existing levees, this discussion is limited to the terrestrial habitat of the Delta islands and thier surrounding levees. At least 230 species of birds and 43 species of mammals occur in the Delta island region (CDFG 1987). Thousands of shorebirds use inner-island farm fields, flooded during the late summer and fall for weed control and flooded during the winter due to seepage and rainfall (SWRCB and USACE 1995). Wildlife species and population differ by Delta location and from island to island, varying with the extent of remnant natural habitat and extent and type of agricultural cultivation. Wildlife habitats that occur within the Delta islands and levee system include riparian woodlands, marsh, permanent pasture, and agricultural fields. A list of the wildlife species of the Estuary is presented in Appendix I.

The general bird species of the Delta island region include piscivorous (i.e., fish-eating) birds, wading birds, shorebirds, gulls and terns, swallows, blackbirds and starlings, bird species typically associated with riparian woodlands and scrub (i.e., riparian birds), and birds species typically associated with grassland and agricultural habitats (e.g., raptors). The most common riparian birds include house finch, American robin, song sparrow, white-crowned sparrow, yellow-headed blackbirds, and red-winged blackbirds. The most common raptor species include black-shouldered kite, red-tailed hawk, and American kestrel. Other common wildlife species include small mammals (e.g., rodents) and reptiles (e.g., snakes and turtles) (SWRCB and USACE 1995).

The population size of migratory waterfowl wintering in the Delta fluctuates from year to year due to changes in weather, habitat conditions, and flyway populations. Despite these annual fluctuations, large populations of waterfowl used the Delta area in most years until the 1980s. Since that time, wintering waterfowl populations have declined dramatically in the Delta, as they have throughout the Central Valley and Pacific Flyway. This general population decline is most pronounced for ducks; however, substantial declines are also evident for swans and geese. Although the waterfowl population decline is attributed to a variety of factors, including the prolonged drought between 1986 and 1993 and subsequent expansion of agricultural activities in the northern breeding areas, the loss of winter habitat in the Delta and Central Valley is also a contributing factor (Implementation Board of the Central Valley Joint Venture 1990).

PLANT COMMUNITY. The plant community of the Delta levee system is divided among the external (out-board) side of the levee, the levee top, and the internal (in-board) side of the levee. The outboard side of Delta levees are often riprapped and therefore exhibit the characteristics of the bushy-riprap plant community, described above for riparian woodlands. The density of vegetation that forms on the riprapped banks of levees ranges from dense to barren, depending on degree of maintenance clearing. Older and under-maintained Delta levees may exhibit characteristic riparian shrub-brush vegetation, including broad-leaved woody growth, generally under 18 feet tall. The tops of the Delta levees may contain low growth shrub-brush vegetation; however, many levee tops are maintained in a barren or grass covered state, allowing the tops to be used as roadways for levee inspection and maintenance activities.

The in-board side and toe areas of the Delta levees vary greatly, ranging from grass and forbs where levees are regularly maintained, to wetland species, such as cattails and bulrush, in areas where groundwater, surface water, or seepage ponds. Riparian woodlands can also develop along the in-board levee toes of the Delta region. Agricultural cultivation and grazing (often with grazing encouraged on in-board levee faces) generally reduces vegetative communities to a single stand or small grouping of tall trees and shrubs intermixed with grasses and forbs.

SPECIAL STATUS SPECIES. The LTMS agencies requested an informal consultation with the USFWS during the preparation of this EIS/EIR. Subsequently, the USFWS provided a list of the important and special status species that could potentially be affected by implementation of any of the LTMS EIS/EIR alternatives. Special status species that occur within the upland portions of the Planning Area are presented in Table 4.4-1. The USFWS list, in its entirety (including Latin nomenclature), is presented in Appendix J. Brief descriptions of the federally listed special status species found in the upland portions of the Planning Area are contained in Appendix J.

State- and federally listed threatened and endangered species that could occur within the Planning Area in the Delta include Aleutian Canada goose, American peregrine falcon, California black rail, giant garter snake, Swainson's hawk, and Valley elderberry longhorn beetle, as well as the state-listed threatened plant species Mason's lilaeopsis (Table 4.4-1, see also Appendix J). A variety of other special status species that are state or federal species of concern may also occur.

The riparian habitats of the Delta may support rookery sites for special status animal species such as herons and double-crested cormorants, nesting cover for colonies of tricolored blackbirds, basking sites for western pond turtles, and den habitat for ringtails. These species all forage in or adjacent to riverine habitat. Other special status species may use Delta riparian habitat areas for migration corridors and/or perch sites. Special status plant species that may occur in the riparian habitats of the Delta include rose-mallow and Delta tule pea.

SALINITY, POLLUTANTS, AND WATER QUALITY. Water in the Delta is a mixture of fresh water from the Sacramento River, San Joaquin River, and other source streams, and tidally-introduced saline water from the Pacific Ocean. Each of these Delta water sources has a distinct chemical composition and contains pollutants from both point and non-point sources. The drainage basins of the rivers that empty into the Delta cover about 37 percent of the land area in the state and carry about 40 to 50 percent of the freshwater runoff in the state. The Sacramento River contributes approximately 70 percent of Delta inflow. Water quality in the Sacramento River is generally good. The San Joaquin River contributes approximately 15 percent of Delta inflow and is more saline than the Sacramento River, carrying higher concentrations of several constituents including nitrates, selenium, nickel, manganese and boron (SFEP 1992b).

The use of persistent organic chemicals on Central Valley farmlands has resulted in their eventual transport to the Delta. In addition, pesticides applied in the farmlands of the Delta are washed directly into waters of the Estuary. Urban development of lands surrounding the Estuary has increased in acreage, bringing increased pollutant loadings to the water environment.

The Basin Plan for the Delta and Central Valley region prepared by the CVRWQCB identified the following beneficial water uses within the region: municipal supply, agricultural supply, industrial supply, groundwater recharge, freshwater replenishment, navigation, water contact recreation, warm freshwater habitat, cold freshwater habitat, wildlife habitat, migration of aquatic organisms, and fish spawning and/or early development habitat. The Basin Plan specifies a "non-degradation" policy to protect water quality in the basin (region) for these uses. A similar "Basin Plan" has also been prepared by the SFBRWQCB for the San Francisco Bay Area.

The Bay and Delta regions are recognized by state and federal agencies as highly sensitive aquatic ecosystems. These agencies are actively involved in setting policy and regulations for the protection of water quality. In addition to water quality concerns regarding fish and wildlife, water quality standards are applied in the Bay and Delta regions for the protection of municipal, industrial, and agricultural uses. Salinity and turbidity are the primary water quality parameters of concern for the Delta. In addition to salinity issues, the use of dredged material for levee maintenance and stabilization raises concerns regarding water quality impacts resulting from heavy metals and synthetic organic compounds contained in the dredged material. The concerns regarding metals and organics are applicable to levee maintenance and stabilization projects.

DRINKING WATER. Drinking water for about 20 million Californians flows through the Delta (DWR 1994). This water is treated to meet all state and federal drinking water criteria prior to use, but the continuing suitability of the Delta as a source of drinking water is a concern.

Because of concerns about drinking water supplies, $12 million annually for 10 years was appropriated in 1988 for SB 34 for the Delta Levee Subvention Flood Protection Program. Flood protection projects on eight western Delta islands — Sherman, Twitchell, Bradford, Webb, Bethel, and Jersey islands and Hotchkiss and Holland tracts — are being developed as a part of this program. The primary purpose of this Western Island Project is to protect the fresh water supply for the federal Central Valley Project and the State Water Project.

#### 4.4.2.5 Urbanized Areas

Since the mid-1800s human activities in the Bay and Delta regions have had a major influence on the lands around the Estuary. Today, nearly 30 percent of the land in the nine-county Planning Area and 10 percent of the land in the three Delta counties are urbanized. This increase in urban areas around the Estuary reflects the historical and continued population growth in the region. The Bay Area is now the fourth largest metropolitan area in the United States, with a population of 7.5 million people (SFEP 1992b). In addition to filling the Bay for agricultural and urban purposes, areas of the Bay's aquatic environment are also used intensively. Located in San Francisco Bay proper are the ports of Richmond, Oakland, San Francisco, and Redwood City. Adjoining the Bay in the Sacramento-San Joaquin Delta region are the ports of

Sacramento and Stockton. The impacts associated with the urbanization of the Estuary are well documented in the EPA's SFEP Status and Trends Reports (SFEP 1990, 1991a, 1991b, 1992a, 1992b, 1992c).

