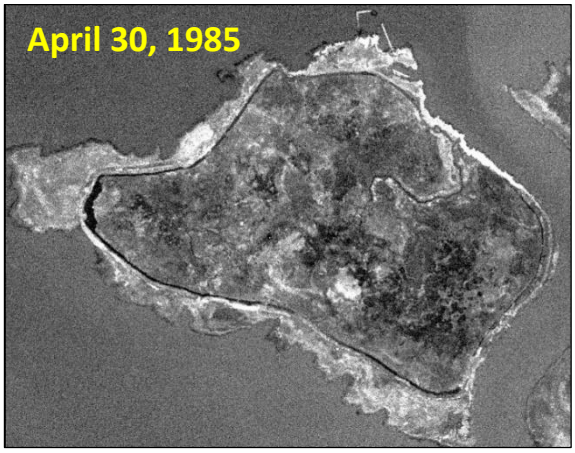
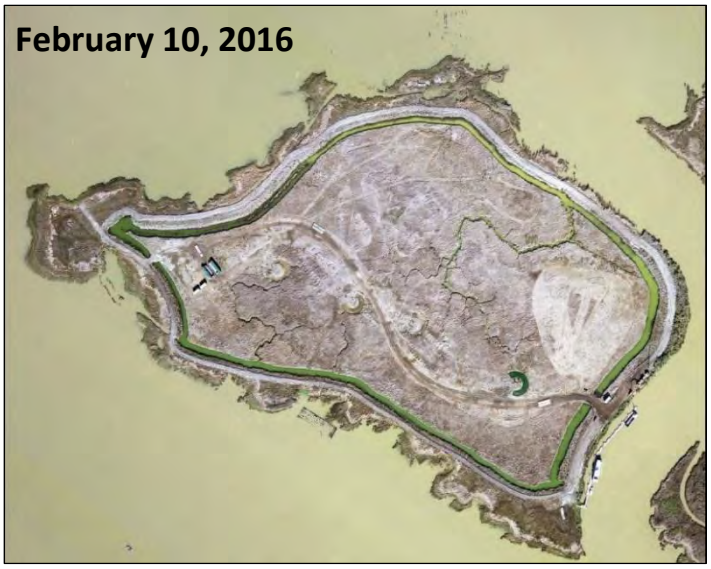
POINT BUCKLER TECHNICAL ASSESSMENT OF CURRENT CONDITIONS AND HISTORIC RECONSTRUCTION SINCE 1985





Prepared for:

San Francisco Bay Regional Water Quality Control Board
In the Matter of Point Buckler Island

Prepared by:

Siegel Environmental
San Rafael, California

May 12, 2016

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Water Board. 2016. Point Buckler Technical Assessment of Current Conditions and Historic Reconstruction Since 1985. Prepared by Siegel Environmental, San Rafael, CA, published by San Francisco Bay Regional Water Quality Control Board, Oakland, CA. May 12.

Definitions

- **Borrow and drainage ditch** – Wide and deep ditch excavated interior of the perimeter levee, continuous with water control structures discharging to Suisun Bay, constructed as the primary source of borrow materials for the new levee in 2014. Also called perimeter ditch.
- **Crescent basins** – crescent-shaped shallow excavations on the interior marsh plain with no drainage outlet or connection to the primary perimeter drainage ditch.
- **Trenches** – excavations on the tidal marsh plain of unmeasured depths, widths similar to the borrow and drainage ditch and lengths approximately two to five times the width.
- **Bench** – Fill placed on marsh surface between perimeter ditch and levee.
- **Ramp** – Access fill extending from levee edge of tidal marsh platform, to edge of bay waters, on the western end of the island.
- **Tidal marsh** – Emergent estuarine wetlands subject to flooding by periodic or episodic reach of tidal waters.
- **Diked non-tidal marsh** – Emergent estuarine wetlands impounded by dikes (artificial levees) that exclude periodic or episodic flooding by tidal waters; subject to seasonal flooding or artificially managed flooding and drainage by operation of water control structures.
- **Old/remnant/relict levee** – Non-functional, non-serviceable tidally breached artificial levee remnants from formerly repaired levee (circa) pre-1985
- **Old/remnant/relict borrow ditch** – Tidally reconnected remnants of pre-1985 interior borrow ditch, established by levee failure allowing either daily tidal (channelized) or episodic tidal (overmarsh) flows.
- **New levee** – Levee (dike) constructed or reconstructed in 2014 over tidal marsh, ditch, channel, and remnants of old levee
- **Channels** – remnants of naturally formed, sinuous antecedent tidal channels extending into the Island marsh interior.

Synonyms

- Andy Mason Slough = Annie Mason Slough
- Point Buckler = Point Buckler Island = Point Buckler Club = Annie Mason Club = Andy Mason Club = Taylor Club = Club #801 = Site = Property
- U.S. Army Corps of Engineers = Corps of Engineers = Corps = USACE
- Regional Water Quality Control Board = Water Board = RWQCB
- San Francisco Bay Conservation and Development Commission = Commission = BCDC

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1 Introduction

Point Buckler is an approximately **39-acre tidal marsh island** located in Suisun Marsh, Solano County, California (Figure 1). The Island is located off the western tip of Simmons Island and is shown on the Vine Hill 7.5-minute United States Geological Survey topographic map (Figure 2). The waters to the south and west are Suisun Cutoff and Andy Mason Slough (also referred to as Annie Mason Slough), respectively, both of which connect Honker Bay to Grizzly Bay. Ryer Island is south across Suisun Cutoff and Simmons Island is east across Andy Mason Slough (Figure 2). The property parcel is approximately 45 acres in size (per Solano County Assessor's Office geographic information system data) or 51.51 acres in size (Solano County Assessor's Parcel Map Book 0090, Page 02), both somewhat larger than the current area of the island of 39 acres (Figure 3). This discrepancy in stated acreage by Solano County has not been researched and is not material to any of the findings in this report.

In 2011, the property was purchased by John Sweeney. At that time, the property was a tidal marsh (Figure 4) and had been so since 1993 when its managed marsh levee system had failed and was left unrepaired. Between 2012 and 2016, Mr. Sweeney carried out a range of activities on the island without any local, state or federal authorizations. In particular, in 2014 he constructed a new levee that diked the tidal marsh, and he excavated a borrow and drainage ditch that was used to obtain levee construction soils, and subsequently was used to drain the tidal marsh (Figure 5). In 2015 and 2016, he imported a variety of structures placed on the now-diked tidal marsh, which are used at least in large part to facilitate operation of a kite surfing club[1]. These activities and its associated substantial change in use of the property have had significant adverse impacts on a range of beneficial uses of Waters of the State and Waters of the United States, to critical habitats for federally listed species, to other listed species and species of concern, and to protected natural resources of Suisun Marsh. These unpermitted activities are now the subject of enforcement actions.

The data and analyses presented in this report originate from seven sources:

1. A boat tour around the property perimeter on May 28, 2003
2. A reconnaissance site visit on October 21, 2015
3. New aerial photographs flown on February 10, 2016
4. A boat tour around the property perimeter on February 17, 2016
5. A site inspection on March 2, 2016
6. Acquisition of numerous historical aerial photographs from 1948 to 2015
7. Literature reviews

Point Buckler has been a tidal marsh since 1993 (Photo 1) and was so in 2011 when the island was purchased by Mr. John Sweeney (Figure 4). As such, the island is subject to regulatory jurisdictions of the U.S. Army Corps of Engineers under Section 404 of the Clean Water and Section 10 of the Rivers and Harbors Act, of the San Francisco Bay Regional Water Quality Control Board under Section 401 of the Clean Water and the Porter-Cologne Water Quality Control Act, and of the San Francisco Bay

[1] www.facebook.com/pointbucklerclubvip

Conservation and Development Commission under the McAteer-Petris Act and Suisun Marsh Preservation Act (Figure 4).

Levees at the property were last repaired around 1985. By 1993, the five main breaches had re-established, leading to no operational levee and water control structure system to manage waters. Two more small breaches opened in 2003. By 2011, no attempts to repair the failed levees had taken place and the remnant levee had degraded around most of the island allowing higher tides direct overland flow to the tidal marsh interior (Figure 6). The 18 years between levee breaches in 1993 and property sale to Sweeney in 2011 is considered beyond the "reasonable" period of time in which to repair damaged levees to maintain pre-breach land uses, and is beyond the 5-year period of each Regional General Permit that can allow for levee maintenance and repair. The 3,570 feet of remnant borrow ditch and 5,170 feet of tidal channels on the island provided full, unimpeded daily tidal action to the island interior (Photo 1, Figure 6), and the higher high tides could overtop the island edges and directly flood the island (Photo 1). Only the eastern, wind-sheltered side of the island remained as terrestrial lowlands. The old club house on the island eroded into the bay by 1997, and limited use of the property continued perhaps through 2006 when the dock on Andy Mason Slough was removed.

Photo 1. Point Buckler, May 28, 2003.
View into interior tidal marsh of Point Buckler at northeastern levee breach, with tidal remnant levee visible either side of the breach. Suspended fine tidal sediment (tan-gray bay mud suspended in turbulent, turbid water) is visible in the channel. Photo by Stuart Siegel.

Report Purpose

The purpose of this report is to establish baseline conditions, identify the State and federal agency jurisdictional extents of the baseline, document the unpermitted activities by time and quantities, and assess the effects of the unpermitted activities on beneficial uses and overall site ecological functions.

Report Organization

This report is organized as follows:

1. Introduction
2. Summary of Analytical Approach
3. Baseline Tidal Marsh Conditions and Inapplicability of 1984 Individual Management Plan
   3.1. Baseline Conditions Summary
   3.2. Consequent Inapplicability of the 1984 Annie Mason Club Individual Management Plan
4. Unauthorized Activities and Current Land Uses
   4.1. List of Unauthorized Activities
   4.2. The Time Sequence of Construction Events
   4.3. Current Land Use
   4.4. Review of Land Owner's Technical and Legal Submittals of October 2015
5. Consequences of Tidal Marsh Diking and Draining and Current Land Uses
6. Technical Questions to Be Addressed
7. Key to Technical Appendices
8. Report Preparers
9. Appendices

2 Summary of Analytical Approach

The technical analyses presented in this report utilize information gathered from a variety of sources and activities beginning in October 2015:

- Field visits:
  - October 21, 2015 on the island
  - February 17, 2016 around the island perimeter by boat
  - March 2, 2016 on the island including collection of new topographic, vegetation, water quality, and site conditions data
- Aerial photograph analysis
  - Historic aerial photographs obtained from a variety of sources
  - New aerial photograph flown on February 10, 2016 in natural color and color infrared
  - Aerial photographs obtained for Point Buckler and two nearby reference sites with a similar history of natural levee failure followed by re-establishment of tidal marsh (Freeman Island and Snag Island)
- Literature review
- Review of technical and legal documents submitted to the Regional Water Quality Control in October 2015 on behalf of Mr. Sweeney

In addition, one of the report authors, Stuart Siegel, and others boated around the island perimeter on May 28, 2003 (conducted as part of a separate effort unrelated to recent Sweeney actions).

Table 1. Field Observational Data Collection Summary

Field Visit Date	Location	Data Collected
May 28, 2003	On water around island	• Reconnaissance visit by large research team to assess suitability as a study site for a multi-year research project examining the ecological functions associated with restored tidal marshes in the San Francisco Estuary • Examined site access, vegetation, and tidal connectivity
Oct 21, 2015	On island	• Observation of site vegetation, channels, grading, constructed levee and borrow ditch, new water control structure, and shipping containers, trailers and other equipment and facilities brought to the island by Mr. Sweeney • Information presented verbally by Mr. Sweeney and his attorneys
Feb 17, 2016	On water around island	• Observations of tide heights relative to island elevations • Observations of exterior emergent vegetation growth characteristics • Observations of exterior high water debris wrack lines • Observations of exterior equipment and improvements and interior where visible from boat

Mar 2, 2016	On island	• Collect new topographic data of levee, interior marsh plain, borrow ditch, interior channels and ditches, debris wrack lines, crescent basins, path to water, pathway across site, water control structure, air photo rectification points, local survey control points
		• Collect wetland jurisdiction data on soils, vegetation, hydrology
		• Examine for possible imported fill soils within pathway across site, western improvements area, and levee
		  o Soil pits at toe of all new levee inboard and outboard slopes and at the edges of any fill pads in interior especially where there is bare substrate.
		  o Photograph pits and describe buried soils, sediments, and relict vegetation
		  o Focus on contacts between unconforming strata to identify potential edges and fill type
		• Observations of ecological conditions on and around island, including condition of vegetation communities, occurrence of listed or special status plant, fish or wildlife species
		• Collect in-situ water quality measurements from within areas of standing water including borrow ditch and crescent basins on island interior, and from tidal waters adjacent to the site
		• Measure areas of structural fill features
		• Photo document water control structure, locations of prior tidal channels and connections, structural and non-structural fill

3 Baseline Tidal Marsh Conditions and Inapplicability of 1984 Individual Management Plan

3.1 Baseline Condition Summary

At the time of property transfer in 2011, the baseline condition of Point Buckler was tidal marsh (see Appendix G and H of this report). We established this condition based upon a review of historic aerial photos from 1948 to 2011 (Appendix G) and from direct observation during the May 28, 2003 site visit by Stuart Siegel and others (Appendix S). Review of publicly available wetlands classification databases corroborates these findings – the EcoAtlas developed by San Francisco Estuary Institute (SFEI) and the U.S. Fish and Wildlife Service National Wetlands Inventory, both of whose data were updated in 2011 by SFEI (Figure 7).

Key attributes of the baseline site conditions are:

1) Point Buckler was subject to daily tidal inundation to the tidal channels, tidal ditches, and tidal marsh on the island interior through seven levee breaches the largest of which had been open since 1993 and through overland tidal flows on higher high tides across the degraded levee.
2) The baseline condition of Point Buckler wetland vegetation during the period from 2002-2014 was tall, emergent tidal marsh dominated by tule, bulrush, cattail, and reed, with a narrow band of riparian/transitional scrub (California rose/coyote brush) on a portion of the eastern terrestrial levee remnant. The baseline condition also included tidal channels and tidal ditches from its prior managed wetland history.
3) About 69 percent of the remnant levee had subsided and degraded to high tidal marsh elevations and had long been colonized by tidal marsh species and some tidal marsh-terrestrial transitional species found within the very upper reaches of the tides.
4) The site is designated critical habitat for Delta Smelt (*Hypomesus transpacificus*; Federally and State threatened), Steelhead Central California Coast Distinct Population Segment (*Oncorhynchus mykiss;* Federally and State threatened), and Green Sturgeon Southern Distinct Population Segment (*Acipenser medirostris*; Federally threatened).
5) The site likely supported Longfin Smelt (*Spirinchus thaleichthys*; State threatened), California Black Rail (*Laterallus jamaicensis coturniculus*; fully protected species, California Fish and Game Code), Salt marsh yellowthroat (*Geothlypis trichas sinuosa*; state species of concern) and Suisun song sparrow (*Melospiza melodia samuelisis*; state species of concern). The site may have supported salt marsh harvest mouse (*Reithrodontomys raviventris halicoetes*; Federally and State endangered; fully protected species, California Fish and Game Code) and possibly California Ridgway's rail (*Rallus obsoletus;* Federally and State endangered; fully protected species, California Fish and Game Code). The site supports Mason's Lilaeopsis, (*Lilaeopsis masonii*), a species of concern evaluated in CEQA.

3.2 Current Inapplicability of the 1984 Annie Mason Club Individual Management Plan

The Suisun Marsh Preservation Act (SMPA) of 1974 and the Suisun Marsh Protection Plan (SMPP) certified in 1976 established two management areas within Suisun Marsh, each with different regulatory oversight. Activities in the "Primary Management Area" of Suisun (all lands below the 10-foot NGVD29 contour) are regulated by BCDC, and activities in the "Secondary Management Area" of Suisun Marsh (all lands above the 10-foot NGVD29 contour) are regulated by Solano County, following adoption of its Local Protection Program. Point Buckler is located within the Primary Management Area and thus is subject to BCDC regulatory oversight. Development of Individual Management Plans (IMPs) for all the privately owned duck clubs (diked managed wetlands) in Suisun Marsh was required under the SMPA (California Public Resources Code §29412.5). The Suisun Marsh Management Plan (SMMP), prepared by the Suisun Resource Conservation District and certified by BCDC in 1980 as part of the Solano County Local Protection Program for Suisun Marsh, incorporated the IMP requirement.

By the mid-1980s, the U.S. Soil Conservation Service had prepared IMPs for all of the roughly 150 privately owned duck clubs (diked managed wetlands) in Suisun Marsh[2], and BCDC had approved them. These IMPs allowed a duck club to carry out routine maintenance work (e.g., levee repairs, water control structure repairs) and wetland management activities (e.g., vegetation mowing, disking, burning) for the specific purpose of promoting desirable waterfowl habitats, without the need for further regulatory authorization from BCDC. Work activities beyond the scope authorized through each IMP required separate regulatory authorization from BCDC. Regulatory authorizations from the Corps of Engineers and Water Board were still required for all clubs including those with approved IMPs, and were addressed through Regional General Permits issued and renewed periodically by the Corps of Engineers and certified by the Water Board.

The SMPA defines managed wetlands as follows (California Public Resources Code § 29105, emphasis below added):

> Managed wetlands means those **diked areas in the marsh in which water inflow and outflow is artificially controlled or in which waterfowl food plants are cultivated, or both**, to enhance habitat conditions for waterfowl and other water-associated birds, wildlife, or fish, regardless of whether such areas are used for hunting or fishing or non-consumptive uses such as nature study, photography, and similar passive wildlife activities, or a combination of both such consumptive and non-consumptive uses.

Key to this managed wetland definition is the artificial control of water inflow and outflow. Both the IMPs and the Regional General Permits allow for maintenance and repair of levees and water control structures to allow for artificial control of water inflow and outflow. When such infrastructure no longer functions, water inflows and outflows cannot me managed, and the property is no longer a managed

[2] Declaration of Steven Chappell in the April 22, 2016 Executive Director Cease and Desist Order ECD2016.01 issued by BCDC.

wetland. When failures occur to such infrastructure, land owners clearly have a reasonable amount of time to carry out repairs and continue operating as diked, managed wetlands. In the case of Point Buckler, 18 years had elapsed between the failure of the site's water control infrastructure and property transfer, and another 3 years elapsed before the new levee was built. A 21-year lapse clearly extends well beyond "a reasonable amount of time" to carry out repairs: it significantly exceeds the duration of Regional General Permit 3 (5-year authorization for Suisun Marsh managed waterfowl marsh activities).

Once a duck club has fallen into disrepair, its levees breached and degraded allowing unmanaged tidal action to the wetlands within the duck club, the property is no longer a managed wetland. At that point in time, the regulatory benefits of its IMP no longer apply and the property is not eligible for work authorizations under the Regional General Permit. Having reverted to tidal marsh, such properties then fall under the SMPP policy of preserving tidal marshlands (SMPP Land Use and Management Policy 3) and under the tidal marsh policies and regulations under the federal Clean Water Act, state Porter-Cologne Water Quality Act, and the state and federal Endangered Species acts, all reflecting the importance of tidal marshes to Suisun Marsh, the Estuary, and listed species protection.

Based on these definitions and site history, the 1984 Club 801 Individual Management Plan is no longer valid or applicable.

4 Unauthorized Activities and Current Land Uses

4.1 List of Unauthorized Activities

Several unauthorized activities took place between 2012 and 2016 (Figure 5, Appendix Q Table Q-1). The activity numbers are referenced in Appendix K that quantify the locations, amounts, and timing of these activities.

Earthen Fill in Wetland and Waters to Dike Island by Constructing a New Levee (2.56 acres)

1) On remnant of 1985 levee (tidal marsh plain): to reconstruct the degraded levee, terminating high tide overland flows to the interior tidal marsh.
2) On tidal marsh plain: to construct new earthen levee, terminating high tide overland flows to the interior tidal marsh.
3) In tidal remnant borrow ditch: to construct new earthen levee, terminating daily tidal channel exchange with the bay.
4) In tidal marsh channels: to construct new earthen levee, terminating daily tidal channel exchange with the bay.
5) In newly excavated trench: to construct new earthen levee, filling aquatic habitat.

Earthen Fill in Wetlands for Ramp to Water's Edge and to Place Spoils from Excavating Crescent Basins and Trenches (0.51 acre)

6) On tidal marsh: adjacent to crescent basins and trench excavations and where trees planted.
7) On tidal marsh: to construct an access ramp fill from the levee to the water's edge at the western tip of the island.

Excavation in Wetlands and Waters to Construct New Borrow Ditch (2.62 acres) -- Excavating a new ditch interior to the levee, providing borrow ditch fill for the levee construction and providing new drainage channel system for the marsh interior connected to water control structures connected to Suisun Bay.

8) Excavation of tidal marsh plain
9) Excavation of tidal remnant borrow ditch (some of which were also excavated to construct trenches)
10) Excavation of tidal marsh remnant levee
11) Excavation of tidal marsh channels (some of which were also excavated to construct the crescent basins)

Excavation in Wetlands to Construct Crescent Basins and Trenches (0.31 acre)

12) Excavation of tidal marsh to construct four small unvegetated crescent basins in the island interior, capable of being flooded and some of which were flooded at the March 2, 2016 site inspection.
13) Excavation of tidal marsh to construct five trenches, one of which was later filled during levee construction (Activity 6) and a second became part of the new interior borrow ditch (Activity 8)

Structural Fill (0.17 acre)

14) Installation of a new water control structure connecting Suisun Bay and the newly excavated interior ditch.
15) Placement of shipping containers, trailers, helicopter pads, wind-break platforms, and other structures onto the island interior.
16) Planting of about ten ornamental trees with wire fence cages on the island interior.
17) Installation of pilings, floating boat dock, and fixed gangway on the eastern side of the island, in Annie Mason Slough.

4.2 The Time Sequence of Construction Events

1985 was the last time major levee repairs took place on Point Buckler, by a prior owner based upon review of historic aerial photographs (see Appendix G). Within a few years, the repaired levee had failed again and limited efforts to address the erosion were inadequate. By 1993, five large breaches had formed in the levee, allowing unimpeded daily tidal flows to the interior wetlands. Though the property continued to be used to some extent in the subsequent years, its owners made no further levee repair efforts. Two more small levee breaches formed in 2003. Over time, the levee itself was eroded away or subsided into the underlying wetlands, leaving only a high marsh trace of its former path around most of the island. Only the eastern side of the island, along Andy Mason Slough, continued to support terrestrial vegetation.

This fate has befallen several properties in Suisun Marsh (Figure 1). At least 13 properties in Suisun Marsh are currently open to the tides from natural levee degradation, more than 2,000 acres in total,

with either unimpeded or muted[3] daily tidal action. Eleven of these properties are along the southern open water areas of Suisun Marsh like Point Buckler and, depending on how long they have been open to the tides, support varying degrees of emergent vegetated tidal marsh and tidal open waters. Two independent wetlands mapping efforts show Point Buckler, and these many other properties, as tidal marsh: the U.S. Fish and Wildlife Service's National Wetlands Inventory[4] and the San Francisco Estuary Institute's EcoAtlas[5] (Figure 7). Evidence collected in this assessment validates these two independent wetlands mapping efforts.

By the time John Sweeney purchased the property in 2011, Point Buckler had been subject to unimpeded daily tidal action for 18 years through channels at the levee breaches and by high tide flows directly over the surface. Over these many years, the property had reverted to 38 acres of emergent vegetated tidal marsh, with tides circulating through a tidal channel network and the remnants of the old borrow ditch, with another roughly one acre on the east remaining terrestrial (Figure 4).

Alterations to the property were relatively small for the following two years. During 2012, some paths were mowed across the site, three trenches had been excavated with the spoils placed atop the nearby tidal marsh surface, two dock pilings were installed in Andy Mason Slough, and two trailers were brought onto the property. In 2013, some additional mowing took place, a wood pile was placed on the tidal marsh, and a small dock was installed at the pilings in Andy Mason Slough.

Major levee construction took place in 2014. By early February 2014, the small dock was replaced with a large dock in Andy Mason Slough, construction equipment (crane, excavator and bulldozer) were mobilized to the site, and grading on the tidal marsh began. Construction of the 4,700 feet of levee to fully enclose the interior tidal marsh of Point Buckler, and its associated borrow ditch, took place between February and October 2014. The first 1,400 feet of this new levee roughly followed the path of the remnant levee (which itself had long become tidal marsh), along the southern side of the property. The remaining 3,300 feet of new levee was built directly atop the tidal marsh outside the alignment of the old levee. Some of the new levee was built on the remnant tidal borrow ditch (Figure 5). A total of about 16,000 cubic yards of tidal marsh soils were excavated to construct the new levee, which filled about 2.60 acres of tidal marsh and tidal channels and ditches. One 2-foot diameter water control structure was installed in the southwest corner of the site, with flap gates at each end that can be manually opened with a rope[6]. At the end of 2014, two shipping containers and two platforms were brought to the island and placed on the now-diked tidal marsh. A small section of tidal marsh was left unexcavated in the east, providing an access road across the borrow ditch between the new perimeter levee and the now-diked interior.

[3] Muted tides as used here reflect constrictions in tidal action due to small levee breach sizes relative to tidally flooded areas, and do not refer to tidal constrictions associated with water control structures.
[4] http://www.fws.gov/wetlands/Data/Mapper.html
[5] http://www.ecoatlas.org/regions/ecoregion/bay-delta
[6] Method of flap gate opening described by John Sweeny on October 21, 2015 site visit.

The next year, 2015, saw more construction. Four small crescent basins were excavated on the island interior, about 10-12 trees were planted (all of which have apparently died), mowing and grading took place in particular to establish a dirt road across the site, an equipment and "social" area were set up on the west side of the island with the shipping containers and two of the trailers, a section of the newly excavated borrow ditch was filled in the southwest corner to allow access between the island interior and the perimeter levee, and a small road was built from the new levee to the water's edge in the western tip of the island. A third trailer was set up on the eastern side, and at the time of the October 21, 2015 agency site visit, several goats were enclosed by a fence around this trailer. At that site visit, the two shipping containers on the west side were set up for social use and eight numbered storage lockers.

The final work to date took place in early 2016. Three platforms were brought to the island and placed between the two shipping containers on the west side and both ends of the platforms raised, creating a wind-sheltered "patio" between the two shipping containers. Four more platforms were brought to the island and set up in pairs and painted with a large circled "H" – helicopter landing pads. The March 2, 2016 site visit also revealed that a gate was installed at the eastern borrow ditch road crossing, and a second set of gates and pilings were stockpiled nearby, presumably for installation at the second borrow ditch crossing at the west end. These two gates would allow the goats to be released on the island interior without allowing them onto the new perimeter levee.

None of these construction activities, shown in aggregate in Figure 5, were undertaken with any required regulatory authorizations.

4.3 Current Land Uses

The land use currently established at Point Buckler is a kite surfing "base camp". The western side of the island has an indoor-outdoor lounge connected to storage units for kite surfing equipment, with solar power and a composting toilet. A short distance away, outside the levee, is a dirt road to the water's edge for launching and landing for the kite surfing. There are two access options to the island and these facilities. By boat, there is a large dock on the east side of the property in Andy Mason Slough and an interior and levee road to get across the tidal marsh to the facilities. By helicopter, there are two marked landing platforms on the tidal marsh interior and the interior road to the facilities. A large houseboat is also commonly docked.

Photo 2. Aerial View of Kite Surfing Facilities at Point Buckler
Source: https://www.facebook.com/pointbucklerclubVIP/photos_stream?ref=page_internal, accessed 4/26/2016

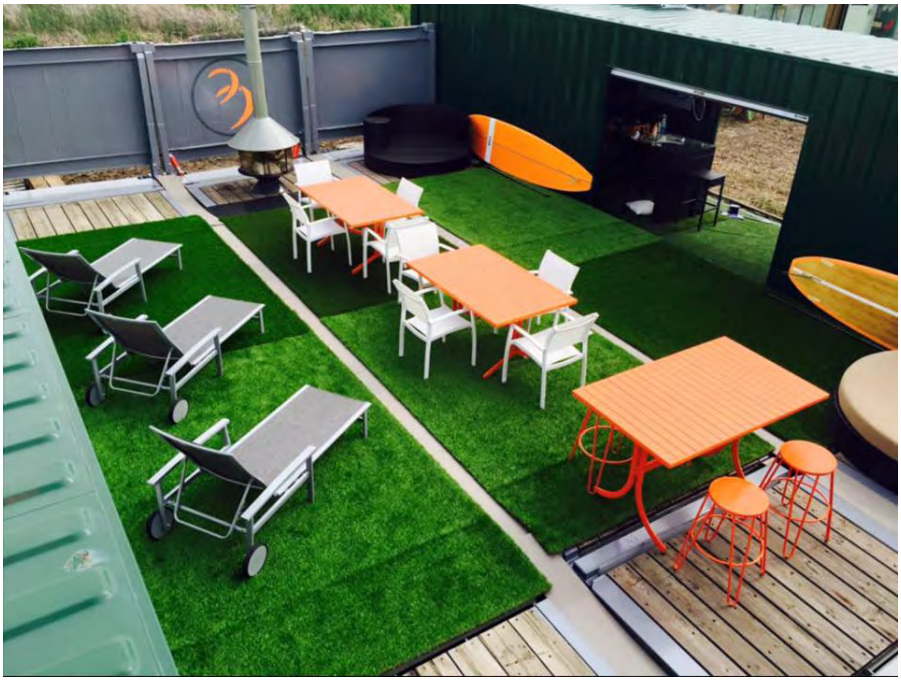

Photo 3. Outdoor Sheltered Lounge and Shipping Container Indoor Lounge Facilities at Point Buckler
Source: https://www.facebook.com/pointbucklerclubVIP/photos_stream?ref=page_internal, accessed 4/26/2016

Photo 4. Outdoor Sheltered Lounge and Shipping Container Locker Facilities at Point Buckler
Source: https://www.facebook.com/pointbucklerclubVIP/photos_stream?ref=page_internal, accessed 4/26/2016

Photo 5. Two Helicopter Landing Pads at Point Buckler
Source: https://www.facebook.com/pointbucklerclubVIP/photos_stream?ref=page_internal, accessed 4/26/2016

4.4 Review of Land Owner's Technical and Legal Submittals of October 2015

Briscoe Ivester & Bazel LLP submitted a response to the Water Board Cleanup and Abatement Order R2-2015-0038 on October 16, 2015, on behalf of Point Buckler Club, LLC, prepared by L. Bazel. Also on behalf of Point Buckler Club, Applied Water Resources Corporation (AWR) submitted a technical "conditions" report, dated October 16, 2015, providing a description of all levee and ditch repair activities, boat dock activities, and grading and/or vegetation removal activities performed at Point

Buckler Island. The Bazel response does not cite the information in the AWR conditions report. The Bazel response is not consistent with the technical conditions report's presentation of pre-project and post-project conditions at Point Buckler. The Bazel response also cites Regional General Permit 3 (RGP 3), issued by the U.S. Army Corps of Engineers (USACE) for activities in the Suisun Marsh (File Number 242156N; reissued 2013), as authorization for the project. The scope, terms, and conditions of RGP 3 are not consistent with the physical activities described by the Bazel response or the AWR conditions report, nor did Sweeney seek or obtain USACE authorization under RGP 3 as required to work under its authorization (S. Chappell, declaration in BCDC EDCDO 2016.01). This document analyzes the inconsistencies between the Bazel response and AWR report in light of RGP 3.

4.4.1 RGP 3 Is Limited to Activities with Minimal Impacts in Non-Tidal Wetlands

RGP 3 is a General Permit. The term "general permit" as used in these regulations (33 CFR Parts 320-330) refers to both those regional permits issued by district or division engineers on a regional basis. The definition of "general permit" at 33 CFR § 322.2(f) is **(emphasis added in bold)**:

> The term *general permit* means a Department of the Army authorization that is issued on a nationwide or regional basis for a category or categories of activities when:
>
> (1) Those activities are substantially similar in nature and **cause only minimal individual and cumulative environmental impacts**; or
>
> (2) The general permit would result in avoiding unnecessary duplication of the regulatory control exercised by another Federal, state, or local agency provided it has been determined that the environmental consequences of the action are **individually** and **cumulatively minimal**. (See 33 CFR 325.2(e) and 33 CFR part 330.)

In order to be eligible for authorization by a USACE general permit, an activity must have only minimal impacts. RGP 3 does not authorize enclosure (diking) and impoundment of tidal channels, tidal ditches, or tidal marshes by newly constructed or reconstructed levees. RGP 3 is restricted to maintenance activities within <u>non-tidal</u> seasonal and perennial wetlands and uplands of Suisun Marsh duck clubs. The impact analysis and less than significant impact determination (Finding of No Significant Impact; National Environmental Policy Act) for RGP 3 was based on the restriction of RGP activities to non-tidal marsh, and permit conditions limiting the RGP 3 applicability to non-tidal marsh only.

The AWR report states (p. 9) "The hydrology of the Island prior to the recent repairs to the ditch and levee system consisted of **tidally influenced portions of some channels and some old ditches**", and (p. 3) "In an aerial photograph from 2013, it appears that approximately 4,200 linear feet of the old ditch system remained on the Island, of which approximately **54% appears to be open to tidal influence**, while approximately 46% appears to have been silted in". In addition, the AWR report confirms that the Soil Conservation Service mapped portions of Point Buckler Island as "Tidal Marsh"; the Solano County Soil Survey mapping unit of "Tidal Marsh" extends across the "repaired levee" footprint in AWR Figure 1.

Notwithstanding the "silting in" vegetated ditch elevations below the High Tide Line (upper limit of Clean Water Act Section 404 jurisdiction), the AWR report affirms that at least the majority of the pre-existing ditches and channels within the island were tidal. RGP 3 does not authorize any work in tidal wetlands or channels. No dredging or excavation of borrow material from tidally influenced ditches or tidal marshes is authorized under RGP 3. In fact, a separate permit (Letter of Permission or LOP) for the "Suisun Marsh Dredging Program" in tidal channels was proposed in 2012 to supplement the continued exterior levee maintenance activities under the RGP 3 for the entirety of the 199.82 miles of exterior levees in Suisun Marsh[7].

Under the LOP procedure for Suisun Marsh dredging, the Suisun Resource Conservation District (SRCD) would act as the first-line gatekeeper for dredging applications. This role of SRCD was established by statute in 1977 (PRC Sections 9960-9963). Landowners would submit dredging request applications to SRCD and Department of Fish and Wildlife. Dredging under the Suisun Marsh LOP was restricted to occur **outside** areas that have been tidally restored, in the deepest slough areas, with maximum avoidance of wetland vegetation. Compensatory mitigation (3:1 ratio replaced:lost) for tidal marsh is a condition for individual levee maintenance projects that excavate or disturb tidal marsh under the LOP. The Point Buckler levee and ditch construction as described in the AWR report did not comply with any of these conditions of the Suisun LOP for levee maintenance dredging from tidal areas.

Thus, the AWR report confirms that the project occurred in tidal wetlands outside the non-tidal geographic scope of RGP 3 activities. The Bazel response argues that the project was authorized by RGP 3, but does not address this fundamental non-compliance with RGP 3 due to work in tidal areas admitted by the AWR report. The Bazel response does not claim that the project was authorized by the only USACE permit (LOP) for levee maintenance in Suisun Marsh that allows for borrowing sediment from tidal areas.

4.4.2 RGP 3 Is Limited to "Maintenance" in Non-Tidal Wetlands

RGP 3 authorizes only "maintenance" of levees in accordance with the drawings attached to the RGP labeled "Department of the Army Regional General Permit Number 3 for Activities in the Suisun Marsh". RGP 3 attached drawing 3 of 7 illustrates exterior (perimeter) levee maintenance authorized. The drawing shows no fill on the tidal slope below the highest line of "tidal water" near the crown of the levee, and shows fill placement restricted to the crown (top) above the tides and interior ("land side") side slope of the levee. There is no description of new levee construction, and no attached drawing for new levee construction.

The AWR report on page 1 explicitly defines and distinguishes the "old" ditch and levee systems from the "repaired" ones of the project. It defines the "repaired" ditch and levee systems at Point Buckler as those "constructed in 2014". The "constructed" levees and ditches in 2014 were mostly outside the configuration (footprint) of the original levee fill and ditch system, as shown in AWR figures 1 and 2. See

[7] http://www.suisunrcd.org/documents/2014DredgingLOP.pdf

also Appendix K of this report for further assessment of the new levee footprint in relation to the alignment of the remnant levee most of which had reverted to tidal marsh.

The term “maintenance” in USACE permit regulations is defined in two contexts: exempt “maintenance” 33 CFR 323.4(a)(2) and generally permitted “maintenance” under Nationwide Permit 3, under Section 404 of the Clean Water Act. Exempt “maintenance” applies only to “currently serviceable” structures such as dikes and levees. Exempt “maintenance” does not include *any modification* that changes the *character, scope, or size of the original fill design*. The only reconstruction of non-serviceable structures that may qualify for the “maintenance” exemption is “emergency” reconstruction that must occur within a reasonable period of time (conventionally 1 year) after damage. At Point Buckler, a period of 21 years had lapsed between significant levee failures establishing full tidal action (1993) and the new unpermitted levee work (2014), well beyond a “reasonable period of time”. Generally permitted but non-exempt “maintenance” under NWP 3 differs from the exempt maintenance in allowing “Minor deviations in the structure's configuration or filled area”, and in being restricted to activities with only minimal cumulative and individual impacts, like all generally permitted activities.

Since the AWR report Figures 1 and 2 identify levee “repair” that is defined as “construction” of levee at locations outside the alignment and configuration of the “old levee”, the AWR report confirms the so-called “levee maintenance” activities cited in the Bazel response were neither authorized by RGP 3 (which is restricted to interior non-tidal levee slope and crown fill in pre-existing levees), nor NWP 3, nor exempt. More importantly, the volume limitations of borrow material dredged/excavated from ditches in RGP 3 is 1,000 cubic yards per year for clubs under 50 acres. Point Buckler is 39 acres in size, and its Solano County Assessor’s Parcel size is about 45 acres (Figure 3). The volume excavated in one year (2014) from new borrow ditches was approximately 16,000 cy (see Appendix K of this report). This volume reflects the extensive new construction of levees (not authorized by RGP 3) in contrast with capping of pre-existing and functional levees authorized by RGP 3.

4.4.3 Point Buckler Conflicts of Implemented Activities with Annie Mason Point Club 1984 Individual Management Plan (IMP) Water Management

The Bazel response cites the SRCD preparation of an Individual Management Plan (IMP) with “water management program for each managed wetland in private ownership”, specific to the Annie Mason Point Club, as the basis for its claim of exemption from general regulation under the Suisun Marsh Preservation Act. The Bazel response claims that the structures (water control structures, levees, ditches) are required and authorized by the IMP, but it fails to identify the full substantive requirements of the water management plan for the Club and the conflict between the unauthorized activities and the Club’s water schedule. The Club IMP proposes that it follow a “regular program of water management” consisting of the “alkali-bulrush program” water schedule to promote waterfowl habitat. That program requires flooding the club repeatedly in fall, winter and spring, alternating with rapid drainage and flushing (leach) periods to reduce soil salt accumulation. A detailed seasonal schedule of flooding and drainage cycles is included in the IMP. Activities such as mowing are specified to be followed by flooding. The only period of prolonged drainage (not followed by prolonged flooding) is summer.

In fact, there is no evidence of any flooding, or any flood-drain cycles in fall, winter, or spring since levees were constructed in 2014. Neither the Bazel response nor the AWR report cite any flooding or flood-drain cycles. The operation of the levees and water control structures since 2014 do not comply with the Club IMP requiring fall-spring flood-drain cycles. The site is evidently maintained in a state of perennial drainage and mowing, with no flooding. (See Appendix L of this report). Thus, there is no IMP basis for the construction of the levees, ditches, and water control structures without operation to maintain flood-drain cycles of alkali-bulrush program water management.

Also not addressed in the Bazel response is that the IMP is no longer valid and applicable for Point Buckler. To have a valid IMP, a duck club must be a "managed wetland" which requires functional water control infrastructure (see 3.2 above). The 21-year lapse in functional water control infrastructure rendered the Annie Mason Club IMP no longer in effect.

Finally, the Department of Water Resources (DWR) prepared a memorandum dated January 20, 2016, to describe the basis for why DWR had never provided a pump to the Annie Mason Club as directed in its 1984 Plan of Protection for Suisun Marsh. In that memorandum, DWR documents the long history of assessing conditions of the levees, stating that "the pump would not be effective without the levees being intact. Several documents and other sources…indicate a long history of the levees being in disrepair". According to that memorandum, DWR reviewed site conditions in 1984, 1987, 1988, 2002, 2005, and 2014.

4.4.4 Erroneous Jurisdictional Tidal Elevations and Criteria

The AWR report erroneously assumes that the MHW line correlates with the "debris line" (wrack, drift-lines deposited by waves and tides), and that the extent of jurisdictional waters of the U.S. or State are limited to areas below MHW (page 3), as in Rivers and Harbors Act Section 10 jurisdiction. The correct tidal jurisdictional boundary for the Clean Water Act Section 404 is the High Tide Line (HTL), which lies above Mean Higher High Spring tidal elevations, and correlates with upper drift-line, vegetation discontinuities in the shoreline, or erosional scarps (see Appendix N of this report). All tidal marshes below the HTL are jurisdictional under Section 404. Tidally silted ditches with marsh vegetation are jurisdictional waters of the U.S. and California. The AWR report made no estimate of the extent of tidal marsh (p. 6).

5 Consequences of Tidal Marsh Diking and Draining and Current Land Uses

Tidal Marsh Loss. A total of **29.74 acres of tidal marsh were removed from tidal action** as a result of these activities and another **0.30 acres were subjected to reduced tidal inundation** exterior to the new levee and the new dock in Andy Mason Slough **covered 0.07 acre of tidal waters** (Figure 8, Table 2). About 2.56 acres of tidal marsh were directly impacted by fill and conversion to the new levee. Another 27.18 acres of tidal marsh interior of the new levee were diked (cut off from the tides). The ramp fill from the levee top road to the Bay intertidal water edge filled 0.04 acres. Another 0.26 acre of earthen

fill covered the tidal marsh outside the new levee. A small amount of this now-diked tidal marsh was filled with spoils from internal excavation (0.16 ac) and placement of the various structures (0.10 ac).

Table 2. Area of Fill and Loss of Tidal Action

Type	Area (acres)
Fill Activities in Wetlands and Waters	
Within footprint of and interior to new levee	
New levee	2.555
Crescent basin spoils	0.164
Borrow ditch crossing	0.043
Subtotal	**2.762**
Exterior to new levee	
Road to water's edge	0.038
Trench spoils	0.262
Subtotal	**0.300**
Structural fill internal to new levee	0.096
Structural fill external to new levee	0.071
Subtotal	**0.167**
Total Fill	**3.229**
Fill Removing Tidal Action	
Direct fill (levee footprint)	2.555
Diked by new levee	27.181
Total Area Removed from Tidal Action	**29.736**
Fill Reducing Tidal Action	
Road to water's edge exterior to new levee	0.038
Trench spoils exterior to new levee	0.262
Total Area Removed from Tidal Action	**0.300**

Impacts to Beneficial Uses. This loss of emergent vegetated tidal marsh and its associated tidal channels and ditches resulted in the loss of several designated beneficial uses as designated in the Basin Plan[8]: preservation of rare and endangered species habitat (RARE), fish migration (MIGR), fish spawning (SPWN), estuarine habitat (EST), and commercial and sport fishing (COMM). Suisun Bay, including Point Buckler, is designated critical habitat for three listed fish species: Delta Smelt (*Hypomesus transpacificus*), the Central California Coast population segment of Steelhead (*Oncorhynchus mykiss*), and the southern population segment of Green Sturgeon (*Acipenser medirostris*). The area is along the migratory route of all populations of Chinook Salmon that spawn in the Central Valley. Tidal marshes along the southern reaches of Suisun Marsh are particularly important foraging and predation refuge habitat for migrating Chinook Salmon. They also provide food resources for pelagic fish (Delta Smelt and

[8] San Francisco Bay Regional Water Quality Control Board, 2015.

Longfin Smelt in particular) that transit Suisun Cutoff and Andy Mason Slough between Honker Bay and Grizzly Bay where abundances of these fish species are especially high (see Appendix P). The impact to Delta Smelt in particular may be acutely severe, as the time period during which tidal marshes at Point Buckler were eliminated coincided with the worst drought California has experienced in many years. Loss of vital food production resources at a location transited heavily by Delta Smelt, at a time when drought pressures have significantly reduced this listed endangered species' population size, places an outsized adverse impact on the survival and recovery of this species. The tidal marshes at Point Buckler likely also served as nesting habitat for passerine bird species of concern, and may have supported listed small mammals such as the salt marsh harvest mouse and Suisun shrew. The Island currently supports one special status plant species, Mason's Lilaeopsis, which was likely impacted by project activities.

Impacts from New Invasive Plant Species Establishment. As a result of diking, disturbance and drainage of the tidal marsh at Point Buckler, perennial pepperweed (*Lepidium latifolium*) has become the dominant invasive species in the island interior, where it was previously either absent or a negligible, minor component of the former bulrush, tule, and cattail-dominated tidal marsh. The invasion is likely to result in progressively increased spread and dominance of perennial pepperweed in the diked, drained marsh dieback zones of the Island interior.

Impacts of Ongoing Marsh Drainage. The tidal marsh diked by the new levee construction has also been subjected to ongoing drainage efforts. Point Buckler Island exhibits strong and conspicuous evidence of exceptionally prolonged drainage, and lack of seasonal managed flooding schedules of any normal Suisun Marsh managed wetland. Drainage appears to be perennial, cumulative, and ecologically significant. It is causally associated with mass dieback of obligate wetland plants composing the tule-cattail-bulrush marsh vegetation.

Tule-bulrush marsh was documented to dominate the lower marsh on the island since at least the mid-1970s, and tule-bulrush-cattail-reed dominated marsh was mapped over almost all the island from 2000-2012; conversion of that vegetation to standing dead litter, associated with rapid invasion of broadleaf wetland weeds, terrestrial weeds, and native high marsh plants, is strong direct evidence that drainage has shifted the island vegetation to an alternate state.

The marsh drainage trends appear to be persistent and progressive: despite a return to average winter rainfall, terrestrial weeds, as well as native and non-native high and transition zone plants, overwintered and grew to pre-flowering stages among dead former tule-bulrush-cattail marsh vegetation. Observed highly elevated winter groundwater salinity, and exceptionally depressed groundwater elevations, are consistent with permanent marsh drainage and lack of leaching from managed flood-drain cycles. Drainage ditches with low water levels relative to the interior marsh surface and groundwater levels appear to maintain permanent positive drainage gradients from the interior marsh to the ditch. Turbid, green ditch water with significantly elevated salinity in winter, indicates a lack of periodic flood-drain management or episodic tidal flows that would otherwise flush salts and microalgae from the ditches. Iron oxide films on the upper ditch banks also indicate prolonged low water levels in the ditches.

Soil acidification is currently evident (severe) in only a couple of sample points, but it's a high potential for Joice Muck in its drained phase[9]. Soil groundwater salinization is also likely to become a source of long term degradation if water management under existing conditions is continued. Elevated salinity levels of shallow groundwater in diked non-tidal Suisun Marsh is a significant driver of vegetation change, in addition to perennial drainage of the upper marsh soil horizons. Without tidal flushing or typical Suisun Marsh managed non-tidal flood-drain cycles over fall, winter, and spring, soil salts are likely to accumulate in the root zone by capillary movement and evaporative concentration. Recurrent elevated soil salinity during the growing season would be a source of significant potential resistance to restoration of brackish tidal marsh, just as it is a significant constraint on quality of waterfowl habitat in managed non-tidal conditions. Persistent elevated salinity in the soil root zone and shallow groundwater would likely require remediation (corrective measures) that are based on increased hydroperiods and salt leaching in winter.

6 Technical Questions to Be Assessed

1) **Historical conditions from time of last levee repairs (mid 1980s) to time alterations initiated:**
    a) Purpose: to establish length of time of jurisdictional extents and ecological conditions
    b) Questions:
        i) Number, location, and size of tidal connections and interior tidal channels
        ii) Timeline of reversion from diked to tidal
        iii) Evidence of property management from mid 1980s levee repairs to time alterations initiated
        iv) Number and location of water control structures and timing of their inoperability (see 1984 Individual Management Plan)
        v) Change in vegetation community composition
2) **Pre-alteration conditions at time alterations initiated ("baseline"):**
    a) Purpose: to establish baseline jurisdiction type and extent and baseline ecological conditions
    b) Questions:
        i) Extent of remnant levee, and location of remnant levee in relation to new levee footprint
        ii) Extent of impoundment (diking) hydrological effects of degraded, unrepaired remnant levees over time
        iii) Number, location, and size of tidal connections and interior tidal channels
        iv) Estimated jurisdictional extent under CWA, RHA, MPA, SMPA
        v) Vegetation community composition on remnant levee and on marsh plain
3) **Evolution of alterations through to current conditions as of March 2016**
    a) Purpose: to establish types, magnitudes and extents of modifications
    b) Supports:
        - Harm assessment in relation to Basin Plan beneficial uses

[9] See Soil Conservation Service 1977. Solano County Soil Survey.

- Harm assessment in relation to California and federal Endangered Species Acts
- Conversion of tidal to diked conditions in relation to MPA, RHA, CWA, SMPA jurisdiction
- Violation types, quantities and durations
- Work since Jan 30, 2015 when BCDC requested no further work be done

c) Questions:

i) Start and end dates of each activity involving fill

ii) Area of constructed levee and western pathway with as much temporal detail as can be determined

iii) Area of fill placement in interior marsh (fill pads, terrestrial conversion of diked marsh, vehicle paths, etc.)

iv) Area of structures, whether or not placed on fill, in interior diked marsh (trailers, storage containers, wind breaks, etc.)

v) Areas of excavated borrow ditch, crescent basins, temporary borrow pits including the east pit subsequently filled

vi) Area of wetland converted to non-wetland, or waters of the U.S. or state converted to non-waters, as a result of fill placement or alteration of drainage due to combined effects of ditching, diking and water control structures

vii) Area of structures in tidal waters (docks, gangways, etc.)

viii) Estimated volume of earthen fill placed

7 Key to Technical Appendices

Table 3. Annotated List of Appendices

No.	Name	Contents
A	Baseline Aerial Imagery, 1948-2011	Aerial photographs of Point Buckler 1948 to 2011 (Baseline)
B	Aerial Imagery, Freeman Island Reference Site	Aerial photographs of Freeman Island 1948 to 2016
C	Aerial Imagery, Snag Island Reference Site	Aerial photographs of Snag Island 1968 to 2016
D	Alteration Period Aerial Imagery, 2012-2016	Aerial photographs of Point Buckler 2012 to 2016, during and following site alterations
E	March 2016 Topographic Survey, Digital Elevation Model Generation, and Cut-Fill Volume Calculations Data Report	Documentary report on methods and procedures for March 2, 2016 topographic data collection efforts, generation of DEM, and cut-fill volume calculations
F	March 2016 Topographic Survey Findings	Topographic data collection locations, elevation statistics, topographic profiles, DEM, tidal datum relationships
G	Opening of Tidal Connectivity and Establishment of Tidal Marsh, 1985 to 2011	Assessment of changes in tidal connectivity from last major levee repair in 1985 to baseline tidal marsh conditions
H	Baseline (2011) Site Conditions Assessment	Assessment of ecological conditions at baseline tidal marsh
I	High Tide Line and Tidal Datums	Basis of establishing and results for High Tide Line and tidal datums at Point Buckler
J	Closure of Tidal Connectivity in 2014	Description of changes in tidal connectivity as a result of site alterations

No.	Name	Contents
K	Fill and Excavation in Wetlands and Waters Since 2011	Description of fill and excavation activities in wetlands and waters as a result of site alterations
L	Wetlands Drainage Since 2011	Description of wetlands drainage as a result of site alterations
M	Jurisdiction: McAteer-Petris Act and Suisun Marsh Preservation Act	Establish jurisdictional extent, summarize regulated activities, and assess site alterations relative to regulatory authorities under the MPA and SMPA
N	Jurisdiction: Rivers and Harbors Act Section 10 and Clean Water Act Section 404	Establish jurisdictional extent, summarize regulated activities, and assess site alterations relative to regulatory authorities under the CWA and RHA
O	Jurisdiction: Porter-Cologne Water Quality Control Act	Establish jurisdictional extent, summarize regulated activities, and assess site alterations relative to regulatory authorities under the PCWQCA
P	An Assessment of Adverse Effects on Beneficial Uses Related to Listed Fish Species by Point Buckler Tidal Marsh Diking and Closure from Daily Tidal Connectivity	Assessment of harm to fish Beneficial Uses as a result of site alterations
Q	An Assessment of Adverse Effects on Beneficial Uses Related to Listed Wildlife Species, Estuarine Marsh, and Other Ecological Effects of Tidal Marsh Diking, Fill and Perennial Drainage	Assessment of harm to wildlife and wetlands Beneficial Uses and other ecological functions as a result of site alterations
R	March 2, 2016 Field Photographs	Annotated field photographs from March 2, 2016 field visit
S	May 28, 2003 Field Photographs	Annotated field photographs from May 28, 2003 field visit

8 Report Preparers

This report has been prepared by three authors and one Geographic Information Systems specialist and with an engineering firm conducting the new topographic survey, developing the digital elevation model, and calculating cut-fill quantities.

Report authors

Stuart Siegel, Ph.D., P.W.S., *Wetland Scientist*

Stuart Siegel is a wetlands scientist who has worked in the San Francisco Estuary for over 30 years. He received his Ph.D. from the University of California at Berkeley, Department of Geography, in 2002, studying the geomorphology of tidal marsh restoration projects in the San Francisco Estuary. Dr. Siegel received his certification as a Professional Wetland Scientist in 1994. He is currently Adjunct Professor in the Department of Earth and Climate Sciences at San Francisco State University and the Coastal Resilience Specialist for the San Francisco Bay National Estuarine Research Reserve. Dr. Siegel previously established Wetlands and Water Resources in 1996, a small consulting firm that he sold in 2014. He now owns Siegel Environmental. Dr. Siegel focuses on climate change issues and wetlands restoration in the San Francisco Estuary, combining work on restoration projects, applied science, regional environmental planning, and natural resources policy. Dr. Siegel has extensive experience in Suisun Marsh, having been the Science Advisor from 2005 to 2010 for development of the Suisun Marsh Habitat Management,

Preservation, and Restoration Plan and as lead author of the Suisun Marsh Conservation Strategy completed in 2011. He was co-lead scientist (with Bruce Herbold and Tina Swanson) of the Delta Regional Ecosystem Restoration Implementation Plan. He worked for the Delta Vision Blue Ribbon Task Force during its 2007-2008 period of operation, serving as the technical lead for its Ecosystem Work Group. He authored much of the 2010 Delta Ecosystems White Paper for the Delta Stewardship Council. He was the lead Principal Investigator for the CALFED Science Program's Integrated Regional Wetland Monitoring Pilot Project completed from 2003-2006. Dr. Siegel is also the lead Principal Investigator of two water quality studies on the diked, managed wetlands of Suisun Marsh, aiming to improve water quality in the tidal sloughs of Suisun Marsh through improved management of the diked wetlands. Dr. Siegel is the lead author of this technical report.

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Peter Baye, Ph.D., *Coastal Ecologist*

Peter Baye is a coastal ecologist and botanist specializing in conservation management of coastal vegetation. He received his Ph.D. from the University of Western Ontario, Department of Plant Sciences, Canada, in 1990. In California, Peter worked for the U.S. Army Corps of Engineers, San Francisco District, as a senior ecologist specializing in wetlands regulatory projects, from 1991-1997. He was responsible for EIS management and environmental assessments for NEPA compliance, complex jurisdictional determinations, Clean Water Act Section 404(b)(1) analyses, and enforcement actions. As a senior biologist at the U.S. Fish and Wildlife Service from 1997-2002 in Sacramento, he prepared endangered species recovery plans for coastal species and ecosystems, including the first draft of the tidal marsh recovery plan covering the San Francisco Estuary. After leaving the Fish and Wildlife Service in 2002, Peter continued his diverse wetlands and endangered species conservation work in the Bay Area and Central California as an independent ecological consultant. Adaptation of coastal ecosystems management to accelerated sea level rise and shoreline retreat has been a major focus of his independent consulting work in the Bay and outer coast. His projects include original designs for mixed gravel-sand estuarine beaches as "soft" shoreline and marsh-edge erosion control (alternative to rock armoring), terrestrial transition zones of tidal marshes (including slope wetland "horizontal levees"), high tidal marsh mounds, submerged aquatic vegetation beds, and specialized habitats for endangered plant and wildlife species. Dr. Baye is lead author of Appendix H, baseline conditions, Appendix L, wetlands drainage, and Appendix Q, wetland beneficial use impacts. Dr. Baye also provided regulatory and jurisdictional analysis, and peer review of scientific and technical aspects of the report.

Bruce Herbold, Ph.D., *Fisheries Ecologist*

Bruce Herbold has worked with the fishes of the estuary since 1979, when he began graduate studies at UC Davis with Peter Moyle. As a result of his studies in Suisun Marsh that showed a precipitate decline in smelt abundance throughout its range, he and Professor Moyle petitioned to add delta smelt to the

list of California's threatened fish and wildlife. After getting his PhD, Bruce started work at USEPA to develop new water quality standards to protect estuarine habitat. The federal standards were eventually adopted into state law. Since then he has worked to improve the scientific basis for management decisions in the estuary, largely through the Interagency Ecological Program. He was a team leader in the development of the Vernalis Adaptive Management Program, Delta Cross Channel studies, and the Pelagic Organism Decline studies. Dr. Herbold is author of Appendix P, fisheries beneficial use impacts.

GIS Specialist

Dan Gillenwater, *Wetland Scientist*

Dan Gillenwater is a GIS specialist and wetland scientist with over 10 years experience working on wetlands restoration in the San Francisco Estuary. Mr. Gillenwater holds a Master's of Science in Environmental Science from The Ohio State University. He has carried out complex GIS dataset compilations, analyses, and cartographic efforts for a wide range of wetland restoration and regional restoration planning projects in the San Francisco Estuary. He established Gillenwater Consulting in 2015, after 10 years working for Dr. Siegel. He was the project manager and primary environmental scientist for several ecosystem restoration and enhancement projects in the San Francisco Estuary. Three of the projects that he managed (the Aramburu Island Enhancement Project and the Lower Tolay Creek, Tubbs Island Marsh Enhancement Project, and the Sonoma Creek Marsh Enhancement Project) were successfully constructed in the past six years. Dan also has significant experience in preparing and reviewing CEQA documents and permit applications for a variety of projects and has demonstrated the ability to work with agency staff to ensure regulatory authorizations are obtained in a timely manner. Many of the projects Dan has managed have involved extensive coordination between several participating entities, including clients, community stakeholders, government agencies, and subcontractors.

Engineering Data Collection and Analysis

CLE Engineering

Founded in 1987 as Coastal Engineering, CLE originated as a consulting firm that specialized in civil and marine engineering. Over the years, its capabilities have become more diverse, and today, CLE is known as a premier full-service engineering firm offering expertise in the fields of hydrographic and topographic surveys, dredge engineering and material management and in the disciplines of structural, geotechnical, architectural, marine, environmental, and civil engineering. As a complement to our professional engineering and surveying capabilities, CLE also offers comprehensive planning, permitting and construction management services. The CLE Team is comprised of a dedicated group of professional engineers, LEED-certified associates, scientists and ACSM/THSOA certified hydrographers. It is through our diversity, team approach and our commitment to client advocacy that makes CLE a recognized leader in the engineering industry on land and water, earning us the reputation for making things happen from coast to coast. With offices located in the northeast, southeast, northwest and along the west coast, we are readily available to service clients from the private and public sectors and the construction community throughout the United States.

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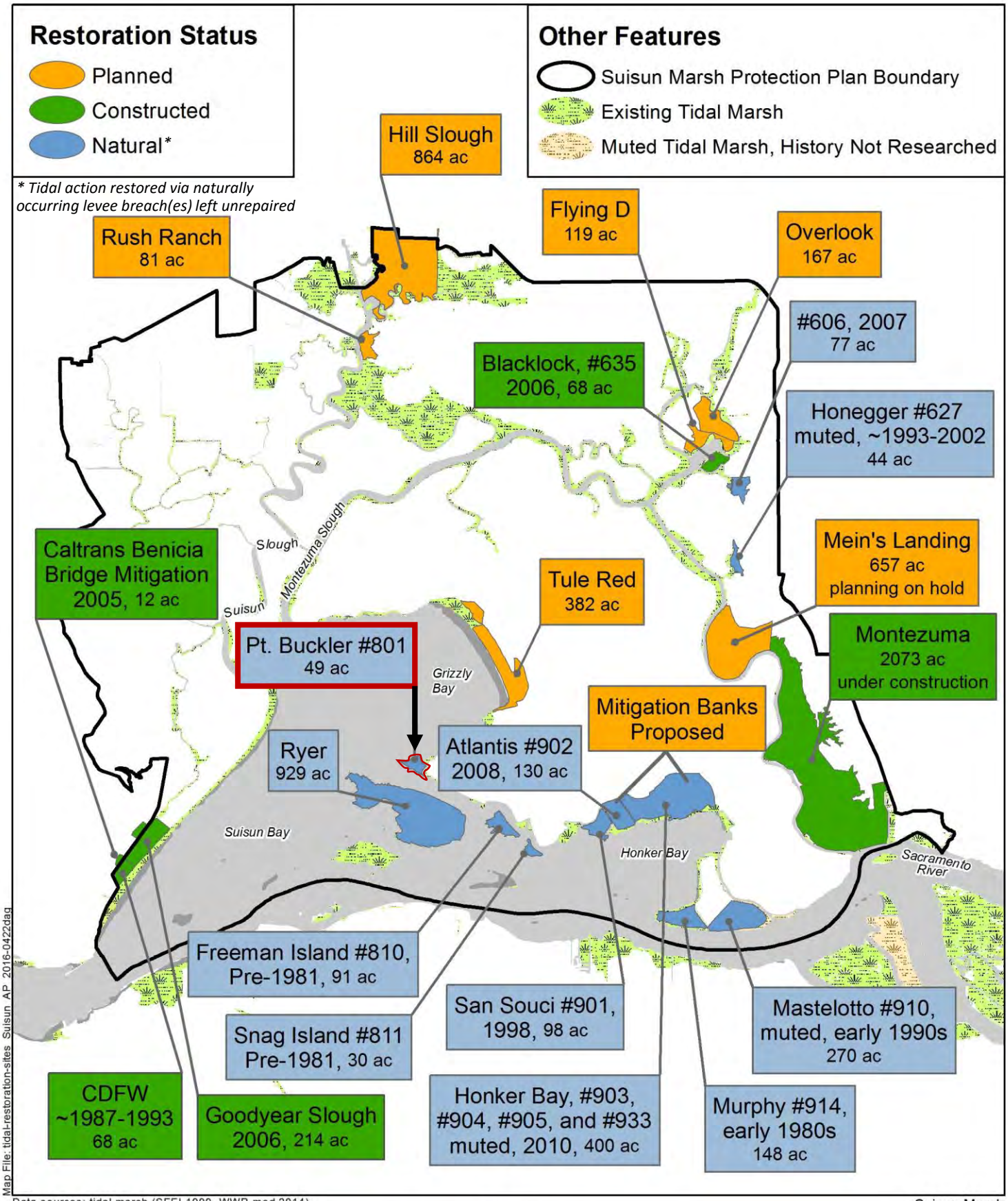


Suisun Marsh
Solano County, CA

Figure 1

Suisun Tidal Restoration Sites

Map File: vicinity-map_Buckler_v2_2016-0422

Data sources: Basemap (ESRI, 2016)

1:63,360 (1" = 1 mi at letter size)

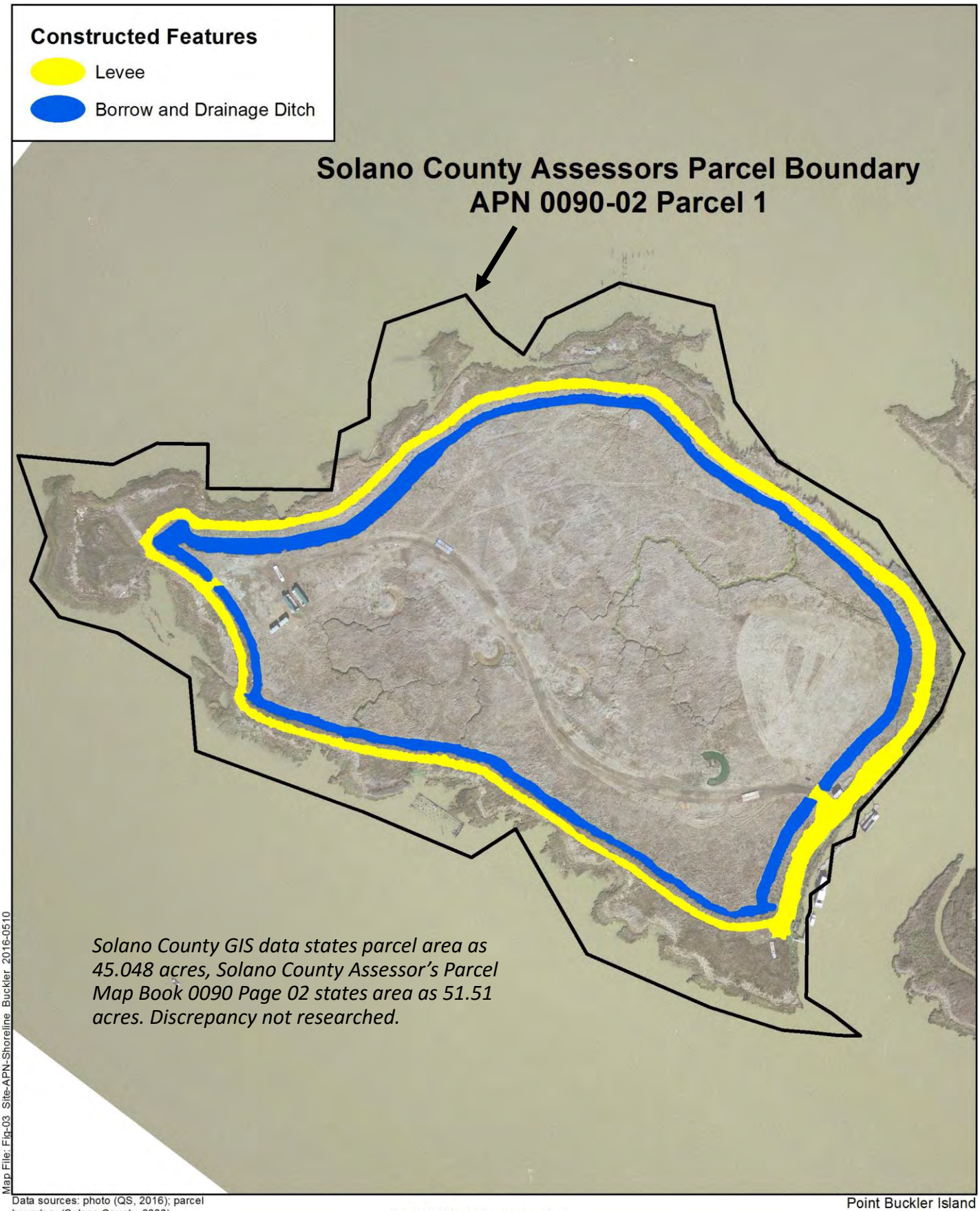
0 0.5 1 Miles

0 0.75 1.5 Kilometers

Point Buckler Island
Solano County, CA

Figure 2

Point Buckler Vicinity Map



Map File: Fig-03_Site-APN-Shoreline_Buckler_2016-0510

Data sources: photo (QS, 2016); parcel boundary (Solano County, 2008)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

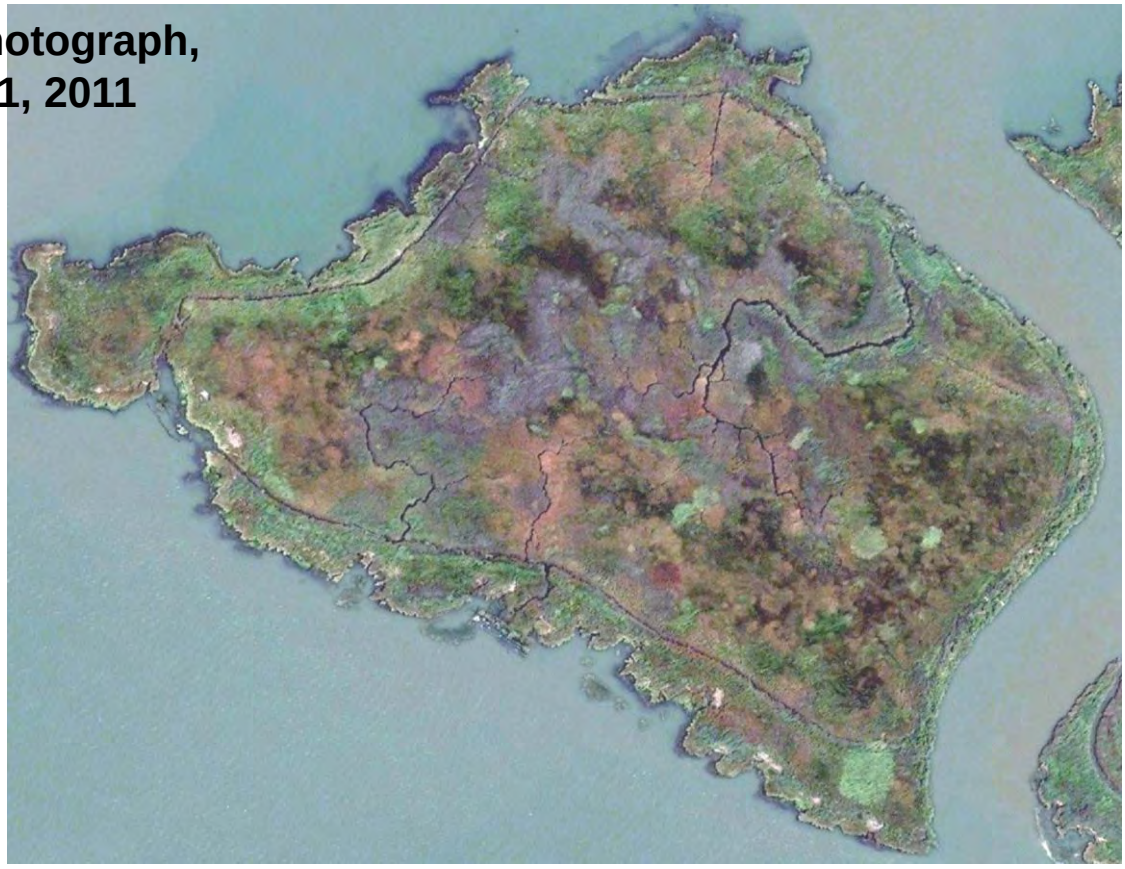
0 50 100 m

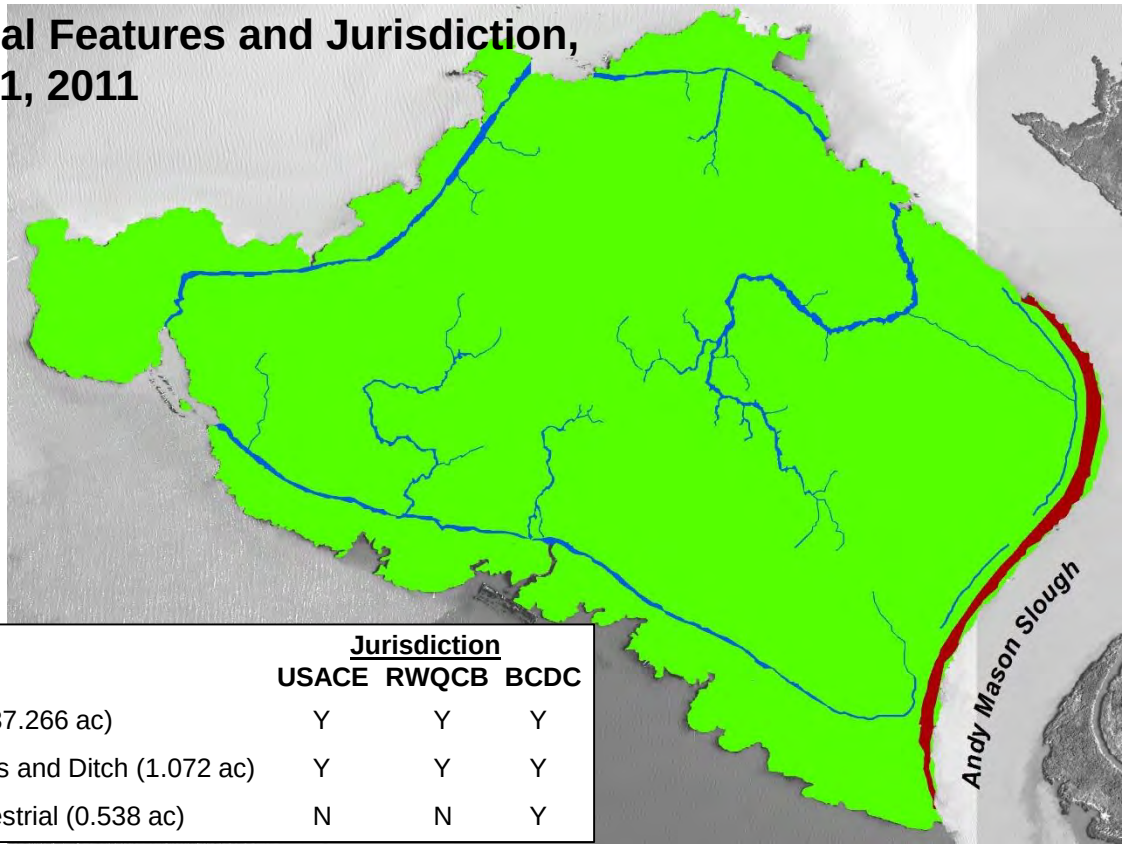
Point Buckler Island
Solano County, CA

Figure 3

Site Map with Assessors Parcel and Constructed Features

Base air photo: (Quantum Spatial) February 10, 2016





Ecological Features	Jurisdiction USACE	RWQCB	BCDC
Tidal Marsh (37.266 ac)	Y	Y	Y
Tidal Channels and Ditch (1.072 ac)	Y	Y	Y
Lowland Terrestrial (0.538 ac)	N	N	Y

File: Figs 3,4,7_NWI-EA_Buckler_2016-0427.pptx

Point Buckler Island
Solano County, CA

Figure 4

0 150 300 ft
0 50 100 m

Baseline Conditions and Jurisdiction, 2011

Earthwork

Excavation

- Excavation in Tidelands/Marshlands[1] (2.925 ac)

Fill

- Fill in Tidelands/Marshlands[1] (3.021 ac)
- Fill in Terrestrial Lowlands[2] (0.092 ac)

Excavation then Fill

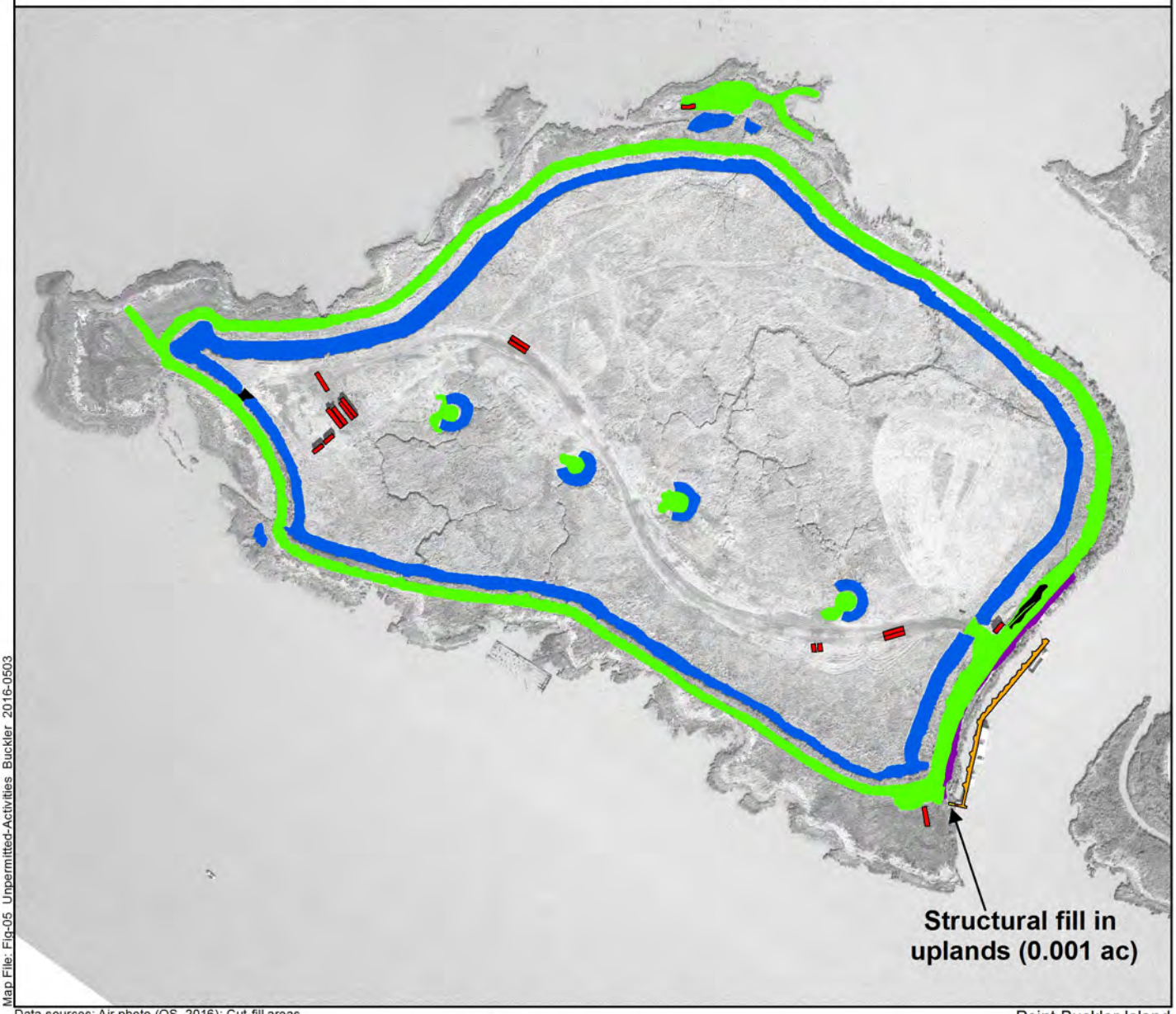
- Excavation then Fill in Tidelands/ Marshlands[1] (0.039 ac)

Structures

- Fill in Tidelands/Marshlands[1] (0.096 ac)
- Fill in Terrestrial Lowlands[2] (0.001 ac)
- Fill in Submerged Lands[1] (0.071 ac)

[1]Suisun Marsh Preservation Act Primary Management Area jurisdiction also applies to these areas of McAteer-Petris Act jurisdiction

[2]These terrestrial areas, all below 10ft NGVD29 (~12.6ft NAVD88) elevation, are within Suisun Marsh Preservation Act Primary Management Area jurisdiction but are not within McAteer-Petris Act jurisdiction



Map File: Fig-05_Unpermitted-Activities_Buckler_2016-0503

Data sources: Air photo (QS, 2016); Cut-fill areas (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure 5

Base air photo: (Quantum Spatial) February 10, 2016

Unpermitted Activities, 2012 - 2016

Site Tidal Hydrology

A. Tidal Channel Connectivity

- Remnant Borrow Ditch (3,200 ft)
- Interior Marsh Channels (3,050 ft)
- Eroded Interior Marsh at Breaches[1]
- Breaches through 1985 Levee (545 ft, 11%)
- Remnant Borrow Ditch Centerline (890 ft)[2]
- Interior Marsh Channel[2] (2,125 ft) / Ditch Centerline[2] (370 ft)

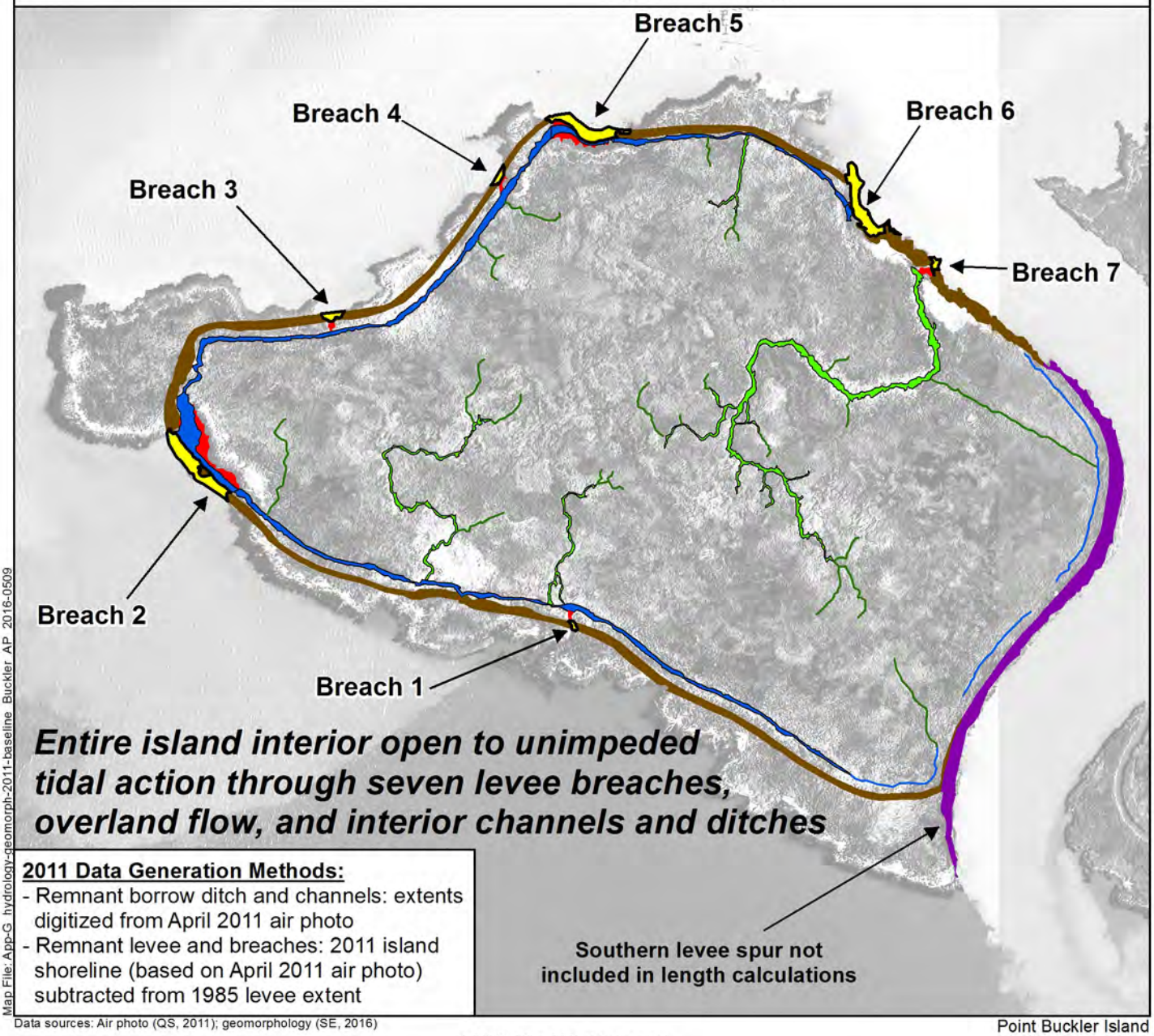
B. Overland Tidal Connectivity

- Remnant 1985 Levee, Wetlands[3] (3,385 ft, 69%)

