Peter R. Baye, Ph.D.
Botanist, Coastal Ecologist
P.O. Box 65,
Annapolis, California 95412

(415) 310-5109

baye@earthlink.net

Regulatory Analysis of Clean Water Act Section 404 and Rivers and Harbors Act Section 10 Jurisdiction at Redwood City Salt Ponds, San Mateo County, California

Prepared by
Peter R. Baye Ph.D.

Prepared for:
Citizen's Committee to Complete the Refuge, Palo Alto, California

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Cargill Salt Redwood City Pond 10, west, January 2010

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EXECUTIVE SUMMARY

This report provides a critical regulatory analysis of U.S. Army Corps of Engineers jurisdiction (Clean Water Act Section 404, Rivers and Harbors Act Section 10) over commercial industrial salt ponds of the Cargill Salt Redwood City salt pond complex in South San Francisco Bay at Redwood City, San Mateo County, California. Key factual determinations for contemporary Corps jurisdiction under the Clean Water Act and Rivers and Harbors Act include:

- The permit history of the San Francisco District confirms that prior to the Clean Water Act, **the Corps in fact "traditionally" asserted Rivers and Harbors Act (traditional navigable waters) jurisdiction over the minor, nameless tributary sloughs and "banks" (salt marsh) of the tidelands of Westpoint Slough** (the site of modern Redwood City salt ponds) as portions of the traditionally navigable waterbody, San Francsico Bay. (Sections 3.0 and 4.0)

- The tidal channel beds within the diked marsh plain that forms the bed of the salt ponds were regulated as (and remain under current regulation and guidance) **lateral extensions of the traditionally navigable waterbody, San Francisco Bay**.

- The brines and salt pond beds (including slough beds) are **impoundments** of San Francisco Bay. Salt pond brines comprise vast volumes of navigable San Francisco Bay tidal waters that have been artificially managed to maximize evaporation, brine concentration, salt saturation, and salt crystallization, like natural salt-producing salt pans and salt ponds (Ver Planck 1958). Impoundments of navigable waterbodies are subject to Corps Section 404 jurisdiction. (Section 1.0).

- The salt ponds at Redwood City have "**significant nexus**" to the traditionally navigable waterbody of San Francisco Bay in modern times because all solutes (salts) of direct commercial and indirect biological values of national importance (including its designation to be included in a National Wildlife Refuge) are derived exclusively through **intake and impoundment** of navigable San Francisco Bay waters. (Sections 1.0, 4.0)

- The **original, existing dikes (levees) that created the salt pond impoundments** at Redwood City were authorized by the revocable Department of the Army (DA) permit under the authority of the Rivers and Harbors Act, issued to Stauffer Chemical Company in 1940.

- But for the (revocable) historic federal Department of Army permit to construct dikes and slough dams along Westpoint Slough, the beds and banks of the salt ponds would be continuous with those of the adjacent traditionally navigable waterbody, San Francisco Bay.

- The surface waters of San Francisco Bay would ebb and flow over the diked sloughs, banks and marsh plains but for the (revocable) historic federal Department of Army permits to construct dams across sloughs and dikes on the banks of slough.

- Rivers and Harbors Act jurisdiction is not extinguished by DA permits or sudden artificial changes, and the San Francisco District has asserted Section 10 jurisdiction at least over unfilled tidal sloughs (below the plane of former mean high water) behind dikes.

- The former bittern ponds were **converted** from concentrator ponds that were long used for industrial purposes in interstate commerce (salt production) (Ver Planck 1958; 1953 map of SF Bay Pond system) (Section 1.0)

- **Salt pond types such as concentrator, bittern, and pickle ponds are interconvertible at the discretion of the salt pond operator** (Van de Kamp 1986). Pond 13 is a former concentrator pond converted to bittern storage use after commercial sale of bittern was discontinued. (Sections 1.0, 4.0)

- **Bittern brines produced in the South Bay solar salt industry were themselves were sold in interstate commerce**, (Ver Planck 1958) and are susceptible to use for interstate commerce. (Section 1.0)

- Salt ponds in general are also susceptible for use, and have been used for commercial harvest and transport of **brine shrimp** sold in interstate commerce, under past lease agreement from the Refuge (USFWS 1992) (Section 1.0)

- The **Corps has established consistent modern precedents of asserting Section 10 RHA and Section 404 jurisdiction over salt ponds**, and explicitly over salt ponds with saturated and supersaturated brines and slough traces (crystallizers at **Napa**; Corps Permit No. 400258N, 2007; crystallizers in South Bay, Corps Permit No. 19009S98; Westpoint Marina, Pond 10 Redwood City, Corps Permit No. 22454S) **without exception since the 1980s**

- **The Corps has asserted "traditional" Section 10 jurisdiction** (prior to 1970s regulatory criteria for geographic jurisdiction under Section 10) over construction of dikes on tidal slough banks (marsh banks) and dams across tidal sloughs in San Francisco Bay for purposes of marsh reclamation (conversion to salt ponds and agriculture) **since at least 1904**.

- The Regional Water Quality Control Board (RWQCB) has documented **significant hydrologic connections between bittern ponds and the traditionally navigable waterbody San Francisco Bay**, due to spillage cracks, holes, and subsurface seepage of bittern into adjacent tidal marshes and sloughs, affecting water quality (Sections 1.0, 4.0).

1.0 Introduction

The purpose of this report is to provide a critical regulatory analysis of U.S. Army Corps of Engineers jurisdiction (Clean Water Act Section 404, Rivers and Harbors Act Section 10) over commercial industrial salt ponds of the Cargill Salt Redwood City salt pond complex in South San Francisco Bay at Redwood City, San Mateo County, California. This diked bayland site (including crystallizers, desalting ponds, wash ponds, bittern ponds, ditches) has been proposed for urban development as "Redwood City Saltworks" by Cargill and its partner, DMB Associates. This report reviews the physical condition of the Redwood City salt ponds, its history, permit and jurisdictional history, related documentation, and Corps regulations on jurisdiction.

The Corps has consistently asserted Clean Water Act Section 404 (CWA §404) jurisdiction extensively over salt ponds in San Francisco Bay since the 1970s, and it has also asserted Rivers and Harbors Act Section 10 (RHA §10) jurisdiction over portions of Redwood City salt ponds, tidelands, tidal channels (including non-navigable ditches and small tidal creeks) since at least the 1940s (see Section 3.0). Cargill Salt, and its predecessor, Leslie Salt Co., have disputed the Corps' assertion of jurisdiction, variously over some or all portions of the salt pond complexes in San Francisco Bay.

1.1. Site History

The salt ponds at Redwood City, like the majority of those of the South Bay in general, were originally constructed in the 20th century by converting tidal salt marshes and creeks to non-tidal impoundments that function as salt evaporation ponds (solar salterns or salt pans).
Since at least 1953, almost all of the existing salt pond system at Redwood City (with the exception of Pond 10, which was converted to a marina and habitat reserve after 2005) has been in continuous commercial industrial use in a configuration similar to its current condition (Ver Planck 1958, Plate 1; Figures 1-3, this report). Antecedent industrial salt ponds have been operating within the area occupied by the northern portions of the existing Redwood City salt ponds (most of the crystallizer area and Pond 10) since the beginning of the 20th century (Ver Planck 1958, p. 112).

The Redwood City salt pond system was amalgamated by Leslie Salt Co. in 1936. It consolidated some local salt works predecessors, primarily Stauffer Chemical Corporation and Leslie Salt Refinery Company, by 1936 (Ver Planck 1958,). The southern half of the existing Redwood City salt pond system between First Slough and Flood Slough (Ponds 9, 9A, 8W, 8E, 7A, 7B, 7C) was reclaimed by diking tidal salt marsh and damming tidal sloughs after 1943, and was operational by 1953 (Figures 1, 2; see also Section 3.0).

Cargill began decommissioning industrial salt production in the Bay Area beginning with its North Bay (Napa) salt pond system in the mid-1990s. The former Napa salt pond system is currently owned by the State of California. In the South Bay, Cargill sold either its industrial use rights (in ponds owned by the U.S. Fish and Wildlife Service Refuge) or fee title of most of the South Bay salt pond system to the U.S. Fish and Wildlife Service (San Francisco Bay National Wildlife Refuge Complex) or the State of California. Most salt ponds in San Francisco Bay are currently owned and managed by federal or state agencies. Most publicly owned salt ponds have been authorized to be converted from industrial salt production to different wildlife habitats (tidal mudflat, tidal marsh,

and saline to hypersaline lagoons or ponds with damped tidal range), and many are currently in transition.

The Redwood City salt pond complex was connected to the Newark salt plant by brine pipelines that run under the bay, and received brines produced by East Bay salt evaporation ponds that concentrated bay intake water from tidal slough sources (Siegel and Bachand 2002). The existing Redwood City salt pond system appears to have no active industrial connections to bay intake and concentrator (evaporation) ponds in the South Bay salt pond system. The solar salt production system has been cut off at its source: remaining intake ponds have been converted to shallow lagoons with damped tides, and brine is no longer concentrated by evaporation to saturation. Former intake and concentrator ponds are also being converted to tidal mudflats in succession to salt marsh. Since the South Bay salt ponds ceased new production of brines circa 2004, remaining salt-saturated and near-saturated brines processed in the system have been concentrated in the last salt ponds that remained in industrial operation: the Newark and Redwood City plant sites (U.S. Fish and Wildlife Service and California Coastal Commission 2007). The brines contained at Redwood City, therefore, are remnants of former industrial production, not ongoing production.

1.2. Site Description

1.2.1. General description of the Cargill Redwood City salt ponds.

The Redwood City salt pond complex is privately owned by Cargill Salt. It was not included in the sale by Cargill of 16,500 acres (fee-title and mineral rights acquisition) to the Department of Interior and the State of California. All salt ponds within the Redwood City salt pond complex, however, were authorized by Congress for inclusion within the San Francisco Bay National Wildlife Refuge Complex (USFWS 1990; Public Law 100-556, 1988). The Redwood City salt pond system consists of approximately 1433 acres of salt ponds (levees, ditches, locks, and all enclosed types of basin that retain, convey, or form concentrated (hypersaline) brines derived from evaporation of bay water, with variable ionic composition.

The remaining salt ponds at Redwood City (including former crystallizers, bittern desalting and storage ponds, "pickle" or saturated brine ponds) are now (2010) disassociated from the extensive former bay intake and solar salt evaporator (concentrator) pond system that supplied them with fresh batches of brine. In the absence of an integrated bay intake and concentrator system, industrial salt production capacity is limited to residual brines within the remnants of the former South Bay salt pond system. The remaining system is, however, apparently in a serviceable condition and actively repaired and maintained. Operations and repairs activities are authorized under regional permits issued by the U.S. Army Corps of Engineers (permit 19009S98, issued in 1995 and presumably extended beyond its prescribed 10 year period; Cargill application for renewal submitted to USACE on April 15, 2008).

