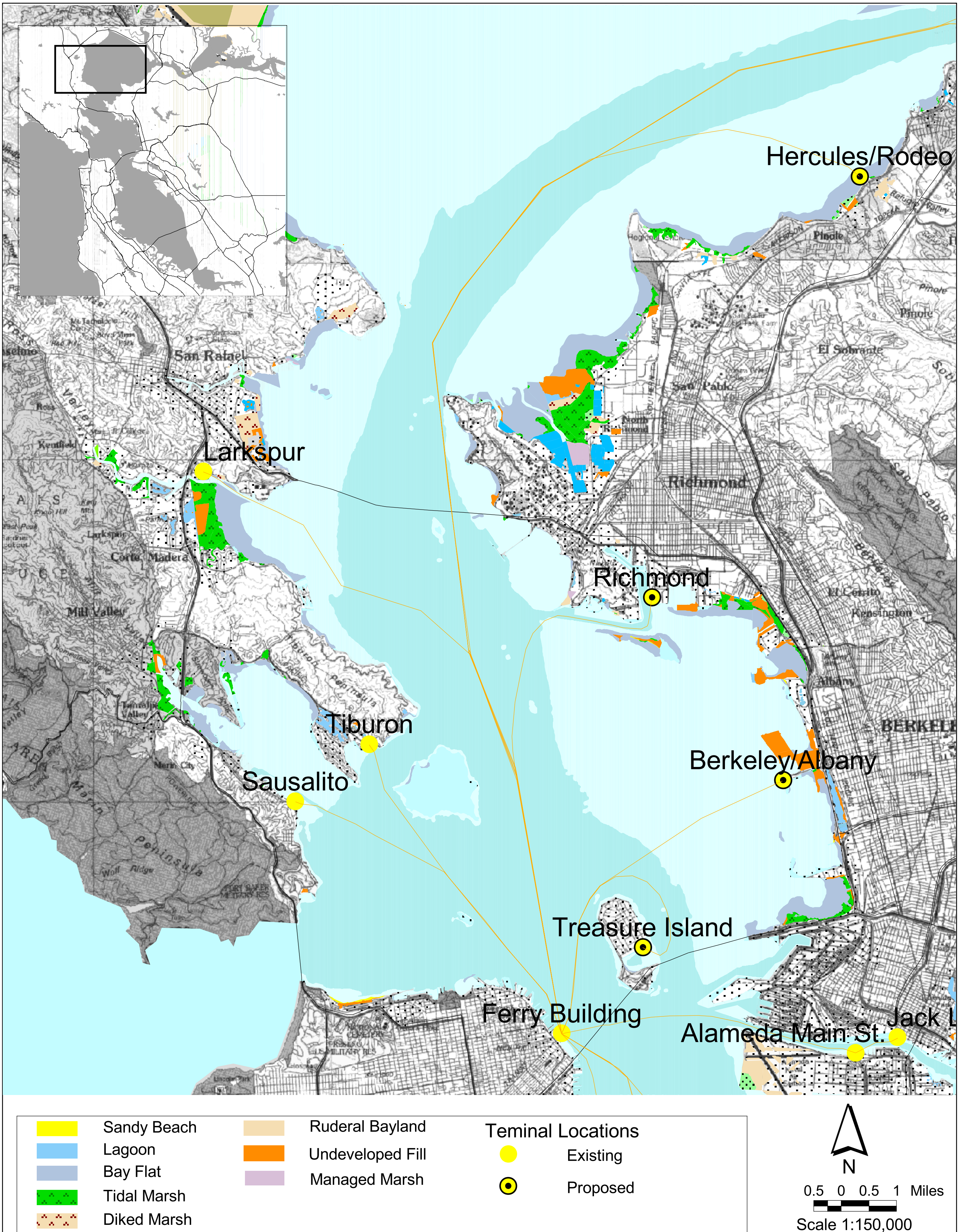

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Program EIR

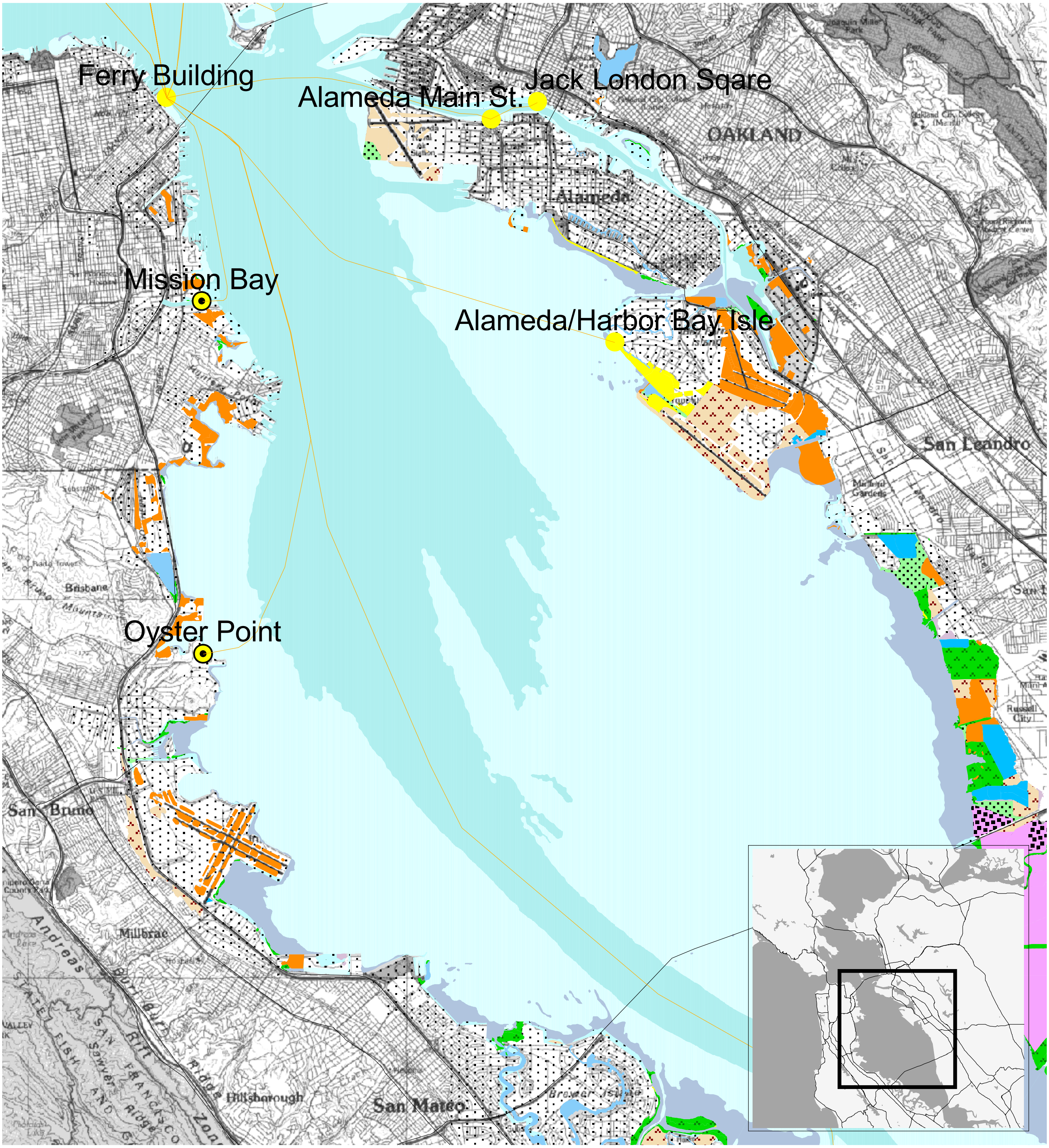
Project No. 43-00066890

Habitat Types for Existing and Potential Terminal Locations - Central Bay

Source: Goals Project 1999

Figure 3.5.3

L:GIS/projects/wta/apr/habitat_types_updated_0503.apr



Legend			
Bay Flat	Sandy Beach	Undeveloped Fill	Terminal Locations
Tidal Marsh	Lagoon	Developed Island or Fill	Existing
Diked Marsh	Muted Tidal Marsh	Deep Bay	Proposed
	Managed Marsh	Shallow Bay	

N

0.6 0 0.6 Miles

Scale 1:150,000

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Water Transit Authority
Program EIR

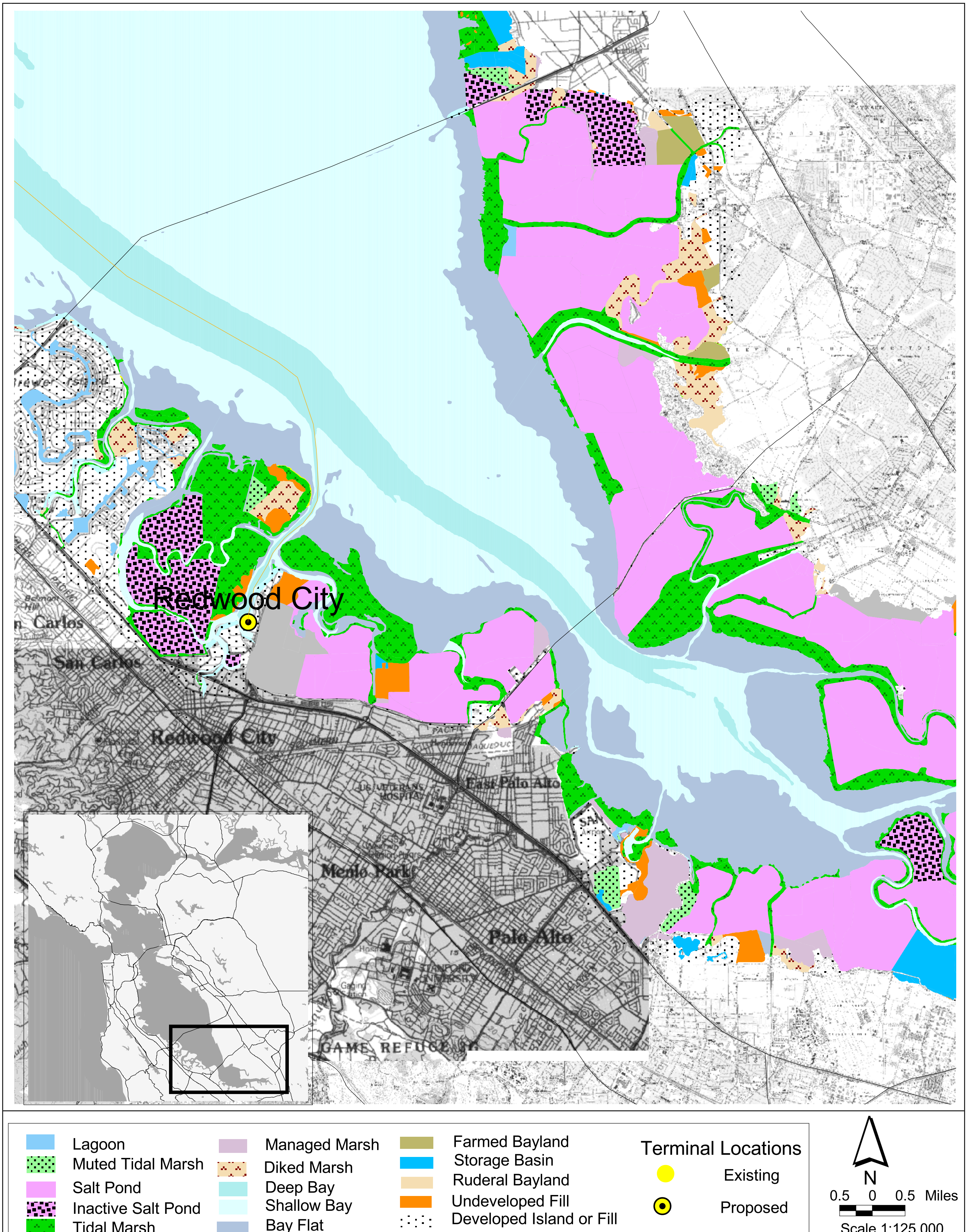
Project No. 43-00066890

HABITAT TYPES FOR EXISTING
AND POTENTIAL TERMINAL
LOCATIONS - SOUTH BAY

Source: Goals Project 1999

Figure
3.5.4

L:GIS/projects/wta/apr/habitat_types_updated_0503.apr



URS

Water Transit Authority Program EIR

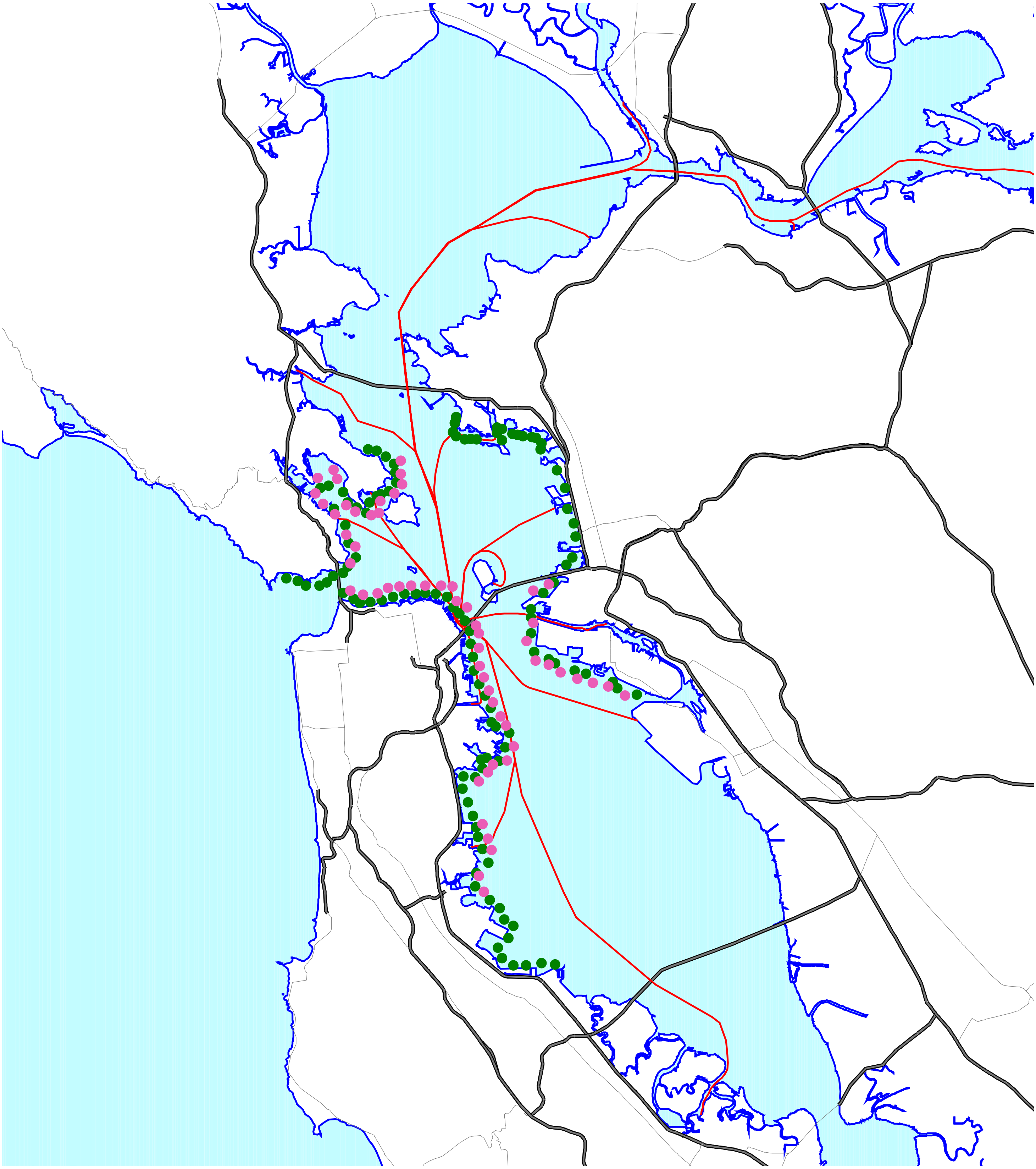
Project No. 43-0006689

HABITAT TYPES FOR EXISTING AND POTENTIAL TERMINAL LOCATIONS - EXTREME SOUTH BAY

Source: Goals Project 1999

Figure 3.5.5

L:GIS/projects/wta/apr/habitat_types_updated_0503.apr



Legend

- Inclusive Since 1973
- Inclusive After 1980
- Transit Routes

Source: Griggin and Cherr, 2001; Herring spawning regions from Sratt, 1981 and CDF6 Pacific Herring Project, 1999. Sightings locations are approximate

1 0 1 2 Miles

Scale 1:300,000

N

URS	Water Transit Authority Program EIR Project No. 43-00066890	HERRING SPAWNING REGIONS OF SAN FRANCISCO BAY	Figure 3.5.6

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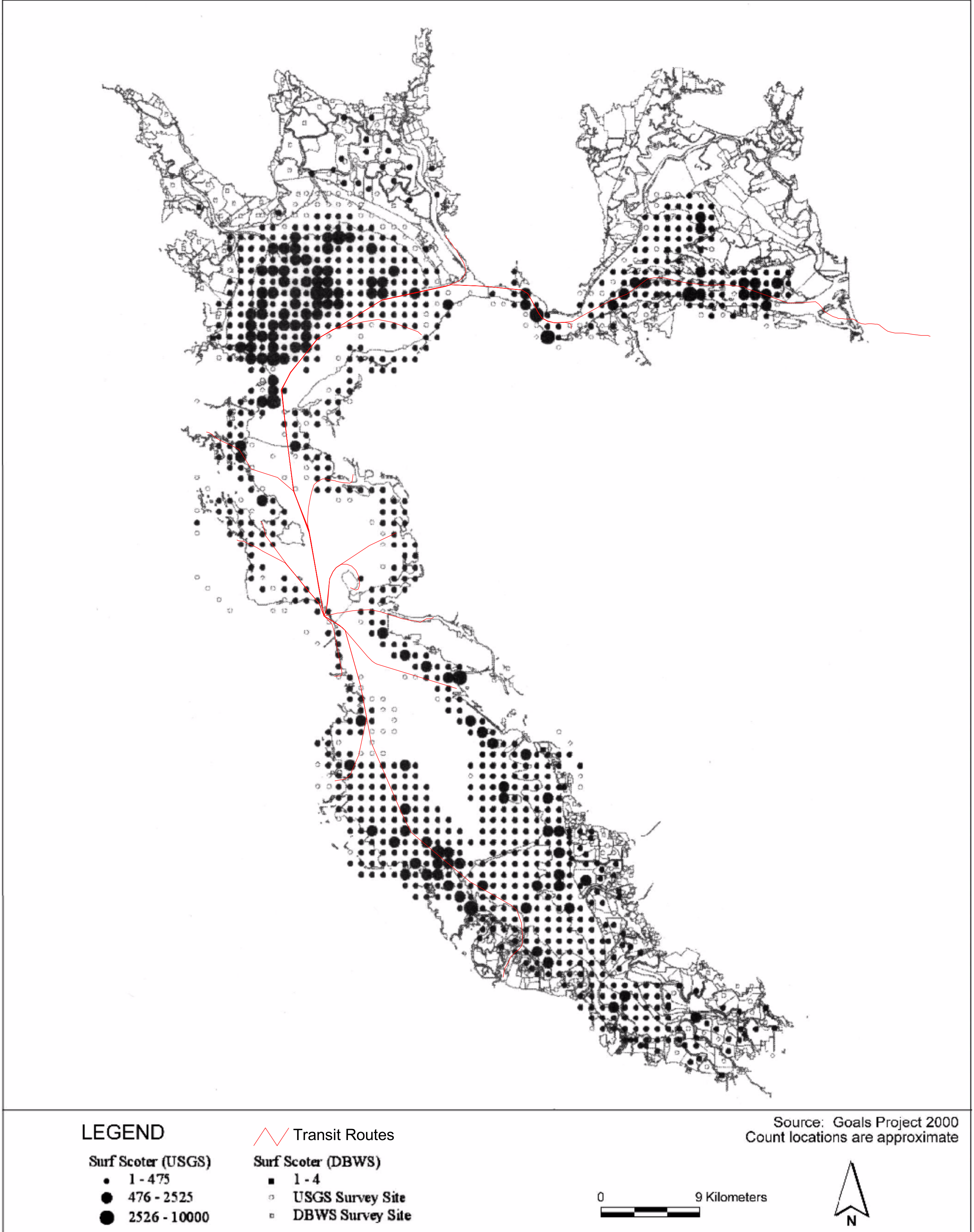


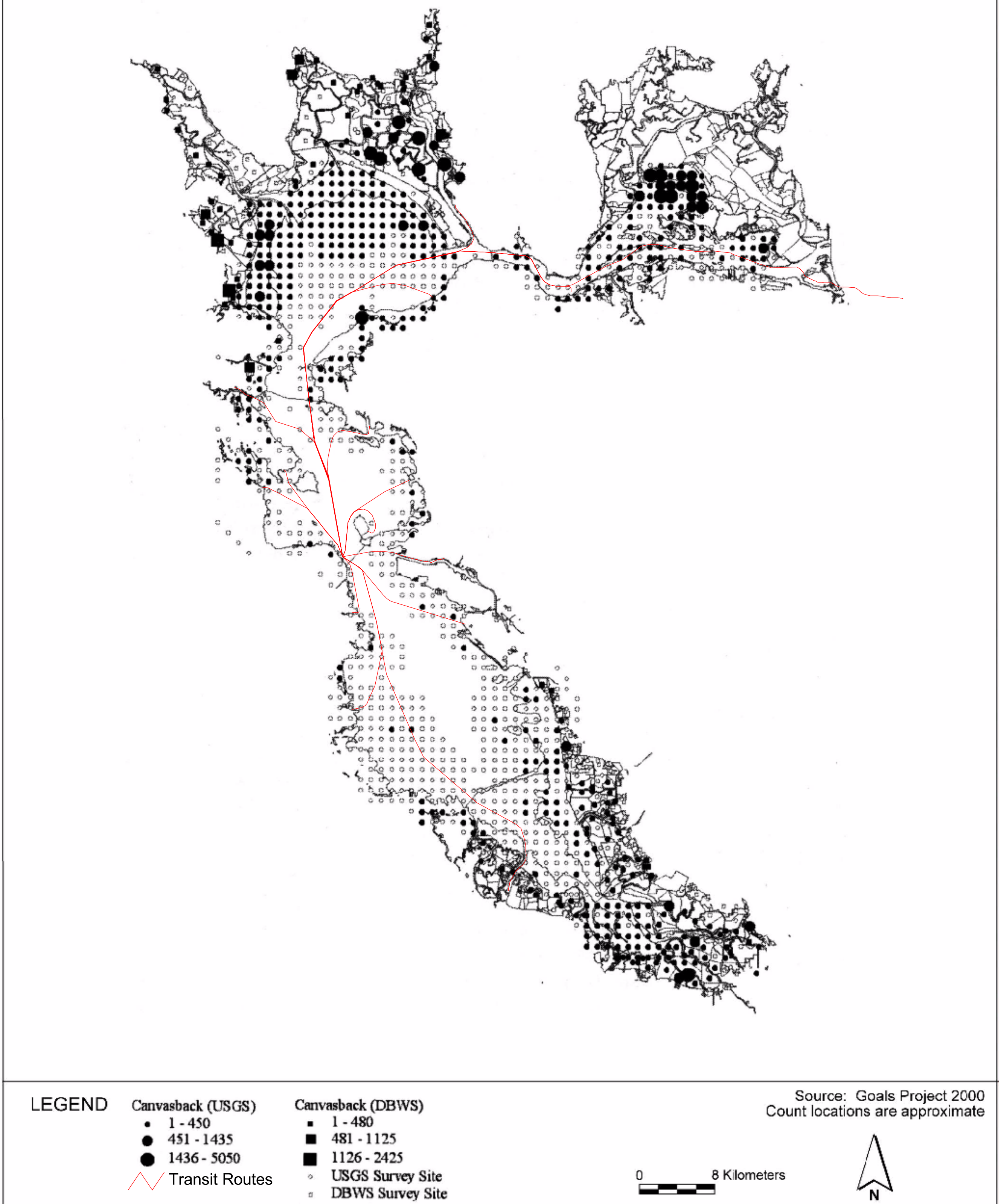
URS

Water Transit Authority
Program EIR

Project No. 28065624

MAXIMUM COUNTS OF SURF SCOTER

Figure 3.5.7



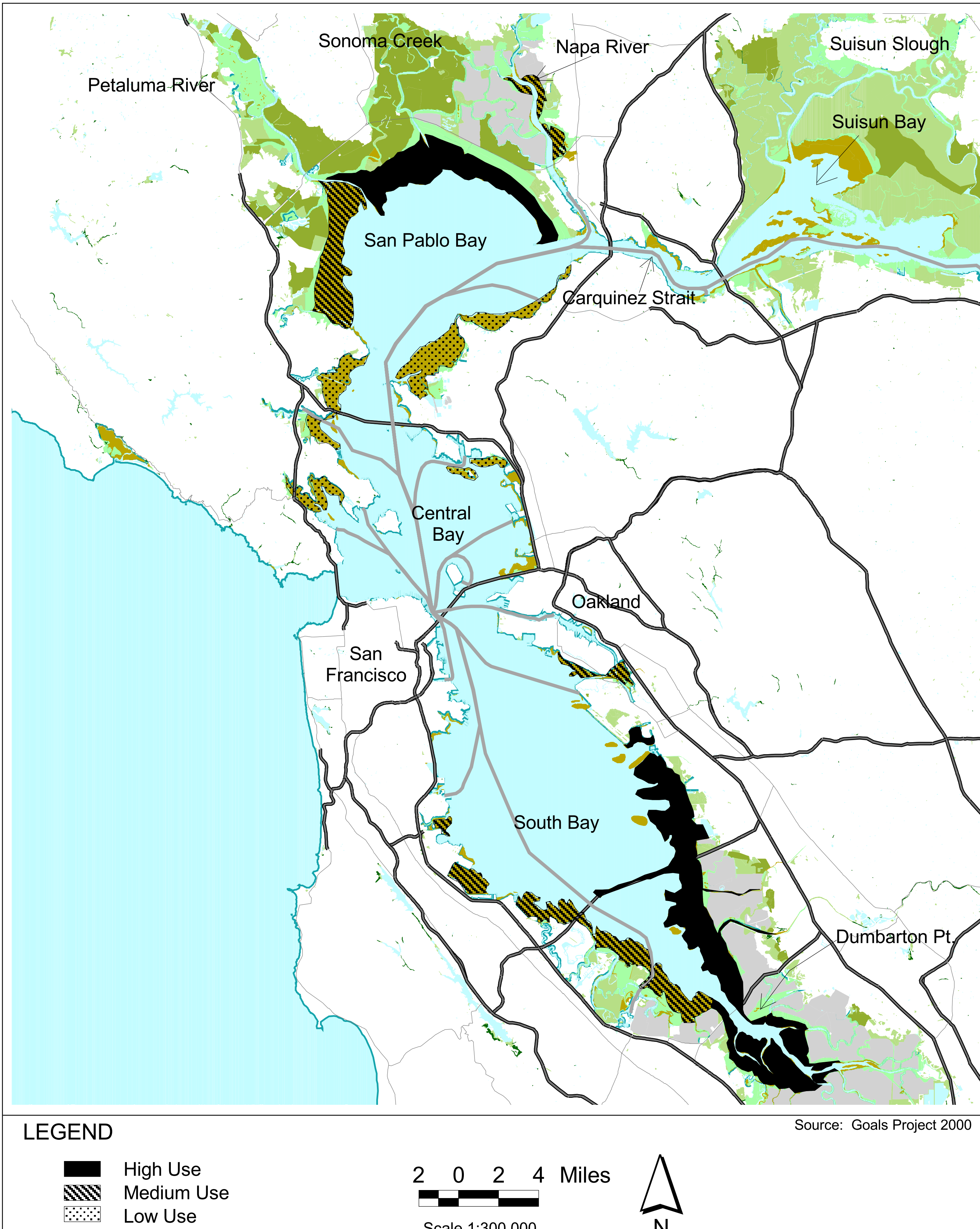
URS

Water Transit Authority
Program EIR

Project No. 28065624

MAXIMUM COUNTS OF CANVASBACK

Figure
3.5.8



Source: Goals Project 2000

URS

Water Transit Authority
Program EIR

Project No. 43-00066890

RELATIVE USE OF DIFFERENT
MUDFLAT AREAS BY SHOREBIRDS

Figure
3.5.9

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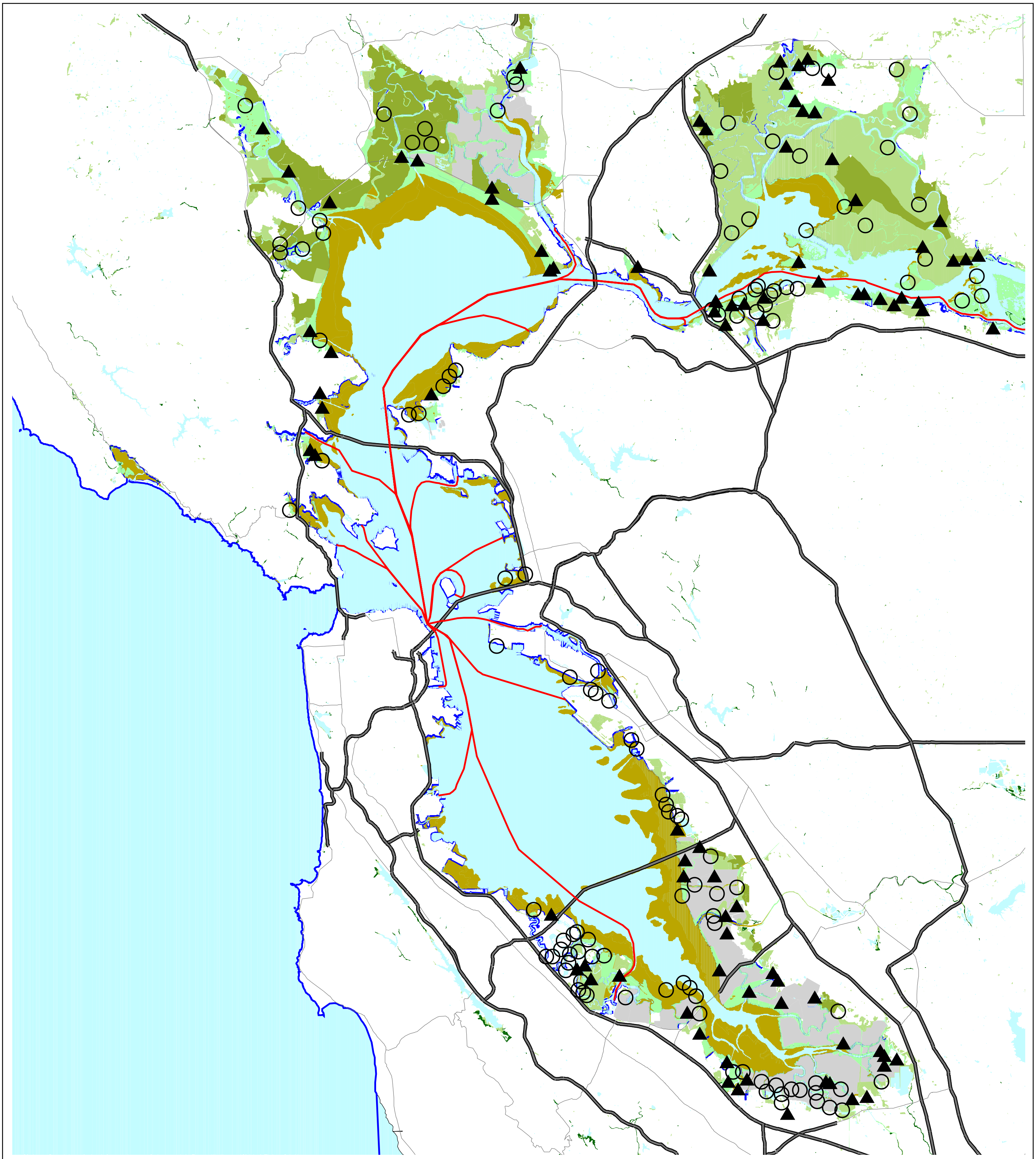

LEGEND

▲ Known presence

○ Suitable Habitat

Transit Routes

Farmed wetlands

Intertidal Mudflat and Rocky Shores

Lakes and Ponds

Open Water

Riparian Woodland

Salt Ponds

Seasonal Wetlands

Tidal Salt and Brackish Freshwater Marsh

Source: Goals Project 2001

Locations of harvest mouse habitat and presence are approximated

2 0 2 4 Miles

Scale 1:450,000

N

URS	Water Transit Authority Program EIR	SALT MARSH HARVEST MOUSE Some Current Locations and Suitable Habitat	Figure 3.5.10
	Project No. 43-00066890		

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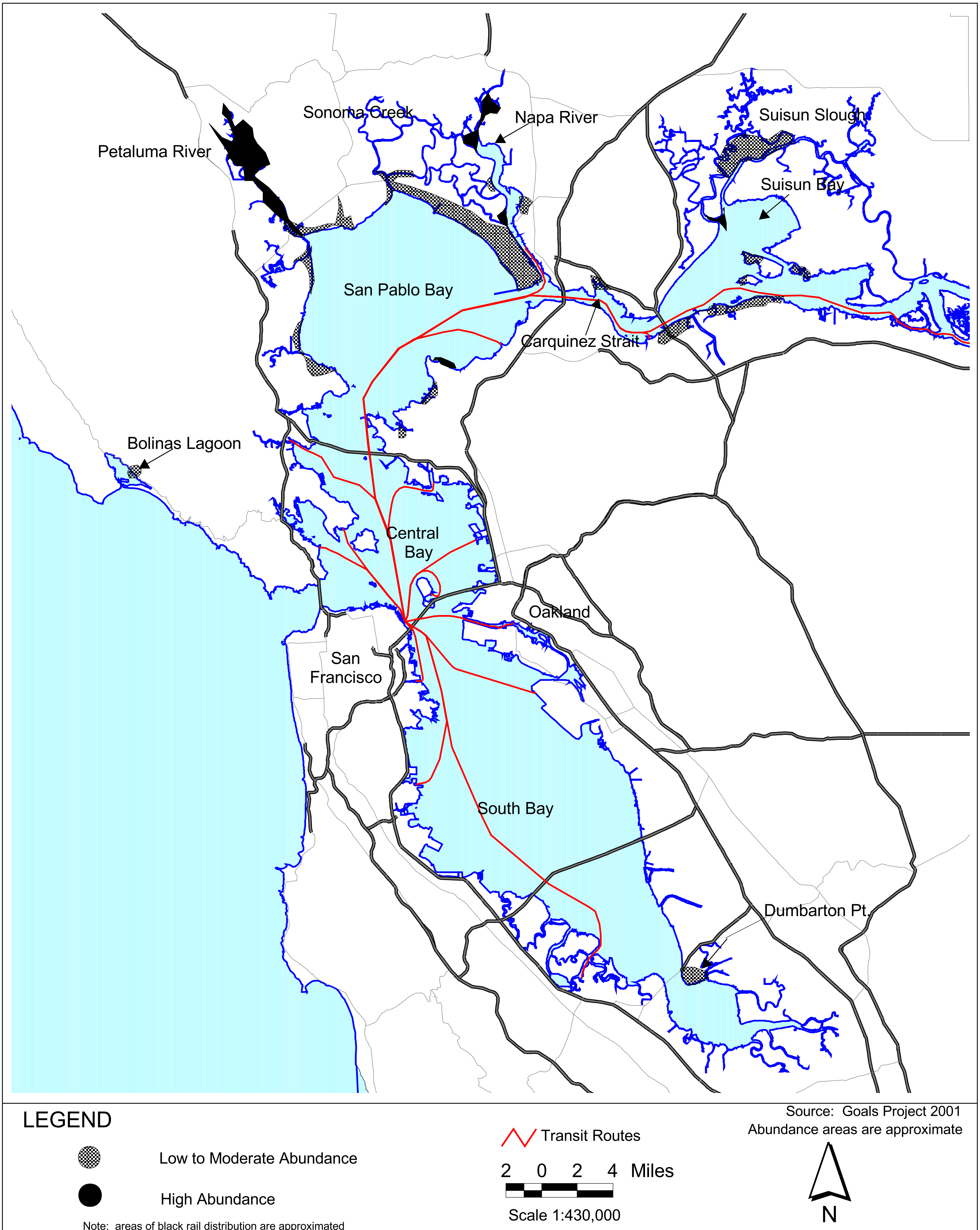

URS	Water Transit Authority Program EIR Project No. 43-00066890	DISTRIBUTION AND RELATIVE ABUNDANCE OF BLACK RAIL (Laterallus jamaicensis coturniculus) IN SAN FRANCISCO BAY REGION	Figure 3.5.11

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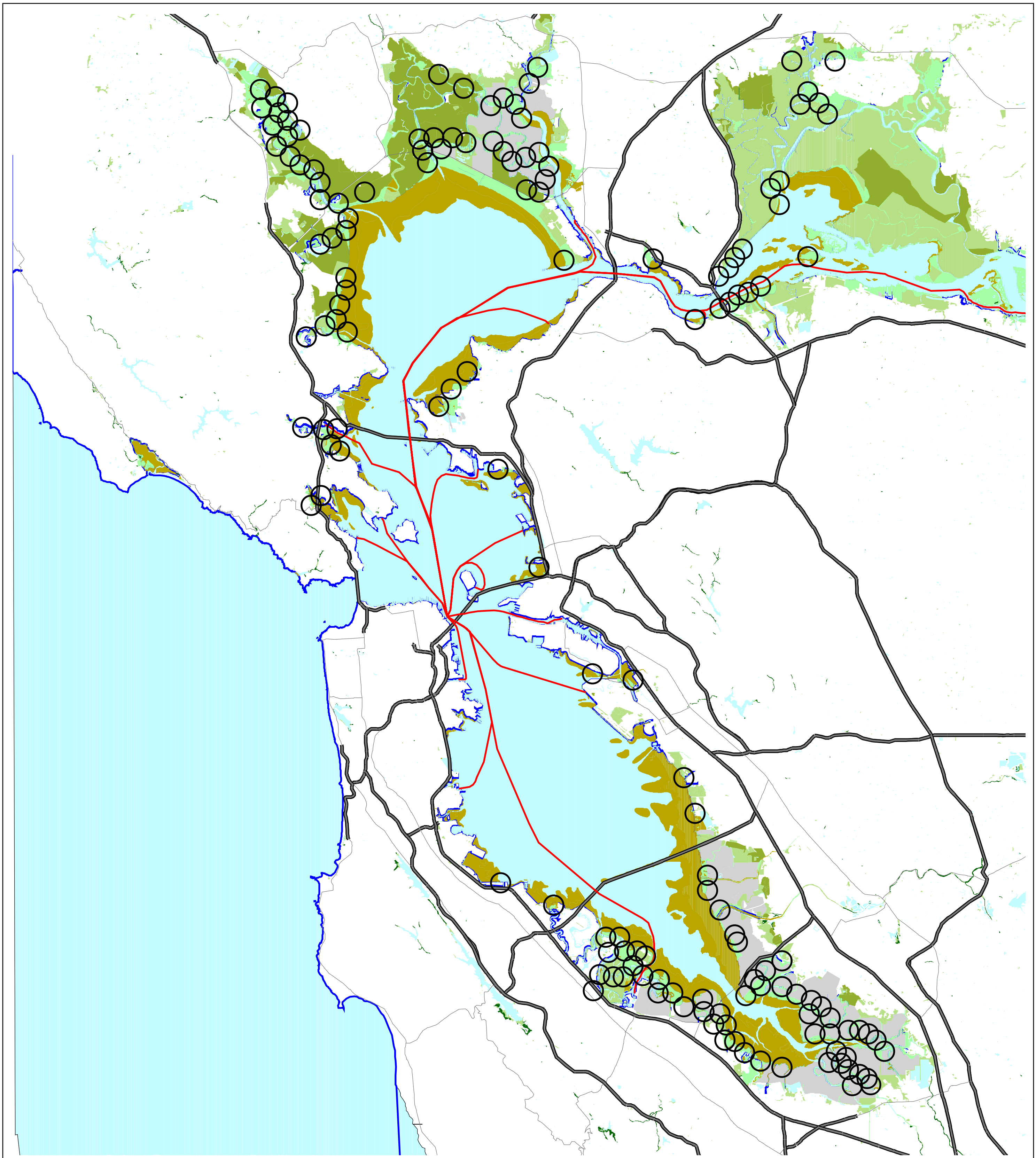

LEGEND

Clapper Rail Distribution

Transit Routes

Farmed wetlands
Intertidal Mudflat and Rocky Shores
Lakes and Ponds
Open Water
Riparian Woodland
Salt Ponds
Seasonal Wetlands
Tidal Salt and Brackish Freshwater Marsh

Source: Goals Project 1999
Locations of clapper rail distribution are approximate

2 0 2 4 Miles
Scale 1:450,000

N

URS

Water Transit Authority
Program EIR

Project No. 43-00066890

KNOWN DISTRIBUTION OF THE CALIFORNIA CLAPPER RAIL

Figure 3.5.12

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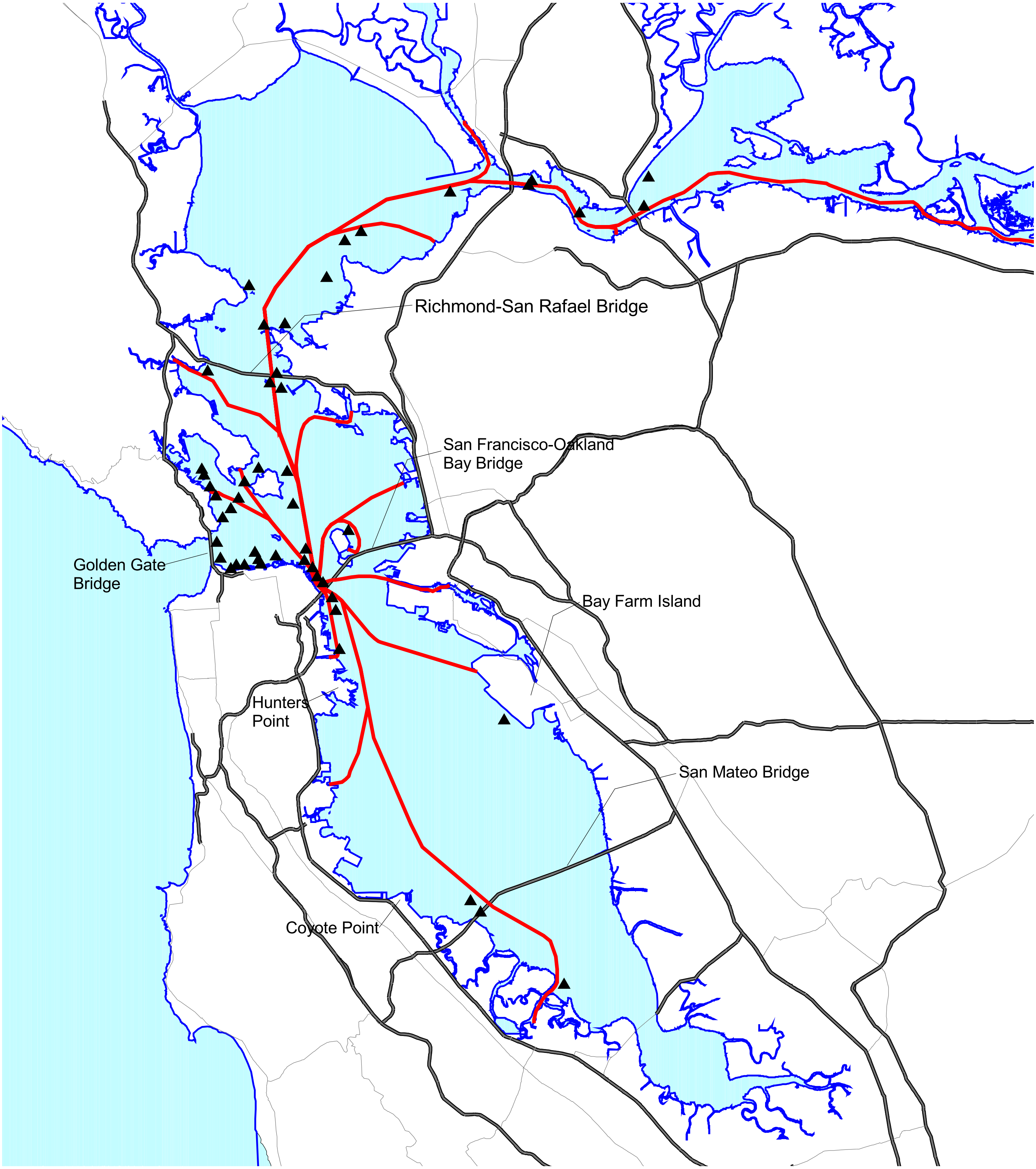

LEGEND

Gray Whale Sightings

Source: The Oceanic Society
Sightings locations are approximate

2 0 2 4 Miles

Scale 1:500,000

N

URS	Water Transit Authority Program EIR	SIGHTINGS OF GRAY WHALES IN SAN FRANCISCO BAY (Spring 2000)	Figure 3.5.13
	Project No. 43-00066890		

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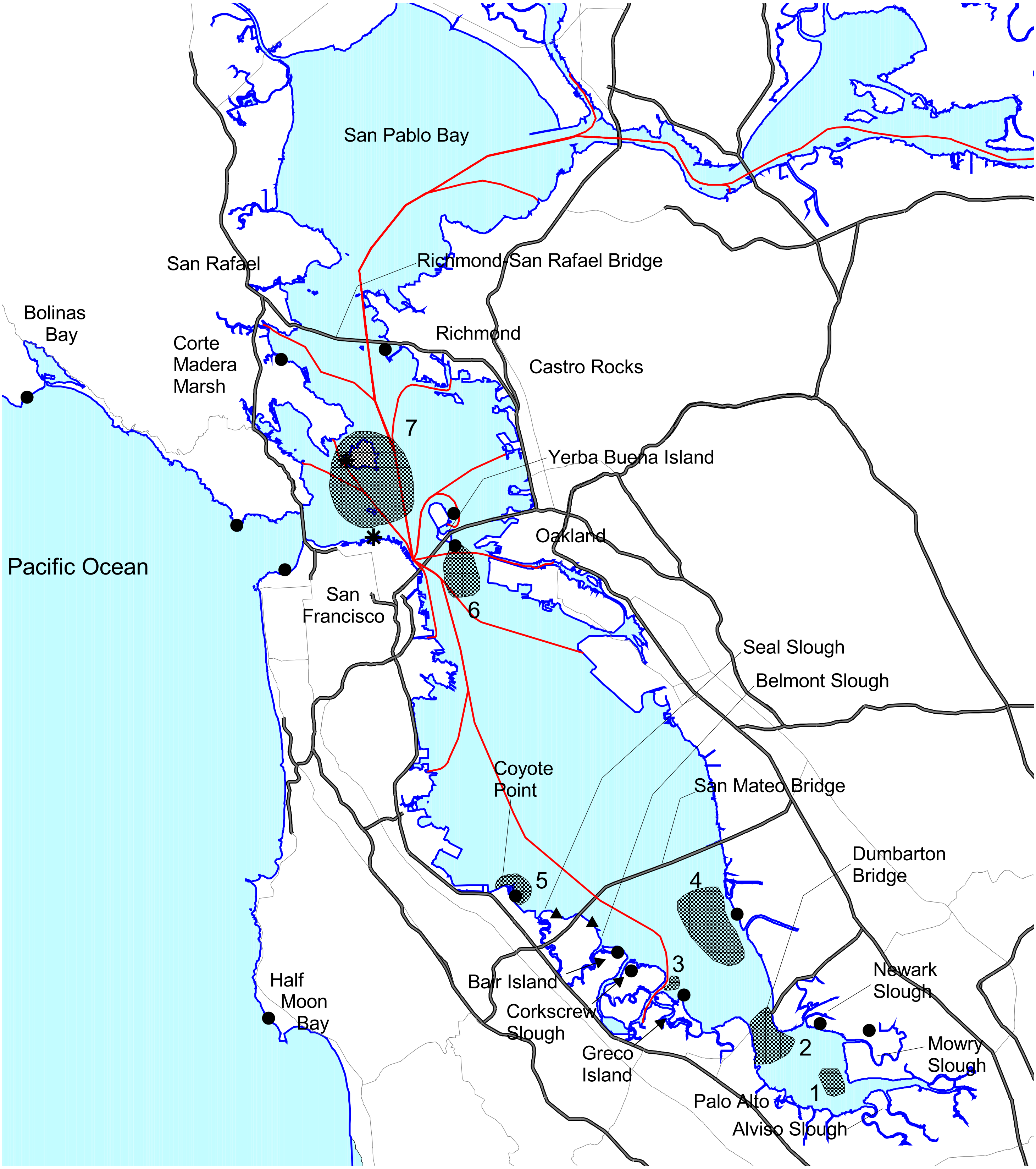

LEGEND

- Transit Routes
- Harbor Seal Feeding Areas (1-7)
- ● Active Harbor Seal Haul-out Sites
- ▲ Abandoned Harbor Seal Haul-out Sites
- ✱ Active California Sea Lion Haul-out Sites

Sources:

Harbor Seal Information

Harvey and Torok (1994)
Kopec and Harvey (1995)
Allen (1999)

California Sea Lion Information

Goals Project (2000)

Feeding areas and haul-out sites are approximate

2 0 2 4 Miles

Scale 1:400,000

N

URS	Water Transit Authority Program EIR Project No. 43-00066890	HARBOR SEAL AND CALIFORNIA SEA LION HAUL-OUT SITES AND FEEDING AREAS IN THE SAN FRANCISCO BAY AREA	Figure 3.5.14

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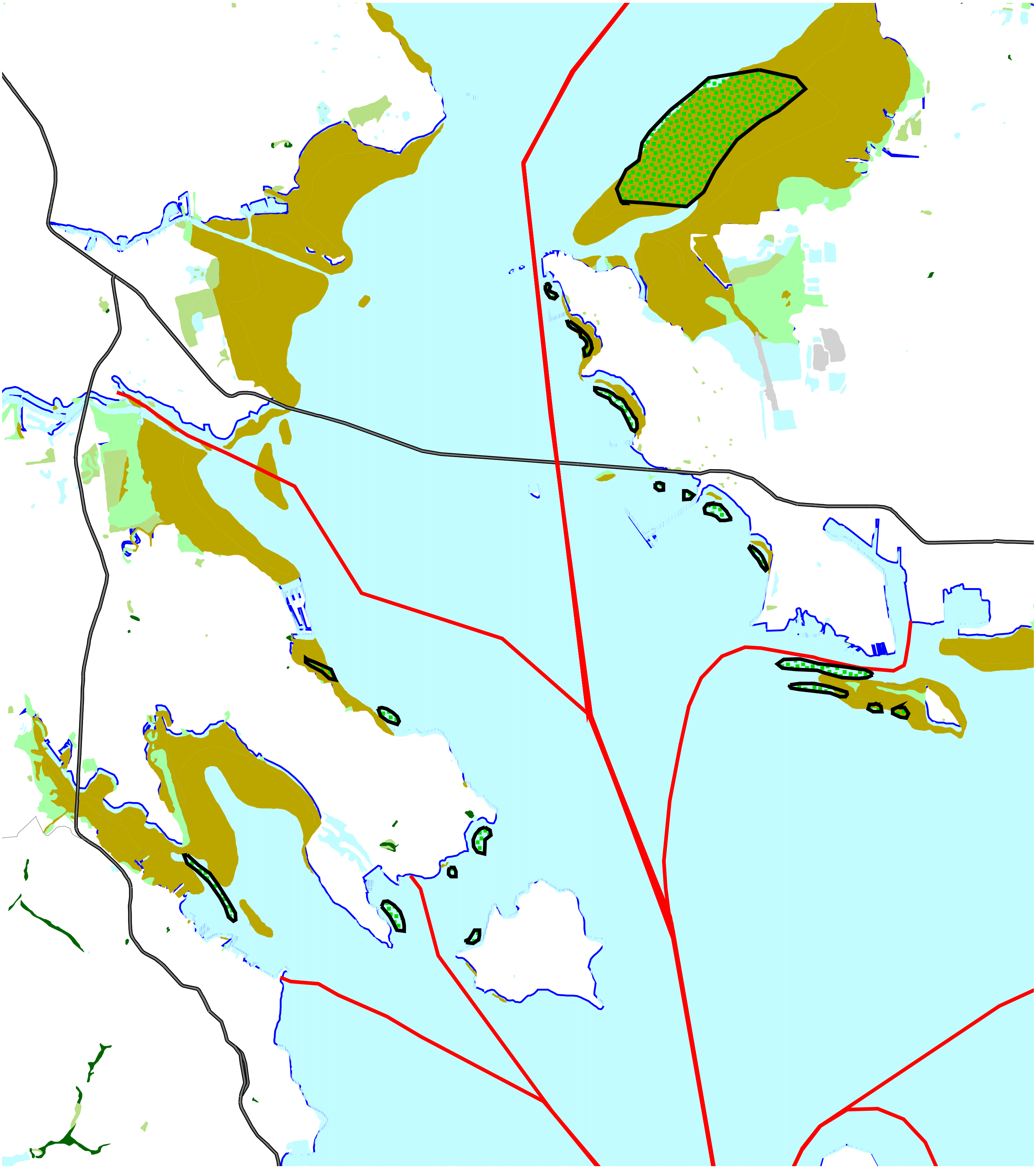

LEGEND

Location of Eelgrass Beds

Transit Routes

Farmed wetlands
Intertidal Mudflat and Rocky Shores
Lakes and Ponds
Open Water

Riparian Woodland
Salt Ponds
Seasonal Wetlands
Tidal Salt and Brackish Freshwater Marsh

Source: National Marine Fisheries Service 1989
Locations and areas of eelgrass beds are approximated

0.5 0 0.5 1 Miles

Scale 1:123,000

N

URS

Water Transit Authority
Program EIR

Project No. 43-00066890

LOCATIONS OF EELGRASS BEDS - NORTH BAY

Figure
3.5.15

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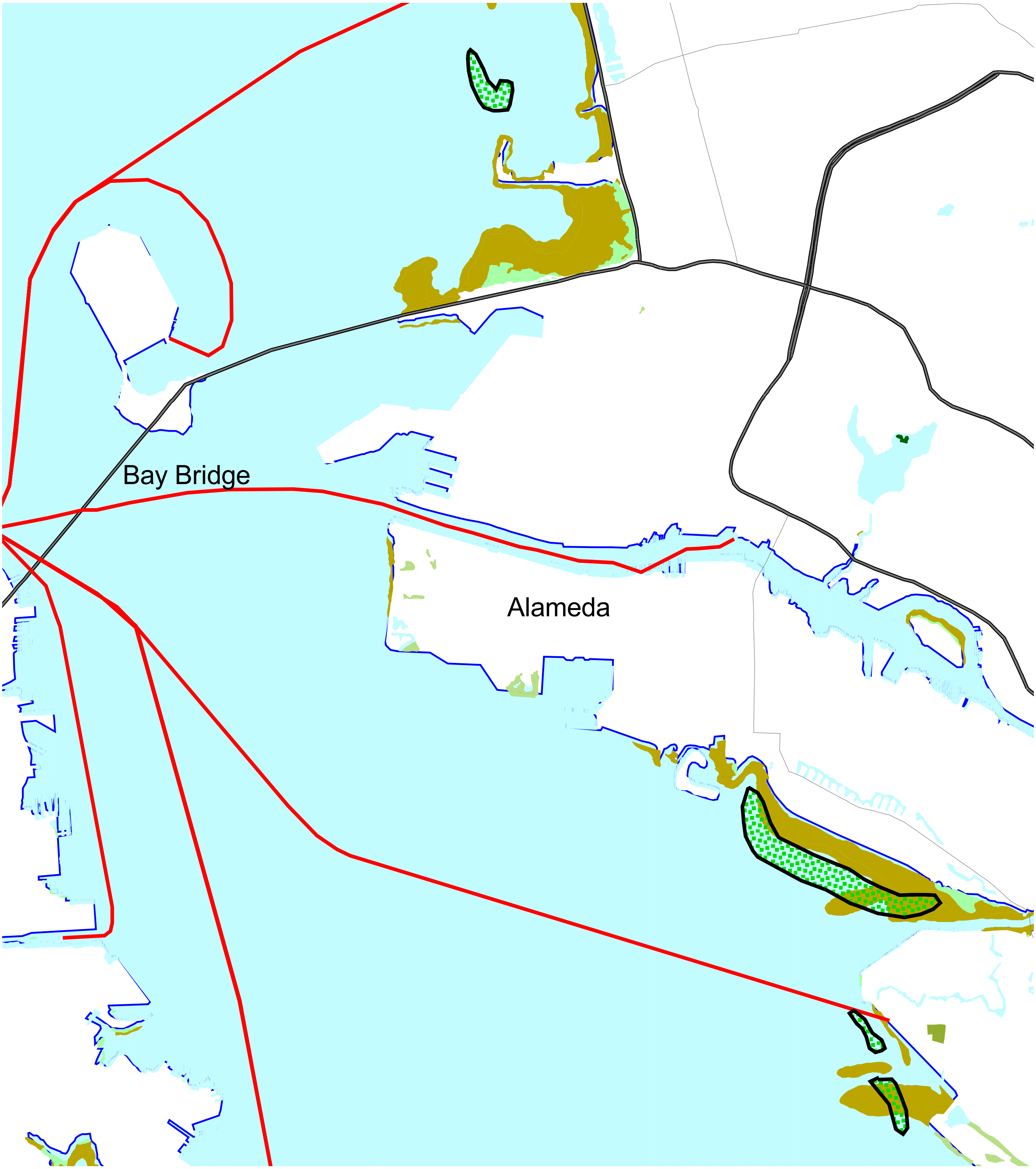

LEGEND

Location of Eelgrass Beds
Transit Routes
Farmed wetlands
Intertidal Mudflat and Rocky Shores
Lakes and Ponds
Open Water
Riparian Woodland
Salt Ponds
Seasonal Wetlands
Tidal Salt and Brackish Freshwater Marsh

Source: National Marine Fisheries Service 1989
Locations and areas of eelgrass beds are approximated

0.5 0 0.5 1 Miles

Scale 1:100,000

N

URS

Water Transit Authority
Program EIR

Project No. 43-00066890

LOCATIONS OF EELGRASS BEDS - CENTRAL BAY

Figure
3.5.16

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URS

Water Transit Authority
Program EIR

Project No. 43-00066890

LOCATIONS OF EELGRASS BEDS - SOUTH BAY

Figure 3.5.17

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3.4 WATER RESOURCES

The waters within San Francisco Bay provide critical sheltered water habitat for a wide variety of ocean and coastal species that are important both ecologically and to commercial and recreational interests such as fisheries and water contact recreation. Ocean and coastal resources are affected by commercial, transit, and recreational activities in the Bay because dredge and fill operations, fuel spills, and pollutants can adversely affect water quality.