Among the various dredged material placement options analyzed in this EIS/EIR is the reuse of dredged material in upland-urbanized environments. Technical studies managed by the LTMS Upland Non-Aquatic Reuse Workgroup have indicated that dredged material is suitable for a variety of upland purposes including cover material at regional landfills and as construction fill material for projects in the urbanized areas around the Bay and Delta (BCDC 1994, 1995). The use of dredged material for this purpose reduces the need and impacts associated with the extraction of fill and cover materials from other sources.

In addition to dredged material reuse options in the urbanized environments of the Estuary, dredged material could also be placed in confined disposal facilities or processed for reuse through constructed rehandling facilities, both of which could be located within urbanized areas or are considered to be industrial land uses, exhibiting urban land use characteristics. The specific design of both these disposal/reuse options depends on the physical and chemical characteristics of dredged material, existing and adjacent site conditions, the design life of the facilities, regulatory and land use requirements, and environmental concerns (LTMS 1994d).

*Pollutants and Water Quality*

Once precipitation reaches the ground it enters two hydrologic pathways. Some of the water is stored in the receiving ecosystem, where it is either returned to the atmosphere by evapotranspiration or slowly released into watercourses. The remainder of the stormwater flows out of the system as runoff, both above and below the ground surface. The amount of runoff is influenced by many factors, including soil characteristics, topography, and rainfall volume. In a non-urban setting, the environmental conditions that effect the rate of runoff can also contribute to the removal of pollutants that would otherwise be carried to a receiving water body. However, this natural hydrologic process is altered in the urban environment through the creation of vast areas of impermeable land surfaces. Subsequently, urban storm runoff is usually quite rapid, primarily related to the urban stormwater collection/conduit system and rainfall volume/intensity. Pollutants deposited on the urban surface are dissolved in runoff and carried to the receiving waters. As a result, urban stormwater runoff increases potential impacts on receiving water quality.

Past studies conducted by the U.S. Public Health Service, EPA, and others report that significant levels of biochemical oxygen demand (BOD), coliform bacteria, nitrogen, and phosphorus are contained in urban runoff. Urban stormwater also contains toxic pollutants, including trace metals, petroleum hydrocarbons, and synthetic organic chemicals. The current state of knowledge, particularly with respect to the concentration of toxic pollutants in urban stormwater, makes it difficult to accurately estimate pollutant loading by this pathway. Urban runoff, however, is considered to be one of the primary sources of pollutants to the Estuary (SFEP 1991a).

*Noise*

Sources that contribute to ambient noise levels in the urban environment include such contributors as vehicular traffic, trains, ship traffic, and aircraft overflights. Industrial noise sources contribute to a steady background noise level in isolated areas. Land uses such as residential, religious, educational, convalescent, and medical facilities are more sensitive to noise than commercial and industrial uses. Wildlife may also be considered a noise-sensitive receptor. Table 4.4-2 shows the noise level of different activities and the human response to various noise levels.

**Table 4.4-2. Common Noise Levels and Human Response**

| *Sound Source* | *dBA* | *Response Criteria* |
|---|---|---|
| within 200 feet of jet takeoff | 130 | threshold of pain |
| hard rock band | 120 | -- |
| accelerating motorcycle | 110 | deafening |
| noisy urban street | 90 | |
| school cafeteria (untreated surfaces) | 80 | very loud |
| nearby freeway auto traffic | 60 | loud |
| average office | 50 | -- |
| soft radio music in apartment | 40 | moderate |
| average residence without stereo playing | 30 | -- |
| average whisper | 20 | faint |
| threshold of audibility | 0 | -- |

*Source:* U.S. Department of Housing and Urban Development. 1985. *The Noise Guidebook.*

Noise is customarily measured in decibels (dB), units related to the apparent loudness of sound. An A-weighted decibel (dBA) represents sound frequencies that are normally heard by the human ear. On this scale, the normal range of human hearing extends from about 3 dBA to 140 dBA, with speech normally occurring between 60 and 65 dBA. A 10-dBA increase in the level of a continuous noise would represent a perceived doubling of loudness, whereas a 3-dBA increase would be just noticeable to most people (USACE and Port of Oakland 1993).

Noise guidelines and standards have been developed by federal, state, and local agencies. The standards most applicable to the proposed action alternatives of this EIS/EIR are the California Office of Noise Control standards and the General Plan noise elements of each county within the Planning Area. The Office of Noise Control guidelines, presented in Table 4.4-3, provides criteria for the acceptability of noise levels for various land uses. Most of the affected counties' noise standards or guidelines (General Plan Noise Elements) are based on, or are similar to, the Office of Noise Control criteria (USACE and Port of Oakland 1993).

*Traffic*

The threshold of significance used to evaluate land transportation impacts is generally the level of additional traffic that would be perceptible by the motoring public. While there is no absolute standard for a significant change (increase) in traffic levels, an increase in the ratio of traffic volume to highway capacity (V/C) that is greater than 3 percent is used to define significance for levels of service (LOS) in categories A through D. LOS is a qualitative measure of traffic performance during some peak period (usually 1 hour). There are six letter levels of service, from A (best) to F (poorest). This 3 percent threshold level is used because it represents the likely increase in traffic levels that would be noticeable to most drivers. The LOS categories are described in the following text box.

**Table 4.4-3. California Office of Noise Control Land Use Compatibility Guidelines**

| | NOISE EXPOSURE (dB) | | | |
|---|---|---|---|---|
| *Land Use Category* | *Clearly Unacceptable* | *Normally Unacceptable* | *Conditionally Acceptable* | *Normally Acceptable* |
| Residential -- low density | >75 | 70-75 | 55-70 | 50-60 |
| Residential -- multi-family | >75 | 70-75 | 60-70 | 50-65 |
| Transient Lodging | >80 | 70-80 | 60-70 | 50-65 |
| Schools, Libraries, Churches, Hospitals | >80 | 70-80 | 60-70 | 50-70 |
| Playgrounds, Neighborhood Parks | >72.5 | 67.5-75 | --- | 50-70 |
| Golf Courses, Water recreation, Cemeteries | >80 | 70-80 | --- | 50-75 |
| Industrial, Utilities, Agriculture | --- | 75-85 | 70-80 | 50-75 |

*Source*: California Department of Health Services 1976.

Typically, dredged material would be brought to rehandling facilities by scow, as truck transport of wet dredged material would be difficult and expensive. The unloading of the scows would likely be conducted by hydraulic pumping of the material or by clamshell.

Increases in truck traffic would therefore occur only from facility construction and the transport of processed (rehandled) material to end-use sites. Truck transport of rehandled material would likely be performed by dump-truck with haul capacities ranging in size from 10-cy to 22-cy.

**Traffic Levels of Service (LOS) Categories**

| | |
|---|---|
| LOS A: | Primarily describes free-flowing traffic operations at average travel speeds, usually at least 90 percent free-flow speed. For example, for a street where the posted speed is 30 miles per hour (mph) at free-flow (uncongested) conditions, the average speed would be approximately 27 mph. |
| LOS B: | Represents reasonable unimpeded operation at average travel speeds, usually at least 70 percent of free-flow speed. |
| LOS C: | Represents stable traffic operations, but the ability to maneuver and change lanes is more restrictive than LOS B. Average travel speeds are generally at least 50 percent free-flow speed. |
| LOS D: | Borders on a range in which small increases in traffic may cause substantial increases in delay. Speeds are generally at least 40 percent free-flow speed. |
| LOS E and F: | Characterized by significant delays, long waits at signal and stop signs, and average speeds less than 40 percent of free-flow speed. |

*Source*: USACE and the Port of Oakland 1993.

