Appendix C- Summary of Duck Club Projects

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Summary of Duck Club Restoration Projects
KMEP Suisun Slough Release Site
Fairfield, California

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Prepared for
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1.0 INTRODUCTION

On April 27, 2004, a release of diesel fuel occurred from an underground 14-inch diameter petroleum pipeline owned and operated by Kinder Morgan Energy Partners, L.P (KMEP). The release of diesel fuel was contained within the privately owned Drake Sprig Duck Club (or, "the release site"). The release site is located on the western edge of Suisun Marsh, on the northern shore of Suisun Bay, which is situated between the Sacramento-San Joaquin River Delta to the east and San Pablo Bay to the west. The Drake Sprig Duck Club includes approximately 224 acres of managed wetlands located east of the Union Pacific Railroad (UPRR) right-of-way near Fairfield, California, approximately 0.5 miles south of Chadbourne Road.

2.0 PURPOSE

The purpose of this document is to identify potential restoration projects that could be implemented in Suisun Marsh to compensate for the natural resource service losses resulting from the release. Because the release occurred in a Duck Club, and natural resource injuries are considered to have been limited to the club, the most direct restoration of the attendant service losses would result from restoration projects implemented in the wetland portions of nearby duck clubs. Accordingly, KMEP identified potential restoration projects that could be implemented in these duck clubs by obtaining a number of restoration project proposals from duck club owners. Initial responses from the owners included a variety of project types. After evaluation of these initial project proposals, KMEP concluded that enhancement of water management by means of water control device improvement and associated ditch construction would be most likely to generate habitat improvements leading to natural resource service gains and that such projects could be quantified to calculate restoration credits. This report therefore focuses on this category of restoration projects.

3.0 PROJECT IDENTIFICATION

A letter soliciting proposals for restoration projects was transmitted to the owners of nearby (within an approximate 2 mile radius) duck clubs on November 29, 2004. Responses included proposed projects in 22 duck clubs. Most of these projects involve enhancement of habitat conditions that will generate additional natural resource services in wetlands already existing in the duck clubs. Therefore, such enhancement projects are considered to be a subset within the broad category of restoration projects. It was decided that projects involving the grading of existing wetlands, whether to create new conveyance ditches or change the elevation of an area to eliminate a hill or to create a pond, would be eliminated because it was difficult to estimate the resulting service gain. This elimination reduced the

number of sites retained for consideration to 19. These 19 proposed projects and a brief description of the elements of each are listed in Table 1.

The project descriptions presented in this report represent the information provided in the responses, including estimates of acreage enhanced and costs. Cost estimates are based on similar work historically performed for the owners in the respective club. Details on each proposed project, including a discussion of the need for the proposed projects, how the projects would enhance habitat, and how many acres would be enhanced, are presented elsewhere in this report.

4.0 SUMMARY OF NATURAL RESOURCE SERVICE CREDITS

As explained below, should all the proposed projects be implemented, 4,601 acres would be enhanced at an owner-estimated cost of $620,230. These projects would generate a total of approximately 11,607 acre-years of natural resource service credits based on the information provided in this report and employing the credit algorithm used by the Trustees in their REA.

As discussed elsewhere in this report, the data presented herein overall have a high degree of reliability for the following reasons: 1) the data were generated by parties not associated with KMEP, 2) many parties independently contributed information, 3) most information is based on historical project implementation experience, and 4) a degree of conservatism was used when assumptions were made (i.e., service gains and restoration trajectories). Notwithstanding these factors, we have made further allowance for uncertainty in the owners' cost estimates (as well as allowance for inflation) by applying a 20% contingency to the owner-estimated costs, bringing the total projected cost for all projects to $744,276.

5.0 DUCK CLUBS IN SUISUN MARSH

5.1 Ecology

According to the Department of Water Resources (DWR), the approximately 150 duck clubs in the Suisun Marsh ("the Marsh") comprise nearly half (52,000 acres) of the total 116,000 acres of the Marsh (DWR, 2005). Located between the Delta formed by the San Joaquin and Sacramento Rivers, and San Francisco Bay, the Marsh is an important element of the estuary providing, among other benefits, substantial habitat for the wintering waterfowl of the Pacific Flyway. It supports a diversity of plant communities, a variety of fish and wildlife, and several rare and endangered species, such as the endangered salt marsh harvest mouse (SMHM; *Reithrodontomys raviventris*) (BCDC, 1976).

The ecology of the release site, and of the wetland portions of the duck clubs, is strongly influenced by the artificial annual hydrologic cycle (continually flooded in the fall and winter, desiccated in summer), which results in a disturbance-mediated habitat. For example, the vegetation pattern in this habitat exhibits a mosaic of natural and exotic and/or invasive species in contrast to tidal marshes, where the vegetation generally exhibits vertical (and sometimes horizontal) zonation (LFR, 2005). Owing to saline soils, extended periods of flooding, and management practices such as mowing and disking, such diked, managed wetlands are not equivalent to natural tidal marshes.

They do, however, still provide many of the functions of natural wetlands, and those located in the Suisun Marsh are considered to play a valuable role in the San Francisco Estuary's ecology, despite no longer being exposed to unimpeded tidal action (LFR, 2005). Factors determining what plants can grow on a managed marsh include geographical salinity gradients within a property, depth to submerged soil, soil salinity, and salinity of applied water (SRCD, 1998; Rollins, 1981). The variation in details of management methods implemented across all of the duck clubs creates, on a Marsh-wide scale, a mosaic of habitat conditions producing a diverse assemblage of plant and animal communities.

5.2 Beneficial Uses

The San Francisco Bay Basin Plan (RWQCB, 1995) defines several beneficial water uses for areas and watersheds in the San Francisco Bay Basin. Beneficial water uses define resources, services, and qualities of the aquatic systems. In the Suisun Marsh, beneficial water uses include Wildlife Habitat; Preservation of Rare and Endangered Species; Water Contact Recreation; Noncontact Water Recreation; Fish Migration; Fish Spawning; and Estuarine Habitat. Beneficial water uses are also defined more specifically for the Suisun Slough itself, which is the main water source for most of the Duck Clubs named in Table 1. These uses include Navigation, Water Contact Recreation, Noncontact Water Recreation, Fish Spawning, Warm Freshwater Habitat, and Wildlife Habitat. For Montezuma Slough, another water source for several of the Table 1 Duck Clubs, all the same beneficial water uses are listed, with the addition of Preservation of Rare and Endangered Species.