This section presents the existing water and sediment quality in the Bay along with current water and sediment quality concerns. These concerns potentially relate to the ferry expansion from potential dredging of new channels for ferry use, potential water pollution from ferries (i.e., fuel spills) due to increased number of transits, stormwater runoff pollution from ferry terminal facilities, and risks associated with building new terminal facilities in a floodplain.

A certain fraction of airborne pollutant emissions from ferry fuel combustion could be deposited on Bay waters. Emissions of nitrogen and sulfur oxides would be deposited as nitrates and sulfates, respectively. A portion of the particulate matter in the diesel exhaust, mostly in the fine fraction ($PM_{2.5}$) would also be deposited. Not all of the exhaust emissions would be deposited on the bay; some would be advected over land by winds. This issue is further addressed in the Air Quality Section, which discusses the potential impact of airborne pollutant deposition in water and proposes mitigation measures.

3.4.1 Environmental Setting

3.4.1.1 Study Area

San Francisco Bay and the San Joaquin-Sacramento River Delta combine to form the West Coast's largest estuary, where fresh water from the rivers and numerous smaller tributaries flows out through the Bay and into the Pacific Ocean. The San Francisco Bay Estuary (Estuary) currently encompasses roughly 1,600 square miles, drains more than 40 percent of the state, and provides drinking water to approximately two-thirds of California (SFEP 1999). The Estuary is composed of three distinct hydrographic regimes: the South Bay, which extends from the Bay Bridge to the southern terminus of the Bay in San Jose, and the Central and North Bays, which connect the Delta and the Pacific Ocean.

The North Bay consists of several small embayments, the two largest being San Pablo Bay and Suisun Bay. The embayments are connected to each other and the ocean by deep, narrow channels ranging from 42 feet deep in San Pablo Bay to over 360 feet deep at the Golden Gate. San Pablo Bay is characterized by a deep channel surrounded by broad shoals. San Pablo Bay is connected to Suisun Bay by the narrow Carquinez Strait. Suisun Bay is a shallow basin consisting of braided channels and shallow shoals.

The Central Bay has a highly complex bathymetry. East of the Golden Gate, the depth is approximately 300 feet, while extensive intertidal mudflats are present at the eastern edge of the Central Bay. In addition, several islands are located within the Central Bay.

The South Bay is characterized by large areas of broad shallows incised by a main channel 30 to 65 feet deep. It has similar bathymetry to San Pablo and Suisun Bays. A relatively deep channel extends along the western side of the South Bay, surrounded by broad mudflats.

Freshwater inflows, tidal flows, and their interactions largely determine variations in the hydrology of the Estuary. Hydrology has profound effects on all species that live in the Estuary because it determines the salinity in different portions of the Estuary, and controls the circulation of water through the channels and bays.

Ninety percent of the freshwater inflow to the Bay comes from the Delta (Cheng et al. 1993) and flows through the northern portion of the Bay, resulting in a partially to well-mixed Estuary (Walters et al. 1985; Uncles and Peterson 1995). The North Bay is hydrologically distinct from the Central and South Bays. The degree of mixing depends on seasonally varying river inflow. The timing and magnitude of the highly seasonal river inflow modulates permanent estuarine circulation, which is largely maintained by salinity-controlled density differences between river and ocean waters.

Very little freshwater flows into the South Bay. It is a tidally oscillating, lagoon-type estuary, where salinity variations are determined by water exchange between the northern reach and the ocean. Water residence times are much longer in the South Bay than in the North Bay.

Beneficial uses of the Bay include commercial and sport fishing, estuarine habitat, industrial water supply, fish migration, navigation, industrial process water supply, preservation of rare and endangered species, contact and non-contact water recreation, shellfish harvesting, fish spawning, and wildlife habitat (RWQCB 1995).

3.4.1.2 Water Quality

The overall goals of water quality regulation according to the Water Quality Control Plan for San Francisco Bay Basin (Basin Plan) (RWQCB 1995) are to protect and maintain thriving aquatic ecosystems and the resources those systems provide to society, and to accomplish these goals in an economically and socially sound manner.

Since 1993, the San Francisco Estuary Institute (SFEI) has administered a Regional Monitoring Program (RMP) for the Regional Water Quality Control Board (RWQCB) and major Bay dischargers. Most dischargers to the Bay are required to participate as a condition of their discharge permit. SFEI conducts monitoring three times a year along the central line of the Bay, from the Delta to the South Bay (Figure 3.4.1). The RMP measures concentrations of trace constituents in water, sediment, and transplanted bivalves at various locations in the Estuary.

The RMP seeks to characterize contaminant concentrations in San Francisco Estuary water, sediment, fish, and shellfish. The ultimate goal is to determine how contaminant concentrations in the estuary are changing in response to pollution prevention and reduction measures, and to provide feedback to water quality management agencies. The five key objectives are:

- To describe patterns and trends in contaminant concentration and distribution;
- To describe general sources and loadings of contamination to the estuary;
- To measure contaminant effect on selected parts of the estuary ecosystem;
- To compare monitoring information to relevant water quality objectives and other guidelines; and

- To synthesize and distribute information from a range of sources to present a more complete picture of the sources, distribution, fates, and effects of contaminants in the estuary ecosystem.

The RMP routinely monitors:

- Conventional water quality (such as salinity, dissolved oxygen, and temperature) and chemistry (such as metals and pesticides);
- Water toxicity (effects on laboratory organisms);
- Sediment characteristics (such as particle size) and chemistry;
- Sediment toxicity (effects on laboratory organisms); and
- Contaminant bioaccumulation in transplanted shellfish.

Regional Monitoring Program Findings

Data collected for the RMP over the past 7 years indicate contamination areas in the Estuary. Top known contamination problems include:

- High levels of mercury and PCBs in fish and water;
- Estuary water is periodically toxic, probably due mainly to pesticides; and
- Estuary sediment is frequently toxic, probably due in part to heavy metals.

According to the 2001 *Pulse of the Estuary*, which summarized the status of chemical contamination in the Estuary using RMP results: "For most well known contaminants, the Estuary is clearly better than in earlier decades. Since the start of the RMP monitoring in 1993, there is some suggestion but no definite indication of continued improvement. If contamination levels are going down, the decrease is very gradual" (SFEI 2001). Sampling sediment at a series of depths indicates that most sediment contaminants have dropped from peak levels seen in the 1960s and 1970s, probably in response to wastewater treatment improvements, product bans, and other regulatory actions. However, the *Pulse of the Estuary* notes that concentrations of lead and other metals in water have changed little in the last 20 years.

Sites of Greatest and Least Concern

Overall, monitoring sites in the lower South Bay, the Petaluma and Napa River mouths, San Pablo Bay, and Grizzly Bay are more contaminated than other sites. The South Bay sloughs are particularly contaminated; however, similar sloughs in other parts of the Estuary are not monitored. Contamination in the Central Bay is lower primarily due to mixing with relatively clean ocean water. The least contaminated site is in the ocean west of the Golden Gate.

Status of Sediment

Concentrations of contaminants in sediments are generally compared to two sets of criteria established by the National Oceanographic and Atmospheric Administration (NOAA) (Long et al. 1995): Effects Range Low (ERL) are numerical criteria indicating *possible* harm to aquatic life. Effects Range Median (ERM) indicate *probable* harm to aquatic life. At most RMP monitoring sites, several trace elements (arsenic, chromium, copper, nickel, mercury) and organic compounds (DDTs, chlordanes, some polynuclear aromatic hydrocarbons [PAHs]) frequently exceed the ERLs. Nickel usually exceeds the ERM; however, many trace elements are naturally at high levels in Estuary sediment, and may not be a problem. Few significant Estuary-wide trends in sediment contamination were discernible over the last 7 years. Chromium and nickel appear to be increasing, but this is thought to be a natural event due to increased rainfall.

Within the Estuary, ambient concentrations of some metals are already at or above criteria or objectives. Of particular concern is chromium in Suisun Bay, Carquinez Strait, and San Pablo Bay; copper, mercury, and nickel in the South, San Pablo, and Suisun Bays, and Carquinez Strait; and lead in San Pablo Bay and Carquinez Strait. At certain times of the year, depending on riverine flows, ambient concentrations of these metals in these embayments have exceeded the criteria (SFEI 1994).

Summary of California 303(d) List and Total Maximum Daily Load Priority Schedule

Section 303(d) of the Clean Water Act (CWA) requires each state to identify waters that will not achieve water quality standards after application of effluent limits. For each water and pollutant, the state is required to propose a priority for development of load-based (as opposed to concentration-based) limits called total maximum daily loads (TMDLs). The TMDL determines how much of a given pollutant can be discharged from a particular source without causing water quality standards to be violated. Priorities for development of TMDLs are set by the state, based on the severity of the pollution and uses of the waters.

This section summarizes the 1998 California 303(d) list and TMDL priority schedule for the Central, Lower, and South Bays as defined by the Basin Plan (note: the Basin Plan subdivides the South Bay into the Lower Bay and the South Bay).

High-Priority Constituents

Constituents that are of high priority for TMDL implementation in the Central, Lower, and South Bays include dioxin compounds, furan compounds, dioxin-like PCBs, and mercury. Dioxins, furans, and dioxin-like PCBs have been listed as high-priority constituents by the U.S. Environmental Protection Agency (USEPA). Mercury is designated as high priority because consumption of fish and wildlife from the Bay is impacted, and a health advisory is in effect for multiple fish species, including striped bass and shark.

Copper and nickel are high-priority constituents in the South Bay. These metals have been prioritized due to exceedances of the California Environmental Protection Agency (Cal-EPA) Department of Toxic Substances Control's California Toxics Rule dissolved metals criteria, National Toxics Rule total metals criteria, elevated water and sediment concentrations, and elevated fish tissue levels.

Medium-Priority Constituents

Diazinon and nondioxin-like PCBs are designated as medium-priority constituents in the Central, Lower, and South Bays. Diazinon has been found to cause water column toxicity. An interim health advisory is in effect for fish due to elevated PCB concentrations. Copper in the Central and Lower Bays, and nickel in the Lower Bay are medium-priority constituents due to exceedances of California Toxics Rule dissolved metals criteria, National Toxics Rule total metals criteria, elevated water and sediment concentrations, and elevated fish tissue levels.

Low-Priority Constituents

Pesticides, chlordane, DDT, and dieldrin have been designated by the Cal-EPA as low-priority constituents in the Central, Lower, and South Bays. Selenium is a low-priority constituent in the Central and South Bays due to adverse effects in one branch of the food chain (the most sensitive indicator is hatchability in nesting diving birds). The introduction of exotic species may have made the food chain more susceptible to selenium accumulation. Moreover, a human health advisory by the RWQCB has been issued for the consumption of scaup and scoter (diving ducks) due to selenium levels in these animals.

Organic Contaminants

Organic contaminants may be flushed into the Bay in stormwater runoff from ferry terminal facilities, and they readily bind to and move with suspended sediment, which has implications for increasing water pollution when channels are dredged.

High concentrations of dissolved and total (dissolved plus particulate) polynuclear aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) were measured in the Estuary Interface (river monitoring stations on the Guadalupe River, Coyote Creek), Southern Sloughs, and South Bay in 1999. Peak concentrations of dissolved and total PAHs and dissolved PCBs were measured at San Jose in July, with the highest PCB concentration found in the Guadalupe River in April. Dissolved PAHs were generally higher in July at most stations, while dissolved PCBs were typically highest in February. Because dissolved PAHs and PCBs comprise a relatively small portion of the total concentrations of these compounds (approximately 16 percent and 31 percent, respectively), elevated concentrations of total PAHs and PCBs were consistent with high total suspended solids concentrations at several RMP stations: San Jose, Guadalupe River, San Pablo Bay, Davis Point, and Napa River.

The organochlorine pesticides DDT, chlordane, HCH, and dieldrin also had higher concentrations in the southern reaches of the Bay. Dissolved and total concentrations of DDTs, chlordanes, and dieldrin, generally showed spatial gradients decreasing from the Estuary Interface to the Central Bay during all seasons, with high pulses measured in the Napa River in February.

Concentrations of diazinon and chlorpyrifos, two organophosphate insecticides used extensively for agricultural and urban applications, showed spatial gradients decreasing from the River stations in the Delta to the Central Bay during February sampling. Chlorpyrifos concentratons also decreased along a distinct spatial gradient from the Estuary Interface to the Central Bay during February and April sampling, with elevated concentrations measured at Guadalupe River in February and Standish Dam in April. Unlike PAHs and PCBs, dissolved concentrations of diazonon and chlorpyrifos comprised greater than 80 percent of the total concentration averaged over the entire Bay.

3.4.1.3 Sediment Quality

The potential for dredging to accommodate expanded ferry service exists in certain parts of the Bay. Currently, dredging activities within the Bay are conducted for the routine maintenance of desired hydrologic features and navigational depths in existing channels, harbors, and marinas. Dredging and the disposal of sediments directly relate to the health of the Bay and for this reason regulatory controls greatly restrict, if not prevent, new activities that might require dredging.

Processes that govern sediment movement affect the distribution of wetlands, and dredging of new channels may expose and suspend sediment, some of which may be contaminated. An understanding of what contaminants exist within the Bay, how these behave in relation to sediment, and where the contaminated areas of highest concern occur is important in siting any new facilities that might require dredging.

The Bay's sediment can be both a source of and sink for pollutants in the overlying water column. Past and present waste disposal practices from the surrounding land and waste discharges have resulted in the introduction of pollutants into the Bay, some of which have degraded Bay sediments. The overall influx of pollutants can cause increases in sediment pollutant levels. These pollutants are not distributed evenly in the Bay, and localized areas are highly contaminated. Natural resuspension processes, biological processes, other mechanical disturbances, dredging, and sediment disposal can remobilize particulate-bound pollutants. While pollutant loading to the Estuary from point sources has declined dramatically over the past two decades, and surface sediment contamination may be declining from historical highs, Bay sediments are still an important source and sink of pollutants. The mean concentrations of metals in sediments vary according to grain size, organic carbon content, and seasonal changes associated with riverine flow, flushing, sediment dynamics, and anthropogenic inputs. Anthropogenic inputs appear to have the greatest effect on sediment levels of copper, silver, cadmium, and zinc, but may also have elevated concentrations of chromium, nickel, and cobalt above background (RWQCB 1994).

Sediment contamination concerns include:

- Various toxic contaminants found only in barely detectable amounts in the water column can accumulate in sediments to much higher levels;
- Sediments serve as both a reservoir for contaminants and a source of contaminants to the water column and organisms;
- Sediments integrate contaminant concentrations over time, whereas water-column contaminant concentrations are much more variable and dynamic;
- Sediment contaminants (in addition to water column contaminants) affect bottom-dwelling organisms and other sediment-associated organisms, as well as both the organisms that feed on them and humans; and
- Sediments are an integral part of the aquatic environment that provide habitat, feeding, spawning, and rearing areas for many aquatic organisms.

Trace metals were detected in all samples collected at the 24 RMP stations from 1993 to 1998. With the exception of Red Rock, Davis Point, and Yerba Buena Island, whose concentrations were significantly lower than other stations, the concentrations of metals in sediments were very consistent among the 24 RMP stations. Generally, the Napa River, Petaluma River, Coyote Creek, South Bay, Grizzly Bay, and Honker Bay station metal concentrations were higher than those at the other 18 stations. The similarity of the results, however, allows for aggregate regional metal concentrations to be considered by combining results from the 24 stations. The average concentrations of trace metals in this data set do not exceed the Bay Ambient Thresholds. The average concentrations in this data set exceed the ERM for nickel; however, the Bay ambient concentration of nickel is more than 2 times greater than the respective ERM. The average concentrations in this data set exceed the ERL for arsenic, chromium, copper, mercury, and nickel.

Chlorinated pesticides were detected at low levels in all samples collected at the 24 RMP stations from 1993 to 1998.

Numerous organic contaminants have been measured in Bay sediments. These include three major classes of compounds: PAHs, PCBs, and pesticides. Great differences in PAHs are observed in sediment concentrations between basins and peripheral areas, with the latter often having PAH concentrations 3 to 10 times greater than the former. PCBs were detected in all but 24 samples collected from 1993 to 1998 in the 24 RMP stations in the region. The total concentration of PCBs for each sample was compared to the Bay Ambient Threshold, and the ERL and ERM guidelines. At nine stations, the average total PCB concentration was above the 14.8 parts per billion (ppb) Bay Ambient Threshold. Of these samples, one station (San Jose) was above the ERL and ERM. No dioxin or total recoverable petroleum hydrocarbons (TRPH) analyses were performed on RMP samples collected in the region.

Bay Protection and Toxic Cleanup Program

Sediment "toxic hot spots," where sediment dredging could result in the degradation of water quality, have been identified in San Francisco Bay by the Bay Protection and Toxic Cleanup Program (BPTCP). The Bay Protection and Toxic Cleanup section of the California Water Code (Division 7, Sections 13390-13396.5) established a program to identify and plan remediation of toxic hot spots in bays and estuaries. Figure 3.1.4 in the Dredging Section shows the toxic hot spots identified in the BPTCP. Under this law, the RWQCB has implemented a program to identify potential toxic hot spots, sample and assess biological impacts in areas of unknown condition, confirm the biological impacts in areas that have been previously sampled, and assess the relationship between toxic pollutants and biological effects. In the Bay region, the RWQCB has reviewed existing data and reports; collected and analyzed new water, sediment, and tissue samples; and prepared reports. The *Final Regional Toxic Hot Spot Cleanup Plan* (RWQCB 1999) summarizes the situation in the Bay, and identifies Sites of Concern and Candidate Toxic Hot Spots.

3.4.1.4 Drainage and Runoff

Drainage and runoff from existing and proposed ferry terminals and associated facilities, including parking lots and access roads, are likely to add pollutants to stormwater discharges unless mitigation measures are implemented. Stormwater pollution occurs when rain comes into contact with materials onsite and picks up and washes contaminants into storm drains, creeks, or the Bay. Common sources of pollution include equipment and vehicles that may leak oil, grease, hydraulic fluid or fuel, construction materials and products, waste materials, landscaping runoff containing fertilizers, pesticides or weed killers, and erosion of disturbed soil. Stormwater discharges associated with industrial and construction activities are regulated according to CCR Section 402(p) under the National Pollutant Discharge Elimination System (NPDES) Permitting System. The State of California has permitting authority from the USEPA and implements the NPDES permit program.

Typical pollution control measures include Best Management Practices (BMPs) that are designed to reduce quantities of materials used that may produce pollutants, change the way various products and materials are handled or stored, employ various structural devices to catch and restrict the release of pollutants from the site, and set out appropriate responses to spills and leaks. Some examples of BMPs include temporary silt fences, protection devices such as rock aprons at pipe outlets, stabilized pads of aggregate at points where construction traffic will be entering or leaving an unimproved construction site to or from a public street, temporary drain inlet protection devices such as filter fabric and sand bags, concrete washouts for cement mixers, preservation of existing vegetation, vehicle and equipment cleaning, etc. Site-specific BMPs are described in a stormwater pollution prevention plan (SWPPP). A SWPPP has two objectives:

1. To identify and evaluate sources of pollutants associated with industrial and construction activities that may affect the quality of stormwater discharges and authorized nonstormwater discharges from the facility; and
2. To identify and implement site-specific BMPs to reduce or prevent pollutants associated with industrial or construction activities in stormwater discharges or authorized nonstormwater discharges.

Stormwater NPDES permitting for certain classes of activities, including ferry terminal activity, are regulated under the Industrial Activities General Permit adopted by the SWRCB on April 17, 1997 (WQO 97-03-DWQ NPDES Permit No CAS000001). To comply with the conditions of this permit, facility operators are required to submit a Notice of Intent, develop a SWPPP, and conduct stormwater monitoring, in addition to submitting annual reports by July 1 of each year.

Stormwater discharges associated with construction activities are regulated under the General Construction Activity Stormwater Permit adopted by the State on August 19, 1999 (WQO 99-08 DWQ, NPDES Permit No. CAS000002). Under this permit, owners of land where a construction activity occurs that disturbs more than 5 acres of land must submit a Notice of Intent, develop a SWPPP, conduct monitoring and inspections, retain records of the monitoring, report incidences of noncompliance, and submit annual compliance reports.

3.4.1.5 Floodplain Risk

Some areas of the Bay along the shoreline and drainages leading to the Bay are potential floodplains. Risks associated with building in a floodplain include threats to life and property. The level of risk is determined by the nature of the facility (i.e., parking lots, ticket purchase stations, access roads, docks, etc.), its location, and appropriate mitigation measures specific to each water transit terminal facility. Local city or county government agencies regulate floodplain construction, management, and mitigation through land use controls, based on determinations of flood elevations. The Federal Emergency Management Agency (FEMA) maintains maps of 100-year flood areas in the Bay counties. A "100-year flood" refers to a flood level with a 1 percent or greater chance of being equaled or exceeded in any given year.

3.4.1.6 Groundwater

Groundwater is of concern where it might occur near ferry terminals or dredging areas that could impact a groundwater basin's water quality. Groundwater is defined as subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated. Where groundwater occurs in a saturated geologic unit that contains sufficient permeable thickness to yield significant quantities of water to wells and springs, it can be defined as an aquifer. A groundwater basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers. Water-bearing geologic units occur within groundwater basins in the San Francisco Bay region that do not meet the definition of an aquifer. For instance, there are shallow, low-permeability zones throughout the region that have extremely low water yields. Groundwater may also occur outside of currently identified basins. Therefore, for basin planning purposes, the term "groundwater" includes all subsurface waters, whether or not these waters meet the classic definition of an aquifer or occur within identified groundwater basins.

The areal extent of groundwater basins in the region has been evaluated by the Department of Water Resources (DWR 1980). Of special importance to the region are the 31 groundwater basins classified by DWR that produce, or potentially could produce, significant amounts of groundwater (Figure 3.4.2). This computer groundwater mapping GIS system was developed by the RWQCB and has the capacity to present information on each basin at a much higher level of resolution. The Northern San Francisco Peninsula and East Bay Plain basins have been studied in further detail by the RWQCB and have been divided into proposed groundwater management zones including: (1) significant drinking water resource; (2) limited drinking water resource; and (3) nonpotable water resource. The South Bay is currently being mapped to this level, with the North Bay and Delta region to be mapped in the future by the RWQCB (Bartow 2002). Existing and potential beneficial uses applicable to groundwater in the region include municipal and domestic water supply, industrial water supply, industrial process water supply, agricultural water supply, and freshwater replenishment to surface waters. More detailed information that lists the 31 identified groundwater basins located in the region and their existing and potential beneficial uses can be obtained from the RWQCB Basin Plan. Unless otherwise designated by the RWQCB, all groundwater is considered suitable, or potentially suitable, for municipal or domestic water supply.

Groundwater quality can be degraded through the intrusion of saltwater. Degradation of water quality would reduce the groundwater basin yield, diminishing production from existing activities and limiting future groundwater development. In undeveloped coastal areas, saltwater is prevented from migrating landward by the hydraulic head of the fresh water, which must be high enough above sea level to compensate for the greater density of saltwater. Water production from wells located in the vicinity of the shoreline must be monitored. If pumping of the aquifer reaches rates high enough to reduce the freshwater hydraulic head (over-pumping), the denser saltwater will migrate towards the well and will eventually be extracted from the well. For example, when the Oakland estuary was dredged to create Alameda Island between 1880 and 1910, the dredging cut through a mud and sand layer and caused seawater intrusion into the east side of Alameda Island. Saltwater intrusion was then exacerbated by pumping from adjacent water supply wells on the island. Groundwater protection plans are prepared at the local government level.

According to findings of the Final LTMS Management Plan (USACE 2001), dredging may potentially affect groundwater resources. However, for this to occur would require dredging of Bay mud deep enough to strip the "cover" from the top of a freshwater reservoir under the Bay, allowing the saltwater to contaminate the fresh water. Not all groundwater elevations below the Bay have been mapped, but known elevations are well below the maximum dredging depth (about -7 feet) considered in this study.

Dredging Policy 9 of the Amendments to the Bay Plan specifies that "to protect fresh water reservoirs (aquifers): (a) all proposal for the dredging or construction work that could penetrate the mud "cover" should be reviewed by the San Francisco Bay Regional Water Quality Control Board and the State Department of Water Resources; and (b) dredging or construction work should not be permitted that might reasonably be expected to damage an underground water reservoir. Applicants for permission to dredge should provide additional data on groundwater conditions in the area of construction to the extent necessary and reasonable in relation to the proposed project."

A concern for saltwater intrusion into underlying aquifers was raised regarding the Oakland Harbor navigation improvement project. The project proposed to deepen and widen portions of the Inner and Outer harbor shipping channels. A hydrogeologic investigation was performed by the Port of Oakland (Todd Engineers 2000) to study the potential for saltwater intrusion into the local groundwater system. The study demonstrated that channel deepening would have a minimal impact on groundwater flow paths, vertical flux of groundwater into the lower aquifer, and changes in total dissolved solids concentrations over time.

San Francisco International Airport conducted a study (URS 2001) to evaluate the potential for saltwater intrusion into freshwater aquifers in the East Central Bay and around the airport (West Central Bay) due to proposed dredging of Merritt Sand and Young Bay Mud (YBM). The primary concern was that groundwater resources would be affected if the removal of low-permeability YBM from alluvial sediments (Merritt Sand in the East Bay, Upper Layered Sediments in the West Bay) were to enhance the hydraulic connection between the Bay and adjacent aquifers with sensitive uses. The evaluation was based entirely on existing hydrogeologic information gathered from public agencies and local consulting firms. It was found that previous dredging has already potentially contributed to saltwater intrusion in the localized Merritt Sand deposit. However, it is noted that the openings in YBM from dredging are self-healing, due to the continuing deposition of YBM.

3.4.1.7 Water Pollution from Vessels

Prevention of fuel spills, through risk reduction and containment measures, has reduced and minimized releases of petroleum products within the Bay. An expanded ferry system would increase transits and ferry operations. This could affect the potential for a fuel or petroleum product release. San Francisco Bay is the largest harbor on the Pacific Coast of the United States and ranks as the fifth largest crude oil handling port in the United States. It is the sixth largest handler of refined oil product in the nation. Extensive foreign and domestic commerce is handled at the port and harbor facilities in San Francisco, Oakland, Alameda, Richmond, and Redwood City. In the most recent year for which statistics have been compiled, 67,119,000 tons of cargo passed through the Golden Gate, of which 47,838,000 tons were either crude oil or refined liquid petroleum products. Because risk of spills is closely associated with the volume of traffic and its proximity to other vessel traffic, the approach to San Francisco Bay is the highest risk area in California. A vessel separation scheme is operative for the approach to San Francisco Bay. A Vessel Traffic Service (VTS) also operates to assist traffic to enter, to depart, and while inside of San Francisco Bay. There is lightering (i.e., transfer) activity at Anchorage 9 inside the Bay. There are numerous marine facilities surrounding San Francisco Bay where the transfer of crude oil and refined product occur on a daily basis. These transfer activities can be potential sources for oil spills.

Marine Fuel Spills

Marine fuel spills can result from leaks or breaks in vessel fueling equipment, vessel collisions or sinkings, mechanical or structural failures, or simple human errors such as leaving valves open or aligning them improperly. Very few spills linked to ferries have occurred and the volumes involved have been minimal. Accidental spills only account for a small fraction, up to 10 percent, of the total fuel contamination of waters. As much as 90 percent of oil in marine waters is from chronic sources that are difficult to identify, such as urban runoff, small craft boating, and improper disposal of used oil products (CDFG 2002). Since 1991, when the California Oil Spill Prevention and Response Act and the Federal Oil Pollution Act (OPA 90) took effect, there has been an 86 percent drop in the volume of oil spilled from oil tankers and barges in the United States[1].

The primary mission of the Marine Environmental Protection (MEP) Division of the United States Coast Guard (USCG) San Francisco Marine Safety Officer (MSO) is emergency response to pollution incidents. This includes containment and cleanup of oil discharges and hazardous substances introduced into the navigable waters of the United States. The MSO coordinates response efforts with other agencies—federal, state, and local—in a joint effort to minimize damage to the environment caused by pollutants.

The MEP Division consists of a total of 18 personnel in the Alameda and Concord offices. Personnel are trained in Incident Command System procedures and carry the qualifications of pollution investigators and Federal On-Scene Coordinators. Actual removal is primarily done by qualified clean-up contractors and supervised by MSO personnel on scene.

The MEP Division is also involved in preparedness planning. The Oil Pollution Act of 1990 mandated that Area Contingency Plans (ACPs) be created to respond to large oil spill incidents. Three ACPs are maintained by the San Francisco MSO: California North Coast, San Francisco Bay and Delta, and Central Coast. The latest update was published in 2000.

Several Oil Spill Response Organizations (OSROs) operate in the Bay and collaborate with the USCG, California Office of Spill Prevention and Response (OSPR), and other organizations in the Unified Command System during drills and spill responses. Response is available to OSRO members, or through the USCG or OSPR for orphan spills. Spill cleanup costs are paid by the party accepting responsibility for the spill. Spills occurring within the Bay can be attended to within one hour or less.

Coastal Fuel Spills

Fuel spills can potentially occur from a wide range of sources within the Bay. Potential incidents may involve spills of magnitudes that would far exceed those of spills from ferry vessels. Over a thousand tankers pass under the Golden Gate each year, along with container ships, recreational boats, and other vessels. In addition, numerous refineries, fuel tanks, and pipelines are found along the shoreline. The Federal Minerals Management Service prepared oil spill risk assessments for the West Coast in 1980 and 1988. According to these studies, for ships bound from Alaska to Los Angeles, there is a 53 percent probability of a spill of 1,000 barrels or more and a 26 percent probability of a spill of 10,000 barrels or more. Oil spills from offshore tankers have damaged California's coastal resources in the past, and continue to pose a threat. Large and

[1] It is important to note, however, that not all spills are necessarily reported.

small oil spills have occurred in the past 25 years. In 1971, two tankers collided under the Golden Gate Bridge in San Francisco Bay, spilling 20,000 gallons of oil. The oil moved out of the Bay and as far south as San Gregorio Beach in the Monterey Bay National Marine Sanctuary (MBNMS) and killed about 4,000 seabirds. Other notable spills involved tankers transiting to and from or docked at local ports. In 1984, the oil tanker *Puerto Rican* spilled between 25,000 to 35,000 barrels of oil (1 barrel equals 42 to 45 gallons oil). The slick reached Pigeon Point in the MBNMS and killed about 2,900 seabirds. In 1986, the *Apex Houston* leaked 616 barrels of oil across several hundred miles from Marin to San Luis Obispo counties, killing over 10,000 birds.

On October 28, 1996, the military reserve vessel SS Cape Mohican spilled an estimated 96,000 gallons of intermediate fuel oil (IFO 180) into a dry-dock structure. Approximately 40,000 gallons of fuel escaped into the San Francisco Bay at Pier 70. The spill allegedly occurred during routine maintenance when an opened valve discharged stored fuel while oil was being transferred from a stabilization tank. The oil impacted many sensitive natural resources including the Gulf of the Farallones and Monterey Bay National Marine Sanctuaries; Golden Gate National Recreation Area (including the Presidio, Alcatraz, and Fort Mason); Point Reyes National Seashore; the San Francisco Maritime National Historical Park; Angel Island State Park; and Fort Point National Historical Site. The spill resulted in physical fouling of artificial structures (such as pier pilings, riprap, and seawalls), sand and gravel beaches, rocky intertidal habitat, kelp beds, mudflats, and wetlands. The spill also caused closures of recreation areas and oiling of marinas and vessels, including historic ships.

Not all serious spills recorded in the Bay have originated in transiting vessels. In October 1996, an oil spill at the San Francisco dry docks poured about 8,000 gallons of bunker C fuel oil into San Francisco Bay. Initial efforts to contain and collect the oil were only partially successful. The spill broke up into many small slicks that spread over much of the Bay, out the Golden Gate, and along the coast.

In addition to the threat of large spills, small oil spills are an ongoing problem. The California Oil Spill Prevention and Response Agency reports that in 1993 alone, 39 lesser spills, mostly less than 1 barrel, occurred between Bodega Bay and Cambria, mostly from fishing vessels and recreational boats.

Ferry Fuel Spills in San Francisco Bay

Ferry refueling and other operations involving the handling of potentially harmful products and materials are carried out under strict U.S. Army Corps of Engineers (USACE) and USEPA regulations prohibiting water pollution. American regulatory bodies treat large vessels, including transit ferries, like major industrial facilities sited on land. All were recognized years ago as potential “point specific” sources of water pollution. Marine oil spills can result from leaks or breaks in vessel fueling equipment, vessel collisions or sinkings, mechanical or structural failures, or simple human errors such as leaving valves open or aligning them improperly. Highly detailed procedures and engineering requirements were then written into public law to prohibit harmful spills and discharges. Severe monetary fines and even criminal penalties are mandated for offenses. This program has been extremely effective. It is also noteworthy that, in addition to federal regulations, industrial and marine facilities and operations are subject to the state and local environmental regulations imposed by water quality boards, departments of fish and game, and other related regulatory agencies.

Data for water pollution from ferry boats in San Francisco Bay are presented in Table 3.4.1. Six incidents of pollution occurred from ferries from 1998 to 2001; the largest spill size was 15 gallons. The total number of ferry transits from 1998 to 2001 was 317,335, which means that less than one percent of transits (0.002 percent) resulted in an incident of pollution.

Current Oil Spill Preparedness and Response Conditions of Ferry Operators

The fuel characteristics of current ferry operators are detailed in Table 3.4.2. The following subsections summarize existing ferry operator fueling operations and contingency planning.

Golden Gate Ferry

All of the Golden Gate Ferry vessels have a fuel capacity less than 250 barrels. Both vessels and terminals are therefore exempt from USCG OPA oversight, except for vessel overflow containment for vents and other standard Title 33 Code of Federal Regulations vessel outfit rules. Vessels are fitted with aircraft-type fuel fittings to help reduce risk of spillage. Golden Gate holds a permit from the California OSPR to operate its "publicly owned/single user/single commodity (D-2)" over-water fuel transfer system. OSPR visits for occasional drill/inspection. Golden Gate has an OSRO (Parker) on retainer as its water responder and another OSRO (PSC) as its shoreside responder. The operator conducts regular drills. It has had a few small spills due to plugged fuel delivery filters, cracked bilge overboard valve seats, etc. GGBHTD posts an annual self-insurance certificate to OSPR.

An annual amount of 1.3 million gallons of fuel are transferred. All fuel is received by truck at the Larkspur fuel farm. Each truck delivers 7,500 gallons. Fueling of vessels is done from the tank farm, but can also be done directly from delivery trucks when the terminal system is down for maintenance. The Spaulding ferries can hold enough fuel for 5 to 7 days. All clean and dirty lube oil is handled by drum directly to and from the vessel using air-lift pumps. Bilge water is pumped ashore to holding tanks for disposal by a licensed hauling company.

Golden Gate ferries carry some response equipment such as absorbent material on all vessels. In addition, the Larkspur, San Francisco, and Sausalito terminals have over-water hydraulic rams and hoses for cleanup purposes. The Larkspur terminal has a fixed boom protecting the shoreline under the terminal, plus two 40-foot deployable booms to seal vessels and/or berths where a spill might occur.

The Spaulding ferries were modified in 1994-1995 to reduce fuel capacity from 252 to 247 barrels (bbls). The operator rarely fuels them to 6,000 gallons (60 percent) to avoid carrying fuel that is not needed and is essentially extra weight. The Catamarans have two 1,750-gallon tanks, which are kept to 90 percent capacity. They require about 1,800 gallons for a full-day schedule. The Sausalito (MVGG) vessel has a 4,800-gallon tank that is filled weekly. It uses 3,700 gallons in winter and 4,150 gallons in summer (Courtois 2002).

Blue and Gold Fleet

Blue and Gold Fleet maintains oversight and training of vessel operators and shore maintenance operators, who have responsibility for initial response to and notification of a fuel spill. The Blue and Gold Fleet maintains booms and absorbent materials at each of their operational locations to respond to spills at the berth and fueling areas. Only absorbent materials are aboard the vessels for spill response. The OSRO for Blue and Gold is Foss Environmental. The fleet uses approximately 32,000 bbls of diesel in a typical year and the vessels are fueled from an underground facility at Pier 41, San Francisco. Vessels are fueled to 80 percent capacity, usually every other day. Tank sizes range from 1,000 gallons to 2,700 gallons, depending on vessel class, and the vessels have two tanks each. Oil waste is typically collected into an underground facility at Pier 41 and recycled, or directly removed from the vessels by the recycler (Hie 2002).

Vallejo Baylink Ferry

Vallejo Baylink Ferries contracts with Foss Environmental to act as its shoreside and waterside OSRO and to perform cleanup in the event of a spill. All the fueling personnel receive training and are periodically tested in accordance to regulations. The Vallejo Ferry service has had no spills since being operated by the Blue and Gold Fleet. The Vallejo ferry maintains required spill response equipment (bulk absorbent, absorbent boom, absorbent pads, gloves, eye protection, type-x suits, and written inventory). The Vallejo Baylink service consumed approximately 1.2 million gallons of diesel in 2001. Fueling takes place at Berths 3 and 4 in Mare Island, which is the Vallejo Baylink Maintenance Facility. Vessels are fueled daily in the evenings: two vessels have two 1,750-gallon tanks, and one vessel has two 1,500-gallon tanks, which are all filled to 90 percent capacity. Two vessels operate on weekdays and summer weekends, and one vessel operates on winter weekends. Oily bilge water is offloaded to a holding tank shoreside. Artesian, an oil recycler, is hired to process the oily water (Robbins 2002).

3.4.1.8 Regulatory Setting

Water resources are regulated under a variety of federal and state laws. The following summarizes the applicable water quality regulations that apply to San Francisco Bay.

Federal Regulations

At the federal level, two agencies hold key regulatory authority regarding oil spills. The USCG is focused on prevention and response, while National Oceanic and Atmospheric Administration (NOAA) is focused on restoration of oil-damaged resources. The Clean Water Act, Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), and Oil Pollution Act (OPA) mandate that parties releasing hazardous materials and oil into the environment are responsible not only for the cost of cleaning up the release, but also for restoring any injury to natural resources that resulted. The National Marine Sanctuaries Act mandates that parties who destroy, cause the loss of, or injure sanctuary resources are responsible for their restoration.

Clean Water Act (33 USC 1251 et seq.)

This is the principal statute governing water quality. The statute’s goal is to end all discharges entirely and to restore, maintain, and preserve the integrity of the nation's waters, with an interim goal of providing water that is both fishable and swimmable. The Act regulates both the direct and indirect discharge of pollutants into the nation's waters. It mandates permits for wastewater and stormwater discharges, regulates publicly owned treatment works that treat municipal and industrial wastewater, requires states to establish site-specific water quality standards for navigable bodies of water, and regulates other activities that affect water quality, such as dredging and the filling of wetlands. The Clean Water Act was enacted in 1977 as a series of amendments to the Federal Water Pollution Control Act of 1948.

Federal Water Pollution Control Act, as Amended by the Clean Water Act of 1977 (33 USC 1251 et seq.)

The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Specific sections of the CWA control the discharge of pollutants and wastes into the marine and aquatic environments. The major sections of the CWA that apply to activities potentially occurring as parts of the proposed project include dredging and disposal activities (Sections 401 and 404) and the National Pollutant Discharge Elimination System (NPDES) (Section 402).

Oil Pollution Act (OPA) of 1990 (33 USC 2701-2761)

This is the principal statute governing oil spills into the nation's waterways. The OPA was passed in the wake of the Exxon Valdez oil spill in March of 1989. The statute establishes liability and limitations on liability for damages resulting from oil pollution, and establishes a fund for the payment of compensation for such damages. In conjunction with CERCLA, OPA mandates a "National Oil and Hazardous Substances Pollution Contingency Plan (NCP)" to provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants. OPA requires preparation of spill prevention and response plans by coastal facilities, vessels, and certain geographic regions. OPA amended the Clean Water Act and includes the Oil Terminal and Oil Tanker Environmental Oversight and Monitoring Act of 1990.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or Superfund) (42 USC 9601 et seq.)

This is the principal statute governing the cleanup of sites contaminated with hazardous substances, and responses to spills of those substances. The statute establishes liability for site cleanup, prescribes a procedure for identifying and ranking contaminated sites, provides funding for site cleanups, reduces uncontrolled releases of hazardous substances, establishes cleanup procedures that provide protection for humans and the environment, and restores injured natural resources through provisions administered by the natural resource trustees. In conjunction with OPA, it mandates a National Oil and Hazardous Substances Pollution Contingency Plan (NCP) to provide the organizational structure and procedures for preparing for and responding to discharges of oil and releases of hazardous substances, pollutants, and contaminants. The statute was amended by the Superfund Amendment and Reauthorization Act (SARA) in 1986, which adds extensive public "right-to-know" and emergency planning requirements, establishes a fund for leaking underground storage tanks, and imposes worker safety requirements for hazardous materials.

National Marine Sanctuaries Act (NMSA) (16 USC 1431 et seq.)

This is the principal statute governing the designation and management of protected marine areas of special significance. The statute requires NOAA to designate National Marine Sanctuaries in accordance with specific guidelines and to develop and review management plans for these sites. It provides for the continuation of existing leases, licenses, and other established rights in sanctuary areas, and for the development of research and education programs. The statute also prohibits destruction, injury, or loss of sanctuary resources, and establishes liability for response costs and natural resource damages for injury to these resources. The NMSA was formerly referred to as Title III of the Marine Protection, Research, and Sanctuaries Act of 1972.

The Ports and Waterways Safety Act of 1972 (33 USC 1221 et seq.)

The Ports and Waterways Safety Act of 1972 as amended by the Port and Tanker Safety Act of 1978, provides the strongest authority for the Coast Guard's program to increase vessel safety and protect the marine environment in ports, harbors, waterfront areas, and navigable waters. It authorizes VTS, controls vessel movement, establishes requirements for vessel operation, and other related port safety controls.

In addition, a number of other laws call for Coast Guard enforcement. These include the Federal Water Pollution Control Act, which delegates enforcement authority and responsibility to the Coast Guard in cases where oil and hazardous substances are discharged into U.S. waters in harmful quantities. The Act to Prevent Pollution from Ships (33 USC 1901 et seq.) limits the operational discharges of oil from ships and requires reception facilities to receive waste that cannot be discharged at sea. The Marine Protection, Research and Sanctuaries Act of 1972 (33 USC 1401 et seq.) requires Coast Guard surveillance of ocean dumping activities. The Oil Pollution Act of 1990 (33 USC 2701 et seq.) requires increased Coast Guard involvement with vessel traffic service systems, vessel and facility monitoring, and oil spill prevention and cleanup, in addition to amending the Federal Water Pollution Control Act.

NOAA established the Damage Assessment and Restoration Program (DARP) in 1990 to fulfill natural resource trustee responsibilities assigned in the CWA, CERCLA, OPA, and the NMSA and other federal laws. DARP has the mission to restore coastal and marine resources that have been injured by releases of oil or hazardous substances and to obtain compensation for the public's lost use and enjoyment of these resources.

State

Water Quality Control Act (Porter-Cologne Act)(California Water Code Section 13000 et seq.; CCR Title 23, Chapter 3, Subchapter 15)

The Porter-Cologne Water Quality Control Act is the primary state regulation that addresses water quality. The requirements of the Act are implemented by the State Water Resources Control Board (SWRCB) at the state level, and the RWQCB at the regional level. The SWRCB, as authorized by the Act, has promulgated regulations in Subchapter 15 of Title 23 of the California Code of Regulations (CCR) designed to protect water quality from the effects of waste discharges to land. Under Subchapter 15, wastes that cannot be discharged directly or indirectly to waters of the state (and therefore must be discharged to land for treatment, storage, or disposal) are classified to determine specifically where such wastes may be discharged. This classification requirement would apply to dredged material or fill that would be disposed of in an upland environment.

In addition to the provisions contained in the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act, the California Fish and Game Code provides general law regarding water pollution prohibitions and both criminal and civil penalties on discharges of petroleum and other hazardous materials entering California waters (Sections 5650 et seq.). State Fish and Game wardens enforce these sections.

Further, California Water Code Section 13272 requires any person who knows of any oil or petroleum product discharge into California waters to notify the Office of Emergency Services. Failure to comply is a misdemeanor.

All Oil Spill Prevention and Response regulations are found in Title 14, CCR. Regulations promulgated by the State Lands Commission are found in Title 2, CCR.

California State Lands Commission Marine Facilities Division (MFD) derive legislative authority from the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act of 1990 Division 7.8 of the Public Resources Code. The Act expanded the CSLC's pollution prevention responsibilities.

Local

Water Quality Control Plan for San Francisco Bay Basin

The Basin Plan identifies surface waters in the region as consisting of inland surface water (freshwater lakes, rivers, and streams), estuaries, enclosed bays, and ocean waters. Historical and ongoing wasteloads contributed to the surface water bodies in the region come from upstream discharges carried into the region via Delta outflow, direct input in the forms of point and nonpoint sources, and indirect input via groundwater seepage (RWQCB 1995). The Basin Plan describes the water quality control measures that contribute to the protection of the beneficial uses of the Bay watershed. The Basin Plan identifies beneficial uses for each segment of the Bay and its tributaries, water quality objectives for the reasonable protection of the uses, and an implementation plan for achieving these objectives.

McAteer-Petris Act (Public Resources Code Section 66600 et seq.)

The San Francisco Bay Conservation and Development Commission (BCDC) is responsible for implementing the McAteer-Petris Act. The Act directs BCDC to exercise its authority to issue or deny permit applications for placing fill, extracting minerals, or changing the use of any land, water, or structure within the area of its jurisdiction (the Bay waters and 100 feet above the shoreline). The BCDC also carries out determinations of consistency with the Federal Coastal Zone Protection Act for federally sponsored projects.

3.4.2 Impacts and Mitigation

3.4.2.1 Significance Criteria

Impacts to water resources would be considered significant if they would:

- Substantially reduce ability to achieve water quality objectives consistent with improved habitat conditions;
- Cause a degradation in water quality from on-site stormwater discharges due to construction of new terminal facilities, including buildings, roads, parking lots, and associated structures;

- Cause substantial flood hazards to human safety and property damage due to construction of new terminal facilities within a floodplain; or
- Result in a substantial increase in the incidence of fuel spills from ferries.

3.4.2.2 Impacts and Mitigation

Impact W-1 **Construction and operation of terminal facilities, including parking lots, access roads, and buildings, would increase the amount of impervious surface at terminal sites, causing an increase in stormwater discharge. If the stormwater came in contact with pollutants or disturbed soil, discharge of the runoff could impact the quality of the receiving water.**

Stormwater pollution occurs when rainwater comes into contact with materials on site and washes contaminants into storm drains, creeks, or directly into the Bay. Sources of pollution during project construction could include oil leaked from heavy equipment and vehicles, grease, hydraulic fluid, fuel, construction materials and products, waste materials, landscaping runoff containing fertilizers, pesticides or weed killers, and erosion of disturbed soil.

Stormwater discharges associated with project construction activities are regulated according to CCR Section 402(p) under NPDES. Under the NPDES construction permit, owners of the proposed terminal locations where construction would disturb more than one acre of land would have to submit a Notice of Intent (NOI), develop a SWPPP, conduct monitoring and inspections, retain monitoring records, report incidences of noncompliance, and submit annual compliance reports by July 1 of each year.

The majority of terminals included in the Proposed Project are in developed areas, many of which may already have water quality problems. However, the potential for impacts exists, and this impact is therefore considered potentially significant.

Summary of Impact W-1

- The Proposed Project would involve new terminal facilities. Construction and operation of these facilities could impact water quality due to stormwater discharges. These impacts could be potentially significant.

Mitigation W-1.1: Adoption of BMPs during construction to prevent, minimize, and clean up spills and leaks from construction equipment would reduce the potential for impacts to water quality. Examples of BMPs include refueling and maintenance of equipment only in designated lined and/or bermed areas, isolating hazardous materials from stormwater exposure, and preparing and implementing spill contingency plans in specified areas. Any equipment with a fuel tank or other oil tank, such as heavy excavation machinery, must be considered as a potential source of released oil. Storage and parking of such equipment shall take into account oil spill prevention regulations to ensure that the area is free of drains or other avenues though which spills may escape containment.

Mitigation W-1.2: New terminal facilities shall be designed such that stormwater runoff would be controlled and discharged in an appropriate manner. Construction and industrial stormwater NPDES permits would be required, and BMPs shall be adopted to reduce the chance of pollutants entering surface and groundwater, thereby reducing the potential for impacts to water quality. Typical pollution control measures include BMPs designed to reduce the quantities used of materials that may produce pollutants, changing the way various products and materials are handled or stored, employing various structural devices to catch and restrict the release of pollutants, and establishing appropriate responses to spills and leaks. Examples of BMPs include temporary silt fencing, protection devices such as rock aprons at pipe outlets, stabilized pads of aggregate at points where construction traffic would be leaving an unimproved construction site to enter a public street, temporary drain inlet protection devices such as filter fabric and sand bags, concrete washouts for cement mixers, preservation of existing vegetation, and vehicle and equipment cleaning.

Impact After Mitigation: Impact W-1 would be less than significant after implementation of Mitigations W-1.1 and W-1.2.

Impact W-2 **Construction of new terminal facilities within a 100-year floodplain could expose people to the hazard of flooding and terminal facilities to flood damage.**

Some areas along the shoreline and drainages leading to the Bay are potential floodplains. Risks associated with building in a floodplain include threats to life and property. The level of risk is determined by the nature of the facility (i.e., parking lots, ticket purchase stations, access roads, docks, etc.), its location, and the adoption of mitigation measures specific to each water transit terminal facility. Local city or county government agencies regulate floodplain development through land use controls, based on determinations of flood elevations. The Federal Emergency Management Agency (FEMA) maintains maps of 100-year flood areas in the Bay counties. A "100-year flood" refers to a flood level with a 1 percent or greater chance of being equaled or exceeded in any given year.

Existing and proposed water transit terminal locations, not including access roads, have been evaluated for their location within the FEMA 100-year flood boundary, based on published FEMA maps (Figure 3.4.3). None of the potential terminal sites in the Proposed Project lie within the 100-year floodplain as mapped by FEMA. However, base flood elevations in the areas of the proposed facilities should be verified or determined from FEMA Flood Insurance Rate Maps (FIRMs) when specific sites are identified.

Summary of Impact W-2

- None of the potential terminal sites in the Proposed Project lie within the 100-year floodplain as mapped by FEMA. Therefore, the potential for impacts from flooding is considered less than significant and no mitigation is required.

Impact W-3 **Increased numbers of ferry transits could bring an increased potential for fuel spills and water quality degradation in the Bay.**

Marine oil spills can result from leaks or breaks in vessel fueling equipment, vessel accidents, mechanical or structural failures, or human errors such as valves left open or misaligned. Ferry refueling and other operations involving the handling of potentially harmful products and materials are carried out under strict USACE and USEPA regulations prohibiting water pollution. Existing regulations and codes treat large vessels, including transit ferries, similar to major industrial facilities sited on land. They are recognized as potential "point specific" sources of water pollution. Detailed procedures and engineering requirements have been written into regulations to prohibit harmful spills and discharges.

Data for water pollution from ferries in San Francisco Bay are presented in Table 3.4.1. Six incidents of pollution occurred from ferries from 1998 to 2001; the size of the largest spill was 15 gallons. The total number of ferry transits during the four years of record was 317,335, which means that approximately two one-thousandths of one percent of transits (0.002 percent) resulted in an incident of pollution. While statistics for the existing ferry system indicate a low-probability and low-volume situation, spills may continue to happen. Spills could occur in transit, as a result of a navigational incident, such as collision or grounding, or due to equipment failure or malfunction. Spills can also take place at a refueling station as a result of accidental releases or malfunctions.

Currently, each of the three Bay Area ferry operators has concentrated its fueling operations at a single company location (i.e., Larkspur, Mare Island, and Pier 41). Current Bay Area ferry service requires approximately 77,000 gallons of fuel weekly to operate. Expansion of ferry service would require additional fuel storage and transfer capacity. This would require the expansion of existing fueling operations at the three centralized locations and/or the construction and operation of new fueling facilities at other locations to be determined. Both the expansion of existing facilities and the construction of new facilities would require permits according to relevant regulations and codes.