### 4.4.3 LTMS Ranking of UWR Sites

The LTMS conducted a study that screened, ranked, and evaluated 73 non-tidal and diked historic bayland (i.e., upland) sites in terms of their reuse potential for dredged material (LTMS 1995d). The ranking system evaluated the sites in terms of the following reuse/disposal options: confined disposal, rehandling/reuse, habitat development, levee rehabilitation, and landfills. The following factors were considered in the ranking of each site: land use considerations, engineering constraints, environmental issues, the potential benefits of dredged material, and regulatory issues. The ranking results of this study are presented in the following seven tables. The first four tables show the ranking results for confined disposal sites (Table 4.4-4), rehandling facility sites (Table 4.4-5), habitat development sites (Table 4.4-6), and levee rehabilitation sites (Table 4.4-7). The last three tables list, for the various reuse/disposal options, the high feasibility sites (Table 4.4-8), the moderate feasibility sites (Table 4.4-9), and the low feasibility sites (Table 4.4-10).

### 4.4.4 Capacity Estimates for UWR

As discussed previously, dredged material beneficial reuse in the upland/non-aquatic environment includes habitat development (restoration and enhancement), levee maintenance and rehabilitation, various uses at existing sanitary landfills, and general construction uses. All of these reuse categories, with the exception of habitat restoration and levee maintenance and stabilization, require dredged material processing at rehandling facilities prior to reuse. However, rehandled/processed dredged material could be used at habitat restoration and levee maintenance and rehabilitation sites, particularly when direct barge access is not possible or material stockpiling capacity is limited.

Potential dredged material reuse volumes (capacities) were developed by BCDC for the LTMS as estimates of the potential quantities of material that could be used for beneficial reuse purposes in the upland/non-aquatic environment under high, medium, and low reuse scenarios (BCDC 1995b). These estimates are speculative, based on available knowledge, and are developed only for general planning purposes. They are not intended to predict with any degree of certainty the actual breakdown percentages of reuse volumes in the upland environment. Rather, these estimates were developed to help plan for a very uncertain future over the 50-year LTMS planning period.

**Table 4.4-4. Confined Disposal Site Ranking**

| *Site Name* | *Feasibility Ranking* |
|---|---|
| Mare Island | High |
| Alameda NAS | High |
| Airport Borrow Pits | High |
| Skaggs Island | High |
| Baumburg Tract | Moderate |
| Hamilton Antenna Field | Moderate |
| Hamilton Army Airfield | Moderate |
| Tubbs Island | Moderate |
| City of Petaluma | Moderate |
| Hog Island | Moderate |
| St. Vincent | Moderate |
| Camp Islands | Moderate |
| North Point | Moderate |
| Adjacent to Days Island | Moderate |
| Next to Hog Island | Moderate |
| Bull Island | Low |
| San Leandro | Low |
| Sherman Island | Low |

*Source*: LTMS 1995d.

**Table 4.4-5. Rehandling Facility Site Ranking**

| *Site Name* | *Feasibility Ranking* |
|---|---|
| Mare Island | High |
| Alameda NAS | High |
| Airport Borrow Pits | High |
| San Leandro | Existing (High) |
| City of Petaluma | Existing (High) |
| Baumburg Tract | Moderate |
| Hamilton Antenna Field | Moderate |
| Hamilton Army Airfield | Moderate |
| Tubbs Island | Moderate |
| Hog Island | Moderate |
| St. Vincent | Moderate |
| Camp Islands | Moderate |
| Sherman Island | Moderate |
| North Point | Moderate |
| Adjacent to Days Island | Moderate |
| Bair Island | Moderate |
| Next to Hog Island | Moderate |
| Bull Island | Low |
| Skaggs Island | Low |

*Source*: LTMS 1995d.

**Table 4.4-6. Habitat Development Site Ranking**

| *Site Name* | *Feasibility Ranking* |
|---|---|
| Hamilton Army Airfield | High |
| Bel Marin Keys | High |
| North Point | High |
| Skaggs Island | High |
| Bair Island | Moderate |
| Camp Islands | Moderate |
| Hog Island | Moderate |
| Sherman Island | Moderate |
| St. Vincent | Moderate |
| Tubbs Island | Moderate |
| Adjacent to Days Island | Low |

*Source*: LTMS 1995d.

**Table 4.4-7. Levee Rehabilitation Site Ranking**

| *Site Name* | *Feasibility Ranking* |
|---|---|
| Brannan-Andrus Island | High |
| Jersey Island | Existing (High) |
| Sherman Island | High |
| Bouldin Island | Moderate |
| Staten Island | Moderate |
| Twitchell Island | Moderate |
| Mandeville Island | Moderate |
| Webb Tract | Moderate |
| Bethel Island | Moderate |
| Bradford Island | Moderate |
| Venice Island | Moderate |
| Grand Island | Moderate |
| Lower Roberts Island | Low |
| Ryers Island | Low |
| Hotchkiss Tract | Low |
| Empire Island | Low |
| Tyler Island | Low |
| McDonald Island | Low |

*Source*: LTMS 1995d.

**Table 4.4-8. High Feasibility Sites**

| *Site Name* | *Reuse Option* |
|---|---|
| Airport Borrow Pit | CD/RR |
| Alameda NAS | CD/RR |
| Bel Marin Keys | HD |
| Brannan-Andrus Island | LR |
| City of Petaluma (existing) | RR |
| Hamilton Army Airfield | HD |
| Jersey Island (existing) | LR |
| Mare Island | CD/RR |
| North Point | HD |
| San Leandro (existing) | RR |
| Sherman Island | LR |
| Skaggs Island | CD/HD |

*Notes*: CD = Confined Disposal
HD = Habitat Development
LR = Levee Rehabilitation
RR = Rehandling/Reuse
*Source*: LTMS 1995d.

**Table 4.4-9. Moderately Feasible Sites**

| *Site Name* | *Feasibility Ranking* |
|---|---|
| Bair Island | RR/HD |
| Baumburg Tract | CD/RR |
| Bethel Island | LR |
| Bouldin Island | LR |
| Bradford Island | LR |
| Camp Islands | CD/RR/HD |
| City of Petaluma | CD |
| Adjacent to Days Island | CD/RR |
| Grand Island | LR |
| Hamilton Antenna Field | CD/RR |
| Hamilton Army Airfield | CD/RR |
| Hog Island | CD/RR/HD |
| Next to Hog Island | CD/RR |
| Mandeville Island | LR |
| North Point | CD/RR |
| Sherman Island | CD/HD |
| St. Vincent | CD/RR/HD |
| Staten Island | LR |
| Tubbs Island | CD/RR/HD |
| Twitchell Island | LR |
| Venice Island | LR |
| Webb Tract | LR |

*Notes*: CD = Confined Disposal
HD = Habitat Development
LR = Levee Rehabilitation
RR = Rehandling/Reuse
*Source*: LTMS 1995d.

**Table 4.4-10. Low Feasibility Sites**

| *Site Name* | *Reuse Option* |
|---|---|
| Bull Island | CD/RR |
| Adjacent to Days Island | HD |
| Empire Island | LR |
| Hotchkiss Tract | LR |
| Lower Roberts Island | LR |
| McDonald Island | LR |
| Ryers Island | LR |
| San Leandro | CD |
| Sherman Island | CD |
| Skaggs Island | RR |
| Tyler Island | LR |

*Notes*: CD = Confined Disposal
HD = Habitat Development
LR = Levee Rehabilitation
RR = Rehandling/Reuse
*Source*: LTMS 1995d.

It was assumed under these scenarios that during the next 50 years, up to 6 mcy would be dredged annually from the Estuary, and that 80 percent (4.8 mcy/year) of this material would be of sufficient quality (chemically and toxicologically) for disposal in the Bay or ocean or could be reused in the upland environment in an unconfined fashion. The remaining 20 percent (1.2 mcy/year) of the material would not be considered suitable for unconfined disposal in any setting (LTMS 1994k). This unsuitable material, known as "not acceptable for unconfined aquatic disposal" (NUAD) material (see section 3.2.3), may in fact be acceptable for some confined upland beneficial reuse purposes such as landfill daily cover and liner material and as non-cover material at habitat restoration sites.

The low reuse scenario represents the placement of up to 20 percent (~1 mcy) of the "suitable for unconfined aquatic disposal" material within (SUAD) upland areas; the medium placement scenario represents the upland reuse of up to 50 percent (~2.4 mcy) of the SUAD material; and the high placement scenario represents the upland reuse of up to 80 percent (~3.8 mcy) of the SUAD material. These volume estimates do not include any quantity of NUAD material that may be used in a confined manner at the upland reuse project locations.

In developing the potential dredged material reuse volumes, three primary upland reuse options were examined: (1) habitat (wetland) restoration; (2) rehandling facilities; and (3) Delta levee maintenance and stabilization.