The human uses of the Duck Clubs are strongly related to the population of ducks visiting them. The Clubs are used as duck hunting areas, and this is the primary value attributed to the land in the Marsh. Hunting is classified as a Noncontact Water Recreation beneficial water use in the San Francisco Bay Basin Plan (SFBRWQCB, 1995).

5.3 Management

Two general objectives of the water management practices are to provide habitat for ducks and to maintain a natural range of soil salinity. A natural range of soil salinity results in vegetation that is more desirable for duck production, or makes the soil useable for farms (LFR, 2005). Poor or inefficient water management in the properties of the Suisun Marsh

results in hypersaline conditions, as water evaporates and leaves its salts behind, or fails to leach salts from the soils and carry them out of the property when it is drained. Any improvement to the management capabilities of a site will improve conveyance and utilization of applied water, which in turn improves better habitat for waterfowl and the ability of the ownership to maintain a natural range of salinity.

In Suisun Marsh, the typical duck-hunting season begins in mid to late October and ends in mid to late January. From February through September of each year, the owners of the Clubs conduct a variety of management practices to prepare the marsh for the subsequent duck-hunting season. These include mowing and disking vegetation to create duck habitat, flushing their property with fresh water to remove salts from the soils, contouring their property for ponds and ditches that can drain quickly, improving water control structures to facilitate inlet and outlet of water, and improving levees that portion off their property or hold back salt water from outside.

On December 29, 1999, the State Water Resources Control Board adopted Decision 1641, which implemented flow and water quality objectives for the Bay-Delta Estuary in order to protect beneficial water uses (DWR, 2005). To meet these requirements, the Duck Clubs must effectively control the water flow into and out of their properties, and this is the basis on which the restoration projects were considered. The salinity gradient in the marsh is aligned primarily on an east-west axis, with the western portions located nearer to the source of sea water and thus in need of stronger management controls to maintain required salinity levels than the eastern portions.

Duck Clubs have to flush their properties regularly with near-fresh water in order to keep soil salinity below the levels mandated in D-1641, because poor circulation of water, leaking water control structures, and poor management capabilities can result in hyper-saline conditions (SRCD; Steve Chappell, personal communication, March 2, 2005). For this reason, the wetland management capabilities enhanced by the projects detailed below are important in maintaining the San Francisco Bay Basin Plan's beneficial water uses in Suisun Marsh.

6.0 SALT MARSH HARVEST MOUSE (SMHM) HABITAT

6.1 SMHM Habitat Needs

Evaluation of the relative benefits/impacts of the proposed plan for a restoration or enhancement of Duck Clubs is dependent upon existing knowledge of SMHM behavior and habitat use. This section briefly summarizes SMHM information from the literature relevant to Suisun Marsh diked wetlands.

Most of the published information on SMHM has come from studies of tidal marshes. This species is typically observed in tall lush pickleweed (*Salicornia*) dominated habitat mixed with saltbush (*Atriplex*) and alkali heath (*Frankenia*) (Fisler,1965; Wondolleck et al., 1976) However, it has been found in areas not dominated by pickleweed. Botti et al. (1986) found SMHM in an area that appeared to contain no pickleweed, but consisted of 45% Fat hen (*Atriplex patula*), 14% saltgrass (*Distichlis spicata*), 13 % annual grasses, 10% Baltic rush (*Juncus balticus*), and 9% alkalai heath.

SMHM has been shown to consume saltgrass,, pickleweed, and other green vegetation, and fresh green grasses are preferred in winter. Seeds are not readily available in SMHM habitat, but are consumed when available, and insects are rarely eaten (Fisler, 1965; USFWS 1984).

Shellhammer (2000) inferred from previous research (Bias, 1994; Bias and Morrison, 1993, as cited in Shellhammer, 2000) that there is a possibility that younger pickleweed dominated salt marshes are more productive than older ones for SMHM.

Thick plant cover is generally accepted as a critical element of SMHM habitat (Fisler, 1965; USFWS, 1984; Wondolleck et al. 1976; Shellhammer et al., 1982). Bias (1994) determined that the average vegetation stature value for SMHM captures was 27.3 cm, whereas USFWS (1984) stated that SMHM vegetation stature preference is between 30 and 50 cm. Fisler (1965) showed that SMHM is only able to utilize grasslands on the outskirts of salt marshes in the spring and summer, when cover is at a maximum. Vegetation specifically known to not be used by SMHM include bulrushes (*Scirpus* sp.), cattails (*Typha* sp.), and peppergrass (*Lepidium*, sp.) (Shellhammer, 2000). SMHM is known to be able to survive on sea water and brackish water (Fisler, 1965).

Shellhammer et al. (1982) noted that the growth forms of the vegetation may determine the value as cover. Alkali bulrush (*Scirpus robustus*) has strictly vertical stems, and has little value as cover because it may be more penetrable by predators, especially when flooded, whereas pickleweed produces horizontal as well as vertical stems and likely provides better cover. When pickleweed produces a closed canopy, the sub-canopy is usually open at ground level. Another study found that, within a range of 0% to 15%, the percent of bare ground did not seem to correlate to capture rate, but amount of debris (cut lumber, garbage, etc) seemed to act as a deterrent (Gilroy and Shellhammer, 1980).

In diked marshes specifically, SMHM have been shown to be less dependent on cover, and to have considerable ability to expand their niche when subject to the conditions of a diked marsh (Geissel et al., 1988). Geissel et al. (1988) also noted that SMHM is able to use grasses more in diked marshes than in tidal, is able to quickly colonize areas disturbed by flooding, and has a distinct competitive advantage over similar species as salinity increases.

In an investigation of SMHM use of marginal habitats, Zetterquist (1977) found SMHM in diked marshes, both in areas of dense pickleweed and greater than 220ppth salinity, and in areas with as little as 62% vegetative cover. Another study of a diked marsh (McGinnis and

Hodge, 2001) showed a high trapping success for SMHM in pickleweed along the dikes where water would collect during the rainy season.

6.2 Effects of Restoration Projects on SMHM

As stated above, vegetation specifically known to not be used by SMHM include bulrushes (*Scirpus* sp.), cattails (*Typha* sp.), and peppergrass (*Lepidium*, sp.), and the reason for this is thought to be that growth forms of the vegetation may determine the value as cover (Shellhammer, 2000; Shellhammer et al., 1982). The duck clubs manage specifically with the intent of reducing the amount of cattails and tules (*Scirpus acutus*), species not used by SMHM, because ducks prefer plants with higher seed content. Alkali bulrush (Scirpus robustus) in particular is noted for heavy use by waterfowl and its heavy seed production, and for these reasons is a target species of many of the management practices of the Duck Clubs (Rollins, 1981; SRCD, 1998). However, seed production from this species may serve as an important food source for SMHM.