C. Probable Terrestrial - Little or No Tidal Connectivity

- Remnant 1985 Levee, Terrestrial Lowlands[3] (990 ft, 20%)

[1] Areas of marsh plain loss between 1985 and 2011
[2] Minor features symbolized as lines - width not to scale
[3] Extent based on 2012 CA Dept. of Fish and Wildlife vegetation mapping



2011 Data Generation Methods:
- Remnant borrow ditch and channels: extents digitized from April 2011 air photo
- Remnant levee and breaches: 2011 island shoreline (based on April 2011 air photo) subtracted from 1985 levee extent

Map File: App-G_hydrology-geomorph-2011-baseline_Buckler_AP_2016-0509

Data sources: Air photo (QS, 2011); geomorphology (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

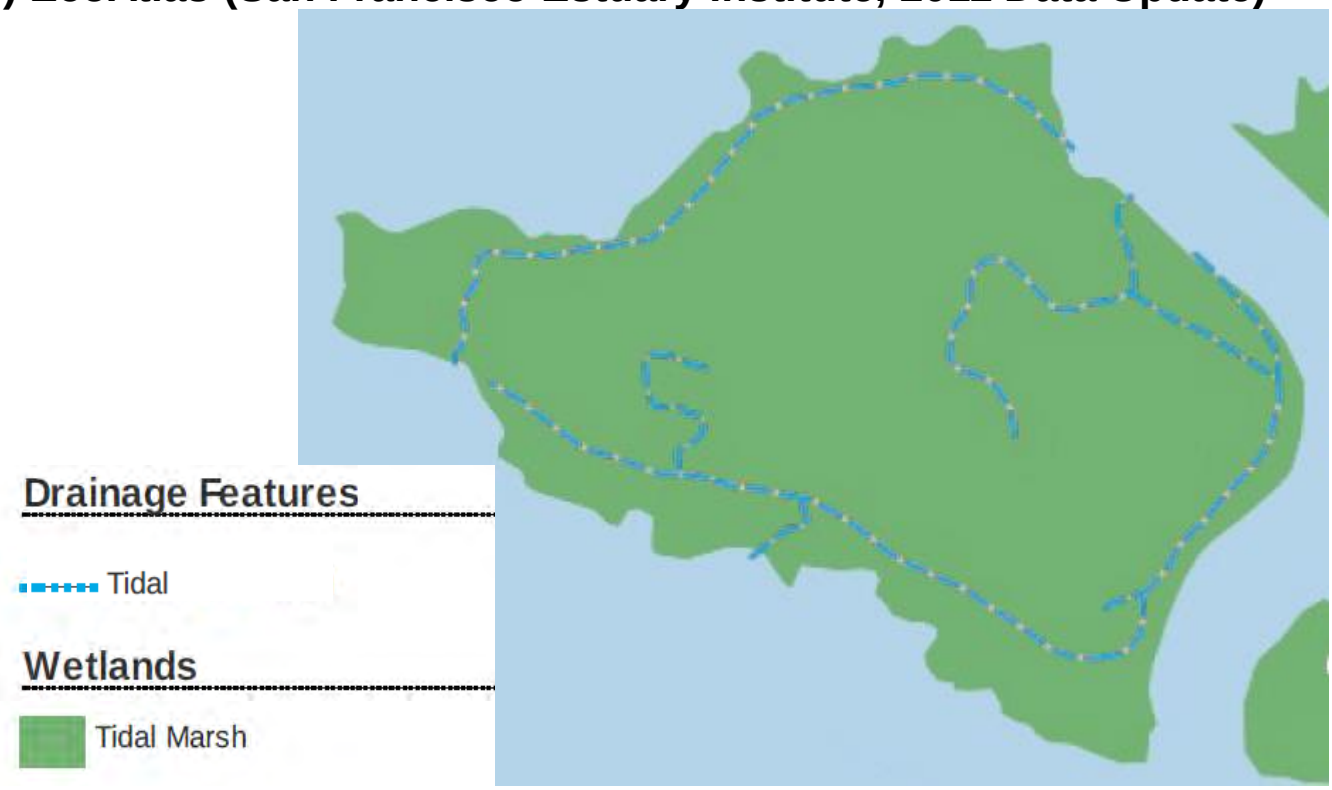
Figure 6

Baseline Tidal Hydrology and Geomorphology, April 2011

Base air photo: (Quantum Spatial) April 2011

A) National Wetlands Inventory (U.S. Fish and Wildlife Service, 2011 Data Update)

B) EcoAtlas (San Francisco Estuary Institute, 2011 Data Update)

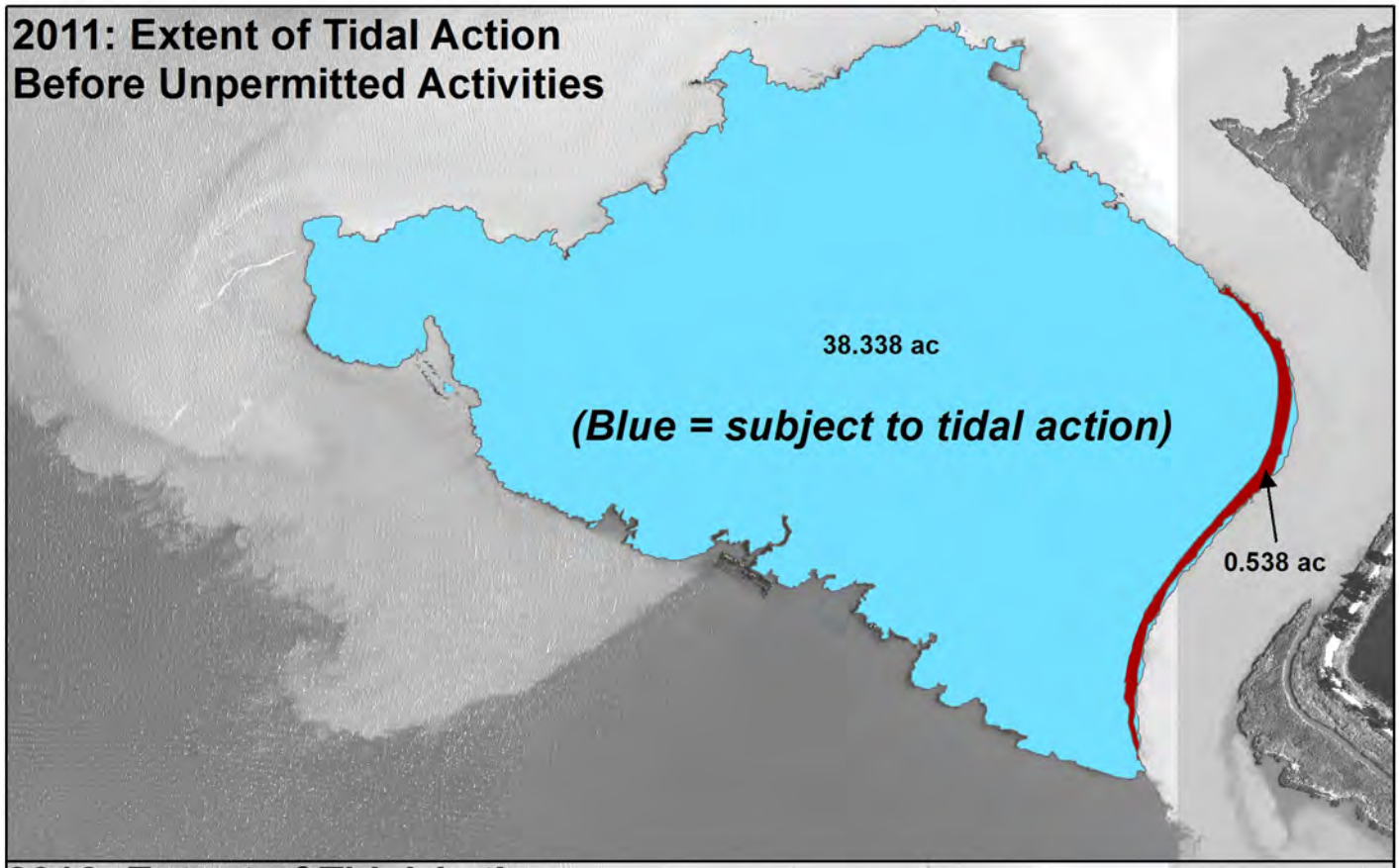


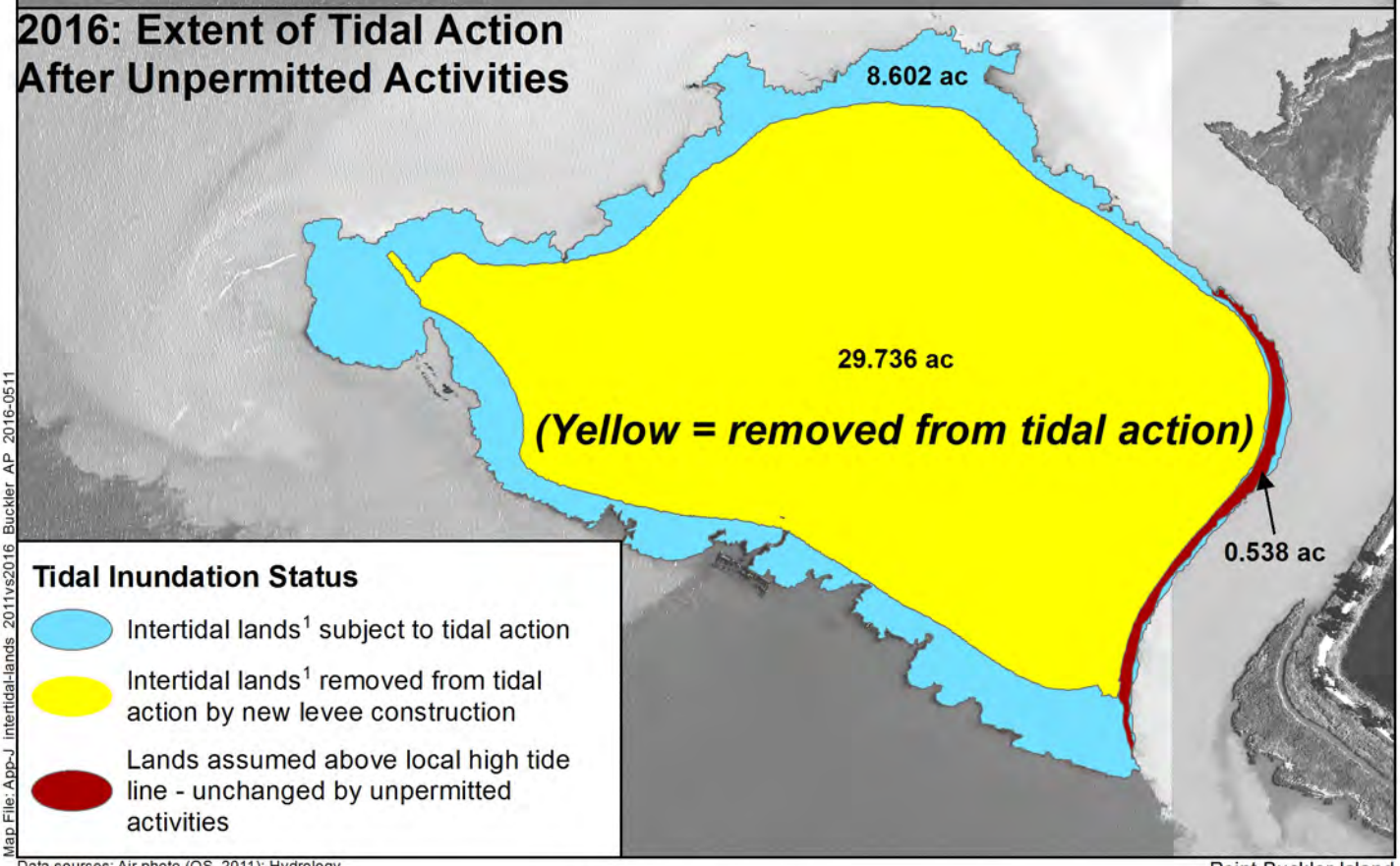
File: Figs 3,4,7_NWI-EA_Buckler_2016-0427.pptx

National Wetlands Inventory and EcoAtlas accessed 4/22/2016

Point Buckler Island
Solano County, CA
Figure 7

National Wetlands Inventory and EcoAtlas Mapped Habitat Types at Point Buckler





Map File: App-J intertidal-lands 2011vs2016 Buckler AP 2016-0511

Data sources: Air photo (QS, 2011); Hydrology (SE, 2016)

1:4,800 (1" = 400' at letter size)

0 200 400 ft

0 65 130 m

Point Buckler Island
Solano County, CA

[1]*Lands below the local high tide line (8.2 ft NAVD88) prior to unpermitted activities*

Figure 8

Loss of Lands Subject to Tidal Action, 2011 to 2016

Base air photo: (Quantum Spatial) April 2011

Appendix A Baseline Aerial Imagery, 1948-2011

Twenty-five aerial photographs and satellite images were obtained from a number of sources, representing the time period from 1948 to 2011. The 1948 shows early stages of island management. 1958 shows a relatively new complete levee system. 1981 shows at least two open levee breaches and perhaps two more small breaches connecting bay tides to the interior channel and ditch network. 1985 represents when the last major levee repairs were completed on Point Buckler Island that provided the necessary infrastructure for hydrologic control to establish managed wetland conditions. The remaining 20 images from 1988 to 2011 illustrate the progressive levee breaches connecting bay tides to the interior channel and ditch network. See Appendix G for the annotated aerial photographs that highlight these changes over time. Note that the brightness and contrast of most aerial photographs have been adjusted from the originals for visual clarity.

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Figure A-4. April 30, 1985 Aerial Photograph (Quantum Spatial)

Figure A-5. July 15, 1985 Aerial Photograph (Corps of Engineers)

Figure A-6. July 14, 1988 Aerial Photograph (Quantum Spatial)

Figure A-7. August 18, 1988 Aerial Photograph (Quantum Spatial)

Figure A-8. June 13, 1990 Aerial Photograph (Corps of Engineers)

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Figure A-11. July 6, 1995 Aerial Photograph (Quantum Spatial)

Figure A-12. July 3, 1996 Aerial Photograph (Quantum Spatial)

Figure A-13. July 22, 1997 Aerial Photograph (Quantum Spatial)

Figure A-14. June 16, 1999 Aerial Photograph (DWR)

Figure A-15. July 10, 2000 Aerial Photograph (Quantum Spatial)

Figure A-16. October 2002 Aerial Photograph (USGS)

Figure A-17. Summer 2003 Aerial Photograph (DWR)

Figure A-18. October 20, 2003 Aerial Photograph (USGS)

Figure A-19. Summer 2005 Aerial Photograph (NAIP)

Figure A-20. Summer 2006 Aerial Photograph (DWR)

Figure A-21. September 1, 2008 Aerial Photograph (USGS)

Figure A-22. Summer 2009 Aerial Photograph (DWR)

Figure A-23. Summer 2010 Aerial Photograph (NAIP)

Figure A-24. April 2011 Aerial Photograph (Quantum Spatial)

Figure A-25. September 1, 2011 Aerial Photograph (Digital Globe)

Map File: App-A_air-photo-1948_Buckler_2016-0421

Data sources: photo - 1EF0000010008_feb12-1948.tif (USGS, 1948)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-1

(USGS) February 12, 1948
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-1958 Buckler 2016-0421

Data sources: photo -1VUO000010115_Jul21_1958.tif (USGS, 1958)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-2

(USGS) July 21, 1958
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A_air-photo-1981_Buckler_2016-0421

Data sources: photo -1VEZR00020022_Feb20-1981.tif (USGS, 1981)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-3

(USGS) February 20, 1981
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-1985-0430 Buckler 2016-0421

Data sources: photo - AV2630-01-12_04-30-85.tif (QS, 1985)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-4

(Quantum Spatial) April 30, 1985
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-1985-0715 Buckler 2016-0421

Data sources: photo - Point Buckler 07-15 1985a_Cropped_Buckler.jpg
(USACE, 1985)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-5

(USACE) July 15, 1985
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-1988-0714 Buckler 2016-0421

Data sources: photo - C3812264.NES.808113_Jul14_1988.tif (USGS, 1988)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

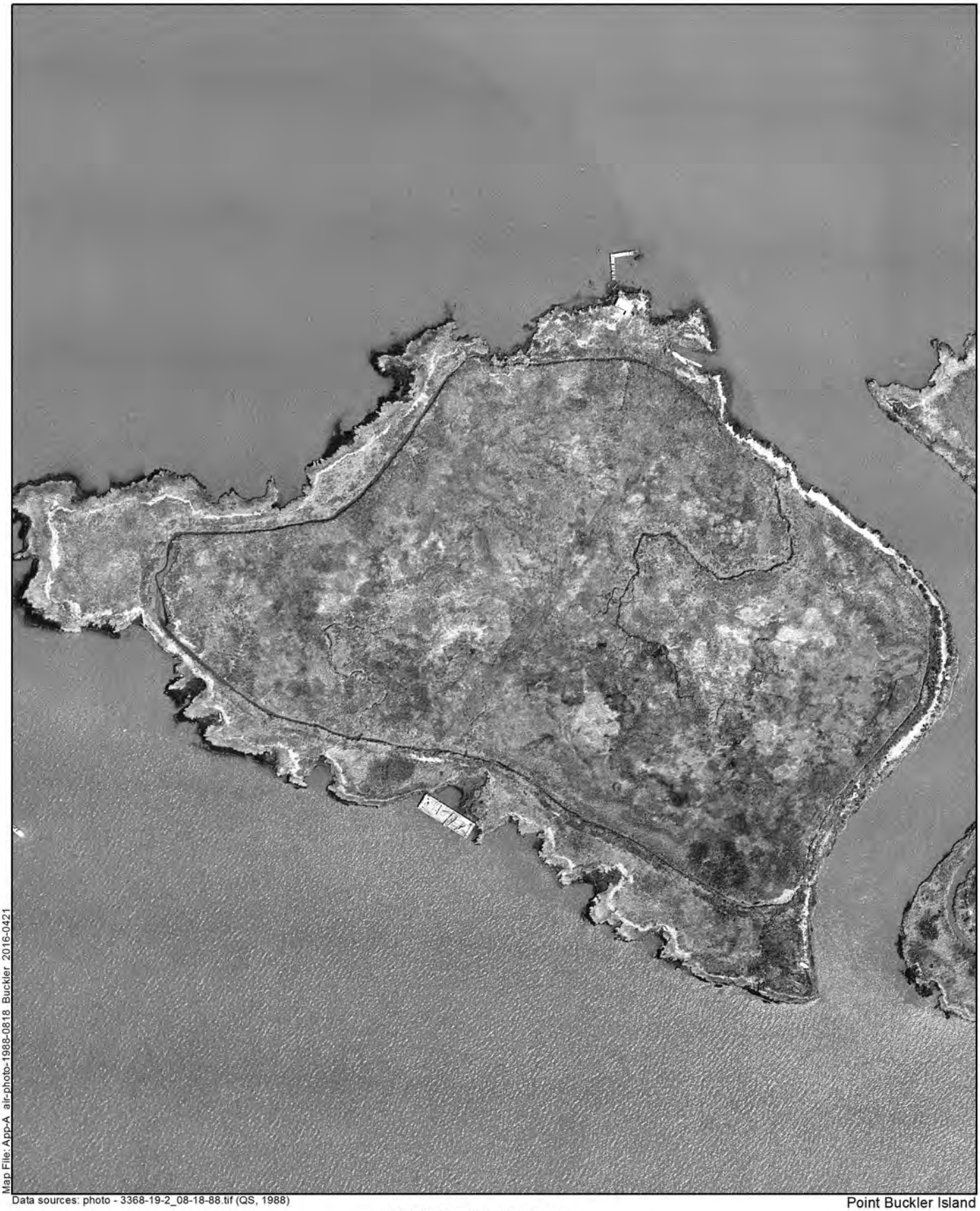
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-6

(USGS) July 14, 1988
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A air-photo-1988-0818 Buckler 2016-0421

Data sources: photo - 3368-19-2_08-18-88.tif (QS, 1988)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-7

(Quantum Spatial) August 18, 1988
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-1990-0613 Buckler 2016-0421

Data sources: Air Photo (USAE, 1990);

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-8

(USACE) June 13, 1990 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-1991-0528 Buckler 2016-0421

Data sources: photo - 4070-30-45_05-28-91.tif (QS, 1991)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

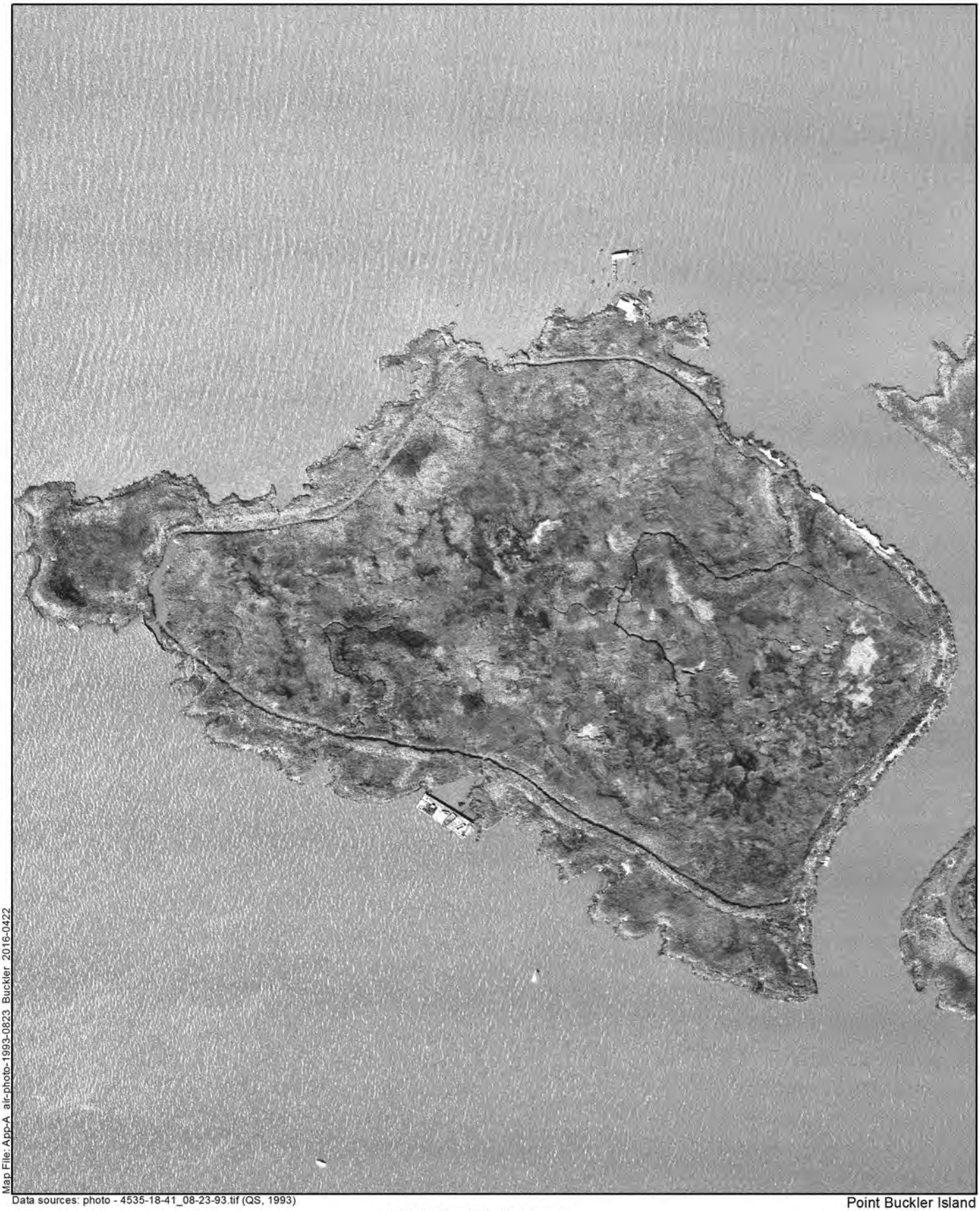
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-9

(Quantum Spatial) May 28, 1991
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A_air-photo-1993-0823_Buckler_2016-0422

Data sources: photo - 4535-18-41_08-23-93.tif (QS, 1993)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

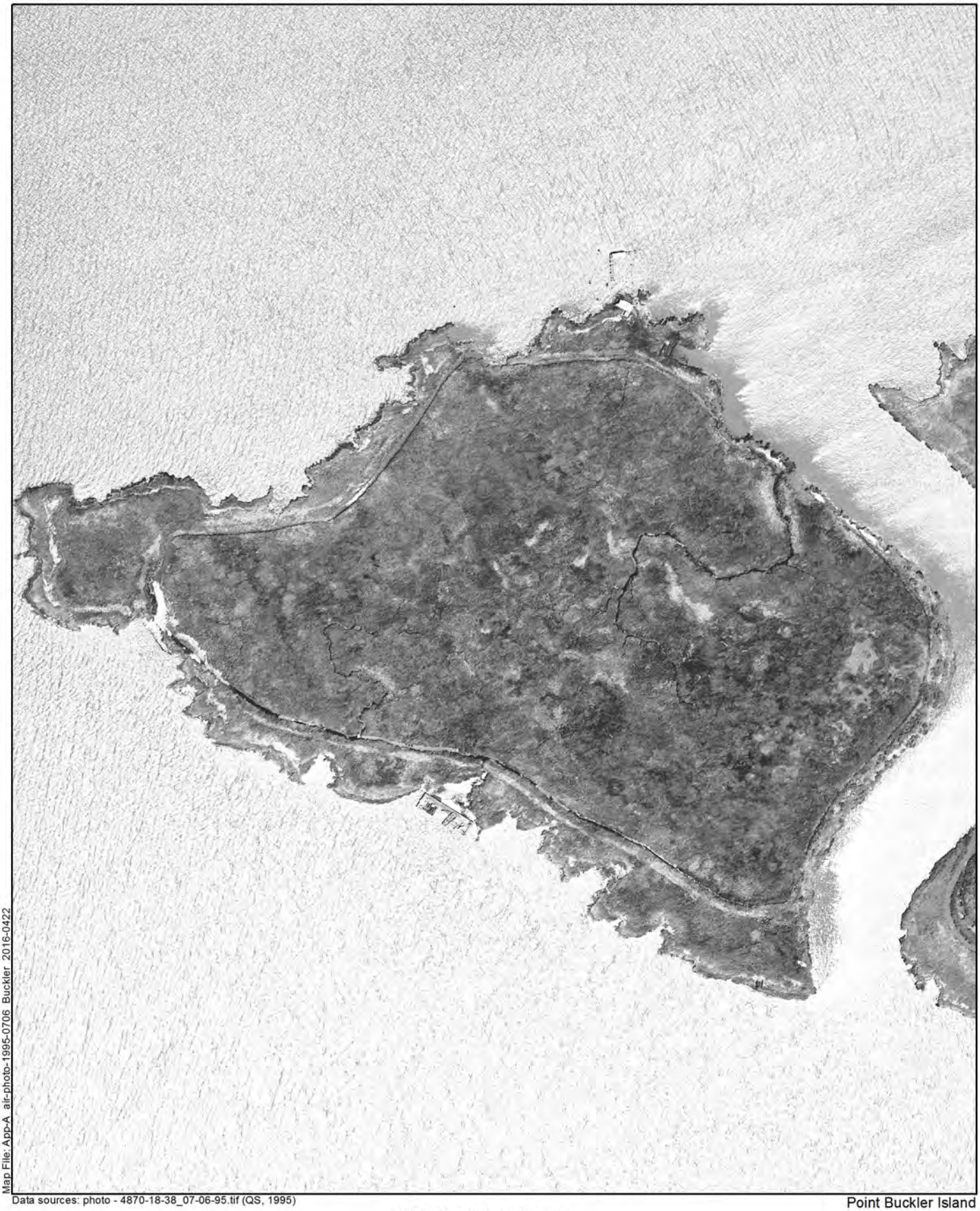
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-10

(Quantum Spatial) August 23, 1993
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A_air-photo-1995-0706_Buckler_2016-0422

Data sources: photo - 4870-18-38_07-06-95.tif (QS, 1995)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

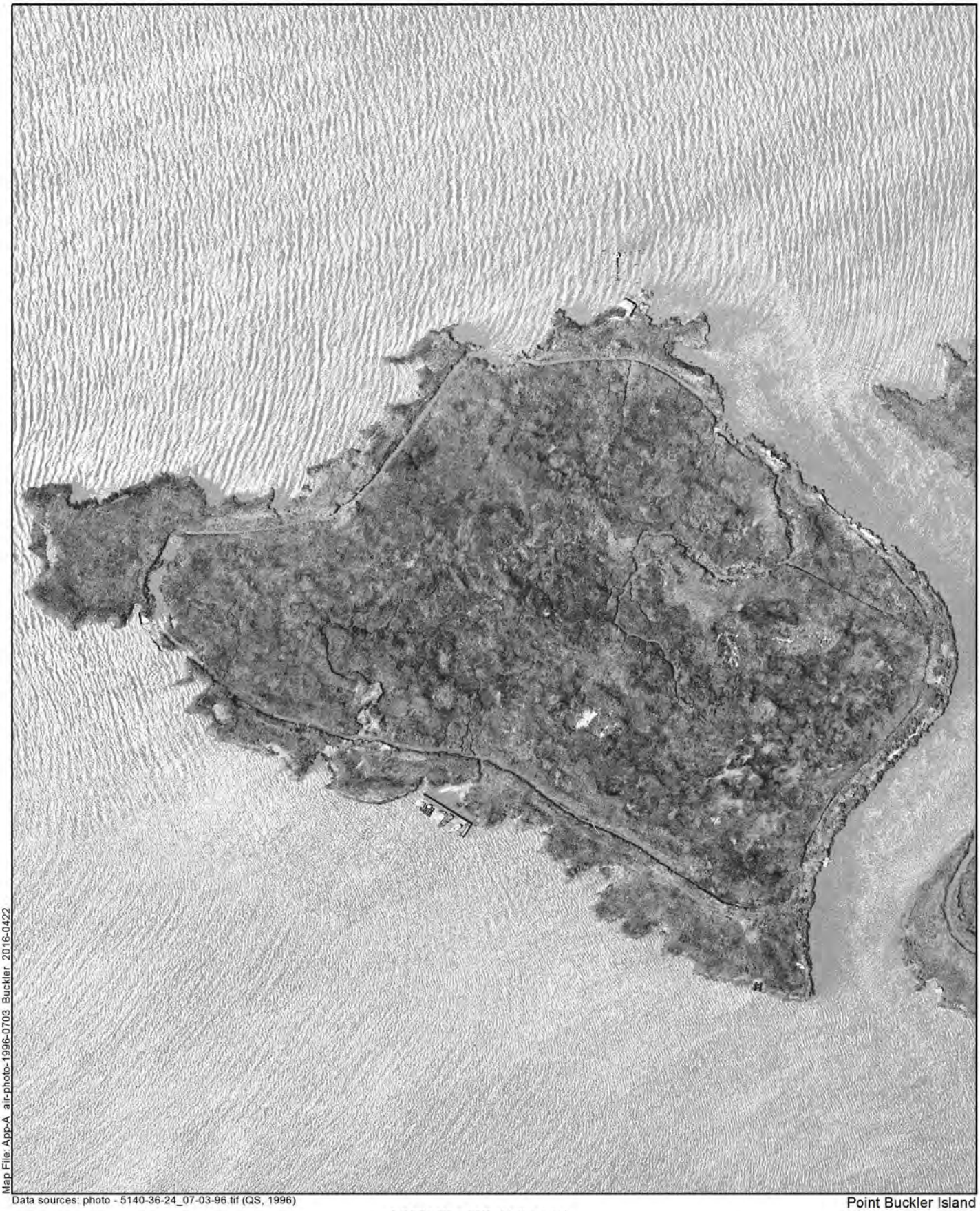
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-11

(Quantum Spatial) July 6, 1995
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A_air-photo-1996-0703_Buckler_2016-0422

Data sources: photo - 5140-36-24_07-03-96.tif (QS, 1996)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

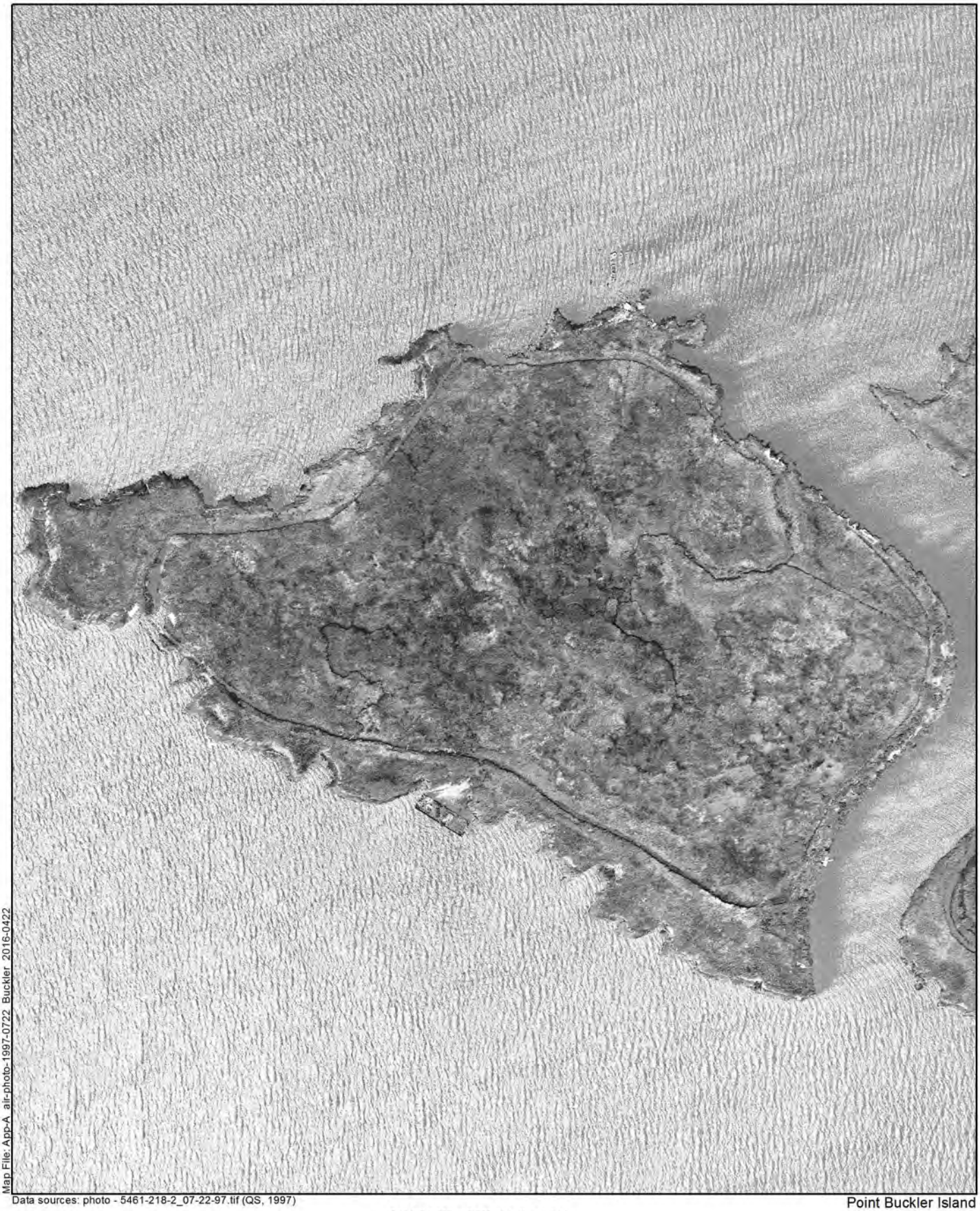
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-12

(Quantum Spatial) July 3, 1996
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A_air-photo-1997-0722_Buckler_2016-0422

Data sources: photo - 5461-218-2_07-22-97.tif (QS, 1997)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-13

(Quantum Spatial) July 22, 1997
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A_air-photo-1999-0616_Buckle_2016-0422

Data sources: photo - 51005a_1999.jpg (DWR, 1999)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

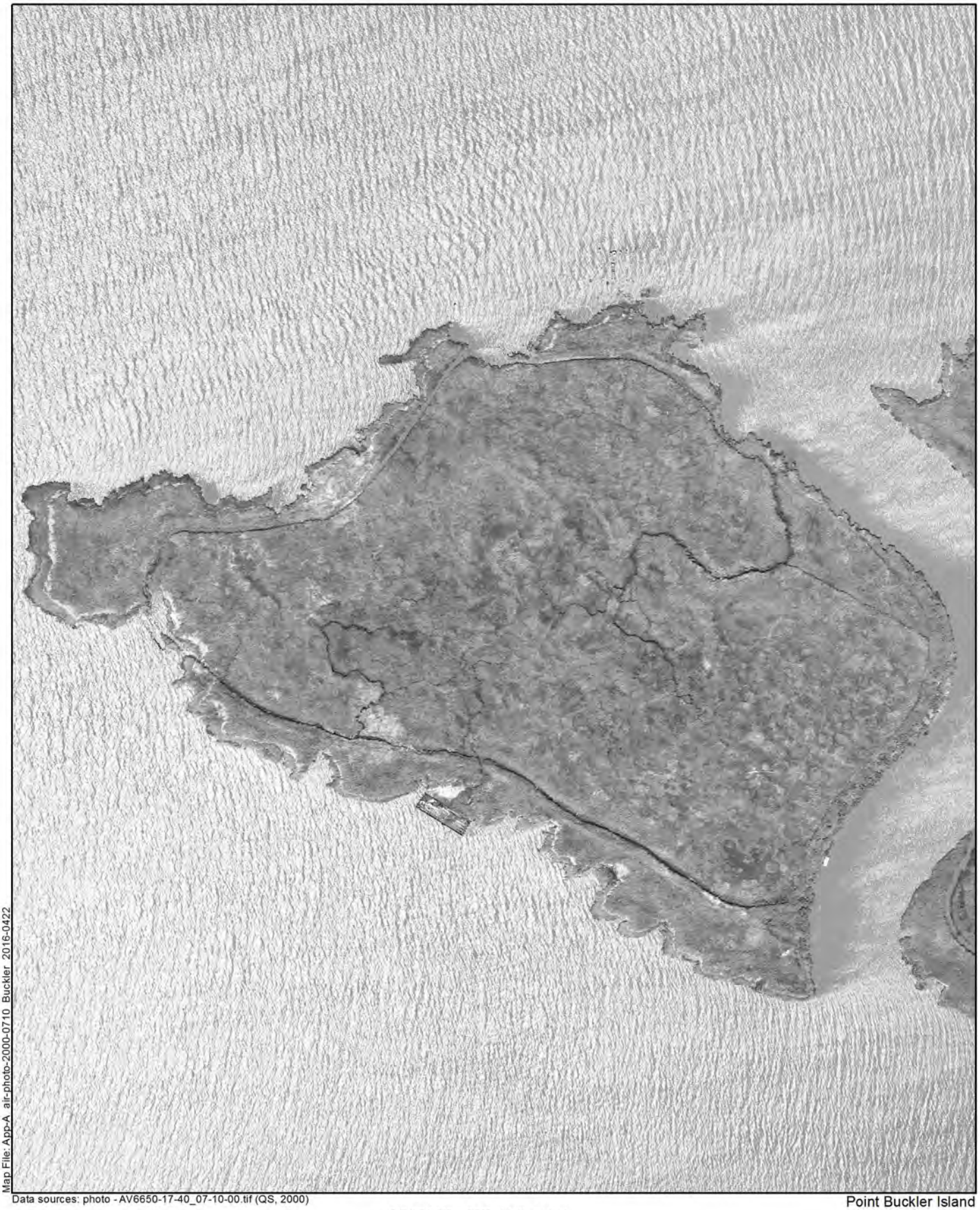
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-14

(DWR) June 16, 1999
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A_air-photo-2000-0710_Buckler_2016-0422

Data sources: photo - AV6650-17-40_07-10-00.tif (QS, 2000)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-15

(Quantum Spatial) July 10, 2000 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-2002-10 Buckler 2016-0422

Data sources: photo - 10seh8520715617.tif, 10seh8520717117.tif (USGS, 2002)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-16

(USGS) October 2002 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A_air-photo-2003-summer_Buckler_2016-0422

Data sources: photo - 2003_brs6554295_1802300.tif, 2003_brs6554395_1796300.tif (DWR, 2003)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure A-17

(DWR) Summer 2003 Aerial Photograph

Map File: App-A air-photo-2003-1020 Buckler 2016-0422

Data sources: photo - 10seh850165.tif, 10seh865165.tif (USGS, 2003)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

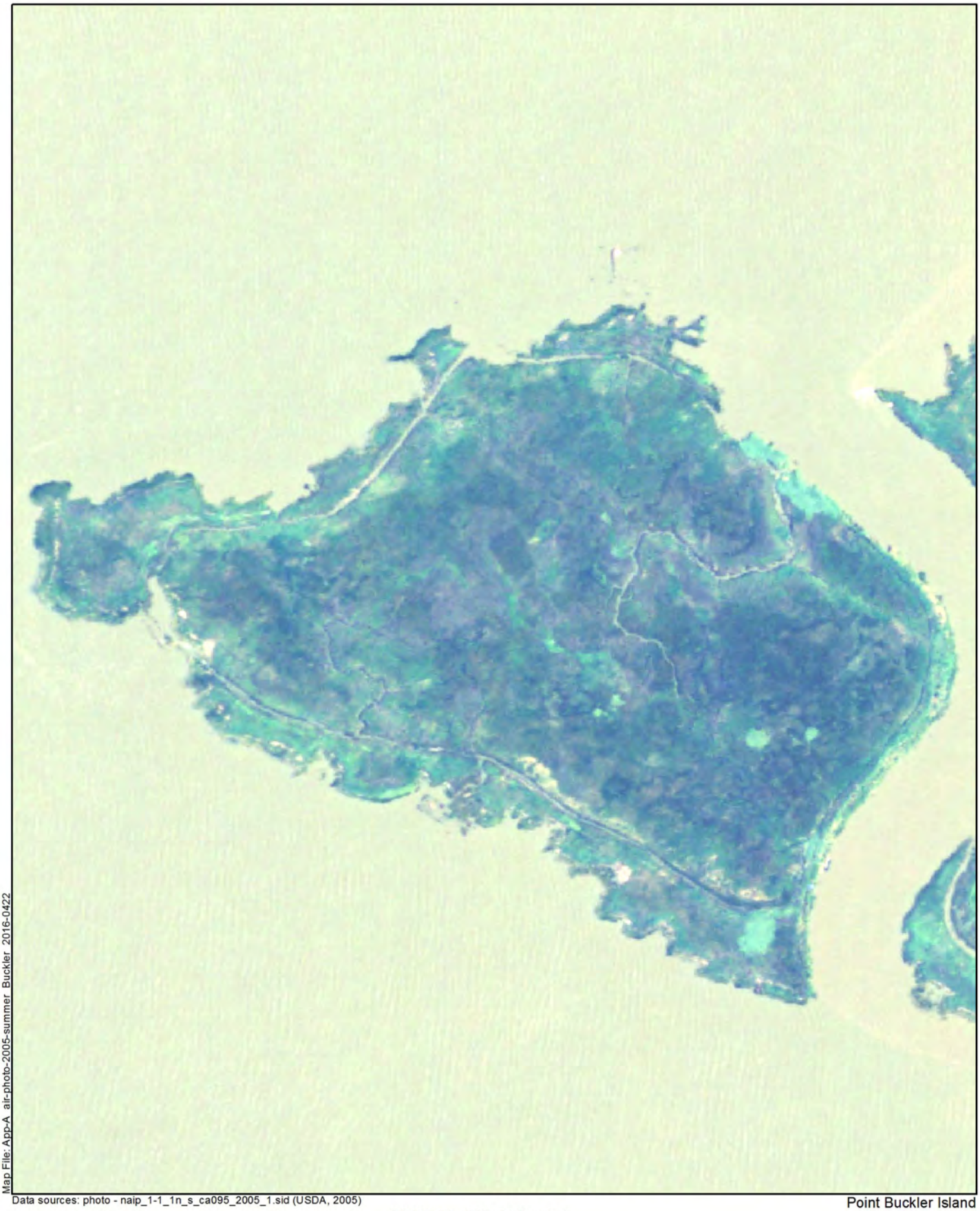
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-18

(USGS) October 20, 2003 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A_air-photo-2005-summer_Buckler_2016-0422

Data sources: photo - naip_1-1_1n_s_ca095_2005_1.sid (USDA, 2005)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure A-19

(NAIP) Summer 2005 Aerial Photograph

Map File: App-A_air-photo-2006-summer_Buckler_2016-0422

Data sources: photo - orthobsw9_8_2006.tif (DWR, 2006)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

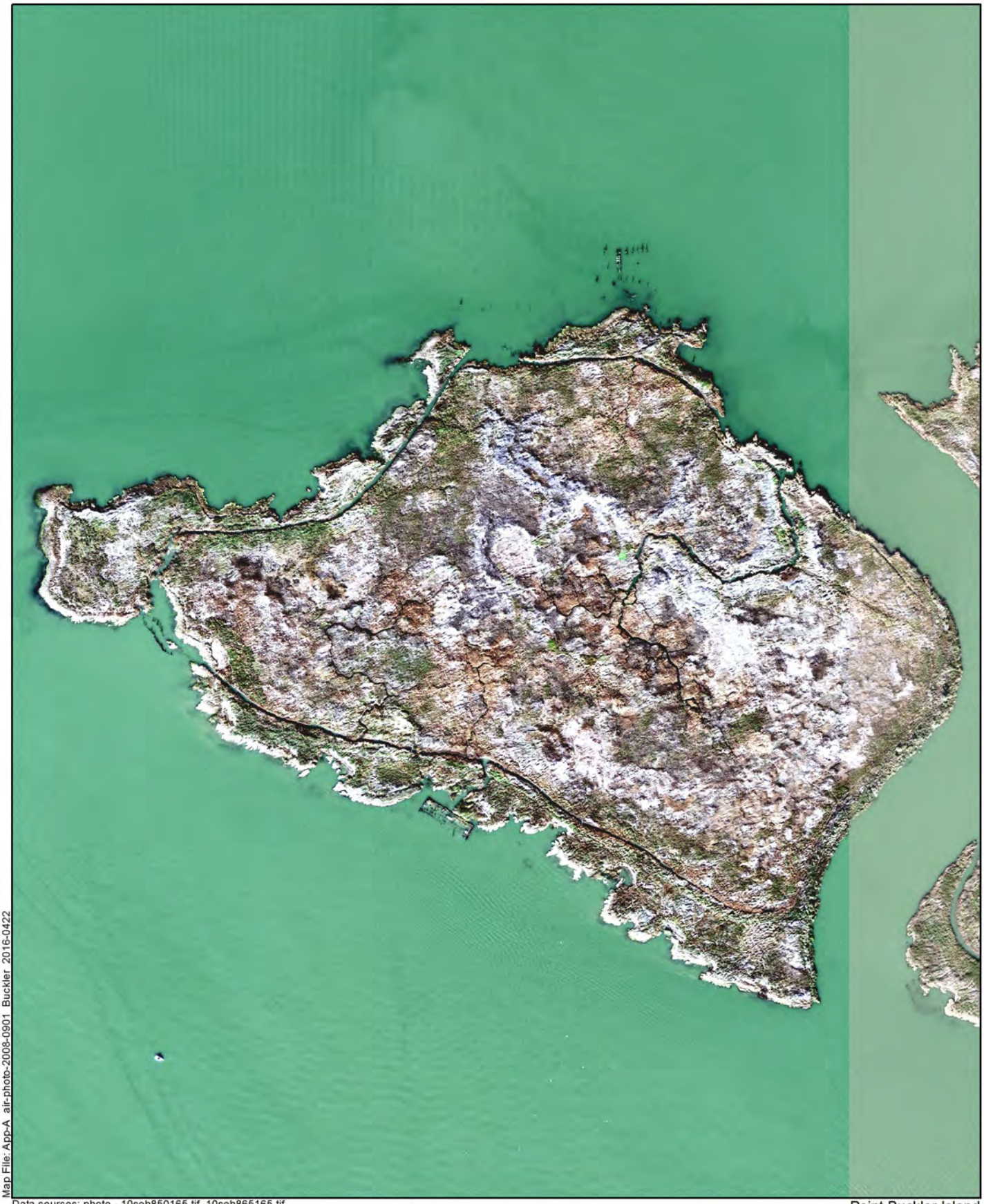
0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-20

(DWR) Summer 2006 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: App-A air-photo-2008-0901 Buckler 2016-0422

Data sources: photo - 10seh850165.tif, 10seh865165.tif
(USGS, 2008)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-21

(USGS) September 1, 2008
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A_air-photo-2009-0901_Buckler_2016-0422

Data sources: photo - 2010btw9_9.tif (DWR, 2009)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-22

(DWR) Summer 2009 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A_air-photo-2010-summer_Buckler_2016-0422

Data sources: photo - ortho_1-1_1n_s_ca095_2010_1.sid
(USDA, 2010)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

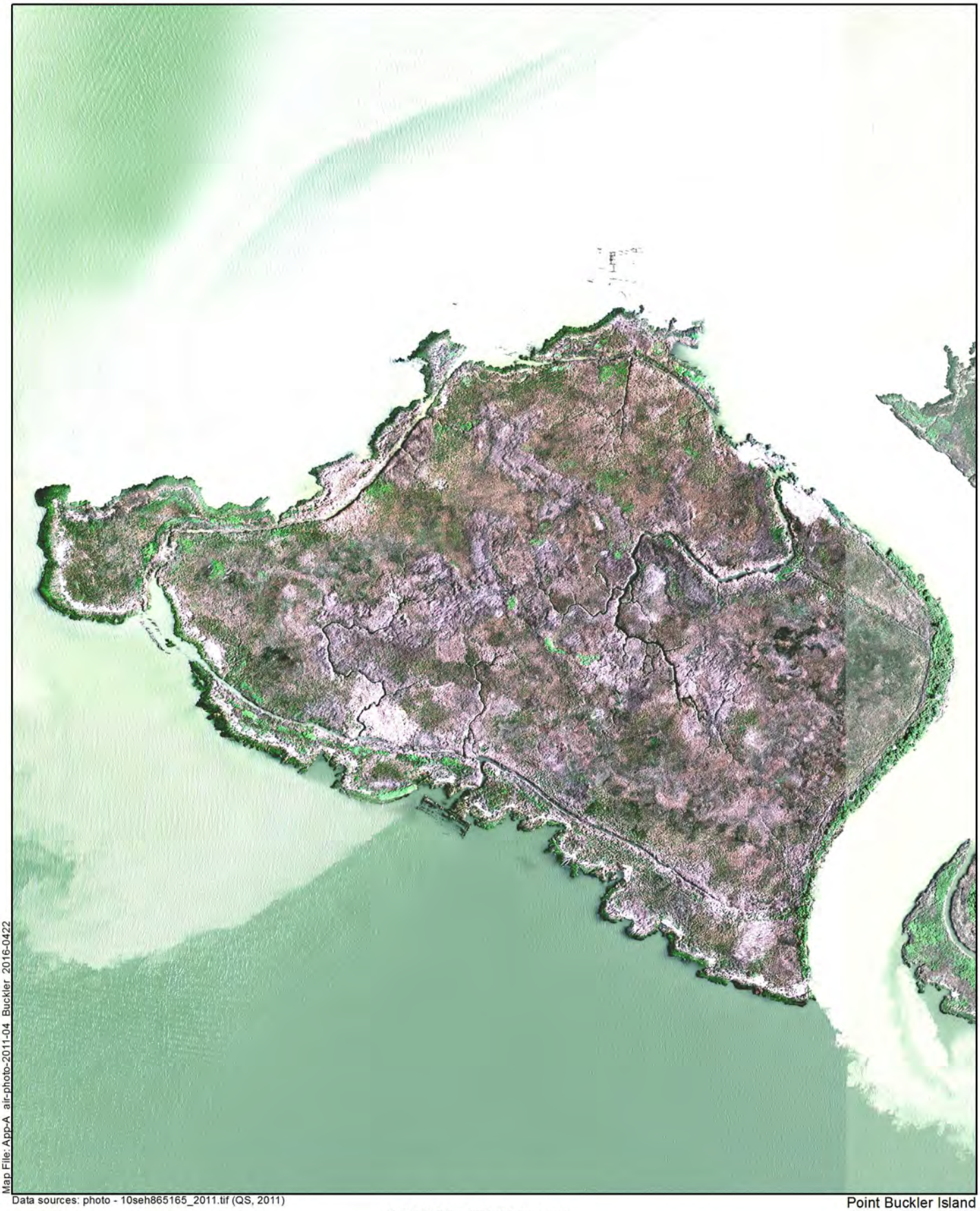
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure A-23

(NAIP) Summer 2010 Aerial Photograph



Map File: App-A air-photo-2011-04 Buckler 2016-0422

Data sources: photo - 10seh865165_2011.tif (QS, 2011)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-24

(Quantum Spatial) April 2011 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: App-A air-photo-2011-0901 Buckler 2016-0422

Data sources: photo - GBM_DG_eb9ebc4cf3ff132a3d941fdb9fc82600_20110901.tif (DG, 2011)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure A-25

(Digital Globe) September 1, 2011 Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

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Appendix B Aerial Imagery, Freeman Island Reference Site

Twenty-six aerial photographs and satellite images were obtained from a number of sources, representing the time period from 1948 to 2016. Freeman Island has a similar history of natural levee failures occurring over time that were not repaired, rendering inoperable the infrastructure necessary to establish hydrologic control for a managed wetland. At Freeman Island, the levees were breached naturally in the 1975 aerial photograph (Figure B-2), with further naturally occurring breach expansion and additional breaches evident in all subsequent aerial photographs.

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Figure B-1. February 12, 1948 Aerial Photograph, Freeman Island (USGS)

Figure B-2. November 12, 1975 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-3. May 12, 1979 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-4. February 20, 1981 Aerial Photograph, Freeman Island (USGS)

Figure B-5. February 6, 1982 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-6. June 10, 1985 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-7. July 15, 1987 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-8. June 4, 1989 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-9. June 14, 1991 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-10. April 23, 1992 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-11. August 23, 1993 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-12. July 6, 1995 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-13. July 3, 1996 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-14. July 22, 1997 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-15. December 15, 1998 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-16. June 16, 1999 Aerial Photograph, Freeman Island (DWR)

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Figure B-18. Summer 2003 Aerial Photograph, Freeman Island (DWR)

Figure B-19. Summer 2005 Aerial Photograph, Freeman Island (NAIP)

Figure B-20. Summer 2006 Aerial Photograph, Freeman Island (DWR)

Figure B-21. Summer 2010 Aerial Photograph, Freeman Island (NAIP)

Figure B-22. April 2011 Aerial Photograph, Freeman Island (Quantum Spatial)

Figure B-23. September 1, 2011 Aerial Photograph, Freeman Island (Digital Globe)

Figure B-24. Summer 2012 Aerial Photograph, Freeman Island (DWR)

Figure B-25. Summer 2015 Aerial Photograph, Freeman Island (DWR)

Figure B-26. February 10, 2016 Aerial Photograph, Freeman Island (Quantum Spatial)

Map File: App-B_air-photo-1948_Freeman_2016-0510

Data sources: air photo (USGS, 1948)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

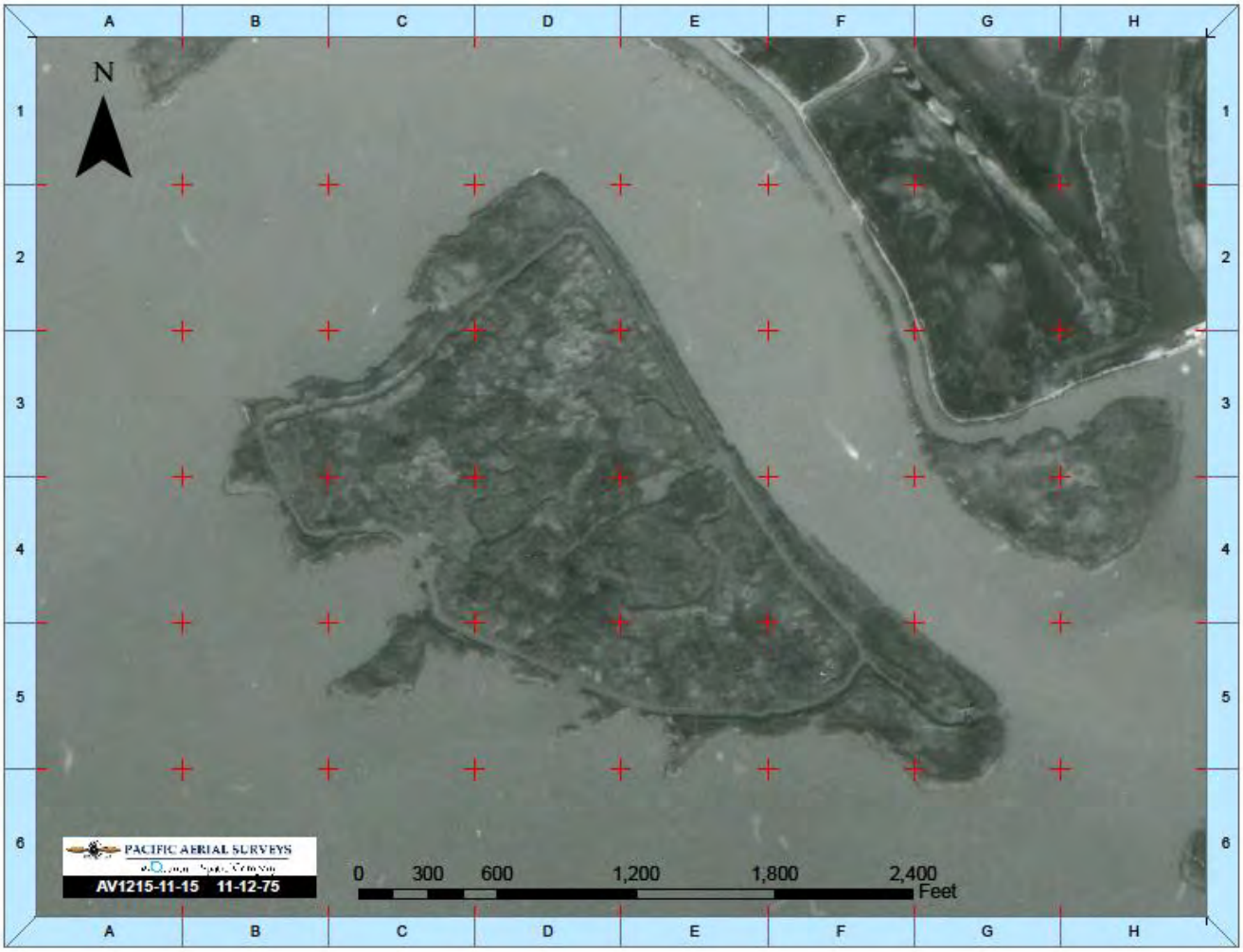
0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-1

(USGS) February 12, 1948
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity



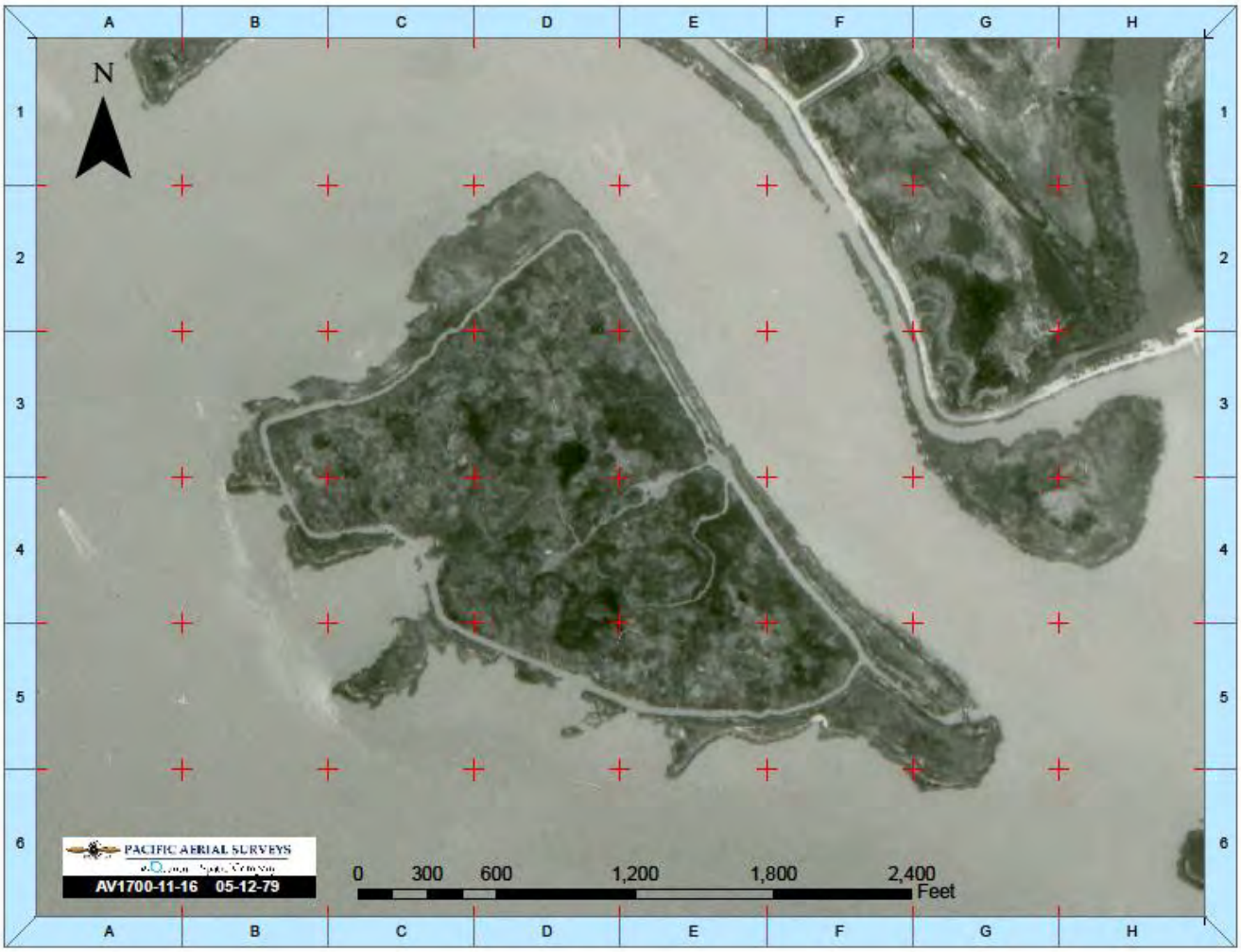
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1975)

Point Buckler Island
Solano County, CA

Figure B-2

(Quantum Spatial) November 12, 1975
Aerial Photograph – Freeman Island



Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1979)

Point Buckler Island
Solano County, CA

Figure B-3

(Quantum Spatial) May 12, 1979
Aerial Photograph – Freeman Island

Map File: App-B_air-photo-1981_Freeman_2016-0510

Data sources: air photo (USGS, 1981)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

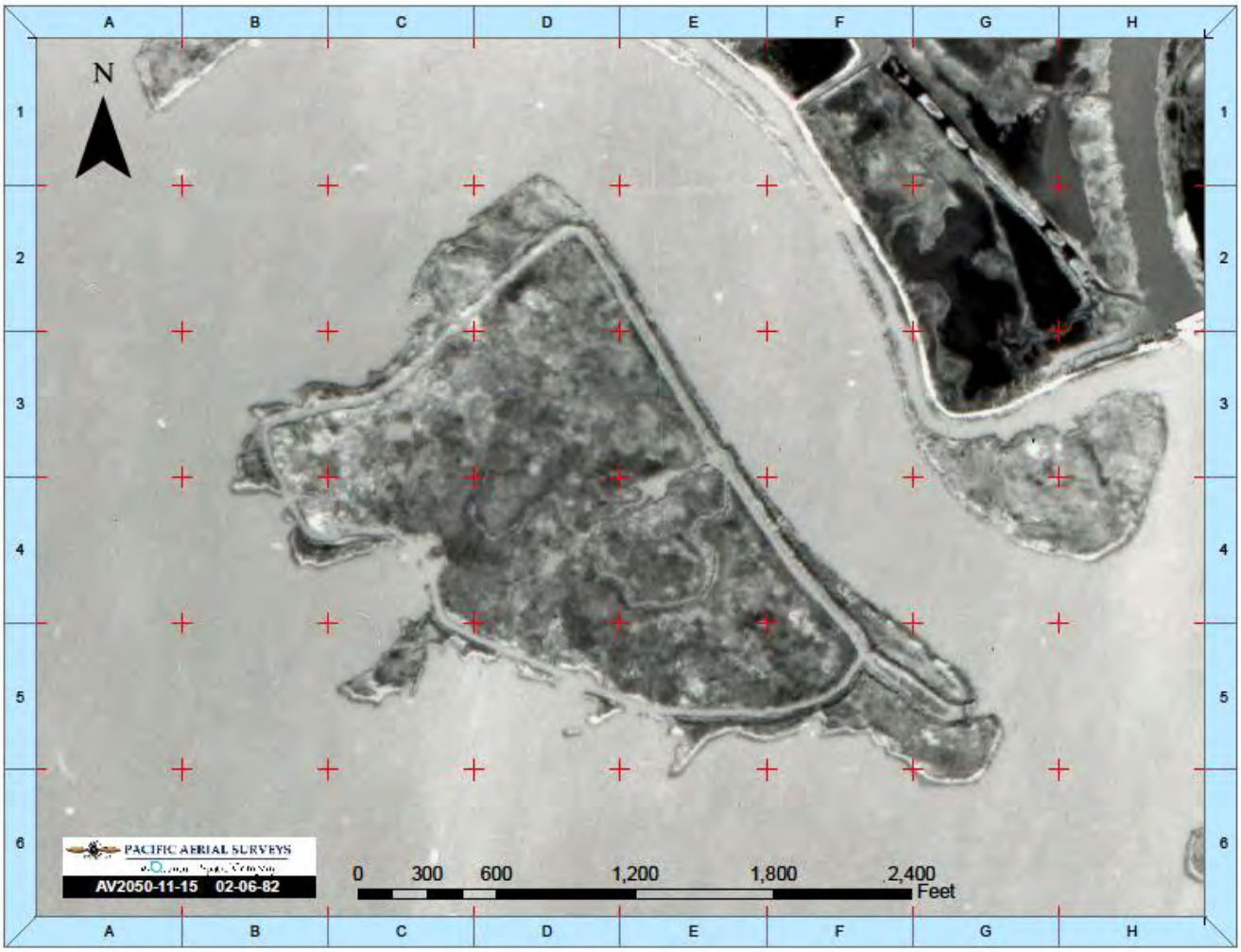
0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-4

Image brightness and contrast adjusted from original for visual clarity

(USGS) February 20, 1981
Aerial Photograph - Freeman Island



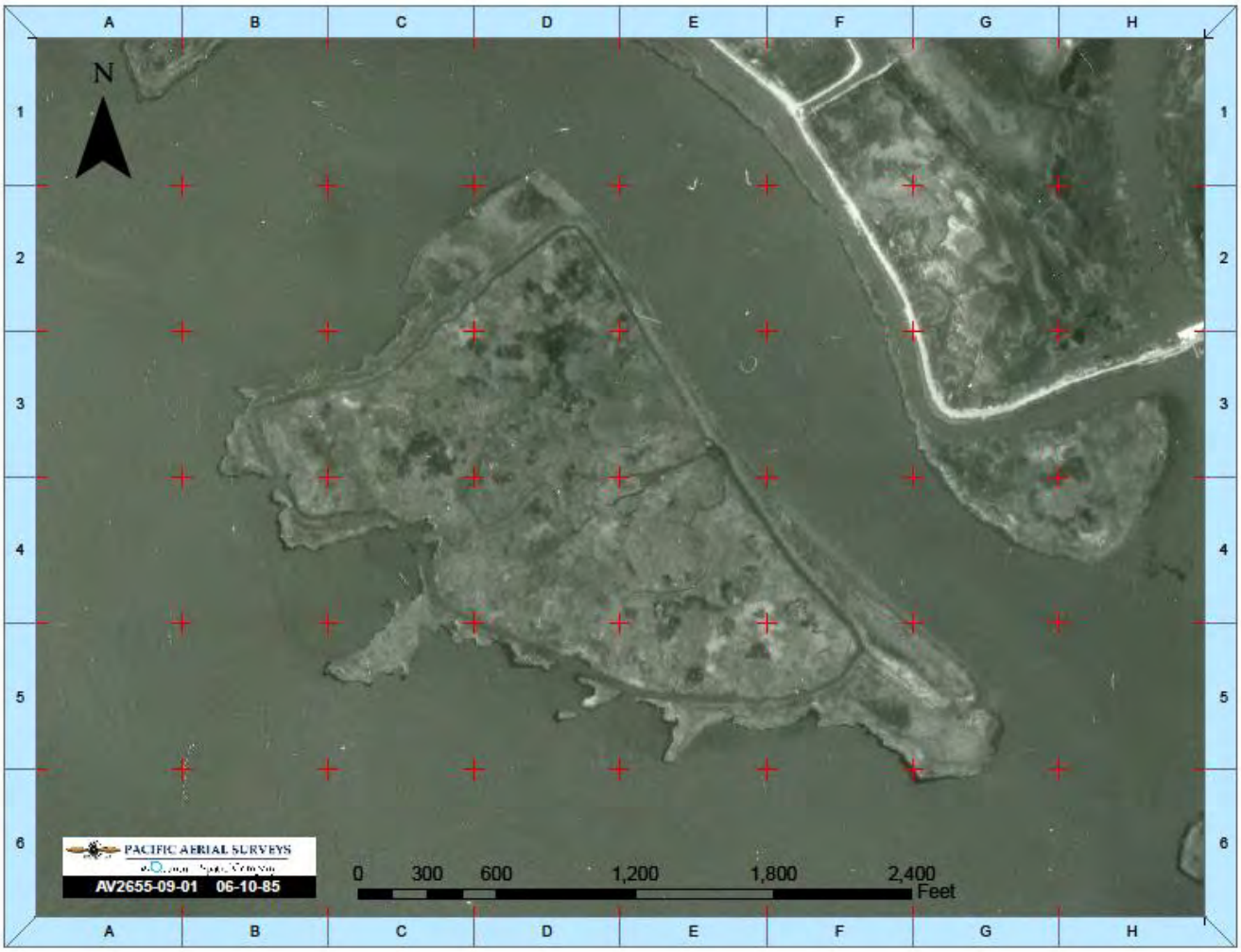
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1982)

Point Buckler Island
Solano County, CA

Figure B-5

(Quantum Spatial) February 6, 1982
Aerial Photograph – Freeman Island



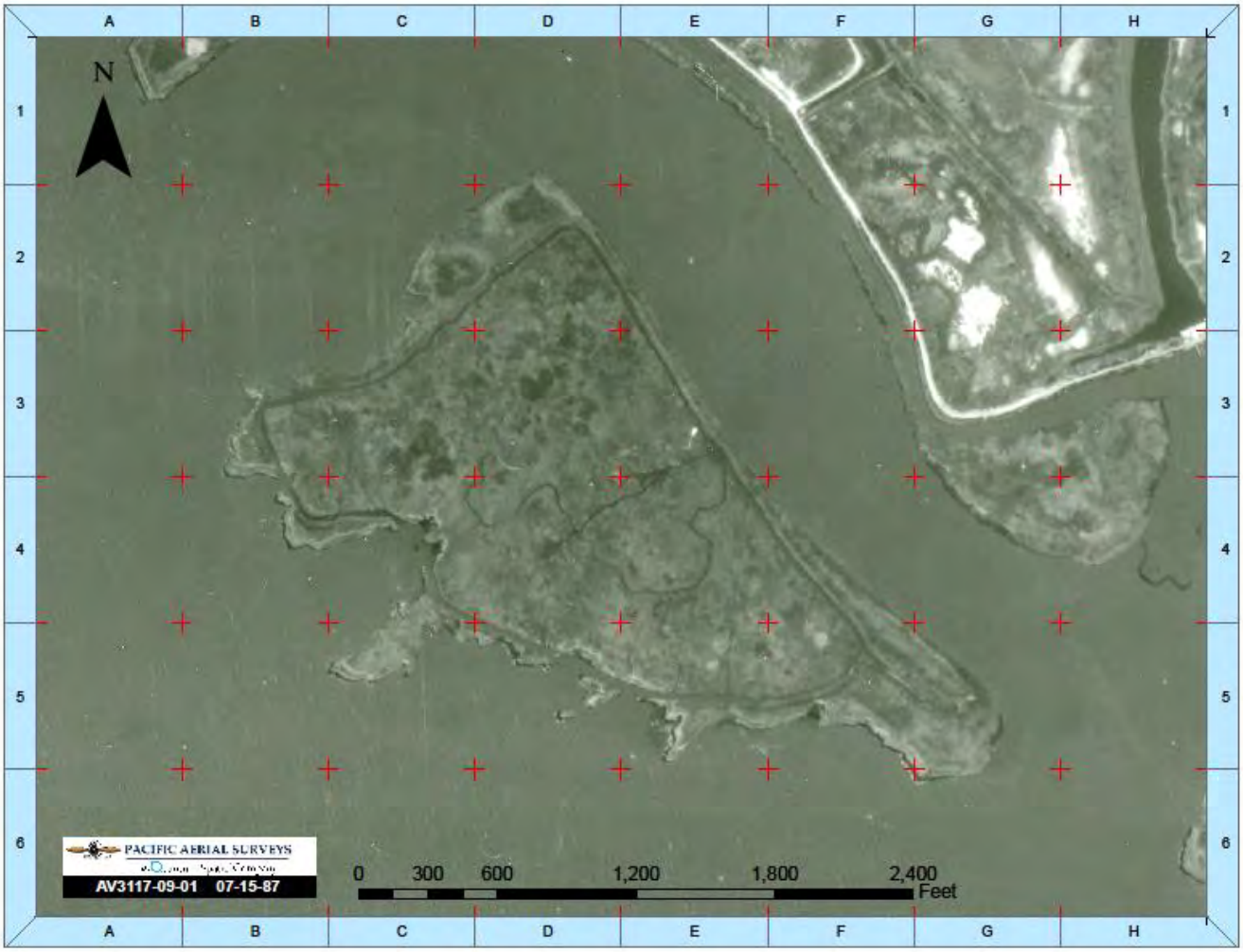
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1985)

Point Buckler Island
Solano County, CA

Figure B-6

(Quantum Spatial) June 10, 1985
Aerial Photograph – Freeman Island



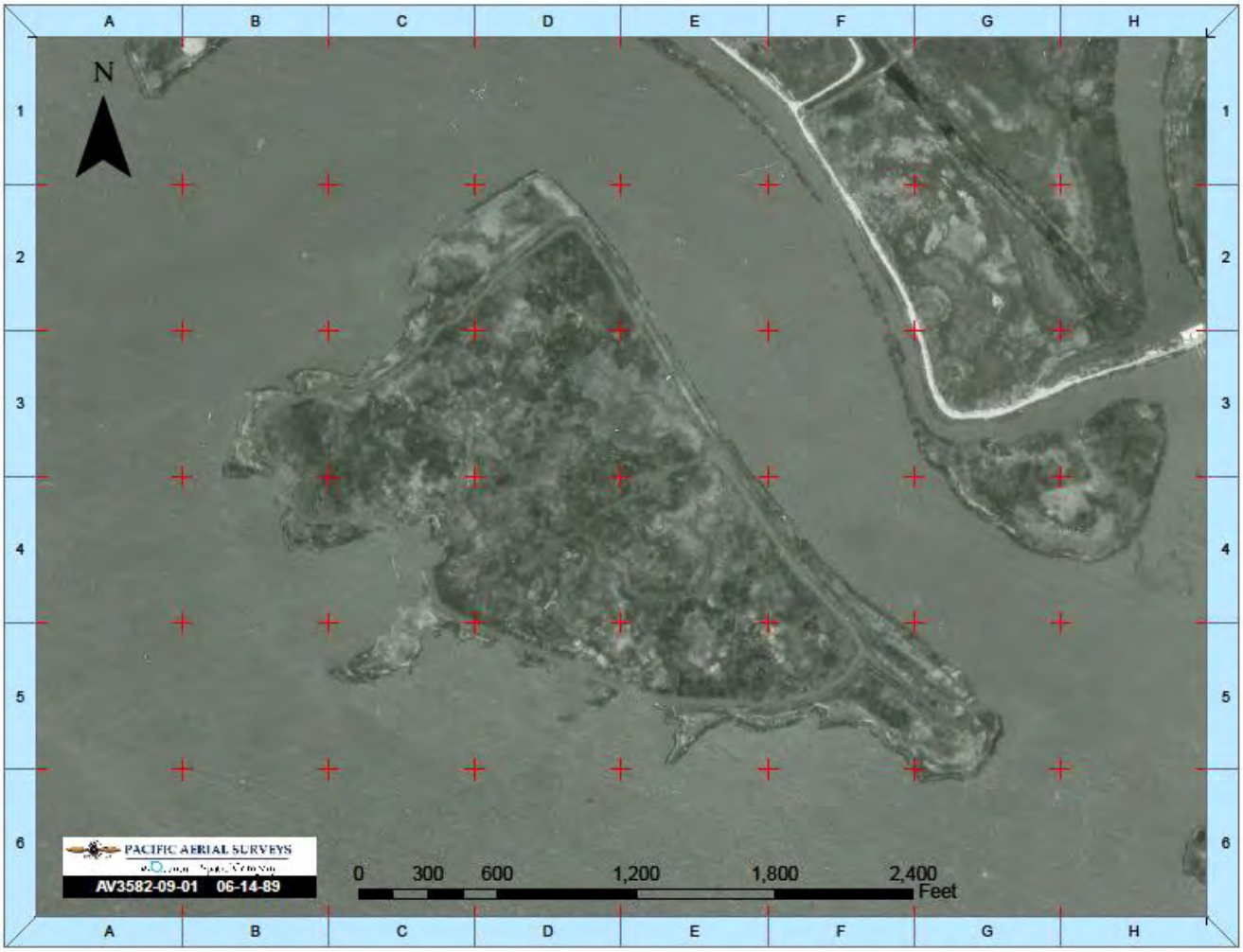
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1987)