#### 4.4.4.1 SUAD vs. NUAD Material

The majority of NUAD material would be disposed of in commercial Class I, II, and III landfills or confined disposal units constructed specifically to contain such dredged material. Depending on the makeup of the dredged material, there may be some limited uses in confined upland areas, which would be determined on a project-specific basis by the applicable RWQCB. This Policy EIS/EIR does consider, in general policy terms, the environmental effects of disposing of NUAD material in confined disposal units as related to the upland/wetland environment.

#### 4.4.4.2 Habitat Restoration

Habitat restoration involves the use of SUAD material, under the different volume scenarios, for various wetland restoration and enhancement purposes (e.g., tidal, seasonal, managed wetlands, etc.). For each volume scenario (low, medium, and high), it was assumed that the priority reuse option would be habitat restoration. Average-sized discrete wetland reuse projects were assumed to have an approximate site capacity of 7 to 8 mcy, although smaller wetland restoration and/or enhancement projects could use volumes of 4 to 6 mcy. These figures reflect average site capacities with a moderate to high restoration potential as analyzed by Gahagan & Bryant Associates (GBA) and Dr. Josh Collins of the San Francisco Estuary Institute (LTMS 1994g; 1994h) for the LTMS.

Site capacity projections and the evaluation regarding the feasibility of restoring habitat at a site are based principally on information generated by the LTMS (1994g, 1994h). All sites considered for wetland reuse, rehandling facilities, and levee restoration were ranked as having moderate to high restoration or reuse potential. If some sites considered in this evaluation are not actually restored, other sites with lower reuse potential could be used.

Within the upland portions of the 11-county Planning Area, dredged material reuse for habitat restoration and enhancement is most likely to affect habitats located between mean lower low water (MLLW) and the historic inland boundary of the Estuary's tidal marshes. These areas support a diversity of habitats, including intertidal mudflats and rocky shore, tidal marsh, seasonal wetland, salt pond, riparian, and riverine habitats.

Large-scale environmental restoration projects would be centered on the diked historic baylands. Restoration of these areas represents the last potential to enlarge the Bay and its wetlands. Many of these diked former baylands have not been filled or developed and are presently cultivated or used as pastureland. Due to their location close to the Bay, dredged material can be feasibly used for tidal wetland restoration projects.

#### 4.4.4.3 Rehandling Facility

Rehandling facility volumes were estimated assuming that the primary purpose of such facilities would be the processing of NUAD material. The throughput capacity at rehandling facilities is expected to exceed the volume of NUAD material generated during the LTMS planning period. Therefore, the residual throughput capacity of the rehandling facility could be used to process SUAD material. Although other end-uses of dredged sediment are possible, only those material volumes with the potential reuse of dredged materials at landfills (i.e., daily cover, and liner and capping material) were assumed under the rehandling facility category. This was done to avoid over-estimating upland reuse capacities. Additionally, based on BCDC's 1995 Landfill Report, it was determined that there is an existing landfill capacity of up to 5 mcy/year (BCDC 1995a). However, under the placement scenarios, it was determined that only approximately half of the estimated landfill capacity would actually be available.

Although not considered within the placement scenarios, rehandling facilities could supply clean material for other reuse options (i.e., road foundation, levee maintenance and stabilization, etc.). By including other potential end-uses for rehandled/processed dredged material, the upland reuse capacity volumes would increase. Given that the LTMS has a 50-year planning period, it is likely that other end-uses will be implemented over time. These other end-uses could include processing material for purposes such as construction base and fill material, auxiliary needs for levee maintenance, stabilization, and construction. Sites determined by the LTMS Technical Studies (LTMS 1995d) to be feasibly developed as rehandling facilities are presented in Table 4.4-11. The identification of feasible rehandling facility sites does not predesignate any site for such use, nor does it imply that other sites not reviewed by the LTMS are infeasible for such use. Site-specific environmental review would be required on a case-by-case basis for each potential rehandling facility site.

**Table 4.4-11. Potentially Feasible Rehandling Facility Sites**

| *Name* | *General Location* | *Ranking* |
|---|---|---|
| Airport Borrow Pit | Delta | High |
| Alameda Navel Air Station | Alameda | High |
| Bull Island | San Pablo Bay, Napa County | Low |
| Camp Island | San Pablo Bay | Medium |
| Cargill East** | San Pablo Bay | High |
| Days Island | Marin County | Low |
| Hamilton Air Field | San Pablo Bay, Marin County | Medium |
| Hamilton North Antenna Field | San Pablo Bay, Marin County | Medium |
| Hog Island | Sonoma County | Medium |
| Leonard Ranch** | San Pablo Bay, Sonoma County | High |
| Mare Island Naval Shipyard | Mare Island | High |
| Montezuma Wetlands** | Suisun Bay, Collinsville | High |
| Next to Hog Island | Sonoma County | Medium |
| North Point Property | San Pablo Bay, Sonoma County | Medium |
| Petaluma Drying Ponds* | City of Petaluma | High |
| Port Sonoma Marin | Sonoma County | High |
| Praxis-Pacheco** | Suisun Bay, Martinez | Medium |
| San Leandro Marina* | City of San Leandro | High |
| Sherman Island | Western Delta | Medium |
| Skaggs Island | Sonoma County | Low |
| St. Vincent/Silvera Ranch/Los Gallinas Valley Sanitation District | San Pablo Bay, Marin County | Medium |
| Tubbs Island | Sonoma County | Medium |

*Source*: LTMS. 1995d. *Volume I: Reuse/Upland Site Ranking, Analysis and Documentation*. Prepared by Gahagan & Bryant Associates, Inc., in association with ENTRIX, Inc., and San Francisco Bay Conservation and Development Commission. December.
* Indicates that the project already exists.
** Indicates that sites were analyzed during previous studies, not as part of the *Volume I: Reuse/Upland Site Ranking, Analysis and Documentation* study.

### 4.4.4.4 Levee Maintenance and Stabilization

Estimates of dredged material reuse for levee maintenance and stabilization under the upland reuse volume estimates described above was limited to the Delta region. This does not imply that levee maintenance and stabilization using dredged material could not occur in other areas of the Estuary; rather, it was determined by the LTMS agencies that the Delta region has the highest potential for beneficial reuse. Deep-draft, levee-side access — the water depth necessary for barge access along the outboard side of a levee — is a constraint for Delta levee reuse. Dredged material needed for levee maintenance for areas outside the Delta would be met by using rehandled material, in part due to barge access constraints. However, levee restoration estimates for areas outside the Delta were not assessed by the LTMS Technical Studies.

Because levee-side access in the Delta region requires the use of trucks to transport material, thereby necessitating the processing/drying of material at rehandling facilities, it was assumed that such rehandling facilities would be built in or near the Delta region. Therefore, the total capacity for dredged material reuse for levee maintenance and stabilization in the Delta region was included under Delta reuse, whether such material required rehandling or not.

Additionally, it was assumed that maximum Delta levee reuse would be limited to 1 mcy during the 1- to 5-year period, 5 mcy during the 5- to 15-year period, and 20 mcy during the 15- to 50-year period due to water quality concerns such as the presence of metals and salinity, and constraints caused by levee-side barge access. It was also assumed that only dredged material from the eastern portions of San Francisco Bay would be suitable for reuse in the Delta region, primarily due to concerns of elevated salinity contained in material dredged from lower reaches of the Estuary.

### 4.4.4.5 UWR Reuse Scenario Estimates

As presented in Table 4.4-12, a total of 49 mcy of SUAD material would be reused under the low scenario (20 percent of material for upland disposal). Under this scenario, one small wetland restoration project (4 mcy) would occur during the first 5 years, a single large project (7 mcy) would occur during years 5 to 15, and two large projects (17 mcy each) would occur during years 15 to 50. Delta placement during the first 5 years would be maximized at 1 mcy but would be limited to 3 and 17 mcy during the 5- to 15-year and 15- to 50-year periods, respectively.

Disposal within the Delta would be limited by the availability of dredged material. Further, the Department of Water Resources' projection regarding potential capacity for dredged material in the Delta is significantly higher, approximately 200 mcy.