In 2002, the operational salt pond system at Redwood City ponds was mapped by Wetlands Research Associates (WRA 2002), showing rectangular crystallizer ponds numbered 1-9, bittern desalting pond 10, bittern storage ponds 9, 9A, and pickle (saturated brine) ponds 7A, 7B, 7C, 8E and 8W. The former salt pond types based on normal recent past industrial uses at the time (Fig. 2; pickle, bittern desalting, bittern storage, crystallizer) cannot be presumed to apply to the existing

post-industrial conditions. Salt crystallizer operations, bittern, desalting, and pickle (saturated brine) ponds are described by Ver Planck (1958) and Siegel and Bachand (2002). Bay intake and concentrator (evaporation) ponds are not reviewed here because they are no longer part of the Redwood City salt pond system owned and managed by Cargill Salt. The Redwood City salt pond system also includes two dredge locks at ponds 9 and 9A, continuous with the perimeter levee system.

Crystallizer, pickle, and bittern ponds are normally periodically flooded with and drained of saturated brines through an artificial system of pumps, siphons, ditches, and water control structures. All the brines remaining in the salt pond system derived from evaporation of tidal bay water (estuarine sea water) in other parts of the salt pond system (bay intake ponds, evaporator ponds). The brines derived from San Francisco Bay tidal water today are essentially the same physically, chemically, and biologically as the natural saturated brines that produced halite and natural bittern brines in the historic Crystal Salt Pond (Fig. 9), San Lorenzo (Ver Planck 1951). The pickle ponds at Redwood City (7A-C) contained brines with dark orange-red hues in January 2010, indicative of *Dunaliella* and halobacteria (salt-tolerant natural single-celled green algae and bacteria) productivity and pigments at high salt concentrations (Javor 1989, Baye 2000).

Cargill Salt and its predecessor, Leslie Salt Co., have stressed repeatedly that all hypersaline brines of the solar salt industrial facility, expressly including bittern salts are "concentrated Bay water", with bittern distinguished merely as "concentrated bay water with sodium chloride removed" (Washburn 1985a). Cargill's legal representatives have declared that bittern storage ponds are not "waste treatment ponds" or "waste management systems", but holding ponds (Washburn 1985b).

1.2.2. Salt pond substrate

With the exception of some levees and berms that support vegetation or imported earthen fill, the bay mud substrate of Redwood City salt ponds generally consists of unvegetated non-tidal hypersaline flats composed of bay mud with variable salt or mineral film deposits. Bay mud is clay-silt estuarine sediment that dominates the surface of San Francisco Bay. Bay mud of salt pond beds is variably emergent or submerged under brines. Perimeter levees are subject to leaching with rainwater and tidal influence, reducing substrate salinity to levels that enable salt-tolerant wetland vegetation to establish (Fig. 8). The bay mud beds of the salt ponds were deposited naturally over the antecedent tidal marsh surface soils and tidal channels that were diked and impounded to form salt ponds (Ver Planck 1958). Relict tidal drainage topography, including First Slough (incorporated in ponds 4, 8E, 8W, 7A), has remained evident in aerial photography of the salt ponds from the 1940s to the present, including relict drainage patterns in multiple crystallizer beds.

The surface bay mud sediment in the salt ponds may be original tidal marsh sediment (bay mud with decomposed organic matter from vascular plants), or a veneer of naturally redeposited bay mud (resuspended fine sediment either from internal salt pond wind-wave erosion or suspended sediment load of former bay intake water). In the crystallizer beds, bay mud has been artificially redeposited by mechanical placement of wash pond mud (sediment removed from harvested halite by washing with saturated brines). The bay mud surfaces of salt ponds retaining saturated brines (including bittern, brines with high concentrations of potassium and magnesium salts) may also become mantled with precipitated halite (water-soluble sodium chloride solids or slush-like crystals

suspended in saturated brine) as well as mineral precipitates of relatively insoluble calcium sulfate (gypsum). Halite precipitated in crystallizer beds was periodically harvested (along with some adhering bay mud), partially re-exposing underlying bay mud. (Ver Planck 1958).

There is no evidence that any salt pond beds at Redwood City include significant areas of any artificial substrates; the pond bed surfaces are composed of either bare bay mud, bay mud coated with precipitated halite, or bay mud coated with mineral precipitates from hypersaline brines.

1.2.3. Crystallizer salt ponds

Crystallizer and concentrator ponds are interchangeable salt pond types, depending on operational and internal structural modifications. Crystallizer ponds at Redwood City are distinguished from other salt ponds by their rectangular shape, wooden partitions, and beds that are periodically resurfaced (replenished with bay mud and re-smoothed) with wash pond muds to compensate for substrate loss during harvest of crystallized salt. The rectangular array of crystallizer ponds at Redwood City were depicted in the 1953 map of Redwood City salt production facilities (Ver Planck 1958, Plate 1), and were evidently converted from antecedent non-rectangular concentrator ponds visible in 1943 aerial photograph of the site (Fig. 1). Other crystallizers in the South Bay have been converted to concentrators in the past, such as A8 (Alviso; rectangular crystallizer beds evident in USGS topographic map, Milpitas quadrangle). Pond A8 was reported as a concentrator pond in Corps permit application environmental assessment documents by Cargill, permit 19009E98).

Crystallizer pond hydrology during the non-rainfall season is managed by artificial ditches and pumps and is designed for rapid filling with saturated brine (pickle) and emptying of bittern (brine supernatant following precipitation of sodium chloride/halite). During production, crystallizers are drained and filled with fresh saturated brine (pickle) two to five times (Ver Planck 1958). Halite deposits 4 to 6 inches thick form on the crystallizer bed.

Crystallizer pond hydrology is also significantly influenced by direct natural rainfall inputs in these artificial impoundments of bay water. Rainwater stratifies on the surface of dense concentrated brine, with little mixing except through strong wind-wave action (Ver Planck 1958). Heavy rainfall can cause strong dilution and overfilling of brines in crystallizer ponds, and sometimes induces a need for pumping to concentrator ponds to remove excess diluted brine (Cargill Salt 1996). Rainwater impoundment in salt ponds can be a major hydrologic control in wet years: in the wet winter of 1995, Napa pond 2A was breached under emergency conditions by California Department of Fish and Game (Jim Swanson, CDFG, retired; pers. comm. 1995) to relieve pressure in the salt pond system and prevent widespread levee failure due to salt pond internal overtopping.

Dilution of crystallizer brines during the winter-spring rainfall season is associated with development of pale to rich brine hues in the orange-red range (Siegel and Bachand 2002, cover photo;), indicating significant organic matter content and biological activity and productivity of *Dunaliella salina* and halobacteria (Javor 1989, Baye 2000).

Portions of crystallizer 4 and pickle pond 8E have recently been filled to an unknown elevation (date unknown) sufficient to create slipface side-slopes of the fill) by earthmoving equipment (Fig. 10). These modifications do not appear to correspond with repair and new work activities authorized

under USACE permit 19009S98. The extent of fill modifications of the Redwood City salt ponds after cessation of industrial salt production is unclear.

1.2.4. Bittern salt ponds

Bittern ponds (bittern "storage" ponds) are former concentrator ponds used to store the supernatant saturated brine following precipitation of most sodium chloride from pickle in the crystallizers. Bittern was characterized by Leslie/Cargill salt's legal representatives as merely as "concentrated bay water with sodium chloride removed" (Washburn 1985). Bittern is transferred from crystallizers to bittern "desalting ponds", where residual sodium chloride (up to 12.5% of bittern at 30 Be; Ver Planck 1958) is precipitated. The desalted (sodium-reduced) bittern is composed of potassium and magnesium chloride and sulfate, with minor amounts of bromide and other seawater minerals.

Bittern storage in former concentrator or pickle ponds began after 1968, when the primary industrial consumers of bittern (caustic magnesium industry, Westvaco Chlorine Products Corporation and FMC) terminated its agreement with Leslie Salt (Washburn 1985a, b). Bittern is generated at a 1:1 ratio with sodium chloride salts, estimated at 800,000 tons of each salt type per year in the 1950s (Ver Planck 1958). Without an industrial consumer of bittern at rates commensurate with production, bittern storage became necessary by the 1970s, when State and Federal water pollution control laws regulated direct disposal of undiluted bittern in San Francisco Bay. Large salt evaporator pond acreage (e.g., ponds 12 and 13, Newark at Mowry Slough; ponds 9 and 9A, Redwood City) became dedicated to bittern storage. Most bittern produced since 1972 has been stored (Siegel and Bachand 2002). Bittern that was described as being in "temporary' storage for resale in the early 1980s (Washburn 1985b) persisted until the end of new brine production after 2005.

The relict tidal channel patterns typical of concentrator ponds were clearly evident in the beds of the Redwood City bittern ponds prior to 2007 (Fig. 2), despite the obscuring coverage of bittern solid salt deposits and bittern liquids. The tidal creek patterns corresponding with the antecedent morphology of tidal marsh are clearly visible in the 1943 aerial photograph (Fig. 1).

Bittern ponds may have subsurface hydrologic connection to the Bay, at least at times and in some conditions. Bittern storage ponds are converted concentrator ponds, and Ver Planck (1958) concluded that significant leakage occurs in concentrator ponds; the theoretical 10:1 ratio of concentrator to crystallizer pond area is in practice 15:1 because of pond leakage and rainfall inputs (Ver Planck 1958). Leslie Salt conceded at least one instance of direct tidal overtopping of a bittern pond levee (hydrologic input of tidal water) and backflow of "diluted" bittern to tidal waters of the Bay in December 1982 (Washburn 1985b). Bittern seepage through levees at Plummer Creek (Newark) on to adjacent tidal pickleweed marshes (where it apparently resulted in conspicuous dieback of vegetation and pooled bittern) was documented at up to 15 locations in 1984 by Regional Water Quality Control Board and U.S. Fish and Wildlife Service staff (RWQCB 1985). Bittern flow rates through cavities in levees were estimated at 5 gallons per minute, with seepage persisting for weeks. More recent (1999-2002) examples of bittern discharges to San Francisco Bay, ranging from thousands to hundreds of thousands of gallons, have been reported, including bittern overtopping levees due to high winds (Rogers 2007). Bittern ponds are therefore not completely isolated hydrologically from tidal aquatic habitats of San Francisco Bay: they may affect tidal water quality

where leakage occurs, and they may be affected by extreme high tides where sufficient wave runup occurs near low or eroded levee crest segments.