NOAA's Hazardous Materials Response and Assessment Division and the Office of Response and Restoration have issued a fact sheet on small diesel spills, which are defined as those in the range of 500 to 5,000 gallons (www.response.restoration.noaa.gov). This would be the general range of potential spills from vessels in the current and proposed ferry fleet. Diesel fuel is a light, refined petroleum product with a relatively narrow boiling range, meaning that, when spilled on water, most of the oil evaporates or naturally disperses within a few days. According to the NOAA fact sheet, this is particularly true for small spills, even in cold water. Consequently, after a few days there is rarely any oil on the surface for oil spill responders to recover.

After spilling on water, diesel oil spreads very quickly to a thin film. Even when the oil is described as a heavy sheen, it is 0.0004 inch thick and contains about 1,000 gallons per square nautical mile of continuous coverage. Diesel has a very low viscosity and is readily dispersed into the water column when winds reach 5 to 7 knots.

Diesel oil is much lighter than water (its specific gravity is about 0.85, compared to 1.03 for seawater). It is not possible for this oil to sink and accumulate on the seafloor as pooled or free oil. However, it is possible for the oil to be physically mixed into the water column by wave action, forming small droplets that are carried and kept in suspension by the currents. Oil dispersed in the water column can adhere to fine-grained suspended sediments, which would eventually settle on the estuary bottom. However, this process is not likely to result in measurable sediment contamination from small spills.

Diesel oil is not very sticky or viscous, compared to black oils. When small spills strand on the shoreline, the oil tends to penetrate porous sediments quickly, but also tends to be washed off quickly by waves and tidal flushing. Shoreline cleanup is usually not needed. Diesel oil is readily and completely degraded by naturally occurring microbes in one to two months.

Diesel is considered to be one of the most acutely toxic oil types. Fish, invertebrates, and seaweed that come in direct contact with a diesel spill may be killed. However, according to the NOAA fact sheet, small spills in open water are so rapidly diluted that fish kills have never been reported. Fish kills have been reported for small spills in confined, shallow water. Crabs and shellfish can be tainted from small diesel spills in shallow, nearshore areas. Small diesel spills can affect marine birds by direct contact, though the number of birds affected is usually small because of the short time the oil is on the water surface. Mortality is caused by ingestion during preening as well as hypothermia from matted feathers. According to NOAA's experience with small diesel spills, few birds are directly affected. However, small spills could result in serious impacts to birds under worst-case conditions, such as grounding of a vessel next to a large nesting colony or transport of diesel sheens into areas of high bird concentrations.

Summary of Impact W-3:

- The Proposed Project would involve expansion of ferry service and increased numbers of ferry transits. It would introduce new routes across the Bay, with the potential to impact areas not currently served by water transit. Based on the historic record, spills associated with ferry operations have an extremely low probability of occurrence. This has likely been due to the procedures followed by the ferry operators. Ferry service expansion should not result in a substantial increase in the incidence of spills, assuming continued use of similar procedures. This impact would likely not be significant in light of its low probability and the past record. However, a potentially significant spill could still occur.

Mitigation W-3.1: Although this impact is considered to have a low probability of occurring, a spill still has the potential to occur, and safety and avoidance measures are prudent. The Harbor Safety Committee of the San Francisco Bay Region adopted a Harbor Safety Plan in 1992 for San Francisco, San Pablo, and Suisun Bays. The plan, as mandated by the California Oil Spill Prevention and Response Act (OSPRA) of 1990, is aimed at improving the prevention, removal, abatement, response, containment, and cleanup and mitigation of oil spills in the state's waters. OSPRA also requires an annual review of the harbor safety plans to be submitted to the state Oil Spill Prevention and Response Administrator for comment and approval. The Bay Area ferry operators participate in the Harbor Safety Committee. The safety issues raised by expansion of ferries in the San Francisco Estuary and relevant recommendations and modifications will need to be incorporated into the annual plan review. A strengthened Harbor Safety Plan would reduce the potential for impacts to water resources resulting from expansion of ferry operations.

Mitigation W-3.2: Ferry operators shall update their contingency plans and continue to use emergency response services for pollution incidents. Several OSROs operate in the Bay and collaborate with the USCG, California Office of Spill Prevention and Response (OSPR), and other organizations in the Unified Command System during drills and spill responses. Ferry operators have retained OSRO services and maintain response equipment on board vessels and at ferry terminals. As part of the ferry expansion program, the contingency plans, drill exercises, and emergency response service agreements would be reviewed and modified, if necessary, to reduce potential impacts to water resources resulting from spills. Such modifications would include ensuring that all of the spill response equipment required at new terminals is available. Review of updates and modifications to plans will be done under the USCG's regular oversight of oil spill contingency plans. The work of updating and expanding the spill response plans should be based on NOAA's Environmental Sensitivity Index (ESI). The ESI involves the systematic compilation in a standardized format of information related to coastal shoreline sensitivity, biological resources, and human uses. ESI maps have been prepared for San Francisco Bay and are useful tools for setting protection priorities and cleanup strategies before a spill occurs (www.mapfinder.nos.noaa.gov/ mapfinderHTML3/surround/esi/atlas.html).

Mitigation W-3.3: A regular program shall be developed and maintained to train fueling operators on correct fueling methods to minimize spills due to human error or improper use of equipment would decrease the potential for spills.

Mitigation W-3.4: New vessels to be adopted in a ferry expansion program and the equipment to service any new fleets shall include technological designs to avoid fuel spills.

Mitigation W-3.5: Applicable measures recommended by the Ferry Safety Plan (ABS Consulting 2002) shall be adopted to minimize safety risks and prevent navigational incidents with the potential for spills. Ferry operators must take those new measures into account in their updates to contingency plans and OSRO service agreements**.**

Impact After Mitigation: The potential for Impact W-3 would be reduced to less than significant levels after implementation of Mitigations W-3.1 through W-3.5.

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Table 3.4.1
San Francisco Bay Ferry Boat Pollution Data 1998-2001

Year	Date	Location	Type of Pollution	Spill Size (gallons)
1998	07-Jul-98	Larkspur Ferry Landing	Oil, fuel: No. 2-D	10
2000	03-Nov-00	San Francisco	Hydraulic fluid or oil	15
2000	09-Nov-00	Pier 41	Oil, waste/lubricants	1
2001	01-Mar-01	Larkspur	Bilge slops (bilge oil and waste)	1
2001	17-Mar-01	Larkspur	Oil: Diesel	5
2001	09-Jul-01	Port of Richmond	Oil: Crude	5

Source: US Coast Guard Office of Investigations and Analysis, Assistant Commandant for Marine Safety and Environmental Protection, 2002.

Table 3.4.2
Bay Area Ferry Fuel Characteristics

Vessel Name	Owner	Operator	Fuel Type	Fuel Consumption	Fuel Capacity
Marin	GGBH&TD	GGBH&TD	Diesel ASTM D-2	600-1100 gpd	10,375 gallons, normally filled to 6,000 gallons
Sonoma	GGBH&TD	GGBH&TD	Diesel ASTM D-2	600-1100 gpd	10,375 gallons, normally filled to 6,000 gallons
San Francisco	GGBH&TD	GGBH&TD	Diesel ASTM D-2	600-1100 gpd	10,375 gallons, normally filled to 6,000 gallons
Del Norte	GGBH&TD	GGBH&TD	Diesel ASTM D-2,	1800 gpd	3,400 gallons
Mendocino	GGBH&TD	GGBH&TD	Diesel ASTM D-2	est. 2000 gpd	2 x 2100 gallons
Golden Gate	GGBH&TD	GGBH&TD	Diesel ASTM D-2	3900 gal / week annual average	4,600 gallons
Zelinsky	Blue & Gold	Blue & Gold	Diesel ASTM D-2	No data	No data
Vallejo	Vallejo	Blue & Gold	Diesel ASTM D-2	210 GPH	2020 gallons
Intintoli	Vallejo	Blue & Gold	Diesel ASTM D-2	260 GPH	3,500 gallons
Mare Island	Vallejo	Blue & Gold	Diesel ASTM D-2	260 GPH	3,500 gallons
Encinal	Vallejo	Blue & Gold	Diesel ASTM D-2	150 GPH	5400 gallons
Peralta	Vallejo	Blue & Gold	Diesel	No data	No data
Bay Breeze	Harbor Bay Maritime	Harbor Bay Maritime	Diesel ASTM D-2	No data	2,200 gallons
Harbor Bay Express II	Harbor Bay Maritime	Harbor Bay Maritime	Diesel	No Data	No Data

Source: JJMA 2002.

Not to scale

URS	Water Transit Authority Program EIR	Regional Monitoring Program Sampling Stations	Figure 3.4.1
	Project No. 43-00066890.12		

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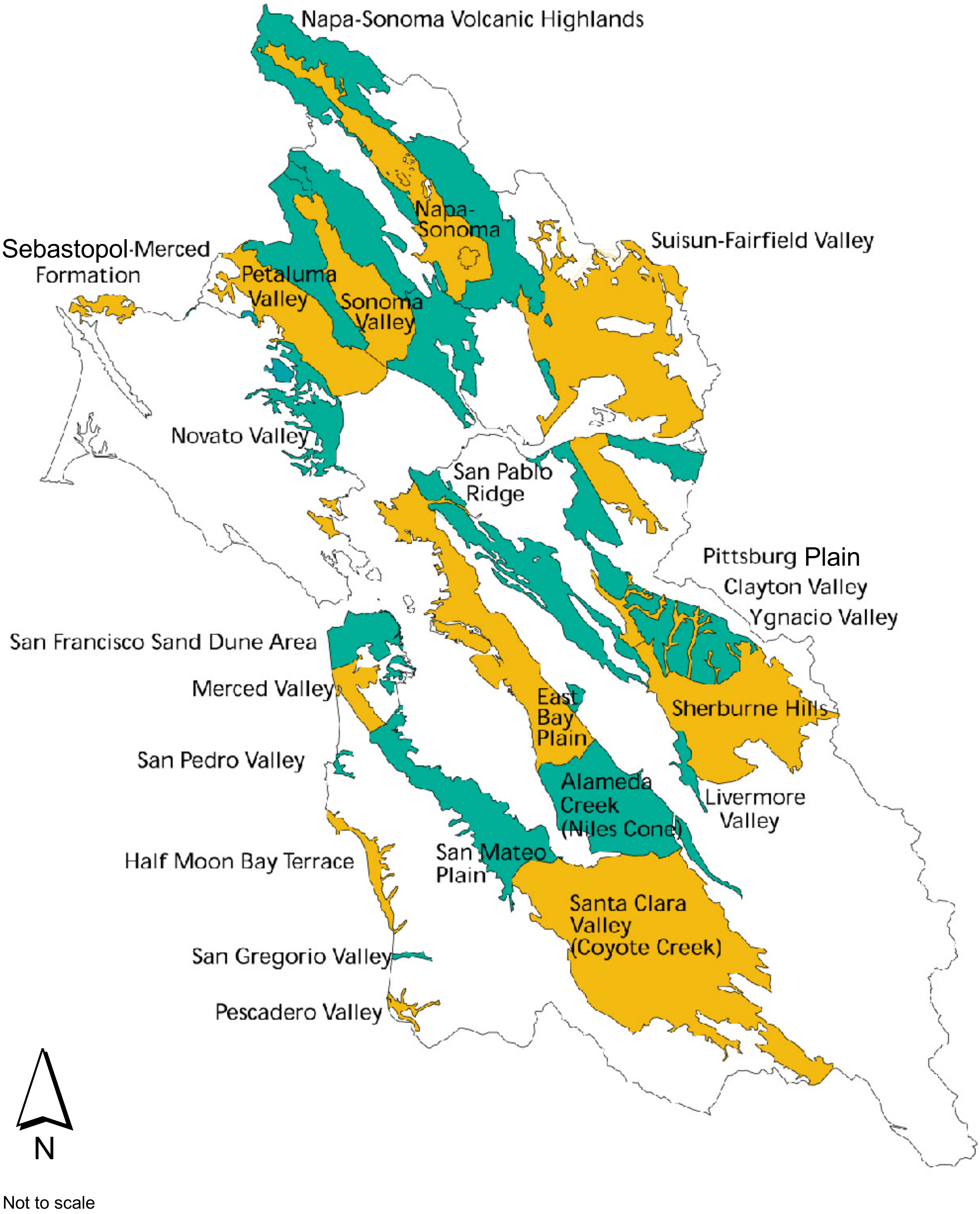
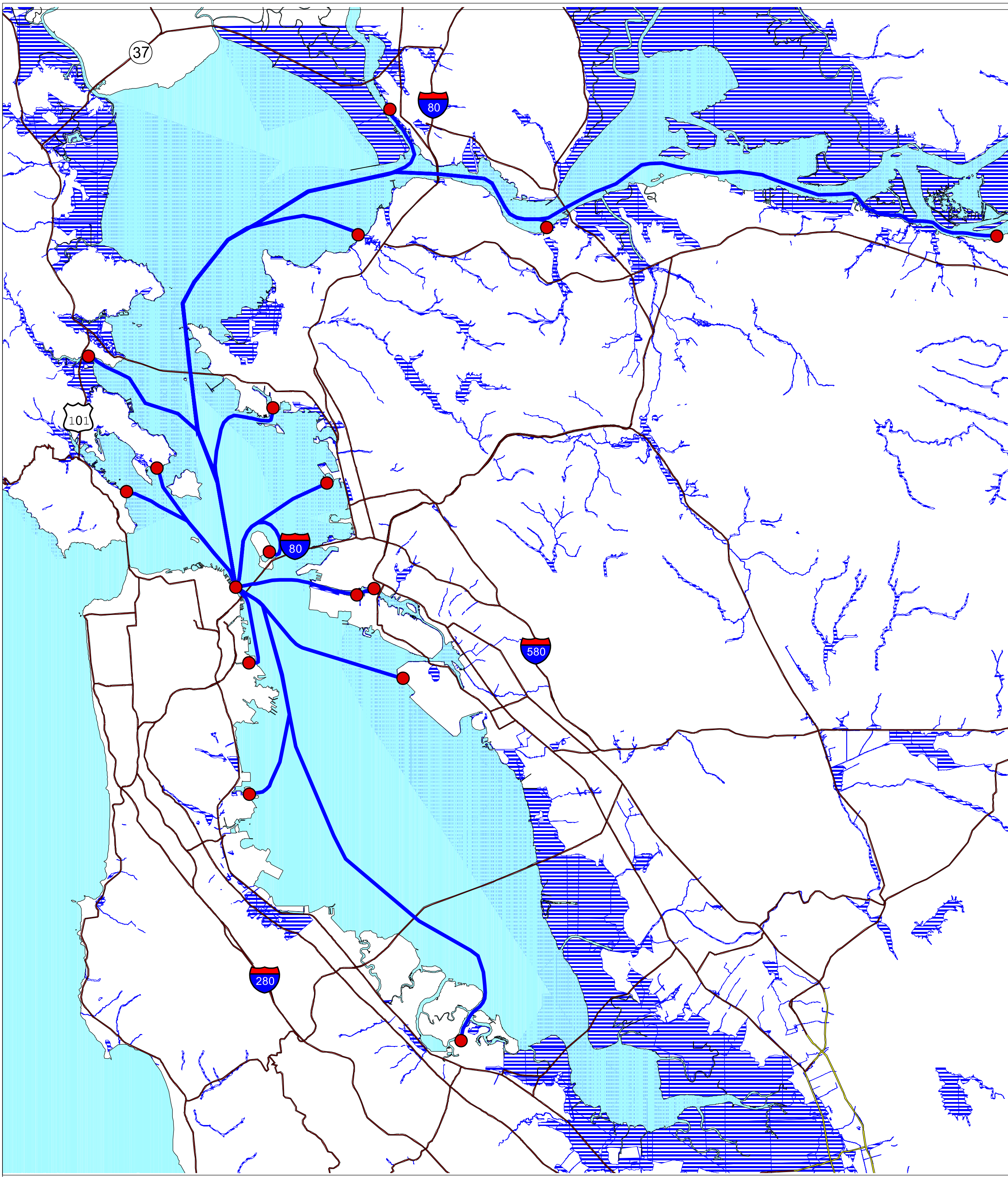


URS	Water Transit Authority Program EIR Project No. 43-00066890.12	Significant Groundwater Basins in the San Francisco Bay Region	Figure 3.4.2



LEGEND

Primary Roads

Existing or Proposed Ferry Terminal

FEMA 100-yr Floodplain

3 0 3 6 Miles

Scale 1:385,000

N

URS

Water Transit Authority
Program EIR

Project No. 43-00066890

FERRY TERMINALS AND FEMA 100-YR FLOOD ZONE

Figure 3.4.3

L:/projects/wta/apr/water_resources.apr

3.3 WAKE ANALYSIS

This section describes the existing San Francisco Bay shoreline, the overall wave and wake setting, and the potential impacts from additional wake wash created by expanded ferry service.

Waves occur in the natural environment as the result of energy, usually from wind, being transferred to the water surface. Seasonal variations in wave energy account for significant seasonal variations in shorelines.

Vessels with submerged hulls also create waves, referred to as vessel wake or wake wash. Vessel wake results from water being pushed aside, or displaced, by the hull and the resistance of the water to hull movement. The waves move outward from the hull. Depending on the water depth and type of shoreline, they may either dissipate harmlessly or cause undesirable impacts. The characteristics of wake wash that reaches the shoreline depend on the size and shape of the hull, vessel speed, vessel direction, and water depth.

If wake-generated waves have significantly greater wave heights or energy at the shoreline than natural wind waves, the wake wash can lead to excess resuspension of shoreline sediments and shoreline erosion or damage shoreline development.

Wake wash is of concern where wetlands, other sensitive habitats, and marinas are close to ferry routes. For example, the existing high-speed ferry service out of Larkspur and Vallejo are both subject to speed restrictions in their approach channels. In Larkspur, the primary concerns are impacts to Corte Madera marsh and to the marina at Paradise Cay, while in Vallejo, the concern is for impacts to houses and private slips built close to shore along the mouth of the Napa River.

3.3.1 Environmental Setting

3.3.1.1 Shoreline Types

Existing shoreline environment types in the Bay Area are described in detail in the Goals Project (Goals Project 2000). They can be grouped into five general categories: tidal marsh, bay flats, sandy beach, rocky shoreline, and armored shoreline (seawalls, riprap, etc.). Habitats along the San Francisco Bay shoreline are shown on Figure 3.3.1.

Geographically, the Bay Area shoreline can be broadly divided into three subregions, which are defined as the following:

- North Bay – North of the Richmond Bridge including San Pablo Bay, Carquinez Strait, Suisun Bay and the west Delta
- Central Bay – Richmond Bridge to the Bay Bridge east of the Golden Gate Bridge
- South Bay – South of the Bay Bridge

The majority of the San Pablo Bay portion of the North Bay shoreline consists of bay flats. Bay flats are sparsely vegetated intertidal areas that provide protection to banks and upland shoreline from wave energy and sediment. During low tide, bay flats provide foraging and roosting areas for numerous shorebirds that utilize the Bay during spring migration. In San Pablo Bay, bay flats generally border tidal marsh and farmed bayland areas. Tidal marsh can be salt marsh or brackish marsh, depending on its salinity. Tidal marsh vegetation specially adapted for saline conditions provide special foraging and roosting habitats for several species that could potentially be affected by wake wash.

Further east toward the Suisun Bay portion of the North Bay, the shoreline near potential ferry terminal sites mainly consists of marinas and armored shoreline (i.e., riprap). In Suisun Bay, the shoreline consists primarily of tidal marsh, muted tidal marsh, and managed marsh. There is also a limited area of bay flats along the northwestern shoreline.

Most of the shoreline in the Central Bay consists of rocky shoreline or manmade structures (i.e., marinas, piers, and riprap). Some bay flats exist along the Central Bay shoreline, mostly near the Larkspur, Berkeley, and Oakland areas. These bay flats are generally near small areas of tidal marsh and undeveloped fill. Towards the southern part of the Central Bay, a strip of sandy beach exists along the San Francisco shoreline between potential ferry terminal locations in Presidio and Fort Mason.

The northwestern portion of the South Bay shoreline is mainly developed and undeveloped fill. Around and south of the San Francisco Airport, bay flats occur along the shoreline. On the east side of the South Bay, bay flats occur around the Oakland Airport and San Leandro, and to the south along the shoreline all the way to the southernmost part of the South Bay, where there are extensive areas of bay flats, salt ponds, and tidal marsh.

Other types of shoreline habitats in the South Bay include sandy beach areas to the south of Harbor Bay Isle and diked marsh areas to the north of San Leandro.

3.3.1.2 California Clapper Rail Habitat

The California clapper rail (*Rallus longirostris obsoletus)*, an endangered species, was used to represent shoreline habitat impacts from vessel wake. Clapper rail are yearlong residents of emergent salt and tidal marshlands of San Francisco Bay (Goals Project 2000; Avocet Research 1992). They are most abundant in marshes south of San Mateo Bridge and in San Pablo Bay. The known distribution of California clapper rail in the Bay Area is shown on Figure 3.5.12 in the Biology Section (3.5). Disturbances to clapper rail habitat, such as inundation of nests, have potential to cause a negative impact on the endangered species' survivability during the nesting season.

California clapper rail nest between February 15 and June 15, building their nests in marsh vegetation such as bullrush (*Scirpus robustus*) and *Spartina sp.* at the maximum water level for the nest period (Collins et al. 1994; Avocet Research 1992). The whole breeding season for California clapper rail is February 1 through August 31, including courtship, nesting and renesting (Floerke 2002). The nests are generally located at least 100 meters inland from the marshland shoreline and less than 2 meters from small (first-order) channels (Collins et al. 1994). Nests are constructed entirely above mean higher high water (MHHW), with the base typically 10 to 20 centimeters (cm) above the ground (although one was observed built directly on the ground) and the top of the nests 25 to 30 cm above the ground. The nests are fixed to the vegetation and cannot move with the tide or waves. The clapper rail builds its nest only as high as necessary to prevent inundation while maintaining as much overhead cover protection from the surrounding vegetation as possible (Collins et al. 1994).

3.3.1.3 Bathymetry

The North Bay includes San Pablo Bay, Carquinez Strait, and Suisun Bay. San Pablo Bay consists of a 30-foot-deep ship channel surrounded by wide shallow shoals, especially north of the channel. The average depth of San Pablo Bay is approximately 9 feet Mean Lower Low Water (MLLW) and approximately 57 percent of the total area of San Pablo Bay is shallower than about 7 feet (USGS 1984).

Carquinez Strait, which consists of the transitional region between San Pablo Bay and Suisun Bay, has a mean depth and width of 30 feet and 1.6 mile, respectively (USGS 1984). Suisun Bay consists of several deep channels surrounding numerous shoals and islands. It includes two embayments, Grizzly and Honker Bays, with a mean depth of less than 7 feet. Suisun Bay has a total area of 36 square miles and a mean depth of 14.1 feet MLLW. A 30- to 46-foot-deep MLLW main channel connects Carquinez Strait and the Delta (USGS 1984).

The Central Bay is defined as the area between the Golden Gate Bridge to the west, the Bay Bridge to the south, and the Richmond Bridge to the north. The Central Bay has a total area of approximately 103 square miles and a mean depth of 35 feet MLLW. It is the deepest embayment on average of the entire San Francisco Bay and has the smallest percentage of shoal area (20 percent of total area). A ship channel with a depth of at least 29.5 feet originates at the entrance of the Bay and extends through the entire Central Bay, leading to channels in the North Bay and South Bay. The deepest area of the Central Bay is at the Golden Gate constriction (~360 feet), where depth is maintained by the strong tidal currents experienced at this narrow passage (USGS 1984).

The South Bay is defined as the area located south of Oakland Bay Bridge. It has a mean water depth of 17.4 feet MLLW (USGS 1995). A deep channel is located on the southwestern side of the South Bay. Its depth varies from about 35 to 40 feet MLLW north of the Dumbarton Bridge to 20 feet MLLW south of the Dumbarton Bridge (USGS 1984). The shoal areas located on either side of the channel are on average less than 10 feet deep south of the San Mateo Bridge and less than 5 feet deep south of the Dumbarton Bridge.

3.3.1.4 Tides and Currents

The maximum rise and fall of tide in San Francisco Bay is 2.4 meters. Currents vary considerably throughout the Bay with the strongest currents in the central Bay and weaker currents toward the southern extremities. The strongest outgoing (ebb tide) currents, exceeding 4 knots, occur in the Golden Gate and in the approaches to the Golden Gate such as Raccoon Strait (between Alcatraz and the Tiburon Peninsula), and between Treasure Island and the Ferry Terminal in San Francisco. Incoming (flood tide) currents are similar in strength. Currents near the mouth of the Sacramento and Petaluma Rivers are strongly influenced by fresh water run-off from these rivers, and vary with rainfall.

3.3.1.5 Sediment Sources and Transport

The San Francisco Bay is a very dynamic regime and the sediment movement and distribution within the Bay reflects the energy of the system. Short-term tidal fluctuations, mid-term seasonal patterns, and long-term historical changes influence sediment distribution. Resuspension and deposition of sediment occurs naturally each tidal cycle, in particular, during the monthly spring tides. Large volumes of sediment enter the Bay from the Sacramento, San Joaquin, and other rivers each spring.

The sediment in the shallow waters and shorelines of the Bay is predominantly fine silts and clays (cohesive sediments). While the sediments entering the North Bay from the San Joaquin and Sacramento Rivers contain coarser sandy material, a natural winnowing process takes place in the deeper channels. The finer silty sediment remains in suspension longer and hence is transported to shallower waters while the heavier material is carried by currents along the channel bottoms.

Studies have shown that tidal currents, large tidal variations, wind-wave resuspension, outflow from the Sacramento-San Joaquin River Delta (Delta), and transport are the most important process governing dynamics of sediment movement in the Bay (Schoellhamer 1996; McDonald and Cheng 1994). Throughout the Bay, the spring-neap tide cycle is an important factor in suspending and transporting sediment.

The Bay mudflat and marsh areas of the shoreline are in long-term dynamic equilibrium with effects of wave, tide and current action. Dynamic equilibrium means that in some areas mudflats and marshes are accreting sediment, whereas in other areas, marshes are being undercut and mudflats are eroding. Whether an area is accreting or eroding is a function of the supply of sediment.

In the North Bay, sediment transport is dominated by input from the Delta and outflux through the Golden Gate. The Delta is the predominant source of sediment to San Francisco Bay as a whole, supplying up to 86 percent of the total fluvial sediment (Krone 1996). The remaining sediment is contributed from local tributaries. Most of the sediments entering the Bay are silts and clays in suspension (Conomos and Peterson 1977).

The South Bay is characterized by large areas of broad shallows that are incised by a main channel 10 to 20 meters deep. Bottom sediments are typically composed of clays and silts (Thompson et al. 1981), with mixtures of silts with sand and shell fragments in the eastern shallow areas (Nichols and Thompson 1985).

3.3.1.6 Net Sediment Accretion and Erosion in the Bay

The Bay bottom contours (bathymetry) and, hence, the position of the Bay shoreline, is not constant but changes in response to sediment entering the Bay from rivers and exiting the Golden Gate. General regional patterns of accretion (deposition) and erosion for the Bay have been developed, but even these patterns are subject to local variations.

Hydraulic mining in the Sierra Nevada Mountains started in the mid-1800s. As a result, large amounts of sediment have entered the North Bay. The area continues to be a significant sediment source. As well as historic mining sediments, the Sacramento and San Joaquin Rivers naturally discharge sediments. The California Department of Water Resources (DWR) calculated the average annual inflow of sediment from the Sacramento and San Joaquin Rivers between 1956 to 1990 to be 7.8 million cubic yards (mcy). In addition, an estimated 0.89 tons of sediment enters Suisun, San Pablo, and San Francisco Bays from local tributaries (Ogden Beeman and Krone 1992).

The sediment inflows and outflows can be combined to develop a sediment budget. For 1960, the most recent available evaluation, a total of 10.5 mcy of sediment entered the Bay, 1 mcy were dredged and disposed on land, 5.5 mcy accumulated in the Bay, and 4.0 mcy exited through the Golden Gate (Krone 1996). This budget indicates that, overall, the Bay is accumulating sediments.

There are regional variations within the Bay, with the North and Central Bays being depositional and the South Bay erosional. Based on computed bathymetric changes from 1955 to 1990, Ogden Beeman and Krone (1992) concluded that the Central and North Bays were accretional over the 35-year period, with highest rate of deposition occurring in the Central Bay (0.2 to 0.4 inch per year) followed by Suisun Bay (1 to 0.3 inch per year). San Pablo Bay was almost neutral although the northern portion of San Pablo Bay showed slight erosion. The South Bay north of San Mateo Bridge was primarily erosional in the eastern and depositional near San Bruno Shoals. The largest sediment accumulation was located south of Dumbarton Bridge.

Other studies (Jaffe et al. 2000; Cappiella et al. 2000) have reached different conclusions on the rates of erosion and deposition in subregions of the Bay. However, this brief review of the sediment patterns indicates that the Bay is dynamic and that bathymetry and shorelines are not static. Hence, changes in sediment movement resulting from ferry operations needs to be considered in the context of a dynamic system that has daily, seasonal and long-term temporal variations.

3.3.1.7 San Francisco Bay Area Winds

Local geographic features strongly influence wind patterns and as such, the wind regimes for San Francisco Bay can be split up into three main regions: North, Central, and South Bays. The San Bruno Gap, located north of San Francisco Airport, is one of the most important features influencing Bay Area wind patterns. During the spring and summer, west to northwest winds are funneled through the gap, resulting in stronger westerly winds.

3.3.1.8 Wave Climate in San Francisco Bay

Naturally occurring waves within San Francisco Bay are predominantly those created by local winds. Swells, which are produced by storm systems far away, generally do not contribute significantly to the wave climate within the most of the Bay. However, long period swells from wind forces hundreds of miles to the west coming through the Golden Gate can mix with long fetch northeast wind-driven waves in the shallow South Bay to create, at times, steep and complex wave patterns. In San Pablo Bay (North Bay), short period wind-driven waves and the tidal effects of the Sacramento and Petaluma Rivers create a different wave pattern. The northerly winds in San Pablo Bay cause short wavelength “choppy” waves, while in the South Bay, these same waves, coming on the shallow waters of the south end, often break into steeper waves. These two systems come together at the Golden Gate.

Wind-Driven Wave Height and Energy Calculations

Because there are no comprehensive measurements of waves in San Francisco Bay, wave “hindcasting” was conducted using computer models for 15 representative locations throughout the Bay. This technique allows wave characteristics such as wave height and energy to be calculated using empirical equations based on past meteorological conditions. The calculations are described in detail in Appendix Wake-A.

Analysis of wind data from Oakland and San Francisco airports indicates that the 1992-1993 year was a typical or representative wind year. Therefore, the 1992-1993 wind records from these airports and data from a wind station in San Pablo Bay were used in this analysis.

Table 3.3.1 presents maximum sustained wind wave heights (in meters) for wind-driven waves reaching the shore for the 15 representative Bay locations. These values were calculated using the 1992-1993 wind data as presented in Appendix Wake-A. Table 3.3.2 presents monthly wave energy (MJ/m) reaching the shore for the same locations. Considerable seasonal variation is evident. The locations with the greatest wind wave heights are those with the longest fetch lengths across the Bay. While the Petaluma Wetland location has the longest fetch length and hence the largest wind-driven waves, in reality, much of that energy will dissipate on the mudflats. Wave breaking, refraction, and diffraction were not considered in the computations.

3.3.1.9 Wake Wash Climate in San Francisco Bay

When a vessel with a submerged hull moves through the water, it displaces water and meets resistance, some of which is transformed into wave energy. The displaced water first moves up whereupon gravity acts upon it, resulting in the familiar form of an undulating wave with predictable shape and properties. These waves appear similar to wind-driven waves.

The waves move toward the shoreline, where, depending on the water depth and type of shoreline, they may either dissipate harmlessly or may cause undesirable impacts, such as erosion. The detailed characteristics of wake wash when it reaches the shoreline depend on the size and shape of the vessel hull, vessel speed, vessel direction, and water depth (Stumbo et al. 1999).

If vessel wake results in waves at a shoreline that have significantly greater wave heights or energy compared to natural wind waves, the wake wash can lead to excess resuspension of shoreline sediments and erosion or cause damage to shoreline development.

The wake wash characteristics of existing conventional and high-speed ferry vessels operating on the six services in San Francisco Bay were measured over a 3-day period in February 2002 for this assessment. Details of the measurements and calculations are presented in Appendix Wake-B. The technical aspects of wake wash, as well as the wake assessment methodology utilized, are described in more detail in Appendix Wake-D.

Existing Vessel Traffic on San Francisco Bay

In recent times, ferry service has been offered on the Bay since the early 1970s when commuter service restarted in response to increasing congestion on regional highways. Service increased in response to a number of natural and manmade disasters including the Loma Prieta earthquake, the landslide on U.S. 101 in Marin County, and the BART tunnel fire. Existing conventional and high-speed ferry traffic is therefore a component of the environmental setting.

There are currently six major ferry routes on the Bay, with an average of 78 daily one-way transits. They include routes from San Francisco to Larkspur, Sausalito, Tiburon, Vallejo, Harbor Bay, Oakland, and Alameda. The service from San Francisco to Oakland and Alameda is a circular route owned by the Alameda Oakland Ferry Service (AOFS) and operated by Blue & Gold. Harbor Bay Maritime runs the San Francisco/Harbor Bay route. The San Francisco to

Vallejo route is owned by Vallejo and run by Blue & Gold. Golden Gate runs the remaining routes. Existing ferry traffic in San Francisco Bay is shown in Table 3.3.3.

Other vessel traffic on the Bay includes tugboats, other public vessels, pleasure craft, and tankers, container vessels, roll-on/roll-off vessels, and bulk carriers calling in the Ports of Oakland, San Francisco, and ports up the Sacramento River. Table 3.3.4 presents the traffic in San Francisco Bay in a typical month. The total number of trips for the month shown (September 2001) was 6,078. Of these, 4,146 were by ferries, or approximately 68 percent.

Wash From Existing Vessel Traffic

The wake wash measurements from ferries observed in Francisco Bay for this analysis is presented in Table 3.3.5. The wake wash data are presented using the following quantities:

- **Energy "packet" size:** The height (cm), period (s), and energy (Joules/m) of the tallest wave in the vessel's wave train at the distance from the sailing line of the area of concern. These values are generally reported at a standardized distance of 300 meters.
- **Energy from one transit's wave train:** Determined from a single vessel's wash characteristics at the point of measurement.

Table 3.3.5 lists conventional monohulls ("Spaulding" class ferries and pusher tugs), intermediate speed (25 knot), and high-speed catamarans (35+ knot "Mare Island" class ferries). The conventional 725-passenger Spaulding class monohulls, which operate at 20 knots, show the largest wake heights and energies (up to 58 cm and 16,400 J/m respectively). The 149-passenger 35-knot vessels show the lowest wake heights and energies for high-speed ferries at operational speeds (20 cm and 800 J/m). The wave heights and energies are also shown for two of the high-speed vessels (350 passengers, 35 knots; 149 passengers, 35 knots) when they are operated at a reduced speed of 10 knots. The 149-passenger 35-knot vessel shows a slight increase in wake wash energy at reduced speed.

There is no standard wash pattern for nonferry traffic in the Bay. Table 3.3.6 summarizes available wake wash characteristics of other types of vessels. As a general rule, the large container vessels and bulk carriers move slowly, either under their own power or by tug, and they create very little wash. However, when large container vessels or tankers travel in constricted straits or narrow channels, they can create a very large wake as they displace a significant volume of the water in the channel. Tugs produce significant short-period high-energy wash as they move from location to location at their maximum speed, which is typically at the hump speed, or the highest energy peak in their speed/power profile. The dinner vessels are generally of the same hull configuration as the monohull ferries. While their wake profile at top speed is significant, they seldom operate at top speed and they do not travel standard routes.

The contribution of the nonferry traffic to Bay Area wake wash is estimated to be less than one-third of the Bay-wide total. In some areas such as the Carquinez Straits, nonferry vessel traffic causes the majority of total wake. This estimate is based on conversations with U.S. Coast Guard (USCG) personnel based at the Vessel Traffic Center on Yerba Buena Island, and a month of vessel traffic data supplied by the USCG. Data was supplied for the month of September 2001, which the USCG indicated was a typical month for vessel traffic.

3.3.1.10 Regulatory Setting

There are currently no federal, state, or local wave wash regulations. However, a search of information available on the Internet was conducted to identify legislative criteria or operational guidelines for wave wash generated from high-speed ferries around the world.

For the majority of areas, specific criteria for wave wash generated from high-speed ferries was not identified within legislation, regulations, or guidelines. However, the issue is assessed in some areas during the Environmental Impact Assessment process (in particular in Denmark, Australia, New Zealand, Italy, and United Kingdom). Areas with specific criteria are summarized below and discussed in more detail in Appendix Wake-C.

Washington State Ferries

The Washington State Ferries (WSF) system currently operates two high-speed catamaran passenger-only ferries, the *Chinook* and *Snohomish*, from Bremerton to Seattle. The route passes through Rich Passage, which is approximately 3 miles long and ½ mile wide at the narrowest point. The vessel wake wash specifications (28 cm wave height measured at 300 meters) were based on a wake study (Hartman 1990) to determine the minimum design criteria that would not cause significant harm to the shoreline.

The *Chinook* began service in May 1998 and was generally run at 34-35 knots. A second high-speed ferry, the *Snohomish,* was scheduled to begin service in September 1999. In April 1999, Bainbridge Island landowners along Rich Passage filed a lawsuit, charging that wake wash from the ferries was damaging their waterfront bulkheads, eroding beaches, and harming marine life.

In August 1999, as a result of the lawsuit, WSF was ordered to reduce the speed of the ferries to 12 knots in the vicinity of Rich Passage. The decision was appealed and the court-ordered slowdown was lifted in April 2000 (Kucera vs. State).

The *Snohomish* began operations in November 1999. In 2000 and 2001, a wave action study was performed to form the basis for further recommendations (RPWAST 2001). Some of the study sites showed no evidence of POFF wave impacts. One stretch of shoreline, however, experienced substantial erosion.

Starting October 1, 2001, state ferry officials enacted a slowdown to 12 knots in a section of Rich Passage, lengthening the crossing by 10 minutes (Pritchett 2001). The slowdown did not extend the entire length of Rich Passage as the previous slowdown had but was based on the results of the Rich Passage Wave Action Study (RPWAST 2001).

Europe

The Danish Maritime Authority (DMA) established wake wash regulations in 1997 (DMA 1997). Before a shipping company establishes a high-speed ferry route operating in a Danish port or puts a new high-speed ferry into service on an existing route, the operator must present documentation that the waves generated by the high-speed ferry do not constitute an unnecessary risk to navigation safety and to leisure activities in coastal areas based on a calculation of maximum wave height.

In the United Kingdom, the Maritime and Coastguard Agency is currently working with Marinetech South Limited on the Ships Wash Impact Management (SWIM) Research Project Collaboration. The objectives of the SWIM Project, which is due for completion in 2003, include development of techniques for predicting wave generation, identifying the impact of hull form, trim, speed, and water depth on wash characteristics, development of methodologies to quantify ecological impacts of wash, and proposal of guidelines for managing wash impacts. The project is supported by the Maritime Safety Committee of the International Marine Organization (IMO).

New Zealand

In the Marlborough Sounds in New Zealand, 35-knot fast ferries began operating in 1994. Based on a risk assessment and the results of a continuing ferry wash monitoring program, the Marlborough District Council (MDC) approved a bylaw (The Navigation Bylaw 2000) imposing an 18-knot speed restriction on high-speed craft in December 2000. It includes an exemption if ferry operators can demonstrate that waves generated by their vessels will not exceed prescribed levels (MDC 2002). MDC is continuing to assess potential controls for high-speed vessels to be included in an updated *Marlborough Sounds Resource Management Plan* (MDC 2001).

3.3.2 Impacts and Mitigation

The following section describes the potential impacts that wake wash from expanded ferry service could have on the environment. This is an evaluation of potential impacts from the overall ferry service expansion program. Therefore, the discussion addresses the overall potential for impacts, and, where applicable, the mitigation measures that can be adopted to avoid or minimize these effects.

3.3.2.1 Significance Criteria

Qualitatively, impacts to the shoreline from wake wash from new ferry service would be considered significant if they would:

- Cause a significant increase in wave height (energy) at a shoreline receptor compared to that of natural wind-driven waves and existing wake; or
- Cause a significant increase in shoreline erosion or loss of wetland habitat; or
- Impact special-status species such as California clapper rail (a threatened species) or Pacific harbor seal (a protected species).

Physical Shoreline Significance Criteria

To enable quantitative assessment of potential impacts to shorelines, specific criteria for San Francisco Bay were developed as described in Appendix Wake-D. The significance criteria include a 16-cm wake wash wave height at the shoreline and a 1,500-meter distance from sensitive shorelines to ferry routes. Potentially sensitive shorelines include mudflats, salt marshes, narrow channels, and sandy beaches. Potential impacts from increased ferry service would not be significant for rocky or armored shorelines. Erosion at rocky shorelines is a consequence of cumulative extreme storm events and armored shorelines are designed to resist the waves occurring during extreme storm events. The 16-cm criterion is based on an analysis of daily average wind waves. The 1,500-meter criterion is based on the distance required for the wake from a vessel with a design wake wave height of 27 cm (measured at 300 meters) to attenuate to the 16-cm shoreline criterion. (The 27-cm wake height design criterion is based on the largest anticipated vessel that would be used for the increased ferry service – a 350-passenger, 35+ knot vessel.) The rationale for these criteria is described in detail in Appendix Wake-D.

However, even if the 16-cm and 1,500-meter criteria are not met, wake wave impacts may not be significant at the shoreline. Comparison with site-specific data would be necessary to make such a determination. If predicted wake waves at the shoreline are less than 50 percent of the average sustained wind wave height on a monthly basis, significant impacts are not anticipated because the wake wash waves would be indistinguishable from the natural variation of the wind-driven waves.

With these criteria, impacts to the shoreline would be considered significant if:

- A ferry route passes within 1,500 meters of a potentially sensitive shoreline and the predicted wake wash wave at the shoreline is greater than the 16-cm shoreline wave height criterion; and
- Predicted wake waves at the shoreline are greater than 50 percent of the average sustained wind wave height on a monthly basis.

To aid in the impact assessment for individual ferry routes and shoreline areas, a decision tree was developed (Figure 3.3.2) that includes a series of questions to determine whether impacts to shorelines would be significant.

Biological Significance Criterion for Clapper Rail Nest Inundation

As described in Appendix Wake-D, in discussion with area biologists and resource agencies, California clapper rail, an endangered species, was selected as a surrogate for sensitive biological receptors. Specifically, being protective of clapper rail habitat is considered to be protective of sensitive bio-receptors.

Impacts to California clapper rail nesting sites could be considered significant if:

- Ferry routes were within 50 meters of known or potential nesting sites.

It is important to note that a clapper rail nest within 50 meters of a route will not necessarily be impacted, but would only potentially be impacted.

3.3.2.2 Potential Impacts to Shorelines

Impact WW-1 **New routes and increased frequency of ferry trips across the Bay could increase the wave height (energy) at some shorelines, potentially causing increased erosion.**

Shorelines tend to be in dynamic equilibrium with the "typical" or average wind wave energy reaching them. Erosion could be increased or altered due to additional ferry service if wake wave heights and energy were significantly greater than those of existing wind-driven waves (see Appendix Wake-D for discussion).

For shorelines at a distance greater than 1,500 meters from a proposed ferry route, impacts are not anticipated to be significant because of the attenuation of wave height with distance. Impacts could potentially be significant for sensitive shorelines (tidal marshes and mudflats) that are within 1,500 meters of a ferry route. Impacts are not anticipated at rocky or armored shorelines as these shorelines can withstand extreme weather events, which subject them to conditions only experienced every 50 or 100 years. Figure 3.3.3 shows areas of potentially sensitive shoreline that are within 1,500 meters of a ferry route for the Proposed Project. If a potentially sensitive shoreline is within 1,500 meters of a route, it does not indicate that there would be impacts, only that there is a potential for significant impacts.

The highlighted shoreline areas are based on an approximate 1,500-meter measurement from the proposed routes. When exact terminal locations and routes are identified, they will need to be accurately plotted on navigational charts. Potentially sensitive shoreline areas within 1,500 meters of those routes could then be identified with more precision.

A decision tree (Figure 3.3.2) was developed to help evaluate whether impacts to shorelines could be significant.

As shown on Figure 3.3.3, potentially impacted shorelines for the Proposed Project in the North Bay include the shorelines from Antioch to Martinez in New York Slough and Suisun Bay, areas in the Carquinez Strait near Martinez and Vallejo, and south of Point Pinole. In the Central Bay, potentially sensitive areas include shorelines near the terminal locations (Larkspur, Richmond, and Harbor Bay Isle). In the South Bay, the shoreline along the approach to Redwood City could potentially be impacted by wake wash.

Summary of Impact WW-1

- For the Proposed Project, potentially impacted areas in the North Bay include the shorelines from Antioch to Martinez in New York Slough and Suisun Bay, areas in the Carquinez Strait near Martinez and Vallejo, and south of Point Pinole. In the Central Bay, potentially sensitive areas include shorelines near the terminal locations (Larkspur, Richmond, and Harbor Bay Isle). In the South Bay, the shoreline along the approach to Redwood City could potentially be impacted by wake wash. This is a potentially significant impact.

The decision tree (Figure 3.3.2) can be used to determine whether impacts would be significant. Appendix Wake-E presents example analyses for representative shoreline types.

Mitigation WW-1.1: To meet the criteria evaluated for Impact WW-1, ferry routes and service may need to be modified such that:

1. The route alignments are maintained at more than 1,500 meters from potentially sensitive shorelines (e.g., mudflats, unprotected tidal marshes). This should maintain wake impacts at a less than significant level.
2. Operation of the vessels (primarily speeds) are maintained such that predicted wake wave heights at the shoreline would be less than 16 cm. This would also reduce this impact to a less than significant level.
3. Operation of vessels are maintained such that predicted wake waves at the shoreline would be less than 50 percent of the average sustained wind wave height on a monthly basis.

If resulting ferry routes meet one or more of the above criteria, impacts would be less than significant.

Mitigation WW-1.2: New ferry routes could potentially be modified to redirect energy away from sensitive habitats, to reduce or eliminate increased wake energy. Adjustment to routes can be used to focus wave energy on rocky or armored shorelines or to direct energy away from sensitive areas. Detailed wave refraction, diffraction, and reflection analysis would be required to predict the efficacy of wave energy focussing. This mitigation measure would only be feasible and effective on portions of routes where the operation of the vessel can incorporate these adjustments. For example, the approach routes to terminals near sensitive areas could be designed such that wake wash is directed away from sensitive tidal marsh environments, and turning movements are not permitted at a speed and/or direction that exceeds criteria 2 or 3, listed above. Route bending could, however, involve compromises in service and cost, which would need to be evaluated on a route-by-route basis.

Mitigation WW-1.3: Use of existing low-wake vessel technology could reduce both the total wake wash energy and heights of individual waves. As shown in Figure Wake-D-2 (in Appendix Wake-D) existing light-weight high-speed vessels have 25 percent or better wave height and wave energy characteristics than the 350-passenger high-speed vessels presently operating on the Bay. For example, if a vessel with a wave height profile such as the *Bravest* (Appendix Wake-D) were specified (which has an operating design wave height of 22 cm measured at 300 meters) the 16-cm shoreline wave height criterion would be met at a distance of 780 meters, almost half the 1,500 meter distance for vessels with a 27-cm design wave height. Because wave energy is proportional to the square of wave height, slight reductions in design wave heights are equivalent to significant reductions in wave energy, and hence equivalent to significant reductions in wave heights at distance. However, this mitigation could involve compromises in service and cost, which would need to be evaluated on a route-by-route basis.

Mitigation WW-1.4: Operational adjustments, such as slowing down vessels, could be implemented to reduce wake energy near sensitive tidal marsh habitat. Note, as shown in Figure Wake-D-2 (in Appendix Wake-D), a considerable reduction in vessel speed is required with an efficient high-speed vessel before the wake wash height is less than that at design operational speeds. For example, for the Mare Island class of high-speed catamaran currently operating on the Bay, the normal operating speed of 34 knots (40 mph) would need to be reduced to 10 knots (11 mph) or less in order to achieve a reduction in wave height. The change in wave form (and hence wave period) would also need to be considered as high-speed ferries generate a different wave patterns at high (operating) and low (motoring) speeds. At high speed when the vessel is planing, a divergent wave pattern is generated, while at slow speeds, the transverse stern wave dominates the wave pattern.

Since speed reduction could have a substantial impact on high-speed routes, this measure would only be practical in specific areas that cannot be mitigated by any of the other measures. However, these mitigation measures could involve compromises in service and cost, which would need to be evaluated on a route-by-route basis.

To ensure that ferries do not exceed any slow speed limits that are set, a monitoring and enforcement program should be developed to ensure compliance with routes and speeds. This mitigation could provide funding for the Department of Fish and Game to monitor routes and speeds on a random basis.

Impact After Mitigation: Impact WW-1 would be less than significant with successful implementation of one or more of the above mitigation measures (or other site-specific mitigations such as shoreline protection[1]). However, if there are situations where it is not possible to implement the mitigation measures, impacts would be potentially significant. The proposed routes with potentially significant erosional wake wash impacts could be removed from consideration or terminal locations could be changed. Until final routes and terminal locations are determined, this impact is considered potentially significant.

The routes that are most likely to have unmitigable wake wash impacts are those traversing the Carquinez Strait to Pittsburg/Antioch. These routes are within 1,500 meters of the shoreline and adjacent to long stretches of tidal marsh. Site-specific studies of the existing natural wave climate and wake wash from existing vessels would be required to determine whether impacts would be significant. Use of low-wake vessels may be feasible for this route, but site-specific study would be required to make that determination.

3.3.2.3 Potential Impacts to Marinas

Impact WW-2 **Increased frequency of ferry trips across the Bay could increase the wave heights at surrounding marinas, potentially damaging moored vessels and interfering with recreational users.**

Individual wave height is the primary factor of concern for impacts at unprotected marinas, due to the potential for damage to moored vessels, docks, etc., or potential safety issues for users of the marina.

For the Proposed Project, unprotected marinas could potentially be impacted throughout the Bay if individual wave heights from wake due to additional ferry service were significantly higher than existing waves. Marina locations are shown on Figure 3.2.2 in the Navigation Section.

Summary of Impact WW-2

- The Proposed Project would involve expansion of ferry service and increased numbers of ferry transits, thereby potentially increasing wave heights impacting nearby marinas. It also includes new routes across the Bay, with the potential to impact areas not currently served by water transit. Different routes or vessels could result in larger wave heights from wake wash reaching the shoreline. Unprotected marinas could potentially be impacted throughout the Bay if individual wave heights from wake due to additional ferry service were significantly higher than existing waves.

Mitigation WW-2.1: The mitigation measures for impacts to marinas are the same as for Mitigations WW-1.1 through WW-1.4.

Impact After Mitigation: Impact WW-2 would be less than significant after implementation of one or more of the mitigation measures.

[1] Shoreline protection may be feasible for some types of shorelines, but would require site specific evaluation to determine whether it would be environmentally appropriate.

3.3.2.4 Potential Impacts on Indicator Species

Impact WW-3 **Wake wash impacts from increased ferry service could have an adverse effect on California clapper rail, a listed species, by inundating nests.**

California clapper rail (*Rallus longirostris obsoletus*), an endangered species, was used to represent shoreline habitat impacts from vessel wake. As previously described, being protective of clapper rail habitat is considered to be protective of sensitive bio-receptors. As discussed in Section 3.5.1 (Biology), clapper rail are yearlong residents of emergent salt and tidal marshlands in the Bay Area, primarily in marshes south of San Mateo Bridge and in San Pablo Bay. The known distribution of California clapper rail in the Bay Area is shown on Figure 3.5.12 in Section 3.5 (Biology). Clapper rail have been observed near Martinez, Richmond, and Redwood City.

Nests are typically constructed with their bases 10 to 20 cm above the ground and their tops 25 to 30 cm above the ground. Inundation of nests by wake wash has the potential to cause a significant negative impact on the endangered species' survivability during the nesting season (between February 15 and June 15). The nests are generally located at least 100 meters inland from the marshland shoreline.

Wake from passenger ferries near clapper rail nesting sites would not be likely to have detrimental impacts on nests located more than 50 meters from a healthy marsh fringe (see Appendix Wake-D). Wake wash could have significant impacts on nest sites located within 50 meters of the marsh fringe. It is also possible that wake wash could impact nesting areas less than 50 meters from a marsh fringe, under conditions of high wake energy and no wake attenuation (degraded marsh habitat).

Summary of Impact WW-3

- The Proposed Project would involve expansion of ferry service and increased numbers of ferry transits, thereby potentially increasing wake wash impacts to California clapper rail nesting sites. The Proposed Project also includes new routes across the Bay, with the potential to impact areas not currently served by water transit. Nesting sites could be within 50 meters of ferry routes in areas near Martinez and Richmond in the North Bay and along the shoreline near the Redwood City terminal in the South Bay. This impact could be potentially significant.

Mitigation WW-3.1: For any shoreline areas that have potential clapper rail nesting habitat within 50 meters of the edge of a marshland (or within marshland that does not appear healthy and could limit attenuation of wave energy as a result) and are along a proposed ferry route, habitat surveys should be conducted to determine whether nesting sites exist. If nesting sites or suitable nesting habitat do exist within 50 meters of the edge of the marshland, site-specific measurements of wake attenuation should be performed at the potential site to determine whether wash will be an issue. An analysis such as that provided as part of the documentation for the Wave Height Analysis for Flood Insurance Studies (WHAFIS) model could be used to predict wave propagation and decay at high water (FEMA 1988). If the measurements/calculations indicate that nest inundation could potentially occur, one of the following additional mitigation measures may be necessary. For nesting sites more than 50 meters inland from the edge of the marshland, no significant impacts would occur.

Mitigation WW-3.2: Use of existing low-wake vessel technology could reduce both the total wake wash energy and height of individual waves. Use of this mitigation in areas where clapper rail nests are within 50 meters of the shoreline could reduce impacts to less than significant levels.

Mitigation WW-3.3: New ferry routes could be adjusted to redirect energy away from sensitive habitat or to reduce or eliminate increased wake energy. Use of this mitigation in areas where clapper rail nests are within 50 meters of the shoreline could reduce impacts to less than significant levels. However, this mitigation could involve compromises in service and cost, which would need to be evaluated on a route-by-route basis.

Mitigation WW-3.4: Operational adjustments, such as slowing the vessel down near sensitive areas, could be performed during ferry operation to reduce wake energy. Use of this mitigation in areas where clapper rail nests are within 50 meters of the shoreline could reduce impacts to less-than-significant levels. However, this mitigation could involve compromises in service and cost, which would need to be evaluated on a route-by-route basis.

Impact After Mitigation: Impact WW-3 would be less than significant after successful implementation of one or more of the above mitigation measures (or other site-specific mitigations). However, if no mitigation can be implemented to reduce impacts to less than significant levels, impacts to clapper rail could be potentially significant. Until final routes and terminal locations are determined, allowing site-specific analysis and mitigation, this impact is considered potentially significant. Mitigation for any final specific routing that may cause a potentially significant impact should require a Biological Opinion from the U.S. Fish and Wildlife Service under the federal Endangered Species Act.