Sustaita et al. (2004) reported that mixed-halophyte and pickleweed habitats support roughly equal SMHM population densities, reproductive potential, and survivorship, and that uplands are seldom used. Furthermore, results indicated that demographic performance is similar in both diked and tidal wetland systems for the most part, although densities tend to be higher in the diked wetlands. These results suggest the "apparent efficacy" of diked wetlands for sustaining SMHM populations.

One study (Kramer, et al., 1995) restored tidal action to a 28-ha brackish marsh to evaluate effects on mosquito populations, and noted that pickleweed dropped in coverage by 65%, allowing rushes, reeds, typha, and brass buttons to increase their coverage by almost 80%. Therefore, non-tidal marshes may produce relatively more pickleweed vegetation than tidal marshes.

McGinnis & Hodge (2001) reported losses of SMHM resulting from flooding associated with tidal marsh restoration in San Pablo Bay. A pre-flooding survey was performed in this non-tidal marsh, and a high trapping success for SMHM was obtained, as stated above. After this, grading and filling associated with the restoration to tidal influence caused substantial effects on the SMHM population (McGinnis & Hodge estimated that 100 individuals of SMHM were lost), and in addition it was assumed that the remainder of the population perished upon flooding.

To summarize the above information: SMHM consume seeds when available, are less dependent on cover in diked marshes, duck clubs work to increase high seed-producing species such as alkali bulrush, and pickleweed coverage can be much more extensive in managed wetlands than in a natural tidal marshes. These are considered to be among the most important factors explaining why the SMHM is able to live in higher densities in managed wetlands.

7.0 PROJECT IDENTIFICATION

The restoration projects listed in Table 1 were identified through the activities of the Suisun Resource Conservation District. On November 29, 2004, at the request of KMEP, Mr. Steven Chappell of SRCD sent a letter soliciting all landowners with property located within 2 miles of the release site for proposals for possible restoration projects (Figure 1).

Four types of project elements are being considered based on their potential for long term benefit to habitat by means of improvement to water control and circulation structures. These include: Improvement of exterior water control devices (EWC), Improvement or installation of interior water control devices (IWC), Improvement of existing large ditches (DI), and Other (O).

- Improvement of exterior water control devices: Exterior water control devices allow water into a club, hold it back or control its flow rate in either direction. Water control devices include 1) flap gates, 2) screw gates, 3) flashboard risers and, 4) levees themselves (Figure 2). These structures use pipe of 24" to 48" diameter to move water from one side of a levee to the other. Corrugated metal pipe has typically been used in the Suisun Marsh, but the metal can corrode over time, and the corrugation has the drawback of slowing the water flow. More recent installations have often used heavy duty polyethylene (HDPE) pipe, which is smooth and thus drains water with a 15-20% improvement in drainage efficiency over corrugated pipe, durable, corrosion resistant, and can last up to 50 years with normal maintenance. Also, corrugated pipe comes in segments, and the joints can leak, whereas HDPE comes in one piece.

    - Flap gates and screw gates are both types of tide gates, which function to keep saline water from encroaching upstream. The flap gate is hinged to the downstream side of a culvert. Once the tide reaches a certain elevation, above the culvert invert, the hydrostatic force of the water is great enough to shut the flap gate. Often tide gates will have many flap gates. The flap gate functions analogously to a swing check valve in a closed plumbing system.

    - A screw gate is located on the downstream end of a culvert. The gate opening can be set by screwing down on a rod, which lifts or drops the gate. The screw gate is used to manipulate flow to or from the area of interest, or simply stop flow. The disadvantage of screw gates is that they require constant monitoring when discharging.

    - Flashboard risers are a type of weir control structure usually constructed from corrugated steel and (more recently) plastics. The intake elevation can be adjusted (usually with removable boards) thereby controlling the quantity and/or flow of water that enters/or leaves the property with the tides. These structures are one of the most inexpensive control structures.

    - A levee is an earthen embankment raised in order to prevent water from breaching onto the other side. This is simplest form of water control. Levees are fixed structures and cannot be modified easily. Several projects include levee improvements and/or construction work as a portion of the proposal, often as a location to place spoils from ditch cleaning.

- Improvement or installation of interior water control devices: These devices include all the same structures and pipe types as those listed for exterior water control, but are used for a wider range of purposes than the exterior structures, and different permitting issues apply. A property may employ these structures to create a permanent pond within a particular area, or to force water to flood one area before it can flood another adjacent portion of the property. The ownership could employ interior levees and water control structures to implement different management regimes on separate portions of their property.

- Improvement of existing large ditches: Ditches are used for routing flow from one location to the next, or simply acting as overflow protection for a control structure such as a levee. Ditches may also be used in order to transport water from a gate structure such as a tide gate at the site boundary to the rest of the site, and primary ditches should be able to flood the property within 10 days (SRCD, 1998). Improvement of ditches can last and continue to benefit a property for at least 10 years. Often, excavated material from ditches is used in order to construct or enhance berms or levees along the ditches. Improvements include but are not limited to the following:

    - Lining the ditch with gravel or other suitable armoring material.

    - Cleaning and grubbing of ditch in order to increase velocity or flow volume.

    - Modifying cross section or size of ditch in order to reduce maintenance needs, induce desired water profiles or simply provide more flow capacity.

- Other: The "other" category was included to allow for projects that would be beneficial but do not fall under the categories above, such as a project that might include construction of new large ditches or beneficial changes to a site's topography where there is no adverse effect on wetlands. New ditches may be constructed in order to provide channels for movement of water between internal structures or in and out of the club boundaries, or topography altered to remove a levee that currently prevents water from reaching a portion of a property. The "Other" category applies to only one project, which will be discussed in detail with the others in Section 5.

8.0 PROJECT SELECTION

As stated above, a letter soliciting proposals for restoration projects from nearby property owners was sent out by Steve Chappell of the Suisun Resource Conservation District on November 29, 2004. The letter stated that submission of a project proposal does not guarantee funding, and that the restoration projects may be implemented in 2005 or 2006. The letter was sent with a form which included a list of possible activities to be funded by the cost-share program. These options included Pond Bottom Grading, Cutting New V-Ditches, Improving Interior Water Control Structures, Improving Water Conveyance through Existing Ditches, Cutting New Circulation and Drainage Ditches, Improving Exterior Water Control Structures, Disking and Seeding Uplands, and Disking Wetlands.

