FARMING FOR WILDLIFE:
AN OVERVIEW OF
AGRICULTURAL OPERATIONS AT STATEN ISLAND, SAN JOAQUIN COUNTY, CALIFORNIA

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1.0 INTRODUCTION

This report was prepared to document the past and present farming operations on Staten Island in the Sacramento-San Joaquin Delta (Delta) of California and to specifically relate these operations to the successes in "wildlife-friendly" farming on the island. Agricultural conversion of the rich bottomlands and marshes of the Sacramento-San Joaquin Delta began with the passage of the Swamp and Overflow Act shortly following the California Gold Rush in 1850 (Delta Protection Commission 1994). Large areas of the Delta's natural habitats were diked and drained (i.e., reclaimed) and converted to some of the richest farmland in the world. The undeniable productivity of Delta farmland is only rivaled by its past productivity as natural wetland habitat that supported greater numbers and variety of resident and migratory fish and wildlife than currently found in the Delta.

At present, the Delta region supports over 500,000 acres (202,429 ha) of agricultural land, most of which was formerly wetland habitat consisting of either riparian or seasonal and perennial marsh communities. Staten Island, located within the Delta in the floodplain of the Mokelumne river system, was historically primarily composed of perennial marsh, which was reclaimed for agriculture (Soil Conservation Service 1993). Flood control on the Mokelumne River upstream of Staten Island curtailed seasonal flooding of riparian and other floodplain habitats and allowed conversion of many floodplain areas to agricultural uses such as tomatoes, grains, and orchards. Tomato production was a key agricultural commodity to the east of Staten Island and was also a key component of agriculture in the Sacramento Valley until market forces caused a drop in prices in the early 1990s (Delta Protection Commission 1994). The drop in tomato prices fostered a conversion of agricultural lands in the Delta to other crops, including wine grapes. Between 1976 and 1993 nearly 4,500 acres of new orchards and vineyards were introduced to the Delta region replacing either "native" lands or other intensively farmed areas (i.e., tomatoes) (Department of Water Resources 1993). As a result of past and present agricultural conversion, many of the wintering areas that migratory waterfowl and wading birds depended on in this portion of the Pacific Flyway have been lost. Because the vast majority of historic natural wetland habitats have been lost to agricultural uses the agricultural lands are left to fill the wildlife habitat void where possible. Some agricultural areas (e.g., orchards, vineyards, turf farms)are not able to provide suitable habitat for migratory birds; however, sites producing row or field crops are often flexible enough in cropping patterns and management options to provide some form of habitat during part of the year.

At Staten Island, the farm managers have been engaged in a long-term effort to tailor the farming operations and practices so that the island's agricultural operation is economically viable while providing abundant wildlife values during critical periods of the year. The successes from both an agricultural as well as a wildlife habitat standpoint have resulted in Staten Island often being cited as a prime example of what is frequently referred to as "wildlife-friendly farming." This report documents the history of agricultural operations at Staten Island and also describes the practices, operations, and maintenance activities that have helped create the unique blend of viable agriculture and wildlife habitat that we see on Staten Island today.

1.1 SETTING

Staten Island is located within the Delta between the North and South Forks of the Mokelumne River, near Walnut Grove in San Joaquin County (Figure 1). Currently owned by The Nature Conservancy and operated by Conservation Farms and Ranches, Inc., a non-profit affiliate of

The Nature Conservancy, this 9,200-acre (3725 ha) farm plays an important role in supporting habitat for wildlife in the Delta region. The area receives high use by wintering sandhill cranes (*Grus canadensis*) and waterfowl, as well as supporting a wide variety of other wildlife throughout the year (May & Associates, Inc. 2003). The heart of the Delta region is characterized by expanses of deep organic peat soils reclaimed from the marsh habitats that formerly typified the Delta. Similar to other reclaimed Delta islands most areas of Staten Island lie below sea level due to soil subsidence and aggradation of waterways (Soil Conservation Service 1993). Surface elevations at Staten Island range from sea level to nearly 26 feet (6.1 m) below sea level. Large perimeter levees along the North and South Forks of the Mokelumne River surround the island and provide protection from winter floods.