Point Buckler Island
Solano County, CA

Figure B-7

(Quantum Spatial) July 15, 1987
Aerial Photograph – Freeman Island



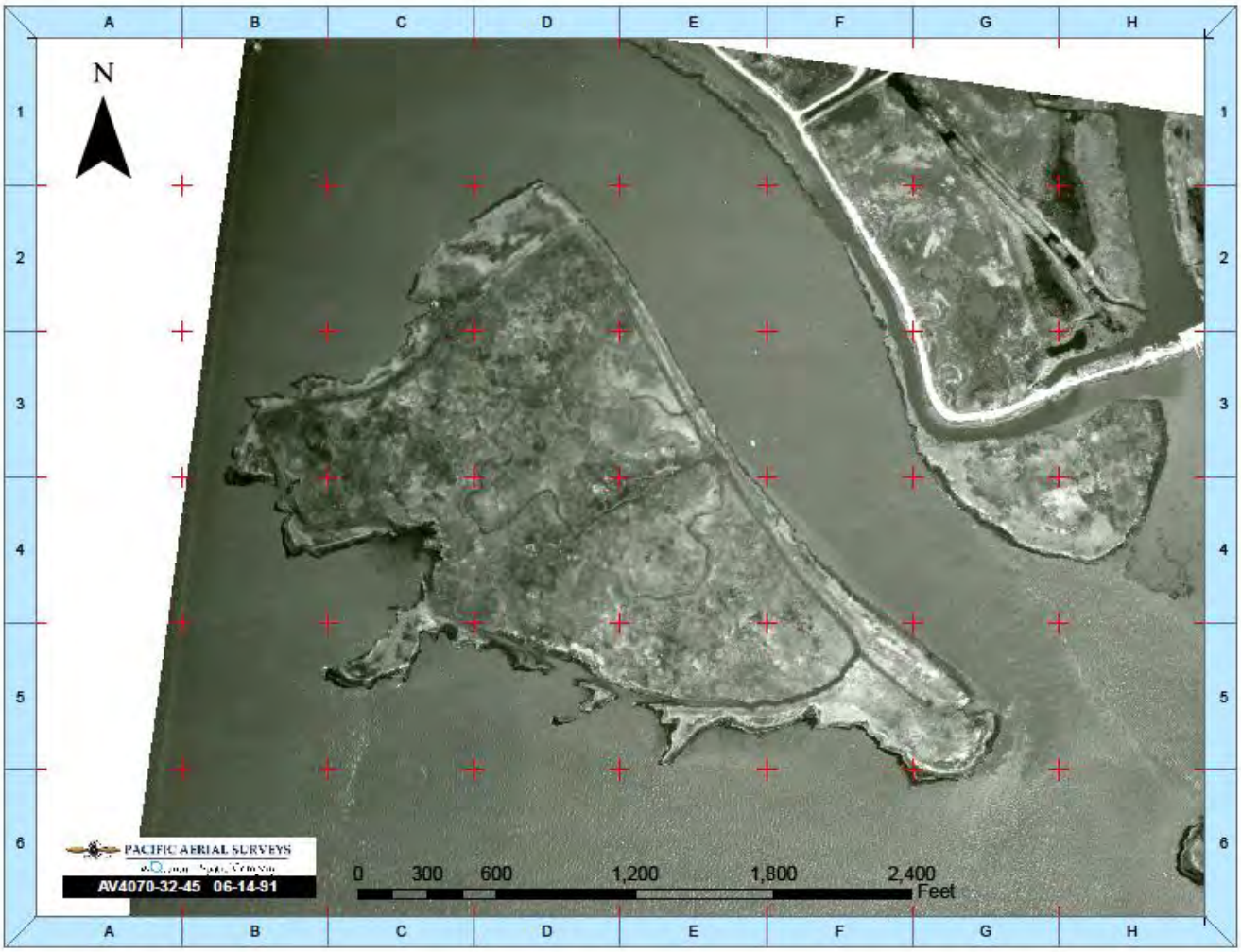
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1989)

Point Buckler Island
Solano County, CA

Figure B-8

(Quantum Spatial) June 14, 1989
Aerial Photograph – Freeman Island



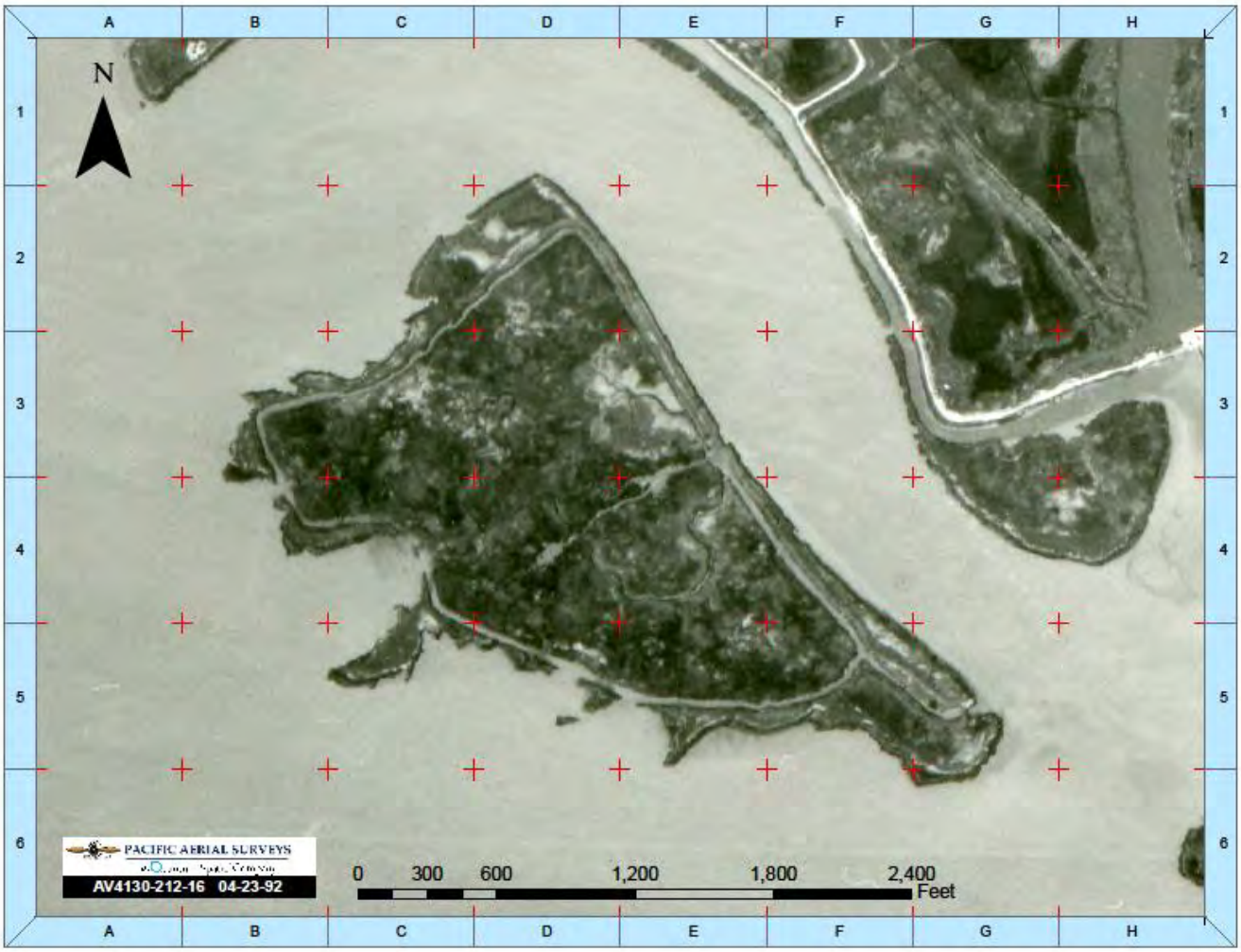
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1991)

Point Buckler Island
Solano County, CA

Figure B-9

(Quantum Spatial) June 14, 1991
Aerial Photograph – Freeman Island



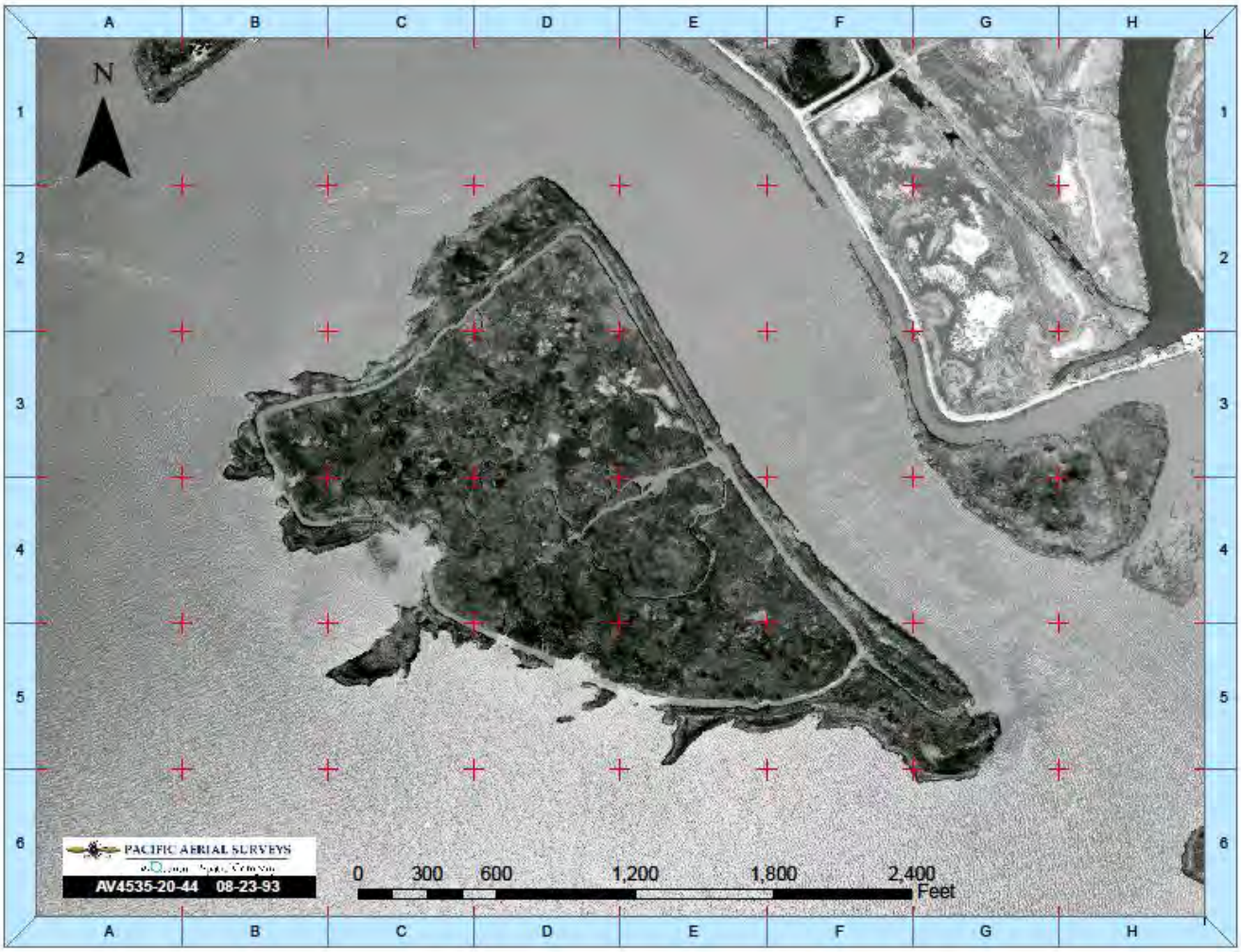
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1992)

Point Buckler Island
Solano County, CA

Figure B-10

(Quantum Spatial) April 23, 1992
Aerial Photograph – Freeman Island



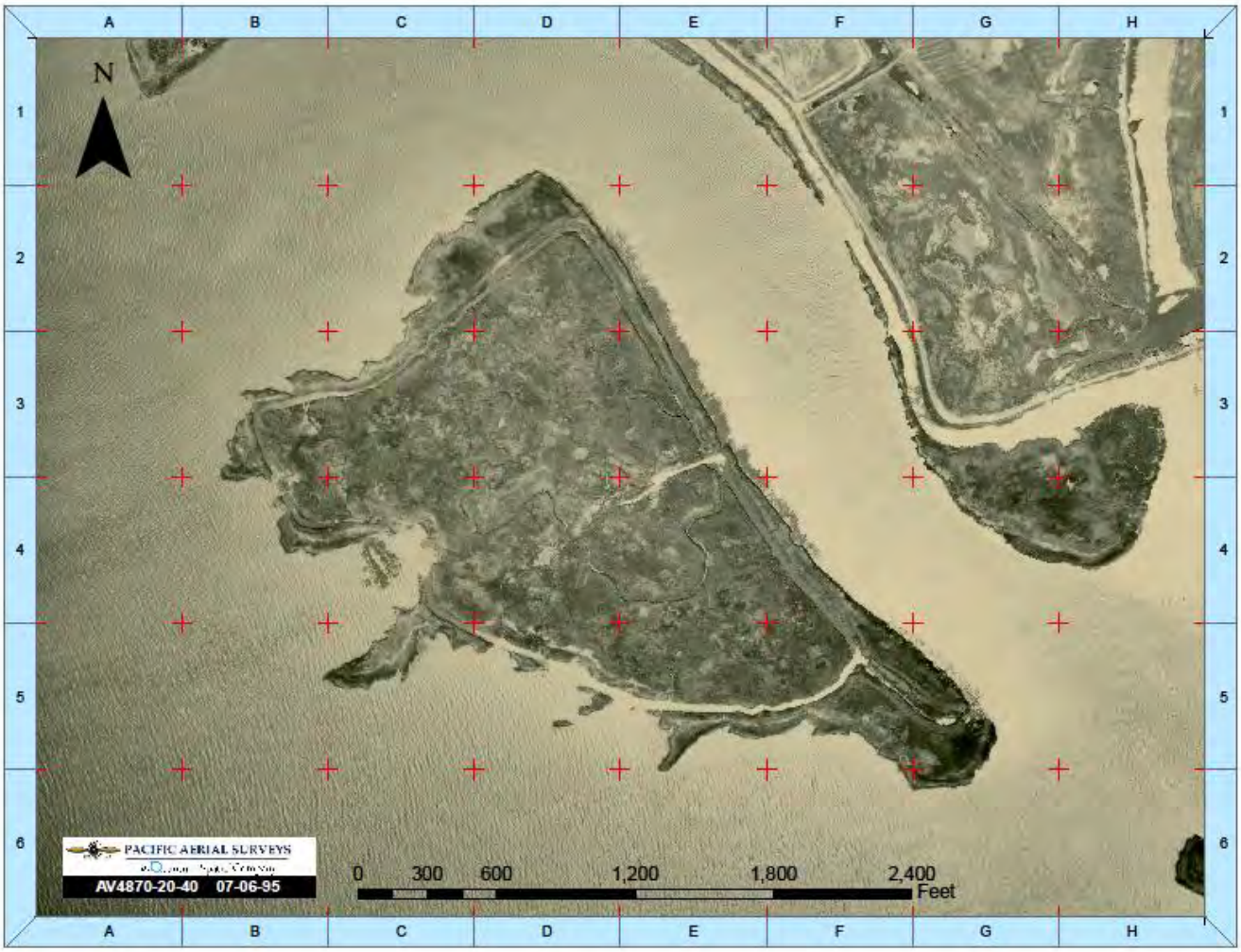
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1993)

Point Buckler Island
Solano County, CA

Figure B-11

(Quantum Spatial) August 23, 1993
Aerial Photograph – Freeman Island



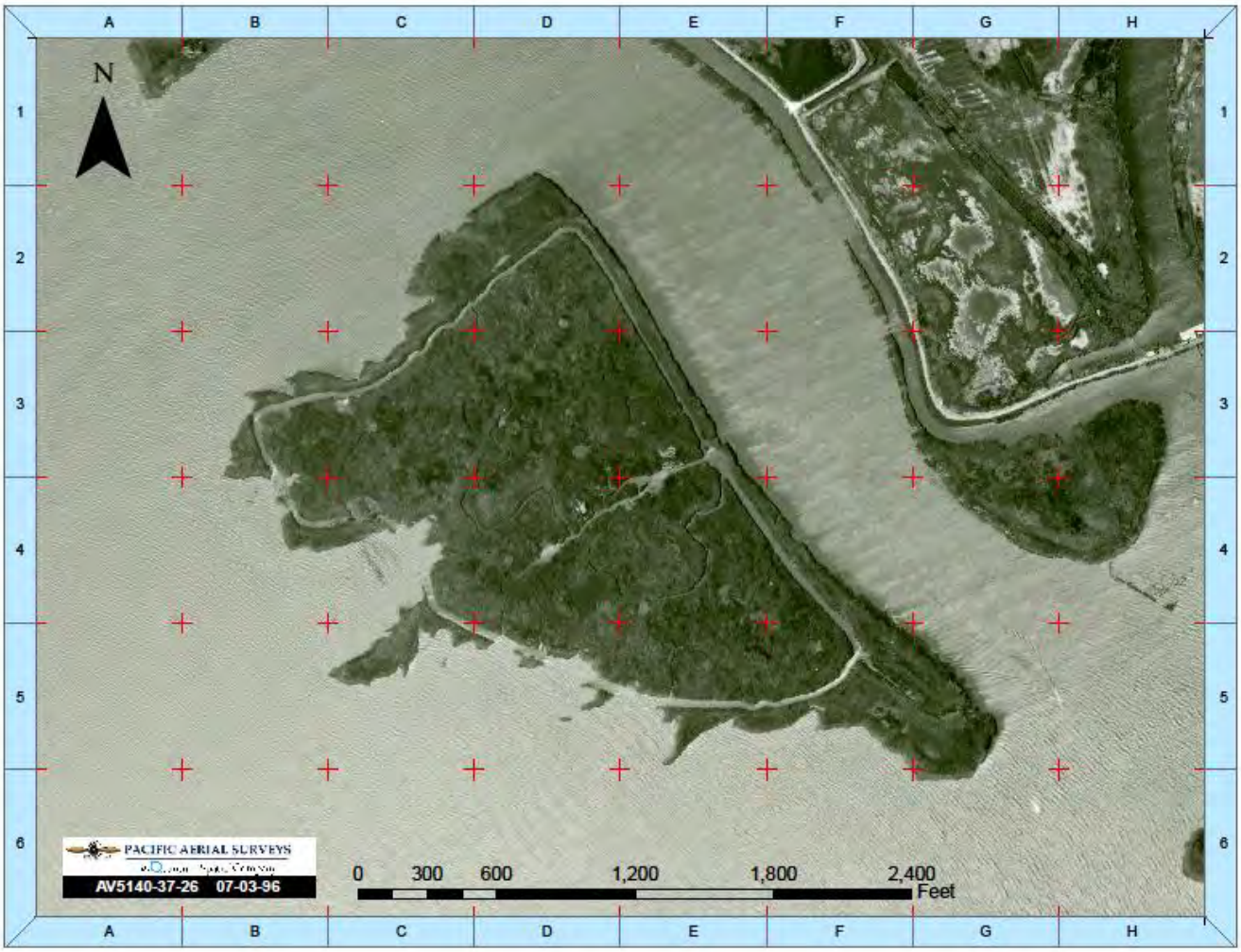
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1995)

Point Buckler Island
Solano County, CA

Figure B-12

(Quantum Spatial) July 6, 1995
Aerial Photograph – Freeman Island



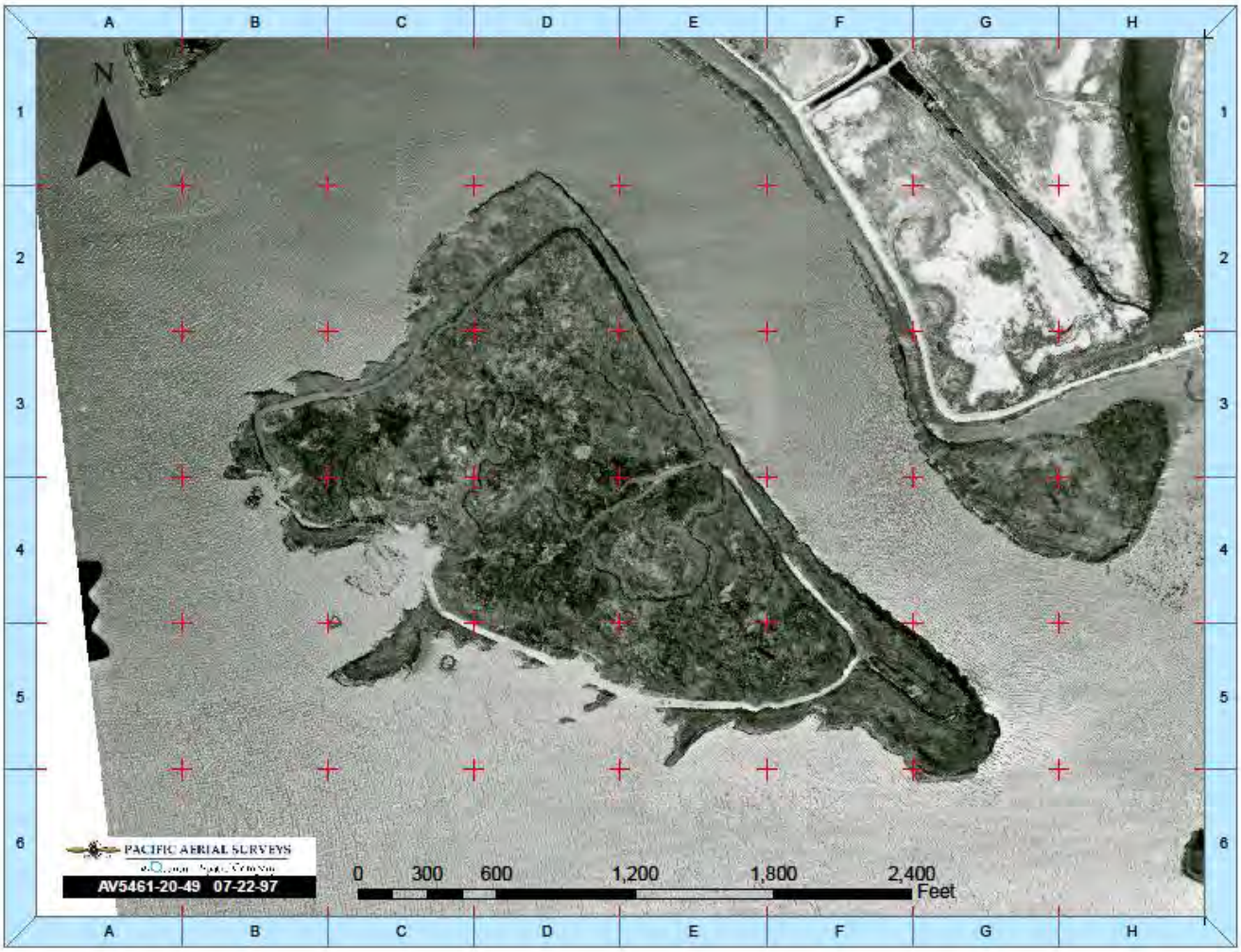
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1996)

Point Buckler Island
Solano County, CA

Figure B-13

(Quantum Spatial) July 3, 1996
Aerial Photograph – Freeman Island



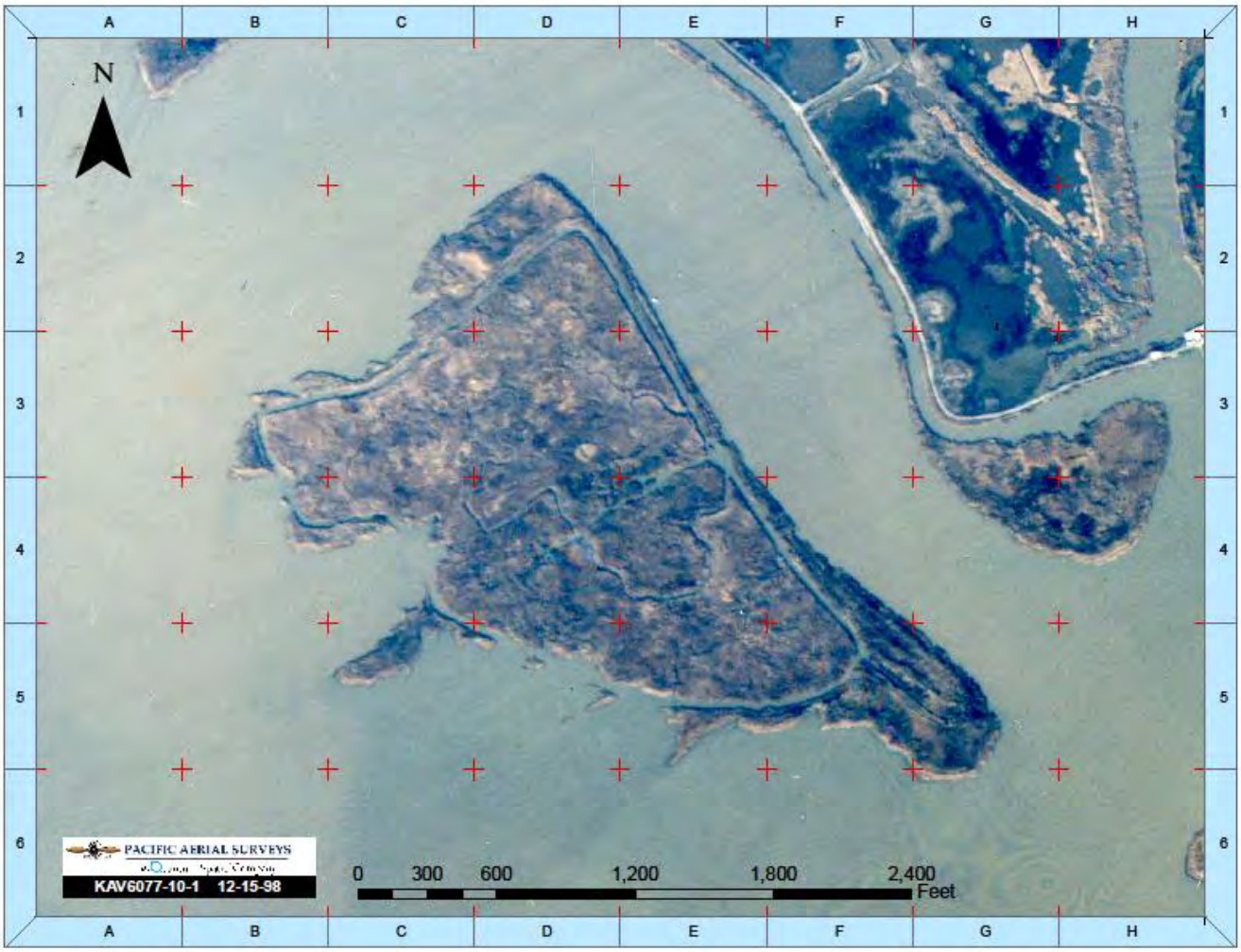
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1997)

Point Buckler Island
Solano County, CA

Figure B-14

(Quantum Spatial) July 22, 1997
Aerial Photograph – Freeman Island



Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1998)

Point Buckler Island
Solano County, CA

Figure B-15

(Quantum Spatial) December 15, 1998
Aerial Photograph – Freeman Island

Map File: App-B_air-photo-1999_Freeman_2016-0510

Data sources: air photo (DWR, 1999)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

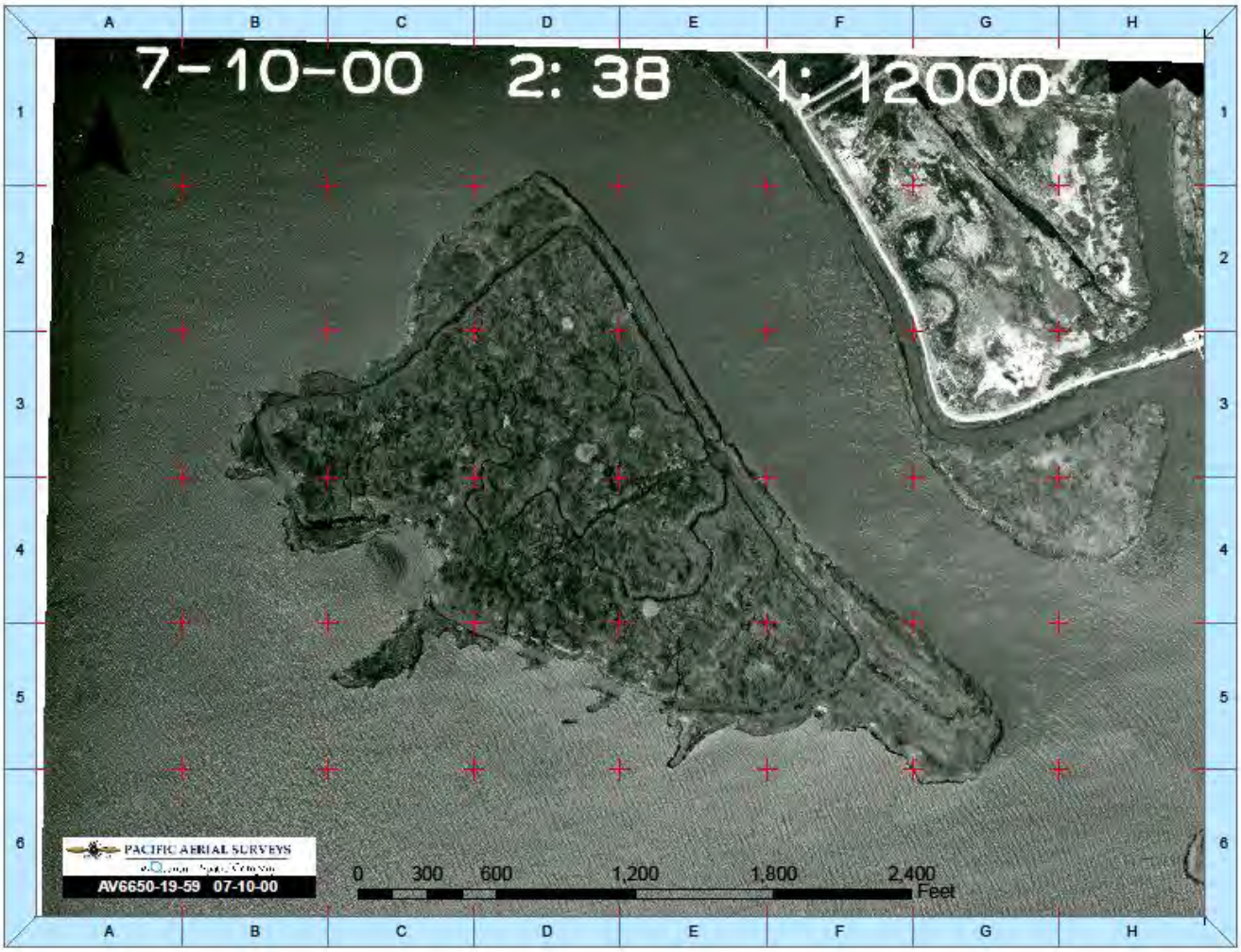
0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-16

(DWR) June 16, 1999
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity



Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 2000)

Point Buckler Island
Solano County, CA

Figure B-17

(Quantum Spatial) July 10, 2000
Aerial Photograph – Freeman Island

Map File: App-B_air-photo-2003_Freeman_2016-0510

Data sources: air photo (DWR, 2003)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-18

(DWR) Summer 2003
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-B_air-photo-2005_Freeman_2016-0510

Data sources: air photo (NAIP, 2005)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-19

(NAIP) Summer 2005
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-B_air-photo-2006_Freeman_2016-0510

Data sources: air photo (DWR, 2006)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-20

(DWR) Summer 2006
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-B_air-photo-2010_Freeman_2016-0510

Data sources: air photo (NAIP, 2010)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

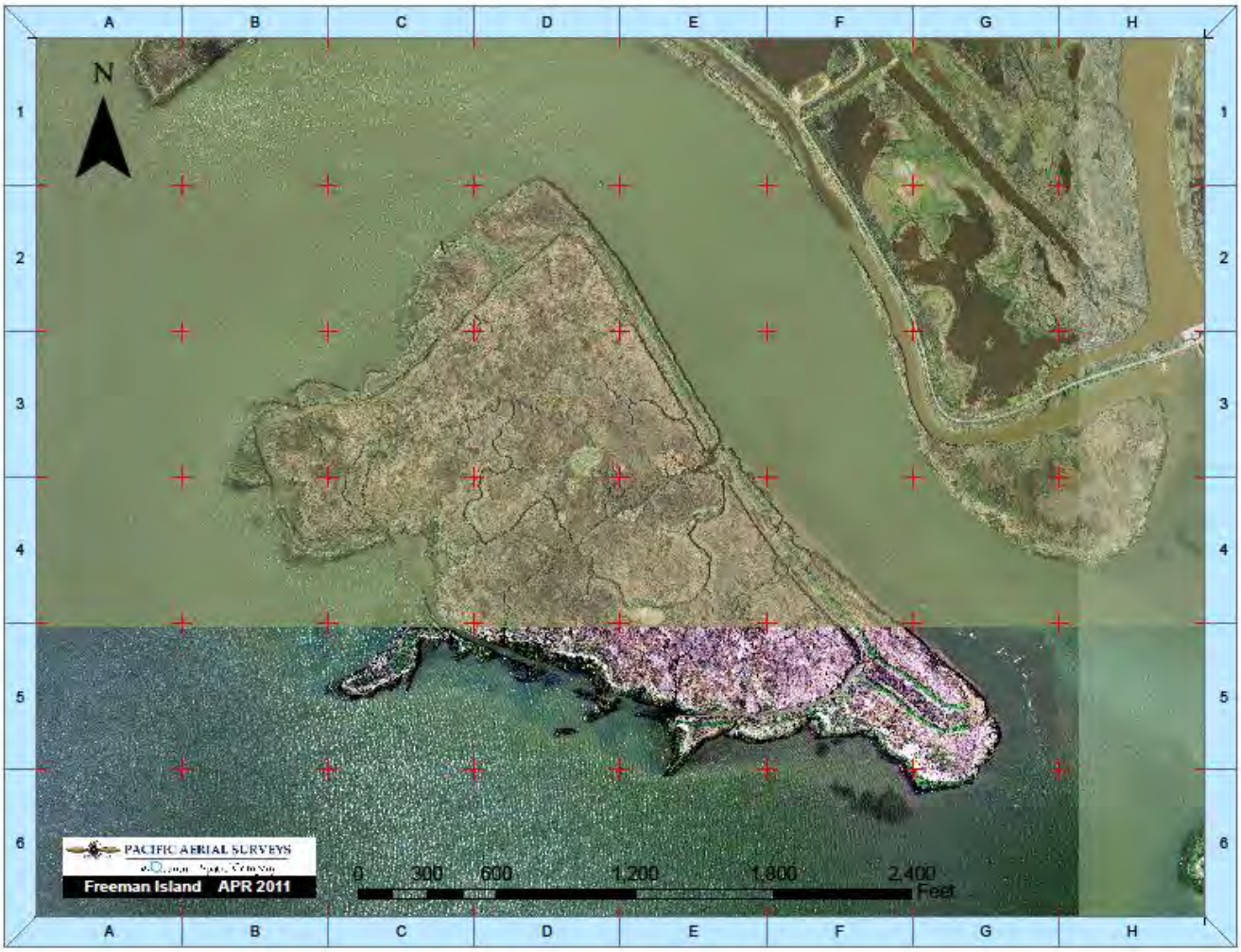
0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-21

Image brightness and contrast adjusted from original for visual clarity

(NAIP) Summer 2010
Aerial Photograph - Freeman Island



Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 2011)

Point Buckler Island
Solano County, CA

Figure B-22

(Quantum Spatial) April 2011
Aerial Photograph – Freeman Island

Map File: App-B_air-photo-09-2011_Freeman_2016-0510

Data sources: air photo (Dig Globe, 2011)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-23

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) September 1, 2011
Aerial Photograph - Freeman Island

Map File: App-B_air-photo-2012_Freeman_2016-0510

Data sources: air photo (DWR, 2012)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-24

(DWR) Summer 2012
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-B_air-photo-2015_Freeman_2016-0510

Data sources: air photo (DWR, 2015)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-25

(DWR) Summer 2015
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-B_air-photo-2016_Freeman_2016-0510

Data sources: air photo (QS, 2016)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

0 75 150 m

Point Buckler Island
Solano County, CA

Figure B-26

(Quantum Spatial) February 10, 2016
Aerial Photograph - Freeman Island

Image brightness and contrast adjusted from original for visual clarity

Appendix C Aerial Imagery, Snag Island Reference Site

Twenty-six aerial photographs and satellite images were obtained from a number of sources, representing the time period from 1968 to 2016. Snag Island has a similar history of natural levee failures occurring over time that were not repaired, rendering inoperable the infrastructure necessary to establish hydrologic control for a managed wetland. At Snag Island, the levees were breached naturally in the 1975 aerial photograph (Figure C-2), with further naturally occurring breach expansion and additional breaches evident in all subsequent aerial photographs.

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Figure C-2. November 12, 1975 Aerial Photograph, Snag Island (Quantum Spatial)

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Figure C-4. February 20, 1981 Aerial Photograph, Snag Island (USGS)

Figure C-5. February 6, 1982 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-6. June 10, 1985 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-7. July 15, 1987 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-8. August 18,1988 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-9. June 4, 1989 Aerial Photograph, Snag Island (Quantum Spatial)

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Figure C-12. August 23, 1993 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-13. July 6, 1995 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-14. July 3, 1996 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-15. July 22, 1997 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-16. December 15, 1998 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-17. June 16, 1999 Aerial Photograph, Snag Island (DWR)

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Figure C-19. Summer 2003 Aerial Photograph, Snag Island (DWR)

Figure C-20. Summer 2005 Aerial Photograph, Snag Island (NAIP)

Figure C-21. Summer 2006 Aerial Photograph, Snag Island (DWR)

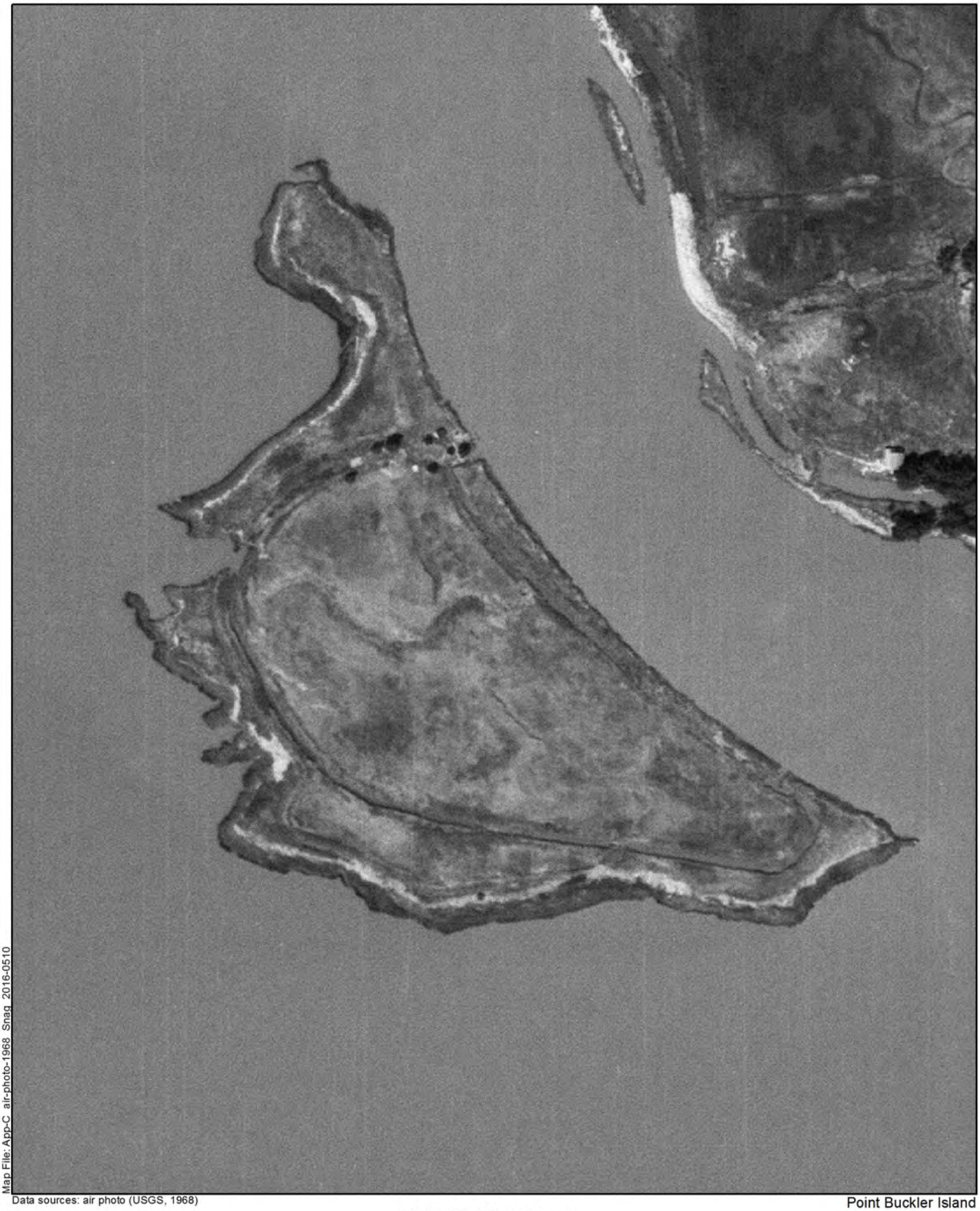
Figure C-22. Summer 2010 Aerial Photograph, Snag Island (NAIP)

Figure C-23. April 2011 Aerial Photograph, Snag Island (Quantum Spatial)

Figure C-24. Summer 2012 Aerial Photograph, Snag Island (DWR)

Figure C-25. Summer 2015 Aerial Photograph, Snag Island (DWR)

Figure C-26. February 10, 2016 Aerial Photograph, Snag Island (Quantum Spatial)



Map File: App-C air-photo-1968 Snag 2016-0510

Data sources: air photo (USGS, 1968)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

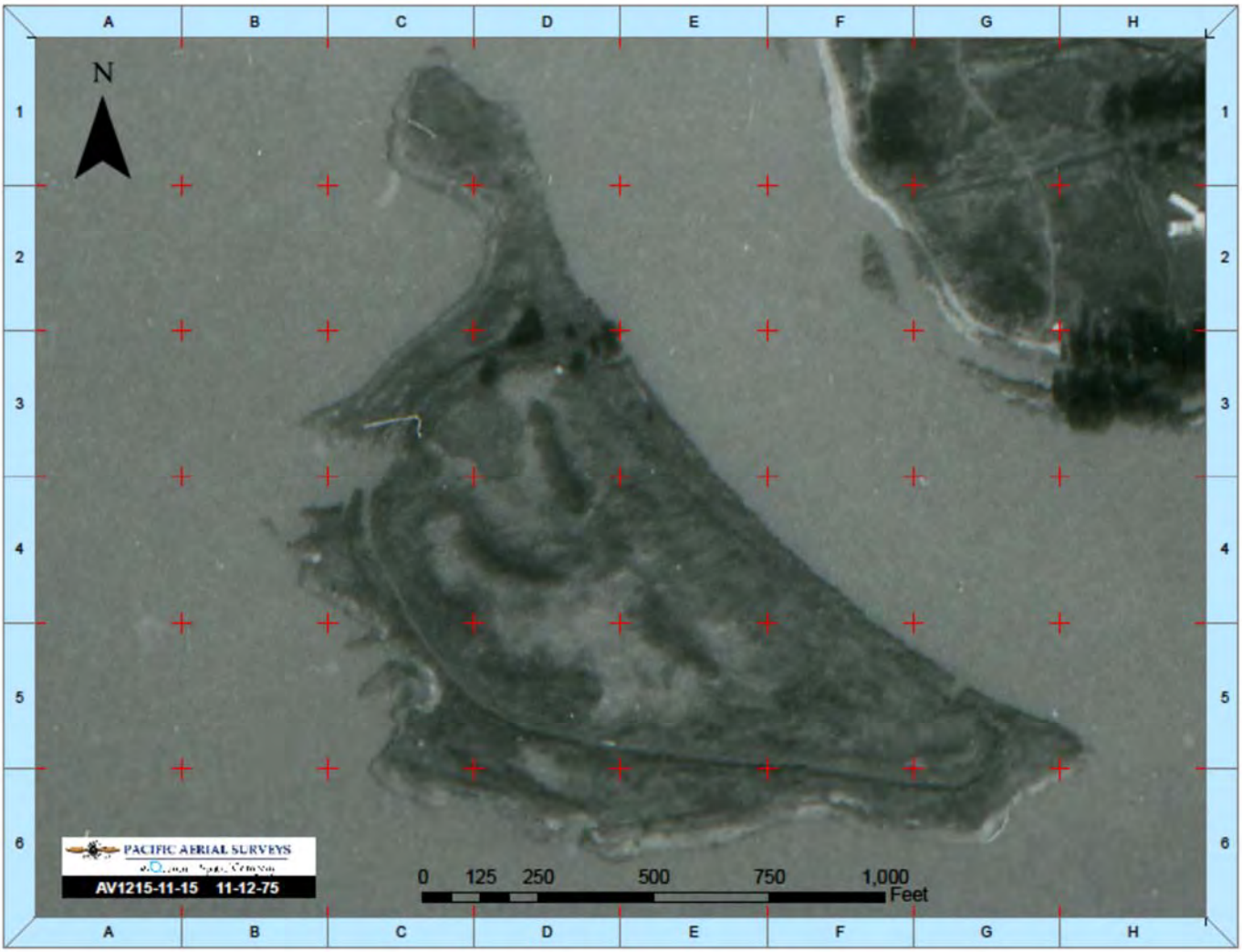
0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-1

(USGS) April 22, 1968
Aerial Photograph - Snag Island

Image brightness and contrast adjusted from original for visual clarity



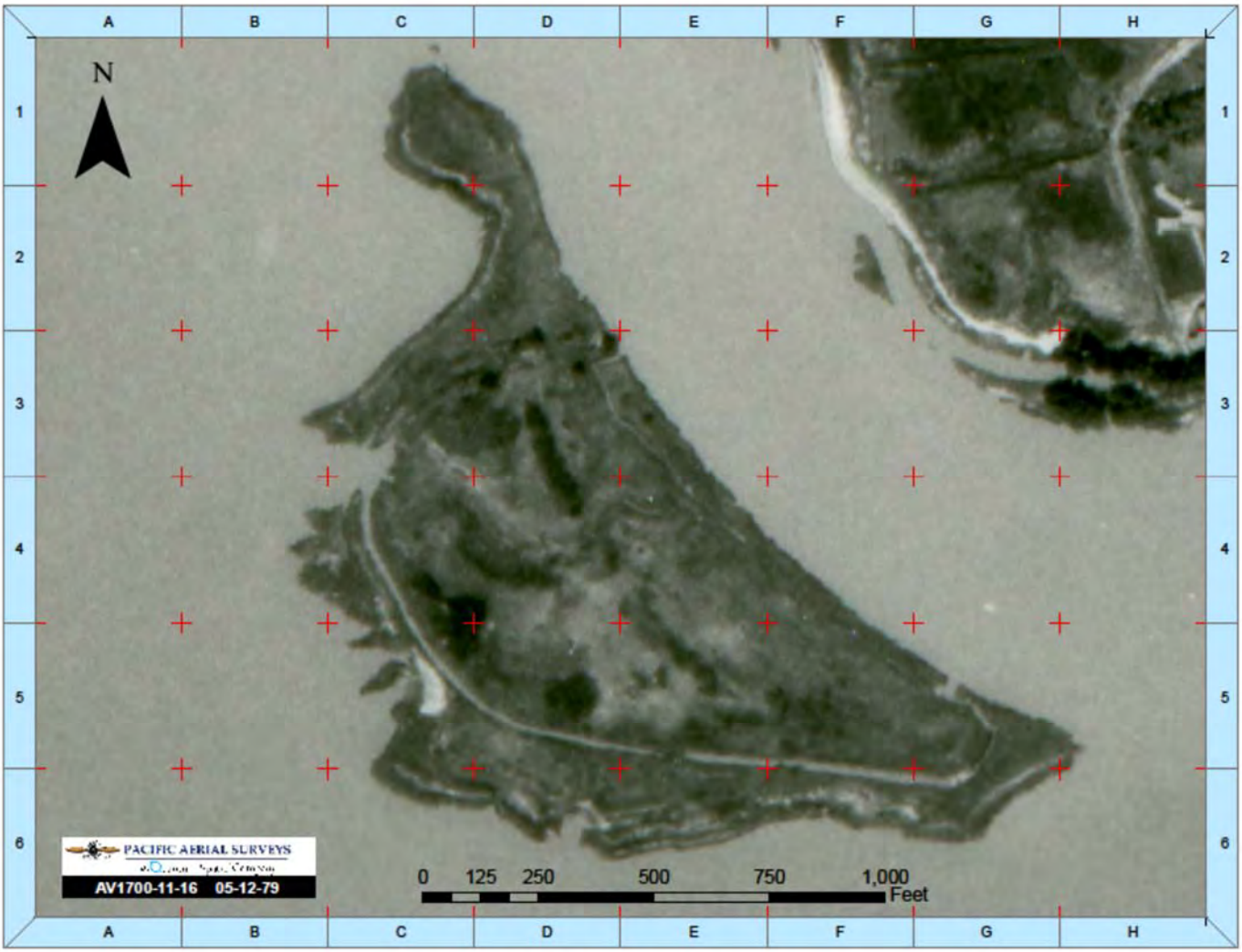
File: Snag-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1975)

Point Buckler Island
Solano County, CA

Figure C-2

(Quantum Spatial) November 12, 1975
Aerial Photograph – Snag Island



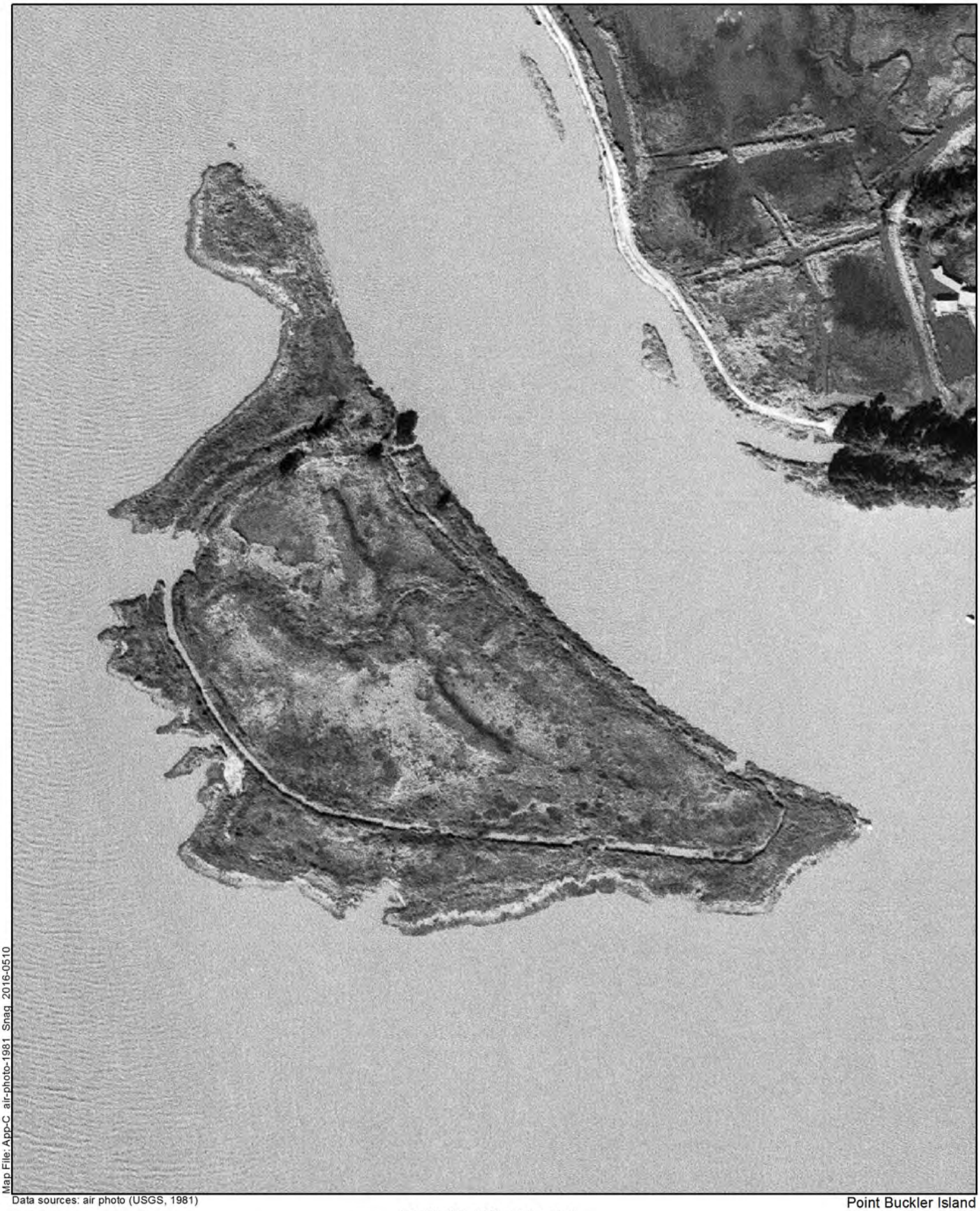
File: Snag-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1979)

Point Buckler Island
Solano County, CA

Figure C-3

(Quantum Spatial) May 12, 1979
Aerial Photograph – Snag Island



Map File: App-C_air-photo-1981_Snag_2016-0510

Data sources: air photo (USGS, 1981)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

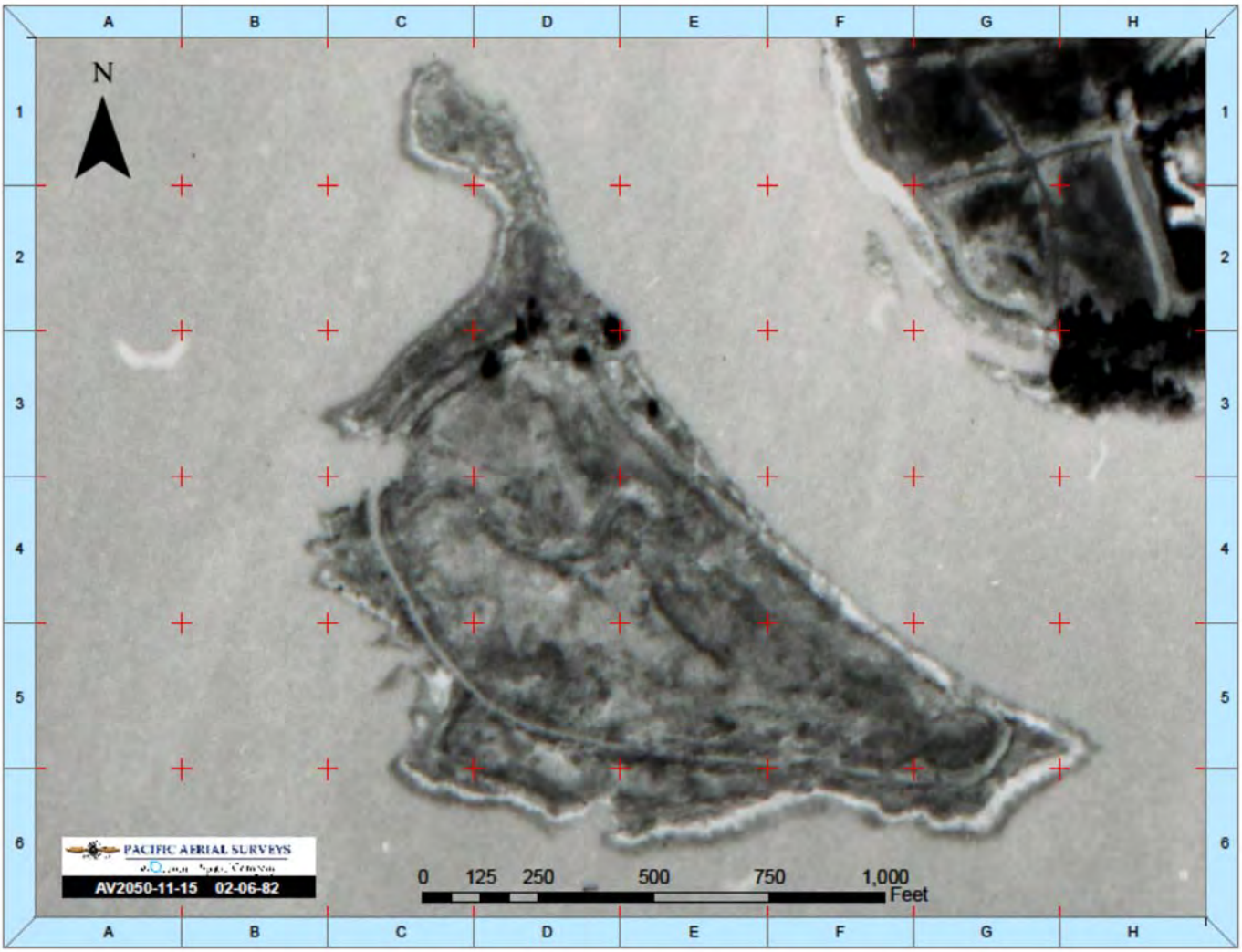
0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-4

Image brightness and contrast adjusted from original for visual clarity

(USGS) February 20, 1981
Aerial Photograph - Snag Island



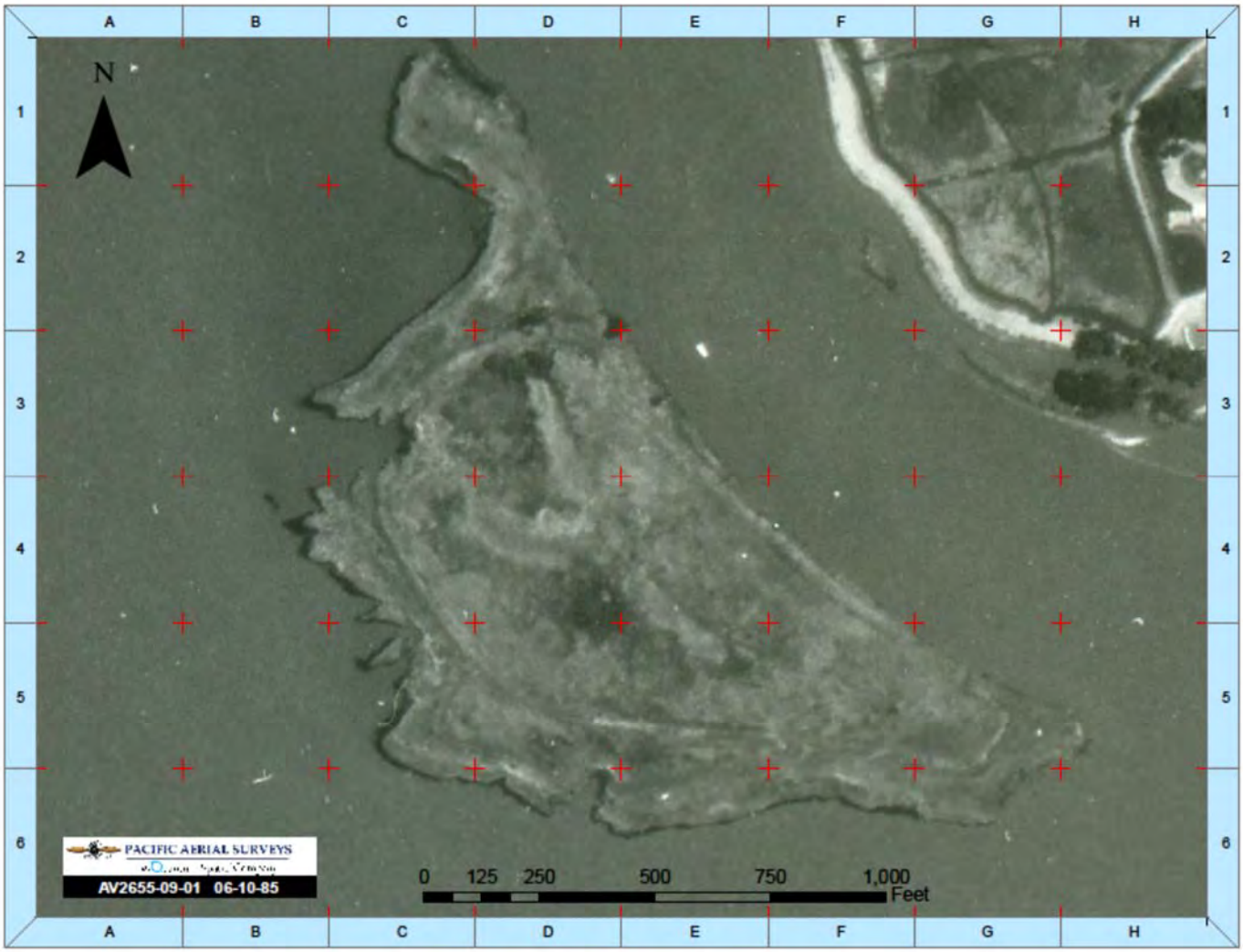
File: Snag-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1982)

Point Buckler Island
Solano County, CA

Figure C-5

(Quantum Spatial) February 6, 1982
Aerial Photograph – Snag Island



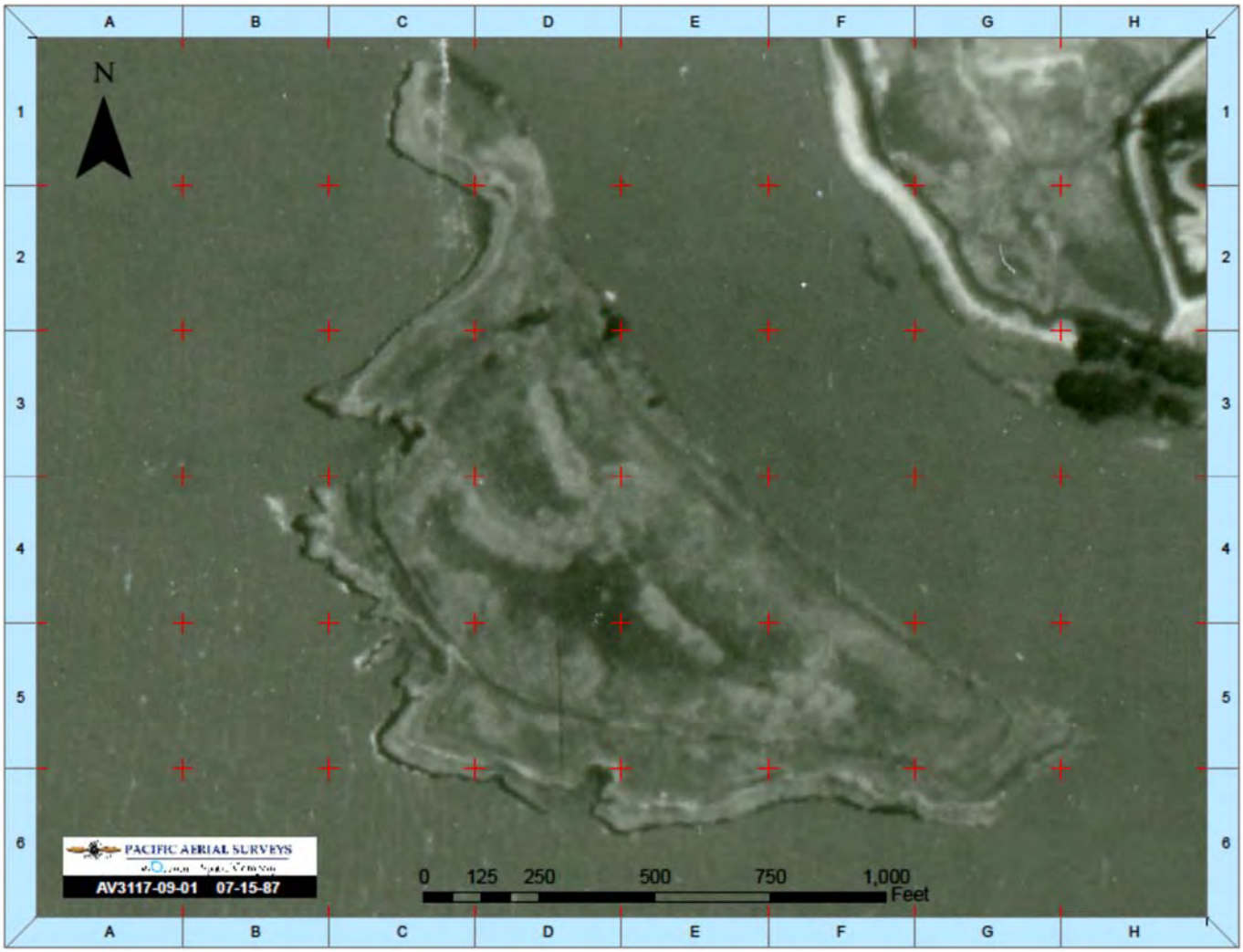
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1985)

Point Buckler Island
Solano County, CA

Figure C-6

(Quantum Spatial) June 10, 1985
Aerial Photograph – Freeman Island



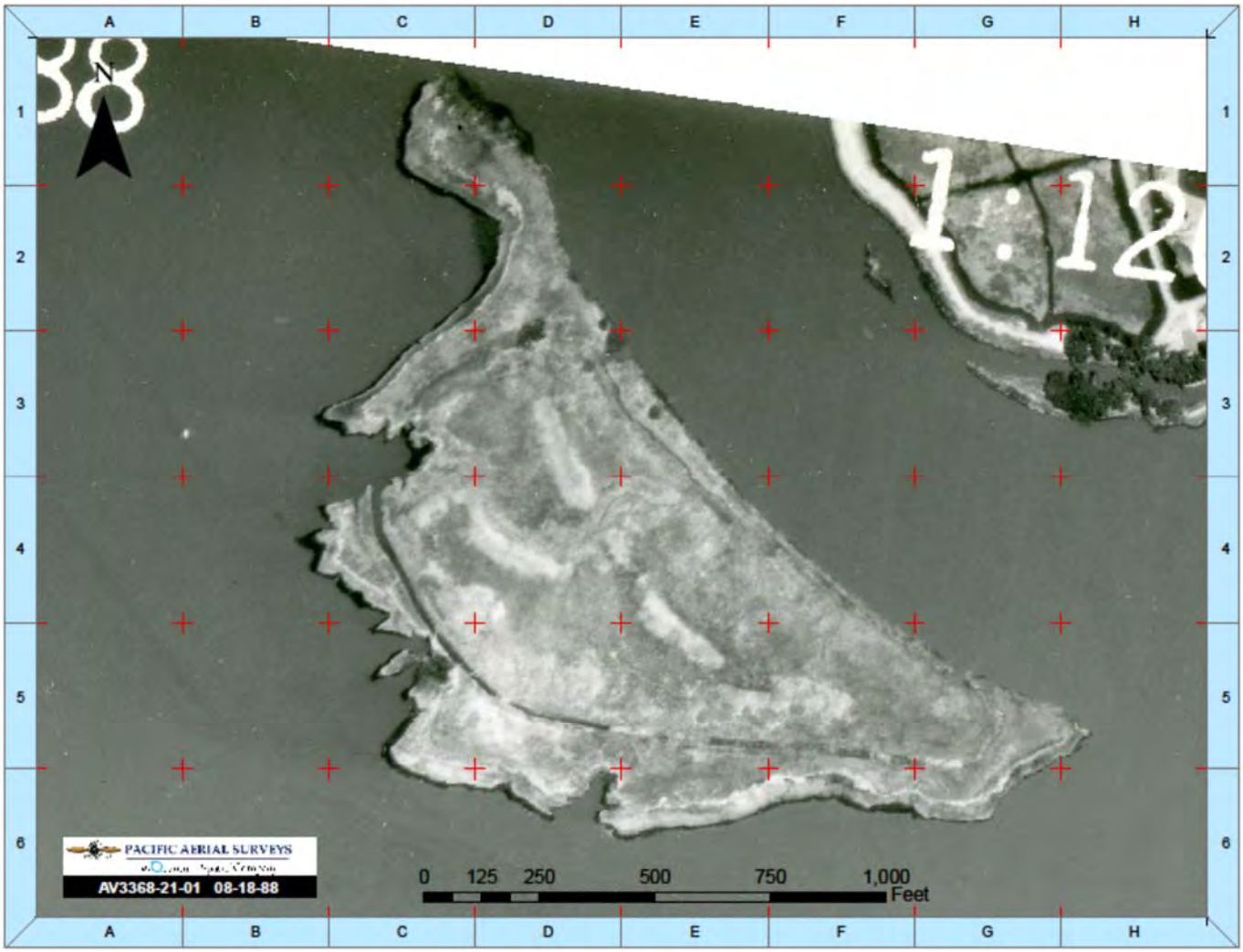
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1987)

Point Buckler Island
Solano County, CA

Figure C-7

(Quantum Spatial) July 15, 1987
Aerial Photograph – Snag Island



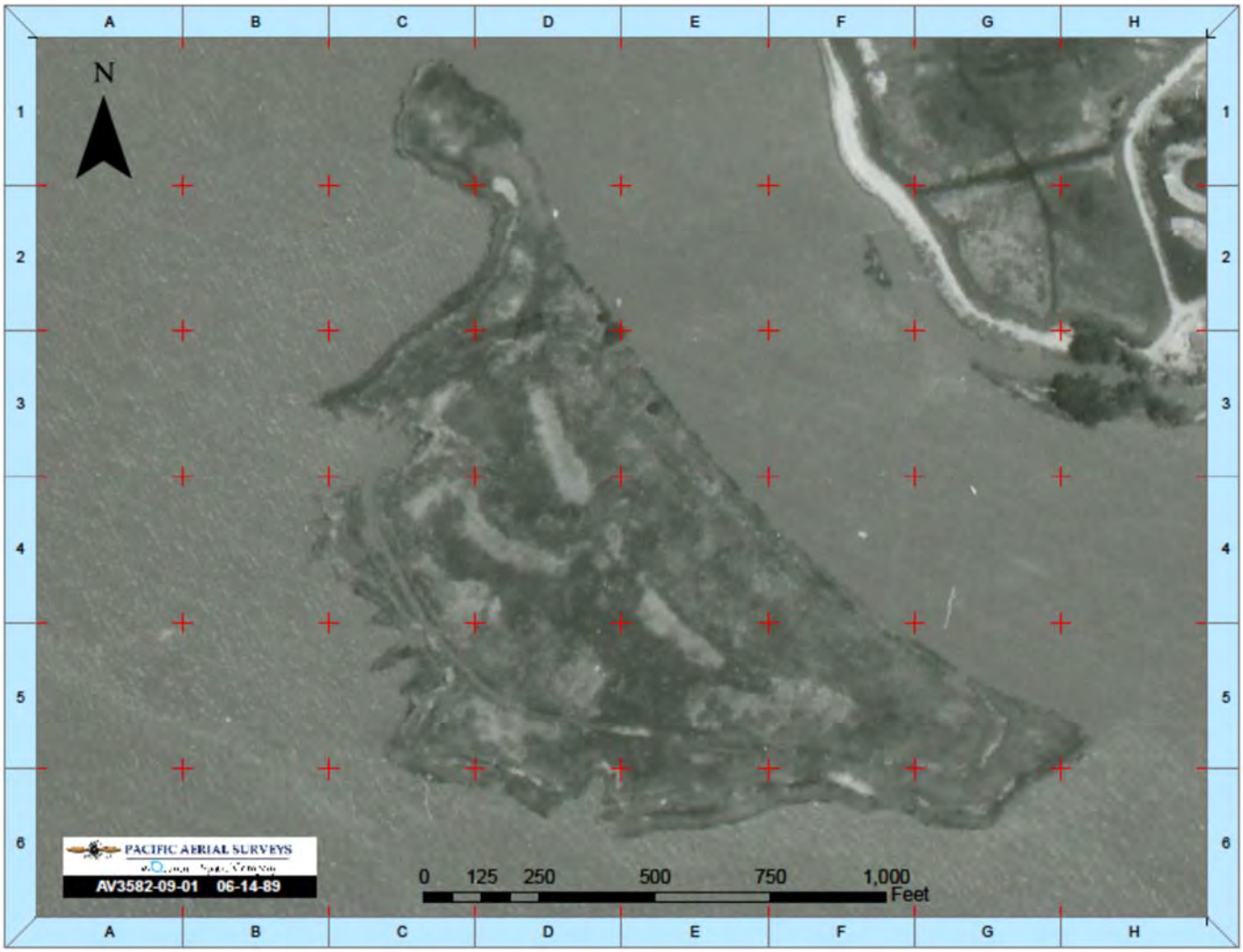
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1988)

Point Buckler Island
Solano County, CA

Figure C-8

(Quantum Spatial) August 18, 1988
Aerial Photograph – Snag Island



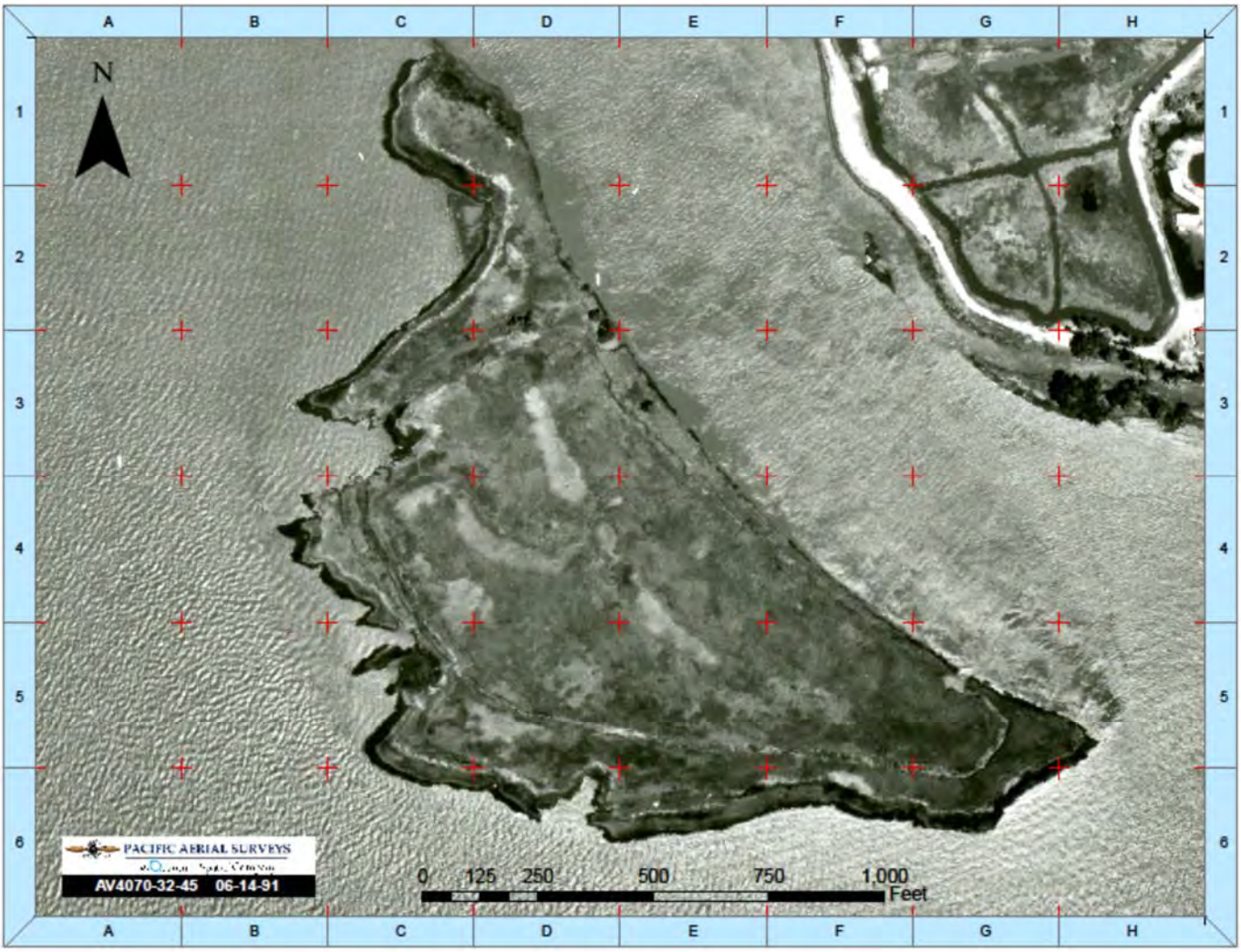
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1989)

Point Buckler Island
Solano County, CA

Figure C-9

(Quantum Spatial) June 14, 1989
Aerial Photograph – Snag Island



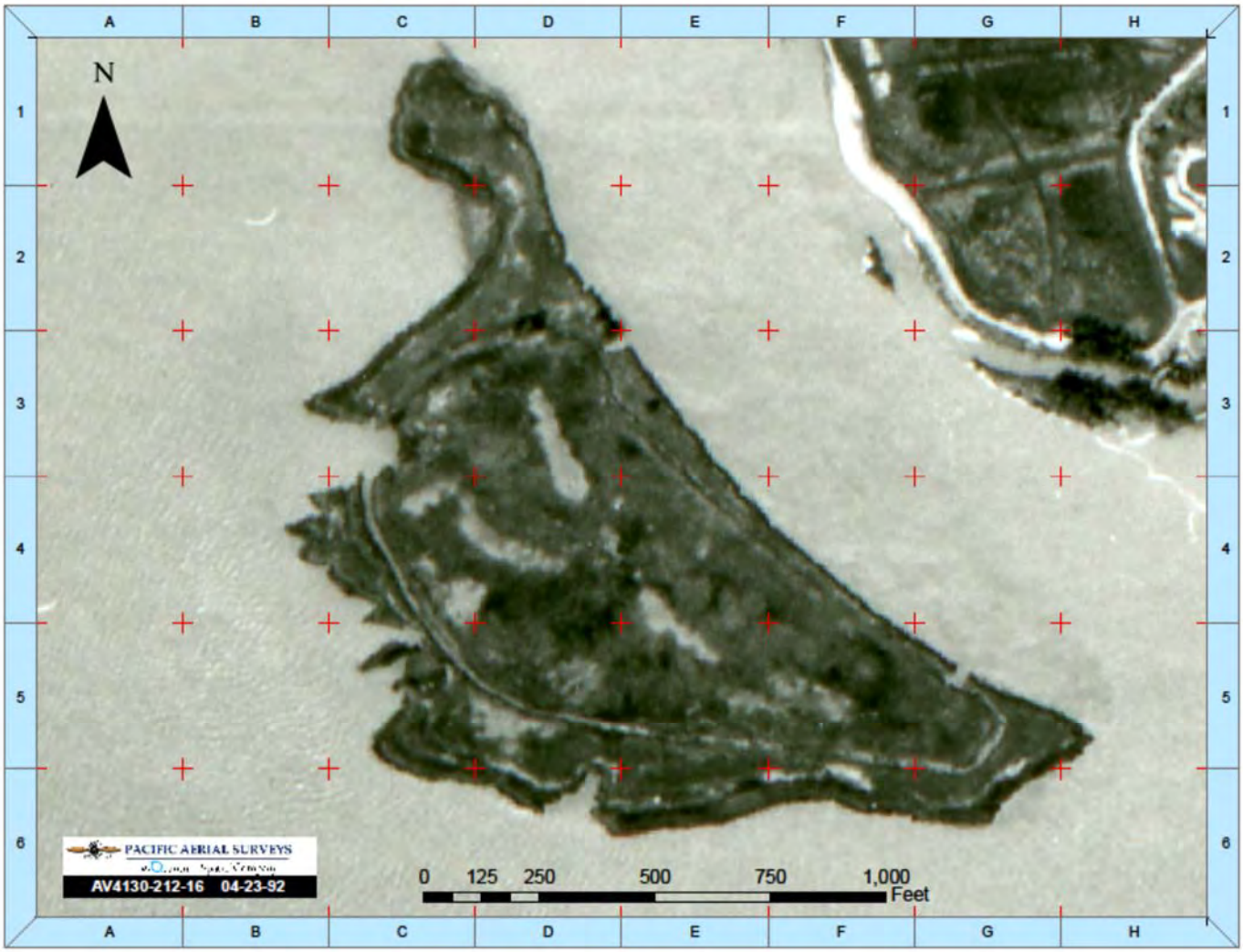
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1991)

Point Buckler Island
Solano County, CA

Figure C-10

(Quantum Spatial) June 14, 1991
Aerial Photograph – Snag Island



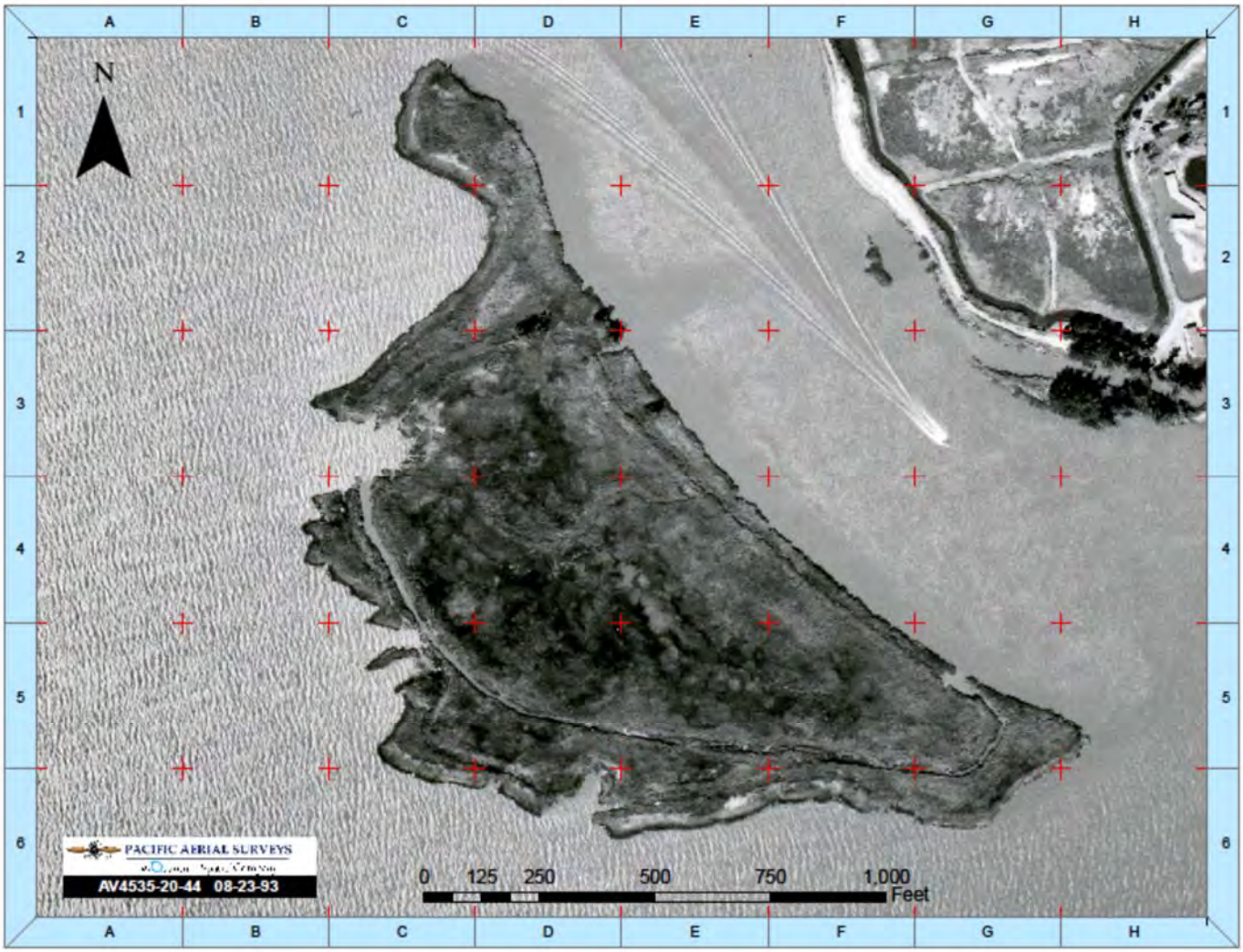
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1992)

