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BIOLOGICAL ASSESSMENT FOR ENDANGERED, THREATENED, AND CANDIDATE SPECIES

INTERIM NORTH DELTA PROGRAM

U.S. Bureau of Reclamation
Mid-Pacific Region

and

State of California
Department of Water Resources

Prepared by:
Miriam Green Associates

January 1996

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BIOLOGICAL ASSESSMENT FOR ENDANGERED, THREATENED, AND CANDIDATE SPECIES

INTERIM NORTH DELTA PROGRAM

Prepared for:

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I. INTRODUCTION

Purpose of the Biological Assessment

This Biological Assessment for the U.S Bureau of Reclamation's (USBR) and Department of Water Resources' (DWR) Interim North Delta Program (INDP) has been prepared pursuant to Section 7 of the federal Endangered Species Act of 1973 (16 USC 1536). This document also will be submitted to the California Department of Fish and Game (DFG) as part of USBR's and DWR's consultation under the California Endangered Species Act. A separate Biological Assessment is being prepared for fisheries; this document addresses only terrestrial resources, i.e., plants and wildlife.

The USBR and DWR have determined that the proposed project may affect the Swainson's hawk, greater sandhill crane, giant garter snake, western pond turtle, valley elderberry longhorn beetle (VELB), Mason's lilaeopsis, and rose mallow. The giant garter snake is designated as threatened by both the U.S. Fish and Wildlife Service (USFWS) and DFG. The Swainson's hawk is designated as threatened by DFG and the VELB is designated as threatened by the USFWS. All other species are designated as Category 2 candidates by the USFWS. No federally-listed plant species would be affected by the INDP.

This Biological Assessment summarizes the results of field surveys within the INDP area; evaluates listed, proposed, and candidate plant and wildlife species that could be affected by the INDP; and evaluates the extent of impacts on species to determine whether the project is likely to be detrimental to the continued existence of those species. Recommended measures to avoid or minimize impacts on sensitive species are also included.

Background Information

Prior to conducting field surveys for the INDP considerable research was undertaken on federally-designated threatened, endangered, proposed, and candidate plant and animal species; state-listed rare, threatened, and endangered plant and animal species and California wildlife species of special concern; and plants of concern to the California Native Plant Society (CNPS) which could occur in the geographic area affected by the proposed project. A master list of 101 species that could potentially be affected by the project was compiled from separate lists prepared by the USFWS and DFG. Written accounts describing the legal status, distribution, habitat requirements, critical habitat, and reasons for decline were then prepared for each sensitive plant and animal species. Individual range maps were also prepared. This information is contained in the Phase I Report on Sensitive Species for the Interim South Delta Project prepared by Miriam Green Associates (MGA) (1993) and is hereby incorporated into this Biological Assessment by reference. Copies of this report are available from both the USBR and DWR offices in Sacramento.

Instead of repeating lengthy narratives contained in the above report, this Biological Assessment focuses on those species that have been confirmed as occurring in the INDP area from field surveys. Although summary tables of special-status species determined not to be in the project area are included in this assessment, the reader is referred to the Phase I Report (MGA 1993) for more detailed species-specific information.

II. PROJECT DESCRIPTION

Introduction

The purposes of the INDP are to improve State Water Project (SWP) reliability through reduction in reverse flow and to improve flood protection in the lower Mokelumne River system. Potential additional benefits of implementing the program include improved water quality, reduced fishery impacts, greater SWP operational flexibility, enhanced recreational opportunities, and improved wildlife habitat.

Previous Work

The Draft Environmental Impact Report/Environmental Impact Statement (EIR/EIS) for the North Delta Program was released in November, 1990. Since then, DWR has conducted additional studies, and revised project alternatives to reflect current institutional, biological, and engineering constraints. The program was originally initiated in response to reverse flows induced by SWP and Central Valley Project export operations in the south Delta and serious, repeated flooding in the north Delta area, such as the February, 1986 flood and the May, 1972 flooding of Brannan-Andrus Island. Historical records suggest that channel dredging has been undertaken periodically for levee construction and channel enlargement in north Delta channels since the early 1900s.

Project Location

The proposed INDP alternatives are located in the northeastern portion of the Sacramento-San Joaquin River Delta, generally within an area which lies south of Freeport, west of Interstate 5 (I-5), north of the San Joaquin River, and east of Georgiana Slough (Figure II-1).

Channel Names

The Cosumnes River, Dry Creek, and the Mokelumne River converge east of I-5. During high flows, the combined flows of these streams split to pass westward around both the north and south sides of McCormack-Williamson Tract. On the north side, Lost Slough conveys flows to Snodgrass Slough. On the south side, the Mokelumne River flows to the northeastern end of Staten Island, where it splits into two channels, the North Mokelumne River and the South Mokelumne River. The North Mokelumne River flows on the northern and western sides of Staten Island; the South Mokelumne River flows on its eastern and southern sides. The two channels meet again at the southwestern tip of Staten Island, from where the channel is again called the Mokelumne River until it meets the San Joaquin River.

Snodgrass Slough and Dead Horse Cut rejoin the Mokelumne River system at the northern end of Staten Island. They convey flows southward from the Morrison Creek system, the Delta Cross Channel, and as noted earlier, also convey a portion of the flow from the Mokelumne River, Cosumnes River, and Dry Creek.

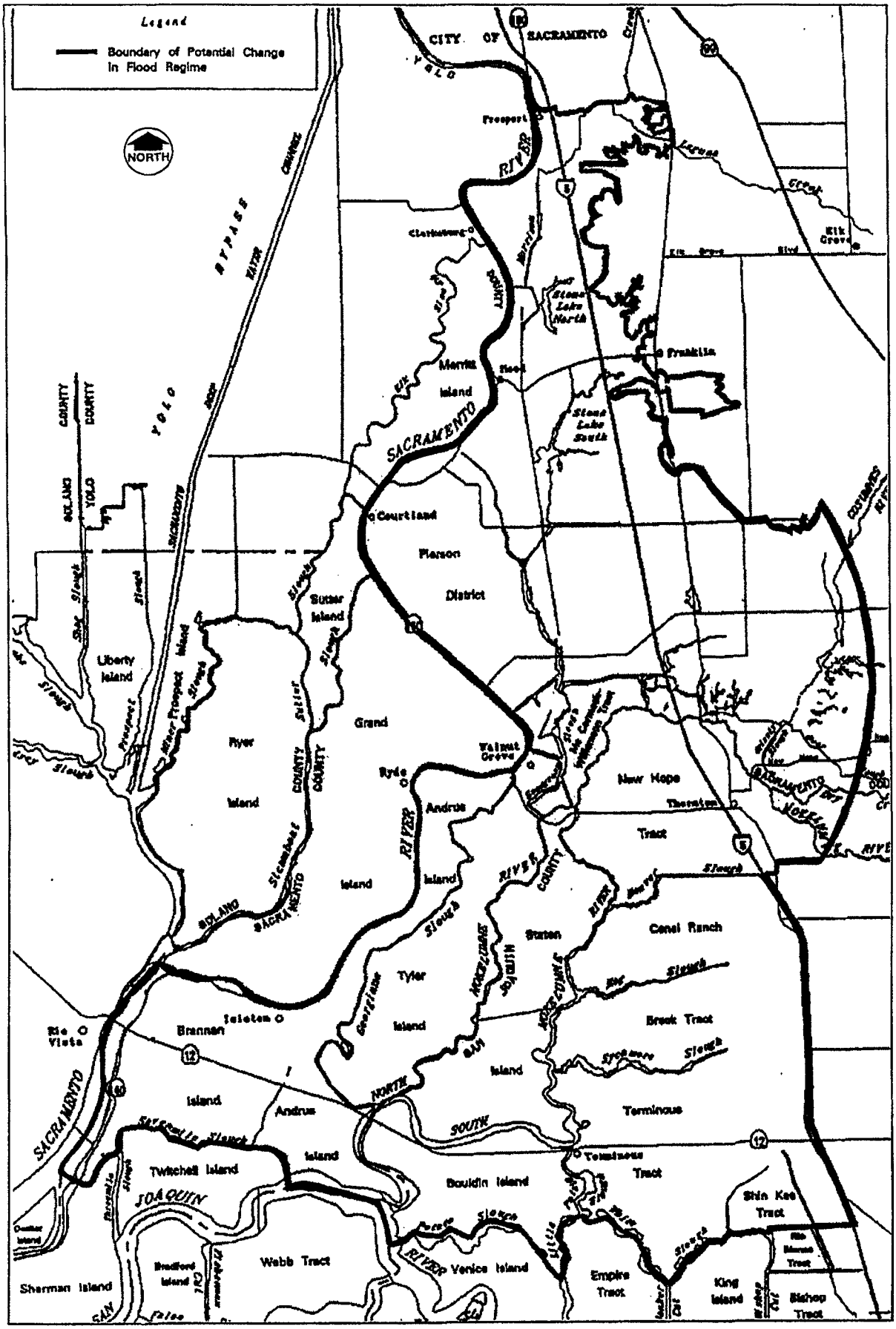

Figure II-1. Interim North Delta Program Area

Program Alternatives

Alternatives considered in detail in the Biological Assessment are identical to those analyzed in the EIR/EIS, with the exception of Alternative 7, the Non-Structural Alternative. Alternative 7 involves other (non-structural) means of accomplishing the goals of the INDP and would not affect biological resources. The alternatives considered in this report are as follows:

1) No Action;
2) South Mokelumne Dredging;
3) South Mokelumne Dredging, North Mokelumne Dredging;
4) South Mokelumne Dredging, North Mokelumne Dredging, and Delta Cross Channel Enlargement;
5) South Mokelumne Dredging, North Mokelumne Dredging, and Screened Diversion at Hood; and
6) South Mokelumne Dredging, North Mokelumne Dredging, Levee Setbacks, and Delta Cross Channel Enlargement.

Each of these alternatives consists of one or more components. To avoid repetitive descriptions of the components which are common to more than one alternative, each of the components will be described in the following sections, first in general terms, then followed by more detailed and technical information on each component.

Based upon currently available information, Alternative 5 has been identified as the preferred alternative. In this Biological Assessment Alternative 5 is referred to as the "Proposed Project".

Summary of Alternative Components

All of the alternatives which involve construction of some sort in the INDP project area consist of various combinations of the following components:

- South Mokelumne Dredging
- North Mokelumne Dredging
- Levee Setbacks
- Delta Cross Channel Enlargement
- Screened Diversion at Hood

South Mokelumne Dredging

Channel dredging and levee improvements would include levee reinforcement, erosion protection, vegetated water-side berms, and levee vegetation best management practices along the following channel segments (Figure II-2):

- Mokelumne River from the San Joaquin River to the junction of the South Mokelumne River and North Mokelumne River.

- South Mokelumne River.

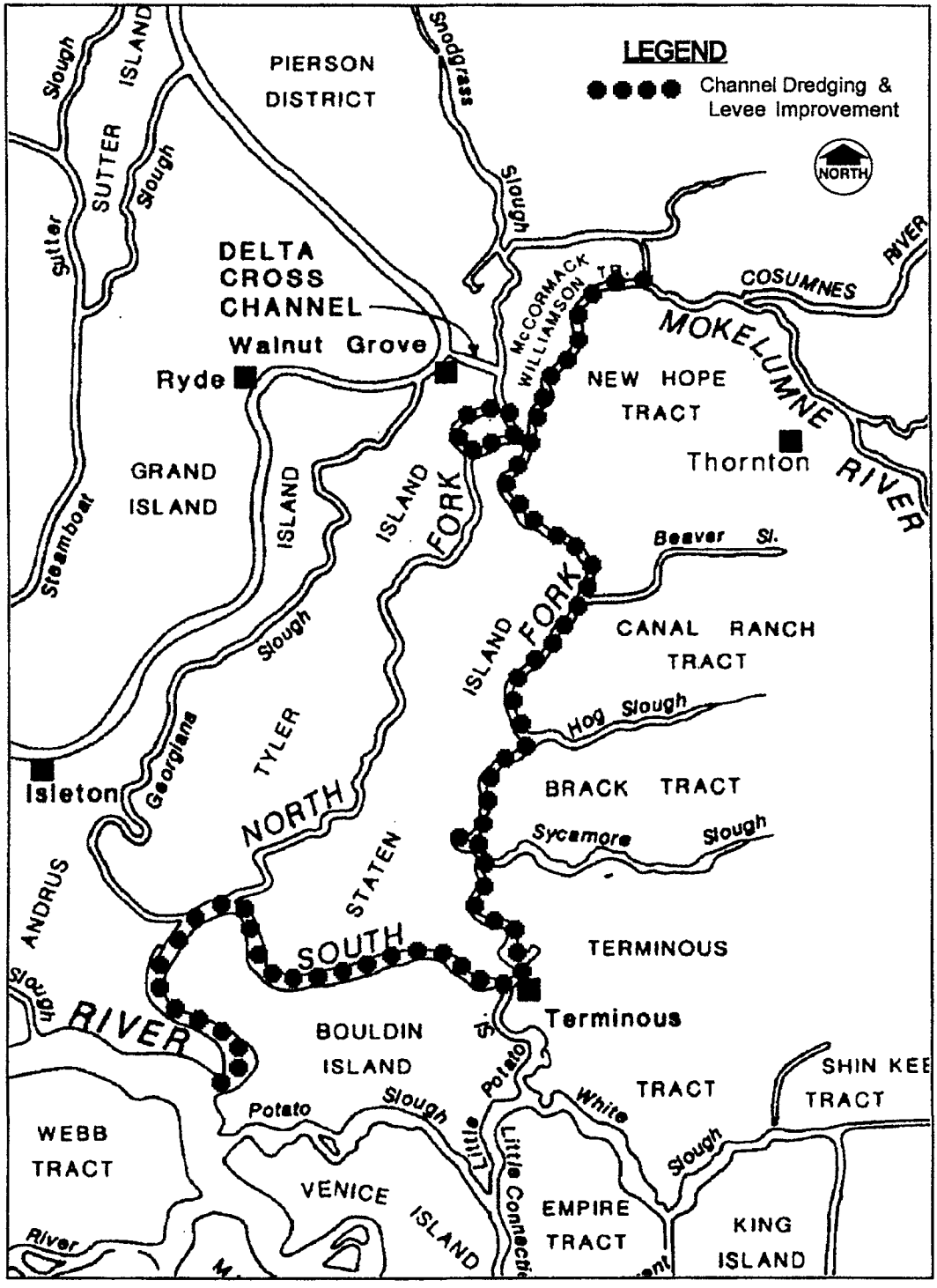

Figure II-2. Alternative 2 - South Mokelumne Dredging

- All the channels surrounding Dead Horse Island, including Snodgrass Slough, Dead Horse Cut, and a portion of the North Mokelumne River.

- Mokelumne River from New Hope Landing upstream to the upstream end of McCormack-Williamson Tract.

North Mokelumne Dredging

Channel dredging and levee improvements would include levee reinforcement, erosion protection, vegetated water-side berms, and levee vegetation best management practices along the North Mokelumne River from its confluence with the South Mokelumne River at the southwestern tip of Staten Island to its confluence with Snodgrass Slough at the northwestern tip (Figure II-3).

Levee Setbacks

This option would include excavating a new parallel channel and constructing new setback levees. Construction of new setback levees would be in lieu of improvements to the levees they would replace when combined with dredging options. Setback levees would be constructed mostly on unconsolidated peat soils along the following channel segments (Figures II-4 and II-5):

- Mokelumne River from the San Joaquin River to the junction of the South Mokelumne and North Mokelumne rivers.

- North Mokelumne River from its confluence with the South Mokelumne River at the southwestern tip of Staten Island to its confluence with the South Mokelumne River at the northeastern tip of Staten Island.

- Mokelumne River from New Hope Landing upstream to the upstream end of McCormack-Williamson Tract.

- Two new bridges would be constructed to cross the new channel, one for State Highway 12 across the lower Mokelumne River, and one for Thornton-Walnut Grove Road across the North Mokelumne River.

Delta Cross Channel Enlargement

Delta Cross Channel enlargement would consist of a new intake channel and a new three-gate intake structure north of the existing Delta Cross Channel (Figures II-6 and II-7).

The Delta Cross Channel enlargement would include the following: a new intake channel, a fish deflector wall, a new bridge, a radial gate control structure, control building and a propane tank buildings, levee embankments, and downstream dredging and enlargement of the existing Delta Cross Channel. Dredging and levee improvements would include levee reinforcement, erosion protection, vegetated water-side berms, and levee vegetation best management practices along Snodgrass Slough from the Delta Cross Channel to Dead Horse Cut.

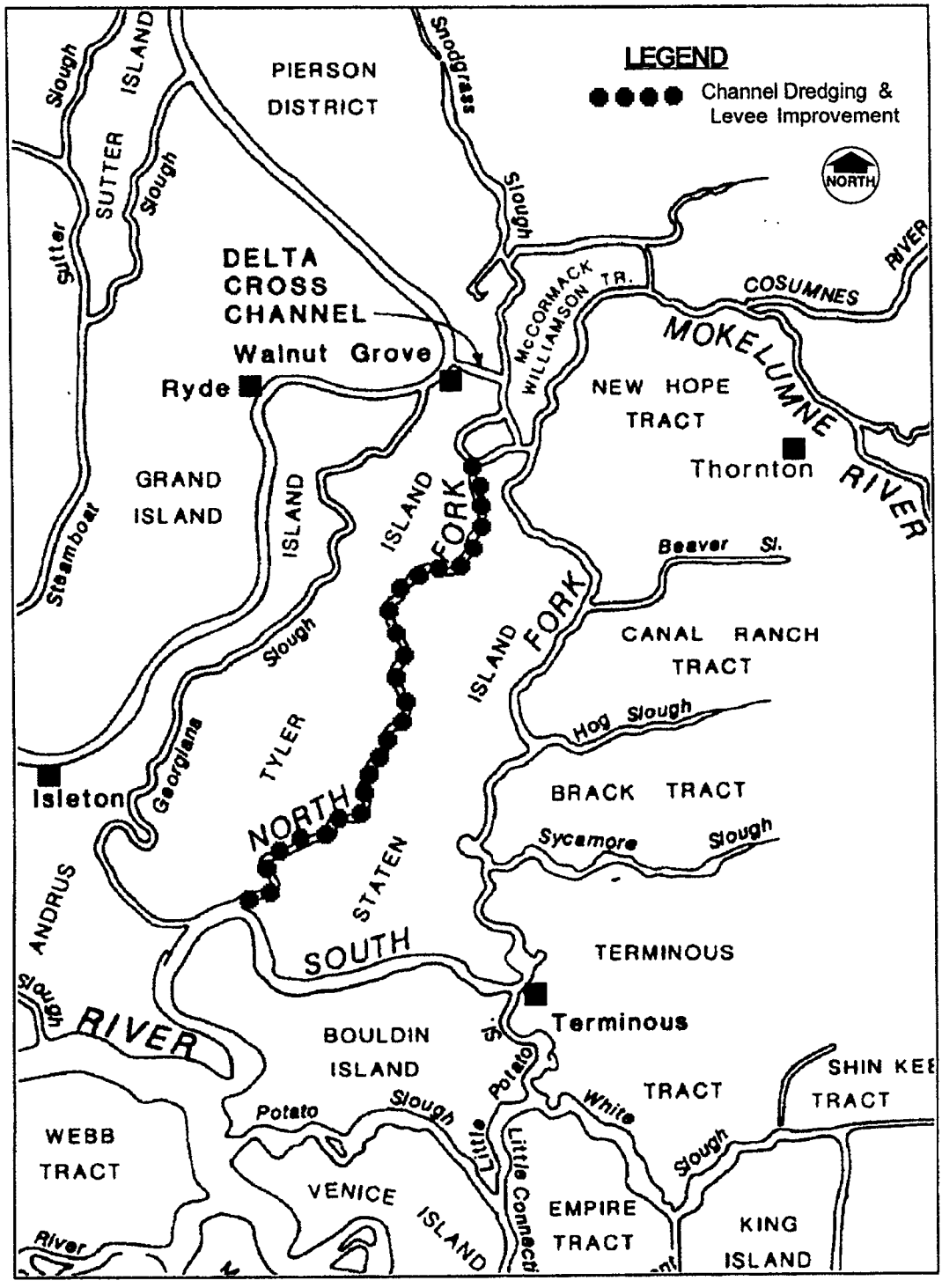

Figure II-3. Alternative 3 - North Mokelumne Dredging

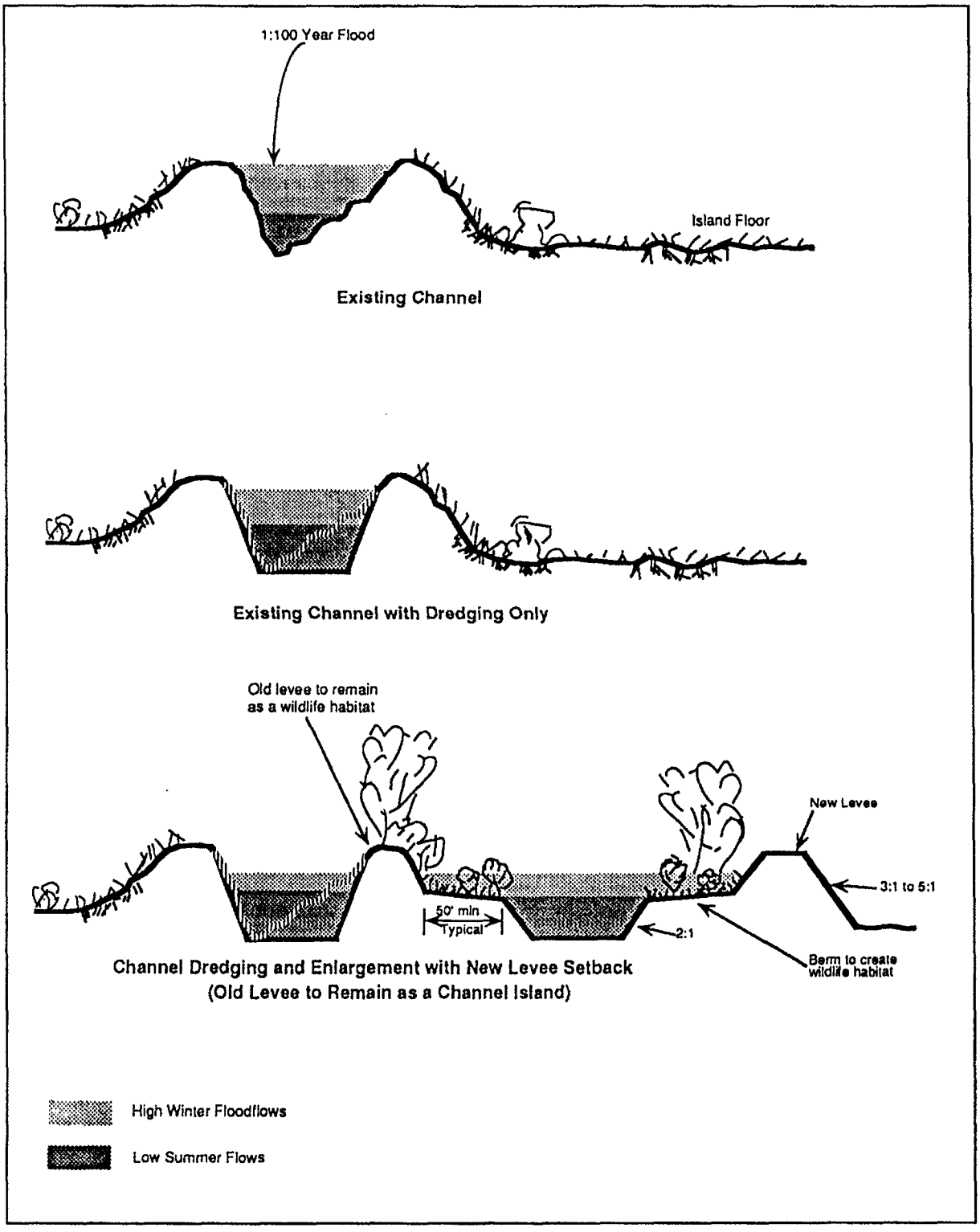

Figure II-4. Levee Setbacks, Typical Cross Section

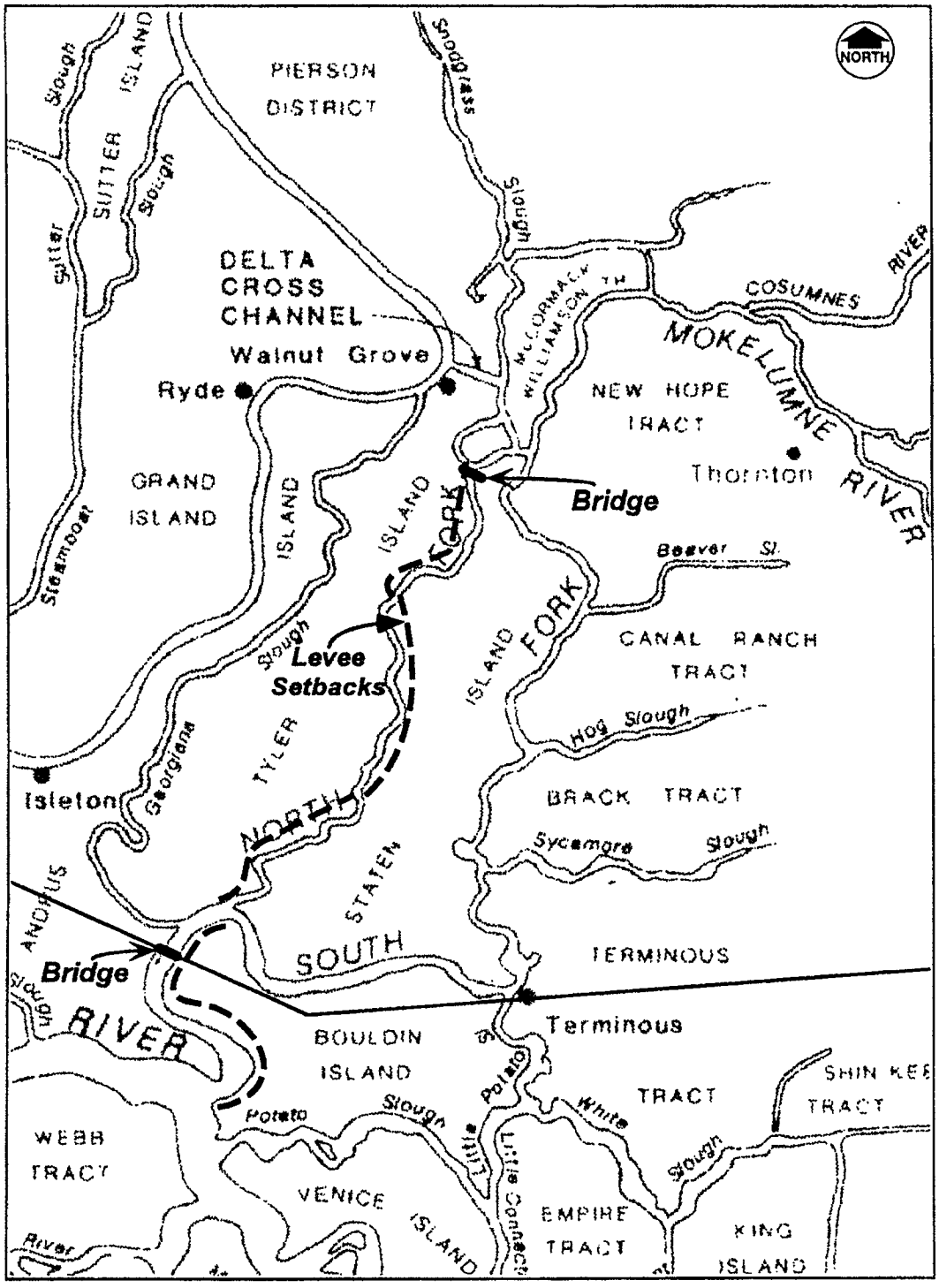

Figure II-5. Levee Setbacks

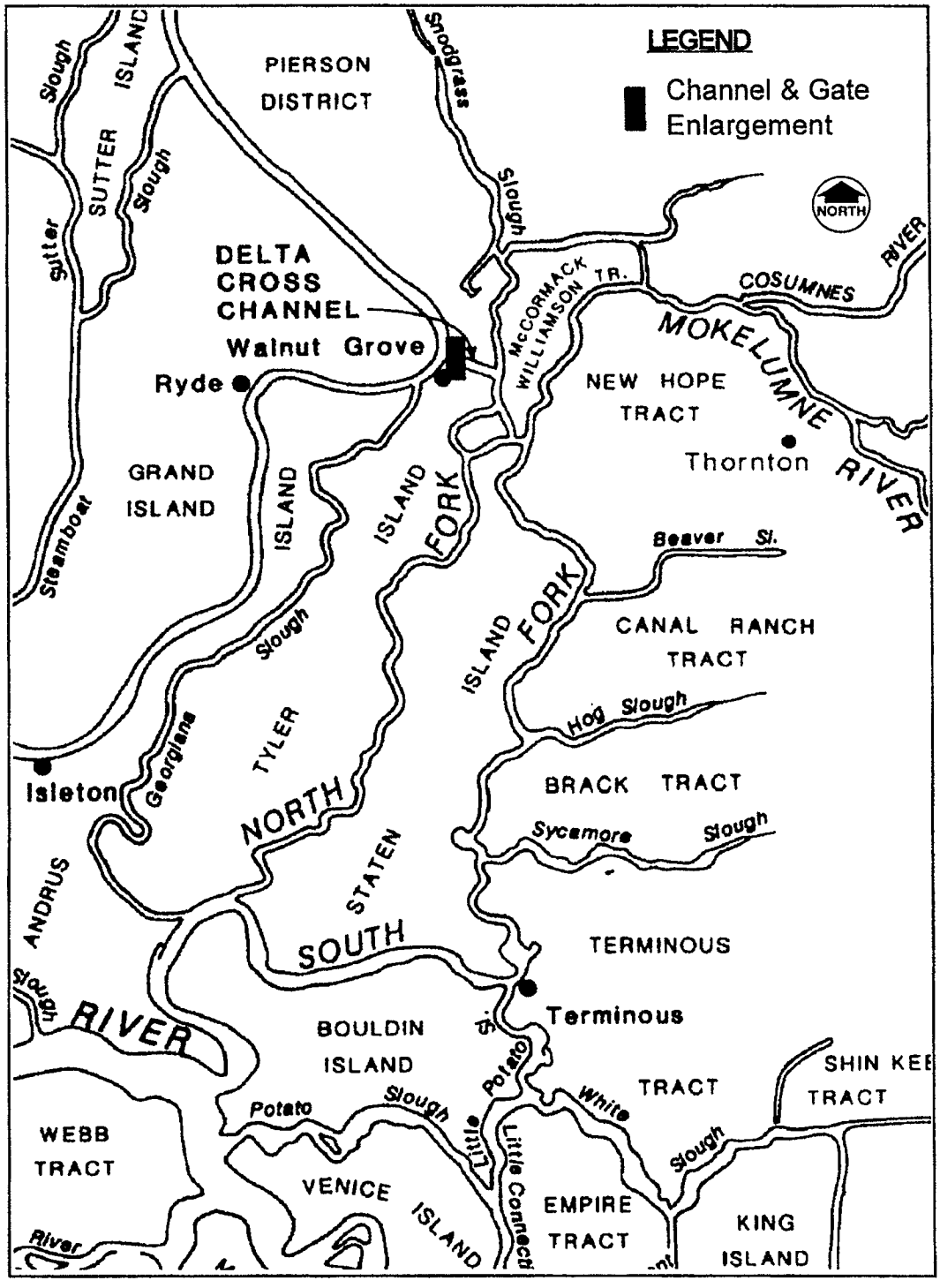

Figure II-6. Delta Cross Channel Enlargement

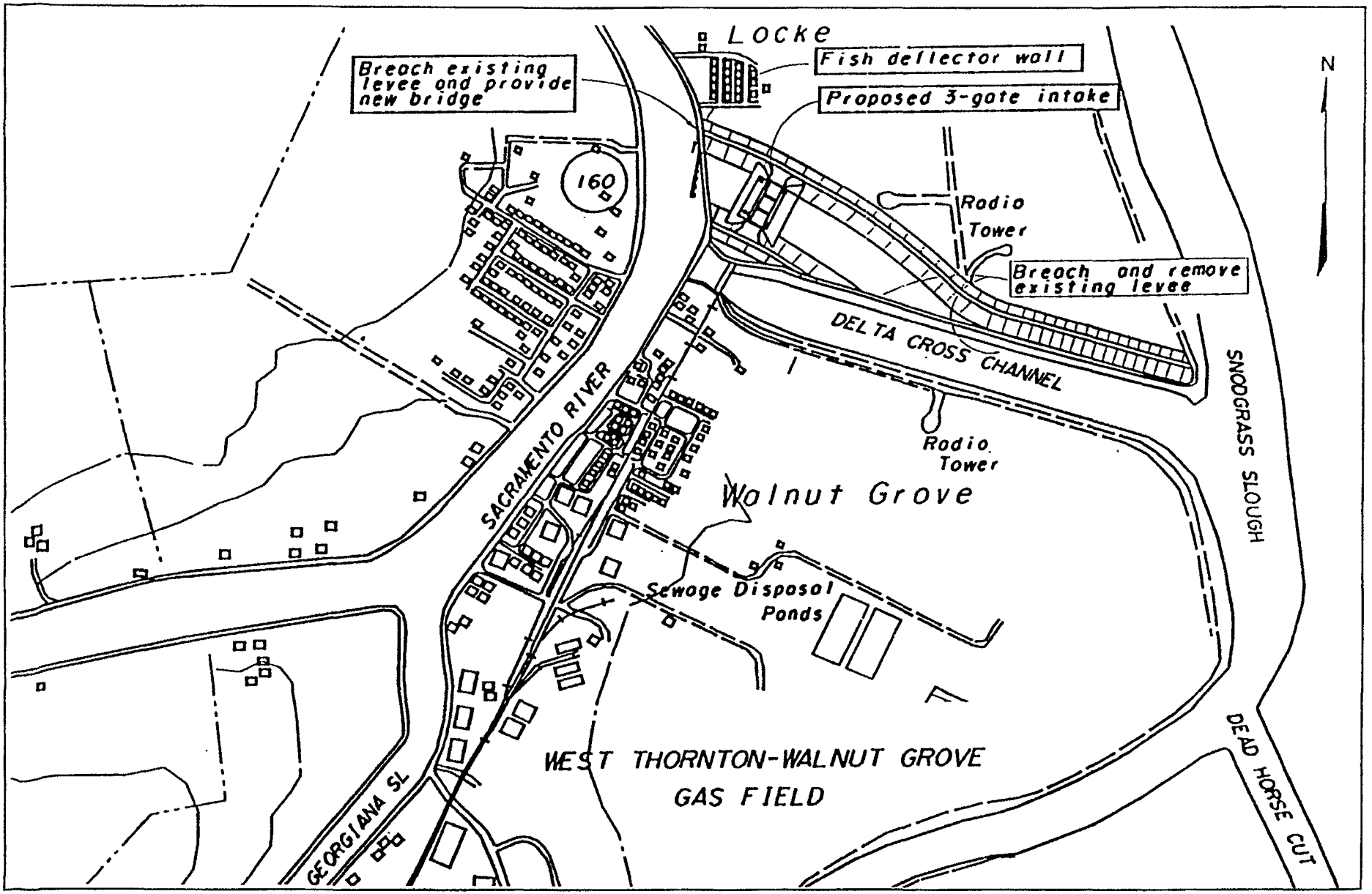

Figure II-7. Delta Cross Channel 3-Gate Enlargement

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Screened Diversion at Hood

The new screened diversion facility near Hood would have a capacity of approximately 2,000 cubic feet per second (cfs). It would divert water from the Sacramento River at Hood into the Mokelumne River system via the Stones Lakes drainage canal (Figures II-8 and II-9). The facility would include a trash rack on the riverbank, a rectangular concrete intake channel, stoplogs to isolate the intake channel from the Sacramento River, vertical folded "V" screens, a sediment trap, a fish bypass and return system, pumps, conveyance pipeline, and an energy dissipator and outfall structure. Facilities for guiding, capturing, and transporting upstream-migrating adults would also be provided. This could include a guide screen, a floating screw trap and live box, and a fish tank truck or live box truck for transporting the adults back to the Sacramento River. A bridge would be constructed for conveying Highway 160 over the intake channel. Access roads, parking facilities, an office, and a maintenance building would also be required.

More Detailed Discussion of Alternative Components and Construction Methods

Channel Dredging

Barge-mounted clamshell dredging is proposed as the preferred method for excavating material from channels and obtaining fill material for levee improvements.

Clamshell dredging provides several advantages important to the north Delta area. Material excavated by clamshell has a much lower water content than that excavated by suction dredge. In addition, the material is typically semi-solid when excavated. Thus, the material can be placed on the land-side levee slope as soon as it is excavated from the channel. Once on the levee slope, it can dry quickly, then be shaped and compacted.

Suction dredging requires that a cascade of large ponds be established to contain and clarify the excess water. Drying is slow, and the material cannot be placed on levee slopes for several months. The excess water must be pumped back into the river channel due to the fact that most lands in the area to be dredged are near, or below, sea level. Finally, large amounts of land would be taken out of production, resulting in both economic and wildlife impacts. For these reasons it is likely that suction dredging would be far more expensive and difficult than clamshell dredging.

The proposed dredging would not extend below a depth of about 20 feet below mean sea level. Dredging would generally follow the existing side slopes, no steeper than two horizontal to one vertical (2:1), while maintaining the existing rip-rap and vegetation as much as possible. The need to maintain levee stability may require a reduction of slopes in some areas.

Channel islands would not be disturbed in order to preserve their integrity as wildlife habitat areas. Channel dredging would be coordinated to ensure that there would not be damage to marinas and/or hydraulic structures.

Increased turbidity in the channels would occur only during the dredging and levee improvement periods. DWR would periodically monitor water quality throughout the dredging operation period in accordance with a monitoring plan approved by the Regional Water Quality Control Board.

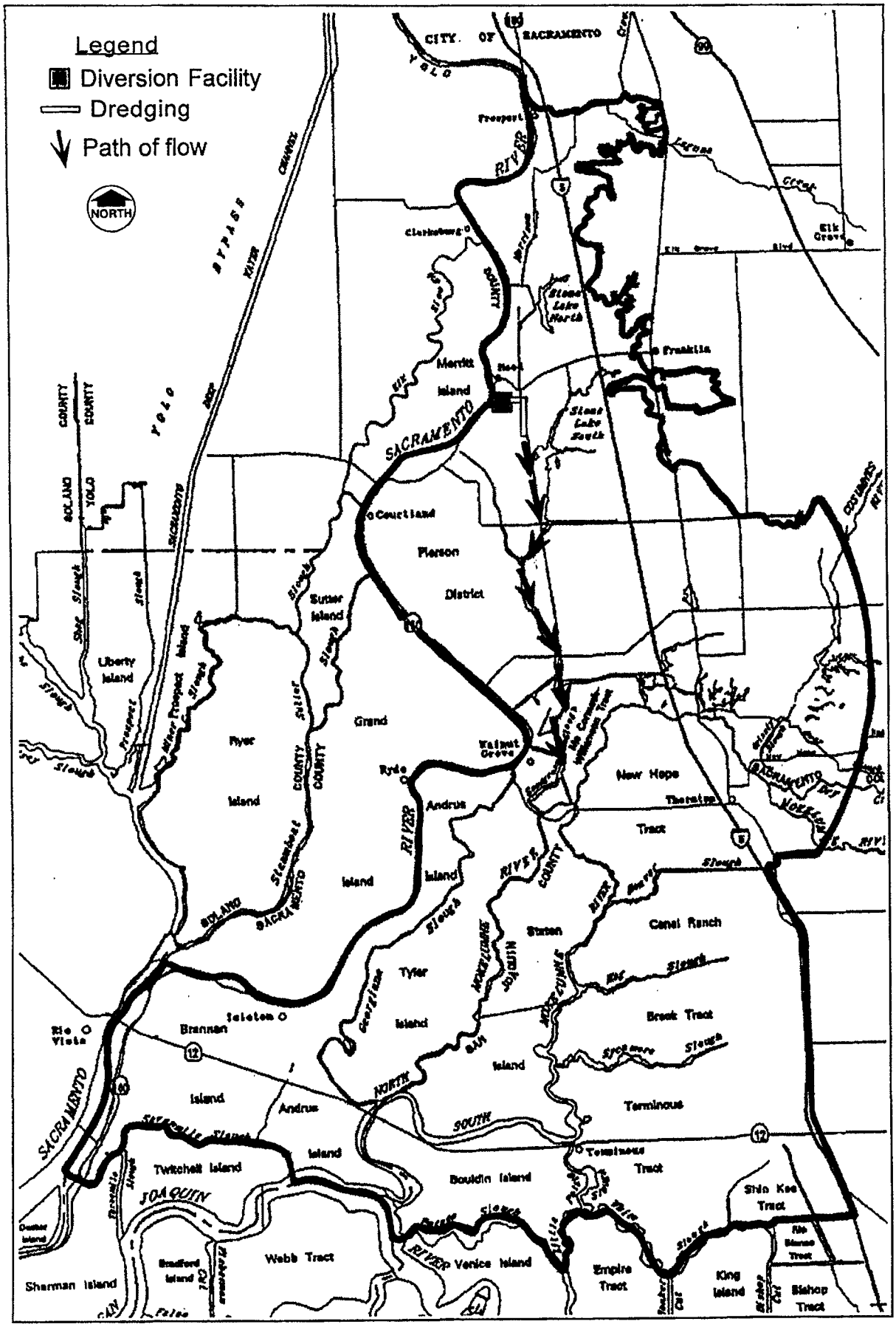

Figure II-8. Screened Diversion at Hood

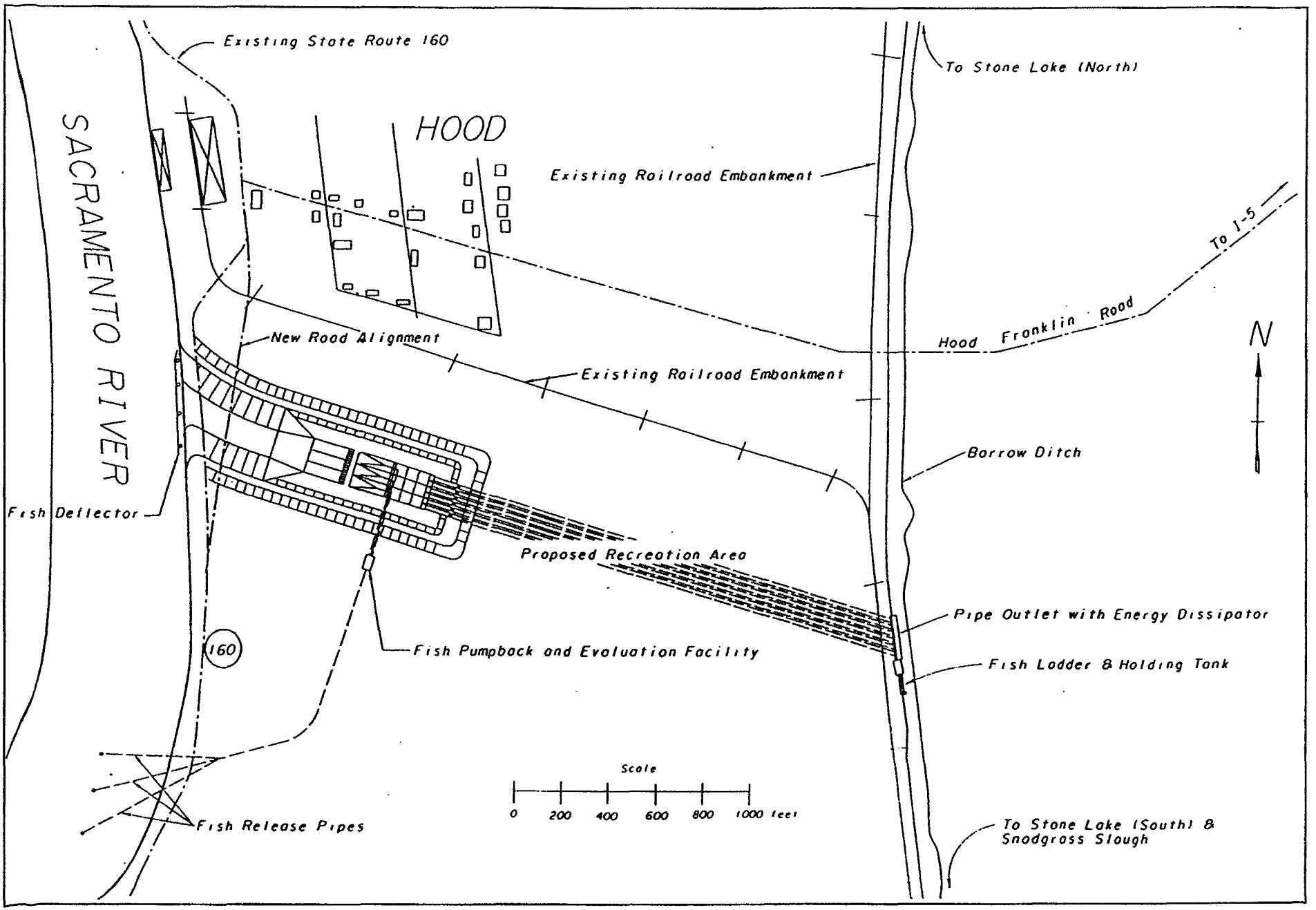

Figure II-9. Fish Facility Layout

Levee Reinforcement

With a combination of clamshell dredger and a barge, the dredged material from the channel would be either deposited directly by clamshell on the appropriate disposal locations or loaded onto barges and transported to the disposal locations. The dredged material would be used to improve the land-side slope of existing levees, construct land-side slope stabilizing berms, repair shoreline erosion sites, and create vegetated water-side berms where appropriate. In general, the area of material placement would include the levee crown and a band extending about 150 feet landward from the levee crown shoulder (Figure II-10).

With a combination of clamshell and barge in the water and front end loaders, bulldozers, graders, vibrating compaction equipment, and other earth moving equipment on the ground, the dredged material from the channel would be placed on the land-side levee slope and in land-side berms to improve levee stability. A filter/drain system consisting of a drain fabric, a drain rock, and lateral drainage pipes connected to a perforated pipe, would be inserted in the land-side levee, if required.

After placement, the dredged material deposited on the land-side levee slope would require grading to achieve correct slopes, which would vary from 2:1 to 5:1. The dredged material placed in the land-side berm would require contouring to create a land-side stabilizing berm. This berm would be approximately three feet thick. Some construction material, such as soil and drain rock, would be imported with dump trucks.

During the construction of land-side levee improvements, DWR would require the contractor to comply with local, state, and federal noise and air quality ordinances and to minimize adverse effects. The contract specifications would also require the contractor to apply appropriate dust control measures on detours and operating roads.

Earthmoving equipment such as loaders, bulldozers, graders and compacting equipment would be transported by trucks to the job sites to help place, shape, and compact the dredged material. Trucks would deliver the construction material to the construction sites at designated lay down areas. At the end of every work day, construction equipment would be parked at the construction site. Other equipment and material would be laid down on, or stored in, one of the selected staging areas.