**Table 4.4-12. Dredged Material Capacity Estimates for Upland and Wetland Reuse Low Scenario**

| Low Scenario — 20 Percent to Upland Disposal | | | | |
|---|---|---|---|---|
| *Timeframe* | *Wetland Restoration* | *Delta Restoration* | *Rehandling* | *Total* |
| 1-5 years | 4 mcy, 80 percent | 1 mcy, 20 percent | 0 mcy, 0 percent | 5 mcy |
| 5-15 years | 7 mcy, 70 percent | 3 mcy, 30 percent | 0 mcy, 0 percent | 10 mcy |
| 15-50 years | 17 mcy, 50 percent | 17 mcy, 50 percent | 0 mcy, 0 percent | 34 mcy |
| **Total** | **28 mcy, 57 percent** | **21 mcy, 43 percent** | **0 mcy, 0 percent** | **49 mcy** |

*Notes:* It was assumed that under upland and wetland reuse scenarios, over the next 50 years, up to 6 million cubic yards (mcy) annually would be dredged from the Estuary, and that 80 percent (4.8 mcy/year) of this material would be of sufficient quality (chemically and toxicologically) for disposal in the Bay or ocean or for reuse in the upland environment in an unconfined fashion, while 20 percent (1.2 mcy/year) of the material would not be considered suitable for unconfined disposal in any setting (LTMS 1995a). Under the potential dredged material reuse volume estimates, the low reuse scenario represents the placement of up to 20 percent (~1 mcy) of the "suitable for unconfined aquatic disposal" (SUAD) material in the upland environment; the medium placement scenario represents the upland reuse of up to 50 percent (~2.4 mcy) of the SUAD material; and the high placement scenario represents the upland reuse of up to 80 percent (~3.8 mcy) of the SUAD material.

However, the lower estimate was developed in light of existing constraints concerning the use of dredged material for Delta levee maintenance projects, and thus to provide a more realistic figure. Additionally, under this low upland reuse scenario, only NUAD material would be processed at rehandling facilities during the 50-year planning period, since sufficient upland reuse capacity would exist for all SUAD material without the need for rehandling/processing.

Table 4.4-13 presents the reuse volume estimates for the medium scenario (50 percent of material for upland disposal). Under this scenario two small wetland projects (5.5 mcy each) would occur during the first 5

**Table 4.4-13. Dredged Material Capacity Estimates for Upland and Wetland Reuse Medium Scenario**

| MEDIUM SCENARIO — 50 PERCENT TO UPLAND DISPOSAL | | | | |
|---|---|---|---|---|
| *Timeframe* | *Wetland Restoration* | *Delta Restoration* | *Rehandling* | *Total* |
| 1-5 years | 11 mcy, 92 percent | 1 mcy, 8 percent | 0 mcy, 0 percent | 12 mcy or 100 percent |
| 5-15 years | 16 mcy, 67 percent | 5 mcy, 21 percent | 3 mcy, 13 percent | 24 mcy |
| 15-50 years | 48 mcy, 57 percent | 20 mcy, 24 percent | 16 mcy, 19 percent | 84 mcy |
| **Total** | **75 mcy, 63 percent** | **26 mcy, 22 percent** | **19 mcy, 16 percent** | **120 mcy** |

*Notes*: It was assumed that under upland and wetland reuse scenarios, over the next 50 years, up to 6 million cubic yards (mcy) annually would be dredged from the Estuary, and that 80 percent (4.8 mcy/year) of this material would be of sufficient quality (chemically and toxicologically) for disposal in the Bay or ocean or for reuse in the upland environment in an unconfined fashion, while 20 percent (1.2 mcy/year) of the material would not be considered suitable for unconfined disposal in any setting (LTMS 1995a). Under the potential dredged material reuse volume estimates, the low reuse scenario represents the placement of up to 20 percent (~1 mcy) of the "suitable for unconfined aquatic disposal" (SUAD) material in the upland environment; the medium placement scenario represents the upland reuse of up to 50 percent (~2.4 mcy) of the SUAD material; and the high placement scenario represents the upland reuse of up to 80 percent (~3.8 mcy) of the SUAD material.

years; two larger projects (8 mcy each) would occur during years 5 to 15; and six large projects (8 mcy each) would occur during years 15 to 50. Under this scenario, during the first 5 years disposal within the Delta would be maximized at 1 mcy and increased to 5 and 20 mcy during the 5- to-15 year and 15- to 50-year periods, respectively. As stated above, potential dredged sediment reuse in the Delta under this scenario would be constrained by water quality impacts and barge access. Under this scenario, clean material would not be processed at rehandling facilities during the 1- to 5-year period, however, 3 mcy and 16 mcy could be processed at such facilities during the 5- to 15-year and 15- to 50-year periods, respectively.

Reuse estimates calculated for the high scenario (80 percent of material for upland disposal) are presented in Table 4.4-14.

Under this scenario, two large wetland projects (8 mcy each) would occur during the first 5 years; four larger projects (7 mcy each) would occur during years 5 to 15; and 82 mcy would be used during years 15 to 50.

Under this scenario, a restoration project every 3 years would be implemented and Delta reuse would be maximized at 1 mcy during the 1- to 5-year period, 5 mcy during the 5- to 15-year period, and 20 mcy during the 15- to 50-year period. Delta reuse under this scenario is still limited by water quality and barge access constraints. Under this scenario, 2 mcy of clean material would be processed at rehandling facilities during the 1- to 5-year period, 5 mcy during the 5- to 15-year, and 32 mcy during the 15- to 50-year period.

**Table 4.4-14. Dredged Material Capacity Estimates for Upland and Wetland Reuse High Scenario**

| HIGH SCENARIO — 80 PERCENT TO UPLAND DISPOSAL | | | | |
|---|---|---|---|---|
| *Timeframe* | *Wetland Restoration* | *Delta Restoration* | *Rehandling* | *Total* |
| 1-5 years | 16 mcy, 84 percent | 1 mcy, 5 percent | 2 mcy, 11 percent | 19 mcy or 100 percent |
| 5-15 years | 28 mcy, 74 percent | 5 mcy, 13 percent | 5 mcy, 13 percent | 38 mcy |
| 15-50 years | 82 mcy, 61 percent | 20 mcy, 15 percent | 32 mcy, 24 percent | 134 mcy |
| **Total** | **126 mcy, 66 percent** | **26 mcy, 14 percent** | **39 mcy, 20 percent** | **191 mcy** |

*Notes*: It was assumed that under upland and wetland reuse scenarios, over the next 50 years, up to 6 million cubic yards (mcy) annually would be dredged from the Estuary, and that 80 percent (4.8 mcy/year) of this material would be of sufficient quality (chemically and toxicologically) for disposal in the Bay or ocean or for reuse in the upland environment in an unconfined fashion, while 20 percent (1.2 mcy/year) of the material would not be considered suitable for unconfined disposal in any setting (LTMS 1995a). Under the potential dredged material reuse volume estimates, the low reuse scenario represents the placement of up to 20 percent (~1 mcy) of the "suitable for unconfined aquatic disposal" (SUAD) material in the upland environment; the medium placement scenario represents the upland reuse of up to 50 percent (~2.4 mcy) of the SUAD material; and the high placement scenario represents the upland reuse of up to 80 percent (~3.8 mcy) of the SUAD material.

### 4.4.5 Types of Upland and Wetland Reuse — Resources of Concern

#### 4.4.5.1 Habitat Restoration

The use of dredged material for tidal wetland restoration and enhancement would primarily occur in the nine counties of the San Francisco Bay Area, although some limited wetland restoration using dredged material may also occur on islands and along riparian corridors of the Sacramento-San Joaquin Delta region.

Tidal wetland restoration in the Bay Area primarily involves the restoration of historic tidelands that were diked, drained, and converted to agricultural uses, then subsequently subsided below elevations suitable for the establishment of tidal wetland habitat. This restoration process typically involves the placement of dredged material within these diked areas to re-establish appropriate elevations for tidal wetlands formation. After placement and consolidation of dredged material, the dikes surrounding a restoration site are breached to re-establish tidal action.

Critical factors for a successful restoration project include the following: the use of dredged material with the appropriate physical and chemical characteristics to form a suitable substrate for wetland vegetation; attaining appropriate fill elevations; constructing tidal channels with the appropriate geometry to provide sufficient tidal inundation; and, in some cases, the introduction of seed sources or plant stocks for revegetation.