Point Buckler Island
Solano County, CA

Figure C-11

(Quantum Spatial) April 23, 1992
Aerial Photograph – Snag Island



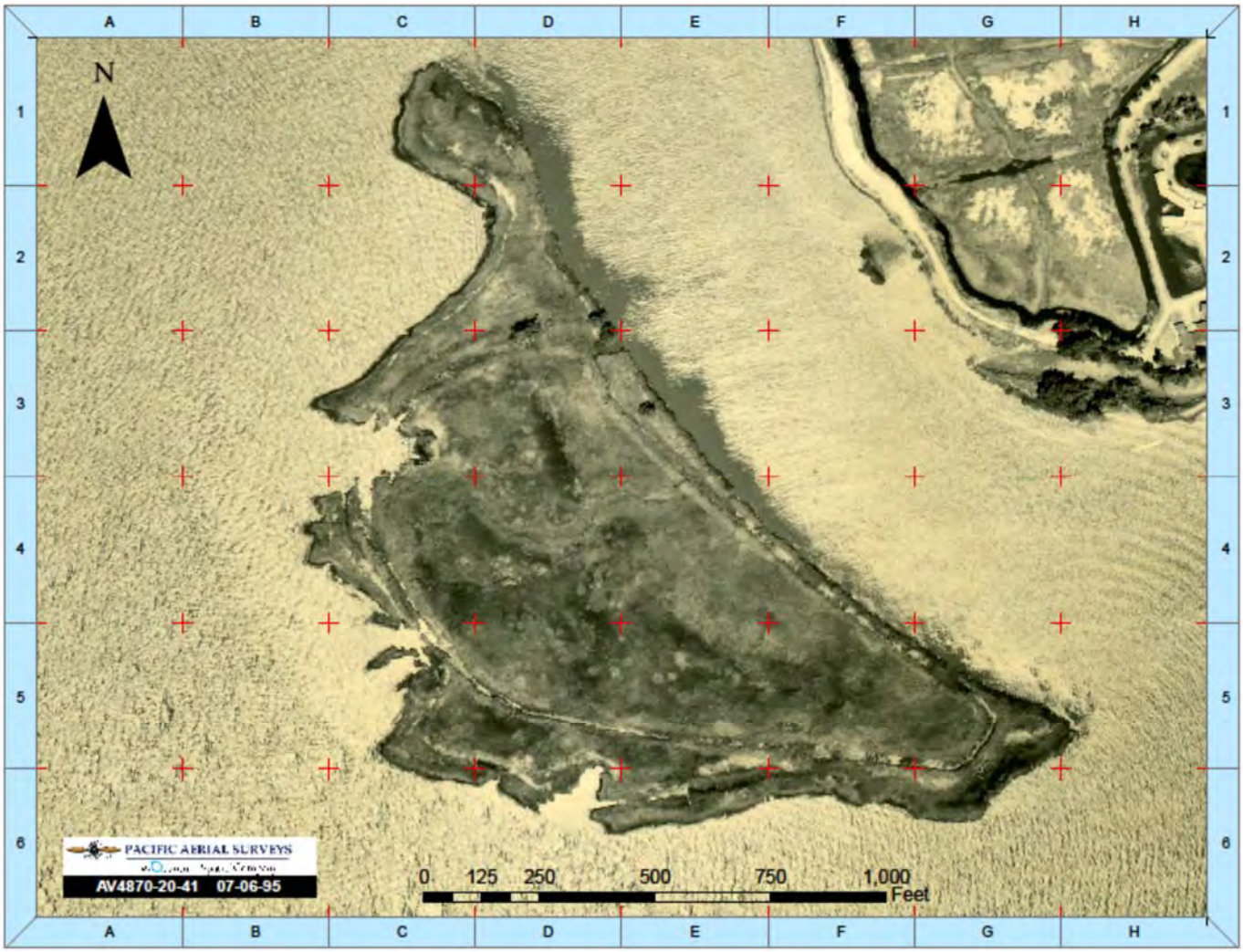
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1993)

Point Buckler Island
Solano County, CA

Figure C-12

(Quantum Spatial) August 23, 1993
Aerial Photograph – Snag Island



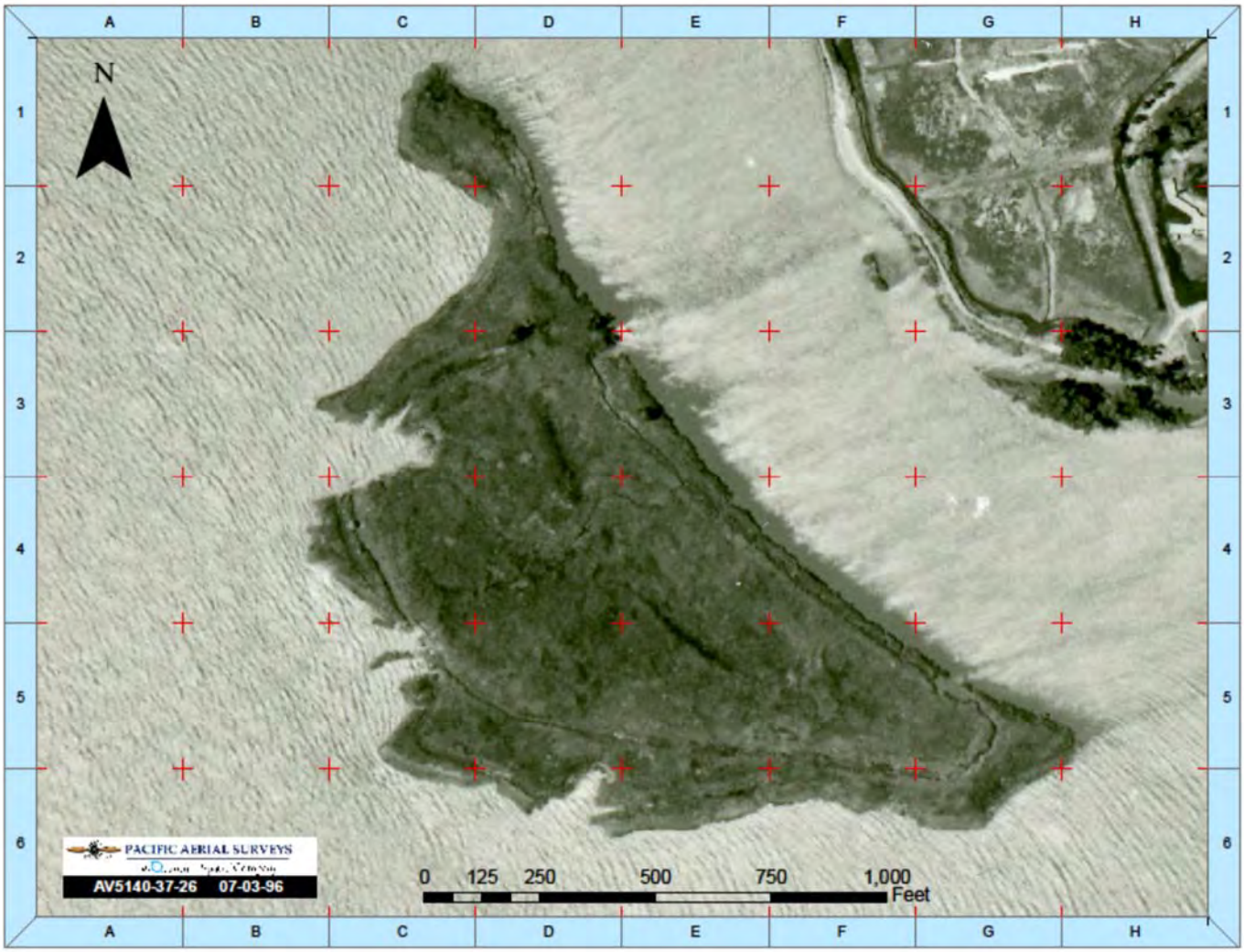
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1995)

Point Buckler Island
Solano County, CA

Figure C-13

(Quantum Spatial) July 6, 1995
Aerial Photograph – Snag Island



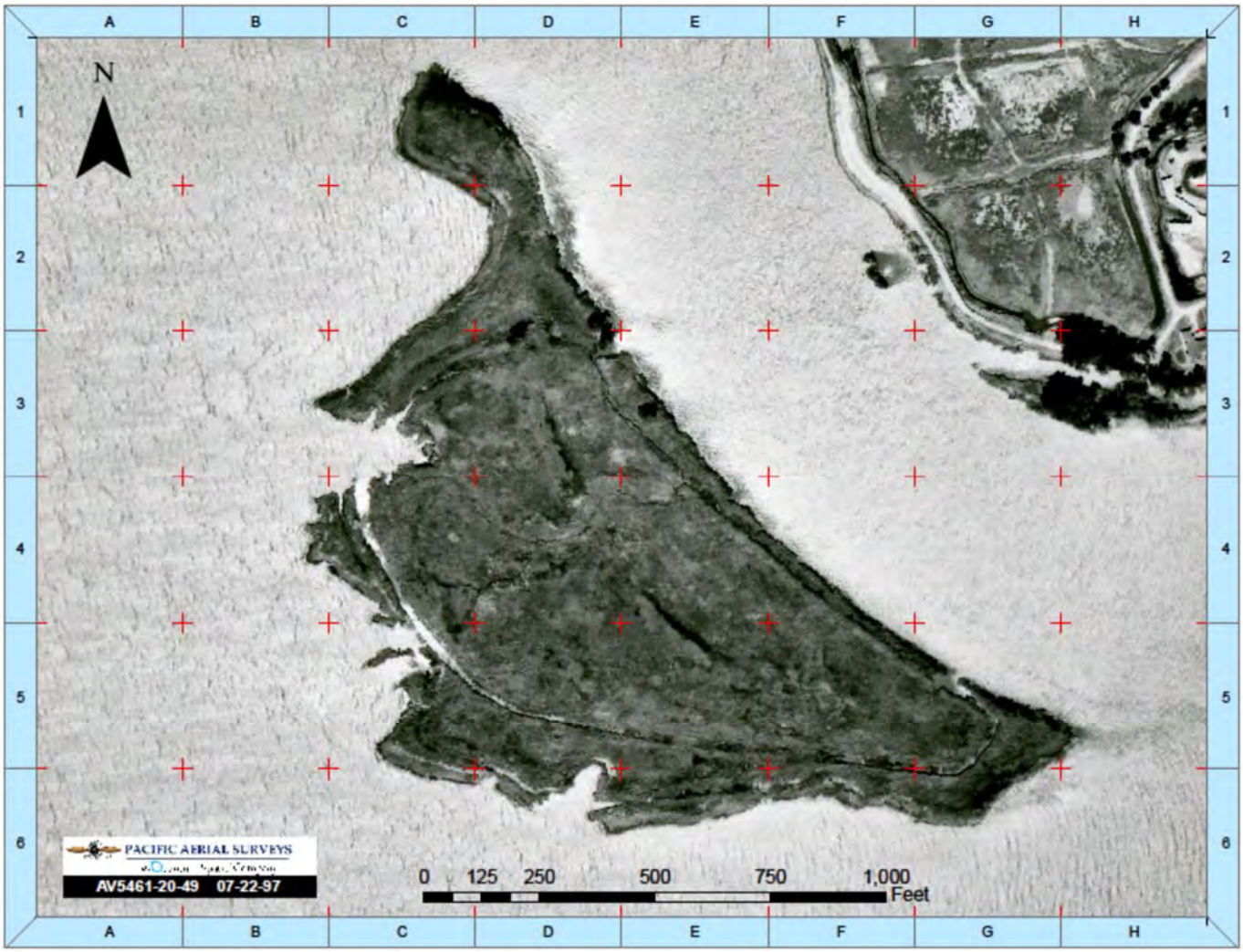
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1996)

Point Buckler Island
Solano County, CA

Figure C-14

(Quantum Spatial) July 3, 1996
Aerial Photograph – Snag Island



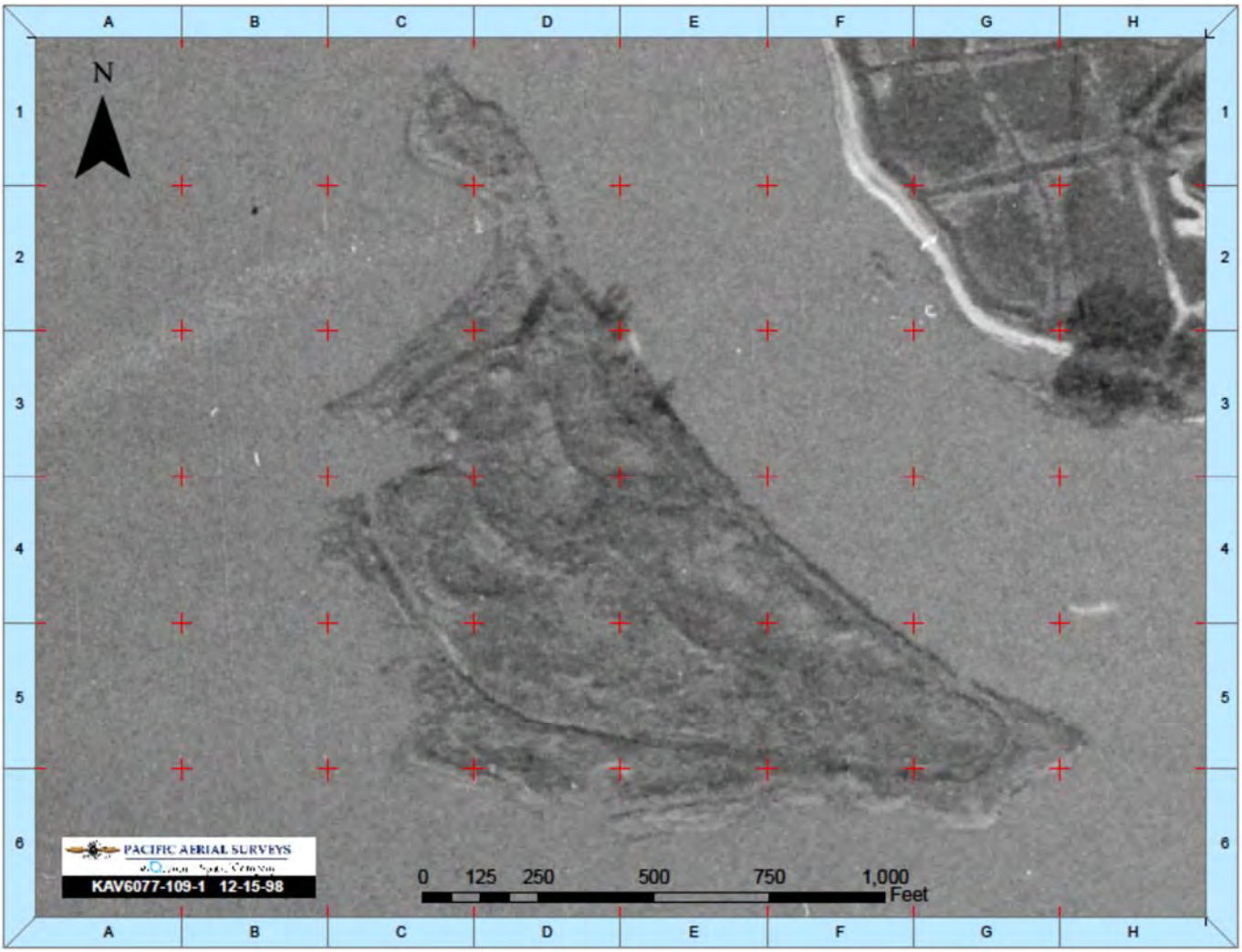
Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1997)

Point Buckler Island
Solano County, CA

Figure C-15

(Quantum Spatial) July 22, 1997
Aerial Photograph – Snag Island



Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 1998)

Point Buckler Island
Solano County, CA

Figure C-16

(Quantum Spatial) December 15, 1998
Aerial Photograph – Snag Island

Map File: App-C air-photo-1999 Freeman 2016-0510

Data sources: air photo (DWR, 1999)

1:6,000 (1" = 500' at letter size)

0 250 500 ft

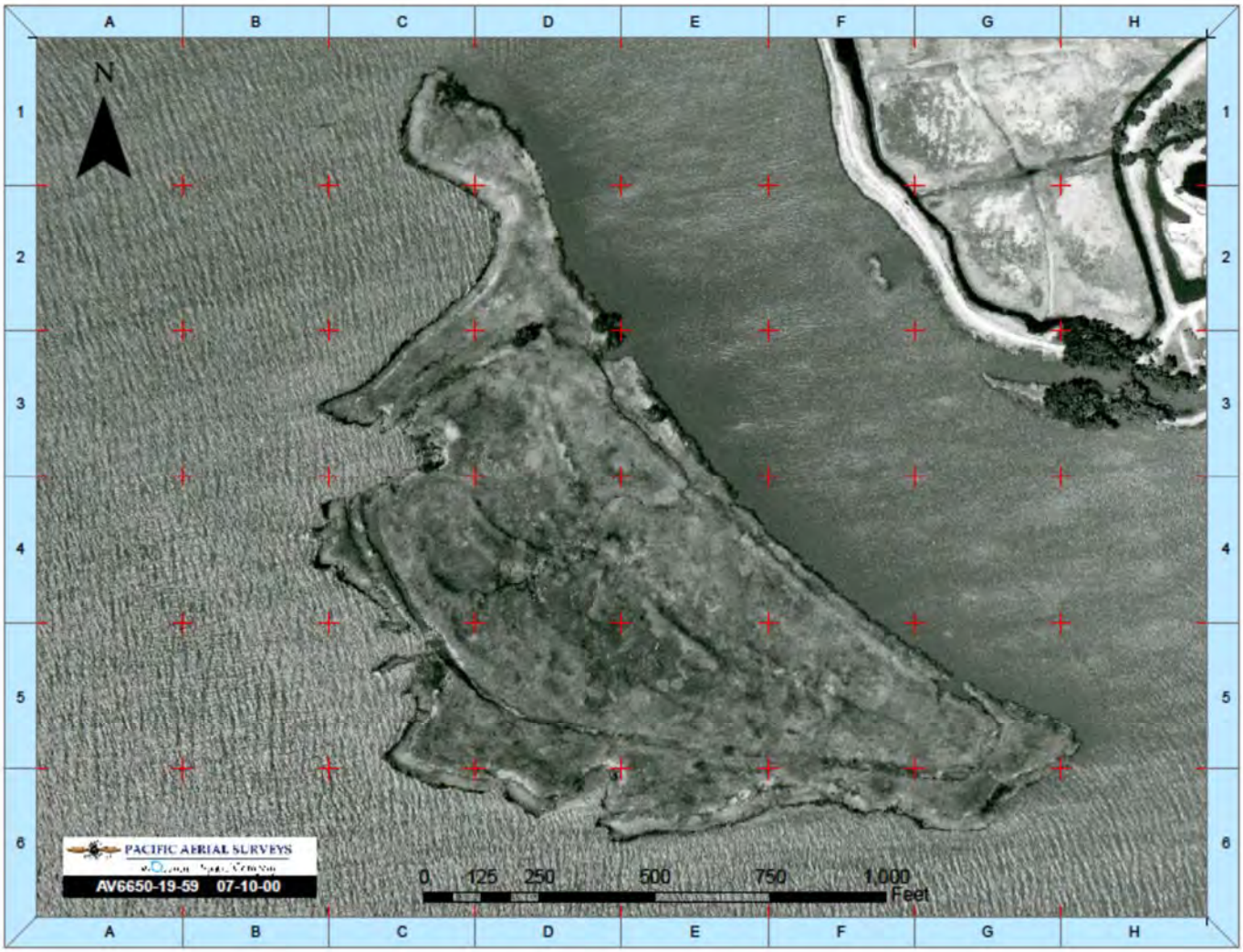
0 75 150 m

Point Buckler Island
Solano County, CA

Figure C-17

(DWR) June 16, 1999
Aerial Photograph - Snag Island

Image brightness and contrast adjusted from original for visual clarity



Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 2000)

Point Buckler Island
Solano County, CA

Figure C-18

(Quantum Spatial) July 10, 2000
Aerial Photograph – Snag Island

Map File: App-C_air-photo-2003_Snag_2016-0510

Data sources: air photo (DWR, 2003)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-19

(DWR) Summer 2003
Aerial Photograph - Snag Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-C air-photo-2005 Snag 2016-0510

Data sources: air photo (NAIP, 2005)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-20

Image brightness and contrast adjusted from original for visual clarity

(NAIP) Summer 2005
Aerial Photograph - Snag Island

Map File: App-C_air-photo-2006_Snag_2016-0510

Data sources: air photo (DWR, 2006)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-21

(DWR) Summer 2006
Aerial Photograph - Snag Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-C_air-photo-2010_Snag_2016-0510

Data sources: air photo (NAIP, 2010)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

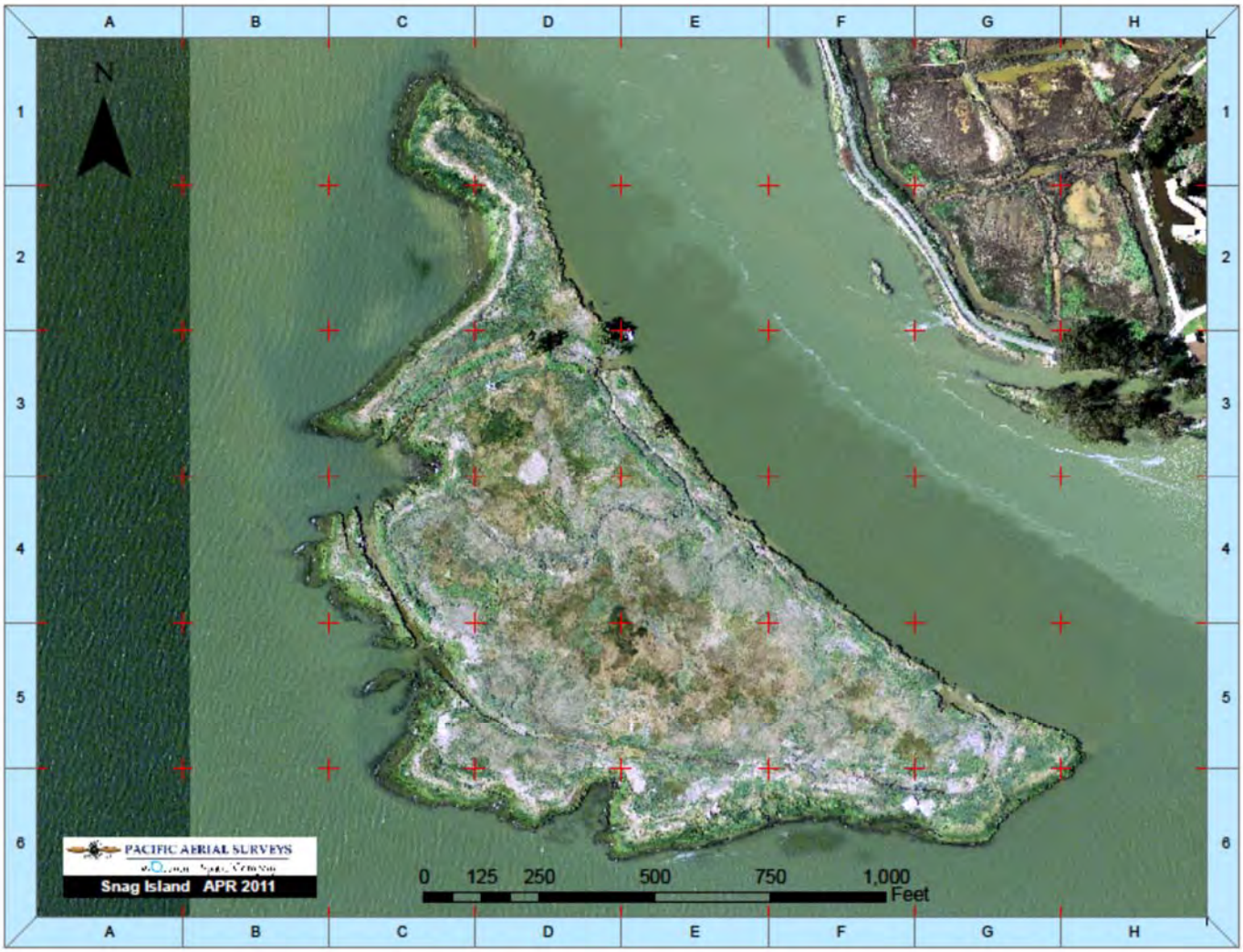
0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-22

(NAIP) Summer 2010
Aerial Photograph - Snag Island

Image brightness and contrast adjusted from original for visual clarity



Freeman-QS-figures_2016-0510.ppt

Data source: air photo (QS, 2011)

Point Buckler Island
Solano County, CA

Figure C-23

(Quantum Spatial) April 2011
Aerial Photograph – Snag Island

Map File: App-C_air-photo-2012_Snag_2016-0510

Data sources: air photo (DWR, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-24

(DWR) Summer 2012
Aerial Photograph - Snag Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-C_air-photo-2015_Snag_2016-0510

Data sources: air photo (DWR, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-25

(DWR) Summer 2015
Aerial Photograph - Snag Island

Image brightness and contrast adjusted from original for visual clarity

Map File: App-C_air-photo-2016_Snag_2016-0510

Data sources: air photo (QS, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure C-26

Image brightness and contrast adjusted from original for visual clarity

(Quantum Spatial) February 10, 2016
Aerial Photograph - Snag Island

Appendix D Alteration Period Aerial Imagery, 2012-2016

Thirty-six aerial photographs and satellite images were obtained from a number of sources, representing the time period from 2012 to 2016. These series of images illustrate the progression of site alteration activities. See Appendix I for the annotated aerial photographs that highlight these changes over time. Note that the brightness and contrast of most aerial photographs have been adjusted from the originals for visual clarity.

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Figure D-20. July 10, 2014 Aerial Photograph (Digital Globe)

Figure D-21. August 6, 2014 Aerial Photograph (Digital Globe)

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Figure D-23. September 21, 2014 Aerial Photograph (Apollo

Figure D-24. October 19, 2014 Aerial Photograph (Apollo)

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Figure D-30. May 1, 2015 Aerial Photograph (Digital Globe)

Figure D-31. May 9, 2015 Aerial Photograph (Digital Globe)

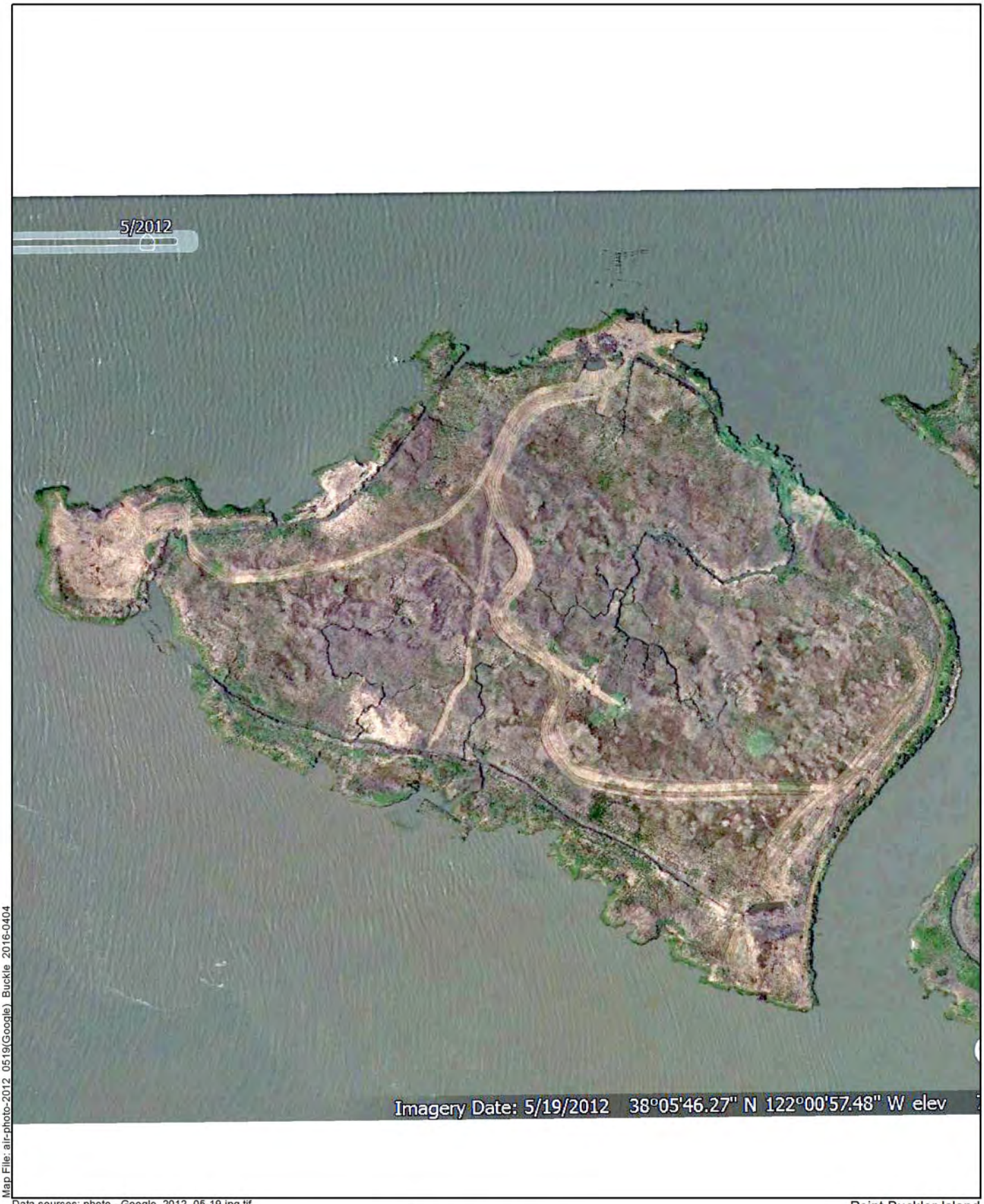
Figure D-32. June 7, 2015 Aerial Photograph (Digital Globe)

Figure D-33. Summer 2015 Aerial Photograph (DWR)

Figure D-34. August 12, 2015 Aerial Photograph (Digital Globe)

Figure D-35. November 19, 2015 Aerial Photograph (Digital Globe)

Figure D-36. February 10, 2016 Aerial Photograph (Quantum Spatial)



Map File: air-photo-2012_0519(Google) Buckle 2016-0404

Data sources: photo - Google_2012_05-19.jpg.tif
(Google Earth, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

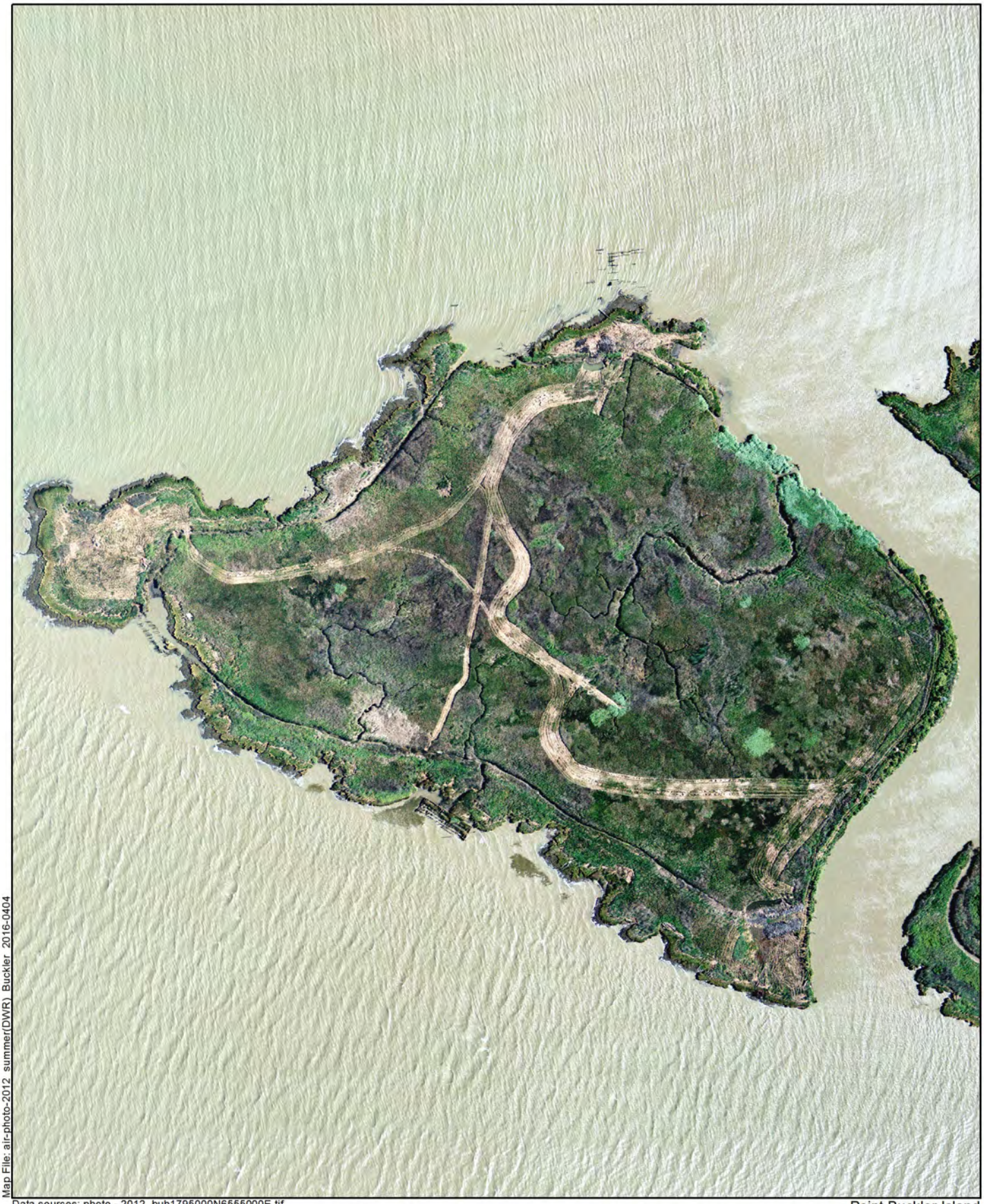
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-1

(Google Earth) May 19, 2012
Aerial Photograph



Map File: air-photo-2012_summer(DWR)_Buckler_2016-0404

Data sources: photo - 2012_buh1795000N6555000E.tif
(DWR, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

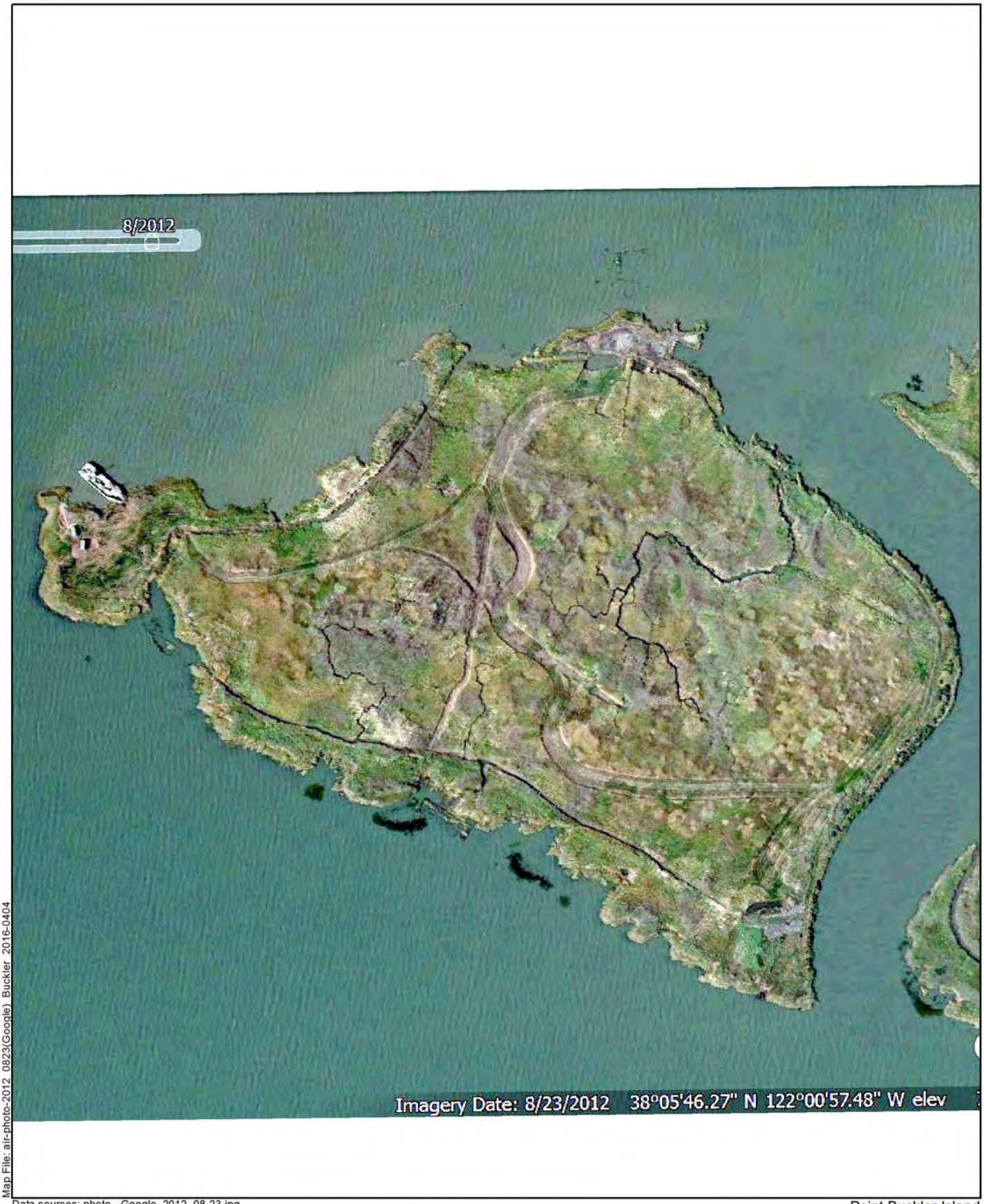
0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-2

(DWR) Summer 2012
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: air-photo-2012_0823(Google) Buckler 2016-0404

Data sources: photo - Google_2012_08-23.jpg
(Google Earth, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

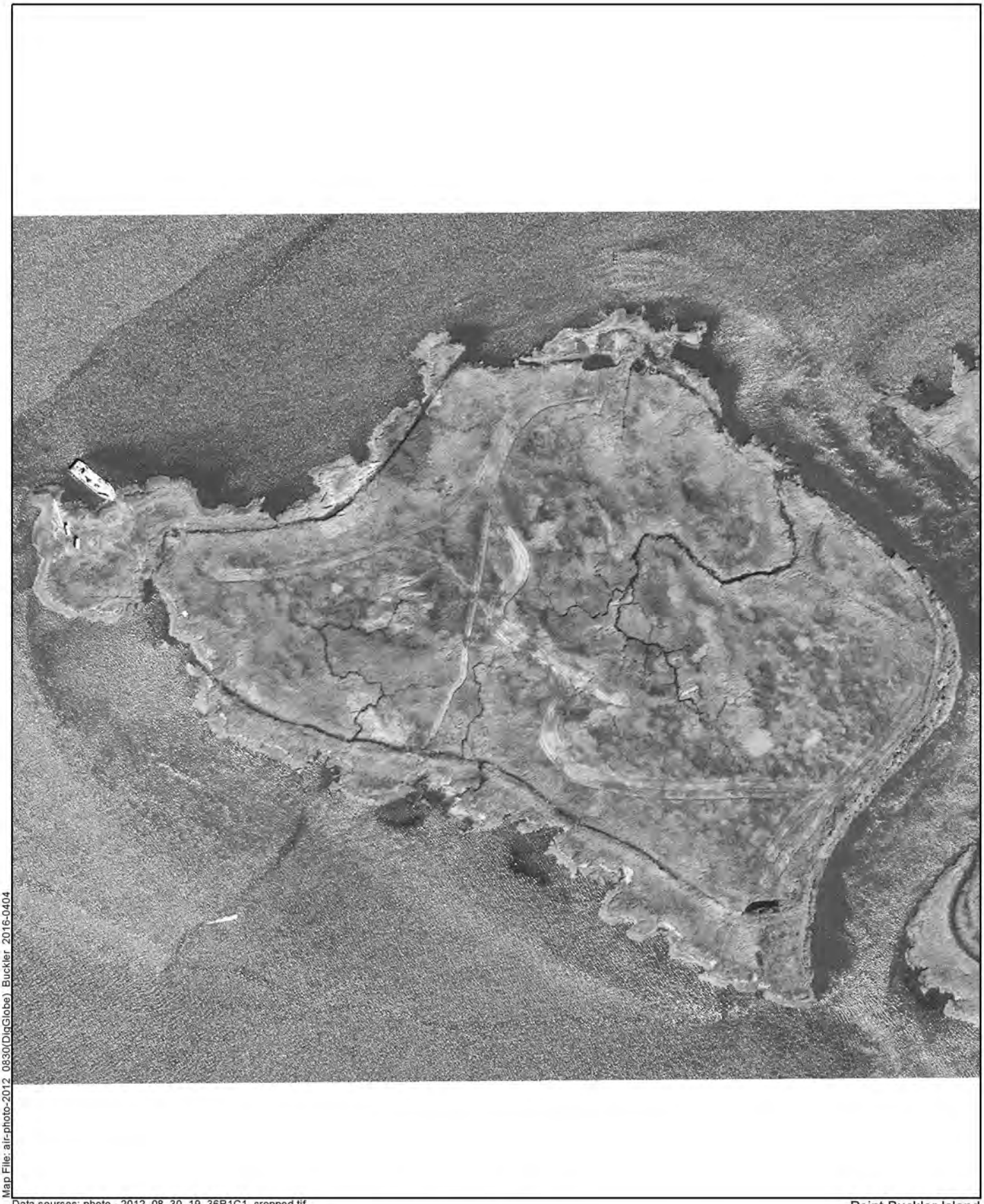
0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-3

(Google Earth) August 23, 2012
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity



Map File: air-photo-2012_0830(DigGlobe) Buckler 2016-0404

Data sources: photo - 2012_08_30_19_36R1C1_cropped.tif
(Digital Globe, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

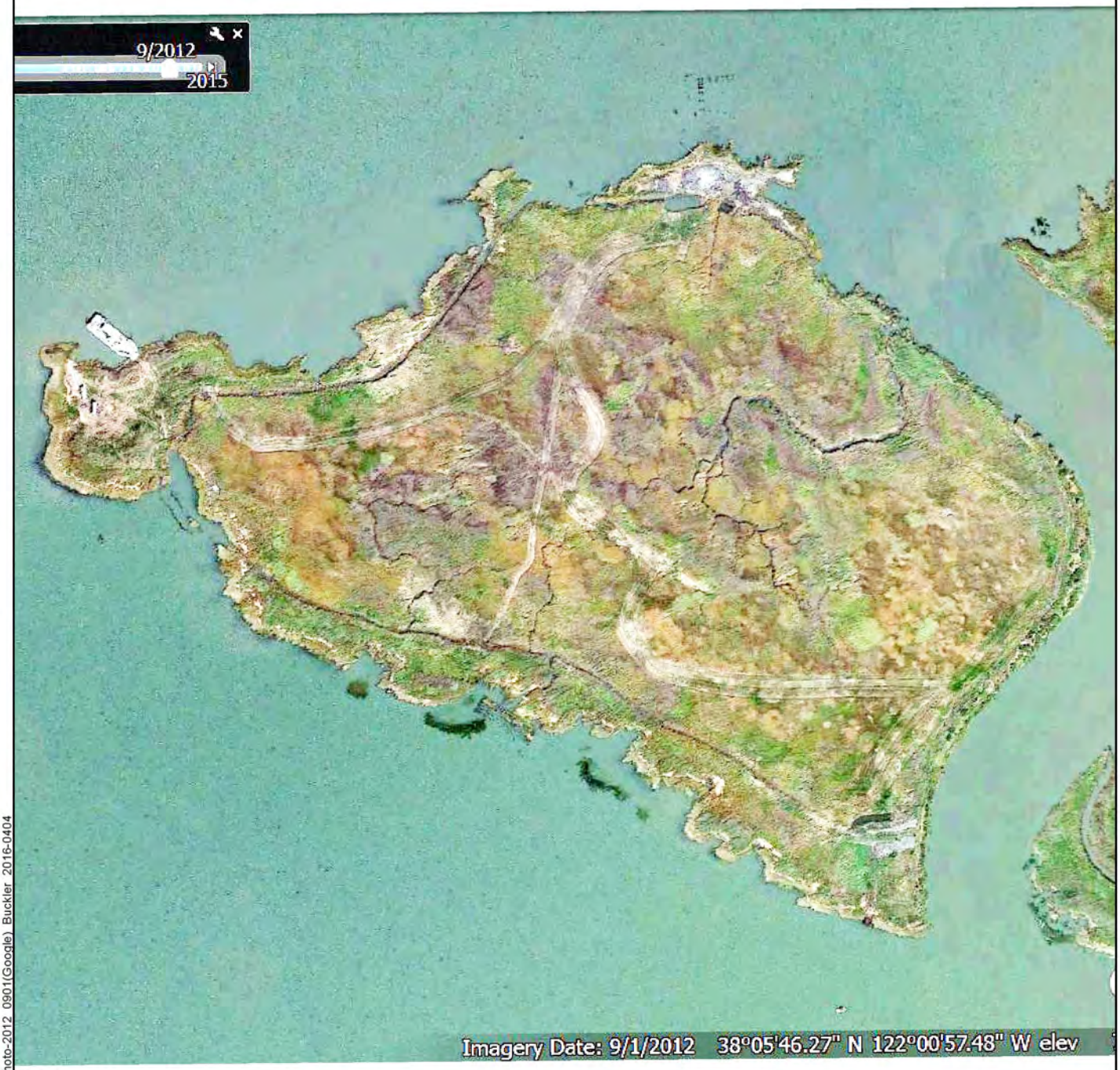
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-4

(Digital Globe) August 30, 2012
Aerial Photograph



Map File: air-photo-2012_0901(Google) Buckler 2016-0404

Data sources: photo -Google_2012_09-01.jpg
(Google Earth, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-5

Image brightness and contrast adjusted from original for visual clarity

(Google Earth) September 1, 2012
Aerial Photograph

Map File: air-photo-2013_0126(Google) Buckler 2016-0404

Data sources: photo -Google_2013_01-26.jpg
(Google Earth, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-6

Image brightness and contrast adjusted from original for visual clarity

(Google Earth) January, 26 2013
Aerial Photograph

Map File: air-photo-2013_0416(Google) Buckler 2016-0404

Data sources: photo -Google_2013_04-16.jpg
(Google Earth, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

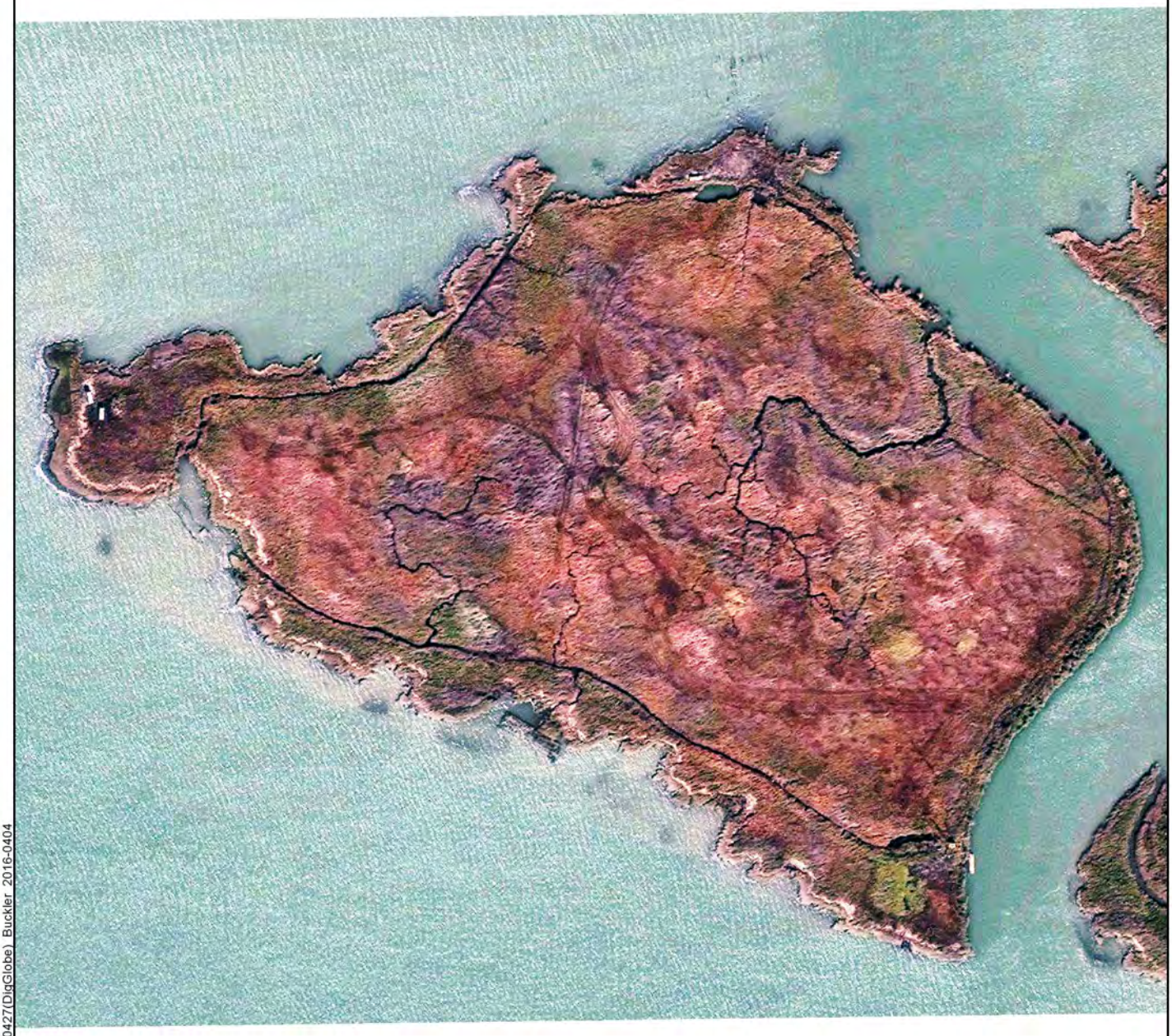
0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-7

Image brightness and contrast adjusted from original for visual clarity

(Google Earth) April 16, 2013
Aerial Photograph



Map File: air-photo-2013_0427(DigGlobe) Buckler 2016-0404

Data sources: photo -2013_04_27_1943_UTC_R1C1_Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-8

(Digital Globe) April 27, 2013
Aerial Photograph

Map File: air-photo-2013_0601(Google) Buckler 2016-0404

Data sources: photo Google_2013_06_01.jpg
(Google Earth, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-9

Image brightness and contrast adjusted from original for visual clarity

(Google Earth) June 1, 2013
Aerial Photograph

Map File: air-photo-2013_0922(DigGlobe) Buckler 2016-0404

Data sources: photo - 2013_09_22_1937_UTC_R1C1 Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

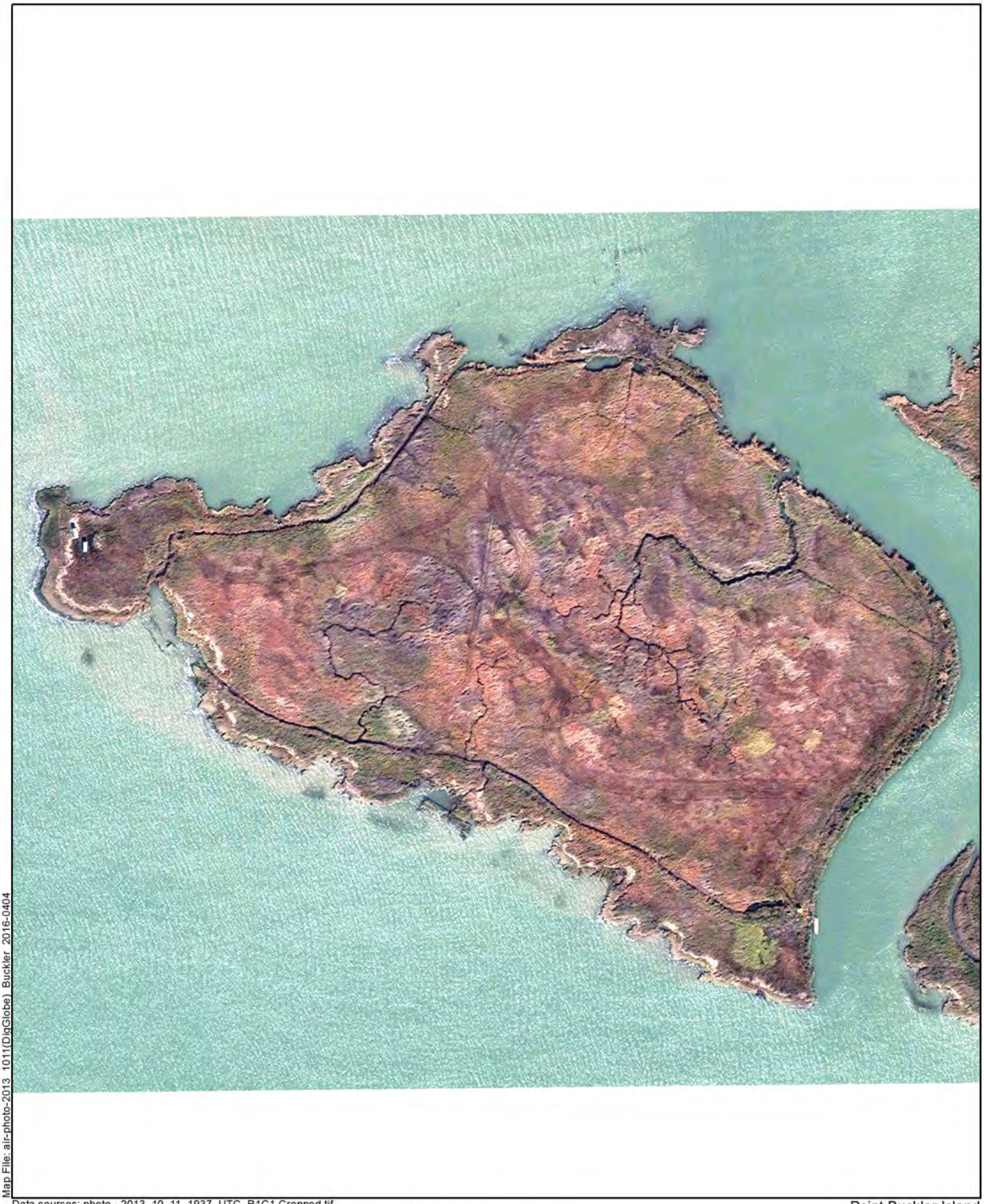
0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-10

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) September 22, 2013
Aerial Photograph



Map File: air-photo-2013_1011(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2013_10_11_1937_UTC_R1C1 Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-11

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) October 11, 2013
Aerial Photograph

Map File: air-photo-2013_1221(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2013_12_21_1937_UTC_R1C1 Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-12

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) December 21, 2013
Aerial Photograph

Map File: air-photo-2014_0112(DigGlobe) Buckler 2016-0404

Data sources: photo - 2014_01_12_1915_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

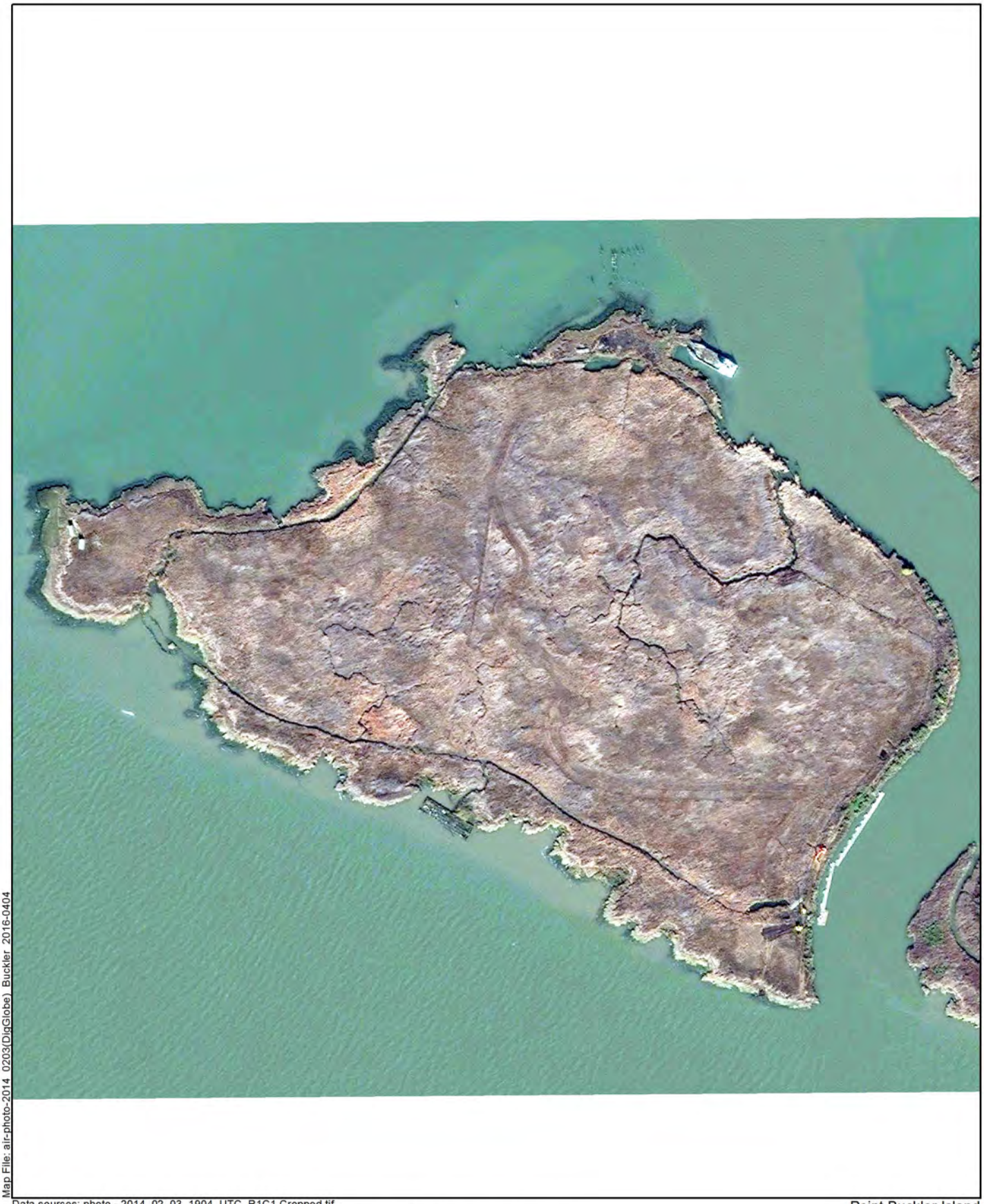
0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-13

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) January 12, 2014
Aerial Photograph



Map File: air-photo-2014_0203(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_02_03_1904_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-14

(Digital Globe) February 3, 2014
Aerial Photograph

Map File: air-photo-2014_0308(Apollo)_Buckler_2016-0419

Data sources: photo - 3-8-2014_80cm_Ortho_ColorBalance.tif
(Apollo Mapping, 2014)

1:3,600 (1" = 300' at letter size)

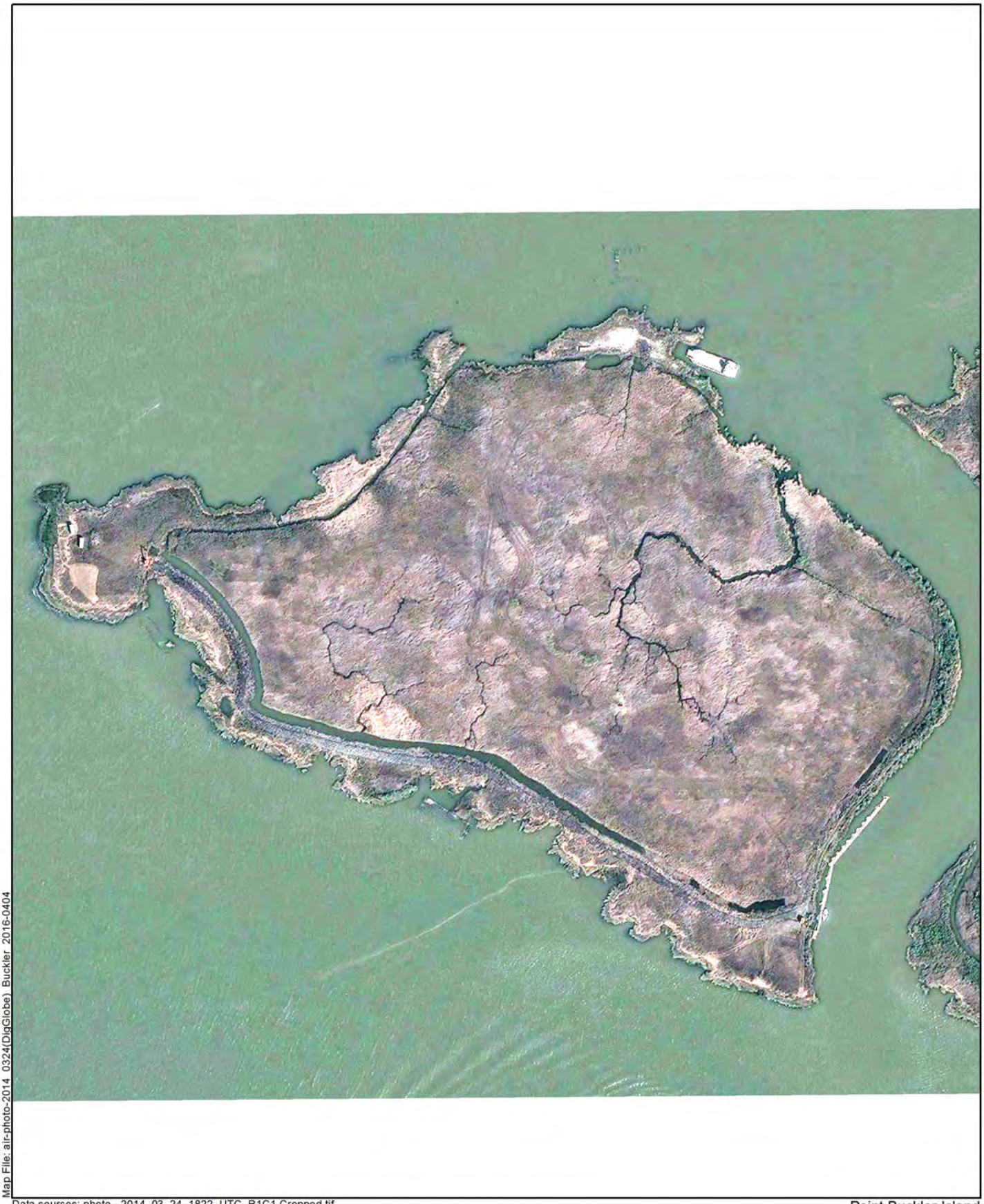
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-15

(Apollo Mapping) March 8, 2014
Aerial Photograph



Map File: air-photo-2014_0324(DigGlobe) Buckler 2016-0404

Data sources: photo - 2014_03_24_1822_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

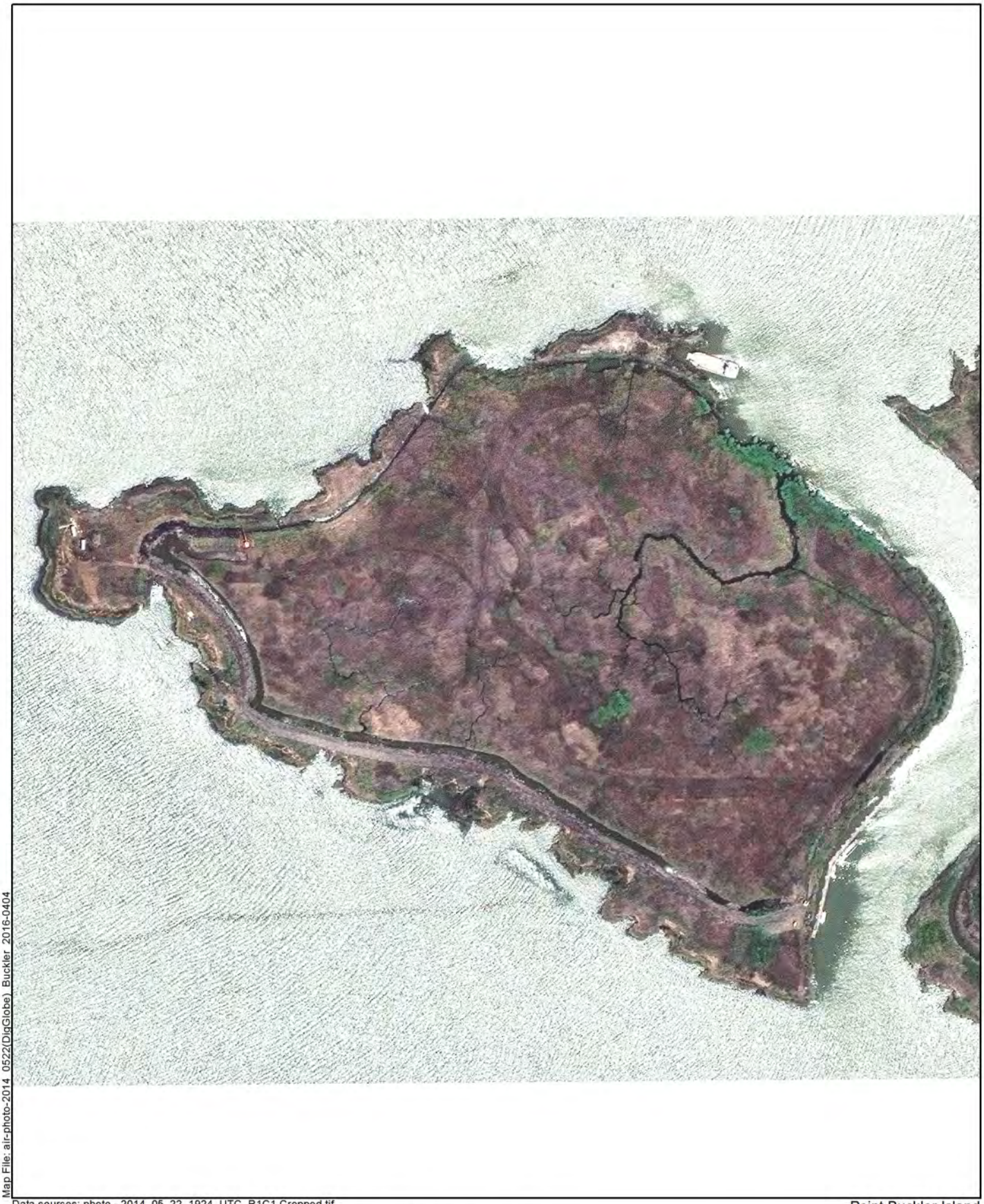
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-16

(Digital Globe) March 24, 2014
Aerial Photograph



Map File: air-photo-2014_0522(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_05_22_1924_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-17

(Digital Globe) May 22, 2014
Aerial Photograph

Map File: air-photo-2014_0526(Google) Buckler 2016-0404

Data sources: photo - Google_2014_0526.jpg
(Google Earth, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-18

(Google Earth) May 26, 2014
Aerial Photograph

Image brightness and contrast adjusted from original for visual clarity

Map File: air-photo-2014_0605(DigGlobe) Buckler 2016-0404

Data sources: photo - 2014_06_05_1909_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-19

(Digital Globe) June 5, 2014
Aerial Photograph

Map File: air-photo-2014_0710(DigGlobe) Buckler 2016-0404

Data sources: photo - 2014_07_10_1917_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

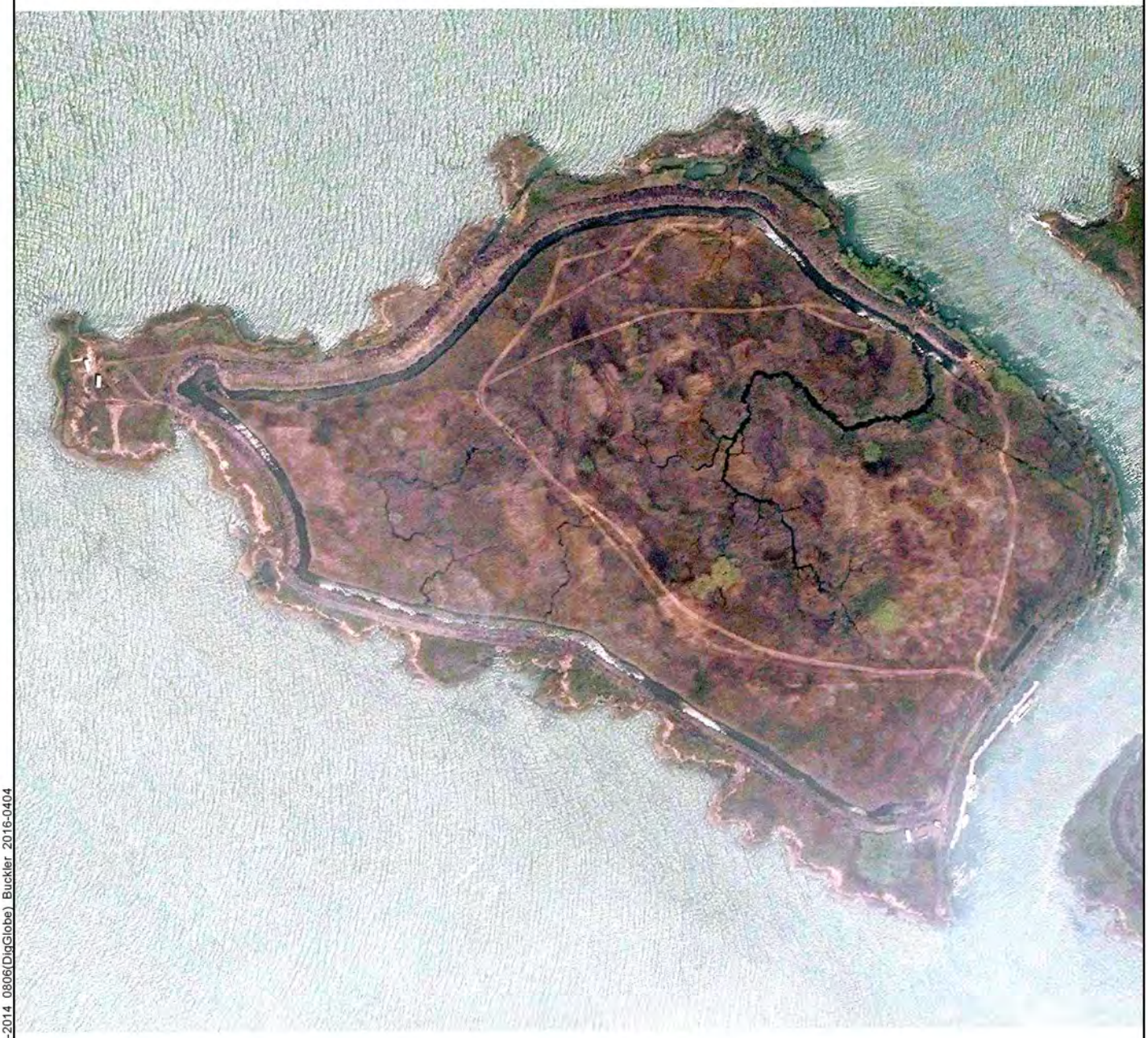
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-20

(Digital Globe) July 10, 2014
Aerial Photograph



Map File: air-photo-2014_0806(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_08_06_1921_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

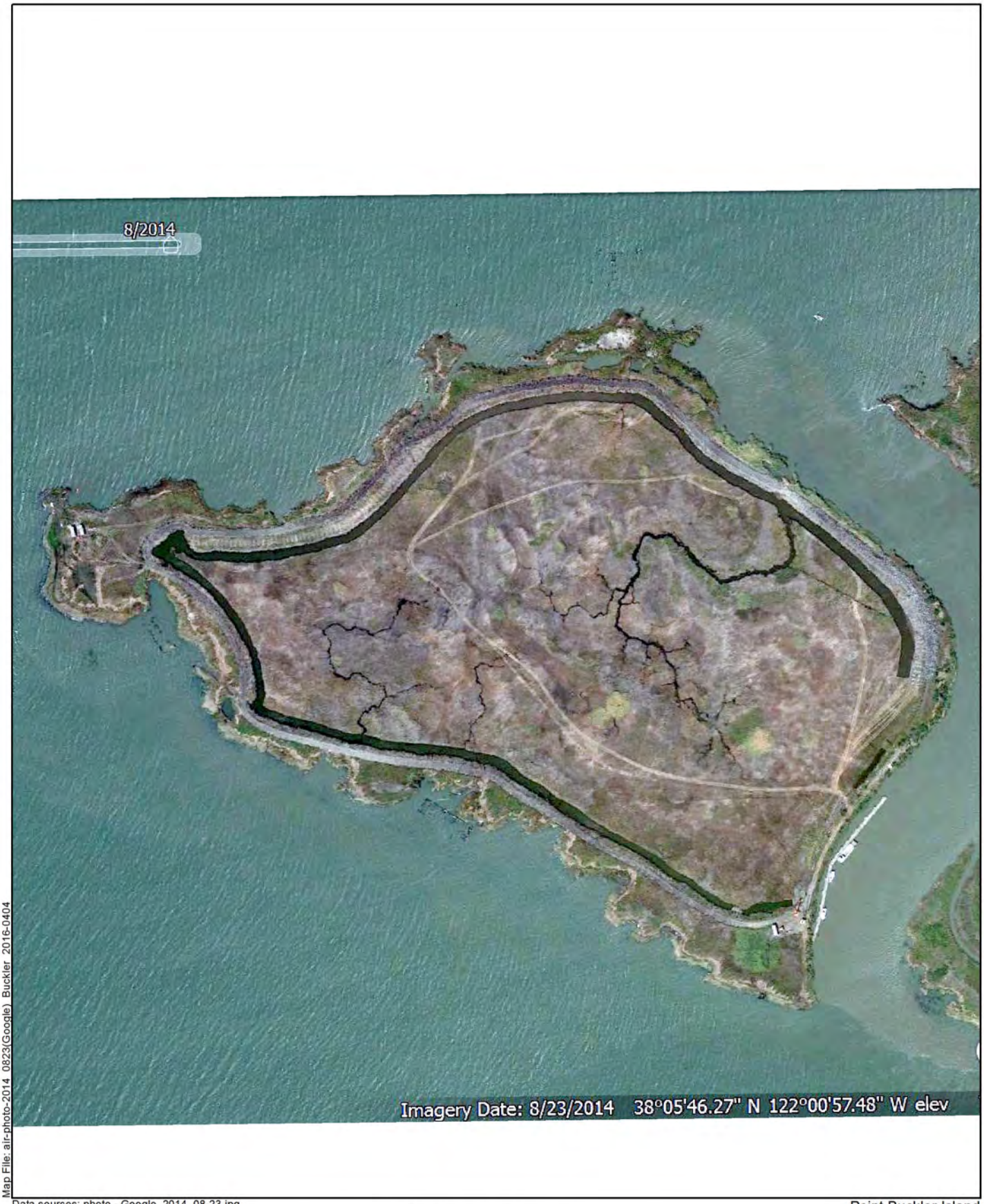
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-21

(Digital Globe) August 6, 2014
Aerial Photograph



Map File: air-photo-2014_0823(Google) Buckler 2016-0404

Data sources: photo - Google_2014_08-23.jpg
(Google Earth, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-22

Image brightness and contrast adjusted from original for visual clarity

(Google Earth) August 23, 2014
Aerial Photograph

Map File: air-photo-2014_0920(Apollo)_Buckler_2016-0419

Data sources: photo - 9-20-2014_K3_70cm_Ortho_ColorBalance.tif
(Apollo Mapping, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-23

(Apollo Mapping) September 20, 2014
Aerial Photograph

Map File: air-photo-2014_1018(Apollo)_Buckler_2016-0419

Data sources: photo - 10-18-2014_K3_70cm_Ortho_ColorBalance.tif
(Apollo Mapping, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-24

(Apollo Mapping) October 18, 2014
Aerial Photograph

Map File: air-photo-2014_1029(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_10_29_1920_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

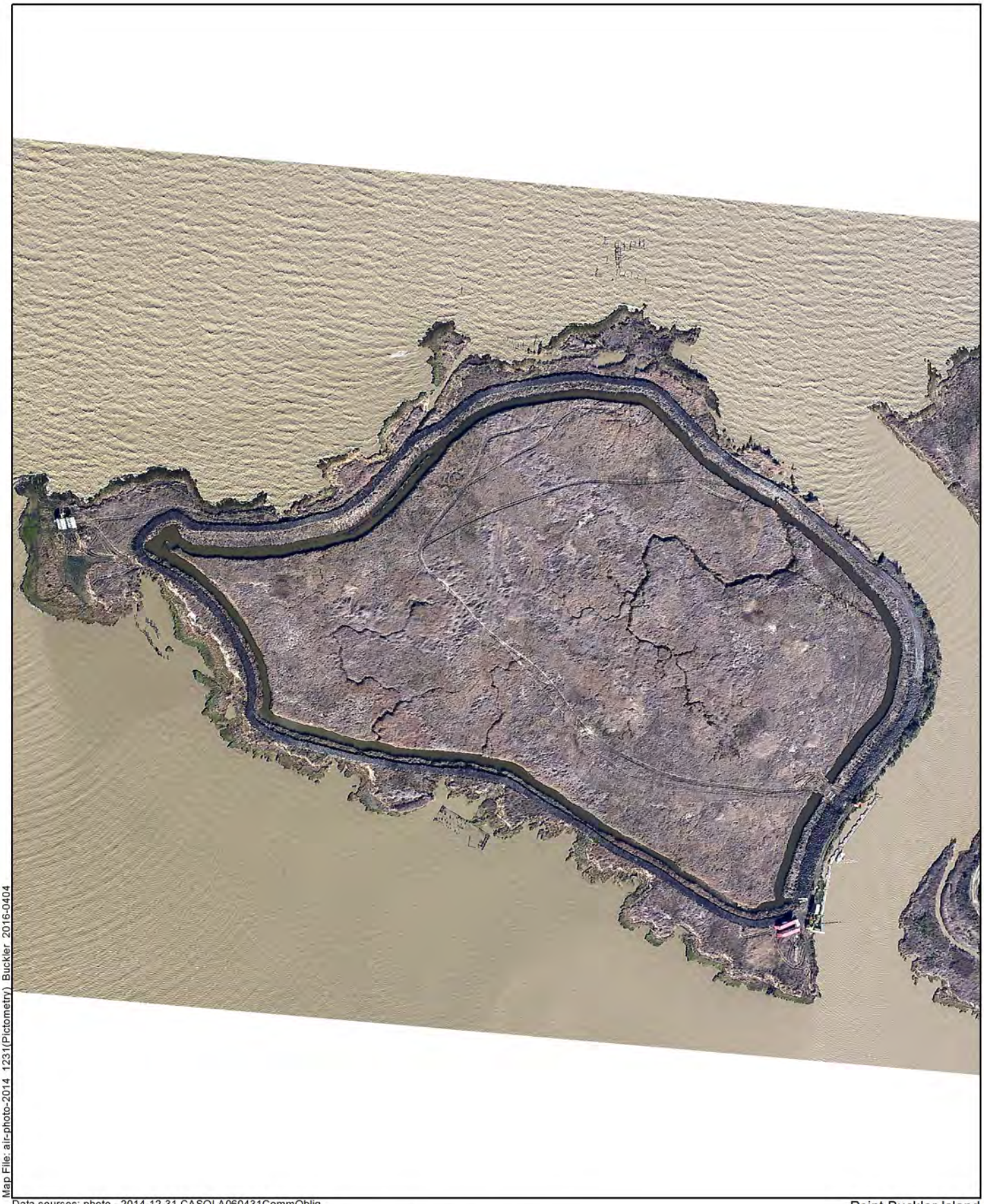
0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-25

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) October 29, 2014
Aerial Photograph



Map File: air-photo-2014 1231(Pictometry) Buckler 2016-0404

Data sources: photo - 2014-12-31 CASOLA060431CommObliq
48560E_141231 Cropped.tif (Pictometry, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