Erosion Protection Methods

Existing riparian vegetation would be protected and enhanced wherever possible. However, experience has shown that vegetation alone is not enough to protect fragile Delta levees from erosion due to wave wash, tidal currents, and flood flows. Isolated areas of active erosion and slippage need to be repaired and protected. In addition, levees can be made more stable and erosion resistant, while at the same time provide an additional substrate for riparian or shallow water habitat, through the use of vegetated water-side berms.

Rip-rapping has traditionally been used to protect levee slopes from erosive currents and wave wash in the Delta. It consists of placing broken rock in the size range of one to 20 pounds on the levee slopes by use of clamshell or dragline. It has proven to be the most economical and flexible technique. However, the rip-rap is vulnerable to loss of underlying levee material when waves break against the shoreline, pumping jets of water between the rocks. The eventual loss of fine material

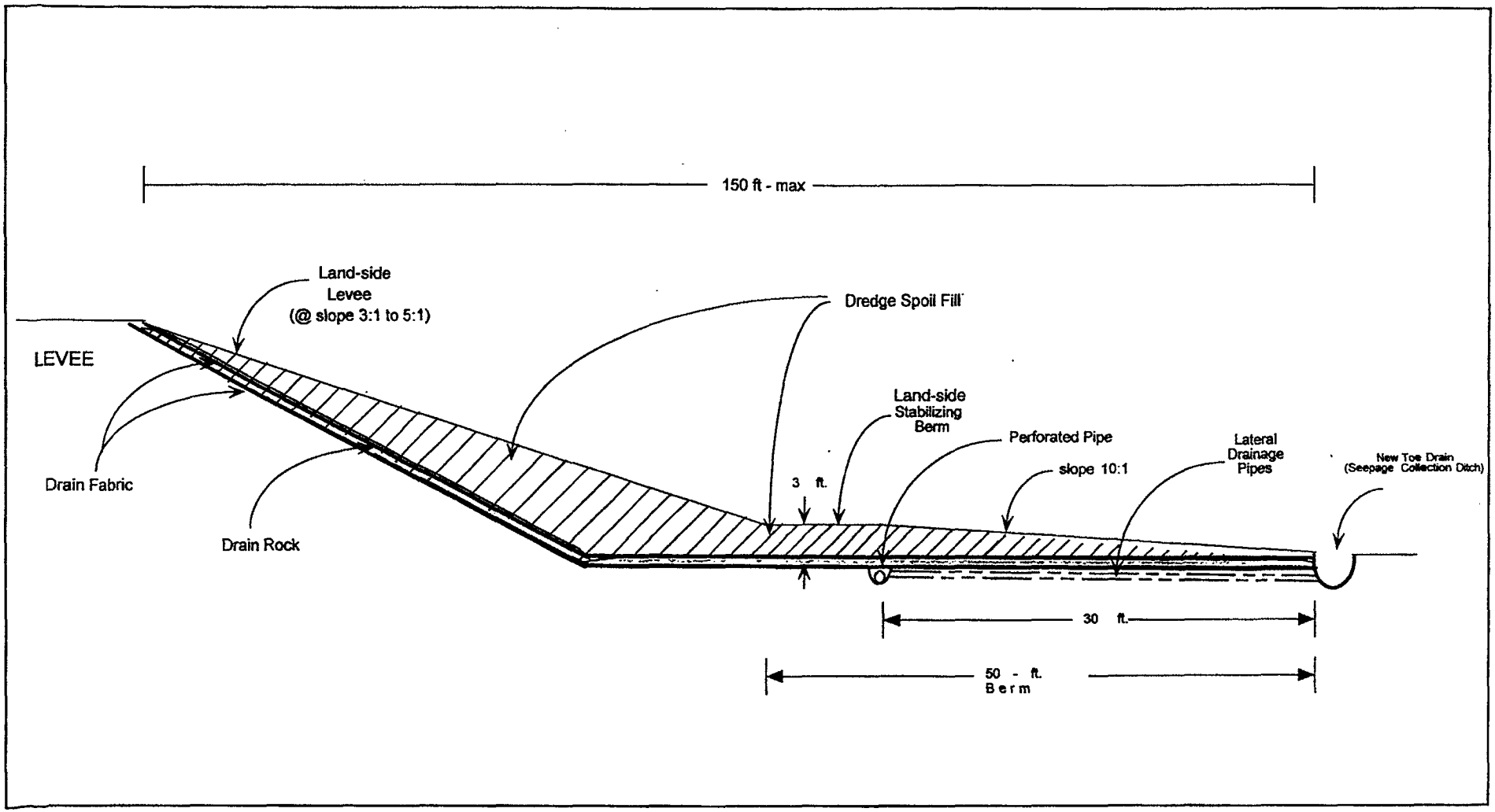

Figure II-10. Levee Reinforcement

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through this pumping action undermines the rock and results in slippage. Once the underlying levee is exposed, erosion accelerates.

When a layer of construction fabric is placed underneath the rock layer, it effectively retains the fine levee material and thus improves the effectiveness of the rip-rap layer. It is anticipated that for most areas where additional erosion protection is required, this system would be used (Figure II-11).

In areas of exceptional erosion potential, other, more expensive and effective protective systems may be employed on a case-by-case basis. These include interlocking concrete blocks, synthetic mats to help hold rooted plants, gabions, fabric bags, and other systems.

Vegetated Water-Side Berms

Vegetated water-side berms can improve levee stability, increase erosion protection and enhance riparian or shallow water habitats. Various construction techniques have been tried by the U.S. Army Corps of Engineers along project levees and by Reclamation Districts in the Delta.

A recent 3-year project along the levees of Staten Island has included over 4,000 feet of berm construction. The berms were constructed by placing a rock prism about 15 feet from the existing shoreline, placing a layer of construction fabric on the bottom and over the rip-rap, backfilling between the rock and the levee with dredged material, and wrapping the construction fabric back over the dredged material (Figure II-12).

A similar approach is proposed for berm construction associated with the INDP. A barge-mounted dragline or clamshell would be used to place the rip-rap and dredged material to construct the berms. In general, the rock dike would be raised to a height of about one foot above the mean high tide, so that the berm would be kept moist and the outer zone of the new berm would occasionally be subjected to inundation. The berm elevation could be varied to create a range of microhabitats, including protected shallow water habitat, tidal wetland, riparian scrub shrub, and riparian forest.

Following construction of the new water-side berm, cuttings would be inserted into the surface of the new berm to accelerate growth of desirable riparian or shallow water vegetation species. Experience with this construction approach has shown that the berms revegetate rapidly. A temporary increase in surface erosion may occur due to channel flow, rain, and wind until a new vegetation cover is established. This erosion could be mitigated by planting at the appropriate times of the year.

Local water quality problems, such as increased turbidity, would occur for a short time in the channel due to dropping and positioning of rock along shorelines. This impact would be extended through the dredging and levee improvement periods only.

Levee Vegetation Best Management Practices

Vegetation management along levees in the project area is an important tool to be used in conjunction with other techniques to reduce wave damage to levees. Management of vegetation on levee slopes is important for levee inspection, erosion protection, wildlife habitat value, and aesthetics. The preferred vegetation consists of grasses and herbaceous cover, which can be rapidly established by hydroseeding. Maintenance methods to retain the preferred cover may include periodic

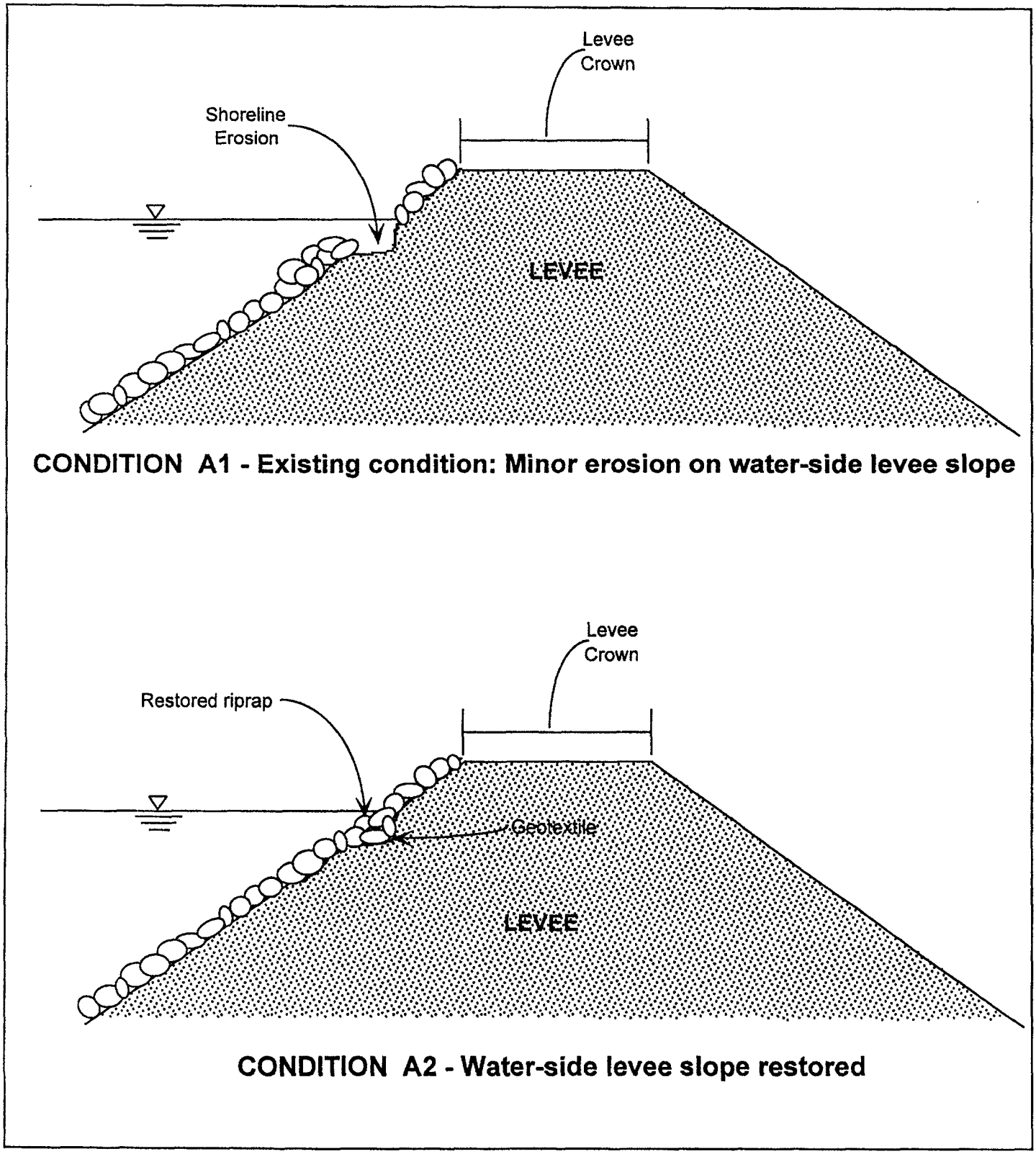

Figure II-11. Erosion Protection

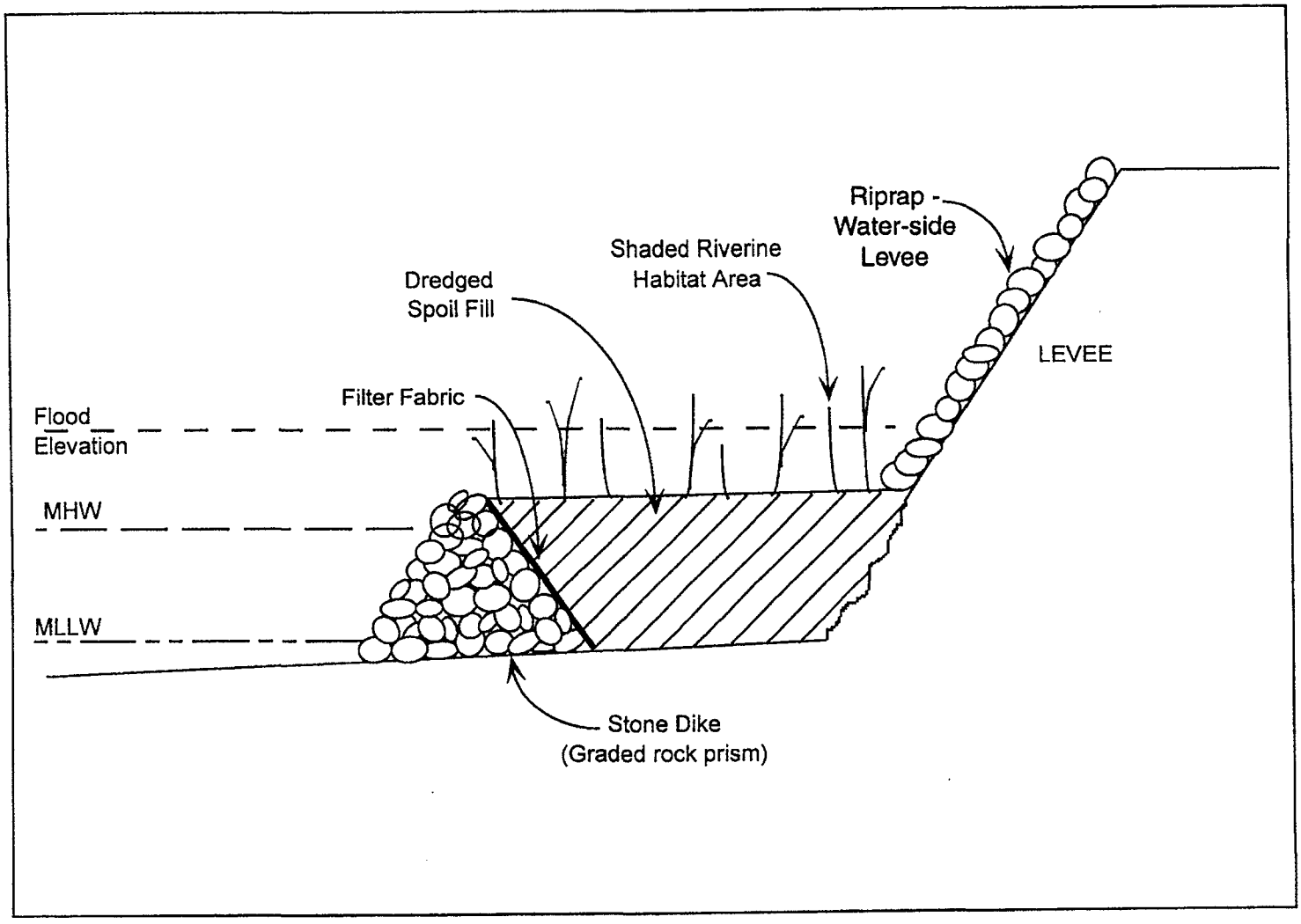

Figure II-12. Water-Side Berm, Typical Section

removal of new woody vegetation on both water-side and land-side slopes, selective grazing, mowing, use of herbicides, and periodic re-seeding.

Levee Setbacks

Setback levees are levees constructed inland from an existing levee, running parallel to the existing levee, but set back on the land-side an appropriate distance. A new channel would be excavated between the new and existing levees (Figures II-4, II-5, and II-13 through II-18). The setback levees would be constructed on generally weak, unconsolidated peat, sand, and clay foundations.

The old levees would be left in place as channel islands to provide channel separation, high quality riparian habitat, and destination points for recreational activities. Water-side levee slopes would be protected with rip-rap, normally placed between the low water and high water elevations to guard against erosion (see Figure II-11).

Setback levees would alternate from one side of the channel to the other depending on existing vegetation, soil conditions, public utility facilities, distance to borrow sites, and location of structures, such as homes, silos, and marinas.

In addition to the new setback levee, the dredged material from the existing channel bottom would be transported by a combination of clamshell and barge, and deposited on the land-side of existing levees or on the new levees, or to create vegetated water-side berms.

The foundation materials on which the new levees would be constructed are composed of unconsolidated peat, clay, silt, and sand soils with depths of peat soils varying from 0 feet in the northern limit of the proposed levee setbacks to approximately 20 feet in the southern portion of both Staten and Tyler islands and on Bouldin Island.

The total length of the setback levees and the new parallel channels would be 16.5 miles. This component would require an estimated 7.0 million cubic yards of borrow materials of which 5.5 million cubic yards would be imported from outside the project area and the remaining 1.5 million cubic yards would be borrowed from channel excavation. Imported materials would be hauled to the project area by trucks.

For the new parallel channels and setback levees, it was estimated that 1,041 acres of land would be acquired from McCormack-Williamson Tract, Dead Horse Island, Tyler Island, Staten Island, and Bouldin Island. The 1,041 acres would consist of the lands between the land-side toe of the proposed setback levees and the existing channels.

The cross-sectional area of the new channel, plus the existing North Mokelumne River, would be about 8,000 square feet. The maximum depth of excavation would be limited to 20 feet below mean sea level for both the existing and the newly constructed channels, with water-side slopes no steeper than 2:1. The side slopes of the setback levee would vary from 3:1 to 5:1 on the land-side, depending on the depth of underlying peat in the foundation.

Setback levees would be constructed over generally poor foundations of unconsolidated materials. In the southern portion of the project area layers of peat, poorly consolidated clays, silts, and sands create particularly poor foundation conditions. In order to induce controlled foundation consolidation,

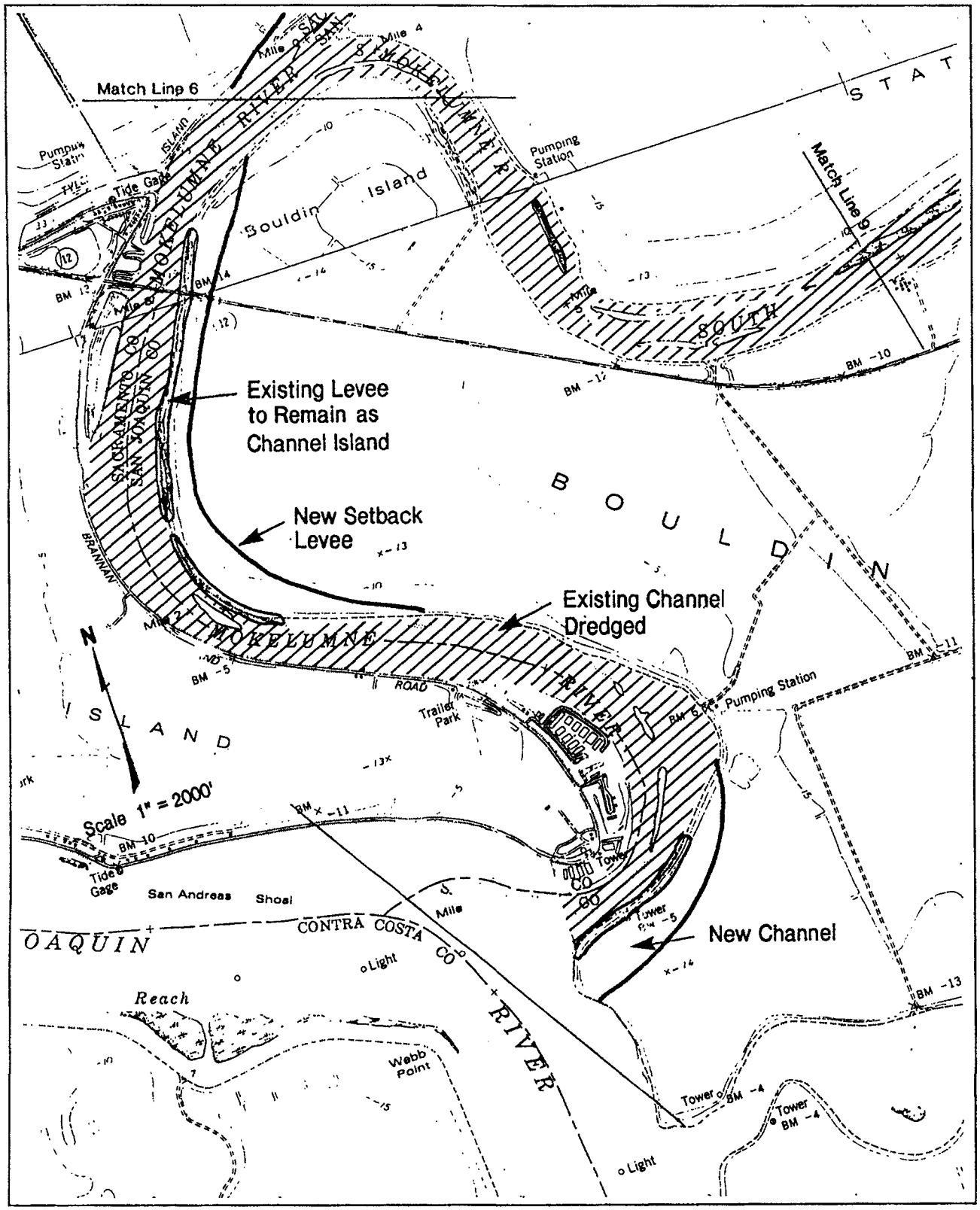

Figure II-13. Levee Setbacks

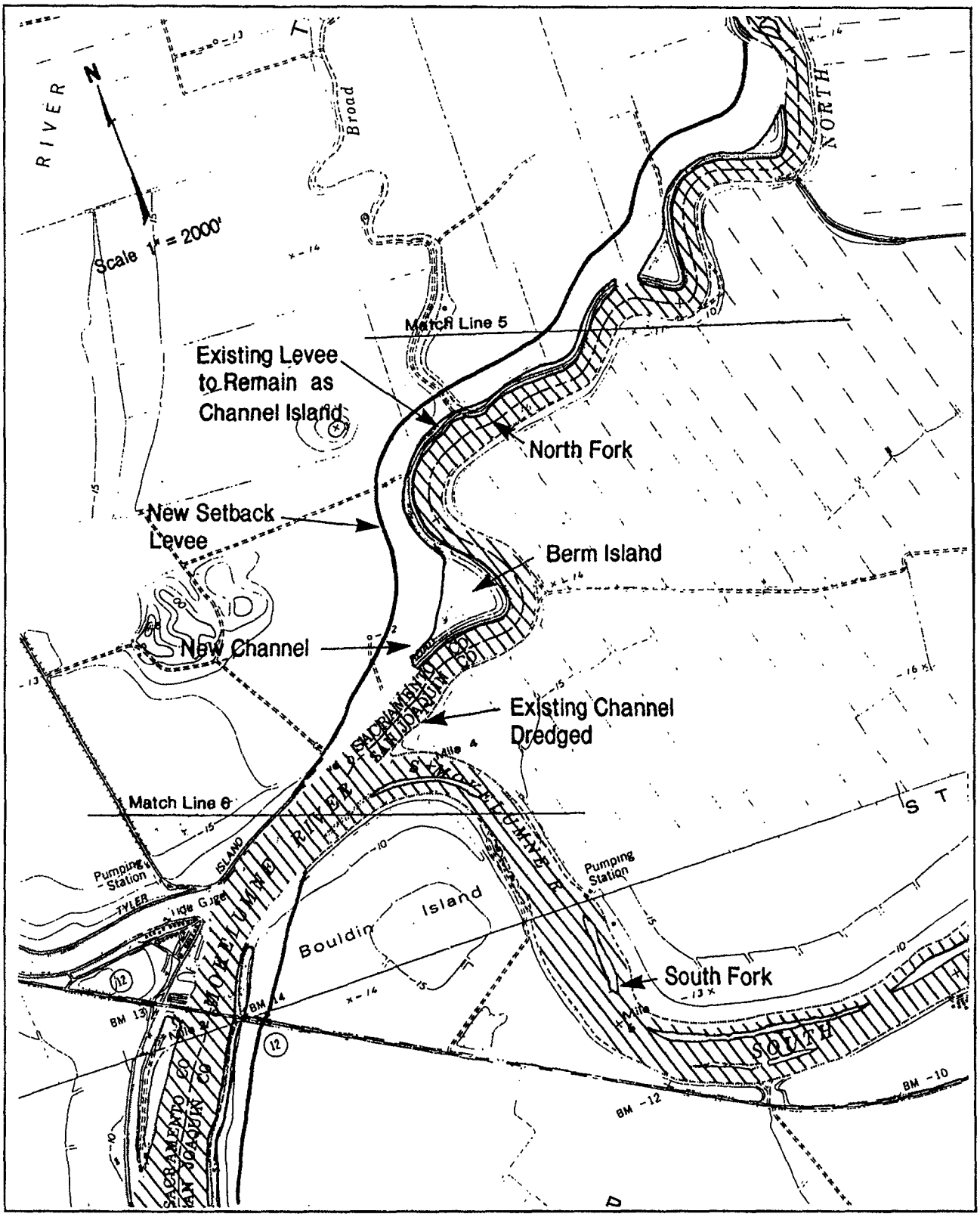

Figure II-14. Levee Setbacks

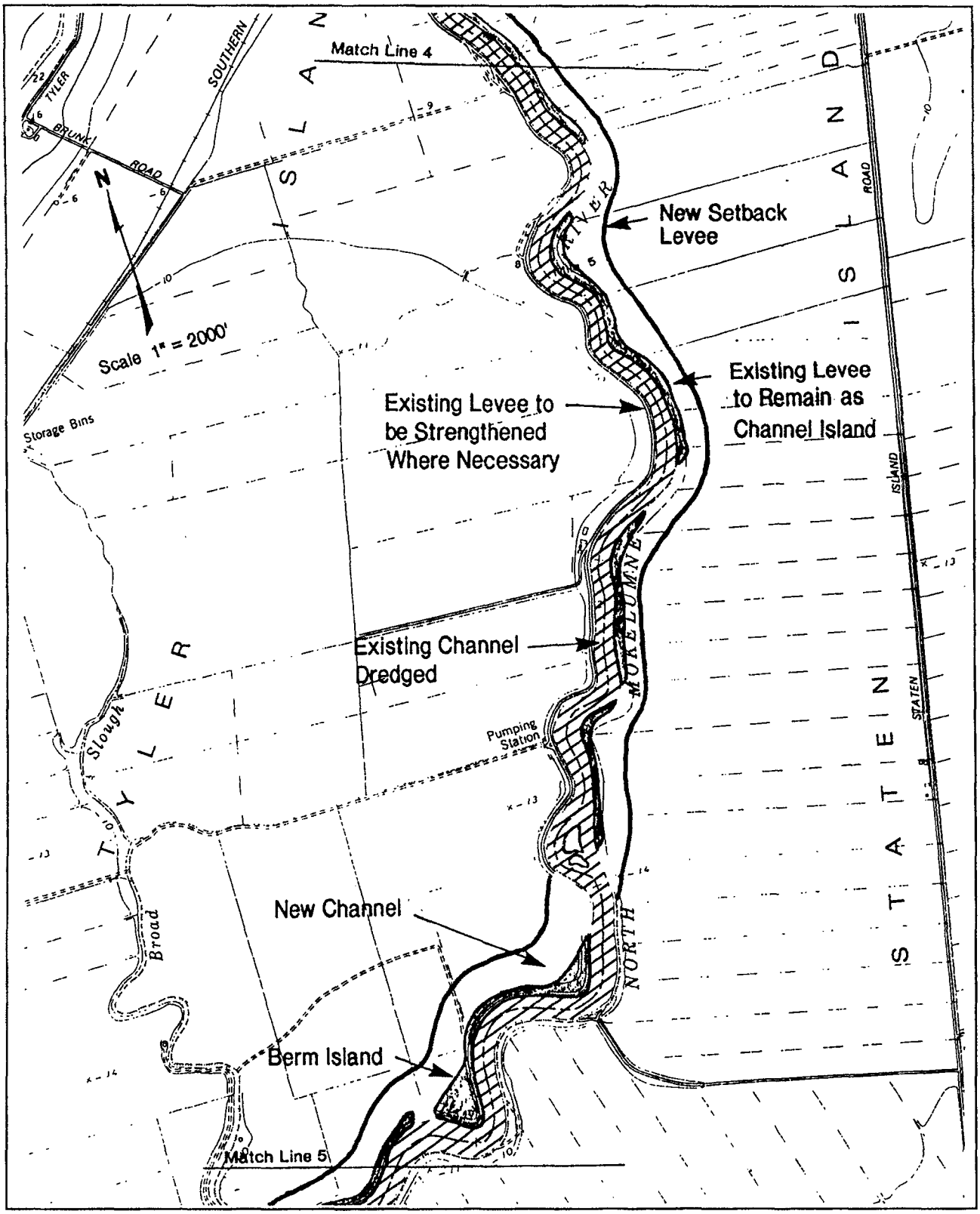

Figure II-15. Levee Setbacks

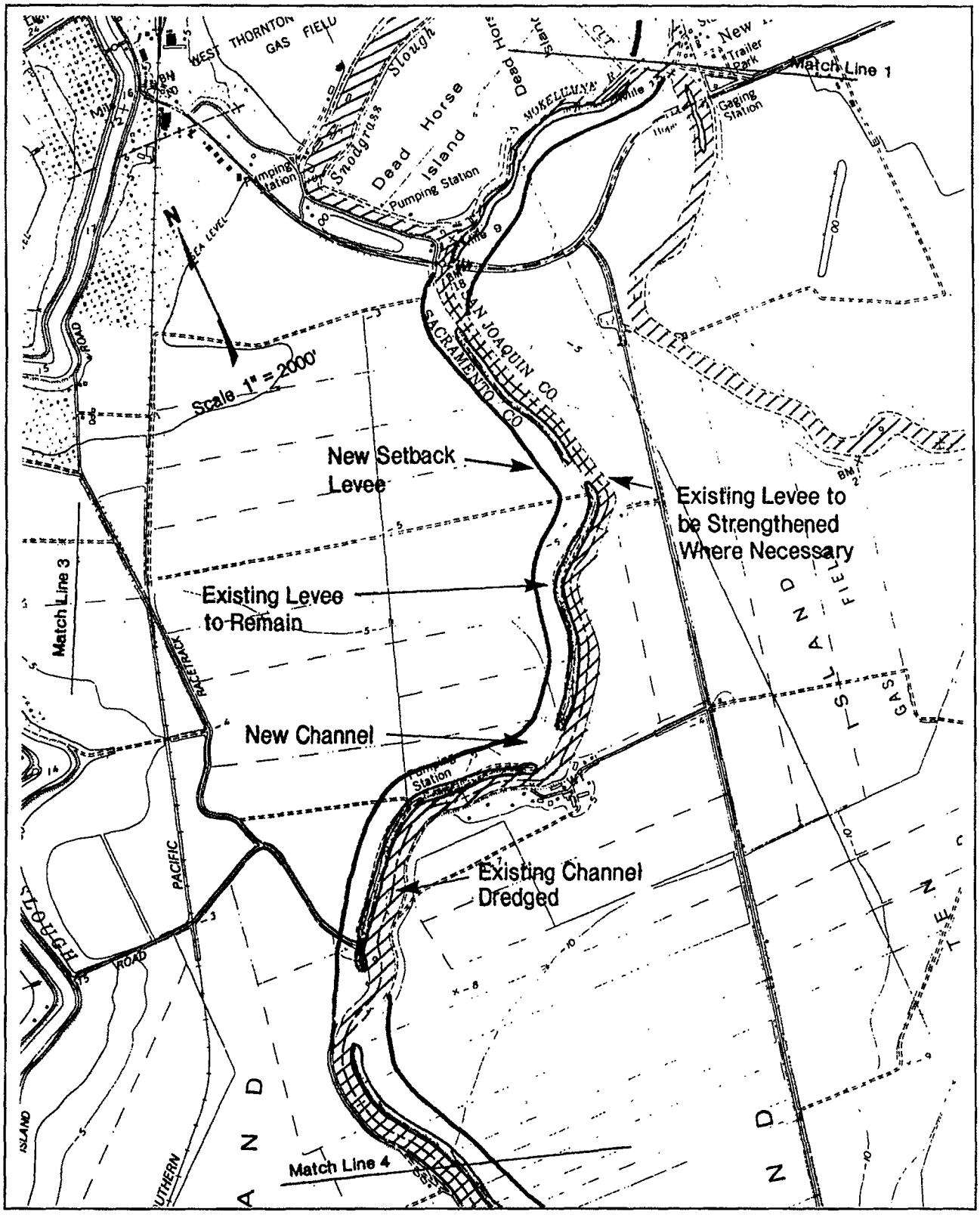

Figure II-16. Levee Setbacks

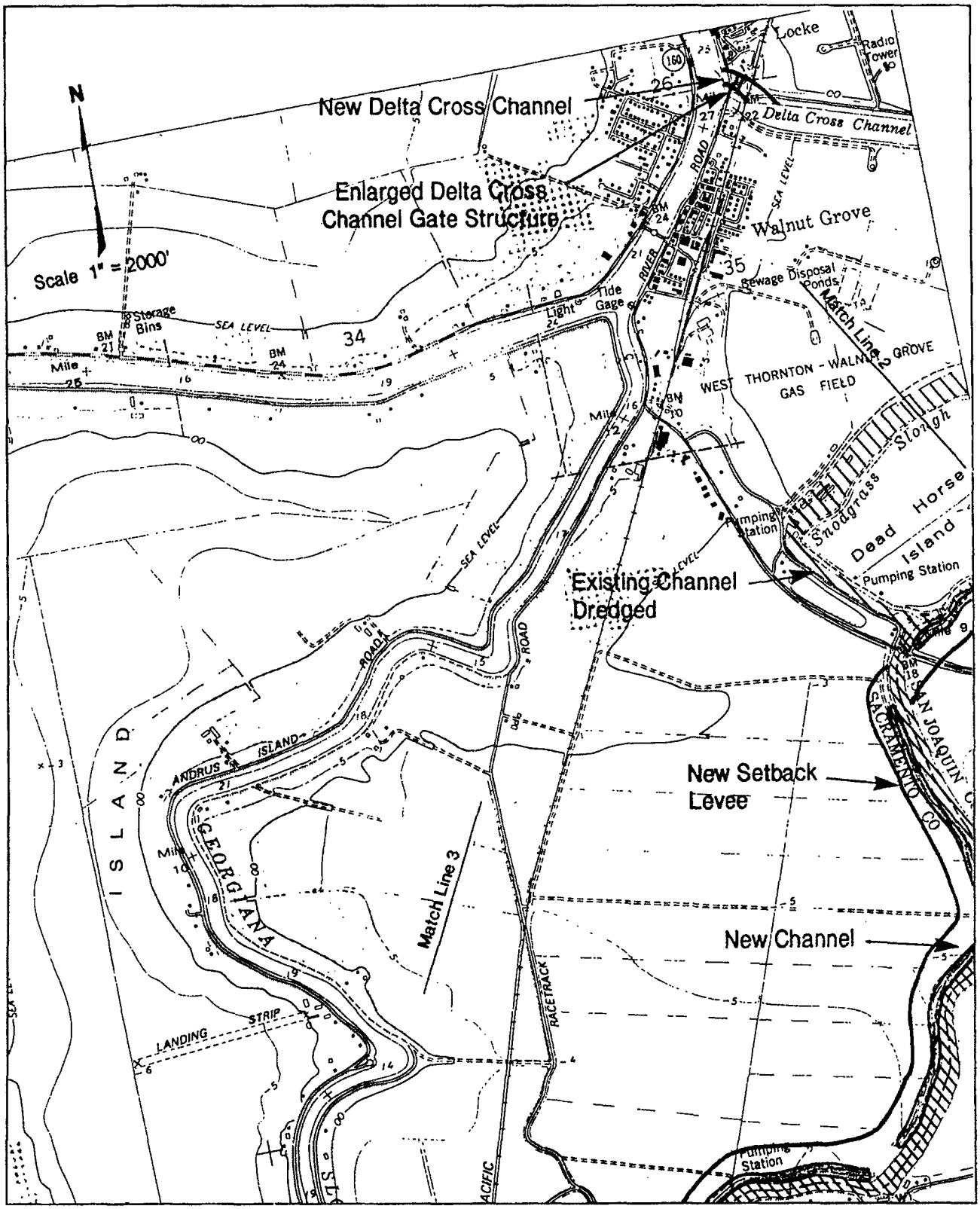

Figure II-17. Levee Setbacks

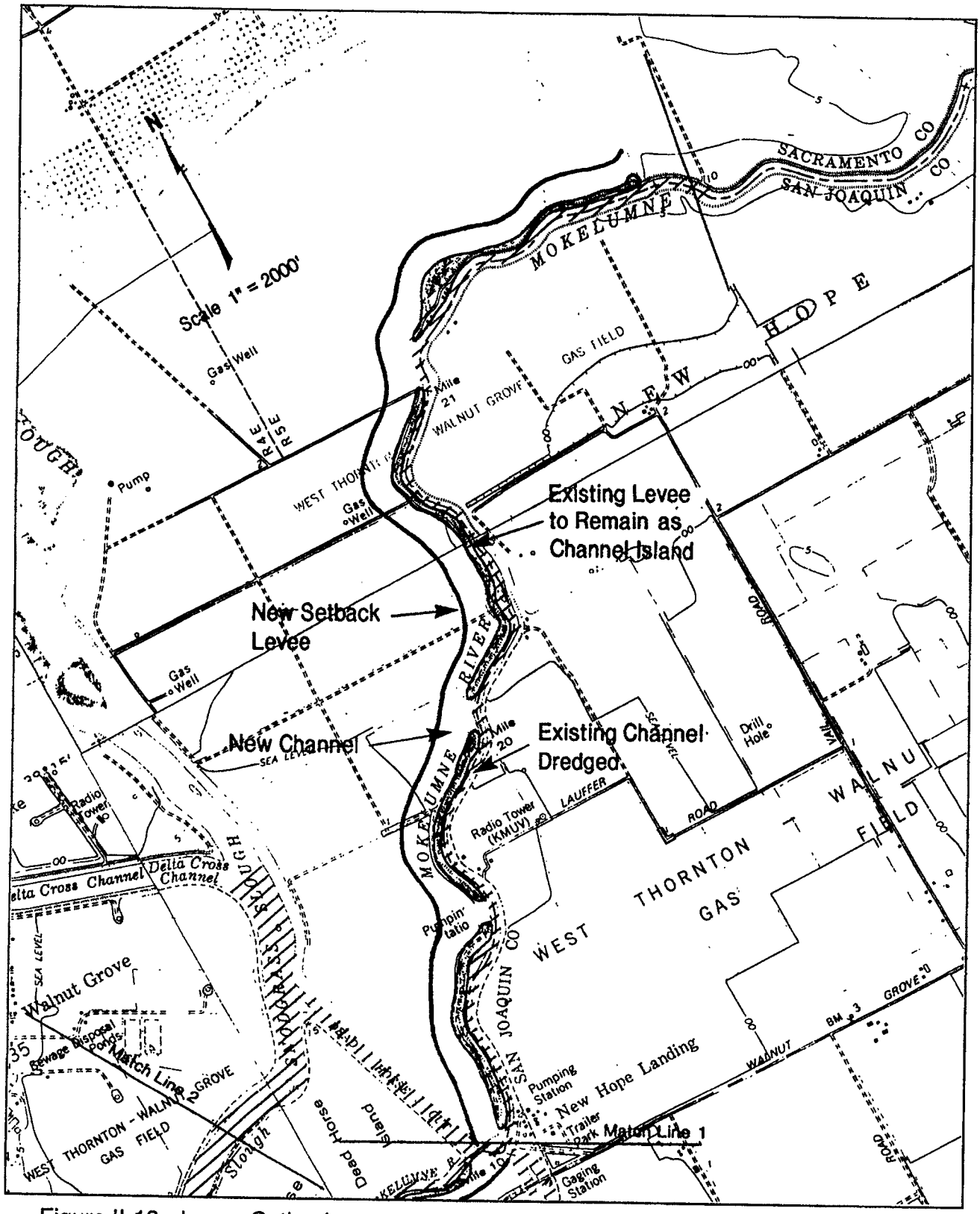

Figure II-18. Levee Setbacks

the new levees would need to be constructed in a series of lifts, spread over three to five years. It is anticipated that fairly rapid consolidation would continue for a decade after initial construction, requiring periodic repair and addition of levee embankment material to maintain proper levee elevations.

The new channel area between the old levee and the new setback levee would be filled with water using siphons, with careful monitoring during the filling process. The existing levees would be breached only after monitoring of foundation, embankment, and seepage conditions indicates that the setback levees are stable and secure.

There is a great deal of uncertainty regarding the feasibility of constructing large setback levees on unconsolidated peat, clay, silt, and sand foundation conditions. A multi-year setback levee test program would be required to verify construction methods prior to implementing this alternative.

A new two-lane bridge would be required on Thornton-Walnut Grove Road to span the enlarged channel. The west end of the new bridge would be built next to the east end of the existing bridge, which is located along Walnut Grove Road, at Staten Island, over the North Mokelumne River, 280 feet downstream of its confluence with Snodgrass Slough. The new bridge would be approximately 40 feet wide by 500 feet long (Figure II-19). The main part of the new bridge would be similar to the existing one.

The State Highway 12 bridge over the Mokelumne River would also be extended to span the enlarged channel. The new bridge would be approximately 50 feet wide by 500 feet long (Figure II-20).

For the construction of the new bridges, after consultation with the DWR project manager, the contractor would select appropriate sites for staging areas. An estimated nine acres of land would be impacted for the bridge extension on State Highway 12 on the lower portion of the Mokelumne River (Figure II-20).

The construction material and equipment for the new bridges would be transported to the construction sites by truck. At the end of every work day, non-portable construction equipment would be parked at the construction site. Other equipment and material would be laid down on, or stored in, one of the selected staging areas.

During construction of the new bridges, DWR would require the contractor to comply with local, state, and federal noise ordinances and to minimize fugitive dust by watering. The contract specifications would also require the contractor to apply appropriate dust control measures on detours and operating roads. Road safety regulations would be obeyed.

Local water quality problems, such as increased turbidity, may occur during foundation preparation.