Impact WW-4 **Wake wash impacts from increased ferry service could have an adverse effect on Pacific harbor seals at haul-out sites.**

Pacific harbor seals (*Phoca vitulina*) are common year-round in San Francisco Bay and are protected by the Marine Mammal Protection Act of 1972. Harbor seals haul out in groups ranging in size from a few individuals to several hundred seals. As discussed in the Biology Section, harbor seal habitats used as haul-out sites include tidal rocks, bay flats, sandbars, and sandy beaches and tend to be relatively consistent from year to year. Known locations of haul-out sites are shown on Figure 3.5.14 in the Biology Section. Haul-out sites that support some of the largest concentrations of seals include Corte Madera Marsh and Castro Rocks in the Central Bay, Mowry Slough south of the Dumbarton Bridge, and Yerba Buena Island. Ferry routes in the Proposed Project are generally well away from most haul-out sites in the Bay. Existing routes pass near Yerba Buena Island and Castro Rocks, two major haul-out sites in the Bay.

Ferries passing near sensitive areas such as haul-out sites could potentially disturb seals using these areas. As discussed in the Biology Section, seals react to both visual and acoustic disturbances from boats, kayaks, jet skis, aircraft, foot traffic, and dogs in the vicinity of haul-out sites. Disturbances that occur closer to the animals tend to provoke a stronger negative response.

Green et al. (2001) found that watercraft, especially those that exhibit erratic movements, are a common disturbance to seals on San Francisco Bay. Green et al. (2001) conducted studies of disturbances at Castro Rocks and Yerba Buena Island. They found that the average distance at which watercraft caused animals to flee the site (flush) was approximately 183 meters at Castro Rocks and approximately 133 meters at Yerba Buena Island. Larger boats such as tugboats and ferries tended to cause a flush at greater distance than smaller watercraft such as jet skis and kayaks. For example, at Castro Rocks, larger watercraft caused a flush at an average of approximately 264 meters (ranging from 121 to 511 meters) while jet skis and kayaks caused a flush at an average of approximately 150 meters (ranging from 10 to 500 meters). Watercraft that exhibit erratic movements such as sudden changes in speed or direction were more likely to cause a disturbance than those traveling at steady speeds, slow speeds and constant direction (Green et al. 2001; Kopec and Harvey 1995).

Because seal haul-out sites tend to be in rocky areas that experience significant natural wave action, and individual wake wash wave heights are smaller than those generated by average or normal winds, it is unlikely that wake wash from ferries would significantly impact seals. As described in the Biology Section, a greater concern for seals is the startle effect caused by sudden changes in vessel direction or location.

Summary of Impact WW-4

- The Proposed Project would involve expansion of ferry service and increased numbers of ferry transits, thereby potentially increasing wake wash impacts to seal haul-out sites. It includes routes that pass near seal haul-out sites, in particular Yerba Buena Island and Castro Rocks. Passing too close and disturbing marine mammals at these locations would be considered significant. The Proposed Project also includes new routes across the Bay, with the potential to impact areas not currently served by water transit. This impact could potentially be significant.

Mitigation WW-4.1: As discussed in Mitigation B-14.1 in the Biology Section, the National Marine Fisheries Service (NMFS) currently has guidelines for avoidance of marine mammals to reduce disturbance. For seals and sea lions, the minimum avoidance distance for haul-out sites is 30 meters (this distance, however, does not take vessel speed or wash into account).

Distances discussed from the literature show that, in general, seals tend to flush at greater distances than those in the NMFS guidelines. Given the site-specific information available for San Francisco Bay (Castro Rocks), it is recommended that ferry routes should be at least 100 to 250 meters from the Castro Rocks and Yerba Buena Island haul-out sites to reduce disturbance to the animals at these locations (see Biology Mitigation B-14.1).

Impact After Mitigation: Impact WW-4 would be less than significant after successful implementation of the above mitigation measure.

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Table 3.3.1
Monthly Sustained Wind Wave Heights (m) for Selected Locations in San Francisco Bay 1992-1993

Location	Month												Avg.	Max
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec		
Petaluma Wetlands	1.6	1.5	1.0	1.1	1.3	1.3	1.3	1.4	1.2	1.2	0.88	1.4	1.3	1.6
Hercules (Martinez)	0.86	0.84	0.96	0.96	1.1	1.1	0.94	0.85	0.74	0.69	1.0	0.90	0.91	1.1
Gallinas Creek	0.82	0.96	0.59	0.52	0.55	0.31	0.21	0.26	0.21	0.86	0.64	0.79	0.56	1.0
Corte Madera Marsh	1.6	0.84	0.78	0.99	0.69	0.58	0.29	0.20	0.46	0.99	0.49	0.89	0.73	1.6
Paradise Cay	1.6	1.1	1.0	1.2	0.77	0.62	0.28	0.24	0.44	0.96	0.50	0.87	0.80	1.6
Sausalito	1.3	1.1	1.0	0.76	0.76	0.60	0.33	0.33	0.31	0.96	0.49	0.84	0.73	1.3
Yerba Buena	0.94	1.4	2.6	1.4	1.0	0.82	0.55	0.63	0.91	0.72	0.64	0.94	1.04	2.6
Oyster Point	0.87	0.82	0.56	0.70	0.51	0.51	0.34	0.25	0.25	0.59	0.52	0.79	0.56	0.9
Redwood City Channel	0.64	0.64	0.42	0.34	0.31	0.31	0.37	0.28	0.25	0.25	0.37	0.52	0.39	0.6
Coyote Creek	0.36	0.39	0.41	0.41	0.42	0.40	0.45	0.44	0.42	0.37	0.40	0.36	0.40	0.5
Alameda Creek	0.89	0.84	0.90	0.90	0.93	0.91	1.0	0.99	0.93	0.78	0.87	0.85	0.90	1.0
San Leandro Channel	1.2	0.83	0.89	0.97	1.0	1.1	1.2	0.95	0.83	0.62	1.0	0.86	0.95	1.2
Berkeley	0.62	0.82	1.2	0.64	0.68	0.68	0.68	0.62	0.58	0.49	0.68	0.68	0.69	1.2
Point Pinole	1.1	0.77	0.78	0.86	1.1	0.99	0.87	0.78	0.77	0.61	1.1	1.0	0.89	1.1
New York Slough	0.36	0.40	0.27	0.28	0.22	0.21	0.21	0.22	0.18	0.32	0.22	0.36	0.27	0.4

Table 3.3.2
Monthly Wave Energy (MJ/m) Reaching the Shore for Selected Locations in San Francisco Bay 1992-1993

Location	Month												Avg.	Max
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec		
Petaluma Wetlands	197.7	268.1	298.5	157.7	1178	1541	2445	2907	1671	528.0	56.2	463.3	975.9	2907
Hercules (Martinez)	393.4	106.6	164.7	606.0	288.7	391.3	87.6	58.7	61.9	70.2	279.3	357.7	238.8	606.0
Gallinas Creek	599.7	212.5	52.4	7.6	12.3	1.0	0.5	2.0	1.6	26.3	198.6	545.5	138.3	599.7
Corte Madera Marsh	114.9	201.6	81.7	29.6	29.7	7.8	0.7	0.5	1.7	23.1	24.0	137.4	54.4	201.6
Paradise Cay	159.2	232.6	111.4	37.0	48.4	11.8	3.2	1.9	3.7	29.8	34.8	165.1	69.9	232.6
Sausalito	56.0	111.6	86.3	45.4	71.4	48.5	33.5	23.2	21.3	30.1	15.4	66.6	50.8	111.6
Yerba Buena	90.2	129.3	128.5	124.8	175.7	143.5	104.2	88.1	65.4	59.9	43.3	91.1	103.7	175.7
Oyster Point	77.7	108.5	32.0	20.3	24.7	8.1	5.0	3.9	4.8	10.9	34.8	121.5	37.7	121.5
Redwood City Channel	38.7	36.5	14.1	10.2	12.6	10.7	10.6	8.9	10.0	8.8	19.4	48.3	19.1	48.3
Coyote Creek	10.0	9.2	35.7	73.8	75.8	91.9	102.8	121.7	104.5	51.6	34.9	12.0	60.3	121.7
Alameda Creek	100.0	88.6	239.1	550.9	634.8	823.0	798.6	860.4	682.8	316.8	236.3	129.8	455.1	860.4
San Leandro Channel	77.7	111.7	186.2	438.9	512.2	688.1	512.3	348.4	202.2	114.7	79.5	119.1	282.6	688.1
Berkeley	30.9	52.4	122.0	239.5	268.2	325.5	258.6	209.0	162.2	103.8	59.1	31.8	155.3	325.5
Point Pinole	1020.9	251.6	184.4	490.9	397.0	540.0	256.6	153.3	131.6	110.8	435.7	877.9	404.2	1021
New York Slough	3.5	6.0	4.0	4.3	5.6	7.0	10.7	13.8	7.9	2.6	1.9	7.7	6.2	13.8

Table 3.3.3
Major Existing Ferry Routes in San Francisco Bay

Operator	Route	Vessel(s)	Distance (nm)	Average # of Daily One-Way Transits	Trip Miles per Day (nm)
Golden Gate	Larkspur/SF	*Mendocino, Del Norte, San Francisco, Marin, Sonoma*	10.9	42	462
Golden Gate	Sausalito/SF	*Golden Gate, San Francisco*	5.7	18	103
Blue & Gold	Tiburon/SF	*Zelinsky, Encinal*	5.8	15	86
Blue & Gold	Vallejo/SF	*Intintoli, Mare Island*	23.3	22.4	522
Blue & Gold	Oakland/Alameda/SF	*Peralta, Encinal, Zelinsky*	4.4	24.4	108
Harbor Bay Maritime	Harbor Bay/SF	*Bay Breeze*	7.6	10.2	78
TOTAL				**81**	**1,411**

Table 3.3.4
Typical Monthly Vessel Traffic in San Francisco Bay[1]

Vessel Name or Type	# of Trips	Route
Bay Breeze	306	San Francisco, Harbor Bay
Bay Clipper	173	San Francisco, Angel Island, Alcatraz, Tiburon
Bay Flyer	278	San Francisco, Oakland, Pac Bell Park, Jack London Sq.
Bay Monarch	140	San Francisco, Sausalito, Tiburon
Del Norte	175	San Francisco, Larkspur
Encinal	912	San Francisco, Clay St. Oakland, Tiburon
Golden Gate	490	San Francisco, Sausalito
Intintoli	322	San Francisco, Vallejo
Mare Island	352	San Francisco, Vallejo
Marin	82	San Francisco, Larkspur
Mendocino	310	San Francisco, Larkspur
San Francisco	317	San Francisco, Larkspur
Sonoma	152	San Francisco, Larkspur
Dinner Tour Boats	373	San Francisco-San Francisco
Zelinsky	681	San Francisco, Tiburon, Sausalito, Pac Bell Park, Angel Island, Alcatraz
Tow Boat/Tug Boat	691	Baywide
Tank Ships	109	Various
Roll On – Roll Off	10	Various
Public Vessels	68	Various
Container Ships	90	Various
Bulk Carriers	47	Various

Notes:
1) September 2001

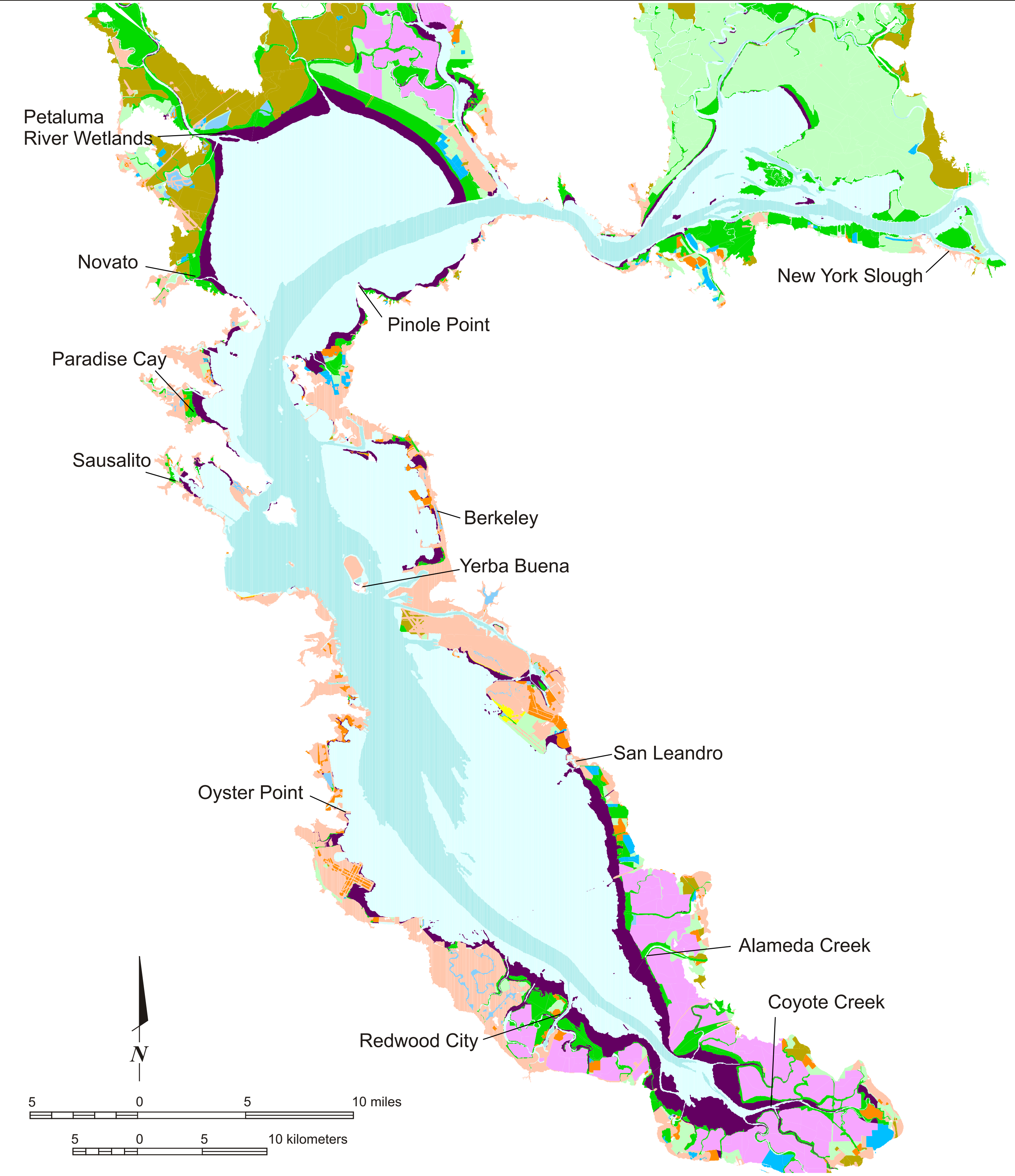
Table 3.3.5
Wake Wash From Existing Ferries

Vessel or Class	Energy Packet Size at 300 Meters			Total Wave Train Energy (KJ/m)
	Height (cm)	Period (s)	Energy (J/m)	
Spaulding Class	51	5.3	14,100	94
San Francisco	44	5.6	11,887	94
Sonoma	57.8	5.0	16,374	94
Mare Island Class (350 pax, 35 kt)	31	4.3	3,500	26
Mare Island Class (350 pax, 35 kt) at 10 kts (consultant database)	24.8	3.0	2,497	17.5 [1]
Mendocino	33.4	4.57	4,584	26
Del Norte	27	4.71	3,140	24
Encinal/Zelinsky (based on sister ship)	45.7	2.72	3,030	18
Pusher Tug without Barge	33	3.72	2,943	22
149 pax, 35 knot vessel (consultant data base)	20	3.2	800	9.95
149 pax, 25 kt vessel (consultant data base)	22	4.6	2,000	20.4
149 pax, 35 kt vessel at 10 kts (consultant data base)	15.4	3.0	832	8.25
Hovercraft	unk	unk	unk	unk

Notes:
1) Total number of waves in train was unavailable for this measurement and therefore total wave train energy was calculated assuming 7 waves per train.

Table 3.3.6
Wake Wash Characteristics of Non-Ferry Traffic

Vessel Type	Wash Height	Wash Period	Wash Energy	Comments
Pusher Tugs without Barges	33	3.72	2,943	This is a frequent daily operation in San Francisco Bay.
<15 kt Deep Draft Merchant Vessels	Not observed	Not observed	Not observed	This is an infrequent operation and generally avoids sensitive areas.
USCG Vessels	Not observed	Not observed	Not observed	This is an infrequent operation and generally avoids sensitive areas.
Dinner & Harbor Cruise Vessels	Not observed	Not observed	Not observed	These vessels are similar in hull form to the monohull ferries. They usually operate at low speed and avoid sensitive areas.



LEGEND

Deep Bay Channel	Sandy Beach	Lagoon	Agricultural Bayland
Shallow Bay Channel	Tidal Flat	Salt Pool	Undeveloped Fill
Storage Basin	Tidal Marsh	Diked Marsh	Developed Bay Fill

Scale
1:400,000

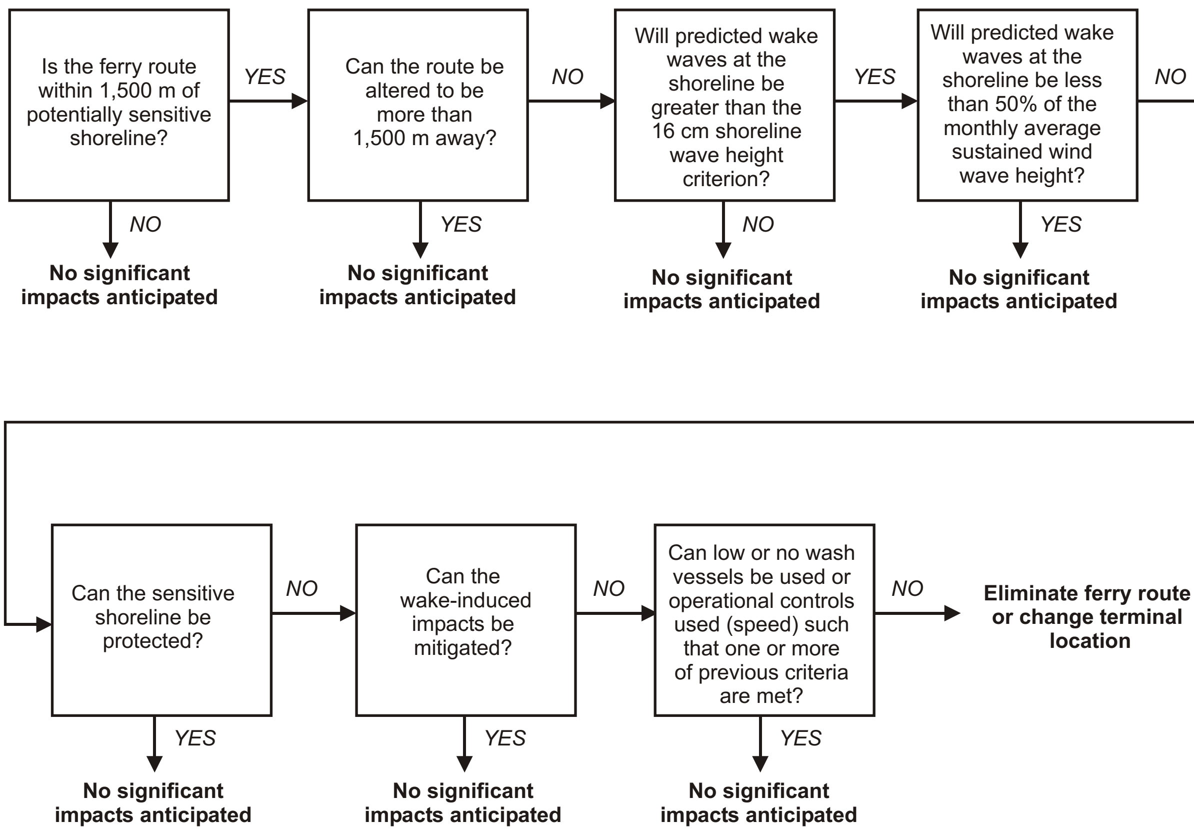
URS

Water Transit Authority
Program EIR

Project No. 28066519

Habitats Adjacent to
San Francisco Bay

Figure
3.3.1

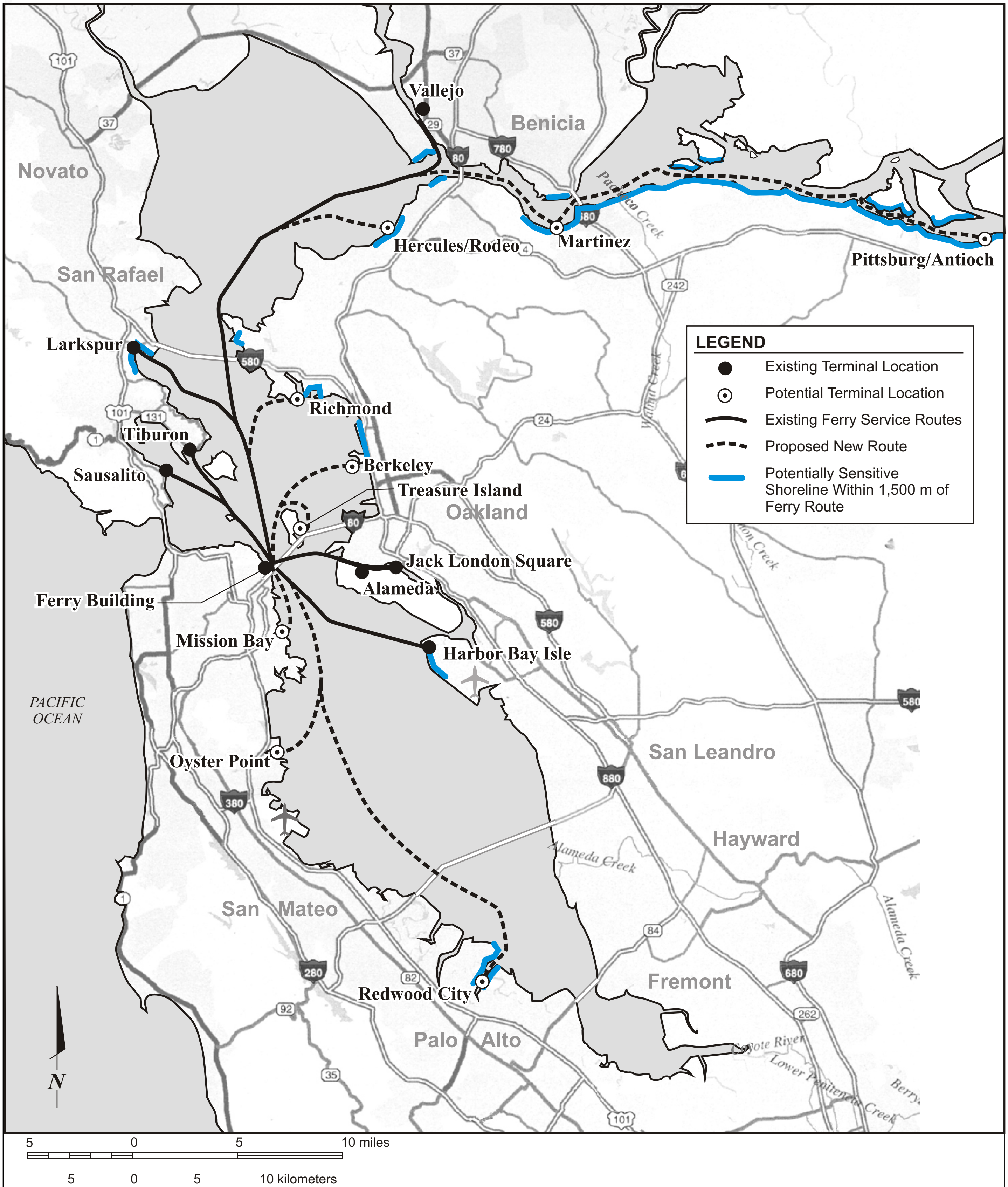


Water Transit Authority Program EIR

Project No. 28066519

Decision Tree - Evaluation of Potentially Significant Shoreline Impacts

Figure 3.3.2



URS

Water Transit Authority
Program EIR

Project No. 28066519

Potentially Wake Sensitive Shoreline
Based on 1,500 m Criterion

Figure
3.3.3

5/09/03 vsa ...\28066519 WTA\F3.3.3 wakeshore_mar03.cdr

3.2 NAVIGATION

This section provides an overview of navigation in San Francisco Bay and its importance from the environmental and regulatory perspectives. The existing ferry systems in the Bay make over 80,000 trips annually, primarily to and from San Francisco. The ferries share the Bay waters with commercial, military, and recreational users. The natural harbor of the Bay serves the shipping and fishing industries. The shipping industry is a particularly vital part of the Bay Area economy. Approximately 100,000 jobs are dependent upon the shipping industry. Located within the Bay are eight ports and twenty-one marine terminals, as well as facilities at Concord Naval Weapons Station and Moffett Field. Because much of the Bay shoreline is urbanized, recreational boating is very popular, with an estimated 20,000 boat berths around the Bay, exclusive of the Sacramento and San Joaquin Rivers. Other water sports, such as boardsailing, represent a growing recreational use of the Bay.

3.2.1 Environmental Setting

3.2.1.1 Study Area

The study area for navigation impacts encompasses the Bay and its embayments, Carquinez Strait, and Suisun Bay to Antioch at the San Joaquin River, as well as the portion of the Pacific Ocean along the shoreline from Half Moon Bay to the entrance of San Francisco Bay at the Golden Gate. The 548-square-mile Bay has an irregular 1,000-mile shoreline composed of a variety of urban and suburban areas, marshes, and salt ponds. Several significant islands are within the Bay, including Angel Island, Alcatraz Island, Yerba Buena Island, and Treasure Island.

3.2.1.2 Navigation Into and Within San Francisco Bay

Vessel traffic in the Bay consists of a complex variety of inbound and outbound vessels and wholly in-Bay vessel movements within a series of bays, channels, and rivers that comprise the San Francisco Bay Estuary. This traffic includes tugs, government vessels, passenger ferry ships, recreational boats, commercial and sport fishing boats, board sailors, and personal watercraft.

West of the Golden Gate Bridge, in the Gulf of the Farallones, approach lanes to the entrance of San Francisco Bay have been established from the north, west, and south. Each approach lane is composed of a 1-mile-wide inbound traffic lane and a 1-mile-wide outbound traffic lane with a 1-mile-wide separation zone between the traffic lanes. Outside these lanes, the U.S. Navy has designated areas for submarine operations within which barge operations are precluded. The approach lanes lead to the precautionary area centered on the San Francisco Approach Lighted Horn Buoy that marks the beginning of the main channel to the Golden Gate Bridge. The lighted horn buoy, which is located 10 miles west of Point Bonita, is in the center of a precautionary area where all ships leaving and entering port converge. This is the area where San Francisco Bar Pilots embark and disembark ships and other vessels requiring pilots.

Piloting in and out of the Bay and adjacent waterways is compulsory for all vessels of foreign registry and U.S. vessels under enrollment not having a federally licensed pilot on board. San

Francisco Bar Pilots provide these services for vessel movements to and from all terminals in the Bay and tributaries to the Bay, including the Carquinez Strait.

Ships bound for San Francisco Bay proceed in an easterly direction toward the Golden Gate Bridge through a narrow channel, which consists of 600-yard-wide inbound and outbound traffic lanes with a 150-yard separation zone between them. The channel is marked on either side with a series of buoys through a shoal area, approximately halfway between the lighted horn buoy and a line drawn from Point Bonita to Point Lobos. The water is usually more than 90 feet deep throughout this area, with the exception of shoal areas. A navigation channel through the shoal is maintained at a depth of 55 feet. Shoal waters less than 30 feet deep exist on either side of this narrow channel. Standard aids to navigation such as horns, bells, and lights are provided at appropriate locations near submerged rocks and points of land.

Regulated Navigation Areas

Within San Francisco Bay, the U.S. Coast Guard (USCG) has established Regulated Navigation Areas (RNAs) shown in Figure 3.2.1. The RNAs increase navigational safety by organizing traffic flow patterns; reducing meeting, crossing, and overtaking situations between large vessels in constricted channels; and limiting vessel speed. The RNAs, which were established in 1993 with input from the Harbor Safety Committee, modified the previous voluntary traffic routing measures to better conform to International Maritime Organization (IMO) traffic routing standards. The 1993 modifications added a Golden Gate precautionary area, a deep-water traffic lane separation zone north of Harding Rock, and an expanded Central Bay precautionary area. It also eliminated the former traffic lanes in the North Ship Channel and the San Pablo Strait.

RNAs apply to "large vessels" (defined as power-driven vessels of 1,600 or more gross tons, or tugs with a tow of 1,600 or more gross tons). Ferries do not present that tonnage. When navigating within the RNAs, large vessels follow specific guidelines. They must have their engines ready for immediate maneuver, operate their engines in a control mode and on fuel that allows for an immediate response to any engine order, and not exceed a speed of 15 knots through the water.

San Francisco Bay RNA

The San Francisco Bay RNA extends from the precautionary zone east of the Golden Gate Bridge to Alcatraz Island. Because of the large number of vessels entering and departing San Francisco Bay, traffic lanes were established under the Golden Gate Bridge and in the Central Bay to separate opposing traffic and reduce vessel congestion. The lanes are located where voluntary traffic lanes previously existed. Use of these lanes and adherence to the indicated direction of travel is required by the USCG for large vessels, and recommended for all other vessels.

Because vessels converge and cross in such a manner that one-way traffic flow patterns could not be established, two precautionary areas were established in this RNA. These are the Golden Gate Precautionary Area, which encompasses the waters around the Golden Gate Bridge between the Golden Gate and the Central Traffic Lanes; and the Central Bay Precautionary Area, which encompasses the large portion of the Central Bay and part of the South Bay.

Oakland Harbor RNA

The Oakland Harbor RNA encompasses the Oakland Bar Channel, Oakland Outer Harbor Entrance, Middle Harbor, and Inner Harbor Entrance channels (Figure 3.2.1). A power-driven vessel of 1,600 or more gross tons, or tug with a tow of 1,600 or more gross tons, cannot enter this RNA while another vessel or tug meeting these same criteria is navigating within its boundaries, if such an entry would result in meeting, crossing, or overtaking the other vessel.

North Ship Channel RNA and San Pablo Strait Channel RNA

The North Ship Channel and San Pablo Strait Channel RNAs consist of the existing charted channels and delineate the only areas where the depths of water are sufficient to allow the safe transit of large vessels (Figure 3.2.1). The strong tidal currents in these channels severely restrict the ability of large vessels to safely maneuver to avoid smaller vessels.

Pinole Shoal Channel RNA

The Pinole Shoal Channel RNA is a constricted waterway that extends from approximately Light 7 to Light 13 of the Pinole Shoal Channel (Figure 3.2.1). Its use is restricted to vessels with a draft greater than 20 feet, or towboats with tows drawing more than 20 feet.

Southern Pacific Railroad Bridge RNA

The Southern Pacific Railroad (SPRR) Bridge RNA consists of a small, circular area, 200 yards in radius, centered on the middle of the channel under the SPRR Bridge (Figure 3.2.1). The limited horizontal clearance results in a greater chance of vessel collisions with the bridge, which is significantly increased when visibility is poor. Large vessels are precluded from transiting this RNA when visibility is less than 1,000 yards.

Hazards to Navigation

Hazards to navigation in general can be divided into five categories: (1) shoals and islands; (2) bridges and other structures; (3) fog and inclement weather; (4) vessel traffic; and (5) tides and currents. The Bay has a number of hazards to navigation, such as strong tides and currents and variable bottom depths, which confine large vessels to specified shipping lanes within the Bay. Navigating the Bay becomes more difficult during periods of restricted visibility due to winter storms, and fog.

The San Francisco Bar Pilots Association regularly compiles recommended guidelines for safe navigation, entitled "Port Safety Guidelines for Movement of Vessels of San Francisco Bay and Tributaries." The 1992 edition recommended guidelines are currently being updated and revised. The guidelines are sent to members of the shipping industry and are based on a general consensus among pilots as to recommended navigational practices.

Shoals and Islands

There is a shoal area just west of the Golden Gate Bridge and north of the main entry channel to the Bay. This area, commonly known as the 4-fathom bank or Potato Patch Shoals, is a potential navigational hazard for any vessel with a draft greater than 24 feet. Once inside the Golden Gate, shallow areas around such islands as Alcatraz, Angel Island, Treasure Island, and Yerba

Buena Island are hazards to navigation, and when combined with other elements including fog, traffic, or malfunctioning radar equipment, can present extreme hazards.

Weather

Meteorological conditions that contribute to navigational difficulties include fog during the warmer months and storms in the winter. Fog occurs much of the time during the summer months, blowing in through the Golden Gate in the late afternoon and typically burning off by late morning. Some types of commercial vessels, including tankers carrying hazardous materials such as fuel oil, have been restricted from transiting the Bay during periods of intense fog. Fog by itself does not pose a serious problem if ship navigation radar is in good condition, but combined with other vessel traffic, the strong tides and currents in the Bay, and the possibility of other ships straying from the traffic lanes, navigation can be extremely difficult.

Vessel Traffic

The greatest hazard to vessel navigation is other vessel traffic. Large commercial and naval vessels are required by USCG regulations to use designated traffic lanes when traveling in inland waterways. Ferry boats and other small commercial vessels (i.e., tugboats and private vessels) often do not navigate within specific traffic lanes, but rather travel in the most direct route. These vessels can pose hazards to navigation, particularly if other circumstances such as fog are present. Private vessel traffic is heaviest during weekend days and can pose hazards to dredge scows under tow. Tugboats may have trouble controlling their tows. Sporadic incidents, such as towing bridles that break and barges that run aground, can be found in USCG vessel traffic reports.

A risk assessment conducted for Washington State Ferries (WSF), which services Puget Sound, showed that interactions between ferries are less likely to lead to a collisions than interactions between ferries and non-ferry vessels (van Dorp et al. 2001). In this study, several risk reduction measures were ranked by their percentage of reduction in the statistical frequency of collisions. The most effective risk reduction measures for the Washington State Ferries included:

- Fleetwide implementation of the International Safety Management code with a 16 percent reduction in the risk of collisions;
- Implementation of mechanical failure reducing measures (11 percent risk reduction); and
- Implementation of traffic separation rules for high speed ferries (6 percent risk reduction).

The remaining four risk reduction measures evaluated, all indicating less than 5 percent reduction in collisions, include weather and visibility restrictions, high speed ferry rules and procedures, traffic control for deep draft traffic, and increasing the time available for response which is aimed at reducing the consequences if a collision occurs. In the risk assessment summary, it was recommended that the WSF continue to implement safety management and training programs, provide adequate relief crews as necessary to accomplish training, and coordinate with the USCG to minimize the likelihood of an accident. In terms of minimizing the potential consequences of accidents, the risk assessment recognized that the skills of the ferry crew were crucial in an emergency situation and strongly recommended enhancing these emergency skills through training, certification, drills, and exercises. It was finally concluded that the most cost-effective way to minimize the risk of potential accidents was to invest in

Washington State Ferry people and systems and to make improvements and changes to policies, procedures, and management systems rather than to merely invest in capital equipment such as survival craft.

Currents and Tides

Tidal action causes extremely strong currents throughout the Bay, especially during periods of maximum ebb and maximum flood tides. Currents above 2 knots are considered strong and potentially hazardous if not properly "corrected for" during slow-speed maneuvering. The greatest currents occur at the Golden Gate, with the average maximum flood being 3.3 knots and the maximum ebb being 4.5 knots. There are also strong currents all along San Francisco's city waterfront from the Golden Gate Bridge to the Bay Bridge, and around Treasure Island on the east and west sides. These currents, combined with the strong winds, make maneuvering large vessels at slow speed hazardous without the aid of tugboat assistance. Even as far south as Hunters Point, there are currents up to 2.2 knots.

3.2.1.3 Existing Recreational Uses

The potential impact to recreational uses of the Bay was raised as an important concern during scoping meetings. Bay Area residents enjoy using the Bay itself for waterborne recreational activities and water contact sports, including boating, fishing, kayaking, swimming, jetskiing, and windsurfing. This section provides background information about these recreational activities, and describes the popular access points to the Bay within the study area.

Numerous interest groups in the Bay Area have formed to share information, promote safety, and protect the Bay resources for activities they value most. Examples include the Yacht Racing Association of San Francisco Bay, United Anglers, San Francisco Bay Swimming Association, Bay Area Sea Kayakers, and the San Francisco Boardsailing Association. Many dive clubs also exist in the Bay Area, but they do not normally dive in San Francisco Bay because the Bay’s turbidity makes it difficult to see underwater. Many of these groups organize special events such as races on the Bay or festivals. Below is a description of the marinas and windsurfing sites within the study area.

Marinas

Figure 3.2.2 shows the locations of marinas along the San Francisco Bay shoreline in Marin, San Francisco, San Mateo, Alameda, Contra Costa, Napa, and Sonoma Counties. All of these marinas have permanent berths, and many also have trailered boat storage facilities and public ramps that can be used to launch small sailboats, kayaks, rowboats, personal watercraft, or jetskis, etc. Once these vessels are launched, they can be used to travel virtually anywhere in San Francisco Bay, San Pablo Bay, and even the Sacramento River Delta, depending on the capabilities of the vessel and the operator.

Table 3.2.1 lists the number of berths at each of the 51 marinas identified.[1] These marinas have a total of more than 16,000 berths, with approximately half of the berths located on each side of the Bay.

[1] This list may not be comprehensive. It was composed though searches of various boating databases.

Windsurfing Sites

Windsurfers typically do not use the existing marinas. Rather, different launching facilities have developed in the Bay Area because of the need for particular site amenities for that sport, such as shore accessibility and parking, and to take advantage of particular wind and water conditions. The desire to avoid conflicts with other user groups also plays a role in the selection of launch sites. Table 3.2.2 presents currently used launch sites, their locations, the season with best conditions, and the rating level of their users. Figure 3.2.3 shows the approximate location of the launch sites. No accidents involving windsurfers and ferries have been documented. Ferry operators at the Larkspur terminal report no known accidents since windsurfing has become a popular recreational activity in the area, especially since ferries are travelling at slow speeds (10 knots) near the terminal and can stop relatively quickly if a windsurfer has fallen in the path of the ship (David Clark 2002). No written navigational rules exist for windsurfers, but windsurfers are reported to honor the ferries' approach and departure route since ferries are restricted to the dredged channel. Ferries occasionally pick up windsurfers who drift too far from shore. The navigational situation and relationship between ferry operators and windsurfers is currently agreeable, and each group is said to "look out for each other" (David Clark 2002).

3.2.1.4 San Francisco Bay Transit and Incident Data

Ship traffic density in San Francisco Bay has increased greatly in the past two decades (Black 2002). In 1987, there were approximately 87,000 vessel transits in the Bay. Coast Guard data show that total annual transits increased to 97,683 in 1996 and to 127,704 in 2000. Along with the increase in the total number of vessels transiting the Bay, the number of ferry/passenger trips has increased from 66,290 in 1996 to 88,469 in 2000 (Table 3.2.3). In both these years, ferry/passenger vessel traffic represented approximately 68 percent of the total traffic.

Vessel Traffic Service in San Francisco Bay

The Coast Guard's Office of Vessel Traffic Management (VTM) maintains the Vessel Traffic Service (VTS) for the San Francisco Area. The VTS is a mandatory system that applies to all vessels of 40 meters or more in length, all vessels certified to carry 50 or more passengers, and all commercial vessels 8 meters or more in length engaged in towing another vessel. The VTS may issue directions to enhance navigation and vessel safety and protect the marine environment. During conditions of vessel congestion, restricted visibility, adverse weather or other dangerous conditions, the VTS may manage vessel traffic by specifying times of entry, movement, or departure to, from, or within the VTS area. The San Francisco VTS area "begins" at the outer limit of the Offshore Sector, a 38.7-nautical-mile radius around Mount Tamalpais, which is 10 miles north of the Golden Gate. The Offshore Sector includes the Traffic Separation Scheme in the approaches to San Francisco Bay, the busy Central San Francisco Bay, and the southern part of San Francisco Bay, ending at the Port of Redwood City in the south. To the north and east, it extends to the entrance to the Petaluma River, into the Napa River as far as the Mare Island Causeway Bridge, and upriver to Sacramento and Stockton. Deep draft ships as large as 760 feet in length overall, 60,000 gross tons, and 35 feet draft call in these two river ports. Central San Francisco Bay is the busiest part of the VTS area. It must be traversed by each tanker, container ship, and other large vessel inbound to any of the Bay Area's ports, and also by almost every scheduled ferry route in the Bay Area. Finally, it is also one of the most popular recreational sailing areas in the United States, resulting in a challenging transit for large ships on busy summer weekends.

The San Francisco VTS area is divided into two sectors. Sector 1, the offshore sector, is controlled through communications and reporting in VHF frequency Channel 12. Sector 2, the inshore sector including the Bay, is controlled through VHF Channel 14. Portions of the San Francisco VTS are covered by radar and close circuit television surveillance. The VTS receives reports regarding defects in aids to navigation, involvement in casualties, pollution incidents, and hazardous conditions. It also provides advisories on traffic, weather, and status of aids to navigation, as well as information on harbor operations, including ferry routes and dredging, and anchorage availability.

Vessel Incidents

The VTS collects detailed reports of every vessel incident in the Bay. The VTS records indicate that from 1991 through 2001 the annual number of reported incidents averaged 61, with a low of 33 reported incidents in both 1994 and 2001, and a high of 87 incidents reported in 1995. The categories of incidents include collisions, near-misses, vessel grounding, noncompliance (not listening to the VTS or acting contrary to their instructions), non-participation (turning the vessel radio off), hindering navigation (e.g., a sail boat passing in front of a commercial vessel confined to narrow channels or fairways), and loose barges (the tow line breaks and the barge is set adrift or the tugboat loses power).

Baseline statistics for incidents on the Bay were obtained from the VTS website for 1997, 1998, and 1999. The data were evaluated to determine the number of incidents per 1,000 transits. The total average yearly transits and the incidents per 1,000 transits were compared to other ports of both larger and smaller size than San Francisco Bay. These ports include Berwick Bay, Houston/Galveston, New York, Sault Sainte Marie, and Los Angeles/Long Beach (Table 3.2.4). This comparison shows that the number of vessel incidents varies widely and independently of the number of vessel transits. On San Francisco Bay, the average number of collisions per 1,000 transits is 1. Four near misses, 2 groundings, and 5 allisions (an allision occurs when a moving vessel strikes an inanimate object such as a pier) occur on average for every 1,000 transits on the Bay. Vessel incidents are recorded and reported as "casualties," a broadly applied term that technically includes violations of load lines and discharge of garbage, personal injury, or property damage.[2]

San Francisco Bay ferry boat casualty data for years 1996-2001 are presented in Table 3.2.5 (USCG 2002). Approximately 70 percent of ferry "casualties" were due to equipment failure, while the remainder were attributed to one collision, 8 allisions, and two of each of the

[2] Approximately 31 vessel casualties occur for every 1,000 transits, Title 46 Code of Federal Regulations (CFR) Part 4 defines a reportable marine casualty as: (1) groundings - whether intentional or not; (2) bridge strikes; (3) loss of main propulsion, steering, or associated components, which resulted in a reduction of a vessel's maneuverability; or (4) occurrences affecting seaworthiness or fitness for service (fire, flooding, lifesaving equip, bilge pumping, etc.); (5) loss of life; (6) injury: (a) beyond first aid or (b) to a crew-member on commercial vessel unfit for routine duties; (7) damage to property greater than $25,000; (8) alleged misconduct or negligence by Coast Guard licensed, certified, or documented members of the Merchant Marine; (9) damage to aids to navigation; (10) certain recreational boating deaths, waterfront facility casualties, and others as directed; (11) reports of load line violations; and (12) marine pollution: discharges of oil, hazardous materials, or garbage into the navigable waters of the United States.

following: groundings, floodings, fires, and structural failures. It is important to note that this table represents a six-year sampling of data and may not accurately represent all vessel incidents to date.

Ferry Incident Rates Compared to Other Transit Modes

A preliminary risk assessment performed for the WTA by ABS Consulting found ferries in San Francisco Bay to be the "safest federally subsidized transit mode in the Bay Area." The analysis compared fatality and injury rates for patrons, employees and others. The ferry safety record showed no fatalities while the 5-year average for rail and roadway transit were 0.004 fatalities per 1 million passenger miles. Ferries had less than one-fourth the patron injury rate of the rail and roadway transit modes, with only 0.28 injuries per 1 million passenger miles (ABS 2002).

3.2.1.5 Regulatory Setting

Federal

In the United States, two sets of regulations govern navigation. The Inland Navigational Rules Act of 1980 (Title 33, Chapter 34, Subchapter I, Part A) became effective on December 24, 1981. These rules, more commonly known as the Inland Rules, govern many rivers, lakes, harbors, and inland waterways. The International Regulations for Preventing Collision at Sea, also known as the Rules of the Road or International Navigation Rules, or 72 COLREGS, govern open bodies of water in which foreign shipping traffic is possible, and are a set of statutory requirements designed to promote navigational safety. These rules include requirements for navigation lights, dayshapes, and steering, as well as sound signals for both good and restricted visibility. The most recently adopted version of these regulations took effect on July 15, 1977. The boundaries between where the Inland Rules and the International Rules apply are displayed as Demarcation Lines on navigational charts. These boundaries are commonly identified on charts as purple dashed lines containing the label COLREGS DEMARCATION LINE. The COLREGS line in the regional area is found outside the Golden Gate.

Directly applicable to the navigation of ferries in San Francisco Bay is Inland Navigation Rules Part B – Steering and Sailing, including Section 1 – Conduct of Vessels in Any Condition of Visibility; Section II – Conduct of Vessels in Sight of One Another; and Section III – Conduct of Vessels in Restricted Visibility. Requirements for the interaction between power-driven vessels and between power-driven and sailing vessels are delineated in Rule 18.

The Ports and Waterways Safety Act of 1972 (Title 33, Chapter 25, Section 1221) authorized the USCG to establish, operate, and maintain vessel traffic services for ports, harbors, and other waters subject to congested vessel traffic. As a result, in 1972 the Coast Guard established the VTS for San Francisco Bay and designated traffic lanes for inbound and outbound vessel traffic, specified separation zones between vessel traffic lanes, and set up rules to govern vessels entering and leaving ports. The VTS, which is located on Yerba Buena Island, controls marine traffic throughout the Bay Area. Although some small and private vessels are not required to coordinate their movements by contacting the VTS, the Coast Guard monitors all commercial, Navy, and private marine traffic within San Francisco Bay and local coastal waters.

State

The California Harbors and Navigation Code vests authority with the Department of Boating and Waterways to regulate matters of navigational safety for the state's boating public. The California Department of Boating and Waterways was formed in 1979 through the consolidation of functions previously held by a number of divisions in the Departments of Natural Resources, Motor Vehicles, and Parks and Recreation. By the end of the 1950s, boating had become one of California's most popular forms of recreation. Under the authority of the Federal Boating Act of 1958, the State Harbors and Navigation Code was amended to provide registration of vessels by the State instead of the USCG. Also, the Code established a comprehensive set of state laws and regulations governing the equipment and operation of vessels on all waters of the state. A system for reporting boating accidents was initiated. California accident statistics are compiled under state law, Section 656 of the California Harbors and Navigation Code, which requires a boater who is involved in an accident to file a written report with the Department of Boating and Waterways when:

- A person dies, disappears, or is injured requiring medical attention beyond first aid; or
- Damage to a vessel or other property exceeds $500, or there is complete loss of a vessel.

Department staff review reported accidents, determine the causes, and identify preventative measures and specific safety-related problems. Safety education and public information program staff incorporate these safety problems and related solutions into updated course materials, promotional activities, and brochures. Law enforcement staff also communicate these safety problems during Department-sponsored training sessions for law enforcement officers.

Local

Harbor Safety Committee of the San Francisco Bay Region

In 1990, the California state legislature enacted the Lempert-Keene-Seastrand Oil Spill Prevention and Response Act (OSPRA) (California Government Code Chapter 7.4). The goals of OSPRA are to improve the prevention, removal, abatement, response, containment, and cleanup and mitigation of oil spills in the marine waters of California. OSPRA created Harbor Safety Committees for the major harbors of the state of California to prepare Harbor Safety Plans, encompassing all vessel traffic, for the safe navigation and operation of tankers, barges, and other vessels within each harbor. The Harbor Safety Committee of the San Francisco Bay Region was officially sworn in on September 18, 1991, and held its first meeting on that date. The original Harbor Safety Plan for San Francisco, San Pablo and Suisun Bays was adopted on August 13, 1992. OSPRA also mandates that the Harbor Safety Committee must annually review its previously adopted Harbor Safety Plan and recommendations and submit the annual review to the Oil Spill Prevention and Response Administrator for comment. The most recent available San Francisco Bay Region Harbor Safety Plan is for 2001.

The full committee for the Harbor Safety Committee holds regular monthly public meetings. The committee chairperson appoints a series of work groups to review the mandated components of the Harbor Safety Plan (e.g., weather and tides; harbor depths, channel design, and dredging; contingency routing; communications; and vessel traffic patterns, pilotage, etc.) and other timely issues. Public notices are published prior to all committee and work group meetings. Public comments are received throughout discussions of the various issues, which results in full public participation in developing the Harbor Safety Plan recommendations for the San Francisco Bay Region.

Regulatory Context for Recreational Water Uses

Policies relating to the development, operation and protection of water-related recreational facilities are found both in laws and in different types of planning documents pertaining to recreation in general. At the federal government level, legislation has been passed to protect recreational facilities and prevent their conversion to other uses. State, regional, and county parks and recreational facilities typically have a General or Master Plan guiding their development and usage. For cities within the San Francisco Bay Area, goals and policies for recreational facilities are typically found in the Recreation or Open Space Element of each city's adopted General Plan.

San Francisco Bay Plan

The San Francisco Bay Plan (Bay Plan) was adopted by the San Francisco Bay Conservation and Development Commission (BCDC) in 1968 and incorporated by the California Legislature into the McAteer-Petris Act in 1969, thereby giving the plan the force of law. The Bay Plan contains findings about the value of the Bay, policies to guide future uses of the Bay, and maps that apply these policies to the Bay and its shoreline. Part Four of the Bay Plan contains findings and policies pertinent to development of the Bay and shoreline. Policies from the "Recreation" and "Public Access" subsections are described below.

Bay Plan - Recreation (last amended March 1986). This section states that, as the population of the Bay region increases, more people are expected to use their leisure time in water-oriented recreational activities. It predicts that many more water-oriented recreational facilities will be needed to accommodate the needs of Bay Area residents and visitors. The Bay Plan maps include about 5,800 acres of potential new parks along the approximately 1,000-mile shoreline, as well as 4,400 acres of parkland that could be created if military use of the properties (particularly near the Golden Gate) ceases. The Bay Plan states that water-oriented recreational facilities should be well distributed around the shores of the Bay, to the extent consistent with criteria specified elsewhere in the Bay Plan. Recreational facilities should not, however, preempt sites needed for ports, waterfront industry, or airports, but efforts should be made to integrate recreational uses into these facilities to the extent that they might be compatible. The Bay Plan also advises that waterfront land needed for parks and beaches by the year 2020 should be reserved now to preserve them from being used for other purposes. These facilities need not be built all at once, however.

Bay Plan - Public Access (last amended March 2001). This section states that, although public access to the Bay shoreline has increased since adoption of the Bay Plan in 1968, additional public access is still needed. Public agencies have limited funds for providing or improving shoreline access, but private capital can provide public access in association with a wide variety of shoreline developments. Any proposed fill project should enhance public access to the Bay to the maximum extent feasible in accordance with Bay Plan policies. In addition to the public access provided by waterfront parks, beaches, marinas, and fishing piers, maximum feasible access to and along the waterfront and on any permitted fills should be provided in and through every new development in the Bay or on the shoreline, including airport development. In those cases where public access is inconsistent with the project because of public safety considerations or significant use conflicts (such as significant adverse effects on wildlife), in-lieu public access should be provided, preferably near the project site.

Public access as a condition of development should be permanently guaranteed and should be consistent with the development project, as well as with the physical environment of the Bay and shoreline. Access to and along the waterfront should be provided by walkways or trails and should be convenient to parking and/or public transit. In addition, the BCDC, special districts, and federal, state, regional, and local jurisdictions should cooperate to provide new public access areas, especially to link the entire series of shoreline parks, regional trail systems, and existing public access areas to the extent feasible, without additional Bay filling or adversely affecting natural resources. BCDC's *Public Access Design Guidelines* should be used in siting and designing public access associated with a proposed project. The Design Review Board should advise the BCDC on the adequacy of the public access proposed.

3.2.2 Impacts and Mitigation

3.2.2.1 Significance Criteria

Impacts would be considered significant if they would:

- Affect the safe navigation of the Bay (including commercial shipping), resulting in substantial increases in the number of incidents reported by the Vessel Traffic Service (VTS); and/or
- Interfere substantially with the recreational water uses in San Francisco Bay through increases in the number of accidents involving the interaction of ferries and recreational vessels.

3.2.2.2 Impacts and Mitigation

Impact NAV-1 **Existing ferry service results in some navigational incidents, including accidents involving collisions, allisions, and groundings. There is a potential for an increase in these incidents with expansion of water transit service.**

Bay Area ferries currently serve terminals in San Francisco Bay. Most ferry trips are within the Central Bay. Expanded ferry service would add ferry traffic throughout the Bay, involving new trips to and from terminals in localities not currently accessed by ferries. This could lead to a potential increase in navigational incidents.

Three passenger service companies currently provide daily ferry service from 5:30 a.m. to 12:30 a.m. In 2000, ferry traffic reached a volume of 88,469 trips, or approximately 68 percent of the total vessel trips reported by the USCG VTS in San Francisco Bay for that year. The Proposed Project involves expansion of ferry service and would increase the number of ferry transits in the Bay. The year 2025 ferry trips were derived from projections prepared for WTA as of April 2002. Ferry traffic projections were calculated through modeling and testing of different assumptions and are subject to revision (Bruzzone 2002). 165,850 ferry trips are projected for the year 2025. For the No Project Alternative, the number of trips is assumed to remain constant at the levels reported in 2000.

Available data for San Francisco Bay and other heavily used harbor areas in the United States (presented in Tables 3.2.1 and 3.2.2) suggest that there is no direct correlation between the number of vessel transits and the number of reported incidents (Law 2002). This lack of correlation is also depicted on Figure 3.2.4. For example, despite having the lowest number of transits compared to other U.S. ports, the total number of incidents reported in Prince William Sound was larger than four of the six other ports. Similarly, there appears to be no relationship solely between higher traffic and reports of near misses, groundings, allisions, or other vessel casualties for the main U.S. harbors.

The comparison of number of transits and number of navigational incidents between different harbors could indicate that some harbors are more navigationally dangerous than others, regardless of the number of trips. However, evaluation of navigational incidents within San Francisco Bay over time also does not show a clear correlation of any increase in incidents with an increase in transits. USCG incident statistics for the Bay for 1996-2001 are presented in Table 3.2.6. The trend indicated is that both ferry and total transit trips by all vessel types generally increase over time. However, over the same period, the number of incidents does not change in a consistent pattern.