Pond 9 was identified as a bittern pond as recently as 2002 (WRA 2002). Pond 9 in January 2010 was mostly drained of bittern, and was extensively excavated and filled. Its bed was converted from hypersaline mudflats with residual tidal creek topography to parallel rows of fill mounds that formed discontinuous ridges and troughs (Fig. 4). Ridges emerged approximately 1 ft to over 2 ft above the brine surface (Fig 4). Despite substantial rainfall, Pond 9 had a partly emergent bed over its western half (Fig. 5). The east end of the Pond 9 was holding some type of brine in the troughs and pits impounded between the linear mud mound ridges (Fig. 4). These unprecedented features for any bittern pond in either the South Bay or Napa salt pond systems are modifications that do not appear to correspond with repair and new work activities authorized under USACE permit 19009S98.

In the presumed absence of bay discharge of bittern (which requires long-term discharge of highly diluted bittern over years, under permit), it appears that bittern stored in Pond 9 has been remixed and recirculated in either pickle or crystallizer pond brines, or both. In any case, visual evidence that liquid bittern has been evacuated from Pond 9 (Fig. 5) indicates that it is now only nominally or historically a "bittern storage pond".

Former bittern (desalting) Pond 10 was converted to a marina and separate managed wildlife habitat area, under a separate permit issued by the Corps and BCDC (Fig. 6). Pond 10 lies outside the proposed Saltworks development area.

1.2.5. Pickle salt ponds

Near-saturated and saturated brines in pickle ponds are formed in batches from late-stage concentrator pond brines, and are pumped to crystallizer ponds (Ver Planck 1958). The depth of brine in the pond varies according to the stage of refilling or evacuation, and may be influenced by rainfall as well (Ver Planck 1958). Brine depths in the South Bay salt ponds in general is highly variable (Warnock *et al.* 2002), ranging from partly or completely emergent pond beds (exposure of bay mud; Warnock *et al.* 2002) to depths supporting abundant migratory shorebirds, dabbling and diving ducks (Takekawa *et al.* 2000).

The pickle ponds at Redwood City (7A-C) contained brines turbid with dark orange-red hues due to high concentration of *Dunaliella* and halobacteria indicating significant primary productivity (Javor 1989, Baye 2000). Relict tidal channel patterns are clearly evident in the beds of the Redwood City pickle ponds, corresponding with the antecedent morphology of tidal marsh in the 1943 aerial photograph (Figures 1, 2).

2.0 Natural salt ponds: comparison with industrial salt ponds

Salt ponds are not inherently artificial: the industrial salt pond system displaced its natural antecedents. San Francisco Bay historically supported natural salt ponds that generated halite deposits and saturated brines (Ver Plank 1951, Goals Project 1999). Hypersaline lagoons are widespread in arid and Mediterranean-climate barrier coasts of the world (Davis and Fitzgerald 2004, Woodroffe 2002). The largest natural salt pond near San Lorenzo (Alameda Co.), which is labeled "Crystal Salt Pond" in the U.S. Coast Survey T-sheet of 1857, (Fig. 9) has been interpreted geomorphically to be a natural impoundment of a tidal marsh and creek system, associated with a wave-deposited marsh berm or remnant of a low estuarine barrier beach (Atwater *et al.* 1979). The natural salt ponds were flooded by the high spring tides of June and July, and concentrated brine and produced halite up to 8 inches thick during neap tides of late summer and fall (Ver Planck 1951, 1958). The halite deposits of natural salt ponds were rapidly exhausted by commercial harvest by the 1860s, triggering the "improvement" of salt ponds for increased yield of salt. Natural salt ponds were the precursors of artificial salt ponds that evolved from "improved" bermed impoundments of natural pools to extensively diked tidal marshlands with dammed sloughs (Ver Planck 1958). The transition between natural and artificial salt ponds in San Francisco Bay occurred in the 1850s-1870s.

Specialized hypersaline microalgae (*Dunaliella salina,* the primary producer of salt ponds), and its primary aquatic invertebrate grazer brine shrimp, *Artemia franciscana*) inhabit modern salt ponds of San Francisco Bay. They originated in natural salt ponds, and colonized the industrial salt pond system (Larsson 2000). Primary production of *Dunaliella* also provides trophic support to brine flies (*Ephydra* spp.) a key prey item for some waterbird species foraging in late-stage salt ponds and their levees (Maffei 2000). Brine shrimp production was abundant enough (estimated adult population up to 4.5 billion; Larsson 2000) to support commercial industrial harvests from San Francisco Bay salt ponds (U.S. Fish and Wildlife Service 1992). Brine shrimp grow in hypersaline brines between 70 and 200 ppt, and survive as long-lived cysts (dormant resistant life-history stages, remaining viable for decades) in brines near saturation (U.S. Fish and Wildlife Service 1992, Larssen 2000). Brine shrimp are consumed by salt pond waterbirds including eared grebes, mallards, American avocets, Wilson's phalarope, whimbrels, California gulls, mallard, western and least sandpipers, willets, and greater yellowlegs (Larsson 2000). *Dunaliella salina* is ubiquitous in salt ponds of San Francisco Bay, and can remain photosynthetically active (alive and productive) near brine saturation (near 350 ppt). Only undiluted bittern may lack metabolically active *Dunaliella* (Javor 1989, Brock 1975).

Small salt ponds form internally within salt marshes of San Francisco and San Pablo Bays, in both remnant prehistoric salt marshes as well as historic-era salt marshes. Salt pans (variant spelling "panne", Fr.) are depressions or pools in undrained sections of salt marsh plains between tidal creeks (Chapman 1961, Pethick 1972), and also occur as undrained flats along the edges of alluvial fans or the landward edges of salt marsh plains (Baye *et al.* 2000, Baye 2000). Natural salt pans can evaporate in late summer, forming saturated brines and crystalline salt films or crusts, just as industrial salt ponds do. They similarly produce conspicuous pigmented "blooms" of *Dunaliella*, blue-green halotolerant bacteria, and brine flies. Their brines at various stages of concentration are essentially identical biologically and chemically with those of salt concentration ponds, pickle ponds, and crystallizer ponds of the industrial system. Natural brines also originate from tidal Bay sources, as do salt pond intake pond brines.

Because Crystal Salt Pond was destroyed before any detailed biological accounts (wildlife use) were prepared, it is uncertain whether playa-like dry salt pans were used by species that are currently federally listed as threatened or endangered under the Endangered Species Act, such as the western snowy plover, Pacific population (*Charadrius alexandrinus nivosus*) or the California least tern (*Sterna antillarum browni*). Western snowy plovers and California least terns inhabit the artificial salt ponds that replaced the Bay's natural salt ponds (Goals Project 1999).

3.0 Jurisdictional history of San Francisco Bay salt ponds

The Corps has a long and consistent history of asserting jurisdiction over the tidelands from which salt ponds were reclaimed, the process of salt pond reclamation, and the salt ponds and levee systems themselves. The earliest history of Corps regulation of salt pond construction occurred prior to the Clean Water Act, under the Rivers and Harbors Act of 1899. A brief and selective review of representative and key examples of Corps jurisdictional assertins (public notices, permits issued or denied, jurisdictional determination letters) over salt pond construction, salt pond operational activities, and the tidelands from which they were reclaimed, is presented below. This permit history is significant for analysis of contemporary jurisdiction over salt ponds because it shows how broadly the Corps interpreted its traditional (pre-Clean Water Act, pre-NEPA) jurisdiction over "navigable waters of the United States" in the "navigable waterbody" of San Francisco Bay and its tidelands.

3.1. Early historic assertion of Rivers and Harbors Act jurisdiction (traditional "navigable waterbody/waterway")

In contrast with modern Rivers and Harbors Act (RHA Section 10) regulations (33 CFR Section 328), which describes jurisdictional limits with explicit precision, the Corps San Francisco District had traditionally applied broad discretion in assertion of its jurisdiction over San Francisco Bay, including man-made ditches, small sloughs, tidal channels that were not named on official lists of "navigable waterways", and even construction of levees on "overflow lands" (tidal marsh) as well as dams across small tidal sloughs. The examples below provide counter-evidence to previous arguments by Leslie/Cargill Salt that the Corps narrowly asserted Rivers and Harbors Act jurisdiction over "navigable waterways" identified on official lists. The Corps even regulated overhead structures (above tide) that affected navigability. Examples of specific permit and public notice actions demonstrating traditional assertion of RHA Section 10 by the San Francisco District are reviewed below to provide a documented historic context for interpretation of "traditional navigable waters" in San Francisco Bay tidelands, relevant to "traditional navigable waterways" interpretation today (Section 3.2, Section 4.2.4.).

The Corps regulated reclamation of tidal marshes described as "overflow lands". The South San Francisco Land & Improvement Company submitted an application to "reclaim overflow land in the southern part of S.F. Bay at Point San Bruno, San Mateo County" on August 5, 1915. The permit was issued by the Division Engineer on August 23, 1915, citing "S.F. Bay (General)" as the affected waterway in the card file record of the permit action early in the Rivers and Harbors Act history in San Francisco Bay. Similarly, the Division Engineer authorized a permit on May 21, 1917 to "inclose [sic] with a levee a tract of about 1400 acres lying west of Petaluma River and north of San Antonio Creek, about 10 miles below the town of Petaluma" to W.O. Wright, citing "Petaluma River" as the affected waterway. This permit identifies the regulated location of fill (levee construction) on the banks of marshlands "lying west of the Petaluma River", and not in the navigable river itself.

On August 17, 1914, the Corps (Secretary of War) issued a permit to the Dumbarton Land and Improvement Company to "build a levee and close within the inclosure [*sic*] such sloughs situated

between the left bank of Newark Creek on the north and the Santa Fe Pacific Railroad and Spring Valley pipe line on the south, as are not navigable [*sic*], in accordance with the plans and drawings attached…". This permits explicitly regulated sloughs tributary to the navigable waterbody of San Francisco Bay that were not navigable in fact, and were not named on official lists of navigable waterways. These marshlands later became part of the Leslie (Cargill) Salt pond system.

The most direct and site-specific evidence for early historic assertion of Rivers and Harbors Act jurisdiction over tidal marshlands at Redwood City is provided by the permit issued to Leslie Salt's predecessor, Stauffer Chemical Company, at the existing salt pond system on January 16, 1940. That permit expressly authorized levee construction (placement of dredged sediment) on the salt marsh banks, above tidal channels along Westpoint Slough and its tributaries, as well as across the First Slough: "…authorized to…construct an earth dyke [sic] or levee across and along the banks of First Slough and along the bank of Westpoint slough and an unnamed tributary thereof…". The Public Notice for this application, dated December 9, 1939, stated the proposal to "…construct about three miles of earth levee from the proposed dam extending along the southerly bank of Westpoint Slough."

Several critical conclusions about the Corps' assertion of Rivers and Harbors Act jurisdiction necessarily follow from the wording of the permit and Public Notice for the Stauffer Chemical Company proposal to construct salt ponds in tidal marshlands at Redwood City in 1939. First, it expressly authorized damming of "<u>unnamed tributary</u>" of Westpoint Slough, which indicates that the Corps asserted Rivers and Harbors Act jurisdiction over activities in waterways that were not included in any official lists of "navigable waterways" (since an unnamed tributary cannot be named in a list). Second, it expressly authorized construction of dikes <u>along banks of the slough</u>, not merely the dams across the mouths of channels. The Corps was in fact regulating discharge of fill on the marsh plain "banks" to construct levees.