Delta Cross Channel Enlargement

The new intake channel would be constructed approximately 300 feet north of the existing channel (Figures II-21 through II-23). The cross-section of the new intake channel would be trapezoidal with side slopes of 2:1, horizontal to vertical, with an approximate base width of 195 feet. Invert elevation of the new intake channel would be approximately 15 feet below sea level. This new intake channel

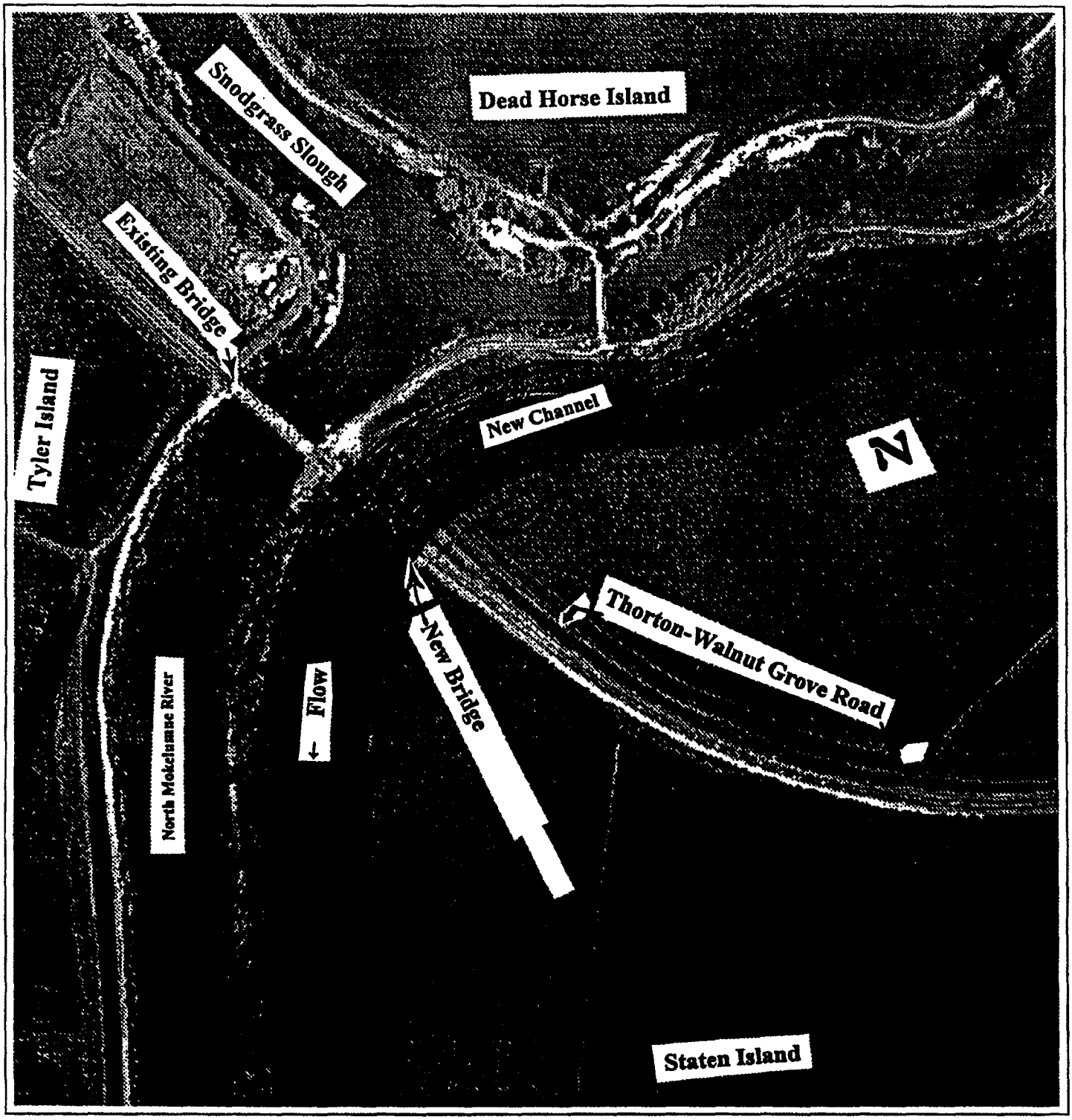

Figure II-19. New Two-Lane Bridge on Thornton-Walnut Grove Road

Scale: 1" = 300' Base Map
Not to scale: New Channel and Bridge

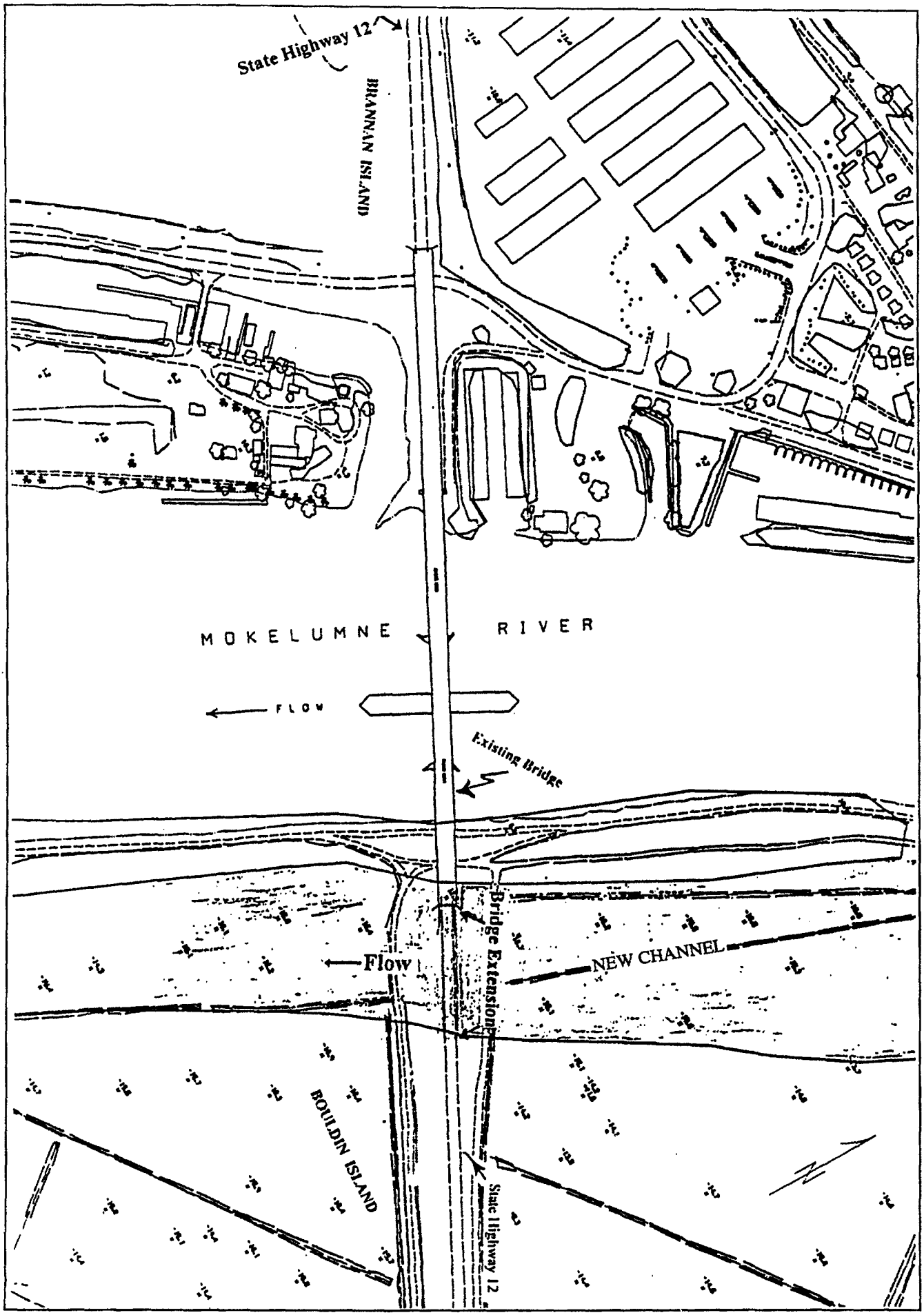

Figure II-20. Highway 12 Bridge Extension Over Mokelumne River

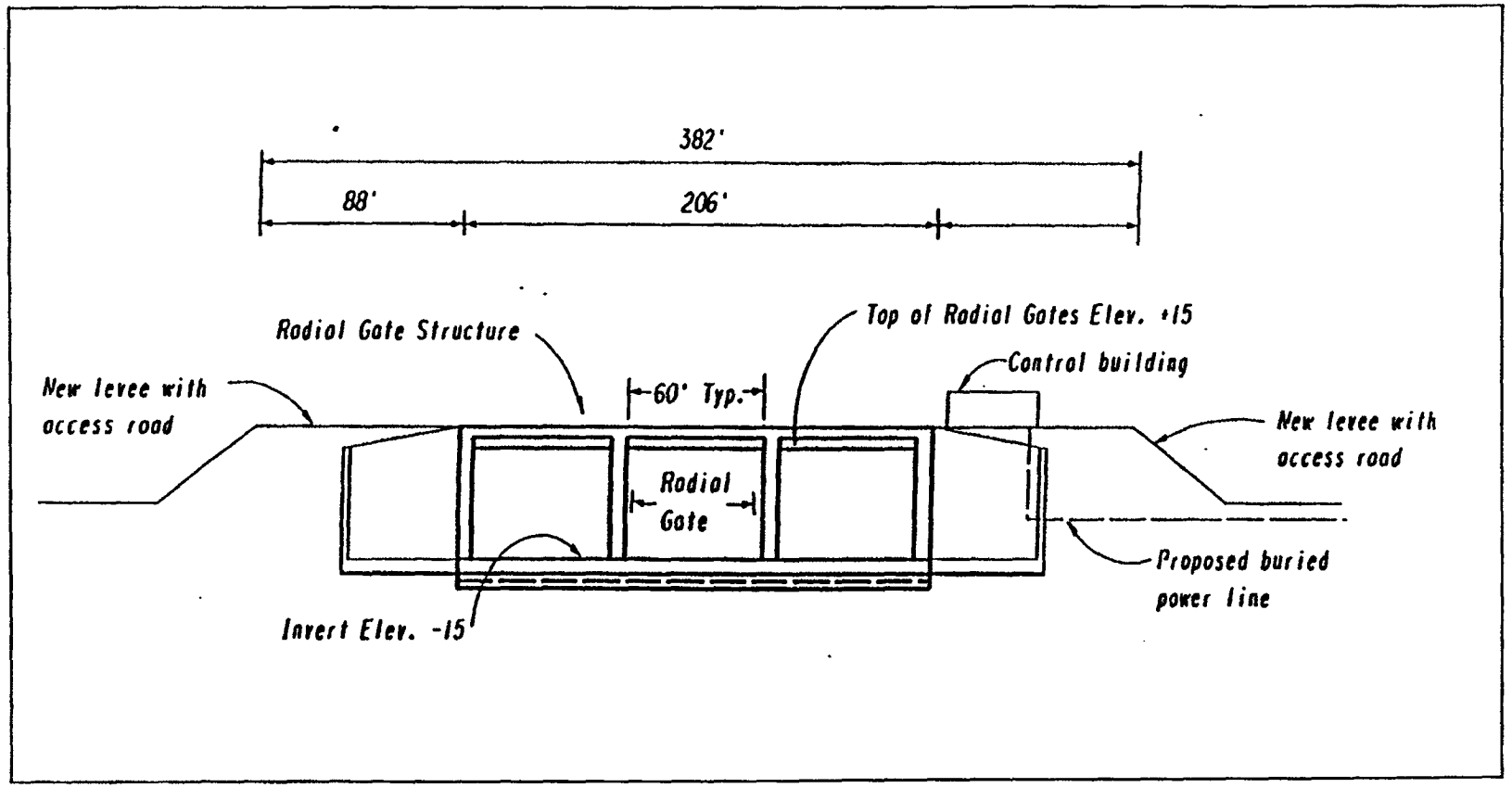

Figure II-21. ELEVATION VIEW - Delta Cross Channel 3-Gate Enlargement

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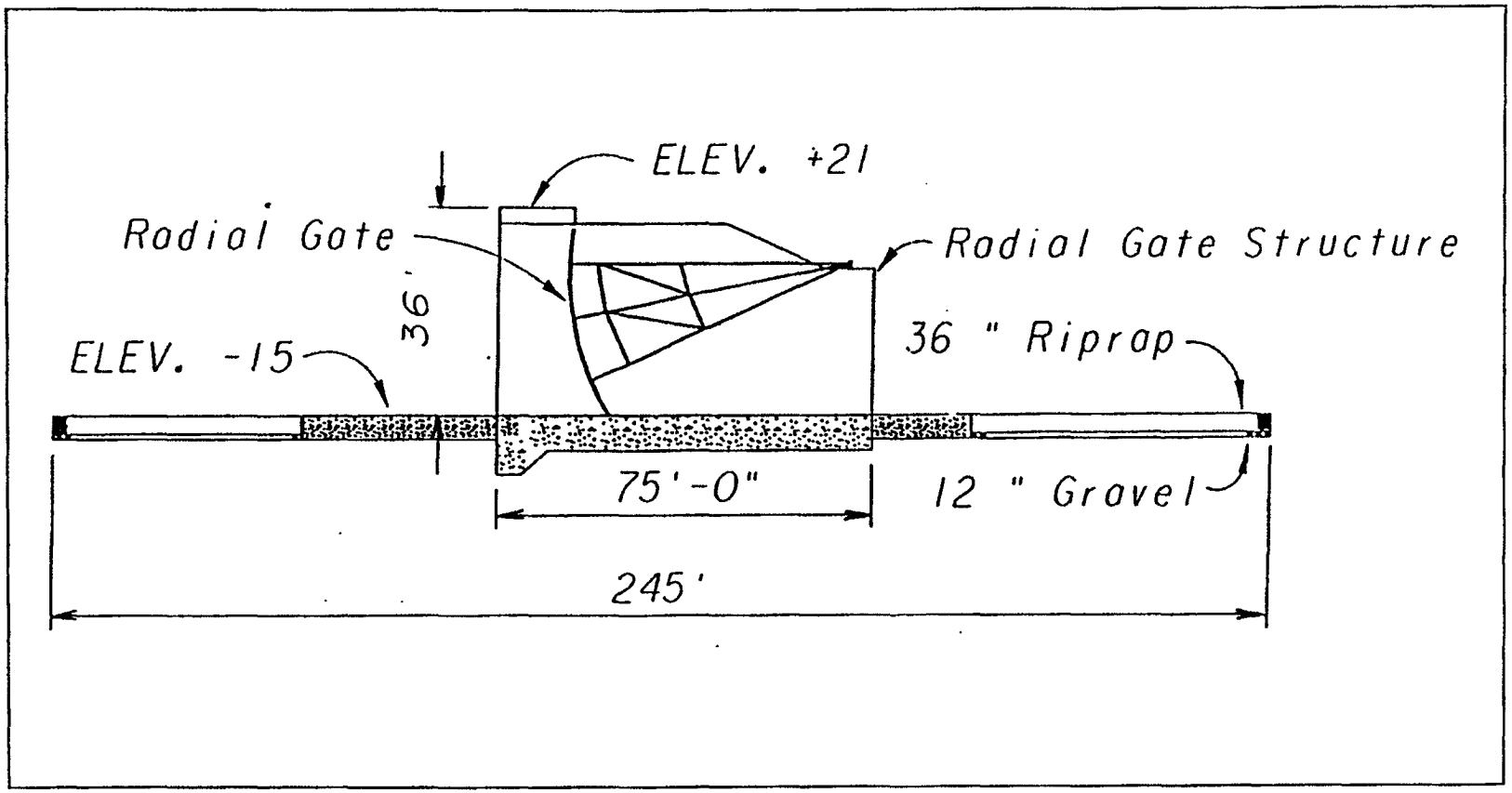

Figure II-22. SECTION VIEW - Delta Cross Channel 3-Gate Enlargement

D—003070

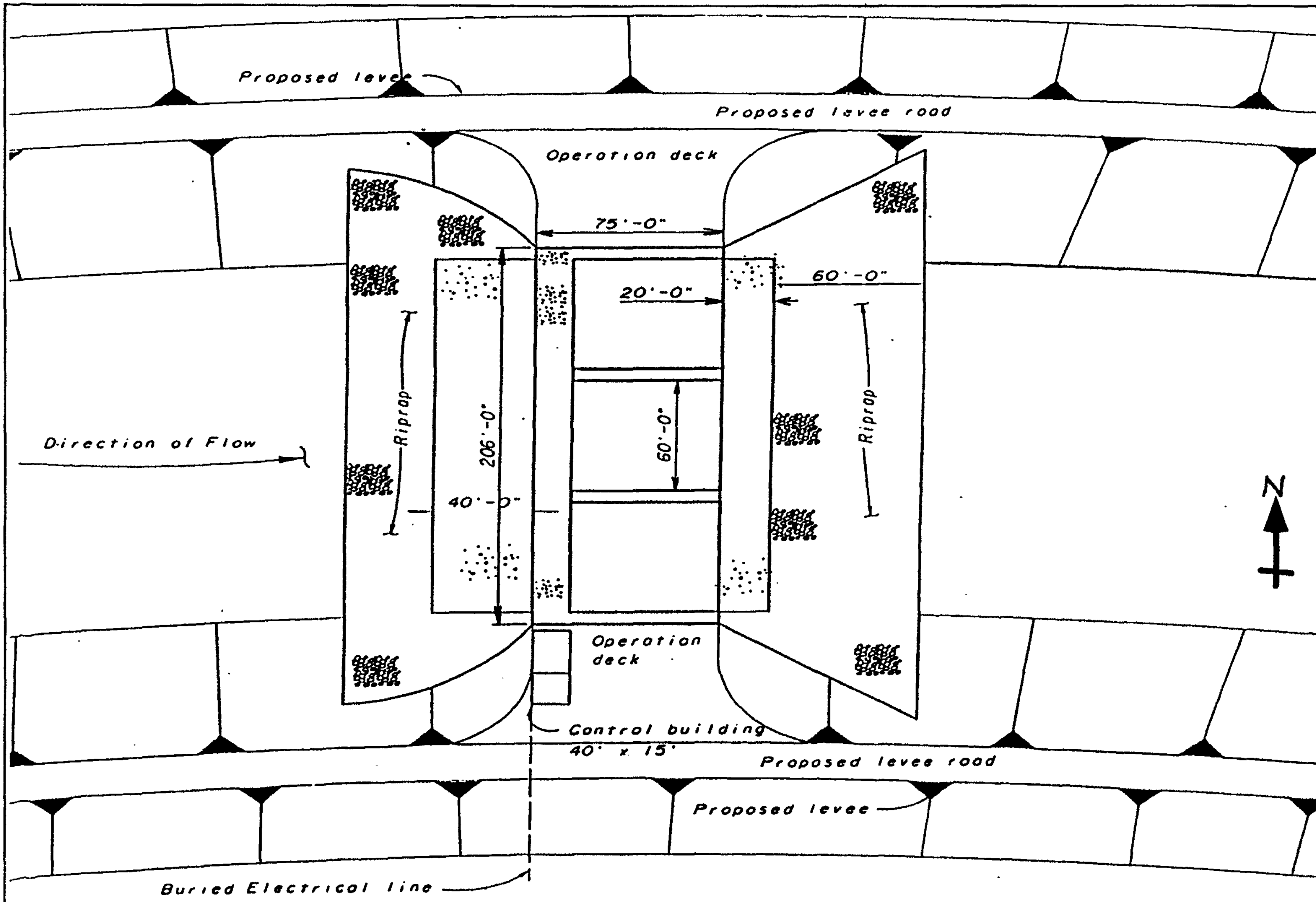

Figure II-23. PLAN VIEW - Delta Cross Channel 3-Gate Enlargement

would link the new three-gate structure with the Sacramento River and the enlarged Delta Cross Channel.

A fish deflector wall would be constructed to divert fish away from the Delta Cross Channel at the mouth of the new intake channel. The fish deflector wall would be constructed of 1/2-inch thick steel plate and would be approximately 200 feet long and 10 feet high. The fish deflector wall would be attached to bracing beams which would be mounted on a series of vertical and sloped (1:4) battered driven piles spaced approximately 20 feet apart. The lower portion of the fish deflector wall would be bent away from the piles (toward the center of the Sacramento River channel) at 1:1 slope.

A new reinforced concrete box girder bridge would be provided for County Road E-13 over the proposed new intake channel. The bridge would be approximately 500 feet long and 40 feet wide. It would have four spans supported on three piers and two abutments and would accommodate two lanes of traffic with six-foot-wide shoulders.

The radial gate control structure would be 206 feet wide, 75 feet long, and 36 feet high. It would be located approximately 250 feet downstream from the mouth of the intake channel and would house the three radial gates, each 60 feet wide by 30 feet high.

The levee embankments for the new channel would be constructed with imported material to a crown elevation of 21 feet NGVD and would have 16-foot-wide graveled roads. Side slopes of the levees would be 2:1, horizontal to vertical. The water-side levee side slopes would be protected using 24 inches of rip-rap.

The existing Delta Cross Channel would be enlarged downstream from its confluence with the new channel to accommodate the increased flow provided by the additional three radial gates. Approximately 900 lineal feet of the existing downstream north-side levee of the existing channel would be relocated approximately 95 feet further north to become a part of the new cross channel levee system.

Located next to, and south of, the gate control structure, a control building would house the control system for the three radial gates. Power used to operate the control system would be supplied through buried power cables. A propane tank building would house the standby propane fueled power system. An existing transmission tower would need to be relocated because the new channel would affect some of the tower stay cables.

Construction for the Delta Cross Channel Improvement would take approximately 30 months, with a construction crew of about 75 people. The project cost is estimated to be 28 million dollars.

Screened Diversion at Hood

This component would be constructed in such a way as to ensure that the integrity of the Sacramento River Flood Control Project would remain intact. This would be accomplished by surrounding the intake channel with embankments reaching the same crown elevation as the existing Project levee (about 27 feet MSL). As noted earlier, the intake and screen structure includes a trash rack at the river bank, a rectangular, concrete-lined intake channel, screens, a fish bypass system, and an afterbay with pumps to control flow rates through the structure (Figures II-8, II-9, II-24, and II-25).

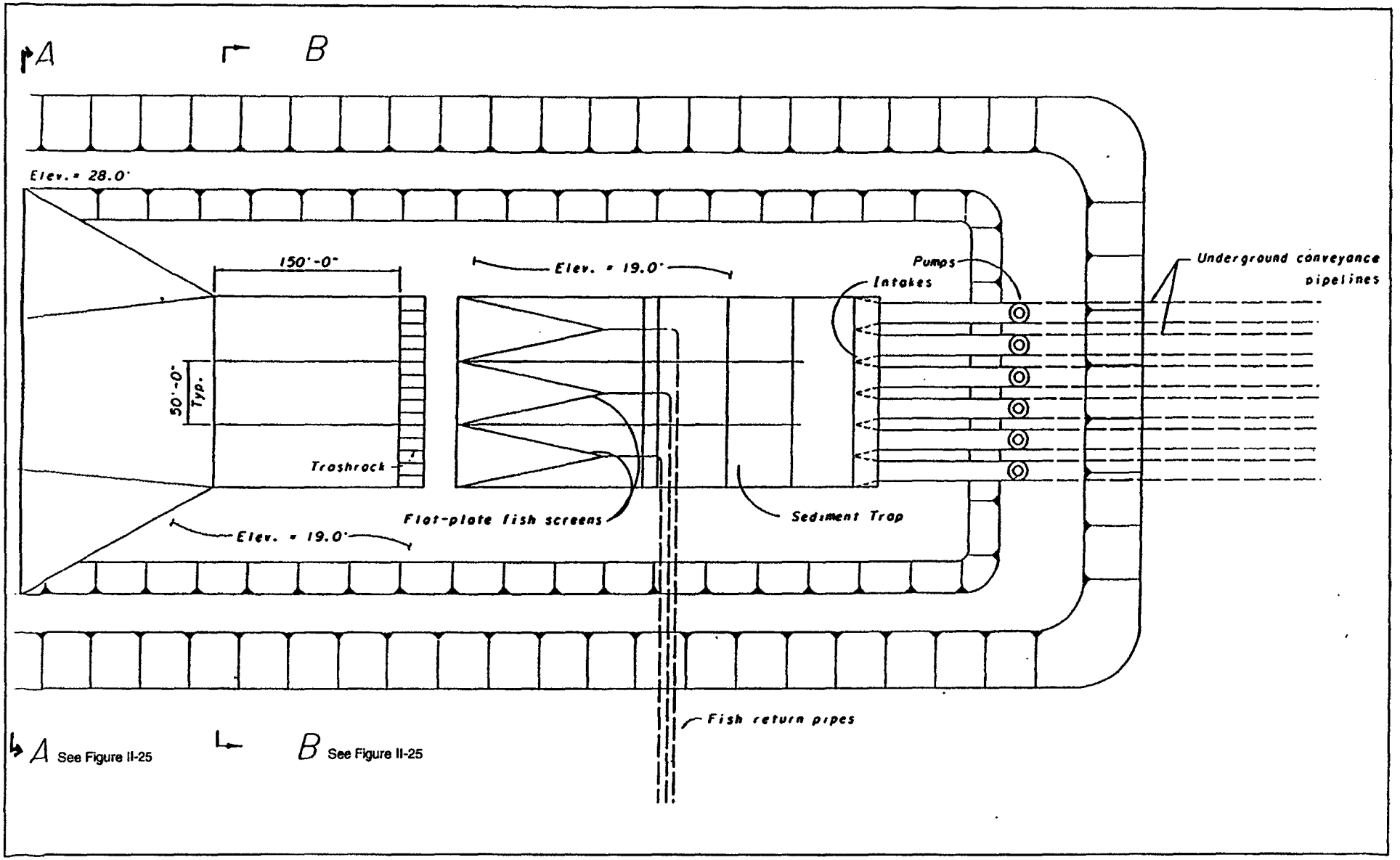

Figure II-24. PLAN VIEW - Fish Screens

D-003073

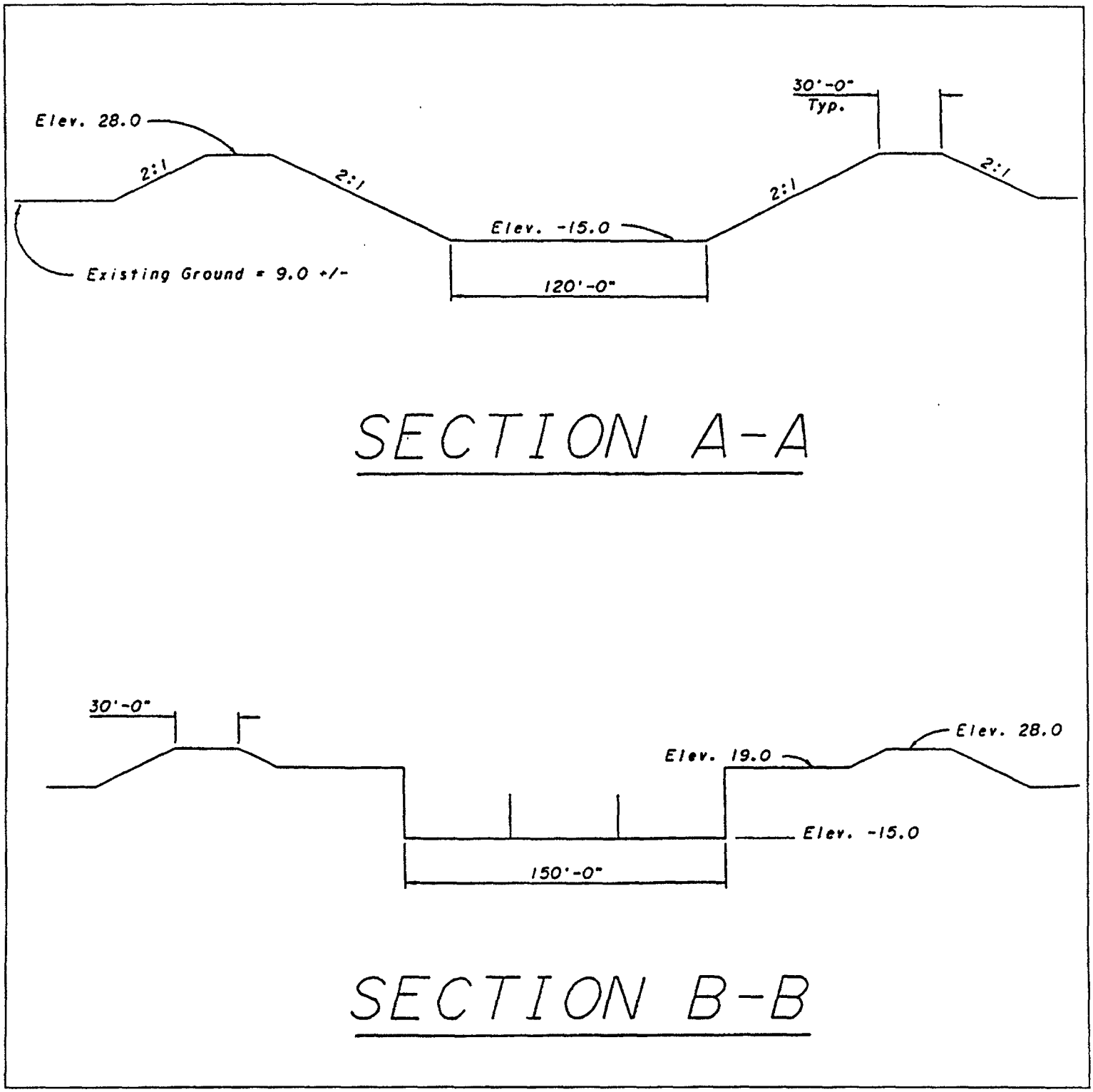

Figure II-25. SECTIONS - Screened Diversion Structure

The intake channel would be about 150 feet wide and 350 feet long, from riverbank to pump structure. It would be separated into three 49-foot-wide, parallel channels by concrete walls about 15 feet high. The screens would be set back about 250 feet from the riverbank. From the pump structure the water would be conveyed by a series of parallel pipes eastward to the Stone Lakes Basin. The pipes would pass through the Southern Pacific Railroad embankment, which provides flood protection to the Hood area.

A new bridge would be constructed for Highway 160 about 100 feet landward from the existing levee road. The bridge would cross over the intake channel at approximately current grade.

The facility would be constructed without breaching the Sacramento River levee until the new embankment is completed. Construction would be completed in three stages. First, the new embankment material and the portion of the intake and screen system east of the existing levee would be constructed. Second, the new Highway 160 bridge would be constructed. Lastly, construction of the trashrack and the first segment of the intake channel would be completed, including excavating the existing project levee to accommodate the intake channel. This would require placement of sheetpiles in the Sacramento River around the intake to provide a dry construction environment. This would be the last major phase of construction.

The screened Sacramento River flow would be released into the Stone Lakes drainage, just south of Hood Franklin Road. The flow would be conveyed through an existing borrow channel west of the Southern Pacific Railroad embankment. However, the channel bottom would need to be dredged to a depth of about -10 feet MSL to accommodate the additional flow. In addition, two multi-culvert bridges across this channel would be replaced by one or more clear span bridges to provide access for private landowners in the South Stone Lakes area. The screened water would flow into South Stone Lake, through the Lambert Road hydraulic structure, and southward into Snodgrass Slough. The Lambert Road structure may need to be modified to accommodate the increased flow.

This diversion would have two inter-related effects. First, it would reduce the net flow through the Delta Cross Channel and Georgiana Slough by simultaneously reducing the stage in the Sacramento River and increasing it in Snodgrass Slough. The effect would be a partial substitution of screened flow through the diversion at Hood for unscreened flow through the Delta Cross Channel and Georgiana Slough.

The second effect would be a net reduction in reverse flow in the lower San Joaquin River and adjoining channels. With the Delta Cross Channel open and Sacramento River flow low, the Hood diversion primarily acts to reduce Delta Cross Channel flow. When the Delta Cross Channel is closed, the Hood diversion primarily acts to reduce reverse flow, because it has a relatively smaller effect on Georgiana Slough flows.

III. PLANTS

Introduction

Table III-1 lists the special-status plants that were considered for the Biological Assessment but were not found in the INDP project area during 1993 and 1994 field surveys. Based on habitat requirements and distribution, these species have no potential to occur in areas of indirect impact which were not covered by detailed field surveys. The distributions and habitats of these plants are summarized from MGA (1993).

Botanical Survey Methodology

Botanical surveys were limited to the INDP area as identified in Figure III-1. The survey area was defined to include all areas that could sustain direct or related impacts from implementation of any of the proposed INDP alternatives. Direct impacts include the placement and maintenance of facilities, channel dredging, channel enlargement, the installation of setback levees, and the placement of dredge spoils.

Field surveys for sensitive plants were conducted on August 19, September 28, October 1 and 4, 1993 and September 14, 1994. No early spring surveys were conducted in the INDP area because all of the special-status plants expected to occur in areas directly impacted by project alternatives are later flowering species. The late summer surveys were conducted from the water of the main channels and sloughs by small boat and by walking or driving inland irrigation and drainage ditches and levee banks. All plants encountered during field surveys were identified to the extent necessary to determine their status as special-status species.

Population sizes of sensitive plants were estimated by areal extent (Mason's lilaeopsis, Delta tule pea, Sanford's arrowhead) or plant count (rose-mallow, Suisun aster). Populations are mapped and discussed either as isolated occurrences or by island, depending on the continuity of the species' distribution.

Results

Table III-2 lists those species that may occur in the floodplain areas of southern Sacramento County, but for which detailed field surveys were not conducted. The presence or absence of these species within the INDP area are unknown. INDP actions will not have a direct impact on populations of these species if they are present, but reduction in size of the 100-year floodplain could allow land use changes incompatible with the preservation of native plant habitat.

Tables III-3, III-7, III-10, III-13, and III-16 provide detailed locational information on rare plant populations encountered during 1993 and 1994 field surveys. A discussion of these populations and how they may be impacted by INDP actions and possible alternative actions is presented in the individual species accounts following Table III-2. Location maps of all sensitive plants found in the INDP area are included in Appendix A.

Table III-1. Special-Status Plants That Were Considered in the Biological Assessment But Do Not Occur In The Interim North Delta Project Area

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Ahart's dwarf rush (*Juncus leiospermus* F.S. Herm. var. *ahartii* Ertter)	C1/--/1B	eastern edge of Sacramento Valley	borders of vernal pols	Out of range of the INDP area
Ahart's whitlow-wort (*Paronychia ahartii* Ertter)	C2/--/1B	northern Sacramento Valley	annual grassland	No suitable habitat present Out of range of the INDP area
Antioch Dunes evening-primrose (*Oenothera deltoides* Torr. & Frem. ssp. *howellii* [Munz]W.Klein)	E/E/1B	Antioch Dunes, Brannan Island	stabilized interior dunes	No suitable habitat present Out of range of the INDP area
Beach layia (*Layia carnosa* [Nutt.] T. & G.)	E/E/1B	coastal zone from Mendocino to Santa Barbara County	dunes and dune scrub	No suitable habitat present Out of range of the INDP area
Bearded allocarya (*Plagiobothrys hystriculus* [Piper] Jtn.)	C3a/--/1A	Montezuma Hills, Solano County	vernal pools	No suitable habitat present Out of range of the INDP area
Brewer's dwarf-flax (*Hesperolinon brewerí* [Gray] Small)	C2/--/1B	inner Coast Range above 750 feet	chaparral, grassland	No suitable habitat present Out of range of the INDP area
Butte County meadowfoam (*Limnanthes floccosa* T.J. Howell ssp. *californica* Arroyo)	E/E/1B	Butte and Tehama counties	seasonal wetlands	No suitable habitat present Out of range of the INDP area
Caper-fruited tropidocarpum (*Tropidocarpum capparideum* Greene)	C2*/--/1A	base of Mt. Diablo in Contra Costa, Alameda, and San Joaquin counties; also Bay area and Glenn County	alkaline grassland	No suitable habitat present Out of range of the INDP area.

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Contra Costa buckwheat (*Eriogonum truncatum* T. and G.)	C3a/--/1A	Mount Diablo area	oak woodland or coastal sage scrub	No suitable habitat present Out of range of the INDP area
Contra Costa goldfields (*Lasthenia conjugens* Greene)	C1/--/1B	Delta region and coastal California to Santa Barbara	seasonal wetlands and vernal pools	Out of range of the INDP area.
Contra Costa wallflower (*Erysimum capitatum* [Dougl.] Greene var. *angustatum* [Greene] G. Ross B.)	E/E/1B	Antioch Dunes	stabilized interior dunes	No suitable habitat present Out of range of the INDP area
Delta button celery (*Eryngium racemosum* Jeps.)	C2/E/1B	Lower San Joaquin River Basin	seasonally ponded clay flats	Lower Sacramento Valley floodplain area may have suitable habitat, but is outside of plant's known range
Diablo rock-rose (*Helianthella castanea* Greene)	C2/--/1B	Mt. Diablo area above 700 feet	chaparral, woodland,	No suitable habitat present Out of range of the INDP area
Diamond-petaled California poppy (*Eschscholzia rhombipetala* Greene)	C2/--/1A	inner South Coast Range and Colusa County	grassland, clay slopes	No suitable habitat present Out of range of the INDP area
Dudley's lousewort (*Pedicularis dudleyi* Elmer)	C2/R/1B	coastal zone, San Mateo to San Luis Obispo County	old growth coast redwood or Douglas-fir forest; maritime chaparral	No suitable habitat present Out of range of the INDP area

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Gairdner's yampah (also known as squaw root) (*Perideridia gairdneri* [Hook & Arn.] Mathias ssp. *gairdneri*)	C2/--/4	Coast Ranges from Napa to Monterey, and southern California	wetlands in broadleaved forest or chaparral	No suitable habitat present Out of range of the INDP area
Greene's tuctoria (*Tuctoria greenei* [Vasey] J. Reeder)	PE/R/1B	eastern Great Valley from Tehama to Tulare County	vernal pools	No suitable habitat present Out of range of the INDP area
Hairless popcornflower (*Plagiobothrys glaber* [Gray] Johnston)	C3a/--/1A	Alameda, Santa Clara, and San Benito counties	wet alkaline soils	Out of range of the INDP area
Hartweg's pseudobahia (*Pseudobahia bahiifolia* [Benth.] Rydb.)	PE/E/1B	eastern Great Valley	annual grassland	Out of range of the INDP area
Heartleaf saltbush (*Atriplex cordulata* Jeps.)	C2/--/1B	Basinlands of the lower San Joaquin River and Glenn County	alkaline grassland	No suitable habitat present.
Hispid bird's-beak (*Cordylanthus mollis* Gray ssp. *hispidus* [Penn.] Chuang & Heckard)	C2/--/1B	Lower San Joaquin Valley and Placer County	saltgrass; seasonal wetlands	No suitable habitat present
Hoover's button celery (*Eryngium aristulatum* Jeps. var. *hooveri* Sheikh)	C1/--/4	South San Francisco Bay area to San Luis Obispo County	alkaline depressions	No suitable habitat present. Out of range of the INDP area.
Large-flowered fiddleneck (*Amsinckia grandiflora* [Gray] Kleeb. ex Greene)	E/E/1B	Mt. Diablo area	foothill woodland	No suitable habitat present Out of range of the INDP area
Marin knotweed (*Polygonum marinense* T. Mert and Raven)	C2/--/3	Marin and Napa counties	upper salt marsh	No suitable habitat present Out of range of the INDP area

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COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Marsh sandwort (*Arenaria paludicola* Rob.)	E/E/1B	San Francisco to San Bernardino County	coastal zone wetlands	No suitable habitat present Out of range of the INDP area
Palmate-bracted bird's-beak (*Cordylanthus palmatus* [Ferris] Macbr.)	E/E/1B	Fresno to Colusa County	alkaline grassland and seasonal wetlands	No suitable habitat present.
Point Reyes bird's-beak (*Cordylanthus maritimus* Nutt. ssp. *palustris* [Behr] Chuang & Heckard)	C2/--/1B	San Francisco Bay and north along the coast	coastal salt marsh	No suitable habitat present Out of range of the INDP area
Recurved larkspur (*Delphinium recurvatum* Greene)	C2/--/1B	Colusa to Kings County	alkaline grassland	No suitable habitat present
Sacramento orcutt grass (*Orcuttia viscida* [Hoover] J. Reeder)	PE/E/1B	eastern Sacramento County	vernal pools	No suitable habitat present Out of range of the INDP area
San Francisco gumplant (*Grindelia maritima* [Greene] Steyermark)	C2/--/1B	central California coast from Marin to San Luis Obispo	grassy slopes and north coast scrub	No suitable habitat present Out of range of the INDP area
Showy Indian clover (*Trifolium amoenum* Greene)	C2*/--/1B	Coast Ranges from Mendocino to Alameda County	grasslands	No suitable habitat present
Slender orcutt grass (*Orcuttia tenuis* Hitchc.)	PT/E/1B	northern Sacramento Valley, and Sacramento and Lake counties	vernal pools	No suitable habitat present Out of range of the INDP area

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COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT	REASON PLANTS NOT FOUND
Slough thistle (*Cirsium crassicaule* [Greene] Jeps.)	C2/--/1B	San Joaquin River basin-lands	seasonal marsh, alkaline swales	Out of range of INDP area.
Soft bird's-beak (*Cordylanthus mollis* Gray ssp. *mollis*)	C1/R/1B	eastern San Francisco Bay, Suisun Marsh, Napa and Petaluma Rivers	salt marshes	No suitable habitat present Out of range of the INDP area
Solano grass (*Tuctoria mucronata* [Crampton] Reeder)	E/E/1B	Solano and Yolo counties	playa lakes and vernal pools	No suitable habitat present Out of range of the INDP area
Sonoma alopecurus (*Alopecurus aequalis* Sobol. var. *sonomensis* Rubtzoff)	C2/--/1B	Sonoma and Marin counties	freshwater and seasonal marsh, riparian	Out of range of the INDP area
Suisun thistle (*Cirsium hydrophilum* [Greene] Jeps. var. *hydrophilum*)	C1/--/1B	Suisun marshes	freshwater marsh	Out of range of the INDP area
Veiny monardella (*Monardella douglasii* Benth ssp. *venosa* [Torr.] Jeps)	C2/--/1B	eastern edge of the Great Valley	clay soils	No suitable habitat present Out of range of the INDP area
Wedge-leaved horkelia (*Horkelia cuneata* Lindl. ssp. *sericea* [Gray] Keck)	C2/--/1B	coastal zone Sonoma to Santa Barbara counties	closed cone pine, coastal scrub	No suitable habitat present Out of range of the INDP area

* Status Explanations:

Federal

E = Listed as endangered under the federal Endangered Species Act.

D—003081

T = Listed as threatened under the federal Endangered Species Act.

PE = Proposed as endangered.

PT = Proposed as threatened.

C1 = Category 1 candidate for federal listing. Category 1 includes species for which the USFWS has sufficient biological information to support a proposal to list as endangered or threatened.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

C2* = Category 2 candidate for federal listing,but plant is presumed to be extinct.

C3c = No longer a candidate for federal listing. Category 3c species have been dropped from the candidate list because they are too widespread or not threatened at this time.

State

-- = No designation.

E = Listed as endangered under the California Endangered Species Act.

R = Listed as rare under the California Endangered Species Act. This category is no longer used for newly listed plants, but some plants previously listed as rare retain this designation.

California Native Plant Society

1A = List 1A species: presumed extinct in California.

1B = List 1B species: rare, threatened, or endangered in California and elsewhere.

3 = List 3 species: plants about which more information is needed to determine their status.

4 = List 4 species: plants of limited distribution.

D-003082

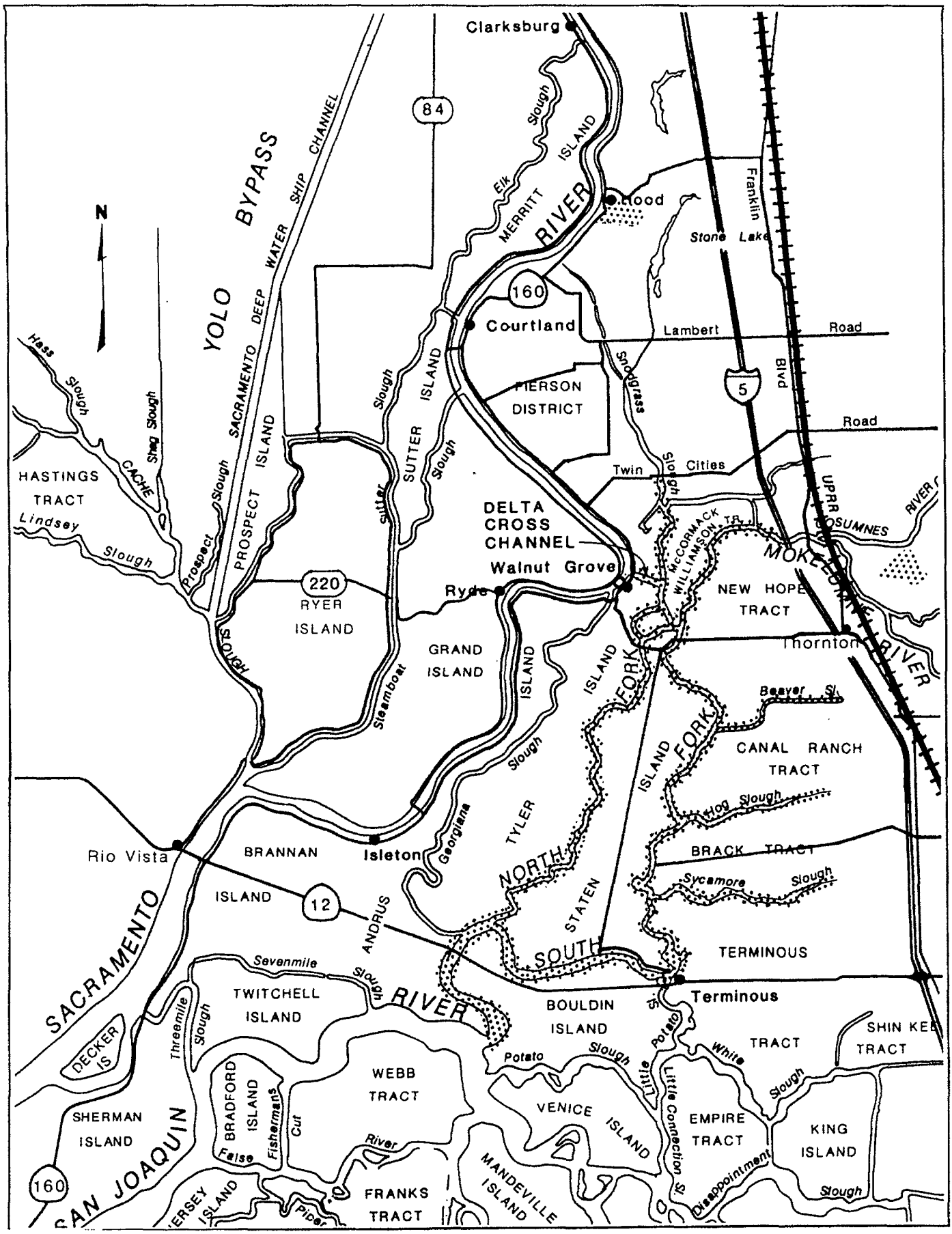

Figure III-1. Interim North Delta Program Survey Area (1993-94)

Area surveyed

Table III-2. Special-Status Plants that may Occur in the Interim North Delta Project Area (within the 100-Year floodplain of Sacramento County) but for which Detailed Field Surveys were not Conducted

COMMON NAME (*Scientific Name*)	STATUS* Federal/State/CNPS	DISTRIBUTION	HABITAT
Adobe lily (*Fritillaria pluriflora* Torr. in Benth.)	C2/--/1B	Solano County north of the Delta region	heavy clay soils
Bogg's Lake hedge-hyssop (*Gratiola heterosepala* Mason & Bacig.)	C3c/CE/1B	Lake to Modoc counties south to Solano and San Joaquin counties, southern Oregon	vernal pools, lake and reservoir margins
Colusa grass (*Neostapfia colusana* [Davy] Davy)	T/E/1B	eastern edge of the San Joaquin Valley and Solano and Yolo counties north of the Delta	playa lakes and vernal pools
Fragrant fritillary (*Fritillaria liliacea* Lindl.)	C2/--/1B	Coast Ranges from Sonoma to Monterey County	grassland or chaparral
Legenere (*Legenere limosa* [Greene] McVaugh)	C2/--/1B	lower Sacramento and San Joaquin valleys	vernal pools and seasonal wetlands
Sacramento Valley milk-vetch (*Astragalus tener* A. Gray var. *ferrisiae* Liston)	C2/--/1B	basin lands of the Sacramento Valley	alkaline meadows and grassland
San Joaquin spearscale (*Atriplex joaquiniana* Nelson)	C2/--/1B	San Benito to Delta region and basin lands of the Sacramento Valley	alkaline meadows and grassland

* See status explanations at the end of Table III-1.

Suisun Marsh Aster

Status

Suisun Marsh aster (*Aster lentus* Greene) is a Category 2 candidate species for federal listing. It is closely related to a widespread species, *A. chilensis,* and at one time was considered a subspecies of that taxon. The plant has no state status. CNPS includes it on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Suisun Marsh aster is known from several locations in the western Sacramento/San Joaquin Delta and Suisun Bay (NDDB 1992, CNPS 1994).

Habitat Requirements

Suisun Marsh aster grows in brackish and freshwater marshes. It occurs along brackish sloughs, riverbanks, and levees affected by tidal fluctuations. Associated species include marsh plants such as bulrush, cattail, common reed, willow, and hibiscus. The plants are often found at or near the water's edge. One location of Suisun Marsh aster is inside the Delta levees along irrigation and drainage ditches (NDDB 1992).

Critical Habitat

No critical habitat has been designated for this species.

Reasons for Decline

Factors leading to the endangerment and decline of Suisun Marsh aster include the filling or draining of wetland habitats within the plant's range, pollution (oil spills, sewage discharges), and changes in water chemistry from water projects affecting Delta or Bay salinity (Niehaus 1977a). Levee maintenance, erosion, and fishing access in high traffic areas also are cited as threats (NDDB 1992).

Occurrence in the INDP Area

Numerous locations for asters were recorded in the INDP area (Table III-3 and Appendix A, Figures A-3, A-4, A-7, A-10, A-11, and A-12). Most of these locations are near the downstream ends of the Mokelumne River tributaries and the lower Mokelumne River. Observations of these plants in the field and from collections revealed characteristics of both the rare *Aster lentus* and the widespread *Aster chilensis* within INDP populations. A comparison of characteristics that separate the two species is provided in Table III-4.