This comparison of recorded navigational incidents and vessel traffic statistics does not appear to associate an increase in trips directly with an increase in the probability of incidents. Other factors appear to affect the occurrence of navigational incidents for any given volume of harbor transits. These may include the condition of mechanical equipment, navigational aids, and training of bar pilots for safety. It is important to note that Puget Sound and San Francisco Bay are among the harbors with the lowest number of incidents. Ferries represent approximately 80 and 70 percent, respectively, of Puget Sound and San Francisco Bay annual vessel trips. This could imply that the familiarity of the ferryboat captains with the navigational conditions and procedures in those harbors account for fewer incidents.

To evaluate the potential significance of increased ferry traffic within the overall vessel traffic in San Francisco Bay, two extreme scenarios were evaluated, as represented in Figures 3.2.5 and 3.2.6. The purpose of this evaluation was to capture the possible range of the contribution of passenger ferry transits to the overall vessel traffic in the Bay. In the conservatively low scenario, all non-ferry traffic was assumed to remain at year 2000 levels. This scenario does not consider any further expansion in waterborne traffic that would naturally occur in response to regional economic demand. Alternatively, in the conservatively high scenario, non-ferry traffic was assumed to continue to grow steadily, based on the rates of increase shown in recent years. This scenario does not consider any logistical constraints or infrastructure limitations on the capacity of the Bay to accommodate waterborne traffic. The number of vessel trips on the Bay in each vessel traffic growth scenario is presented in Table 3.2.7.

Under the No Growth scenario, the proportion of ferry transits as part of the total vessel transits in the Proposed Project would increase to a level of 81 percent of total vessel transits from the current level of 69 percent corresponding to the No Project Alternative. Under the Sustained Growth scenario, the proportion of ferry transits as part of the total vessel transits for the Proposed Project drops to 61 percent. This indicates that ferries would account for between 61 and 81 percent of the total vessel transits in the Bay under the Proposed Project.

Incidents such as collisions and near misses involve the interaction of two vessels. A model was developed by ABS Consulting as part of a preliminary risk assessment for the WTA that counts vessel interactions (ABS 2002). Any vessel (i.e., VTS-monitored vessel, recreational boater, or another ferry) within 0.5 miles of a ferry was considered an interaction. An interaction also includes situations in which a vessel is within 5 minutes of crossing tracks, and the crossing occurs either within 1 mile ahead or within 0.5 mile behind the ferry. The counting does not define the level of risk related to collision. It only provides a measure of hazardous exposure. The ABS model was used to simulate navigational conditions and produce spatial distribution of vessels for the year 2000 with the ferry fleets and routes corresponding to the project alternatives (Alternatives 1 through 3) and the No Project Alternative (Alternative 4) as the base case. The model results were extrapolated to approximate the growth in vessel interactions for the Proposed Project, compared to the No Project Alternative.

The model predicts that the number of total vessel interactions would increase three-fold. As discussed above, ferry transits constitute the majority of all vessel traffic under the Proposed Project in either the No Growth or Sustained Growth scenarios, accounting for 81 percent and 61 percent of all traffic, respectively. Thus, even under a three-fold predicted increase in total vessel interactions, the interactions between ferries would predominate over the interactions between ferries and other vessels as well as over the interactions between non-ferry vessels. Therefore, attention to safe ferry transit, including proper maintenance of fleets, ferry pilot training, and the use of appropriate navigational aids would be the most important factors to address potential navigational risks created by the additional transits and the increased hazardous exposure created by the increased interactions. As stated before, increased vessel traffic does not correlate with increased navigational incidents in the nation's harbors. Other factors, such as procedures, will continue to be more significant than the number of vessel interactions in determining the level of risk.

The WTA ferry expansion would involve 15 different ferry routes. These routes pose varying degrees of navigational challenge and location-specific navigational concerns. However, ABS modeling results indicate that the majority of the increased interactions would take place northeast of San Francisco, because the city is the origin/destination for a large number of trips.

Summary of Impact NAV-1

- Implementation of the Proposed Project could potentially have impacts on navigational incidents resulting from the increase in the number of ferry transits and service to and from new terminal locations. The level of significance of such impacts is difficult to determine. Therefore, the potential for impacts is potentially significant.

Mitigation NAV-1.1: Implementation of best practices to meet or exceed USCG requirements as recommended by the preliminary risk assessment prepared by ABS (2002) will serve to minimize navigation-related risk. These practices are listed below:

1. Design and implement a preventive maintenance system that meets or exceeds manufacturer's service requirements.
2. Require a licensed master to complete an extended familiarization training program aboard the hull and route before being qualified as master-in-charge. (Note: Program training should meet or exceed the requirements in the USCG National Maritime Center Policy Letter 06-01 subj.: "Qualification for Issuance of Type Rating Endorsements Authorizing Service on High-Speed Craft.")

3. Design the terminal to facilitate docking under both prevailing and seasonal environmental conditions.
4. When conditions make it difficult for the master-in-charge to effectively maintain situational awareness, assign another person to the bridge watch (i.e., another licensed master or a senior deckhand) to share the workload and serve as a safety double check.
5. Design and install gangway systems (1) that help steady the ferry and hold it firmly to its dock, (2) that can be adjusted to accommodate changing environmental forces, and (3) that can be manipulated by crew having different physical abilities.
6. Install, operate, and maintain technology (e.g., portable pilot units, and/or automatic identification system tracking and display) to facilitate communication of intent and to audit conformance with navigational protocols.
7. Install, operate, and maintain a backup radar and separate power supplies for radars.
8. Train/certify all bridge watchstanders in radar operation.
9. Periodically survey the water depth in the vicinity of a terminal to identify shoaling, and set and maintain private markers to identify shoal water.
10. Conduct periodic electrical safety inspections and daily check of ground faults. Install a bridge alarm/indicator that alerts the licensed master of the location of electrical shorts.
11. Install and maintain a fixed fire suppression system that has sufficient capacity to flood the engine room twice with CO_2 or equivalent fire suppression agent.
12. Eliminate or minimize hazardous materials used in maintenance and repair.
13. Use a closed gauging system for checking fuel levels.
14. Develop company policy and standard procedures for emergencies and adverse weather and normal operating conditions. Implement and enforce procedures through training and company communications. Audit conformance. Provide job aids for critical procedures.

    Note: Policy and procedures manual and an operational training program should be developed using the guidance in the USCG Navigation and Vessel Inspection Circular 5-01 subj.: “Guidance for Enhancing the Operational Safety of Domestic High-Speed Vessels.”

    14a. Develop, communicate, and enforce standard operating procedures for ferry startup and shutdown.

    14b. Develop, communicate, and enforce navigational protocols for routes.

    14c. Identify areas/conditions in which meeting, crossing, or overtaking may significantly increase the risk of collision and develop/enforce a “no passing” policy for those areas.

    14d. Develop and exercise vessel mutual assistance plans.

    14e. Develop and exercise emergency response protocols to facilitate communication and ferry traffic control during emergencies.

    14f. Determine with emergency care providers (e.g., ambulance services) locations along a route at which the ferry can transfer people in medical distress.

14g. Develop, communicate, and enforce a hot work permit program.

14h. Develop, communicate, and enforce lock-out/tag-out program.

14i. Develop, communicate, and enforce a safe lifting program for deckhands.

14j. Develop and enforce standards for emergency training. Establish a frequency for emergency drills that meets or exceeds USCG requirements. Establish criteria for measuring drill performance. Require all shifts and all crew on each shift to participate. Document training.

Impact After Mitigation: The potential for Impact NAV-1 would be reduced after implementation of Mitigation Measure NAV-1.1. Expansion of service using these mitigation measures would minimize risks. No significant increase in incident occurrence has been identified. However, no system can ensure risk-free navigation conditions in the Bay. This impact is potentially significant because of the remaining risk.

Impact NAV-2 **Increased numbers of ferry transits in the Bay may increase the risk of incidents (such as collision and near misses) between recreational water users (e.g., windsurfers) and ferries. This raises concerns for public safety, especially where windsurfers launch and sail in close proximity to ferry vessels.**

Windsurfers typically do not enter the Bay from marinas. Rather, different launching facilities have developed in the Bay Area because of the need for particular site amenities for that sport, such as shore accessibility and parking, and to take advantage of particular wind and water conditions. The desire to avoid conflicts with other user groups also plays a role in the selection of launch sites. No accidents involving windsurfers and ferries have been documented to date.

Figure 3.2.3 presents the location of existing windsurfing launch sites relative to existing and proposed ferry terminals. The figure also shows the season during which the best windsurfing conditions prevail at each location, and therefore, when these locations are most heavily used. The following proposed terminals would be located in the vicinity of an existing windsurfing launch site: Benicia, Martinez, Crissy Field, Oyster Point, San Francisco International Airport, and Coyote Point.

Larkspur is the only existing ferry terminal located close to a windsurf launch site. No windsurfing accidents have been reported by ferry operators at the Larkspur terminal, even though windsurfing has been a popular recreational activity in the area for many years. This may be attributed to the fact that ferries travel at slow speeds (10 knots) near the terminal and can quickly stop if a windsurfer falls along their path (Clark 2002). No written navigational rules exist for windsurfers, but windsurfers are reported to honor the ferries' approach and departure route, because ferries are restricted to the dredged channel. Depending on wind and tide conditions, windsurfers generally sail within a 1- to 2-mile radius from their launch sites. Windsurfers require a minimum wind speed of 9 knots, and typically sail with winds ranging from 15 to 30 knots. Consequently, in the areas where interaction between windsurfers and ferries might occur, windsurfers may be sailing at higher speeds than ferries. The navigational situation and relationship between ferry operators and windsurfers is reportedly agreeable, and each group is said to "look out for each other" (Clark 2002).

That view of the situation was corroborated by Tom Lloyd, owner of Boardsports Marin, located at Larkspur Landing, and an experienced windsurfer in the Larkspur channel. Mr. Lloyd noted that "ferries usually honk their horn to alert a windsurfer who has either not noticed the ferry is approaching or who has lost control of their board so that they can get out of the ferry's way. As long as the two groups communicate and stay aware of their surroundings, there shouldn't be any problems" (Lloyd 2002). The North Bay Chapter of the San Francisco Boardsailing Association monitors the activities between windsurfers and other vessels, including ferries, near Larkspur Landing to ensure a safe recreational environment for their members.

Summary of Impact NAV-2

- The Proposed Project would increase the number of ferry transits in the Bay and expand service to and from new terminal locations. Some of those proposed terminals could be located in the vicinity of windsurf launch sites. Because no incidents between ferries and windsurfers have been reported, it is not possible to determine the effect of additional transits. Lacking information to the contrary, the impact of increased ferry traffic on windsurfers is considered potentially significant.

Mitigation NAV-2.1: Appropriate training of crew of ferry vessels servicing new terminals located near existing windsurfing launch sites could reduce the risk of incidents involving ferries and windsurfers. Training shall include awareness of windsurfing locations and specific windsurfing events. The San Francisco Boardsailing Association should be encouraged to participate in the development and delivery of such training.

Mitigation NAV-2.2: Specific ferry employees shall be designated to stand watch on the bridge of ferries on select routes to watch for navigational hazards (i.e., during periods of high use by windsurfers within the vicinity of selected terminal locations) to reduce the risk of incidents involving ferries and windsurfers.

Impact After Mitigation: Impact NAV-2 would be reduced after implementation of Mitigations NAV-2.1 and NAV-2.2. As exemplified by the case of the Larkspur terminal, windsurfers and ferry crews will "look out for each other" and develop a relationship that will serve to minimize incidents. Based on the lack of previous incidents, and the implementation of mitigation specific to windsurfing, there is no expectation of a significant increase in incidents. However, no system can ensure risk-free navigation conditions in the Bay, and this impact remains potentially significant.

Impact NAV-3 **Increased numbers of ferry transits in the Bay may lead to an increased risk of collision between recreational boaters and ferries.**

As the population of the Bay region increases, more people are expected to use their leisure time in water-oriented recreational activities. According to USCG information, California had 904,863 registered boats in 2000 and ranks second (after Michigan) among the states in the number of registered recreational vessels (motor and non-motor watercraft). Accident statistics indicate that in 2000, a total of 900 boat accidents took place in California, involving 49 deaths and 519 injuries, and totaling $3 million in property damages. One third of all California boat accidents that year involved collisions with other recreational vessels. A similar proportion was observed nationwide, with 2,706 accidents out of a total 7,740 involving collisions with other vessels (www.uscgboating.org). The majority of accidents between recreational boats are caused by improper control of the vessels due to operator recklessness. National and state statistics of boating accidents do not indicate that there were any accidents involving ferries and recreational boats. The 1996-2001 record of ferry accidents indicates only one collision during that period, and it did not involve a recreational boat.

Figure 3.2.2 presents the locations of marinas along the San Francisco Bay shoreline, where local recreational water users berth or store their vessels. While most marinas are concentrated in the Central Bay, once vessels are launched, they can travel virtually anywhere in San Francisco Bay, San Pablo Bay, and the Sacramento-San Joaquin River Delta, depending on the capabilities of the vessel and the operator. Therefore, there is potential for interaction between ferries and recreational boaters along any of the existing and potential future ferry routes.

Requirements for the safe interaction between power-driven vessels and between power-driven and sailing vessels are delineated in the International Regulations for Preventing Collision at Sea, Inland Navigation Rules Part B – Steering and Sailing, Rule 18. These regulations govern open bodies of water in which foreign shipping traffic is possible and provide a set of statutory requirements designed to promote navigational safety. These rules include requirements for navigation lights, dayshapes, and steering, as well as sound signals for both good and restricted visibility.

General public education and specific boat operator training in regard to safe operation of boats, appropriate rescue and life-saving equipment, boating under the influence of drugs and alcohol, and other key topics is widely recognized as an important tool to prevent and reduce watercraft accidents. The Federal Boating Safety Act of 1971 (recodified under Title 46 of the United States Code) gave the USCG authority to administer two separate grant programs aimed at recreational boating safety. These programs are a State Grant Program to assist U.S. states and territories, and an award program for nonprofit public service organizations to support recreational boating safety activities.

Boating activities in the Bay Area are well organized. Sail races are scheduled and planned well in advance of the events. USCG, the California Department of Boating and Waterways, marina associations, yacht clubs, and community-based entities such as Boat U.S. Foundation have collaborated extensively in matters of boating education and improving recreational navigation safety in Northern California.

Summary of Impact NAV-3

- The Proposed Project would increase the number of ferry transits in the Bay and expand service to new terminal locations. The increase in the potential for incidents between recreational vessels and increased ferry traffic is potentially significant.

Mitigation NAV-3.1: Additional training, education, and public advisory programs for recreational watercraft users related to navigational safety requirements could reduce the risk of incidents associated with expanded ferry service in the Bay. The project proponent could work with the Harbor Safety Committees (which include recreational boaters) and could fund or sponsor new education and advisory training programs and strengthen existing ones. Potentially affected recreational users, especially those docking at marinas located in the vicinity of proposed new ferry terminals, shall be reached through public notices.

Mitigation NAV-3.2: Designating specific ferry employees on selected ferries/routes to stand watch on the bridge for navigational hazards (i.e., during periods of high recreational use, such as weekends or race events, or when weather hazards exist) could reduce the risk of navigational incidents.

Impact After Mitigation: Impact NAV-3 would be reduced after implementation of Mitigations NAV-3.1 and NAV-3.2. No system can ensure risk-free navigation conditions in the Bay. This could remain a potentially significant impact.

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Table 3.2.1
San Francisco Bay Marinas

	# Berths
Marin County:	
1. Loch Lomond Marina, San Rafael	505
2. Marin Yacht Club, San Rafael	116
3. Lowries Y. Harbor, San Rafael	100
4. San Francisco Yacht Club, Belvedere	189
5. Kappas Yacht Harbor, Sausalito	220
6. Clipper Yacht Harbor, Sausalito	650
7. Schoonmaker Point Marina, Sausalito	161
8. Marina Plaza Harbor, Sausalito	103
9. Pelican Harbor, Sausalito	90
10. Paradise Cay Harbor, Tiburon	*
11. Presidio Yacht Club, Sausalito	190
12. San Rafael Yacht Harbor, San Rafael	*
13. Sausalito Yacht Harbor, Sausalito	*
San Francisco County:	
14. San Francisco Marina - East Harbor (Gashouse Cove), San Francisco	
15. San Francisco Marina - West Harbor, San Francisco	700
16. Pier 39 Marina, San Francisco	300
17. South Beach Harbor, San Francisco	700
18. Treasure Isle Harbor, San Francisco	117
San Mateo County:	
19. Brisbane Marina, Brisbane	570
20. Oyster Cove Marina, South San Francisco	235
21. Oyster Point Marina, South San Francisco	570
22. Coyote Point Marina, San Mateo	580
23. Peninsula Marina, Redwood City	420
24. Pete's Harbor, Redwood City	280
25. Port of Redwood City Yacht Harbor, Redwood City	183
26. Pillar Point Harbor, Half Moon Bay	400
Alameda County:	
27. San Leandro Marina, San Leandro	455
28. Alameda Marina, Alameda	530
29. Grand Marina, Alameda	402
30. Fortman Marina, Alameda	486
31. Ballena Isle Marina, Alameda	455
32. Marina Village Yacht Harbor, Alameda	750
33. Embarcadero Cove Marina, Oakland	152
34. Oakland Yacht Club, Oakland	226
35. Oakland Harbor - Union Point, Oakland	92
36. Jack London Square Marina, Oakland	124
37. Oakland Harbor – North Basin, Oakland	113
38. Emery Cove Yacht Harbor, Emeryville	430
39. Emeryville City Marina, Emeryville	409
40. Berkeley Marina, Berkeley	1,100
41. Fifth Ave. Marina, Oakland	107
42. Aeolian Yacht Club, Alameda	90
Contra Costa County:	
43. Richmond Marina Bay, Richmond	750

Table 3.2.1 - Continued
San Francisco Bay Marinas

44. Richmond Yacht Club, Richmond	250
45. Brickyard Yard Cove, Richmond	250
46. Point San Pablo Yacht Harbor, Richmond	210
47. Antioch Marina, Antioch	310
48. Pittsburg Marina, Pittsburg	460
Napa County:	
49. Benicia Marina, Benicia	321
50. Clen Cove Marina, Benicia	209
Sonoma County:	
51. Petaluma Marina, Petaluma	190

*No Data Available

Table 3.2.2
Bay Area Windsurf Launch Sites

Launch Site	Location	Best Season	Rating
South Bay			
Candlestick Point	San Francisco	May - August	Beginner – Intermediate
Oyster Point	South San Francisco	March – October	Intermediate - Advanced
Genentech	South San Francisco	March – October	Intermediate – Advanced
Flying Tigers at Haskins Way	South San Francisco	March – October	Intermediate - Advanced
Embassy Suites	Burlingame	March - October	Intermediate - Advanced
Coyote Point	San Mateo	March - October	Beginner – Advanced
Seal Point	San Mateo	March - October	Intermediate - Advanced
Third Avenue	Foster City	April - September	Beginner – Advanced
Central Bay			
Point Isabel	Richmond	June-August	Intermediate
Berkeley Marina	Berkeley/ Emeryville	Late June – Mid August	Beginner – Advanced
Marine Park	Emeryville	Late June – Mid August	Beginner – Advanced
Crissy Field	San Francisco	April - October	Intermediate - Advanced
Crown Beach	Alameda	June - August	Beginner – Intermediate
Larkspur Landing	San Rafael	Mid-June to Mid-August	Beginner – Intermediate
Rod and Gun	San Rafael	Late April - June	Intermediate - Advanced
North Bay			
Benicia	Benicia	June - August	Beginner – Intermediate
Sherman Island. *(This location has several launch sites along the levees)*	Near Antioch	June - August	Beginner – Advanced

Table 3.2.3
Routine San Francisco Bay Vessel Trip Statistics

Vessel Type/ Year	Tanker	Freighter	Tug/ Tow	Ferry/ Passenger	Public	Other	TOTAL
1996	3,045	5,262	15,682	66,290	3,911	3,673	97,863
1998	3,136	7,128	19,239	76,421	2,179	3,168	111,273
2000	3,763	9,086	21,478	88,469	2,436	2,472	127,704

Source: All data from U.S. Coast Guard Vessel Transportation Service (VTS) electronic monthly activity reports.
Notes:

- Tanker: self-propelled vessels carrying flammable or hazardous materials in bulk as cargo or residual;
- Freighter: bulk dry cargo, container, break bulk carriers, roll-on/roll-off, lighter aboard ships, etc;
- Tug/Tow: vessels designed for towing one or more vessels;
- Ferry/Passenger: passenger lines or cruise ships; ferry movements calculated from published schedules or counted (actually observed),
- Public: police or fire;
- Other recreational vessels, fishing, etc.

Table 3.2.4
Vessel Transits and Incidents for Various Ports[1]

Port	Total Transits	Collisions	Near Misses[2]	Groundings	Allisions	Vessel Casualties[3]	Total Collisions & Near Misses	Total Incidents
							Per 100,000 Transits	
Berwick Bay	97,032	1	0	0	0	0	1.03	1
Houston/Galveston	248,935	8	0	67	15	69	3.21	64
Prince William Sound	4,336	0	0	0	0	3	0.00	69
Puget Sound	217,030	5	12	9	9	237	7.83	125
San Francisco	**127,704**	**0**	**8**	**2**	**5**	**31**	**6.26**	**36**
Sault Ste Marie	62,433	0	0	7	5	22	0.00	54
New York	88,109	5	4	18	21	36	10.21	95

Notes:
1) Year 2000 data from www.uscg.mil/vtm/pages/reports
2) "Near Miss" information is not collected uniformly at each port.
3) "Casualties" is a broadly applied term that technically includes violations of load lines and discharge of garbage, personal injury, or property damage.

Table 3.2.5
San Francisco Bay Ferry Boat Casualty Data 1996-2001

Date	Nature of Casualty*	Total Damage	Vessel Name	Location
03/25/97	Allision	$5,500	Sonoma	Point Blunt
10/06/97	Allision	$850	Zelinsky	Larkspur Ferry Terminal
03/02/98	Allision	-	Zelinsky	Pier 41
06/17/98	Allision	$500	Mare Island	Larkspur Terminal
01/27/00	Allision	$500	Jet Cat Express	San Francisco Bay
03/04/00	Allision	$54,000	M/V Catamarin	Tiburon Ferry Dock
04/10/01	Allision	-	Sonoma	Larkspur Channel
07/05/01	Allision	-	Encinal	Alameda
08/24/00	Collision	$5,000	Golden Gate	San Francisco Bay
08/18/96	Equip. Failure	$8,800	Encinal	San Francisco Bay Pier 1
08/23/96	Equip. Failure	$0	Bay Breeze	Pier 41
09/23/96	Equip. Failure	$6,000	Del Norte	Larkspur Terminal Berth
10/02/96	Equip. Failure	$7,000	Bay Clipper	San Francisco Bay
10/27/96	Equip. Failure	-	Golden Gate	Aquatic Park
11/11/96	Equip. Failure	$12,000	Encinal	Off Blossom Rock
01/03/97	Equip. Failure	$50	Bay Breeze	San Francisco Pier 39
03/07/97	Equip. Failure	$300	Golden Gate	San Francisco Ferry Terminal
04/18/97	Equip. Failure	$26,000	Sonoma	Oakland Estuary Buoy #8
06/05/97	Equip. Failure	$0	San Francisco	San Francisco Bay Pier 1
06/10/97	Equip. Failure	$12,000	Del Norte	Anchorage Eight
09/27/97	Equip. Failure	$5,000	Golden Gate	San Francisco Pier 9
09/29/97	Equip. Failure	$5,000	Bay Breeze	San Francisco Ferry Terminal
11/12/97	Equip. Failure	$50	San Francisco	San Francisco Bay
11/18/97	Equip. Failure	-	Jet Cat Express	South of Alcatraz Island
03/05/98	Equip. Failure	$1,500	Jet Cat Express	San Francisco Bay
05/31/98	Equip. Failure	-	Intintoli	Marin Boat House
01/14/99	Equip. Failure	$22,000	Sonoma	Larkspur
01/19/99	Equip. Failure	$0	Bay Breeze	1/4 mile off San Francisco Ferry Bldg.
03/09/99	Equip. Failure	$250	M/V Intintoli	San Francisco Bay Pier 1
04/10/99	Equip. Failure	$0	Oski	Vallejo
06/01/99	Equip. Failure	$2,000	Jet Cat Express	Marine Terminal, Pier 41
09/23/99	Equip. Failure	-	M.S. Marin	
10/19/99	Equip. Failure	$2,500	Bay Clipper	San Francisco Bay
01/03/00	Equip. Failure	$50,000	Bay Breeze	San Francisco Ferry Terminal
03/28/00	Equip. Failure	$4,000	Sonoma	San Francisco Pier 41
04/24/00	Equip. Failure	$1,200	The Real McCoy	San Francisco Bay
06/14/00	Equip. Failure	$0	Bay Flyer	Half mile N of Pt. Pinole
07/19/00	Equip. Failure	$142,000	M/V Golden Gate	San Francisco Bay
08/17/00	Equip. Failure	$0	Bay Flyer	San Francisco Bay
08/21/00	Equip. Failure	$200	Encinal	
09/02/00	Equip. Failure	$1,000	Intintoli	San Francisco Bay
09/03/00	Equip. Failure	$500	M.S. San Francisco	San Francisco Bay
10/02/00	Equip. Failure	$75,000	Royal Star	San Francisco Bay Pier 48
10/30/00	Equip. Failure	$0	Bay Clipper	San Francisco Bay
11/01/00	Equip. Failure	$150,000	Intintoli	San Rafael
03/01/01	Equip. Failure	$50	Zelinsky	San Francisco Ferry Terminal
11/12/01	Equip. Failure	-	Sonoma	Tiburon Ferry Landing
11/30/01	Equip. Failure	-	Mare Island	Steam Boat Slough
12/03/01	Equip. Failure	-	Sonoma	Alcatraz Island
12/05/01	Equip. Failure	$200	Mare Island	Btwn. Sausalito and San Francisco
09/29/98	Fire	$1,000	San Francisco	Cache Slough
01/18/00	Fire	$0	San Francisco	Vallejo

Table 3.2.5 - Continued
San Francisco Bay Ferry Boat Casualty Data 1996-2001

Date	Nature of Casualty*	Total Damage	Vessel Name	Location
03/18/96	Flooding	-	Sonoma	Inbound San Francisco Bay
09/22/96	Flooding	$5,000	Royal Star	San Francisco Bay
09/02/99	Grounding	$0	M/V Encinal	San Francisco Bay
12/12/00	Grounding	$100	Del Norte	Entrance to Larkspur Channel
07/26/96	Struct. Failure	$0	Royal Star	San Francisco Bay
09/08/96	Struct. Failure	$0	Zelinsky	Basin at San Francisco Ferry Bldg.

Notes:
* "Casualty" is a broadly applied term that technically includes violations of load lines and discharge of garbage, personal injury, or property damage

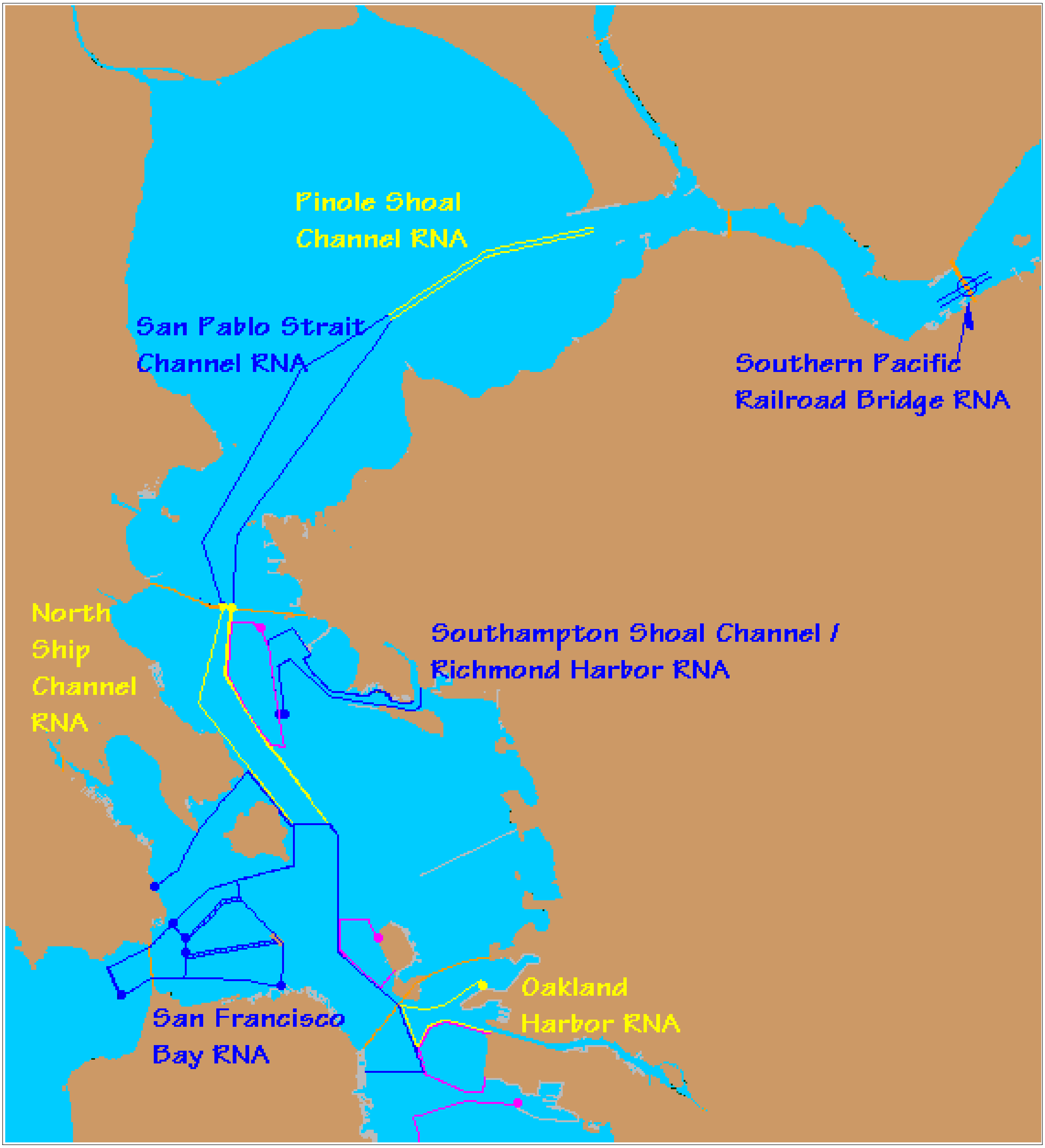
Table 3.2.6
San Francisco Vessel Transits and Incidents (1996-2001)

Year	Ferry Transits	Total Transits	No. of Incidents[1]
1996	66,290	97,863	21
1997[2]	66,198	95,708	47
1998	76,421	111,273	50
1999[3]	73,694	107,826	46
2000	88,469	127,704	42
2001	78,751	118,165	33

Notes:
1) Data include all vessels in San Francisco Bay. Incidents include: collisions, groundings, near misses, vessel casualties, allisions, and pollution events.
2) No data were available for the month of April 1997
3) No data were available for the month of September 1999

Table 3.2.7
Projected 2025 Annual Vessel Transits in San Francisco Bay

	2025 Non-Ferry No Growth				2025 Sustained Non-Ferry Growth		
	Ferry Transits	Non-Ferry Transits	Total Transits	% Ferry Transits	Non-Ferry Transits	Total Transits	% Ferry Transits
Proposed Project	165,850	39,235	205,085	81	103,962	269,812	61



URS	Water Transit Authority Program EIR Project No. 43-00066890.12	Regulated Navigation Areas (RNAs) in San Francisco Bay	Figure 3.2.1

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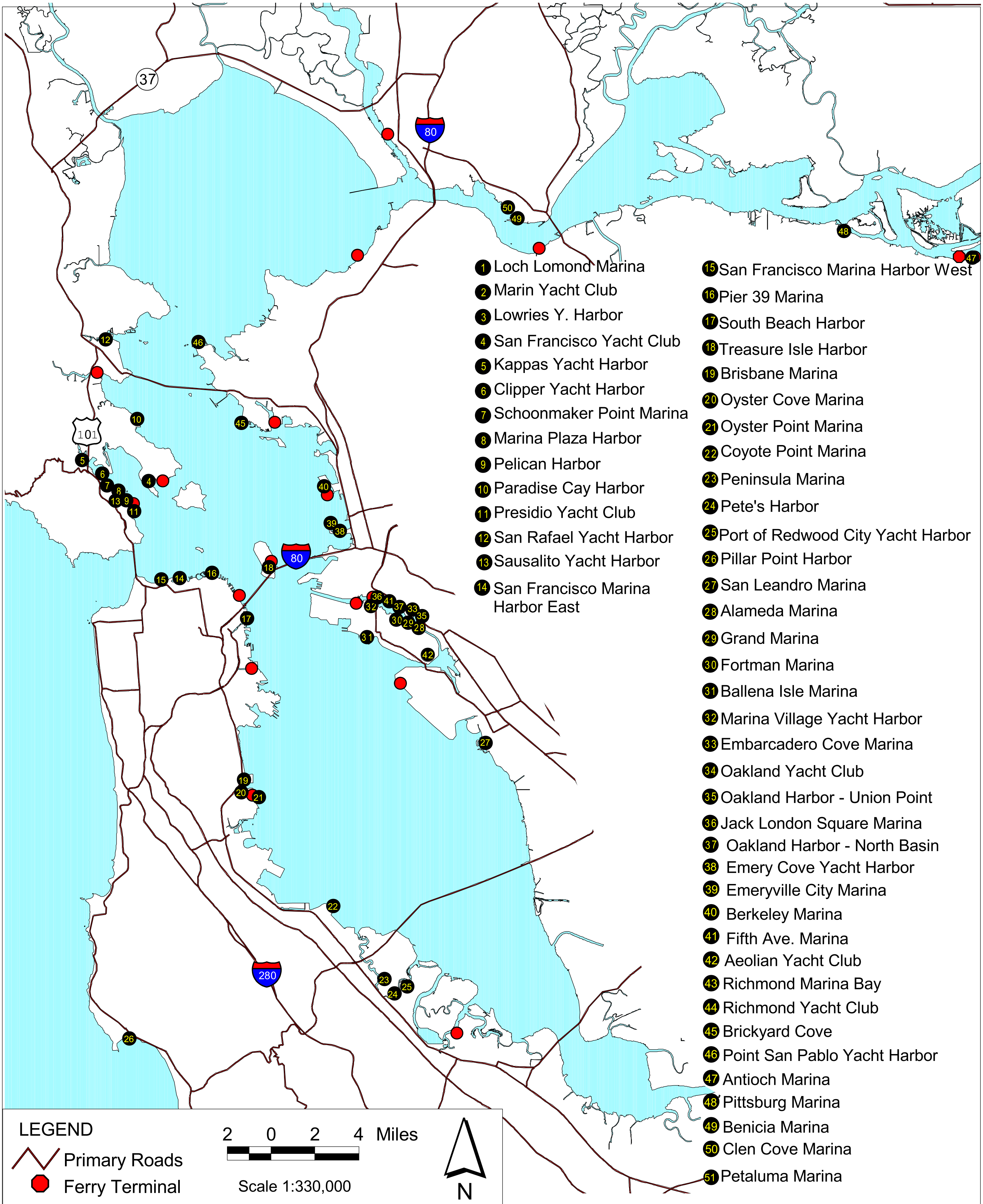

URS

Water Transit Authority
Program EIR

Project No. 43-00066890.12

LOCATION OF MARINAS
AND FERRY TERMINALS

Figure
3.2.2

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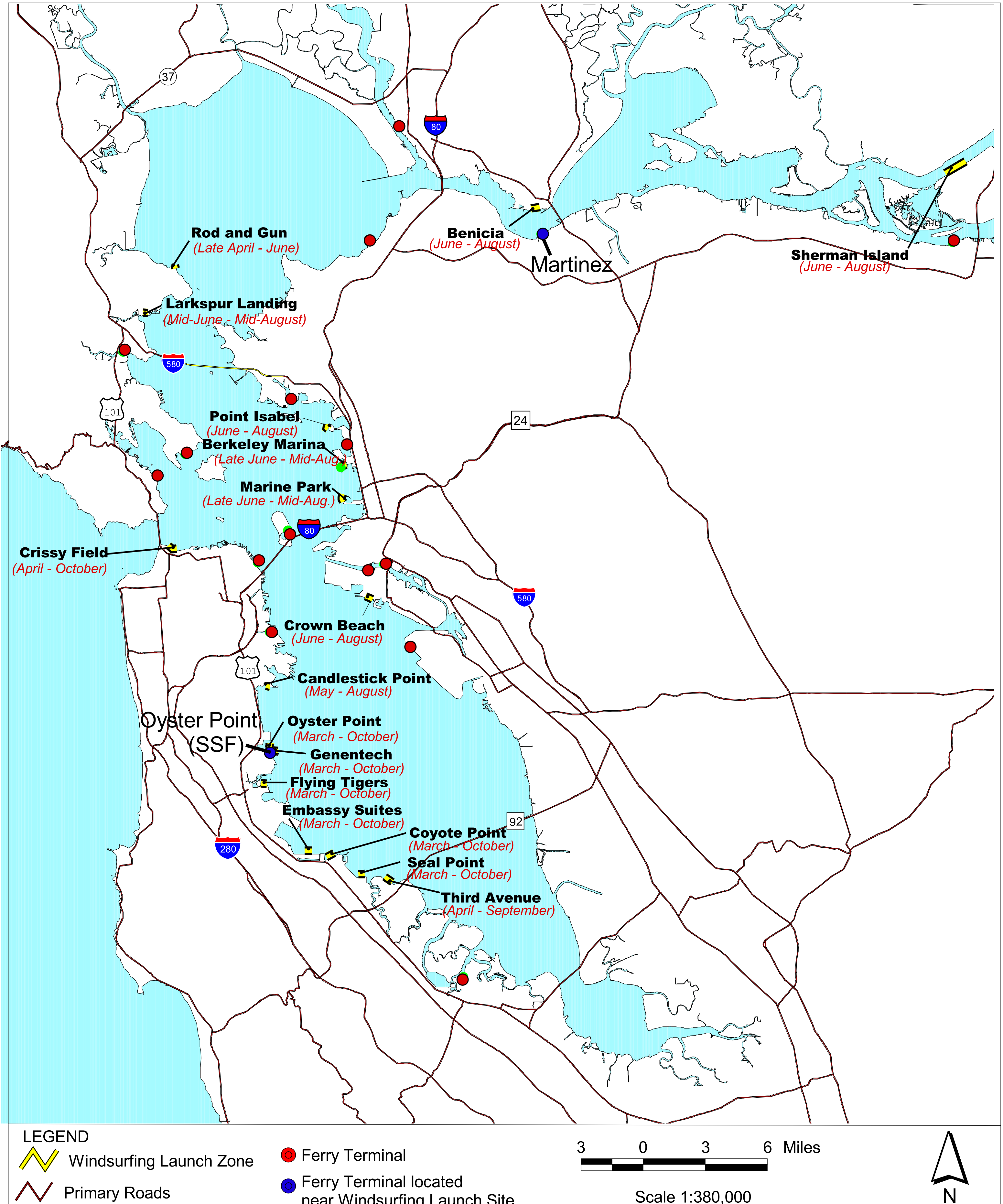

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Water Transit Authority
Program EIR

Project No. 43-00066890

WINDSURFING LAUNCH SITES AND SEASONAL USE

Figure 3.2.3

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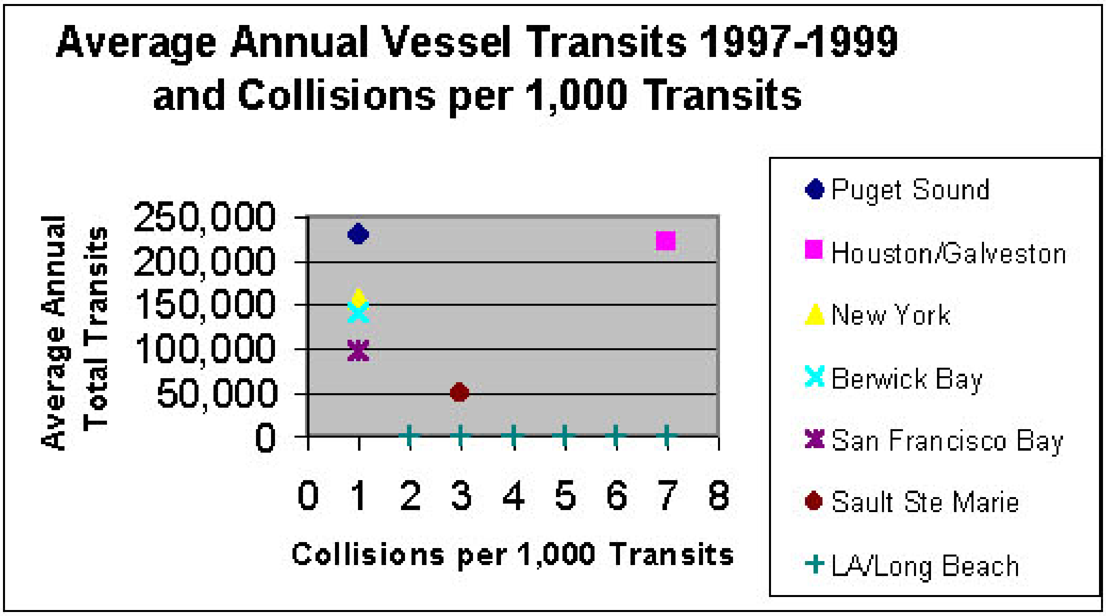

URS	Water Transit Authority Program EIR Project No. 43-00066890	AVERAGE ANNUAL VESSEL TRANSITS (1997-1999) AND COLLISIONS PER 1,000 TRANSITS FOR MAIN U.S. HARBORS	Figure 3.2.4

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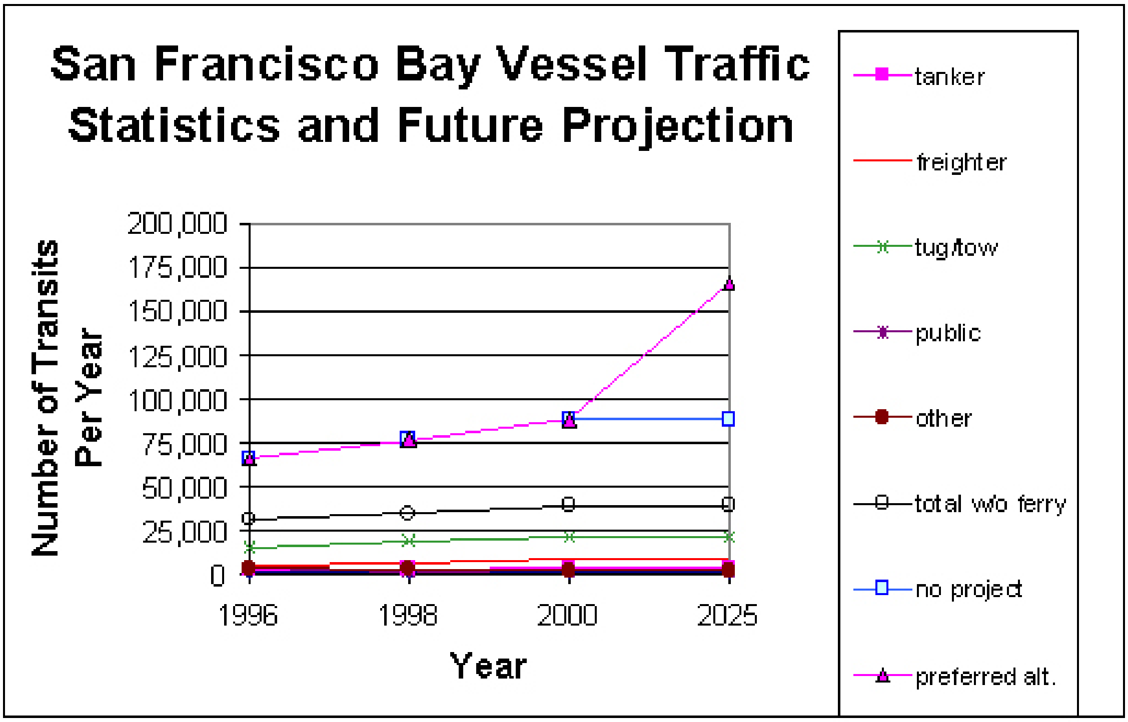
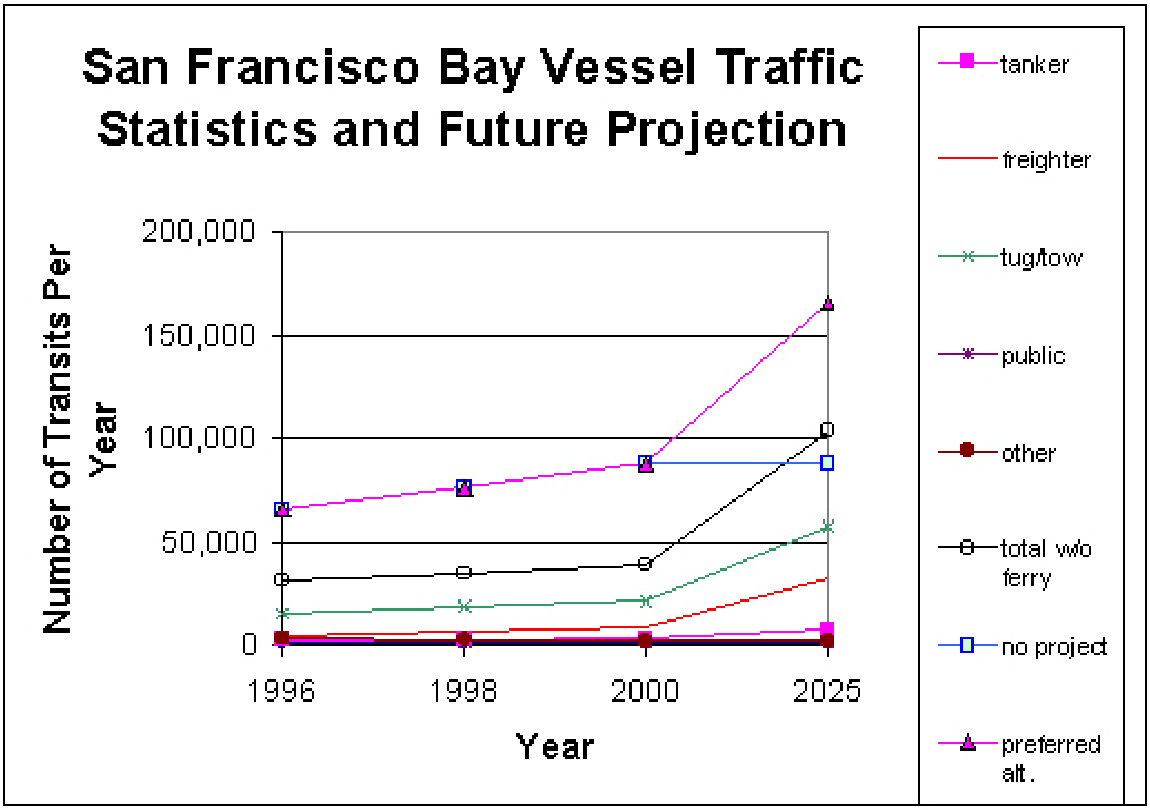


URS	Water Transit Authority Program EIR Project No. 43-00066890	YEAR 2025 FERRY TRANSIT PROJECTIONS AND NO GROWTH IN NON-FERRY VESSEL TRIPS	Figure 3.2.5



URS	Water Transit Authority Program EIR Project No. 43-00066890	YEAR 2025 FERRY TRANSIT PROJECTIONS AND SUSTAINED GROWTH IN NON-FERRY VESSEL TRIPS	Figure 3.2.6

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3.1 DREDGING

The San Francisco Bay Estuary System (Estuary) is the largest estuary along the Pacific Coast of North and South America. Waters from the Sacramento and San Joaquin River systems and the Bay flow through a single opening at the Golden Gate, which is less than 1 mile wide at its narrowest point. While the Bay is extremely deep at the Golden Gate (110 meters, or 356 feet), approximately two-thirds of the Bay is less than 5.5 meters (18 feet) deep. The Bay bottom in shallower areas is covered with silt, sand, and clay that have been carried from tributaries, recirculated in the Bay, and eventually deposited. The San Francisco Estuary Project (SFEP 1992) estimated that 286 million cubic yards (mcy) of previously deposited bottom sediments are resuspended and redistributed annually by currents and wind-driven waves.

To maintain navigational depths within the Bay, dredging is required from channels, harbors, and marinas. Each year between 3 and 5 mcy of sediment are dredged from such locations and deposited at permitted disposal sites in the Bay. The shallow areas of the Bay also constrain navigational movement. For example, the water depths near the refineries in Contra Costa and Solano Counties are too shallow to safely accommodate larger oil tankers. These tankers must transfer oil to smaller tankers or barges to move their cargo to the shallower marine terminals.

Dredging and disposal of sediment directly affects the environmental health of San Francisco Bay. Some contaminants adsorb to specific sediment types, making contaminant movement largely dependent on sediment movement. Processes that govern natural sediment movement also affect the distribution of wetlands, a crucial habitat.

This section provides an overview of dredging and disposal in the Bay and discusses their importance from environmental and regulatory perspectives.

3.1.1 Environmental Setting

3.1.1.1 Study Area

The study area for dredging and dredge disposal impacts encompasses jurisdictions of nine Bay Area counties. It comprises San Francisco Bay and its embayments as well as the Carquinez Strait and Suisun Bay to Antioch at the San Joaquin River. Also included are the portion of the Pacific Ocean along the shoreline from Half Moon Bay to the entrance of San Francisco Bay at the Golden Gate and the route to the San Francisco Deep Ocean Disposal Site (SF-DODS) (Figure 3.1.1).

<u>Sediment Sources</u>

The Estuary has two distinct hydrographic regimes: the South Bay, which extends from the Bay Bridge to the southern terminus of the Bay in San Jose, and the Central and North Bays, which connect the Sacramento-San Joaquin River Delta (Delta) and the ocean.

The South Bay is characterized by large areas of broad shallows that are incised by a main channel 10 to 20 meters deep. Bottom sediments are typically composed of clays and silts (Thompson et al. 1981), with silts containing sand and shell fragments in the eastern shallow areas (Nichols and Thompson 1985). The North Bay consists of several small embayments, the two largest being San Pablo Bay and Suisun Bay. The embayments are connected to each other and the ocean by deep, narrow channels ranging from 13 meters deep in San Pablo Bay to over 110 meters deep at the Golden Gate. The shallower regions of San Pablo and Suisun Bays consist of mudflats primarily composed of poorly sorted silt and clay. Bottom sediments in deeper waters are sand and silty sand (Conomos and Peterson 1977).

The Delta is the largest source of sediment load entering the Bay and contributes about 86 percent of the total fluvial sediment supply (Krone 1996). The remaining sediment is contributed from local tributaries. Most of the sediment entering the Bay in suspension is silts and clays (Conomos and Peterson 1977). The bathymetry of the Bay changes with time as a result of erosion and deposition of sediment, which can be characterized by its grain-size distribution. Fine-grained sediment, which has particle sizes smaller than a few microns, is dominant in the South Bay and most parts of the Central and North Bays. It consists mainly of cohesive clays and fine silts. This cohesiveness is a main factor in the deposition, re-entrainment, and transport of sediment under waves (Mehta 1993, 1996).

Sedimentation in the Estuary is a complex process that has been affected by 150 years of human activity in the region. Changes in sedimentation patterns are related to changes in the runoff, alteration of the Bay shoreline wetlands and marshes that trap sediment, Bay filling, and sediment dredging and excavation activities.

Large amounts of sediment entered the North Bay between approximately 1853 and 1884 due to hydraulic mining in the Sierra Nevada Mountains. This sediment was resuspended by waves and transported by currents further down the Bay. Sediment entering into the North Bay also increased significantly from 1923 to 1950, indicating sediment from mining operations was continuing to impact the North Bay (Krone 1996). Beyond the movement of historic mining sediments, the Sacramento and San Joaquin Rivers continue to naturally discharge sediments. Studies conducted by the U.S. Geologic Survey (USGS) from 1957 to 1966 yielded an estimate of an annual median sediment discharge of 2.6 million tons for 1960 conditions. This 1960 sediment budget estimated that a total of 10.5 mcy of sediment entered the Bay, of which 1 mcy was dredged and disposed on land, 5.5 mcy accumulated in the Bay, and 4.0 mcy exited from the Golden Gate (Krone 1996). The California Department of Water Resources (DWR) calculated an average annual sediment inflow of 7.8 mcy between 1956 to 1990, with an annual average discharge of 5.9 mcy in 1990.

The Delta is the largest but not the only source of sediment to the Bay. Based on data from 1909 to 1966, an estimated 0.89 million tons of sediment entered Suisun, San Pablo, and San Francisco Bays each year from local tributaries (Ogden Beeman and Associates 1992).

In addition to new inputs of sediment, as many as 286 mcy of existing sediments in the shallows of San Francisco Bay are resuspended by currents and wind-driven waves. As a result, areas that have been dredged lower than the surrounding substrate begin to refill with sediment. The rate at which the dredged areas fill ranges from 0.1 to 5.2 feet per year (USACE 1990). Maintenance of design depths requires dredging. The frequency of maintenance dredging at a particular site depends on the rate at which it fills, and may vary from once a year to once a decade.

Sediment Quality

Bay sediments have been influenced by natural and anthropogenic influxes of toxic chemicals over time, with a significant increase since the 1800s, when mining and industrial activities in the Northern California watersheds became widespread. To evaluate whether sediments have elevated levels of toxic chemicals, the San Francisco Bay Area Regional Water Quality Control Board (RWQCB) performed a statistical analysis of available sediment analytical data. The results of this study are reported in Gandesbury et al. (1998). The objective of the study was to determine what the RWQCB should consider as “ambient” levels of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), heavy metals, and pesticides in the Bay. Sediment quality is further described in Section 3.4 (Water Resources).

3.1.1.2 Dredging Activities in San Francisco Bay

Dredging activities in San Francisco Bay can be generally divided into dredging for the purpose of new projects and “maintenance” dredging, which is done on a periodic or regular basis to maintain existing facilities. The U.S. Army Corps of Engineers (USACE) San Francisco District conducts most of the dredging in San Francisco Bay.

Since 1824, USACE has planned, built, and maintained federal navigation projects in the Bay. The San Francisco Bay region has in excess of $5.4 billion of annual economic activity directly dependent on deep and shallow draft navigation channels (OGDEN BEEMAN 1990). Because over 70 percent of the Bay is shallow (less than 6 meters deep), this dredging work is extremely important to maintain required navigational depths. Recent historical annual dredge volumes have averaged 5.0 mcy. Annual maintenance of navigational channels represents the bulk of this removal. Actual maintenance dredge volumes vary from year to year and have reached up to 4.5 mcy. Recently, new work has become more important and pending new channel improvements, including the Oakland 50-foot dredging project, will call for removal of an additional 16 mcy in the coming years. The USACE San Francisco District’s operation and maintenance program projects represent the most significant routine dredging in the Bay Area. Other dredging activities are conducted by both public and private marine operators, ports, refineries, and flood control and reclamation districts around the Bay.