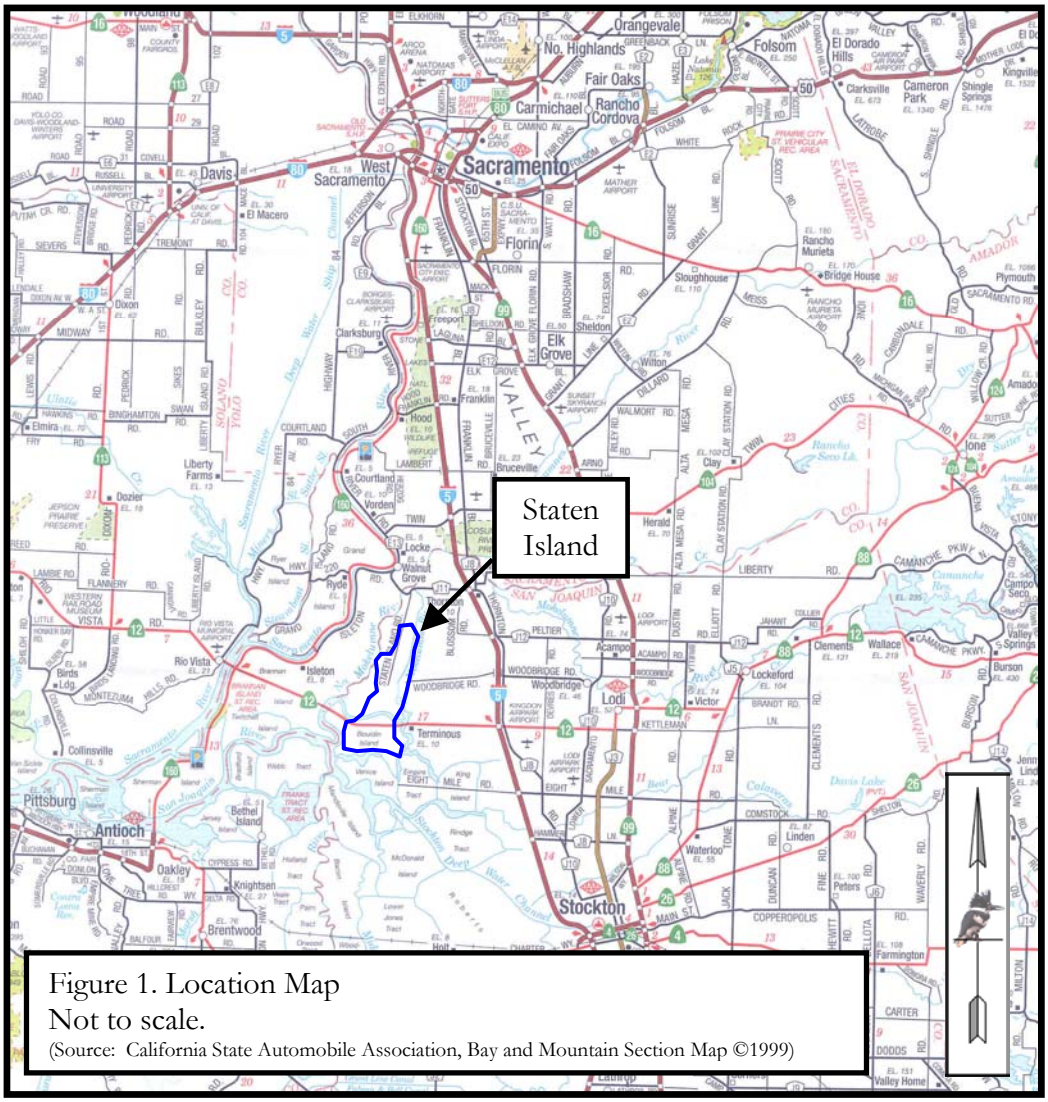

Figure 1. Location Map
Not to scale.
(Source: California State Automobile Association, Bay and Mountain Section Map ©1999)

Of the 9,200 acres (3,725 ha), approximately 8,419 (3409 ha) are suitable for farming on 153 fields ranging in size from approximately 12-124 acres (4.9-50 ha) (Figure 2). The remaining land is composed of levees, roads, ditches, canals, buildings, and operational facilities.

Included among the latter is the granary site at the north end of the island, including a dryer, six silos, and flat storage with a combined storage capacity of 10,000 tons. The grain silos were built about 1950, the flat floor warehouse in 1964, and the dryer in 1983. Some of the other non-agricultural areas on the island are also shown on Figure 2.

Staten Island has a complex irrigation system, with approximately 30 miles (48.4 km) of irrigation ditches, 81 miles (130.6 km) of drainage ditches (including 65 miles [104.8 km] of ditches between fields, and the 16-mile [25.8 km] main canal), 54 siphons, two discharge pump stations, and one river pump. Because farmed areas are below the water levels in the surrounding river channels, irrigation water delivery can be accomplished by gravity flow through a series of siphons to major farming units, and since it does not have a large associated cost (i.e., no cost to pump), delivering water to farm fields is less expensive and complicated than getting it out of the system. Irrigation tail waters accumulate in drainage ditches and flow to lower elevations at the southern end of the island, and are discharged back into the river system via pumps at the two large pumping stations (see Figure 3 for location).

Currently there are ten year-round employees (three managers, three shop workers, and four field crew) and an additional 12-14 seasonal workers are required for crop planting and harvest. Operations and maintenance for a farm of this scale is costly and to minimize outside expenditures, property maintenance activities are completed in-house whenever possible. Habitat management and improvement activities are also generally carried out using farm staff and equipment; these activities provide opportunities for use of labor and equipment when not needed by the farm operation.

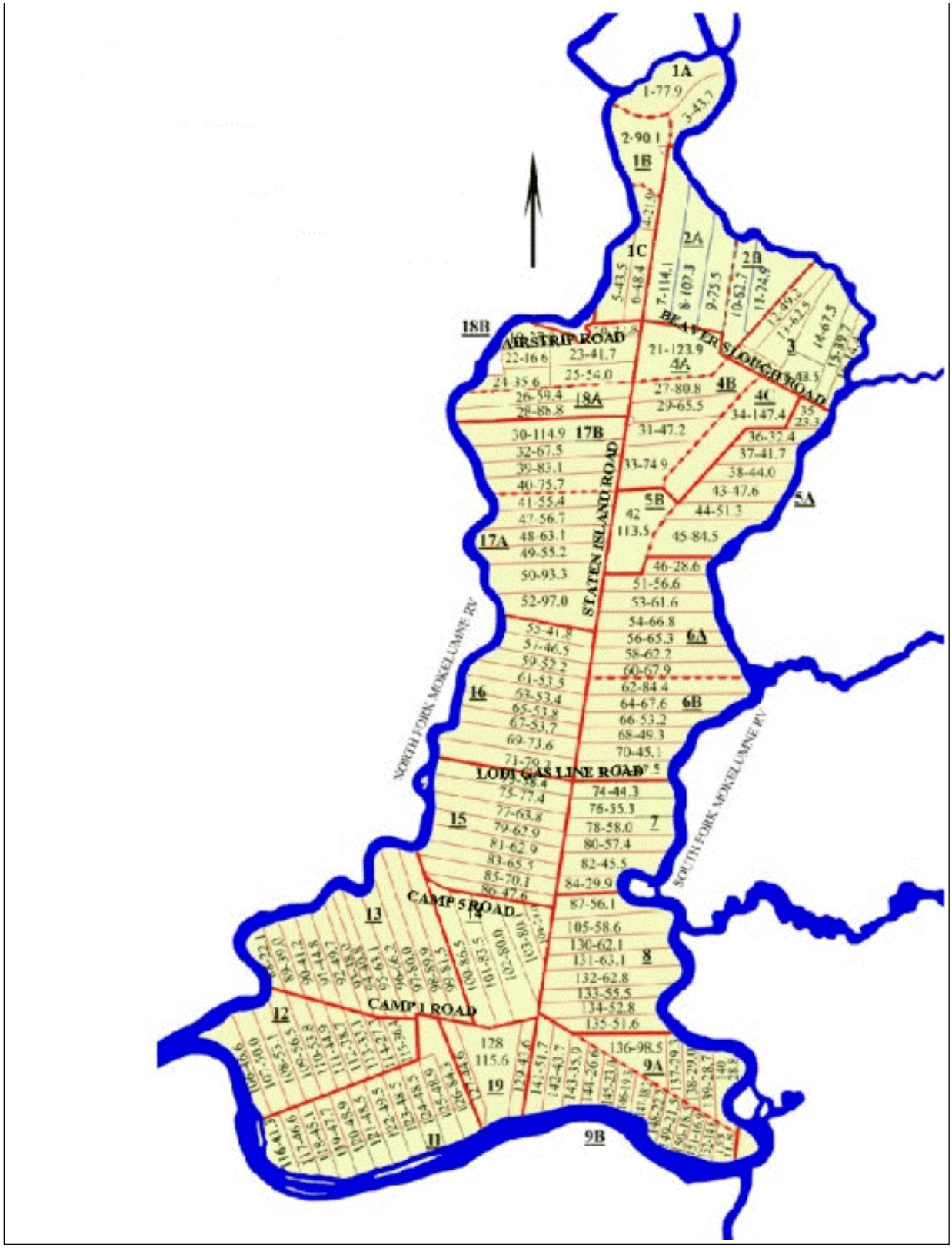

Figure 2. Field Map
Not to scale.
(Map Source: Conservation Farms and Ranches)