Table III-3. Locations of Suisun Marsh Aster (*Aster lentus*) and Hybrids in the Interim North Delta Program Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Isleton	Delta Cross Channel	South bank of the channel approximately 500 feet west of railroad tracks, many plants, count approximate	30
	North Mokelumne River	On pilings off Staten Island levee approximately 200 feet NE of the Walnut Grove Road bridge	2
		On Tyler Island levee 1,000 feet NNE of River Mile 5	1
		On pilings off the Staten Island levee approximately 2,500 feet SSE of River Mile 5	2
		On piling off Tyler Island at pumping station located approximately 3 miles NE of confluence with South Mokelumne River	1
		On Staten Island levee approximately 500 feet NE of islands located 2 miles upstream of confluence with South Mokelumne River	1
		On log off of Staten Island levee located 1,700 feet south of islands found 2 miles upstream of confluence with South Mokelumne River	1
		On pilings off Tyler Island near the levee confluence with Broad Slough	1
	Mokelumne River	At the western tip of Staten Island	3
		On pilings off Tyler Island 700 feet west of River Mile 0	4
		On Tyler Island levee approximately 900 feet west of River Mile 0	1
		On Tyler Island levee 1,600 feet NE of tide gauge on Georgiana Slough	6

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
		On Tyler Island levee 1,000 feet ENE of tide gauge on Georgiana Slough	13
		On Bouldin Island levee 400 feet NE of Highway 12 bridge	1
		On piling off Bouldin Island approximately 100 feet NE of Highway 12 bridge	1
		On piling off Bouldin Island approximately 100 feet SW of Highway 12 bridge	1
	South Mokelumne River	On Bouldin Island levee approximately 200 feet north of residences on island's northern tip	1
		On Brack Tract levee approximately 500 feet NNE of River Mile 12	1
		On pilings off Brack Tract approximately 150 feet SE of River Mile 12	5
Thornton	South Mokelumne River	On Staten Island levee approximately 500 feet north of River Mile 15, across from island	1
	Beaver Slough	On Canal Ranch levee approximately 3,600 feet west of Highway 5 bridge	3
Bouldin Island	South Mokelumne River	On pilings of Bouldin Island near residences on island's north shore	3
		On Bouldin island levee at junction of levee access road 3,000 feet west of residences	1
		On Bouldin island levee located approximately 1,300 feet NNW of River Mile 5	1
		On pilings off Staten Island levee 2,000 feet north of River Mile 5	1
	Mokelumne River	On Bouldin Island levee 60 feet SW of Highway 12 bridge	2

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
		On Bouldin Island levee 2,100 feet SW of Highway 12 bridge	3
		On Bouldin Island levee 700 feet north of River Mile 2	1
		Near the NE end of marina development levee at the tip of Andrus Island	1
		On piling off of Bouldin Island approximately 500 feet NE of River Mile 1	1
		On Bouldin Island levee 200 feet north of pumping station	2
		On Bouldin Island levee 500 feet south of pumping station	2
		On pilings of abandoned levee in channel at River Mile 0.5	6

Table III-4. A Comparison of Morphological Characteristics of *Aster chilensis* and *Aster lentus* (from Allen 1993)

Characteristic	*Species*	
	A. chilensis	*A. lentus*
Stem Pubescence	hairy above	more or less without hairs
Leaf Shape	oblanceolate	linear to narrowly lanceolate
Leaf Pubescence	more or less hairy	generally without hairs
Inflorescence	heads in cymes	open cyme heads at branch tips
Phyllary Shape	oblong-ovate, obtuse	linear-oblong
Outer Phyllary Margin	green more or less to the base	more or less pale margined at base

Two other members of the genus *Aster* (*A. eatonii* and *A. lanceolatus* ssp. *hesperius)* are taxonomically similar but do not occur in the Delta Region (Allen 1993). While *Aster lanceolatus* ssp.. *hesperius* has been noted at Delta Meadows State Park (Bowcutt 1993), it is thought to be primarily from southern coastal and eastern regions of California and eastward (Allen 1993).

None of the plants found in the INDP had all features consistent with the typical description of *A. lentus*. Where clusters of plants were found, such as at the mouth of Georgiana Slough or on pilings of the abandoned levee across from Moore's Riverboat near the southeastern tip of Andrus Island, populations contained plants with a mixture of characteristics. Some individuals of a population would have most of the features of *A. lentus* while others growing on adjacent pilings would have most of the characteristics of *A. chilensis*. There was not a discernible segregation of the habitat that corresponded to the morphologic features that separate the two species.

An analysis of the six characters on which the taxonomy of *Aster lentus* is based from these North Delta populations showed that the greatest fidelity among the characters was among leaf shape and pubescence (78 percent of observed plants showed linkage of these characters), phyllary shape and margin character (71 percent), and stem pubescence and inflorescence branching pattern (71 percent). Character linkage is used here to indicate which attributes appeared to be consistently representative of one or another species. For instance, many plants had stem and inflorescence characters of *A. chilensis*, but phyllary characters of *A. lentus*.

All of the asters mapped in the INDP are found in disturbed settings such as riprapped levee banks and pilings; none occur on islands or in close association with other special-status plants of the region.

Impacts of the Proposed Project (Alternative 5)

Direct impacts to a total of 30 hybrid clusters of Suisun Marsh aster consisting of 71 individuals could result from actions undertaken as part of the Proposed Project. Dredging and levee improvement in the South Fork Mokelumne River could impact 23 clusters of asters consisting of 62 individuals; seven clusters consisting of nine individuals could be affected by dredging of the North Fork Mokelumne River.

Although habitat for typical Suisun Marsh aster may not be present in the INDP area, loss of potential habitat for hybrids would occur as a result of levee reinforcement. Specifically, the use of erosion control fabric to cover the exposed wave-wash zone would hinder the establishment of seedlings on levee-banks.

Habitat alteration due to changes in flood intensity as a result of Alternative 5 are not expected to adversely affect Suisun Marsh aster hybrids. The data presented in Table III-2 are from DWR modeling for Alternative 4 which includes the expansion of the Delta Cross Channel (DWR 1995a). These data are applicable to flood flows expected under the Proposed Project since both the Cross Channel and the Hood Diversion would be closed during flood periods and would have no effect on the hydrology of the North Fork or South Fork Mokelumne rivers during these periods. The operation of a diversion at Hood would augment flows in Snodgrass Slough during the low flow period, but the volume of water is insufficient to change water surface elevations during the summer growing season (Darabzand pers. comm.).

Under existing channel conditions, all mapped Suisun Marsh aster hybrid sites in the INDP area, with the possible exception of plants in Beaver Slough, would be inundated by 5 to 10 feet of water during the 100-year flood. Under the Proposed Project, water surface elevations would be lower or unchanged in 11 of the 14 aster sites. Water surface elevations would be higher by 0.2 foot to 0.4 foot in three sites in the lower reaches of the South Fork Mokelumne River.

Water velocities during the 100-year flood would be higher by 0.2 foot to 1.7 feet per second in nine out of 14 hybrid aster sites (see Table III-5). High water velocities in combination with greater depth could increase the erosive power of the flood flows and may remove vegetation or damage levee or island habitats. During an average year (2-year flood event), hydrology would be unchanged or more favorable at all but one of the aster sites.

Thus, a few Suisun Marsh aster hybrid clusters would be subject to higher erosive forces during catastrophic floods if the Proposed Project were implemented. A greater number of colonies would experience less physical stress. However, the degree to which this augmentation or relief of stress may effect the survival of plants or their habitats is unknown. The critical volume and velocity of water which endangers these plants would differ at each site due to the rooting elevation and underlying substrate.

Since the habitats that would be affected by levee reinforcement are not selectively used by typical Suisun Marsh aster, no cumulative loss of potential habitat for the plant can be ascribed to the Proposed Project.

Plants of Suisun Marsh aster are not expected to occur in the 100-year floodplain area in southern Sacramento County, and therefore, would not be affected by land use changes enabled by additional flood protection in those areas.

Table III-5. Changes in Water Surface Elevation and Velocity anticipated under the Proposed Project at Known Locations for Suisun Marsh Aster Hybrid Clusters

Numbers of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity From the Pre-Project Condition (feet per second)	
Clusters	Individuals	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
1	2	25	- 1.8	- 0.5	0.8	- 0.5
1	30	97	- 1.3	- 0.5	1.1	0.0
1	2	106	- 0.9	- 0.1	- 0.4	- 0.4
3	3	107	- 0.7	- 0.1	- 0.6	- 0.3
1	1	108	- 0.6	0.0	0.2	- 0.2
1	1	31	- 0.2	- 0.1	- 1.4	- 0.7
1	1	110	- 0.2	0.0	- 1.1	- 0.3
2	2	48	0.0	0.0	0.5	0.0
1	3	116	0.0	0.0	0.6	0.0
15	45	118	0.0	0.0	0.6	0.0
2	4	46	0.2	0.0	0.5	0.0
1	1	47	0.2	0.0	0.6	0.0
2	6	38	0.4	0.0	1.7	0.2

Mitigation Measures

Avoidance of those sections of the water-side levee and pilings colonized Suisun Marsh aster hybrids during the dredging and erosion control phases of the described work would eliminate direct impacts to this species.

Establishment of suitable colonization sites for Suisun Marsh aster hybrids through the construction of water-side berms would mitigate losses which might be due to augmented flows during flood events. The newly-created sites should be in the upper reaches of the North or South Fork Mokelumne rivers which would benefit from flood relief provided by the Proposed Project.

Grizzly Slough Mitigation Site

There is no opportunity for mitigation for the Suisun Marsh aster at the Grizzly Slough site because it is outside of the plant's known range.

Alternative 1

Impacts - The No-Action Alternative would not affect this species since Suisun Marsh aster as a clearly distinct taxonomic entity does not occur in the INDP area. Appropriate habitat for typical Suisun Marsh aster may not be present in the INDP area. The presumably hybrid plants growing in disturbed settings on the water-side of levees are threatened by vegetation management resulting from levee maintenance, grazing, recreational use of the levee banks, fire, and levee erosion from recreational boat wave wash and winter floods. These endangering factors would continue regardless of INDP actions.

Mitigation Measures - None required.

Alternative 2

Impacts - Direct impacts to a total of 23 clusters and 62 individuals of Suisun Marsh aster hybrids could occur from dredging the South Fork Mokelumne River and other channels described under Alternative 2. Fewer populations of Suisun Marsh aster hybrids would be affected under this alternative than the Proposed Project because of the reduced amount of dredging.

Detailed hydrologic modeling for Alternative 2 was not available for analysis, but the anticipated effects, both beneficial and detrimental to sensitive plants in the INDP area, should be less than those of the Proposed Project. Some populations may benefit from a reduction of physical stress during flood events; other populations would be subject to an increase in water surface elevations or velocity which may speed habitat deterioration. Since beneficial and adverse impacts should balance out, and the changes are expected to be small in relation to the existing regime, no significance is assigned to the change in flood regime expected under Alternative 2.

No additional indirect or cumulative impacts are anticipated.

Mitigation Measures - Avoidance and habitat replacement measures proposed for Alternative 5 would reduce the potential impacts to Suisun Marsh aster.

Alternative 3

Impacts - Impacts to Suisun Marsh aster would be the same under Alternative 3 as were discussed under the Proposed Project. No additional indirect or cumulative impacts are anticipated.

Mitigation Measures - Avoidance and habitat enhancement measures described under Alternative 5 would eliminate potential impacts to Suisun Marsh aster.

Alternative 4

Impacts - Direct and indirect impacts described for the Proposed Project also could occur under Alternative 4. One large cluster of Suisun Marsh aster hybrids consisting of approximately 30 individuals is found on the south bank of the existing Delta Cross Channel. These plants would not

be affected by construction of a new intake channel on the northern side of the existing cross channel.

Water level changes anticipated and discussed for the Proposed Project also would apply to Alternative 4. Widening of the Delta Cross Channel would not change the impact of dredging on water surface elevation and velocities since the Delta Cross Channel is in operation only during the low flow periods.

No additional indirect or cumulative impacts are associated with Alternative 4.

Mitigation Measures - Avoidance and habitat enhancement measures described for Alternative 5 would reduce impacts to Suisun Marsh aster to less-than-significant levels.

Alternative 6

Impacts - As discussed under the Proposed Project (Alternative 5) direct impacts to a total of 31 clusters and 71 individual asters could occur as a result of actions proposed under Alternative 6. One Suisun Marsh aster plant located on the Bouldin Island levee could be removed by establishment of the new channel at the mouth of the Mokelumne River. No additional populations of Suisun Marsh aster or hybrids were found on the interior of the islands or on the land-side of levees.

The types of hydrologic changes predicted under Alternative 6 for sites supporting Suisun Marsh aster hybrids are similar to those discussed for the Proposed Project. The increase in channel volume allowed by levee setbacks augments the beneficial effects described for the Proposed Project and reduces the negative effects (see Table III-6). The potential improvements are small and the degree to which the survival of plants or their habitats may be affected by the changes is unknown. The source of these data are described for the Proposed Project (Alternative 5).

The exposure of approximately 11.7 miles of land-side levee habitat to water would provide a substantial amount of additional habitat for sensitive plants in the INDP area. If natural habitat values were incorporated into the design of levee setbacks, this alternative would have a net beneficial affect on sensitive plants in the INDP area.

Mitigation Measures - Avoidance measures described for the Proposed Project would eliminate potential impacts to Suisun Marsh aster during dredging activities. Relocating the levee break on Bouldin Island near the confluence of the Mokelumne and the San Joaquin rivers 50 feet downstream would avoid direct impacts to the Suisun Marsh aster found at that location.

The creation of suitable revegetation or colonization sites for Suisun Marsh aster hybrids by the inundation of land-side levees in the setback channels would mitigate any losses due to augmented flows during flood events. Logjams placed across the mouth of the newly-created channels could help protect these habitats from erosion caused by wave wash.

Table III-6. Changes in Water Surface Elevation and Velocity anticipated under Alternative 6 at Known Locations for Suisun Marsh Aster Hybrid Clusters

Numbers of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity from the Pre-Project Condition (feet per second)	
Clusters	Individuals	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
1	2	25	- 2.9	- 0.4	0.4	- 0.7
1	30	97	- 2.4	- 0.4	0.3	- 0.8
1	1	31	- 0.7	- 0.1	- 1.9	- 0.9
3	3	107	- 0.5	0.0	0.7	- 0.2
1	1	108	- 0.4	0.0	- 0.4	- 0.2
1	2	106	- 0.4	0.0	- 1.4	- 0.6
1	1	110	- 0.2	0.0	- 0.1	- 0.2
2	2	48	0.0	0.0	0.4	0.0
1	3	116	0.0	0.0	0.2	- 0.1
15	45	118	0.0	0.0	0.2	- 0.1
1	1	47	0.1	0.0	0.4	0.0
2	4	46	0.1	0.0	0.4	0.0
2	6	38	0.2	0.0	1.3	0.1

Northern California Black Walnut

Status

Northern California black walnut (*Juglans californica* Wats. var. *hindsii* Jeps.) is classified as a Category 2 candidate species for federal listing. It has no state status. CNPS includes northern California black walnut on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

The original distribution of northern California black walnut is unknown. Stands along Walnut and Lafayette creeks in Contra Costa County, near Walnut Grove in Sacramento County, and near Wooden Valley in Napa County, are cited as the "native" stands of this species and are considered endangered (NDDB 1992, CNPS 1994). The species was commonly planted as street trees in central California and used as root stock for the early California walnut industry; it freely hybridizes with commercial varieties (Munz and Keck 1968). California black walnut and various crosses have since become widely naturalized in riparian forests of the Great Valley and surrounding foothills (Griffin and

Critchfield 1972, NDDB 1992, CNPS 1994). Many sites are associated with Indian settlements, undoubtedly brought there by the residents (Munz and Keck 1968).

Habitat Requirements

Northern California black walnut is associated with deep alluvial soil near creeks, streams, or springs that provide summer water. It is a riparian canopy tree, often associated with Valley oak, Oregon ash, and poison oak (CNPS 1994).

Critical Habitat

No critical habitat has been designated for northern California black walnut.

Reasons for Decline

Only two of the original, "native" stands of northern California black walnut still survive as pure genetic stock (CNPS 1994). The species is threatened by hybridization with English walnut and the black walnut of the eastern United States, both of which were widely used in the early walnut industry.

Occurrence in the INDP Area

Many black walnut trees were observed on levee banks particularly along the upper Mokelumne River above New Hope Landing. Detailed descriptions of these sites are not provided in this report because black walnut trees are a common species in the Delta. It is highly likely that these trees are hybrids with English walnuts and are not of significance as rare or endangered. The native Valley and coastal live oak forests upstream on the Cosumnes and Mokelumne rivers do not have a native black walnut component; therefore, it is unlikely that the walnuts growing in disturbed levee banks are genetically pure "native" stands.

Impacts of the Proposed Project (Alternative 5)

No adverse impacts to northern California black walnut are expected as a result of INDP actions.

Mitigation Measures

None required.

Rose-Mallow

Status

Rose-mallow, formerly known as California hibiscus (*Hibiscus lasiocarpus* Cav.), is classified as a Category 3b species. This classification reflects the recent nomenclature change of this taxon from *H. californicus*, which was previously considered to be restricted to California. The plant has no state status. CNPS includes rose-mallow on List 2: Plants Rare, Threatened, or Endangered in California But More Common Elsewhere (CNPS 1994).

Distribution

Rose-mallow occurs along the Sacramento River and adjoining sloughs from Butte County to the Delta. Outside of California, the species is widespread, but threatened, in western North America; it occurs as far east as Missouri (NDDB 1992, CNPS 1994).

Habitat Requirements

In California, rose-mallow is restricted to freshwater marsh habitats in riverine backwaters, irrigation canal banks, and Delta islands. It is associated with tules, willows, buttonwillow, and other marsh and riparian species on heavy silt, clay, or peat soils (NDDB 1992).

Critical Habitat

No critical habitat has been designated for this species.

Reasons for Decline

Within California, the loss of riverine wetlands, sloughs, and other freshwater marsh habitats through channelization of the Sacramento River and its tributaries is the leading cause of the plant's decline (CNPS 1994). In the South Delta region, levee maintenance, bank erosion, and island erosion have led to the loss of some populations of rose-mallow (NDDB 1992).

Occurrence in the INDP Area

Rose-mallow populations or individual plants were found primarily on islands in Sycamore Slough and the lower South Fork Mokelumne River (Table III-7 and Appendix A, Figures A-1, A-3, A-4, A-5, A-8, A-13, and A-15). Only three of the 63 plants counted in 1993 and 1994 were found growing on levees.

Table III-7. Locations of Rose-Mallow (*Hibiscus lasiocarpus*) in the Interim North Delta Program Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Thornton	Sycamore Slough	On south bank of slough 3,800 feet east of confluence with South Mokelumne River	1
		On island 4,000 feet east of confluence with South Mokelumne River	1
		On island 4,300 feet east of confluence with South Mokelumne River	2
		On island 4,400 feet east of confluence with South Mokelumne River	2
		On island 4,700 feet east of confluence with South Mokelumne River	3
		On island 5,000 feet east of confluence with South Mokelumne River	4
		On island 5,300 feet east of confluence with South Mokelumne River	14
		On island 5,500 feet east of confluence with South Mokelumne River	16
		On island 600 feet WSW of siphon on Brack Tract	12
		On island 400 feet WSW of siphon on Brack Tract	1
		At outer base of Brack Tract levee 1,600 feet ESE of siphon on Brack Tract	1
		At outer base of Staten Island levee 5,200 feet south of Walnut Road bridge	1
	South Mokelumne River	On instream island north of Hog Slough (ECOS 1990b)	2

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Bouldin Island	South Mokelumne River	On long linear island 4,000 feet WSW of Staten Island Road where it climbs the south levee; two plants - one located near the east end of the island on the north shore, one located on the south shore; one plant located on the south shore approximately 1,000 feet from the island's western tip	2
		On linear-shaped island approximately 1,000 feet NE of the junction of Highway 12 and a short (400-foot-long) spur road which accesses the Bouldin Island levee	1
Courtland	Railroad Cut	Two locations mapped by Bowcutt (1993)	2
Bruceville	Lost Slough	South shore of central island (ECOS 1990b)	3
	Snodgrass Slough	Several locations north of The Meadows (ECOS 1990b)	>11
		Near the old railroad crossing in Delta Meadows State Park (ECOS 1990b)	10

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Impacts of the Proposed Project (Alternative 5)

Direct impacts could occur to a total of five rose-mallow plants in three locations due to dredging of channel islands in the South Fork Mokelumne River. Actions proposed by the Proposed Project are not expected to have direct impacts on, or alter habitats, of the 12 populations (58 individuals) of rose-mallow mapped in Sycamore Slough.

Though no populations of rose-mallow are known from the areas within the 100-year floodplain in southern Sacramento County, potential habitat for the plant is present along most of the larger waterways. Land use changes enabled by greater flood protection in these areas are unlikely to affect the marshlands that could support rose-mallow. Other regulatory constraints on the development of wetlands would continue to provide protection to these habitats.

Loss of potential habitat could occur from levee reinforcement in the INDP area. Although most of the plants in the region are found in association with "natural" marsh habitats on islands, rose-mallow does colonize the water-side levees where bare soil is exposed. No plants would be directly affected by levee reinforcement in the South or North Fork Mokelumne rivers.

Changes in the water surface elevation and velocity that are likely to occur under the Proposed Project at locations supporting rose-mallow are presented in Table III-8. The source of data presented for the changes in water surface elevations and velocities under the 100-year and 2-year flood events is discussed earlier in the section on Suisun Marsh aster.

Table III-8. Changes in Water Surface Elevation and Velocity anticipated under the Proposed Project at Known Locations for Rose-Mallow

Numbers of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity from the Pre-Project Condition (feet per second)	
Clusters	Individuals	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
1	>11	85	- 2.2	- 0.4	- 0.4 r*	0.0 r*
1	10	89	- 2.3	- 0.4	- 1.5 r*	0.0 r*
1	3	53	- 2.4	- 0.4	0.3	0.0
1	2	46	0.2	0.0	0.5	0.0
1	1	47	0.2	0.0	0.6	0.0
1	2	33	0.6	0.0	0.0	0.0

r* denotes reverse flow

Hydrologic changes in the South Fork Mokelumne River could impact three populations consisting of five individual rose-mallow plants. These plants would be subject to higher water surface elevations during the 100-year flood. The rest of the known rose-mallow populations in the INDP area

(consisting of at least 82 individuals) could be potentially benefited or unchanged by flow changes during catastrophic floods. The channel volume or water velocity which could damage rose-mallow plants or their habitat would differ among habitats and substrate, and is unknown.

During the average (2-year) flood event, all rose-mallow sites would be benefited or unchanged by the Proposed Project.

The operation of a diversion at Hood would augment flows in Snodgrass Slough during the low flow period, but the volume of water would be insufficient to change water surface elevations during the summer growing season (Darabzand pers. comm.). It is unlikely that the addition of Sacramento River discharge into Snodgrass Slough riparian and marsh communities would cause harm to these systems or to the rose-mallow populations found there. Sections of this waterway are clogged by water-hyacinth during the summer months. Augmented streamflows which could help keep the channel clear could benefit rose-mallow seed dispersal.

Mitigation Measures

Avoidance of the five plants in the South Mokelumne River during dredging of this channel would prevent impacts to these plants. Creation of suitable marsh habitat behind water-side berms could mitigate for potential losses due to augmented flood flows and loss of potential habitat by levee reinforcements.

Grizzly Slough Mitigation Site

The Grizzly Slough area is possibly outside of the plant's original range; however, it has been successfully transplanted into the Cosumnes River preserve just north of Grizzly Slough (Griggs pers. comm.). There is an opportunity to mitigate potentially adverse impacts to rose-mallow at Grizzly Slough.

Alternative 1

Impacts - The No-Action Alternative threatens rose-mallow in the north Delta region by loss of habitat due to boat wake and flood-caused erosion of island habitats, recreational use of the islands, vegetation management on levees, and herbicide drift.

Mitigation Measures - None required.

Alternative 2

Impacts - Direct impacts to five rose-mallow plants arising from the dredging of the South Fork Mokelumne River are discussed under the Proposed Project.

Changes in the flood flow regime under Alternative 2 are expected to have minimal effect on the rose-mallow populations. Both the beneficial and potentially damaging effects described under the Proposed Project would be reduced. It is unknown if these small changes in flood flows would be sufficient to alter rose-mallow habitat or populations. No additional impacts are anticipated.

Mitigation Measures - Mitigation measures described for the Proposed Project would also apply to Alternative 2. Avoidance of the instream island habitats during the dredging of the South Mokelumne River would prevent direct impacts to rose-mallow.

Establishment of water-side berms with appropriate habitats for rose-mallow should mitigate impacts to the rose-mallow populations due to changes in flood regime or loss of potential habitat from levee reinforcement.

Alternative 3

Impacts - Direct impacts to five rose-mallow plants as described under the Proposed Project (Alternative 5) would also occur under Alternative 3. Changes in hydrology and loss of potential habitat discussed for the Proposed Project would apply to Alternative 3.

Mitigation Measures - Mitigation measures for the Proposed Project also apply to Alternative 3.

Alternative 4

Impacts - Impacts described for the Proposed Project would also occur under Alternative 4. No additional impacts are associated with this alternative.

Mitigation Measures - Mitigation measures for the Proposed Project also apply to Alternative 4.

Alternative 6

Impacts - As discussed for the Proposed Project direct impacts to five rose mallow plants could occur during the dredging of South Fork Mokelumne River. Levee setback construction along the North Fork Mokelumne River would not affect any additional existing rose-mallow populations.

Changes in water surface elevation and velocity anticipated under Alternative 6 are shown in Table III-9. The source of data presented for the changes in water surface elevations and velocities under the 100-year and 2-year flood events is discussed in the previous section on Suisun Marsh aster.

Hydrologic changes predicted for Alternative 6 at existing sites for rose-mallow are similar to those discussed under the Proposed Project. The increase in channel volume created by the setback levees would augment the beneficial effects of the project and reduce the negative affects described for the Proposed Project. Water surface elevations would generally be lower during the 100-year flood. During the 2-year event, water surface elevations would be lower or unchanged at all rose-mallow sites.

A beneficial effect would arise from the partial inundation and conversion of nearly 11.7 miles of land-side levee habitat to potential habitat for rose-mallow.

Table III-9. Changes in Water Surface Elevation and Velocity anticipated for Alternative 6 at Known Locations for Rose-Mallow

Numbers of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity from the Pre-Project Condition (feet per second)	
Clusters	Individuals	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
1	2	33	0.2	0.0	- 0.4	- 0.4
1	1	47	0.1	0.0	- 0.4	0.0
2	2	46	0.1	0.0	0.4	0.0
2	2	48	0.0	0.0	0.4	0.0
1	>11	85	- 2.2	- 0.8	- 0.4 r*	0.0 r*
2	10	89	- 2.3	- 0.8	- 1.6 r*	0.2 r*
1	3	53	- 2.4	- 0.8	0.3	0.5
2	10	89	- 2.3	- 0.8	- 1.6 r*	0.2 r*

r * denotes reverse flow

Mitigation Measures - Avoidance measures described for Alternative 5 would eliminate potential impacts to existing rose-mallow populations.

Creation of suitable colonization sites for rose-mallow by the inundation of land-side levees in the setback channels would mitigate any losses due to the augmented flood flows and loss of potential habitat from levee reinforcement.

Delta Tule Pea

Status

Delta tule pea (*Lathyrus jepsonii* Greene ssp. *jepsonii*) is classified as a Category 2 candidate species for federal listing. It has no state status. CNPS includes Delta tule pea on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Delta tule pea occurs on the Delta islands of the lower Sacramento and San Joaquin rivers and westward through Suisun Bay to the lower Napa River. The plant also has been reported in western Alameda and Santa Clara counties, as well as from the mountains of San Benito and Fresno counties (NDDB 1992, CNPS 1994).

Habitat Requirements

Delta tule pea is a sprawling perennial vine found in coastal and Valley freshwater marsh. It has been observed in association with a broad spectrum of other plants ranging from common tule to Valley oak to arrowgrass. It prefers sites above tidal influence, but still within the area of soil saturation (NDDB 1992). Delta tule pea is distinguished from a similar-appearing subspecies, *Lathyrus jepsonii* ssp. *californica*, by its hairless stems and preference for marsh habitats over disturbed levee banks.

Critical Habitat

No critical habitat has been designated for the Delta tule pea.

Reasons for Decline

Agricultural conversion, water diversions, vegetation burning, dredge spoil disposal, recreation, changes in salinity, and levee construction and maintenance all are cited as reasons for the species' decline (Niehaus 1977b, CNPS 1994).

Occurrence in the INDP Area

Both Delta tule pea and California pea (*L.j.* ssp. *californica*) are found in the INDP area. All but one location of Delta tule pea are on islands in channels of the North or South Fork Mokelumne rivers (Table III-10 and Appendix A, Figures A-1, A-3, A-7, A-12, and A-13). All locations of California pea are on levee banks in disturbed settings.

Impacts of the Proposed Project (Alternative 5)

Dredging of the South Fork and North Fork Mokelumne rivers could directly impact seven populations of Delta tule pea growing on instream islands and levee banks. Two of these populations growing on water-side levee banks would be impacted by levee reinforcements. Loss of potential habitat for Delta tule pea also could occur from levee bank reinforcement.

There are no known populations of Delta tule pea within the 100-year floodplain in southern Sacramento County although seemingly appropriate habitat for the plant is present along most of the larger waterways. Land use changes enabled by greater flood protection in these areas are unlikely to affect the marshlands that could support Delta tule pea. Other regulatory constraints on the development of wetlands would continue to provide some protection to these habitats.

Changes in flood flow regimes as a result of actions described in the Proposed Project would affect five channels where Delta tule pea is located. Two of these sites would be subject to slightly higher surface water elevations (0.2 foot to 0.3 foot) during catastrophic (100-year) flood events. Three other populations would experience lower water elevations during flood events. It is unknown whether these small changes are significant in terms of the long-term survivorship of the plants or their habitat. However, a greater number and area of Delta tule pea plants potentially could benefit from flow changes under the Proposed Project due to a reduction of physical stress during flood periods.

Table III-10. Locations of Delta Tule Pea *(Lathyrus jepsonii* ssp. *jepsonii)* in the Interim North Delta Program Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Isleton	North Mokelumne River	On outer bank of Tyler Island levee approximately 3,700 feet north of northern tip of an island complex in North Mokelumne River	200 ft^2
Bouldin Island	South Mokelumne River	On north side of island located 1,000 feet NE of junction of Highway 12 and (short) levee spur road; probably 1 plant	30 ft^2
		On north side of island located 600 feet north of junction of Highway 12 and (short) levee spur road; probably 1 plant	30 ft^2
Thornton	South Mokelumne River	On northeast tip of island located 2,500 feet SW of confluence with Beaver Slough; probably 1 plant	30 ft^2
		On outer bank of Staten Island levee northwest of island located 2,500 feet SW of confluence with Beaver Slough; 1 plant	30 ft^2
Terminous	South Mokelumne River	On northernmost island in island complex at the mouth of Islemouth "Slu"; island is actually "C"-shaped opening to the SE; 2 plants are located at the eastern tip; 2 plants are located on the north shore of the island's inlet and one plant is located just west of the inlet's bottom "hook" on the island's outer shore	150 ft^2
		On easternmost island of island complex at the mouth of Islemouth "Slu"; 1 plant located in the middle of the island's western side	30 ft^2
Courtland	Railroad Cut	One location mapped by Bowcutt (1993)	30 ft^2?
Bruceville	Snodgrass Slough	Nine populations in Snodgrass Slough around The Meadows and instream islands (ECOS 1990b)	270 ft^2

During an average year (2-year event), water surface elevations at Delta tule pea sites would be lower or unchanged by the Proposed Project.

Populations of Delta tule pea in Snodgrass Slough and the Delta Meadows area are not expected to be impacted by increases in summer low flows due to the diversion at Hood. Water surface elevations would not be changed during the low-flow periods (Darabzand pers. comm.).

Changes in the water surface elevation and velocity that are likely to occur under Proposed Project conditions at locations supporting Delta tule pea are presented in Table III-11. The source of data presented for these changes in water surface elevations and velocities under the 100-year and 2-year flood events is discussed earlier in the section on Suisun Marsh aster.

Table III-11. Changes in Water Surface Elevation and Velocity anticipated under the Proposed Project at Known Locations for Delta Tule Pea

Area of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity From the Pre-Project Condition (feet per second)	
Clusters	Area	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
1	200	107	- 0.7	- 0.1	- 0.6	- 0.3
2	60 ft2	29	- 1.0	- 0.2	2.4	0.3
9	> 270	89	- 1.0	- 0.4	0.8r*	0.0
2	60	47	0.2	0.0	0.6	0.0
2	180	43	0.3	0.0	0.6	0.0

r* denotes reverse flow

Mitigation Measures

Avoidance of the seven populations of Delta tule pea in the North and South Mokelumne rivers during dredging and levee reinforcement activities in these channels would eliminate the potential for direct impacts to this species.

The creation of high marsh habitat suitable for colonization by Delta tule pea behind water-side berms could mitigate for any potential loss of habitat due to levee reinforcements or changes in flood flow regime.

Grizzly Slough Mitigation Site

The Grizzly Slough area is outside of the Delta tule pea's known range; therefore, Grizzly Slough would not be an acceptable mitigation site.

Alternative 1

Impacts - The No-Action Alternative threatens Delta tule pea through ongoing levee vegetation maintenance, and loss of island habitats due to wave-wash and flood flows. Most of the populations in the INDP area are found on island habitats and threats to these populations would continue regardless of any water project actions.

Mitigation Measures - None available.

Alternative 2

Impacts - Direct impacts to six populations of Delta tule pea located in South Fork Mokelumne River would occur during dredging and levee reinforcements in that channel. Less potential habitat would be lost to levee reinforcements because of the reduced size of the project under Alternative 2.

Changes in flood flow regimes would be smaller than described for the Proposed Project. Both adverse and potentially beneficial changes would also be reduced.

Mitigation Measures - Mitigation measures provided for the Proposed Project would compensate for the loss of potential habitat and potential habitat degradation due to marginally higher flood flows in the lower portion of the South Fork Mokelumne River.

Alternative 3

Impacts - Impacts to Delta tule pea populations under Alternative 3 would be the same as described for the Proposed Project.

Mitigation Measures - Mitigation measures described for the Proposed Project also would compensate for adverse impacts to Delta tule pea under Alternative 3.

Alternative 4

Impacts - Impacts to Delta tule pea populations under Alternative 4 would be the same as those described for the Proposed Project. No additional impacts are anticipated from the widening of the Delta Cross Channel. Water level changes during the low-flow period are not expected to differ as a result of increased diversions into the North Fork Mokelumne River.

Mitigation Measures - Mitigation measures provided for the Proposed Project would compensate for impacts to Delta tule pea under Alternative 4.

Alternative 6

Impacts - As described for the Proposed Project, direct impacts to seven populations of Delta tule pea could occur during dredging of the North Fork and South Fork Mokelumne rivers.

The increase in channel volume provided with the construction of setback levees increases the beneficial effects of this flood control project on Delta tule pea sites and reduces the negative effects of higher surface water elevations or velocity during flood periods. These changes are small and may not significantly alter the probability of Delta tule pea plants or their habitat surviving a large flood event. The changes represent a favorable reduction in physical stress for the majority of Delta tule pea populations in the INDP area. Under Alternative 6, the water surface elevations at Delta tule pea sites would be reduced or unchanged during average (2-year) flood events in relation to existing channel conditions.

Changes in the water surface elevation and velocity that are likely to occur under Alternative 6 are presented in Table III-12. The source of data presented for these changes in water surface elevations and velocities under the 100-year and 2-year flood events is discussed earlier in the section on Suisun Marsh aster.

Table III-12. Changes in Water Surface Elevation and Velocity anticipated for Alternative 6 at Known Locations for Delta Tule Pea

Areas of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity from the Pre-Project Condition (feet per second)	
Clusters	Area	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
2	180	43	0.2	0.0	0.4	0.0
2	60	47	0.1	0.0	0.4	0.0
1	200	107	- 0.5	0.0	0.7	- 0.2
2	60 ft2	29	- 1.5	- 0.1	1.9	0.1
9	> 270	89	- 2.3	- 0.8	- 1.6 r*	0.2

r* denotes reverse flow

Mitigation Measures - Avoidance of Delta tule pea populations during dredging and levee reinforcement in the North Fork and South Fork Mokelumne rivers would eliminate direct impacts to this species.

Although levee embankments are not preferred habitat for the Delta tule pea, the inundation of 11.7 miles of land-side levees would provide a substantial amount of new habitat for the plant and would reduce the potential impact to Delta tule pea to a less-than-significant level.

Mason's Lilaeopsis

Status

Mason's lilaeopsis (*Lilaeopsis masonii* Math and Const.) is classified as a Category 2 candidate species for federal listing. It is listed as rare by DFG. CNPS includes Mason's lilaeopsis on List 1B: Plants Rare, Threatened, or Endangered in California and Elsewhere.

Distribution

Mason's lilaeopsis is found at scattered localities throughout the Sacramento/San Joaquin River Delta and in sloughs and marshes westward to the lower Napa River (NDDB 1992, CNPS 1994). An historic location for Mason's lilaeopsis is recorded in Tomales Bay at Chicken Ranch Beach (Golden and Fiedler 1991).

Habitat Requirements

Mason's lilaeopsis is found in tidally-inundated freshwater and brackish water marshes. It grows on the banks of islands or along the bases of earthen levees where it forms a low turf with arrowgrass and marsh pennywort (Golden and Fiedler 1991, NDDB 1992).

Critical Habitat

No critical habitat has been designated for Mason's lilaeopsis.

Reasons for Decline

Flood control, levee construction and protection, bank erosion, salt water intrusion, and weed control (especially for water hyacinth) all are known to have extirpated local populations of this species (Golden and Fiedler 1991, NDDB 1992, DFG 1992, DWR 1993). Mudbank erosion due to high winter flows and boat wake action during the rest of the year have resulted in net losses of monitored *Lilaeopsis* populations (DWR 1994).

Occurrence in the INDP Area

The largest populations of Mason's lilaeopsis in the INDP are found on island habitats in the lower reach of the South Fork Mokelumne River. In addition, a single small population was found in Sycamore Slough and a more extensive patch was found on the pilings of the abandoned levee of Bouldin Island near the mouth of the Mokelumne River (see Table III-13). Locations of Mason's lilaeopsis are mapped in Appendix A, Figures A-3, A-5, A-8, A-11, A-12, and A-13).

Two Mason's lilaeopsis populations observed in previous surveys were not relocated during 1993 and 1994 (ECOS 1990b, NDDB 1992). These two populations appear to have been lost to erosion of their

Table III-13. Locations of Mason's Lilaeopsis (*Lilaeopsis masonii*) in the Interim North Delta Program Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Thornton	Sycamore Slough	On outer levee base of Terminous Tract located approximately 3,200 feet ENE of confluence with South Mokelumne River	1 ft^2
Isleton	South Mokelumne River	On western tip of island located 2,000 feet NW of confluence with Sycamore Slough; two subpopulations of 6 ft^2 and 8 ft^2	14 ft^2
		On south bank of narrow island at the mouth of the South Mokelumne River, plants located approximately 600 feet from the island's western tip; two subpopulations	20 ft^2
Bouldin Island	South Mokelumne River	On easternmost of three small islands located approximately 4,500 feet ESE of where Staten Island Road climbs the south levee, plants on the easternmost tip	15 ft^2
		On piling adjacent to residences on Bouldin Island located 2,700 feet SW of Staten Island Road where it climbs the south levee	1 ft^2
		On small (25 ft^2) island located 3,000 feet SW of where Staten Island Road climbs the south levee	12 ft^2
		On large narrow island located 3,500 feet WSW of where Staten Island Road climbs the south levee; three subpopulations, one at eastern tip, one on island's north shore near the western tip, and one on south shore approximately 600 feet from island's eastern tip	30 ft^2
		On piling near residences on Bouldin Island located 3,000 feet ENE of junction of Highway 12 and (short) levee access road	1 ft^2
		On the long narrow island that is south of, and parallel to, the SW end of Staten Island; six subpopulations located along the length of the island, a discontinuous band of plants	60 ft^2

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	SQUARE FOOTAGE
Bouldin Island	South Mokelumne River	On narrow island paralleling the Bouldin Island levee located 700 feet NNW of junction of Highway 12 and a short levee access road; a discontinuous band of plants from island's eastern tip across its north shore	400 ft^2
		On narrow island off the western shore of Staten Island near its SW tip; plants on western shoreline near the southern tip of the island and the northern half of the island	50 ft^2
		On abandoned pilings and dock 500 feet east of the marina at the SE tip of Andrus Island	20 ft^2
Courtland	Railroad Cut	One location mapped by Bowcutt (1993)	unknown

mudbank habitats. One of these populations, located at the southwest tip of Staten Island, was extensive covering over 400 square feet). No *Lilaeopsis* plants were found at this site, although a few plants of Delta mudwort (*Limosella subulata*) were present. The alders and other associated vegetation had been toppled or removed from the site by water action. Because of the loss of large, woody vegetation, it is probable that high winter flood flows caused much of this erosional loss.

Impacts of the Proposed Project (Alternative 5)

Direct impacts to 11 populations (623 square feet) of Mason's lilaeopsis would occur during dredging and levee reinforcement in the North Fork and South Fork Mokelumne rivers.

Predicted hydrologic changes during flood flows would have a net negative effect on Mason's lilaeopsis populations. Water surface elevations are predicted to be unchanged in two sites and increased (0.2 foot to 0.3 foot) during the 100-year flood at the nine other Mason's lilaeopsis sites. Water velocities would be increased at all but two Mason's lilaeopsis sites in the north Delta (Sycamore Slough and Railroad Slough sites excepted). No changes are predicted for all but one Mason's lilaeopsis site during the average flood flows (2-year event). These small changes may not be significant in terms of the survivorship of Mason's lilaeopsis or its habitat during high flow events. However, there are no potential benefits in flood protection provided by the Proposed Project for this species.

Changes in the water surface elevation and velocity that are likely to occur under Proposed Project conditions at locations supporting Mason's lilaeopsis are presented in Table III-14. The source of data presented for these changes in water surface elevations and velocities under the 100-year and 2-year flood events is discussed earlier in the section on Suisun Marsh aster.

Table III-14. Changes in Water Surface Elevation and Velocity anticipated under the Proposed Project at Known Locations for Mason's lilaeopsis

Area of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity From the Pre-Project Condition (feet per second)	
Clusters	Area	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
1	20	118	0.0	0.0	0.6	0.0
1	20	48	0.0	0.0	0.5	0.0
3	43	46	0.2	0.0	0.5	0.0
4	511	47	0.2	0.0	0.6	0.0
1	14	39	0.3	0.0	1.2	0.2
1	15	44	0.3	0.0	0.5	0.0

Loss of potential habitat would occur with the reinforcement of water-side levees by the placement of erosion control fabric over exposed earth. This wave-wash zone is appropriate habitat for Mason's lilaeopsis and plants are able to colonize even short segments of exposed levee bases.

Suitable habitat for Mason's lilaeopsis is not present outside the Delta in the 100-year floodplain of southern Sacramento County, and so land use changes enabled by greater flood protection in that area would not affect Mason's lilaeopsis populations.

Mitigation Measures

Avoidance of Mason's lilaeopsis populations during dredging and levee improvement in the South Fork Mokelumne River would eliminate direct impacts to the plants.

Indirect impacts due to increased flood scour could be mitigated by establishing populations of Mason's lilaeopsis in flood protected areas. The goal of this mitigation measure would be to assist the dispersal of Mason's lilaeopsis into uncolonized habitats, not transplant entire populations found in the South Fork Mokelumne River.

Suitable unoccupied habitat for the species is present in portions of Snodgrass Slough, Delta Meadows River Park (Bowcutt pers. comm.) and possibly, Lost Slough. Under the Proposed Project these areas would benefit from the reduction of flood flows. Most of Snodgrass Slough is upstream from known populations of Mason's lilaeopsis so there is a low probability for natural colonization of these channels. (Reverse flows do occur during flood periods but these would be reduced by the Proposed Project).

Though the tidal range and width of habitat suitable for Mason's lilaeopsis is reduced in the upper sections of these waterways, the species has been found in the upper reaches of Barker Slough and has been successfully transplanted in that location (McCarten pers. comm.). However, habitat selection for the introduction of Mason's lilaeopsis seed stock should consider the effect of the Hood diversion on the tidal range during the growing season.

Creation of potential habitat for Mason's lilaeopsis behind water-side berms would compensate for the loss of potential habitat due to levee reinforcement.

Grizzly Slough Mitigation Site

The Grizzly Slough area is outside of Mason's lilaeopsis' known range; therefore, Grizzly Slough would not be an acceptable mitigation site.

Alternative 1

Impacts - Under the No-Action Alternative continued loss of Mason's lileaopsis habitat through boat wave-wash, flood scour, and recreational use would occur and endanger the species. These actions in combination with herbicide drift, levee maintenance, and other water projects threaten Mason's lilaeopsis in the Delta region. These factors would continue regardless of INDP actions.

Mitigation Measures - None available.

Alternative 2

Impacts - Direct impacts to Mason's lilaeopsis would be the same as for the Proposed Project. Indirect impacts due to long-term changes in flood regime would be reduced under Alternative 2 as compared to the Proposed Project. Mason's lilaeopsis would receive no beneficial effects from this alternative.

Mitigation Measures - Avoidance and habitat replacement mitigation as described for the Proposed Project would compensate for impacts to Mason's lilaeopsis under this alternative.

Alternative 3

Impacts - Impacts for Alternative 3 would be the same as those described for the Proposed Project. Mason's lilaeopsis would receive no beneficial effects from the flood protection provided by this alternative.

Mitigation Measures - Avoidance and habitat replacement mitigation as described for the Proposed Project would compensate for impacts to Mason's lilaeopsis under Alternative 3.

Alternative 4

Impacts - Impacts for Alternative 4 would be the same as those described for the Proposed Project. Mason's lilaeopsis would receive no beneficial effects from the flood protection provided by this alternative.

Mitigation Measures - Avoidance and habitat replacement mitigation as described for the Proposed Project would compensate for impacts to Mason's lilaeopsis under Alternative 4.

Alternative 6

Impacts - Direct impacts to 11 populations of Mason's lilaeopsis would occur as described under the Proposed Project. The construction of levee setbacks would not impact additional populations of Mason's lilaeopsis. The loss of potential habitat would occur with levee reinforcement and placement of erosion control fabric in the wave wash zone.

Indirect impacts due to increased flood scour would be reduced as compared to the Proposed Project. Water surface elevations and velocities during the 100-year flood would be greater or unchanged for all but two Mason's lilaeopsis sites in the north Delta (Sycamore Slough and Railroad Slough sites excepted). There would be essentially no change in streamflows during the average flood year (2-year event) for Mason's lilaeopsis sites. Mason's lilaeopsis would receive no beneficial effects from the flood protection provided by this alternative.

Changes in the water surface elevation and velocity that are likely to occur under Alternative 6 are presented in Table III-15. The source of data presented for these changes in water surface elevations and velocities under the 100-year and 2-year flood events is discussed earlier in the section on Suisun Marsh aster.

Table III-15. Changes in Water Surface Elevation and Velocity anticipated for Alternative 6 at Known Locations for Mason's Lilaeopsis

Area of Plants Affected		Location	Change in Water Surface Elevation from the Pre-Project Condition (feet above mean sea level)		Change in Water Velocity from the Pre-Project Condition (feet per second)	
Clusters	Area	(Cross-section #)	100-year flood	2-year flood	100-year flood	2-year flood
1	20	48	0.0	0.0	0.4	0.0
1	20	118	0.0	0.0	0.2	-0.1
4	511	47	0.1	0.0	0.4	0.0
3	43	46	0.1	0.0	0.4	0.0
1	15	44	0.1	0.0	0.4	0.0
1	14	39	0.2	0.0	0.9	0.1

The partial inundation and conversion of 11.7 miles of land-side levee habitat to tidal habitats would increase the potential habitat available to Mason's lilaeopsis in the north Delta.

Mitigation Measures - Avoidance of known populations of Mason's lilaeopsis during the dredging and levee reinforcement work in the South Fork Mokelumne River would eliminate direct impacts to the plants.

Creation of potential habitat by the inundation of 11.7 miles of land-side levees could compensate for the loss of potential habitat from levee reinforcement. Mason's lilaeopsis plants and habitat that might be lost to increased flood scour could be compensated by transplant measures described for the Proposed Project.

Sanford's Arrowhead

Status

Sanford's arrowhead, also known as Valley sagittaria, (*Sagittaria sanfordi* Greene) is classified as a Category 2 candidate species for federal listing. It has no state status. CNPS includes Sanford's arrowhead on List 3: Plants About Which We Need More Information - A Review List.

Distribution

Sanford's arrowhead has been collected from Del Norte County to Fresno and Ventura counties. Though the plant has a wide geographic distribution, few populations are known and several populations in the Great Valley are known to be extirpated (CNPS 1988). One population is known

to exist in the Delta within the North Fork Mokelumne River (ECOS 1990a). Other populations are found in Sacramento County along the lower American River and along portions of Strawberry Creek south of the City of Sacramento (McCarten pers. comm.).