The construction of salt pond levees was described in detail by Ver Planck (1958), who noted the necessity of placing dredged sediment in multiple lifts on the marsh so that the "crust" would not be broken and cause the new levee to collapse (Ver Planck 1958, p. 46-47). The "crust" is the cohesive pickleweed marsh plain with relatively high shear strength, more than ten times greater than compared with cordgrass marsh and unvegetated mud sediments studied in Palo Alto by Pestrong (1969). The location of approximately 40 ft wide salt pond levees (Ver Planck 1958) constructed at Redwood City, as elsewhere in San Francisco Bay, is generally inside of the edge of tidal creek banks delineated in U.S. Coast Survey T-sheets and USGS quandrangle maps at the time of their construction. These channel banks "black line" mapped features are generally interpreted as the Mean High Water line – as Cargill has asserted in past jurisdictional disputes and case law.

Thus, the regulated fill discharge on the high marsh bank capable of supporting a levee that was authorized in the Stauffer Chemical Company permit was <u>above</u> Mean High Water. This jurisdictional area is part of the <u>same marsh plain substrate and topography that forms the beds of the levee-enclosed salt ponds today</u>. Thus, the Corps previously asserted jurisdiction over "navigable waters" of San Francisco Bay <u>more broadly</u> than it does today 1986 Section 10 Rivers and Harbors Act regulations at 33 CFR Part 329. The Corps permit for Stauffer Chemical's reclamation of tidal marshes clearly indicates that the Corps traditional interpretation of its jurisdiction (pre-Clean Water Act) extended over "navigable waters" of San Francisco Bay that included its "unnamed tributary"

sloughs and "banks" of tidal marsh plains. Cargill's past arguments that the Corps traditionally interpreted "navigable" waters narrowly and regulated only specific named, listed "navigable waterways" within San Francisco Bay contradict the site-specific permit history at Westpoint Slough's tidelands that became the Cargill Redwood City salt ponds. (Note: The aerial photograph from 1943 shows that the authorized levee construction along Westpoint Slough was not completed by that date: open tidal marsh plains and creeks extended from the open mouth of First Slough to Flood Slough).

Other Corps permits of the mid-20th century also confirm that the Corps regulated small, unnamed and even artificial tidal channels within salt marshes. Corps San Francisco District Public Notice 50-54 (10 May 1950) announced an application by Leslie Salt company of Newark, California, to "construct an earthen dam across the outlet of the borrow pit ditch…" for reclamation of tidelands south of the Dumbarton Bridge, near "Bellehaven" (near Palo Alto). This permit was part of the construction of the modern Redwood City salt pond system. The "borrow ditch", by definition, was clearly an artificial canal extension of San Francisco Bay as the parent navigable waterbody – not even a named tidal slough or a listed "navigable waterway". Borrow ditches were navigable by the Leslie Salt dredge, the Mallard, and smaller craft. The permit was issued on 29 May, 1950.

Corps San Francisco District Public Notice 55-36 (6 December 1954) announced an application by Leslie Salt Company to seek after-the-fact approval of a previously constructed unauthorized dam across Angelo Slough at its junction with Belmont Slough, San Mateo County. The Corps card file for permit actions reports that the permit was "refused", and cites the navigable "waterway" as "S.F. Bay (South)", rather than the sloughs where the dam was constructed.

Another permit action that demonstrates that the Corps traditionally regulated tidal sloughs that were too small to be navigable in fact (in their unimproved state) by commercial vessels, as well as adjacent tidelands, was granted to the Santa Fe Land Improvement Company to "fill the extreme upper end of Ellis Slough, and a small area adjacent to the high water line on the south side", citing "Richmond Harbor" as the affected waterway. The permit was issued on August 6, 1930. The card file indicates that authorized construction was completed on 2/7/31.

The Corps regulated activities that affected navigability of San Francisco Bay and its tributary navigable waterways, even when the activity was conducted above the reach of tides. The Corps issued a permit to PG&E Co. on January 29, 1940, to "install a 4,000 volt overhead power line crossing across the mouth of Gray Goose Slough, citing "Alviso Slough" as the waterway. The card file indicates that authorized construction was completed on 10/9/53. A similar permit to "construct an aerial power cable with a minimal vertical clearance of 25 ft above MHHW near Sears Point" over Tolay Creek (cited as the "waterway", but which was not listed by the Corps separately as a "navigable waterway") was issued to PG&E on October 20, 1953.

The permit history cited above establishes supports the following conclusions that are relevant to contemporary Clean Water Act and Rivers and Harbors Act jurisdiction and interpretation of "navigable waters of the United States":

- Long before the passage of the Clean Water Act and other federal environmental laws, the Corps' San Francisco District interpreted "San Francisco Bay", including unnamed

tributaries and man-made tidal ditches, as extensions of this traditional "navigable waterbody". The Corps did not narrowly assert jurisdiction only over certain listed, named "navigable waterways" within San Francisco Bay.

- Long before the passage of the Clean Water Act and other federal environmental laws, the Corps' San Francisco District expressly regulated the construction of dikes on tidal marsh "banks" of tidal sloughs – specifically, at Westpoint Slough, the original dikes of the modern Cargill Redwood City salt ponds. The "banks" regulated as extensions of South San Francisco Bay (the navigable waterbody) were continuous with the tidal landforms that became the beds of the modern Redwood City salt ponds.

- The historic (and modern) RHA regulation of power lines located high above the navigable waterbody of San Francisco Bay indicates that the Corps' jurisdiction was not narrowly asserted within the tidal frame, but based on an "effects test" on the navigable capacity of San Francisco Bay. This conclusion is consistent with the Corps' historic regulation of marsh reclamation in tidelands, and damming of small unnamed tidal tributaries or ditches: diking these extension of the Bay, or removing dikes, indirectly affected its navigable capacity by altering tidal prism, tidal energy, consequently silting and shoaling (a process recognized following widespread marsh reclamation) that could interfere with navigations, as power lines can.

- The Corps traditionally asserted its regulatory authority over diking and damming small sloughs in tidal marshlands not only by issuing, but also by denying permits for after-the-fact fills (Angelo Slough example).

3.2. Modern assertion of Rivers and Harbors Act and Clean Water Act jurisdiction

Since the current Corps regulations on jurisdiction under Rivers and Harbors Act (RHA) Section 10 and Clean Water Act (CWA) Section 404 were published in 1986 (33 CFR Part 328 and 329; 33 USC 1344 and 33 USC 401 *et seq.*), the Corps' jurisdictional determinations became more explicitly precisely documented. The history of salt pond authorizations and enforcement actions since 1986 (current Corps permit regulations) are directly applicable precedents for contemporary salt pond regulation under Rivers and Harbors Act Section 10 and Clean Water Act.

The most recent permit issued for salt pond fill activities, including fills within intact former industrial commercial crystallizer ponds of Cargill (now owned and managed by the California Department of Fish and Game) dates from 2008 (Corps permit file no. 4000258N). The final jurisdictional determination report was approved by the Corps on April 21, 2008. This jurisdictional determination is particularly pertinent to Redwood City salt ponds because nearly the entire area over which the Corps asserted Section 404 jurisdiction as "non-wetland Waters of the United States" consisted of post-industrial crystallizer beds and post-industrial wash ponds that normally contained saturated or supersaturated brines. These ponds are substantively equivalent to the crystallizers and pickle ponds in Redwood City. The significance of this very recent and specifically

applicable jurisdictional precedent cannot be overestimated. Notably, some jurisdictional "wetlands" were identified and mapped on levees internal to the crystallizer ponds.

The most recent regional permit issued by the Corps for all South Bay salt pond operations (Corps file no. 19009S98) was issued November 29, 1995 to Cargill Salt Division (Robert C. Douglass, Manager, Real Property). This permit expired on its own terms on July 31, 2005, but was provided a general permit condition (#1) allowing time extension. The permit covers activities "including operation, repair and new construction associated with the production of solar salt in the southern portion of San Francisco Bay" for the purpose "to sustain operation and production of the solar salt facilities…". At the time it was issued, activities related to decommissioning of salt ponds were neither proposed nor authorized. The permit was issued under authority of both CWA Section 404 and RHA Section 10. The explicit regulation of fill and excavation of crystallizer beds is shown at part 1.f of the permit. "Spot repairs and rehabilitation of crystallizer beds. This work will be accomplished with land based equipment". The explicit regulation of fill and excavation in salt pond interiors is also shown in authorization of new work with reporting and approval requirements for:

> 2.b) "Dredging of existing and new borrow ditches within the salt ponds…" and
> 2.c) "Dredging in salt ponds to allow the floating dredge to cross a pond, with the placement of dredged material on the bottom along the side of the dredged channel" to allow internal navigation; and
> 2.g) "Construction of new pumping donuts, internal coffer dams, and internal salt pond levees"

Finally, and also most recently, the Corps issued a permit (2008-00103S, January 23, 2009) to Mendel Stewart of the U.S. Fish and Wildlife Service San Francisco Bay National Wildlife Refuge Complex, for South Bay salt pond restoration Phase 1 permit activities in the approximately 4,155 acres of former salt ponds located at the Ravenswood (SF2), Alviso (A5, A6, A7, A8, A16, & A17) and Eden Landing Ponds (E8, E9, E12, and E13), for activities that will involve discharge of fill within the same salt pond interiors and levees that were formerly regulated under permits 19009E98 and 19009S98 issued to Cargill Salt.

Review of all modern permits issued for salt pond operation, repair, and new work in salt pond beds, ditches, internal berms, and perimeter levees, indicates the following:

- The Corps has consistently asserted jurisdiction over fill discharges in salt pond beds without distinction among salt pond types or water quality variables such as salinity or ionic composition. The Corps has explicitly regulated fill discharges in crystallizer beds, as shown in Section 404 jurisdictional maps (Napa) and in explicit narrative descriptions of activities authorized in crystallizer pond beds (South Bay).

- The Corps has consistently asserted jurisdiction over excavation/dredging within ditches and beds of salt pond interiors, without distinction among salt pond types or water quality variables such as salinity or ionic composition.

- The Corps has consistently asserted jurisdiction over placement of fill on interior levee benches and slopes below the (nontidal) high water line, on exterior levee slopes up to the high tide line.

4.0. Jurisdictional analysis of San Francisco Bay salt ponds

The following is a regulatory analysis of Clean Water Act Section 404 and Rivers and Harbors Act Section 10 geographic and activity jurisdiction over salt ponds. It applies the factual background information discussed in Section 1.0 to the fundamental jurisdictional criteria cited at 33 CFR Part 328 and Part 329.