*Habitat Restoration — Overview*

The use of dredged material for the restoration of tidal wetlands has been demonstrated at three former upland sites in the Estuary: Muzzi Marsh in Corte Madera, Marin County; Faber Tract in Palo Alto, Santa Clara County; and Salt Pond No. 3 in Fremont, Alameda County. An additional tidal wetland restoration project, the Sonoma Baylands Restoration Project, is underway in Sonoma County. This latter project uses a new design concept that incorporates the placement of dredged material below the ultimate marsh plain, allowing for natural on-site sedimentation during the restoration process. This design aspect was developed to reduce the potential of over filling a restoration site (Figure 4.4-4). Another proposed project is the Montezuma Wetlands in Suisun Marsh, Solano County. These last two projects are relatively large, using approximately 2.75 mcy and 20 mcy of material, respectively. Examples of successful wetland restoration projects in the Bay/Delta Area include Donlin Island and Venice Cut.

Wetland restoration projects using dredged material will need to comply with applicable local, state and federal regulatory processes. However, such projects should also be coordinated with restoration goals and planning at the regional and subregional level. Concern has already been expressed by members of the public that such tidal restoration projects could occur at the expense of seasonal wetland resources. These issues can be dealt with on a project by project basis, but a superior approach is to ensure that dredged material habitat projects are consistent with regional habitat plans. These include: the U.S. Fish and Wildlife Service's Endangered Species Recovery Plan, the Regional Wetlands Management Program of the San Francisco Bay Regional Board (including the Regional Wetlands Monitoring Program), the interagency Regional Wetlands Ecosystem Goals Project, The San Francisco Bay Joint Venture, the U.S. EPA North Bay Initiative, and BCDC's North Bay Wetlands Protection Program.

The obvious advantage of this approach is that project sponsors can use the results of regional planning to assure that individual restoration projects will be consistent with local and regional wetland efforts, and issues of ensuring the desired mix of wetland pattern and type can be resolved on a regional and sub regional level.

*Habitat Restoration — General Siting Criteria*

Through the implementation of the LTMS EIS/EIR alternatives, dredged material would be used whenever feasible for the purpose of enhancing and restoring the Estuary's historic tidal wetlands that have been diked or filled. As explained above, this loss of tidal wetland areas has been correlated with the dramatic reduction in wildlife populations that depend on Bay marsh lands for their habitat or nursery grounds. It should be noted that seasonal wetland, upland, and transitional habitats were historically important to Bay area wildlife as well, and the loss of these habitats is also correlated with reductions in wildlife populations.

The ecological restoration of tidal wetlands with dredged material must recognize the natural geomorphic processes of the Estuary and must provide for the recovery and maintenance of population size and the viability of the species of plants and wildlife that use the Estuary's wetland habitats. Various wetland types (classifications) exist within the Estuary that are defined by physical characteristics such as salinity regimes and

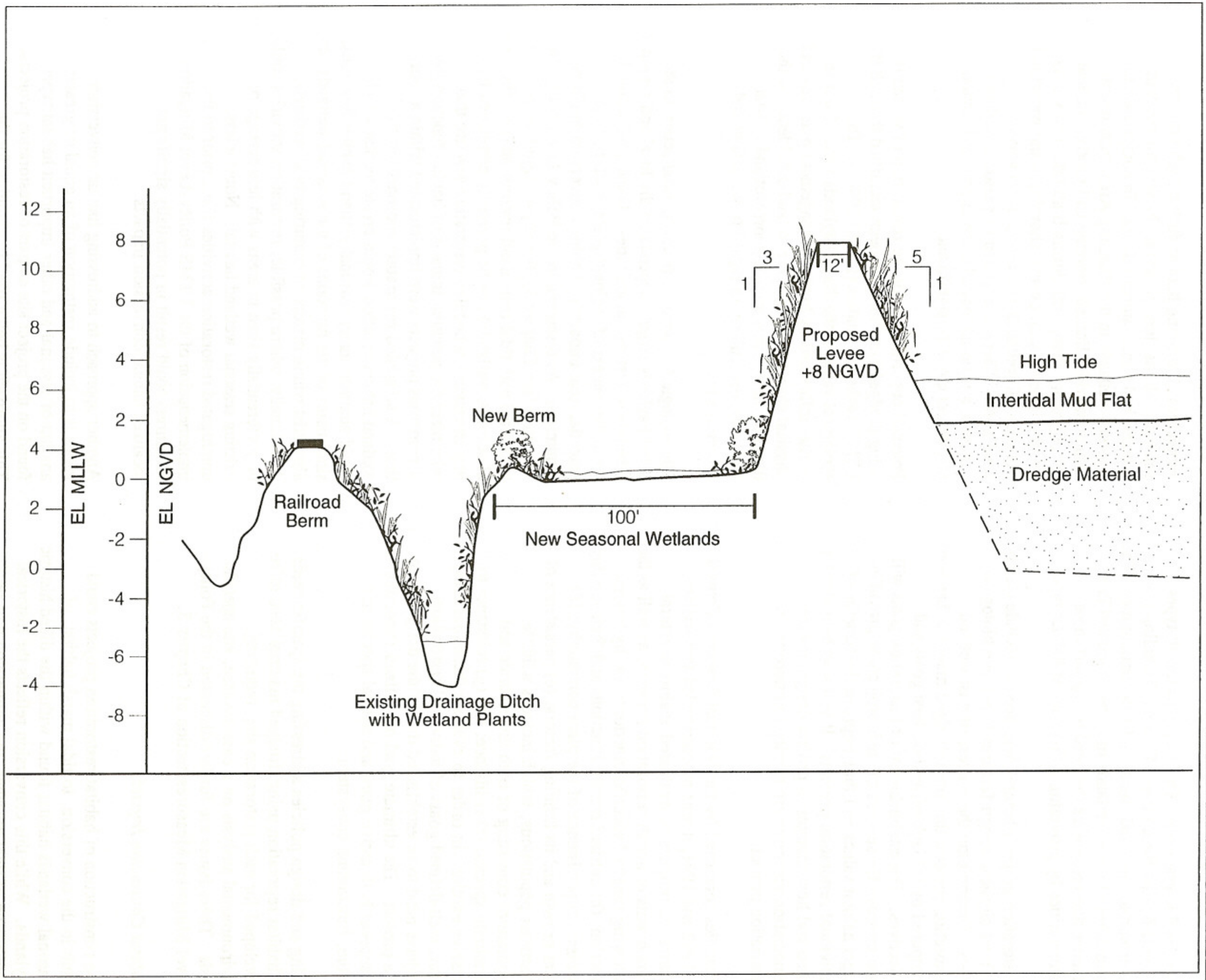


**Figure 4.4-4. Sonoma Baylands Tidal Marsh Restoration Site – Typical Levee Section**

topographic gradients. These various marsh types provide habitat for a range of species including plant, invertebrate, mammal, bird, and fish communities. The restoration of these wetlands must be conducted in a manner that recognizes the need to support these communities by providing a diversity of habitat types.

Restoration project planning will need to include clearly defined physical design features to achieve biological goals. Determining the success of past wetland restoration projects that used dredged materials has been hampered by the lack of well-defined goals and objectives. The establishment of restoration goals will help improve the success of such projects in providing target habitat values and thus improve the benefits of individual restoration projects. It will also help identify when and how changes in project design or other remediation measures are needed to improve the restoration project.

In studies conducted by the National Research Council in 1992 and 1994, it was recommended that wetland restoration projects be evaluated against structural components of marsh restoration projects, as well as the following range of specific functions: (a) hydrologic function; (b) nutrient supply functions and their limiting factors; (c) persistence of the plant community; (d) plant growth and its limiting factors; (e) persistence of consumer populations, which includes wildlife populations consisting of both invertebrate and vertebrate species; (f) resilience; and (g) resistance to invasive exotics. In order to evaluate these functions, clear, well-defined goals of individual restoration projects need to be established during the design phase of a project. The ultimate goal of wetland restoration is to support both native plant and animal species in a stable, functioning ecosystem.

Siting and design policies addressing the specific needs of habitat restoration using dredged material need to be developed for each restoration site, requiring environmental analysis on a case-by-case, site-specific basis. These issues are further discussed in the Policy-Level Mitigation Measures section of Chapter 5.