The criteria applied to projects from the submitted proposals included geographic proximity, type of service restoration, acreage of the area to be enhanced, cost effectiveness, and level of impact that would result from implementation. The cost-share ratio to be applied has yet to be determined.

With regard to the geographic proximity criterion, it was preferred that the restoration project take place within two miles of the release. This would ensure that monitoring of the final restoration projects could be performed simultaneously with the monitoring of the restoration at the release site, and that the habitat enhanced by the proposed projects would be similar in species constituency and other environmental features to the release site. The geographic proximity criterion was applied in the first step of mailing the letter only to duck clubs within two miles of the release site.

Due to permitting requirements, duration of associated benefits, maintenance required, level of disturbance to vegetation and habitat associated with implement proposed enhancements, and other factors, projects involving installation or improvement of "V-Ditches," installation of new exterior water control structures, grading of pond bottoms, disking, and seeding, are no longer being considered. After further evaluation, the project category of Ditch Construction was eliminated. Ditch construction involves not just cleaning, re-sizing, or armoring existing ditches, but excavating new ditches in order to circulate water to areas to which water had not been circulated before. The reason projects in this category were eliminated from consideration is that while it may be beneficial to create new wet areas out of middle- and upper-marsh zones, doing so may also eliminate some habitat for the endangered Salt Marsh Harvest Mouse, which needs these areas to escape from high tides. The one exception was relegated to the "Other" category in Table 1.

9.0 RESTORATION PROJECTS

9.1 Overview of Projects

The elements of the various restoration projects proposed in response to the solicitation varied widely, and once certain criteria were applied, only the four categories discussed in Section 3 remained. However, within those four categories, there is still a wide range of possibilities. Several different types of enhancements were proposed, for example, in the category of Exterior Water Control Devices. Strictly speaking, the levees themselves are water control devices, and improvements to them are included in the projects listed below. Some projects include several elements, covering multiple element categories, such as when spoils from the cleaning of a ditch were to be used for improvement of a levee, or when improvements to a ditch would be futile without improving the structure that puts water into that ditch. Figure 1 is a map showing the location of the release site and the proposed projects, identifying each property by its Ownership Number as designated by the Suisun Resource Conservation District. The projects are listed below and in Table 1 by Ownership Number in increasing numerical order. Club names or abbreviations thereof are given with the Ownership Number below for clarity.

9.2 Project Implementation

All of the management practices and restoration projects described in this report are permitable under the Suisun Marsh Management Plan.

KMEP has not identified a specific administrative process for implementing the projects described herein. However, the Suisun Resource Conservation District has had a high degree of success administering similar publicly funded programs in the past. Therefore, one alternative implementation plan would be for KMEP to provide funding for restoration projects to the SRCD which would administer the restoration program working with duck club owners. SRCD has expressed an interest in participating in such a program. One benefit of SRCD's participation would be to encourage cost-sharing from the owners. Cost-sharing would leverage the restoration benefit of KMEP's contribution, resulting in benefits to natural resources substantially higher than those required to compensate for the service losses associated with the release.

9.3 Project Descriptions

This section gives details on each individual project, including the property location, water source for the property, expected benefits of the proposed restoration project, and why the enhancement is needed. A portion of the name of the property is included in the sub-header for each project for clarity and reference with Figure 1 and Table 1. Where specific

information has been provided, such as the locations of the project elements or the linear footage of a ditch cleaning project, that information has been included below.

Also given in Table 1 are the acreage of each club and the acreage enhanced by each project. The determination of how many acres are enhanced by a project, and how it is enhanced, are also detailed below. Several projects could be implemented this year (2005), as they were included by the property owners in this year's annual permitting process, while other projects would have to wait until the Spring or Summer of 2006.

The restoration trajectory of an area is affected by site specific factors such as topography, as well as yearly variability in hydrology; the salinity of applied water is affected by the amount of rainfall not just on the site, but upstream of the Delta. And at any one location within a property, the soil salinity is affected by the quality of applied water, depth of water (topography), and duration of submergence. It is estimated that each project could achieve its full extent of benefits approximately 5 years after implementation and that enhancements to the wetland management capabilities would improve wetland functions at these sites by 15-30%, though improvements in waterfowl habitat, more effective leaching of the soils, and the ability to better control the salinity of the applied water. In view of these uncertainties, the projected improvement to wetland functions has been conservatively estimated on average as 20% across the board, with an assumed linear trajectory of 4% per year.

As stated in Table 1, should all the proposed projects be implemented, 4,601 acres would benefit ecologically from the enhancement of wetland management capabilities at an estimated cost of $620,230. However, to provide for uncertainties in the supplied cost estimates, a 20% contingency has been applied, bringing the total estimated cost to $744,276.

9.3.1 Hollywood, 132

Hollywood Duck Club proposes replacing an exterior water control structure with two 24" combo gates at their "C Gate" location, and replacement of a 36" exterior flashboard riser and flapgate.

9.3.1.1 Location

The Hollywood Duck Club is Ownership Number 132, and is located north of the release site, adjacent to the east side of the UPRR right of way.

9.3.1.2 Acreage

This property encompasses 93 acres in total, and an estimated 80 acres of that would be enhanced by the project.

9.3.1.3 Project Description

The "C Gate" that is proposed for enhancement is located on the southern half of the eastern property line. The "C Gate" allows water in from Wells Slough, an offshoot of Suisun Slough. This project element would cost of $14,000. The 36" pipe replacement would cost $19,000.

This project would enhance wetland management capability and water conveyance into the site at an estimated total cost of $33,000.

9.3.2 Volanti, 219

The Volanti Duck Club project comprises the installation of a new 36" water control flashboard riser and open pipe within the club's boundaries, and 4500 linear feet of existing ditch to be excavated.

9.3.2.1 Location

The Volanti Duck Club is Ownership Number 219, and is located northeast of the release site, adjacent to Suisun Slough on the west property line.

9.3.2.2 Acreage

This property encompasses 510 acres in total, and 200 acres are estimated to benefit from the project.

9.3.2.3 Project Description

The project's Interior Water Control element would be located on an interior levee in the club, and would enhance wetland management capabilities by making flooding and drainage in that portion of the club easier, which brings down soil salt content and facilitates growth of vegetation favorable to waterfowl. This element would cost an estimated $2,500. The ditch improvement would be located along the inside of a levee on Suisun Slough, and would facilitate water circulation from an existing intake pipe to areas of stagnation. This project element would cost approximately $15,000, and improve connectivity between perimeter ditches and pond areas with four or five secondary ditches, and spoils would be added to the existing levee.