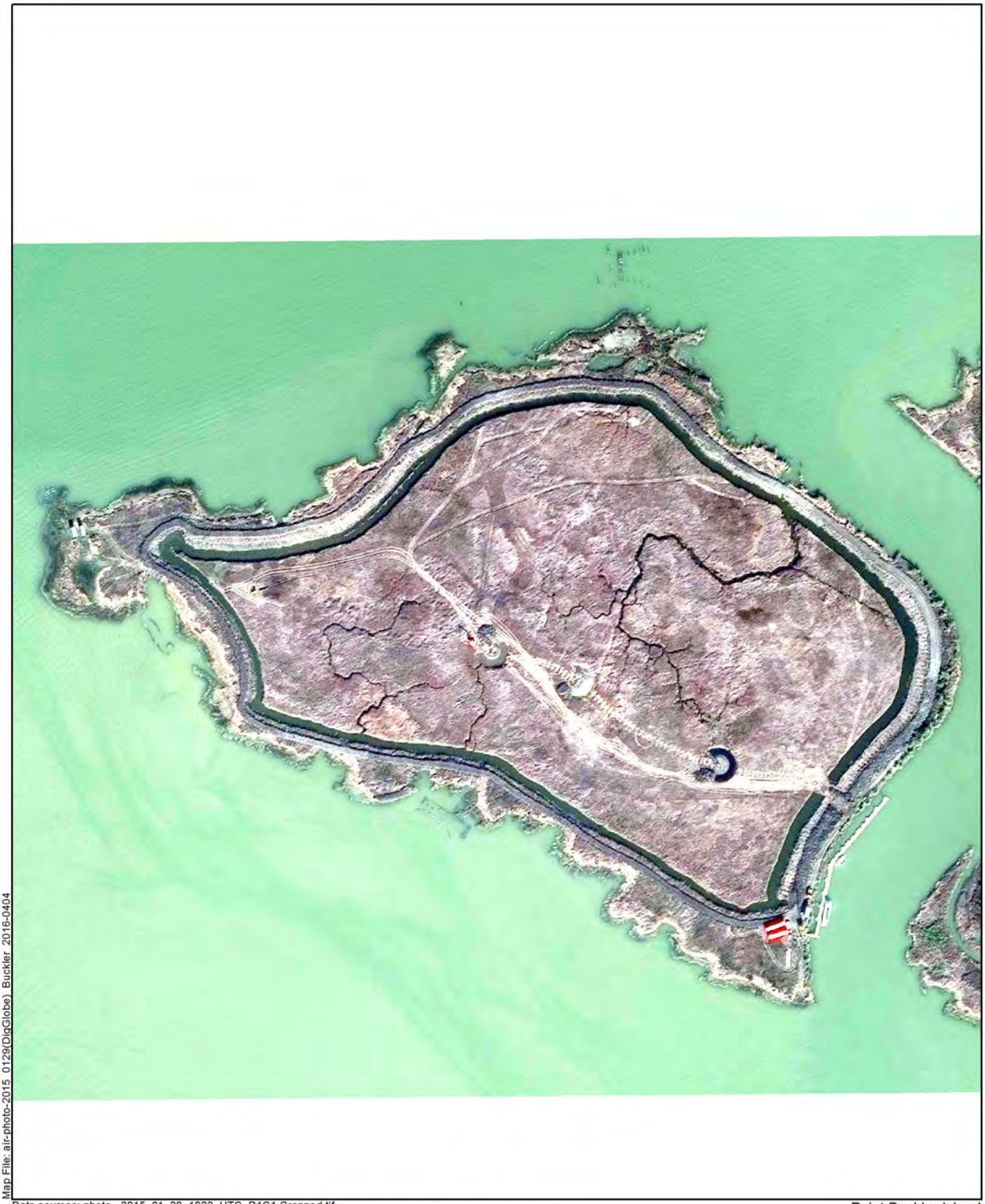
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-26

(Pictometry) December 31, 2014
Aerial Photograph



Map File: air-photo-2015_0129(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_01_29_1922_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-27

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) January 29, 2015
Aerial Photograph

Map File: air-photo-2015_0401(Google) Buckler 2016-0404

Data sources: photo - Google_2015_0401.jpg
(Google Earth, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-28

Image brightness and contrast adjusted from original for visual clarity

(Google Earth) April 1, 2015 Aerial Photograph

Map File: air-photo-2015_0418(DigGlobe) Buckler 2016-0404

Data sources: photo - 2015_04_18_1911_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-29

(Digital Globe) April 18, 2015
Aerial Photograph

Map File: air-photo-2015_0501(DigGlobe) Buckler 2016-0404

Data sources: photo - 2015_05_01_1915_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-30

(Digital Globe) May 1, 2015
Aerial Photograph

Map File: air-photo-2015_0509(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_05_09_19_28_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

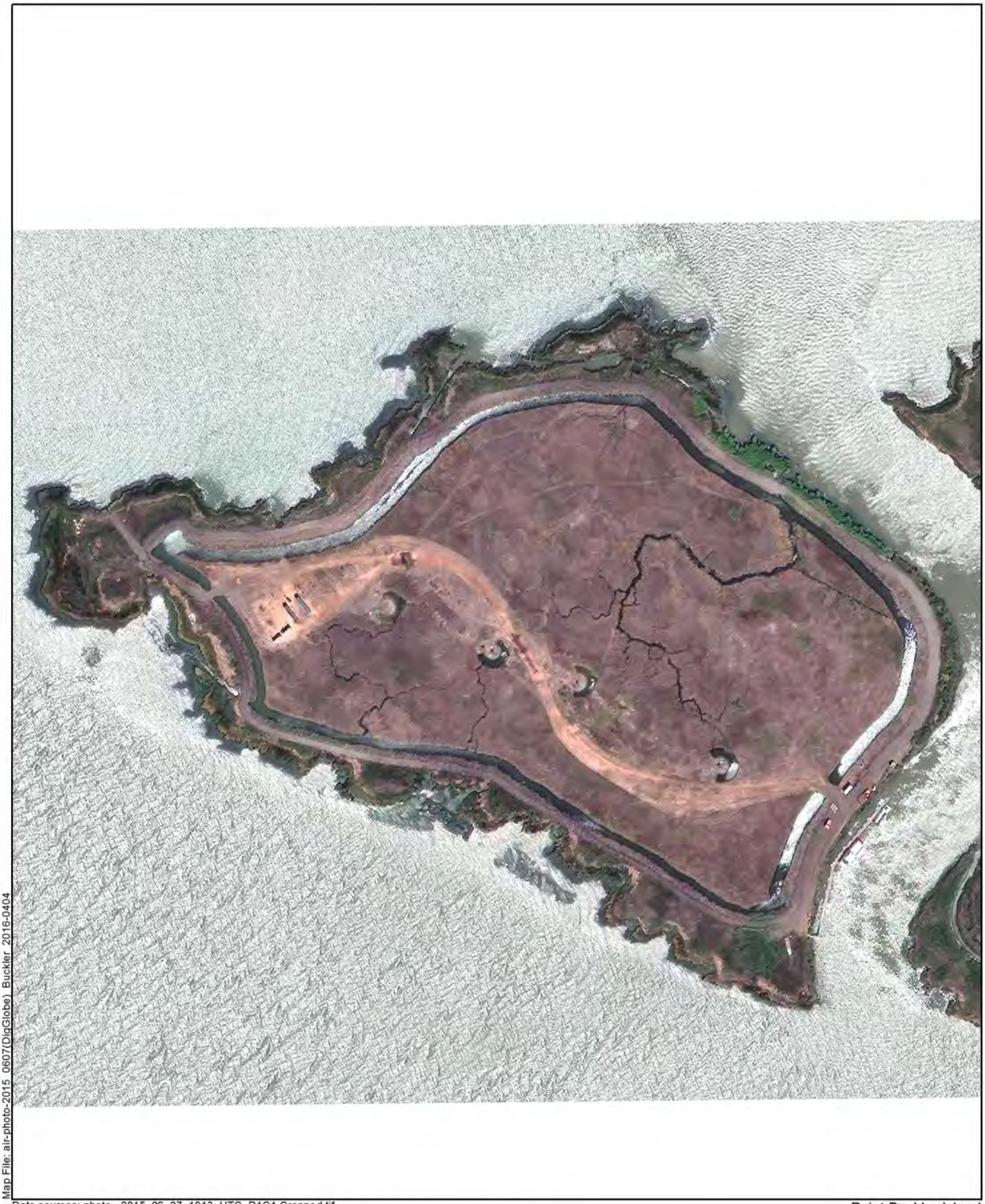
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-31

(Digital Globe) May 9, 2015
Aerial Photograph



Map File: air-photo-2015_0607(DigGlobe) Buckler 2016-0404

Data sources: photo - 2015_06_07_1913_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-32

(Digital Globe) June 7, 2015
Aerial Photograph

Map File: air-photo-2015_summer(DWR)_Buckler_2016-0404

Data sources: photo - 2015_bus1795000N6555000E.tif
(DWR, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

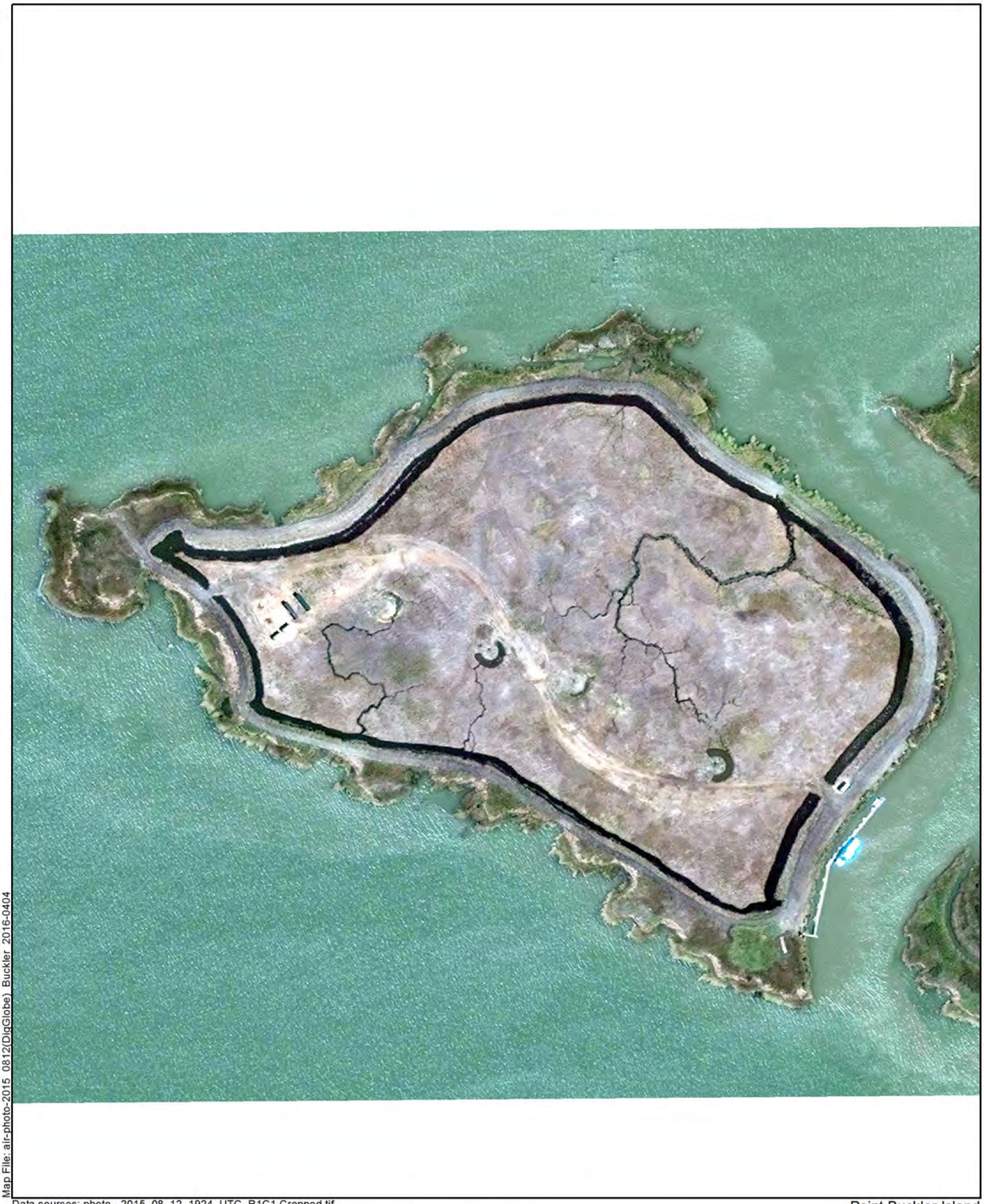
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-33

(DWR) Summer 2015 Aerial Photograph



Map File: air-photo-2015_0812(DigGlobe) Buckler 2016-0404

Data sources: photo - 2015_08_12_1924_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

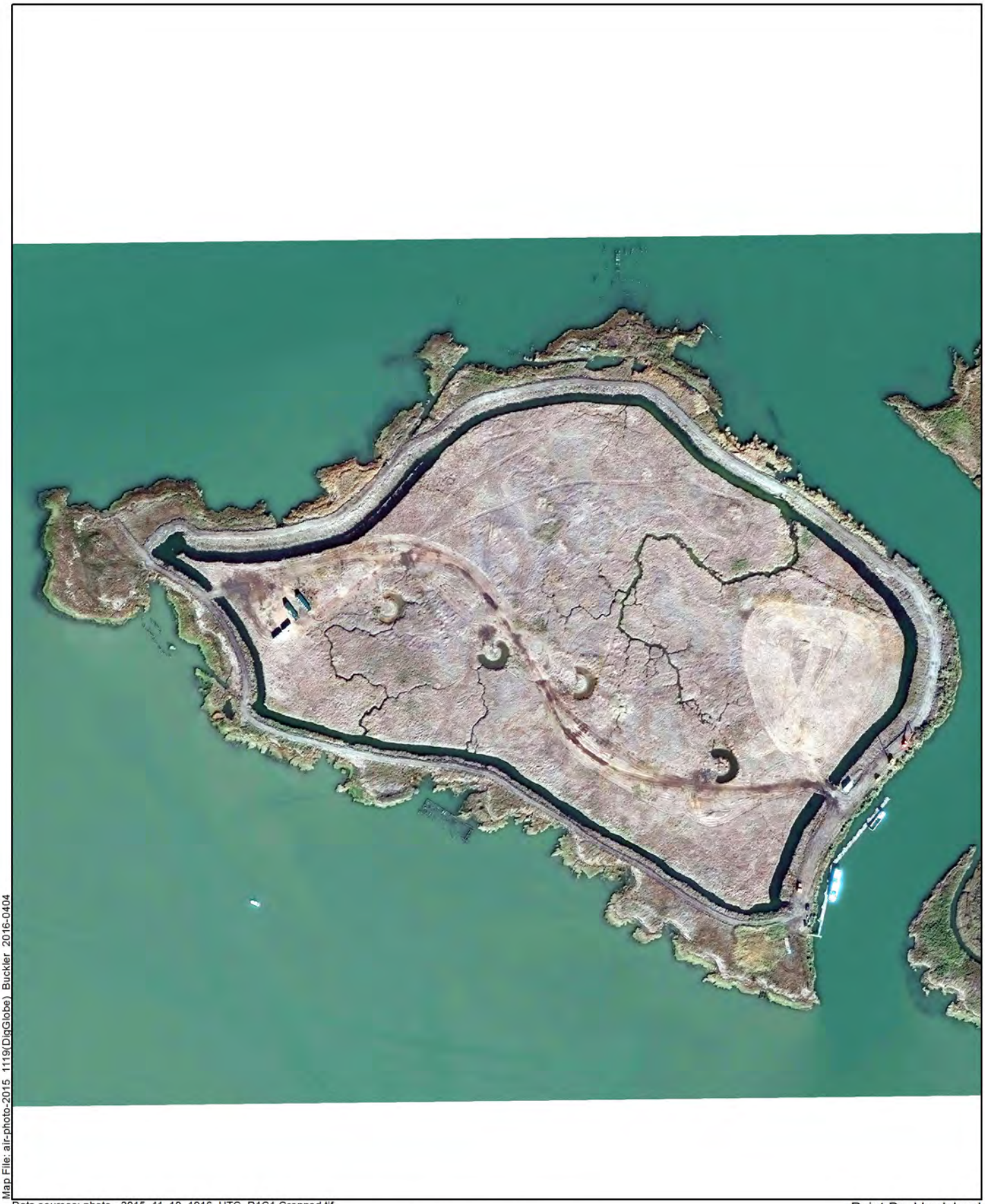
0 50 100 m

Image brightness and contrast adjusted from original for visual clarity

Point Buckler Island
Solano County, CA

Figure D-34

(Digital Globe) August 12, 2015
Aerial Photograph



Map File: air-photo-2015_1119(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_11_19_1916_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

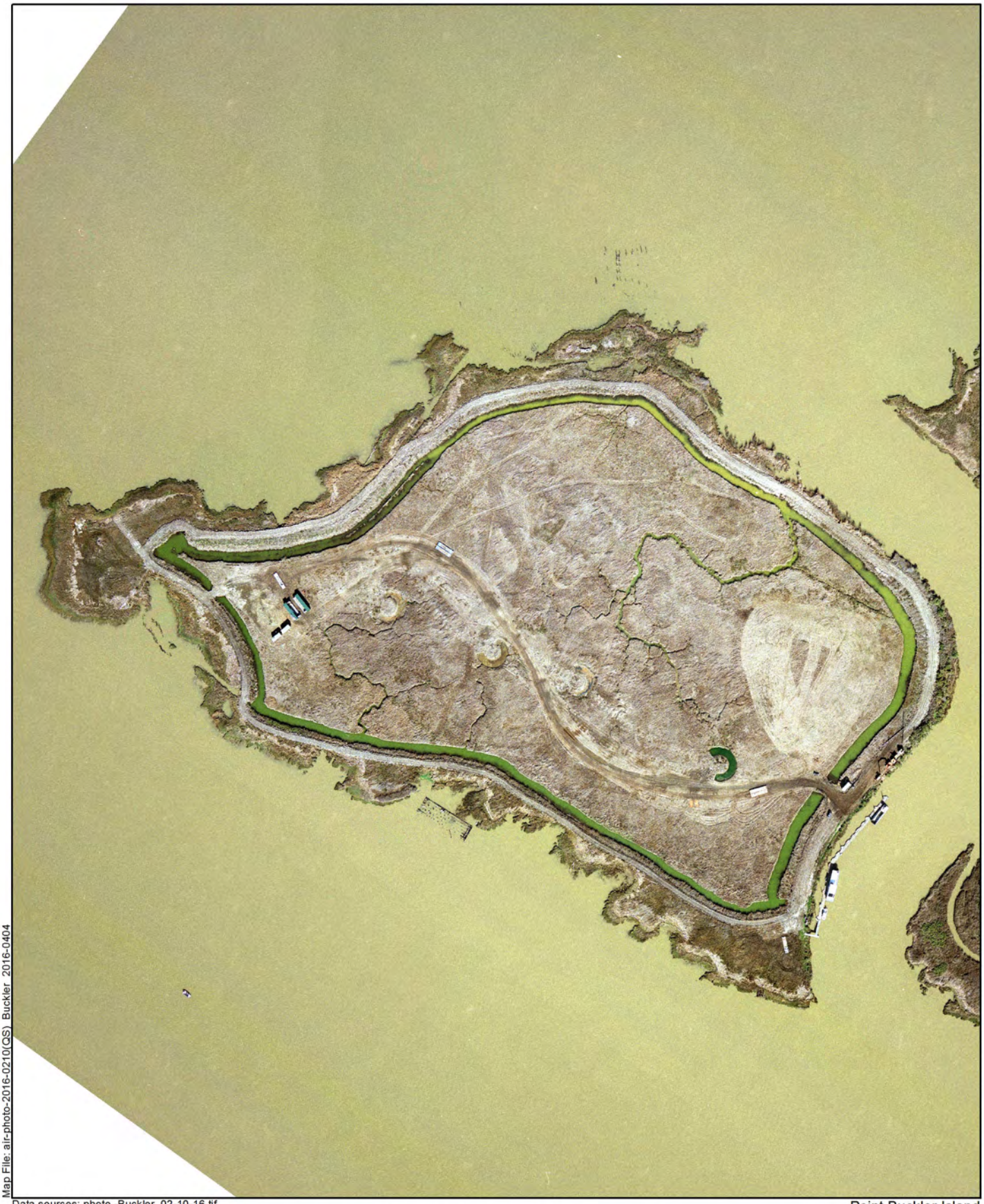
0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-35

Image brightness and contrast adjusted from original for visual clarity

(Digital Globe) November 19, 2015
Aerial Photograph



Map File: air-photo-2016-0210(QS) Buckler 2016-0404

Data sources: photo -Buckler_02-10-16.tif
(Quantum Spatial, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure D-36

Image brightness and contrast adjusted from original for visual clarity

(Quantum Spatial) February 10, 2016
Aerial Photograph

Appendix E March 2016 Topographic Survey, Digital Elevation Model Generation, and Cut-Fill Volume Calculations Data Report

CLE Engineering collected new topographic data at Point Buckler on March 2, 2016. This survey included points on the new levee, the new borrow ditch, the marsh plain interior and exterior to the new levee, the ramp to the water's edge on the west side of the island, the four excavated crescent basins, the water control structure, debris wrack lines along the bay water's edge exterior to the levee, and water surface elevations within the borrow ditch and in shallow test pits on the marsh interior. CLE produced a digital elevation model (DEM) from these data. CLE also calculated cut and fill quantities of the unpermitted work activities.

This appendix contains the data collection report prepared by CLE Engineering describing the methods and procedures used for the topographic survey, DEM development, and cut and fill volume calculations. Appendix F presents the topographic data and DEM. Cut and fill volumes are presented in Appendix K.

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Point Buckler
Topographic Surveys
Solano County, CA

Field Data Collection and Processing Procedures and Results

April 2016

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Siegel Environmental

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Services provided pursuant to this agreement are intended solely for the use and benefit of Siegel Environmental. No other person or entity shall be entitled to rely on the services, opinions, recommendations, plans or specifications provided pursuant to this agreement without the express written consent of CLE Engineering.

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Appendix A **NGS Control Point Sheets**
Appendix B **OPUS Solutions**
Appendix C **Cut / Fill Memo**
Appendix D **Scanned Field Notes**

List of Acronyms

Abbreviation	Definition
DEM	Digital Elevation Model
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NGS	National Geodetic Survey
NGS PID	National Geodetic Survey – Point Identification
OPUS	Online Positioning User Service
RTK-GPS	Real-Time Kinematic GPS
TIN	Triangulated Irregular Network
UTM	Universal Transverse Mercator

1. INTRODUCTION

1.1 PROJECT OVERVIEW

The Point Buckler project site is a ~40 acre tidal wetland island located in southern Grizzly Bay, just west of Simmons Island, Suisun Marsh, Solano County, California. The purpose of the survey was to support the local and federal investigation into alleged illegal earthmoving and other related activities on the subject property. (Figure 1).

CLE carried out three work tasks: topographic data collection, digital elevation model (DEM) generation, and cut-fill volume calculations. The topographic survey included establishment of a survey control network, collection of topographic data on the project site on March 2, 2016, and processing and quality assurance/quality control of the data. The DEM generation included using the field topographic data, breaklines established by CLE and Siegel Environmental, and utilization of computer software to generate the DEM. The cut-fill calculations were performed with computer software, calculating a difference between the "as built" topographic surface in the DEM and the "baseline" conditions defined by Siegel Environmental. This report outlines the methods, procedures, and results of these three work activities.

1.2 SURVEY PLANNING AND RECONNAISSANCE

Most of the project planning and reconnaissance was completed in the office using Google Earth imagery and conversations with individuals who have had firsthand knowledge and experience working in the area.

Based on site access issues that required a court-issued investigative warrant, the survey team was limited to one working day on the site to collect all site-specific survey data. In order to maximize data collection for that one day, we determined survey Day 1 would establish an off-site survey control network, and Day 2 would be the topographic survey on Point Buckler.

On Day 1 the survey team would establish two project control points on Simmons Island near the subject property for use during Real Time Kinematic-Global Positioning System (RTK-GPS) data collection operations on Day 2. These control points would be collected using Static GPS survey methods utilizing the National Geodetic Survey Online Positioning User Service (NGS - OPUS)[1] which enables the determination of survey-grade coordinates and elevations relative to the most current datum, the North American Datum of 1983, epoch 2010 (NAD83 (2011)) and the North American Vertical Datum of 1988 using Geoid 2012B (NAVD 88 (Geoid12B)). It was also requested that we work on the California State Plane coordinate system, Zone 3. For additional information about computed accuracies: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

[1] OPUS is an online application from the NGS which takes an uploaded GPS data file (RINEX format), processes it using three appropriate Continually Operated Reference Stations (CORS) and returns the location of the point in various reference frames. The web interface can be found here: http://www.ngs.noaa.gov/OPUS/

Background Image: Google 2014

Point Buckler
Condition Topographic Surveys
Location Map

March 2016

Figure 1

On day two we would set two RTK-GPS base stations on the two established control points and use 5 RTK-GPS rovers to collect all the necessary site topographic data.

Topographic data collection included points on the new levee, in the new borrow ditch, on the interior marsh surface, in the interior marsh "crescent" ponds, water surface elevations in the new borrow ditch and in soil tests pits excavated by others on the survey day, on the road between the levee and the water's edge, and on the tidal marsh and tidal remnant levee outboard of the new levee.

2. METHODS AND RESULTS

2.1 CONTROL SURVEY – DAY 1

On February 25, 2016 the field team conducted a final reconnaissance of the nearby survey control property and other logistically related areas. We identified several potential locations suitable for placing and occupying survey control and were able to recover a National Geodetic Survey (NGS) benchmark which was observable using Static GPS.

Survey control field work was conduct on March 1, 2016. Survey control consisted of installing and surveying two new control points established at the Rich Island Duck Club on Simmons Island, approximately 350 feet east of Point Buckler across Andy Mason Slough. After both control points were installed, each was surveyed with a GPS base station for two hours of static data collection then the base stations relocated to the other control point for an additional two hours of survey. By occupying both control points with both GPS base stations, we controlled for possible GPS base station differences.

- At 11:09 am we set a Trimble R10 base station (SN: 5412460030) on Control Point (CP)-1 (set 24" Rebar and plastic cap) to collect static data for an OPUS solution. This system collected data until 1:24 pm.

- At 11:54 am we set a Leica GX1230 base station (SN: 733245) on CP-2 (set 1"x2"x1' with tack) to collect static data for an OPUS solution. This receiver was programmed to collect static data as well as RTK data, which enables the survey team to utilize an RTK rover while the base station collected raw observation data. This system collected data until 2:15 pm.

- At approximately 12:30 pm we located NGS benchmark "GRIZ" (Attachment A). An RTK position and elevation were acquired as a check against published NAVD88 data.

- At 2:24 pm we set the Trimble R10 base station (SN: 5412460030) on CP2 to collect static data for an OPUS solution. This system collected data until 4:41 pm.

- At 2:51 pm we set the Leica GX1230 base station (SN: 733245) on CP1 to collect static data for an OPUS solution. This system collected data until 5:14pm.

All four static sessions were uploaded to OPUS for processing (OPUS solution sheets are located in Appendix B). We determined to utilize the OPUS solutions yielded from the Leica GX1230 for the following reasons: 1) We felt using solutions from just one system would provide the most continuity, 2) The OPUS solution from the LEICA provided the lowest overall root-mean-square error as compared to the Trimble solutions, 3) The check-in surveys on March 2, 2016 utilizing RTK-GPS supported the values obtained by the Leica base station. The RTK check-in data for each system is provided below.

2.2 TOPOGRAPHIC DATA COLLECTION – DAY 2

The morning of March 2, 2016, we set up the *Leica Viva* base station on CP1 to broadcast RTK corrections (RTCM V3) via a narrow band UHF to the RTK rover team. The *Leica GX1230* base station was set up on CP2 to broadcast via radio RTK corrections for one *Leica GX1230* rover. The Trimble R8 RTK rover was setup to receive corrections via cellular/bluetooth Networked Transport of RTCM via Internet Protocol (NTRIP). All five rovers and the survey crew were ferried by CLE boat to the subject property for the topographic survey. After all rovers were checked against the project control points, a common "job site" control point was identified on the island so all rovers could occupy this point before and after the survey work of the day as a final check.

The larger site data collection effort was broken down into specific tasks and each operator was given specific tasks with plans for contingencies.

While the topographic survey was being completed, various other persons from both private entities and public agencies were on the site to supervise, take other measurements and observations, verify safety, and to provide other support as needed.

2.3 SURVEY QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

Survey gear mobilization QA/QC procedures included measuring the rod height of each rover and checking it against the programmed rod height; as well as double checking the programming of each rover data collector (horizontal and vertical datums, horizontal coordinate system and geoid model). Notes of these activities were recorded in separate field books, one for each rover.

Survey point descriptions (top of bank, point on slope etc.) were standardized and digitized and loaded into each data collector. This facilitated more efficient data collection and smoother post-survey data management for developing the digital elevation modeling (DEM) (in terms of identifying break lines) and for Siegel Environmental to produce other topographic data products such as cross sections and profiles.

Since the survey consisted of collecting topographic data utilizing five RTK-GPS rovers, it was imperative that each rover checked into a common point on the survey site. This procedure ensured that each rover is calculating the same position and elevation within the project datums and coordinate system.

There were three control points that were checked into: 1) CP1 on nearby Simmons Island, 2) CP2 on nearby Simmons Island, and 3) the on-site temporary check-in point (TempCP – Figure 2). CP1 and CP2 were established on March 1, 2016 (described above). The TempCP was established as a metal nail head that attached a gate at the top of the dock gangway on Pt. Buckler (pointed to in photo below). Rover 1 checked into CP1, while Rovers 2 – 5 checked into CP2. All rovers checked into Temp PC. Table 3 shows the results of the check-in survey.

Background Image: Google 2014

Point Buckler
Condition Topographic Surveys
"TempCP" Check-In Point

March 2016

Figure 2

Table 3 – CP Check-in Results

GPS Rover	CP1				Onsite Temp CP Check In			
	Surveyed Northing	Surveyed Easting	Surveyed Elevation	Date / Time	Surveyed Northing	Surveyed Easting	Surveyed Elevation	Date / Time
Rover 1	2224585.53	6126442.68	9.16	3/2/2016 10:003	2224501.72	6126036.78	10.79	3/2/2016 11:10
Rover 1	2224585.58	6126442.62	9.22	3/2/2016 5:15	2224501.70	6126036.79	10.76	3/2/2016 4:14
	Reported Northing	Reported Easting	Reported Elevation	Date / Time	Reported Northing	Reported Easting	Reported Elevation	Date / Time
	2224585.57	6126442.64	9.24		2224501.72	6126036.78	10.79	
GPS Rover	CP2				Onsite Temp CP Check In			
	Surveyed Northing	Surveyed Easting	Surveyed Elevation	Date / Time	Surveyed Northing	Surveyed Easting	Surveyed Elevation	Date / Time
Rover 2	2222197.23	6130328.22	8.08	3/2/2016 11:06	2224501.74	6126036.72	10.81	3/2/2016 11:36
Rover 2	2222197.25	6130328.06	8.07	3/2/2016 16:57	2224501.67	6126036.74	10.84	3/2/2016 16:09
Rover 3	2222197.14	6130328.07	8.07	3/2/2016 11:05	2224501.76	6126036.70	10.83	3/2/2016 11:36
Rover 3	2222197.24	6130328.06	8.06	3/2/2016 16:58	2224501.80	6126036.74	10.80	3/2/2016 16:08
Rover 4	2222197.25	6130328.07	8.07	3/2/2016 11:06	2224501.74	6126036.70	10.83	3/2/2016 11:33
Rover 4	2222197.06	6130328.10	8.06	3/2/2016 16:56	2224501.80	6126036.74	10.77	3/2/2016 16:15
Rover 5	2222197.50	6130327.87	8.01	3/2/2016 11:01	2224502.04	6126036.55	10.70	3/2/2016 11:39
Rover 5	2222197.51	6130327.77	8.01	3/2/2016 16:58	2224502.04	6126036.55	10.75	3/2/2016 16:18
	Reported Northing	Reported Easting	Reported Elevation	Date / Time	Reported Northing	Reported Easting	Reported Elevation	Date / Time
	2222197.22	6130328.09	8.05		2224501.72	6126036.78	10.79	

2.4 POST PROCESSING AND DATA REDUCTION

All the rover data was downloaded from each data collector and assigned to a different sub-folder for each rover assignment (Rover 1 – 5). Each rover field book was also scanned and stored in the same sub-directory. Each downloaded data file was imported into *Leica Geo-Office* geospatial data processing software. Geoid separations were applied to the data (difference between the geoid and ellipsoid), and a point number, northing, easting, orthometric height value, and point quality number were assigned to each data point. All the RTK data was adjusted to the final iteration of control point data. A quality control review was completed of point numbers and codes. Processed data files were then exported to an ASCII-based file. All data was uploaded into AutoCAD for modeling. Figure 3 shows the final survey coverage.

Background Image: Google 2014

Point Buckler
Condition Topographic Surveys
Topographic Survey Coverage

March 2016

Figure 3

2.5 DIGITAL ELEVATION MODEL CONSTRUCTION

After all of the topographic data points were checked and edited, a subset of the full dataset containing only ground surface elevations was exported for use in creating the site digital elevation model (DEM). In addition to the topographic data points, Siegel Environmental provided top of bank breaklines for the new borrow ditch and toe of slope breaklines for the levee, which were digitized based on interpretation of the topographic survey data points and the February 10, 2016 aerial photograph of the site. The topographic data points and breaklines were imported into Autodesk Civil3D 2014. The CAD technician then created additional breaklines for the levee top of bank and centerline, the borrow ditch toe of slope and centerline, and the top of bank, toe of slope, and centerline for the marsh crescents. Internal marsh channels were ignored in the DEM due to the lack of data within them. The survey data points and breaklines were used to generate a preliminary surface by triangulated irregular network (TIN) interpolation. The resulting surface was exported to raster format for review and quality control by staff from CLE and Siegel Environmental that had familiarity with ground conditions on the project site. An iterative process of breakline editing, TIN interpolation, and review was undertaken until all major interpolation anomalies (identified as jagged contour lines) had been resolved and a satisfactory surface had been generated. The area of the internal marsh channels was then removed from the DEM based on polygons digitized from the February 10, 2016 aerial photograph (provided by Siegel Environmental) and the final DEM was exported in TIFF image format at a 0.5-foot resolution.

2.6 CUT AND FILL VOLUME CALCULATIONS

The volumes of cut and fill within the various constructed site features (borrow ditch, levee, levee road, marsh crescents, test trenches, etc.) were determined by comparing the site DEM to a "pre-site modification" surface. This pre-site modification surface was created from polygons provided by Siegel Environmental indicating where antecedent geomorphic features were converted to the various constructed features by excavation and fill activities. Siegel Environmental assigned each of these "cut/fill categories" an assumed pre-site modification elevation based on analysis of the topographic data, aerial photograph interpretation, review of existing information available on site vegetation, and the results of on-site inspections conducted on March 2, 2016. The CAD technician converted these polygons into CAD surfaces with the assigned elevations and sent them to Siegel Environmental staff for review and QA/QC. After approval of the pre-site modification surfaces, the cut and fill quantities were calculated by Mat Keenum (CAD Technician, CLE). The Siegel Environmental instructions to the CAD technician are located in Appendix C.

For areas where the new levee and new borrow ditch did not have a level surface between them, we had to determine the boundary of these cut and fill features. In these areas, the levee (outer) side of the new borrow ditch was defined by using the elevation at the top of the new borrow ditch on the marsh (interior) side and creating a boundary line at approximately the same elevation on the levee side of the new borrow ditch. In other words, a flat surface was extended across the new borrow ditch to establish its outer edge. A surface was then created using the described boundary lines as break lines.

Following completion of the “pre-site modification surface”, cut and fill quantities were calculated using Autodesk Civil3D 2014 by comparing the March 2, 2016 DEM to the pre-site modification surface.

Cut/fill quantities were calculated for the entire project site. In addition, cut/fill quantities for the new levee and new borrow ditch features were calculated for 10 construction time steps provided by Siegel Environmental. The pre-site modification surfaces were cut into sub-areas by time step polygons provided by Siegel Environmental. These time step polygons were created by aerial photograph analysis for the period of construction of the new levee and new borrow ditch.

APPENDIX A
NGS PID Sheets

The NGS Data Sheet

See file dsdata.txt for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 8.8
1         National Geodetic Survey,   Retrieval Date = FEBRUARY  4, 2016
 AH7472 ***********************************************************************
 AH7472  HT_MOD      -  This is a Height Modernization Survey Station.
 AH7472  FBN         -  This is a Federal Base Network Control Station.
 AH7472  TIDAL BM    -  This is a Tidal Bench Mark.
 AH7472  DESIGNATION -  941 5144 H TIDAL
 AH7472  PID         -  AH7472
 AH7472  STATE/COUNTY-  CA/CONTRA COSTA
 AH7472  COUNTRY     -  US
 AH7472  USGS QUAD   -  VINE HILL (1980)
 AH7472
 AH7472                        *CURRENT SURVEY CONTROL
 AH7472  ___________________________________________________________________
 AH7472* NAD 83(2011) POSITION- 38 03 18.94511(N) 122 02 18.38323(W)   ADJUSTED
 AH7472* NAD 83(2011) ELLIP HT-   -28.770 (meters)        (06/27/12)   ADJUSTED
 AH7472* NAD 83(2011) EPOCH   -  2010.00
 AH7472* NAVD 88 ORTHO HEIGHT -     3.40  (meters)       11.2   (feet) GPS OBS
 AH7472  ___________________________________________________________________
 AH7472  NAVD 88 orthometric height was determined with geoid model    GEOID03
 AH7472  GEOID HEIGHT    -        -32.159 (meters)                     GEOID03
 AH7472  GEOID HEIGHT    -        -32.144 (meters)                     GEOID12B
 AH7472  NAD 83(2011) X  - -2,667,627.258 (meters)                     COMP
 AH7472  NAD 83(2011) Y  - -4,262,729.550 (meters)                     COMP
 AH7472  NAD 83(2011) Z  -  3,910,258.050 (meters)                     COMP
 AH7472  LAPLACE CORR    -         -1.37  (seconds)                    DEFLEC12B
 AH7472
 AH7472  Network accuracy estimates per FGDC Geospatial Positioning Accuracy
 AH7472  Standards:
 AH7472         FGDC (95% conf, cm)     Standard deviation (cm)     CorrNE
 AH7472            Horiz  Ellip           SD_N   SD_E   SD_h      (unitless)
 AH7472  -------------------------------------------------------------------
 AH7472  NETWORK    0.55   0.84           0.23   0.22   0.43      0.02266335
 AH7472  -------------------------------------------------------------------
 AH7472  Click here for local accuracies and other accuracy information.
 AH7472
 AH7472
 AH7472.The horizontal coordinates were established by GPS observations
 AH7472.and adjusted by the National Geodetic Survey in June 2012.
 AH7472
 AH7472.NAD 83(2011) refers to NAD 83 coordinates where the reference
 AH7472.frame has been affixed to the stable North American tectonic plate. See
 AH7472.NA2011 for more information.
 AH7472
 AH7472.The horizontal coordinates are valid at the epoch date displayed above
 AH7472.which is a decimal equivalence of Year/Month/Day.
 AH7472
 AH7472.The orthometric height was determined by GPS observations and a
 AH7472.high-resolution geoid model using precise GPS observation and
 AH7472.processing techniques.
 AH7472
 AH7472.Significant digits in the geoid height do not necessarily reflect accuracy.
 AH7472.GEOID12B height accuracy estimate available here.
```

```
AH7472
AH7472.This Tidal Bench Mark is designated as VM 994
AH7472.by the CENTER FOR OPERATIONAL OCEANOGRAPHIC PRODUCTS AND SERVICES.
AH7472
AH7472.The X, Y, and Z were computed from the position and the ellipsoidal ht.
AH7472
AH7472.The Laplace correction was computed from DEFLEC12B derived deflections.
AH7472
AH7472.The ellipsoidal height was determined by GPS observations
AH7472.and is referenced to NAD 83.
AH7472
AH7472. The following values were computed from the NAD 83(2011) position.
AH7472
AH7472;                     North         East     Units Scale Factor Converg.
AH7472;SPC CA 3     -   673,716.109 1,864,990.257   MT  0.99994323   -0 56 30.8
AH7472;SPC CA 3     - 2,210,350.27  6,118,722.20   sFT  0.99994323   -0 56 30.8
AH7472;UTM  10      - 4,212,382.917   584,359.987   MT  0.99968765   +0 35 33.9
AH7472
AH7472!             -  Elev Factor  x  Scale Factor =   Combined Factor
AH7472!SPC CA 3     -   1.00000451  x   0.99994323  =   0.99994774
AH7472!UTM  10      -   1.00000451  x   0.99968765  =   0.99969216
AH7472
AH7472                          SUPERSEDED SURVEY CONTROL
AH7472
AH7472  NAD 83(2007)-  38 03 18.94464(N)    122 02 18.38110(W) AD(2007.00) 0
AH7472  ELLIP H (02/10/07)  -28.786  (m)                       GP(2007.00)
AH7472  NAD 83(1998)-  38 03 18.94229(N)    122 02 18.37949(W) AD(2002.86) B
AH7472  ELLIP H (10/28/05)  -28.764  (m)                       GP(2002.86) 4 1
AH7472  NAD 83(1998)-  38 03 18.94034(N)    122 02 18.37780(W) AD(1998.50) A
AH7472  ELLIP H (04/06/00)  -28.773  (m)                       GP(1998.50) 3 1
AH7472  NAVD 88 (04/06/00)    3.4    (m)  GEOID99 model used   GPS OBS
AH7472
AH7472.Superseded values are not recommended for survey control.
AH7472
AH7472.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
AH7472.See file dsdata.txt to determine how the superseded data were derived.
AH7472
AH7472_U.S. NATIONAL GRID SPATIAL ADDRESS: 10SEH8435912382(NAD 83)
AH7472
AH7472_MARKER: DB = BENCH MARK DISK
AH7472_SETTING: 59 = STAINLESS STEEL ROD IN SLEEVE (10 FT.+)
AH7472_STAMPING: 5144 H 1976
AH7472_MARK LOGO: NOS
AH7472_PROJECTION: FLUSH
AH7472_MAGNETIC: N = NO MAGNETIC MATERIAL
AH7472_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
AH7472_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
AH7472+SATELLITE: SATELLITE OBSERVATIONS - October 28, 2014
AH7472_ROD/PIPE-DEPTH: 10.0 meters
AH7472_SLEEVE-DEPTH  : 0.1 meters
AH7472
AH7472  HISTORY     - Date     Condition        Report By
AH7472  HISTORY     - 1976     MONUMENTED       NOS
AH7472  HISTORY     - 19970401 GOOD             NGS
AH7472  HISTORY     - 19980429 GOOD             NGS
AH7472  HISTORY     - 20021101 GOOD             CADWR
AH7472  HISTORY     - 20021105 GOOD             CADWR
AH7472  HISTORY     - 20141028 GOOD             BESTOR
AH7472
AH7472                          STATION DESCRIPTION
AH7472
AH7472'DESCRIBED BY NATIONAL GEODETIC SURVEY 1997
```

```
AH7472'RECOVERED IN GOOD CONDITION.
AH7472
AH7472                          STATION RECOVERY (1998)
AH7472
AH7472'RECOVERY NOTE BY NATIONAL GEODETIC SURVEY 1998 (CSM)
AH7472'THE STATION IS LOCATED NEAR THE SOUTH SIDE OF SUISUN BAY, ABOUT 8 KM
AH7472'(4.95 MI) NORTHEAST OF MARTINEZ, 9.6 KM (5.95 MI) NORTH-NORTHEAST OF
AH7472'CONCORD, 9.6 KM (5.95 MI) NORTHWEST OF WEST PITTSBURG, AT THE PORT
AH7472'CHICAGO CONCORD NAVAL WEAPONS STATION, NEAR THE INSHORE END OF THE TUG
AH7472'PIER, IN THE SOUTHEAST QUADRANT OF THE JUNCTION OF JOHNSON RD AND
AH7472'WHITE ROADS, IN A GRASS STRIP BETWEEN BUILDING A-16 AND A RAILROAD
AH7472'TRACK.  OWNERSHIP--U.S. NAVY.  TO REACH THE STATION FROM THE JUNCTION
AH7472'OF STATE HIGHWAY 4 AND PORT CHICAGO HIGHWAY, ABOUT 1.6 KM (1.00 MI)
AH7472'NORTHEAST OF THE JUNCTION OF INTERSTATE HIGHWAY 680, GO NORTH FOR 1.2
AH7472'KM (0.75 MI) ON PORT CHICAGO HIGHWAY TO A STOP SIGN. TURN RIGHT,
AH7472'SOUTHEAST FOR 0.16 KM (0.10 MI) TO A BUILDING AND A PARKING LOT ON THE
AH7472'RIGHT OF A GUARDHOUSE AND GATE.  CHECK IN AND GET A PASS.  FROM THE
AH7472'STOP SIGN ON PORT CHICAGO HIGHWAY, GO NORTH-NORTHWEST FOR 0.08 KM
AH7472'(0.05 MI), BEARING LEFT THROUGH A GUARDED GATE (CHECK IN) AND CONTINUE
AH7472'NORTH FOR 3.2 KM (2.00 MI) ON THE ROAD AND ALONG THE RAILROAD TRACKS
AH7472'UNTIL CROSSING A BRIDGE, BEAR LEFT AT A FORK ONTO JOHNSON ROAD.
AH7472'CONTINUE NORTHERLY FOR 0.96 KM (0.60 MI) ON THE ROAD TO THE JUNCTION
AH7472'OF WHITE RD AND THE STATION ON THE RIGHT, IN THE GRASS STRIP.  THE
AH7472'STATION IS A PUNCH MARK ON THE TOP CENTER OF A DISK CRIMPED TO THE TOP
AH7472'OF AN UNSPECIFIED ROD WITHOUT SLEEVE ABOUT FLUSH WITH GROUND, ENCASED
AH7472'IN A 4-INCH PVC PIPE WITH SCREW CAP PROJECTING 20 CM ABOVE GROUND.
AH7472'LOCATED ABOUT 97 M (318.2 FT) SOUTHEAST OF THE INSHORE END OF THE TUG
AH7472'PIER, 50.0 M (164.0 FT) EAST OF THE CENTER OF JOHNSON ROAD, 30.0 M
AH7472'(98.4 FT) WEST OF THE WESTERLY CORNER OF BUILDING A-16, 30.0 M (98.4
AH7472'FT) SOUTH OF THE CENTER OF WHITE ROAD, 27.0 M (88.6 FT) NORTHEAST OF
AH7472'THE NORTHEAST CORNER OF BUILDING A-14, 14.6 M (47.9 FT) NORTHEAST OF
AH7472'THE NEAR RAIL AND 1.4 M (4.6 FT) EAST OF A 4-INCH WOOD POST WITH
AH7472'WITNESS SIGN. NOTE--A LARGE PAIR OF CHANNEL-LOCKS OR PIPE WRENCH IS
AH7472'NEEDED TO REMOVE SCREW CAP.
AH7472
AH7472                          STATION RECOVERY (2002)
AH7472
AH7472'RECOVERY NOTE BY CA DEPT OF WATER RES 2002 (WLB)
AH7472'RECOVERED AS DESCRIBED.   THE STATION WAS OBSERVED AS PART OF THE DWR
AH7472'DELTA 2002 SUBSIDENCE NETWORK  HEIGHT MODERNIZATION SURVEY.
AH7472
AH7472                          STATION RECOVERY (2002)
AH7472
AH7472'RECOVERY NOTE BY CA DEPT OF WATER RES 2002 (WLB)
AH7472'RECOVERED AS DESCRIBED WITH THE FOLLOWING ADDITIONAL NOTES.
AH7472'PERMISSION MUST BE  OBTAINED FROM MILITARY TO ACCESS SITE. FROM THE
AH7472'FORK ONTO JOHNSON RD, CONTINUE NORTHERLY FOR 0.6 MI THE THE JUNCTION
AH7472'WITH  WHITE RD, JUST AFTER BUILDING A-14.  TURN RIGHT ON WHITE RD,
AH7472'CROSS THE RR TRACKS, AND  TURN RIGHT ON A GRAVEL TRACK, PAST POLE 1227
AH7472'ABOUT 85 FT, TO THE STATION ON THE LEFT.   BUILDING A-16 IS A
AH7472'CORRUGATED STEEL BLDG, BUILDING A-14 IS A WHITE CLAPBOARD BLDG.
AH7472'THERE IS AN UPWARD BULGE OF 1-2 MM IN THE DISK ABOUT 1/2-IN DIA THAT
AH7472'IS CENTERED AT THE  BOTTOM OF THE CIRCLE SURROUNDING THE CENTER PUNCH
AH7472'HOLE. THE STATION WAS OBSERVED AS PART OF THE DWR DELTA 2002
AH7472'SUBSIDENCE NETWORK  HEIGHT MODERNIZATION SURVEY.
AH7472
AH7472                          STATION RECOVERY (2014)
AH7472
AH7472'RECOVERY NOTE BY BESTOR ENGINEERS INCORPORATED 2014 (DT)
AH7472'RECOVERED IN GOOD CONDITION.