Dredged material from navigation channels and other sources in San Francisco Bay has been historically disposed at more than three dozen sites in and around the Bay. Currently, in-Bay disposal is limited to four state and federally designated sites (see Figure 3.1.1): Carquinez Strait (SF-9), San Pablo Bay (SF-10), Suisun Bay (SF-16), and Alcatraz (SF-11)[1]. In 1982, it was discovered that dredged materials at Alcatraz, the most used site, were mounding instead of dispersing as originally planned. Despite site management changes, this mounding persisted to the point that it posed potential navigation problems. The concern regarding site capacity was heightened due to the expectation of large dredge volumes to be generated from large projects. The long-term dredging and disposal need for the Bay Area was estimated at approximately 300 mcy over a 50-year period, an average of 6 mcy per year (USACE 1998). This is a conservatively high estimate based on historical dredge volumes.

Disagreements between regulatory agencies, environmental interest groups, and dredge operators over how to address dredging and disposal needs resulted in project-by-project and agency-by-agency considerations that became known as the “mudlock,” delaying permits and nearly halting dredge activities in the Bay Area during the 1980s. In 1990, the U.S. Environmental Protection Agency (USEPA), USACE, RWQCB, and Bay Conservation and Development Commission (BCDC) joined with diverse interest groups to establish the Long-Term Management Strategy

[1] Nomenclature in parentheses refers to USACE designation of disposal sites.

Program (LTMS) for the dredged material from the Bay Area (USACE 2001). The LTMS goals are to:

- Maintain in an economically and environmentally sound manner those channels necessary for navigation in San Francisco Bay;
- Eliminate unnecessary dredging activities in the Bay and Estuary;
- Conduct dredged material disposal in the most environmentally sound manner;
- Maximize the use of dredged material as a resource; and
- Establish a cooperative permitting framework for dredging and disposal applications.

3.1.1.3 Dredging Technologies

The National Shipbuilding Research Program (NSRP) Contaminated Sediment Management Guide (1999) describes several current dredge technology categories commonly used for environmental dredging. Each of these methods, summarized below, results in some suspension of sediments. The appropriateness of each method depends on site conditions, including dredged material volumes, sediment grain size, and depth of excavation.

Mechanical

Clamshells: These dredges use a two-part bucket manipulated and controlled by cables and can be used for almost all types of sediments. They have a relatively high production rate. Limitations are that large rocks or debris prevent the two halves from closing completely, they can tend to bring up large quantities of water, and there can be a significant amount of resuspension while the bucket is being lifted.

Cable-arm: This system is a variation on clamshell dredges, which is designed to increase precision and reduce material loss. They are designed to work more precisely and enclose the sediments. While this system is widely available and can be used in deep water, it is expensive and has a relatively low production rate.

Hydraulic

Conventional Excavators: These are similar to land-based excavators that use hydraulically operated arms and buckets. This method can be difficult to control the resuspension of sediments and is limited to shallow operating depths of 15 to 20 feet of water (which would be sufficient for the depth needed for ferry vessels). The use of a visor has been shown to reduce the resuspension losses.

Portable Hydraulic: Similar in operation to a vacuum cleaner, the portable hydraulic dredge creates a low pressure that siphons the sediment off the bottom. Portable systems are limited to operations involving unconsolidated sediments in relatively shallow water and can be controlled very well in such conditions. Production rates associated with this technology are fairly low.

Plain Hydraulic: Larger than portable hydraulic dredges, plain hydraulic systems operate on the same principle but can operate in much deeper water. The water to solids ratio is high and resuspension of sediments can be a problem.

Cutter Head: Cutter head systems add a mechanical device to loosen sediments to a plain hydraulic dredge. Cutter head dredges can work in a greater variety of sediments than plain hydraulic dredges and tend to have higher production rates, but they are not as widely available and are costlier to operate.

Pneumatic

Air-Lift: Air-lift systems work on the same principle as hydraulic dredges but they rely on vacuum pumps and chambers to draw sediment off the bottom. Although not as widely available as portable or plain hydraulic dredges, air-lift systems generate a slurry with a lower water to solids ratio and fewer resuspended solids. They can be more efficient at depth and have a good production rate but are relatively expensive.

Miscellaneous Technologies

A variety of innovative dredging technologies have been developed and tested. The Eriksson Sediment Systems Method for Marine Sediment Removal and Dewatering freezes the sediment and removes it in solid blocks. By freezing the sediment adjacent to that being removed, this technology releases very little sediment into the water column. The STUMP (Submersible, Transportable, Utility Marine Pump) encloses the sediment in a cylinder, loosens it with water jets, and pulls it to the surface with standard hydraulic pumps.

Several commercially available dredging mechanisms can be applied for the dredging and removal of contaminated sediments that can reduce impacts associated with the methods listed above. These techniques are referred to as "environmental dredging" and are listed in Table 3.1.1. Environmental dredging techniques have been required in areas of known sediment contamination, but can have a higher cost of operation. The methods used for any necessary dredging would be determined for each project or situation, and would depend on the appropriateness of the available environmental techniques to the specific logistic needs and conditions of contamination, depth, and sediment compaction at proposed new dredge channels.

3.1.1.4 Dredge Disposal Options

Only finer-grained materials (Bay Mud and sand) are suitable for aquatic disposal or upland reuse. Rock, coarse gravel, or materials such as concrete, steel, and other construction debris are not suitable for aquatic disposal/upland wetland reuse and must be taken to appropriate locations for disposal or recycling. Depending on volume and suitability of dredged materials, dredging projects may consider a range of reuse/disposal sites within the nine-county region. Options include:

- In-Bay disposal;
- Ocean disposal;
- Upland/wetland reuse (UWR);
- Upland landfill disposal; and
- Reuse as fill material for construction projects.

Beneficial reuse sites identified by the LTMS are shown in Figure 3.1.2. A list of sites has been compiled as part of the Dredging and Disposal Road Map (BCDC and USACE 1998). The Road

Map is a compilation of existing and planned sites identified by the BCDC and the USACE that can potentially accommodate current and potential dredged Bay materials. Table 3.1.2 summarizes the status of each of these potential sites.

Suitability for Disposal

Suitability refers to the chemical, biological, and physical properties of the sediment. Materials can be categorized as Suitable for Unconfined Aquatic Disposal (SUAD) or Not Suitable for Unconfined Aquatic Disposal (NUAD). SUAD material is chemically and biologically suitable for any reuse option and can be placed in a wide variety of locations, including in-Bay, ocean, construction, landfills, and can be used to create/restore wetlands. NUAD materials may not be biologically and/or chemically suitable for use in all environments. There are three classes of NUAD material. Category 1 material can be used in wetland creation/restoration as “noncover” material if SUAD materials are used to cap the NUAD material. NUAD Category 2 material requires additional analyses and may or may not be suitable as wetland noncover material. NUAD Category 3 material generally must be taken to appropriate landfills. Allocation of materials according to their suitability categories to appropriate disposal or reuse sites will be part of the dredging permit conditions.

In-Bay Disposal

Current annual dredge maintenance in San Francisco Bay results in disposal of between 2 and 5 mcy. Less than 3 mcy are disposed of at in-Bay disposal sites. All aquatic dredged material disposal sites are operated as dispersive sites; that is, material disposed at the sites tends to disperse and be carried by currents. Bay currents are very complex and do not necessarily transport material out to the sea. Dispersal is dependent upon material type, disposal volume, and frequency. Dredged materials are disposed of at sites downstream of the dredging sites with the intention of moving sediments away and out of the Bay, although this is only partly effective.

Alcatraz (SF-11)

The Alcatraz disposal site (SF-11) is located approximately 0.3 mile south of Alcatraz Island in central San Francisco Bay (Central Bay). The site is a circular area, approximately 2,000 feet in diameter. The site was formally designated as a sediment disposal site in 1972, although dredged material has been deposited there since 1894. Because of frequent disposal at this site, a mound developed in the 1980s, which posed a potential threat to navigation in the area. The site is actively managed by the USACE to maintain it at navigable depths. It currently has an annual limit of 3,058,104 cubic meters, or 4 mcy, with a monthly restriction of 400,000 cubic yards from October to April, and 300,000 cubic yards from May to September (USEPA and USACE 1998).

Ocean Disposal

San Francisco Deep Ocean Disposal Site (SF-DODS)

This site is located on the continental shelf, approximately 50 nautical miles west of the Golden Gate, at a depth of approximately 760 feet. This site was designated in 1994 under Section 102 of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA). It can accept up to

4.8 mcy per year. MPRSA requires project sponsors to consider feasible, practicable, and environmentally superior alternatives to the use of this site if alternatives are available.

Wetland Reuse

Hamilton Wetlands Restoration

The former Hamilton Army Airfield (HAAF) is located near the City of Novato in Marin County. The site is bounded by San Pablo Bay to the east and U.S. 101 and Hamilton Base facilities to the west. The site was historically within the tidal zone of San Pablo Bay. In the 1930s, portions of the area were diked and used as a military base and airfield until the 1970s, when the base was closed. The site is currently being prepared for transfer and reuse under the Base Realignment and Closure Act of 1988. A wetlands restoration project has been proposed to restore a mix of seasonal and tidal wetlands on up to 900 acres of land, which were previously used as the airstrip for the base and an adjacent antenna field to the north (State Lands Commission parcel). The State of California is the project sponsor for the Hamilton Wetlands Restoration Project and is considering use of dredged material from a variety of sources. USACE is the federal sponsor. The Hamilton restoration project is managed by USACE, the California Coastal Conservancy (Conservancy), and the San Francisco BCDC, with the close coordination of the City of Novato, which is managing the contracts for preparation of the conceptual restoration plan, and the Hamilton Restoration Group, composed of representatives of government, business, and environmental communities.

Montezuma Restoration Project

Montezuma Wetlands is the site of a privately sponsored wetlands restoration proposal, referred to as the Montezuma Wetlands Project (MWP). The MWP would use dredged material to restore approximately 1,800 acres of historic tidal wetlands, providing habitat for a variety of sensitive species that inhabit brackish tidal marshes and shallow-water habitats. The MWP is currently being considered by federal, state, and local agencies. A Final EIR/EIS on the MWP was released for public review in July 1998 (USACE and Solano County 1998).

Upland Landfill Disposal and Reuse

Specific permit restrictions for each landfill may apply depending on the results of a waste characterization analysis, which must be performed within 1 year prior to disposal. In general, Class III landfills accept only nonhazardous materials. Class II landfills can accept nonhazardous materials in addition to designated wastes. Class I landfills can accept hazardous materials. However, Bay dredged materials have never been found to be hazardous. If dredged material is determined to be suitable for disposal at a Class III facility, then a number of potential landfill sites may be considered. The following are Class III sites that can accept nonhazardous material only:

- Vasco Road – Located in Livermore on Vasco Road off of I-580 in eastern Alameda County.
- Redwood Landfill – Located in Novato on Redwood Highway, off Highway 101 in northern Marin County.
- Newby Island – Located in Milpitas on Dixon Landing Road off I-880 in northern Santa Clara County.

- Ox Mountain – Located near Half Moon Bay on Highway 92 in San Mateo County.

The following is a Class II site that can accept nonhazardous material and designated waste:

- Altamont Landfill – Located near Altamont Pass off of Interstate 580 in eastern Alameda County.

Limitations of Upland Sites

If dredged material is taken to a landfill, the material must be dried to a moisture content of less than 50 percent by weight prior to disposal. The material cannot contain any free liquids if it is to be transported by truck. When fine-grained sediments are polluted, uncontrolled dumping in the environment must be avoided. When recycling and cleaning operations are not applicable, storage must then take place in special depots that are isolated from their surroundings. No existing sediment depots have been identified in the Bay Area as part of this EIR.

Reuse and Rehandling Facilities at Dredge Sites

Some dredging operations have associated rehandling and reuse facilities for the dredged materials in the vicinity of the dredge site. This is the case for dredging projects near two of the proposed ferry terminal locations: the San Leandro and Port Sonoma Marinas, discussed below. The Suisun City marina also has a rehandling/disposal site at Pearce Island.

San Leandro

According to the City of San Leandro Draft General Plan (City of San Leandro 2001), dredging and the disposal of dredge material are a large part of the cost of operating San Leandro Marina. The City has received federal funds for dredging since the early 1970s. The boat basin is dredged about once every 8 years, and the Maltester Channel is dredged approximately every 4 years. Dredging is authorized to a depth of 8 feet. Although the City maintains a dredge materials management site, current federal regulations stipulate that the site may be used for drying purposes only. Because the site is also managed as a tidal mudflat and provides habitat for shorebirds, its use for additional material disposal is not assured. Ongoing coordination with state and federal agencies will be necessary to develop long-range solutions for material disposal.

Port Sonoma

Dredging of the marina and channel has been conducted for approximately 20 years to maintain a depth of -7 feet using 10- to 12-inch suction dredges. The dredge permit allows up to an annual volume of 60,000 cubic yards, but the marina typically only dredges between 30,000 and 50,000 cubic yards annually. The Port Sonoma Marina owns a reuse facility, which consists of 20 acres of dewatering ponds onsite. The marina's dredged material is placed on a 110-acre upland site, of which 43 acres are typically wetlands. Dredged material has been used for levees, landfill caps, and an agriculture enhancement project. The marina reuse site ceased taking outside dredge materials about 10 years ago (Sweetburg 2002).

3.1.1.5 Long-Term Management Strategy

The LTMS is being conducted in five separate phases:

- Phase I – Evaluation of Existing Management Options
- Phase II – LTMS Technical Studies
- Phase III – LTMS EIS/EIR
- Phase IV – Preparation and Implementation of Management Plan
- Phase V – Periodic Reviews and Revisions of the Management Plan

Phases I and II were completed between 1991 and 1992. In 1992, Phase III was initiated. The EIS/EIR evaluated five alternative long-term dredged material management strategies for the Bay, in addition to the “no action alternative,” representing existing conditions. Each alternative reflected a combination of volumes of dredged material placement at the Bay, ocean, and beneficial reuse environments. Alternative 3, emphasizing placement of dredged material at upland and ocean environments (40 percent of material each) with limited in-Bay disposal (the remaining 20 percent of the material), was selected because it provided the best balance of the overall goals and objectives of the LTMS. Compared to the other alternatives, the EIS/EIR determined that Alternative 3 would result in significant environmental benefits, no direct risk to the ocean site, and only a low risk to sensitive resources at beneficial reuse areas.

In 1999, the Record of Decision (ROD) for the EIS was signed by USEPA and USACE, completing the federal requirements under the National Environmental Policy Act (NEPA). That same year, the State Water Resources Control Board (SWRCB) certified the EIR, according to California Environmental Quality Act (CEQA) requirements.

Phase IV began with the preparation of an LTMS Management Plan. An Interim Management Plan was completed in 1994 and replaced in 2000 by a Management Plan, which contains specific guidance to implement the new dredged material management strategy for the Bay Area over the next 50 years. The overall policy for dredging and disposal under LTMS was adopted by amendments to the RWQCB Basin Plan and BCDC Bay Plan in July 2001. These amendments reflect the complementary mandates of the two agencies. The amendments to the Bay Plan focus on the process for regulating dredging and disposal activities within BCDC’s jurisdiction.

The goals of LTMS include a reduction of in-Bay disposal volumes and increased emphasis on beneficial reuse of dredged material. The most likely beneficial reuse is wetland restoration projects or levee maintenance and repair. The long-term goal is to reduce disposal at in-Bay sites to approximately 20 percent of recent historical volumes. A transition schedule with overall volume targets for in-Bay disposal has been established, as shown on Table 3.1.3.

The remainder of dredged material generated each year should be disposed of at SF-DODS or any of the existing or potential beneficial reuse and upland sites (Figure 3.1.2).

Phase V of LTMS involves periodic updating of the Management Plan. During the initial 3-year period following finalization of the Management Plan (2001-2003), LTMS agencies will produce annual progress reports. Subsequently, the Management Plan would be reviewed every 3 years and revised if necessary to reflect statutory, regulatory, technical, and environmental changes.

Dredged Material Management Office

In 1995, the Dredged Material Management Office (DMMO) was established as a coordinated permit application review program. The purpose of the DMMO is to increase the efficiency and to reduce redundancy in the dredging permitting process. The multi-agency DMMO seeks to foster a comprehensive and consolidated approach to handling dredged material management issues. Agency members include:

- USACE;
- USEPA;
- BCDC;
- San Francisco RWQCB; and
- California State Lands Commission (SLC).

A number of resource agencies, while not formal members, participate in application review:

- California Department of Fish and Game (CDFG);
- U.S. Fish and Wildlife Service (USFWS); and
- National Marine Fisheries Service (NMFS).

Although the DMMO issues a recommendation regarding preferred dredged material management options, individual agencies must still issue specific regulatory approvals.

With the establishment of the DMMO, one of the original goals of the LTMS program was accomplished. Non-DMMO local, state, and federal agencies also have a role in permit application decision making. California law provides for local government at the city and/or county level to oversee the use of local resources through a variety of requirements for project proponents. Adherence to plans, permits, and approvals may be required for dredging activities and the use of beneficial reuse sites. Disposal at SF-DODS may also require a permit or a federal consistency determination from USEPA, which oversees consistency with the California Coastal Act outside the area of jurisdiction of the BCDC.

The DMMO is working toward improving coordination and implementation of the laws, regulations, and policies of the member agencies as part of a cooperative permitting framework. The DMMO has devised a consolidated dredging and dredge material reuse/disposal permit application form. The DMMO consolidated application may now be used by the BCDC to issue a standard 5-year permit.

While the individual member agencies continue to meet their statutory requirements, the DMMO makes joint staff reviews and recommendations regarding:

- Approval of sampling and testing plans;
- Results of testing conducted as part of approved plans;
- Completeness of consolidated permit applications; and
- Material suitability for disposal at existing in-Bay disposal sites, ocean disposal site, and upland disposal sites.

DMMO staff members make a recommendation for a given site only if their own agencies have regulatory authority over that site. Different regulatory agency requirements apply to disposal permits for in-Bay and deep-ocean sites. Permitted upland wetland reuse/disposal and upland landfill disposal sites have their own individual regulatory requirements, which are the responsibility of the site operators and not of the dredger.

3.1.1.6 Current USACE Dredge Projects in San Francisco Bay

A number of ongoing dredging projects are underway in the Bay Area. These activities include dredging of channels that are currently used by ferry vessels. These projects are briefly discussed below.

Navigation Projects

Oakland Harbor Deepening

Sponsor: Port of Oakland

Status: Deepening of the harbor to -42 feet mean lower low water (MLLW) was completed in 1998. A feasibility study and an EIS/EIR for deepening the harbor to -50 feet MLLW was completed in 1999. This project was initiated in 2001.

Richmond Harbor Deepening

Sponsor: Port of Richmond and USACE

Status: The existing channel has been deepened to -38 feet MLLW. Further deepening to -41 feet is authorized and may be scheduled according to sponsors' needs.

San Francisco Bay to Stockton

Sponsor: Contra Costa County

Status: Two phases of this project have already been implemented. Implementation of an additional phase, consisting of deepening the main channel in Suisun Bay to -45 feet MLLW, and providing a maneuvering area for a petroleum terminal and a turning basin at Avon, is delayed pending analysis of environmental impact concerns to the Delta.

Southampton Shoal Channel

Sponsor: Contra Costa County is a prospective sponsor

Status: The channel is the entrance to Richmond Harbor and the Richmond Longwharf Maneuvering Area. It is currently maintained at a depth of -45 feet MLLW. A study, dependent on funding availability, will address the potential improvements to channel alignment and depth for more efficient navigation.

Mare Island Strait Dredging Expansion

Sponsor: U.S. Navy

Status: The channel has never been dredged to its fully authorized width. USACE maintained the channel to a depth of -36 feet MLLW until 1995, when the U.S. Navy announced that the channel was no longer needed for naval operations. Once a redevelopment plan for the Mare Island facility is prepared, dredging needs may be reevaluated.

Concord Naval Weapons Station Channel Deepening

Sponsor: TRANSCOM Military Command

Status: USACE has been tasked with the evaluation and potential construction of a deep draft navigation channel (-42 feet MLLW) to accommodate the current and future fleet of container ships. Design and construction are contingent upon modeling results and testing to determine impacts.

Operations and Maintenance Projects

Oakland Harbor

Sponsor: Port of Oakland

Status: Maintenance is scheduled on an annual basis and includes entrances to Inner Harbor, Outer Harbor, turning basin, and channels to Howard Terminal, Government Island, and San Leandro Bay. Deepening of Outer and Inner Harbors to -42 feet was completed in 1998, and deepening to -50 feet was scheduled for Fiscal Year 2001.

San Francisco Harbor

Sponsor: USACE. This is 100 percent federally maintained, because no local sponsor has been identified.

Status: The project provides for maintenance of various channels in San Francisco Bay, including annual dredging of the 2,000-foot-wide Main Ship Channel to -55 feet MLLW; dredging at Presidio Shoal, Black Point Shoal, Blossom Rock, Rincon Reef, and Alcatraz Shoal to -40 feet MLLW; dredging at Arch Rock, Harding Rock, Shag Rocks, Point Stuart Light and an approach to Islais Creek to -35 feet MLLW; and a 10-foot-deep channel at San Francisco Airport.

San Leandro Marina

Sponsor: City of San Leandro

Status: Operation and maintenance project of the Jack Maltester Channel, a shallow-draft light commercial and recreational channel, provides for 4-year cycle maintenance of Main Access and Interior Auxiliary Channels to -6 and -7 feet MLLW, respectively. The sponsor is responsible for providing a suitable upland disposal site.

San Pablo Bay and Mare Island Strait

Sponsor: City of Vallejo (formerly U.S. Navy property)

Status: The project provides for dredging of a 600-foot-wide, 11-mile-long channel to -35 feet MLLW in San Pablo Bay (across Pinole Shoal), and through Mare Island Strait, with a turning basin between Mare Island and Vallejo. The Pinole Shoal channel is dredged every 2 years. Mare Island Strait was dredged annually until 1994. With the closing of the Navy's facility in 1995, the center of the channel (400 feet) is the only portion of the Mare Island Strait Channel economically justifiable for maintenance dredging. Because the channels are needed now for recreational and commercial uses only, existing depths are more than sufficient and maintenance dredging frequency has been reduced.

Suisun Bay Channel

Sponsor: USACE. This is 100 percent federally maintained, because no local sponsor has been identified.

Status: Suisun Bay is dredged annually to maintain a channel 300 feet wide and -35 feet deep from the Carquinez Strait at Martinez to Pittsburg. Under this project, the dredging continues further upstream to Antioch through the New York Slough Channel, which is dredged every 4 years.

Suisun Channel

Sponsor: City of Suisun

Status: The project provides an entrance channel to the head of navigation at the City of Suisun that is -8 feet, with widths between 100 and 200 feet. Upland disposal options to accommodate materials for the last dredging cycle were not found.

Petaluma River

Sponsor: City of Petaluma

Status: This project provides for maintenance dredging of a channel 200 feet wide and -8 feet deep across the flats in San Pablo Bay to the mouth of the Petaluma River, and then 100 feet wide along the river to Petaluma. The City of Petaluma has requested USACE to conduct river surveys every 2 years to determine shoaling conditions that may warrant dredging.

San Rafael Creek

Sponsor: City of San Rafael

Status: This project is a shallow draft channel for light commercial and recreational uses. The maintenance project includes two dredge sections: the Across-the-Flats Channel dredged to -8 feet MLLW every 7 years, and the Inner Canal Channel dredged to -6 feet MLLW every 4 years. The City of San Rafael has been unable to provide adequate upland disposal for material located at the upper Turning Basin, which is unsuitable for unconfined aquatic disposal. Therefore, this area has not been dredged according to the maintenance cycle.

Larkspur Ferry Channel

Sponsor: Golden Gate Highway and Transportation District, which provides ferryboat transit service between Marin County and San Francisco.

Status: This project has a design of -13 feet MLLW depth for the main navigation channel, and -5 feet MLLW for the Terminal Turning Basin. USACE assumed maintenance responsibility under the 1986 and 1999 Water Resources Development Acts. The channel was last dredged in 2002 and will also occur in 2003.

Redwood City

Sponsor: Redwood City

Status: The federal channel is authorized to be dredged to -30 feet on a 3-year maintenance cycle.

In addition to USACE-maintained dredging projects, there are numerous small- and medium-sized dredge operations in San Francisco Bay that do not require USACE involvement except for permitting. "Small dredgers" are considered those with project depth of less than 12 feet and annual volume of 50,000 cubic yards. Medium dredgers are those non-USACE projects exceeding the depth or volume limits of the small dredger category. The total and average annual dredged volumes for the period from 1991 through 1999 that have been disposed of at in-Bay disposal sites for all the dredger categories in San Francisco Bay are presented in Table 3.1.4.

3.1.1.7 Regulatory Setting

Regulatory requirements applicable to dredging and dredged material disposal/reuse are presented in the following sections and summarized in Table 3.1.5. Section 3.5 (Biology) presents additional regulations that apply to dredging impacts.

Federal

Clean Water Act (33 USC 1251–1376)

Section 401. In accordance with Section 401 of the Clean Water Act (CWA), dredging permit applicants intending to dispose material in water must obtain water quality certification from the State of California through the RWQCB with jurisdiction over the project area. The RWQCB, after reviewing the project, may recommend to the SWRCB that certification be granted or denied.

Dredged material considered for disposal in water must be tested to determine disposal suitability. Authority to determine suitability is exercised by the state under Section 401 of the CWA. The RWQCB defined its testing guidelines for wetland and upland beneficial reuse of dredged material in *Interim Screening Criteria and Testing Requirements for Wetland Creation and Upland Beneficial Use* (Wolfenden and Carlin 1992). Those guidelines have been superceded by the Draft Staff Report *Beneficial Reuse of Dredged Materials: Sediment Screening and Testing Guidelines* (RWQCB 2000).

Section 404. Dredged material disposal is regulated pursuant to Section 404 of the CWA, which requires authorization from the Secretary of the Army, acting through USACE, for the discharge of dredged or fill material into all waters of the United States, including wetlands. The USACE is mandated to protect and maintain navigable capacity of the nation's waters under 33 Code of Federal Regulations (CFR), Navigation and Navigable Waters. Section 33 CFR requires the USACE to issue permits for dredging and placement of dredged or fill material into the waters of the U.S. (Part 323), and for ocean dumping of dredged material (Part 324).

Dredging material for disposal at aquatic sites must undergo testing to determine its potential effects on the disposal site environment. Testing is also used to determine whether dredged material is suitable for unconfined aquatic disposal (SUAD). For disposal sites in or potentially affecting inland waters, such as San Francisco Bay, testing requirements are defined by Section 404 of CWA. Guidance for suitability testing procedures for inland waters is provided by the *Evaluation of Dredged Material for Discharge in Inland and Near Coastal Waters – Testing Manual,* also called Inland Testing Manual or ITM (USEPA/USACE 1998). For ocean disposal sites, suitability requirements are defined by 40 CFR 227.6. Guidance for suitability testing is provided by the *Evaluation of Dredged Material Proposed for Ocean Disposal – Testing Manual,* also known as the Green Book (USEPA and USACE 1991).

Rivers and Harbors Act of 1899 (33 USC 401 et seq.)

The Rivers and Harbors Act of 1899 (33 USC 401 et seq.) regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters, and vests regulatory authority in the Secretary of the Army, acting through the USACE, for work in, under or over any navigable water of the U.S. The law applies to any dredging or disposal of dredged materials, excavation, filling, rechannelization, or any other modification of a navigable water of the United States.

Marine Protection, Research, and Sanctuaries Act of 1972 (16 USC 1431 et seq.)

Section 103 of the MPRSA, as amended, requires authorization from the Secretary of the Army, acting through the USACE, for the transportation of dredged material for the purpose of ocean disposal. The USEPA is charged with providing oversight of the USACE's regulatory program and maintaining the integrity of the nation's waters. USEPA has responsibility for designating ocean disposal sites. According to the MPRSA, the USEPA oversees disposal of materials into ocean waters and must provide written concurrence before material can be disposed in the ocean.

State

Water Quality Control Act (Porter-Cologne Act) (California Water Code Section 13000 et seq.; CCR Title 23, Chapter 3, Subchapter 15)

Under the California Water Quality Control Act (Porter-Cologne Act), the RWQCB may also act by either issuing or waiving waste discharge requirements for the dredging project for upland disposal of dredged material. These actions by the RWQCB are not equivalent to issuing or waiving water quality certification. The RWQCB must issue a separate 401 Certification.

State Lands Commission (Public Resources Code Section 6001 et seq.)

Projects involving use of state lands may require lease or permitting from the SLC, which is charged with managing California's sovereign lands for purposes consistent with the public trust.

Local

McAteer-Petris Act (Public Resources Code Section 66600 et seq.)

The BCDC regulates dredging and disposal under the provisions of the McAteer-Petris Act. BCDC, on the basis of the Suisun Marsh Preservation Act of 1977 (Public Resources Code Section 29000-29612) and the Federal Coastal Zone Management Act (CZMA) (33 USC 1451 et seq.), is mandated to reduce Bay fill and to protect and manage the coastal zone resources of San Francisco Bay. The BCDC's jurisdiction includes the Bay and a 100-foot shoreline band, salt ponds, managed wetlands, tidal marshes five feet above mean sea level, and certain named tributary waterways, such as rivers. According to the Bay Plan, BCDC can authorize dredging when it can be demonstrated that the dredging is needed to serve a water-oriented use or other important public purpose, the materials to be dredged meet the water quality requirements of the RWQCB, important fisheries and natural resources would be protected through seasonal restrictions established by CDFG, USFWS and/or NMFS, dredging is minimized through project siting and design, and the materials would, if feasible, be reused or disposed outside the Bay and certain waterways. The amendments to the Basin Plan focus on regulating the known and potential impacts to water quality, and beneficial uses of those waters by disposal activities.

3.1.2 Impacts and Mitigation

3.1.2.1 Significance Criteria

Impacts from dredging would be considered significant if they would:

- Result in a substantial adverse impact on water quality;
- Affect threatened, endangered, or protected species in a manner that results in a take under the Endangered Species Act; or
- Result in the reduction of protected wetland habitat as defined in Section 404 of the Clean Water Act or result in alteration of desirable functions and values established in applicable regulations through direct removal, filling, hydrological interruption, or other means; or
- Hinder achievement of Long Term Management Strategy (LTMS) goals for allocation of dredged materials to in-Bay, ocean, and upland reuse sites.

Potential impacts to habitats due to dredging are addressed in Section 3.5.2.2 (Biology).

3.1.2.2 Impacts

Construction and Operation (Maintenance Dredging)

Impact D-1: **New channel dredging and maintenance dredging, which would be conducted on a periodic basis in shallow areas, would add to the total annual volume of dredged materials in San Francisco Bay.**

A relatively small amount of dredging would be required for implementation of the Proposed Project. Of the sixteen ferry terminal locations included, seven currently have ferry service and would, therefore, not require additional dredging. All but one of the nine new terminal locations (Hercules/Rodeo) already have port or maritime land uses at the site and have water depths, either naturally or through maintenance dredging, capable of accommodating ferries. Ferries have relatively low draft requirements (approximately 7 feet) and would not require channels deeper than those at existing marinas and ports. Therefore, new channel dredging would only be required at Hercules/Rodeo. At other locations, retrofitting of existing piers or expansion of existing terminals could require additional minor amounts of dredging.

Dredging in San Francisco Bay currently includes dredging for new projects and maintenance dredging for existing navigational channels. USACE San Francisco District conducts most of the dredging in the Bay. The long-term dredging and disposal need for the Bay Area is estimated as approximately 300 mcy over a 50-year period, or an average of 6 mcy per year (USACE 1998a). This is a conservatively high estimate based on historic dredge volumes as well as on proposed projects foreseen during the period of LTMS EIR/EIS preparation. Some of the new projects included in the estimates, such as a round-the-bay channel, have since been eliminated from consideration. Dredge volume varies greatly from year to year, depending on new projects as well as the level of dredging maintenance required, which appears to have declined in recent years. In 2001, for example, total dredging and disposal in the Bay Area was only 2.0 mcy according to USACE data (Dwinell 2002). Dredge materials disposal sites are shown on Figure 3.1.1.

The goals of the LTMS include a reduction of in-Bay disposal volumes and increased emphasis on beneficial reuse of dredged material. The most likely beneficial reuses are wetland restoration and levee maintenance and repair. The long-term goal is to reduce disposal at in-Bay sites from approximately 50 percent of recent dredged volumes to approximately 20 percent by the year 2013. Volume targets have been established for each in-Bay disposal site, based on sediment-dispersive dynamics and historical information (USACE 1998b). A transition schedule with overall volume targets for in-Bay disposal has been established, as shown on Table 3.1.3. In addition to the target volumes, the LTMS contemplates a contingency volume of 0.25 mcy per year, which would be allowed for emergency situations or for years when sedimentation or other factors result in unanticipated volumes of deposited sediment to be dredged. The remainder of dredged material generated each year should be disposed of at the San Francisco Deep Ocean Disposal Site (SF-DODS) or at any of the existing or potential beneficial reuse and upland sites (Figure 3.1.2).

Figure 3.1.3 presents a Geographic Information System (GIS) map of San Francisco Bay showing the bathymetry and the proposed WTA ferry routes for the Proposed Project. The potential dredge volume was calculated by delineating three-dimensional segments on a GIS map. These segments were defined to allow safe passage of ferries; they include a buffer zone 300 feet wide (150 feet to each side of the center line to enable two vessels to pass with sufficient separation) and depth of 7 feet, which is conservative for ferry navigation (i.e., 5 feet maximum navigational draft and 2 feet of required keel clearance). The depth to be dredged was derived from bathymetric data.[2]

As indicated, only the Hercules/Rodeo site would require construction dredging. The required volume is approximately 49,830 cy. This potential construction dredging volume is very small when compared to current dredging activities in the Bay; it would represent 0.08 percent of the Bay Area's long-term annual new and maintenance dredging requirements of 6.0 mcy estimated in the LTMS.

In addition to construction dredging, the channel at Hercules/Rodeo would likely require maintenance dredging. Although the long-term dredging maintenance requirements cannot be determined without location-specific sedimentation rates and hydrodynamic conditions, it is

[2] The GIS map was developed using NOAA National Ocean Service Bathymetric Digital Elevation Models (DEM) that were generated from original point soundings collected during hydrographic surveys conducted by the National Ocean Service and its predecessors. Mean High Water shoreline as defined by NOAA nautical charts was used as a constraining boundary and assigned its local elevation relative to the local datum (typically Mean Low Water) (NOAA-National Ocean Service 1998).

reasonable to assume that maintenance dredge volumes would not exceed the construction dredging volumes, and would likely recur on 3- to 8-year periods, as is the case for other channels in the Bay. This volume is very small in comparison with the total average volume of 4.5 mcy dredged for annual maintenance of USACE channels in the Bay. Since the LTMS estimate of 6.0 mcy is conservatively high and includes dredged volumes for projects that are no longer planned, such as proposed tourism navigation channel ring around the Bay, volumes generated by the WTA ferry expansion should not result in the average annual estimate being significantly exceeded in the long term.

The LTMS dictates that by the year 2013 only 20 percent of the annual volume of dredged material may be disposed of at in-Bay disposal sites. The LTMS goals are based on historical information and sediment-dispersive dynamics (USACE 1998b). In-Bay sites are generally reserved for disposal of USACE maintenance dredging materials. Therefore, during project implementation, WTA would have to ensure that new ferry channel dredged materials could be accommodated at either the ocean disposal site or at beneficial reuse sites while observing annual and/or total capacity restrictions at those sites. Alternatively, the small volume of dredge materials could be disposed of at an upland disposal site.

Consultation with the DMMO and associated permitting agencies will be required before proceeding with dredging and disposal plans in order to comply with regulatory requirements. At that time, DMMO will advise on available opportunities for the creation of new upland and wetland reuse areas for disposal of dredged materials associated with the proposed ferry routes. Fostering such opportunities would facilitate achievement of LTMS goals for reduction of in-Bay disposal. Potential beneficial dredged sediment reuse sites have been identified throughout the Bay Area by the LTMS (Figure 3.1.2). Those sites and other sites that may be eventually identified should be evaluated in terms of logistics, availability, and capacity to accommodate the disposal needs of the WTA ferry expansion.

In-Bay dredge disposal will be restricted by permit conditions for each individual project and is expected to be minimal. The LTMS target for the amount of annual in-Bay disposal will vary with respect to when the disposal would occur, based on other scheduled or proposed dredging projects.

Summary of Impact D-1

- The Proposed Project involves expansion of ferry service to new terminals. Construction dredging of approximately 49,830 cy could be required. The construction dredging would represent approximately 0.08 percent of the dredging activities occurring in the Bay. Because the volumes of dredged materials required for construction and maintenance of new channels are relatively small for the Proposed Project, and they would be within the LTMS goals for reduction of in-Bay disposal, impacts are anticipated to be less than significant. In addition, implementation of Best Management Practices (BMPs) described in Impact D-2 would minimize water quality impacts from dredging. However, consultation with the DMMO and associated permitting agencies would be required before proceeding with dredging and disposal plans in order to comply with regulatory requirements.

Impact D-2 **Dredging of new channels to accommodate expanded ferry service could locally reduce water quality by exposing and suspending contaminated sediment.**

Bay sediments have been influenced by natural and anthropogenic influxes of toxic chemicals over time, with a significant increase since the 1800s, when mining and industrial activities in Northern California watersheds became widespread. Dredging and the disposal of sediments directly affect the health of the Bay because these activities can remobilize previously deposited particulate-bound pollutants. For this reason regulatory controls greatly restrict new activities that might require dredging.

Contaminated sediments are not distributed evenly in the Bay, but tend to be in localized areas. Trace metals, pesticides, and numerous organic contaminants are monitored for Bay sediments through the Regional Monitoring Program (RMP). Pollutant concentrations in sediments tend to be highest in harbors, harbor entrances, marinas, and industrial waterways, and lowest in the central portions of the embayments.

Sediment "toxic hot spots", where sediment dredging could result in the degradation of water quality, have been identified in San Francisco Bay by the Bay Protection and Toxic Cleanup Program (BPTCP) and are shown on Figure 3.1.4. For the Proposed Project, only one terminal location, Hercules/Rodeo, would require construction dredging. As indicated on Figure 3.1.4, no known toxic hot spots are located near this area; however, unknown contaminated sediment could be present. In addition, retrofitting of existing piers or expansion of existing terminals could require dredging at other locations. Before dredging, proposed bottom sediments would have to be sampled and tested for contamination in accordance with DMMO guidelines.

If impacted sediments are to be dredged, precautions to prevent release of contamination must be taken. The National Shipbuilding Research Program (NSRP) Contaminated Sediment Management Guide (1999) describes several commercially available dredging technologies commonly used for environmental dredging (listed in Table 3.1.1). Environmental dredging techniques have been required in areas of known sediment contamination, but can have a higher cost of operation. The methods used for any dredging would be determined for each project or situation. Which methods are used would depend on the appropriateness of the available environmental techniques to the specific logistic needs and conditions of contamination, depth, and sediment compaction at proposed new dredge channels.

All methods result in some suspension of sediments. However, dredging impacts to water quality can be minimized through the use of BMPs, including:

- Use of silt curtains, which prevent suspended sediment from migrating out of the immediate project area;
- Dredging only on the incoming tide;
- Hydraulic or closed clamshell dredging to reduce the generation of suspended sediments;
- Shunting, which involves pumping of the free water in a sediment holding barge to the bottom of the water body, which reduces turbidity; and
- Employment of an independent, certified, on-board dredging inspector to ensure compliance with permit conditions.

Monitoring should be conducted during dredging to allow for the following:

- Measurement of the efficiency of contaminated sediment removal;
- Determination of dredged volumes;
- Measurement of sediment resuspension at the dredge site; and
- Checking performance of barriers and other controls.

These are commonly used BMPs that have been accepted by the RWQCB as significantly reducing the impacts to water quality from sediment resuspension. A Section 401 Water Quality Certification is required from the RWQCB under the Clean Water Act for dredging permits.

As part of the DMMO dredging permit requirements, proposed dredging locations are required to be sampled and tested to determine the existence and extent of any contamination and to determine suitability for disposal. Suitability refers to the chemical, biological, and physical properties of the sediment. As described in Section 3.1.1.4, materials can be categorized as SUAD or NUAD. SUAD material is chemically and biologically suitable for any reuse option and can be placed in a wide variety of locations, including in-Bay, ocean, construction, and landfills, and can be used to create wetlands. NUAD materials may not be biologically and/or chemically suitable for use in all environments. There are three classes of NUAD material. Category 1 material can be used in wetland creation as "noncover" material if SUAD materials are used to cap the NUAD material. NUAD Category 2 material requires additional analyses and may or may not be suitable as wetland noncover material. NUAD Category 3 material generally must be taken to appropriate landfills.

Summary of Impact D-2

- The Proposed Project would require construction dredging at Hercules/Rodeo. While no known contamination is present at this location, the sediments to be dredged could be contaminated. In addition, retrofitting of existing piers or expansion of existing terminals could require dredging at other locations. If proposed channel bottom sediments are found to be contaminated after pre-dredging testing, a potentially significant impact to water quality could occur if contaminants were substantially resuspended or contaminated dredged material were not disposed of properly.

Mitigation D-2.1: Dredging shall be minimized. For dredging that is required, as part of the DMMO dredging permit requirements, proposed dredging locations shall be sampled and tested to determine the existence and extent of any contamination. Whenever contaminated materials are to be dredged, negative impacts on water quality shall be minimized through the use of the most appropriate dredge type and dredging techniques for each site. Engineering included in the plans and permits for dredging projects shall include the use of BMPs described above to reduce potential impacts to less than significant levels.

The DMMO permit requirements also include a Section 401 Water Quality Certification from the RWQCB, which will require implementation of appropriate BMPs if they are necessary to protect water quality. Individual project proponents shall incorporate appropriate BMPs for dredging plans and specifications.

Impact After Mitigation: Impact D-2 would be less than significant after implementation of Mitigation Measure D-2.1.

Impact D-3 **There is a possibility that dredging new channels could remove bottom sediments that could result in a salinity intrusion into groundwater basins.**

Maintaining groundwater quality is of concern near ferry terminals or where dredging could impact a groundwater basin's water quality. Groundwater quality can be degraded through the intrusion of saltwater. Saltwater intrusion would reduce the groundwater basin yield, diminishing production from existing activities and limiting future groundwater development. Deep dredging of Bay mud could strip the "cover" from the top of a freshwater reservoir under the Bay, allowing the saltwater to contaminate the fresh water, or allowing fresh water (if artesian) to escape in large quantities, thus causing land to sink. However, the precise location of groundwater reservoirs under the Bay is not well known. Dredging Policy 9 of the Amendments to the Bay Plan, found in Chapter 10 of the Final LTMS, specifies that "to protect fresh water reservoirs (aquifers): (a) all proposals for the dredging or construction work that could penetrate the mud 'cover' should be reviewed by the San Francisco Bay Regional Water Quality Control Board and the State Department of Water Resources; and (b) dredging or construction work should not be permitted that might reasonably be expected to damage an underground water reservoir. Applicants for permission to dredge should provide additional data on groundwater conditions in the area of construction to the extent necessary and reasonable in relation to the proposed project" (USACE 2001).

With the exception of terminals proposed in the San Francisco and Oakland Bay front areas, where groundwater is not used as a fresh water reservoir since it is not considered fit for consumption, other future dredging may be required in the vicinity of aquifers that are subject to protection. The only terminal that would require construction dredging is Hercules/Rodeo. Retrofitting of existing piers or expansion of existing terminals could also require dredging at other locations. Dredging for the purpose of terminal access would not be sufficiently deep to strip the freshwater reservoir cover. Furthermore, in most cases, dredging would be used to rehabilitate former dredged channels. However, following DMMO procedures, WTA may be required to document aquifer depth and conditions at proposed terminal locations.

Summary of Impact D-3

- The Proposed Project could require channel dredging in areas underlain by freshwater aquifers. Dredging would not extend to depths where protective layers may be damaged. The maximum dredging depth would be approximately -7 feet Mean Lower Low Water (MLLW), which is well above the top elevations of known aquifers (see Water Resources Section 3.4.1.6). Groundwater pollution is not expected to occur as a result of dredging. This would be a less than significant impact. Therefore, no mitigation is required.

Impact D-4 **Dredging activities could adversely impact threatened, endangered, or protected species.**

Dredging and the disposal of dredged material temporarily increases turbidity, which could influence bottom-feeding organisms at and near dredge and disposal sites, and may affect the behavior and physiology of fish and other organisms. Temporarily increased suspended sediment concentrations are an unavoidable consequence of dredging and disposal of dredged material. During dredging, sediments are suspended as material is excavated from the bottom. Clamshell dredges also release sediments into the water column as the bucket is raised from the bottom, and hopper dredges release suspended sediments during barge dewatering. Regardless of the dredging method, the aquatic disposal of material increases suspended sediment concentrations at the disposal site. Increased turbidity can cause acute and chronic effects in adult fishes. Direct mortality results from impaired oxygen exchange caused by the laceration, irritation, or clogging of the gills. Even if exposed to suspended sediment concentrations found adjacent to disposal barges or in the water column immediately following disposal, fish would have to be exposed for several hours in order for death to occur. Plumes of highly concentrated suspended solids last only for minutes.

Construction dredging for the Proposed Project would be limited to Hercules/Rodeo. As shown on Figure 3.1.5, this location is not included as an area requiring restricted dredging for species of special concern. However, consultation with the CDFG and/or site specific studies could be required as verification.

At other locations, retrofitting of existing piers or expansion of existing terminals could require additional dredging in areas where dredging is restricted. Potential impacts to endangered species at these locations will require reviews and concurrence by federal and state agencies.

Summary of Impact D-4

- The Proposed Project requires dredging at Hercules/Rodeo. This location does not appear to be a restricted dredging area for special status species. However, proposed dredging activities will require review by the DMMO to determine whether impacts to special status species could occur. At other locations, retrofitting of existing piers or expansion of existing terminals could require additional dredging in areas where dredging is restricted. Potential impacts to endangered species at these locations will require reviews and concurrence by federal and state agencies. Dredging could be a potentially significant impact on species of concern.

Mitigation D-4.1: Negative impacts on threatened, endangered, or protected species shall be minimized through use of dredge types and techniques and implementation of BMPs. BMPs could include use of silt curtains and adhering to dredge windows for special status species. Use of BMPs and appropriate dredging techniques will be part of the DMMO recommendation and incorporated as conditions for regulatory approval of the permit application.

Mitigation D-4.2: Individual projects would undergo consultation with the resource agencies. Several mitigation measures have been utilized in previous projects to reduce or avoid impacts to biological resources related to dredging operations. These include the use of physical barriers such as silt curtains to contain the turbidity plume; selection of dredging equipment to reduce suspension of materials; and, if construction sequencing permits, restricting dredging in shallow water to between June 1 and November 30.

During the preparation of the LTMS EIS/EIR, the LTMS agencies consulted with USFWS, NMFS, and the CDFG regarding potential impacts of dredging and dredged material disposal on sensitive biological resources. These resource agencies, in conjunction with LTMS agencies, developed a list of restrictions specific to San Francisco Bay to protect critical habitat for special status and important commercial and recreational species. Figure 3.1.5 shows areas and times of restricted dredging activity related to these species. Dredging shall be conducted in conformance to applicable seasonal restrictions to minimize impacts to biological resources.

Impact After Mitigation: Impact D-4 would be reduced after implementation of Mitigations D-4.1 and D-4.2. Implementation of site-specific mitigation measures at the project level would further reduce Impact D-4 to a less than significant level.

Impact D-5 **Dredging for construction of access channels to new ferry terminals could result in the loss or disturbance of jurisdictional wetlands.**

Dredging of new access channels would be conducted for the Proposed Project only at Hercules/Rodeo. This impact is addressed in Section 3.5.2.2 (Biology), Impact B-1.

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Table 3.1.1
Commercial Environmental Dredging Technologies

Mechanism	Capability
Specialized clamshell	Large or small volumes; high precision; low loss, depth limited by need for divers and visibility
Mechanical shovel with sliding cover (visor)	Small or large volumes; resuspension control with visor; sensitive to debris; limited to shallow sites
Hydraulic dredge	Moderate volumes; rake to remove debris; good precision; 8-meter depth
Air-suction	Small to large volumes; screens to operate with debris; depth to 8 meters; good precision
Suction dredge	Small volumes; debris sensitive

Table 3.1.2
Applicability of Regulatory Requirements to Dredge, Disposal and Reuse Options

	Section 404	**Section 401**	**MPRSA**	**CZMA**	**McAteer-Petris Act**	**Porter Cologne**	**California Public Resources Code**
Dredge Operations	N/A	Certification required of applicant	N/A	BCDC consistency required of applicant	BCDC permit required of applicant	N/A	State Lands Commission lease/ Determination required of applicant under various provisions of the Code
In-Bay Disposal	404(b)(1) Guidelines compliance required of applicant	Certification	N/A	BCDC consistency required of applicant	BCDC permit required of applicant	N/A	N/A
Ocean Disposal	N/A	N/A	Section 103 compliance required of applicant	N/A		N/A	N/A
Upland Wetland Reuse	Guideline compliance, if existing site is jurisdictional or decant to water of U.S. Permit required of site operator	Certification required of site operator, if existing site is jurisdictional or decant to water of U.S.	N/A	BCDC permit may be required of applicant	BCDC permit may be required of applicant	Discharge permit required of applicant because of potential impacts to groundwater	N/A
Upland Landfills	N/A	Certification required of fill operator	N/A	N/A		Discharge permit required of applicant if dewatering	N/A

Source: Draft LTMS Management Plan 2000
Note: MPRSA= Marine Protection, Research, and Sanctuaries Act, CZMA= Coastal Zone Management Act

Table 3.1.3
LTMS Transition Volume Targets for In-Bay Disposal

Years	Target Volume (mcy)
2001-2003	2.80
2004-2006	2.41
2007-2010	2.03
2010-2013	1.64
After 2013	1.25

Table 3.1.4
Total and Average Annual Maintenance Dredging Volumes (1991-1999), cubic yards

Project Category	Total Volume Dredged 1991-1999	Annual Average Volume 1991-1999
Small Dredgers	2,095,842	232,871
Medium Dredgers	6,745,814	749,535
USACE projects	12,302,512	1,366,946
Total	21,144,168	2,349,352

Source: Appendix H, Table H-1, Final LTMS Management Plan, July 2001.

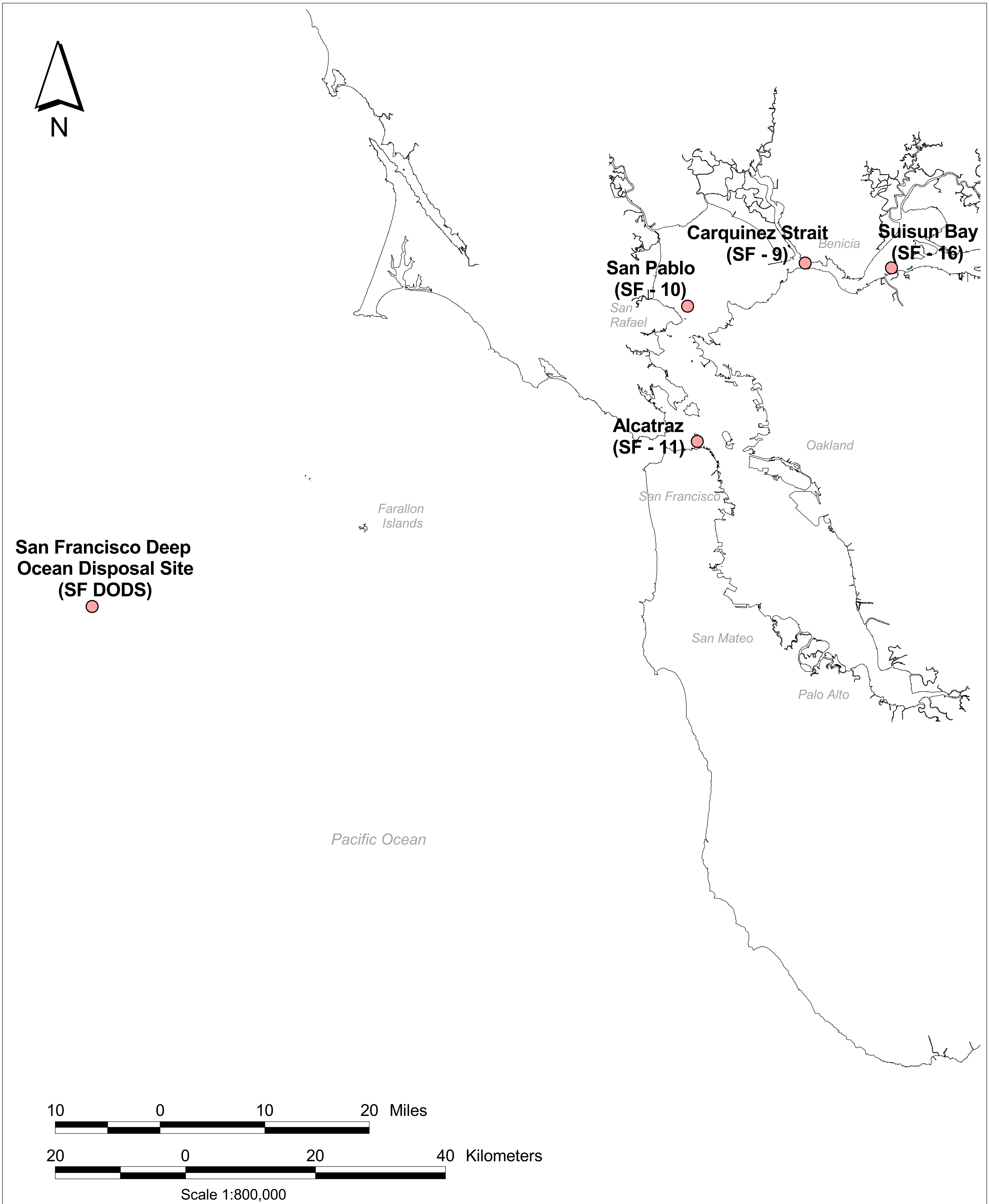
Table 3.1.5
Existing and Potential Dredge Material Reuse and Disposal Sites

Reuse/Disposal Site	Comments
In-Bay	
Alcatraz (SF-11)	Site presents seasonal volume disposal constraints. May accept SUAD material.
Carquinez Strait (SF-9)	Site has volume limits and seasonal restrictions on disposal capacity. May accept SUAD material.
San Pablo Bay (SF-10)	Site has volume limits and seasonal restrictions on disposal capacity. May accept SUAD material.
Suisun Bay (SF-16)	Site is used exclusively for Suisun Bay Channel material disposal.
Bay Farm Island	Site does not currently exist and has low feasibility of being built.
Middle Harbor Enhancement Areas	Site will be constructed as part of 50' project for placement of Port of Oakland material; site priority is for Port of Oakland materials. No need for sediments from other projects.
Ocean	
S.F. Bar Channel (SF-8)	Site is used exclusively for Bar Channel material placement.
S.F. DODS	Site is designated (Marine Protection, Research, and Sanctuaries Act Section 102 permit); sufficient volume for SUAD material under EPA rulemaking limit.
Reuse/Non Tidal	
Airport Borrow Pits, Solano	Site does not currently exist as a UWR site. May accept NUAD (material not suitable for unconfined aquatic disposal) for rehandling.
Alameda Naval Air Station, Alameda	Site has feasibility study for golf course underway; it has been proposed for the Port's 50' project use and has a priority for that project. Environmental documentation and project planning underway but not complete.
Blackpoint, Marin County	Site does not currently exist as a UWR but has potential to be restored. Property is owned by State Lands Commission. Site will require environmental review, permitting, and wetland design. Environmental issues at this site include historic structures, endangered species, and seasonal wetlands.
Bel Marin Keys, Marin	Project in SEIS/R stage. Site does not yet ready for reuse/disposal; it may be incorporated into Hamilton restoration project. Will require permitting, and wetland design.
Cargill Salt Evaporator Ponds, Solano and Napa	Site does not currently exist for reuse/disposal; opposition from owner makes construction unlikely.
Cargill Salt Crystallizer Ponds, Solano and Napa	Site does not currently exist as a UWR site; would require land acquisition, environmental review, permitting, and wetland design.
Cullinan Ranch, Napa and Solano	Site does not exist for reuse/disposal; restoration concepts call for tidal marsh restoration using natural processes. Dredged materials are not being sought.
Galbraith Golf Course, Alameda	Site capacity has been utilized by Port of Oakland 42' project. No additional capacity.
Hamilton Airfield, Marin	CEQA/NEPA process started March 1998. Final EIR/EIS completed 1999.