4.1. Clean Water Act Section 404 jurisdiction (33 CFR Part 328)

4.1.1. Commerce clause nexus. 33 CFR §328.3(a)(1) defines "waters of the United States" under the Clean Water Act in terms of fundamental commerce clause nexus: "All waters which are currently used, or were used in the past, or may be susceptible to use in interstate and foreign commerce, including all waters which are subject to the ebb and flow of the tide;".

This basic criterion of past, present, or potential interstate commerce is fully satisfied by the pervasive commercial industrial origin, nature, and historic use of the Redwood City (and all San Francisco Bay and San Pablo Bay) salt ponds for the production, harvest, refining, and sale of crude solar salt. All portions of the solar salt production system are commercial industrial enterprises with an obvious and demonstrable history of interstate commerce – the marketing and sale of salt and salt by-products including bittern (sold as road dust suppressant, and formerly as raw material for the caustic magnesium industry) and brine shrimp harvested from salt ponds. Salt is the primary commercial product, and bittern and brine shrimp are secondary commercial products of solar salt production. There is no question that the Redwood City salt ponds (particularly crystallizers, which have no other purpose than to produce harvestable salt) produced in the past, and "are susceptible to use", for production of solar salt sold in interstate commerce.

The basic commerce clause nexus of industrial salt ponds is even more explicitly established by 33 CFR §328.3(3)(iii), "All other waters…the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters: (iii) which are used or could be used for industrial purpose by industries in interstate commerce;" .

The fact that salt ponds are "susceptible to use" for commercial production of brine shrimp in late-stage salt concentrator ponds also provides explicit commerce clause nexus at 33 CFR §328.3(3) "All other waters…the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters: (ii) from which fish or shellfish are or could be taken and sold in interstate or foreign commerce…". Even though "brine shrimp" are not traditional "shellfish" for human consumption, they are aquatic invertebrates harvested, processed (desiccated for preservation) and sold in a manner analogous with krill or small fish for fish meal.

In the case of salt ponds that have been publicly acquired (for the San Francisco Bay National Wildlife Refuge or the California Department of Fish and Game reserve system), there is no

question that salt ponds "are or could be used by interstate or foreign travelers for recreational or other purposes". The San Francisco Bay National Wildlife Refuge Complex is one of the most heavily visited Refuges in the country because of its spectacular displays of migratory shorebirds. The primary purpose of a National (as opposed to a county, regional or state) Wildlife Refuge is to support interstate visitor recreational and educational conservation uses. The authorized boundary of Don Edwards San Francisco Bay National Wildlife Refuge expressly includes Tracts 165 and 166 (Redwood City salt ponds including current and past crystallizers, bittern, wash ponds, pickle ponds, desalting ponds) identified in the September 1990 Land Use Protection Plan of the U.S. Fish and Wildlife Service San Francisco Bay National Wildlife Refuge. On October 28, 1988, Congress passed Public Law 100-556, which increased the Service's acquisition authority for the refuge to a total of 43,000 acres.

It is important to note that the most significant federal nexus for jurisdiction over waters in Redwood City salt ponds is directly provided by their historic and essential interstate commercial industrial use, and secondarily provided by their demonstrated and federally authorized recreational potential for use. The presence of migratory birds, regardless of their number or frequency, is not essential to establish sufficient federal commerce clause jurisdiction in salt ponds.

Similarly, threatened or endangered under the Endangered Species Act, such as the western snowy plover, Pacific population (*Charadrius alexandrinus nivosus*) of the California least tern (*Sterna antillarum browni*) do nest on some portions of the former South Bay salt pond system, such as levee tops and dry concentrator pond beds. Because the distribution, frequency and abundance of these listed species at Redwood City salt ponds is unknown (or at least undocumented and unreported) under existing and recent past conditions, their importance in establishing commerce clause nexus may be relatively minor or insignificant compared with recent past commercial industrial use of the salt ponds.

4.1.2. Types of "waters of the United States" applicable to salt ponds

Listed among the "All other waters such as…" at 33 CFR §328.3(3) are "playa lakes", which are salt evaporation basins, such as the Great Salt Lake. The Redwood City solar salt ponds are hydrologically similar to playa lakes, as a result of their being artificially constructed impoundments of San Francisco Bay tidal marshes and tidal channels (see Section 1.0).

The fact that they are "impoundments of waters otherwise defined as waters of the United States under the definition" (33 CFR 328.33(4)), *i.e.,* they are impoundments of tidal waters from San Francisco Bay, is sufficient to bring them under jurisdiction of the Clean Water Act.

4.1.3. "Artificiality" of salt ponds and Corps Section 404 jurisdiction

The salt ponds of the south bay are composed of natural tidal marsh plains impounded by artificially constructed levees. The salt ponds are non-tidal impoundments of pre-existing, natural tidal wetlands including tidal channels extending the bed and surface of San Francisco Bay at the time of impoundment (section 3.0). The degree of modification of salt marsh to salt pond varies: the beds of crystallizer ponds, for example, are modified and maintained as flat, relatively impermeable beds

(Ver Planck 1958), while most ponds retain residual tidal marsh and creek topography, modified by internal ditches and berms.

Cargill has proposed various versions of *ad hoc* arguments that salt ponds are categorically "artificial" (rather than semi-artificial impoundments of antecedent tidal marshes), wholly transformed to a condition that renders them non-jurisdictional. Cargill has failed to cite any regulatory or policy basis for the theory that artificial impoundments of tidal wetlands are non-jurisdictional because they are "artificial". On the contrary, the definition of "waters of the United States" at 33 CFR §328.3(4) expressly includes "All impoundments of waters otherwise defined as waters of the United States…", which are by definition artificially diked or dammed enclosures of waters. Impoundments of tidal waterbodies (San Francisco Bay and all its lateral extensions or tributaries) or waterways defined as "navigable) are categorically jurisdictional (33 CFR 328.3(4)). Thus, "artificiality" *per se* cannot possibly in be a barrier to Section 404 jurisdiction. There are no jurisdictional disclaimers or exclusions in official policy guidance or regulation that apply to artificial waterbodies that otherwise meet fundamental Section 404 jurisdictional criteria.

The opinion of the Ninth Circuit Court of Appeals ruled in 1990 (Leslie Salt Co. v. United States and Save San Francisco Bay Association, February 6, 1990, CA No 89-15337) held that artificiality of salt ponds (specifically former crystallizers and calcium chloride pits in derelict salt ponds in Newark) poses no obstacle to Corps jurisdiction. The Ninth Circuit rejected a fundamental distinction between artificial and natural waters relevant to Clean Water Act jurisdiction.

33 CFR §328.5 expressly states "man-made changes may affect the limits of waters of the United States". To the extent that "man-made changes" are "artificial", and may affect the limits of jurisdiction rather than cancel jurisdiction altogether, artificial modification of wetlands does not nullify Corps jurisdiction. Furthermore, "artificial" salt ponds remain influenced by natural hydrologic influences of San Francisco Bay (significant seepage, tidal overtopping, wave run-up, as well as deliberate bay intake to salt ponds; see Section 1.0) as well as natural precipitation. The alleged categorical "artificial" status of salt ponds is itself an artificial, exaggerated, and arbitrary distinction that does not affect the fundamental jurisdictional status of the salt pond beds.

4.1.4. Extreme hypersalinity and Corps Section 404 jurisdiction

Cargill and its predecessor, Leslie Salt, have argued that some salt ponds are non-jurisdictional under the Clean Water Act because of the extreme hypersalinity (saturated brines) of their waters. This argument is fallacious. Neither the Clean Water Act nor its regulations establish any upper limit of salinity, or any compositional threshold for aqueous solutions that may be treated as "waters of the United States". The definition of "waters of the United States" at 33 CFR §328(a)(3) includes haline (marine salinity) and hypersaline (higher than marine salinity, with ionic composition differing from sea salt, typical of inland saline soils and waters) aquatic habitats, such as "mudflats", "wetlands" (including tidal marshes that become hypersaline), and "playa lakes"(which are by definition naturally saline or hypersaline, like the Great Salt Lake, a jurisdictional waterbody). Some highly beneficial natural and managed aquatic habitat functions for particular water-dependent wildlife depend on upper ranges of hypersalinity (Takekawa *et al.* 2000, Warnock et al. 2002, U.S. Fish and Wildlife Service 1992, Goals Project 1999). Natural waterbodies such as the Great Salt Lake, and historic San Francisco Bay natural aquatic habitats such as Crystal Salt Pond, regularly developed

hypersaline and even saturated and supersaturated brines resulting in salt crystallization and precipitation of thick halite beds (Ver Planck 1951).

The Section 404(b)(1) guidelines expressly identify potential adverse impacts of restricting saline water on salinity-dependent biota (40 CFR §230.25, Salinity gradients), and considers the environmental context of salinity in terms of organism adaptations and natural patterns and processes of salinity gradients. Thus, Section 404 does not presume that salinity per se is contrary to the overall aims of the Clean Water Act. Neither the Corps nor EPA have established any guidance, policy, or regulations that establish a non-arbitrary, scientifically supported upper limits of aqueous salinity that may be considered thresholds for converting "waters of the United States" to a non-jurisdictional state. Such a threshold would be absurd, because it would allow natural or artificially manipulated saline waters to pass in and out of Clean Water Act jurisdiction based on short-term salinity fluctuations, or artificial salinity regimes intended to defeat jurisdiction (see Section 4.1.5, below). There is no regulatory or Corps/EPA policy basis to justify any salinity or hypersalinity level as a barrier to Section 404 jurisdiction.

Cargill's (Leslie Salt Company's) arguments that derelict Newark crystallizer ponds were non-jurisdictional aquatic features under the Clean Water Act merely because of their artificial origin were rejected by the Ninth Circuit Court of Appeals.

4.1.5. Conversion of salt pond types and brines, and Corps Section 404 jurisdiction

A corollary of Cargill's theory that saturated brines are not jurisdictional waters of the United States is that the geographic salt pond areas impounding saturated brines are themselves non-jurisdictional – implying that the allegedly non-jurisdictional waters could leave an imprint of jurisdictional exclusion on certain geographic areas. This is also a fallacy. It leads to the absurd conclusion that the artificial transfer of saturated brines among salt ponds could eliminate geographic jurisdiction at the whim (or with intent to circumvent regulation) of brine management within the system. Informal legal opinion and factual determinations prepared by the California Attorney General in 1986, prepared in response to inquiry from the San Francisco Bay Conservation and Development Commission (BCDC) about the extent of its "salt pond" jurisdiction, are applicable to some aspects of Section 404 Clean Water Act jurisdiction:

> Finally, we note that it is not difficult to convert salt ponds from one type of use to another. For example, certain bittern ponds on the Baumberg Tract have been converted to and used as concentrators and pickle ponds. See June 10, 1985 letter from Raymond Thingaard to Steve McAdam, BCDC, p. 2; see also Dorn, Salt, Univ. of California, Berkeley, November 161982 (unpublished manuscript), noting that "crystallizing ponds can easily be converted to concentrator ponds if needed"). If BCDC's jurisdiction were construed as being limited to only one type of pond (for example, concentrators), then certain areas might pass in and out of BCDC's jurisdiction depending solely upon the fortuitous production patterns of the salt making company. We doubt that the legislature intended to make BCDC's jurisdiction so variable and uncertain. (Van de Kamp 1986, p. 13)

The same principle would apply to Clean Water Act jurisdiction: if the geographic area of jurisdiction depended on the particular range of concentration or ionic composition of a brine solution, salt ponds would pass in and out of Section 404 jurisdiction within and among years, based on the discretion (or whim, or intent to circumvent regulation) of the salt pond operator. In theory,

if the Corps arbitrarily decided that bittern ponds and bittern brines were too rich in potassium and magnesium, and too poor in calcium to be "waters of the U.S." the salt pond operator could degrade environmental quality of a salt pond by flooding it with bittern, and be rewarded with elimination of Clean Water Act Section 404 jurisdiction and its environmental protections.