*** retrieval complete.
```

1 National Geodetic Survey, Retrieval Date = FEBRUARY 24, 2016

```
DH6896 ***********************************************************************
DH6896  HT_MOD      -  This is a Height Modernization Survey Station.
DH6896  DESIGNATION -  GRIZ
DH6896  PID         -  DH6896
DH6896  STATE/COUNTY-  CA/SOLANO
DH6896  COUNTRY     -  US
DH6896  USGS QUAD   -  HONKER BAY (1980)
DH6896
DH6896                      *CURRENT SURVEY CONTROL
DH6896  ___________________________________________________________________________
DH6896* NAD 83(2011) POSITION- 38 07 14.50310(N) 121 57 17.44253(W)   ADJUSTED
DH6896* NAD 83(2011) ELLIP HT-   -30.154 (meters)        (06/27/12)   ADJUSTED
DH6896* NAD 83(2011) EPOCH   -  2010.00
DH6896* NAVD 88 ORTHO HEIGHT -     2.03  (meters)        6.7   (feet) GPS OBS
DH6896  ___________________________________________________________________________
DH6896  NAVD 88 orthometric height was determined with geoid model    GEOID09
DH6896  GEOID HEIGHT    -        -32.190 (meters)                    GEOID09
DH6896  GEOID HEIGHT    -        -32.197 (meters)                    GEOID12B
DH6896  NAD 83(2011) X  - -2,659,033.334 (meters)                    COMP
DH6896  NAD 83(2011) Y  - -4,262,814.815 (meters)                    COMP
DH6896  NAD 83(2011) Z  -  3,915,973.553 (meters)                    COMP
DH6896  LAPLACE CORR    -         -0.69  (seconds)                   DEFLEC12B
DH6896
DH6896  Network accuracy estimates per FGDC Geospatial Positioning Accuracy
DH6896  Standards:
DH6896         FGDC (95% conf, cm)     Standard deviation (cm)     CorrNE
DH6896           Horiz  Ellip          SD_N   SD_E   SD_h      (unitless)
DH6896  ----------------------------------------------------------------
DH6896  NETWORK    0.39   0.55          0.18   0.13   0.28      0.14225333
DH6896  ----------------------------------------------------------------
DH6896  Click here for local accuracies and other accuracy information.
DH6896
DH6896.The horizontal coordinates were established by GPS observations
DH6896.and adjusted by the National Geodetic Survey in June 2012.
DH6896
DH6896.NAD 83(2011) refers to NAD 83 coordinates where the reference
DH6896.frame has been affixed to the stable North American tectonic plate. See
DH6896.NA2011 for more information.
DH6896
DH6896.The horizontal coordinates are valid at the epoch date displayed above
DH6896.which is a decimal equivalence of Year/Month/Day.
DH6896
DH6896.The orthometric height was determined by GPS observations and a
DH6896.high-resolution geoid model using precise GPS observation and
DH6896.processing techniques.
DH6896
DH6896.Significant digits in the geoid height do not necessarily reflect accuracy.
```

DH6896.GEOID12B height accuracy estimate available here.
DH6896
DH6896.The X, Y, and Z were computed from the position and the ellipsoidal ht.
DH6896
DH6896.The Laplace correction was computed from DEFLEC12B derived deflections.
DH6896
DH6896.The ellipsoidal height was determined by GPS observations
DH6896.and is referenced to NAD 83.
DH6896
DH6896. The following values were computed from the NAD 83(2011) position.
DH6896
DH6896; North East Units Scale Factor Converg.
DH6896;SPC CA 2 - 550,402.263 2,003,959.770 MT 1.00005500 +0 01 42.5
DH6896;SPC CA 2 - 1,805,778.09 6,574,658.01 sFT 1.00005500 +0 01 42.5
DH6896;UTM 10 - 4,219,722.399 591,612.428 MT 0.99970336 +0 38 42.9
DH6896
DH6896! - Elev Factor x Scale Factor = Combined Factor
DH6896!SPC CA 2 - 1.00000473 x 1.00005500 = 1.00005973
DH6896!UTM 10 - 1.00000473 x 0.99970336 = 0.99970809
DH6896
DH6896 SUPERSEDED SURVEY CONTROL
DH6896
DH6896 NAD 83(2007)- 38 07 14.50177(N) 121 57 17.44098(W) AD(2007.00) 0
DH6896 ELLIP H (02/10/07) -30.171 (m) GP(2007.00)
DH6896 NAD 83(1998)- 38 07 14.50052(N) 121 57 17.43927(W) AD(2002.86) 1
DH6896 ELLIP H (10/28/05) -30.152 (m) GP(2002.86) 4 1
DH6896 NAVD 88 (10/28/05) 2.07 (m) GEOID03 model used GPS OBS
DH6896
DH6896.Superseded values are not recommended for survey control.
DH6896
DH6896.NGS no longer adjusts projects to the NAD 27 or NGVD 29 datums.
DH6896.See file dsdata.txt to determine how the superseded data were derived.
DH6896
DH6896_U.S. NATIONAL GRID SPATIAL ADDRESS: 10SEH9161219722(NAD 83)
DH6896
DH6896_MARKER: DD = SURVEY DISK
DH6896_SETTING: 60 = ALUMINUM ALLOY ROD IN SLEEVE (10 FT.+)
DH6896_STAMPING: GRIZ 2001
DH6896_MARK LOGO: CADWR
DH6896_PROJECTION: FLUSH
DH6896_MAGNETIC: N = NO MAGNETIC MATERIAL
DH6896_STABILITY: B = PROBABLY HOLD POSITION/ELEVATION WELL
DH6896_SATELLITE: THE SITE LOCATION WAS REPORTED AS SUITABLE FOR
DH6896+SATELLITE: SATELLITE OBSERVATIONS - April 01, 2011
DH6896_ROD/PIPE-DEPTH: 8.5 meters
DH6896_SLEEVE-DEPTH : 1.2 meters
DH6896
DH6896 HISTORY - Date Condition Report By

DH6896 HISTORY - 20010505 MONUMENTED CADWR
DH6896 HISTORY - 20021203 GOOD CADWR
DH6896 HISTORY - 20110401 GOOD CADWR
DH6896
DH6896 STATION DESCRIPTION
DH6896
DH6896'DESCRIBED BY CA DEPT OF WATER RES 2002 (WLB)
DH6896'THE STATION IS IN ABOUT THE CENTER OF GRIZZLY ISLAND, IN THE
DH6896'SACRAMENTO-SAN JOAQUIN DELTA, ABOUT 8 MI STRAIGHTLINE SOUTHEAST OF
DH6896'THE CITY OF FAIRFIELD. TO REACH THE STATION FROM, SOUTHEAST OF
DH6896'FAIRFIELD, THE INTERSECTION OF STATE HWY 12 AND GRIZZLY ISLAND RD, A
DH6896'SIDE ROAD SOUTH, TURN SOUTH ON GRIZZLY ISLAND RD. DRIVE SOUTH 5.5 MI
DH6896'TO MONTEZUMA SLOUGH BRIDGE. PROCEED ACROSS BRIDGE (SETTING OF HT MOD
DH6896'STATION MONTEZUMA GPS, PID AE7865), AND DRIVE SOUTHEASTERLY AND
DH6896'SOUTHERLY 3.6 MI TO THE CA FISH AND GAME HEADQUARTERS COMPLEX ON THE
DH6896'LEFT. TURN RIGHT AND DRIVE 2.4 MI TO THE HUNTERS CHECK-IN STATION,
DH6896'CONTINUE ON GRAVEL LEVEE ROAD 1.75 MI TO A DIRT FIELD ROAD. TURN RIGHT
DH6896'ON THE FIELD ROAD AND WHEN IT SPLITS TO BOTH SIDES OF A DRAINAGE
DH6896'DITCH, TAKE THE RIGHT HAND ROAD AND DRIVE 0.1 MI TO A YELLOW PIPE
DH6896'GATE AND THE STATION ON THE RIGHT. THE MARK IS A 2.5-IN-DIA DWR DISK
DH6896'ON A 5/8-IN COPPER CLAD ROD. THE MARK IS 13 FT NORTHEAST OF THE
DH6896'NORTHWESTERLY END OF THE PIPE GATEPOST, 3.5 FT FROM THE SOUTHEASTERLY
DH6896'END, 6 FT FROM THE CENTER OF A LARGE ANISE BUSH, 3 FT FROM THE TOE OF
DH6896'A SPOIL PILE, ABOUT 25 FT WEST OF THE WEST EDGE OF A NORTH-SOUTH
DH6896'GRAVEL RD, AND ABOUT 10 FT NORTH OF THE NORTH EDGE OF AN EAST-WEST
DH6896'GRAVEL RD. THE STATION WAS OBSERVED AS PART OF THE DWR DELTA 2002
DH6896'SUBSIDENCE NETWORK HEIGHT MODERNIZATION SURVEY.
DH6896
DH6896 STATION RECOVERY (2011)
DH6896
DH6896'RECOVERY NOTE BY CA DEPT OF WATER RES 2011 (GS)
DH6896'RECOVERED AS DESCRIBED.

APPENDIX B
OPUS Solutions

CP1 - LEICA NGS OPUS SOLUTION REPORT
==========

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: pls8526@gmail.com DATE: March 04, 2016
RINEX FILE: cp1_056w.16o TIME: 00:22:19 UTC

SOFTWARE: page5 1209.04 master51.pl 022814 START: 2016/02/25 22:51:00
EPHEMERIS: igr18854.eph [rapid] STOP: 2016/02/26 01:14:00
NAV FILE: brdc0560.16n OBS USED: 5680 / 5962 : 95%
ANT NAME: LEIAX1202GG NONE # FIXED AMB: 35 / 35 : 100%
ARP HEIGHT: 1.584 OVERALL RMS: 0.010(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2016.1530)

X:	-2664260.681(m)	0.012(m)	-2664261.599(m)	0.012(m)
Y:	-4261651.000(m)	0.019(m)	-4261649.655(m)	0.019(m)
Z:	3913703.216(m)	0.014(m)	3913703.198(m)	0.014(m)

LAT:	38 5 40.90285	0.019(m)	38 5 40.91547	0.019(m)
E LON:	237 59 15.25657	0.003(m)	237 59 15.19536	0.003(m)
W LON:	122 0 44.74343	0.003(m)	122 0 44.80464	0.003(m)
EL HGT:	-29.371(m)	0.019(m)	-29.897(m)	0.019(m)
ORTHO HGT:	2.816(m)	0.040(m) [NAVD88 (Computed using GEOID12B)]		

	UTM COORDINATES UTM (Zone 10)	STATE PLANE COORDINATES SPC (0403 CA 3)
Northing (Y) [meters]	4216782.201	678055.038
Easting (X) [meters]	586595.540	1867343.452
Convergence [degrees]	0.60933279	-0.92595733
Point Scale	0.99969235	0.99994712
Combined Factor	0.99969696	0.99995173

US NATIONAL GRID DESIGNATOR: 10SEH8659516782(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DH3879	P224 SIBLEYVOLCCN2005 CORS ARP	N375150.014	W1221308.563	31401.5
DN7574	P267 DIXONAVIATCN2005 CORS ARP	N382249.194	W1214923.591	35772.2
DG8210	P261 HUNTERHILLCN2004 CORS ARP	N380910.643	W1221303.088	19111.9

NEAREST NGS PUBLISHED CONTROL POINT

JT2077	POINT BUCKLER WINDMILL	N380548.679	W1220047.490	249.6

CP1 - TRIMBLE NGS OPUS SOLUTION REPORT
==========

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: pls8526@gmail.com DATE: March 04, 2016
RINEX FILE: r10_056t.16o TIME: 00:24:37 UTC

SOFTWARE: page5 1209.04 master52.pl 022814 START: 2016/02/25 19:09:00
EPHEMERIS: igr18854.eph [rapid] STOP: 2016/02/25 21:24:30
NAV FILE: brdc0560.16n OBS USED: 5039 / 5125 : 98%
ANT NAME: TRMR10 NONE # FIXED AMB: 29 / 31 : 94%
ARP HEIGHT: 1.724 OVERALL RMS: 0.014(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2016.1526)

X:	-2664260.695(m)	0.007(m)	-2664261.613(m)	0.007(m)
Y:	-4261651.010(m)	0.015(m)	-4261649.665(m)	0.015(m)
Z:	3913703.226(m)	0.015(m)	3913703.208(m)	0.015(m)

LAT:	38 5 40.90279	0.006(m)	38 5 40.91541	0.006(m)
E LON:	237 59 15.25630	0.002(m)	237 59 15.19509	0.002(m)
W LON:	122 0 44.74370	0.002(m)	122 0 44.80491	0.002(m)
EL HGT:	-29.352(m)	0.022(m)	-29.878(m)	0.022(m)
ORTHO HGT:	2.835(m)	0.044(m) [NAVD88 (Computed using GEOID12B)]		

	UTM COORDINATES UTM (Zone 10)	STATE PLANE COORDINATES SPC (0403 CA 3)
Northing (Y) [meters]	4216782.199	678055.036
Easting (X) [meters]	586595.534	1867343.446
Convergence [degrees]	0.60933274	-0.92595737
Point Scale	0.99969235	0.99994712
Combined Factor	0.99969695	0.99995173

US NATIONAL GRID DESIGNATOR: 10SEH8659516782(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DN7574	P267 DIXONAVIATCN2005 CORS ARP	N382249.194	W1214923.591	35772.2
DH3879	P224 SIBLEYVOLCCN2005 CORS ARP	N375150.014	W1221308.563	31401.5
DO2386	BRIB BRIONES RESERVOIR CORS ARP	N375509.846	W1220909.139	23023.7

NEAREST NGS PUBLISHED CONTROL POINT

JT2077	POINT BUCKLER WINDMILL	N380548.679	W1220047.490	249.6

CP2 - LEICA NGS OPUS SOLUTION REPORT
==========

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: pls8526@gmail.com DATE: March 04, 2016
RINEX FILE: cp2_056t.16o TIME: 00:23:06 UTC

SOFTWARE: page5 1209.04 master53.pl 022814 START: 2016/02/25 19:54:00
EPHEMERIS: igr18854.eph [rapid] STOP: 2016/02/25 22:15:00
NAV FILE: brdc0560.16n OBS USED: 5364 / 5618 : 95%
ANT NAME: LEIAX1202GG NONE # FIXED AMB: 36 / 36 : 100%
ARP HEIGHT: 1.514 OVERALL RMS: 0.013(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2016.1527)

X:	-2663478.182(m)	0.020(m)	-2663479.100(m)	0.020(m)
Y:	-4262655.424(m)	0.012(m)	-4262654.080(m)	0.012(m)
Z:	3913145.101(m)	0.016(m)	3913145.081(m)	0.016(m)

LAT:	38 5 17.91238	0.017(m)	38 5 17.92494	0.017(m)
E LON:	238 0 4.33447	0.015(m)	238 0 4.27330	0.015(m)
W LON:	121 59 55.66553	0.015(m)	121 59 55.72670	0.015(m)
EL HGT:	-29.735(m)	0.014(m)	-30.262(m)	0.014(m)
ORTHO HGT:	2.456(m)	0.032(m) [NAVD88 (Computed using GEOID12B)]		

	UTM COORDINATES UTM (Zone 10)	STATE PLANE COORDINATES SPC (0403 CA 3)
Northing (Y) [meters]	4216086.398	677327.067
Easting (X) [meters]	587798.602	1868527.740
Convergence [degrees]	0.61765745	-0.91761092
Point Scale	0.99969494	0.99994645
Combined Factor	0.99969960	0.99995112

US NATIONAL GRID DESIGNATOR: 10SEH8779816086(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DO2386	BRIB BRIONES RESERVOIR CORS ARP	N375509.846	W1220909.139	23106.8
DH3882	P230 MORGANTRTYCN2005 CORS ARP	N374908.258	W1214710.986	35254.5
DH3879	P224 SIBLEYVOLCCN2005 CORS ARP	N375150.014	W1221308.563	31546.7

NEAREST NGS PUBLISHED CONTROL POINT

JT2079	RYER ISLAND EAST TREE	N380521.390	W1220055.012	1448.3

CP2 - TRIMBLE NGS OPUS SOLUTION REPORT
==========

All computed coordinate accuracies are listed as peak-to-peak values.
For additional information: http://www.ngs.noaa.gov/OPUS/about.jsp#accuracy

USER: pls8526@gmail.com DATE: March 04, 2016
RINEX FILE: r10_056w.16o TIME: 00:24:59 UTC

SOFTWARE: page5 1209.04 master90.pl 022814 START: 2016/02/25 22:25:00
EPHEMERIS: igr18854.eph [rapid] STOP: 2016/02/26 00:40:30
NAV FILE: brdc0560.16n OBS USED: 5428 / 5531 : 98%
ANT NAME: TRMR10 NONE # FIXED AMB: 32 / 34 : 94%
ARP HEIGHT: 1.653 OVERALL RMS: 0.014(m)

REF FRAME: NAD_83(2011)(EPOCH:2010.0000) IGS08 (EPOCH:2016.1530)

X:	-2663478.218(m)	0.023(m)	-2663479.136(m)	0.023(m)
Y:	-4262655.458(m)	0.006(m)	-4262654.114(m)	0.006(m)
Z:	3913145.143(m)	0.011(m)	3913145.123(m)	0.011(m)

LAT:	38 5 17.91249	0.015(m)	38 5 17.92505	0.015(m)
E LON:	238 0 4.33396	0.019(m)	238 0 4.27278	0.019(m)
W LON:	121 59 55.66604	0.019(m)	121 59 55.72722	0.019(m)
EL HGT:	-29.672(m)	0.008(m)	-30.198(m)	0.008(m)
ORTHO HGT:	2.519(m)	0.026(m) [NAVD88 (Computed using GEOID12B)]		

	UTM COORDINATES UTM (Zone 10)	STATE PLANE COORDINATES SPC (0403 CA 3)
Northing (Y) [meters]	4216086.402	677327.071
Easting (X) [meters]	587798.589	1868527.727
Convergence [degrees]	0.61765737	-0.91761101
Point Scale	0.99969494	0.99994645
Combined Factor	0.99969959	0.99995111

US NATIONAL GRID DESIGNATOR: 10SEH8779816086(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DH3879	P224 SIBLEYVOLCCN2005 CORS ARP	N375150.014	W1221308.563	31546.7
DH3882	P230 MORGANTRTYCN2005 CORS ARP	N374908.258	W1214710.986	35254.5
DO2386	BRIB BRIONES RESERVOIR CORS ARP	N375509.846	W1220909.139	23106.8

NEAREST NGS PUBLISHED CONTROL POINT

JT2079	RYER ISLAND EAST TREE	N380521.390	W1220055.012	1448.3

APPENDIX C

Cut / Fill Technical Memo to CLE Engineering

MEMORANDUM

To: James Kulpa, CLE Engineering, Inc.
From: Stuart Siegel
Date: April 26, 2016
Re: Instructions for Cut-Fill Volume Calculations for, Point Buckler, Solano County, California

Siegel Environmental has requested CLE Engineering to prepare cut and fill volume calculations for Point Buckler, to compare the in-place volumetric differences between the topographic surface developed from the March 2, 2016 field topographic data collected by CLE at Point Buckler and the "baseline" topographic surface.

This memorandum provides our instructions on establishing the baseline surface and describes the breakdown of the cut-fill volume calculations we need.

Baseline Surface Determination

The baseline surface determination is spilt between areas with and without active construction activities.

Areas without visible evidence of excavation and fill activities

- **Applies to** most of the interior of the island, interior to the new levee and borrow ditch and to any areas exterior to the new levee and within the boundary of the Digital Elevation Model developed from newly created from the March 2, 2016 topographic survey data.
- **Excludes** within the island interior the excavated marsh "crescents" and the fill placement of the spoils from that excavation work.
- **Baseline surface** = surface established from the March 2, 2016 topographic survey.

Areas with visible evidence of excavation and fill activities

- **Applies to** footprints of the new levee, new borrow ditch, new finger road to the water's edge, marsh "crescents", spoils placed near the marsh crescents, and west borrow ditch crossing.
- **Baseline surface** – Table 1 provides elevations to use for establishing the baseline surface. Refer to attached Figures K-1 and K-2 for the locations of these areas, for your reference, and Figure F-10 for the remnant levee elevations.

637 Lindaro Street, Suite 201, San Rafael, CA 94901
415.299.8746 • www.swampthing.org

Table 1. Baseline Elevations to Use in Areas of Land Disturbance

Area		Location	Elevation (ft NAVD88)	Elevation Basis
1	Remnant levee east side where upland conditions persisted	Intersection of upland vegetation from the California Department of Fish and Wildlife 2012 Suisun Marsh vegetation dataset and the remnant levee footprint established from the 1985 aerial photographs	8.21	just above the local High Tide Line, to reflect conditions supporting mapped upland vegetation
2	Remnant levee remainder of site, supporting tidal marsh	Established by comparing the 1985 and 2011 aerial photographs.	6.42	Assumed 1 ft above average interior tidal marsh elevation. Six data points were later determined to be on the remnant levee and had an average elevation of 5.71 ft. Using the higher value results in lower fill volumes.
3	Tidal marsh outboard of the new levee	Western "road" from the levee to the water's edge, established from the February 10, 2016 aerial photograph	5.58	average elevation of the outboard marsh from the March 2, 2016 topographic survey
4	Tidal marsh underneath and interior to the new levee	Established by comparing the 1985 and 2011 aerial photographs.	5.42	average elevation of the outboard marsh from the March 2, 2016 topographic survey
5	West borrow ditch crossing	Established from the 2015 and 2016 aerial photographs	Varies	Width and depth of new borrow ditch on either side of crossing
6	Tidal marsh channels	Established from the 2011 aerial photographs	1.93	Channel invert near Breach 7
7	Tidal remnant borrow ditch[1]	Established from the 2011 aerial photographs	A) 5.42 B) 1.93	A) Assumes no borrow ditch B) Assumes borrow ditch invert same as tidal channels

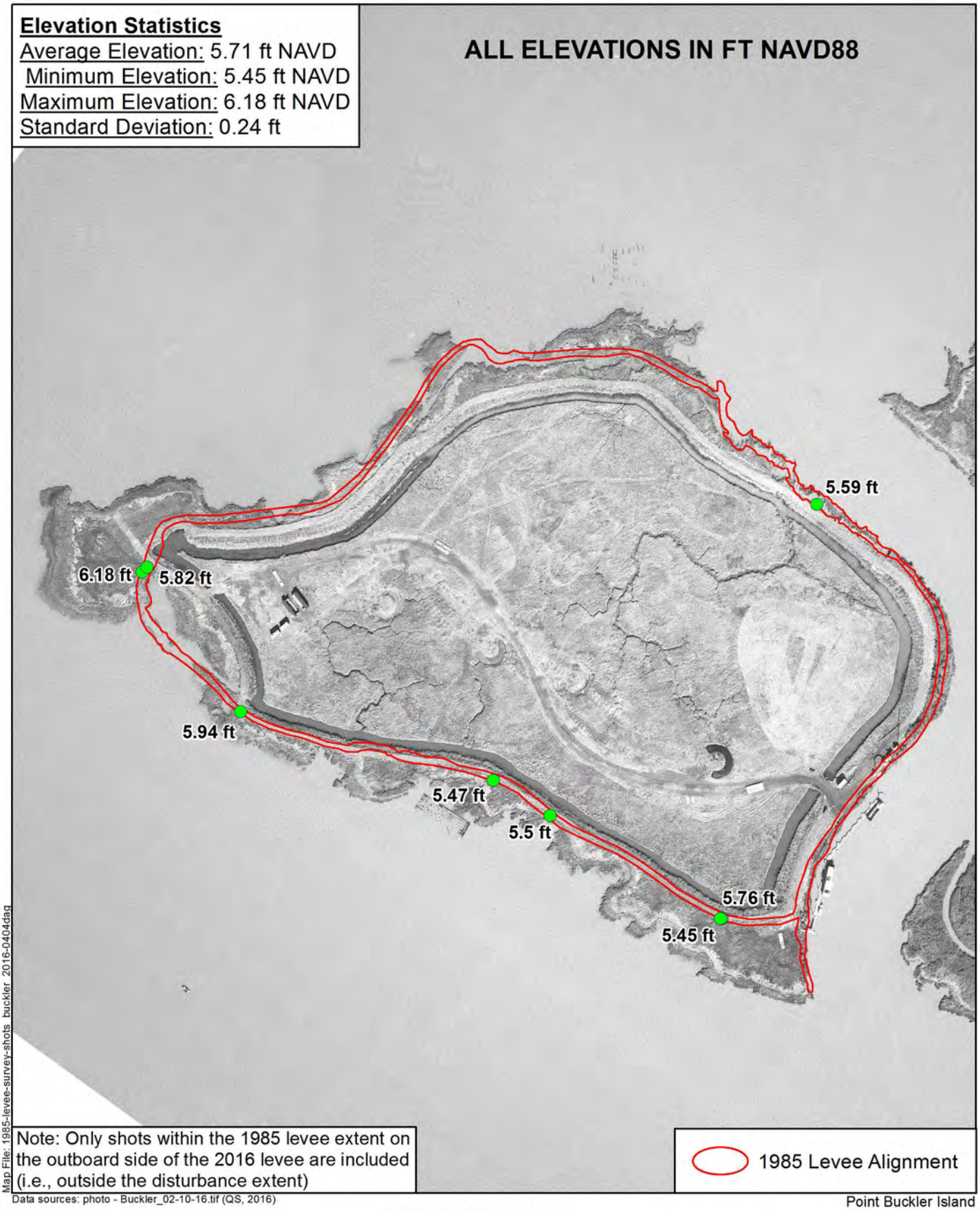
Notes:

1) *Data on depths of remnant borrow ditch not available, so two assumptions made for volume calculations, one that no borrow ditch was present (marsh plain elevation) and second that borrow ditch invert same as that of the larger tidal channels surveyed on March 2, 2016.*

"In-Place" Cut and Fill Polygons

To establish the polygons for CLE Engineering to use for the in-place cut and fill volume calculations, we undertook the following steps:

- Overlaid the 2016 constructed features GIS layer on the 2011 geomorphology layer to generate the intersection of built (2016) features and baseline (2011) geomorphology. This provided the cut-fill category polygons.
- Converted the cut-fill category polygons to CAD data and sent to CLE to use as data input to the CAD calculation process.
- CLE provided Siegel Environmental with CAD surfaces from these polygons and assigned them the elevations as dictated in the instructions, for review and verification before performing the calculations.
- For the time steps corresponding to levee and borrow ditch construction during 2014, Siegel Environmental used the series of 2014 aerial photographs to establish the time steps and to determine the construction progress at each time step. The levee and borrow ditch footprint was divided into sub-areas corresponding to these time steps and these polygons were exported to CAD for CLE to bound cut-fill calculations for each time step.



Map File: 1985-levee-survey-shots_buckler_2016-0404dag

Data sources: photo - Buckler_02-10-16.tif (QS, 2016)

1:3,600 (1" = 300' at letter size)

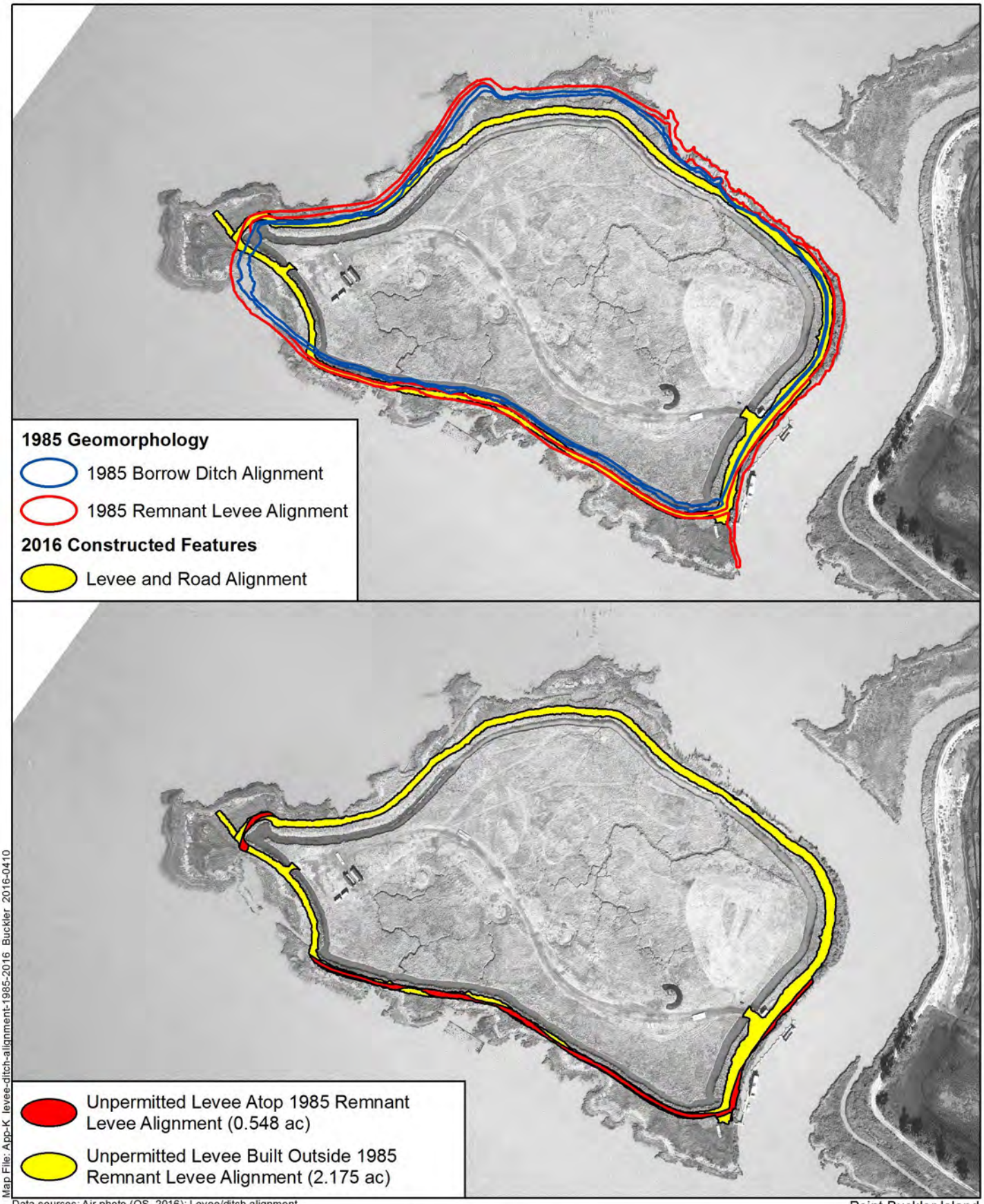
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-10

March 2, 2016 Elevations of 1985 Remnant Levee



Map File: App-K_levee-ditch-alignment-1985-2016_Buckler_2016-0410

Data sources: Air photo (QS, 2016); Levee/ditch alignment (SE, 2016)

1:4,800 (1" = 400' at letter size)

0 200 400 ft

0 60 120 m

Point Buckler Island
Solano County, CA

Figure K-1

Unpermitted New Levee in Relation to 1985 Levee and Borrow Ditch

Base air photo: (Quantum Spatial) February 10, 2016

Tidal Wetland and Waters Fill for Levee

- 1 Old Wetland Levee to Levee (0.457 ac)
- 2 Marsh Plain to Levee (1.911 ac)
- 3 Remnant Ditch to Levee (0.140 ac)
- 4 Marsh Channel to Levee (0.017 ac)
- 5a Marsh Plain to Ditch to Levee (0.030 ac)

Tidal Wetland Fill for Other

- 5b Marsh Plain to Ditch to Crossing (0.009 ac)
- 5c Marsh Plain to Crossing (0.034 ac)
- 6 Marsh Plain to Trench Spoils (0.262 ac) / Crescent Spoils (0.164 ac)
- 7 Marsh Plain to Ramp (0.038 ac)

[1]Terrestrial levee extent based on CA Dept. of Fish and Wildlife 2012 vegetation mapping

Tidal Wetland and Waters Cut

- 8 Marsh Plain to Borrow Ditch (2.374 ac)
- 9 Remnant Ditch to Borrow Ditch (0.190 ac) / Trench (0.007 ac)
- 10 Old Wetland Levee to Borrow Ditch (0.019 ac)
- 11 Marsh Channel to Borrow Ditch (0.034 ac) / Crescent (0.019 ac)
- 12 Marsh Plain to Crescent (0.208 ac)
- 13 Marsh Plain to Trench (0.075 ac)

Fill in Non-Jurisdictional Areas

- Remnant Terrestrial Levee to Levee[1] (0.092 ac)

2016 DEM Boundary - areas falling outside boundary not included in cut/fill calculations

Map File: App-K cut-fill-conversions Buckler 2016-0511

Data sources: Air photo (QS, 2016); Cut-fill areas (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-2

Unpermitted Cut and Fill Earthwork In Relation to 2011 Conditions

Base air photo: (Quantum Spatial) February 10, 2016

APPENDIX D
Scanned Field Notes

BUCKLER TOPO

π JUSTIN DANKEL, PLS TERRASCRIBE
π DARREN GENWANT CLE
π JIMMY KULPA CLE
π KYLE BERGER CLE
π SKYLER HURLEY CLE

TOPOGRAPHIC SURVEY OF BUCKLER ISLAND, PROJECT DIVIDED INTO THREE TASKS:

1 - ESTABLISH HIGH ORDER CONTROL
2 - CONDUCT TOPO SURVEY
3 - REDUCE DATA & REPORT

EQUIPTMENT USED:

(1) TRIMBLE R10 (SN: 5412460030) TRIBRACH SECO (SN: T1-01)
(1) LEICA: GX1230: 733245 LEICA: GDF122 SN: 667307
(1) LEICA: AS10 SN 770701
(3) LEICA VIVA
(1) TRIMBLE R10

BUCKLER TOPO

PT 1

SET 3/8" x 2' RB & YELLOW CAP @ W'LY EDGE OF ROAD
TOOK PICTURES
SET UP TRIMBLE FOR STATIC SURVEY
*HI = 5.49 FT 1.674 m ✓ @ BEGIN
*HI = 5.49 FT 1.674 m ✓ @ END
TIME START 11:09 AM
TIME END 1:24 PM

WEATHER CLEAR 70°
LIGHT WIND FROM N

*HI HAD BEEN MEASURED TO BOTTOM OF QUICK RELEASE, 0.164 FT (0.050m) WAS ADDED TO HI FOR PT1 & PT2
HI = 5.65' FT, 1.724 m ✓
FOR OPUS PROCESSING

 2/25/16

BUCKLER TOPO

PT 2 OR CP2

SET 1"X2"X1' W/ TACK FLUSH

TOOK PICTURES

SET UP LEICA FOR STATIC SURVEY

HI= 3.79' 1.154m ✓ @ BEGIN

HI= 3.79 1.154 m ✓ @ END

TIME START: 11:54 AM

TIME END : 2:15 PM

WEATHER: SAME

BROADCASTING FOR RTK SURVEY

SET UP PAC CREST RADIO W/ANT.

 2/25/16

BUCKLER

FD NGS "GRIZ" - DH6896

2" "CA WTR RES. GRIZ 2001"

PN 2" INCASED IN 8" PVC

WITNES 2" SLY

Rite in the Rain

 2/25/16

BUCKLER

PT 2

SET 1"X2"X1' W/ TACK FLUSH

SET UP TRIMBLE FOR STATIC

*HI = 5.26 FT 1.603M @ BEGIN

*HI = 5.26 FT 1.603M ✓ @ END

TIME START: 2:24 PM

TIME END: 4:41 PM

WEATHER SAME

* HI HAD BEEN MEASURED TO BOTTOM OF QUICK RELEASE. 0.164 FT (0.050 M) WAS ADDED TO HI FOR PT1 & PZ

HI = 5.42 FT, 1.653 M

FOR OPUS PROCESSING

Scale: 1 square = _____

 2/25/16

BUCKLER

PT 1

SET 3/8" X2' RB & CAP, YELLOW @ W'LY EDGE OF ROAD

SET UP LEICA FOR STATIC

HI = 4.00 FT 1.224 m ✓ @ BEGIN

HI = 4.00 FT 1.223 m ✓ @ END

TIME START: 2:51 PM

TIME END: 5:14 PM

WEATHER SAME

3/1/16

~~ALL STATIC OBS FILES SENT INTO OPUS FOR PROCESSING.~~

~~*HOLDING LEICA POSITIONS 1&2 FOR HORIZONTAL. ADJUSTING TO FD BM GRIZ FOR VERTICAL~~

~~P, N, E, EL, DESC CAZZ, USSF~~

~~1, 2222197.22, 6126442.64, 9.46, RB~~

~~2, 2222197.22, 6130328.09, 834, 1X2~~

~~3, 2233789.52, 6143159.11, 6.7, FD BM~~

~~1, 2224585.57, 6126442.64, 9.46, RB CAP~~

Scale: 1 square = _____

Rite in the Rain

TRIMBLE CHECK (RTK)

CP.2 7.90

CP.1 9.09

SETUP LEICA BASE (VIVA) @ CP1

3.86 FT 1.177 M

BROADCASTING RTK @ 10:15

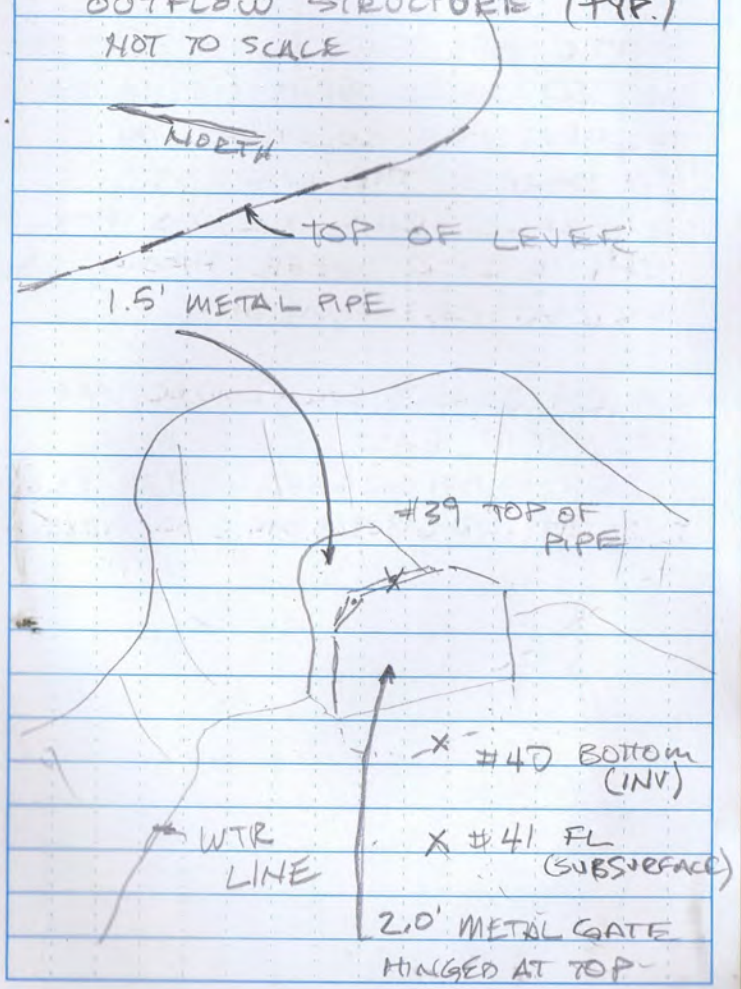
(3) LEICA VIVA RTK ROVERS TO COLLECT ~~RTK~~ TOPO DATA

(1) TRIMBLE R8 RTK ROVER TO COLLECT TOPO DATA

END OF SURVEY. CHECKS INTO CP1 & CP2 MADE. HI CHECKS WERE DONE. GEAR CLEANED & STORED AWAY.

FREQ
461.075

ISOMETRIC SKETCH OF OUTFLOW STRUCTURE (TYP.)
NOT TO SCALE



Rite in the Rain

 3/4/16

BUCKLER

STATIC OBS. FOR BOTH R10 & GX1230 WERE SENT (UPLOADED) TO OPUS FOR SOLUTIONS IN CA ZONE 3. THE LOWEST OVERALL RMS VALUES FOR CP1 & CP2 WERE FROM THE GX1230 OBSERVATIONS

NAD83, CA ZONE 3, EPOCH 2010.00, USSF
P#, NORTH, EAST, ELEV, DESC
1, 2224585.571, 6126442.649, 9.24, RB CAP
2, 2222197.218, 6130328.094, 8.06, 1X2X12

Appendix F March 2016 Topographic Survey Findings

F-1.0 Introduction

CLE Engineering collected topographic survey data on March 2, 2016 (see Appendix E for the full data report describing methods and procedures). This appendix presents these data in maps and plots:

- Figure F-1 to Figure F-6 show the location of survey points by point type with elevation statistics.
- Figure F-7 and Figure F-8 show the locations and data plots of the new levee and new borrow and drainage ditch.
- Figure F-9 and Figure F-10 show locations and data plots of the marsh plain transects.
- The digital elevation model developed from these data is shown in Figure F-11 with the data grouped by elevation associated with tidal datums, and Figure F-12 with the data shown with a mix of one- and half-foot contour intervals.
- Figure F-13 summarizes interior tidal marsh plain elevations in relation to tidal datums and the daily tides at the nearby Port Chicago station from October 1, 2015 (beginning of the current California Water Year) to March 10, 2016.
- Table F-1 provides summary statistics of each of the surveyed features identified in Figure F-1.

F-2.0 Key Findings

F-2.1 Interior Tidal Marsh Is at Intertidal Elevations and Thus Was Regularly Inundated by the Tides Prior to New Levee Construction.

A vast majority of the now-diked tidal marsh elevation is at and below local Mean High Water (MHW) (see Figure F-9, Figure F-11, and Figure F-13), directly supporting the conclusion that the site interior was tidal marsh, not uplands, prior to construction of the new levee that cut off channel and overland tidal flows. The average elevation of the interior tidal marsh surface is 5.43 ft NAVD88 (Table F-1), about 0.4 feet below the 5.81 ft NAVD88 elevation of local MHW (Table I-1). The highest elevation surveyed on the interior tidal marsh surface, located on the graded path across the interior, was 6.43 ft NAVD88 or about 0.1 ft above local Mean Higher High Water (MHHW) of 6.31 ft NAVD88. The lowest surveyed elevation of the tidal marsh surface was 4.21 ft NAVD88, about half a foot above Mean Tide Level of 3.66 ft NAVD88 (Table I-1).

F-2.2 Tidal Remnant Levees Are at Intertidal Elevations and Thus Allowed Overland Tidal Flows to the Interior Tidal Marsh

There are sections of the remnant levee last maintained in 1985 that are still present on the site today. The southern portion of the new levee was built mostly within the alignment of the remnant levee, and the remainder of the new levee was built mostly to the interior side of the remnant levee. About three quarters of the remnant levee length (3,385 feet) had long ago subsided and eroded below its originally

constructed heights and now are at intertidal elevations (Figure G-21). These reaches were determined from the CDFW 2012 Suisun Marsh vegetation data set that identified the eastern remnant levee as terrestrial vegetation (Figure H-2), which we have assumed translates to higher elevations. Six elevation points were measured on the tidal reaches of the remnant levee (Figure F-6). Surveyed elevations ranged from 5.45 to 6.18 ft NAVD88, with an average elevation of 5.71 ft NAVD88 (Table F-1), all below local MHHW and on average below local MHW. Prior to new levee construction, many high tides would have flowed over the tidal remnant levee to the interior tidal marsh. Based on reviewing the 19-year record of high tides at nearby Port Chicago, about 50 percent of high tides would have overtopped the tidal remnant levee (Figure I-2(C)).

F-2.3 Debris Wrack Line Elevations Help to Establish the High Tide Line

The debris wrack lines are used in Appendix I to help establish local High Tide Line (HTL). Twenty-four debris wrack line points were surveyed on Point Buckler around the southern, western, and north shorelines. Another four points were surveyed on the outboard levee of nearby Simmons Island (see Figure F-4). The average debris wrack line elevation on Point Buckler was 7.12 ft NAVD88 and on Simmons Island was 7.52 ft NAVD88. Point Buckler had a slightly higher maximum debris wrack line elevation relative to Simmons Island, 8.34 ft vs. 8.24 ft NAVD88, respectively.

F-2.4 New Borrow and Drainage Ditch Depths Sufficient for Tidal Marsh Drainage

The average ground surface at the top of the new borrow and drainage ditch was 5.44 ft and the average invert elevation was -0.22 ft NAVD88 (Table F-1). Thus, average depth of the new borrow and drainage ditch was about 5.7 feet. Maximum depths were about three feet deeper, around 8.8 feet. The average invert elevation of -0.22 ft NAVD88 (Table F-1, Figure F-8) is well below local Mean Lower Low Water elevation of 1.20 ft NAVD88 (Table I-1), meaning this ditch is deep enough to facilitate drainage of the interior tidal marsh throughout nearly every low tide.

F-2.5 Interior Tidal Marsh Surface Test Pit Groundwater Depths Are Higher than in the New Borrow and Drainage Ditch

The average water surface elevation in the new borrow and drainage ditch during the March 2, 2016 field topographic survey was 3.29 ft NAVD88 (Figure F-5). The five shallow test pits hand-dug on March 2 2016 had water surface elevations, after allowing them to equilibrate for about an hour each, ranged from 3.54 ft to 4.39 ft NAVD88. The water control structure flap gates were closed on the interior and exterior side during the March 2, 2016, and the lack of variation in the borrow and drainage ditch during the field survey day indicate that water levels in the borrow ditch are not being allowed to vary with the tides. In addition, a small discharge to the bay was observed at outlet side of the water control structure during the March 2, 2016 field surveys. Water levels in the test pits ranging from 0.15 ft to 1.1 ft higher than in the borrow and drainage ditch indicate groundwater flow gradient from the interior wetlands to the borrow and drainage ditch, promoting wetland drainage. Appendix L describes these findings in greater details.

Table F-1. Elevations of Selected Site Features, March 2, 2016 Topographic Survey

Survey feature	Elevation (ft NAVD88)			Standard Deviation (ft)	Number of survey points
	Maximum	Average	Minimum		
Tidal marsh plain, interior	6.17	5.43	4.21	0.27	438
Tidal marsh plain pathway, interior	6.43	5.29	4.76	0.23	72
Tidal marsh plain, exterior	6.43	5.57	3.89	0.46	27
Tidal remnant levee, exterior	6.18	5.71	5.45	0.26	8
Levee crest	9.76	8.20	6.69	0.52	324
Levee toe	6.76	5.50	2.23	0.92	33
Crescent basin top of bank	5.91	5.22	4.50	0.31	57
Crescent basin invert	4.13	3.05	1.94	0.67	17
Borrow ditch top of bank	6.07	5.44	4.40	0.31	63
Borrow ditch invert	3.20	-0.22	-3.35	1.52	61
Western ramp to water	7.33	6.52	5.28	0.73	15
Water control structure, interior invert		1.81		--	1
Water control structure, interior soffit		3.84		0.03	3
Water control structure, exterior invert		2.50		0.06	2
Water control structure, exterior soffit		4.27		0.01	4
Debris wrack line – Pt. Buckler	8.34	7.12	6.32	0.53	24
Debris wrack line – Simmons Island	8.24	7.52	6.28	0.89	4

List of Figures

Figure F-1. March 2, 2016 Ground Topographic Survey Data Points

Figure F-2. March 2, 2016 Levee Topographic Survey Data Points

Figure F-3. March 2, 2016 Marsh Plain Topographic Survey Data Points

Figure F-4. March 2, 2016 Wrack Line Topographic Survey Data Points and Elevations

Figure F-5. March 2, 2016 Water Surface Elevation Locations and Data

Figure F-6. March 2, 2016 Elevations of 1985 Remnant Levee

Figure F-7. March 2, 2016 Levee and Borrow Ditch Profile Stationing

Figure F-8. March 2, 2016 Levee and Borrow Ditch Topographic Profiles

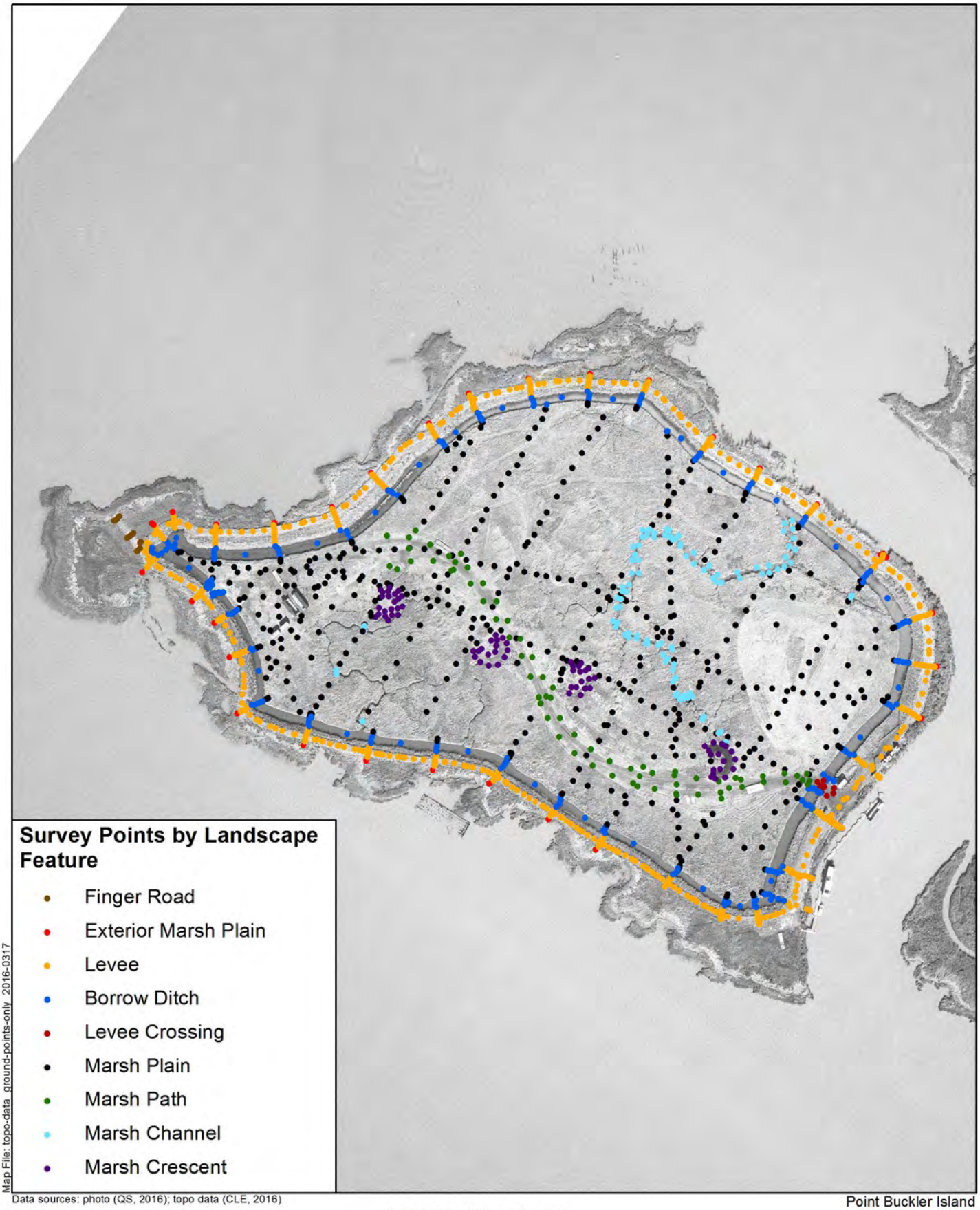
Figure F-9. March 2, 2016 Marsh Plain Transect Profile Stationing

Figure F-10. March 2, 2016 Marsh Plain Representative Transects

Figure F-11. Tidal Elevation Classes, Digital Elevation Model, March 2, 2016 Topography

Figure F-12. Elevation Detail, Digital Elevation Model, March 2, 2016 Topography

Figure F-13. March 2, 2016 Interior Marsh Plain Topography Summary of Data Related to Tide Heights



Map File: topo-data_ground-points-only_2016-0317

Data sources: photo (QS, 2016); topo data (CLE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-1

March 2, 2016 Ground Topographic Survey Data Points

Map File: topo-data_levee-points-only_2016-0316

Data sources: photo (QS, 2016); topo data (CLE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-2

March 2, 2016 Levee Topographic Survey Data Points

Elevation Statistics	Interior Marsh Plain	Exterior Marsh Plain	Interior Marsh Path
Average (ft NAVD88)	5.42	5.58	5.30
Minimum (ft NAVD88)	4.21	3.89	4.89
Maximum (ft NAVD88)	6.17	6.43	6.43
Standard Deviation (ft)	0.28	0.47	0.23

Map File: App-F topo-data marsh-only buckler 2016-0422

Data sources: photo - Buckler_02-10-16.tif (QS, 2016);
Topo data (CLE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-3

March 2, 2016 Marsh Plain Topographic Survey Data Points

Base air photo: (Quantum Spatial) February 10, 2016

ALL ELEVATIONS IN FT NAVD88

Wrack Line Statistics		
Statistics	Pt. Buckler Island	Simmons Island
Average Elevation (ft NAVD)	7.12	7.52
Min Elevation (ft NAVD)	6.32	6.28
Max Elevation (ft NAVD)	8.34	8.24
St Dev (ft)	0.53	0.89

Map File: wrack-line-shots_buckler_2016-0309

Data sources: photo - Buckler_02-10-16.tif (QS, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

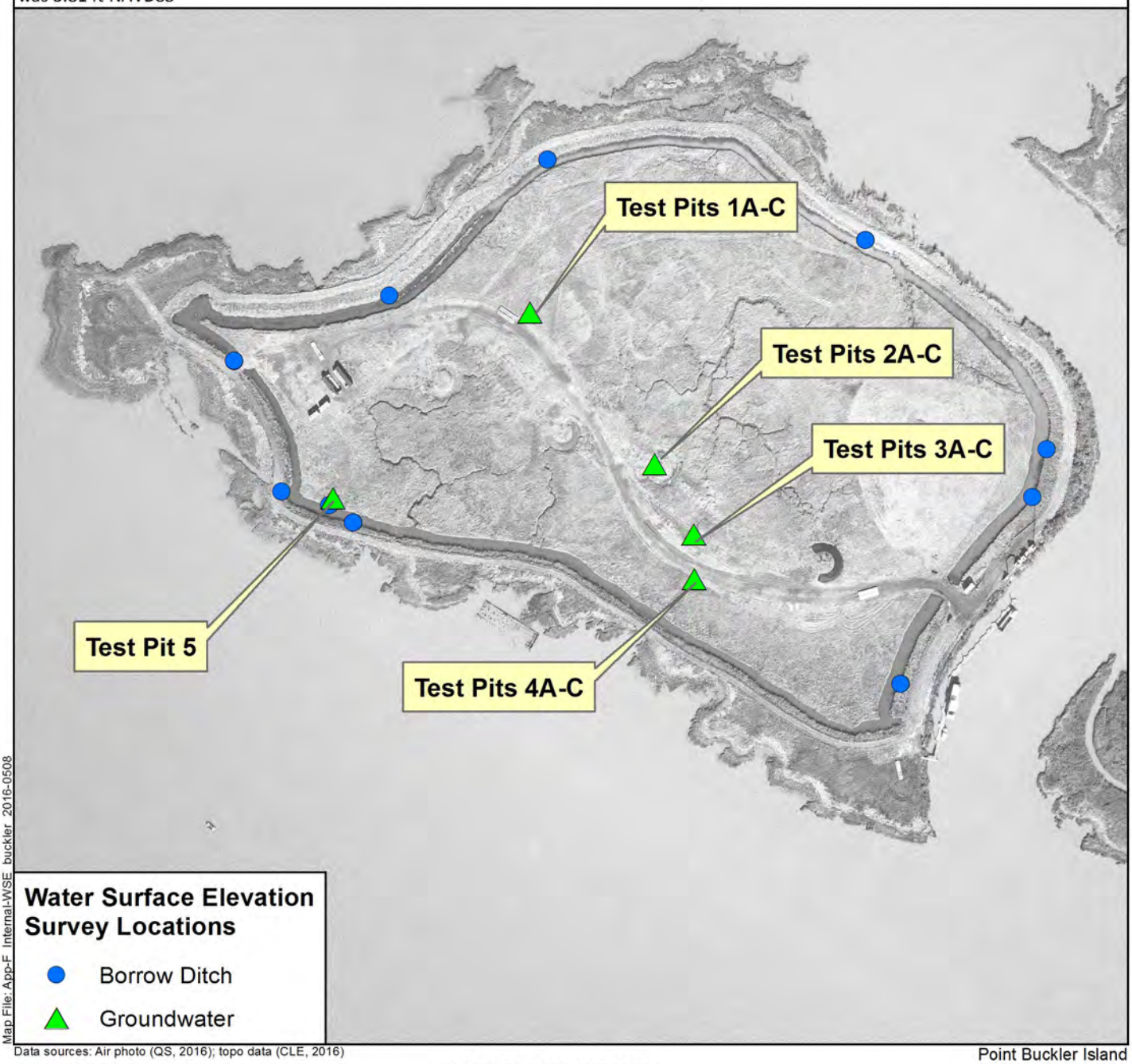
Figure F-4

March 2, 2016 Wrack Line Topographic Survey Data Points and Elevations

Water Surface Elevation Statistics	Borrow Ditch	Test Pits 1A-C[1]	Test Pits 2A-C[1]	Test Pits 3A-C[1]	Test Pits 4A-C[1]	Test Pit 5[2]
Avg Elevation (ft NAVD88)	**3.29**	**4.05**	**3.54**	**3.58**	**4.39**	**4.30**
Min Elevation (ft NAVD88)	3.16	3.93	3.46	3.41	4.37	4.30
Max Elevation (ft NAVD88)	3.33	4.15	3.64	3.86	4.43	4.30
St. Deviation (ft)	0.04	0.11	0.09	0.24	0.03	--
Number of Measurements	19	3	3	3	3	1
Avg Ground Surface Elevation (ft NAVD88)	--	5.32	5.09	4.43	5.35	5.54

[1]Groundwater levels allowed to stabilize for over 1 hour before surveying - elevation reported is water surface

[2]Groundwater levels did not stabilize - elevation reported is top of saturated soil zone, water surface elevation in pit at time of survey was 3.81 ft NAVD88



Map File: App-F_Internal-WSE_buckler_2016-0508

Data sources: Air photo (QS, 2016); topo data (CLE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

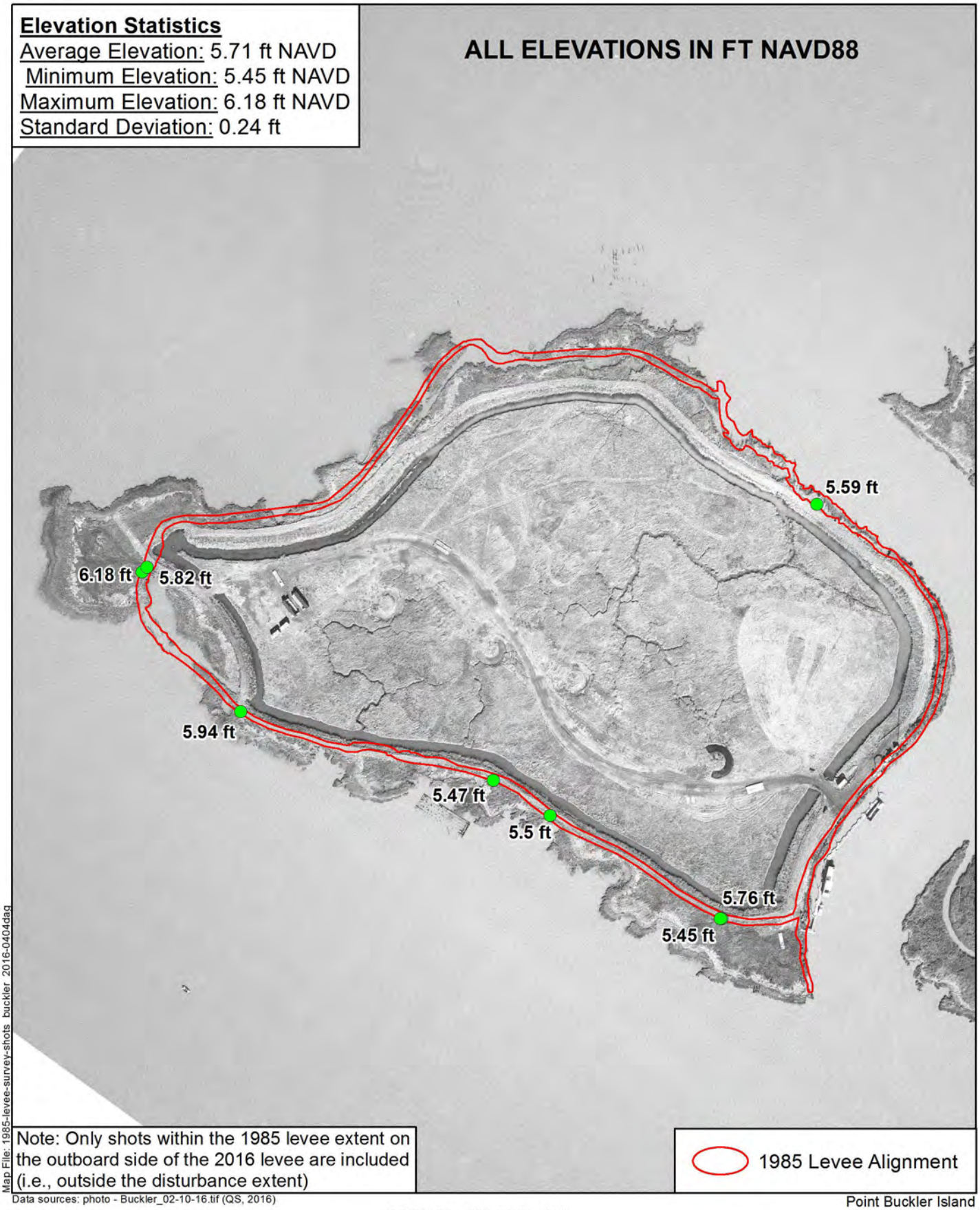
0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-5

March 2, 2016 Water Surface Elevation Locations and Data

Base air photo: (Quantum Spatial) February 10, 2016



Map File: 1985-levee-survey-shots_buckler_2016-0404dag

Data sources: photo - Buckler_02-10-16.tif (QS, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-6

March 2, 2016 Elevations of 1985 Remnant Levee

Map File: App-F levee-ditch-profile-lines 2016-0427

Data sources: photo (QS, 2016); survey lines (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

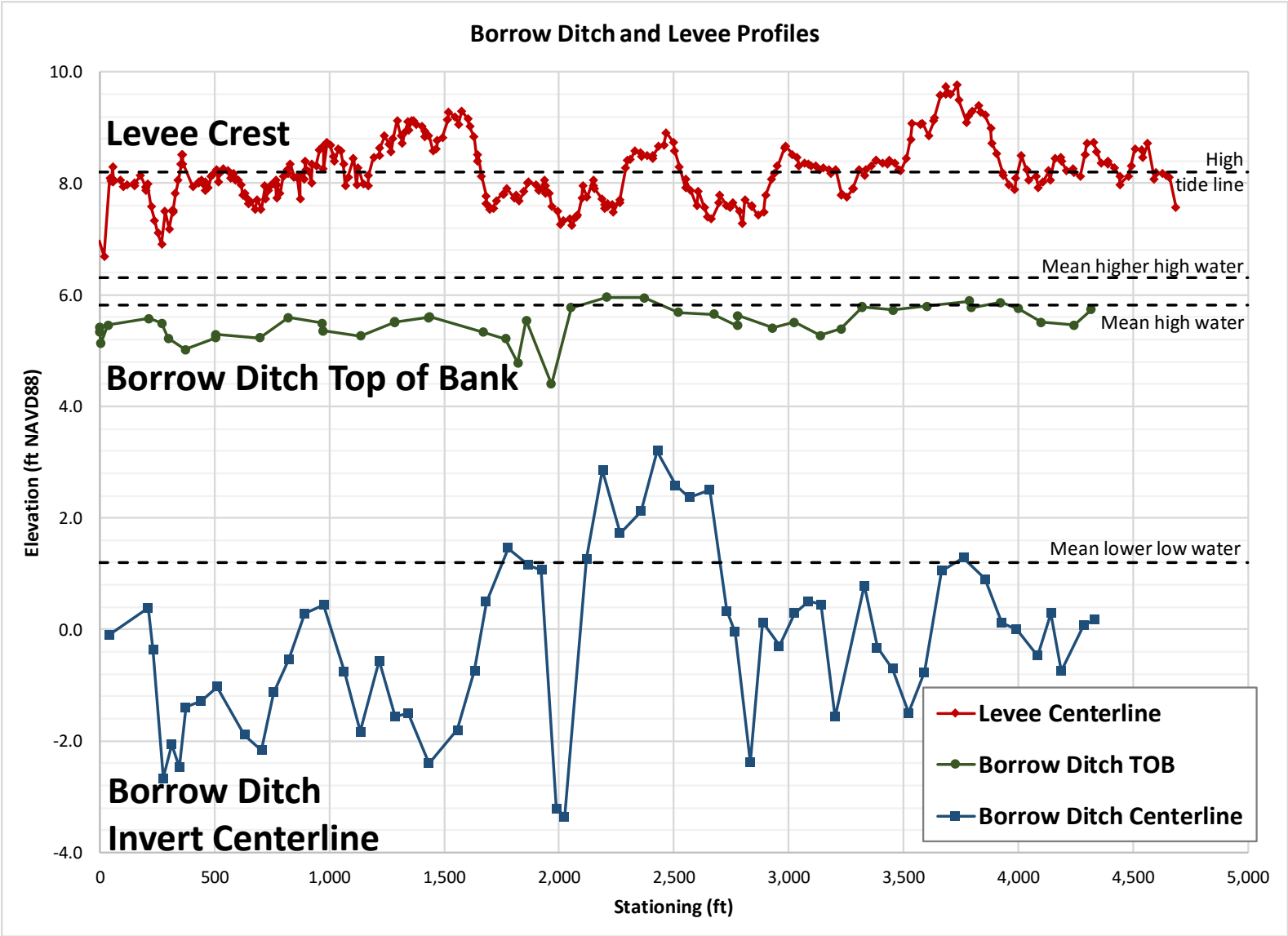
0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-7

Base air photo: (Quantum Spatial) February 10, 2016

Levee and Borrow Ditch Profile Stationing



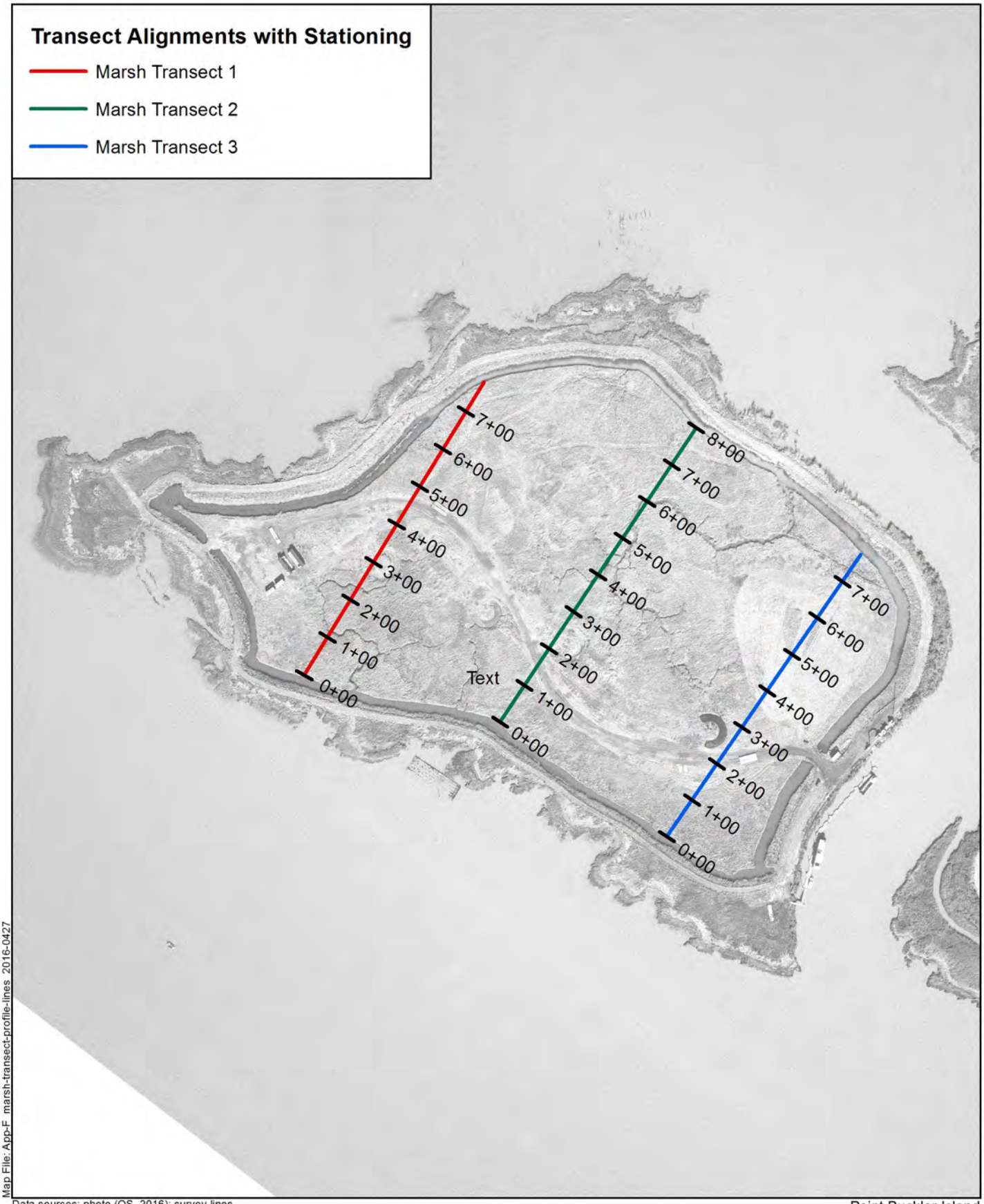
File: Figs F-8,10_Topo profiles_Buckler_2016-0427.pptx

Profile locations shown in Figure F-7

Point Buckler Island
Solano County, CA

Figure F-8

March 2, 2016 Levee and Borrow Ditch Topographic Profiles



Map File: App-F marsh-transect-profile-lines 2016-0427

Data sources: photo (QS, 2016); survey lines (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

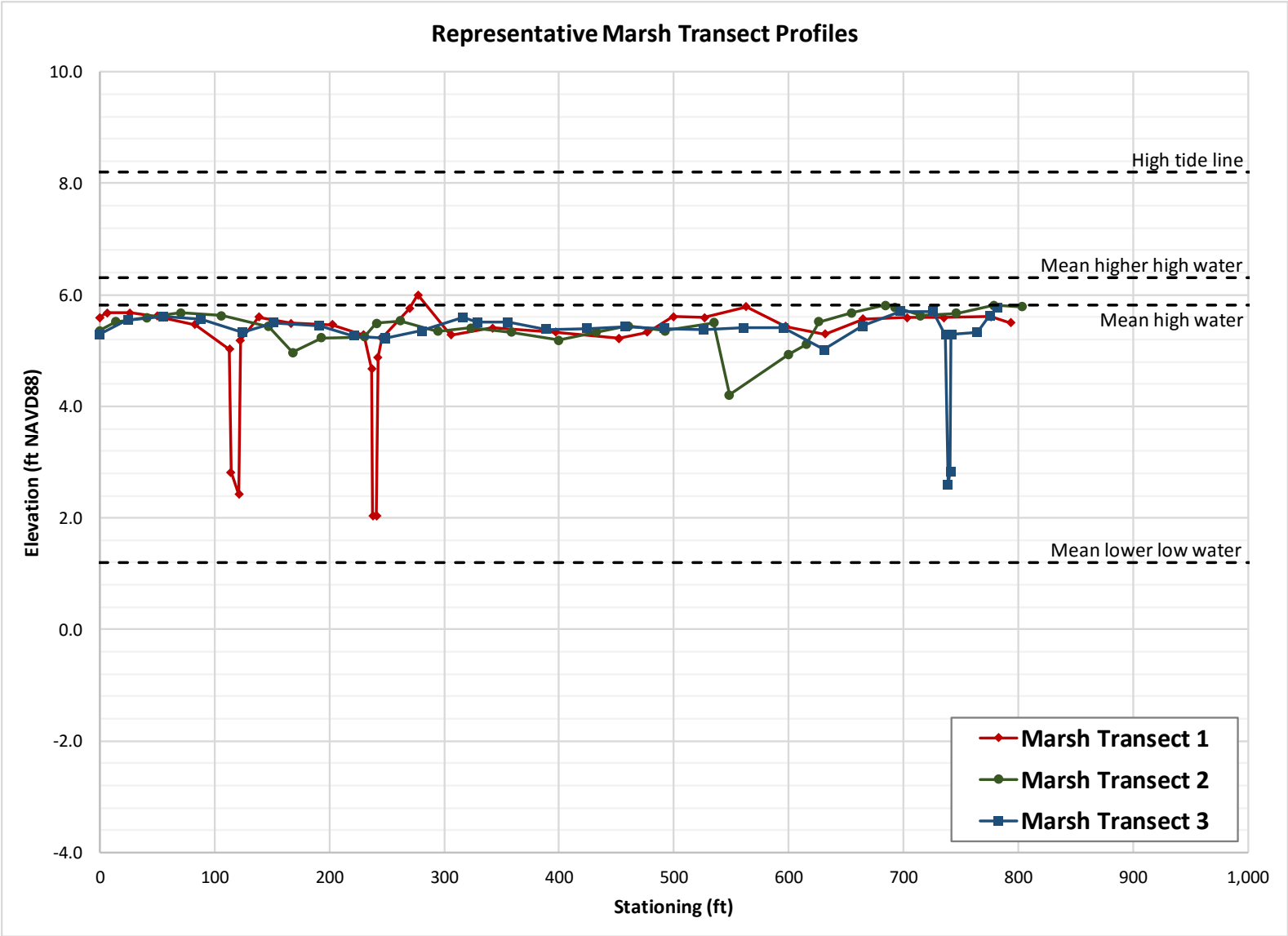
0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-9

Base air photo:
(Quantum Spatial) February 10, 2016

March 2, 2016 Marsh Plain Transect Profile Stationing



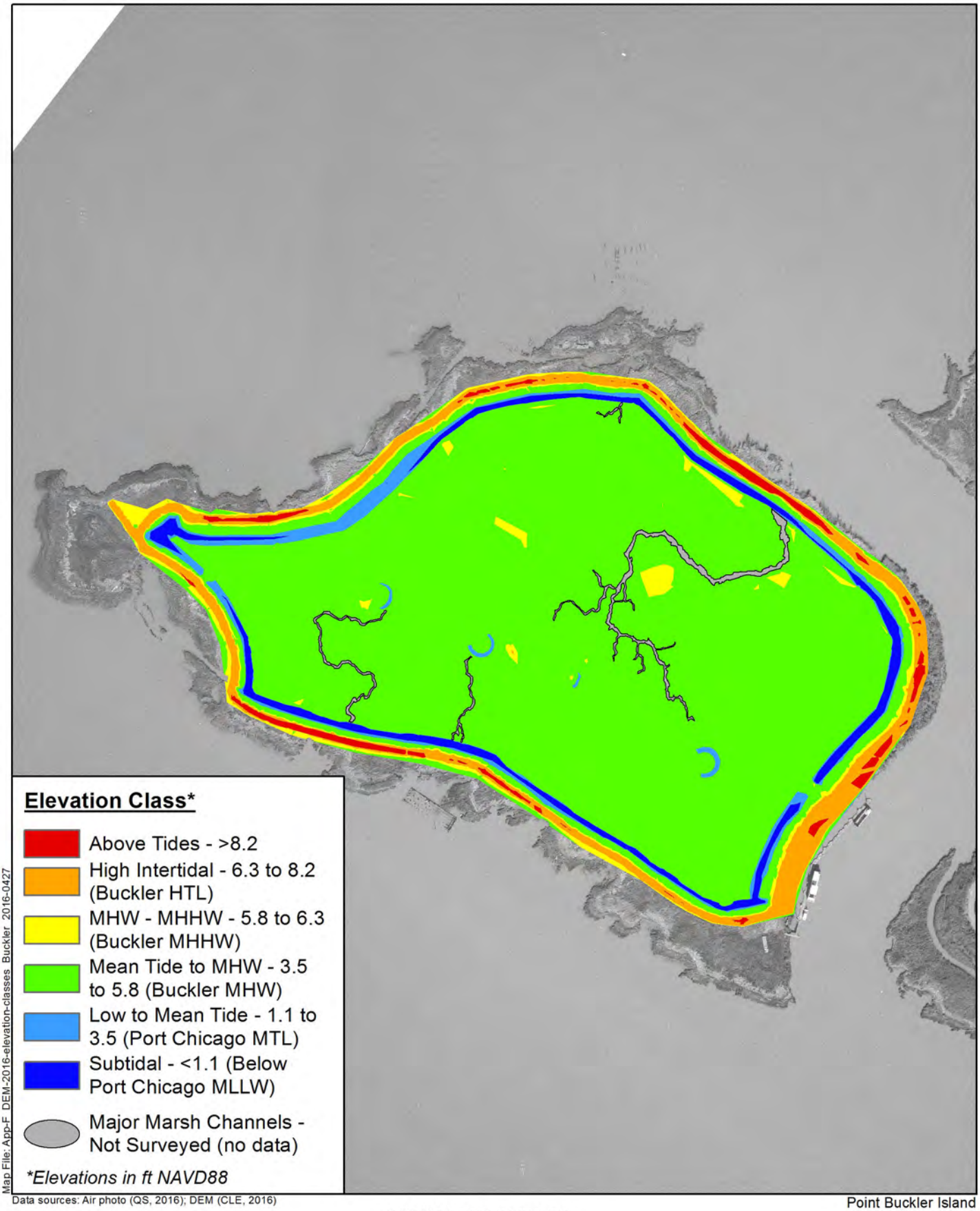
File: Figs F-8,10_Topo profiles_Buckler_2016-0427.pptx

Transect locations shown in Figure F-9

Point Buckler Island
Solano County, CA

Figure F-10

March 2, 2016 Marsh Plain Representative Transects



Map File: App-F_DEM-2016-elevation-classes_Buckler_2016-0427

Data sources: Air photo (QS, 2016); DEM (CLE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

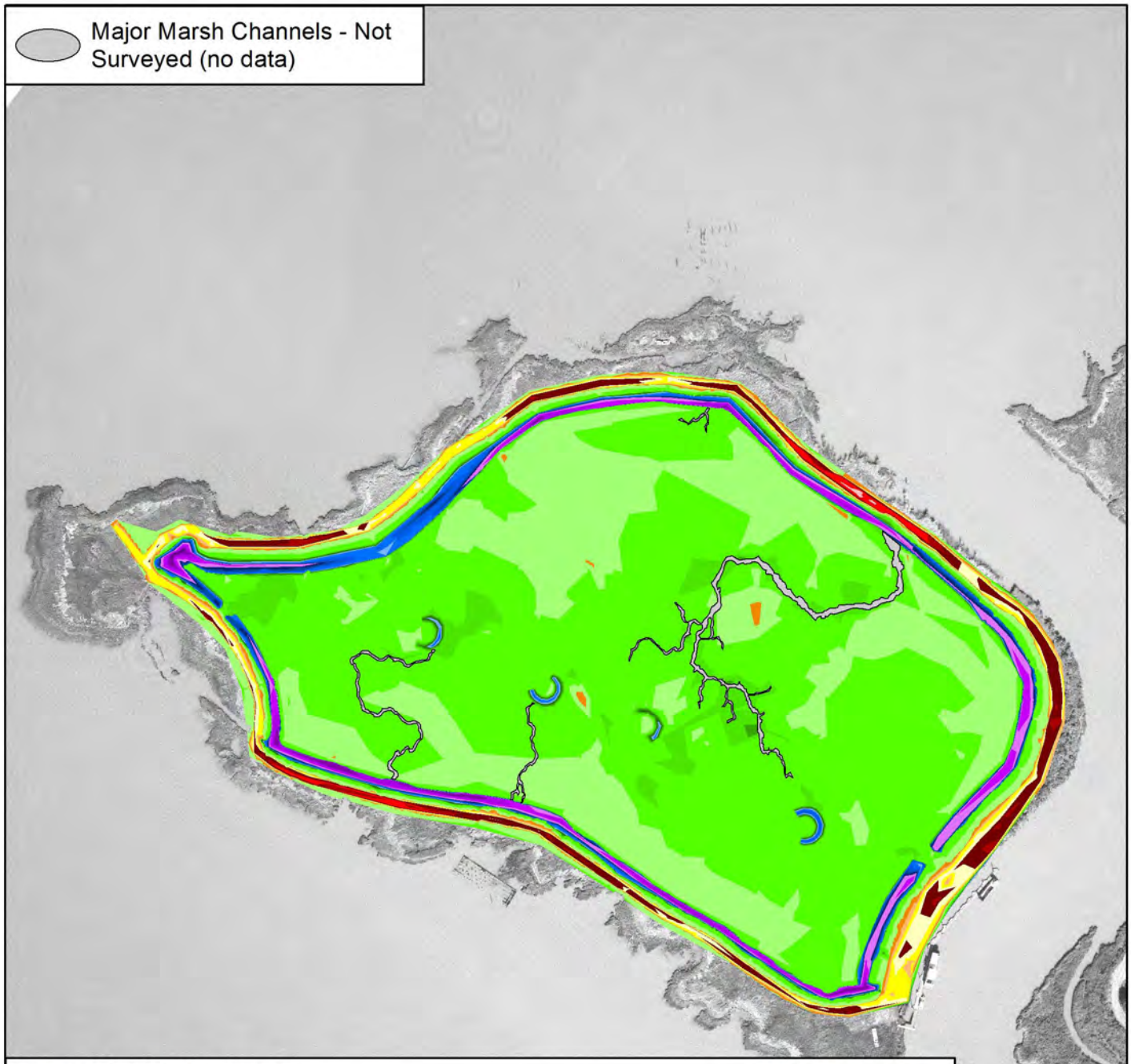
0 50 100 m

Point Buckler Island
Solano County, CA

Figure F-11

Tidal Elevation Classes
Digital Elevation Model, March 2, 2016 Topography

Base air photo:
(Quantum Spatial) February 10, 2016



Elevation (ft NAVD88)

Subtidal	Lower-Intertidal[1]	Upper-Intertidal[1]	Supertidal[2]	Above Tides
0 to 1	3.0 to 3.5	5.5 to 6.0	7.5 to 8.0	9.5 to 10.0
-1 to 0	2.5 to 3.0	5.0 to 5.5	7.0 to 7.5	9.0 to 9.5
-2 to -1	2.0 to 2.5	4.5 to 5.0	6.5 to 7.0	8.5 to 9.0
-3 to -2	1.5 to 2.0	4.0 to 4.5	6.0 to 6.5	8.0 to 8.5
<-3	1.0 to 1.5	3.5 to 4.0		

[1]Based on intertidal range calculated for Pt. Buckler: 1.10 ft NAVD88 (MLLW) to 6.30 ft NAVD88 (MHHW)
[2]MHHW to HTL. HTL (8.2 ft NAVD88) calculated for Pt. Buckler Island

Map File: F-12_DEM-2016_detailed_Buckler_2016-0421

Data sources: Air photo (QS, 2016); DEM (CLE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

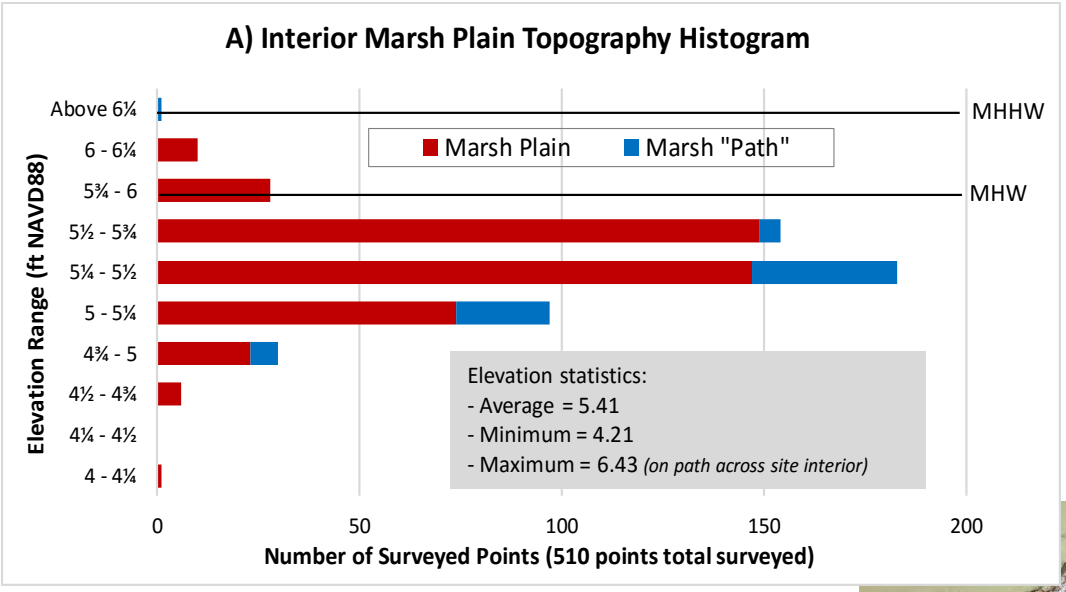
0 50 100 m

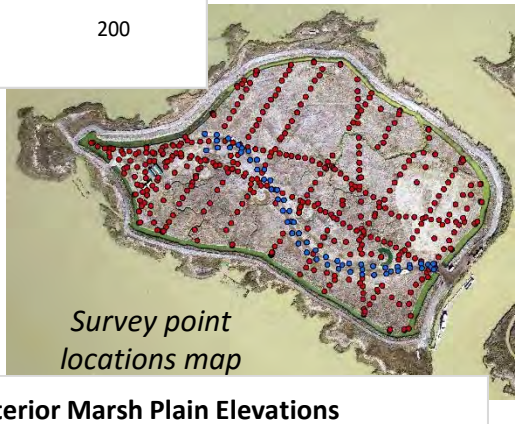
Point Buckler Island
Solano County, CA

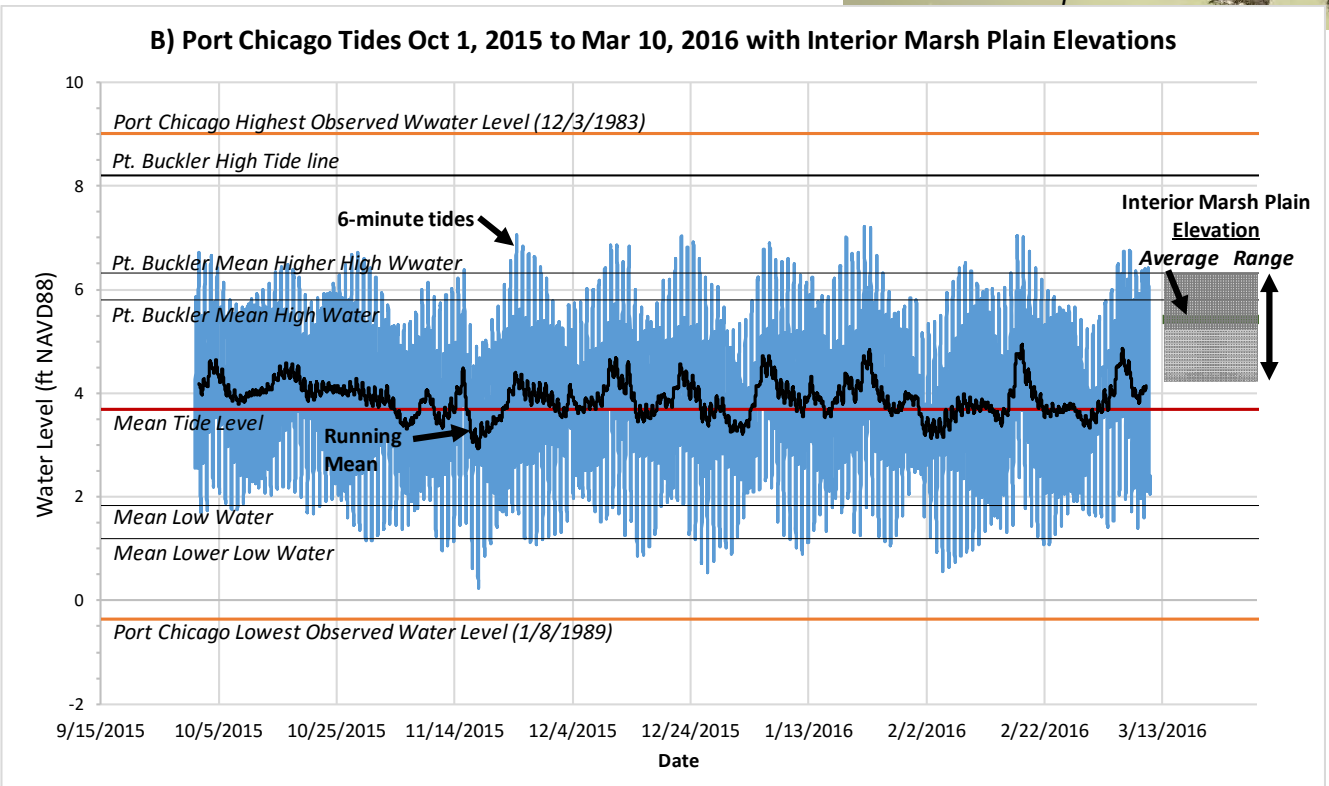
Figure F-12

Base air photo: (Quantum Spatial) February 10, 2016

Elevation Detail - 2016 Site DEM







File: Topo Summary Histo-Tides_Buckler_2016-0502.pptx

Point Buckler Island
Project No. 3019

Figure F-13

March 2, 2016 Interior Marsh Plain Topography
Summary of Data Related to Tide Heights

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Appendix G Opening of Tidal Connectivity and Establishment of Tidal Marsh, 1985 to 2011

G-1.0 Introduction

The purpose of assessing the timing of tidal connectivity opening and tidal marsh establishment from 1985 to 2011 is to establish the condition of Point Buckler in 2011, the duration of time over which unrestricted tidal exchange was present, and the associated extent of lands subject to jurisdiction by the San Francisco Bay Conservation and Development Commission (BCDC) (Appendix M), the U.S. Army Corps of Engineers (Corps of Engineers) (Appendix N), and the Regional Water Quality Control Board (Water Board) (Appendix O). These data also provide the ability to assess whether or not the 1984 Individual Management Plan for Point Buckler remains applicable. Based on a review of historical aerial photographs (Appendix A), 1985 represents the last major levee repair on Point Buckler that established functioning infrastructure to manage water levels on the property, a precondition to being a managed wetland and thus operating under an Individual Management Plan.

G-2.0 Assessment Methodology

This assessment used 20 air photos covering the 26-year time period from 1985 to 2011 (Figure G-1 to Figure G-20). The location of the levee breaches in 2011 served as the basis for identifying the points in time at which each of these breaches opened and whether any levee repair attempts were made to close each breach. We digitized the location of the 1985 levee and borrow ditch alignments from the two 1985 aerial photographs (Figure G-1 and Figure G-2), and compared these locations against the 1958 (Figure A-2) and 1981 (Figure A-3) aerial photographs to validate these locations. We also digitized the position of the 1985 and 2011 island shoreline to identify island erosion. Lastly, we digitized two fixed structures to validate the spatial positioning of each photograph – the dock on the northern end of the property in place prior to 1985, and the barge brought to the property in the late 1980s and that first appears in the August 1988 aerial photograph (Figure G-3).

Once these baseline and 2011 features were established, we manually reviewed each aerial photograph across the intervening years. This review entailed examining for levee erosion, levee breach formation, new structures, new earthwork, presence of levee maintenance equipment, and any other evidence of property management such as large changes in vegetation composition or the relative amounts of vegetation and open water. Changes are logged in Table G-1. Breaches are numbered 1 through 7, clockwise starting in the southeast corner.

G-3.0 Findings

1985 represents the last time major levee repairs were completed on Point Buckler Island that provided the necessary infrastructure to control water levels on the island to establish managed wetland conditions (Figure G-1, Figure G-2). The remaining 18 air photos from 1988 to 2011 (Figure G-3 through Figure G-20) illustrate the progressive levee breaches that connects bay tides to the interior channel and ditch network and the progressive degradation of the levee that connects high tide overland flows to the interior tidal marsh. Table G-1 describes the progression of breaches appearing in the levee following the 1985 repairs along with all observations of island change during this period. Table G-2 summarizes the levee breach sequence. Figure G-21 identifies the overall tidal hydrology of the site in 2011, showing the two kinds of tidal connectivity: tidal channel connectivity through eroded breaches in the 1985 levee and overland flow connectivity where the 1985 levee had degraded but not breached. Table G-3 shows the length of the 1985 levee now allowing these two types of tidal connectivity. Figure G-22 shows the erosion of the island perimeter from 1985 to 2011, and Table G-4 presents the area of shoreline erosion and change in length of the shoreline.