Habitat Requirements

Sanford's arrowhead is an aquatic plant found in sluggish sloughs and freshwater marshes. It is emergent in water approximately one foot deep or found on exposed mud later in the summer season. It is associated with other emergent marsh species such as pondweed and water plantain (Mason 1957, CNPS 1988).

Critical Habitat

No critical habitat has been designated for Sanford's arrowhead.

Reasons for Decline

Alteration of freshwater marsh habitats may have isolated many populations of Sanford's arrowhead resulting in the widespread, but infrequent, occurrence of the plant. Sanford's arrowhead persisted in irrigation ditches in the San Joaquin Valley, where it occasionally grew in such numbers as to choke the canals (Stebbins pers. comm.). Changes in water distribution networks, lining of canals with concrete, improved ditch maintenance, and water conservation have all but eliminated these populations (Stebbins pers. comm.).

Occurrence in the INDP Area

Sanford's arrowhead is known to occur in the North Fork Mokelumne River (ECOS 1990b). No new populations were observed during our 1993 and 1994 field surveys. The existing population was observed to be in good condition (see Table III-16 and Appendix A, Figure A-12).

Sanford's arrowhead could also occur within sloughs or marshes of the 100-year floodplain of southern Sacramento County; however, detailed surveys for sensitive species were not conducted in these areas. Sanford's arrowhead has been transplanted into the bufferlands surrounding the Sacramento Wastewater Treatment Plant (Martin pers. comm.).

Impacts of the Proposed Project (Alternative 5)

Direct impacts to the single Sanford's arrowhead population in the INDP area would occur as a result of dredging in the North Fork Mokelumne River.

Changes in flood flow regimes at this site would result in slightly lower water surface elevations during the 100-year flood (- 0.6 foot) but higher water velocity (0.2 foot per second). During the average flood event the water surface elevation at the Sanford's arrowhead site is expected to be unchanged by the Proposed Project and velocity would be slightly lower (- 0.2 feet per second). It

Table III-16. Location of Sanford's Arrowhead (*Sagittaria sanfordii*) in the Interim North Delta Program Area

QUADRANGLE (USGS 7½')	WATERWAY	LOCATION/DESCRIPTION	NUMBER OF PLANTS
Isleton	North Mokelumne River	In shallow water between two islands located approximately 13,000 feet NE of confluence with South Mokelumne River. The patch of Sanford's arrowhead is located on the west side of marsh vegetation blocking the passage between the islands.	700 ft^2

is not known if these small changes are significant with regard to the protection of this habitat in the North Fork Mokelumne River.

There are known populations of Sanford's arrowhead within the 100-year floodplain in southern Sacramento County and other appropriate habitat for the plant is present along most of the larger waterways. Land use changes enabled by greater flood protection in these areas are unlikely to affect the marshlands that could support Sanford's arrowhead. Other regulatory constraints on the development of wetlands and sensitive plants would continue to provide some protection to these habitats.

Mitigation Measures

Avoidance of the known population of Sanford's arrowhead during dredging activities in the North Fork Mokelumne River would prevent direct impacts to this plant. Creation of suitable shallow water habitat within the water-side berms would benefit the species and compensate for any loss of habitat or plants due to higher flood flow velocities.

Grizzly Slough Mitigation Site

The Grizzly Slough area is within the historic range of Sanford's arrowhead; therefore, this site would be acceptable for mitigation.

Alternative 1

Impacts - Loss of protected shallow water habitat suitable for Sanford's arrowhead would continue regardless of INDP actions.

Mitigation Measures - None required.

Alternative 2

Impacts - Sanford's arrowhead does not occur in the South Fork Mokelumne River; therefore, no direct impacts to the species are anticipated under Alternative 2. Other indirect or cumulative impacts or benefits to Sanford's arrowhead would be similar, but less than what is described for the Proposed Project.

Mitigation Measures - None required.

Alternative 3

Impacts - Impacts to Sanford's arrowhead would be the same as those described for the Proposed Project.

Mitigation Measures - Mitigation as described under the Proposed Project would reduce impacts to Sanford's arrowhead.

Alternative 4

Impacts - Impacts to Sanford's arrowhead under Alternative 4 would be the same as those described for the Proposed Project.

Mitigation Measures - Mitigation described under the Proposed Project would reduce impacts to Sanford's arrowhead.

Alternative 6

Impacts - Direct impacts to Sanford's arrowhead would occur from the dredging of the North Fork Mokelumne River as described under the Proposed Project.

Changes in hydrology due to the larger capacity channels proposed in Alternative 6 would reduce water surface elevations (- 0.3 foot) and velocity (- 0.3 foot per second) in the vicinity of Sanford's arrowhead during the 100-year flood. During the 2-year flood event there would be no change in surface water elevation and a reduction in velocity (- 0.2 foot per second) predicted for this site.

The construction of a levee setback upstream of the two islands where Sanford's arrowhead is found could change flow patterns around the islands and alter the shallow water habitat that supports the plant.

Mitigation Measures - Mitigation measures as described for the Proposed Project could lessen the potential impact to Sanford's arrowhead. Moving the confluence of the levee setback channel downstream of the islands supporting Sanford's arrowhead would reduce the chance of impacting this population.

Other Special-Status Plants in the Interim North Delta Program Area

In addition to the special-status plants known to occur in the waterways of the North Delta, seven other species have been identified as potentially occurring in the 100-year floodplain of southern Sacramento County (Table III-2). The extent of the floodplain would be diminished under various INDP alternatives. While specific occurrences of these species are not known from the area, habitat for these plants including grasslands and vernal pools or seasonal wetlands is present (Jones & Stokes Associates 1993) and their presence or absence cannot be determined without detailed surveys. Increased flood protection could lead to changes in land use that are incompatible with the conservation of special-status plants.

The Proposed Project (Alternative 5), Alternative 3, and Alternative 4 would reduce the 100-year floodplain by about 3,900 acres. Within this zone are habitats for any or all of the special-status plants listed above. The reduction in floodplain under Alternative 2 would be less, but similar to these previous actions. Alternative 6 would reduce the floodplain by approximately 14,720 acres. Much of this additional acreage is in cultivation (Jones & Stokes Associates 1993) and would not likely support special-status plants.

No mitigation measures for the potential loss of the special-status plants or their habitats listed in Table III-2 is provided in this report.

IV. WILDLIFE

Introduction

Table IV-1 lists the special-status wildlife species that were considered during preparation of the Biological Assessment for the INDP, but were determined not to be affected by proposed actions for one or more reasons. Specifically, these reasons were: 1) The known distribution of the species did not overlap with the INDP area; 2) No suitable habitat for the species was present in the INDP area; or 3) The species occurs irregularly [e.g., during the winter months only] or in low numbers and individuals and regional populations are not expected to be adversely affected by the INDP.

Observations of special-status birds that are included in Table IV-1 were recorded and are discussed later in this chapter under the heading *Other Special-Status Birds*. No special-status mammals or amphibians would be affected by the INDP (see Table IV-1). The only invertebrate that could be impacted by the project is the valley elderberry longhorn beetle. Elderberry shrubs are numerous in portions of the INDP area and many would be removed as part of project-related activities. The distributions, habitat requirements, and reasons for decline of all species listed in Table IV-1 are discussed in detail in MGA (1993).

Location maps of sensitive wildlife species and elderberry shrubs found in the INDP area are included in Appendix A of this Biological Assessment.

Table IV-1. Special-Status Wildlife Species Determined Not to be Affected by the Interim North Delta Program

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH INDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
MAMMALS				
Salt marsh harvest mouse (*Reithrodontomys raviventris*)	E/E	X	X	
San Joaquin kit fox (*Vulpes macrotis* ssp. *mutica*)	E/T	X		
Riparian brush rabbit (*Sylvilagus bachmani riparius*)	C1/CSC	X		
San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*)	C2/--	X	X	
San Joaquin Valley woodrat (*Neotoma fuscipes riparia*)	C2/CSC	X		
Point Reyes jumping mouse (*Zapus trinotatus orarius*)	C2/--	X		
Point Reyes mountain beaver (*Aplodontia rufa phaea*)	C2/--	X		
Spotted bat (*Euderma maculatum*)	C2/--	X	X	
Pacific western big-eared bat (*Plecotus townsendii townsendii*)	C2/CSC	X	X	
Greater western mastiff bat (*Eumops perotis californicus*)	C2/-	X	X	
Salt marsh vagrant shrew (*Sorex vagrans halicoetes*)	C1/CSC	X	X	

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH INDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
Suisun ornate shrew (*Sorex ornatus sinuosus*)	C1/CSC	X	X	
San Pablo vole (*Microtus californicus sanpabloensis*)	C2/--	X	X	
BIRDS				
American white pelican (*Pelicanus erythrorhynchos*)	--/CSC	winter only		X
Double-crested cormorant (*Phalacrocorax auritus*)	--/CSC	winter only		X
White-faced ibis (*Plegadis chihi*)	--/CSC	winter only		X
Aleutian Canada goose (*Branta canadensis leucopareia*)	E/--	winter only		X
Osprey (*Pandion haliaetus*)	--/CSC	X		X
Sharp-shinned hawk (*Accipiter striatus*)	--/CSC	winter only		X
Cooper's hawk (*Accipiter cooperii*)	--/CSC			X
Ferruginous hawk (*Buteo regalis*)	C2/--	X		X
Merlin (*Falco columbarius*)	--/CSC	winter only		X

D-003121

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH INDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
American peregrine falcon (*Falco peregrinus anatum*)	E/E	winter only		X
Burrowing owl (*Athene cunicularia*)	--/CSC			X
Short-eared owl (*Asio flammeus*)	--/CSC	winter only		X
Tricolored blackbird (*Agelaius tricolor*)	C2/CSC	winter only		X
REPTILES				
Alameda striped racer (*Masticophis lateralis euryxanthus*)	PE/T	X	X	
AMPHIBIANS				
California red-legged frog (*Rana aurora draytoni*)	PE/CSC		X	
California tiger salamander (*Ambystoma californiense*)	C2/CSC		X	
Western spadefoot toad (*Scaphiopus hammondi hammondi*)	2R/CSC	X		
Foothill yellow-legged frog (*Rana boylii*)	C2/CSC	X		

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH INDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
INVERTEBRATES				
Lange's metalmark butterfly (*Apodemia mormo langei*)	E/--	X		
Conservancy fairy shrimp (*Branchinecta conservatio*)	E/--		X	
Longhorn fairy shrimp (*Branchinecta longiantenna*)	E/--		X	
Vernal pool fairy shrimp (*Branchinecta lynchi*)	T/--		X	
San Joaquin dune beetle (*Coelus gracilis*)	C1/--		X	
Vernal pool tadpole shrimp (*Lepidurus packardi*)	E/--		X	
Ciervo aegialian scarab beetle (*Aegialia [aegialia] concinna*)	C2/--		X	
Antioch Dunes anthicid beetle (*Anthicus antiochensis*)	C2/--		X	
Sacramento anthicid beetle (*Anthicus sacramento*)	C2/--		X	
Sacramento Valley tiger beetle (*Cicindela hirticollis abrupta*)	C2/--		X	
Antioch cophuran robberfly (*Cophura hurdi*)	C2/--		X	
Curved-foot hygrotus diving beetle (*Hygrotus curvipes*)	C2/--		X	

SPECIES	LEGAL STATUS* FEDERAL/STATE	DISTRIBUTION DOES NOT OVERLAP WITH INDP AREA	NO SUITABLE HABITAT PRESENT	OCCURS IRREGULARLY OR IN LOW NUMBERS AND INDIVIDUALS AND REGIONAL POPULATIONS NOT EXPECTED TO BE ADVERSELY AFFECTED BY THE PROJECT
Middlekauff's shield-backed katydid (*Idiostatus middlekauffi*)	C2/--		X	
Hurd's metapogon robberfly (*Metapogon hurdi*)	C2/--		X	
Antioch mutillid wasp (*Myrmosula pacifica*)	C2/--		X	
Yellow-banded andrenid bee (*Perdita hirticeps luteocincta*)	C2/--		X	
Antioch andrenid bee (*Perdita scitula antiochensis*)	C2/--		X	
Antioch sphecid wasp (*Philanthus nasalis*)	C2/--		X	
Delta June beetle (*Polyphylla stellata*)	C2/--		X	

* Status Explanations:

Federal

E = Listed as endangered under the federal Endangered Species Act.

T = Listed as threatened under the federal Endangered Species Act.

PE = Proposed as endangered.

C1 = Category 1 candidate for federal listing. Category 1 includes species for which the USFWS has sufficient biological information to support a proposal to list as endangered or threatened.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

2R = Recommended by the USFWS for inclusion as a Category 2 candidate in the next update of the candidate species list.

State

– = No designated special status.

E = Listed as endangered under the California Endangered Species Act.

T = Listed as threatened under the California Endangered Species Act.

CSC = California species of special concern.

D—003125

BIRDS

Swainson's Hawk

Status

The Swainson's hawk (*Buteo swainsoni*) is listed by DFG as a threatened species. It has no federal status. No critical habitat has been designated for this species.

Distribution

The breeding range of the Swainson's hawk includes western Canada, the western United States, and northern Mexico. In September, following the breeding season, Swainson's hawks migrate to Argentina, Uruguay, and southern Brazil, a round-trip journey that in some cases may exceed 14,000 miles. Wintering birds return to North America to begin nesting in early March.

The breeding population in California is estimated at 550 pairs with 430 pairs in the Central Valley (Estep 1989). The Central Valley population is concentrated in Yolo, San Joaquin, and Sacramento counties. In 1990, 92 pairs were documented in San Joaquin County (Jones & Stokes Associates 1990). Recently, a small population of 20 to 30 individuals was confirmed to regularly winter in the Sacramento/San Joaquin River Delta (Holt personal observation).

Habitat Requirements

Suitable foraging habitat is necessary to provide an adequate energy source for breeding adults and nestlings. Telemetry studies to determine foraging requirements have shown that Swainson's hawks may use in excess of 15,000 acres of habitat or range up to 18 miles from a nest in search of prey (Estep 1989, Babcock 1993). During the breeding season the preferred prey item is the California vole (*Microtus californicus*), although a variety of other rodents, birds, and insects may be taken (Estep 1989). Swainson's hawks typically hunt on the wing rather than from a perch like red-shouldered (*Buteo lineatus*) or red-tailed (*Buteo jamaicensis*) hawks. In the Central Valley, Swainson's hawks have adapted to forage primarily in agricultural fields. DFG (1994a) lists preferred foraging habitats for Swainson's hawks as alfalfa; fallow fields; beet, tomato, or other low growing crops; dry land and irrigated pasture; rice land (during the non-flooded period); and cereal grain crops (including corn after harvest).

Estep (1989) found that 73.4 percent of observed prey captures were in fields being harvested, disked, mowed, or irrigated. Foraging opportunities result when voles or other small rodents are displaced from their protective cover and are accessible for capture. Unsuitable foraging habitat types include vineyards, orchards, and cotton fields. These crops have a vegetational structure which makes prey species inaccessible to Swainson's hawks.

Typical nesting habitats are riparian corridors or isolated trees within efficient flying distance of suitable foraging habitat. Tree species commonly selected are Valley oak (*Quercus lobata*), Fremont's cottonwood (*Populus fremontii*), and willow (*Salix* spp.). More than 85 percent of

Swainson's hawk nesting territories in the Central Valley are along riparian corridors (Bloom 1980, Estep 1989).

Reasons for Decline

The Swainson's hawk population in California has declined by as much as 91 percent since the turn of the century (Bloom 1980). DFG (1994a) attributes this decline to the loss of native nesting and foraging habitats, and more recently, to the conversion of agricultural lands to urbanization and incompatible agricultural crops. In addition, pesticides, shooting, disturbances at the nest site, and impacts on wintering areas may have contributed to the population decline. Although losses at the wintering areas in South America may occur, it is not considered to be a significant factor in the overall decline of the species because breeding populations outside of California remain stable.

In California, the loss of nesting habitat within riparian zones has been accelerated by flood control practices and bank stabilization programs. Smith (1977) estimated that in 1850 over 770,000 acres of riparian habitat were present in the Sacramento Valley. In 1984, Warner and Hendrix estimated that there were only 120,000 acres of riparian habitat remaining in the Sacramento and San Joaquin Valleys. Based on Warner and Hendrix's (1984) estimates approximately 93 percent of the San Joaquin Valley, and 73 percent of the Sacramento Valley riparian habitats, have been eliminated since 1850.

Survey Methodology

NDDB and DFG raptor records were inventoried for previously-recorded nest locations within the INDP area. Field surveys to locate active nests were conducted during the nesting season from late March through early August, 1994. Nesting territories in the INDP area were searched for by biologists navigating the sloughs and rivers by boat or while driving or walking along levees. Survey dates were June 2, 3, 10, 17, and 21; and July 8 and 13 1994.

The phenomenon of wintering Swainson's hawks also was investigated. During the 1993-94 winter season (October 1993 through February 1994), surveys were conducted primarily by driving the public roads, and if necessary, the private roads within the vicinity of the INDP area. Foggy or inclement weather was avoided. Using binoculars and spotting scopes, all raptors and raptor activities were identified. Observation attempts were made on 33 days between October 14, 1993 through February 17, 1994.

Results

One nesting territory was discovered along the Mokelumne River within the INDP area during the 1994 breeding season (see Appendix A, Figure A-13). The nest was located 40 feet above ground, in a 60-foot high non-native locust (*Robinia* sp.) tree on the land side of the levee on New Hope Tract. The U.T.M. coordinate grid numbers for this nest are E.633170 N.4234850. This nest contained one nestling which was perhaps within one week of fledging on July 13, 1994, the last day of observation.

Swainson's hawks also wintered in the INDP area. In particular, a roost was located in a grove of eucalyptus trees on a breakwater at the mouth of the Mokelumne River (Figure IV-1). These birds

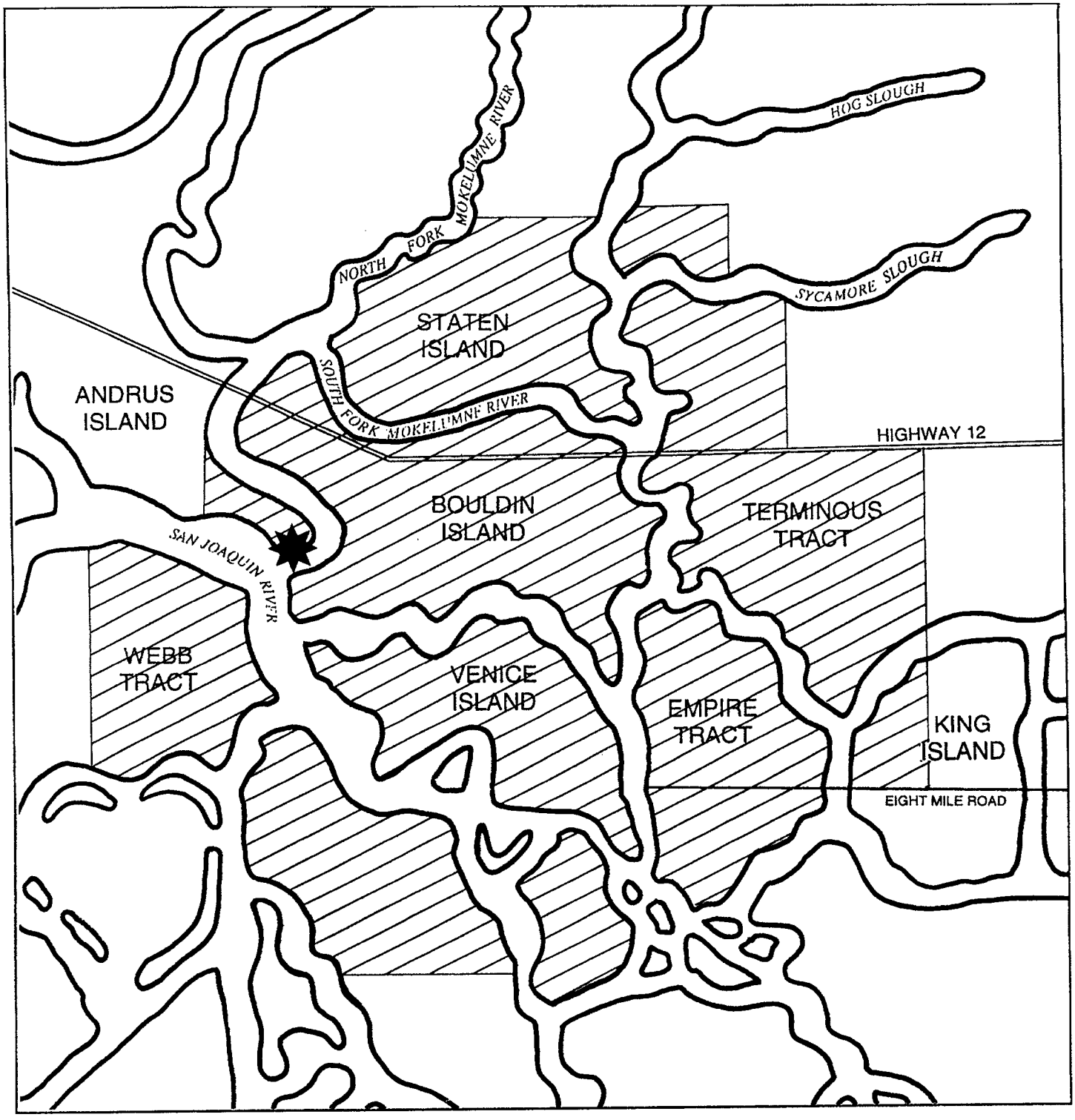

Figure IV-1. Swainson's hawk wintering areas in the Sacramento/San Joaquin River Delta

foraged almost exclusively in harvested grain fields that were being disked or plowed on islands in the northcentral Delta, including Bouldin Island, Staten Island, and Terminous Tract. Table IV-2 summarizes observations of wintering Swainson's hawks in the INDP area. This wintering group may include as many as 29 individuals and it is thought that the same group returns each year to this site (Holt personal observation, Yee personal observation). Observations also confirm the presence of Swainson's hawks within the INDP area during the autumn migration period.

Hood Property

One Swainson's hawk was observed foraging over the tomato field. Three Swainson's hawk nests were located adjacent to the Hood property (see Appendix A, Figure A-16). One was situated directly across the Sacramento River in a valley oak at the toe of the landside slope of the levee (UTM coordinates are E.628850 N.4248710). No chicks were visible. A second nest site was observed in a cottonwood tree immediately east of the property on the east edge of the railroad borrow ditch (UTM coordinates are E.630360 N.4248610). One downy chick was observed in the nest. A third Swainson's hawk nest was found just northeast of the property, also in a cottonwood tree on the eastern edge of the railroad borrow ditch, at the point where that ditch bends to the east toward North Stone Lake (UTM coordinates are E.630425 N.4249690). Two nestlings, perhaps one to two weeks from fledging, were visible in the nest.

Grizzly Slough Mitigation Site

In July, 1993 two Swainson's hawk nesting territories were discovered at the Grizzly Slough mitigation site. One nest site was located in a cottonwood tree along Grizzly Slough (UTM coordinates are E. 638930 N.4233830); one recently-fledged chick was observed standing in this nest (see Appendix A, Figure A-6). The second nest was not observed because trees screened all vantage points, but the defensive behavior of an adult pair indicated that an active nesting territory existed in a grove of valley oaks on the north side of Bear Slough (see Appendix A, Figures A-14). The approximate UTM coordinates for this nest are E.640100 N.4234800. In June, 1994 a pair of Swainson's hawks was observed again defending a nesting territory at the location described above in an oak grove north of Bear Slough but the nest site in the cottonwood on Grizzly Slough was not active. No alternate nest site was discovered.

Discussion

Nesting territories beyond the confines of the INDP area were not searched for, but an inventory of recorded nesting territories (NDDB 1992, Jones & Stokes Associates 1990), coupled with territorial behaviors of Swainson's hawks observed during field surveys for this project, indicates that additional nesting pairs of Swainson's hawks may exist near the INDP area. It is common for breeding pairs of Swainson's hawks to return to the same nesting territory year after year, but they do not always use the same nest tree (USFWS 1994a). The pair that nested within the INDP area in 1994 may use a tree that is outside of the INDP area in the future, or one of the pairs outside of the project area may use a tree that is within the project area. It is also not uncommon for Swainson's hawk nests to be used by other stick-nesting raptors in succeeding or alternate years. Therefore, trees that contain nests of white-tailed kites (*Elanus leucurus*), red-tailed hawks, red-shouldered hawks, or great horned owls (*Bubo virginianus*) may instead host Swainson's hawks in subsequent years, and vice versa.

Table IV-2. Swainson's Hawk Observations in the Interim North Delta Program Area (Winter 1993-94)

Date	Location	Number of Birds
10/14/93	Bouldin Island	17
10/14/93	Terminous Tract	7
10/14/93	Staten Island	0
10/17/93	Andrus Island	0
10/17/93	Bouldin Island	2
10/20/93	Bouldin Island	12
10/22/93	Staten Island	1
10/22/93	Bouldin Island	1
10/22/93	Andrus Island roost site	0 0
10/27/93	Bouldin Island	5
11/1/93	Deadhorse Island	0
11/1/93	Tyler Island	0
11/1/93	McCormack-Williamson Tract	0
11/1/93	New Hope Tract	0
11/1/93	New Hope Road parcel	0
11/6/93	Tyler Island	0
11/6/93	Staten Island	0
11/6/93	Canal Ranch Tract	0
11/6/93	New Hope Tract	0
11/13/93	Brack Tract	0
11/13/93	Bouldin Island	0
11/13/93	Andrus Island roost site	0 0
11/18/93	Terminous Tract	0
11/18/93	Bouldin Island	7

Date	Location	Number of Birds
11/20/93	Brack Tract	0
11/20/93	Staten Island	0
11/21/93	Bouldin Island	0
11/21/93	Andrus Island roost site	0 8
11/25/93	Bouldin Island	14
11/28/93	Bouldin Island	8
12/7/93	Bouldin Island	3
12/7/93	Tyler Island	0
12/10/93	Brack Tract	0
12/12/93	Andrus Island roost site	0 6
12/12/93	Bouldin Island	3
12/15/93	Andrus Island roost site	0 0
12/16/93	roost site	5
12/21/93	Andrus Island roost site	0 1
12/21/93	Bouldin Island	1
12/21/93	Terminous Tract	1
12/21/93	Staten Island	0
12/30/93	Andrus Island roost site	0 7
12/31/93	Andrus Island roost site	0 9
1/10/94	Terminous Tract	0
1/10/94	roost site	16
1/11/94	roost site	13
1/20/94	roost site	18
1/26/94	New Hope Tract	0

Date	Location	Number of Birds
1/26/94	New Hope Road parcel	0
1/26/94	Tyler Island	0
1/29/94	roost site	0
1/29/94	Terminous Tract	18
2/3/94	Terminous Tract	7
2/3/94	roost site	15
2/4/94	Staten Island	0
2/4/94	Canal Ranch Tract	0
2/4/94	New Hope Tract	0
2/4/94	Tyler Island	0
2/5/94	Terminous Tract	13
2/11/94	Terminous Tract	0
2/12/94	Terminous Tract	17
2/15/94	Andrus Island roost site	0 1
2/15/94	Bouldin Island	0
2/15/94	Terminous Tract	0
2/15/94	Brack Tract	0
2/15/94	New Hope Tract	0
2/15/94	Deadhorse Island	0
2/15/94	Tyler Island	0
2/15/94	Staten Island	0

Notes:

1) Roost site refers to Swainson's hawks perched at the roost site located at Korth's Pirate's Lair, at the tip of Andrus Island.

2) Sightings at Andrus Island refer to observations of foraging Swainson's hawks on Andrus Island.

Fewer trees suitable for stick-nesting raptors are available in the central Delta as compared to the number of available nest trees on the outer edges of the Delta. For example, within the INDP area, there are many tall cottonwood, sycamore, walnut, and eucalyptus trees found on levees along the lower Mokelumne River, North Mokelumne River, South Mokelumne River, and Sycamore, Hog, and Beaver sloughs. However, a more abundant supply of suitable trees exists upstream, on the upper reaches of the Mokelumne River and Sycamore, Beaver and Hog sloughs. Correspondingly, stick-nesting raptors, including Swainson's hawks, were found in greater abundance in the areas with more trees.

Other factors should be considered with regard to Swainson's hawk nest site selection since suitable nest trees do exist in the central Delta yet they are unoccupied. It may be that the relatively fewer number of trees available for nesting is not the most important factor limiting Swainson's hawk breeding in the central Delta. Also important is the proximity of the nest to suitable foraging habitat (Bloom 1980, Estep 1989). In Sacramento, San Joaquin, and Yolo counties Swainson's hawks nest in fairly common numbers in areas of mixed row, grain, and hay crops (Bloom 1980, Estep 1989, Jones & Stokes Associates 1990, NDDB 1992). However, Swainson's hawks are not found in equal density in the central Delta region (Bloom 1980, Jones & Stokes Associates 1990, NDDB 1992). Perhaps the large amount of corn that is grown in the central Delta is not conducive to the breeding effort. During the early breeding season, corn fields are thoroughly tilled and lack an adequate supply of rodents for foraging (Estep 1989). Later in the season, the corn crop becomes tall and dense which discourages foraging by Swainson's hawks even though an adequate prey base may exist. The rodent population is not accessible for capture until the fall when the crop is harvested, removing the protecting vegetational cover.

During field surveys in October 1993 and September 1994, groups of Swainson's hawks were observed foraging for small rodents in harvested corn fields next to levees within the INDP area. Migrating Swainson's hawks are perhaps an annual event in the Delta during September and October (Yee pers. comm.). By early November they have moved out of the area, presumably on their way to South America.

In the winter of 1990-91, a group of as many as 29 Swainson's hawks were confirmed to be wintering in the Sacramento/San Joaquin River Delta (Yee *et al.* 1990). This was considered to be an unusual phenomenon (Browning 1974, McCaskie *et al.* 1986). Swainson's hawks were located again in subsequent winter seasons (Holt and Yee in preparation). A regularly-used roosting site was identified. The roosting site was the stand of eucalyptus trees on the breakwater at Korth's Pirate's Lair on Andrus Island, at the mouth of the Mokelumne River. This is the same roosting site that was documented during 1993-94 field surveys.

Foraging was observed almost exclusively in harvested corn fields that were being disked. All foraging activities observed took place on islands in the vicinity of the roost site: Andrus, Brack, Bouldin, Empire, King, Mandeville, Staten, Terminous, Tyler, Venice, and Webb. Swainson's hawks have not been observed away from this very particular locale, which in large part includes and surrounds the INDP area. The number of individuals present each winter has reached a high count of 27 to 29, but throughout the season there is much fluctuation of the population numbers on a day-to-day basis. Because not all of the Swainson's hawks can be accounted for within the central Delta on most days, it is likely that alternate foraging and roosting sites exist, probably in the Central Valley, but as yet no other sites have been identified.

Previous investigations of Swainson's hawks wintering in North America concluded that the overwhelming majority of the population funnels through Panama during migration and that the relatively few winter records are either of migration dropouts in Texas or are of individuals that have become trapped in southern Florida, unable to manage an overwater crossing (Palmer 1988). The preponderance of previous winter records are of first-year birds in immature plumage (Browning 1974). The Swainson's hawk population that winters in the central Delta is very singular in that it is composed almost entirely of adult hawks; only one to three are in immature plumage. Also, based upon repeat sightings of uniquely-plumaged individuals, it appears to be the same population returning each year to its chosen wintering locality (Holt and Yee in preparation).

Data gathered during field surveys in the winter of 1993-94 conforms to data gathered from 1990 through 1993. The last observation of lingering migrants was on October 27, then a 3-week period occurred without any sightings. On November 18, the first observation of the wintering population was recorded. At least some of the individuals from that population are sighted regularly in the INDP vicinity through the winter until the survey is concluded in mid-February. At that time the possibility exists that returning migrants might be represented in species counts.

Based upon unique plumage characters of some of the hawks, it is speculated that the individuals observed in 1993-94 are the same as those observed in previous years. The same roosting site was used regularly. Foraging in harvested grain fields in the same general vicinity was observed, with birds often swooping close behind tractors to grab a small rodent. The highest number of birds counted during INDP surveys was 18 on January 20 and on January 29 but another observer was able to count as many as 27 on January 9 and 29 on January 28, 1994 (Herzog pers. comm.). It is not known where the breeding areas for these hawks are; a telemetry study would have to be undertaken to solve this mystery.

Impacts of the Proposed Project (Alternative 5)

Impact - Disturbance to Nesting Swainson's Hawks. Dredging of the South and North Forks of the Mokelumne River has the potential to adversely impact Swainson's hawks in their nesting territories due to disturbances caused by barges involved in dredging operations, including the deposition of spoils or riprap at specified locations. Also, earthmoving equipment and dump trucks that may be working close to nesting territories could disturb nesting hawks. A collision with a nest tree, as well as disturbances in the nesting territory caused by the operation of heavy equipment, or disturbances in the nesting territory from prolonged human presence, have the potential to disrupt the breeding effort. This could result in abandonment of the nesting territory and/or mortality to eggs or young. This is a potentially significant impact.

Mitigation Measure - Prohibition of Potentially Disruptive Activities. Project-related activities that are likely to disrupt Swainson's hawk reproductive efforts shall not be allowed near active nesting territories during the breeding season. The following paragraphs outline specific conditions related to this mitigation measure.

- During the Swainson's hawk breeding season (March 1 through August 30), a qualified biologist shall locate and monitor all Swainson's hawk nesting sites throughout the INDP project area. If a Swainson's hawk territory is occupied, all potentially disrupting project-related activities that may impact reproductive efforts shall be halted within a one-quarter-mile zone surrounding the nest tree. Potentially disrupting activities include dredging, levee

reinforcement, erosion protection, water-side berm construction, and prolonged human presence. This prohibition shall remain in effect throughout the breeding season or until the young have fledged (from approximately May 25 [the earliest known fledging date in the Central Valley] until August 21 [latest known fledging date in the Central Valley]), or until it can be ascertained that the nesting territory has failed. Continued monitoring by a qualified biologist shall be required to observe and advise on the effectiveness of the no-activity zone(s) and to determine when a no-activity zone becomes unnecessary.

- The period from March 1 through April 30 is the critical time period when Swainson's hawks establish nesting territories, construct nests, and lay eggs. Swainson's hawks are particularly sensitive and prone to nest abandonment during these pre-nesting and incubation phases of the reproductive cycle. It is especially important that none of the disruptive activities identified above occur in potential Swainson's hawk nesting territories during this time period.

  Depending upon the location of construction activities within the INDP area, slightly different applications of ensuring no disturbance to Swainson's hawks during the pre-nesting phases may be necessary (see #1 and #2 below).

  1) Potentially disruptive activities (i.e., dredging, levee reinforcement, erosion protection, water-side berm construction, and prolonged human presence) shall not be permitted from March 1 through April 30 on the Mokelumne River and North Mokelumne River, north of Walnut Grove Road. The nesting habitat along the Mokelumne River and North Mokelumne River north of Walnut Grove Road is a continuous riparian corridor. The nesting habitat throughout the remainder of the INDP area is sparse. Swainson's hawk breeding pairs whose territory includes several potential nest sites, such as along a riparian corridor, may construct a new nest in a different tree each year. As such, permanent nest sites that would be used year after year cannot be identified. For management purposes, all potential nest trees within a Swainson's hawk nesting territory should be considered nesting habitat.

  2) Throughout the remainder of the INDP area (i.e., south of Walnut Grove Road), at any location where a Swainson's hawk nesting territory has been noted from a previous year (i.e., any year prior to construction), potentially disrupting activities (i.e., dredging, levee reinforcement, erosion protection, water-side berm construction, and prolonged human presence) shall be precluded from March 1 through April 30. A one-quarter-mile zone shall be established around potential nest trees in the vicinity of the previous year's nesting territory. Within that zone all potentially disrupting activities shall be halted.

Impact - Tree Removal resulting from Levee Reinforcement. The Proposed Project would result in adverse impacts to Swainson's hawks by removing an unknown number of trees on the levees of the INDP area waterways. The project description does not specify the number or exact location of trees to be removed; however, most of the trees, as well as other vegetation, growing on the land-side of the levee would need to be taken out as part of levee reinforcement. Also, any trees growing on the levee tops would likely be removed so that the crown of the levee can be graveled. It is conceivable that virtually all of the trees in the INDP area upstream of Walnut Grove Road could be eliminated. Trees may be removed that have been, or potentially could be, used by Swainson's hawks for nest sites. Also, trees may be removed that have been, or potentially could be, used as nest sites for other stick-nesting raptors (e.g., red-tailed hawks, red-shouldered hawks, and white-tailed kites). Tree removal would constitute a significant impact to Swainson's hawks by increasing interspecies competition for nest sites.

Mitigation Measure - Retention of Existing Nesting Habitat. It should be a priority to retain any existing trees within the project area. Prior to construction, DWR engineers, with the assistance of a qualified biologist, shall identify and clearly mark all existing trees whose retention would not interfere with the flood protection integrity of the levee. Construction activities shall avoid these trees.

Mitigation Measure - Planting of Replacement Trees. In areas where existing trees cannot be retained, replacements shall be planted at a ratio of 2:1 for all trees that are removed that are greater than 10 inches in diameter at breast height.

The number and locations of trees to be removed are not specified in the project description. The removal of all potential nest trees in the project area, or from a significant portion of the project area, cannot be adequately mitigated by replacement trees planted at a single off-site location. Swainson's hawks compete with other resident stick-nesting raptors for available nesting territories. A line of trees several miles long provides sufficient space and suitable nesting habitat characteristics to support numerous stick-nesting raptor territories. Replacement trees established in a single grove may at best provide only one or two new stick-nesting raptor nesting territories. And, if the potential for stick-nesting raptor territories is currently saturated in the vicinity of where replacement trees are to be located then it is possible that the addition of replacement trees may have no effect in increasing the number of stick-nesting raptor territories.

In addition, the removal of mature potential nest trees cannot be sufficiently mitigated by planting seedlings. Seedlings cannot provide nesting habitat until they have grown to maturity in 20 to 30 years. Therefore, to adequately mitigate for impacts to nesting habitat the following measures, listed in descending order of importance, should be implemented prior to the consideration of establishing replacement trees at an off-site location.

- Locations for water-side berms should be identified and incorporated into the project design. Water-side berms should include habitat for replacement trees wherever appropriate. Priority shall be given to the establishment of native tree species.

  The establishment of potential nest trees on water-side berms within the project area could become beneficial to stick-nesting raptors including Swainson's hawks. However, the project description does not specify where the water-side berms are to be placed, or how many water-side berms are to be created, and what the total acreage of the water-side berms will be. Also unspecified are estimates as to how much of each habitat type would be targeted for creation within the water-side berms. If replacement habitat is planted it shall be at a ratio of 3 acres for each acre lost. Mitigation habitat shall be a combination of linear corridors or patches which accentuate edge habitat.

- Within the INDP area, in areas where water-side berms are not practical to construct (e.g., the Mokelumne River north of Walnut Grove Road), replacement trees should be established at appropriate locations upon the reinforced levees. DWR shall identify locations where replacement trees may be planted, either on the land-side or the water-side of the levee. Reforestation locations are not to conflict with the flood protection integrity of the levee. Priority shall be given to the establishment of native tree species.

- If replacement habitat is not possible within the INDP area it must be adjacent to suitable foraging habitat within 5 miles of the INDP area.

Impact - Loss of Foraging Habitat. An undetermined amount of agricultural land suitable as Swainson's hawk foraging habitat would be removed from crop production as a consequence of levee reinforcement, including the widening of levees at their base. Levee reinforcement would occur throughout the INDP area. Breeding Swainson's hawks, as well as migrating and wintering birds, forage for small rodents primarily in agricultural fields. While it is noted that the strengthening of levees would improve the flood protection for many thousands of acres of agricultural foraging habitat, the loss of this habitat, even temporarily, constitutes a potentially significant impact to Swainson's hawks.

Mitigation Measure - Cooperative Management of the Land-Side Levees for Swainson's Hawks. The opportunity exists to mitigate for losses of agricultural foraging habitat by providing wildlife habitat on the land-side slopes of the reinforced levees. The project description states that the newly reinforced levees shall be managed with levee vegetation best management practices; however, levee vegetation best management practices are not specifically defined. To adequately mitigate for losses of agricultural foraging habitat, the individual Reclamation Districts would have to enter into a mitigation agreement which mandates management practices on the unarmored slope of the levee that are demonstrably beneficial to wildlife. These could include the maintenance of a ground cover of grasses which would create refugia for small rodent species that may serve as prey for Swainson's hawks and other raptors, vegetation control by mowing, and moderation in the use of pesticides. If such a mitigation agreement is not feasible due to concerns for levee integrity or safety, then in-kind replacement of foraging habitat shall be provided elsewhere according to DFG (1994a) mitigation guidelines.

Impact - Loss of Foraging and Potential Nesting Habitat at Hood. Installation of a screened diversion at Hood would remove a small amount of foraging habitat and potential nesting habitat for Swainson's hawks. Several Swainson's hawk nesting territories are located in the vicinity of Hood and the site itself is bordered by suitable Swainson's hawk nesting habitat.

The analysis of potential impacts associated with the diversion of water from the Sacramento River at Hood into Morrison Creek/Stone Lakes/upper Snodgrass Slough/Lost Slough is beyond the scope of this report.

Mitigation Measures. The types of mitigation measures proposed above would also apply to the Hood site.

Alternative 1

Impact. The No-Action Alternative would not affect the Swainson's hawk. Project area levees would remain intact and adjacent lands would continue in their present agricultural uses.

Mitigation Measure. None required.

Alternative 2

Impacts. Dredging of the South Fork Mokelumne River would have the same types of impacts as described for the Proposed Project; however, the extent of impacts would be reduced because only

the South Fork Mokelumne would be disturbed. The North Fork Mokelumne River and the Hood site would remain in their existing condition.

Mitigation Measures. Alternative 2 shall require the same mitigation measures as the Proposed Project.

Alternative 3

Impacts. Dredging of the South and North Forks of the Mokelumne River would have the same impacts as described for the Proposed Project, with the exception of the loss of habitat at the Hood site.

Mitigation Measures. Alternative 3 shall require the same mitigation measures as the Proposed Project.

Alternative 4

Impacts. Dredging of both forks of the Mokelumne River and construction of the Delta Cross Channel Enlargement would have the same impacts as described for the Proposed Project. Construction and operation of the Delta Cross Channel would not affect Swainson's hawk habitat.

Mitigation Measures. Alternative 4 shall require the same mitigation measures as the Proposed Project.

Alternative 6

Impacts. Alternative 6 would have the same impacts as described for the Proposed Project. In addition, Alternative 6 would have other impacts associated with the creation of setback levees. These are described below.

Mitigation Measures. Mitigation measures for Alternative 6 shall be the same as described for the Proposed Project and shall also include the additional measures identified below.

Impact - Disturbance to Nesting Swainson's Hawks during Construction of Levee Setbacks. The construction of levee setbacks would entail the transportation of 7 million cubic yards of soil by trucks and the sculpting of 7 million cubic yards of soil by earthmoving equipment. These activities could create disturbances at nesting territories which could cause failure of the Swainson's hawk reproductive effort.

Mitigation Measure - Prohibition of Potentially Disruptive Activities. The potentially disruptive activities discussed for the Proposed Project (i.e., dredging, levee reinforcement, erosion protection, water-side berm construction, and prolonged human presence) shall also include traffic along the haul roads and earthmoving operations associated with the construction of levee setbacks. These activities shall be restricted during the time periods identified under the Proposed Project.

Impact - Removal of Nest Trees. The possible removal of Swainson's hawk nest trees and potential nest trees within the INDP area due to levee reinforcement would be somewhat less for Alternative 6 than for the Proposed Project. In Alternative 6 only one side of the existing project area waterways would undergo levee reinforcement and almost half of the existing levees would be retained as instream islands. This would allow almost half of the existing potential nesting habitat to remain on the newly-created instream islands. However, under Alternative 6 the removal of more than half of the potential nesting habitat for Swainson's hawks could be removed. Trees may be removed that have been used, or potentially could be used, by Swainson's hawks for nest sites. Also, trees may be removed that have been, or potentially could be, used as nest sites for other stick nesting raptors (e.g., red-tailed hawks, red-shouldered hawks, white-tailed kites). This could have a detrimental effect on Swainson's hawks by increasing interspecies competition for nest sites and constitutes a potentially significant impact.

Mitigation Measure - Establishment of Replacement Habitat. Newly created instream islands are appropriate locations to establish replacement nesting habitat. Protection from wave-caused erosion shall be constructed for the newly created instream islands.

Impact - Loss of Foraging Habitat. The amount of agricultural land suitable for foraging Swainson's hawks that would be removed from agricultural production is increased in Alternative 6, as compared to the Proposed Project. The acreage has not been determined precisely but it would be those lands currently in agricultural production which lie between the line of the current land-side slope levee toe and the line where the newly constructed land-side slope levee toe would be. The loss of these lands would constitute a loss of foraging habitat for breeding, migrating, and wintering Swainson's hawks. This is a potentially significant impact.

Mitigation Measure - In-Kind Replacement Habitat. To compensate for the loss of foraging habitat, in-kind replacement habitat would need to be created according to DFG (1994a) guidelines. The magnitude of the loss of agricultural foraging habitat exceeds that which could be mitigated by implementing wildlife management practices on the land-side levee slopes. The flood protection provided to Delta agricultural habitats is not measurably increased in Alternative 6 over that provided by the Proposed Project.

Cumulative Impacts

The discussion of cumulative impacts relates to Alternatives 2 through 6 only, since Alternative 1, the No-Action Alternative, would not have any impacts to Swainson's hawks.

Impact - Removal of Agricultural Lands from the 100-year Floodplain. If increased flood protection is achieved by the INDP, it may encourage or facilitate urbanization of agricultural lands that are presently in the 100-year floodplain.

Mitigation Measure. None required. This impact is not created by strengthening levee systems to achieve 100-year flood protection; rather it is the result of dredging. Over time, however, the channel will silt back up thus eliminating the protection from a 100-year flood.

Impact - Conversion of Agricultural Lands to Unsuitable Crops for Swainson's Hawks. Strengthening the levee system would increase the flood protection for thousands of acres of agricultural land in the INDP area. This could be a factor in encouraging private landowners to convert crops that are

suitable as foraging habitat for Swainson's hawks, such as grain and row crops, to crops that are incompatible for Swainson's hawks such as vineyards and orchards. Vineyards and orchards typically require an expensive long-term investment which may not be recoverable following an extensive period of flooding.

Mitigation Measure. None feasible.

Greater Sandhill Crane

Status

The Central Valley population of the greater sandhill crane (*Grus canadensis tabida*) is listed by DFG as a threatened species. It has no federal status.

Distribution

The greater sandhill crane is a subspecies of the sandhill crane (*G. canadensis*). There are four populations of greater sandhill crane: Eastern, Rocky Mountain, Lower Colorado, and Central Valley. The Central Valley population winters primarily at eight locations on the floor of California's Central Valley and nests in northeastern California, eastern Oregon, and in British Columbia, west of the Continental Divide (Pogson and Lindstedt 1991).