Similarly, if the Corps arbitrarily decided that crystallizers were too salty to be "waters of the U.S.", then the salt pond operator could artificially draw down and dry out any salt pond to claim elimination of Section 404 jurisdiction. Theoretically, jurisdiction over the entire salt pond system could be eliminated by sequentially moving (arbitrarily 404-deregulated) bittern batches through the salt pond system, "poisoning" jurisdiction iteratively (in effect, polluting away jurisdiction, the inversion of regulatory intent), to escape Section 404 by converting ponds to non-aquatic conditions without regulation. This, of course, would be an absurd and arbitrary interpretation of the Corps regulatory program under Section 404; yet it is the logical consequence of disclaiming 404 jurisdiction over bittern and crystallizer ponds because of their concentration and ionic composition. This would be analogous to allowing a landowner to eliminate Corps jurisdiction by eliminating wetland vegetation, contrary to Corps policy on "normal circumstances" (RGL 86-9) expressly aimed "to respond to those situations in which an individual would attempt to eliminate the permit review requirements of Section 404 by destroying the aquatic vegetation".

Another logical consequence of arbitrary assertion of a salinity or brine composition threshold for CWA Section 404 jurisdiction is that hypersaline waters with naturally important value under the CWA, such as the Great Salt Lake, salt pans of tidal marshes in San Francisco Bay during late summer, and many western playa lakes would pass in and out of jurisdiction – but mostly out. Similarly, in theory, the natural historic Crystal Salt Pond of San Francisco Bay would never have been eligible for protection under Section 404 under this theory.

The salt pond areas dedicated at any given time to bittern storage or crystallizer brines are entirely at the discretion of the operator, particularly during the era of post-industrial decommissioning (phase-out) of commercial salt production. Because the location of different brine types are purely artifacts of operational discretion, and not inherently attached to the geographic salt pond area, they cannot reasonably be used as an instantaneous basis for assertion or disclaimer of Clean Water Act jurisdiction, following the reasoning of the California Attorney General in 1986.

4.2 Rivers and Harbors Act Section 10 jurisdiction

4.2.1. General definition of navigable (in law) waters of the United States: commerce clause and transport

Essentially similar "commerce clause" requirement of the Clean Water Act applies to the general Rivers and Harbors Act (RHA) Section 10 definition of navigable waters of the United States: 33 CFR §329.4 reiterates the fundamental federal jurisdictional requirements for either "ebb and flow of the tide", or present, past, or susceptibility for use to transport interstate or foreign commerce. The key difference for RHA jurisdiction is its specific requirement for transport (navigation for commerce), rather than indefinite commercial use. **RHA determination of "navigability, once made, applies laterally over the entire surface of the waterbody, and is not extinguished by later actions** or events which impede or destroy navigable capacity" under this general definition.

Thus, as "San Francisco Bay" is a "navigable waterbody", as determined by the Corps, RHA jurisdiction extends laterally over the entire surface of the waterbody, and is in principle inextinguishable even by dikes or dams. The presence of the Port of Redwood City adjacent to the Cargill Salt plant at Redwood City verifies that San Francisco Bay remains navigable in fact and in law in the immediate vicinity of the salt production facility.

Moreover, 33 CFR §329.6 clarifies that any historical use of commercial vessels of any size, including canoes or other small craft capable of transporting commercial goods, are sufficient to establish navigability under Section 10. The Redwood City salt ponds are "susceptible for use" by shallow-draft brine shrimp harvest boats that have historically operated in concentrator ponds within the South Bay salt pond system (U.S. Fish and Wildlife Service 1992). Concentrator salt ponds productive of brine shrimp may be converted from any pond type (See Section 4.1.5), and the Redwood City salt ponds include both land access and dredge lock access for small boats to operate within them. Brine shrimp products are sold in interstate commerce. Therefore, historic brine shrimp harvest and navigation in salt ponds establishes that they are "susceptible for use to transport interstate or foreign commerce", regardless of whether or not brine shrimp have in the past been harvested from Redwood City salt ponds specifically.

Furthermore, the salt pond beds include unfilled portions of diked tidal creeks that were originally subject to the ebb and flow of the tide, providing "navigable in law" status that is not extinguished by later actions such as diking (33 CFR §329.9(a). The original condition of the diked tidal creeks does not limit the current extent of RHA Section 10 jurisdiction if navigable capacity is improved by artificial means. Impoundment of (concentrated) bay water within the salt ponds, increasing water depth, constitutes an "improvement" or "artificial aid …used to make the waterbody (diked historic tidal sloughs) suitable for use in navigation" (33 CFR §329.8). Private ownership of the salt pond does not preclude extension of RHA Section 10 from the diked tidal creeks over the entire "improved" brine shrimp boat-navigable water surface of the pond interior (33 CFR §329.8(a)(3)). Thus, the combination of brine shrimp harvest and transport potential in salt ponds, and diked historic tidal slough beds of Redwood City salt ponds with artificially impounded and increased depth of tidal-source bay water over diked slough beds, is sufficient to extend RHA Section 10 jurisdiction over the entire salt pond bed surface (excluding levees and berms).

Unlike industrial dredge lock and dredge navigation within salt ponds, which are components of the commercial production of solar salt, brine shrimp boat harvest operations are essentially commercial transport of goods from the point of harvest to commercial industrial processing and eventual interstate sale (like fishing boats or historic timber boats loaded with logs floated down rivers). Their impact on the extent of Section 10 jurisdiction behind dikes is unique to salt ponds.

4.2.2. Geographic limits of jurisdiction

The navigable waterbody of San Francisco Bay extends laterally over the entire surface of its bed, including sloughs and tidal creeks that were large enough to allow any type of commercial navigation (33 CFR §329.4). The shoreward limit of Section 10 geographic jurisdiction "extends to the line on the shore reached by the plane of mean (average) high water". 33 CFR 329.12(a)(2). This determination is reinforced by the general RHA Section 10 jurisdiction over bays and estuaries (33

CFR §329.12(b)), which also extends to the entire surface and bed of all waterbodies subject to tidal action:

> Jurisdiction thus extends to the edge (as determined by paragraph (a)(2) of this section) of all waterbodies, even though portions of the wterbody may be extremely shallow, or obstructed by shoals, vegetation or other barriers. Marshlands and similar areas are thus considered "navigable in law", but only so far as the area is subject to inundation by the mean high waters. The relevant test is therefore the presence of the mean high tidal waters…"

Dikes that impound tidal creeks, or choke the ebb and flow of the tide in (dammed) sloughs that were historically continuous with San Francisco Bay, do not extinguish Section 10 jurisdiction:"…an area will remain navigable in law" even though no longer covered with water, whenever the change has occurred suddenly, or was caused by artificial forces intended to produce that change." 33 CFR §329.13.

The reasoning in these regulations was the basis of the San Francisco Corps District's pioneering interpretation of Rivers and Harbors Act jurisdiction in unfilled tidal sloughs behind dikes (PN 71-22, June 11, 1971, PN 71-22(a), January 18, 1972), modified to reflect tidal datum limits (Mean High Water rather than Mean Higher High Water) of geographic RHA Section 10 jurisdiction established by case law on jurisdiction over San Francisco Bay salt ponds. Even before these Public Notices, it is clear that the San Francisco District had been asserting its RHA authority broadly over activities that even indirectly affected navigable capacity of San Francisco Bay (Section 3.0, this report).

4.2.3. Determination of navigability: "Navigable waterway" lists and geographic jurisdiction over waterbodies

The navigable-in-law status of the waterbody San Francisco Bay under RHA Section 10 is established by its nature as "bay or estuary", and the exhaustively extensive nature of Section 10 jurisdiction (33 CFR §329.12(b)). The absence of a particular tributary slough or creek in a list of "navigable waterways" within San Francisco Bay does not indicate a lack of Section 10 jurisdiction (33 CFR §329.16(b)). The Corps San Francisco District first prepared lists of "navigable waterways" in 1932, but in fact asserted RHA jurisdiction over portions of San Francisco Bay outside of the listed waterways before, during and after lists were prepared, including unnamed tributaries and even artificial borrow ditches (Section 3.0, this report). Corps permit records prior to the 1970s variously identify "San Francisco Bay" or the nearest named waterway (listed as "navigable" or not) as the "waterway" of permit and Public Notice actions. The Corps in fact did <u>not</u> use the lists of navigable waterways as a geographic boundary of its RHA jurisdiction (Section 3.0). The 1932 list of "navigable waterways" omitted some of the largest tributaries of San Francisco Bay and San Pablo Bay that were used for contemporary navigation and were in fact regulated by Department of Army authorizations, including Novato Creek, Coyote Creek Guadalupe River, Newark slough, Montezuma Slough, Belmont Slough and Steinberger Slough. The list also omitted explicit reference to San Francisco Bay, San Pablo Bay, Suisun Bay, and their connecting Straits. It would be absurd and historically incorrect to interpret their absence from lists as an affirmative disclaimer of RHA jurisdiction.

4.2.4. "Traditional" navigable water status and "significant federal nexus" of historic tidelands and tributary sloughs of Westpoint Slough, San Francisco Bay: Corps permit history

Current Corps and EPA national guidance on jurisdictional determinations (USEPA and U.S. Department of Army 2007) refines criteria for preparing fact-specific analyses to determine whether wetlands and other waters that otherwise meet standard Corps jurisdictional criteria have a "significant nexus" with a "traditional navigable water". The national criteria guidance applies primarily to inland (nontidal) wetlands and fluvial drainage systems and floodplains, but the pre-Clean Water Act Corps permit history of tidelands that became the Redwood City salt ponds, and similar tidelands and sloughs, provide site-specific relevant tests of current national jurisdictional guidance influenced by SWANCC/Rapanos case law.