Reuse/Disposal Site	Comments
Landfills Examples: Redwood Altamont Vasco Road	Upland confined disposal can accept clean cover material (SUAD) as well as NUAD materials.
Leonard Ranch, Sonoma	Site does not exist as a UWR site; may face opposition from owner. Site requires land acquisition, environmental review, permitting and design. Site requires construction of a 1-2 mile pipeline for offloading.
Mare Island, Solano	Reuse plan includes confined disposal and capping.
Marin County Flood Control District	Site does not yet exist as UWR site. Would require environmental review, permitting, and wetland design.
Moffett Field, Mountain View	Site does not currently exist. Property owner has no plans for wetland creation. Wetland development may conflict with current and planned land use. Would require a 3-4 mile pipeline for offloading.
Montezuma, Solano	Site's Final EIR/EIS was issued in July 1998. Site is planning to accept both SUAD and NUAD (non-wetland cover) material.
Napa River, Napa	Site is used exclusively for federal channel material disposal.
North Point Property, Sonoma	Site does not currently exist as a UWR site but has potential to be restored. Would require environmental review, permitting and wetland design. Would require a pipeline for offloading.
Petaluma Drying Ponds, Sonoma	Site is used exclusively for federal channel material disposal.
Pierce Island, Solano	Site is used exclusively for federal channel material disposal.
Port of Oakland Berth 10, Alameda	Site's rehandling facility may be available. Not a reuse/disposal site.
Port of Richmond Shipyard No.3, Contra Costa	Site's rehandling facility may be available. Not a reuse/disposal site.
Port of S.F. Pier 94, San Francisco	Currently used as rehandling facility for Pier 35 material.
Port Sonoma Drying Ponds, Sonoma	Site is used for marina materials only.
Port Sonoma- Hwy 37, Sonoma	Site is used for Port Sonoma materials only.
Praxis-Pacheco, Contra Costa	Site does not exist as a reuse/disposal site; it has been proposed for commercial development. Site development could affect existing wetlands and endangered species. Would require environmental review, permitting, and wetland design.
San Leandro, Alameda	Site is used exclusively for materials from the San Leandro Marina.
Sherman Island Scour Pond, Sacramento	Site does not exist; salinity impacts are a concern. Would require permitting, environmental review, and rehandling of material to reduce salinity.
Skaggs Island, Sonoma	Site's reuse plan contemplates disposal.
Sonoma Baylands, Sonoma	Site's capacity has been reached with Port of Oakland 42' project.
Treasure Island, San Francisco	Site's landfill at site 11 is undergoing remediation. No current plans that would use dredged materials.

Reuse/Disposal Site	Comments
White Slough Project, Route 29/37 Interchange, Solano County	Tidal wetland improvement project may require fill material. Feasibility study has been completed and construction may start in 2003.
Winter Island, Contra Costa	Site is available for dredged material to be used in levee repair and maintenance. Salinity of the Bay sediment is an issue in freshwater areas due to potential degradation of water quality.

Source: BCDC and LTMS 1998; Tetra Tech EMI, January 1999; Port of Oakland 1999; URS 1999, USACE website.



URS

Water Transit Authority
Program EIR

Project No. 43-00066890

Dredge Materials Disposal Sites

Figure
3.1.1

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Source: LTMS 2001

URS	Water Transit Authority Program EIR	Beneficial Reuse Sites Identified in the LTMS	Figure 3.1.2
	Project No. 43-00066890		

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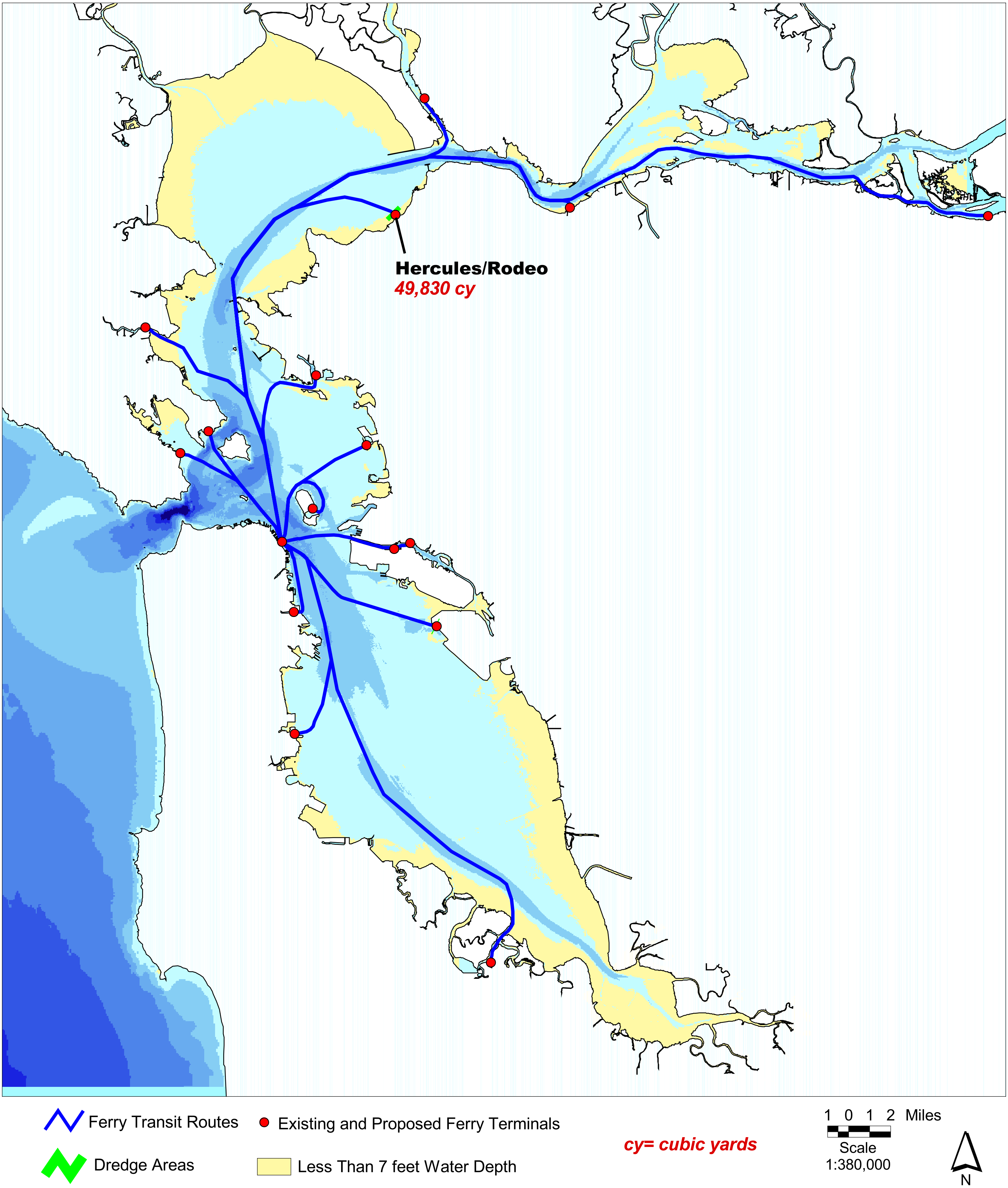

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Water Transit Authority
Program EIR

Project No. 43-00066890

PROPOSED PROJECT
DREDGING AREAS AND
DREDGING VOLUMES

Figure
3.1.3

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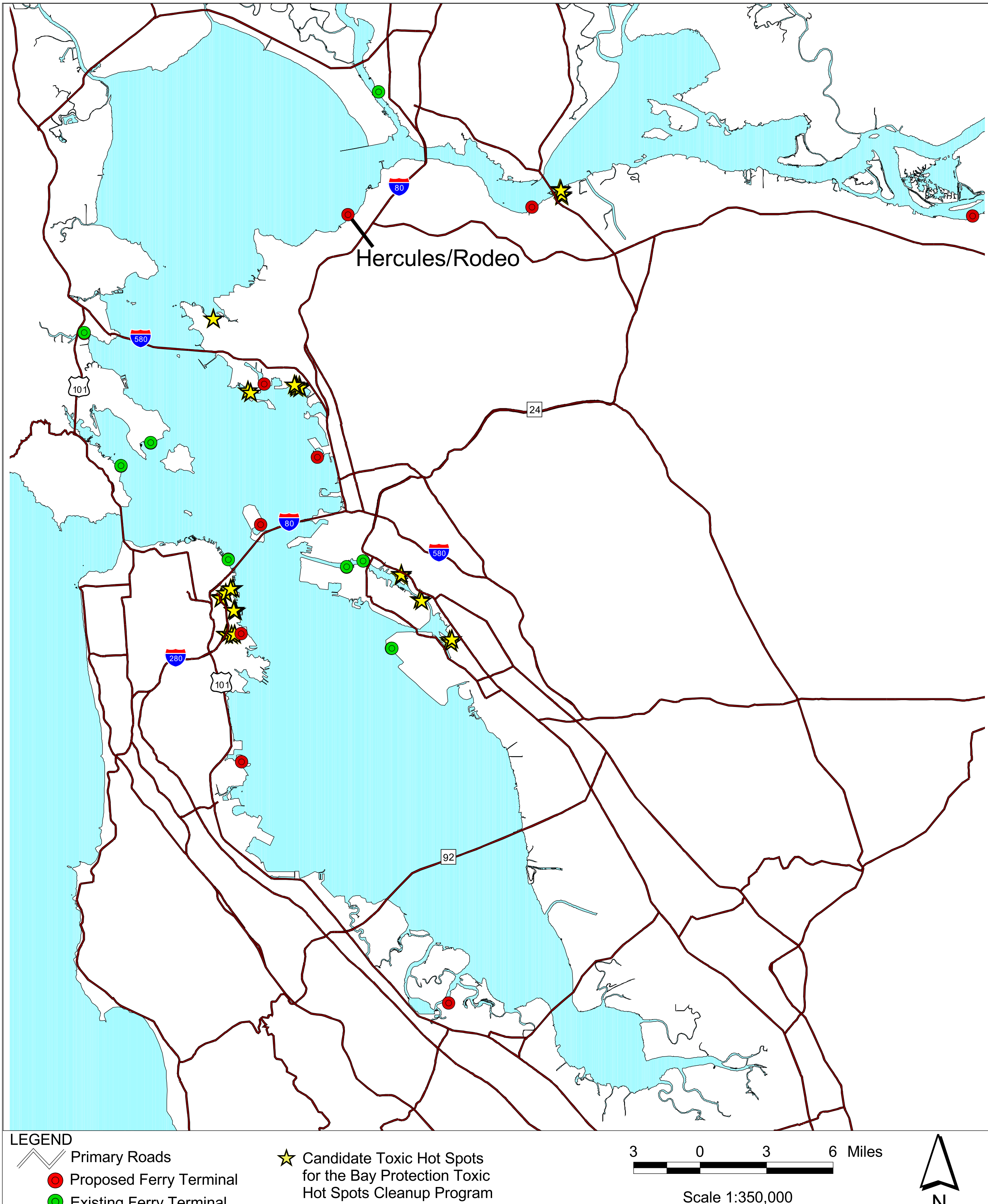

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Water Transit Authority
Program EIR

Project No. 43-00066890

TERMINALS REQUIRING DREDGING AND TOXIC HOT SPOTS

Figure 3.1.4

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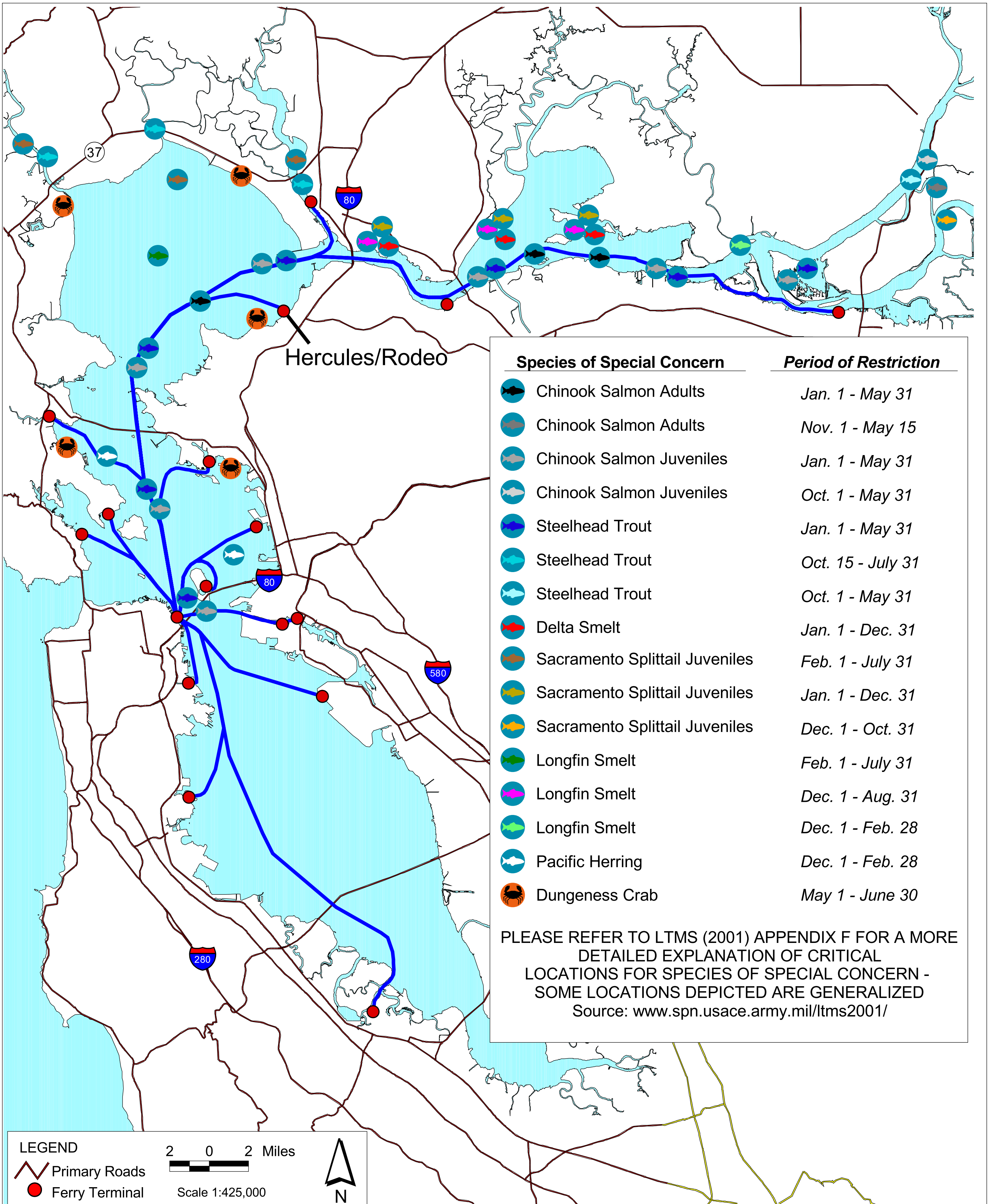

Water Transit Authority
Program EIR

Project No. 43-00066890.12

FERRY TERMINALS REQUIRING DREDGING AND AREAS AND TIMES OF RESTRICTED DREDGING ACTIVITY FOR SPECIES OF SPECIAL CONCERN

Figure 3.1.5

L:/projects/wta/apr/water_resources.apr

The following subsections evaluate and discuss 13 environmental analyses. The potential for the Proposed Project to impact resources, and recommended mitigation measures to avoid or reduce those impacts are described. The impact analyses are regional and broad in discussion but focus on issues and topics of relevance to the potential for impacts. For example, biological issues is a wide-reaching subject area because it encompasses all of San Francisco Bay's local environments, which can be varied. The evaluation does not include a complete inventory of biological resources present in the Bay but does provide information to characterize those resources. Regional types of habitats and species are described, and those that are of most concern to potential ferry system expansion are described and evaluated. Cumulative impacts are discussed in Section 4.3.

Based on California Environmental Quality Act (CEQA) Guidelines (Section 15125), assessment of potential impacts should be conducted against a baseline consisting of existing environmental conditions. The purpose of this comparison is to isolate and identify specific impacts that could occur as a result of the Proposed Project. For this EIR, the alternatives included a "No Project" Alternative that reflects future conditions if none of the other alternatives were implemented. For this alternative, although the WTA project would not be implemented, other ferry service expansion, as well as increases in other vessel traffic and vehicular traffic, would continue.

For the majority of the technical sections presented in this section, potential impacts are evaluated against the existing environmental conditions, which are equivalent to the No Project Alternative. For Air Quality (Section 3.6), Transportation (3.12), and Energy (Section 3.13), however, the analyses include projections for both the Proposed Project and the No Project Alternative. For these three issue areas, comparison of future (year 2025) levels of travel against existing conditions is not a useful evaluation as it would not show whether the project improves or impacts regional travel patterns, and consequently regional air quality emissions and energy consumption. (The study year 2025 was chosen because it is consistent with Bay Area planning horizon years used to represent "buildout" of the regional transportation system). Therefore, these sections include analysis of potential impacts compared to the No Project Alternative for the same study year.

2.1 INTRODUCTION

As described in Section 1.0, the primary purpose of the WTA's program is to increase regional mobility and transportation options by providing new and expanded water transit services and ground transportation terminal access in the San Francisco Bay Area (Bay Area). This section describes the alternatives evaluated in this EIR to achieve that purpose.

The implementing legislation that established the WTA (Government Code Section 66540 et seq.) mandates the study of various water transit routes for consideration by the WTA. The legislation states that the WTA should "investigate ... terminal locations throughout the San Francisco Bay Area." The WTA is to consider, but not be bound by, the Water Transit Initiative (WTI) developed by the Bay Area Council (BAC) and Bay Area Economic Forum (BAEF) (described in Section 1.0). In addition, the Legislature directed the Authority to increase regional mobility through the development and operation of a comprehensive water transit system and its associated landside facilities and adjunct services (Government Code Section 66540.24).

Government Code Section 66540.20 directs the completion of two documents, a program environmental document and the Implementation and Operations Plan (IOP). The WTA completed and circulated a Draft EIR (DEIR) for review that evaluated four program alternatives, representing a range of service expansion options. The initial comment period for the DEIR ended on January 31, 2003. The Draft IOP was also circulated for review, describing expansion of service and the additional new routes. All of the routes and terminals identified in the IOP were included as elements of the various alternatives evaluated in the DEIR.

Partly as a result of public comment and review, the Program DEIR was revised to specifically address the expansion of existing service and the new routes as described in the IOP. This recirculated EIR investigated the potential environmental impacts associated with implementation of the IOP. It was circulated for public review, with the comment period ending on May 16, 2003.

Based partially on the technical information included in the environmental document, the Draft IOP made recommendations for phased implementation. Together, the IOP and this Final EIR (FEIR) will be used to develop the recommendations for the components of the system that are advanced for further evaluation and possible implementation.

2.2 PROPOSED PROJECT AND SYSTEM ALTERNATIVES EVALUATED IN THE EIR

The WTA is proposing implementation of the December 2002 IOP[1] (WTA 2002), which is the "Proposed Project" analyzed in this FEIR as defined in the California Environmental Quality act (CEQA) Guidelines Section 15378. The Proposed Project provides a program for the development and operation of new ferry routes on the San Francisco Bay. Terminal locations and ferry transit routes form the core of the system. While the routes and terminals have not been precisely determined at this time, the Proposed Project described below most closely reflects the anticipated terminals and routes resulting from implementation of the IOP. Prior to the development of any new terminal or addition of any new route, all associated activities would

[1] *A Strategy to Improve Public Transit with an Environmentally Friendly Ferry Service*

be reviewed to ensure that the environmental impacts have been appropriately assessed in this FEIR. It is likely additional documentation would be prepared pursuant to CEQA and the CEQA Guidelines.

2.2.1 Proposed Project

The Proposed Project considered for implementation by the WTA and analyzed in this Program FEIR is the IOP, which provides expanded ferry service and associated land-side transit to be implemented in phases over an approximately ten year period. While the IOP does not represent a precisely fixed set of routes and terminal sites, the Proposed Project is based on the anticipated routes and terminals that would result from implementation of the IOP. The routes, terminals, and frequency of service (headways)[2] associated with the Proposed Project are listed in Table 2.1. The routes and terminals are shown on Figure 2.1. Further site-specific studies and design would be necessary prior to IOP implementation to determine actual terminal sites and routes.

The Proposed Project would utilize clean vessels only, which would exceed EPA 2007 Tier II air quality standards by 85%. The Proposed Project consists of two types of vessels; one providing 350-passenger ferries with speeds up to 35+ knots, and the other providing 149-passenger ferries with speeds up to 25 knots.

Passengers would arrive at ferry terminals by a variety of modes, including public transportation and walking. Anticipated vehicle traffic generated at the proposed terminal locations during the AM peak period would range from zero (at the Treasure Island terminal) to approximately 1,100 trips. Parking demand would range from zero to over 1,400 spaces.

Of the expanded routes included in the Proposed Project and listed in Table 2.1, only the Hercules/Rodeo terminal would require additional dredging for implementation. All other terminal sites proposed for expanded ferry service are within existing ports or marinas. Therefore, other than possible minor dredging for facility improvements, dredging for construction or operations is not anticipated in these locations. All of the routes included in the Proposed Project meet minimum levels of ridership criteria established by the WTA. All routes have a minimum forecast 2025 ridership of at least 900 trips per day. In addition to the routes and terminals listed in Table 2.1 that are included in the Proposed Project or initial Project Alternatives, the IOP also identified other routes for future study. Ridership studies of the Port Sonoma and Recreation Loop routes forecast adequate ridership for these routes to be cost effective. However, those forecasts were based on assumptions related to the provision of parking, access, and ferry landing locations. In the case of both of these routes, potentially significant environmental impacts could make infeasible the ability to access the ferry terminal. For example, adjacent wetlands at Port Sonoma could severely constrain the ability to provide adequate parking facilities at this location. For the Recreation sites, public comments identified potential environmental impacts associated with providing access to recreational land uses. Therefore, as a result of extensive public comment and input during the Draft IOP and initial DEIR scoping and review periods, the feasibility of these potential ferry sites and routes cannot be determined at this time. However, Section 2.6 describes associated projects that are under

[2] *A headway is the distance of time separating each ve*ssel. A smaller headway results in more frequent service, and a larger headway is less frequent.

evaluation by the Golden Gate National Recreation Area (GGNRA).

Other routes, including San Francisco to Benicia, Airport Service, East Bay to Peninsula, San Francisco to Hunters Point, and San Francisco to Moffett Field, were also identified in the IOP for future study. The ridership studies for these routes did not forecast adequate ridership to be cost effective at this time (Cambridge Systematics 2002a,b). However, changes in future land use assumptions could affect the ridership forecasts and the sites were therefore recommended for future study.

Additional details regarding the Proposed Project can be located in the WTA's December 2002 IOP (WTA 2002).

2.2.2 Alternatives to the Proposed Project

This section describes the No Action Alternative and the three other alternatives identified for ferry service expansion during public scoping meetings, the initial DEIR review period, and Draft IOP public meetings held throughout the Bay Area. The initial DEIR addressed a range of alternatives that were considered feasible to meet the purpose and need for the project at the time of publication. The discussion and analysis of these alternatives is intended to further inform both decision-makers, project stakeholders and other members of the public.

Three project alternatives for expanding ferry service in the Bay Area as well as a fourth alternative representing the No Project Alternative were analyzed at the same level of detail in the initial DEIR. The initial DEIR did not contain a Proposed Project or Preferred Alternative. Each of the four alternatives consisted of a set of ferry transit routes and terminals. Together, the alternatives represent a broad range of investment in water transit service expansion.

Table 2.1 lists the routes, terminals, and frequency of service of the project alternatives, along with a comparison to the Proposed Project. Figures 2.2, 2.3, and 2.4 present the routes for each project alternative. The following summarizes these alternatives. Sections 2.2 and 2.3 summarize related programs carried out by the WTA to evaluate terminal design and vessels. Section 2.4 discusses additional alternatives that were considered, but subsequently eliminated from further consideration.

- **Alternative 1 – Augmented Blue Ribbon System (Comprehensive) Alternative** (Figure 2.2). As mandated by the WTA Legislation, the WTA must consider the work of the WTI developed by the BAC and BAEF. Alternative 1 represents the potential buildout system as developed by the BAC. This alternative comprises the largest conceptual improvement of the Bay Area's ferry system. It includes the routes recommended by the Blue Ribbon Task Force, which developed the Bay Area WTI Action Plan, plus additional routes identified by local entities and early project scoping. It includes all of the routes and services included in Alternative 2 but is not necessarily constrained by operational requirements or development costs.

- **Alternative 2 – Expanded System Alternative** (Figure 2.3). The WTA Legislation also mandates the study of an expanded system that could be implemented within a 10-year planning horizon. This alternative includes potentially feasible routes that emerged from the WTI and the Metropolitan Transportation Commission (MTC) ferry studies that could be implemented within a 10-year horizon. It also includes expansion of service on existing routes and a wide range of ferry service corridors throughout the Bay Area. These corridors would serve a number of passenger service markets, including commuter transit, recreation, Bay Area special events, and regional airport connections. The goal for service frequencies would be designed to provide convenient and dependable service for passengers.

- **Alternative 3 – Enhanced Existing Service Alternative** (Figure 2.4). Six ferry routes currently serve the Bay Area. Alternative 3 would focus on limited expansion of this existing system. This alternative would increase and improve service along these routes by adding or substituting new vessels to increase the number of trips and decrease the time (headways) between trips. Existing single routes with more than one destination (e.g., San Francisco to Jack London Square and Alameda) may be divided into two separate routes to improve travel time and performance. Improvements may also be made to existing passenger terminal facilities. This alternative represents the lowest investment of new capital and operating costs, other than the No Project Alternative.
- **Alternative 4 – No Project Alternative**. This alternative consists of existing ferry service with minimal improvements. Ferry service would continue to operate on existing routes (shown on Figure 2.4) at about the same frequency, as determined by each service provider. Funding for changes or improvements to service would continue to be allocated through the MTC.

2.2.2.1 Changes to the Range of Alternatives Identified in the Initial DEIR

The CEQA Guidelines require an EIR to analyze a reasonable range of feasible alternatives to the project or the location of the project that would “avoid or substantially lessen any of the significant effects of the project” (Section 15126.6). In the initial DEIR, Alternatives 1, 2, and 3 were all considered to be feasible ferry service alternatives. However, extensive public comments and other input provided to the WTA have made clear that Alternatives 1 and 2 described in the initial DEIR could not be determined to be feasible without undertaking extensive further studies pertaining to their potential significant environmental impacts.

As a result of this public input, the WTA developed a reduced version of Alternative 2 that would mitigate or avoid many of the environmental impacts identified for Alternative 2. This mitigated version of Alternative 2 became the Proposed Project described in the December 2002 IOP (WTA 2002).

This FEIR eliminates Alternatives 1 and 2 from further consideration. With the identification of the Proposed Project, Alternatives 1 and 2 as described above no longer meet the CEQA requirement that project alternatives reduce or avoid project impacts. Both of these alternatives describe more extensive systems than the Proposed Project and would have more severe impacts than the Proposed Project. In addition, the feasibility of Alternatives 1 and 2 is questionable due to low cost effectiveness. For these reasons, based on evidence provided in the administrative record, this FEIR carries forward for evaluation the Proposed Project, Alternative 3, and the No Project Alternative (Alternative 4).

2.2.2.2 Relationship Between Baseline Conditions and the No Project Alternative

Based on CEQA Guidelines Section 15125, the assessment of potential impacts should be conducted against a baseline consisting of the existing environmental conditions. The purpose of this comparison is to identify specific changes to the physical environment that could occur as a result of the Proposed Project. Significant impacts result from substantial or potentially substantial adverse changes in the physical environment (Guidelines Section 15382).

For this FEIR, the No Project Alternative reflects future conditions if none of the other alternatives were implemented, including the Proposed Project. Under this scenario, existing ferry service would continue, along with increases in other vessel traffic and vehicular traffic.

For the majority of the technical sections presented in Section 3.0 of this FEIR, potential impacts are evaluated against the existing environmental conditions. For Air Quality (Section 3.6), Transportation (3.12), and Energy (Section 3.13), however, the analyses are based on comparison to the No Project Alternative. For these three issue areas, comparison of future (year 2025 [3]) levels of travel at full operation of the Proposed Project against the baseline of existing conditions is not useful because it would not show whether the project improves or impacts regional travel patterns, and consequently regional air quality emissions and energy consumption. Changes resulting from buildout of the Proposed Project would be masked by the much greater changes that will occur as a result of anticipated future growth in the Bay Area. Therefore, these sections include analysis of potential impacts compared to the No Project Alternative for the same study year, rather than the baseline.

2.3 TERMINAL FUNCTION AND DESIGN

Terminal design concepts for an expanded system include the function of the terminal, its connection with other passenger or transit services, and its actual design and appearance. Existing, active ferry terminals provide examples of the range of concepts, from Sausalito or Jack London Square to more developed sites such as Larkspur. The WTA performed studies to initially define design recommendations and concepts, terminal access, connections with other transit, and conceptual design.

2.3.1 Terminal and Passenger Access and Connections with Other Transit Services

Ferry terminal facilities are vital links in the Bay Area regional transit system. The WTA has conceptually considered opportunities for access to the ferry terminals by various modes of public transit, for pedestrians and cyclists, with the overall aim to increase transit ridership and decrease the need for parking at waterfront terminals. Efficiency of connections between passenger systems requires planning in the design and operation of transit transfer facilities. The WTA developed conceptual design guidelines to promote intermodal concepts by providing seamless and efficient transfer between transport modes as well as better integration with the local urban context. The objective of the intermodal terminal facility is to not only complement but also serve as a catalyst to ferry service expansion in the Bay Area.

2.3.2 Terminal Design

The WTA has also prepared conceptual recommendations on terminal architecture and engineering, including operational design parameters (Parsons Brinckerhoff 2002). These recommendations are based on a study of expectations of ferry service that is efficient, secure,

[3] The study year 2025 was chosen because it is consistent with Bay Area planning horizon years used to represent “buildout” of the regional transportation system.

and convenient, as well as on the differentiation between land-based and water-borne transit, namely, the U.S. Coast Guard (USCG) restrictions on the number of passengers allowed on a vessel. The vessel capacity limits influence the design of ticketing, waiting and boarding areas. Several configuration options for the relative placement of queuing areas, control gates, and boat docking floats have been conceptually evaluated. Each option involves trade-offs between passenger comfort, efficiency of boarding procedures, and terminal size.

2.4 VESSEL TECHNOLOGY

The WTA considered and evaluated a wide range of technologies that might be applied to an expanded ferry fleet. Advances in design and operating technologies have increased the range of choices in hull design, fuel type, and propulsion systems. However, each of these technologies have both benefits and limitations that can affect their suitability to meet different performance applications and expectations. These parameters are briefly summarized below.

Types of vessel hulls include hydrofoil, catamaran, conventional monohull, surface-effect-ship, and hovercraft. Of these, the catamaran design has become the vessel of choice by many passenger ferry operators in the Bay Area for its ability to provide high-speed service. It is relatively stable, provides a wide hull to accommodate passenger arrangement options, and has a relatively shallow draft (depth in the water).

The WTA's evaluation of vessel technologies involved a comprehensive investigation of emerging technologies and their relative suitability to Bay Area passenger service (JJMA and BAH 2002). The WTA also formed a "Clean Marine Ad Hoc Work Group" to discuss the scope of the investigation and provide input and peer review. All of the ferries in service in the Bay use diesel-cycle (compression ignition) engines as their main propulsion and power generation method. All currently use diesel.

The evaluation of technologies was based on two representative vessel types, a small moderate-speed vessel and a larger "fast" ferry. The study compiled a list of technology alternatives, including modifications to diesel engines, alternative fuels, and alternative propulsion systems. Engine modifications that can directly provide exhaust emission reductions were examined, including internal and external diesel fuel modifications. Alternative fuels can also provide exhaust reductions, and those evaluated included bio-diesel, natural gas, liquefied petroleum gas (LPG), Fischer-Tropsch (FT), hydrogen, methanol, ethanol, ultra-low sulfur diesel, diesel fuel emulsions, and fuel additives. Propulsion technologies reviewed included sail, solar sail, battery flywheel, internal compression engine generator electric, hybrid sail-solar sail-battery-generator, variations of fuel cell combinations, gas turbine, and diesel. These alternatives were evaluated against a set of performance and economic specifications, which included a survey of the Clean Marine Group that was used to weigh and score the alternatives. Finally, the alternatives were screened for air quality performance in terms of emission reductions. This evaluation resulted in five options that can provide at least an 85 percent reduction in air pollutant emissions in comparison to the EPA Tier II 2007 requirements:

1. Diesel engines with nitrogen oxides adsorbers, SCRs, and/or humidification, combined with DPTs, using low- or no-sulfur diesel fuel
2. Diesel engines using gaseous fuels
3. Diesel engines using hydrogen fuel

4. Electric drive with a clean source of electricity (e.g., fuel cell, battery, or electric photo voltaic cell)
5. Gas turbine drive using either liquid diesel or gaseous fuel

The evaluation provides information and guidance toward the types of emission goals that can be met as an expanded water transit system is implemented. These types of technologies would require further development and review in regard to how they can be incorporated into future service.

2.5 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM FURTHER EVALUATION

In addition to Alternatives 1 and 2, a number of other alternatives were considered by the WTA and eliminated from further evaluation. These alternatives were not carried forward for detailed environmental analysis based on considerations that included cost, feasibility, and environmental effects. Many of the Alternatives are being considered for implementation by other transit agencies. Both the Transportation System Management (TSM) Alternative and the Smart Growth Alternative discussed below provide unique strategies for relieving congestion in the Bay Area. However, as noted by MTC in the Regional Transportation Plan (RTP) EIR, many of the innovative strategies associated with TSM have not yet been sufficiently developed for widespread implementation. Future implementation of a comprehensive TSM strategy would also require further consensus among project stakeholders. Implementation of the Smart Growth Alternative would ultimately require changes to land use through local jurisdictions. To that end, the Association of Bay Area Governments (ABAG) is currently focused on fiscal and regulatory incentives for promoting Smart Growth.

Table 2.2 provides a summary comparison of the anticipated ridership and costs associated with the alternatives discussed below, as well as the Proposed Project, and Alternatives 1 through 3. In addition, Table 2.2 provides the estimated change in total daily vehicle miles traveled (VMTs) within the nine-county Bay Area projected for each alternative.

2.5.1 Express Bus Alternative

The Express Bus Alternative is based on the scenario described in the IOP that would provide express and/or additional bus service for similar origin and destination points as those ferry routes planned for under the IOP. This Alternative would offer similar mass transit opportunities to catchment areas served by the Proposed Project, but in the mode of bus, rather than ferry trips. This alternative was developed to better understand the relative costs and benefits of bus system enhancements that could be implemented in lieu of the expanded ferry service described in the IOP. The alternative includes a combination of express bus service, as well as service to the nearby transit nodes.

Under this alternative, express bus service would be provided from park and ride lots, at or near the terminal locations proposed under the IOP. For example, express bus service to San Francisco would be provided from the vicinity of the proposed Richmond, Alameda, Oakland, and Berkeley ferry terminals. A few of the routes would provide bus service to the nearest BART station: from Antioch/Pittsburg and Martinez to the Pleasant Hill BART station, and Hercules Rodeo to the Del Norte BART station. Similarly, commuters in South San Francisco and Redwood City would be provided bus service to Caltrain. Additional MUNI service would be made available at Treasure Island. The conceptual Express Bus Alternative routes and points of origin are shown on Figure 2.5.

As shown on Table 2.2, this alternative is estimated to result in an annual ridership of 3,219,000 and a total subsidy per rider of $9. The comparative estimates for the Proposed Project are 9,639,100 annual riders and a $9 total subsidy per rider. The Express Bus Alternative is estimated to result in a reduction of 40,145 total daily VMTs compared to the 2025 No Project Alternative.

The Express Bus Alternative would result in approximately one-third of the transit ridership associated with the Proposed Project, and would provide less benefit in terms of total daily VMT reduction. This alternative does provide a similar cost effectiveness to ferry expansion. Further, jurisdictional constraints, such as limitations of additional bus traffic within some areas of San Francisco, could impede full implementation of this alternative. Finally, this alternative would not meet the basic project objectives described in Section 1 of this FEIR. Therefore, the Express Bus Alternative was not carried forward for further evaluation. It should be noted that the WTA studies found that ferry expansion was complimentary with bus expansion and that the combination of bus and ferry expansion provided a high level of cost effectiveness. Bus alternatives to serve bridge corridors are being further investigated for implementation by MTC and other transit agencies.

2.5.2 Express Bus, HOV, and Operational Improvements Alternative

The Express Bus/HOV/Operational Improvements Alternative is based on an alternative from *MTC Bay Crossing Study* (MTC 2001a) that includes the implementation of expanded express bus service, carpool lane extensions, and operational improvements in the Bay Bridge, San Mateo Bridge, and Dumbarton Bridge corridors. Similar to the previous alternative, this would attempt to provide travel opportunities comparable to the Proposed Project, but in modes other than ferry service.

This alternative includes 16 operational improvements related to express bus, high occupancy vehicle, and to the existing transbay corridors (I-80, SR 92, SR 84) and their approach facilities. The projects include restriping of existing lanes; extensions of existing HOV/Fastrak lanes within existing right-of-way; prohibition of parking on San Francisco approach streets; restriction and relocation of casual carpool locations; and construction of new HOV ramps and park and ride lots. In addition, this alternative involves the purchase and use of three-door BART cars and the addition of three additional trains per hour on the transbay routes. The BART improvements were developed to reduce peak hour crowding on BART lines. The routes, terminals, and improvements are shown on Figure 2.6.

Prior analysis prepared by MTC in the *San Francisco Bay Crossing Study, Travel Evaluation Report* (MTC 2002) indicated that this alternative would generate the following increases in transbay transit ridership:

- Bay Bridge – 8,000 passengers/day;
- San Mateo Bridge –6,200 passengers/day (no bus service exists in the Baseline); and
- Dumbarton Bridge – 900 passengers/day.

As shown on Table 2.2, this alternative is estimated to result in an annual ridership of 3,868,400 and a total subsidy per rider of $18. The comparative estimates for the Proposed Project are 9,639,100 annual riders and a $9 total subsidy per rider. The Express Bus/HOV/Operational Improvements Alternative would result in less than one-half the transit riders provided by the Proposed Project. The cost per rider is estimated to be greater than that of the Proposed Project. This alternative would not meet the basic project objectives described in Section 1.0 of this FEIR. Therefore, the Express Bus/HOV/Operational Improvements Alternative was not carried forward for additional analysis in this FEIR. MTC is continuing to study this alternative.

2.5.3 BART Crossing Alternative

This alternative is derived from the MTC's *2000 San Francisco Bay Crossings Study* (MTC 2001a). The BART Crossing Alternative includes the phased implementation of new BART service within San Francisco followed by a new transbay BART tunnel connecting the East Bay with San Francisco. It would attempt to provide transit opportunities comparable to the Proposed Project, but through the BART system rather than ferry service.

The first phase involves construction of a second subway line in San Francisco located on either Mission Street or Howard Street. After passing through the downtown area, the alignment would turn up Geary Street toward the intersection of Van Ness. A total of six new stations would be constructed along an alignment extending for approximately 1.7 miles. In the second phase, a new transbay tube would be constructed connecting the second San Francisco BART alignment to the East Bay via Alameda. Two new BART stations would be constructed on Alameda, and a third at Jack London Square, which would allow for transfer to Amtrak and Capital Corridor trains. The alignment would continue through Oakland to the MacArthur station along a new fourth track.

The new commuter rail tunnel would serve approximately 16,000 new daily transbay passengers on commuter rail lines for service contained within the Bay Area. The 16,000 new trips associated with the new BART tunnel represent an approximately six percent increase over the 2025 Baseline BART forecast. Approximately 68 percent (183,000 daily trips) of BART trips would use the existing tunnel, with 32 percent using the new tunnel (86,000 daily passengers).

As shown on Table 2.2, this alternative is estimated to result in an annual ridership of 4,545,400 and a total subsidy per rider of $149. The comparative estimates for the Proposed Project are 9,639,100 annual ridership and $9 total subsidy per rider. The substantially higher costs associated with the BART Crossing Alternative are due primarily to high capital investment required for implementation. This alternative would provide approximately one-half the ridership of the Proposed Project, and would require a substantial capital investment for implementation. For these reasons, and the fact that this alternative does not meet the basic project objectives outlined in Section 1.0 of this FEIR, the BART Crossing Alternative was not carried forward for further evaluation in this FEIR.

2.5.4 Dumbarton Rail Alternative

This alternative is derived from the *MTC Bay Crossing Study* (MTC 2001a), which addressed two levels of commuter rail service. The Basic Service Plan would connect Union City with San Jose and Millbrae. The Expanded Service Plan would include the Union City service, plus additional service from Tracy to San Jose and Millbrae, and potentially San Francisco/Milpitas service. It would attempt to provide mass transit opportunities comparable to the Proposed Project, but in the mode of enhanced rail service rather than ferry service.

According to the MTC *San Francisco Bay Crossing Study, Travel Evaluation Report* (MTC 2002), the Basic Service Plan from Union City is estimated to result in an additional 3,300 daily transbay passengers. Institution of the Expanded Service Plan would add 2,600 transbay passengers, for a total additional ridership of approximately 5,900 daily riders. A Milpitas-San Francisco service would attract approximately 3,800 new daily transbay riders.

As shown on Table 2.2, this alternative is estimated to result in an annual ridership of 844,800 and a total subsidy per rider of $22. The comparative estimates for the Proposed Project are 9,639,100 annual ridership and $9 total subsidy per rider. Based on prior analysis prepared by the MTC, this alternative is estimated to result in a reduction of 239,564 total daily VMTs compared to the 2025 No Project Alternative.

The Dumbarton Rail Alternative would generally serve a different catchment area than that of the Proposed Project. Mobility benefits of the Dumbarton Rail project are expected to be limited to the southern portion of the nine-county Bay Area. In addition, this alternative does not meet the basic project objectives described in Section 1.0 of this FEIR. For these reasons, the Dumbarton Rail Alternative was not carried forward for additional analysis in this document. The project is under further study by MTC and other transportation agencies.

2.5.5 Transportation System Management (TSM) Alternative

The TSM Alternative includes a set of projects intended to address existing corridor mobility issues. This alternative was developed by MTC during preparation of the 2000 RTP and the environmental analysis of the RTP. The TSM Alternative emphasizes the application of available funds in ways that would improve the operational efficiency of the existing transportation system. This would include additional express bus service, reversible carpool lanes, and a better connected HOV and transit system. The TSM Alternative provides more funding for street and road maintenance shortfalls. Freeway ramp metering would be added to the most congested corridors. Congestion pricing would be implemented on the Bay bridges to generate additional revenues, including transit-operating revenues. Some highway projects would be deferred to provide additional capital funding. Details of the transportation improvements included in this alternative are listed in the Final EIR prepared for the RTP.

As noted on Table 2.2, the total cost of implementing this alternative is estimated to be $511 million ($70 million in capital costs and approximately $18 million annual operating cost). Based on prior analysis provided by MTC in the *RTP Environmental Impact Report* (MTC, 2001b), this alternative is estimated to result in a reduction of 553,537 total daily VMTs compared to the 2025 No Project Alternative.

The TSM Alternative involves innovative strategies, some of which are not available for immediate implementation. Full implementation of this alternative would also require further coordination among, and approval by, the various affected jurisdictions and stakeholders in the transportation community. In addition, this alternative does not meet the basic project objectives outlined in Section 1.0 of this FEIR. Therefore, the TSM Alternative was not carried forward for further evaluation in this FEIR.

2.5.6 Smart Growth Alternative

This alternative would utilize a set of public policies and other incentives to encourage compact, mixed use and mixed income development along transit corridors, near public transit stations, and in town centers. Development of the Smart Growth project is led by the ABAG, along with four other regional planning agencies in the Bay Area (MTC, Bay Conservation and Development Commission, Bay Area Air Quality Management District, and Regional Water Quality Control Board). As noted in *the Smart Growth Strategy, Regional Livability Footprint Project* (ABAG 2002a), the project seeks to minimize sprawl, provide adequate and affordable housing, improve mobility, protect environmental quality, and preserve open space. Presumably, these policies and incentives would result in development patterns that would provide some of the traffic congestion relief that is an objective of the Proposed Project.

The plan was developed through a series of workshops held throughout the Bay Area over a two-year period. Representatives of the five regional government agencies have since developed a set of smart growth policies that were conceptually adopted by the ABAG Executive Board in September 2002. Policy refinement is ongoing.

Because this alternative does not involve direct expenditures for transit, cost and ridership comparisons to the other project alternatives are not applicable. However, prior analysis provided by ABAG in the *Transportation Indicators Summary* (ABAG 2002b) indicated that under this alternative the number of transit trips would increase while total VMTs would decrease, compared to the future baseline. In addition, preliminary analysis prepared for the WTA, which modeled implementation of this alternative along with the IOP Alternative, indicates that ferry ridership would substantially increase for many of the IOP routes. However, because of the alteration of jobs/housing patterns under the Smart Growth Alternative, demand for some IOP routes may not increase.

The benefits and costs of this alternative are not directly comparable to the Proposed Project. However, WTA studies have shown that implementation of the Smart Growth Alternative would increase ferry ridership on most of the routes proposed by the WTA as noted above. Implementation of the Smart Growth Alternative would occur incrementally, subject to changes in land use policies and standards at the city and county level. Because this alternative does not meet the basic project objectives as described in Section 1.0 of this FEIR, and because implementation efforts under the leadership of ABAG are voluntary rather than mandatory (making any determination of their effectiveness speculative), the Smart Growth Alternative was not carried forward for additional analysis.

2.6 ASSOCIATED PROJECTS

The Golden Gate National Recreation Area (GGNRA) of the National Park Service (NPS) is developing a *Water Shuttle Access Plan* consistent with the long-term transportation strategy outlined in the *GGNRA General Management Plan* (GMP) (GGNRA 1980), and the former Congressionally-mandated *Golden Gate Travel Study* (GGNRA 1977). With the park facing the challenges of being the most visited tourist attraction in California (per California Department of Tourism) with over 15 million visitors annually, the GMP identified ferry services as one means to "alleviate existing problems and minimize potential ones in the interest of making park access as pleasant, safe and convenient as possible."

The goals of the *Water Shuttle Access Plan* include: 1) to maintain consistency with GGNRA and applicable regional, state and water transit plans; 2) to contribute to improving the Bay Area environment and preserve and protect the park's natural and cultural resources associated with accessing the park; 3) to enhance the quality of the visitor experience; 4) to increase opportunities for diverse visitor populations to access park sites; and 5) to provide cost-effective, reliable and safe water shuttle service.

To adequately evaluate the demand for such new service to GGNRA, the water shuttle planning efforts in 1999 began with focus groups, intercept surveys, and a telephone survey to help better understand the market. The results of that effort, and the development of a unique, recreational travel model, have been used in developing the preliminary alternatives for providing alternative access to GGNRA sites including Fort Mason, Crissy Field and Fort Baker. The survey findings indicate connections to nearby sites including Fisherman's Wharf, the San Francisco Ferry Building, Sausalito, and Berkeley are key to achieving the plan's goals. Connections to Berkeley, as planned by the WTA, and to Oakland via existing service to the Ferry Building will provide one means of increased opportunity for diverse visitor populations from the East Bay to access the park. East Bay connections to the GGNRA sites are highly constrained at this time.

Development or expansion of service to East Bay terminals is under the jurisdiction of the WTA. Although having separate jurisdiction of terminal sites, the GGNRA Water Access Plan is being developed in coordination with the WTA planning efforts to insure the system are complementary and to achieve common goals and objectives. The environmental considerations addressed as part of the WTA EIR process will serve as a framework in which to evaluate the more specific potential impacts of GGNRA alternatives during Environmental Impact Statement analyses and documentation. Inter-lining of the proposed WTA Berkeley to San Francisco route to Fort Mason during weekday off-peak and weekends is proposed in order to effectively utilize off-peak commuter capacity to provide recreational access to GGNRA sites, and provide a potential bridge service to complement any GGNRA-established service. Such coordination provides benefits in terms of access and flexibility for riders of both systems.