Habitat Requirements

In the breeding season, greater sandhill cranes occur in and near wet meadow, shallow lacustrine, and fresh emergent wetland. They nest in remote portions of extensive wetlands. Commonly, the nest is composed of dead wetland vegetation piled in a small mound surrounded by shallow water. They prefer relatively treeless landscapes, perhaps to more easily detect predators, and are particularly sensitive to human disturbance, especially within a mile of the nest site. In winter they frequent annual and perennial grasslands, moist croplands with rice or corn stubble, and open emergent wetlands. While moist sites are commonly used, at times they can be found on dry plains away from water. They feed on grasses, forbs, and especially cereal crops. They also use their long bill to probe deep into soil for roots, tubers, seeds, grains, earthworms, and insects. Larger prey such as small birds, small rodents, snakes, frogs, and crayfish also are taken. In winter and in migration they roost at night in flocks standing in open fields that are moist or in shallow water.

Reasons for Decline

Historically, the greater sandhill crane was a fairly common breeder on the northeastern plateau of California (Grinnell and Miller 1944). Destruction of wetland habitats in the breeding areas, as well as other threats such as overgrazing and predation, have resulted in low reproductive success. Wetland habitats in the Central Valley have been eliminated by agriculture and urban development, flood control projects, water diversions, and drainage projects. The loss of naturally occurring wetland communities in interior California probably exceeds 99 percent (ESA/Madrone 1982). The

acreage flooded by private duck clubs, which offer supporting habitat for wintering cranes, is dwindling due to higher operating costs. Those cranes that remain are concentrating in fewer areas and competing for shrinking resources. In addition, private as well as state and federal wildlife refuges face serious threats from lack of adequate water supplies and contamination of available water with harmful elements (e.g., selenium, boron, salts, pesticides).

Survey Methodology

The importance of the North Delta region to greater sandhill cranes is well studied and documented (Pogson and Lindstedt 1991, NDDB 1992). Important roosting areas include Staten Island and the former El Dorado Gun Club on Brack Tract, now managed by DFG. A further attempt to obtain census information was deemed unnecessary to the data gathering requirements of this report. However, during winter field surveys that concentrated mainly on wintering Swainson's hawks, occurrences of sandhill cranes were noted and the data collected were compared to locations previously documented by Pogson and Lindstedt (1991).

Observations of sandhill cranes were made using binoculars and spotting scopes and were obtained during stops while driving the public and private roads in the INDP area. Field surveys were conducted during daylight hours during fair weather; foggy or inclement weather conditions were avoided. Special attention was paid to incidences of sandhill cranes utilizing the land side slopes of levees in the INDP area.

Three subspecies of sandhill crane winter in the North Delta region -- the greater sandhill crane, lesser sandhill crane (*G. c. canadensis*), and Canadian sandhill crane (*G. c. rowani*). Identification of the various subspecies was attempted at each observation.

Results

Greater sandhill cranes were found in abundance by MGA biologists on Staten Island, Brack Tract, Tyler Island, Bouldin Island, Terminous Tract, and Canal Ranch (see Appendix A, Figures A-4, A-5, A-7, A-8, A-11, and A-12). Cranes were observed to forage on land side slopes of levees, but primarily foraged in harvested corn fields that were either intentionally flooded or that were otherwise moist due to weather events. The three subspecies of sandhill cranes were present throughout the survey period (mid-October 1993 through mid-February 1994). Some of the more impressive numbers recorded were: 6,035 cranes on Staten Island November 13, 1993; 12,540 cranes on Staten and Brack Tract November 20, 1993; more than 9,000 cranes on Staten Island December 21, 1993; and more than 6,000 cranes on Staten Island February 4, 1994. No cranes were observed in the vicinity of the INDP area north of Walnut Grove Road, as the preferred habitat of flooded corn fields was not found in that area.

During 1994 surveys, DWR biologists documented mixed flocks of sandhill cranes on Brack Tract, Terminous Tract, Shin Kee Tract, and New Hope Tract (DWR 1995b).

Grizzly Slough Mitigation Site

On visits to the Grizzly Slough mitigation site in January and February, 1994, seven greater sandhill cranes were observed foraging in harvested corn fields that were flooded with one foot of water (see Appendix A, Figure A-6).

Discussion

The lesser sandhill crane breeds across the North American tundra, the Pacific flyway portion of that population wintering principally in the Central Valley of California. The Canadian sandhill crane breeds in coastal British Columbia and also winters principally in the Central Valley. During 1993-94 field surveys, all three subspecies of sandhill crane were identified in fields bordering levees of the Mokelumne River in the INDP area.

There are perhaps 30,000 sandhill cranes wintering in California (Small 1994). Lesser sandhill cranes are the most numerous and in winter are more widely distributed in the Sacramento Valley, the San Joaquin Valley, and in southern California. From 5,000 to 6,000 lesser sandhill cranes winter annually in the North Delta region (Pogson and Lindstedt 1991). Generally, lesser sandhill cranes comprised the majority of cranes observed in October and November. However, during December and January, lesser sandhill cranes constituted less than 50 percent of the cranes observed.

Only 893 of the intermediate-sized Canadian sandhill cranes are known to exist, and the post-breeding movements of this subspecies are poorly understood. From a distance Canadian and greater sandhill cranes look similar. Because of the difficulty in differentiating the Canadian from the greater sandhill in the field, these two subspecies are counted together, usually being lumped under the term "large" sandhill cranes.

Pogson and Lindstedt (1991) estimate the total population of "large" sandhill cranes between 6,012 and 6,852 individuals. They have counted as many as 3,829 of these large sandhill cranes wintering in the area which includes Staten Island, Brack Tract, Canal Ranch, Bouldin Island, Terminous Tract, New Hope Tract, and Tyler Island. Thus, the INDP area includes, and is surrounded by, one of the most important wintering areas for the threatened subpopulation of greater sandhill crane. This was reconfirmed during the winter of 1993-94 as field surveys conducted in the INDP area recorded as many as 2,820 large sandhill cranes on November 13, 1993; more than 3,000 cranes were observed on November 20, 1993, and more than 4,500 were observed on December 21, 1993. Virtually all of the cranes were observed in flooded corn fields adjacent to the levees of the Mokelumne River.

With the loss of so much wetland habitat in the Central Valley, areas that are managed for wintering waterbirds have become increasingly important. Agricultural fields that are flooded for hunting or for non-consumptive uses mimic the former natural condition and are attractive to many species. The flooded waste corn fields are particularly responsible for the large numbers of cranes because of the nutritive value of the spilled grain itself as well as the invertebrates and small mammals that this habitat fosters and that are available for consumption. In addition, the open, shallow, flooded landscape is ideal for foraging, loafing, and night roosting.

Impacts of the Proposed Project (Alternative 5)

Impact - Disturbance to Cranes on Wintering Grounds. Dredging of the South and North Fork Mokelumne River could adversely impact greater sandhill cranes due to disturbances caused by construction equipment (e.g., dredging operations and depositing of spoils or riprap, earthmoving equipment, and dump trucks) and the increased human presence associated with working in the vicinity of greater sandhill crane winter foraging areas. These birds are sensitive to disturbances and could be forced from their traditional wintering foraging and roosting areas.

Mitigation Measure - Confinement of Potentially Disruptive Activities. South of Walnut Grove Road, potentially disruptive project-related construction activities shall be confined to a single area, rather than various construction-related activities occurring at multiple locations, during the period when sandhill cranes are present in the INDP area.

The portion of the INDP area which traditionally is heavily used for roosting and foraging by greater sandhill cranes is located south of Walnut Grove Road on Brack Tract, Bouldin Island, Canal Ranch, New Hope Tract, Staten Island, and Tyler Island. By confining potentially disruptive project-related activities to a single dredger and its supporting levee reinforcement earthmoving equipment it would allow sandhill cranes to utilize the remainder of their traditional roosting and foraging habitat without project-related disturbances.

Sandhill cranes are present in the INDP area from roughly the third week of September through the first week of April. Any, or all, of the three subspecies of sandhill crane (greater sandhill crane [*Grus canadensis tabida*], lesser sandhill crane [*G. c. canadensis*], and Canadian sandhill crane [*G. c. rowani*]) may be found in the same habitat in the INDP area during this time period. Because it is sometimes difficult to distinguish the two unlisted subspecies from the threatened subspecies, the prohibitions specified as part of this mitigation measure shall be triggered by the presence of "sandhill cranes".

Impact - Loss of Foraging Habitat. An undetermined amount of agricultural land which is the primary roosting and foraging habitat for greater sandhill cranes will be removed from agricultural production as a consequence of reinforced levees being widened at their base. Levee reinforcement would occur throughout the INDP area. Wintering greater sandhill cranes forage for small rodents, insects, and cereal grains primarily in agricultural fields. Although the loss of foraging habitat constitutes a potentially significant impact, it is noted that the strengthening of the levees would improve the flood protection for many thousands of acres of greater sandhill crane foraging and roosting habitat.

Mitigation Measure - Cooperative Management of the Land-Side Levees for Sandhill Cranes. The opportunity exists to mitigate for losses of agricultural foraging habitat by providing wildlife habitat on the land-side slopes of the reinforced levees. The project description states that the newly reinforced levees shall be managed with levee vegetation best management practices; however, levee vegetation best management practices are not specifically defined. To adequately mitigate for losses of agricultural foraging habitat, the individual Reclamation Districts would need to enter into a mitigation agreement which mandates management practices on the unarmored slope of the levee that are demonstrably beneficial to wildlife. These could include the creation of refugia for small rodent species which may become available as prey for greater sandhill cranes. Management practices should stress a ground cover of grasses, vegetation control by mowing, and moderation in the use of pesticides. If such a mitigation agreement is not feasible due to concerns for levee

integrity or safety, then in-kind replacement foraging habitat shall be created elsewhere. Mitigation habitat shall be at a ratio of 2:1.

Impact - Changes due to the Hood Diversion. The analysis of potential impacts associated with the diversion of water from the Sacramento River into Morrison Creek/Stone Lakes/upper Snodgrass Slough/Lost Slough is beyond the scope of this report.

Alternative 1

Impacts. - The No-Action Alternative would have no impact on the greater sandhill crane.

Mitigation Measures. None required.

Alternative 2

Impacts. Alternative 2 would have the same impacts as described for the Proposed Project; however, the extent of impacts would be reduced because only the South Fork Mokelumne would be dredged. The North Fork Mokelumne River and the Hood site would remain in their existing condition.

Mitigation Measures. Alternative 2 shall require the same mitigation measures as described for the Proposed Project.

Alternative 3

Impacts. Alternative 3 would have the same impacts as described for the Proposed Project.

Mitigation Measures. Alternative 3 shall require the same mitigation measures as described for the Proposed Project.

Alternative 4

Impacts. Alternative 4 would have the same impacts as described for the Proposed Project. Construction of the Delta Cross Channel Enlargement would not affect sandhill cranes.

Mitigation Measures. Alternative 4 shall require the same mitigation measures as described for the Proposed Project.

Alternative 6

Impacts. Alternative 6 would have the same impacts as described for the Proposed Project. In addition, Alternative 6 would have other impacts associated with the creation of setback levees. These are described below.

Mitigation Measures. Mitigation measures for Alternative 6 shall be those described for the Proposed Project. These shall also include the additional measures identified below.

Impact - Disturbances to Sandhill Cranes during Construction of Levee Setbacks. The construction of levee setbacks would entail the transportation of 7 million cubic yards of soil by trucks and the sculpting of 7 million cubic yards of soil by earthmoving equipment. These activities have the potential to create disturbances to foraging and roosting sandhill cranes, a potentially significant impact.

Mitigation Measure - Prohibition of Potentially Disruptive Activities. South of Walnut Grove Road, potentially disruptive project-related activities associated with levee setback construction shall be confined to a single area during the period when sandhill cranes are present in the project area. The impact is to be limited to one section at any time in order to minimize disturbances and to permit the remainder of the traditional foraging and roosting areas to be used by the cranes. Haul roads are to be marked by DWR to minimize disturbances to cranes. The same roads shall be used rather than alternating routes.

Impact - Loss of Foraging Habitat. The amount of agricultural land suitable for foraging and roosting greater sandhill cranes that would be removed from agricultural production is increased in Alternative 6 over the amount of agricultural land to be removed from production in Alternative 2. Although the exact acreage has not been determined, it would be those lands currently in agricultural production which lie between the line of the current land-side slope levee toe and the line where the newly constructed land-side slope levee toe would be. The loss of these lands would constitute a loss of foraging and roosting habitat for wintering greater sandhill cranes, a potentially significant impact.

Mitigation Measure - Habitat Replacement. To compensate for the loss of foraging habitat, in-kind replacement foraging habitat would need to be created at a ratio of 2:1. The magnitude of the loss of agricultural foraging habitat exceeds that which could be mitigated by implementing wildlife management practices on the land-side levee slopes. The flood protection provided to Delta agricultural habitats is not measurably increased in Alternative 6 over that provided under the Proposed Project.

Cumulative Impacts

The discussion of cumulative impacts relates to Alternatives 2 through 6 only since Alternative 1, the No-Action Alternative, would not have any impacts on sandhill cranes.

Impact - Removal of Agricultural Lands from the 100-year Floodplain. If increased flood protection is achieved by the INDP, it may encourage or facilitate urbanization of agricultural lands that are presently in the 100-year floodplain.

Mitigation Measure. None required. This impact is not created by strengthening levee systems to achieve 100-year flood protection; rather it is the result of dredging. Over time, however, the channel will silt back up eliminating the protection from a 100-year flood.

Impact - Conversion of Agricultural Lands to Unsuitable Crops for Sandhill Cranes. Strengthening the levee system would increase the flood protection for thousands of acres of agricultural land in the INDP area. This could be a factor in encouraging private landowners to convert crops that are

suitable as foraging and roosting habitat for greater sandhill cranes, such as cereal grains, to crops that are incompatible for cranes such as vineyards and orchards. Vineyards and orchards require an expensive long-term investment which would not be recoverable after a flood.

Mitigation Measure. None feasible.

California Black Rail

Status

The California black rail (*Laterallus jamaicensis coturniculus*), a subspecies of black rail (*L. jamaicensis*), is designated as a Category 2 candidate for listing by the USFWS. It is listed by DFG as threatened. No critical habitat has been designated for this species.

Distribution

California black rails breed in limited numbers in coastal salt marshes from the San Francisco/San Pablo/Suisun Bay estuaries south to northern Baja California, Mexico. They also breed in inland freshwater marshes including the lower Colorado River, Salton Sea, and Sacramento/San Joaquin River Delta. There is a wider distribution during the non-breeding season (Ripley 1977, American Ornithologist's Union 1983, Ripley and Beehler 1985).

Habitat Requirements

California black rails are secretive birds; therefore, habitat requirements have been difficult to assess. Little is known about black rail food habits but it is thought that they consume arthropods (Huey 1916). Grinnell and Miller (1944) described the habitat preferred by black rails as "chiefly tidal salt marshes, where associated characteristically with heavy growths of pickleweed (*Salicornia*) ... but also occurs in brackish and freshwater marshes ...". Repking and Ohmart (1977) and Manolis (1978) found a definite relationship between black rail distribution and marsh elevation. They found black rails in high, shallow water marshes with little annual and/or daily fluctuations in water level, but not in low, deep water marshes or marshes with considerable fluctuations in water level. Grinnell and Miller (1944) stated that for black rail, the "most important hazards ... appear to be extra high tides". Manolis (1978) found that black rails were absent from areas completely submerged by high tides. A gradual slope into upland marsh appears to be a necessity. Inundation of nests can mean failure of the reproductive effort. Inundation of habitat has been documented as a cause of black rail mortality (Evens and Page 1986), due to predation by carnivorous birds when rising water eliminates protective cover.

Habitat remaining in the Sacramento/San Joaquin River Delta that may be suitable for California black rails includes tidally-influenced berm islands that have a dense *Typha/Scirpus* vegetative cover and that additionally possess an element of upland habitat, usually identified by the presence of willow (*Salix* spp.) and/or redstem or creek dogwood (*Cornus stolonifera* var. *californica*).

Reasons for Decline

Enormous amounts of California's wetlands have been drained and converted to such uses as agriculture, urban development, airports, and salt evaporation sites. Prior to 1853, coastal wetlands were estimated to total 253,000 acres; this amount has been reduced to less than 51,000 acres, more than an 80 percent loss (ESA/Madrone 1982). Also, prior to 1853, interior wetlands were estimated to be in excess of 4,000,000 acres. In 1982, ESA/Madrone estimated that just 40,000 acres of interior wetlands remained, more than a 99 percent loss. Tidal marshes once occupied more than 300 square miles around the margins of the San Francisco, San Pablo, and Suisun bays. Today, less than 19 percent of this habitat remains (Gill and Buckman 1974). In San Diego Bay, where the black rail has been extirpated, only 10 to 15 percent of marsh habitat remains (Mudie 1970, Browning and Speth 1973).

Survey Methodology

Records from the NDDB and other sources were inventoried to determine known locations of black rails in, and near, the INDP area. Potential habitat within the project area was identified from maps, aerial photographs, and from boat reconnaissance surveys. Eleven areas were classified as being potentially suitable habitat for black rails. These habitat areas were then surveyed on five occasions during the nesting season. Survey dates were June 2, 3, 10, 17, and 21, 1994. Early daylight hours from dawn to about 10 a.m. were deemed suitable for censusing (Gifford pers. comm., Manolis pers. comm.). Surveys were not conducted on days when the wind exceeded 5 mph because wind can dissipate the taped call or the response of the rail to the call.

Black rails are extremely secretive and only rarely observed. The surest indication of their presence is their vocalizations. A tape of black rail calls featuring the "kiki do" and both low and intense "grrrr" calls was played from a portable tape machine to elicit vocalizations. Usually the tape was played for one or more minutes and then turned off for one or more minutes, listening all the while for a response. After 10 minutes at one station the process was discontinued and then repeated at another station approximately 100 yards away.

Thirty stations on 11 berm islands in the Mokelumne River, North Fork Mokelumne River, and South Fork Mokelumne River were surveyed in this manner. The procedure was repeated on different days at several of the islands with the most promising habitat.

Results

No positive responses from black rails were received by MGA biologists in the INDP survey area (as indicated in Figure III-1) during 1993-94 surveys. Although one cannot rule out the presence of black rails with absolute certainty, this would indicate that individuals may not be present along project area waterways during the breeding season. California black rails were documented by DWR biologists during March, 1994 surveys in the extensive tidal marsh (Coldani Marsh) west of Pond 11 (DWR 1995b) (see Appendix A, Figure A-2). Vocalizations of six black rails were heard at three separate listening stations within the marsh. These observations are consistent with the historic records of California black rail detections going back to 1974 at the White Slough Wildlife Area (DWR 1995b); however, this marsh is outside the geographic area directly affected by the INDP.

Discussion

Little is known about minimum habitat size for the species. Adequate foraging areas, vegetational cover, and a nesting substrate protected from waves and high tides would be necessities for the species. These conditions can be more easily satisfied in a larger habitat area than in a smaller area. It may be that the berm islands within the INDP area are not large enough to support the species.

Recent surveys for California black rails elsewhere in the Sacramento/San Joaquin River Delta conducted by DFG suggest that rails may be absent on islands smaller than 15 acres in size (Gifford pers. comm.). None of the islands in the INDP area are as large as that. A comparison of aerial photographs taken of portions of the project area in the late 1940s (U.S. Bureau of Reclamation 1949) with more recent photos (Corps of Engineers 1986) reveals that there has been a substantial (more than 50 percent) reduction in the size of some of the berm islands in project area waterways as well as throughout the entire Delta. In some cases, islands that were present in the 1940s have completely disappeared. Delta berm islands are composed of highly erodible peat soils and their decrease in size, as well as in number, over this time period could be attributed to the long-term effects of waves and currents, including boat wakes. This erosion process appears to be ongoing; therefore, further reduction of black rail habitat on berm islands in the Delta may be expected.

Impacts

No impacts to California black rails would result from the INDP.

Mitigation Measures

None required.

Other Special-Status Birds

Table IV-3 summarizes the occurrence of special-status birds in the INDP area other than those discussed above. While the INDP would not adversely impact the majority of these species, it could affect local populations of white-tailed kites, northern harriers, California horned larks, and loggerhead shrikes.

American White Pelican

The American white pelican (*Pelecanus erythrorhynchos*) is designated by the DFG as a Species of Special Concern. Formerly, American white pelicans bred in the Central Valley; now only transient or wintering birds are observed flying overhead, or feeding and roosting on lakes or reservoirs. In the Delta region, they can be observed roosting on sandbars and in fields that are flooded for waterfowl. A small population of between 6 and 30 non-breeding American white pelicans have been observed during the summer months in the central Delta (Holt personal observation). American white pelicans also were observed during 1993-94 winter field surveys in flooded fields on Staten and Tyler Islands. No pelicans were observed using the rivers or levees in the INDP area and no adverse impacts are expected to result from the Proposed Project.

Table IV-3. Special-Status Bird Species Known or Likely to Occur in the Interim North Delta Program Area

SPECIES	STATUS Federal/State*	OBSERVED IN PROJECT AREA	NESTING IN PROJECT AREA	HABITAT TYPES			
				AQUATIC (Rivers and Sloughs)	RIPARIAN FOREST	RIPARIAN MARSH (Berm Islands)	AGRICULTURAL LAND
American white pelican *(Pelecanus erythrorhynchos)*	--/CSC	X		X			X
Double-crested cormorant *(Phalacrocorax auritus)*	--/CSC	X		X	X		
Great blue heron *(Ardea herodias)*	--/CSC	X	X	X	X	X	X
White-faced ibis *(Plegadis chihi)*	--/CSC	X				X	X
Aleutian Canada goose *(Branta canadensis leucopareia)*	E/--			X			X
Osprey *(Pandion haliaetus)*	--/CSC			X	X		
White-tailed kite *(Elanus leucurus)*	--/FP	X	X		X	X	X
Northern harrier *(Circus cyaneus)*	--/CSC	X	X			X	X
Sharp-shinned hawk *(Accipiter striatus)*	--/CSC	X			X		
Cooper's hawk *(Accipiter cooperii)*	--/CSC	X			X	X	X

SPECIES	STATUS Federal/State*	OBSERVED IN PROJECT AREA	NESTING IN PROJECT AREA	HABITAT TYPES			
				AQUATIC (Rivers and Sloughs)	RIPARIAN FOREST	RIPARIAN MARSH (Berm Islands)	AGRICULTURAL LAND
Ferruginous hawk *(Buteo regalis)*	C2/--						X
Swainson's hawk *(Buteo swansoni)*	--/T	X	X		X	X	X
Merlin *(Falco columbarius)*	--/CSC	X			X	X	X
American peregrine falcon *(Falco peregrinus anatum)*	E/E	X			X	X	X
California black rail *(Laterallus jamaicensis)*	C2/T					X	
Greater sandhill crane *(Grus canadensis tabida)*	--/T	X					X
Burrowing owl *(Athene cunicularia)*	--/CSC						X
Short-eared owl *(Asio flammeus)*	--/CSC	X				X	X
California horned lark *(Eremophila alpestris actia)*	C2/--	X	X				X
Loggerhead shrike *(Lanius ludovicianus)*	C2/--	X	X		X	X	X
Yellow-breasted chat *(Icteria virens)*	--/CSC				X	X	
Tricolored blackbird *(Agelaius tricolor)*	C2/CSC	X				X	X

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* Status Explanations:

-- = No designated special status.

Federal

E = Listed as endangered under the federal Endangered Species Act.

C2 = Category 2 candidate for federal listing. Category 2 includes species for which the USFWS has some biological information indicating that listing may be appropriate but for which further biological research and field study are usually needed to clarify the most appropriate status. Category 2 species are not necessarily less rare, threatened, or endangered than Category 1 species or listed species; the distinction relates to the amount of data available and is therefore administrative, not biological.

State

E = Listed as endangered under the California Endangered Species Act.

T = Listed as threatened under the California Endangered Species Act.

CSC = Species of special concern.

FP = Fully protected by the State of California.

Double-Crested Cormorant

The double-crested cormorant (*Phalacrocorax auritus*) is designated by the DFG as a Species of Special Concern. It is considered a very rare breeder in the Central Valley that requires undisturbed nest sites adjacent to water, on ledges or cliffs, or in very tall live or dead trees. In the winter, double-crested cormorants migrate into the Central Valley, probably from breeding colonies in northeastern California and the Great Basin. There are no records of double-crested cormorants nesting in, or near, the INDP area. Some winter residents and non-breeding birds were observed during the 1993-94 field surveys roosting or foraging on fish in the INDP area. The Proposed Project is not expected to adversely impact this species.

Great Blue Heron

The great blue heron (*Ardea herodias*) is designated by the DFG as a Species of Special Concern. They nest mainly in colonies, usually in a tall stand of trees near a variety of fresh or saltwater habitats, including swamps, rivers, sloughs, lagoons, estuaries, and lakes. Great blue herons are common Delta residents. In the winter there is an influx of individuals from colder climates. They are opportunistic feeders, typically hunting at the water's edge for fish, reptiles, and amphibians. Great blue herons also forage in agricultural fields for small mammals.

Foraging herons were encountered regularly during 1993-94 field surveys in the INDP area although no nests were found. A colony nests in a eucalyptus grove on Venice Tip, a few miles south of the INDP area. The Proposed Project is not expected to adversely impact this species.

White-Faced Ibis

The white-faced ibis (*Plegadis chihi*) is designated by the DFG as a Species of Special Concern. This species requires extensive marshes for its nesting colonies, thus it has become a very rare and irregular breeder in the Central Valley as marsh habitat has diminished. In the Delta, white-faced ibis are observed occasionally during the winter months foraging for miscellaneous invertebrates in cropland flooded for waterfowl. White-faced ibis were observed in such habitat during 1993-94 field surveys on Staten Island, but they were not observed to use the rivers or levees within the INDP area. No adverse impacts to this species are expected to result from the Proposed Project.

Aleutian Canada Goose

The Aleutian Canada goose (*Branta canadensis leucopareia*) is designated as endangered by the USFWS. It breeds on islands in Alaska and winters in the Central Valley, primarily west of Modesto in Stanislaus County. In the Delta, migrating Aleutian Canada geese occasionally are observed foraging or roosting in agricultural fields that are flooded for waterfowl. Although no Aleutian Canada geese were observed during the 1993-94 field surveys, isolated individuals or small groups of this subspecies have been observed in flooded agricultural habitats on Staten and Bouldin islands in recent years (Yee pers. comm.). They have not been recorded in INDP area rivers or on levees (Yee pers. comm.). No adverse impacts to this species are expected to result from the Proposed Project.

Osprey

The osprey (*Pandion haliaetus*) is designated by the DFG as a Species of Special Concern. Osprey feed almost exclusively on fish. Formerly, osprey nested throughout the length of the Central Valley, but they are now reported as breeding in this geographic area only on the Sacramento River, in Tehama County (Small 1994). Conservation efforts and curtailment of the use of DDT are thought to have halted the decline of this species. No osprey were observed in the INDP area and no adverse impacts to this species are expected to result from the Proposed Project.

White-Tailed Kite

The white-tailed kite (*Elanus leucurus*) is a fully protected species according to the California Fish and Game Code. White-tailed kites are found primarily in open agricultural and grassland habitats. This species declined noticeably during the early part of the 20th century (Grinnell and Miller 1944), but is now fairly common in suitable habitats, particularly in the Central Valley. White-tailed kites construct a stick nest near the top of dense oaks, willows, cottonwoods, or other trees. They typically nest in an isolated tree or within a stand of trees located near open foraging areas where they can catch voles or other small mammals.

White-tailed kites were observed foraging in fields or perched in trees, within or near the INDP area, at all times of the year. No nests or fledged young were located, but the presence of adult pairs during the breeding season and the presence of suitable nesting trees along the levees within the project area, indicates that it is highly likely that nesting was attempted. Kite pairs were recorded on the South Mokelumne River south of New Hope Landing, and on McCormack-Williamson Tract. The INDP could adversely impact this species.

During a June, 1994 survey of the Hood property, two pairs of white-tailed kites were observed roosting in the box elder and black walnut trees on the eastern edge of the property at the toe of the railroad embankment. No kite nests or fledglings were discovered; however, attempted breeding by white-tailed kites is strongly suspected in the area due to the presence of adult kite pairs in suitable habitat.

One or two white-tailed kites were observed on every visit to the Grizzly Slough property (July 24 and November 1, 1993; January 26, February 15, and June 20, 1994). Birds were either foraging or perched in trees bordering the property on the northeast. No white-tailed kite nests were discovered, although the isolated oak stand or the many trees along Grizzly or Bear sloughs provide suitable nesting habitat.

Northern Harrier

The northern harrier (*Circus cyaneus*) is designated by the DFG as a Species of Special Concern. The number of breeding pairs has declined in California due to the destruction of wetland habitat and native grassland, and the burning and plowing of nesting areas during the breeding season. Northern harriers nest on the ground, mostly in emergent wetland, but may nest in grasslands or grain fields. They forage over open ground such as in fallow fields, grain or row crops, field edges, and irrigation ditches for small mammals, frogs, crustaceans, and insects. Northern harriers can be

locally abundant if nesting and foraging conditions are suitable. Harriers were encountered regularly in the INDP area and were observed foraging in fields adjacent to the INDP area.

No nesting territories were discovered within the INDP area, although one nesting territory was identified just north of the INDP area in an unplowed low spot on McCormack-Williamson Tract (see Appendix A, Figure A-13). Northern harriers may be expected to nest in the INDP area in low growing vegetation such as cattails and tules on the waterside of levees, on berm islands, or in ditches on the land side of levees. Thickets of weedy vegetation on the sides of levees also could provide nesting habitat for harriers. The INDP could adversely impact this species.

During a June, 1994 visit to the Hood property one northern harrier was observed foraging on-site and on the slope of the railroad line embankment. No northern harrier nests were located although suitable nesting habitat exists on the weedy railroad embankment.

One northern harrier was observed foraging over the Grizzly Slough property on every visit (July 24 and November 1, 1993; January 26, February 15, and June 20, 1994). Although no northern harrier nest sites were located, suitable nesting habitat for this species does exist in the weedy areas at the edges of fields and in the weedy vegetation on the floodplain of Bear Slough.

Sharp-Shinned Hawk

The sharp-shinned hawk (*Accipiter striatus*) is designated by the DFG as a Species of Special Concern. Although this species does not breed in the Central Valley, it does winter there. A few sharp-shinned hawks were observed during 1993-94 winter field surveys, primarily within riparian woodlands, but also flying over open ground or perched in isolated trees. Sharp-shinned hawks prey almost exclusively on smaller birds. The Proposed Project is not expected to adversely impact this species.

Cooper's Hawk

The Cooper's hawk (*Accipiter cooperii*) is designated by the DFG as a Species of Special Concern. The species formerly nested in the lowland riparian woodlands of the Central Valley, but extensive losses of riparian woodland habitat and perhaps pesticide contamination largely have eliminated the Cooper's hawk as a breeding bird there today. Cooper's hawks could breed in the INDP area since suitable riparian woodland for breeding sites does exist. Also, there are a few recent records of Cooper's hawk breeding in San Joaquin County (Yee pers. comm.). However, no nest nor any breeding activity was observed within the project area during our field surveys.

During the fall and winter months there is an influx of Cooper's hawks into the Central Valley and a few individuals were observed in these seasons. Observations were made primarily in riparian woodlands, but birds were also observed flying over open ground or perched in isolated trees. Cooper's hawks prey on smaller birds but they will also take small mammals or reptiles. The Proposed Project is not expected to adversely impact this species.

Ferruginous Hawk

The ferruginous hawk (*Buteo regalis*) is a federal Category 2 candidate species. Although this species does not breed in the Central Valley, it is found there during the winter months. It is typically observed foraging in agricultural fields, mainly irrigated pasture and grasslands. However, the ferruginous hawk is not commonly reported in the Sacramento/San Joaquin River Delta, even during the winter months. No ferruginous hawks were observed during 1993-94 field surveys and the Proposed Project is not expected to adversely impact this species.

Merlin

The merlin (*Falco columbarius*) is designated by the DFG as a Species of Special Concern. The species does not breed in California, but is present throughout the Central Valley during the winter months. One merlin was observed during winter field surveys near the INDP area. It was chasing after songbirds near a harvested corn field on Brack Tract. The riparian habitats in the INDP area provide potential winter roosting and perching habitat. The Proposed Project is not expected to adversely impact this species.

American Peregrine Falcon

The American peregrine falcon (*Falco peregrinus anatum*) is listed as endangered by both the USFWS and DFG. It is a rare resident, and uncommon transient and winter visitor to California. Habitat for nesting includes cliffs, ridges, and rocky promontories within hunting range of avian prey, especially waterfowl, shorebirds, and seabirds. In winter peregrines can be found throughout the length of California, including the Central Valley. Conservation efforts and the banning of the pesticide DDT have contributed to a recent upswing in the breeding population.

The INDP area does not provide suitable nesting habitat for this species and no peregrines were observed during the breeding season. Peregrine falcons were occasionally seen during 1993-94 winter field surveys either perched in trees or on poles, or they were observed on swift forays in pursuit of shorebirds. One individual, in immature plumage, was seen repeatedly roosting in trees at either side of the mouth of the Mokelumne River. The Proposed Project is not expected to adversely impact this species.

Burrowing Owl

The burrowing owl (*Athene cunicularia*) is designated by the DFG as a Species of Special Concern. It often nests in colonies, commonly using ground squirrel burrows for nesting and for cover. It is a resident of the Central Valley, but there is some seasonal movement during fall and winter. Burrowing owls feed mainly on insects but will eat small rodents or reptiles. A recent precipitous decline in burrowing owl populations has been noted in the northern San Joaquin Valley (Small 1994).

Although no burrowing owls were observed within the INDP area during 1993-94 field surveys, they were observed occupying burrows in an irrigated pasture on Brack Tract, adjacent to the project area. Burrowing owls could utilize burrows in levees within the INDP area at some future time, in which case the Proposed Project could adversely affect suitable owl habitat by the disposal of dredged

spoils on the land side of existing levees. This would only be considered an adverse impact of the project if owls were to occupy proposed construction sites.

Short-Eared Owl

The short-eared owl (*Asio flammeus*) is designated by the DFG as a Species of Special Concern. It is an uncommon and irregular breeder in the Central Valley. The major known breeding and wintering area in California appears to be Grizzly Island Wildlife Management Area in Solano County (Small 1994). For breeding or roosting short-eared owls require stands of tall grasses in dry or wet lowlands. They hunt over treeless marshes, grasslands, and agricultural lands for small rodents, birds, reptiles, and amphibians.

Although short-eared owls are no longer known to breed in the Delta region, they are present there during the winter months, when they can be seen occasionally foraging or roosting at dawn or dusk in fields that provide suitable food and cover. Short-eared owls were observed during 1993-94 winter field surveys foraging on the land side of levees in the INDP area. As many as 13 were observed on Terminous Tract adjacent to the South Mokelumne River in a weedy field that appeared to have an abundant small rodent population (Herzog pers. comm.). The Proposed Project is not expected to adversely impact this species.

California Horned Lark

The California horned lark (*Eremophila alpestris actia*), a subspecies of the horned lark (*Eremophila alpestris*), is a federal Category 2 candidate species. It is widespread and common to abundant in a variety of suitable, sparsely-vegetated habitats, including grasslands interrupted by bare ground, grassy hillsides, plowed agricultural lands, and deserts. It eats insects and seeds and nests on the ground in the open usually raising two broods a year. After breeding it becomes very gregarious forming large flocks. Horned larks are most abundantly found in grassland habitats in, or near, the foothills of the Central Valley, but they do breed on the Valley floor, usually in bare ground habitats such as fallow fields.

Horned larks were observed in the INDP area during the 1994 breeding season from March through July. Individuals were observed flying overhead or perched on the levees just north of the project area on McCormack-Williamson Tract. No horned lark nests were found but it is likely, due to their presence during the breeding season in suitable habitat, that the species does nest in the INDP area. The boundary line separating the California horned lark from another unlisted subspecies, the ruddy horned lark (*E. a. rubea*), appears to fall in the general area of the Proposed Project (Grinnell and Miller 1944). Because identifying and separating the two subspecies from field observations cannot be done with complete accuracy, it should be assumed for the purposes of this document, that all observations of horned lark are of the federal candidate, the California horned lark. The INDP could adversely impact this species due to loss of habitat during levee reinforcement activities.

Loggerhead Shrike

The loggerhead shrike (*Lanius ludovicianus*) is a federal Category 2 candidate species. It eats insects, but it also is the only passerine bird species that regularly feeds on small rodents, reptiles,

and amphibians. It is a bird of the open country, often found in agricultural fields, nesting in small trees or shrubs. Loggerhead shrikes have declined throughout their range, but particularly in the central United States, where pesticides are thought to be problematic (Ehrlich *et al.* 1988).

In the Delta loggerhead shrikes are uncommon residents (Yee 1990), but an influx of shrikes from colder climates occurs in the winter. A few loggerhead shrikes were observed in the INDP area during the 1994 spring breeding season. Shrikes were perched on powerlines, in trees, and on weedy stalks along levees on Hog and Sycamore sloughs, and near the Mokelumne River on McCormack-Williamson Tract. Loggerhead shrike nests were not specifically searched for, but it is likely, due to their presence during the breeding season and in suitable habitat, that shrikes were nesting in the vicinity of the above observations. The INDP could adversely impact this species due to loss of habitat during levee reinforcement activities.

During June, 1994 surveys of the Hood property, one loggerhead shrike was observed foraging for insects in the tomato field. No loggerhead shrike nests were located although numerous trees at the edges of fields or on the railroad embankment would provide suitable nesting habitat.

Yellow-Breasted Chat

The yellow-breasted chat (*Icteria virens*) is designated by the DFG as a Species of Special Concern. It is a neo-tropical migrant that nests in dense riparian thickets of willow and vine tangles and feeding on insects and fruit. Formerly, it was a fairly common to common breeding bird throughout the Central Valley, but extensive riparian habitat deterioration and elimination, as well as brood parasitism by brown-headed cowbirds (*Molothrus ater*) have diminished its status to local and rare-to-uncommon. Delta riparian habitats, and particularly berm islands, provide suitable habitat for chats; however, no yellow-breasted chats were observed in the INDP area. The Proposed Project is not expected to adversely impact this species.

Tricolored Blackbird

The tricolored blackbird (*Agelaius tricolor*) is a federal Category 2 candidate species and is designated by the DFG as a Species of Special Concern. It is nearly endemic to California and is locally common throughout the Central Valley. It is a highly gregarious bird that nests colonially, mainly in dense cattails and tules, but increasingly it is found nesting in blackberry thickets. The proximity of the nesting area to concentrated insect food supplies is important. The lack of concentrated insect sources near suitable nesting sites could account for many observed tricolor nesting failures (Beedy *et al.* 1991). The loss of wetland habitat for nesting and foraging in the Central Valley is a principal factor in the 89 percent decline in population since the 1930s (Beedy *et al.* 1991).

Tricolor nesting colonies have not been documented previously in the INDP area (ECOS 1990b, Beedy *et al.* 1991, NDDB 1992), and no tricolored blackbirds were observed in the INDP area during the breeding season. Individuals were observed during the winter in corn stubble flooded for waterfowl on Staten Island, Bouldin Island, and Terminous Tract intermixed in large flocks with the more numerous red-winged blackbird (*Agelaius phoeniceus*), Brewer's blackbird (*Euphagus cyanocephalus*), and European starling (*Sturnus vulgaris*). During the non-breeding season, tricolors, as well as other blackbirds, consume fewer insects and rely on gleaning seeds from harvested grain fields. The Proposed Project is not expected to adversely impact this species.

REPTILES AND AMPHIBIANS

Giant Garter Snake

Status

The giant garter snake (*Thamnophis gigas*) is listed as threatened by both the USFWS and DFG. No critical habitat has been designated for this species.

Distribution

The giant garter snake once ranged throughout the wetlands of California's Central Valley from Buena Vista Lake near Bakersfield in Kern County, north to the vicinity of Chico in Butte County (Hansen and Brode 1980). Giant garter snakes appear to have been extirpated from the San Joaquin Valley south of Mendota, Fresno County (Hansen and Brode 1980, Stebbins 1985, Rossman and Stewart 1987). The present known distribution extends from near Chico south to the vicinity of Burrel, Fresno County (DFG 1992a).

Habitat Requirements

Habitats occupied by giant garter snakes contain permanent or seasonal water, mud bottoms, and vegetated dirt banks (Fitch 1940, Hansen and Brode 1980). Prior to reclamation, these wetlands probably consisted of freshwater marshes and low gradient streams. In some rice-growing areas, giant garter snakes have adapted well to some vegetated, artificial waterways and the rice fields they supply (DFG 1992a, Hansen and Brode 1993).

This species appears to be absent from most permanent waters that support predatory game fishes. Introduced bass, sunfish, and catfish compete with giant garter snakes for prey and undoubtedly prey upon the snake as well (Hansen 1988). The species also appears to be absent from natural or artificial waterways that undergo routine mechanical or chemical weed control or compaction of bank soils (Hansen 1988, Hansen and Brode 1993).

Recent field studies have shown that giant garter snakes are associated with aquatic environments that contain the following resources: 1) sufficient water during the active (summer) season to supply food and cover; 2) grassy banks for basking; 3) emergent vegetation for cover during the active season; and 4) high ground or uplands that provide cover and refuge from flood waters during the dormant (winter) season (Hansen 1988, Hansen and Brode 1993).

Reasons For Decline

Factors leading to the decline of the giant garter snake include the fragmentation and loss of Valley wetland habitats to agriculture, urbanization, and flood control (Hansen and Brode 1980). Existing habitats continue to be degraded by toxic chemicals associated with agriculture, industry, and urban runoff. Proposed urban developments, including development of the North Natomas region near Sacramento, threaten several remaining giant garter snake populations (DFG 1992a). Other impacts

of urbanization include pollution, destruction of food resources, and removal by collectors (DFG 1992a).

Predatory fish that were introduced throughout the Central Valley's system of artificial waterways have reduced the suitability of nearly all permanent waters for this species by preying upon, and competing with, giant garter snakes. The widely introduced bullfrog (*Rana catesbeiana*) also preys upon this genus (Treanor 1983), and probably this species.

Potential For Occurrence in the INDP Area

Historically, giant garter snakes occurred in both the South and North Delta regions (Hansen and Brode 1980, Hansen 1988, NDDB 1992). Individuals have been observed in the North Delta region at North Stone Lake, Beach Lake, and near Locke (ECOS 1990b). The species also was recorded from near the Antioch Bridge south of the INDP area (NDDB 1992). Other documented occurrences are distributed around the periphery of the east Delta in habitats similar to those in the INDP area (ECOS 1990b). During 1994, DFG biologists recovered shed skins of what appear to be giant garter snakes from the banks of a landward toe drain on Medford Island, just south of, and similar to, the INDP area island habitats (Brode pers. comm.).

Although the major permanent waterways of the Delta are apparently unsuitable for giant garter snakes, small backwater sloughs and toe drains support small numbers of giant garter snakes (Hansen 1988).

Survey Methodology

Potential supporting habitats of the giant garter snake were located by searching the INDP area from roadways, on foot, and by boat. During initial reconnaissance surveys, USGS 7.5-minute topographic maps were used to mark areas of potentially suitable habitat for later field surveys.

Field surveys for the giant garter snake included walking, wading, and boating along canals, river channels, and marshes. Binoculars were used to search potential basking spots and to identify snakes from a distance. Giant garter snakes were also sought beneath surface objects, especially boards and other debris deposited by floodwaters. Although peak surface activity occurs during the spring (April and May), above-ground activities are dependent upon mild weather. Field surveys were timed to coincide with favorable weather conditions for optimum results. Repeat visits were made to promising sites. During all phases of field work, roadways were searched for living and dead giant garter snakes.

DFG prepared written survey protocols for the giant garter snake in 1993 (DFG 1993b). These were implemented for this project wherever possible. It was not necessary to alter the methodologies presented above to accommodate new protocols, except that the number of visits to sites supporting potential giant garter snake habitat was less than the 10 required by the 1993 survey protocols. This was due to prior contract arrangements and lack of permission to access certain portions of the project area.

Survey Results

Giant garter snakes were observed at scattered locations within the INDP vicinity during 1994 field surveys, but were not encountered within the major waterways of the North Delta. Giant garter snakes were observed in marsh and canal habitats along the Upland Canal from the confluence of Sycamore Slough and the Upland Canal south to the vicinity of White Slough (see Appendix A, Figures A-2 and A-9). These habitats are located on Terminous and Shin Kee Tracts southeast, and outside of, the geographic area directly affected by the INDP.

Potential supporting habitat of the giant garter snake also occurs on New Hope Tract, north of New Hope Road, from Grizzly Slough to Bear Slough. This habitat includes rice fields, water supply ditches, and the toe drains bordering the landward sides of the Grizzly and Bear Slough levees.

The limited time available for field surveys, large number of habitats to be surveyed, and difficult or restricted access to portions of the INDP area during the optimal springtime sampling period made it impossible to rule out the presence of giant garter snakes in many of the vegetated waterways, uplands, and other potential supporting habitats within the INDP area.

Impacts of the Proposed Project (Alternative 5)

Although the likelihood of direct impacts to the giant garter snake as a result of the INDP is remote, the types of potential impacts that could occur are described here because construction activities could affect individual snakes outside of the immediate project area, as well as snakes within the INDP area that were undetected during our field surveys. Also giant garter snakes are known to occur in the periphery of the North Delta region (i.e., in the Upland Canal and the Coldani Marsh, north and east of Shin Kee Tract, respectively). Generalized mitigation measures are provided following the description of impacts, rather than after each individual impact.

Direct Impacts

Impact - Death or Injury to Individual Snakes. Dredging of the South and North Forks of the Mokelumne River and construction of a screened diversion at Hood could have direct impacts on giant garter snakes. Individual snakes could be killed or injured by heavy equipment working in the INDP area or trucks travelling to and from the levee reinforcement sites, especially if construction activities occur around landward irrigation ditches or equipment passes through other habitats occupied by giant garter snakes on its way to the actual construction sites.

Impact - Habitat Loss. Habitat loss could result from dredging and grading activities, as well as placement of dredge spoils within or near such potential habitats as landward irrigation ditches, vegetated channel islands, and channel banks. Channel dredging and levee improvements along the North and South Mokelumne rivers, Dead Horse Cut, and segment of Snodgrass Slough are examples of locations of potential impacts relating to habitat loss.

Dredging operations could also impact individual snakes as they move around vegetated channel islands and near channel banks. Channel dredging may destroy undiscovered habitat values within the major channels, or more likely, could cause suitable landward habitats to be buried under dredge spoils.

In addition, the diversion of water at Hood and resulting changes in flow through the Stone Lakes/Snodgrass Slough/Lost Slough system could adversely impact giant garter snakes.

Impact - Changes in the Prey Base resulting from Changes in Water Quality. Changes in water quality in the INDP area that would occur during dredging operations could affect the fish/amphibian prey base of the giant garter snake. Since this species appears to prefer the smaller island sloughs and drains and may avoid the major channels within the INDP area, adverse impacts would be confined primarily to landward rather than channel habitats.