The Redwood City salt ponds are not inland "isolated" waters: they are diked tidelands of San Francisco Bay itself, separated by dikes revocably permitted by the Corps in 1940. The original, existing dikes (levees) that impound concentrated San Francisco Bay waters at the Redwood City salt ponds along Westpoint Slough were authorized by the revocable Department of the Army (DA) permit under the authority of the Rivers and Harbors Act, issued to Stauffer Chemical Company in 1940. <u>But for</u> the (revocable) historic federal Department of Army permit to construct dikes and slough dams along Westpoint Slough, the beds and banks of the salt ponds, and their water surfaces, would be <u>continuous</u> with those of the adjacent <u>traditionally</u> <u>navigable</u> waterbody, San Francisco Bay. The tidal waters of the Bay would ebb and flow through the diked baylands of the salt ponds but for the revocably permitted slough dams and salt marsh dikes.

It is undisputable that the Corps issued (revocable) permits to construct dams across small unnamed tidal sloughs and ditches, and levees on "banks" (high tidal salt marsh) bordering tidal sloughs of South San Francisco Bay at Westpoint Slough (Section 3.0). It is thus also indisputable that the Corps in fact historically ("<u>traditionally</u>") interpreted all these tidelands and sloughs as part of San Francisco Bay as a navigable waterbody, prior to the Clean Water Act and later regulatory refinements of Rivers and Harbors Act jurisdiction. The permit history cited in Section 3.0 demonstrates that the Corps did not <u>in fact</u> restrict assertion of its "traditional" (pre-Clean Water Act) jurisdiction to selected listed, named waterways within San Francisco Bay or exclude nameless tidal sloughs, ditches, or tidelands from its "traditional" jurisdiction over the whole of San Francisco Bay. The physical and permit history of the diked tidelands that comprise the Redwood City salt ponds demonstrate that the ponds <u>are themselves</u> an extension of a traditional navigable waterbody. Rivers and Harbors Act jurisdiction is not extinguished by DA permits or sudden artificial changes in the condition of a navigable waterbody.

Even if the historic permit record of the Redwood City salt ponds did not establish that they were in themselves a portion of San Francisco Bay as a traditionally navigable waterbody, an analysis of federal "significant nexus" to contemporary San Francisco Bay reveals that its factual connection to the Bay remains ineradicable and extensive:

- The <u>salt ponds are essentially impoundments of San Francisco Bay waters</u>: <u>they could and would not exist except as impoundments of San Francisco Bay waters</u>. The active industrial

manipulation of concentrated bay waters by evaporation and water management does not alter their source.

- The solutes (salts) in the salt ponds that exclusively provide the economic (direct interstate commerce) value of industrial salt ponds derive exclusively from San Francisco Bay. These salts include both halite (sodium chloride, common salt) and bittern, both sold for industrial and other commercial uses.
- The solutes (salts) in the salt ponds that exclusively provide the biological basis for primary productivity (salt-loving microalgae, bacteria), and the organisms themselves, were derived exclusively from San Francisco Bay sources.
- The entirety of the Redwood City salt ponds were authorized by Congress in 1988 to be included in the San Francisco Bay National Wildlife Refuge, which is established to conserve the unique water-dependent fish and wildlife resources of national importance in San Francisco Bay.

In addition to the fundamental hydrologic connectivity between salt ponds and the bay provided by the salt pond intake and concentrator pond system that created all the brines at Redwood City, the following secondary hydrologic connections have been documented in San Francisco Bay:

- The Regional Water Quality Control Board (RWQCB) has documented significant hydrologic connections between a bittern pond (Pond 13, Newark) and the traditionally navigable waterbody San Francisco Bay, due to past cracks, holes, and subsurface seepage of bittern into adjacent tidal marshes and sloughs, affecting water quality (RWQCB 1985).
- Ver Planck (1958) concluded that significant leakage occurs generally in concentrator ponds (the original condition of pond 13); the theoretical 10:1 ratio of concentrator to crystallizer pond area is in practice 15:1 because of pond leakage and rainfall inputs (Ver Planck 1958)
- Leslie Salt conceded at least one instance of direct tidal overtopping of a bittern pond levee (hydrologic input of tidal water) and backflow of "diluted" bittern to tidal waters of the Bay in December 1982 (Washburn 1985b), and other instances should be expected based on the authorized levee repair cycle. A similar phenomenon of bittern pond surface brine spillage the Bay was again reported by the RWQCB in the last decade (Rogers 2007).

Thus, the salt ponds at Redwood City not only have "significant nexus" to the traditionally navigable waterbody of San Francisco Bay in modern times, the Corps in fact "traditionally" asserted jurisdiction over the minor, nameless tributary sloughs and "banks" (salt marsh) of the tidelands of Westpoint Slough (the site of modern Redwood City salt ponds) as portions of the traditionally navigable waterbody itself.

5.0 Conclusions

The geographic extent of CWA Section 404 jurisdiction in all salt ponds is established first by their commerce clause nexus as waters that have been used, and are susceptible to use, for commercial crude salt production in interstate commerce. Additional Section 404 commerce clause nexus is established by their past use and susceptibility to Refuge-type use (recreation, wildlife viewing), variable degrees of migratory bird or endangered species use, and actual or potential brine shrimp harvest. Brine shrimp harvest (past or potential/"susceptible" use) also establishes and expands RHA 10 jurisdiction from diked unfilled slough beds to the entire surface of the impounded historic tidal marshland and creek system of the salt pond bed. At a minimum, RHA 10 jurisdiction extends inextinguishably over all dammed (diked) tidal slough beds below the original relative position of Mean High Water, even if brine shrimp boat transport is not considered in Section 10 RHA determination.

Hypersalinity or specific ion composition of salt pond brines, like the artificial nature of industrial salt ponds, is no barrier to CWA Section 404 jurisdiction. There is no regulatory basis for establishing salinity or brine composition thresholds for CWA Section 404 jurisdiction, and their arbitrary assertion would inevitably cause capricious and unpredictable, meaningless changes in jurisdictional status at best. At worst, an arbitrary salinity or compositional threshold for "waters of the U.S." would provide an arbitrary means of eliminating jurisdiction and circumventing regulation, contrary to the purpose of the CWA – rewarding rather than regulating degradation of water quality. The Corps San Francisco District has a long history of broad assertion of its Rivers and Harbors act authority over diking and filling tidal marshes and small tidal creeks and ditches, even before the era of environmental quality regulation.

Key factual determinations for analysis of contemporary Corps jurisdiction under the Clean Water Act and Rivers and Harbors Act include:

- Prior to the Clean Water Act, the Corps in fact "traditionally" asserted Rivers and Harbors Act (traditional navigable waters) jurisdiction over the minor, nameless tributary sloughs and "banks" (salt marsh) of the tidelands of Westpoint Slough (the site of modern Redwood City salt ponds) as portions of the traditionally navigable waterbody itself. (Sections 3.0 and 4.0)

- The brines that currently occupy the permanently flooded ponds, and the pond beds themselves, are impoundments San Francisco Bay tidal waters. These impoundments have merely been artificially managed to maximize evaporation, brine concentration, salt saturation, and salt crystallization, like natural salt-producing salt pans and salt ponds (Ver Planck 1958), but they are fundamentally jurisdictional impoundments of San Francisco Bay that were permitted by the Corps San Francisco District prior to the Clean Water Act.

- The original, existing dikes (levees) that impound concentrated San Francisco Bay waters at the Redwood City salt ponds along Westpoint Slough were authorized by the revocable Department of the Army (DA) permit under the authority of the Rivers and Harbors Act, issued to Stauffer Chemical Company in 1940.

- The tidal channel beds within the diked marsh plain that forms the bed of the salt ponds were regulated as (and remain under current regulation and guidance) lateral extensions of the traditionally navigable waterbody, San Francisco Bay.

- But for the (revocable) historic federal Department of Army permit to construct dikes and slough dams along Westpoint Slough, the beds and banks of the salt ponds would be continuous with those of the adjacent traditionally navigable waterbody, San Francisco Bay.

- The surface waters of San Francisco Bay would ebb and flow over the diked sloughs, banks and marsh plains but for the (revocable) historic federal Department of Army permits to construct dams across sloughs and dikes on the banks of slough.

- The salt ponds at Redwood City have "significant nexus" to the traditionally navigable waterbody of San Francisco Bay in modern times because all solutes (salts) of direct commercial and indirect biological values of national importance (including its designation to be included in a National Wildlife Refuge) are derived exclusively through impoundment of navigable San Francisco Bay waters. (Sections 1.0, 4.0)

- Rivers and Harbors Act jurisdiction is not extinguished by Department of Army permits or sudden artificial changes, and the San Francisco District has asserted Section 10 jurisdiction at least over unfilled tidal sloughs (below the plane of former mean high water) behind dikes.

- The bittern pond is a former concentrator pond that was long used for industrial purposes in interstate commerce (salt production) (Ver Planck 1958; 1953 map of SF Bay Pond system) (Section 1.0)

- Bittern brines produced in the South Bay solar salt industry were themselves were sold in interstate commerce, (Ver Planck 1958)and are susceptible to use for interstate commerce. (Section 1.0)

- Salt ponds are also susceptible for use, and have been used for commercial harvest and transport of brine shrimp sold in interstate commerce, under lease agreement from the Refuge (USFWS 1992) (Section 1.0)

- Salt pond types such as concentrator, bittern, and pickle ponds are interconvertible at the discretion of the operator (Van de Kamp 1986). Pond 13 is a former concentrator pond converted to bittern storage use after commercial sale of bittern was discontinued. (Sections 1.0, 4.0)

- The Corps has established consistent precedents of asserting Section 10 RHA and Section 404 jurisdiction over salt ponds, and explicitly over salt ponds with saturated and supersaturated brines and slough traces (crystallizers at Napa; Corps Permit No. 400258N, 2007; crystallizers in South Bay, Corps Permit No. 19009S98) without exception since the 1980s.

- The Corps has in general broadly asserted "traditional" Section 10 jurisdiction (prior to 1970s precise regulatory criteria for geographic jurisdiction under Section 10) over construction of dikes on tidal slough banks (marsh banks) and dams across tidal sloughs for purposes of marsh reclamation (conversion to salt ponds and agriculture) since at least 1904.

- The Regional Water Quality Control Board (RWQCB) has documented significant hydrologic connections between bittern ponds and the traditionally navigable waterbody San Francisco Bay, due to spillage cracks, holes, and subsurface seepage of bittern into adjacent tidal marshes and sloughs, affecting water quality (Sections 1.0, 4.0).