This project would improve water conveyance and wetland management capabilities, at an estimated total cost of $17,500.

9.3.3 Cordelia, 404

This Cordelia Duck Club project comprises 1500 linear feet of existing ditches to be excavated and improved.

9.3.3.1 Location

The Cordelia Duck Club is Ownership Number 404, which is located northwest of the release site, draws its water from Cordelia Slough.

9.3.3.2 Acreage

This property encompasses 611 acres in total, and approximately 50 acres will be enhanced by this project.

9.3.3.3 Project Description

This project would be located on the eastern side of the property to improve water quality and conveyance. It would enhance water conveyance and circulation through the site, as well as wetland management capability, at an estimated cost of $3,500.

9.3.4 Teal, 406

The Teal Club project comprises the removal and relocation of a 36" dual drain and the installation of two new 36" drains.

9.3.4.1 Location

The Teal Club is Ownership Number 406, and is located, adjacent to both the southern side of Chadbourne Road just west of its intersection with the UPRR right of way, and the northwest corner of the Drake Sprig Duck Club, where the release occurred.

9.3.4.2 Acreage

This property encompasses 509 acres in total, and 162 acres will benefit from this project.

9.3.4.3 Project Description

This project involves the removal and relocation of a dual 36" drains, and addition of of two new 36" drains. This would enhance wetland management capability at an estimated cost of $40,000.

9.3.5 Gibson, 410

The Gibson Horseshoe Duck Club project comprises a new 30" x 40"drain with box riser and flapper.

9.3.5.1 Location

The Gibson Horseshoe Duck Club is Ownership Number 410, and is located west of the release site.

9.3.5.2 Acreage

This property encompasses 250 acres in total, and the entire property would benefit from this project.

9.3.5.3 Project Description

The new drain would be located on the northwest corner of the property. This project would enhance wetland management capability and improve water conveyance at an estimated cost of $12,000.

9.3.6 Tule Hilton, 412

The Tule Hilton Club project comprises replacing their existing 24" screw gate w/ screw flap to allow drainage and flooding, instead of just flooding, and cleaning 1000 feet of existing ditch.

9.3.6.1 Location

The Tule Hilton Duck Club is Ownership Number 412, and is located adjacent to the UPRR right-of-way, just west of the release site.

9.3.6.2 Acreage

This property encompasses 120 acres in total, and 80 acres would benefit from this project.

9.3.6.3 Project Description

Currently, the water control structure in place in the southwest corner of the property has flooding capabilities, and drainage takes place on the other end of the property. The improvement to this structure would allow the property to drain water from this portion of the property as well, enabling more rapid drainage of the site during leach cycles. This project element would cost an estimated $5,000. The ditch proposed for cleaning is the main central

drainage ditch, which bisects the property from north to south. This ditch cleaning would enhance the drainage of the entire site by allowing more rapid conveyance through the central ditch toward the outlet gate on the north end of the property. Estimated cost for this project element is $2,500.

This project would improve water drainage and conveyance and wetland management capabilities, at an estimated total cost of $7,500.

9.3.7 Sprig A, 413

The Sprig A Teal Club project comprises a new 36" exterior drain, and a retrofitting of two existing pipes with stainless steel flap gates.

9.3.7.1 Location

The Sprig A Teal Club is Cub # 413, and is located adjacent to the southern property line of the release site.

9.3.7.2 Acreage

This property encompasses 184 acres in total, and 180 acres would benefit from this project.

9.3.7.3 Project Description

This project is located in the southwestern corner of the property, and would enhance wetland management capability, decrease drainage time, and improve water conveyance at an estimated cost of $36,000.

9.3.8 Drake Sprig, 414

The Drake Sprig Duck Club project comprises cleaning 1000 feet of existing circulation ditch.

9.3.8.1 Location

The Drake Sprig Suck Club is Ownership number 414, and is site of the April 27, 2004 release.

9.3.8.2 Acreage

This property encompasses 224 acres in total, and 50 acres would benefit from this project.

9.3.8.3 Project Description

This project would enhance wetland management capability by enhancing the drainage of the site, allowing more rapid conveyance through the cleaned ditch toward the adjacent outlet gate. This project is estimated to cost $2,500.

9.3.9 Arnold, 415

This project at Arnold Ranch has several elements. The first element involves the improvement of a levee in three places. The second element entails replacing an existing 36" structure with a new 36" pipe for drainage on the north end of the property. The third element comprises installing a new 36" drainage structure. The fourth element would be a new 36" drainage structure, duplicating the third element. The fifth element would be the replacement of an existing flood structure with a 24" combination valve.

9.3.9.1 Location

The Arnold Ranch Duck Club is Ownership Number 415, and is located between the release site the UPRR tracks on the west, Roos Cut on its southern border, and Suisun Slough on the east.

9.3.9.2 Acreage

This property encompasses 473 acres in total, and 230 acres would benefit from this project.

9.3.9.3 Project Description

The first element would take soils from high ground areas within the club where good clays are available, and cap three sections of the outer levee, raising the levee 10" in one section, and one foot in the other two sections, a total length of 6,700'. This element would cost $28,800. The second element of this project is located at the north end of the club, and would include a combination valve and 25' bulkhead on the water side, with a walkway, and a flashboard riser on the land side, at an estimated cost of $28,050. The third element would be located approximately 2,200' southeast of the second element, and include a flap valve and 25' bulkhead on the water side, and a flashboard riser on the land side, at a cost of $27,300. The fourth element would be a duplication of the third, but be located on Roos Cut, which is to the south of the property, at a cost of $25,300. The fifth element would be located on the south levee on Suisun Slough, and have a walkway and 25" bulkhead on the water side, and a walkway and combination valve on the landside, and cost $27,600. This project would increase the drain capability throughout the site, while adding to the ability to control specific portions of the site individually. This greatly enhances wetland management capability.

The total cost of this project is thus $137,130.

9.3.10 Tule Belle, 416

The Tule Belle Club project comprises the installation of two new 24" drain pipes with flashboard risers and gates, the replacement of a 36" combination flood and drain pipe with a flashboard riser and combination gate, and the cleaning of existing ditches, with spoils being added to the levee tops.

9.3.10.1 Location

The Tule Belle Duck Club is actually three adjacent properties, # 416, # 417, and # 421, located southwest of the release site, and straddling the UPRR right of way.