*Habitat Conversion Impacts*

The construction of habitat restoration projects could result in the conversion, to tidal marsh habitat, of seasonal wetlands habitat found within the diked historic baylands. While this conversion reflects the historical distribution of tidal marshes, the conversion will result in the loss of some important habitat functions for local and migratory shorebirds and waterfowl, including supplemental foraging habitat during high tides for small shorebirds, loss of nesting habitat for resident species, and winter storm refugia. In comparison to seasonal wetlands in the Planning Area, tidal marsh habitat provides limited foraging and roosting habitat for migratory shorebirds during high tides and winter storms. During such events, shorebirds and waterfowl use seasonal wetlands as a refuge from adverse conditions. Where conversion of seasonal wetlands results in a regional loss of these important functions, this impact could be significant.

Potential opportunities for the restoration of wetlands using dredged material have been identified through the LTMS Technical Studies (LTMS 1994e). The ecological value of the diked baylands varies from site to site, influenced by human management practices and physical characteristics. Due to land subsidence of the diked bayland, many sites support wetland habitat functions, particularly in regard to waterfowl and shorebirds use.

The ecological impacts of restoring tidal action to the diked baylands largely depends on the local and regional schedule of restoration activities. Local goals could be set in the context of regional goals, such that the potential local impacts of habitat conversion might be minimized. As discussed in the Policy-Level Mitigation Measures (see Chapter 5), the impact significance associated with tidal marshland restoration (i.e., the loss of seasonal wetlands) can be primarily eliminated by implementing a scheduled restoration practice that minimizes the potential impacts of habitat function loss if numerous projects were implemented within a short time. A scheduled restoration approach for tidal wetland habitat creation would create habitat which could augment many seasonal wetland habitat functions, since many of the functions of the seasonal wetlands can also exist within mature or maturing tidal wetlands. Additionally, where possible, restoration activities could be preferentially sited in areas with less acreage of existing seasonal wetland habitat. Nonetheless, unmitigated restoration activities (i.e., prior to the implementation of the LTMS Policy-Level Mitigation Measures) could result in potentially significant localized habitat conversion impacts.

Another approach to addressing habitat conversion issues is to include restoration of an equal or greater amount of seasonal and other important habitat types found on the project site as part of restoration projects. This approach is being used in planning for the Hamilton Wetlands Restoration Project, where dredged material will be placed in portions of the site to elevations above the tidal plain and graded to pond freshwater in winter to create seasonal wetlands.

*Marsh Plain Elevation Impacts*

One of the most important conditions necessary for a constructed (restored) tidal marsh to develop to a point that approximates the functions of a natural and historic marsh is a controlled final elevation that accounts for consolidation. The design of wetland restoration projects using dredged material needs to allow for the evolution of a complex slough drainage system including sinuous slough channels with a range of sizes containing first order to fourth order channels (ranging from small to large). In particular, fourth order channels appear to be important to the overall circulation in the marsh, the growth and vigor of plants, and the presence of certain wildlife species, specifically the endangered California clapper rail.

LTMS studies have indicated that slough channels do not develop when dredged material is placed higher than approximately 0.5 feet below MHHW (LTMS 1994d). In order to allow natural slough channel and tidal marsh formation, the Sonoma Baylands project did not place dredged material above 0.5 MHHW, in that location. Following the restoration of tidal action to the site, the final marsh plain elevation would be achieved through natural sediment deposition. This approach should ensure abundant slough channels and a more natural marsh. Restoration projects need to be designed and conducted in a manner that adheres to strict material placement elevation guidelines to achieve final defined elevations based on the desired restored biological community, unless additional measures can be included to provide adequate slough channels and other important physical features. Fill elevations exceeding those design guidelines could require remediating a restoration site mechanically, and result in additional impacts beyond those associated with the original restoration project.

The USGS is involved with a study entitled *Meteorological and Flow Variability at Wetland Sites in the San Francisco Bay Ecosystem*. The BCDC is assisting the USGS in this study under the USGS Ecosystem Program and the Wetlands Research Group, headed by BCDC. The goal is to assist management agencies by providing scientific data regarding suspended sediment transport associated with wetland restoration efforts in the Estuary. The study focuses on developing a quantitative model of suspended sediment concentrations brought about by wind, wave, and current forces present at various San Francisco Bay wetlands. One of the study locations is the outboard marsh along the eastern edge of the former Hamilton Army Airfield. Instrument packages include meteorological measurements consisting of wind shear, wind direction, barometric pressure, and air temperature; and sediment flux measurements consisting of current and suspended sediment, as well as water temperature, salinity, and current direction and strength. The other study areas include two sites associated with the San Francisco Bay National Wildlife Refuge in South San Francisco Bay and outboard of the Sonoma Baylands Wetland Restoration Project.

*Pollutants and Water Quality Impacts*

The location, design, and development of a wetland restoration or enhancement project could degrade water quality. These impacts could primarily occur on the restoration site; however, water draining from the placed sediments could cause off-site water quality impacts. The principal water quality impacts resulting from habitat restoration are a function of the chemical characteristics of dredged material and the associated bioavailability of pollutants to the food chain through plant or benthic organism uptake or by direct pollutant leaching into the water column (LTMS 1994e).

All dredged material placed at a restoration or enhancement sites and all discharged water would be required to meet the waste discharge and monitoring requirements of the appropriate RWQCB prior to any drainage water discharge. Wetland restoration projects that include the use of "non-cover" dredged material, as defined by the SFBRWQCB Interim Guidelines, would be subject to the same policies and requirements as any other restoration project using dredged material, except for those additional requirements that may be needed to ensure that non-cover material will not result in unacceptable environmental impacts.

Potential water quality degradation issues regarding the use of dredged material for habitat restoration include the leaching of pollutants (or in some cases salts) into the groundwater and the direct impacts of pollutant laden drainage water to on-site and off-site receiving waters. Under the LTMS, it is proposed that only SUAD material will be placed at a habitat restoration site in an unconfined manner. The concerns regarding sediment associated pollutant mobility are discussed below.

*Sediment Characteristic Impacts*

The dredged material characteristics of concern for wetland restoration projects include both physical and chemical properties. Typically fine-grained dredged material such as silts and clays are more desirable for wetland vegetation restoration than sandy materials. The concern regarding the physical characteristics of the sediment used in habitat restoration relates to the successful colonization of wetland vegetation on the restoration site. Chemical concerns involve the issues of pollutant mobility, vegetative growth-inhibiting effects of certain constituents, and bioaccumulation potential within the food web. The potential sediment characteristic impacts can be viewed as either direct impacts to restoration site plant and animal species, or impacts from habitat conversion and associated degradation due to failed or diminished restoration site success. By carefully evaluating material suitability as mandated by current state and federal regulation, sediment characteristic impacts would be minimal.

*Special Status Species Impacts*

The potential loss or displacement of special status species habitat resulting from dredged material reuse in habitat restoration is primarily a factor of the habitats' conversion (see above. Several wildlife species that occur in the diked baylands of the Estuary are protected under state and federal Endangered Species Acts, including the salt marsh harvest mouse. Additionally, a number of birds, amphibians, reptiles, fish, and insects that use the diked baylands and adjacent tidal marshes are candidates for federal listing and protection (see section 4.4.2.1). Habitat restoration activities within the diked bayland areas would result in the loss of this habitat on a restoration site-by-site basis. Although much of the function of the restoration site's environment would be enhanced by the tidal wetland habitat creation, the foraging and refugia habitat functions associated with individual diked bayland parcels would be lost.

In addition to the direct habitat conversion impacts described above, habitat restoration projects have the potential to impact adjacent off-site tidal wetlands habitat. The breaching of perimeter levees to initiate tidal circulation at a restoration site will likely result in the scouring of existing tidal channels, resulting in the conversion of tidal marsh habitat to open channel. In areas where channels do not form sufficiently to support the requisite tidal prism, mechanical channel creation or enlargement would be necessary. Mechanical methods to create or enlarge tidal slough channels would have associated impacts separate from those described for natural channel scouring (e.g., existing tidal marsh conversion to open water). These impacts would primarily be associated with machinery access and operation within the existing marsh and the disposal of excavated material.

Although the scouring of existing out-board tidal slough channels or the creation of new channels by mechanical means may have initial adverse impacts, the creation or enlargement of tidal slough channels in an existing marsh would result in a net increase of tidal habitat at the restoration site. Additionally, increases in channel size, depth, order, etc., have also been correlated to increased species diversity (LTMS 1994d).