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STATEMENT OF QUALIFICATIONS

Peter Baye (Ph.D. Plant Sciences, University of Western Ontario, Canada) is a coastal ecologist and botanist with over 30 years professional experience in management, restoration, regulation, applied research, and planning of coastal wetlands, beaches, and dunes. He was a environmental analyst and regulatory project manager for the U.S. Army Corps of Engineers, San Francisco District, from 1991 to 1997, where he prepared Clean Water Act Section 404(b)(1) analyses, jurisdictional determinations, public interest evaluations, endangered species consultations, and analysis of environmental impacts, mitigation and alternatives pursuant to the National Environmental Policy Act (including joint EIS/EIR management). He was responsible for regulatory and scientific analysis of the Leslie Salt/Cargill levee and salt pond operation permit application from 1991-1994, and collaborated with the District's Office of Counsel and Department of Justice during litigation over enforcement actions and jurisdictional disputes within the scope of the Cargill permit application. He worked as staff biologist for the U.S. Fish and Wildlife Service (Sacramento Fish and Wildlife Office) Endangered Species Division from 1997-2002, where he prepared endangered species recovery plans, assisted with recovery implementation and technical support, and Endangered Species Act Section 7 consultations. During both USACE and USFWS employment, he contributed to writing the San Francisco Bay Area Wetland Habitat Goals Project. Since 2002, he was worked as an independent consulting coastal ecologist, with emphasis on conservation, restoration and management of coastal wetlands, lagoons, beaches, and dunes, and implementation of endangered species recovery actions.

FIGURES

Figure 1. Aerial photograph dated 10-5-1943, showing the baylands of Redwood City Salt Pond system area as they existed at the time. The baylands between First Slough and (artificial) Flood Slough were tidal salt marsh and creeks (area occupied by modern ponds 9, 9A, 8W, 8E, 7A, 7B, 7C). The diked area along northern Westpoint Slough occupied by modern crystallizer ponds and Pond 10 were salt evaporation ponds (concentrators) or other diked baylands, lacking the rectangular beds of crystallizers. No bittern storage ponds existed (bittern storage did not occur until the 1970s).

a

Figure 2. 2007 Cargill Redwood City salt ponds. a) aerial photograph showing salt ponds and and adjacent salt marshes and tidal sloughs

b

Figure 3. 2007 Cargill Redwood City salt ponds, showing 2002 Cargill pond numbering following WRA 2002. Ponds 9, 9a, and 8e were identified as bittern storage ponds in 2002. Ponds 7A, 7B, 7C, and 8W were identified as pickle ponds in 2002. Rectangular ponds 1-9 were identified as crystallizer ponds in 2002. Pond 10 was identified as a bittern desalting pond in 2002. The current post-industrial production types or uses of these ponds, if any, have not been determined. Bittern Pond 9 exhibited extensive emergent bed and excavated/filled mounds and ridges in winter 2010.

a

b

c

Figure 4. Recent bed modification of bittern pond 9. a. Summer 2009 aerial photo showing parallel rows of cut and fill ridges and troughs. Note the emergent "dry" beds of Pond 9 and adjacent pickle ponds (7A-C; brine in relict tidal slough channel only). b-c. Interior of Pond 9 viewed from Westpoint Slough, January 2010.

Figure 5. Pond 9 (south), hypersaline emergent mudflats and shallow flooded flats outside of excavated/filled portion, viewed from Flood Slough, January, 2010. Scattered fill mounds and pipes are present in the partially drained bittern pond flats.

Figure 6. Recent modification of bittern desalting Pond 10. Conversion to marina in use, and under construction on east side; conversion to shallow saline lagoon and mudflats, west side. Winter 2010 photos.

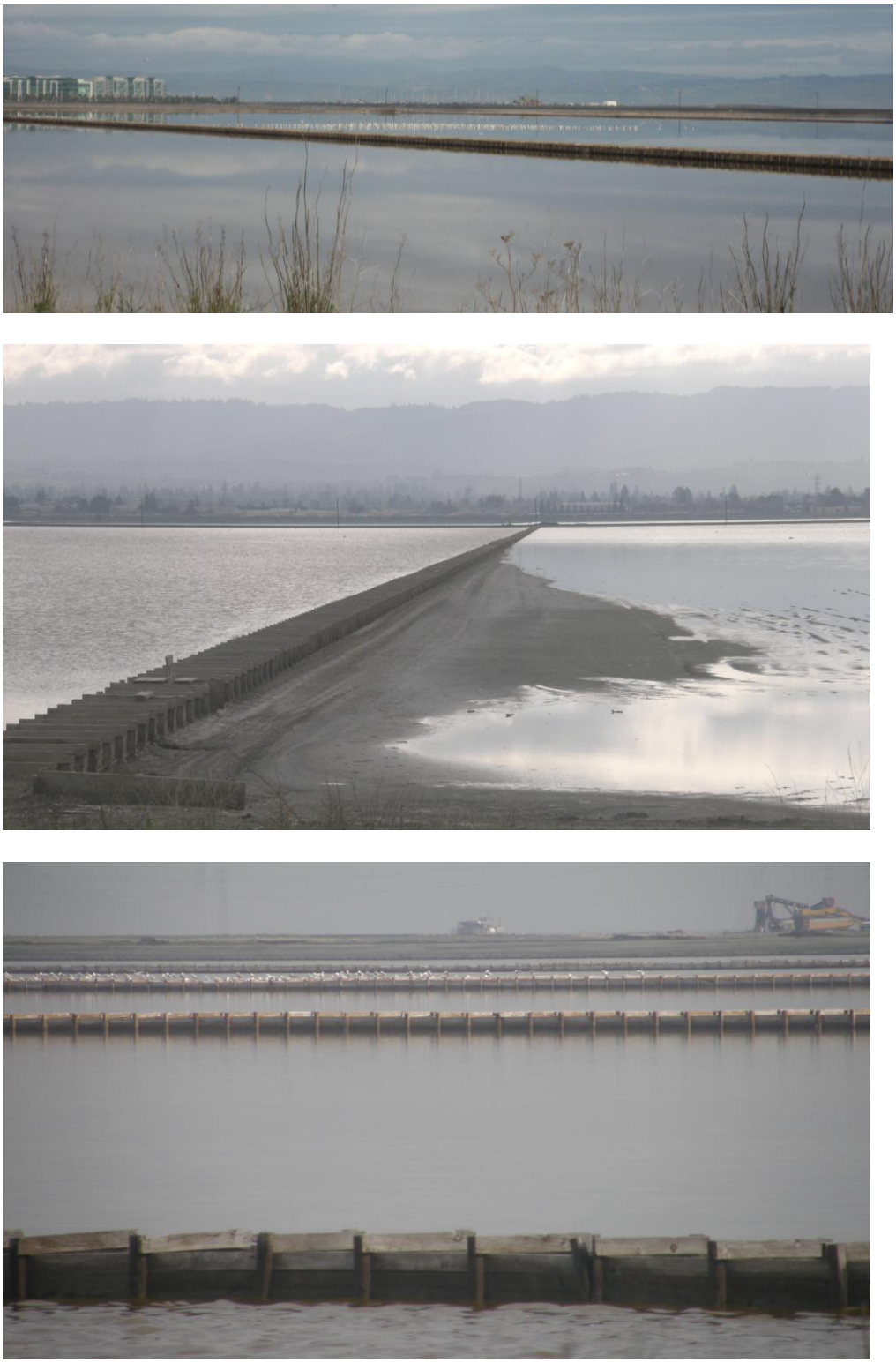

Figure 7. Ground views of crystallizer salt ponds at Redwood City, fall 2009 and winter 2010. Note flock of white waterbirds (unidentified) roosting in the crystallizer pond, top.

Figure 8. Pond 7c, viewed from Bayfront Park/Flood Slough, January 2010. Tidal marsh vegetation extents to crest of perimeter levee; Flood Slough at extreme high tide (marsh submerged), foreground; Pond 7c with internal cross-levees, background.

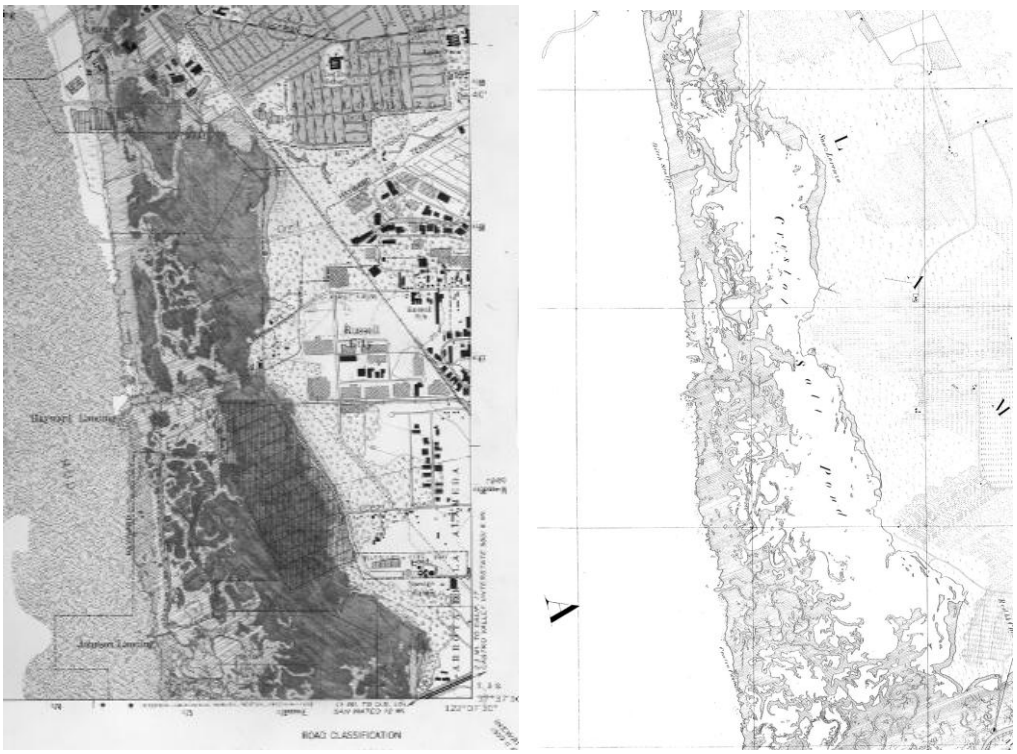

Fig. 9 Crystal Salt Pond (Hayward/San Lorenzo), the largest early historic natural salt pond in San Francisco Bay. a. overlay of salt pond on USGS quad sheet (excerpted from Grossinger and Brewster 2003). b) excerpt of Crystal Salt Pond from U.S. Coast and Geodetic Survey sheet T-635 (early to mid-1850s field mapping) .

Figure 10. Pond 8e and 4 (former crystallizer pond) filling operations. Google Earth image July 2007, accessed February 2010. Note series of spoil (dewatered sediment) piles and slip-face (steep fill edge, shadow) at edge of spread by ground-based (scraper) equipment in Pond 4. Note regular, structured fill pad pattern and topographic relief (shadow of steep slip-face at edge of fill) of fill in Pond 8e. Google Earth image July 2007, accessed February 2010.