9.3.10.2 Acreage

This property encompasses 911 acres in total, and 400 acres would benefit from this project.

9.3.10.3 Project Description

The first element of this project would install new drain pipes, at an estimated cost of $7,600. The second element would install a new flashboard riser and combination gate at an estimated cost of $22,500. The third element of this project would excavate a ditch along the eastern levee at an estimated cost of $22,500. Spoils from the ditch would be used to improve the adjacent levee. All of these project elements would take place on the eastern portion of the eastern tract of this property.

The project would improve water flood and drainage time and water circulation for the eastern tract of the property, enhancing wetland management capability at a total cost of $56,100.

9.3.11 Cygnus, 418

This Cygnus Duck Club project comprises replacing an existing 24" water gate.

9.3.11.1 Location

The Cygnus Duck Club is Ownership Number 418, and is located south of the release site, adjacent to the UPRR right of way and Cordelia Slough.

9.3.11.2 Acreage

This property encompasses 165 acres in total, and 57 acres would benefit from this project.

9.3.11.3 Project Description

This project is located in the southwest corner of the site, and would enhance the wetland management capabilities of the club at an estimated cost of $18,000.

9.3.12 Miramonte, 419

This Miramonte Duck Club project comprises three elements. The first element is a new 24" screw gate and coupler, the second is removing flood capability of 36" gate, while replacing another 18" flap gate with a new 36" flood gate, and the third is replacing 4 interior levee flashboard risers with new plastic models.

9.3.12.1 Location

The Miramonte Club is Ownership Number 419, located south of the release site. This project is located on the southern border of the property.

9.3.12.2 Acreage

This property encompasses 359 acres in total, and 250 acres would benefit from this project.

9.3.12.3 Project Description

The existing screw gate being replaced by the first element of this project is leaking and corroded, and its replacement would increase drainage and prevent saltwater intrusion during the summer at an estimated cost of $6,000. The second element involves two joint actions that cannot be performed independently. Because of the topography of the site, the existing 36" dual gate on Suisun Slough should be used only for drainage. Flooding should be done from a high portion of the property, such as where the 18" pipe is located, but an 18" pipe is insufficient to flood the property. This project would allow the usage of water from Cordelia Slough, which is generally lower salinity than Suisun Sough, and overall water circulation would be greatly improved for the property. Estimated cost for this element is $25,000. The third element would enhance an internal levee by replacing four deteriorated wood flashboard risers with new plastic models. This would allow control of water flowing into/out of the southern portion of the Club, which is separated from the rest of the property by the levee. The estimated cost of this element is $4,000.

The total cost of this project is estimated at $35,000.

9.3.13 Antioch, 420

The Antioch Goldeneye Club project comprises three elements. The first element is the replacement of a 30" combination flood and drain pipe with a flashboard riser and combination gate. The second element is the installation of a new 24" interior drain pipe and flashboard riser. The third element is the cleaning of an existing ditch.

9.3.13.1 Location

The Antioch Goldeneye Club is Ownership Number 420, and is located south of the release site, adjacent to Suisun Slough.

9.3.13.2 Acreage

This property encompasses 257 acres in total, and 200 acres would benefit from this project.

9.3.13.3 Project Description

The first element of the project would enhance the drainage and flood capabilities of the club at an estimated cost of $24,000. This enhancement would improve the wetland management capabilities of the ownership by improving the time it takes to flood or drain the property. The second element would enhance the drainage capabilities of a portion of the club at an estimated cost of $6,000. The third element of this project would clean and widen existing ditches to enhance water conveyance along and flooding around them, at an estimated cost of $8,000.

The total estimated cost of this project is $38,000.

9.3.14 Family, 423

This Family Gun Club project comprises three elements. The first is the installation of a new 24" interior water control structure. The second is ditch cleaning. The third is the creation of a wetland out of a non-wetland portion of their property. On Table 1, this last element falls under the "Other" category.

9.3.14.1 Location

The Family Gun Club is Ownership Number 423, and is located southwest of the release site, adjacent to the UPRR right of way.

9.3.14.2 Acreage

This property encompasses 199 acres in total, and 11 acres would benefit from this project.

9.3.14.3 Project Description

The first element of this project would install a new water control structure on an existing levee in the property at an estimated cost of $6,000. The second element would clean and widen existing ditches to enhance water conveyance along and flooding around them, at an estimated cost of $10,000. The third element involves a portion of the Family Gun Club's

property has never been flooded as part of the regular management of the site. As such, it has been neglected and is currently overrun by Coyote brush (*Baccharis pilularis*) and invasives such as peppergrass (*Lepidium* sp.), and would probably not be determined to be a wetland if formally Delineated. This enhancement was categorized as "Other" because it would bring water to a non-wetland area, creating wetland habitat, and probably involve construction of new levees and ditches, with the associated water control structures to manage water flow. This enhancement would result in improved wetland management capability, improved escape cover for waterfowl, improved brood forage, and increased waterfowl food production, and even create seasonal habitat for SMHM at an estimated cost of $4,000.

The total estimated cost of this project is $20,000.

9.3.15 Joice, 424

The Lower Joice Island Club project comprises improvements to an exterior water control structure that is made up of multiple gates.

9.3.15.1 Location

Lower Joice Island is Ownership Number 424, and is located between Suisun Slough and Montezuma Slough, southeast of the release site.

9.3.15.2 Acreage

This property encompasses 1,311 acres in total, and 500 acres would be improved by this project.

9.3.15.3 Project Description

The gate to be improved is located in the northernmost portion of the Island. This project would improve the flow through the levee by replacing two 36" dual combination gates in two frames and 50' of pipe. This would improve water drainage time and circulation for much of the site. Estimated cost: $64,000.

9.3.16 Tip End, 426

The Tip End project comprises cleaning existing ditches.

9.3.16.1 Location

Tip End is Ownership Number 426, and is located southeast of the release site at the mouth of Montezuma Slough on Grizzly Bay.

9.3.16.2 Acreage

This property encompasses 225 acres in total, and 110 acres would benefit from this project.

9.3.16.3 Project Description

This project would widen existing ditches to enhance water conveyance along and flooding around them, at a cost of $4,500.

9.3.17 Montezuma, 503

This Montezuma Club project comprises improvements to existing ditches and levees.

9.3.17.1 Location

The Montezuma Gun Club is Ownership Number 503, and is a long narrow property located east of the release site, adjacent to Montezuma Slough and Grizzly Bay.

9.3.17.2 Acreage

This property encompasses 491 acres in total, and the entire site would benefit from the project.