Construction activities at a habitat restoration site can interfere with wildlife behavior and result in stress or habitat abandonment. Activities associated with installation of pipelines, breaching of levees, and scouring of outlet channels could result in nest abandonment by special-status avian species. Noise generated by construction and site restoration activities (i.e., sediment unloading station, booster pumps, etc.) may affect sensitive vertebrate wildlife receptors within or adjacent to a habitat restoration area. In general, because of relatively low background noise levels at potential restoration sites, noise associated with restoration activities may potentially effect special-status vertebrate species, such as the salt marsh harvest mouse.

Although the localized impacts associated with habitat restoration activities may be significant in the short term, the long-term restoration of tidal habitat is viewed as a substantial regional benefit for the recovery of these species.

*Pollutant Mobilization Impacts*

Dredged material placed in the upland environment such as a wetland restoration or enhancement site may undergo a change in pH due to oxidation of the material. The pH of dredged sediments may drop as sulfides in the sediment are oxidized and acid is created. The acidification of the material may solubilize metals that would otherwise be stable and bound to the sediment in its previous anoxic aquatic environment. Various methods are used to transport and place dredged material at a habitat restoration site. Methods that maintain saturated conditions during all phases of a restoration project may reduce the potential oxidation of the dredged material and subsequent release of heavy metals. However, the way that sediment oxidation affects heavy metal release is not evident. Recent research conducted by the COE at the Waterways Experiment Station, using John F. Baldwin Ship Channel sediments indicated that concentrations of heavy metals contained in material subjected to experimentally controlled upland placement and simulated rainfall had statistically reduced metals in runoff samples after drying and oxidation compared to material maintained under anoxic conditions. Additionally, most of the metals within the material that were allowed to oxidize remained bound to particulate matter and were therefore considered insoluble. Such studies do not fully address this potential impact and further research is needed.

Dredged material used for wetland restoration and enhancement projects must be of a suitable chemical constituent concentration that provides for the protection of the Estuary's fish and wildlife species, as defined by the SFBRWQCB Interim Wetland Cover/Non-Cover Criteria Guidelines or the CVRWQCB's Waste Discharge Requirements. Only SUAD material will be used in an unconfined manner at habitat restoration sites, and various methods exist to aid in the reduction of pollutant mobility within and outside a habitat restoration site (see Policy-Level Mitigation Measures Section 5.1).

*Habitat Restoration — Resources of Concern Summary Matrix*

As presented in Table 4.4-15 and explained in the text above, the principal identified impact associated with upland/wetland reuse of dredged material is the conversion of any existing wildlife habitat at potential restoration sites. Habitat conversion impacts at these sites would occur with any restoration activity, regardless of whether dredged material is used. Habitat conversion has the potential to adversely impact seasonal wetlands, palustrine wetlands, existing plant communities (including cultivated crops), and special status species habitat. An impact associated solely with the use of dredged material for habitat restoration is the potential to degrade groundwater and surface water due to dredged material leachate or surface water discharges. These potential impacts, as well as those not necessarily restricted to the use of dredged material, are addressed in the general and site-specific policy-level mitigation measures presented in Chapter 5.

The creation of tidal marsh habitat is one of the greatest benefits associated with upland/wetland reuse of dredged material (see Table 4.4-15). The creation of tidal marsh habitat using dredged material presents an opportunity to recreate this depleted habitat type. Such restoration activities would have significant benefits both on a local and regional level for many fish and wildlife that depend on tidal wetland habitat. Additionally, there is the potential for water quality benefits (primarily localized) due to wetland associated sediment entrapment, as well as biochemical binding and filtering of dissolved and suspended pollutants.

### 4.4.5.2 Levee Maintenance and Stabilization

The Delta region presents a unique opportunity for the use of dredged materials for maintenance and stabilization of levees. Most Delta levees were initially constructed and maintained by the direct placement of dredged material from adjacent channels. Recently, regulatory and environmental concerns severely limit the current use of this method. Additionally, due to various factors including land subsidence, there is a large demand for levee rehabilitation material.

The Department of Water Resources has estimated that approximately 200 mcy of dredged material could be accommodated in the Delta for levee maintenance. However, in light of existing constraints concerning the use of dredged material for Delta levee maintenance projects, including water quality issues and restricted barge access, more conservative figures have been developed through the LTMS (BCDC 1995c). These estimates indicate that approximately 26 mcy of dredged material could be used in the Delta over the next 50 years. Additionally, material may be needed at other levee locations in the Bay Area.

The LTMS agencies have also examined the potential reuse of dredged material in the Suisun Marsh for such purposes as the repair and maintenance of existing levees (BCDC 1994). Due to subsidence of the underlying Suisun Marsh peat soils, fill material is needed to raise and stabilize levees throughout the area. The LTMS Upland/Non-Aquatic Technical Studies have shown that dredged material can be successfully used for this purpose.

**Table 4.4-15. Habitat Restoration — Resources of Concern Summary Matrix**

| *Resource* | *Potential Impacts* | *Potential Benefits* | *Location* |
|---|---|---|---|
| **Wildlife Habitat** | | | |
| Seasonal Wetlands | Habitat conversion — loss of shorebird and migratory bird species habitat | Creation of tidal wetland habitat | • On-site impacts<br>• On-site and regional benefits |
| Palustrine Wetlands | Loss of waterfowl, shorebird, and migratory bird species refugia | Creation of tidal wetland habitat | • On-site impacts<br>• On-site and regional benefits |
| Plant Communities | Habitat conversion — loss of agricultural crop land and palustrine wetland plant species | Creation of tidal wetland habitat — development of tidal wetland plan community | • On-site impacts<br>• On-site and regional tidal wetland benefit |
| **Water Quality** | | | |
| Groundwater | Degradation (leachate) | NA | • On-site impacts |
| Surface Water | Degradation (surface water runoff) | Tidal wetland associated water quality improvements | • On-site impacts<br>• On-site and regional tidal wetland benefits |
| Special Status Species | Habitat conversion and outboard marsh hydrological changes | Creation of special status species habitat | • On-site and adjacent wetland impacts<br>• On-site and regional tidal wetland benefits |

Although the use of dredged material for levee maintenance and stabilization has been found to be highly feasible in the Delta region, such uses of dredged material are also possible in other portions of the Planning Area. Access constraints, however, appear to be the limiting factor for such uses outside the Delta region. Therefore it is assumed that much of the dredged material used for levee maintenance and stabilization in the lower reaches of the Estuary will come from rehandling facilities rather than directly from dredging projects.

*Levee Maintenance And Stabilization — Overview*

The first Delta levees were built with soils taken directly adjacent to natural high areas along existing channels and sloughs. In many areas, these soils were peat and subject to wind erosion and decomposition. The light soils were bolstered with logs and brush that were stronger but still ineffective against flood waters. "Modern" levees were constructed with materials that contained a higher percentage of mineral soils scooped from shallow intertidal areas. By digging deeper, clamshell dredges were able to obtain more stable material for levee construction. Repairs made to levees also required the use of mineral soils. As demonstrated by the DWR on Sherman, Twitchell, and Jersey islands, such material can be obtained by using dredged material from routine maintenance.

Delta levees consist of two types: federal project levees and non-project levees (figures 4.4-5 and 4.4-6). The federal project levees were constructed in relation to either a navigation or flood control project and are maintained by the state of California to federal standards. Non-project levees are classified as either private or direct-agreement levees. Private levees were privately constructed and are owner maintained. Neither the state nor the federal government maintain jurisdiction over these levees. Direct-agreement levees are either private levees or under the jurisdiction of a local authority, such as a reclamation district, that have been repaired or restored by the COE. These levees are maintained through an agreement with the federal government. In all, non-project levees constitute approximately 80 percent of the 1,100 miles of the Delta levee system.

The high organic matter of soils the Delta region and the wide disparity in levee construction standards contribute to acute levee settling and instability. The need to upgrade and repair the Delta's levee system is well-documented by state and federal agencies. Levee rehabilitation projects will bring existing levees up to modern design standards by increasing levee elevations and by placing additional material on the levee crests, toes, and landward slopes. Other levee rehabilitation projects include the construction of setback levees that provide new levees inside the existing levees, thereby