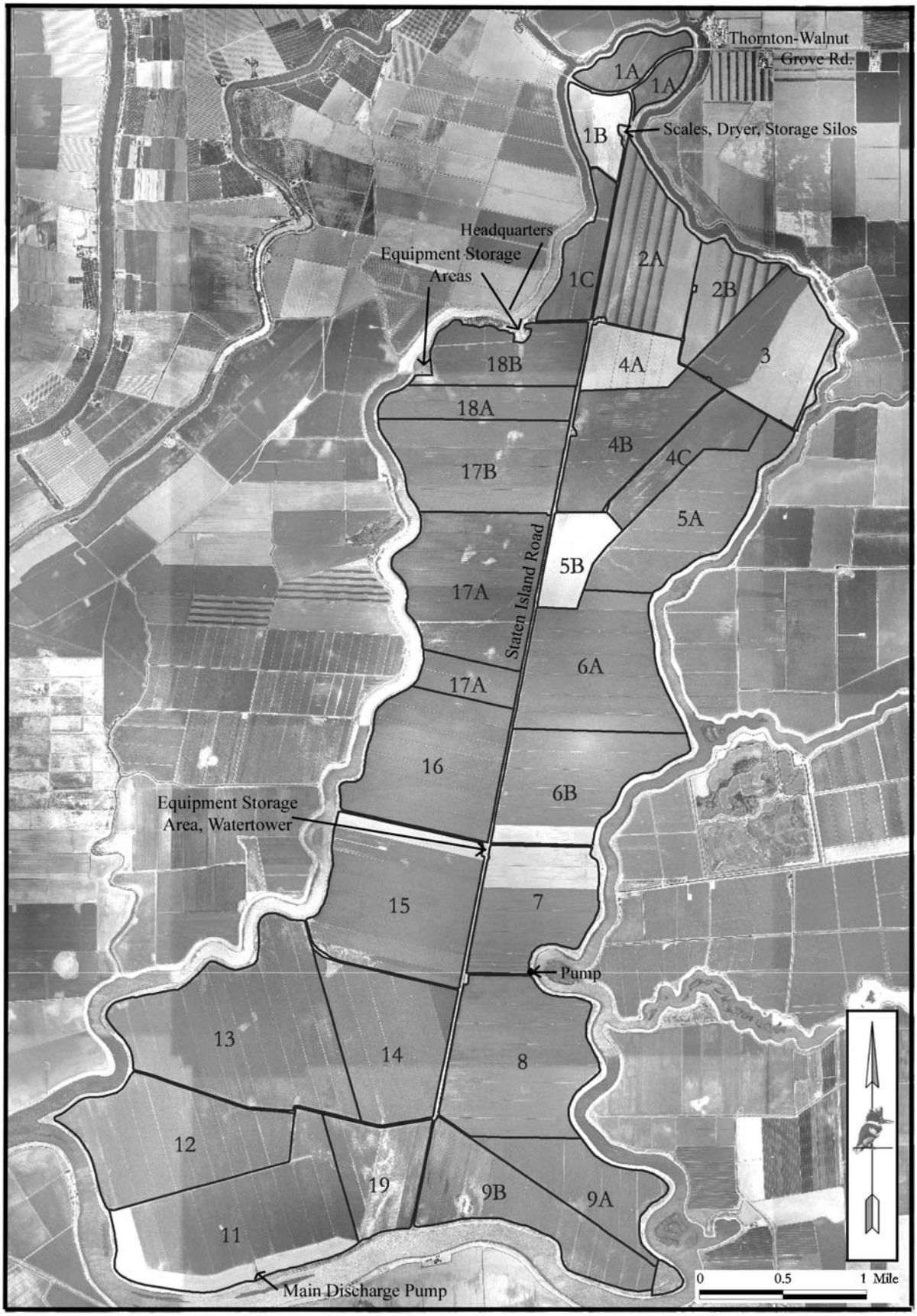

Figure 3. Location of Equipment Storage Areas and Pumps
Scale: 1:56,000±

2.0 HISTORY

The history of Staten Island roughly parallels that of much of the Delta region with complete conversion from marshland to agricultural production (i.e., reclamation) occurring gradually over the mid to late 19th century. Crops grown on Staten Island have varied over time with perhaps the most diversified production occurring when multiple tenants farmed the island in the late 19th and early 20th Centuries. The advent of modern farming equipment, pesticides, and herbicides has allowed Staten farm managers to specialize, producing fewer crop types with higher yields on a rotational basis. Although some wildlife use of Staten Island's agricultural landscape occurred historically, management of the island for wildlife use was not a priority until recently. Additionally, similar to other areas of the Delta, waterfowl and upland game (i.e., ring-necked pheasant) hunting were historically recreational uses of Staten Island. The following section briefly elaborates on the ownership history, cropping patterns, historical hunting pressure, and wildlife use of Staten Island following reclamation.

2.1 OWNERSHIP

Staten Island has been farmed since 1868 when the Kern Land Company began to reclaim the island's swampy marshland. Reclamation continued into the late 19th Century, with multiple tenants farming up to 38 camps (farming units). In 1939, Staten Island came under single ownership when M & T Incorporated purchased the island, and over time took over all active farming operations. Jim Shanks, the current manager, began working on Staten in 1952, and became manager in the early 1970s. In 1984, KKR (a leverage buyout firm) purchased Staten Island on behalf of Pacific Realty Trust, LP (PacTrust) with the idea that they would make a profit by subdividing the island into several large farming parcels and selling them to one or more separate entities. At that time Jim Shanks realized that Staten's wildlife value was beginning to rival its value for agriculture, and was able to convince PacTrust that keeping the island in sole ownership would yield a superior investment opportunity while also better enabling the continuation of wildlife habitat value enhancement.

2.2 CROPS

Historical crop production paralleled much of the rest of the Delta islands and was diversified, with Staten Island producing asparagus, tomatoes, sugar beets, and fruit orchards, with small areas of corn and wheat. Asparagus production was very labor intensive and the culture and harvest employed up to 300 workers at the south end of the island, however, in the late 1970s, asparagus canneries and local freezers abandoned the Delta region because of market conditions, and in combination with the complications of managing such a large group of laborers, lowered the profitability of growing this crop.

Following the downturn in local asparagus markets the major tomato markets shifted to the south of the state, while sugar beets became too labor intensive to grow in a cost effective manner on Staten Island. Historically, potatoes were also tried, but were affected by competition with weeds. Safflower was also attempted, but didn't work well as it required dry field conditions late in the growing season to allow the seeds to dry on the plant which resulted in increased oxidation of the peat soils. Before the availability of modern herbicides, corn was difficult to grow because of competition with dense stands of Johnson grass (*Sorghum halepense*).

Advances in farm machinery combined with the increasing cost of labor made crops which could be harvested using a combine (i.e., grains) more profitable, as much less labor is needed for harvest. Consequently, farming shifted primarily to corn and wheat in the 1970s, but wheat prices plummeted in the 1990s, causing an increase in the amount of corn planted.