9.3.17.3 Project Description

This project would enhance wetland management capability, improve pond circulation, and improve water conveyance, at an estimated cost of $2,500.

9.3.18 Gum Tree, 504

This Gum Tree Farms project comprises the replacement of an old 22" GOLF discharge pipe with HDPE plastic and the installation of a 40 horsepower pump with a 22" discharge pipe.

9.3.18.1 Location

Gum Tree Farms is Ownership Number 504, and is located farther east of the release site than any of the other Clubs.

9.3.18.2 Acreage

This property encompasses 502 acres in total, and 1000 acres would benefit from this project.

9.3.18.3 Project Description

The reason this project on a 502 acre property would benefit 1000 acres of wetlands is that this property is one portion of a greater hydrologic unit. Improvements in wetland management capabilities to this property would be improvements to both properties. The first element of the project is located in the northeast corner of the property, at an existing water control structure. This element would improve water conveyance, decrease drainage time, and enhance wetland management capability, at an estimated cost of $6,000. The second element is located in the northeast corner of the property, at an existing water control structure. This property has an extremely low elevation for the Suisun Marsh, and as such, has difficulty draining water for proper management. The collected water forces the site to accumulate salts far more than properties with proper drainage capacity. For this reason, the installation of the pump would be exclusively for drainage purposes, and would result in improved wetland management capability, improved escape cover for waterfowl, improved brood forage, and increased waterfowl food production, at an estimated cost of $35,000.

The total estimated cost of this project is $41,000.

9.3.19 Morrow, 702

This Morrow Island Land Company project comprises the replacement of a 48" combination gate on an existing HDPE pipe and the cleaning of an existing ditch.

9.3.19.1 Location

The Morrow Island Club is Ownership Number 702, and is located the farthest south of the release site of all of the Clubs discussed. This project is located.

9.3.19.2 Wetland Acreage

Total Acres, wetland acres

9.3.19.3 Project Description

The existing gate on the east side of the property is corroded and has a cracked ring. The leaking gate impairs habitat management efforts. The first element of this project would result in improved escape cover for waterfowl, improved brood forage, improved wetland management capability, and increased waterfowl food production, at an estimated cost of $32,500. The ditch cleaning element is located near the southeast corner of the property, and is estimated to cost $19,000.

This project would cost an estimated total of $52,000.

10.0 REFERENCES

Bias, M. A. 1994. Ecology of the salt marsh harvest mouse in San Pablo Bay. Dissertation, Doc. Philos., Wildland Resource Sc., Univ. of Calif., Berkeley. 243 pp.

Bias, M. A. and Morisson, M. L. 1993. Final Report: Salt Marsh Harvest Mouse on Mare Island Naval Shipyard, 1989-1992. Unpublished report to Nat. Resources Mgmt. Branch, Western Div. Naval Facilities Engineering Command, San Bruno, California, 223 p.

Botti, F., Warenycia, D., and Becker, D. 1986. Utilization by salt marsh harvest mice Reithrodontomys raviventris halicoetes of a non-pickleweed marsh. Calif. Fish Game 72(1):62-64.

Fisler, G. F. 1965. Adaptations and speciation in harvest mice of the marshes of San Francisco Bay. Univ. Calif. Publ. Zool. 77:1-108.

Gilroy, A., and Shellhammer, H. S. 1980. Trapping survey of salt marsh harvest mice, Reithrodontomys raviventris raviventris, in the marshes of Soth San Francisco Bay during the summer of 1980. 27 October.

Geissel, W., Shellhammer, H., and Harvey, H. T. 1988. The ecology of the salt-marsh harvest mouse (*Reithrodontomys raviventris*) in a diked salt marsh. J. Mamm. 69(4):696-703.

Chappell, Steve. 2005. Personal communication. Suisun Resource Conservation District. March 3.

Department of Water Resources (DWR). 2005. Suisun Marsh Program. Interagency Ecological Program. Retrieved from http://www.iep.ca.gov/suisun/facts/index.html on 3/7/05.

Kramer, V. L., Collins, J. N., Malamud-Roam, K., and Beesley, C. 1995. Reduction of *Aedes dorsalis* by enhancing tidal action in a northern California marsh. J. Amer. Mosq. Cont. Ass. 11(4):389-395. [4472]

LFR Levine Fricke (LFR). 2005. Draft Wetland Mitigation Plan; KMEP Suisun Slough Release Site, Fairfield, California. January 28.

McGinnis, S. M., and Hodge, H. 2001. Potential Adverse Impacts to the Endangered Salt Marsh Harvest Mouse (*Reithrodontomyes raviventris halicoetes*) Posed by Tidal Marsh Restoration Projects within Diked Pickleweed Stands. (abstract) p. 104 in: Anon., San Francisco Estuary: achievements, trends and the future. 5th Biennial State of the Estuary Conference. [no publisher given] [xiv]+177+[iv] pp. Palace of Fine Arts, San Francisco, October 9-11, 2001.

Rollins, G. L. 1981. A Guide to Waterfowl Habitat Management in Suisun Marsh. California Department of Fish & Game, The Resource Agency.

San Francisco Bay Conservation and Development Commission (BCDC). 1976. Suisun Marsh Protection Plan. Retrieved from http://www.bcdc.ca.gov/library/smpp/smpp.htm on 3/7/05.

San Francisco Bay Regional Water Quality Control Board (RWQCB). 1995. The San Francisco Bay Basin Plan. Retrieved from http://www.waterboards.ca.gov/sanfranciscobay/basinplan.htm on 3/7/05.

Shellhammer, H. S. 2000. Salt marsh harvest mouse (Reithrodontomys raviventris), pp. 219-228 in: Olofson, P. R. (Goals Project), Baylands ecosystem species and community profiles: life histories and environmental requirements of key plants, fish and wildlife. SFB RWQCB, Oakland, CA. xvi+407 pp.

Shellhammer, H. S., Jackson, R., Davilla, W., Gilroy, A. M., Harvey, H. T., and Simons, L. 1982. Habitat preferences of salt marsh harvet mice (*Reithrodontomys raviventris*). Wasmann J. Biol. 40(1-2):102-114.

Suisun Resource Conservation District (SRCD). 1998. 1998 Individual Ownership Adaptive Management Habitat Plan (unpublished). SRCD.

Sustaita, D., Barthman-Thompson, L., Quickert, P., Patterson, L., and Estrella, S. 2004. Annual salt marsh harvest mouse demography and habitat use in Suisun Marsh conservation areas. p. 211 in: Anon., Science Conference Abstracts. 3rd Biennial CALFED Bay-Delta Program. October 4-6, 2004.