G-3.1 Breaches of the 1985 Levee Provided Daily Tidal Connectivity into Interior Tidal Marsh Channels and Ditches Since 1993

At the time property transfer of Point Buckler took place in 2011, the site had seven breaches in the levee, providing daily tidal connectivity to the site interior (Figure G-21). All seven of the levee breaches had been open since 2003, and the five largest breaches had been open since 1993 (Table G-1, Table G-2). The first breach (the large Breach 5 in the north) was open by 1988 (Figure G-3), and two more large breaches (Breach 2 in the southwest and Breach 6 in the northeast) had opened by 1991 (Figure G-5). Equipment is visible on site in the May 1991 air photo, suggesting that some levee maintenance may be taking place. All breaches open in 1991 were also open in the August 1993 air photo (Figure G-6), along with two more breaches (smaller Breach 1 in the south and smaller Breach 7 in the northeast), suggesting that had any levee maintenance taken place in 1991, it did not repair the breached sections at least in any durable manner. By 2011, a total of 545 feet of the 1985 levee had been breached (Table G-3).

These seven breaches provided daily tidal exchange between Bay waters and the tidal marsh that comprised Point Buckler island, and the interior tidal channels and tidal remnant borrow ditch provided internal tidal circulation throughout the site (Figure G-21). The invert elevations of the interior tidal marsh channels were in the 2 ft to 3 ft NAVD88 range as measured during the March 2, 2016 topographic survey (Figure F-10), between mean low water (MLW) and mean tide level (MTL) elevations of 1.84 ft and 3.68 ft NAVD88, respectively (Table I-1).

G-3.2 Degradation of the 1985 Remnant Levee Provided Higher Tide Overland Flow into the Interior Tidal Marsh Since at Least 2000

At the time of property transfer in 2011, about 90 percent of the remnant 1985 levee remained in place, with about 69 percent (3,385 feet) having become tidal marsh through levee subsidence and erosion (Figure G-21). This tidal marsh remnant levee, along the south, west, and north shoreline of the island,

was surveyed on March 2, 2016 in a few locations and was found to have elevations ranging from 5.45 ft to 6.18 ft with an average elevation of 5.71 ft NAVD88 (Table F-1). These elevations are intertidal, all below local mean higher high water (MHHW) and the average being below local mean high water (MHW). A review of the air photos (see Figure G-1 to Figure G-20) and the California Department of Fish and Wildlife (CDFW) Suisun Marsh vegetation data set (Figure H-2) indicate that the degraded levee exhibited similar colors and vegetation around the entire island, suggesting that these limited topographic data are representative of the remainder of the tidal remnant levee. These data also suggest that the remnant levee degradation had taken place years before, with overland tidal connectivity extending back at least to 2000 as evidenced by the CDFW vegetation data set (Figure H-2).

At these tidal remnant levee elevations, about half of the high tides would have flooded over the remnant levee and into the interior tidal marsh (Figure I-2(C)). The higher the tide, the greater the depth and duration of tidal flooding with each high tide event. Based on these data, there is confidence in concluding that tidal flows overtopped the degraded levee in 2011 and had done so for an extended number of years prior, allowing what is called “overland” flow of tidal waters to the interior tidal marsh.

G-3.3 Island Shoreline Erosion from 1985 to 2011 Decreased Island Size and Eroded Some of the 1985 Remnant Levee and Interior Tidal Marsh

Based on delineating the 1985 shoreline of Point Buckler Island from the two 1985 aerial photographs (Figure G-1 and Figure G-2) and the 2011 shoreline from the two 2011 photographs (Figure G-19 and Figure G-20), it is evident that considerable shoreline retreat (erosion) has occurred around the entire island (Figure G-22). The total island area reduced in size by 4.042 acres, from 42.902 acres in 1985 to 38.860 acres in 2011 (Table G-4). Slightly more erosion occurred than the 4.042 acres, as a small area in the south sheltered by the barge placed in 1988 had accreted new tidal marsh (0.042 acre). Shoreline retreat is more than 100 feet in some locations, and the south, west, northwest, north, and northeast shorelines all exhibit considerable retreat. Only the eastern shoreline along Andy Mason Slough appears to have experienced little to no erosion leading to shoreline retreat.

This erosion demonstrates the challenge of maintaining functional levees at Point Buckler to establish managed wetlands conditions, and the need to “retreat” the levee further to the island interior away from active erosion. Given that relocating levee alignments requires new regulatory authorizations (current authorizations can allow for in-place levee maintenance only), this significant degree of shoreline erosion likely contributed to decisions of prior owners not to continue maintaining and seeking permits to rebuilding the levees outside the footprint of the 1985 levee.

G-3.4 Lack of Evidence of Maintenance of Water Control Infrastructure and Cultivation of Waterfowl Food Plants Since at Least 1993

The near-annual time series of aerial photographs shown in Figure G-1 through Figure G-20 provide no evidence of either water control infrastructure maintenance or cultivation of waterfowl food plants since at least 1993. Evidence would include repaired levee breaches, earthwork along the levee

alignment, changes in vegetation community structure, and variation in the mixture of vegetated diked marsh and open water ponds over time. From at least 1993 onward, the aerial photographs do not show any such evidence. The club house had fallen into the bay by 1997, and the only evidence of any use of the property are a small boat dock placed in Andy Mason Slough in 1991 and removed in 2006, some repairs to the outer sections of the north dock in 2003 that were gone by 2006, and small boats at the island visible in some of the aerial photographs.

G-3.5 Individual Management Plan No Longer Applicable a Reasonable Time After 1993 Return of Tidal Connectivity

The Suisun Marsh Preservation Act (SMPA) of 1974 and the Suisun Marsh Protection Plan (SMPP) certified in 1976 established two management areas within Suisun Marsh, each with different regulatory oversight. Activities in the "Primary Management Area" of Suisun (all lands below the 10-foot NGVD29 contour) are regulated by BCDC, and activities in the "Secondary Management Area" of Suisun Marsh (all lands above the 10-foot NGVD29 contour) are regulated by Solano County, following adoption of its Local Protection Program. Point Buckler is located within the Primary Management Area and thus is subject to BCDC regulatory oversight. Development of Individual Management Plans (IMPs) for all the privately owned duck clubs (diked managed wetlands) in Suisun Marsh was required under the SMPA (California Public Resources Code §29412.5). The Suisun Marsh Management Plan (SMMP), prepared by the Suisun Resource Conservation District and certified by BCDC in 1980 as part of the Solano County Local Protection Program for Suisun Marsh, incorporated the IMP requirement.

By the mid-1980s, the U.S. Soil Conservation Service had prepared IMPs for all of the roughly 150 privately owned duck clubs (diked managed wetlands) in Suisun Marsh, and BCDC had approved them. These IMPs allowed a duck club to carry out routine maintenance work (e.g., levee repairs, water control structure repairs) and wetland management activities (e.g., vegetation mowing, disking, burning) for the specific purpose of promoting desirable waterfowl habitats, without the need for further regulatory authorization from BCDC. Work activities beyond the scope authorized through each IMP required separate regulatory authorization from BCDC. Regulatory authorizations from the Corps of Engineers and Water Board were still required for all clubs including those with approved IMPs, and were addressed through Regional General Permits issued and renewed periodically by the Corps of Engineers and certified by the Water Board.

The SMPA defines managed wetlands as follows (California Public Resources Code § 29105, emphasis below added):

> Managed wetlands means those **diked areas in the marsh in which water inflow and outflow is artificially controlled or in which waterfowl food plants are cultivated, or both**, to enhance habitat conditions for waterfowl and other water-associated birds, wildlife, or fish, regardless of whether such areas are used for hunting or fishing or non-consumptive uses such as nature study, photography, and similar passive wildlife activities, or a combination of both such consumptive and non-consumptive uses.

Key to this managed wetland definition is the artificial control of water inflow and outflow. Both the IMPs and the Regional General Permits allow for maintenance and repair of levees and water control structures to allow for artificial control of water inflow and outflow. When such infrastructure no longer functions, water inflows and outflows cannot me managed, and the property is no longer a managed wetland. When failures occur to such infrastructure, land owners clearly have a reasonable amount of time to carry out repairs and continue operating as diked, managed wetlands. In the case of Point Buckler, 18 years had elapsed between the failure of the site's water control infrastructure and property transfer, and another 3 years elapsed before the new levee was built. A 21-year lapse clearly extends well beyond "a reasonable amount of time" to carry out repairs.

Point Buckler is not alone in Suisun Marsh or in the larger San Francisco Estuary as a property where unrepaired natural levee failures returned diked lands back to tidal marsh or tidal open water. Within Suisun Marsh alone, there are 14 properties totaling nearly 2,300 acres that have reverted to daily tidal action through natural processes breaching levees and the absence of repairs to those facilities within a reasonable period of time (Figure 1). Some of these properties have been open to the tides since at least the early 1980s and some as recently as 2010. The Delta has several such properties as well, totaling more than 10,000 acres, such as Sherman Island, Frank's Tract, Big Break, Liberty Island, and Mildred Island. These properties have been open to the tides since the 1920s in some cases and as recently as 1998 for 4,500-acre Liberty Island. In the South Bay, Whale's Tail Marsh in Hayward breached naturally in the 1930s and has been tidal marsh ever since.

Once a duck club has fallen into disrepair, its levees breached and degraded allowing unmanaged tidal action to the wetlands within the duck club, the property is no longer a managed wetland. At that point in time, the regulatory benefits of its IMP no longer apply and the property is not eligible for work authorizations under the Regional General Permit. Having reverted to tidal marsh, such properties then fall under the SMPP policy of preserving tidal marshlands (SMPP Land Use and Management Policy 3) and under the tidal marsh policies and regulations under the federal Clean Water Act, state Porter-Cologne Water Quality Act, and the state and federal Endangered Species acts, all reflecting the importance of tidal marshes to Suisun Marsh, the Estuary, and listed species protection.

G-4.0 Conclusions

Point Buckler had reverted to unrestricted tidal action by 1993 at which point in time the five large breaches were allowing unrestricted daily tidal exchange to the site interior and its tidal channels and ditches. The two additional breaches in 2003 were small in size and added nominally to the tidal exchange compared to the five earlier breaches. In addition, the 3,385 feet of degraded remnant levee at intertidal elevations around all but the east side of the island allowed overland tidal flows into the interior tidal marsh on about half the high tides, with the depth and duration of tidal flooding depending on the height of each high tide. The only interventions on the island since 1993 (Table G-1) were repairs to the north dock evident in the 2003 aerial photograph (Figure G-13), the 2006 removal of the dock

placed in Andy Mason Slough in 1991. The club house on the northern tip of the island collapsed into the bay by 1997.

Point Buckler had, through the action of natural processes and the absence of levee and water control infrastructure maintenance, reverted to tidal marsh by 1993 and remained as a tidal marsh until new unpermitted levee construction in 2014. From a reasonable time period after 1993 (to allow for repairs) and onward, its Individual Management Plan no longer applied and the property was not eligible for Regional General Permit work authorizations. Instead, work to re-establish artificial water inflows and outflows would be subject to full regulatory review by BCDC, the Corps of Engineers, the Water Board, and the state and federal natural resources agencies, considering the property as tidal marsh under state and federal laws and regulations.

Table G-1. Breaches, Maintenance and Other Changes, Point Buckler, 1985 - 2011

Photo Date	Breach Status, by Number Clockwise from Southeast Corner, Comments							Fig No.
	1	2	3	4	5	6	7	
4/30/1985	Closed	Closed	Closed	Closed	Closed	Closed	Closed	G-1
	- Baseline, major levee repair in place 1985 (black and white photo)							
7/15/1985	0	0	0	0	0	0	0	G-2
	- Baseline, major levee repair in place 1985 (color infrared photo)							
8/18/1988	Closed	***Closed***	Closed	Closed	Newly Open	Open?	Closed	G-3
	- Breach 5 newly open - Retaining wall at breach 2 - Erosion on NE side - Breach 6 perhaps is open - NE levee repair section has begun eroding and continues to its final loss by 1999 - Light soils suggest levee maintenance on east side - New barge (~40'x120') placed nearshore on south side remnants of which remain in 2016 - Small object (~3'x20') appears southeast tip, moved in 1999, gone in 2006.							
6/13/1990	Closed	Newly Open	Closed	Closed	Open	Newly Open	Closed	G-4
	- Breach 2 opens - Breach 6 opens - Breach 5 remains open - Equipment is being loaded or unloaded suggesting levee maintenance - Ongoing erosion NE side - Small dock newly placed near southeast corner in Andy Mason Slough							
5/28/1991	Closed	Open	Closed	Closed	Open	Open	Closed	G-5
	- Breach 2 opens - Breach 6 opens - Equipment is being loaded or unloaded suggesting levee maintenance - Ongoing erosion NE side - Small dock newly placed near southeast corner in Annie Mason Slough							
8/23/1993	Newly Open	Open	Closed	Closed	Open	Open	Newly Open	G-6
	- Breaches 1 and 7 open - Ongoing erosion NE side							
7/7/1995	Open	Open	Closed	Closed	Open	Open	Open	G-7
7/3/1996	Open	Open	Closed	Closed	Open	Open	Open	G-8
	- Club house north tip mostly in/over water, surrounding land has eroded away							
7/22/1997	Open	Open	Closed	Closed	Open	Open	Open	G-9
	- Last ~100-ft vestige of 1985 levee repair in NE remains - Club house gone							
6/16/1999	Open	Open	Closed	Closed	Open	Open	Open	G-10
	- 1985 levee repair in NE has eroded away entirely - Small object SE tip moved short distance to west							
7/10/2000	Open	Open	Closed	Closed	Open	Open	Open	G-11

Table G-1. Breaches, Maintenance and Other Changes, Point Buckler, 1985 - 2011

Photo Date	Breach Status, by Number Clockwise from Southeast Corner, Comments							Fig No.
	1	2	3	4	5	6	7	
10/2002	Open	Open	Closed	Closed	Open	Open	Open	G-12
2003 (summer)	Open	Open	Newly Open	Newly Open	Open	Open	Open	G-13
	- Breaches 3 and 4 on west side open - Partial repairs to north dock made, not all the way to the island							
10/20/2003	Open	Open	Open	Open	Open	Open	Open	G-14
2005 (summer)	Open	Open	Open	Open	Open	Open	Open	G-15
	- 2003 repairs to north dock degraded							
2006 (summer)	Open	Open	Open	Open	Open	Open	Open	G-16
	- Dock in Andy Mason Slough removed - 2003 repairs to north dock gone							
9/1/2008	Open	Open	Open	Open	Open	Open	Open	G-17
2009 (summer)	Open	Open	Open	Open	Open	Open	Open	G-18
Apr 2011	Open	Open	Open	Open	Open	Open	Open	G-19
9/1/2011	Open	Open	Open	Open	Open	Open	Open	G-20

Breach descriptions

1 Small channel south central through outboard marsh
2 Large southwest corner opening
3 Small channel west side, appears to be smallest of all breaches
4 Small channel northwest side
5 Large north central opening
6 Moderate north central opening
7 Connects to large northern interior remnant marsh channel

Table G-2. Sequence of Levee Breaches, 1985 to 2011

Breach Date	Breach Number						
	1	2	3	4	5	6	7
4/30/1985	Closed	Closed	Closed	Closed	Closed	Closed	Closed
8/18/1988					Open		
6/13/1990		Open				Open	
8/23/1993*	Open						Open
Summer 2003			Open	Open			
9/1/2011	All breaches remained open since above dates						

** The five breaches open by 1993 represent the largest tidal connections.*

Table G-3. Length of Levee Breaches and Degradation, 1985 to 2011

Levee Condition	Levee and Breach Lengths			
	1985		2011	
	feet	%	feet	%
A. **Levee:** height adequate to prevent or greatly minimize tidal flows	4,920	100	990	20
B. **Breaches in levee:** allows daily tidal exchange to island interior	0		545	11
C. **Degraded levee:** allows overtopping by higher tides into island interior	0		3,385	69
Total length	**4,920**		**4,920**	

Table G-4. Shoreline Area and Length Changes, 1985 to 2011

Feature	Area (ac)	Length (ft)
Shoreline		
2011	--	9,865
1985	--	8,174
Net (complexity)	**--**	**+1,691**
Island Area		
1985	42.902	--
2011	38.860	--
Net (erosion)	**-4.042**	--
Erosion and Accretion		
Erosion	-4.084	--
Accretion	0.042	--
Net (erosion)	**-4.042**	--

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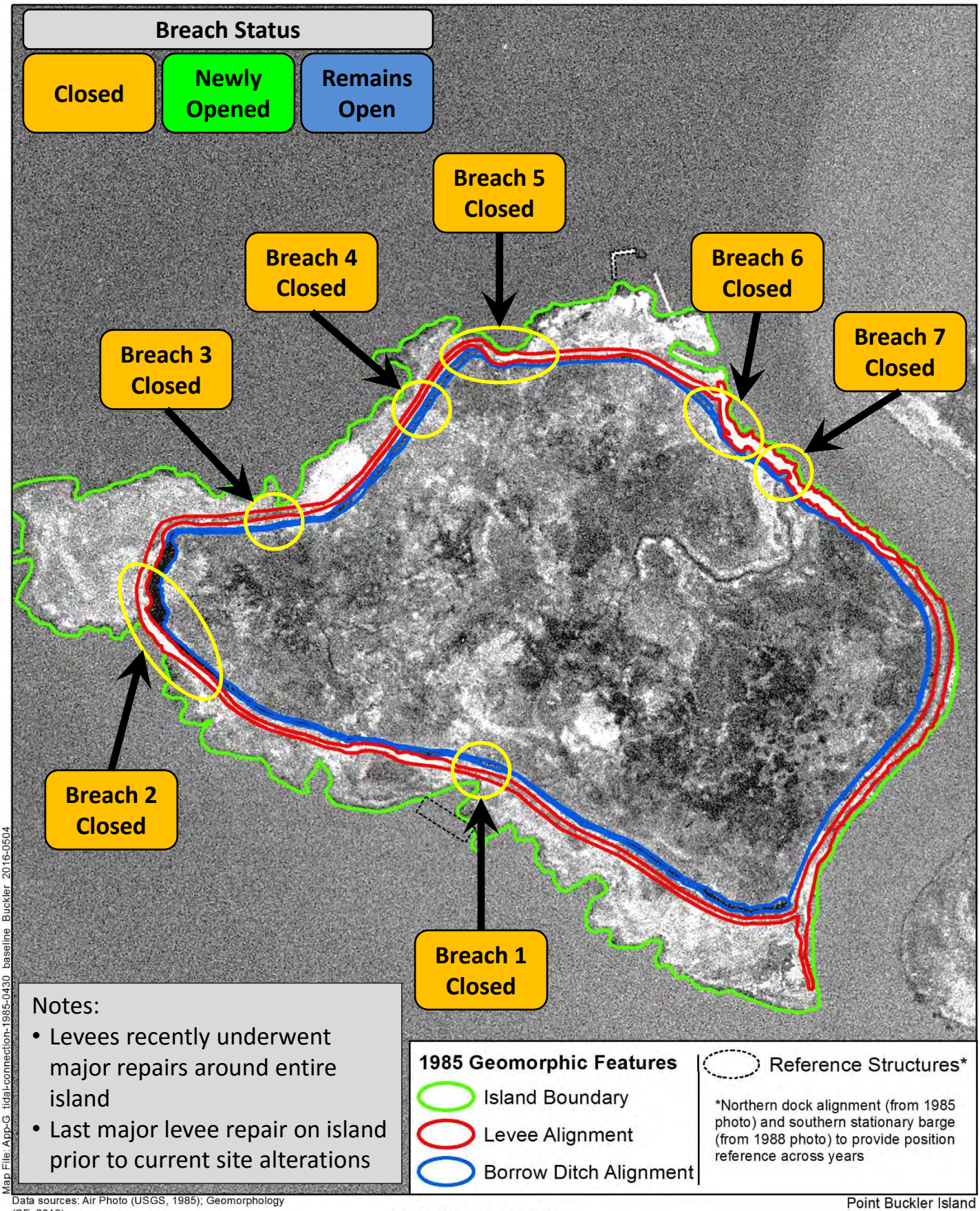
Figure G-20. Tidal Connectivity Conditions September 1, 2011 (Digital Globe)

Figure G-21. Baseline Tidal Hydrology and Geomorphology, April 2011

Figure G-22. Erosion of Island Perimeter, 1985 to 2011



Notes:
- Levees recently underwent major repairs around entire island
- Last major levee repair on island prior to current site alterations

Map File: App-G_tidal-connection-1985-0430_baseline_Buckler_2016-0504

Data sources: Air Photo (USGS, 1985); Geomorphology (SE, 2016)

1:3,600 (1" = 300' at letter size)

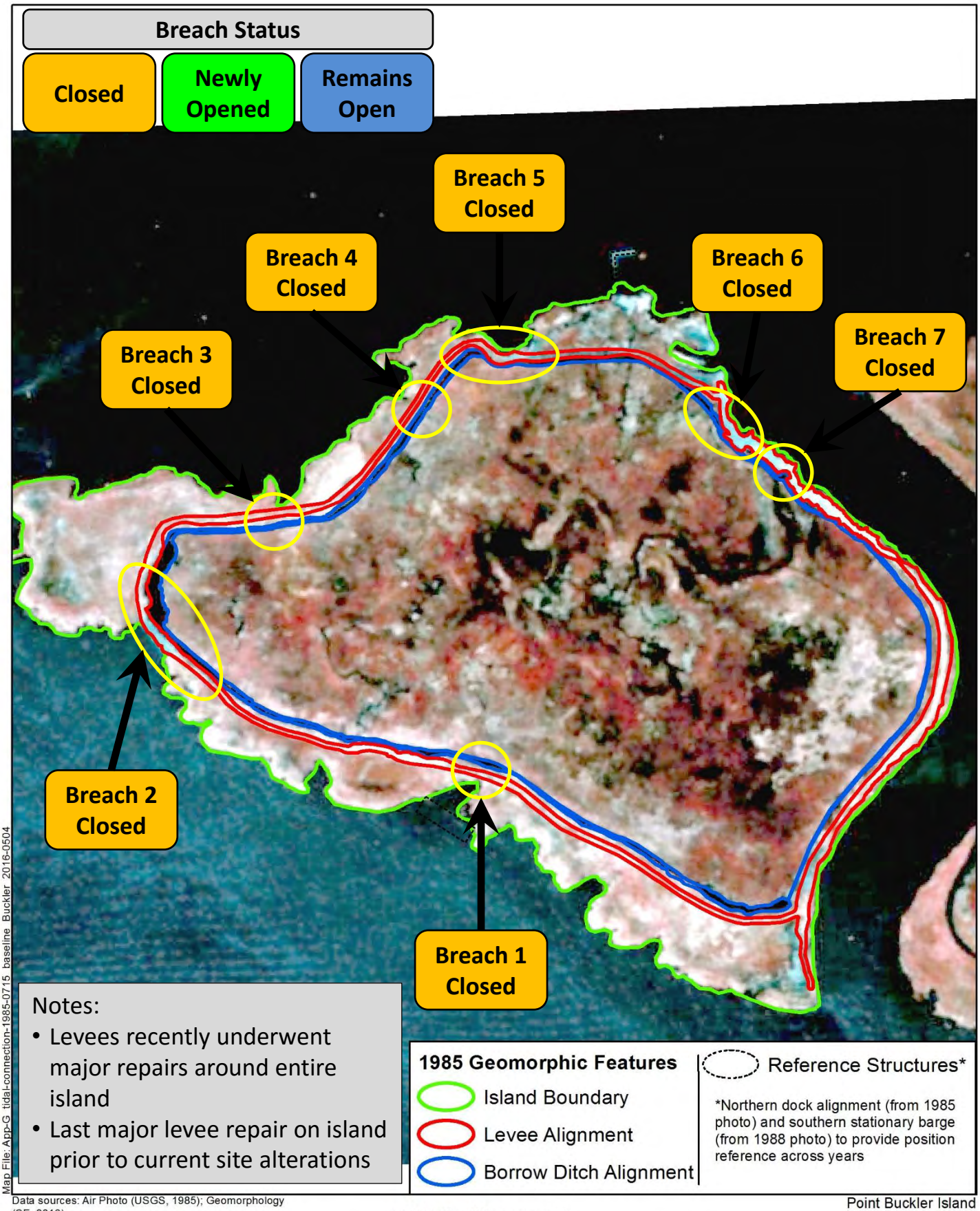
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-1

(USGS) April 30, 1985
Baseline Tidal Connectivity Conditions



Notes:
- Levees recently underwent major repairs around entire island
- Last major levee repair on island prior to current site alterations

Map File: App-G_tidal-connection-1985-0715_baseline_Buckler_2016-0504

Data sources: Air Photo (USGS, 1985); Geomorphology (SE, 2016)

1:3,600 (1" = 300' at letter size)

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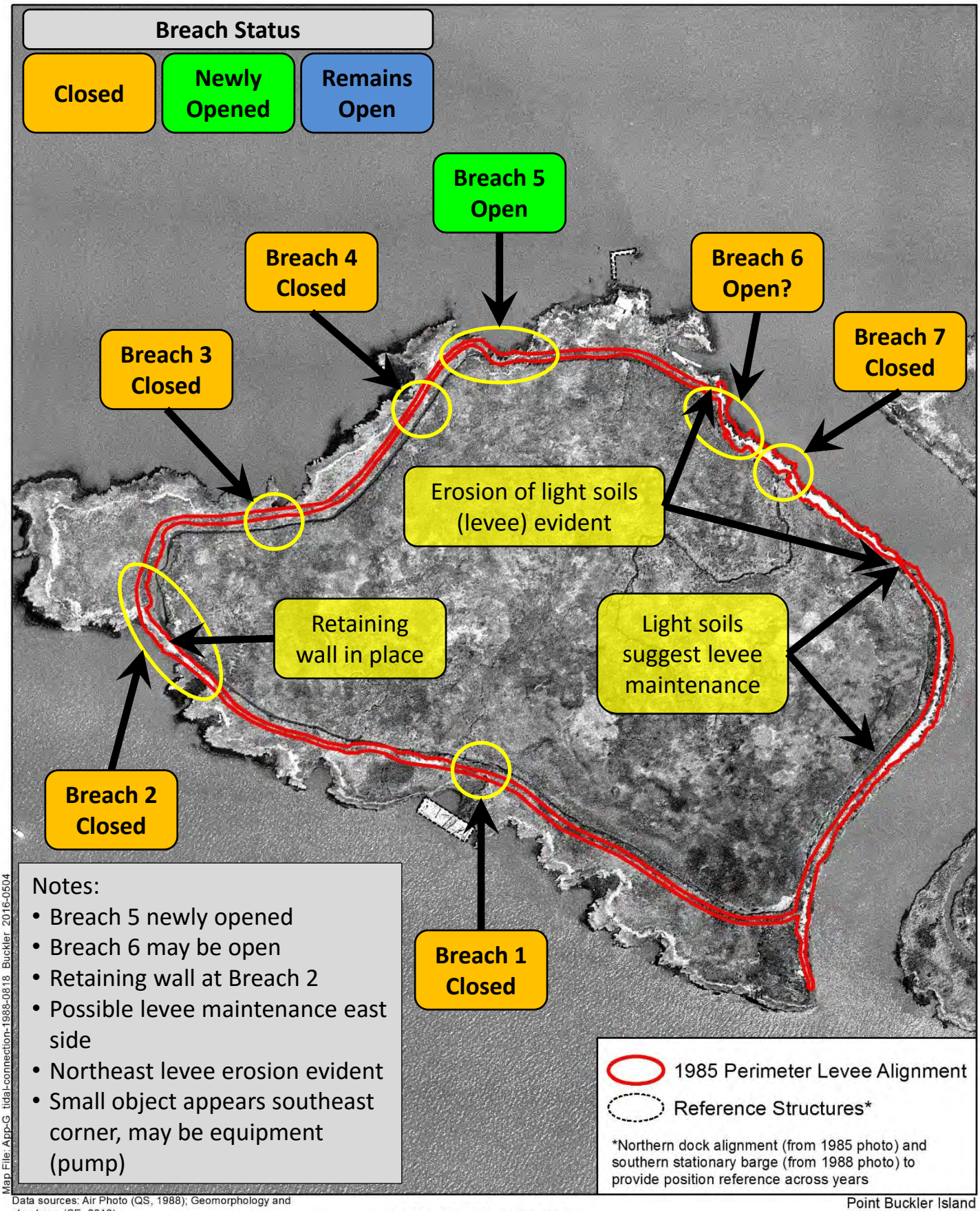
0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-2

(USACE) July 15, 1985
Baseline Tidal Connectivity Conditions



Map File: App-G_tidal-connection-1988-0818_Buckler_2016-0504

Data sources: Air Photo (QS, 1988); Geomorphology and structures (SE, 2016)

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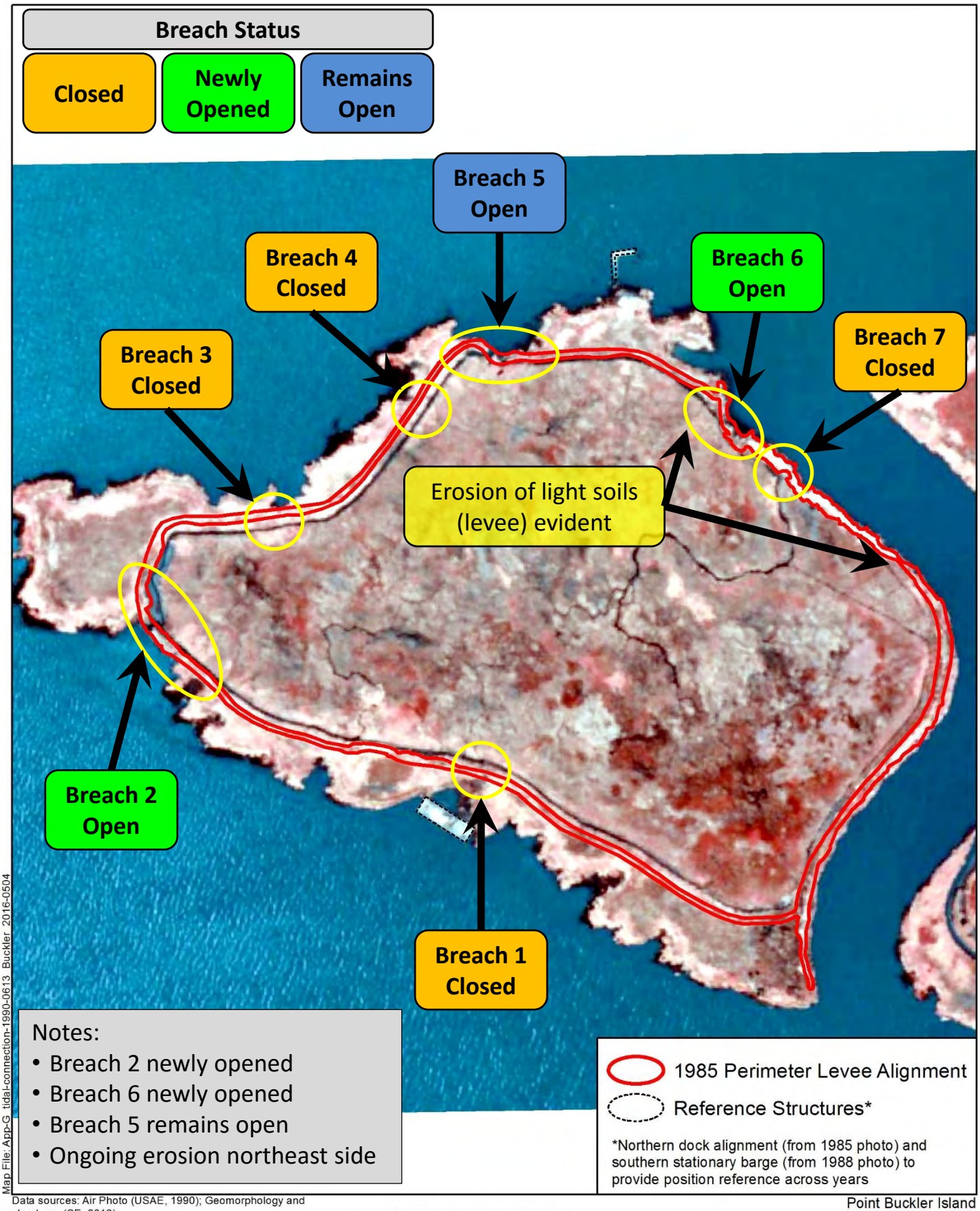
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-3

(Quantum Spatial) August 18, 1988 Tidal Connectivity Conditions



Map File: App-G_tidal-connection-1990-0613_Buckler_2016-0504

Data sources: Air Photo (USAE, 1990); Geomorphology and structures (SE, 2016)

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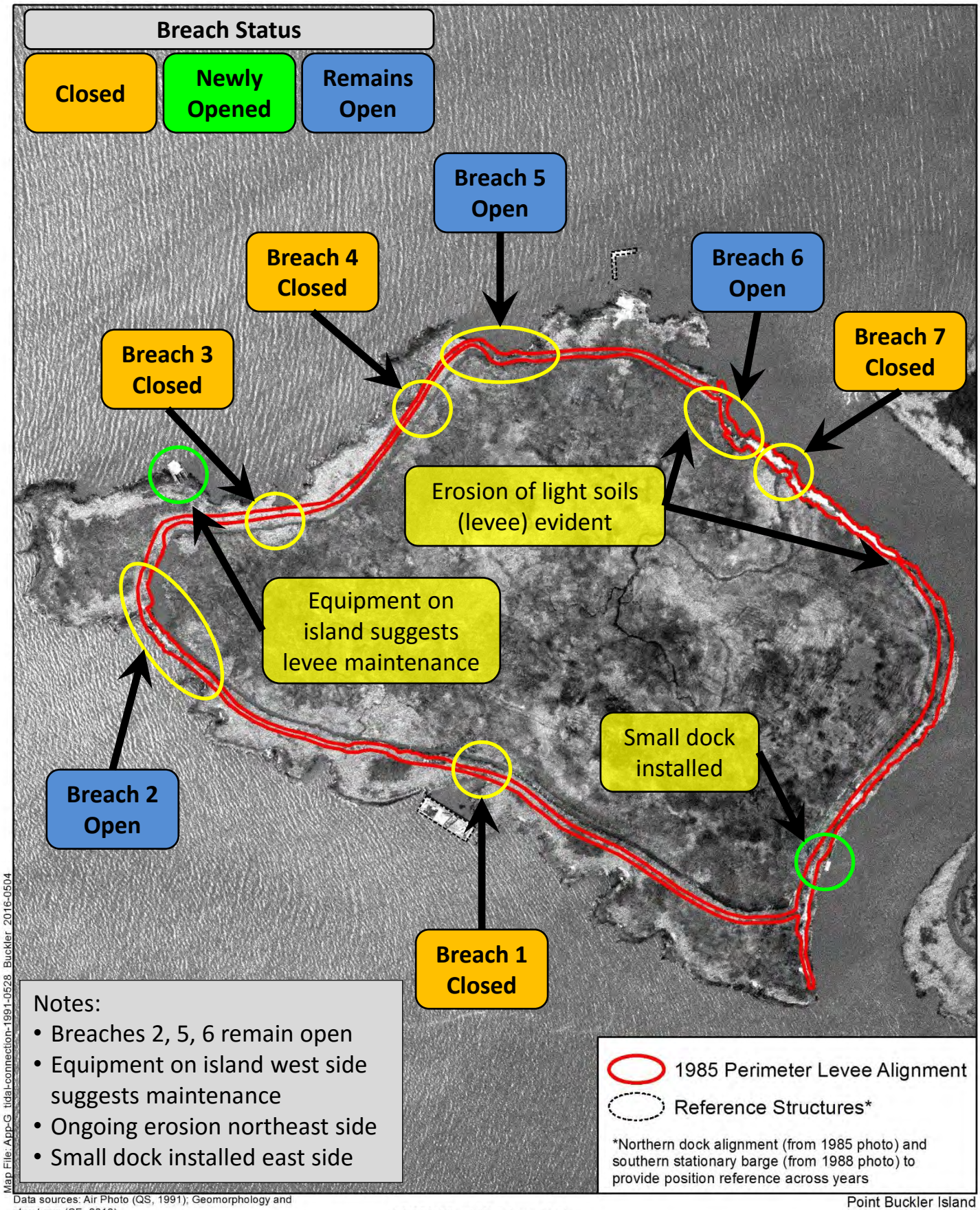
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-4

(USACE) June 13, 1990
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-1991-0528_Buckler_2016-0504

Data sources: Air Photo (QS, 1991); Geomorphology and structures (SE, 2016)

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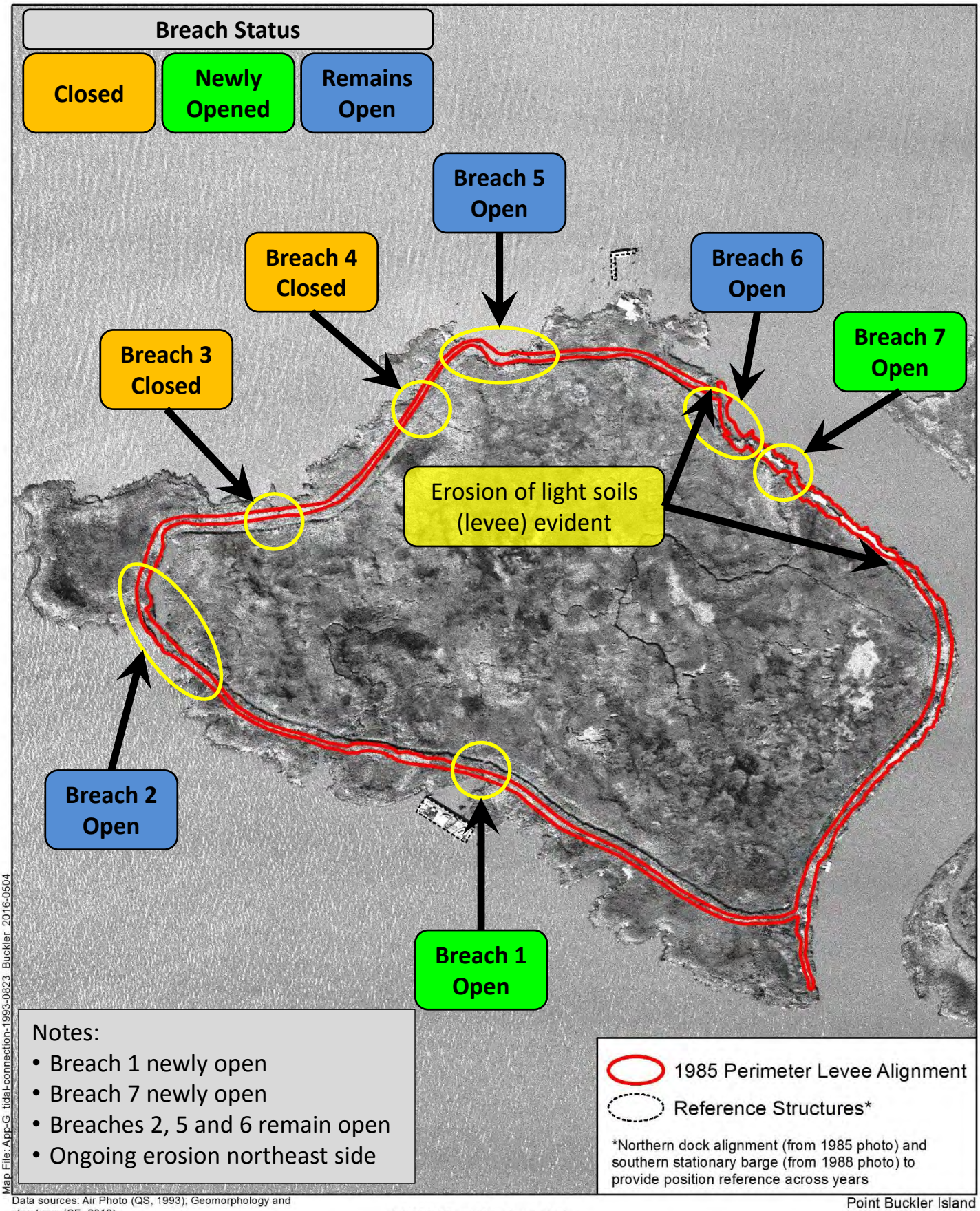
0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-5

(Quantum Spatial) May 28, 1991
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-1993-0823_Buckler_2016-0504

Data sources: Air Photo (QS, 1993); Geomorphology and structures (SE, 2016)

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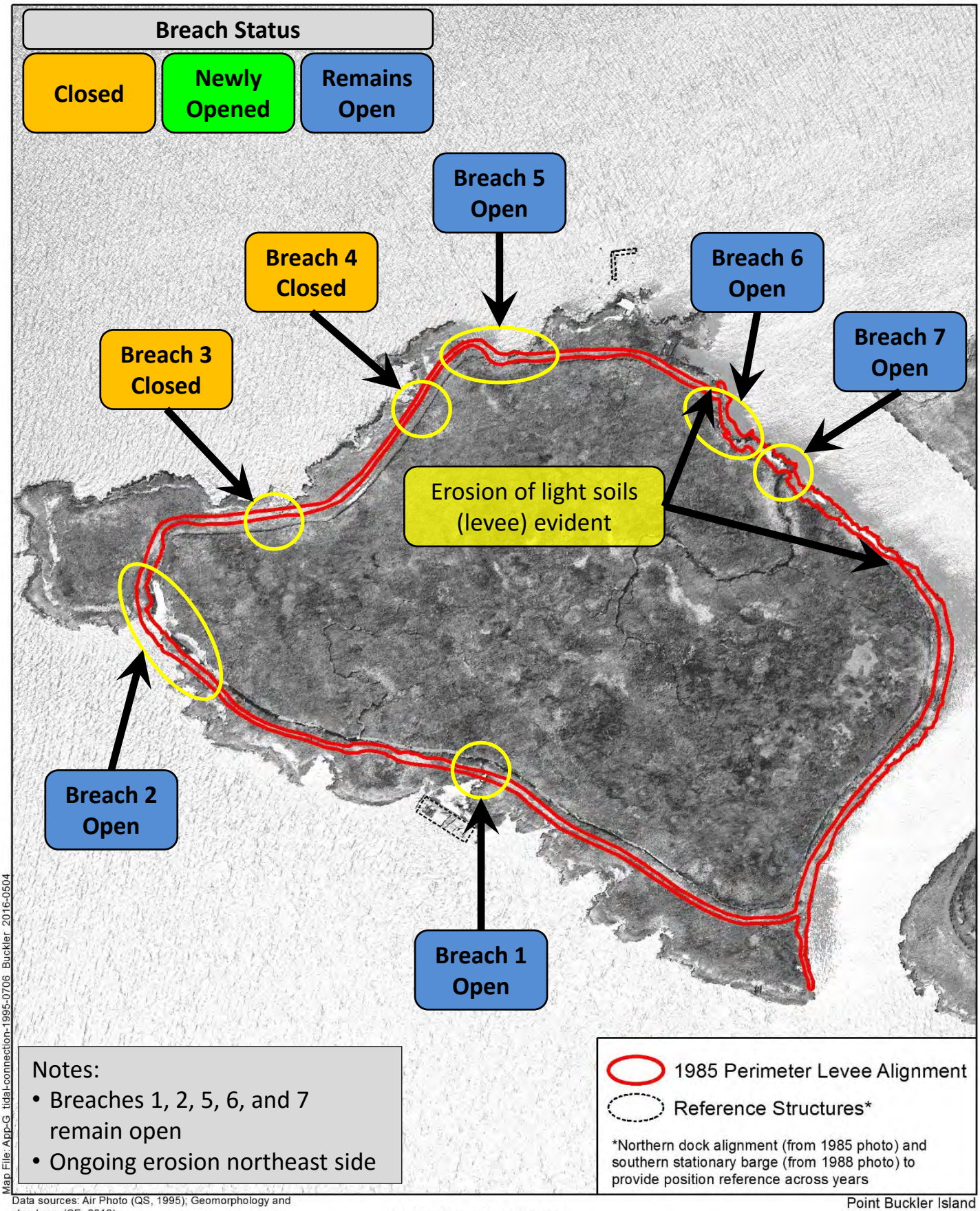
0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-6

(Quantum Spatial) August 23, 1993
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-1995-0706_Buckler_2016-0504

Data sources: Air Photo (QS, 1995); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

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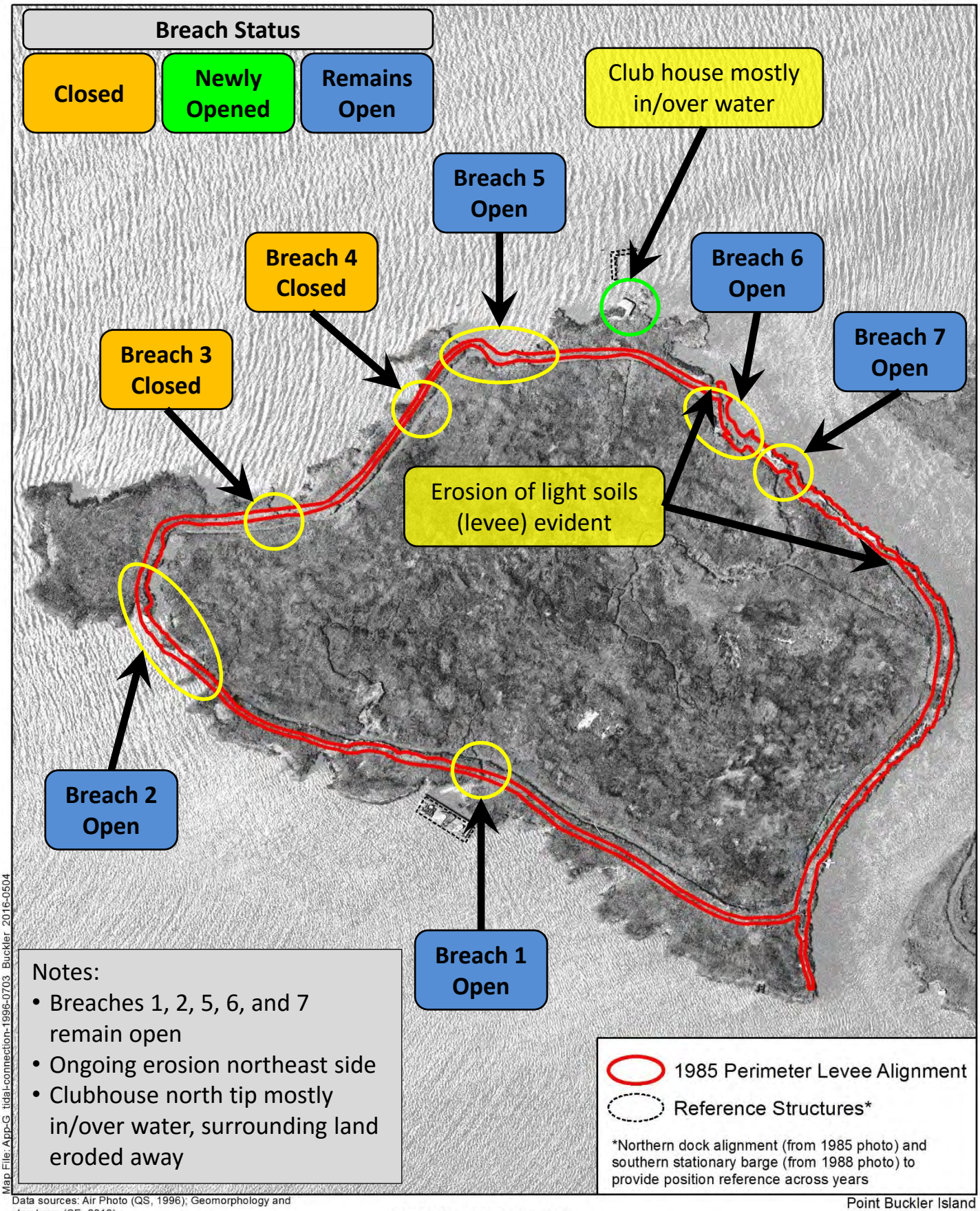
0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-7

(Quantum Spatial) July 6, 1995
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-1996-0703_Buckler_2016-0504

Data sources: Air Photo (QS, 1996); Geomorphology and structures (SE, 2016)

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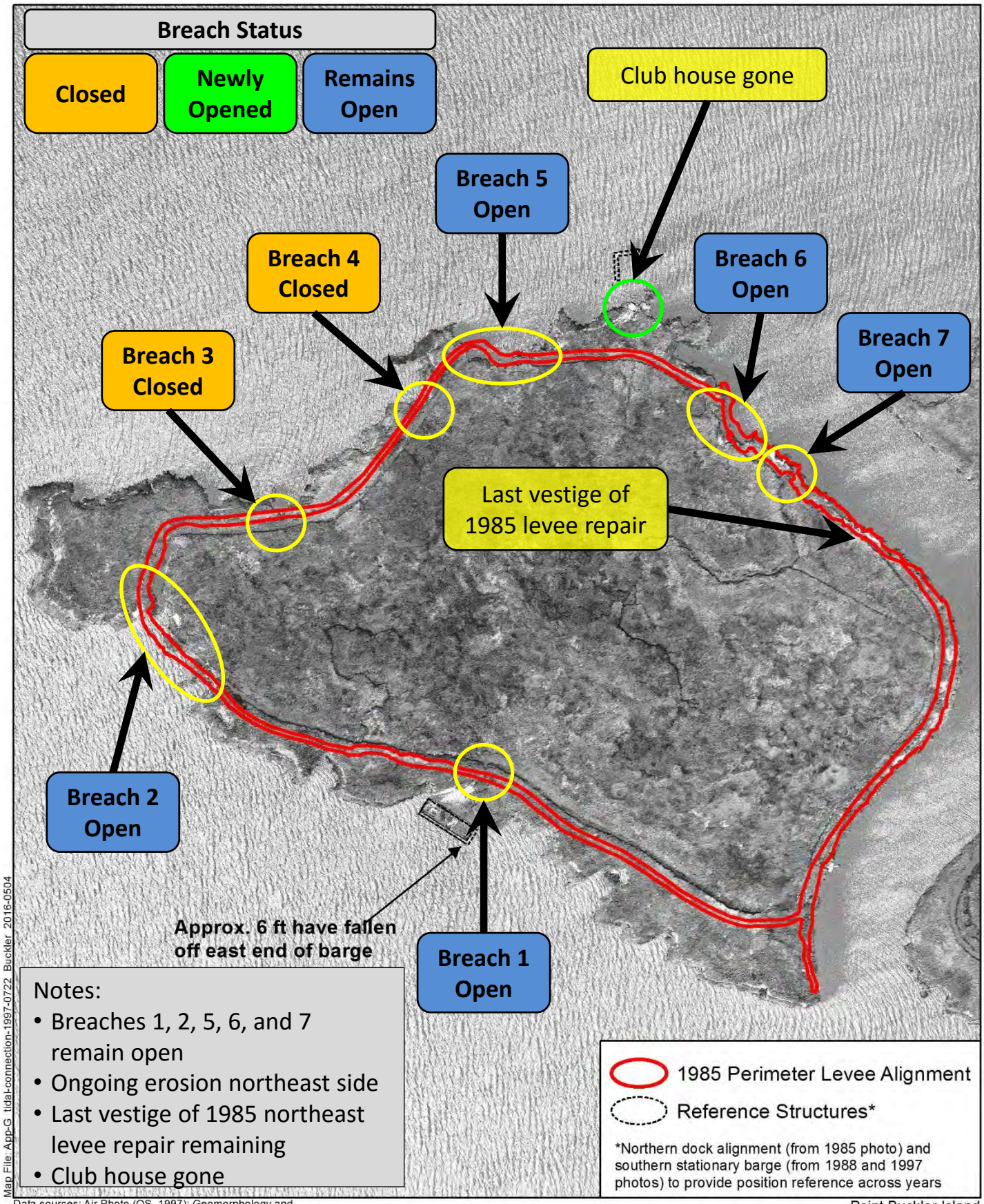
0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-8

(Quantum Spatial) July 3, 1996
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-1997-0722_Buckler_2016-0504

Data sources: Air Photo (QS, 1997); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

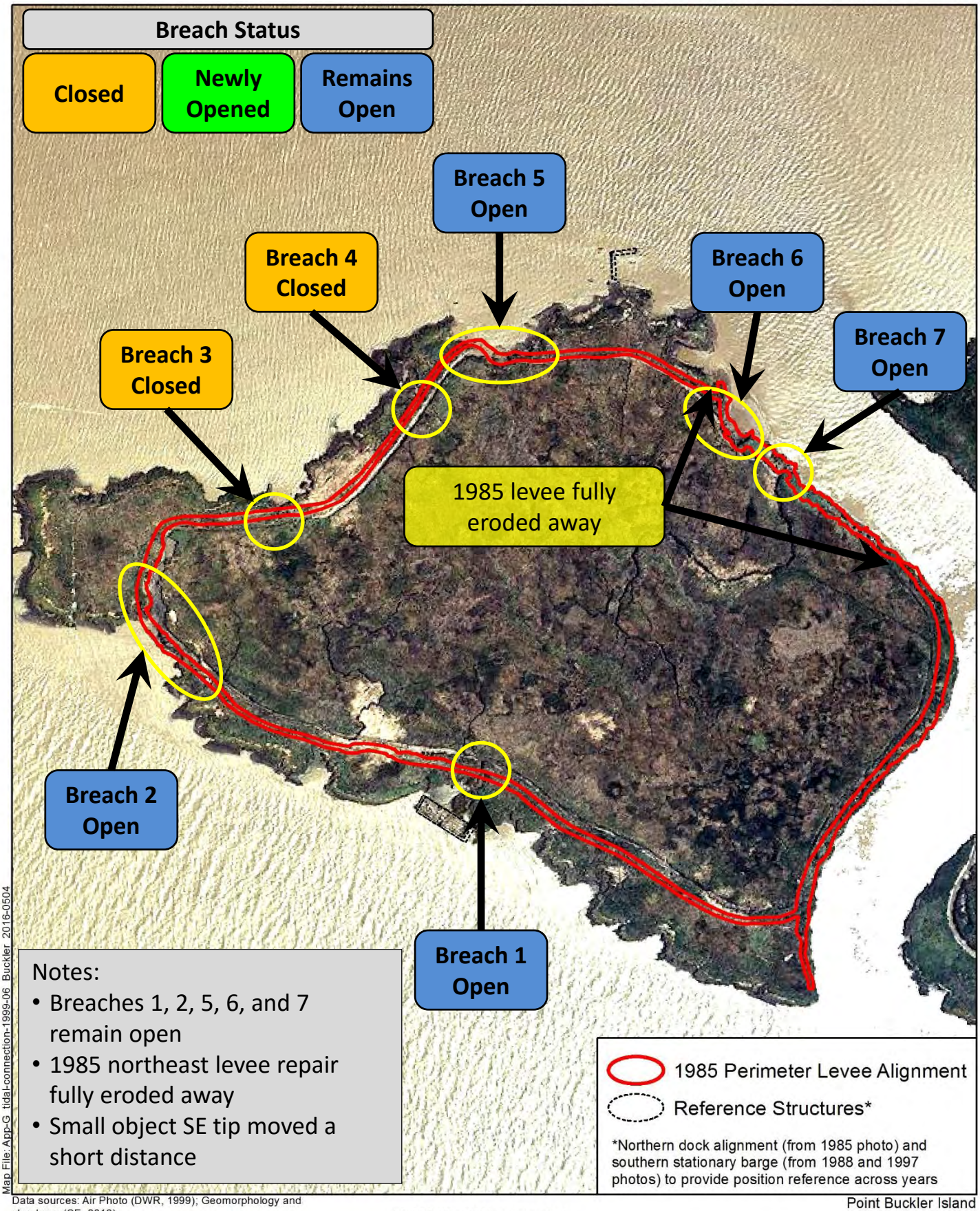
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-9

(Quantum Spatial) July 22, 1997
Tidal Connectivity Conditions



Data sources: Air Photo (DWR, 1999); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

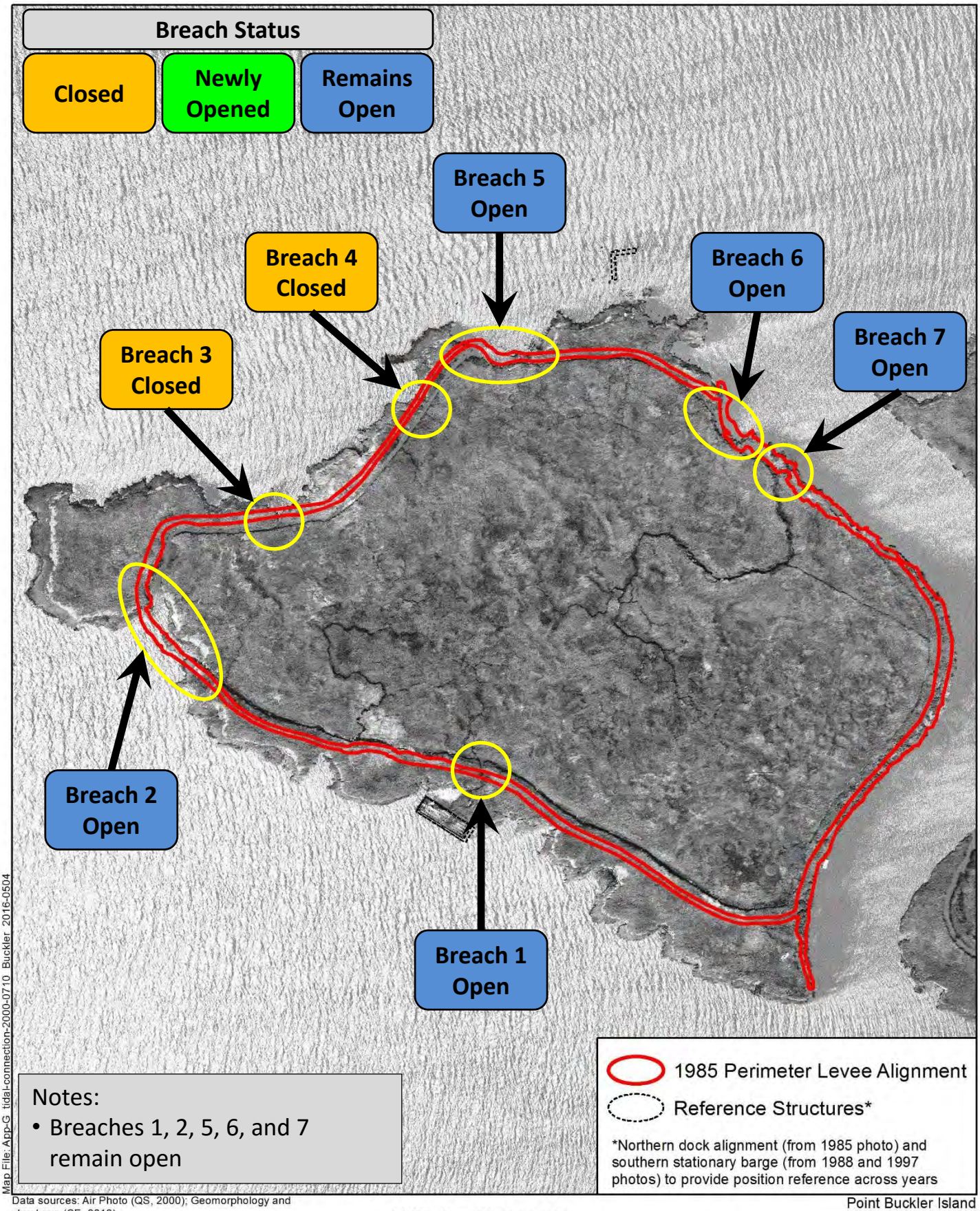
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-10

(DWR) June 1999
Tidal Connectivity Conditions



Notes:
- Breaches 1, 2, 5, 6, and 7 remain open

Map File: App-G_tidal-connection-2000-0710_Buckler_2016-0504

Data sources: Air Photo (QS, 2000); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

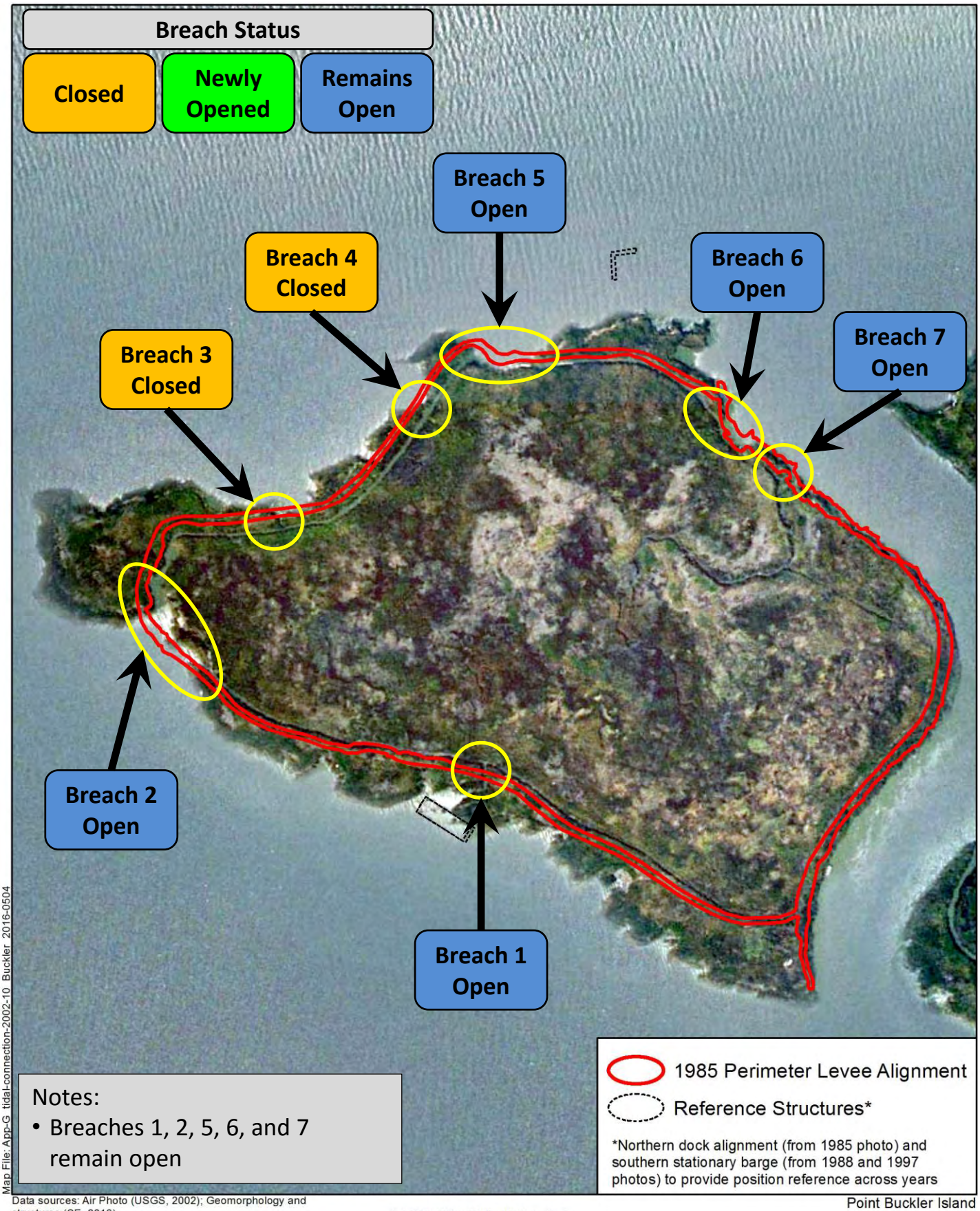
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-11

(Quantum Spatial) July 10, 2000
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-2002-10_Buckler_2016-0504

Data sources: Air Photo (USGS, 2002); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

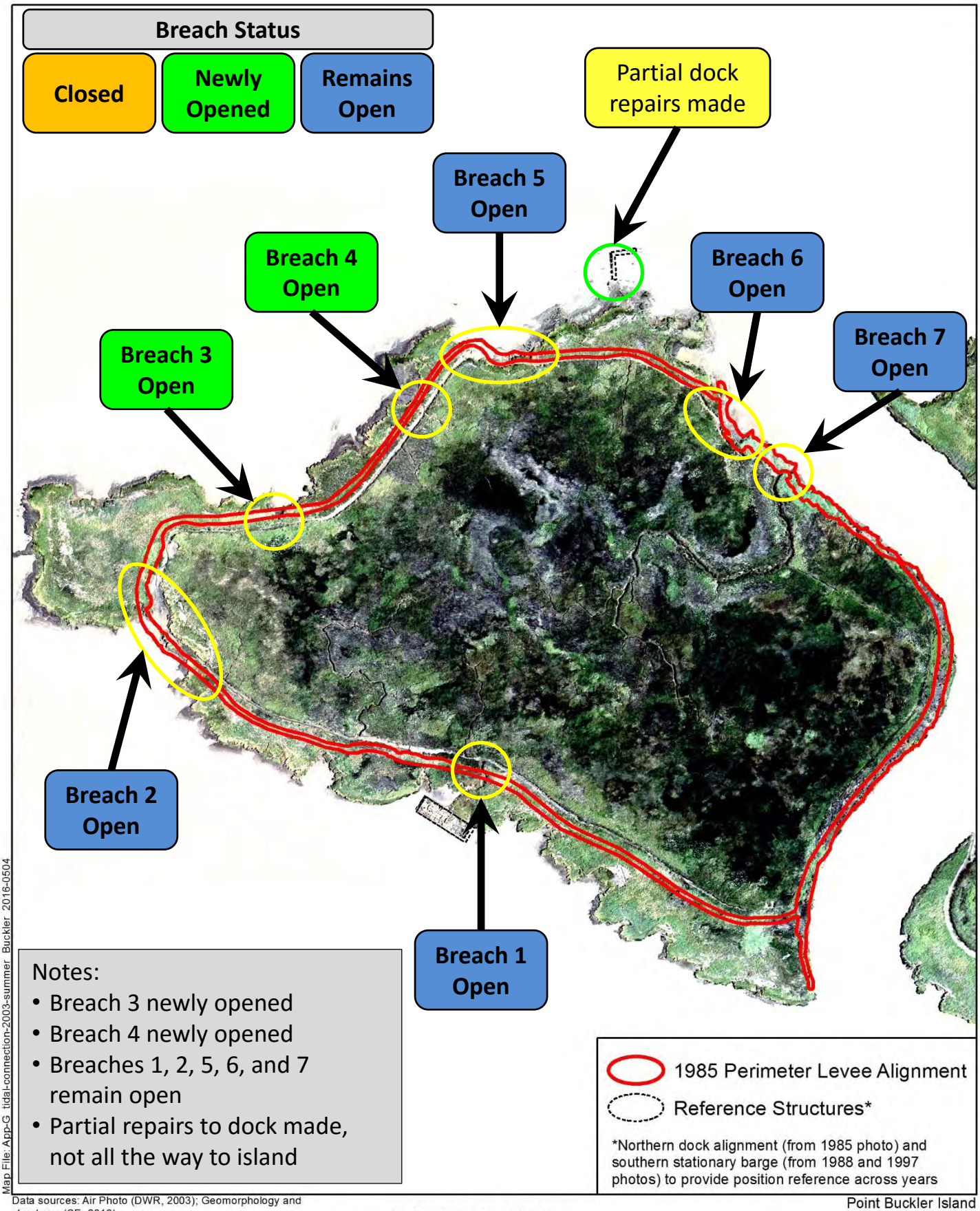
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-12

(USGS) October 2002
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-2003-summer_Buckler_2016-0504

Data sources: Air Photo (DWR, 2003); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

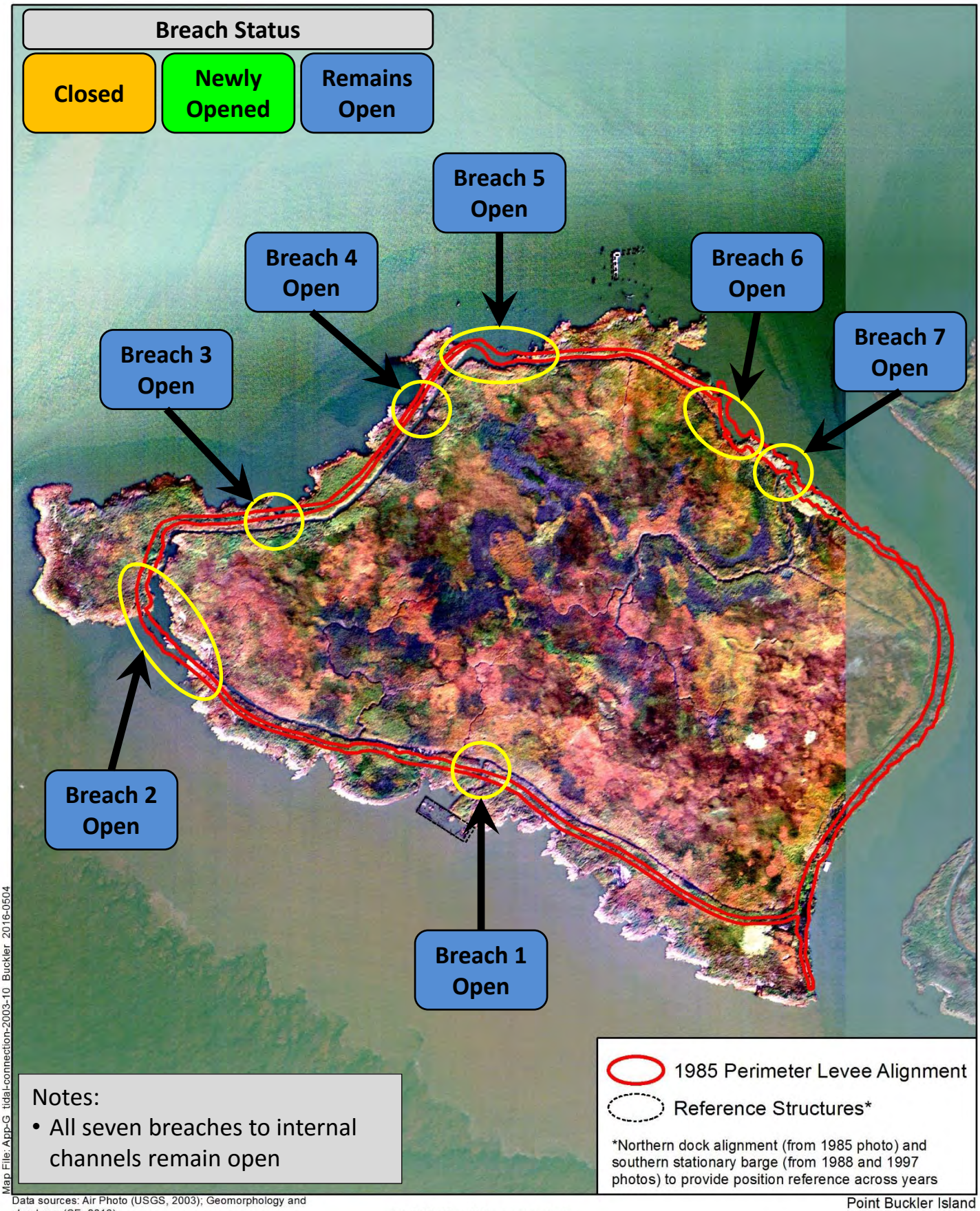
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-13

(DWR) Summer 2003
Tidal Connectivity Conditions



Notes:
- All seven breaches to internal channels remain open

Map File: App-G_tidal-connection-2003-10_Buckler_2016-0504

Data sources: Air Photo (USGS, 2003); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

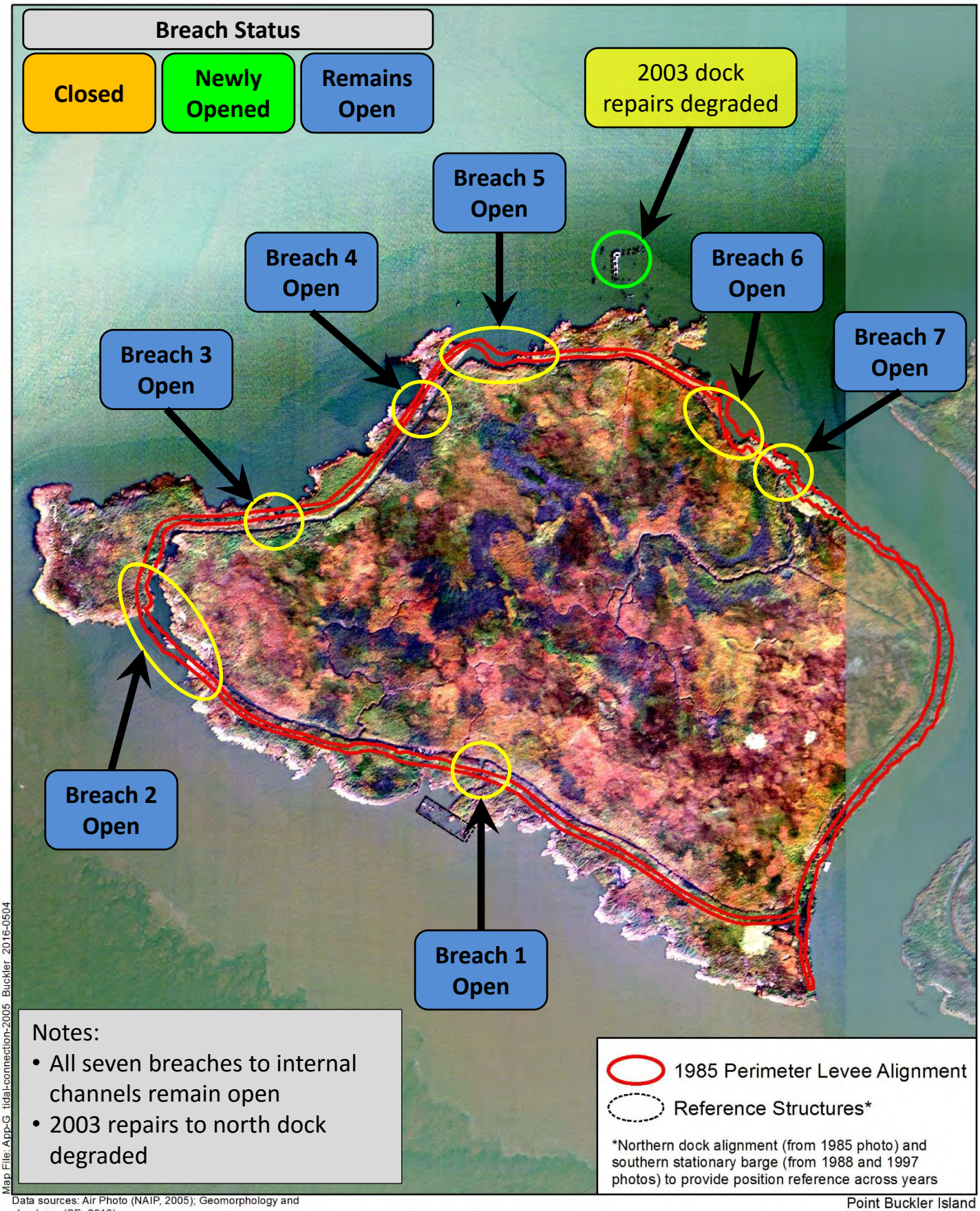
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-14

(USGS) October 20, 2003
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-2005_Buckler_2016-0504

Data sources: Air Photo (NAIP, 2005); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

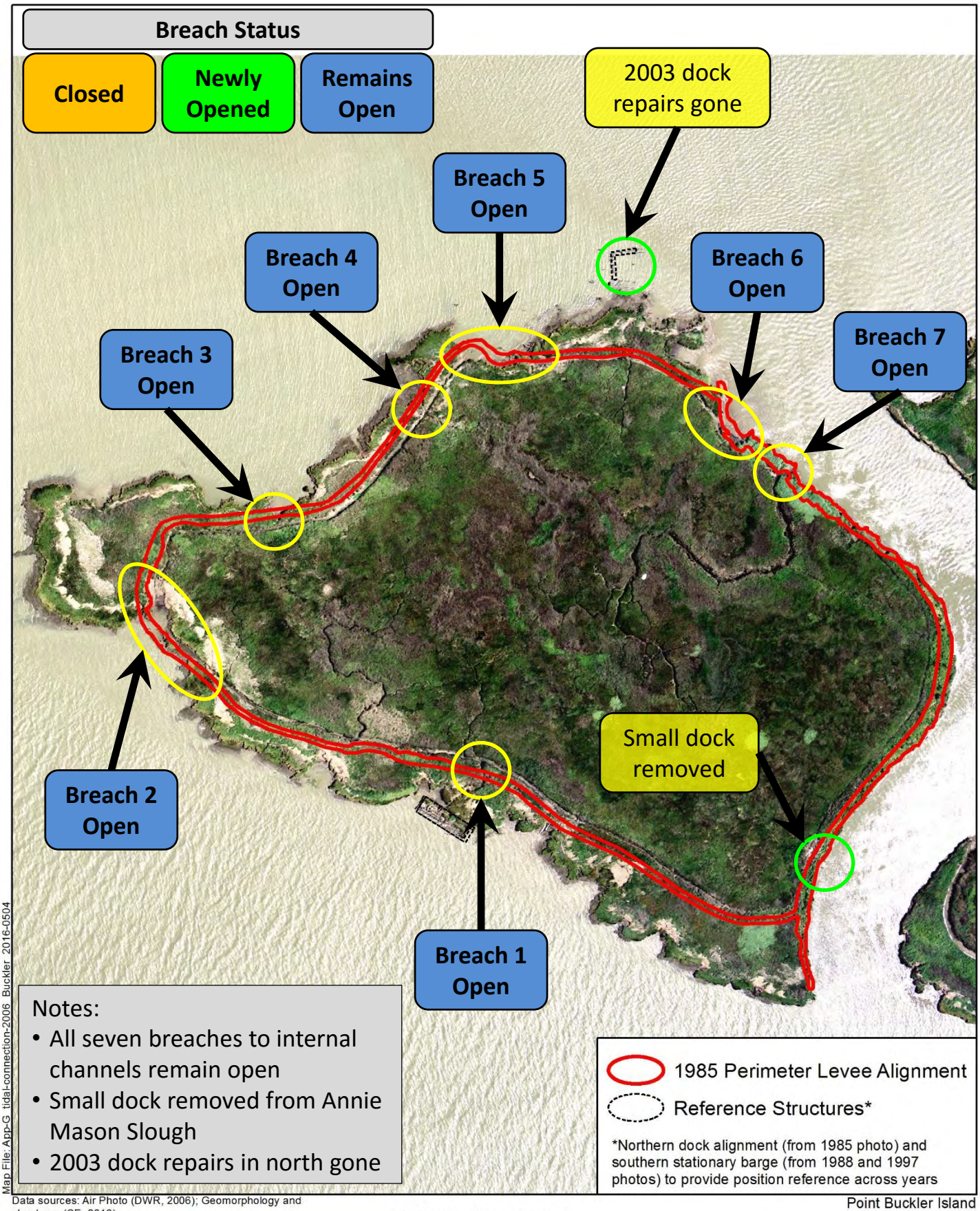
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-15

(NAIP) Summer 2005
Tidal Connectivity Conditions



Map File: App-G_tidal-connection-2006_Buckler_2016-0504

Data sources: Air Photo (DWR, 2006); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

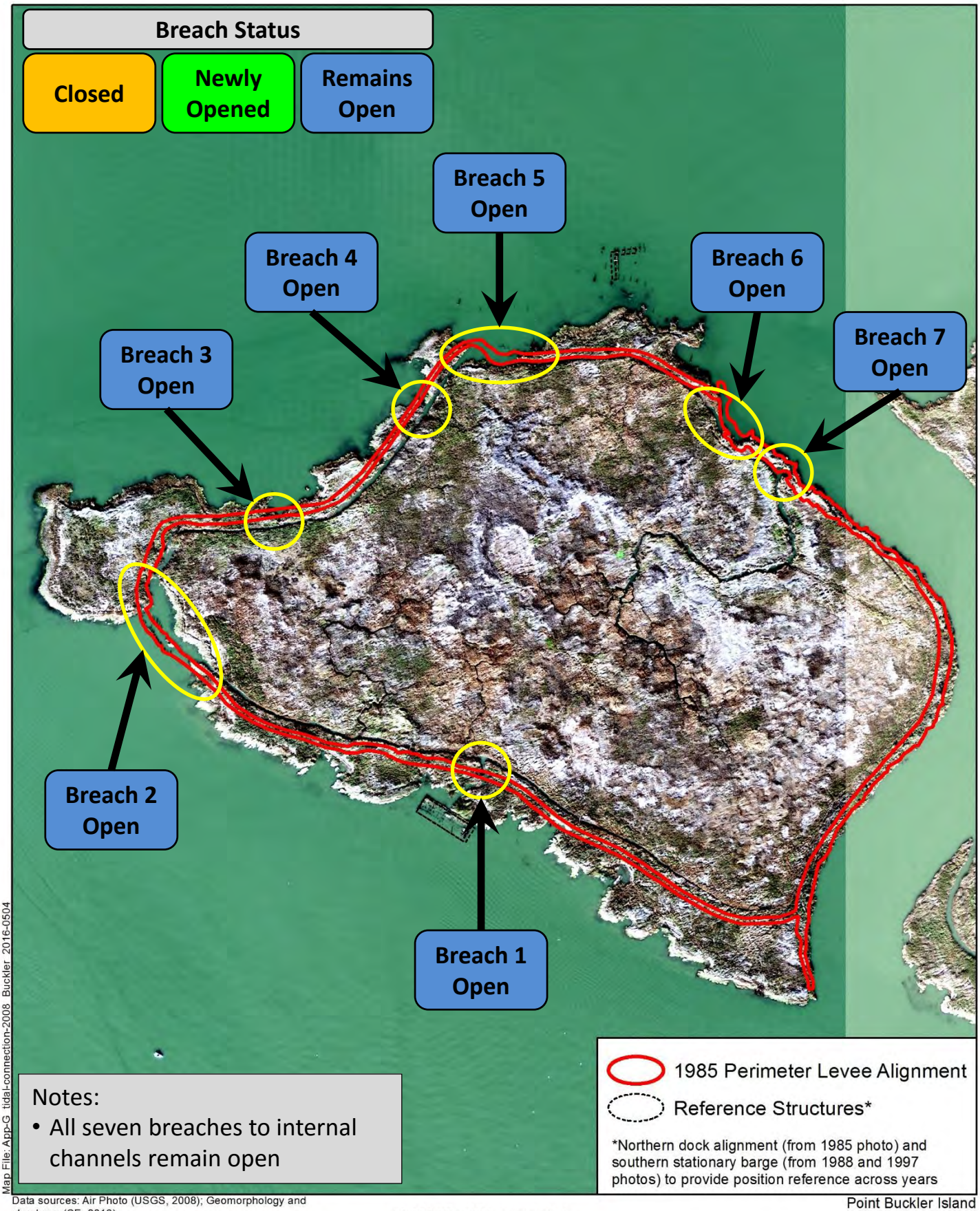
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-16

(DWR) Summer 2006
Tidal Connectivity Conditions



Notes:
- All seven breaches to internal channels remain open

Map File: App-G_tidal-connection-2008_Buckler_2016-0504

Data sources: Air Photo (USGS, 2008); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

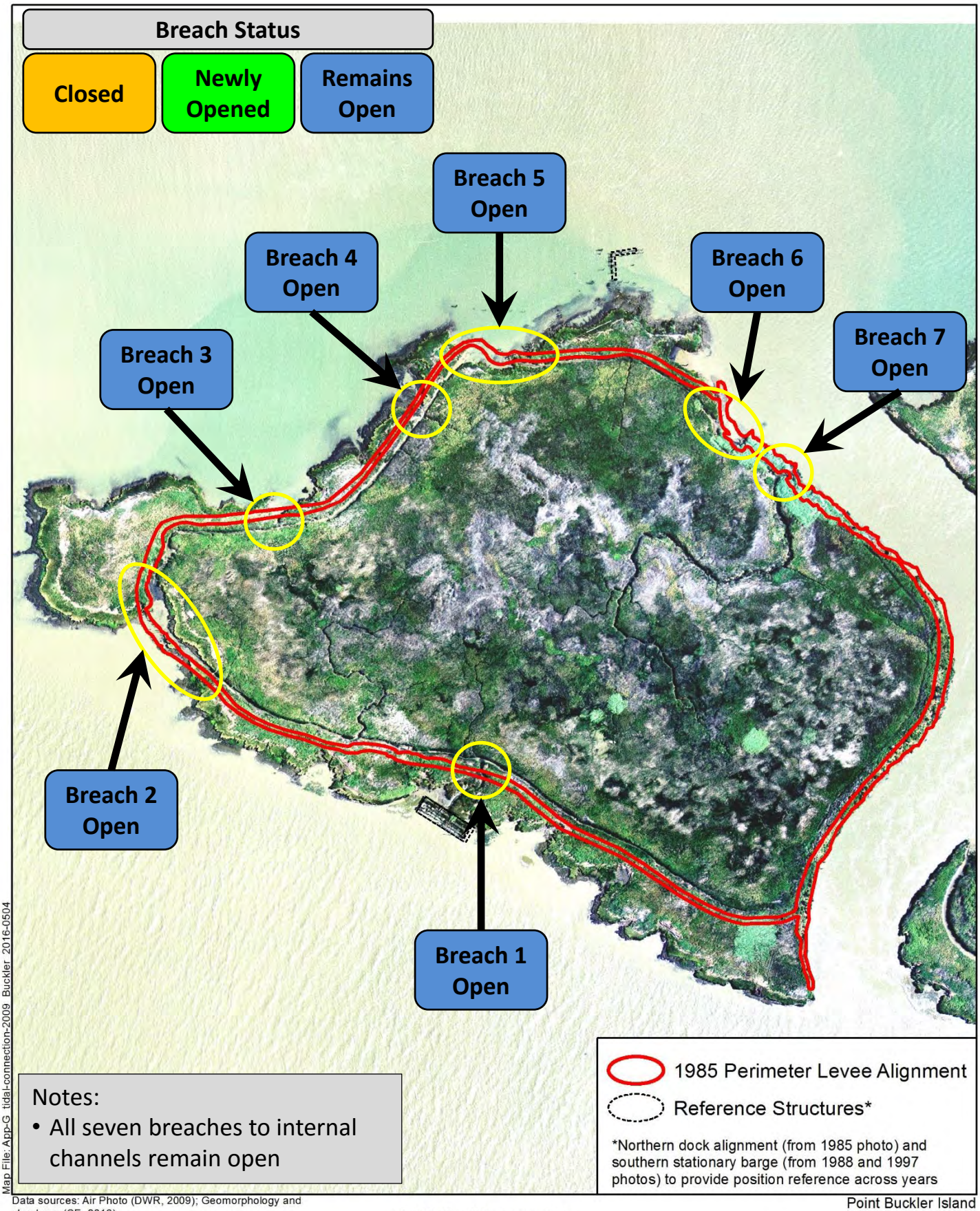
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-17

(USGS) Summer 2008
Tidal Connectivity Conditions



Notes:
- All seven breaches to internal channels remain open

Map File: App-G_tidal-connection-2009_Buckler_2016-0504

Data sources: Air Photo (DWR, 2009); Geomorphology and structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

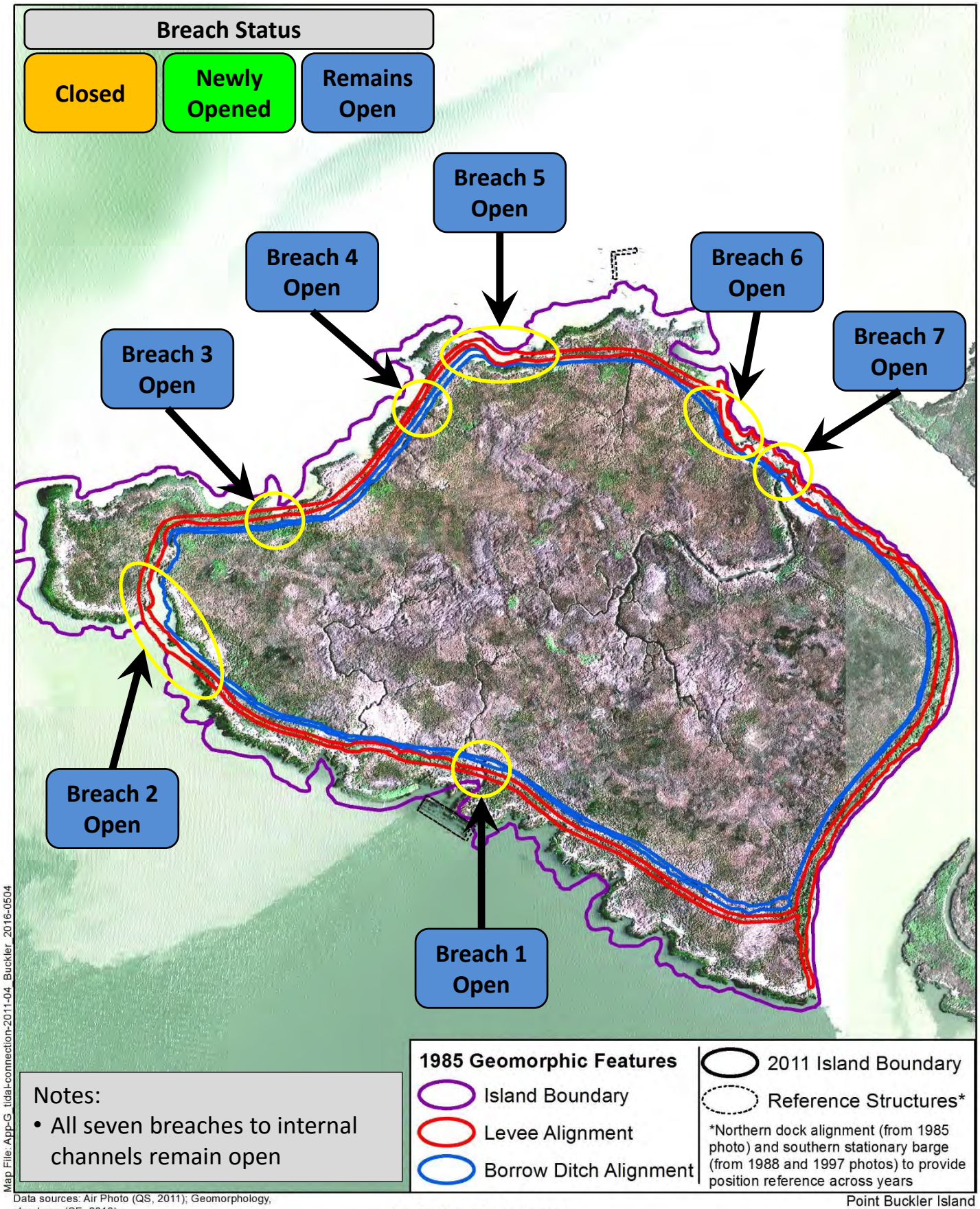
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-18

(DWR) Summer 2009
Tidal Connectivity Conditions



Notes:
- All seven breaches to internal channels remain open

Map File: App-G_tidal-connection-2011-04_Buckler_2016-0504

Data sources: Air Photo (QS, 2011); Geomorphology, structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

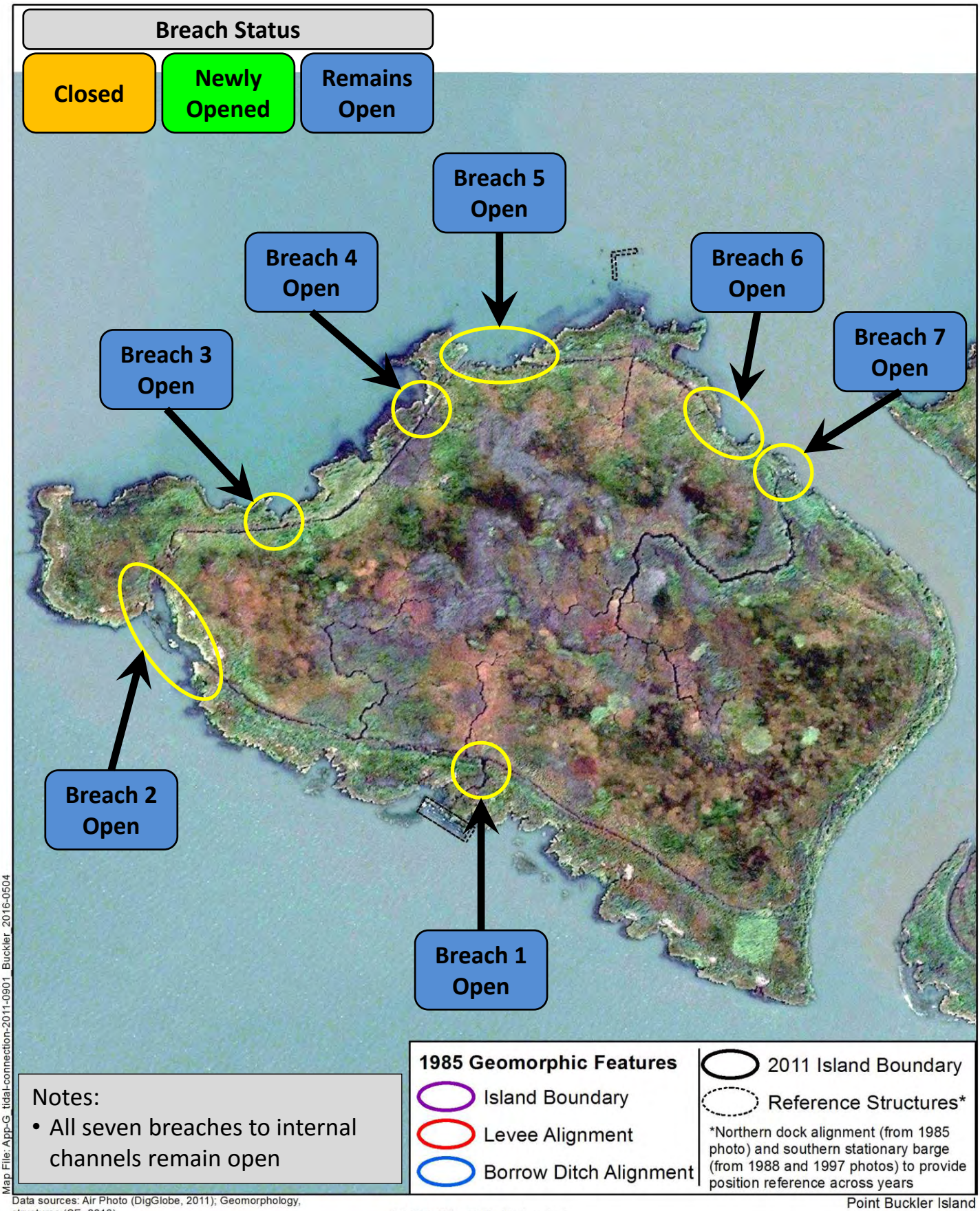
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-19

(Quntum Spatial) April 2011
Tidal Connectivity Conditions



Notes:
- All seven breaches to internal channels remain open

Map File: App-G_tidal-connection-2011-0901_Buckler_2016-0504

Data sources: Air Photo (DigGlobe, 2011); Geomorphology, structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-20

(Digital Globe) September 1, 2011
Tidal Connectivity Conditions

Site Tidal Hydrology

A. Tidal Channel Connectivity

- Remnant Borrow Ditch (3,200 ft)
- Interior Marsh Channels (3,050 ft)
- Eroded Interior Marsh at Breaches[1]
- Breaches through 1985 Levee (545 ft, 11%)
- Remnant Borrow Ditch Centerline (890 ft)[2]
- Interior Marsh Channel[2] (2,125 ft) / Ditch Centerline[2] (370 ft)

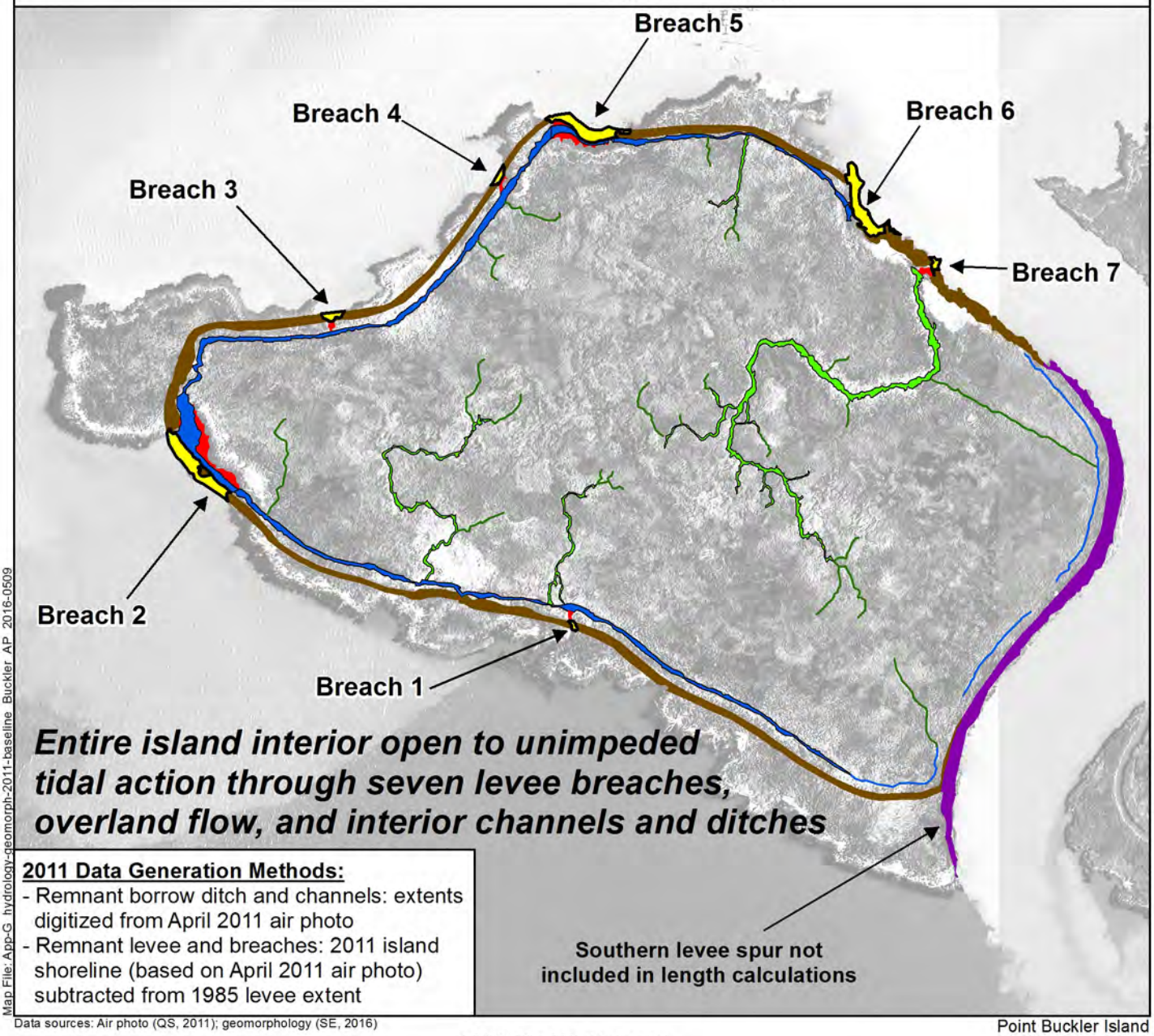
B. Overland Tidal Connectivity

- Remnant 1985 Levee, Wetlands[3] (3,385 ft, 69%)

C. Probable Terrestrial - Little or No Tidal Connectivity

- Remnant 1985 Levee, Terrestrial Lowlands[3] (990 ft, 20%)

[1] Areas of marsh plain loss between 1985 and 2011
[2] Minor features symbolized as lines - width not to scale
[3] Extent based on 2012 CA Dept. of Fish and Wildlife vegetation mapping



2011 Data Generation Methods:
- Remnant borrow ditch and channels: extents digitized from April 2011 air photo
- Remnant levee and breaches: 2011 island shoreline (based on April 2011 air photo) subtracted from 1985 levee extent

Map File: App-G_hydrology-geomorph-2011-baseline_Buckler_AP_2016-0509

Data sources: Air photo (QS, 2011); geomorphology (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-21

Baseline Tidal Hydrology and Geomorphology, April 2011

Base air photo: (Quantum Spatial) April 2011

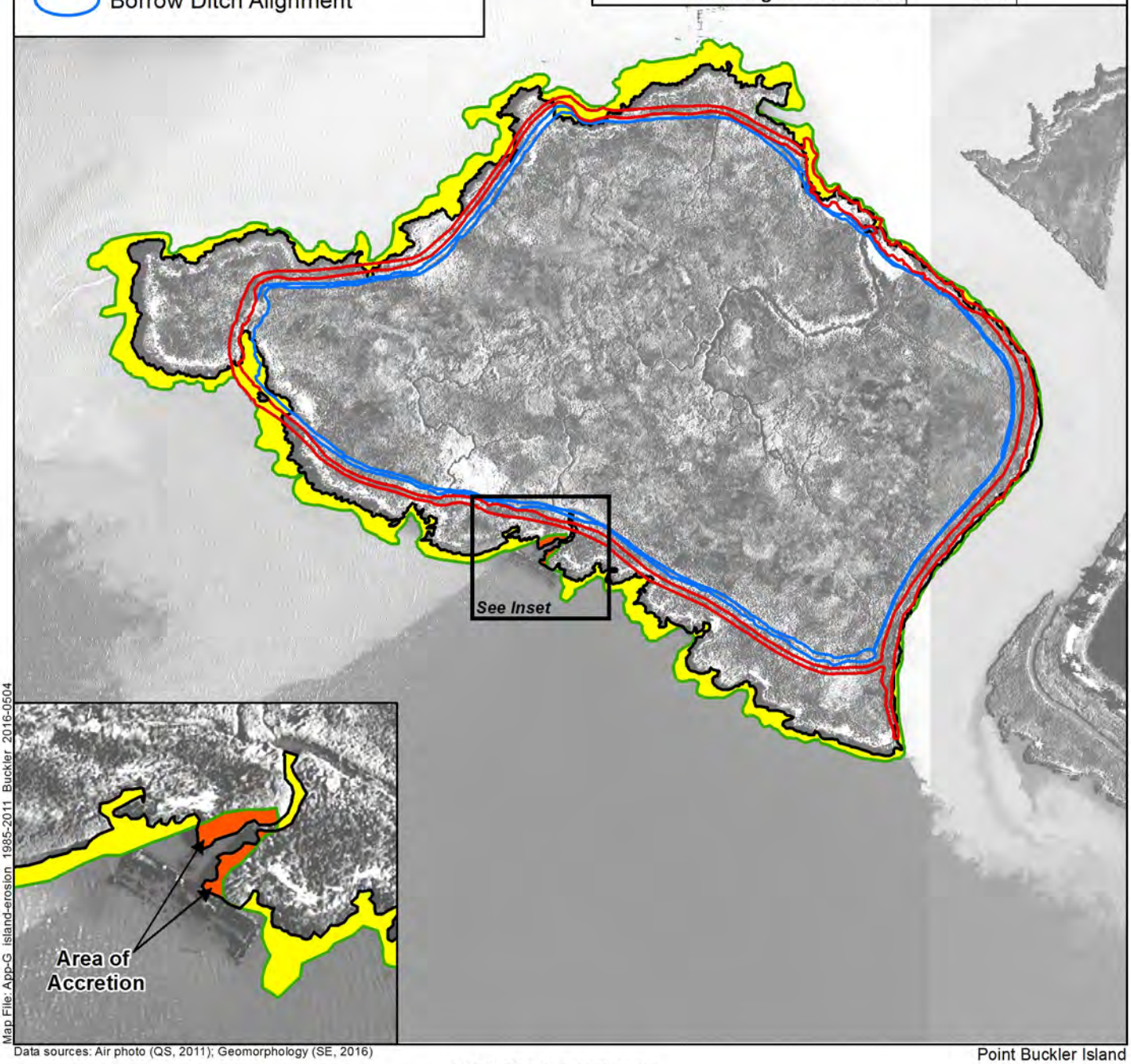
Shoreline Change: 1985-2011

- 1985 Shoreline
- 2011 Shoreline
- Area of Erosion - Shoreline Loss
- Area of Accretion - Shoreline Gain

1985 Geomorphic Features

- Levee Alignment
- Borrow Ditch Alignment

Feature	Area (ac)	Length (ft)
Shoreline		
1985 Shoreline Length	--	8,174
2011 Shoreline Length	--	9,865
Net Change in Shoreline Length (shoreline complexity)	--	**+ 1,691**
Island Area		
1985 Island Area	42.903	--
2011 Island Area	38.860	--
Area of Erosion (loss)	4.084	--
Area of Accretion (gain)	0.042	--
Net Change in Island Area	**- 4.042**	--



Map File: App-G island-erosion 1985-2011 Buckler 2016-0504

Data sources: Air photo (QS, 2011); Geomorphology (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure G-22

Base air photo: (Quantum Spatial) April 2011

Erosion of Island Perimeter, 1985-2011

Appendix H Baseline (2011) Site Conditions Assessment

H-1.0 Introduction

H-1.1 Context and Setting

In order to assess the physical and ecological impacts of unauthorized activities at Point Buckler, it is first necessary to understand the island's baseline conditions. Because the island has historically existed in a highly dynamic (as opposed to static) state, this understanding must be rooted in long-term historic observations, as well as the "snapshot" of the island's conditions immediately before 2012. As a point of reference, adjacent tidal and non-tidal wetlands (west Simmons Island) are also included in this assessment for context where relevant.

The physical and ecological setting of pre-reclamation Point Buckler is a tidal marsh composed of organic peat/muck soils that built over thousands of years from the accumulation of dead plant material. Sediment cores of Suisun Marsh tidal marshes (Byrne *et al.* 2001, Malamud-Roam *et al*. 2004, 2006) indicate that these soils formed in the late Holocene[1] during a period of slow sea level rise and major fluctuations in salinity, alternating between brackish and salt marsh phases over the last 2,000-3,000 years. Observations of Suisun Marsh tidal marsh vegetation in the 18th and 19th centuries occurred during an exceptionally "wet" period, when fresh-brackish (oligohaline[2]) conditions dominated within the Marsh (Malamud-Roam et al. 2004, Manfree 2012, Grewell *et al*. 2012, Whitcraft *et al.* 2011).

H-1.2 Sources of Evidence

Soils. Soils at Point Buckler were mapped by the U.S. Dept. of Agriculture's Soil Conservation Service (SCS)[3] based on field work from 1956-1968; the resulting soil classifications for Solano County (including Point Buckler) were approved in 1969 (SCS 1977). SCS soil maps include descriptions of typical vegetation and the range of vegetation types associated with different soil types, but they do not include location-specific vegetation maps. However, the Solano County Soil Survey uses black and white aerial photos from sometime between 1969 and 1975[4] as the base layer for their soil maps. Informal vegetation descriptions of Point Buckler were included in the 1984 Suisun Marsh waterfowl habitat management plan for "Club 801-Annie Mason Point Club" (BCDC file), citing observations and informal surveys from the mid-1970s through the early 1980s.

[1] The Holocene is the most recent geologic era, which began approximately 10,000 years ago and continues to the present day.
[2] The term "oligohaline" in this context is used to refer to water with a salinity of 0.5 to 3 or 5 ppt (parts per thousand), about one-third of ocean water.
[3] The SCS is now called the Natural Resources Conservation Service, or NRCS.
[4] The Solano County Soils maps, uncommonly, do not state the exact date of photographs used.

Vegetation. Formal vegetation classifications and maps of Suisun Marsh, including Point Buckler, were conducted by the California Department of Fish and Wildlife (CDFW)[5] and the California Department of Water Resources (CDWR) at 3-year intervals from 2000-2012 under the supervision of Todd Keeler-Wolf (Keeler-Wolf et al. 2000), the state vegetation ecologist leading statewide vegetation classification and mapping efforts for CDFW and California Native Plant Society (Sawyer *et al.* 2008). Figure H-2 shows these CDFW vegetation data.

Geomorphology. The geomorphology of baseline 2011 conditions at Point Buckler were developed from the April and September 2011 aerial photographs (Figure A-24 and Figure A-25) and the 2012 CDFW vegetation community data set (Figure H-2).

Ecological Features. The ecological features of baseline 2011 conditions at Point Buckler were developed from a variety of data: the April and September 2011 aerial photographs (Figure A-24 and Figure A-25) and the 2012 CDFW vegetation community data set (Figure H-2), elevation data (Appendix F), observations from field visits onto the island on October 21, 2015 and March 2, 2016, and two boat circumnavigations on February 17, 2016 and May 28, 2003.

March 2, 2015 field observations. Other primary and direct sources of evidence about Buckler Islands soils, hydrology, and vegetation are derived from field observations of relict vegetation (e.g., standing dead plant material, roots and rhizomes[6] buried under recent fill, and remnant live plants) and surface soils (including recently excavated, deposited, and buried soils, as well as surface soils in their original location that are now experiencing altered hydrologic conditions following diking and draining activities). This evidence is compared to observations of tidal wetlands, levees, lowland terrestrial vegetation, and diked non-tidal marshes on the adjacent Simmons Island duck clubs, which serve as reference sites for the same soil types mapped by the SCS at Point Buckler and throughout Suisun Marsh. Historical aerial photographs (black and white, color, and false-color infrared) of Point Buckler and adjacent Simmons Island were also examined in detail to compare and contrast vegetation and surface hydrology patterns in dry and wet seasons.

H-2.0 Findings

H-2.1 Geomorphic Conditions Were Tidal Marsh in 2011

At the time of property transfer in 2011, Point Buckler was a tidal marsh with several distinct geomorphic features: a tidal marsh plain interior and exterior to the 1985 remnant levee alignment, a natural, sinuous (multiple bends) tidal channel network, a tidal ditch remaining from the past managed wetlands uses, tidal remnant levee, terrestrial remnant levee, seven breaches through the remnant levee, and a few patches where tidal marsh interior to the remnant levee alignment had eroded away (Figure H-3, Table H-1). About 69 percent of the remnant levee had reverted to tidal marsh by about the

[5] Formerly California Department of Fish and Game.
[6] Rhizomes are portions of plant stems that grow underground, and send out new roots and shoots.

year 2000 and was tidal marsh in 2011. About 11 percent of the remnant levee had eroded away, creating the seven breaches (see detail in Appendix K).

Table H-1. Baseline Channel, Borrow Ditch, Remnant Levee, and Breach Lengths, 2011

Feature	Length (ft)
Remnant tidal borrow ditch	3,570
Interior tidal channels	5,170
Remnant levee, tidal marsh	3,385
Remnant levee, terrestrial	990
Breaches through remnant levee	545

H-2.2 Historical and Recent Wetland Soils and Hydrology Are of Tidal Marsh

The SCS soil map of Point Buckler and adjacent Simmons Island (Figure H-4) displays one mapped soil type (**Ja,** Joice Muck) in the interior of the island, and maps the rest of the island as a non-soil designation (**Td**, tidal marsh). The map displays the perimeter levee (and levee road) positions as perpendicular cross-hatched lines, sometimes marked "LEVEE", and berms and levees without roads (including interior levees) as dot-dashed lines. The boundaries between adjacent soil types are represented as solid black lines. Fringing marsh outboard of the Simmons Island levee is mapped **Td,** which extends across Andy Mason Slough to the solid black line boundary with Joice Muck in the center of Point Buckler. A discrete area of Joice Muck is mapped in the center of Point Buckler, interior of the levee. In contrast, the adjacent portion of diked Simmons Island is a mosaic of **Ja** (Joice Muck), **Re** (Reyes silty clay), **Ta** (Tamba mucky clay), and "w" (water) in relict sloughs and impoundments. The outboard portions of Simmons Island adjacent to Point Buckler are entirely mapped **Td**, for tidal marsh.

Throughout the SCS map, the symbol **Td** is used infrequently in fringing (outboard) marshes; where used it is extended continuously until it is demarcated by another delineated soil series. Only tidal marshes adjacent to levee boundaries are given the undifferentiated **Td** symbol; large tidal marshes without levees are mapped as tidal marsh soil series such as Tamba, Joice, and Reyes. For example, undiked Roe Island is mapped as two soil types, Tamba and Joice; since there are no levees, the symbol **Td** is not used to describe tidal marsh. Similarly, extensive portions of western Ryer Island near Point Buckler lack the levee symbol, and are mapped Tamba and Reyes series.

The SCS map designation for "tidal marsh" is explicitly described (SCS 1977 p. 41):

> *Tidal marsh (Td) is a very poorly drained, strongly saline land type that* ***is located between constructed levees and bodies of water. It is flooded periodically by tidal water.*** *This land type ranges from mud flats that are covered daily by tidal flow to a mixture of hydrophytic plant remains and alluvium that is covered by water only at high tide. There is no vegetation on the mud flats, but rushes and sedges are in the areas that are less often covered at high tide.* **(emphasis added)**

Outside the area in the island interior mapped as Joice Muck (**Ja**), the rest of the island (including areas within and outboard of the perimeter levee) is mapped as **Td**, consistent and continuous with the designation of tidal marsh along the exterior of nearby Simmons Island. No other soil type is mapped on Point Buckler Island. This unusual condition – marsh interior of levee, distinguished from **Ja**, but with no soil series and no black line boundary to contrast it with **Td** – can be explained in areas with unstable, overtopped, or breached levees that fail to **separate Td from leveed interiors.**

H-2.3 Historical and Recent Point Buckler Vegetation in Relation to Hydrology and Soils Clearly Establishes Tidal Marsh

H-2.3.1 Descriptive Narrative Accounts of Club 801

The oldest site-specific description of Point Buckler vegetation is consistent with a pre-1978 condition of little or no hydrologic control over the interior marsh in "Annie Mason Club 801":

> *An on-club survey of the club in 1976 found the club to be composed predominantly of Olney and hardstem bulrush* [*Schoenoplectus americanus* and *S. acutus* in current taxonomy of The Jepson Manual, 2nd edition] *and saltgrass* [*Distichlis spicata*] *in the higher areas. The 1978 Ca. Department of Fish and Game aerial survey reported tule growth* [*S. californica*] *mixed with the above vegetation. None of these plants has a relatively high use and selection value for waterfowl. Olney and hardstem bulrush … grow along sloughs and in ditches* ***containing water most of the year. ….Their increase was probably due to the club's lack of water control at the time.*** *…. Since then, the situation has greatly improved and the club reports that it now has the water control structures and tight levees necessary for proper water management.*
>
> Club 801 Land Use Summary, Annie Mason Club (1984) **(emphasis added)**

The Club 801 Land Use summary is consistent with the SCS soil mapping: levees that were subject to overtopping, gullying, and breaching allowed tidal flooding and impoundment that facilitated dominance by emergent fresh-brackish marsh tule and bulrush species. These species are typical of strongly waterlogged and/or shallowly flooded soils in both non-tidal and tidal marshes of Suisun Marsh. By 1984, the rehabilitation/upgrade of levees and water control structures had at least temporarily restored the ability to control marsh flooding and draining, according to the summary report by club owners. The instability of the club's levees was significant enough to be noted in the report: *"Levees require frequent inspection and maintenance to prevent major breaks from occurring"*. The land use report also recommended a regime of disking or mowing followed by flooding to control the spread of tules and bulrushes, promote alkali-bulrush (*Bolboschoenus maritimus*), and maintain shallow open ponds within a marsh to support waterfowl.

H-2.3.2 Vegetation Maps

The 1984 description of the club's vegetation and unstable levees is consistent with Suisun Marsh vegetation maps produced by CDFW and CDWR (Keeler-Wolf et al. 2000) (Figure H-2). The vegetation

map of Point Buckler in 2000 reported some of the same dominant species as in 1976-1984 (hardstem tule, *S. acutus, S. californicus*), but with the addition of two new dominants, common reed (*Phragmites australis*) and cattails (*Typha* spp.), both of which are highly flood-tolerant and colonize disturbed and flooded fresh-brackish marsh. These and other freshwater marsh species were observed to spread in Suisun Marsh tidal marshes after the 1997-98 El Niño event (Whitcraft et al. 2012, Baye pers. observ.), which brought record volumes of fresh water through the Sacramento-San Joaquin Delta to Suisun Marsh. Reeds were mapped primarily along the outer marsh of the island's north and south shores, but their distribution was not aligned with levee boundaries.