For several years, an experimental rice program of 15 acres (6 ha) was conducted on the island by the Rice Foundation. Rice has not been grown commercially on Staten because profitability of the crop relies heavily on government subsidies and it has traditionally been over-produced in California. Additionally, growing rice on Staten Island would compete with farmers in the Sacramento Valley whose crop options are very limited due to heavy clay or hardpan soils. Conversion to rice is expensive because fields need to be laser-leveled and rice straw decomposition practices (i.e., burning, rolling, flooding) would need to be implemented, and the crop's high water needs would result in increased tailwater pumping costs. However, it is noteworthy that when the small area of rice was grown on Staten, it was very attractive to duck broods.

2.3 HUNTING

Sometime before 1952 through about 1974, Staten Island was leased to the California Department of Fish and Game as a public waterfowl and pheasant hunting area, hosting up to 300 hunters per day. This intense level of hunting pressure essentially kept waterfowl and crane numbers very low, with only small numbers of cranes (about 200) using the safety zone (closed area). In the mid-1970s, after the public hunting program was terminated because administration funds were cut, hunting became much more restricted by the farm manager in terms of numbers of hunters, time, and areas open to hunting (see Section 5.4 Hunting).

2.4 WILDLIFE USE

Prior to reclamation Staten Island likely supported expanses of permanent marsh, pockets of riparian scrub, and several meandering smaller sloughs. Soil survey data (Soil Conservation Service 1993) suggests that the southern 3/4 of Staten Island was dense permanent marsh with several small dead-end sloughs. The northern 1/4 of the island was probably a mosaic of permanent marsh and riparian scrub. Semi-permanent marsh was probably limited in this area and seasonal marsh was scarce. The island's habitats supported a diverse assemblage of resident wildlife and the open water areas of the marsh likely attracted migrating waterfowl in great numbers. Following reclamation, farming land on Staten Island probably flooded relatively regularly during the winter due to the primitive nature of levee and drainage systems in the late 19th and early 20th centuries. However, flooding probably only occurred following major storm or flood events that overwhelmed the Island's drainage or levee systems and no longer followed the natural hydrologic regime of the Delta. As levee and drainage technology improved the unintentional deep flooding of Delta islands was greatly reduced; however, the intentional shallow flooding of Delta islands for a variety of purposes (e.g., weed control, salt leaching, waterfowl hunting, and wildlife habitat) has been commonplace for nearly the past 70 years (Delta Protection Commission 1994).

The expansion of grain crop acreage in the 1970s, coupled with the reduced disturbance that

resulted from single-ownership farming and careful management of the hunting program, lead to substantial increases in crane and waterfowl use on Staten Island in the late 1970s and 1980s. During this same time period, cranes were losing traditional roost and forage areas due to land conversion to vineyards and orchards. Because of the large numbers of sandhill cranes and waterfowl using the Island, it was recognized as an important site by the Central Valley Habitat Joint Venture (Joint Venture) and Ducks Unlimited, Inc. (DU) in the early 1990s. Jim Shanks then relied on the advice of several wildlife authorities, including Roderick Drewien, a renowned sandhill crane biologist, David Paullin with the Joint Venture, Ed Collins and Fritz Reid of DU, and David Yee of the Stockton Audubon Society, to improve wildlife management on Staten Island.

3.0 FARMING TODAY

3.1 PHILOSOPHY

Since shifting primarily to grain production in the 1970s (and a long-term commitment reflected in installation of the grain dryer in the 1980s), Staten Island management has focused on carefully planning and managing operations with the combined goal of improving efficiency and profitability and enhancing wildlife values. In contrast to mainstream farming philosophy, Jim Shanks strives to find a middle ground between farming and environmental goals. Finding the balance between profitable farming and wildlife habitat is an ongoing process and is being conducted using an adaptive management approach. The current farming program includes 6,800-7,000 acres (2,753-2,834 ha) of corn, 1,000-1,200 acres (405-486 ha) of wheat, and about 500 acres (202 ha) of tomatoes. Genetically modified crops have not been planted. Tomatoes are grown and harvested by a tenant farmer, while Staten Island employees grow and harvest the grain crops.

Two major corn types have traditionally comprised the bulk of the crop, and include both short- and long-season varieties. Additionally, several experimental types of corn are tested each year. Because of the on-site storage facilities it is possible to maximize profit through a combination of pre-selling (i.e., selling prior to harvest) and post-harvest storage to take advantage of seasonal price variations outside the traditional harvest season.

Table 1 illustrates and summarizes the typical farming and wildlife activities on a month-by-month basis on Staten Island, however, farming activities may vary from year to year by as much as a month, depending on field conditions, market conditions, and management considerations.

3.2 TILLAGE

Field tillage (i.e., the cultivation and preparation of a field's soils for planting) is a critical component of any farming operation and can greatly influence the yield from the crop that will be planted that year as well as the yield that the field will produce in the years to come. A farmer's tillage choices can also have an effect on overall profitability because each tillage system (e.g., conventional tillage, conservation tillage, no-till method, etc.) has an associated labor, fuel, and equipment cost that must be considered alongside of the potential yield benefit. At Staten Island, Jim Shanks has been incorporating conservation tillage system principles whereby crop residues are left on the fields covering a third or more of the soil surface resulting in benefits for wildlife (i.e., crop residue for food) as well as the farming operation as a whole (i.e., reduced labor and fuel costs, better soil tilth, reduced wear on machinery). Additionally, within the tillage system there is an assortment of tillage equipment that can be used (i.e., plows, chisels, harrows, etc.), each with distinct advantages as well as disadvantages.

Which tillage system and/or equipment to use and when requires careful consideration of a number of variables including field condition, labor and fuel costs, equipment availability, climate conditions, and market conditions. On Staten Island, Jim Shanks is also adding another variable to the tillage decision, wildlife habitat management. Tillage begins when the fields are prepared for planting, and to be ready for planting a field must be clear of weeds and any crop

residue that could interfere with seeding. Currently, disk-harrowing and ripping are the primary cultivation methods used at Staten Island, however, chopping, chiseling, and plowing are also utilized. Each of these methods is briefly described below:

- Disk harrowing chops and rolls the upper soil 6-8 inches (15-21 cm) deep and buries crop residues and weeds; requires large and powerful equipment to be efficient on a large scale (i.e., wide pass needed to offset slow speed); moderately expensive.
- Ripping uses long steel shanks to lift the soil, helping to aerate and reduce compaction, however, it does not turn the soil over and thereby leaves the crop residue on the soil surface; least expensive method. Tomato fields are typically ripped because of the compaction caused by harvesting equipment.
- Chopping is not a soil tillage method but rather a crop residue management method. Chopping involves cutting and chopping post-harvest residue near ground level and leaving the material on the soil surface as a layer of mulch to decompose over the winter; lower cost than disking in residue.
- Chiseling uses a chisel plow to penetrate and break up the compacted soil surface using vibration while leaving crop residue on the soil surface; different chisel point shapes and sizes can be used to vary degree of soil aeration/turning. Moderate power and fuel requirement; lower cost than disking or plowing but does not turn over soil.
- Plowing lifts and turns over the soil (at a greater depth than a disk harrow) and is used to incorporate crop residue into the soil, aerate the soil, control weeds, and prepare the seedbed. Because of their high power requirement, plows are often narrow and must be operated at a slow speed; high fuel consumption and greater than average tractor wear result in high costs.