Impact - Changes in Habitat resulting from Changes in Water Levels. Changes in vegetational cover that provides suitable habitat for the giant garter snake in the INDP area could result from changes in water level. Since this species appears to prefer the smaller island sloughs and drains and may avoid the major channels within the INDP area, adverse impacts would be confined primarily to landward rather than channel habitats and some of the adjacent sloughs which are connected to major waterways. For example, any changes in Hog, Beaver, and Sycamore sloughs, as well as other unnamed canals that experience tidal influence, could affect marsh habitats that support giant garter snakes (e.g., Coldani Marsh).

Mitigation Measures

The DFG compiled draft mitigation guidelines for the giant garter snake (DFG 1994b). These guidelines provide information on mitigation required for short-term habitat loss, long-term habitat loss, and maintenance of giant garter snake habitat.

A summary of relevant items from these mitigation guidelines is provided below:

Maintenance of Giant Garter Snake Populations and Habitat - Short-Term Habitat Loss

A. Protection of Giant Garter Snake Populations During Maintenance and Operation of Agricultural Canals and Drains

1. Excavate from only one side of the canal during a given year and avoid excavating the banks above the water line. One side of the canal will be left undisturbed indefinitely (the preferred side would be the west or north side).

2. During summer (May 1 to October 1), place the spoils in a designated location and remove or flatten out spoils soon after placement. During winter it may be necessary to transport spoils to an off-site designated area.

3. Leave the vegetation on the levees and sides of the canals undisturbed, except that maintenance roads may be mowed. Mowing shall leave a minimum 6-inch stubble to avoid injury to giant garter snakes.

4. Restrict automobile traffic along the canals to maintenance or other official vehicles.

5. Place semi-buried "clumps" of broken concrete in banks of canals above the water line. This would provide readily identifiable giant garter snake basking and wintering habitat that attracts individuals away from areas disturbed by maintenance work.

Alternative 1

Impact. The No-Action Alternative would not affect the giant garter snake. Project area levees would remain intact and adjacent lands would continue in their present agricultural uses. No dredging would occur and current agricultural practices seem to be maintaining existing populations of giant garter snakes.

Mitigation Measure. None required.

Alternative 2

Impacts. Dredging of the South Fork of the Mokelumne River would have the same types of impacts to giant garter snakes as the Proposed Project. However, impacts would be reduced under this alternative because dredging and levee reinforcement would be confined to only a portion of the INDP area.

Mitigation Measures. Alternative 2 shall require the same types of mitigation measures as specified for the Proposed Project.

Alternative 3

Impacts. Dredging of the South and North Forks of the Mokelumne River would have the same types and extent of impacts to giant garter snakes as the Proposed Project.

Mitigation Measures. Alternative 3 shall require the same mitigation measures as the Proposed Project.

Alternative 4

Impacts. Dredging of the South and North Forks of the Mokelumne River and construction of the Delta Cross Channel Enlargement would have the same types and extent of impacts to giant garter snakes as the Proposed Project. No additional impacts would be expected due to the Delta Cross Channel component of this alternative because there is no suitable giant garter snake habitat in the vicinity of the proposed construction.

Mitigation Measures. Alternative 4 shall require the same mitigation measures as the Proposed Project.

Alternative 6

Impact - Habitat Loss. Although levee setbacks may create future supporting habitat for the giant garter snake, existing habitats such as landward toe drains would be destroyed as they are relocated further inland. Because the toe drains in this area are well-maintained they are unlikely to support giant garter snakes due to lack of supporting habitat; therefore, their loss is considered a temporary and less-than-significant impact.

A net increase in giant garter snake habitat would result from the construction levee setbacks. In between the old and new levees a wide backwater slough/shallow marsh area would be created. This would provide supporting habitat for the giant garter snake as well as other reptiles and amphibians, including the western pond turtle, frogs, and other snakes.

Mitigation Measure - None required.

Cumulative Impacts

Impact - Increased Human Presence in INDP Area. Improved flood protection, increased water volume, and improved water quality would be provided by the INDP. These overall project benefits (to man) could lead to an increased human presence in, and along, the INDP waterways. Such increases in human presence may indirectly impact giant garter snakes in the following ways:

1. Higher water levels could encourage boating and other recreational activities to increase in previously neglected backwater areas that now provide suitable habitat for giant garter snakes, thereby increasing the threats of regular disturbance and physical injury to individual snakes.

2. If project activities lead to increases in the human population of this area because of the reduced size of the 100-year floodplain giant garter snakes could be threatened with increases in human encroachment into occupied habitats leading to increased disturbance of individual snakes and increased chances for accidental or intentional death or injury to any snakes present. An increase in the human population could include both urbanization of previously agricultural lands and increased recreational use along newly "improved" waterways.

Impact - Water Level Changes. Changes in water surface elevations could adversely impact potential giant garter snake supporting habitat by:

1. Increasing water levels could lead to flooding of existing shallow water environments to depths great enough to inhibit the growth of emergent vegetation required by this species.

2. Increasing water levels could encourage the establishment of large introduced "gamefish" which prey upon small snakes and represent a threat to giant garter snakes.

3. Increasing water levels could flood dry land hibernaculae which must remain emergent during the highest floodwaters to provide a safe refuge for giant garter snakes. If these areas are lost as refugia it could lead to displacement of individual snakes from the area.

4. Increasing water levels could encourage increases in human encroachment in and along project area waterways, leading to increased disturbance of individual snakes and increased chances for accidental or intentional death or injury to any snakes present.

5. Decreasing water levels could lead to the drying of vegetated shallow water environments which presently occur along project area waterways, destroying these suitable habitats and possibly stranding any giant garter snakes present.

Beneficial Impacts of Water Level Changes. Changes in water surface elevations could positively impact giant garter snakes by:

1. Decreasing water levels could create new shallow water environments which, in turn, could eventually support giant garter snakes.

2. Increasing water levels could flood formerly dry areas and create new shallow water environments suitable for giant garter snakes.

Impacts of the Conceptual Habitat Plan for the Grizzly Slough Project Area

DFG (1995) prepared a conceptual habitat plan for the 489-acre Grizzly Slough property that DWR purchased on New Hope Tract in Sacramento County. While the creation of the various habitat types proposed would benefit a wide variety of wildlife species, the plan is lacking in its provisions for giant garter snakes, a species designated as threatened by both the USFWS and DFG. Sufficient acreage is available on this property to mitigate for all potential impacts to the giant garter snake resulting from the INDP, as well as to support a viable population of giant garter snakes. The Grizzly Slough property may provide summer habitat and winter hibernaculae for giant garter snakes and is connected to habitats known to support viable garter snake populations.

The plan as proposed actually creates obstacles for this species, rather than enhancing its suitability for occupancy. Other species such as raptors, waterfowl, and wading birds are able to satisfy their habitat needs (e.g., foraging, cover, and nesting) at more than one location, often in more than one habitat type. Raptors, such as Swainson's hawks, regularly fly from the Delta's riparian corridors to the nearby alfalfa fields to hunt or follow the harvesting machines from field to field. Wading birds and waterfowl fly from one type of habitat to another, depending upon their needs. Giant garter snakes, however, are restricted to a much smaller area in which they must satisfy all their food and cover needs throughout the year.

If giant garter snake habitat is to be provided at Grizzly Slough, then it should represent an area large enough to support this species in numbers sufficient to constitute a breeding population, and not a "postage stamp" of habitat surrounded by hazardous terrain, which would actually create impediments for the species. In this case "hazards" would result from adjacent open water marsh, seasonal wetlands, riparian forests, unsuitable uplands, and agriculture lands, and the various wildlife species that each habitat supports.

The Conceptual Plan for the Grizzly Slough area specifies that 489.0 acres of managed habitat are planned for this parcel of land. Of the many habitat types, only Emergent Marsh (30.11 acres), marginally suitable Seasonally Flooded Agriculture (85.13 acres), and Brood Ponds (1.45 acres) provide the habitats known to be occupied by breeding populations of giant garter snakes. This represents 23.9 percent of the area available at the entire site, including the unknown acreage planted in rice.

Problems anticipated for giant garter snakes at each of these proposed habitats include:

Open Water. The primary problem with open water is that it is considered suitable for the presence of "all species of fish". This provides access to the area for predatory, introduced "gamefish" which

pose a threat to small- and medium-sized giant garter snakes. Areas of open water also increase the chances of predation by herons, egrets, otters, and other potential predators.

Seasonal Wetland. Water would be available in the seasonal wetlands during the fall-spring period, but not during the summer. This is the opposite condition of what is required by giant garter snakes, and could lead to snakes being stranded from their required aquatic habitat during the summer activity season. Increased predation by Swainson's hawks, other raptors, herons, egrets, and a variety of mammals could result.

Riparian. Riparian forest is of little habitat value to giant garter snakes except peripherally as a resting place when individual snakes are displaced by floodwaters. Otherwise, this habitat type harbors many avian predators, including night-herons, hawks, and owls, as well as mammalian predators.

Upland. While giant garter snakes do require uplands for hibernating, most uplands proposed are located far from summer aquatic habitat or are occupied by predators of this species.

Mitigation Measures

To enhance the habitat value of the Grizzly Slough property for giant garter snakes the following measures shall be considered:

- Replacement of some of the upland habitat with more interior drainage ditches and canals that maximize "edges". Such aquatic habitats should be criss-crossed throughout the site. Aside from providing suitable habitat for giant garter snakes, this would also be attractive to frogs and western pond turtles. If bullfrogs continued to inhabit the Grizzly Slough property, they would provide a food source for giant garter snakes.

- Reduce the amount of habitat that is being created for predators, especially raptors. Even though wading birds would be attracted to the interior drainage ditches and canals, if sufficient vegetation were maintained along the sides of all channels it would provide cover for the snake.

- Reduce the amount of permanent aquatic habitat that would support large predatory fish such as largemouth bass, striped bass, and catfish. These are important predators of young giant garter snakes. Instead of permanent water, some type of drawdown should be instituted to eliminate these fishes. Or, instead of planting such fish in the aquatic habitats, stock the area with species that are not predators of the giant garter snake (e.g., mosquitofish, Sacramento perch, and hitch). Sufficient aquatic habitats for predatory gamefish already exist throughout the Delta waterways, and probably include Grizzly and Bear sloughs which border the mitigation parcel.

Western Pond Turtle

Status

The western pond turtle (*Clemmys marmorata*) includes two subspecies, the northwestern pond turtle (*Clemmys marmorata marmorata*) and the southwestern pond turtle (*Clemmys marmorata pallida*). Both subspecies are designated as Category 2 candidates for federal listing by the USFWS and as Species of Special Concern by DFG. No critical habitat has been designated for this species.

Distribution

The western pond turtle occurs in suitable aquatic habitats throughout California west of the Sierra crest and in parts of Oregon and Washington (Stebbins 1985, DFG 1988). The northwestern subspecies is found generally north of San Francisco Bay, while the southwestern subspecies is found south of San Francisco Bay. The two subspecies may intergrade throughout the Delta and San Joaquin Valley (Stebbins 1985), or intergrades may be restricted to the Delta region with San Joaquin Valley populations represented by the southwestern pond turtle (USFWS 1992).

Habitat Requirements

Western pond turtles normally are found near a wide variety of wetlands, including ponds, marshes, lakes, streams, and irrigation ditches (Stebbins 1985, DFG 1988). Suitable habitats usually are well-vegetated and contain exposed logs, rocks, or other basking sites from which turtles can easily escape into the water when disturbed (Stebbins 1985). Egg-laying may occur along sandy wetland margins or at upland locations as far as 1,300 feet from water (Holland and Bury 1992).

The species generally is associated with permanent or nearly permanent wetlands in a wide variety of environments below 6,000 feet (DFG 1988). Basking sites are required and nests may be located as far as 0.5 km from water (NDDB 1992). Hatchlings and juveniles apparently require a more specialized aquatic habitat than do adults (USFWS 1992).

Reasons For Decline

Commercial collecting, wetland and upland habitat loss, and introduced predators have all been implicated in the decline of the western pond turtle (Brode pers. comm., Holland and Bury 1992, USFWS 1992). Less than 10 percent of wetlands historically found throughout the species' range in California persist today (Jennings pers. comm., USFWS 1992).

Survey Methodology

Potential supporting habitats were located by searching the INDP area by car, on foot, and by boat. During initial reconnaissance surveys, USGS 7.5-minute topographic maps were used to mark potentially suitable habitats for later field surveys.

Field surveys included walking, wading, and boating along canals, river channels, and marshes. Binoculars were used to search potential basking spots and to locate turtles from a distance. Repeat visits were made to promising sites during the 1994 field season. Also, locations of basking turtles were mapped during field surveys for other species.

Survey Results

Western pond turtles were observed at scattered locations throughout the waterways of the INDP area during 1994 surveys (see Appendix A, Figures A-2, A-5, A-6, A-8, A-9, and A-13). Turtles appear to be widespread throughout the permanent waterways of the Delta (ECOS 1987, 1990a,b; DWR 1992). During prior studies pond turtles were observed in the INDP area basking upon emergent objects in Lost Slough, Snodgrass Slough, and the South Fork of the Mokelumne River (ECOS 1990b). They probably inhabit canals and ditches in this region as well.

During 1994 surveys, western pond turtles were encountered in marsh and canal habitats along the Upland Canal from the confluence of Sycamore Slough and the Upland Canal south to the vicinity of White Slough. These habitats are located on Terminous and Shin Kee Tracts southeast, and outside of, the INDP impact area. Western pond turtles were also observed along Bear and Grizzly sloughs bordering the north portion of New Hope Tract, as well as within toe drains on the landward side of the levees bordering these sloughs (see Appendix A, Figures A-6 and A-14). One western pond turtle was observed in the irrigation ditch on the Hood property during a June 1994 survey.

Impacts of the Proposed Project (Alternative 5)

Direct Impacts

Since western pond turtles occur within major INDP channels as well as within landward ditches and sloughs, pond turtles may suffer adverse impacts from the following proposed INDP activities: Channel dredging and levee improvement along the Mokelumne River, South Mokelumne River, segment of North Mokelumne River, Dead Horse Cut, and a portion of Snodgrass Slough, and construction of a screened diversion at Hood. Turtles could be dredged up or buried with spoil, especially during the winter dormant period when they are unable to flee human activity.

Potential impacts to western pond turtles include the following:

Impact - Death or Injury. Death or injury to individual turtles or their nests could result from construction activities. During late spring and early summer, gravid female turtles leave the water to excavate nests and lay their eggs in terrestrial habitats. Since the nests may be located up to 1,300 feet from water, these turtles are vulnerable to being run over by construction equipment, may become disoriented by altered habitat, or can be exposed to predation or accidents while moving about within the construction area. Turtle eggs laid in construction areas may also be destroyed by routine construction activities such as grading, soil compaction, being buried under spoil material, or being run over by construction equipment.

Impact - Habitat Loss. Habitat loss could result from dredging, grading, or placement of dredge spoils within such potential habitats as landward irrigation ditches, vegetated channel islands, and

channel banks along the Mokelumne River, North and South Forks of the Mokelumne River, Dead Horse Cut, and portions of Snodgrass Slough.

Turtle basking sites such as emergent pipes, culverts, logs, wing dams or jetties, low beaches, and channel islands could also be lost as a result of changes in water levels, especially to inundation if water levels rise. Pond turtles excavate nests on low beaches and probably on channel islands; these nests could be destroyed if inundated by summertime increases in water levels. Also, nesting areas could be lost to rising water prior to nesting.

The installation of fish screens at Hood could prevent the continued use of dispersal routes by turtles that are unknown to us.

Impact - Changes in Prey/Forage Base. Changes in the available prey/forage base for pond turtles could result from changes in INDP water quality.

Impact - Changes in Vegetation and Increased Human Disturbance. Changes in water levels may result in changes to bankside vegetation. Pond turtles were observed most frequently, and in the greatest numbers, in areas where ample basking sites and sheltering vegetation were available, and where human disturbance (especially boaters) was minimal. Human activity within construction areas could displace many turtles as they flee construction-related disturbances. This may force turtles away from once favorable supporting habitat within construction areas into areas of concentrated human activity and increased danger.

Impact - Changes in Flow through the Stone Lakes/Snodgrass Slough/Lost Slough System. The resulting changes in flow through the Stone Lakes/Snodgrass Slough/Lost Slough system could adversely impact pond turtles by changes in water levels. An analysis of potential impacts associated with the diversion of water at Hood is beyond the scope of this report.

Indirect Impacts

Indirect impacts include the reduction in numbers of adult western pond turtles and the disturbance to nesting sites which could result in decreased reproduction. This could induce population declines of unknown duration.

Mitigation Measures

Guidelines prepared by the DFG to mitigate short-term habitat loss for the giant garter snake would also benefit the western pond turtle. These draft mitigation guidelines provide information on mitigation required for short-term wetland habitat loss, long-term habitat loss, and maintenance of wetland habitat (see mitigation measures provided for the giant garter snake).

Alternative 1

Impact. The No-Action Alternative would not affect the western pond turtle. Project area levees would remain intact, adjacent lands would continue in their present agricultural uses, and aquatic habitat would continue to experience its current levels of use. No dredging or change in water levels would occur.

Mitigation Measure. None required.

Alternative 2

Impacts. Dredging of the South Fork of the Mokelumne River would have the same types of impacts to the western pond turtle as the Proposed Project. However, impacts would be reduced under this alternative because dredging and levee reinforcement would be confined to only a portion of the INDP area.

Mitigation Measures. Alternative 2 shall require the same types of mitigation measures as specified for the Proposed Project.

Alternative 3

Impacts. Dredging of the South and North Forks of the Mokelumne River would have the same types and extent of impacts to western pond turtles as the Proposed Project.

Mitigation Measures. Alternative 3 shall require the same mitigation measures as the Proposed Project.

Alternative 4

Impacts. Dredging of the South and North Forks of the Mokelumne River and construction of the Delta Cross Channel Enlargement would have the same types and extent of impacts to western pond turtles as the Proposed Project. Additional impacts due to construction of the Delta Cross Channel Enlargement could involve the destruction of turtles, their eggs, and a limited amount of supporting habitat.

Mitigation Measures. Alternative 4 shall require the same mitigation measures as the Proposed Project.

Alternative 6

Impact - Habitat Loss. Although levee setbacks may create future supporting habitat for this species, turtles and/or their nesting habitat could be buried as landward habitats are relocated farther inland.

A net increase in turtle habitat would result from the construction of levee setbacks. In between the old and new levees a wide backwater slough/shallow marsh area would be created. This would provide supporting habitat for a variety of reptiles and amphibians, including the western pond turtle.

Mitigation Measure - None required.

Cumulative Impacts

Improved flood protection, increased water volume, and improved water quality that the INDP may provide could lead to increases in human presence in and along the North Delta waterways. Such increases in human presence may indirectly impact pond turtles by:

1. Increasing water levels could encourage boating and other recreational activities to increase in waters occupied by turtles (especially along previously neglected backwaters that now support pond turtles), increasing the threats of regular disturbance and physical injury to any individuals present.

2. If project activities lead to increases in the human population of this area (whether dwelling nearby or recreating along newly "improved" waterways), pond turtles would be threatened with increases in human encroachment into their habitats leading to increased disturbance of individual turtles and increased chances for accidental or intentional death or injury.

Impacts of Water Level Changes

Changes in water surface elevations could negatively impact pond turtle supporting habitat by:

1. Increasing water levels could lead to flooding of undetected nesting sites that could force turtles to leave the area or that could destroy unhatched eggs within flooded nests.

2. Increasing water levels within shallow water environments required by newly hatched or small turtles.

3. Increasing water levels could encourage the establishment of large introduced "gamefish" which may prey upon small turtles.

4. Higher water levels could also encourage increases in human encroachment in and along project area waterways, leading to increased disturbance of individual turtles and their nests, and increasing chances for accidental or intentional death or injury to any turtles present.

5. Decreasing water levels could lead to drying of vegetated shallow water environments which presently occur along INDP waterways, destroying these suitable habitats and possibly stranding any turtles present.

Changes in water surface elevations could have beneficial impacts on pond turtles by:

1. Decreasing water levels could create new shallow water environments which, in turn, could eventually support western pond turtles.

2. Increasing water levels could flood formerly dry areas and create new shallow water environments suitable for turtles.

Impacts of the Conceptual Habitat Plan for the Grizzly Slough Project Area

DFG (1995) prepared a conceptual habitat plan for the 489-acre Grizzly Slough property that DWR purchased on New Hope Tract in Sacramento County. The creation of the various habitat types proposed would benefit western pond turtles by providing additional supporting habitat over what is presently available at this site. Of the many habitat types planned, the Open Water (52.02 acres), Emergent Marsh (30.11 acres), and Brood Ponds (1.45 acres) would provide habitat known to be occupied by breeding populations of western pond turtles (see Table 2 of DFG [1995]). This represents 17.1 percent of the area available on the Grizzly Slough site (excluding the questionable rice acreage) available for turtles' warm season activities. While this percentage of the available acreage seems small, it is a considerable increase over the amount of suitable habitat that currently exists on-site.

Mitigation Measures. None required.

INVERTEBRATES

Valley Elderberry Longhorn Beetle

Status

The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (VELB) is listed by the USFWS as threatened with critical habitat.

Distribution

Prior to its listing in 1980, the species was reported only from Putah Creek (Yolo and Solano counties), the Merced River (Merced County), and the American River (Sacramento County). The type-locality was reported as Sacramento, California. The range was described as the lower Sacramento Valley to upper San Joaquin Valley (Linsley and Chemsak 1972).

According to NDDB (1994), the reported range now includes the following major drainages: American River; Calaveras River; Cosumnes River, and its tributary, Dry Creek; Feather River; Merced River; Middle River; Sacramento River, and its historical tributary, Putah Creek; Stanislaus River; and Tuolumne River. Two widely-separated tributaries to the San Joaquin River, Bear Creek and Los Banos Creek, are also included. The distribution of VELB records among these drainages probably is more indicative of survey effort than of VELB distribution. These reports are distributed among the following counties: Butte, Colusa, Glenn, Merced, Napa, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, Tehama, Yolo, and Yuba. In general, these data support the earlier range description of "lower Sacramento Valley to the upper San Joaquin Valley."

Due to extensive work since its listing (particularly during the last 10 years), the reported range has been extended considerably. These new data, based upon both the presence of adults and the presence of characteristic emergence holes in elderberry (*Sambucus* spp.), are well-summarized by Barr (USFWS 1991b) and define the range as extending throughout the Central Valley, from Redding (Shasta County) to Bakersfield (Kern County) (USFWS 1991b). The eastern limit is defined by several observations from the western slope of the Sierra Nevada at elevations up to approximately 3,000 feet (USFWS 1991b). The western limit, much more difficult to define due to limited data particularly from the southwest quadrant of the Central Valley, is defined as Cold Canyon, near Lake Berryessa (Napa County). Elevations range from approximately 30 feet on the Central Valley floor to approximately 3,000 feet in the Sierra Nevada, and to approximately 700 feet in the Coast Range. In addition to those counties reported in the NDDB, VELB range is now considered to include the following counties: Shasta, Placer, El Dorado, Amador, Mariposa, Madera, Fresno, Tulare, and Kern. Cumulatively, these data support a range definition of the Central Valley, from Redding to Bakersfield, extending up to 3,000 feet on the western slope of the Sierra Nevada, and to 700 feet on the eastern slope of the Coast Range. Historically, the range of the VELB is assumed to have included riparian zones surrounding all of the major Central Valley river drainages. These riparian corridors (and associated savannas), once much more extensive, probably offered ample habitat for the VELB.

Habitat Requirements

All stages of the VELB life cycle are closely associated with elderberry. Adults lay eggs upon the plants, after which, larvae bore in and excavate pupal cells. After pupation, new adults emerge and use elderberry for resting, foraging, and mating.

Over the past several years, there has been some speculation regarding host plant preference at the specific level. The problem has been exacerbated by taxonomic problems with *Sambucus*. Recent data indicate that VELBs infest individuals of both *S. mexicana* and *S. racemosa* var. *microbotrys*, with no distinct preference (USFWS 1991b). Similarly, there has been discussion surrounding anecdotal supposition that VELBs seem to prefer "stressed" plants. It is believed that other factors (e.g., ease of visual observation during survey efforts, and/or seasonality of plants) may have confounded this issue. Recent data indicate a clear preference (i.e., 82.5 percent) for "healthy" plants (USFWS 1991b). These data also indicate a distinct preference for larger plants (i.e., maximum branch/trunk diameter 2.5 to 30 inches; mean = 8.1 inches) (USFWS 1991b). The diameter of stems bearing recent emergence holes ranged from 1 to 8.4 inches (mean = 3.5 inches) (USFWS 1991b). Combined, these data suggest a general preference for mature, established elderberry stands; with larval utilization of healthy, somewhat younger stems (most in branches with stem diameters between 2 and 4 inches) (USFWS 1991b).

Critical Habitat

Two critical habitat zones have been established (USFWS 1991c):

1. Sacramento Zone: An area in the City of Sacramento enclosed on the north by the Route 160 freeway, on the west and southwest by the Western Pacific railroad tracks, and on the east by Commerce Circle, and its extension southward to the railroad tracks.

2. American River Parkway Zone: An area of the American River Parkway on the south bank of the American River, bounded on the north by latitude 38 37'30"N, on the west and southwest by Elmanto Drive from its junction with Ambassador Drive to its extension to latitude 38 37'30"N, and on the south and east by Ambassador Drive and its extension north to latitude 38 37'30" N, Goethe Park, and that portion of the American River Parkway northeast of Goethe Park, west of the Jedediah Smith Memorial Bicycle Trail, and north to a line extended eastward from Palm Drive.

In addition, two "essential habitat" zones have been described:

1. American River Parkway Zone: An area within the American River Parkway, consisting of both left and right banks, extending from Nimbus Dam downstream to Arden Bar, adjacent to and encompassing previously-designated "Critical Habitat, American River Parkway Zone" (USFWS 1984)

2. Putah Creek Zone: California. Solano County. Range 2 West, Township 8 North, Sections 25, 26, 35, and 36 (USFWS 1984)

Reasons for Decline

Due to a lack of historical (and current) population data, it has not been established that the VELB is still in decline. However, habitat destruction generally is accepted as the greatest threat to the species. It has been estimated that approximately 90 percent of California riparian systems have been destroyed since the mid-1800s (USFWS 1984). Anecdotal evidence regarding "clumped" distribution suggests that VELB may be relatively poor at dispersal. If true, poor dispersal would be exacerbated by habitat fragmentation. In addition, isolation renders distinct populations much more susceptible to localized upsets due to natural (e.g., fire) or unnatural (e.g., development and/or maintenance) causes. Continued destruction of riparian habitat is considered the single greatest threat to the species.

Survey Methodology

Elderberry shrubs were searched for along major waterways of the INDP area by boat, automobile, and by foot. When elderberries were observed from the water, an observer was dropped off onshore to examine the stems for evidence of VELB infestation (i.e., emergence holes). Walking and driving surveys were conducted along the tops and land-sides of levees to cover areas that were not visible from the water. Field surveys were conducted on eight occasions during August and September, 1993, and from April through June, 1994. Surveys for elderberries targeted the waterways that would be directly impacted by the Proposed Project (see Figure III-1).

The USFWS (1993) considers all elderberry shrubs within the known range of the VELB to provide potential habitat if they have stems one inch or greater in diameter at ground level. Because of the large numbers of elderberries present in portions of the INDP area, measurements of stem diameter and shrub height were not taken. Instead, field surveys focused on identifying and mapping elderberry shrubs, examining stems for emergence holes, and looking for adult VELBs during the adult flight season (mid-April through early June).

Results

Approximately 300 elderberry plants, or discrete clusters, were identified within the INDP area (see Appendix A, Figures A-5, A-10, A-13, and A-14). Map locations do not differentiate between a single shrub and a cluster of several shrubs at the same site. No evidence of VELB infestation was identified in any of the plants in the INDP area.

Elderberry was widely distributed and relatively dense along both sides of the Mokelumne River between Interstate 5 and the juncture of the North and South Fork Mokelumne where it was a common component of the mixed riparian woodland plant community. Plants of all age classes were represented in this stretch of river.

Only a few widely-scattered elderberry were located along the South Fork Mokelumne River between New Hope Landing and Terminous. No riparian woodland remains in this reach, except immediately south of the Walnut Grove Road bridge crossing. A few scattered elderberries were identified on the North Fork Mokelumne River in the stretch of river closest to Dead Horse Island.

Other waterways supporting elderberry include the banks of Snodgrass Slough, Lost Slough, and Dead Horse Cut, the perimeter of Dead horse Island, the Staten Island levee north of Walnut Grove Road, and scattered locations along Highway 160 between Snodgrass Slough and Hood.

Grizzly Slough Mitigation Site

A few elderberries are present within the riparian corridors along Bear and Grizzly sloughs bordering the mitigation site; however, no evidence of VELB emergence holes was found. No elderberry shrubs are located in the interior portion of the Grizzly Slough site.

Impacts of the Proposed Project (Alternative 5)

Impact - Removal of Elderberry during Levee Reinforcement. Although elderberries typically grow on high river terraces and would not be affected by dredging or the magnitude of changes in water levels projected by DWR's modeling studies, they would be directly impacted by levee reinforcement and other construction activities occurring on the land-side of the levees.

Dredged material would be deposited on the land-side levee slope. Once dried, this material would require grading and contouring to achieve the required slopes of 2:1 to 5:1. Existing vegetation on the top and land-side of the levee would be removed to create sufficient space to put the new 3-foot stabilizing berm in place. The tops of levees would be graveled. Elderberries growing at the base of the levee, along the levee slope, and along the tops of the levee would be removed during this process. Because elderberries constitute potential habitat for the VELB, mitigation would be required for their loss.

Elderberries potentially affected by the Proposed Project include those located along the North and South Forks Mokelumne rivers, the Mokelumne River upstream of the confluence of the North and South Forks, and around the western end of Dead Horse Island. The densest concentrations of elderberries in the entire INDP area occur along both sides of the Mokelumne River upstream of Walnut Grove Road to the northern limit of proposed dredging.

No elderberries would be affected by construction of the Hood diversion.

Mitigation Measure - Replacement Plantings. Elderberries would be incorporated into a planting program both along the new land-side levee slopes and at the Grizzly Slough mitigation site. Once the extent of the reinforcement activities is determined a count of the number of elderberries that would be removed shall be taken. All stems greater than one inch in diameter that would be affected shall be subject to a replacement ratio of 2:1 according to USFWS compensation guidelines for the VELB (USFWS 1994).

Elderberries within the proposed construction zone shall be flagged so that if they are on the border of construction activities and can be avoided, construction personnel will be able to easily identify them.

Alternative 1

Impact. The No-Action Alternative would not affect elderberries; therefore, it would have no impact on the VELB.

Mitigation Measure. None required.

Alternative 2

Impacts. Dredging of the South Fork Mokelumne River would have the same impacts as described for the Proposed Project, with the exception that the elderberries along the North Fork would remain undisturbed.

Mitigation Measures. Alternative 2 shall require the same mitigation measures as the Proposed Project.

Alternative 3

Impacts. Dredging of the South and North Fork Mokelumne rivers would have the same impacts as described for the Proposed Project.

Mitigation Measures. Alternative 3 shall require the same mitigation measures as the Proposed Project.

Alternative 4

Impacts. Dredging of both forks of the Mokelumne River and construction of the Delta Cross Channel Enlargement would have the same impacts as described for the Proposed Project. Construction and operation of the Delta Cross Channel Enlargement would not affect elderberries.

Mitigation Measures. Alternative 4 shall require the same mitigation measures as the Proposed Project.

Alternative 6

Impacts. Alternative 6 would result in the removal of fewer elderberries as compared to the Proposed Project. Under this alternative only one side of the existing project area waterways would undergo levee reinforcement and almost half of the existing levees would be retained as instream or channel islands. Therefore, almost half of the potential VELB habitat, especially along the Mokelumne River, would remain undisturbed on the newly-created instream islands.

Mitigation Measures. Replacement plantings for the loss of elderberries shall be incorporated into the planting plan along the upper terraces of the instream islands as well as along the new land-side levee slopes and at the Grizzly Slough mitigation site.

Cumulative Impacts

Increased flood protection provided by the INDP may cause riparian corridors and other lands supporting potential VELB habitat to be cleared for development. However, other constraints are in place that may prevent this from happening. As discussed earlier in this report dredging of the project area waterways is not a permanent solution to siltation and water transport. Eventually the channels will silt back up, eliminating the protection from a 100-year flood.

V. LIST OF CONTRIBUTORS

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Ron Unger, M.S.	Field Assistant - plants
Diane Soule, B.A.	Graphics
Michelle Hutchens, B.A.	Word Processing

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APPENDIX A

Locations of Special-Status Species in the
Interim North Delta Program Area

D-003186

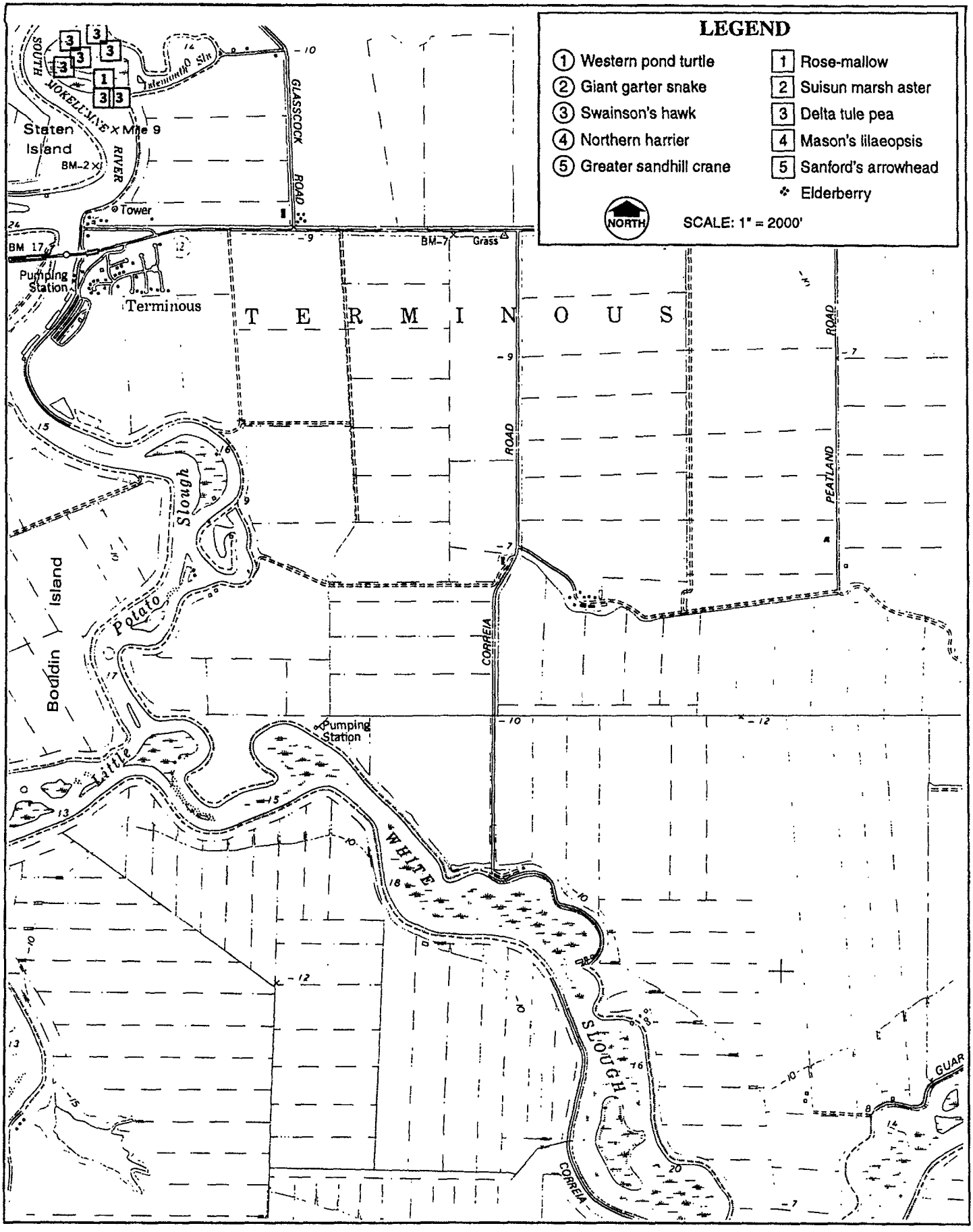

Figure A-1. Locations of Sensitive Species on the USGS Terminous 7.5' topographic quadrangle, NW portion
[Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

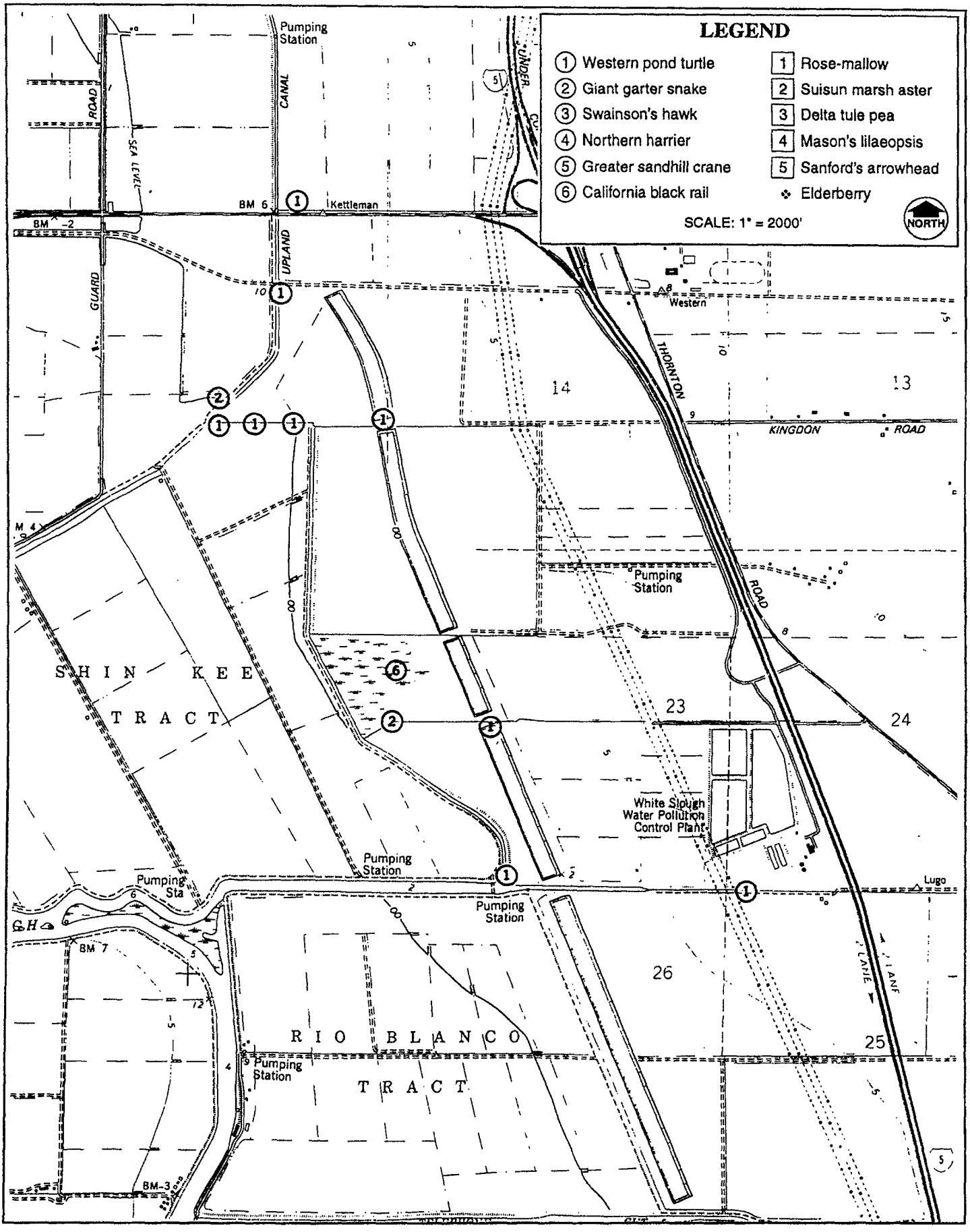

Figure A-2. Locations of Sensitive Species on the USGS Terminous 7.5' topographic quadrangle, NE portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b, DWR 1995b]

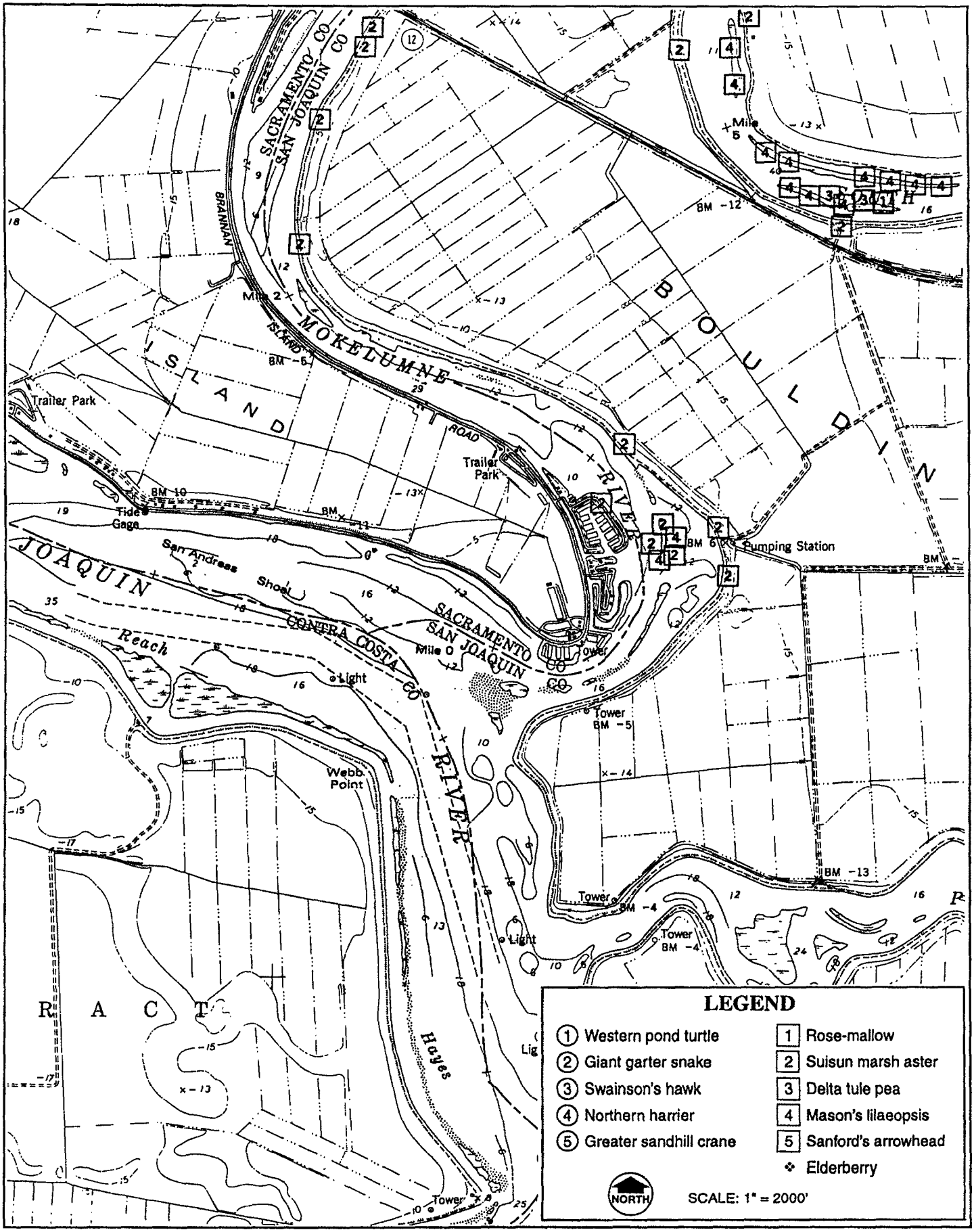

Figure A-3. Locations of Sensitive Species on the USGS Bouldin Island 7.5' topographic quadrangle, NW portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

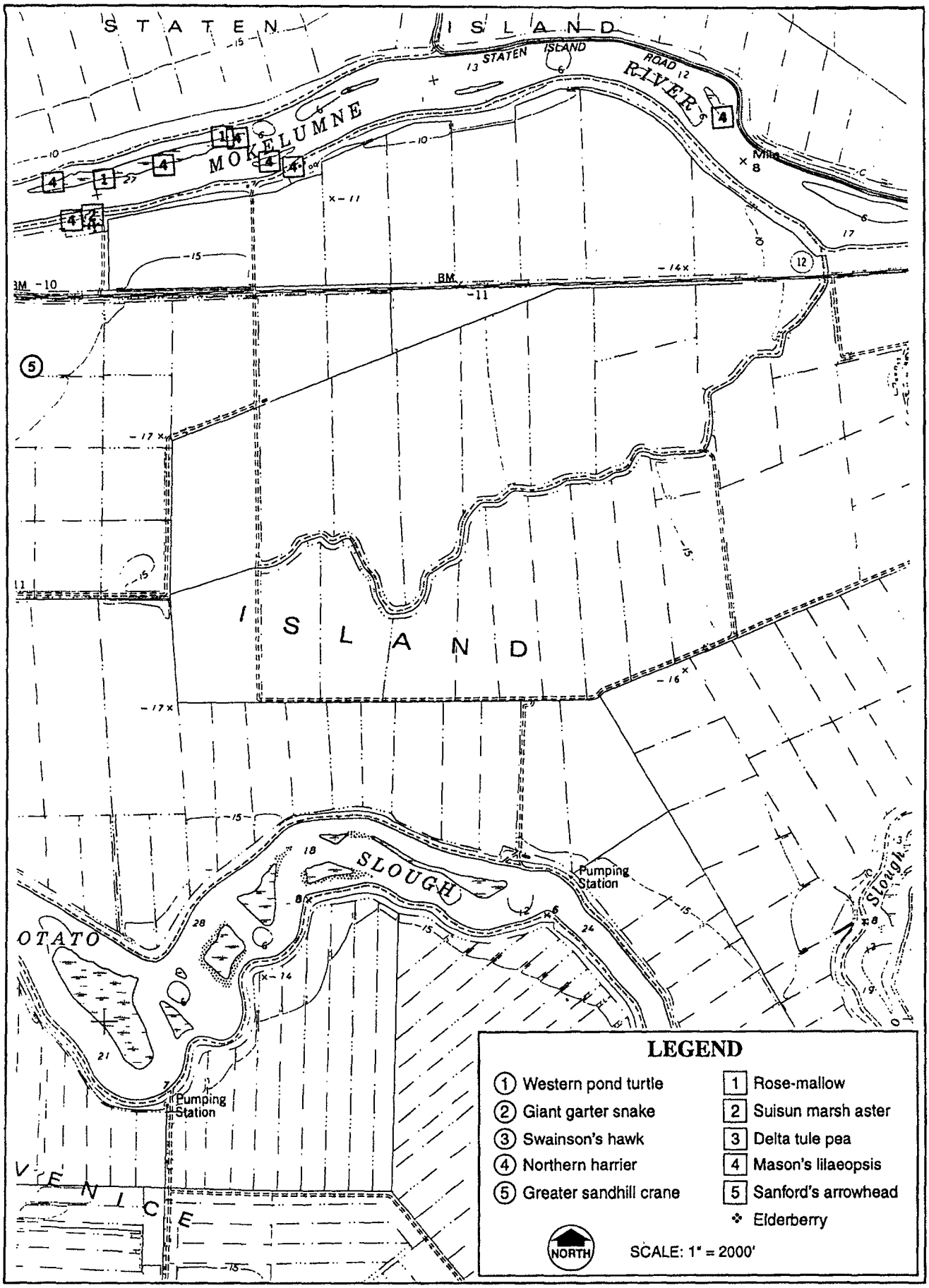

Figure A-4. Locations of Sensitive Species on the USGS Bouldin Island 7.5' topographic quadrangle, NE portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