United States Fish & Wildlife Service (USFWS). 1984. Salt Marsh Harvest Mouse and California Clapper Rail Recovery Plan. Portland, Oregon.

Wondolleck, J. T., Zolan, W., and Stevens, G. L. 1976. A population study of the harvest mice (*Reithrodontomys raviventris* Dixon) in the Palo Alto Baylands salt marsh. Wasmann J. Biol. 34(1):52-64

Zetterquist, D. K. 1977. The salt marsh harvest mouse (Reithrodontomys raviventris raviventris) in marginal habitats. Wasmann J. Biol. 35(1):68-76.

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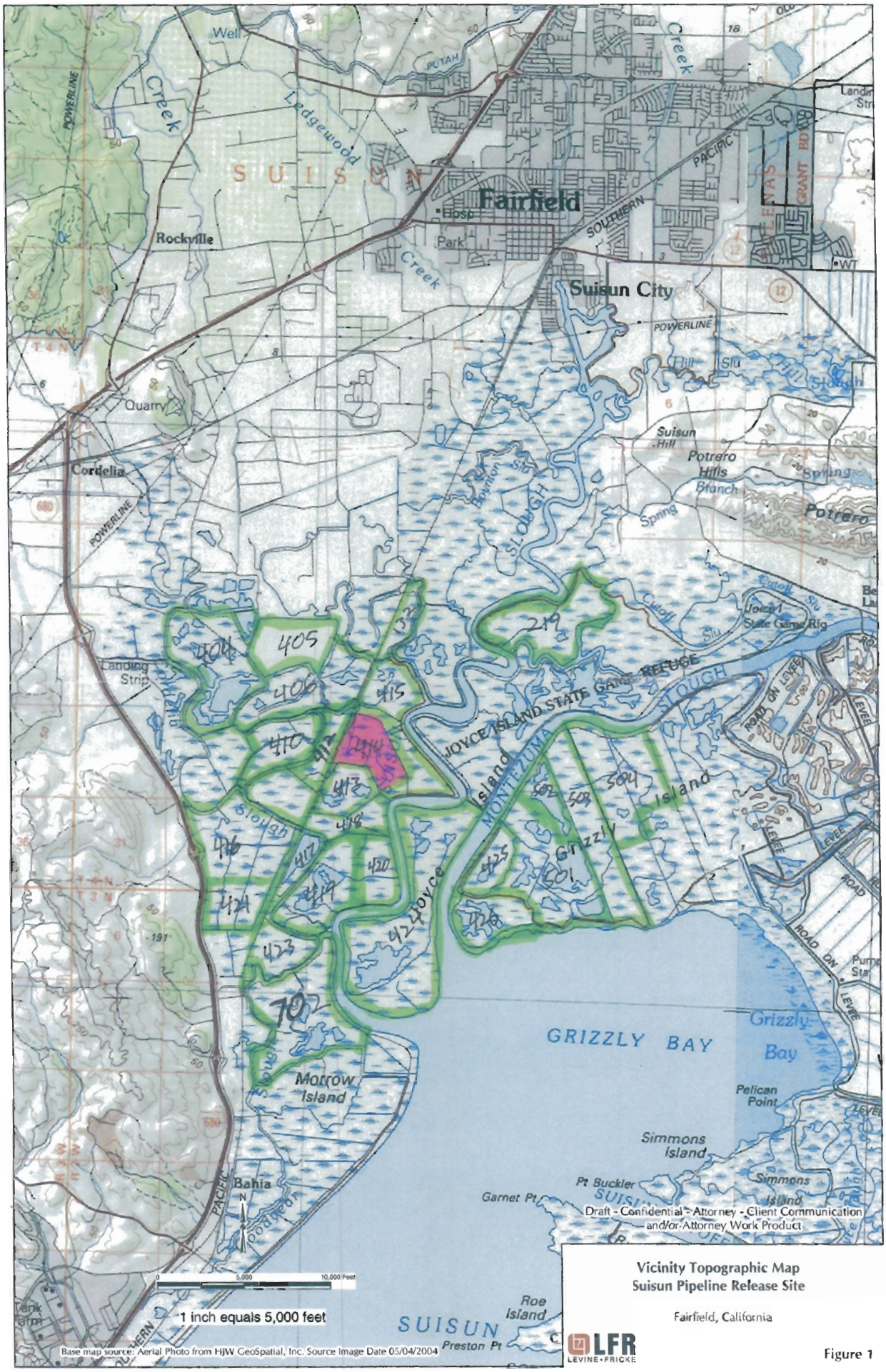

Vicinity Topographic Map
Suisun Pipeline Release Site

Fairfield, California

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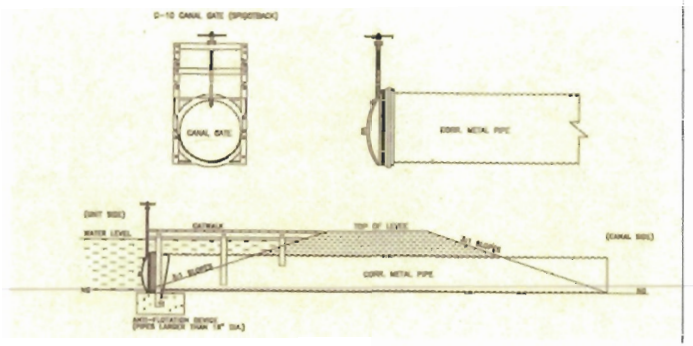
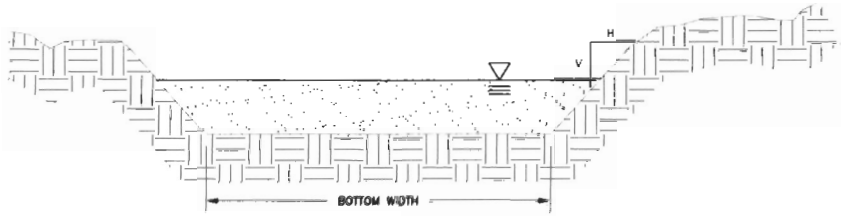
Figure 1

1 — FLASHBOARD RISER
NO SCALE



2 — TYPICAL SCREW GATE
NO SCALE

3 — FLAPGATE
NO SCALE



3 — TYPICAL DITCH CROSS SECTION
NO SCALE

Typical Wetland Water Control Structures

KMEP Suisun Release

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Figure 2