On Staten Island fall chopping of corn residue (i.e., stalks, etc.) has been used extensively for the past two years (2001-2002). This practice results in a layer of crop residue on the soil surface that includes residual grain, once flooded or saturated this residue slowly decomposes releasing nutrients into the soil. As an added benefit, the chopped residue that is left on the soil surface contains residual grain and provides habitat for the growth of some invertebrates, both of which serve as foods for some wintering birds. The residue also provides a protective barrier for the soil, reducing the chance for wind or water erosion. Fall chopping of the corn allows much of the crop residue to decompose on the soil surface thereby minimizing the need for tillage such as plowing and disking to incorporate a large amount of residue. Chopping is also inexpensive in comparison because the equipment (essentially a large header/chopper on a combine) has a wider pass (24 ft [7.3 m]) than a disk harrow or plow. Chopped crop residues can also help suppress weed growth because the mulch restricts the amount of light reaching the soil surface.

In the beginning of the planting season rolling a heavy imprinter or incorporator over chopped fields pushes remaining residues beneath the soil and corrugates the soil surface, making the soil less likely to blow away. In contrast, plowing to incorporate crop residue digs about 16 inches (41 cm) deep and mixes soil horizons, and equipment is only eight feet (2.4 m) wide; it is the most costly in terms of hours, fuel, and tractor wear, and therefore is only used when necessary (e.g., heavy soil at the north end of the Island when it is compacted or for hard to work wet soils). Since new corn planting equipment uses forced air technology, it is more tolerant of the presence of crop residues, and chopping and chiseling have become more compatible; in 2003, these practices reduced spring tillage by 50% (compared to spring plowing of unchopped

residue), saving fuel and labor. From a labor and timeliness standpoint the benefits of chopping are clear because about 250 acres (101 ha) of corn stubble can be chopped by one operator in one day following harvest, while only 110 acres (45 ha) of corn stubble could be disced or chiseled, and only 35-40 acres (14-16 ha) could be plowed.

3.3 WEED CONTROL

Because of the exceptional moisture-holding capacity of Staten's organic soils, weed control is a major challenge to growing a successful crop. However, some plant species deemed weedy in a crop producing area can actually provide habitat for resident wildlife in non-crop producing areas (i.e., ditches and field edges). There is a delicate balance between managing for high crop yields while providing for some wildlife habitat and cover bordering the fields. If left unchecked, some of the noxious weeds growing adjacent to the fields can rapidly become serious pests within the cropland. The managers at Staten Island help maintain this balance by carefully timing herbicide application so that efficiency is maximized in cropped areas which in turn minimizes chemical, fuel, and labor expenses. Additionally, effective herbicide use reduces the need for repeat or rescue applications that can result in additional chemical inputs to the air, soil, and water that may potentially affect the natural environment. In addition to herbicide application, weeds have also been managed using tillage, sheep and horse grazing, and flooding.

For corn field preparation, Roundup® is used in most areas in February following field draining in lieu of discing, as it is less expensive and because fields may be too wet for heavy equipment access. Using Roundup for weed control is also favored over discing because it leaves consistent moisture across fields, and discourages birds from initiating nests (i.e., no suitable cover for nesting) where they might be lost when planted. Up to 80% of the corn seed is pre-treated with Gaucho® (a systemic insecticide) and therefore no insecticide is needed at planting for this portion of the crop.

Historically, large amounts of pre-emergent herbicides were used for weed control in the spring prior to planting. Operations changed to a primary use of post-emergent herbicides in the early 1990s with the development of Accent® for weedy grass control in corn, and in particular for control of Johnson grass (*Sorghum halepense*), a major problem weed in the Delta. Because of Accent's® efficacy, much less chemical is used today than was in the past (i.e., ounces vs. gallons per acre). Today, a total of 7,500 acres (3,036 ha) is treated with one sprayer by one operator, saving twice as much labor and three times as much horsepower and fuel.

The herbicide tank mix and application rate varies according to the weeds targeted at a given site. Clarity®, Permit®, and Lasso® are also mixed with Accent® for post-emergence broadleaf control in corn. Roundup® is also used for broad spectrum weed control. 2,4-D® is used for broadleaf weed control after the wheat is growing. Roundup®, 2,4-D®, and Garlon® are also selectively applied to problem sites in non-crop areas.

Ditches adjacent to corn fields are initially sprayed with Accent® to control broadleaf weeds as many corn varieties are not affected by this herbicide. Weedy vegetation along ditches is then left to grow to provide cover for wildlife unless noxious weeds develop. In wheat fields, 2,4-D® is applied by aircraft in January to control broadleaf weeds in the young wheat. Use of pesticides in tomato fields is more complicated, with pre- and post-emergent herbicides and insecticides

used. Spot spray control of weeds with tomatoes occurs throughout the growing season.

As mentioned previously, non-crop areas (i.e., field borders, ditches, etc.) treated with herbicides primarily include areas where the weeds present have potential to negatively affect the adjacent crops. The main levee on Staten Island comprises the largest non-crop area on the Island and weed management is an important issue especially as it relates to levee integrity and the need for visual inspections. Staten Island managers have been implementing a program of sheep and horse grazing to help manage weeds. Sheep grazing on the main levee begins in late May (after most bird nests have hatched), south of the areas used for horse pastures on the northern half of the Island. After crop harvest, sheep are moved to wheat fields which are planned for flooding. As wheat fields are flooded the sheep are rotated into harvested corn fields that are not planned for flooding that year. Sheep are removed from the Island in October around the time of the first frost (typically in mid-November [Soil Conservation Service 1993]).

Where possible, flooding of fields is also used through the winter as a weed control method, but because the fields are not completely level, water depths vary across the field, complicating weed control as some weed species can germinate and grow in shallow water. Therefore, some spot spraying is periodically needed in problem areas. Light disking is used in some wheat fields where water is too shallow to control weeds, and as mentioned previously, in some corn fields before spring planting.

3.4 FERTILIZER

In corn fields, liquid nitrogen (UN-32) is injected up to two weeks before planting, and starter fertilizer (8-24-6) is injected with seeds during planting. Wheat fields are fertilized as planted (also with 8-24-6). In contrast, tomatoes require larger amounts of fertilizer, both before and during planting, and when plants are about 10 inches (26 cm) high. UN-32 fertilizer is used in preference to ammonium nitrate because of worker safety concerns.

3.5 PLANTING

The selection of fields for specific crops is a complicated, yearly decision, based on irrigation and drainage blocks, summer leveling needs, rotations for weed control, and the placement of wheat in areas that can be used for early roost water for cranes. Corn planting begins in early April and continues for about 40 days. Tomatoes are planted from mid-April through mid-May. Winter wheat is usually planted in November or December, just before the normal period of heavy fall rains.