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Table 2.1
Routes and Frequencies
Proposed Project and Project Alternatives

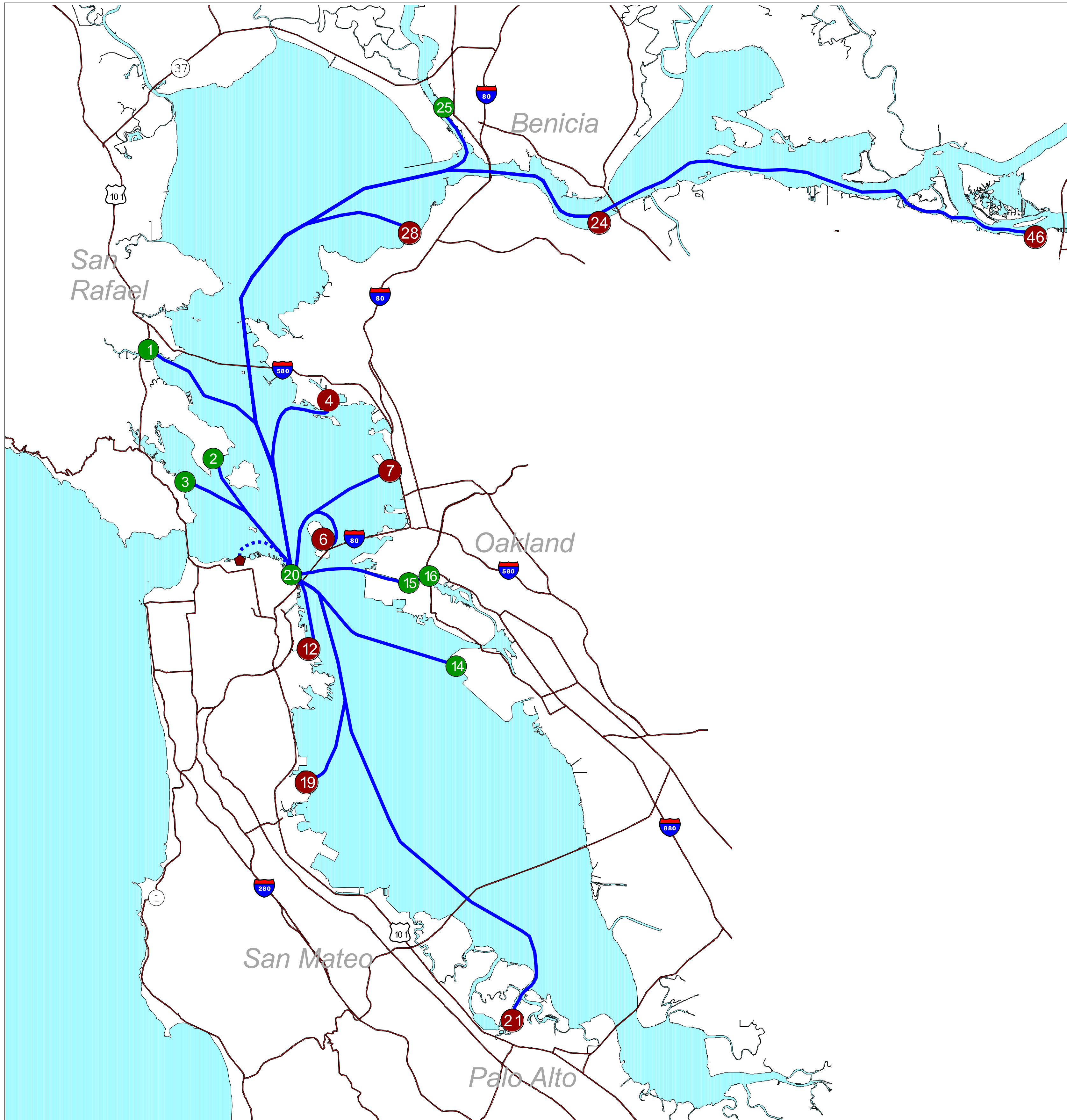
	Corridor/Ferry Route	Proposed Project Peak/ Off-Peak Headway (min)	Alt. 1 Peak/ Off-Peak Headway (min)	Alt. 2 Peak/ Off-Peak Headway (min)	Alt. 3 Peak/ Off-Peak Headway (min)	Alt. 4 (No Project) Peak/ Off-Peak Headway (min)
Existing System	Oakland to San Francisco	30/60	15/15	15/15	30/60	30/60[2]
	Alameda Point-Mission Bay-SF[1]	30/60	15/15	15/15	30/60	X
	Harbor Bay to San Francisco	60/0	30/30	30/30	60/0	60/0
	Vallejo to San Francisco	30/60	15/30	15/30	30/60	45/90
	Sausalito to San Francisco	30/60	30/30	30/30	30/60	70/80
	Larkspur to San Francisco	20/60	15/15	15/15	20/60	20/75
	Tiburon to San Francisco	30/60	30/30	30/30	30/60	45/60
Proposed Project	Berkeley (unspecified) -SF-Mission Bay	X	15/15	15/15	X	X
	Berkeley (University) – SF-Mission Bay (Ft. Mason on weekends)	30/60	X	X	X	X
	Richmond to San Francisco	30/60	15/30	15/30	X	X
	San Francisco to Treasure Island	30/30	15/15	15/15	X	X
	Antioch/Pittsburg to Martinez to San Francisco	60/200	30/60	30/60	X	X
	Hercules/Rodeo to San Francisco	60/240	30/30	30/30	X	X
	South San Francisco (Oyster Pt.) to San Francisco	30/60	30/30	30/30	X	X
	Redwood City to San Francisco	60/60	30/30	30/30	X	X
Alternative Routes and Terminal Locations Considered for Future Study	Benicia/Martinez to San Francisco	X	30/60	30/60	X	X
	San Leandro to San Francisco	X	30/30	30/30	X	X
	Oakland Army Base to San Francisco	X	15/15	X	X	X
	Harbor Bay to So. San Francisco	X	30/30	30/30	X	X
	Harbor Bay to Redwood City	X	30/30	30/30	X	X
	Harbor Bay to Moffett Field	X	30/30	30/30	X	X
	Harbor Bay to Hunters Pt.	X	30/30	X	X	X
	Harbor Bay to Coyote Pt.	X	15/15	X	X	X
	Harbor Bay to Foster City	X	15/15	X	X	X
	Harbor Bay to East Palo Alto	X	15/15	X	X	X
	Port Sonoma to San Francisco	X	30/60	30/60	X	X
	Coyote Pt. To San Francisco	X	30/30	X	X	X
	Foster City to San Francisco	X	30/30	X	X	X
	Moffett Field to San Francisco	X	30/30	30	X	X
	E. Palo Alto to San Francisco	X	30/30	X	X	X
	Berkeley to Treasure Island	X	15/15	15	X	X
	Oakland to Treasure Island	X	15/15	15	X	X

Notes:
1. The route under the Proposed Project is from Alameda to SF only
2. This route under Alternative 4 would include Alameda

Table 2.2
Comparison of Cost, Ridership, and VMTs
Proposed Project and Alternatives

Project Alternative	Capital Cost ($M)	Annualized Cap. Cost ($M)	Capital Cost/ Rider	Annual Operating Subsidy ($M)	Operating Subsidy/ Rider	Total Subsidy/ Rider	Annual Ridership	Change in Daily VMTs from Future Baseline[1]
Proposed Project (IOP Alternative)	$440	$38	$4	$50	$5	$9	9,639,100	(142,460)
Alternative 3	$160	$14	$2	$26	$4	$6	6,399,000	(40,131)
Alternatives Considered but Eliminated from Further Consideration								
Alternative 1	$1,007	$87	$6	$333	$23	$29	14,545,000	(277,659)
Alternative 2	$730	$63	$5	$218	$16	$21	13,685,400	(232,990)
Express Bus	$75	$8	$2	$22	$7	$9	3,219,000	(40,145)
Express Bus/HOV/ Operational Improvements	$547	$50	$13	$18	$5	$18	3,868,400	N/A [2]
BART Crossing	$7,108	$622	$137	$57	$13	$149	4,545,000	N/A[2]
Dumbarton Rail	$180	$16	$19	$3	$4	$22	844,800	N/A[2]
Transportation System Management	$70	NA	NA	$18	NA	NA	NA	(553,537)[3]
Smart Growth	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
1. Total Daily VMT's under the 2025 No Project Alternative (Baseline) are estimated to be 184,279,70
2. VMT not used for evaluating alternatives in MTC Bay Crossings Study
3. Derived from VMT reduction calculated by MTC (MTC 2001b), adjusted to the No Project VMT of 184,279,700



1 Larkspur
Larkspur - Ferry Building (20)

2 Tiburon
Tiburon - Ferry Building (20)

3 Sausalito
Sausalito - Ferry Building (20)

4 Richmond
Richmond - Ferry Building (20)

6 Treasure Island
Treasure Island - Ferry Building (20)

7 Berkeley/Albany/Fort Mason
Berkeley/Albany/Fort Mason* - Ferry Building (20)

12 Mission Bay
Mission Bay - Ferry Building (20)

14 Alameda/Harbor Bay Isle
Harbor Bay Isle - Ferry Building (20)

15 Alameda Main St.
Alameda Main St. - Jack London Square (16)
Alameda Main St. - Ferry Building (20)

16 Jack London Square
Jack London Sq. - Ferry Building (20)
Jack London Sq. - Alameda Main St. (15)

19 Oyster Point (SSF)
Oyster Point - Ferry Building (20)

20 San Francisco Ferry Building 20

21 Redwood City
Redwood City - Ferry Building (20)

24 Martinez
Martinez - Ferry Building (20)

25 Vallejo/Mare Island
Vallejo - Ferry Building (20)

28 Hercules/Rodeo
Hercules/Rodeo - Ferry Building (20)

46 Pittsburg/Antioch
Pittsburg/Antioch - Ferry Building (20)

LEGEND
- Primary Roads
- 1 Proposed Ferry Terminal
- 1 Existing Ferry Terminal
- Existing and PotentialTransit Routes
- Off-peak & Weekend Service to Fort Mason
- Fort Mason

* See Section 2.6

3 0 3 6 Miles

Scale 1:380,000

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Water Transit Authority Program EIR

Project No. 43-0006890

PROPOSED PROJECT

Figure 2.1

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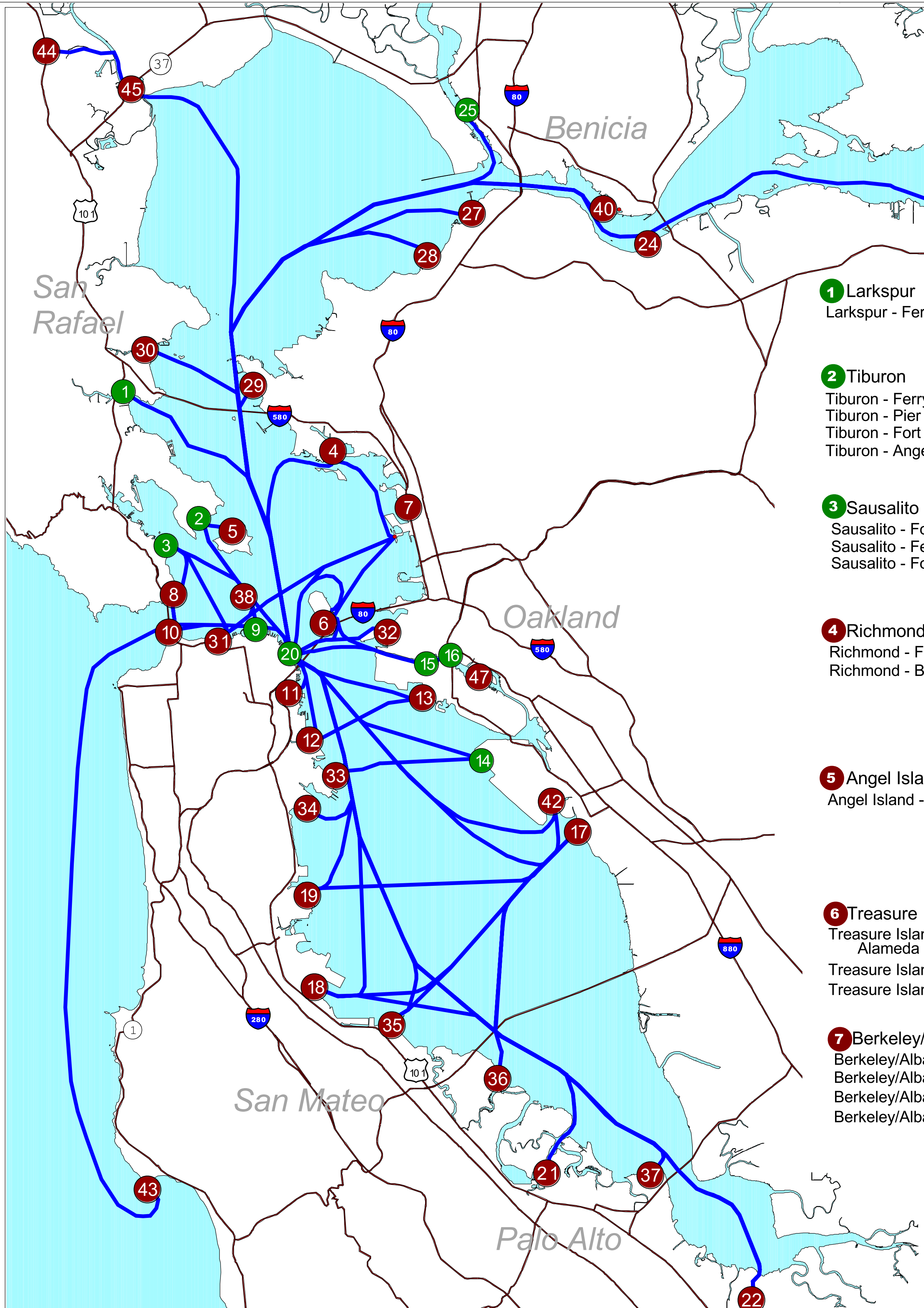

1 Larkspur
Larkspur - Ferry Building (20)

2 Tiburon
Tiburon - Ferry Building (20)
Tiburon - Pier 41/43 (9)
Tiburon - Fort Mason (31)
Tiburon - Angel Island (5)

3 Sausalito
Sausalito - Fort Mason (31)
Sausalito - Ferry Building (20)
Sausalito - Fort Baker (8)

4 Richmond
Richmond - Ferry Building (20)
Richmond - Berkeley/Albany (7)

5 Angel Island
Angel Island - Tiburon (2)

6 Treasure Island
Treasure Island - Jack London Square/ Alameda Main St. (16,15)
Treasure Island - Berkeley/Albany (7)
Treasure Island - Ferry Building (20)

7 Berkeley/Albany
Berkeley/Albany - Treasure Island (6)
Berkeley/Albany - Ferry Building (20)
Berkeley/Albany - Richmond (4)
Berkeley/Albany - Fort Mason (31)

8 Fort Baker
Fort Baker - Presidio (10)
Fort Baker - Sausalito (3)

9 San Francisco Pier 41/43

10 Presidio
Presidio - Fort Baker (8)
Presidio - Fort Mason (31)

11 China Basin/Pac Bell Park
China Basin/Pac Bell Park - Ferry Building (20)

12 Mission Bay
Mission Bay - Ferry Building (20)
Mission Bay - Alameda Point (13)

13 Alameda Point
Alameda Point - Ferry Building (20)
Alameda Point - Mission Bay (12)

14 Alameda/Harbor Bay Isle
Harbor Bay Isle - Ferry Building (20)
Harbor Bay Isle - Hunter's Point (33)

15 Alameda Main St.
Alameda Main St. - Jack London Square (16)
Alameda Main St. - Ferry Building (20)
Alameda Main St. - Treasure Island (6)
Alameda Main St. - SFO (18)

16 Jack London Square
Jack London Sq. - Ferry Building (20)
Jack London Sq. - Treasure Is. (6)
Jack London Sq. - SFO (18)
Jack London Sq. - Alameda Main St. (15)

17 East Bay/San Leandro Marnia
East Bay - Moffett Field (22)
East Bay - Redwood City (21)
East Bay - Oyster Point (19)
East Bay - Coyote Point (35)
East Bay - Foster City (36)
East Bay - East Palo Alto (37)
East Bay - Ferry Building (20)

18 San Francisco Intl. Airport
SFO - Moffett Field (22)
SFO - Ferry Building (20)
SFO - Jack London Square/ Alameda Main St. (16,15)
SFO - Oakland Intl. Airport/ Coliseum (41,42)

19 Oyster Point
Oyster Point - Ferry Building (20)
Oyster Point - East Bay/ San Leandro Marina (17)

20 San Francisco Ferry Building 20

21 Redwood City
Redwood City - East Bay/ San Leandro Marina (17)
Redwood City - Ferry Building (20)

22 Moffett Field
Moffett Field - Ferry Building (20)
Moffett Field - SFO (18)
Moffett Field - East Bay/ San Leandro Marina (17)

24 Martinez
Martinez - Ferry Building (20)

25 Vallejo/Mare Island
Vallejo - Ferry Building (20)

26 Pittsburg
Pittsburg - Ferry Building (20)

27 Crockett
Crockett - Ferry Building (20)

28 Hercules/Rodeo
Hercules/Rodeo - Ferry Building (20)

29 Point Molate
Point Molate - Ferry Building (20)

30 San Rafael
San Rafael - Ferry Building (20)

31 Fort Mason
Fort Mason - Pier 41/43 (9)
Fort Mason - Berkeley (7)
Fort Mason - Presidio (10) - Fort Baker (8) - Sausalito (3)
Fort Mason - Sausalito (3)
Fort Mason - Tiburon (2)

32 Oakland Army Base
Oakland Army Base - Ferry Building (20)

33 Hunter's Point
Hunter's Point - Ferry Building (20)
Hunter's Point - Harbor Bay Is. (14)

34 Candlestick Point
Candlestick Point - Ferry Building (20)

35 Coyote Point
Coyote Point - Ferry Building (20)
Coyote Point - East Bay/ San Leandro Marina (17)

36 Foster City
Foster City - Ferry Building (20)
Foster City - East Bay/ San Leandro Marina (17)

37 East Palo Alto
East Palo Alto - Ferry Building (20)
East Palo Also - East Bay/ San Leandro Marina (17)

38 Alcatraz Island
Alcatraz - Ferry Building (20)
Alcatraz - Pier 41/43 (9)

40 Benicia
Benicia - Ferry Building (20)

42 Oakland Intl. Airport/ Oakland Coliseum 42
Oakland Intl./Coliseum - Ferry Building (20)
Oakland Intl./Coliseum - SFO (18)

43 Half Moon Bay
Half Moon Bay - Pier 41/43 - Ferry Building (20)

44 Gnoss Field
Gnoss Field - Ferry Building (20)

45 Port Sonoma
Port Sonoma - Ferry Building (20)

46 Antioch
Antioch - Pittsburg (26)

47 Oakland Inner Harbor 9th St.
Oakland 9th St. - Jack London Square (16)

LEGEND
Primary Roads
Proposed Ferry Terminals
Existing Ferry Terminals
Existing and PotentialTransit Routes

3 0 3 6 Miles
Scale 1:380,000

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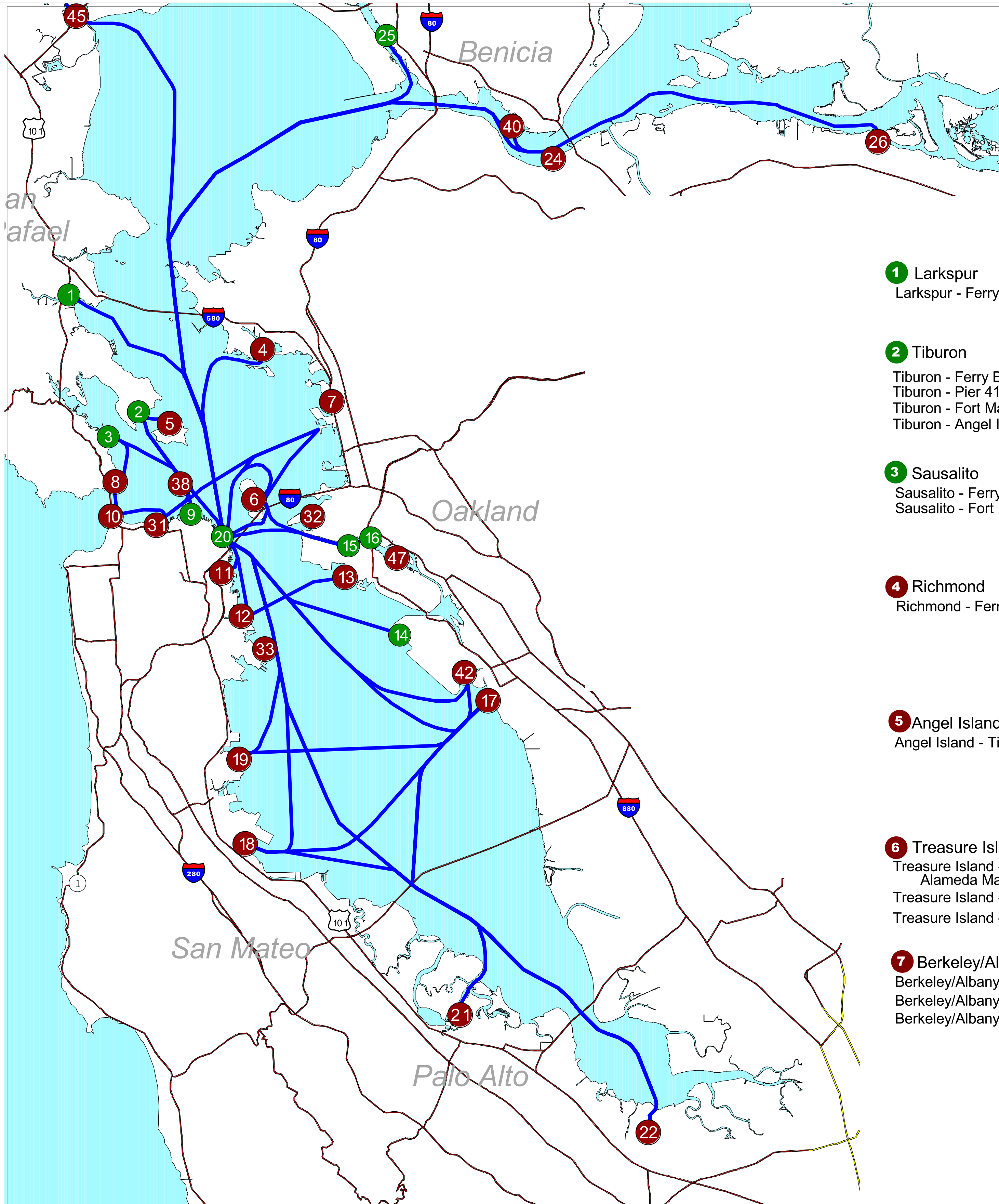
Water Transit Authority
Program EIR

Project No. 43-0006890

ALTERNATIVE 1 COMPREHENSIVE

Figure 2.2

I:/projects/wta/apr/water_resources.apr



1 Larkspur
Larkspur - Ferry Building (20)

2 Tiburon
Tiburon - Ferry Building (20)
Tiburon - Pier 41/43 (9)
Tiburon - Fort Mason (31)
Tiburon - Angel Island (5)

3 Sausalito
Sausalito - Ferry Building (20)
Sausalito - Fort Baker (8)

4 Richmond
Richmond - Ferry Building (20)

5 Angel Island
Angel Island - Tiburon (2)

6 Treasure Island
Treasure Island - Jack London Square/ Alameda Main St. (16,15)
Treasure Island - Berkeley/Albany (7)
Treasure Island - Ferry Building (20)

7 Berkeley/Albany
Berkeley/Albany - Treasure Island (6)
Berkeley/Albany - Ferry Building (20)
Berkeley/Albany - Fort Mason (31)

8 Fort Baker
Fort Baker - Sausalito (3)

9 San Francisco Pier 41/43

10 Presidio
Presidio - Fort Mason (31)

11 China Basin/Pac Bell Park
China Basin/Pac Bell Park - Ferry Building (20)

12 Mission Bay
Mission Bay - Ferry Building (20)
Mission Bay - Alameda Point (13)

13 Alameda Point
Alameda Point - Mission Bay (12)

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Harbor Bay Isle - Ferry Building (20)

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Alameda Main St. - Jack London Square (16)
Alameda Main St. - Ferry Building (20)
Alameda Main St. - Treasure Island (6)
Alameda Main St. - SFO (18)

16 Jack London Square
Jack London Sq. - Ferry Building (20)
Jack London Sq. - Treasure Is. (6)
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Oyster Point - Ferry Building (20)
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Moffett Field - Ferry Building (20)
Moffett Field - SFO (18)
Moffett Field - East Bay/ San Leandro Marina (17)

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Martinez - Ferry Building (20)

25 Vallejo/Mare Island
Vallejo - Ferry Building (20)

26 Pittsburg
Pittsburg - Ferry Building (20)

31 Fort Mason
Fort Mason - Pier 41/43 (9)
Fort Mason - Berkeley (7)
Fort Mason - Presidio (10) - Fort Baker (8) - Sausalito (3)
Fort Mason - Tiburon (2)

32 Oakland Army Base

38 Alcatraz Island
Alcatraz - Ferry Building (20)
Alcatraz - Pier 41/43 (9)
Oakland Army Base - Ferry Building (20)

40 Benicia
Benicia - Ferry Building (20)

42 Oakland Intl. Airport/ Oakland Coliseum 42
Oakland Intl./Coliseum - Ferry Building (20)
Oakland Intl./Coliseum - SFO (18)

44 Gnoss Field
Gnoss Field - Ferry Building (20)

45 Port Sonoma
Port Sonoma - Ferry Building (20)

47 Oakland Inner Harbor 9th St.
Oakland 9th St. - Jack London Square (16)

LEGEND
Primary Roads
1 Proposed Ferry Terminals
1 Existing Ferry Terminals
Existing and PotentialTransit Routes

3 0 3 6 Miles
Scale 1:350,000

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Water Transit Authority
Program EIR

Project No. 43-0006890

ALTERNATIVE 2 EXPANDED SERVICE

Figure 2.3

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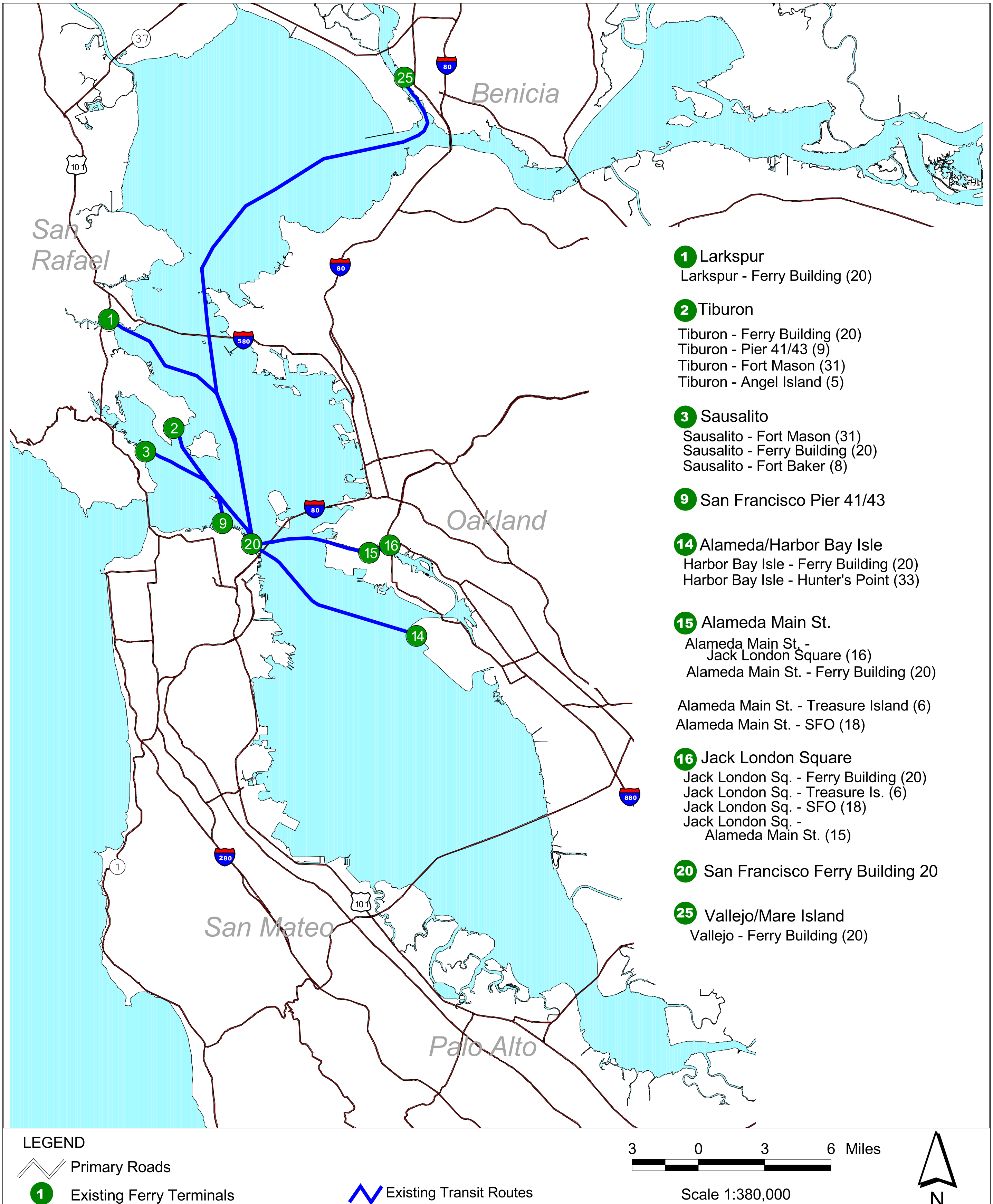
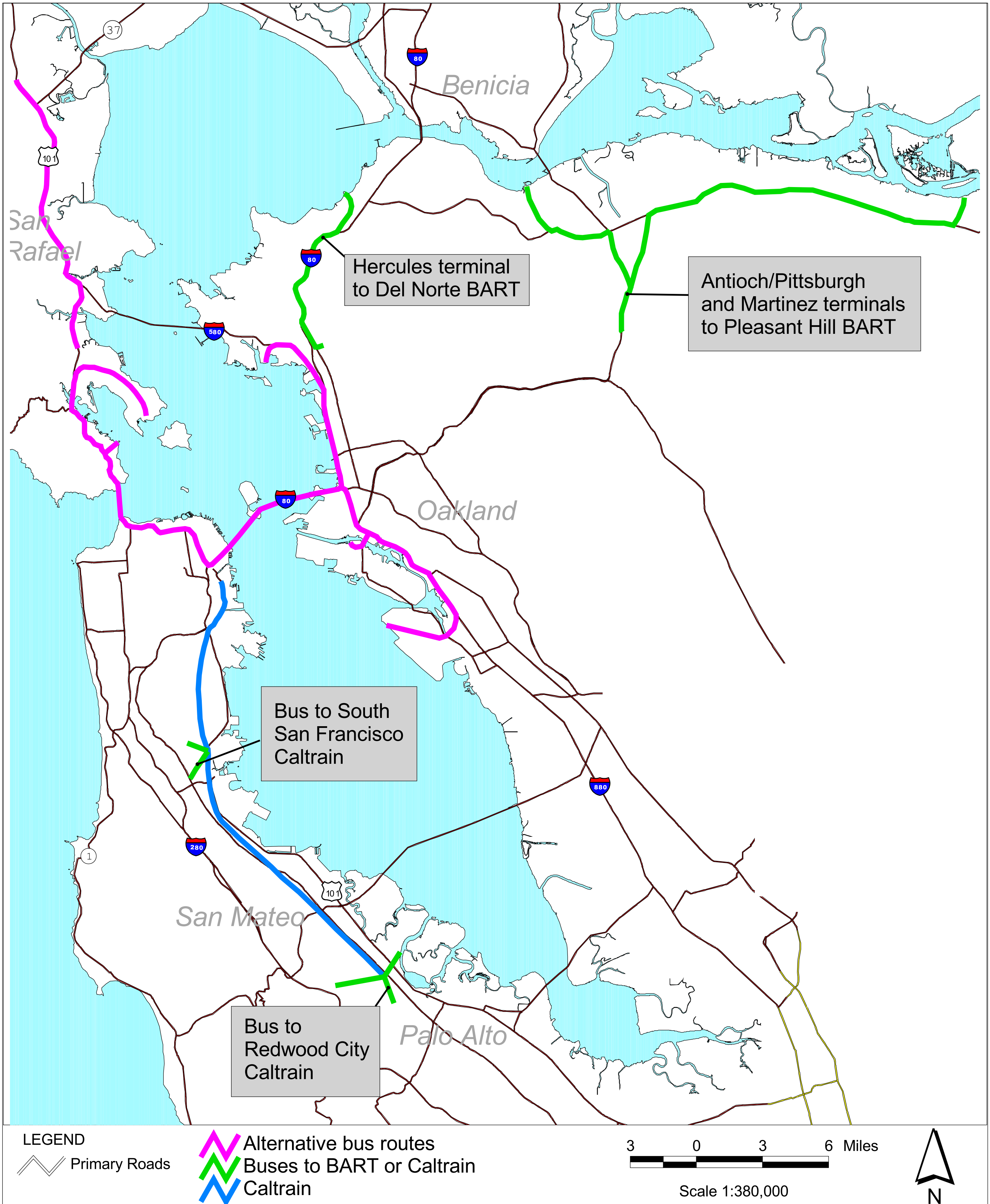


URS	Water Transit Authority Program EIR	ALTERNATIVE 3 ENHANCED EXISTING SERVICE	Figure 2.4
	Project No. 43-00066890		

L:/projects/wta/apr/water_resources.apr



URS

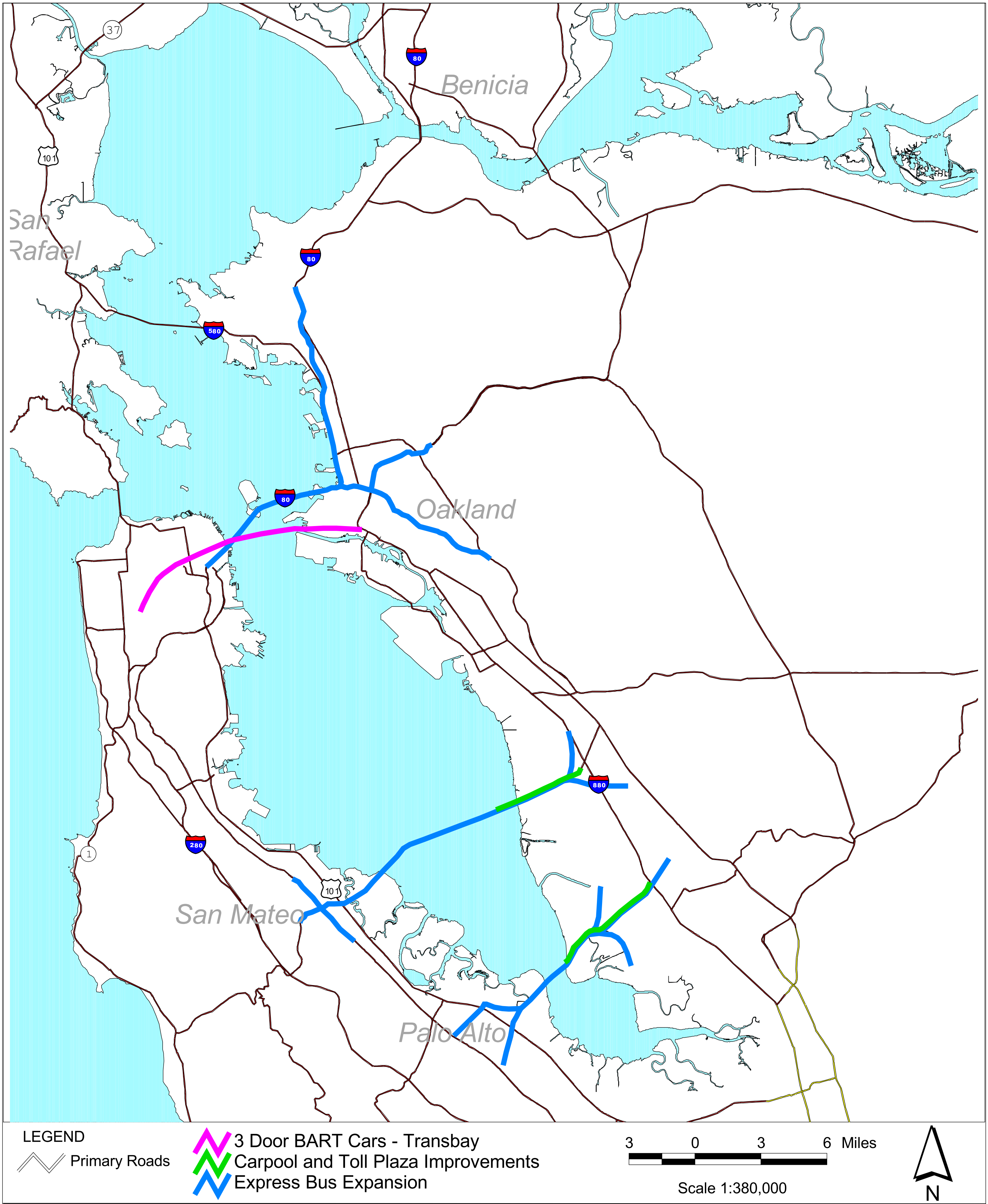
Water Transit Authority
Program EIR

Project No. 43-00066890

EXPRESS BUS
ALTERNATIVE

Figure
2.5

L:/projects/wta/apr/water_resources.apr



URS

Water Transit Authority
Program EIR

Project No. 43-00066890

EXPRESS BUS, HOV, OPERATIONAL IMPROVEMENTS ALTERNATIVE

Figure 2.6

L:/projects/wta/apr/water_resources.apr

This document addresses the potential environmental impacts and mitigation of those impacts resulting from expansion of ferry service defined in the San Francisco Bay Area Water Transit Authority's (WTA) December 2002 Implementation and Operations Plan (IOP). The IOP defines a focused set of routes, terminals, and service improvements for expanded ferry service that will be presented to the California Legislature in 2003, in accordance with the implementing legislation that originally established the WTA.

1.1 INTRODUCTION

When the California Legislature created and directed the WTA to adopt a ferry transit expansion plan, no direction or funding was made available at the time to develop or implement specific routes, terminals, or other associated elements. Once the overall program was defined, priorities would be determined for further action. Therefore, this document is a program Environmental Impact Report (EIR), prepared to comply with the California Environmental Quality Act (CEQA). CEQA defines a program EIR as "an EIR which may be prepared on a series of actions that can be characterized as one large project and are related either:

1. Geographically;
2. A logical part in the chain of contemplated actions;
3. In connection with issuance of rules, regulations, plans, or other general criteria to govern the conduct of a continuing program; or
4. As individual activities carried out under the same authorizing statutory or regulatory authority and having generally similar environmental effects which can be mitigated in similar ways"(CEQA Guidelines Section 15168).

The WTA's program has elements of all of the above criteria, which effectively summarize the overall proposed action.

1. The proposed program considers alternatives that can expand ferry transit use throughout the greater San Francisco Bay Area.
2. The individual elements of the program are part of a potential series of actions consisting of new routes, terminals, and design criteria that can be implemented as ridership, funding, environmental mitigation, and local interest and planning successfully merge.
3. This proposed expansion of water transit service has been designed to advance in connection with the implementation of the IOP and the studies that support it, which are summarized below.
4. Finally, many of the actions associated with expanded ferry transit service have similar impacts, and can and should be studied in similar ways over a regional area to provide a basis for consistent evaluation and consideration of regional cumulative impacts.

This FEIR and the associated IOP are *not* the final steps in the consideration, evaluation, and possible advancement of expanded ferry transit service. Section 2 of this FEIR describes the alternatives, each of which is a regionwide set of routes, terminals, and service. The routes and terminals are identified and evaluated at a generalized level, and have intentionally not been specifically defined in this FEIR or in the IOP. As routes or terminals are advanced for further consideration, they would be further defined based on site-specific studies and evaluations, may be subject to subsequent environmental review consistent with CEQA, and, if federal approval or involvement is necessary, may require environmental review consistent with the National Environmental Policy Act (NEPA).

As noted above, this FEIR is part of number of studies performed by WTA specifically to evaluate the need and feasibility of expanded ferry transit service. Other WTA-sponsored studies include topics such as the following:

- Ridership surveys and modeling that estimate potential demand for and use of an expanded system;
- New technologies, alternative fuels, and the range of engine, fuel, and propulsion options;
- Architectural criteria, addressing the overall design concepts for terminals (appearance and function);
- Intermodal criteria, addressing recommendations for compatibility and linkage with other passenger and transit modes and systems;
- Vessel criteria, dealing with the design options for the passenger vessel fleet;
- Safety plan, regarding recommendations and plans for safe operation of the system; and
- Financial plan, addressing the cost and economic feasibility of system expansion and operation.

These studies can be found at the WTA website, www.watertransit.org, or by contacting the WTA at:

Water Transit Authority
120 Broadway
San Francisco, CA 94111
Phone: (415) 291-3377
Fax: (415) 291-3388

The following subsections describe the purpose and objectives of the WTA program and the need and background for expanded ferry service in the Bay Area. The system alternatives, including routes and terminals, are described in Section 2. Section 3 describes and evaluates the environmental setting, impacts, and mitigation by subject area or discipline. Section 4 evaluates growth inducement potential and other environmental impact issues. Section 5 evaluates impacts and mitigation for other ferry alternatives that were initially considered. Section 6 lists the primary consultation and coordination activities involved with the EIR process and lists the preparers of this FEIR. Section 7 provides a list of acronyms and technical terms used in this document. Technical appendices appear under separate cover. Public comments to the DEIR and revised DEIR and the WTA's responses to those comments are included as a separate volume.

1.2 PURPOSE AND OBJECTIVES

The primary purpose of the WTA IOP is to increase Bay Area regional mobility and transportation options by providing new and expanded water transit services and related ground transportation terminal access in the San Francisco Bay Area.

1.3 NEED FOR THE PROPOSED PLAN

The existing Bay Area transportation network of roads, bridges, rail and bus systems, and ferry service must include plans for future expansion to serve existing and planned growth. The Bay Area is home to a highly diverse population and historically strong economic activity that is served by a complex transportation network. The existing transportation system is overwhelmed at many locations during peak periods, especially those routes and systems that cross the Bay. The ability to expand the capacity of this system is limited by many factors, among them funding and environmental constraints. In addition, commute patterns within the Bay Area are extremely diverse as housing and job centers have increasingly become geographically widespread. These issues all contribute to a need to plan for further improvements to and options for the region's existing transportation systems.

The WTA Bay Area ferry system expansion plan addresses several major Bay Area transportation needs and problems. The following sections describe each of these issues.

1.3.1 Bay Area Highway System is Unable to Meet Current and Future Demand

The 1990s witnessed one of the greatest economic expansions in decades. With an imbalance in the number of new jobs compared to the number of new housing units, people are commuting long distances, with the result of rising levels of travel on all of the region's highways, rail, and transit systems. Between now and 2025, the Bay Area is projected to gain 1.4 million residents and 1.2 million jobs (MTC 2001). This is a population increase of 19 percent and a job number increase of 33 percent. This projected imbalance of jobs and housing will lead to a net in-commute of some 300,000 workers a day from outside of the region, an increase of more than 75 percent from about 170,000 net in-commute daily trips in 2000.

Travel by Bay Area highway commuters has steadily risen by nearly 20 percent in total vehicle miles traveled between 1990 and 2000, and it is predicted to increase by about 48 percent from 2000 to 2025 (MTC 2001). The average hours per day of delay is predicted to increase by 248 percent between 1990 and 2020. In its 2002 San Francisco Bay Crossing Study, the Metropolitan Transportation Commission (MTC) predicted that the next 25 years may experience a 30 percent increase in regionwide travel and a 40 percent increase in transbay travel. The result of this congestion is an increase in travel time for Bay Area motorists. MTC's Regional Transportation Plan (RTP) estimates that an automobile trip from Mountain View to Hayward in the afternoon peak period, a distance of about 25 miles, commonly takes about 74 minutes (20 miles per hour [mph]). A trip from Union City to Moffett Field will take about 50 minutes by 2020. The RTP also estimates that the San Rafael to San Francisco commute will increase from an average of 41 minutes to 62 minutes by 2020 and that the Oakland to San Francisco trip time will slow from 34 minutes to 51 minutes. Overall, the average commute time in the Bay Area is expected to increase by about 25 percent between 2000 and 2025. Travel delays at current conditions already result in substantial frustration among the region's motorists; a 2001 MTC survey found that over 70 percent of Bay Area residents considered traffic, transportation, and congestion among their major issues of concern.

1.3.2 Transbay BART and Bridges Are at Capacity

Of the 10 worst Bay Area congestion locations, three involve approaches to the Bay bridges.

Furthermore, daily transbay trips over the Bay bridges are expected to increase by more than 46 percent in 2025. More specifically, daily transbay travel is expected to increase 42.5 percent over the San Francisco-Oakland Bay Bridge (Bay Bridge) corridor (including bridge traffic, Bay Area Rapid Transit [BART] and ferries), 47.8 percent over the San Mateo and Dumbarton Bridges, and 79.1 percent over the Richmond-San Rafael Bridge (MTC 2001).

MTC has nearly completed its San Francisco Bay Crossings Study and issued draft findings in July 2002. The evaluation identified operational strategies such as expanded bus and carpool networks that could help and be relatively inexpensive. Recommendations for further study included improvements to the approaches of the Dumbarton Bridge, new carpool lanes and carpool connections, and improving the capacity at existing BART stations. Major long-term projects such as a new mid-Bay bridge, widening of the San Mateo-Hayward Bridge, and rail line improvements were noted as having high costs and potential environmental and community constraints.

BART serves crossbay destinations very effectively and carries a substantial number of passengers. The BART transbay tube currently has a capacity of 30 trains per hour – only eight more than BART currently operates during the peak hour. MTC's Bay Crossings Study noted that the BART system will be able to handle demand between now and 2025, but capacity of the transbay trains and San Francisco stations will be a concern in the future.

In the last 10 years, the number of vehicles crossing the Bay Bridge has increased by more than 30,000 per day, or about 12 percent. Total daily travel along the Bay Bridge corridor is about 274,000 vehicles on the bridges, approximately 134,000 BART passengers, 14,000 AC Transit bus passengers, and 4,000 ferry passengers (Vallejo, Alameda/Oakland, and Harbor Bay Isle). Even a 10 percent increase in vehicle counts in the next 10 years (less than one percent annually) would generate about 28,000 new trips, severely limiting travel in the corridor even with improvements planned by BART and AC Transit.

1.3.3 Coping with Accidents, Natural Disasters, and Other Travel Disruptions

Millions of dollars are being invested in the Bay Area transportation system to strengthen bridges, highways, and rail systems to minimize damage from major earthquakes. The Bay Area is crossed by a number of active faults, including the San Andreas and Hayward faults, which are capable of causing significant damage. An earthquake on the San Andreas Fault (the Loma Prieta event in 1989) caused significant temporary damage to the Bay Bridge, and commuters shifted to other options including ferry service. Since 1979, a number of events have disrupted travel across the Bay, resulting in significant use of ferry service:

- 1979 BART tube fire
- 1982 Marin County mudslides (Golden Gate Bridge)
- 1989 Loma Prieta earthquake (Bay Bridge)
- 1997 BART strike
- 1998 BART power outage
- 2001 Events Related to Terrorist Threats in the Bay Area (Bay and Golden Gate Bridges)

These situations have underscored the viability and important benefits of having a variety of transportation options that include ferry services.

Water transit also has the greatest ability to serve as a primary transportation service in times of emergency – such as a major earthquake – because of its inherent flexibility. It is also less likely than other transportation modes to experience severe damage and disruption. On September 11, 2001, the New York Waterway ferry service responded to the destruction of the World Trade Center towers with 23 of their 24-boat fleet within 15 minutes of the attack. Ferry service helped to evacuate more than 160,000 people from Manhattan that day, including over 2,000 injured persons within the first hour. This compares to an average daily service of about 34,000 (Smith 2001). Prepared with a comprehensive water transit system in place, the Bay Area will be better poised to respond to and cope with disruptive events.

1.4 BACKGROUND

1.4.1 Establishment of WTA for Expansion of Water Transit System in the Bay Area

During 1996 and 1997, the Bay Area Council (BAC) and the Bay Area Economic Forum (BAEF) cooperatively convened a wide spectrum of regional experts, stakeholders, and key decision-makers in a series of symposia, interviews, and fact-finding sessions to discuss transportation and mobility problems and the potential role of a water transit system in the Bay Area. These efforts resulted in the California State Senate unanimously passing Senate Resolution 19, which directed the BAC and the BAEF to form a Blue Ribbon Task Force to study and explore the feasibility of greatly expanding water transportation in the Bay Area.

The 52-person Blue Ribbon Task Force assembled by the BAC and the BAEF launched the Bay Area Water Transit Initiative. Together, the Task Force guided the production of the "Action Plan" and investigated whether a viable water transit plan could be developed that would add significant capacity to the regional transportation system, improve mobility, relieve congestion, and provide a viable alternative to driving alone, while minimizing environmental impacts. Based on its investigation, analyses, and public input, the Blue Ribbon Task Force recommended creation of an authority that would oversee expansion of ferry service in the Bay Area.

The WTA was established as a direct consequence of legislation developed from recommendations contained in the Bay Area Water Transit Initiative Action Plan. The charter of the WTA is to develop a Bay Area water transit IOP. The WTA was not granted the authority to implement specific projects at this time. The legislation also does not restrict future implementation of routes or terminals; specific projects could be implemented by others not under WTA jurisdiction.

1.4.2 Summary of Legislation

Based on the recommendations given in the Action Plan developed by the Blue Ribbon Task Force, the California Senate passed Senate Bill No. 428 (Chapter 1011 of the Statutes of 1999), which created the WTA and empowered it to develop a water transit plan for the Bay Area. Funding for the Authority is provided in Chapter 656 of the Statutes of 2000.

As a result of this legislation, WTA is required to prepare and adopt a Bay Area water transit implementation and operations plan, and to operate a comprehensive Bay Area regional public water transit system. This plan will include all appropriate landside, vessel, and support elements, operational and performance standards, and policies. As part of the preparation of the plan, WTA will review and consider, in addition to other materials and information, the findings presented in the document entitled “San Francisco Bay Area Water Transit Initiative,” dated February 1999, prepared by the BAC and the BAEF. The adoption of the plan will be subject to public hearings within the Bay Area, and will be reviewed by the MTC.

The primary focus of WTA and its plan will be to provide new or expanded water transit and related ground transportation terminal access services that were not in operation as of June 30, 1999. As part of the implementation planning and operations, WTA will seek cooperative involvement from existing water transit services and related ground transportation agencies in whose jurisdictions existing or planned water transit terminals are located. Additionally, WTA will avoid impacting water transit services and related ground transportation terminal access services that were in existence as of June 30, 1999.

In connection with the plan, WTA is required to produce a system-wide program EIR and study of the plan, in accordance with the requirements of CEQA. Although the plan does not require formal approval by a federal agency, it should also be consistent with NEPA.

1.4.3 History of Ferry Service in the Bay Area

At one time, the Bay Area had one of the most extensive water transit systems in the world. From the Gold Rush until the completion of the Bay and Golden Gate Bridges, ferries provided the only transportation of goods and people across the Bay waters. In addition to playing an important transportation role in the development of the Bay Area, ferries also served recreational purposes.

The first recorded ferry system on the Bay was established in 1850. By the late 1800s, 22 passenger cross-bay ferry companies were in operation, and five other companies carried only automobiles. Together, the ferries served approximately 30 destinations, about half of them on the San Francisco-Oakland corridor. By the early 1900s most ferry operators had consolidated, and in 1921, the three largest ferry operators together carried about 49 million passengers in the Bay Area.

The ferry transit service peaked between 1935 and 1936, with 50 to 60 million people crossing the Bay annually on almost 50 ferries. Scores of ferry routes traveled between San Francisco and the East and North Bays, and ferries traveled as far north and east on the Bay as Vallejo, Benicia, and Martinez. During this time, San Francisco’s Ferry Building had 250,000 passengers flowing through it on a daily basis. On the waterside, ferries made 340 arrivals and departures daily. On the landside, connecting streetcars left every 20 seconds.

The demise of the ferries started with the building of the Golden Gate and Bay Bridges in the 1930s. By 1958, ferry service on the Bay had ceased. Moreover, regulations related to construction of the bridges and the rapid growth of automobile use discouraged entrepreneurs from operating ferry services.

By the late 1950s and early 1960s, the Legislature recognized that congestion within the Bay Area, especially on bridges crossing the Bay, would reach a critical stage and authorized the BART system. The BART transbay tube was paid for with bridge tolls, as compensation for the two bridge railway tracks removed from the lower deck in the early 1960s.

Over time, assisted by mounting traffic congestion, transit system emergencies and natural disasters (most notably the 1979 BART transbay tube shutdown and the 1989 Loma Prieta earthquake), ferry service slowly started returning to the Bay Area. These difficult times demonstrated the viability and benefits of ferry service and highlighted the role of ferries as important emergency links across the Bay. In response to the 1989 Loma Prieta earthquake, the Legislature repealed the prohibitions against other competing transportation modes, removing the last of the "passive" constraints to increased ferry service.

At the same time, ferry technology has made rapid progress toward achieving higher speeds with lower operating costs. Until the mid-1980s, the fastest ferry operated at about 18 knots (20 mph), too slow to effectively compete with highway travel. The introduction of the high-speed catamaran, powered by conventional diesel engines, brought ferries into the universe of marketable, competitive, and financially viable transit options. Ferries can now routinely achieve speeds of more than 40 mph, substantially increasing their marketability. Modern high-speed catamarans now combine fast speeds with a more stable, comfortable ride. These improvements now enable ferry services to effectively compete for passengers between certain origin and destination points. For example, existing ferry service from Larkspur (Marin County) to the downtown San Francisco ferry terminal on a high-speed catamaran vessel is about 30 minutes. The primary alternative transportation options for this route are automobile and bus service, which must travel the congested routes of U.S. 101, the Golden Gate Bridge, and downtown San Francisco.

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ABAG	Association of Bay Area Governments
ACP	Area Contingency Plan
AP Zone	Alquist-Priolo Earthquake Fault Zone
ARPA	Archaeological Resources Protection Act
BAAQMD	Bay Area Air Quality Management District
BAC	Bay Area Council
BAEF	Bay Area Economic Forum
BART	Bay Area Rapid Transit
Bay Plan	San Francisco Bay Plan
bbl	barrel
BCDC	San Francisco Bay Conservation and Development Commission
BMPs	Best Management Practices
BPTCP	Bay Protection and Toxic Cleanup Program
Btu	British thermal unit
CAC	Community Advisory Committee
CAFE	Corporate Average Fuel Economy program
Cal/OSHA	California Occupational Safety & Health Administration
Cal-EPA	California Environmental Protection Act
Caltrans	Department of Transportation of the State of California
CAP	Clean Air Plan
CARB	California Air Resources Board
CBC	California Building Code
CCR	California Code of Regulations
CDFG	California Department of Fish and Game
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act of 1980
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CHRIS	California Historic Resources Information Service
CNDDB	California Natural Diversity Data Base
CNEL	Community Noise Equivalent Level
CNPS	California Native Plant Society
CO	carbon monoxide
CRHR	California Register of Historic Resources
CWA	Clean Water Act
cy	cubic yard
CZMA	Coastal Zone Management Act
dB	decibel
dBA	"A"-weighted decibels
DD	doubling of distance
DEIR	Draft Environmental Impact Report
DEM	Digital Elevation Models
DFG	California Department of Fish and Game
DMA	Danish Maritime Authority

DMMO	Dredged Materials Management Office
DNL	Day-Night Average Sound Level
DOGG	California Division of Oil, Gas, and Geothermal Resources
DOT	U.S. Department of Transportation
DWR	California Department of Water Resources
EcoAtlas	GIS Bay Area ecological resources database (SFEI)
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIR	Environmental Impact Report
ERL	Effects Range Low
ERM	Effects Range Median
ESI	Environmental Sensitivity Index (NOAA)
ESU	Evolutionarily Significant Unit
FEMA	Federal Emergency Management Agency
FESA	Federal Endangered Species Act
FHWA	U.S. Department of Transportation Federal Highway Administration
FICAN	Federal Interagency Committee on Aviation Noise
FIRM	Flood Insurance Rate Map (FEMA)
FTA	Federal Transit Administration
FVF	Fast Vehicle Ferry
g	acceleration due to gravity
GGBHTD	Golden Gate Bridge Highway and Transportation Department
GGNRA	Golden Gate National Recreation Area
GIS	Geographic Information System
GPG	General Plan Guidelines
HAAF	Hamilton Army Airfield
HABS/HAER	Historic American Building Survey/Historic American Engineering Record
HAP	hazardous air pollutant
HCD	California Department of Housing and Community Development
Headway	the distance or time separating each vessel
HICOMP	Highway Congestion Monitoring Program
hp	horsepower
Hs	significant wave height
HSC	Harbor Safety Committee
HUD	U.S. Department of Housing and Urban Development
HVAC	Heating Ventilation and Air Conditioning
Hz	hertz
IMO	International Marine Organization
IOP	Implementation and Operation Plan
J/m	joules per meter
kHz	kilohertz
KJ/m	kilojoules per meter
km	kilometers
kt	knot
kW	kilowatt

kWh	kilowatt-hour
Ldn	Day-Night Average Sound Level
L_{eq}	equivalent sound level
L_{eq}(h)	hourly equivalent sound level
LIUTO	Low Impact Urban Transport Water Omnibus (Italy)
L_{max}	maximum "A"-weighted sound level
LOS	Level of Service
LPG	liquefied petroleum gas
LTMS	Long Term Management Strategy
M	magnitude (seismic)
mcy	million cubic yards
MDC	Marlborough District Council (New Zealand)
mg/m^3	micrograms per cubic meter
MHHW	Mean Higher High Water
MHW	Mean High Water
MJ/m	megajoules per meter
M_L	Richter Local magnitude
MLLW	Mean Lower Low Water
mm	millimeters
uPa	microPascal
MPRSA	Marine Protection, Research, and Sanctuaries Act of 1972
MRZ	Mineral Resource Zone
MSO	Marine Safety Officer
MTC	Metropolitan Transportation Commission
MTL	mean tide level
M_W	moment magnitude
MWP	Montezuma Wetlands Project
NAGPRA	Native American Graves Protection and Repatriation Act
NCDC	National Climatic Data Center
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NOP	Notice of Preparation
NOS	National Ocean Service
NOx	oxides of nitrogen
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Properties
NSRP	National Shipbuilding Research Program
NUAD	Not suitable for unconfined aquatic disposal
NVIC	Navigation & Vessel Inspection Circular
NWIC	Northwest Information Center
O_3	ozone
OAK	Oakland International Airport

OARB	Oakland Army Base
OMC	Oakland Municipal Code
OPA	Federal Oil Pollution Act
OPR	California Governor’s Office of Planning and Research
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety & Health Administration
OSPR	California Office of Spill Prevention and Response
OSPRA	Oil Spill Prevention and Response Act
OSRO	Oil Spill Response Organization
Pa	pascal
PAH	polycyclic aromatic hydrocarbon
pax	passenger
PCB	polychlorinated biphenyl
PM_{10}	particulate matter less than 10 micrometers in diameter
$PM_{2.5}$	particulate matter less than 2.5 micrometers in diameter
PMT	passenger miles traveled
Porter-Cologne Act	California Water Quality Control Act
ppb	parts per billion
ppm	parts per million
ppq	parts per quadrillion
ppt	parts per thousand
pptr	parts per trillion
PRC	Public Resources Code
PT	particulate trap
PTS	permanent threshold shift
RCRA	Resource Conservation and Recovery Act
RMP	Regional Monitoring Program
RNA	Regulated Navigation Area
ROD	Record of Decision
ROG	reactive organic gas
ROV	Remote Operated Vehicle
RPWAST	Rich Passage Wave Action Study
RTP	Regional Transportation Plan
RWQCB	Regional Water Quality Control Board
SCR	selective catalytic reduction
SEL	Sound Exposure Level
SEPA	State Environmental Protection Act (Washington)
SF-DODS	San Francisco Deep Ocean Disposal Site
SFEI	San Francisco Estuary Institute
SFEP	San Francisco Estuary Project
SFMC	San Francisco Municipal Code
SFO	San Francisco International Airport
SIP	State Implementation Plan
SLC	California State Lands Commission
SO_2	sulfur dioxide
SPL	sound pressure level

SPM	Shore Protection Manual
SPRR	Southern Pacific Railroad
SSC	suspended sediment concentration
SUAD	suitable for unconfined aquatic disposal
SWIM	Ships Wash Impact Management (UK)
SWPPP	Stormwater Pollution Prevention Plan
SWRCB	State Water Resources Control Board
TAC	toxic air contaminant
TAC	Technical Advisory Committee (WTA)
Tm	mean wave period
TMDL	Total Maximum Daily Load
TRB	Transportation Research Board
TRIM	Tidal Residual Intertidal Mudflat
TTS	temporary threshold shift
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCG	U.S. Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UWR	Upland/Wetland Reuse
VMT	Vehicle Miles Traveled
VTM	Vessel Traffic Management
VTS	Vessel Traffic Service
WHAFIS	Wave Height Analysis for Flood Insurance Studies
WHSRN	Western Hemisphere Shorebird Reserve Network
WSF	Washington State Ferries
WTA	Water Transit Authority
WTI	Water Transit Initiative
YBM	Young Bay Mud
YOY	young-of-the-year