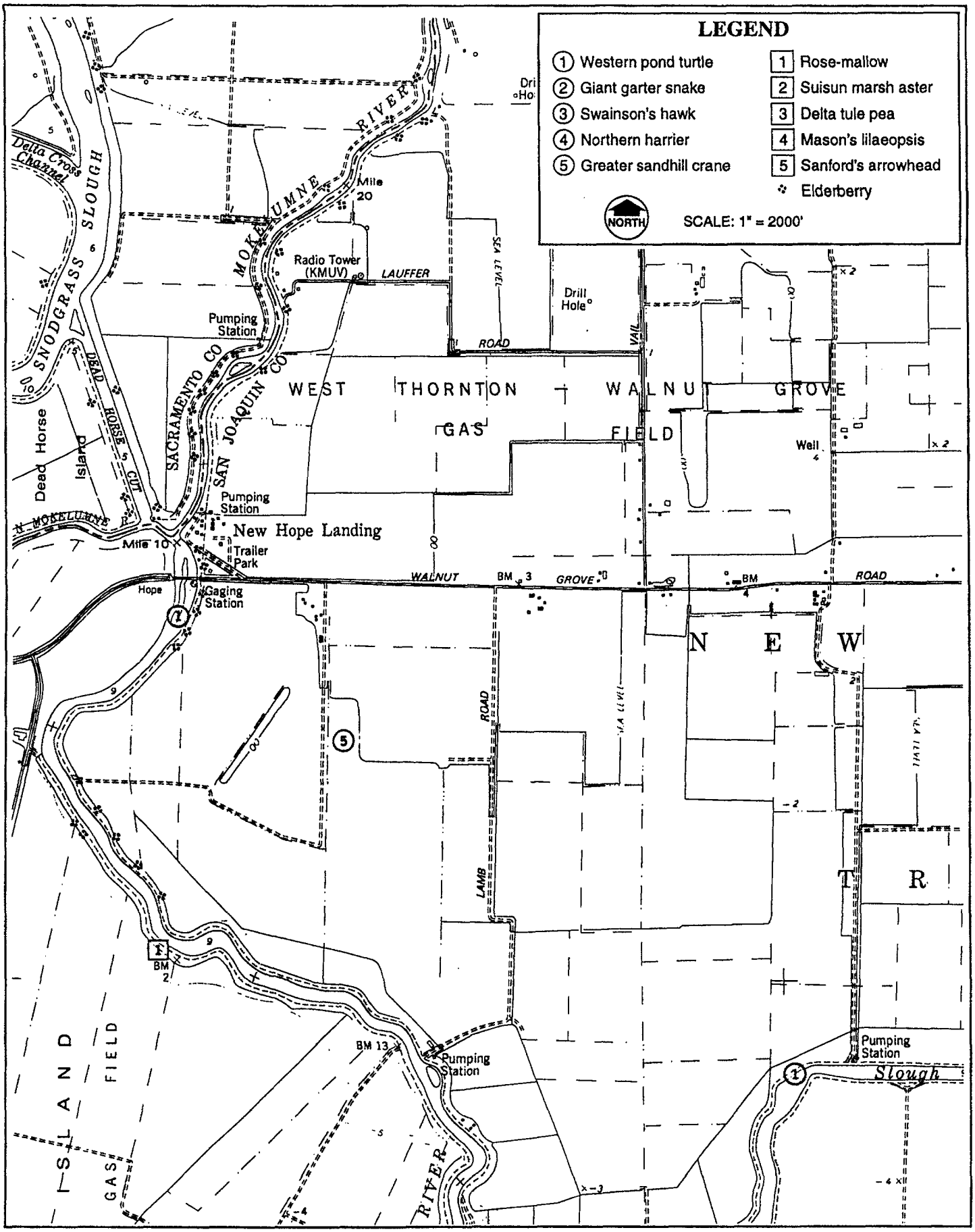

Figure A-5. Locations of Sensitive Species on the USGS Thorton 7.5' topographic quadrangle, NW portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

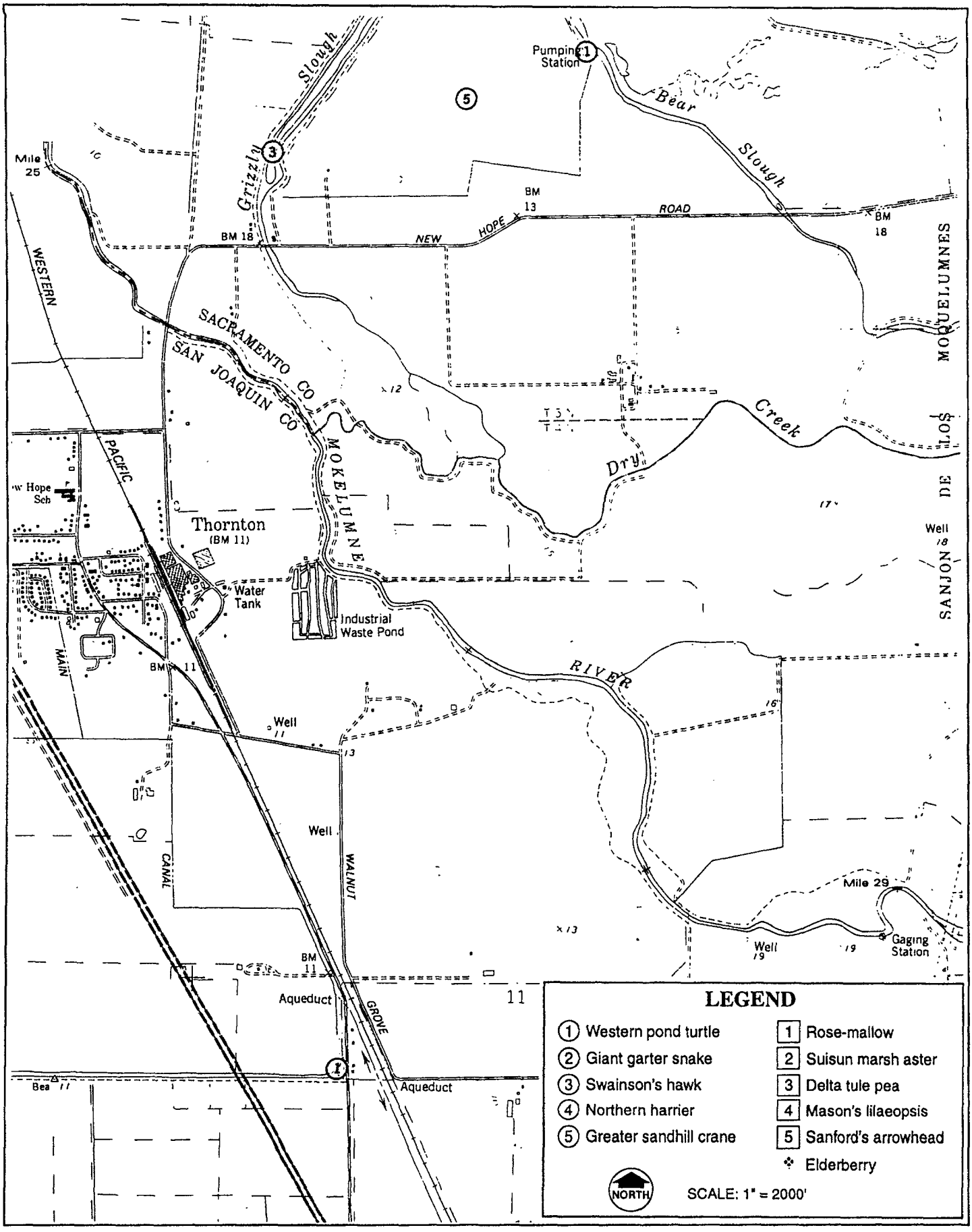

Figure A-6. Locations of Sensitive Species on the USGS Thorton 7.5' topographic quadrangle, NE portion
[Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

D-003192

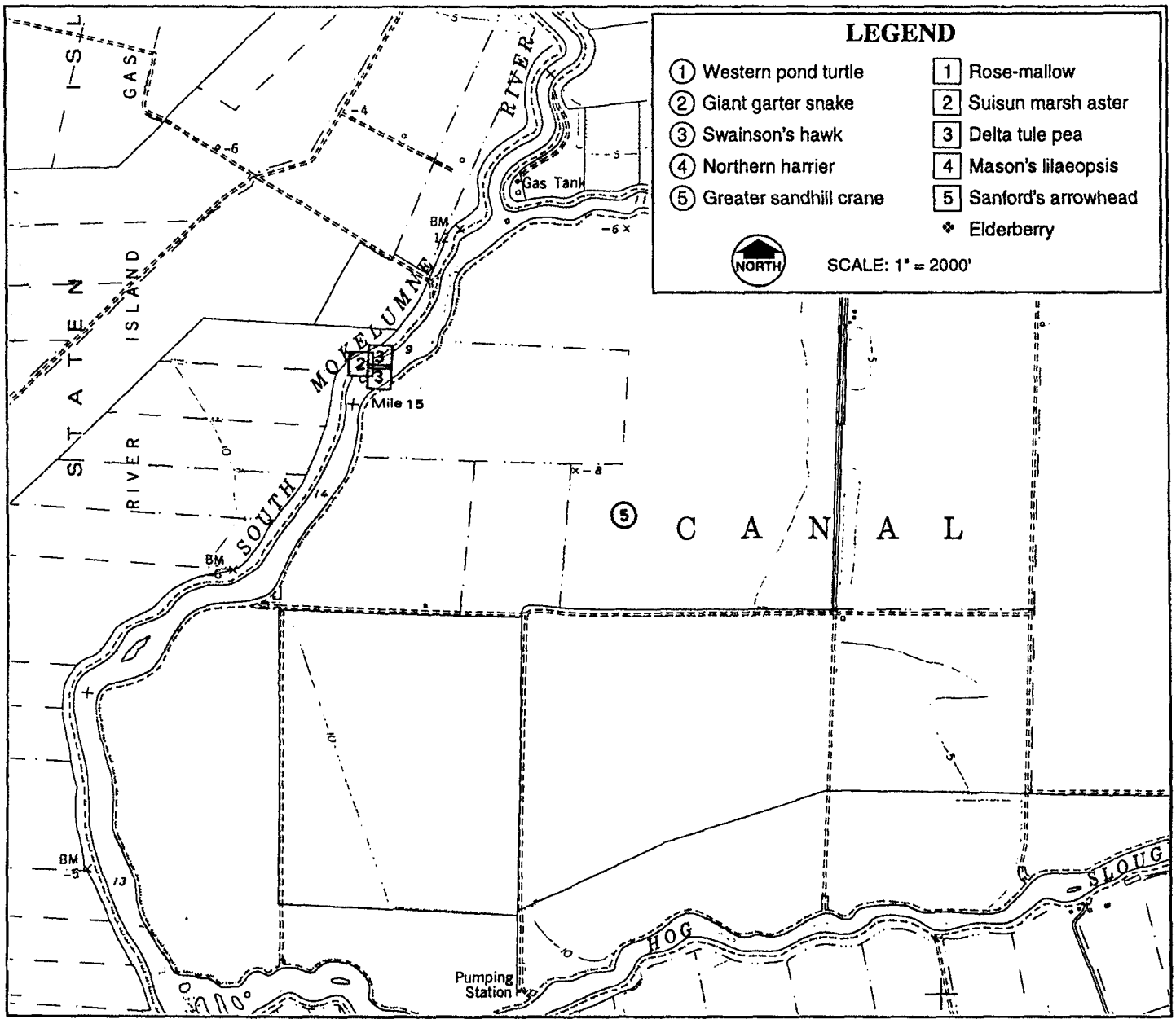

Figure A-7. Locations of Sensitive Species on the USGS Thorton 7.5' topographic quadrangle, W central portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

D-003193

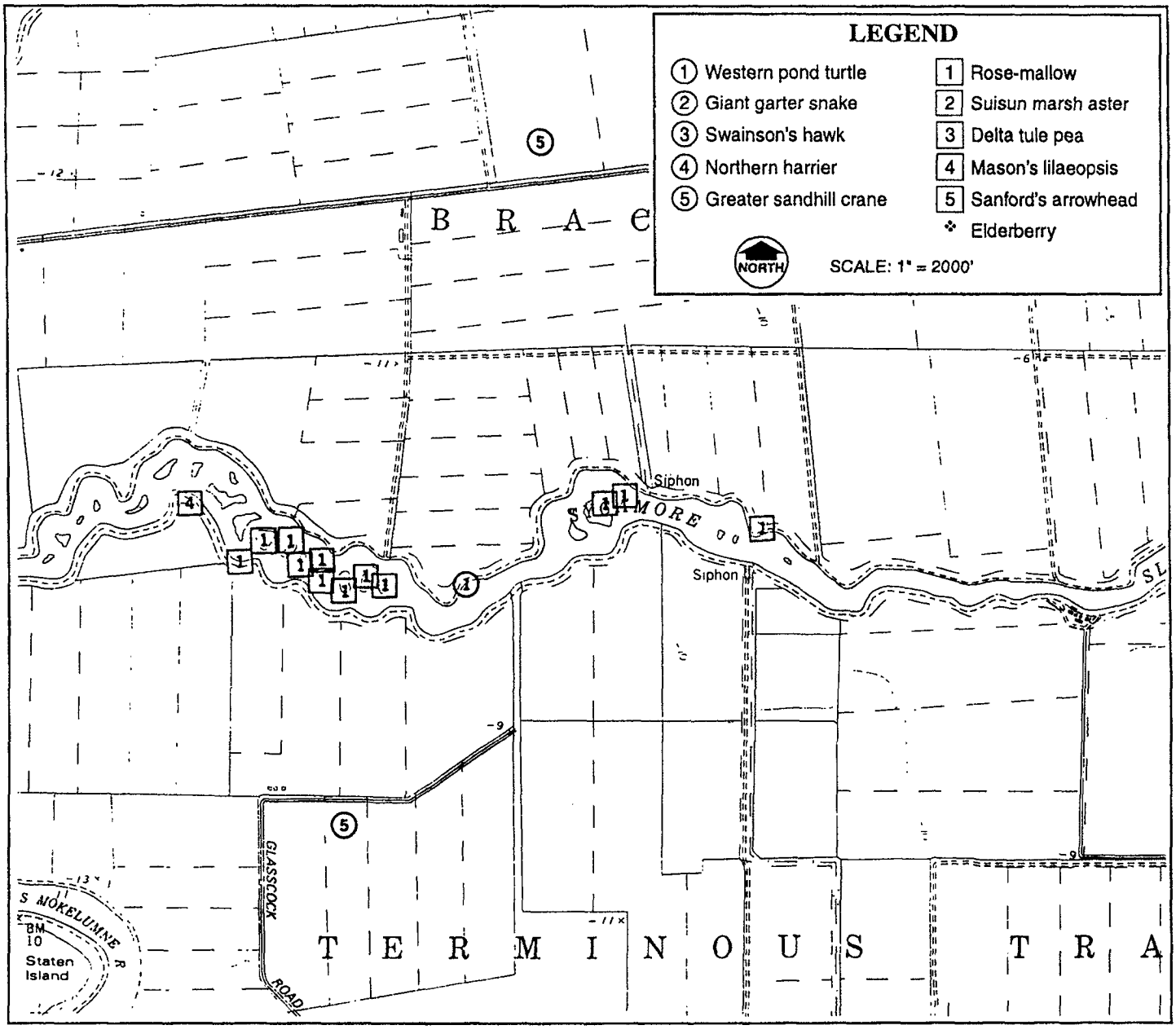

Figure A-8. Locations of Sensitive Species on the USGS Thorton 7.5' topographic quadrangle, SW portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

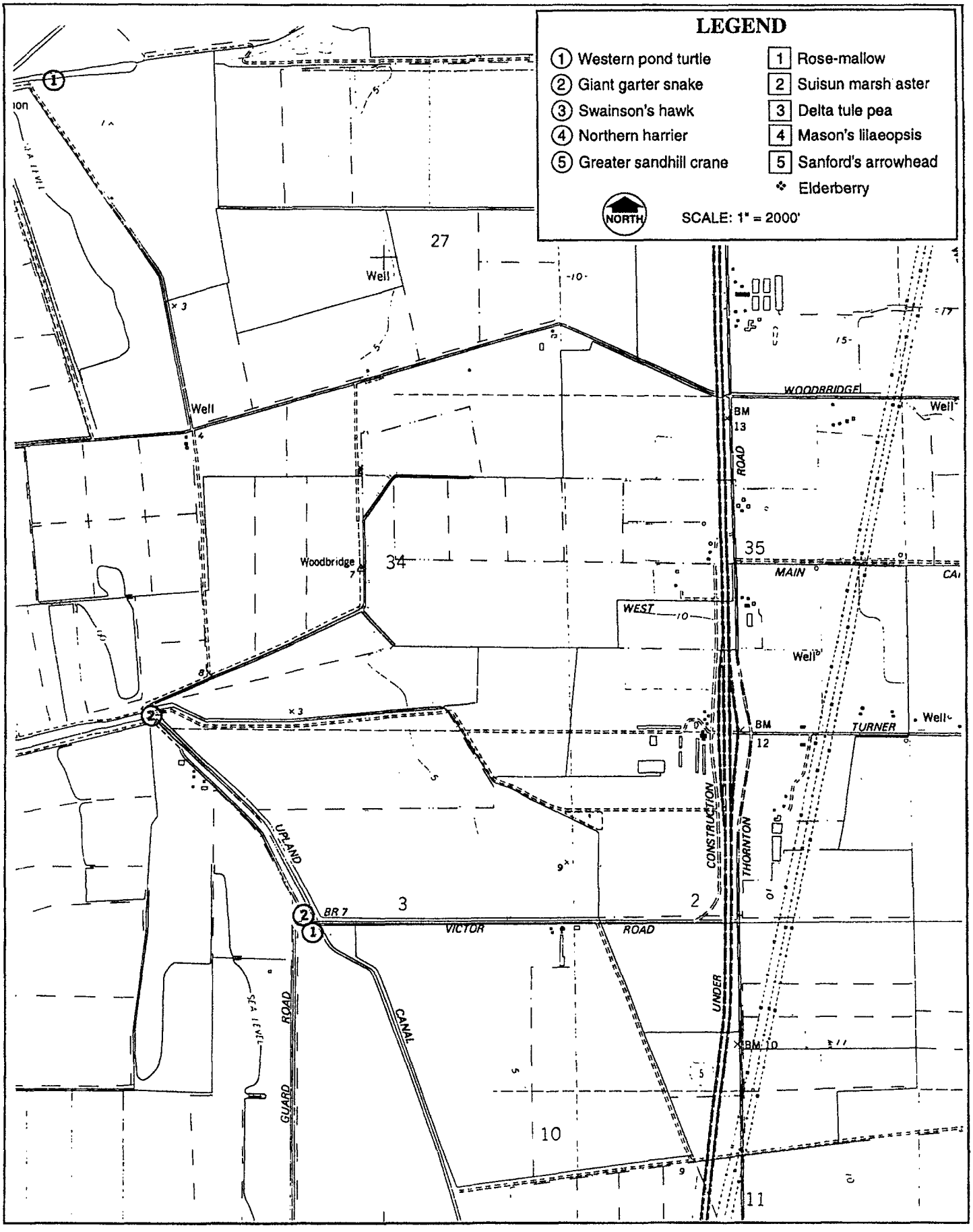

Figure A-9. Locations of Sensitive Species on the USGS Thorton 7.5' topographic quadrangle, SE portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

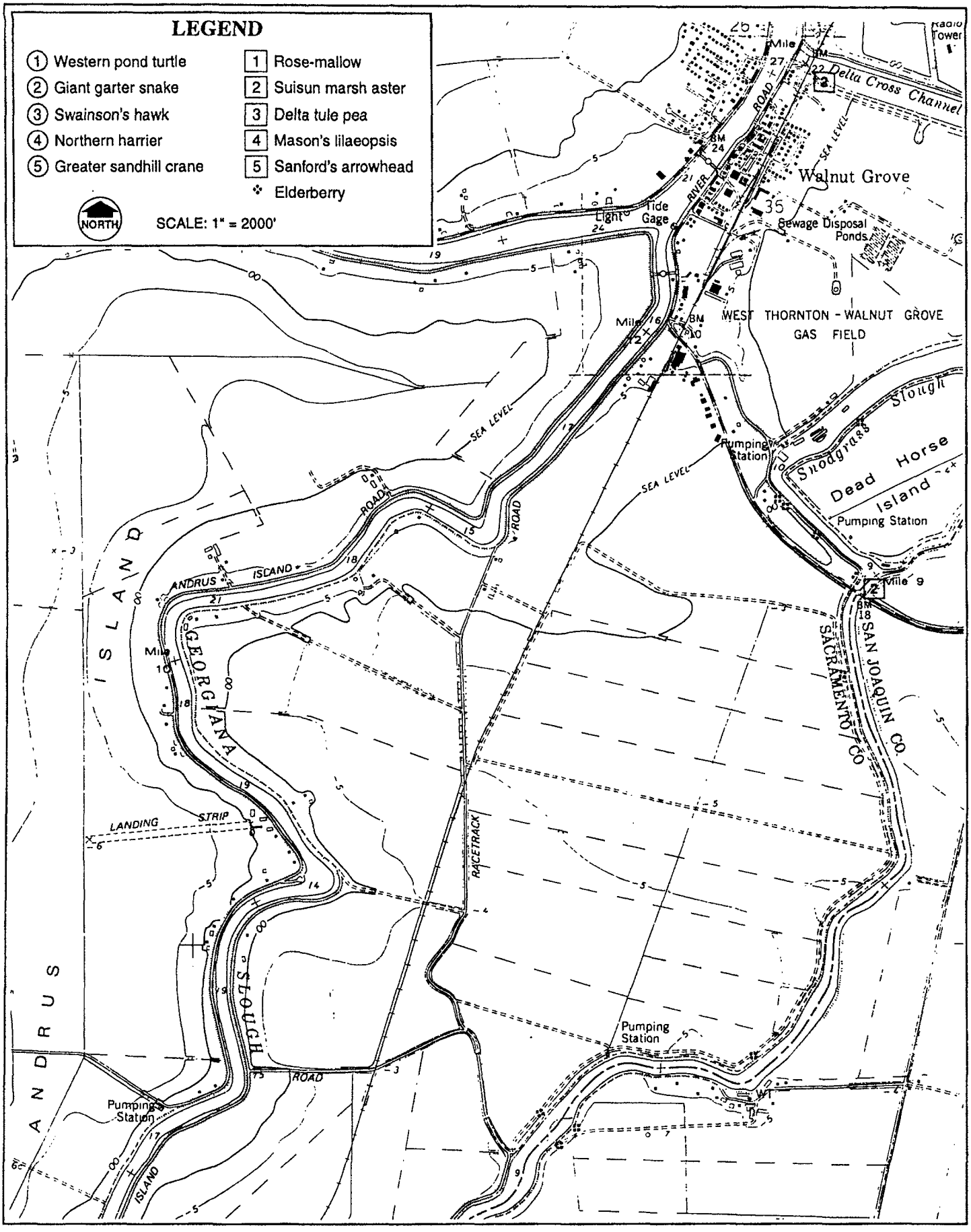

Figure A-10. Locations of Sensitive Species on the USGS Isleton 7.5' topographic quadrangle, NE portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

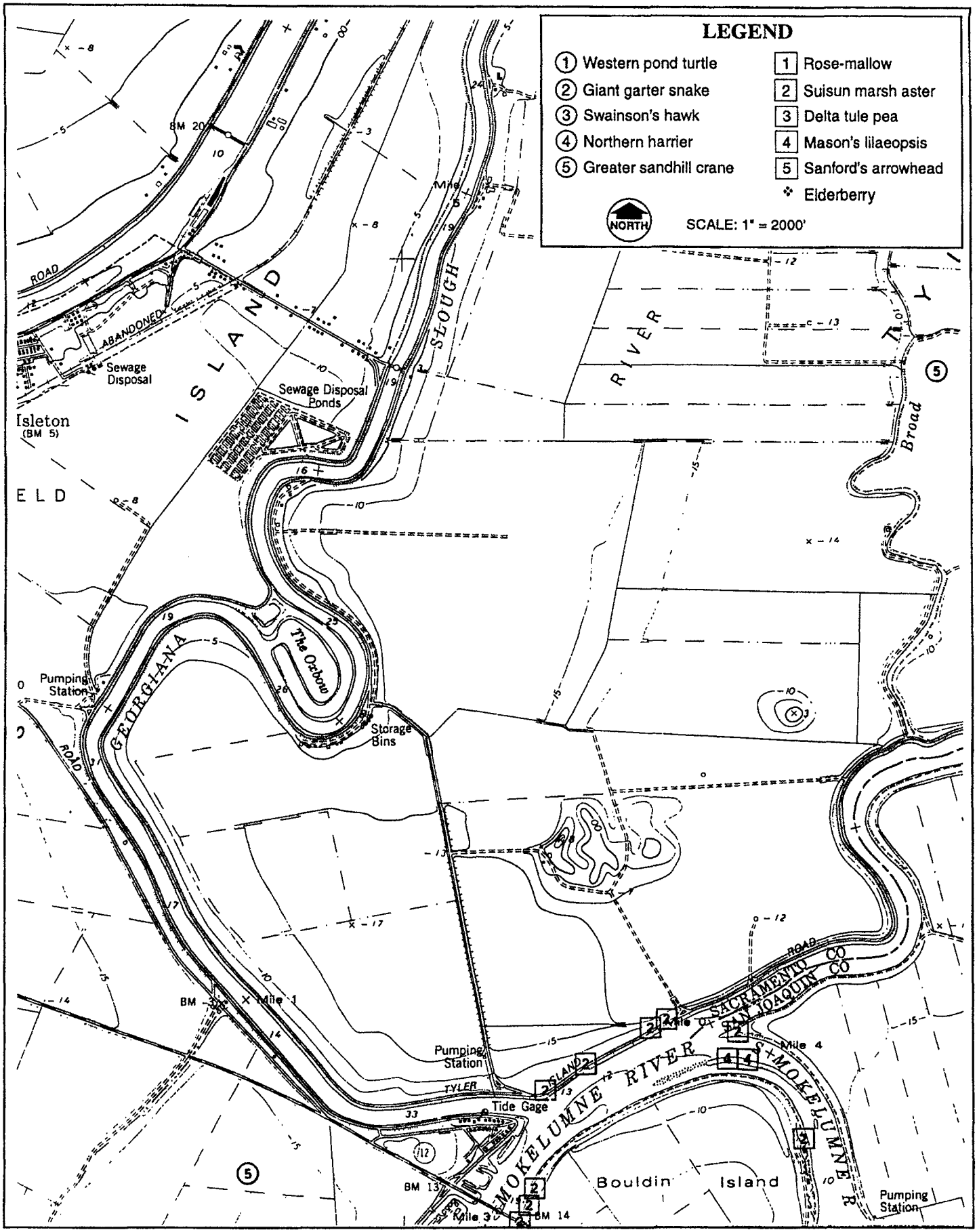

Figure A-11. Locations of Sensitive Species on the USGS Isleton 7.5' topographic quadrangle, SW portion
[Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

D-003197

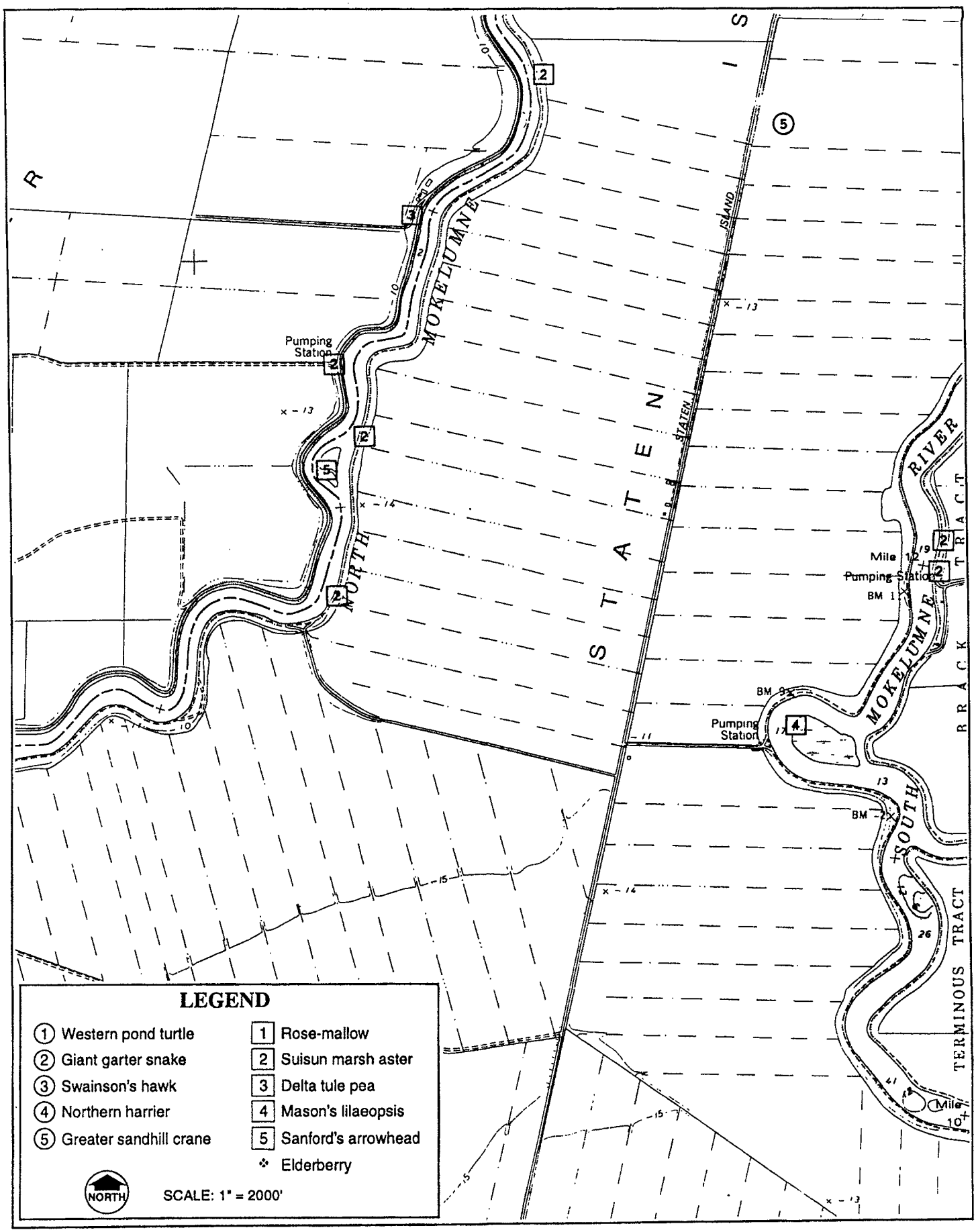

Figure A-12. Locations of Sensitive Species on the USGS Isleton 7.5' topographic quadrangle, SE portion
[Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

D-003198

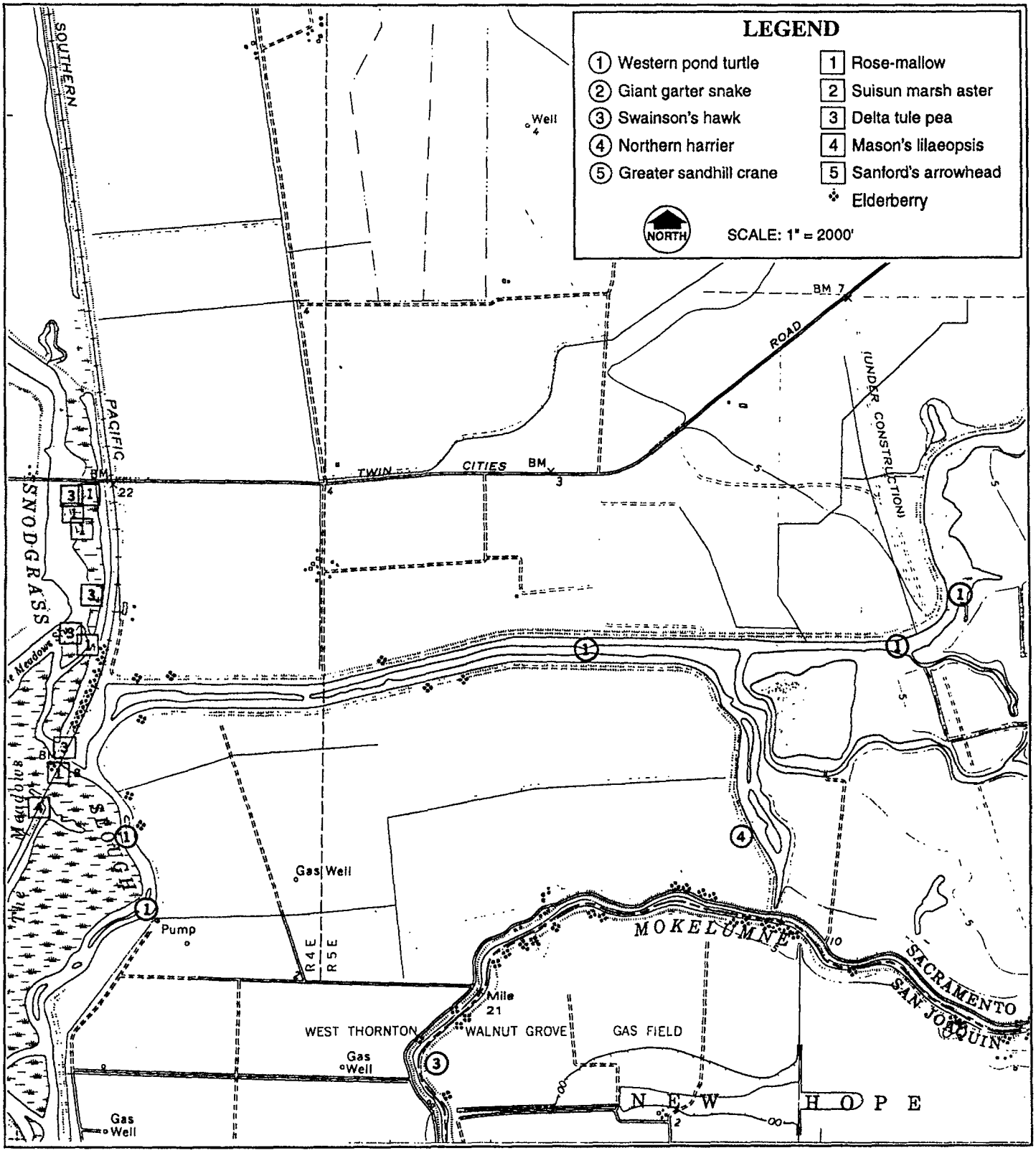

Figure A-13. Locations of Sensitive Species on the USGS Bruceville 7.5' topographic quadrangle, SW portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

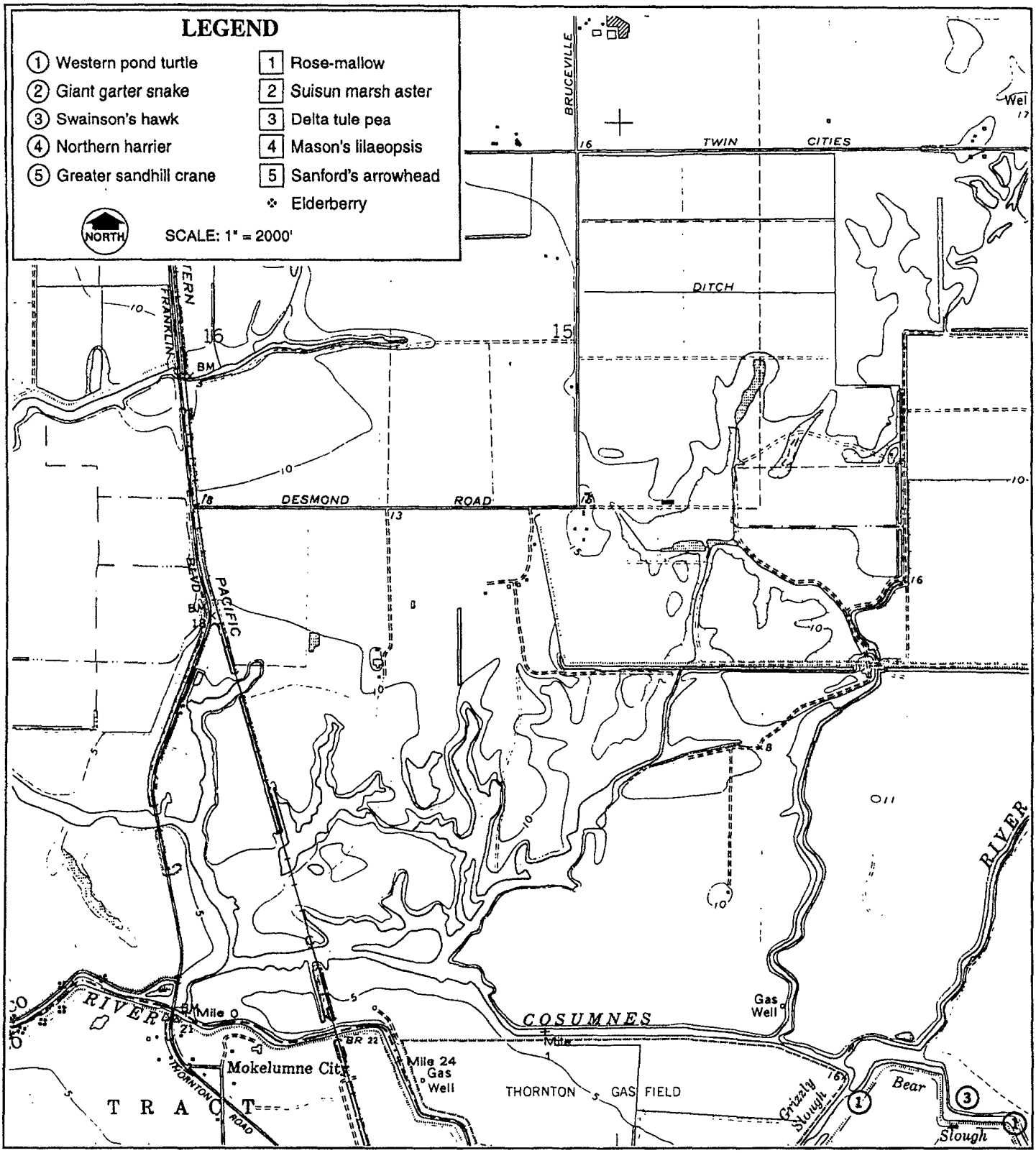

Figure A-14. Locations of Sensitive Species on the USGS Bruceville 7.5' topographic quadrangle, SE portion
[Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

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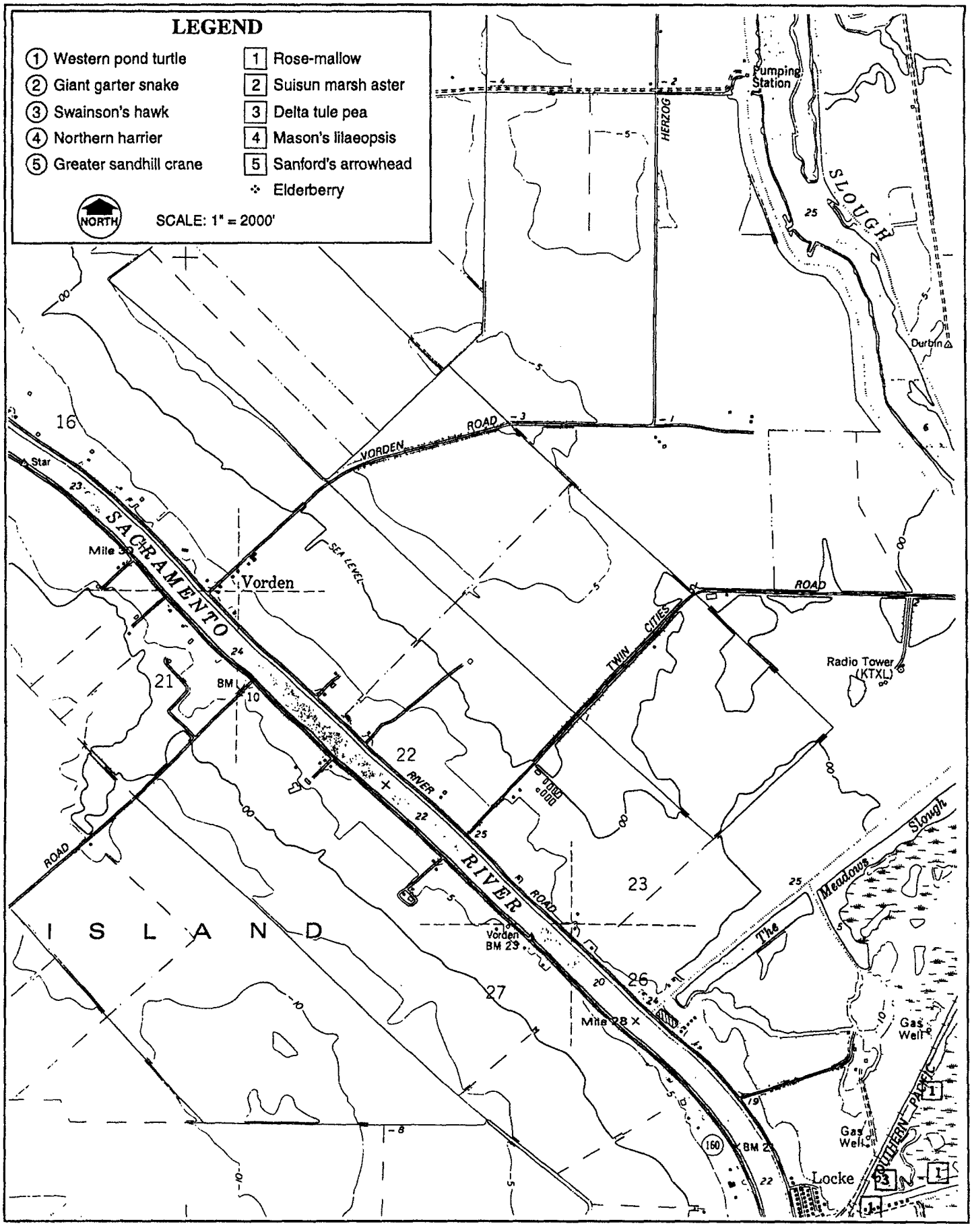

Figure A-15. Locations of Sensitive Species on the USGS Courtland 7.5' topographic quadrangle, SE portion [Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

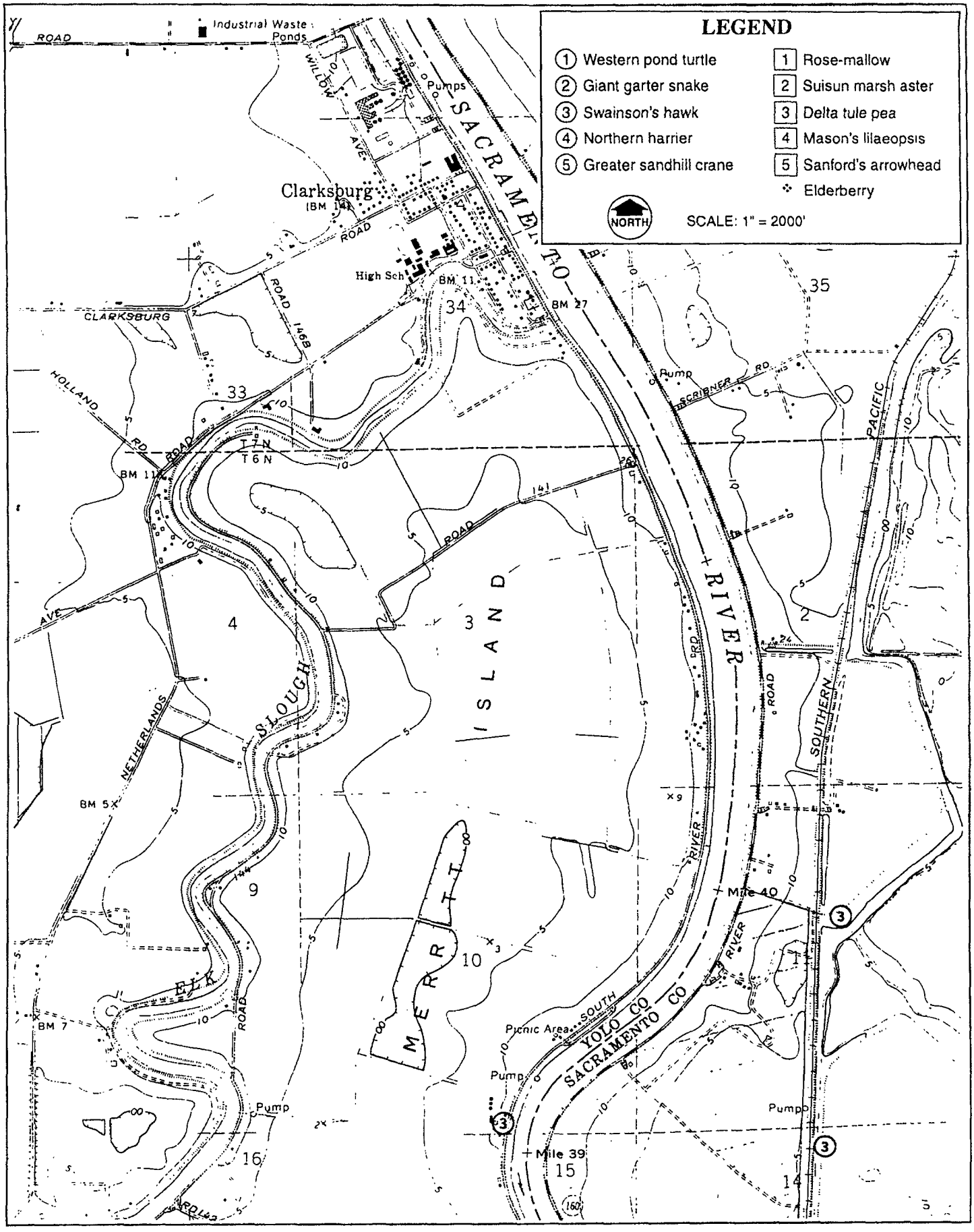

Figure A-16. Locations of Sensitive Species on the USGS Clarksburg 7.5' topographic quadrangle, SE portion
[Source: MGA 1994, Bowcutt 1993, ECOS 1990b]

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