3.6 CROP IRRIGATION

Tomato and corn crops are sub-irrigated three to four times during the growing season by filling in-field ditches with repeated irrigations beginning the end of May, and occurring about two to three weeks apart through mid-August. Irrigation is conducted slowly for deep saturation. Sub-irrigation also generally results in reduced weed infestations. Lower elevation fields at the southern end of the Island are not irrigated as much as the other parts of the Island, as they receive subsurface water from the river (subbing) and their associated ditches function mostly as drains, not water delivery. Winter wheat generally receives sufficient moisture from rainfall

and supplemental irrigation is not necessary. The ditches in wheat fields serve primarily to allow for drainage. However, in drought years, V-ditches are used to irrigate wheat.

3.7 HARVEST

Winter wheat is harvested in mid-July, and tomatoes in mid- to late-August through early October. Corn is harvested from early September through October, and usually begins at the north end of the Island and proceeds south. Corn harvest used to begin in mid-September and continue through November. However, since the price for corn is better early in the season before market saturation, harvest now starts in early September when possible, and is finished by late October, resulting in a higher profit.

Within each corn field, headlands (field ends) are harvested first and disked to allow heavy equipment and truck access, and harvest usually proceeds from the center of the field to the ends. After harvest, residual stubble heights are typically 24 inches (62 cm) for corn and 16-18 inches (41-46 cm) for wheat. Corn harvest used to begin in mid-September and continued through November. However, since the price for corn is better early in the season before market saturation, harvest now starts in early September when possible, and is finished by late October, resulting in higher profit. Because of the early harvest on Staten Island about 25,000 tons of corn is harvested before other local farmers begin. Because more trucks are available early in the season and buyer's storage areas are empty, Staten Island can deliver 40-50 loads of corn a day, compared to other farmers who typically only haul one load per day during peak harvest season. From the field, corn is transported to the dryer and from there to storage. Early in the harvest, corn is moved out of storage to buyers as quickly as possible. Approximately 2/3-3/4 through harvest, out-shipments from storage end and the remaining corn harvested is stored then sold in the spring. The large drier at the mill allows this massive harvest and storage program that is the key to maintaining a good profit from corn. It is only by growing corn in volume and minimizing expenses that grain production at Staten Island is profitable.

3.8 POST-HARVEST

About half of the acreage of harvested corn fields are chopped after harvest and generally, every other field is chopped. Wheat stubble is usually ripped if the field is to be leveled for the next season. Wheat stubble remains unmanipulated in fields planned for winter flooding. Tomato fields are deeply ripped to reduce soil compaction (immediately prior to spring field preparation).

To allow winter flooding of all three crops, temporary levees are pushed up with a Caterpillar D6H bulldozer, and a backhoe is used to install water control structures. Field levee construction takes one operator about one month to complete. Some limited flooding begins in harvested wheat fields before early September to accommodate the arrival of cranes, but flooded acreage increases rapidly as the harvest concludes and staff time can be allocated to building levees in corn and tomato fields.

3.9 WINTER WATER

Some flooding begins in harvested wheat fields in early September to accommodate the arrival

of cranes, but acreages increase as the corn and tomato harvest concludes and more staff time can be allocated to building levees. Flooding of fields provides habitat for cranes, waterfowl, shorebirds, and other waterbirds. Agricultural benefits include weed control, prevention of soil oxidation and subsidence, decomposition of crop residues, and leaching of salts (which can significantly decrease crop yields). Flooding also improves soil texture, which in turn enhances yields. In the Delta region flooding of agricultural land for wildlife habitat, hunting, and soil salt management has been occurring on a fairly large scale (Figure 4) for many years (Delta Protection Commission 1994) and Staten Island fits prominently in the big picture. Flooding over the winter also helps maintain soil moisture after fields are drained, aiding in germination of the next crop.

Ideally, it would be beneficial to rotate winter flooding to all the fields around Staten Island so that each field received a flooding treatment about every three years. However, this is impractical given the present configuration of water management facilities on the Island. Flooding requires construction of temporary in-field levees, and fields west of Staten Island Road (the main gravel road down the center of the Island) are more economical to flood because the roadbed serves as a low levee and therefore only sideboard levees need to be built. In contrast, much more levee work is required to flood fields on the east side of Staten Island Road because a temporary low levee has to be built along the large drain that parallels Staten Island Road.

Water depths in flooded fields range up to about 2.5 feet (0.8 m), but the vast majority are less than one foot. Levels are sometimes drawn down in selected fields and then refreshed with new water, which helps flush salts from the soil, provides high quality late water, and helps to manage potential bird disease outbreaks such as avian cholera.

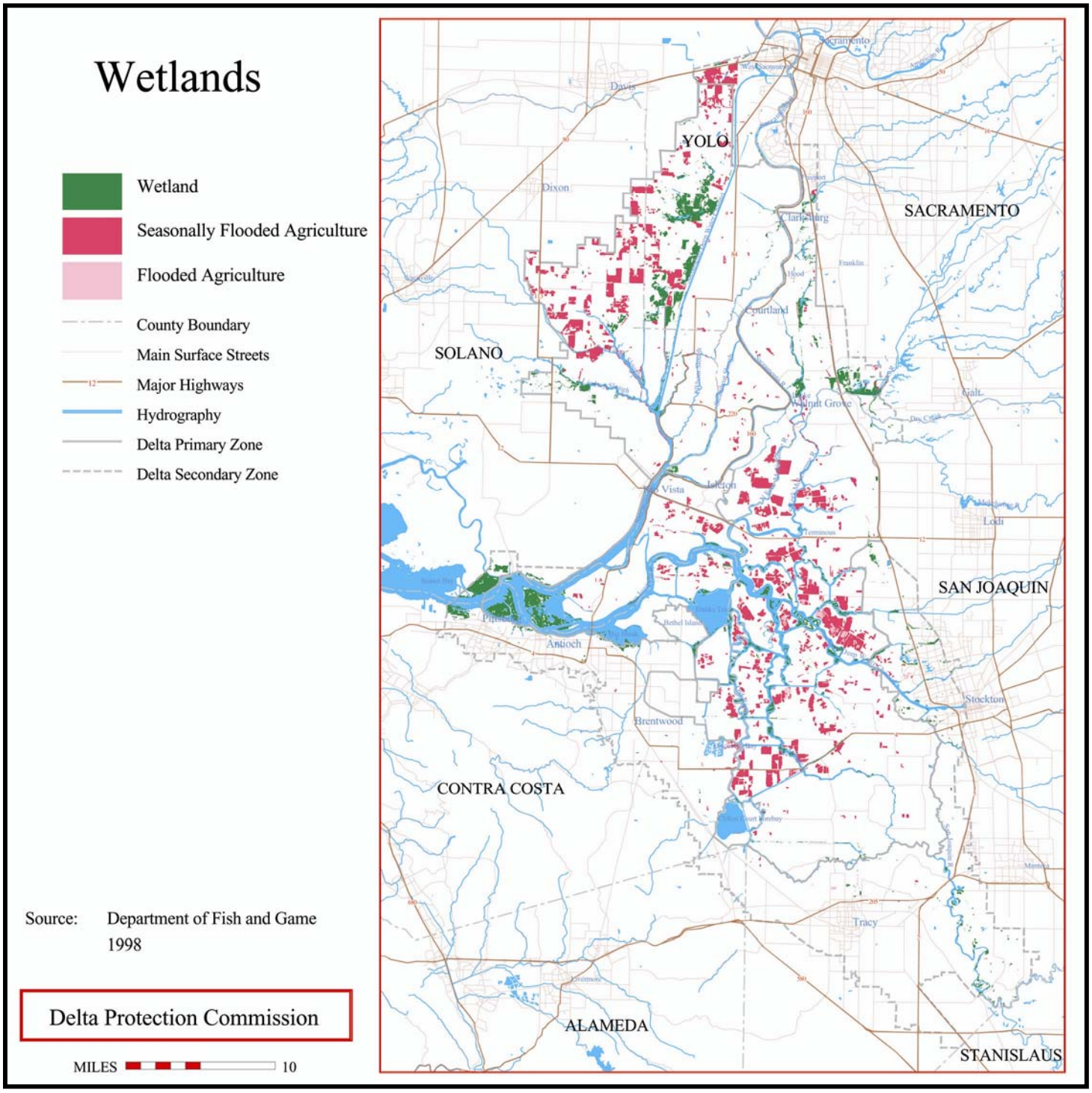

Figure 4. Location of Wetlands and Flooded Agriculture in the Delta
Map Source: Delta Protection Commission

4.0 FACILITIES MAINTENANCE

Over 800 acres (324 ha) of non-cropland areas on Staten Island require maintenance. Most of this area consists of narrow ribbons of roadway, ditches, and levees with a smaller proportion consisting of buildings, homes, and staging areas. These areas all form the habitat linkages between farmed habitats (i.e., fields) and the natural habitat along the two forks of the Mokelumne River. Managers at Staten Island have been managing these facilities from the perspective that they must reliably provide their respective functions; however, some balance can be achieved to benefit resident and migratory wildlife. The general activities associated with the important task of maintaining the island's main levee, roads and water conveyance system (i.e., ditches) are described below.

4.1 MAIN LEVEE

Because Staten Island lies mostly below sea level and surrounded by the North and South Forks of the Mokelumne River, there is the constant threat of flooding, which makes monitoring and maintenance of the main levee a critical task. Flood concerns continue to grow as urban development accelerates within the watershed of the Cosumnes and Mokelumne Rivers, hardening the watershed and increasing runoff. The outside (i.e., water side) of the main levee along both forks of the river is reinforced and maintained with rock riprap to minimize erosion primarily from wave action from recreational boating, but because the North Fork on the west side is larger and wider and experiences higher flows, it requires more maintenance. While trees and shrubs along the outside of the main levee occasionally need to be removed, this is only done when necessary to accomplish a levee rehabilitation project.

On the inside of the levees, a one disc-wide area (8 feet [2.4m]) is kept clear of vegetation at the base to allow monitoring for leaks during periods of elevated river levels. Grass is encouraged along the sides of the levee, but broadleaf weeds are treated with herbicides, applied by aerial application of 2,4-D® in February. Some spot-spraying (mostly just after harvest) of Roundup® on bermuda grass (*Cynodon dactylon*) is conducted as needed to keep it from spreading to the agricultural fields. The road on the top of the levee is occasionally mowed in spring to keep vegetation short to reduce fire hazard. As mentioned previously in the weed control discussion, sheep and horse grazing are also employed to reduce the potential for fire, and to keep vegetation at a low profile to make it easier to find leaks. Sheep-use patterns vary yearly, but cover much of the island, while horses are rotated among seven pastures at the north end. Overall the vegetation maintenance strategy that Staten Island managers have adopted for landside levee vegetation is to allow for maximum upland nesting and cover during the times when cropland is not hospitable but in the course of the year vegetation will eventually need to be removed to accommodate inspections.

Vertebrate pest control on the island includes control measures for coyotes (*Canis latrans*) and California ground squirrels (*Spermophilus beecheyi)*, which can threaten the integrity of the main levee with their burrowing and denning activities. Eradication of these species is not necessary; however, control is necessary to maintain populations at acceptable levels. Coyotes are dispatched on an opportunistic basis, while poison bait stations are placed in plastic PVC pipes distributed along the levee for ground squirrel control. Muskrats (*Ondatra zibethicus*) are not controlled, although they can damage small levees, resulting in the loss of winter water.

4.2 ROAD AND WATER FACILITIES

Gravel roads are graded periodically as needed after rains, in spring before planting starts, and before harvest if enough moisture is present. About 60% of the permanent ditches are cleaned during the winter in a given year, while the main canal is cleaned about every 10 years. Cleaning is necessary to maintain capacity; however, by not cleaning all the ditches annually insures that some cover will be available every year.

5.0 WILDLIFE MANAGEMENT

The basic needs of wildlife are adequate space, food, water, and cover. During fall and winter, sandhill cranes and waterfowl are very sensitive to human disturbance, which is a major factor influencing wildlife distribution. Management of Staten Island has focused on meeting wildlife requirements on a large tract of land and limiting disturbance to the extent possible while still maintaining an efficient and profitable farming program. A variety of wildlife-friendly practices work towards these goals, ranging from how water, crops, and weeds are managed, to how the hunting program is practiced.

5.1 WINTER WATER

Because wheat fields are harvested in July, flooding can begin in early September in time for sandhill crane arrival. This also provides habitat for early waterfowl migrants (including northern pintails [*Anas acuta*] and greater white-fronted geese [*Anser albifrons*]) and shorebirds. The flooding up of corn and tomato fields occurs shortly thereafter in October after fields are harvested, where water will not affect standing crops in adjacent fields and when manpower is available. In 2002-03, approximately 2,271 acres (919 ha) of croplands were flooded to provide fall and winter roosting and foraging sites for cranes, waterfowl, and shorebirds. These areas received heavy use by roosting and loafing sandhill cranes and waterfowl throughout the winter. Cranes and shorebirds are very attracted to newly-flooded areas for feeding, as they apparently prey on terrestrial invertebrates, such as insects and spiders, which are exposed and concentrated at the water's edge. In addition, several thousand ducks would flock into flooded corn fields at dusk to feed at night. A few weeks after flooding, high densities of aquatic invertebrates are present. Aquatic larvae of midges (Family: Chironomidae) typically are very important food items for ducks and shorebirds. Shorebird habitat is enhanced with the gradual flooding and drawdown of water levels. Because open water areas on Staten Island are not treated for mosquitoes during the winter months (J. Stroh pers. comm.), the full complement of aquatic invertebrates is allowed to develop and the only limiting factor may be the use of insecticides during the growing season. However, aerial mosquito surveys conducted during late summer and early fall caused considerable disturbance to cranes loafing in flooded portions of the island, and any spraying after mid-September would likely delay the availability of invertebrates as food for wetland birds.

5.2 MANAGEMENT OF CROPLANDS

As touched upon throughout this document, tillage, weed control, planting, irrigation, and harvesting all have a role in the wildlife-friendly management of cropland on Staten Island. With a piece of farmland of this size the wildlife benefits of these management activities would not be fully realized without an exceptional level of coordination between managers, operators, and workers. The current ownership structure (i.e., single owner with centralized management) is a key component in managing for wildlife habitat and reducing disturbance to wildlife from farming activities.

Besides the selection of grain crops, chopping of harvested corn stubble makes fields more attractive to foraging cranes and geese, while unchopped stubble provides some winter cover, which might be important as a thermal refuge for smaller birds. Cranes prefer newly-planted

winter wheat, which on Staten is planted at an additional rate of 25 lbs. per acre (25± kg/ha) to compensate for losses from feeding birds. This level allows for heavy crane use, but still results in a good crop yield. Later in the spring, these wheat fields provide nesting cover for ducks, ring-necked pheasants (*Phasianus colchicus*), and potentially short-eared owls (*Asio flammeus*), and are harvested after most nests have hatched (i.e., early to mid-July).

Because mallards (*Anas platyrhyncos*) begin nesting in March before fields are worked up for planting, Roundup® is applied to most fields to keep weed cover low and create a mulch layer which impedes further growth and holds soil moisture. This method reduces cover and discourages nesting ducks from using these areas where nests would later be destroyed by tillage. On the main levee, 2,4-D® is used to kill broadleaf weeds and encourage grass cover which is better nesting cover for pheasants and ducks and allows for sufficient visibility to allow inspection of the levees.

5.3 Other Wildlife-Friendly Practices

In addition to the vast nesting and predator escape cover on the main levee, there are two small fallow fields totaling about 27 acres (11 ha): one at the very southeast corner of the island (adjacent to 9B) (see Figure 3), and the other along the main levee, just north of the Beaver Slough Road to the east of Unit 3. For ducklings, the primary brooding habitat is the island's ditch and canal system; the adjacent river channels are less suitable because of high levels of disturbance from boaters. While ditches aren't ideal duck brooding habitat, as ducklings are generally more vulnerable to predators in small confined areas, water levels are held higher in the ditches during the early growing season to enhance conditions for broods. Irrigation water is also held longer for broods in corn and tomato fields that are adjacent to wheat fields which provide duck nesting cover.

To help duck broods escape predators, ditches are constructed with the needs of broods and other wildlife in mind. In wheat fields, the ditches are V-shaped instead of the steep-sided "spud ditch" style typically used by farmers in the region; this shape allows ducks or other wildlife to leave the ditch and hide in nearby cover when predators approach. Generally, ditch-side vegetation is left for wildlife cover when cleaning ditches, and in some cases, emergent vegetation is also left. Larger ditches are configured to be wider, shallower, and weedier than most farmers would tolerate so that the ditches provide habitat for duck broods and other wildlife, with banks on one side occasionally sloped for wildlife escape. Roads, old culverts, and levees also provide habitat for potential nesting and wintering burrowing owls (*Athene cunicularia*). Additionally, dirt road embankments, culverts, and levees provide potential sites for nesting and wintering burrowing owls (*Athene cunicularia*). The mill and other structures (e.g., abandoned water tank) provide nesting and roosting sites for great horned owls (*Bubo virginianus*) and barn owls (*Tyto alba*).

5.4 Hunt Program

Recently, waterfowl and pheasant hunting at Staten Island has been conducted under close supervision by Jim Shanks. Waterfowl hunts in 2002-03 occurred from a series of blinds (about a dozen) in flooded fields, plus a couple blinds in unflooded corn fields for goose hunting. Only six hunters (all employees) were officially assigned to blinds, however, each was authorized to

bring a guest, so a maximum of 12 hunters could have been present during the authorized hunting period. In 2003, hunt days were Saturdays, Sundays, and Wednesdays, but because several blinds were assigned to employees whose only day off was Sunday, hunting was very limited. Waterfowl hunting was not permitted after 10:00 A.M., and hunters were strongly encouraged to be out of the hunt area before this time to minimize conflicts with mid-day loafing cranes. Pheasant hunts have been carried out by employees and guests in designated areas on weekends only. This light level of hunting pressure, combined with the 10:00 A.M. cessation of shooting, allowed moderate numbers of waterfowl and shorebirds and higher numbers of cranes to remain, as cranes generally didn't return to use these flooded areas until mid-day when hunters were out of the fields. In addition, this hunt program, while very limited, encourages waterfowl dispersal to neighboring properties, likely benefiting hunting opportunities there. Staten Island managers keep close tabs on activities within the island and unauthorized hunting or poaching has not been a problem.

6.0 CONCLUSION

Staten's current management is filling a large and increasing void of wildlife habitat in the Delta where substantial habitat losses have occurred to land conversion to vineyards and orchards (Littlefield and Ivey 1999), urban development, and turf farms (Ivey and Herziger 2003). Over time technological advances and changing market conditions have resulted in a wide variety of agricultural commodities being produced in the fertile soils of the Delta region. At present, California agriculture is at a crossroads, with population growth and suburban sprawl threatening farmland and the pressure for higher yielding, more profitable crop varieties is requiring the use of more chemicals and genetically engineered or manipulated (GMO) crops. Unfortunately, the use of GMO varieties may be limiting California's export market, as many overseas markets such as the European Union are leery of GMO products. As a consequence of the pressure and difficulty in running a profitable farming operation, many California farmers are opting to sell out to developers or large corporate farming operations. Whether the next landowner is a developer or corporate farmer, neither is likely to be inclined to conduct wildlife-friendly activities without some monetary incentive and direct efforts to educate them about opportunities and benefits.

The management program developed by Jim and Sally Shanks for Staten Island is a great success from both wildlife and farming standpoints, and provides a valuable model for accommodating wildlife in an agricultural landscape. They have been exploring the relationships between wildlife-friendly farming and a profitable farming operation and have found as successful middle ground. Because of this Staten Island has become a unique example of California agriculture that is immediately applicable to agriculture throughout the Delta region and the Central Valley as a whole. While the natural resources of Staten Island (i.e., water, fertile soil, etc.) have contributed greatly to the success of this program, their farming philosophy alone can be applied to nearly any agricultural operation in the Central Valley.
It is important to continue to explore the relationships that can be fostered between agriculture and wildlife and to employ an adaptive management approach to continue benefiting wildlife while improving farming. As the population continues to grow in California and development pressure increases, Staten Island's leadership role in the art and science of combining a viable farming operation and wildlife-friendly farming practices will become even more important in maintaining California's rich agricultural and natural heritage.

7.0 ACKNOWLEDGMENTS

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8.2 PERSONAL COMMUNICATIONS

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