The only potential non-wetland vegetation mapped on the island was at the outer edge of its eastern end: California rose (*Rosa californica*) and coyote brush (*Baccharis pilularis*), with a ground layer including colonies of creeping wildrye (*Elymus triticoides*) (Figure H-2). This association is widespread in disturbed terrestrial-estuarine transition zones and riparian edges of the San Francisco Estuary's tidal marshes, especially on old levees. The absence of this association in the 2009 re-mapped vegetation of the island, and its replacement with tule and herbs, is likely a mapping error: the association reappeared in the 2012 map more closely aligned with a discrete narrow segment of the eastern levee, and it was evident in field observations in March 2016. Other than this discrete levee-aligned strip of terrestrial/transitional vegetation, none of the vegetation patterns from 2000-2012 conform to levee locations or configurations. The mapped vegetation units are either irregular polygons of obligate[7] marsh plant associations that cut across levees (e.g., 2006, 2009), or they are mapped as extensive obligate marsh plant associations across almost the entire island (e.g., 2012). No high marsh (saltgrass; Baltic rush, *Juncus balticus*) or threesquare bulrush (*S. americanus*) has been mapped by CDFW/CDWR at Point Buckler, but this may be because these shorter species were hidden by taller, dominant tules in mixed stands.

H-2.3.3 March 2016 On-Site Vegetation Reconnaissance Surveys

The remnant vegetation located within the interior of the newly constructed levees was examined on March 2, 2016. The relict vegetation, distinct from new, live growth, is composed of dead, standing plant material (erect stems and seeds from the 2015 growing season) and matted layers of leaf litter from past years in various stages of decomposition. Surviving plants persist as stunted individuals or in very sparse colonies, indicating difficult growing conditions even in the absence of competing live vegetation.

In the now-diked tidal marsh interior, the standing dead plant material and relict stunted individuals persisting from accumulated growth of past years were identified to species level. They were easily recognized as common or dominant species in Suisun tidal and diked, managed marshes (Whitcraft *et al*. 2012, Baye and Grewell 2012, Grewell et al. 2014, Baye *et al.* 2000). Large stands of the same species identified by CDFW and CDWR (Keeler-Wolf et al. 2000) were observed, in addition to formerly long-established stands that were probably not previously detectible without ground surveys. The dominant species occurring over extensive areas as dead standing litter include threesquare bulrush, hardstem

[7] "Obligate" refers to plants that only grow in wetland conditions.

tule, and cattail. These species are dominant in perennially saturated fresh to weakly brackish (oligohaline) marsh, and are all represented in the fringing tidal marshes that previously extended into the island interior before diking. They are also common and abundant to dominant in diked, managed marshes that are shallowly flooded either year-round or for most of the growing season on nearby Simmons and Grizzly Islands. With the exception of Baltic rush, these tule, bulrush, and cattail species do not compete or persist in seasonal wetlands or high marsh that is not predominantly saturated near the surface for most of the growing season.

No stands of alkali-bulrush litter were detected in the marsh interior, and none were observed in the exterior fringing tidal marshes of Point Buckler, despite searches for this species. Alkali-bulrush is actively managed in diked marshes in Suisun, where it occurs in local abundance, but it rarely establishes in fresh to weakly brackish (oligohaline) tidal marshes of Suisun (Grewell et al. 2014). In contrast, alkali-bulrush is abundant in brackish (mesohaline) tidal marshes of San Pablo Bay and San Francisco Bay (Baye *et al*. 2000).

Common reed (*Phragmites australis*) and Baltic rush occurred in the diked interior of Point Buckler in low densities as relatively short, stressed shoots with few, small live leaves per shoot. This contrasts with robust plants (dense stands of tall, living shoots with abundant, large leaves) in adjacent fringing tidal marsh, and in flooded Simmons Island and neighboring Grizzly Island marshes. These two species appeared to be relict populations instead of new colonizers, due to a high proportion of dead shoots connected in clonal (rhizome-linked) colonies with stunted, live shoots. The persistence of these two species as stunted low-density populations is consistent with their relatively greater tolerance for seasonal soil drainage and dryer soils compared with tules, bulrushes, and cattails.

A few areas of severely degraded vegetation remnants in mowed and trampled areas could only be identified incompletely, but with relatively high confidence. These areas also indicate past (prior to 2014 reclamation/diking) prevalence of bulrush marsh, with some reed, cattail, and tule.

The fringing tidal marshes outboard of the new levees were continuous with portions of the marsh interior prior to diking, but they are likely modified by multiple years of extreme drought influence (relatively high salinity during the growing season) and recent (2016) winter storm wave action. The fringing marshes on the wave-exposed southern (Suisun Cutoff) and northwestern (Grizzly Bay) shorelines exhibit a vegetation gradient from wave-scoured bare peat soils, inland to low-lying turf-forming clonal vegetation (Mason's lilaeopsis, *Lilaeopsis masonii*; club-rush, *Isolepis cernuus*), to short, erect grass-like plants (Baltic rush; hairgrass, *Deschampsia cespitosa*), through tall, emergent marsh (hardstem tule; broad-leaf cattail, *Typha latifolia*; common reed). The increasing prevalence of bulrush-tule-cattail marsh at the interior end of the tidal/wave exposure gradient is consistent with the relict interior vegetation patterns, indicating that these species were dominant prior to diking.

The persistent remnants of terrestrial lowland vegetation (California rose, coyote-brush) on the eastern end levee, and the presence of scattered, isolated, estuarine-terrestrial transitional plant populations in

soils bordering the new levee (e.g., clonal colonies of coyote-brush and creeping wildrye) indicate that high brackish marsh very likely existed near the outer edge of the island prior to 2014 diking. These communities possibly grew on wave-deposited marsh berms, or subsided remnants of the old levee.

H-2.3.4 Google Earth Aerial Photography of Point Buckler and Western Simmons Island Wetlands, 2002-2012

Color and false-color infrared aerial photography of Point Buckler in dry and wet seasons shows ecologically significant contrasts in wetland vegetation growth patterns between managed (diked, non-tidal) and tidal marshes through dry and wet seasons. Tidal marshes are tidally flooded year round, with saturated soils near the surface in both dry and wet seasons. Managed marshes may be drained (moist to dry) or flooded (saturated) depending on the timing of active water management. The differences between the fringing tidal marsh outboard of levees and interior diked, managed marsh manifest as contrasts between greenish or grayish and straw-colored patterns. These contrasts are especially evident in the growing season (late winter, spring, & summer), when artificial drainage on diked, managed marsh can cause otherwise healthy plants to deteriorate or die.

The following color aerial photographs compare the marsh vegetation outboard of and interior to the old (pre-2014) Point Buckler tidal remnant levee with reference fringing tidal and diked, managed marsh at nearby Simmons Island. Two time periods are shown to bracket recent historic conditions: 2002-2004, and approximately a decade later (2011-2014).

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
July 27, 2002	summer dry	Green to gray-green marsh vegetation dominates, with no significant contrast in pattern between exterior and interior of the old levee.	Matches majority of Point Buckler pattern, color; finer texture. High contrast in pattern, color with interior Simmons Island diked marsh.	Drained summer-dry marsh with predominant straw, tan-brown, or grayish vegetation color, or rusty-brown (iron oxide) soil color

Aerial Photograph 1. Google Earth, July 27, 2002

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
September 30, 2002	early fall dry	Green vegetation, including the marsh interior, with a substantial minority of patchy standing litter color and pattern (pale straw to tan-gray).	Matches majority of Point Buckler pattern, color; finer texture. High contrast in pattern, color with interior Simmons Island diked marsh.	Drained coarse mosaic of predominantly light rusty-brown to tan or gray-brown areas (iron oxide covering dry soil surfaces and standing dead litter) and a small minority of light green patches (annual weedy herbaceous seasonal wetland vegetation, esp. fat-hen, *Atriplex prostrata*).

Aerial Photograph 2. Google Earth, September 30, 2002

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
November 25, 2002 & December 31, 2002	late fall/ early winter wet dormant	Emergent greenish brown (seasonally dormant) heterogeneous vegetation. There is no evidence of dark ponded water on Point Buckler.	Matches Point Buckler pattern, color; finer texture. High contrast in pattern, color with interior Simmons Island diked marsh.	Coarse mosaic of extensive areas of ponded dark brownish olive-green water in depressions and remnant sloughs, and light tan-gray fringes of standing litter. Typical pattern expected from fall or winter flooding of diked, managed wetlands in Suisun Marsh.

Aerial Photograph 3. Google Earth, December 31, 2002

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
June 21, 2003	late spring dry	Dull green heterogeneous vegetation, including the marsh interior. See also Appendix S photographs taken on May 28, 2003 showing the interior tidal marsh vegetation.	Matches Point Buckler pattern, color, finer texture (less heterogeneous patches). High contrast in pattern, color with interior Simmons Island diked marsh.	Coarse mosaic of predominantly light rusty-brown to tan or gray-brown areas (dry soil, vegetation) and dark reddish-brown iron oxide in flooded pools (remnant sloughs and depressions).

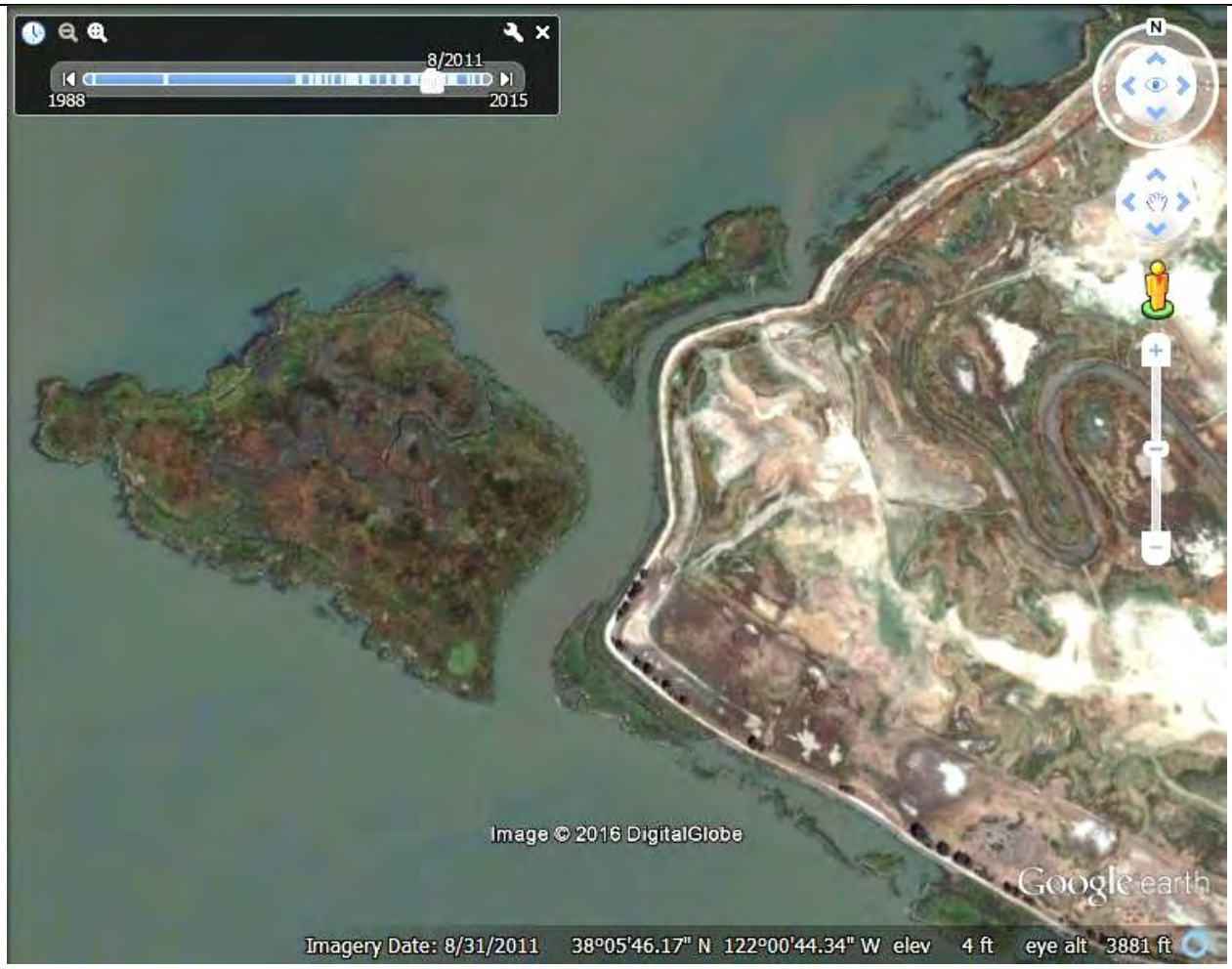
Aerial Photograph 4. Google Earth, June 21, 2003

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
January 31, 2004	early winter wet	Emergent greenish brown and brown (seasonally dormant) heterogeneous vegetation. No evidence of dark ponded water.	Emergent green vegetation (less brown than Buckler). No ponded water. Very strong contrast in pattern, color, with interior Simmons Island diked marsh.	Coarse mosaic of extensive areas of ponded dark brownish water in depressions and remnant sloughs, and pale tan-gray fringes of standing litter. Typical pattern expected from winter flooding of diked, managed wetlands in Suisun Marsh.

Aerial Photograph 5. Google Earth, January 31, 2004

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
June 30, 2004	early summer dry	Dull green heterogeneous vegetation, including the marsh interior, with a substantial minority of patchy standing litter color and pattern (pale straw to tan-gray).	Dull green heterogeneous vegetation matching Point Buckler pattern, color, texture. High contrast in pattern, color with interior Simmons Island diked marsh.	Coarse mosaic of predominantly gray barren dry pond beds, with dark brown flooded remnant former tidal sloughs, and dull green to gray-green vegetation peripheral to the dry (drawdown) gray basin beds.

Aerial Photograph 6. Google Earth, June 30, 2004



Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
August 31, 2011 & September 18, 2011	end summer dry	Dull green-brown heterogeneous vegetation, with circular gray-green sharp-bordered patches (likely reed colonies), brown and gray diffuse patches (standing litter accumulation) in central island between channels.	Dull to dark green-brown vegetation matrix color, but finer texture (less patch heterogeneity), fewer and smaller colonies of reed. Very strong contrast with interior Simmons Island diked marsh.	Coarse mosaic of light gray-white and brown flats (salt and dried algal crust, dried mud beds), dark gray-brown vegetation (pickleweed, *Sarcocornia pacifica*), minor patches of green (annual forbs). Mowing or disking bands local. Relict slough water drawn down.

Aerial Photograph 7. Google Earth, August 31, 2011

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
August 31, 2011 & September 18, 2011	end summer dry	Dull green-brown heterogeneous vegetation, with circular gray-green sharp-bordered patches (likely reed colonies), brown and gray diffuse patches (standing litter accumulation) in central island between channels.	Dull to dark green-brown vegetation matrix color, but finer texture (less patch heterogeneity), fewer and smaller colonies of reed. Very strong contrast with interior Simmons Island diked marsh.	Coarse mosaic of light gray-white and brown flats (salt and dried algal crust, dried mud beds), dark gray-brown vegetation (pickleweed, *Sarcocornia pacifica*), minor patches of green (annual forbs). Mowing or disking bands local. Relict slough water drawn down.

Aerial Photograph 8. Google Earth, September 18, 2011

Google Earth Image date	Growing season stage	*Point Buckler* vegetation pattern and Simmons Island fringing tidal marsh	Exterior fringing *tidal marsh* west Simmons Island	Interior *non-tidal Simmons Island* vegetation, soil, water pattern
September 1, 2012	late summer, dry (extreme drought)	Dull green-brown and brown vegetation matrix with darker brown patches and light gray zones, and circular gray-green sharp-bordered patches. Vehicle tracks and mown paths initiated; no levees or new ditches; turbid bay water in interior sinuous channels.	Dull green-brown and brown vegetation matrix with darker brown patches; no vehicle tracks or mowing tracks. Less brown and gray gradient from dull green vegetation. Very strong contrast with interior Simmons Island diked marsh.	Coarse mosaic of gray-white to gray-brown dry basin beds; greenish gray-brown and dark brown fine-grained vegetation (pickleweed) locally. Trace local green vegetation. Relict slough channel gray; darker thalweg (deepest portion); drawdown.

Aerial Photograph 9. Google Earth, September 1, 2012

H-3.0 Conclusions

The baseline (prior to unpermitted diking and draining) condition of Point Buckler wetland vegetation during the period from 2002-2014 was tall, emergent tidal marsh dominated by tule, bulrush, cattail, and reed, with a narrow band of riparian/transitional scrub (California rose-coyote brush) on a portion of the eastern terrestrial levee remnant. The baseline condition also included tidal channels and tidal ditches from its prior managed wetland history.

The Soil Conservation Service (SCS) published a soil map of Point Buckler in 1977, based on field data collected from 1958-1968. The SCS map displays a levee around the island's perimeter, and delineates a portion of the island's interior within this levee as Joice muck (**Ja**), a soil type that occurs in both tidal marsh and diked wetlands of Suisun Marsh. The remainder of the island both within and outboard of the levee is mapped as a non-soil designation, tidal marsh (**Td**). The **Td** designation extends from Point Buckler across Andy Mason Slough to the fringing marshes of Simmons Island. This combination of soil units within and across levees of the island is consistent with narrative descriptions of club Point Buckler's historic levee instability and reversion to tidal marsh between one or more episodes of levee rehabilitation. The dominant fresh-weakly brackish marsh vegetation described at Point Buckler was consistent with later (2000-2012) CDFW/CDWR vegetation mapping of the island (dominant tules and bulrushes).

Prior to unpermitted diking and draining of the marsh in 2014, Point Buckler vegetation exhibited the same basic seasonal patterns as the nearby fringing tidal marsh of Simmons Island, which contrasted strongly with the diked, managed (alternating flooded and drained) wetland vegetation of interior Simmons Island. Point Buckler wetlands exhibited none of the characteristics or patterns of vegetation development that are associated with pond flooding, pond draining, bed emergence, and drying that dominate in the diked, managed (non-tidal) wetlands of Simmons Island. The complete absence of managed flooding indicators, such as submergence of the vegetation canopy, or patterns of plant dieback associated with prolonged seasonal ponding, is consistent with perennial tidal drainage of Point Buckler.

A review of historic color aerial photographs indicates that in 2002-2004, and again in 2011-2012, there were clear and consistent resemblances between green marsh vegetation in the fringing tidal marshes of west Simmons Island and Point Buckler in the summer-fall dry season. This green vegetation consistently contrasted with the coarse patches of gray, brown, gray-white emergent/desiccated basin beds and dried gray, tan, or brown vegetation in the non-tidal interior of Simmons Island during that same time. This same pattern (similarities between fringing tidal marshes and Point Buckler vegetation, contrasted sharply with non-tidal Simmons Island vegetation) was evident during the wet seasons of 2002-2004. Point Buckler vegetation exhibited no ponds or exposed soil of seasonally drained/flooded pond beds in any color aerial photographs examined from 2002-2012.

Overall, marsh vegetation across the whole of Point Buckler island exhibited a greater variety of size and types of vegetation patches than the narrow fringing marshes of Simmons Island, which lack interior

channels and internal drainage gradients. But both consistently and obviously contrasted with the coarse vegetation and pond bed/pond surface seasonal patterns of Simmons Island diked, managed non-tidal wetlands. There is no evidence at all for abrupt vegetation contrasts between the seaward and interior sides of the old (pre-2014) levees on Point Buckler, which would be expected if the interior tidal marsh was subject to different hydrologic conditions from the exterior fringing tidal marsh. Comparative qualitative evidence from aerial photography from 2002 to 2012 strongly supports the conclusion that Point Buckler vegetation as mapped by CDFW/CDWR was tidal marsh, not diked nontidal marsh.

Existing fringing marsh along the outer edges of the island continue to exhibit strong ongoing erosion indicators such as eroded bare peat slopes, vertical scarps, local dominance of bare peat-colonizing, turf-forming tidal marsh plants, steep gradients of tule and cattail density/height, massive wrack and driftwood deposition, and erosional dieback of California rose thickets. The prevalence of these indicators strongly suggests that the fringing tidal marsh in many locations is too narrow to effectively attenuate wave energy, increasing the risk of levee failure. The high potential for the island's interior vegetation to revert to tidal marsh during periods of derelict levee maintenance is consistent with both the narrative descriptions of vegetation in 1984 and vegetation mapping by CDFW/CDWR 2000-2012, since the emergent fresh to weakly brackish marsh plant assemblages in the Estuary share the same dominant species in tidal and non-tidal low or middle marsh zones (Baye 2000, Baye *et al*. 2000).

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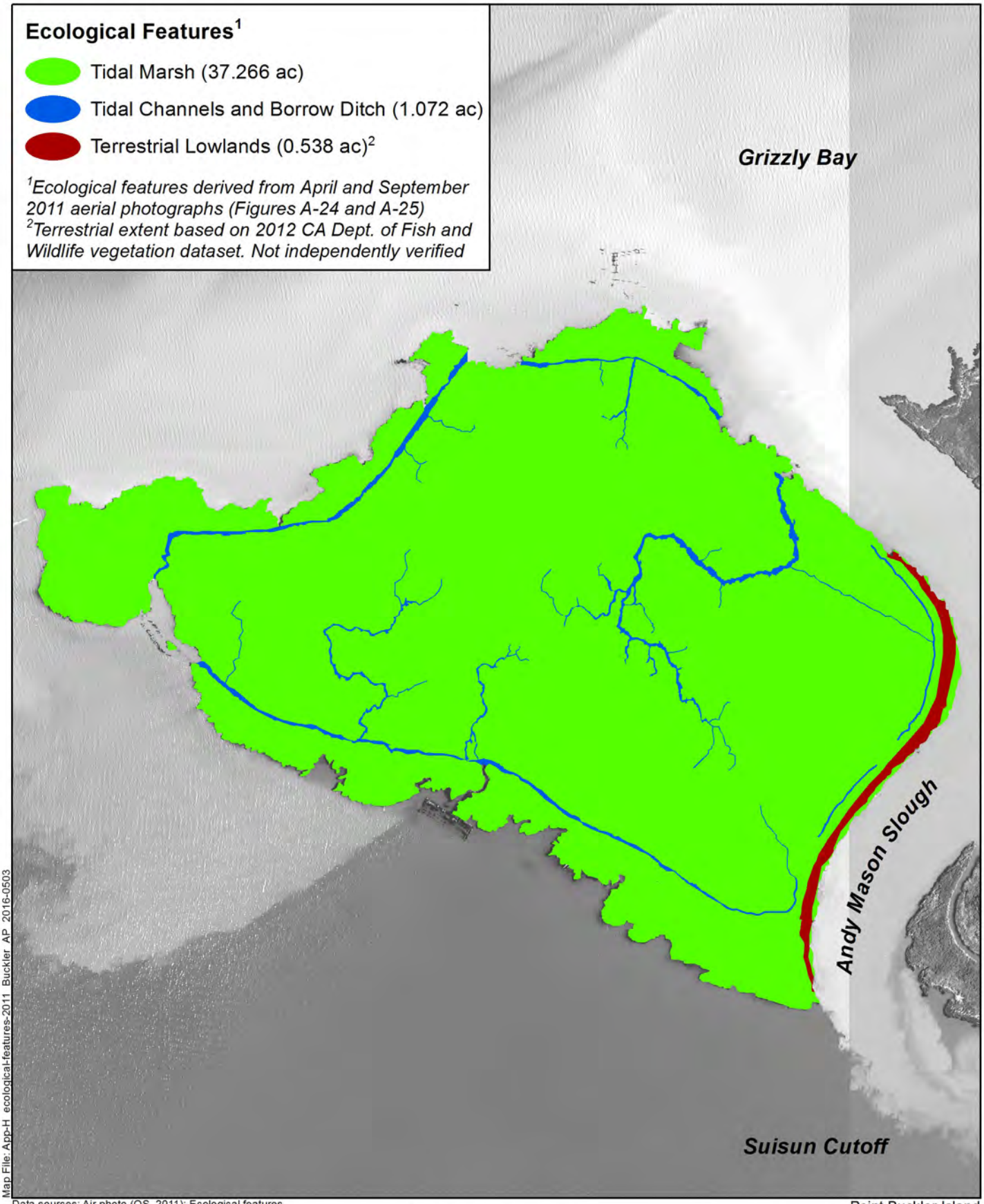


Map File: App-H ecological-features-2011 Buckler AP 2016-0503

Data sources: Air photo (QS, 2011); Ecological features (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

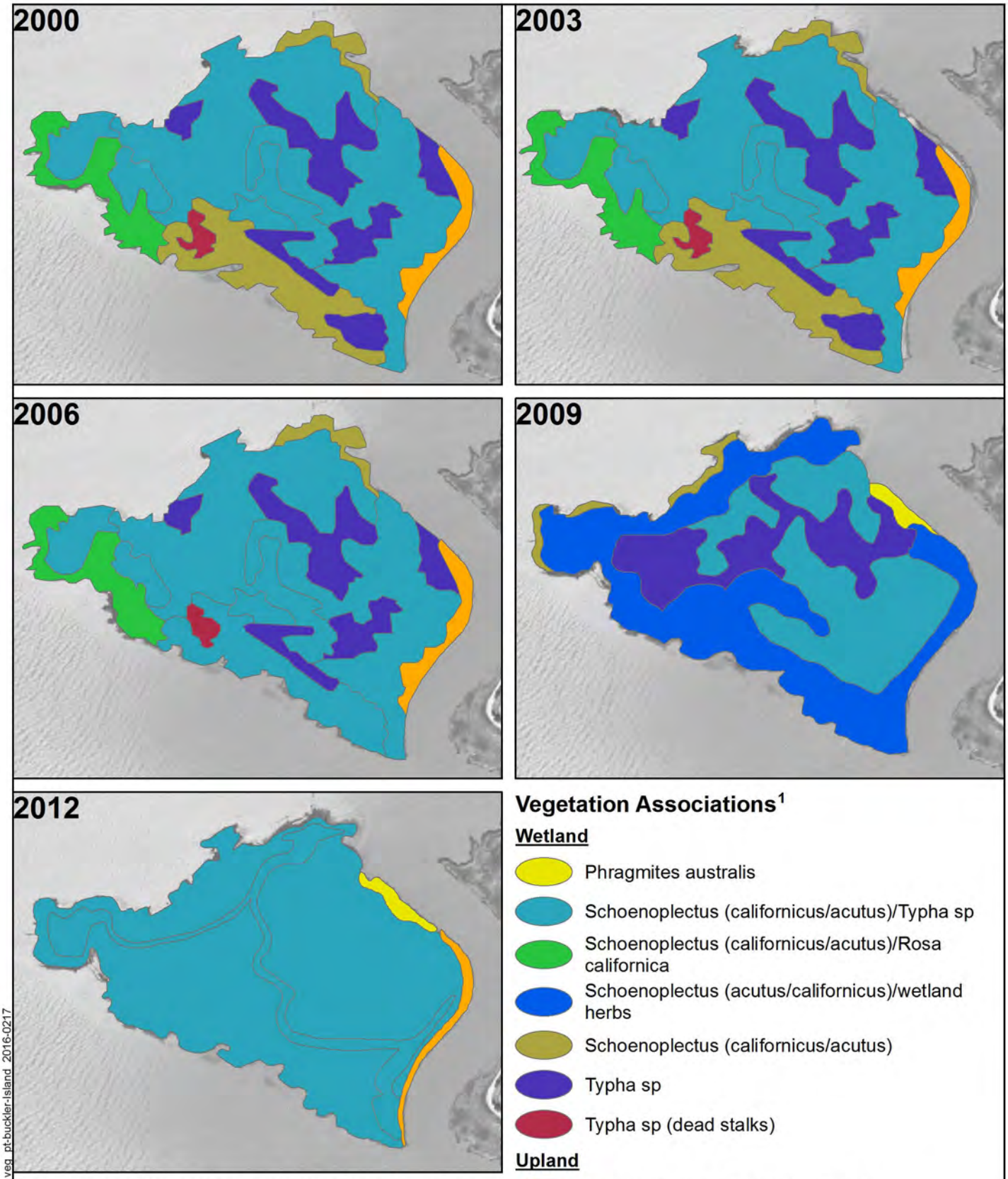
0 50 100 m

Point Buckler Island
Solano County, CA

Figure H-1

Base air photo: (Quantum Spatial) April 2011

Baseline Site Ecological Features - 2011



[1]Vegetation data from triennial Suisun Marsh vegetation surveys conducted jointly by DFW and DWR

Map File: veg_pt-buckler-island_2016-0217

Data sources: photo (NAIP, 2012); Veg (DFW/DWR, 2000-2012)

1:7,800 (1" = 650' at letter size)

0 325 650 ft

0 100 200 m

Point Buckler Island
Solano County, CA

Figure H-2

Pt. Buckler Island Vegetation: 2000-2012

Site Tidal Hydrology

A. Tidal Channel Connectivity

- Remnant Borrow Ditch (3,200 ft)
- Interior Marsh Channels (3,050 ft)
- Eroded Interior Marsh at Breaches[1]
- Breaches through 1985 Levee (545 ft, 11%)
- Remnant Borrow Ditch Centerline (890 ft)[2]
- Interior Marsh Channel[2] (2,125 ft) / Ditch Centerline[2] (370 ft)

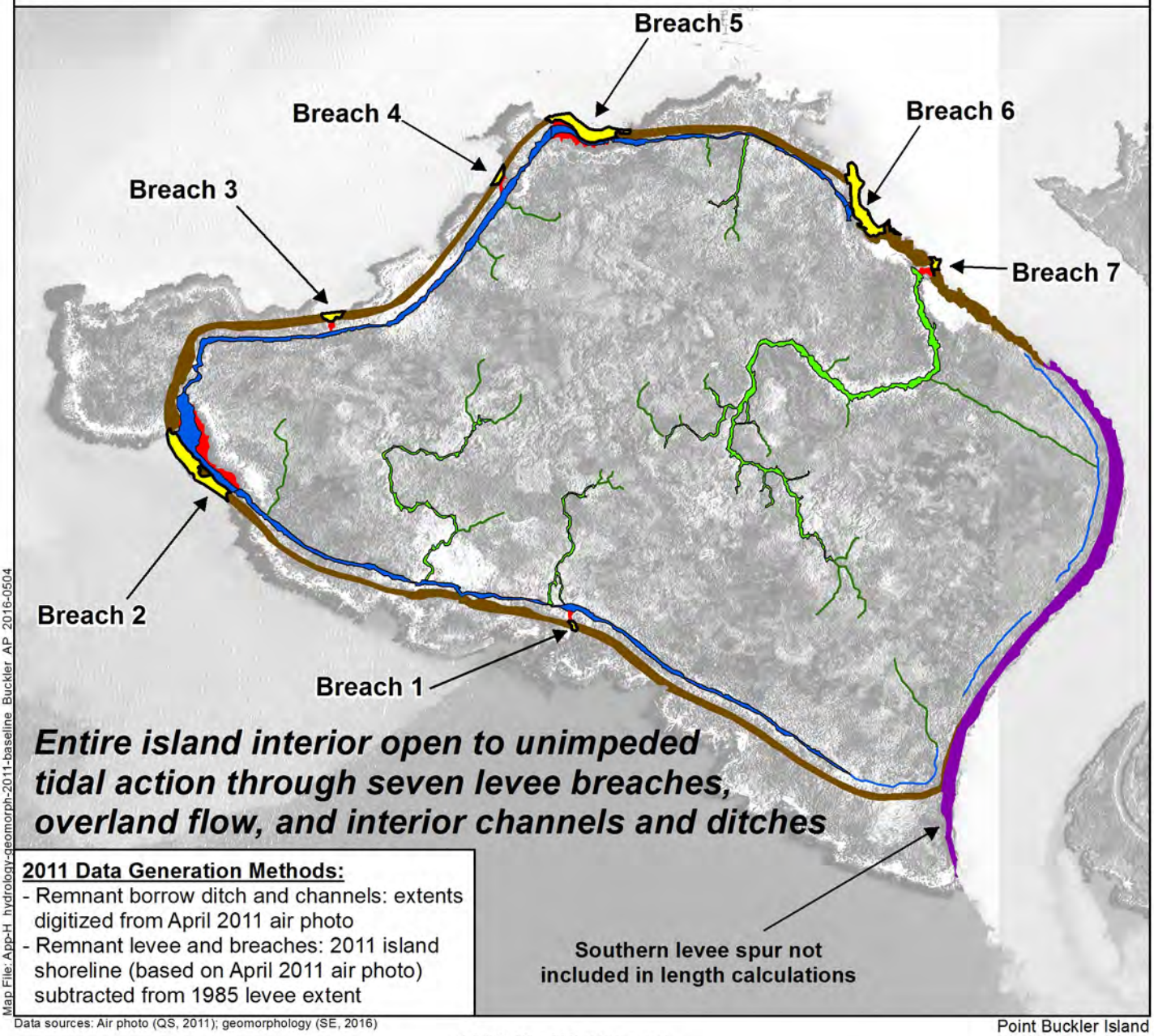
B. Overland Tidal Connectivity

- Remnant 1985 Levee, Wetlands[3] (3,385 ft, 69%)

C. Probable Terrestrial - Little or No Connectivity

- Remnant 1985 Levee, Terrestrial Lowlands[3] (990 ft, 20%)

[1] Areas of marsh plain loss between 1985 and 2011
[2] Minor features symbolized as lines - width not to scale
[3] Extent based on 2012 CA Dept. of Fish and Wildlife vegetation mapping



2011 Data Generation Methods:
- Remnant borrow ditch and channels: extents digitized from April 2011 air photo
- Remnant levee and breaches: 2011 island shoreline (based on April 2011 air photo) subtracted from 1985 levee extent

Map File: App-H_hydrology-geomorph-2011-baseline_Buckler_AP_2016-0504

Data sources: Air photo (QS, 2011); geomorphology (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure H-3

Baseline Tidal Hydrology and Geomorphology, April 2011

Base air photo: (Quantum Spatial) April 2011

Excerpt of Map 47, SCS 1977, showing Point Buckler Island and west Simmons Island soil series map delineations.

File: Fig H-4_SCS Map_Buckler_2016-0505.pptx

Point Buckler Island
Solano County, CA

Figure H-4

Soil Conservation Service
Soils Map

Appendix I High Tide Line and Tidal Datums

I-1.0 Introduction

The High Tide Line (HTL) is the basis of Clean Water Act (CWA) Section 404 jurisdiction for Wetlands and Waters of the United States. Tidal datums – such as Mean High Water (MHW), are the basis for Rivers and Harbors Act Section 10 jurisdiction and pertain also to CWA Section 404 jurisdiction. The purpose of this analysis is to establish the High Tide Line and tidal datums for Point Buckler, located in south-central Suisun Marsh, Solano County, California.

The definition of the High Tide Line in the Clean Water Act is found in 33 CFR Part 328.3(d):

> The term "**high tide line**" means the line of intersection of the land with the water's surface at the maximum height reached by a rising tide. The high tide line may be determined, in the absence of actual data, by a line of oil or scum along shore objects, a more or less continuous deposit of fine shell or debris on the fore shore or berm, other physical markings or characteristics, vegetation lines, tidal gages, or other suitable means that delineate the general height reached by a rising tide. The line encompasses spring high tides and other high tides that occur with periodic frequency but does not include storm surges in which there is a departure from the normal or predicted reach of the tide due to the piling up of water against a coast by strong winds such as those accompanying a hurricane or other intense storm.

Tidal datums refer to the long-term averages of the tides at a particular location. Tidal datums reflect 18.6-year tidal epochs, which correspond to the period of time required for the moon's nodes to complete a 360° circuit of longitude and thus characterize a complete gravitational cycle (National Ocean Service 2000). The National Ocean Service most recently updated the nation's tidal datums in 2005 and represents the time period of 1983 to 2001[8].

I-2.0 Indicators of High Tide Line for Point Buckler

We have identified three indicators of the High Tide Line at Point Buckler. From these suite of indicators, we have identified an elevation of the High Tide Line.

I-2.1 Indicator 1: Observed Water Level, February 17, 2016 to Establish High Tide Differences between Point Buckler and Port Chicago

On the morning of February 17, 2016, staff from the Regional Water Quality Control Board and their technical consultants conducted a boat tour around Point Buckler. That day's high tide corresponded to the time of the boat tour. Bay water conditions during the boat tour were calm winds and no wind

[8] http://tidesandcurrents.noaa.gov/datum_options.html

waves. Several photographs of exterior high water observations were taken around Point Buckler. One of these photographs, shown in Figure I-1, is of a wooden board emerging vertically from the water just adjacent to the levee. During the March 2, 2016 site visit onto the island, the width of this board was measured (1.0 feet) and the top elevation surveyed (8.38 feet NAVD88). The high tide line for February 17, 2016 was thus determined by measuring the distance from the top of the board to the wetted water line in the photograph, comparing that measured distance to the measured distance of the width of the board in the photograph, and applying the field measurements of the board to these measurements from the photograph (Figure I-1). High tide on February 17, 2016 was approximately 7.3 ft NAVD88 at Point Buckler.

The verified high tide recorded at the National Ocean Service Port Chicago station for that same high tide was 7.03 ft NAVD88. Because there was no wind or wind waves on the morning of February 17, 2016, the difference in high tide stage between Point Buckler and Port Chicago, approximately **0.27 feet**, is established as the difference in high tide heights between these two locations in absence of local winds and wind wave conditions. This difference is suitable to apply to long-term records from Port Chicago, below.

I-2.2 Indicator 2: High Tides at Port Chicago, October 1996 to February 2016

Figure I-2(A) shows the records of verified high tides at the Port Chicago Station for the most current 18.6-year tidal epoch period through February 29, 2016. The maximum high tide observed at Port Chicago during this period is 8.94 ft NAVD88, and the maximum observed since establishment of the Port Chicago station in 1976 is 9.02 ft NAVD88, on December 3, 1983. Figure I-2(B) shows the high tides for the top five percent (5%) of high tides, which range from 6.75 ft to the highest 8.94 ft NAVD88. Overlaid on this plot are the field observed high tide (2/17/2016) and surveyed debris wrack line (3/2/2016) at Point Buckler.

These frequency of high tide data exhibit a sharp break in slope near the highest tides (Figure I-2(B)). High tides above this break occur once every three years on average and are most likely associated with storm-driven major Delta outflow events. These occurrences can be disregarded under the Clean Water Act (33 CFR Part 328.3(d)). This break occurs at 7.92 ft NAVD88, which is identified here as the High Tide Line for Port Chicago.

Adding the height increased determined above of 0.27 ft, the highest tide at Point Buckler during this period would be approximately **8.19 ft** NAVD88. This estimation excludes any height increases that wind and wind waves may exert on water levels at Point Buckler.

I-2.3 Indicator 3: Topographic Data of Observed Debris Wrack Lines, March 2, 2016

Figure I-3 shows the elevations of the top of 24 “debris wrack line” locations around the outer margins of Point Buckler and along the outside of the levee on the adjacent property to the east, surveyed on March 2, 2016. Debris wrack lines represent vegetation washed ashore by the tides and wind waves,

and are a primary indicator to establish the High Tide Line under the Clean Water Act (33 CFR 328.3(d), Corps of Engineers 2008). Debris deposit heights can vary depending on the nature of the shoreline and the exposure of the shoreline to wind waves. Shorelines with existing emergent vegetation tend to dampen wind waves and allow debris deposition at elevations more reflective of average high water levels. Shorelines directly open to the water have little wind wave dampening capacity and allow debris deposition at the upper elevations of the wind waves. Shorelines with exposure to longer wind fetches and in the dominant local wind directions will experience higher wind waves, whereas shorelines with less wind fetch exposure will experience smaller wind waves.

Elevations of the debris wrack lines shown in Figure I-3 reveal a range of debris wrack line elevations on Point Buckler. The two highest elevations were 8.28 and 8.34 ft NAVD88, or an average of **8.3 ft**. The highest debris wrack line elevation on the adjacent property to the east was 8.24 ft.

I-3.0 High Tide Line Determination for Point Buckler

The elevation of **8.2 ft NAVD88** is established as the High Tide Line for Point Buckler (Table I-1). This value reflects the lower estimate from the two methods above, namely the High Tide Line from Port Chicago adjusted based on field observations to Point Buckler. This value is 0.1 feet lower than the upper debris wrack line.

I-4.0 Tidal Datums

There are three approaches to calculating tidal datums for Point Buckler. From the perspective of assessing jurisdictional extents under State and federal law, the key datums to establish are Mean Sea Level (MSL), Mean High Water (MHW), and High Tide Line (HTL). The HTL determination was presented above.

The first approach to establish MSL and MHW on Point Buckler is to use the published tidal datums for the nearby Port Chicago station, located 3 miles south-southwest of Point Buckler, on the Contra Costa County shoreline. The National Ocean Service Port Chicago station is one of five continuously operating tide gauges in the San Francisco Estuary and has been in operation since 1976. These five and the nation's many other continuously operating tide stations provide the highest quality tidal datums that the federal government establishes. Port Chicago's close proximity to Point Buckler allows its tidal datums to be directly applicable. Table I-1(A) presents the published Port Chicago tidal datums.

The second approach to establishing MHW and MHHW on Point Buckler is to calculate the values for the most current 18.6-year tidal epoch directly from the high tide data for Port Chicago. Verified tide stage data for the period of October 1, 1996 (beginning of each California water year) to February 29, 2016, a period of 19.4 years, was used. The MHHW datum is calculated as the average of all higher of the two daily high tides, and the MHW datum is calculated as the average of both of the daily high tides (National Ocean Service 2000). Table I-1(B) presents the calculated Port Chicago tidal datums.

The third approach to establishing MHW and MHHW on Point Buckler is to apply the 0.27-ft upward adjustment derived from the 2/17/2016 field visit to the updated tidal datums of Port Chicago. Table I-1(C) presents the calculated Point Buckler MHW and MHHW tidal datums. This method is not applied to the MSL datum as the high tide difference applied may not equate to a similar upward adjustment to the average of all tide levels.

Based on these methods, we have identified for Point Buckler an MSL of 3.66 ft, MHW of 5.81 ft, and MHHW of 6.31 ft NAVD88 (Table I-1).

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U.S. Army Corps of Engineers. 2008. Regional Supplement to the Corps of Engineers Wetland Delineation Manual, Arid West Region (Version 2.0). U.S. Army Research and Development Center, Vicksburg, MS. 135 pp.

National Ocean Service. 2000. Tidal Datums and Their Applications. NOAA Special Publication NOS CO-OPS 1. Center for Operational Oceanographic Products and Services, National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. Silver Springs, MD. 132 pp.

Table I-1. Tidal Datums and High Tide Lines, Port Chicago and Point Buckler

Datum	Water Surface Elevations (ft NAVD88)		
	A) Port Chicago published datums for 1983-2001 tidal epoch[1]	B) Port Chicago calculated for 1997-2016 tidal epoch	C) Applying high tide adjustment from 2016 field observations[1]
HOWL (highest observed water level)	9.02 (12/3/1983)	8.94 (2/6/1998)	
HTL (high tide line)		7.92 [2]	**8.2**
MHHW (mean higher high water)	6.01	6.04	**6.31**
MHW (mean high water)	5.51	5.54	**5.81**
MTL (mean tide level)	**3.68**		
MSL (mean sea level)	**3.66**		
MLW (mean low water)	**1.84**		
MLLW (mean lower low water)	**1.20**		
LOWL (lowest observed water level)	-0.37 (1/8/1989)		

1. Values highlighted in green applied to Point Buckler

2. Estimated from frequency plot in Figure I-2

Photo I-1. Vegetation Litter Wrack Line, South Shoreline, March 2, 2016
Note the vegetation litter atop the levee. Wooden board on left side of levee is same board observed on February 17, 2016 and described in Figure I-1.

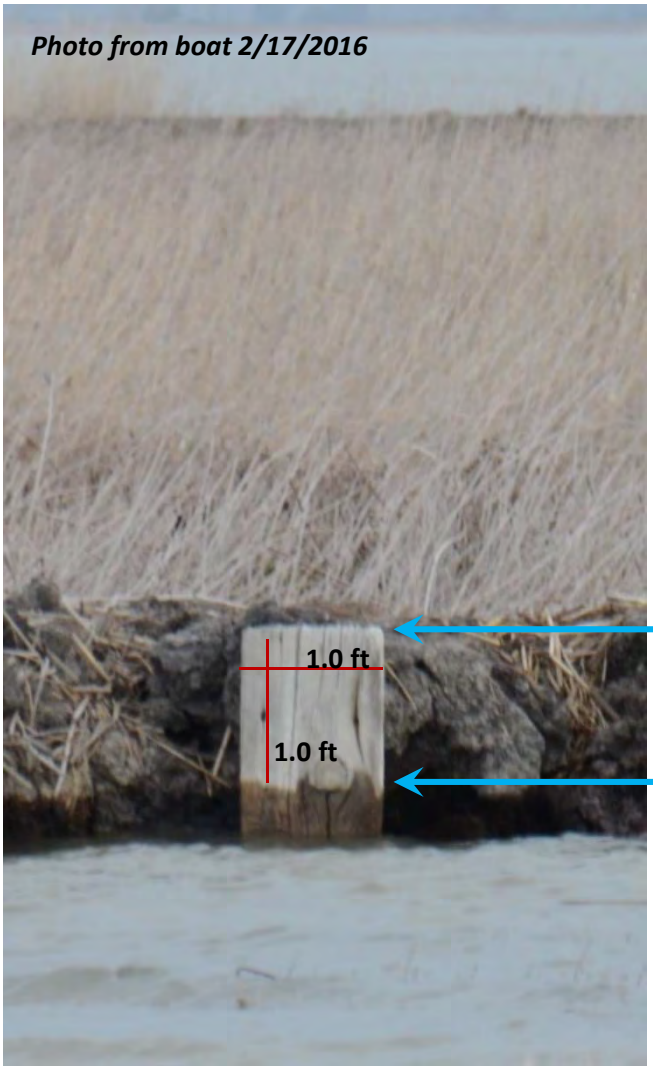
Photo I-2. Vegetation Litter Wrack Line, West Shoreline, March 2, 2016
Note the extensive vegetation litter almost reaching top of the levee.

List of Figures

Figure I-1. Observed High Water Line at Point Buckler, February 17, 2016

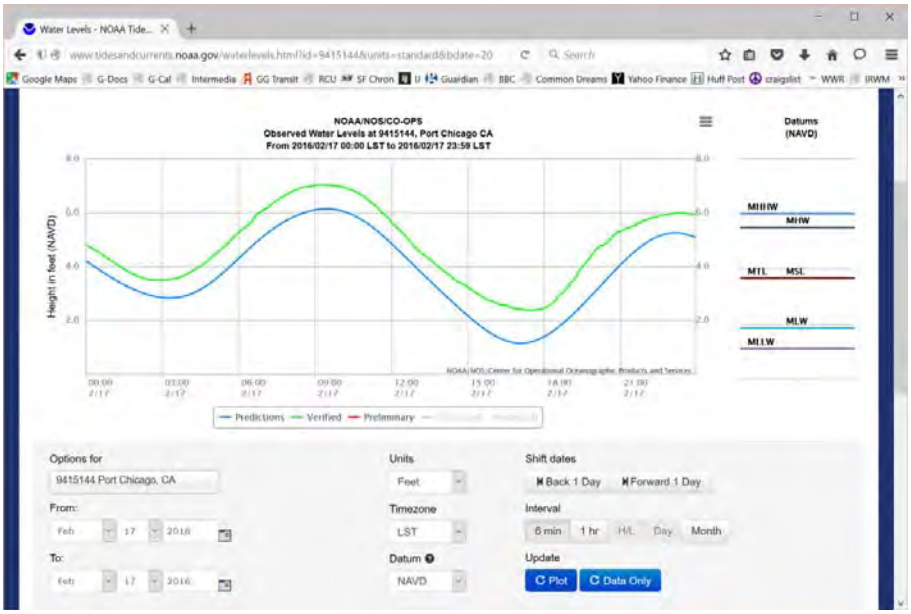
Figure I-2. Port Chicago High Tides, October 1996 to February 2016

Figure I-3. Elevations of Observed Debris Wrack Lines, March 2, 2016



Top of board 8.38 ft NAVD88
(surveyed 3/2/2016)

High water line Feb 17, 2016
~ 1.1 ft below top of board, or
~7.3 ft NAVD88



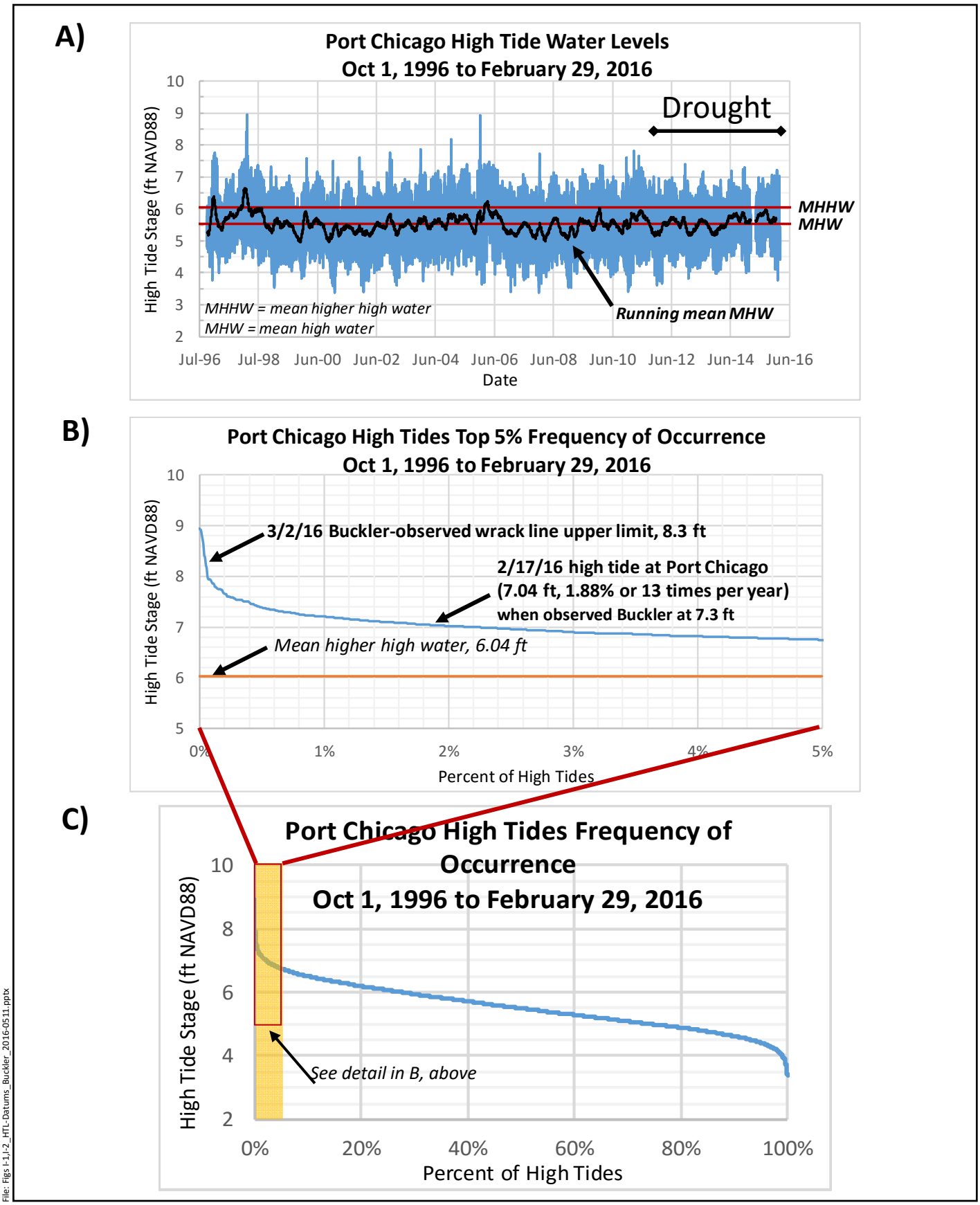
Verified Port Chicago
Water Levels 2/17/2016
High Tide = 7.04 ft NAVD88
At 9:12am

File: Figs I-1,I-2_HTL-Datums_Buckler_2016-0511.pptx

Point Buckler Island
Solano County, CA

Figure I-1

Observed High Water Line at Point Buckler
February 17, 2016



File: Figs I-1,I-2_HTL-Datums_Buckler_2016-0511.pptx

Point Buckler Island
Solano County, CA

Figure I-2

Port Chicago High Tides
October 1, 2011 to February 29, 2016

ALL ELEVATIONS IN FT NAVD88

Wrack Line Statistics		
Statistics	Pt. Buckler Island	Simmons Island
Average Elevation (ft NAVD)	7.12	7.52
Min Elevation (ft NAVD)	6.32	6.28
Max Elevation (ft NAVD)	8.34	8.24
St Dev (ft)	0.53	0.89

Map File: wrack-line-shots_buckler_2016-0309

Data sources: photo - Buckler_02-10-16.tif (QS, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure I-3

March 2, 2016 Wrack Line Elevations

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Appendix J Closure of Tidal Connectivity in 2014

J-1.0 Introduction

This Appendix J describes the closure of all tidal connectivity – both channel and overland flow – to the interior tidal marsh at Point Buckler that took place in 2014. Appendix K describes the full suite of unpermitted site activities that took place since 2011.

J-2.0 Assessment Methodology

Closure of tidal connectivity was assessed by comparing aerial photographs from just prior to initiation of unpermitted site activities (April and September 2011 aerial photographs, Figure A-24 and Figure A-25) to the most recent aerial photographs showing all the changes (February 10, 2016, Figure D-36). We made this comparison using the digitized features of the 2011 tidal remnant levee, tidal remnant borrow ditch, and tidal channels shown in Figure G-21, and the 2016 new levee and borrow ditch shown in Figure 5. We overlaid the boundaries of each of these features on the other year's aerial photograph, to illustrate the footprint of breach closures – cutting off tidal action to interior ditches and channels – and new levee construction – cutting off overland flow tidal action to the interior tidal marsh plain.

J-2.0 Closure of Tidal Connections

J-2.1 Baseline Tidal Connectivity

Prior to unpermitted site activities beginning in 2012, tidal connectivity at Point Buckler occurred through breaches in the remnant levee which connected interior tidal channels and ditches to the bay tides, and on higher tides by direct overland tidal flooding over the tidal remnant levee and out across the interior tidal marsh surface. The result is that the entire island, except for the eastern terrestrial remnant levee, were subject to regular tidal action (Figure J-8 upper panel).

J-2.2 Breach Closures due to Construction of New Levee in 2014

Construction of the new levee in 2014 cut off the tidal connectivity between the bay and the interior tidal marsh channels, ditches, and marsh plain. The locations of the seven levee breaches that existed prior to unpermitted site construction activities are shown in Figure J-1. In Figure J-2 through Figure J-6, the closure of these breaches is illustrated. In each figure, the upper panel shows the April 2011 pre-disturbance conditions with an overlay of the new levee and borrow ditch, to illustrate the location of the breach closure. The lower panel in each figure shows the February 2016 post-construction aerial photograph with an overlay of the 2011 remnant and borrow ditch, illustrating the fill location relative to the pre-existing breach. Table J-1 summarizes the time periods during 2014 when the levee breaches were closed and when overland flows were first curtailed then closed by construction of the unpermitted levee.

Table J-1. Sequence of Closure of Tidal Connectivity in 2014

Closure Date*	Breach Number							
	1	2	3	4	5	6	7	Overland
3/8/2014	Closed							Curtailed
3/24/2014		Closed						Curtailed
6/5/2014			Closed					Curtailed
8/6/2014				Closed	Closed	Closed	Closed	Curtailed
10/29/2014								Closed

** See Table K-1 for details on construction activities that resulted in closure of tidal connectivity*

J-2.3 Overland Flow Closure due to Construction of New Levee in 2014

Construction of the new levee in 2014 cut off the overland tidal flows that occurred across the tidal remnant levee into the interior tidal marsh. The upper panel of Figure J-7 shows the pre-existing overland tidal flows condition and the lower panel of Figure J-7 shows the closure of this route of tidal action due to construction of the new levee in 2014. Prior to the unpermitted new levee construction, about three quarters of the remnant levee (3,385 feet) was at intertidal marsh elevations and thus allowed high tide overland tidal flows to the interior tidal marsh. About 50 percent of high tides reach or exceed elevations that would overtop the tidal remnant levee (see Figure I-2(C)).

J3.0 Reduction in Extent of Tidal Action on Point Buckler

Closure of the levee breaches and overland flow due to construction of the unpermitted new levee in 2014 resulted in the complete disconnection of the site interior to tidal action (Figure J-8). As a result of new levee construction, **29.74 acres of tidal marsh previously subject to regular tidal action were converted to the footprint of the new levee or ramp or lands interior to the new levee no longer subject to daily tidal action** (Table J-2).

Table J-2. Areal Extent of Tidal Connectivity, 2011 vs. 2016

Tidal Connectivity	Area (acres)		
	2011	2016	Change
Below high tide line (HTL)*	38.338	8.602	-29.736

** For the 2016 condition, the new levee is assumed to be above HTL its entire distance.*

List of Figures

Figure J-1. Tidal Connectivity Locations Index Map

Figure J-2. Tidal Connectivity 2011 vs. 2016, Breach 1

Figure J-3. Tidal Connectivity 2011 vs. 2016, Breach 2

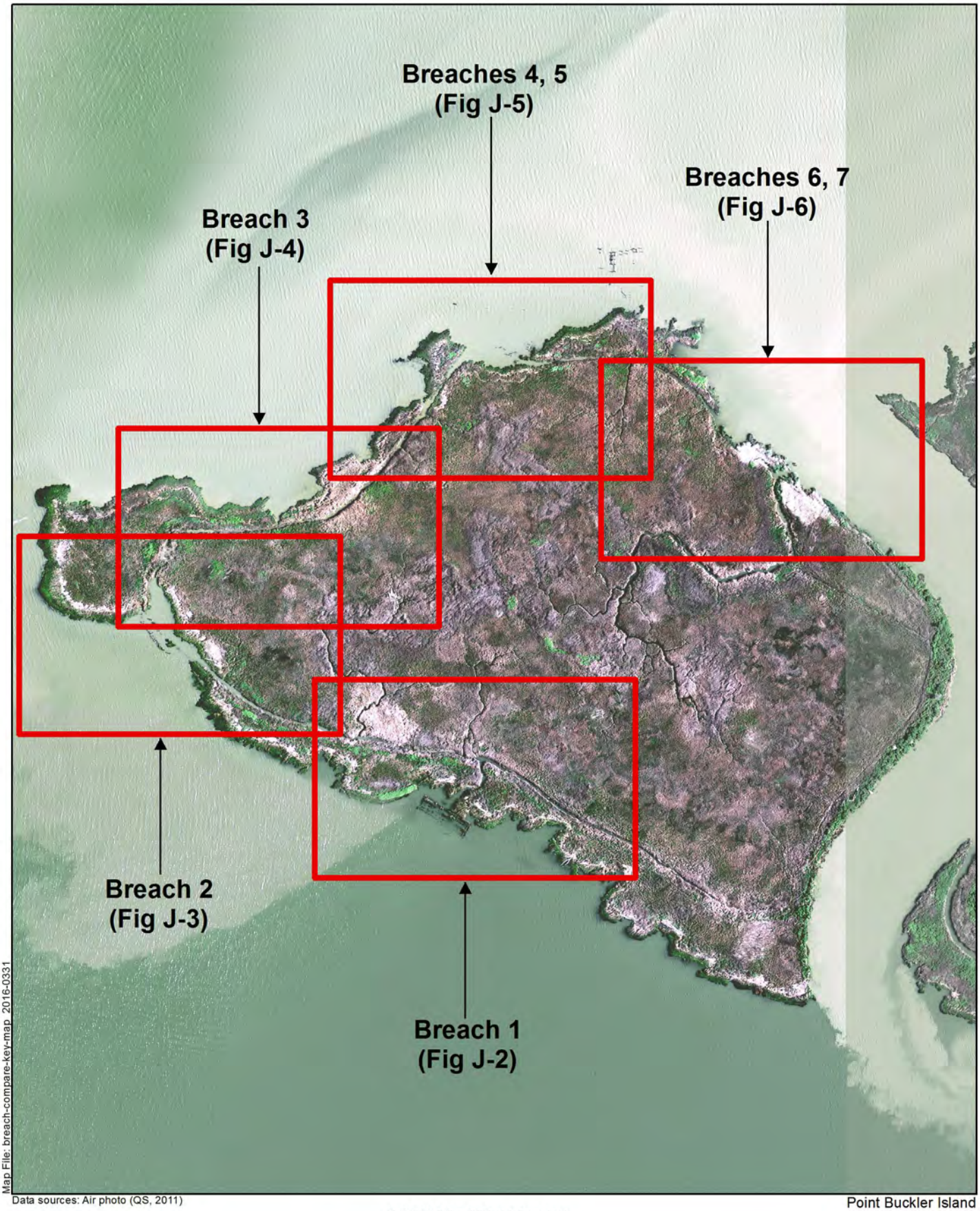
Figure J-4. Tidal Connectivity 2011 vs. 2016, Breach 3

Figure J-5. Tidal Connectivity 2011 vs. 2016, Breaches 4 and 5

Figure J-6. Tidal Connectivity 2011 vs. 2016, Breaches 6 and 7

Figure J-7. Tidal Connectivity 2011 vs. 2016, Overland Flow

Figure J-8. Loss of Lands Subject to Tidal Action, 2011 to 2016



Map File: breach-compare-key-map_2016-0331

Data sources: Air photo (QS, 2011)

1:3,600 (1" = 300' at letter size)

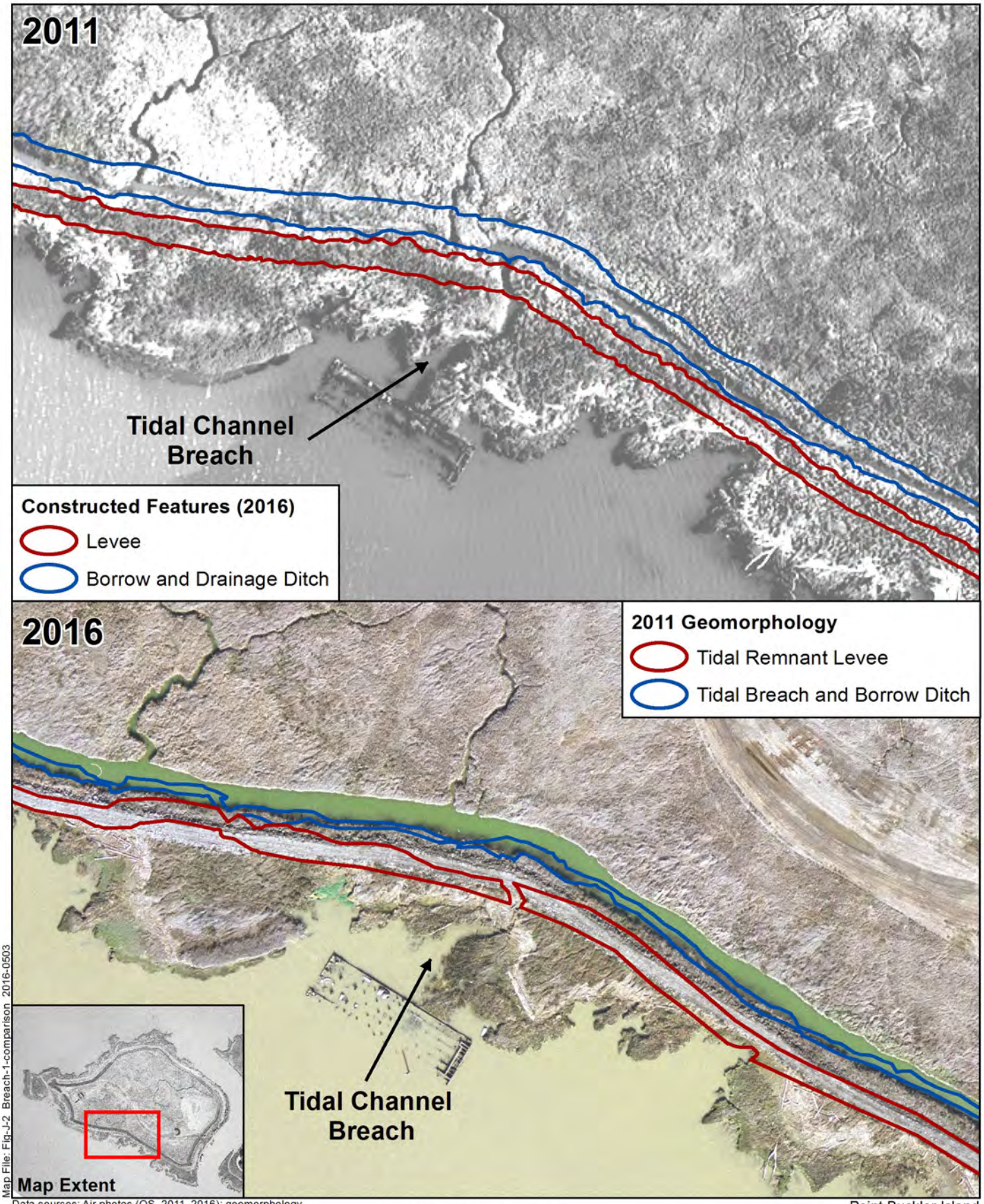
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure J-1

Tidal Connectivity Locations Index Map



Map File: Fig-J-2_Breach-1-comparison_2016-0503

Data sources: Air photos (QS, 2011, 2016); geomorphology (SE, 2016)

1:1,200 (1" = 100' at letter size)

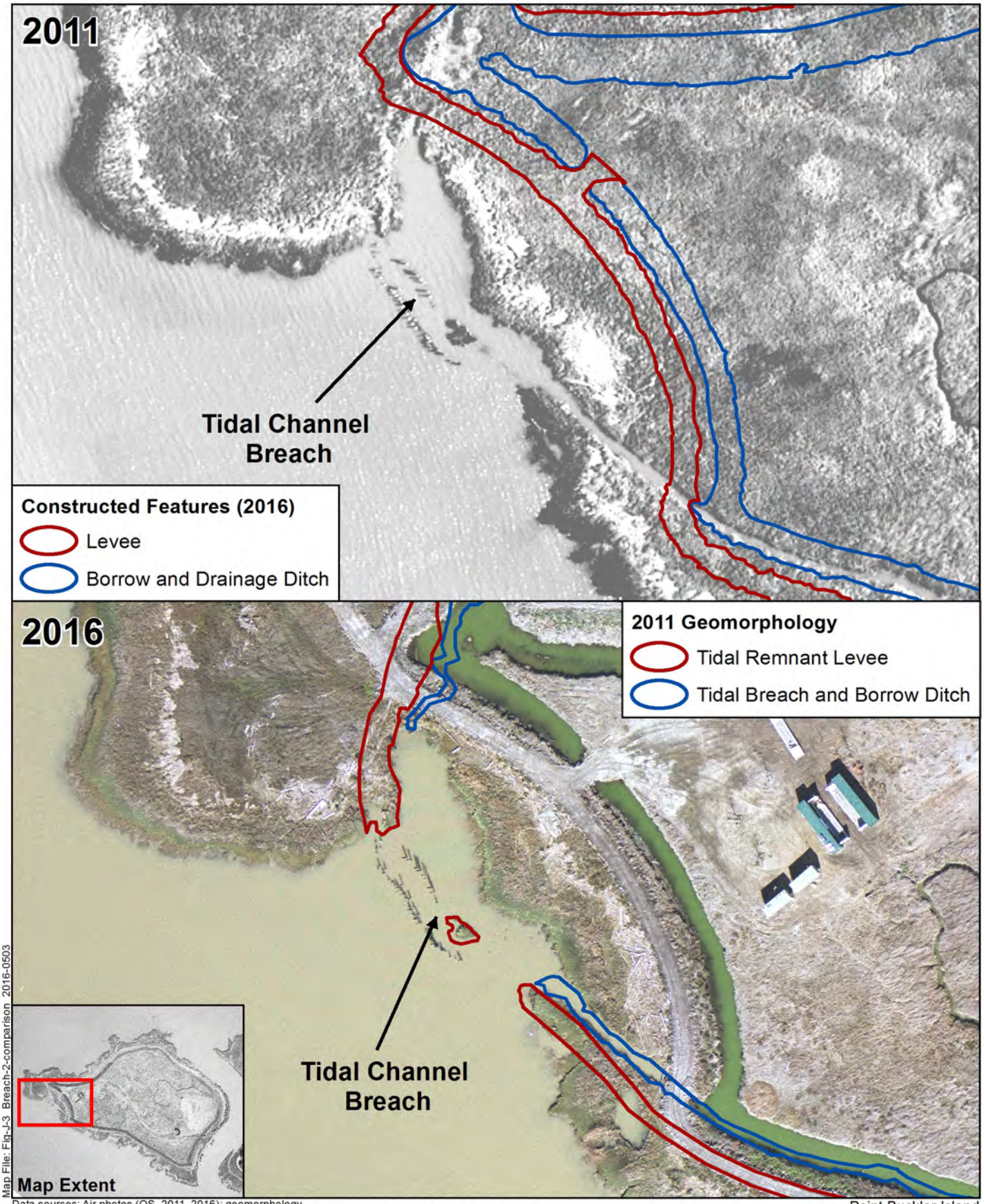
0 50 100 ft

0 15 30 m

Point Buckler Island
Solano County, CA

Figure J-2

Tidal Connectivity 2011 vs. 2016, Breach 1



Map File: Fig-J-3_Breach-2-comparison_2016-0503

Data sources: Air photos (QS, 2011, 2016); geomorphology (SE, 2016)

1:1,200 (1" = 100' at letter size)

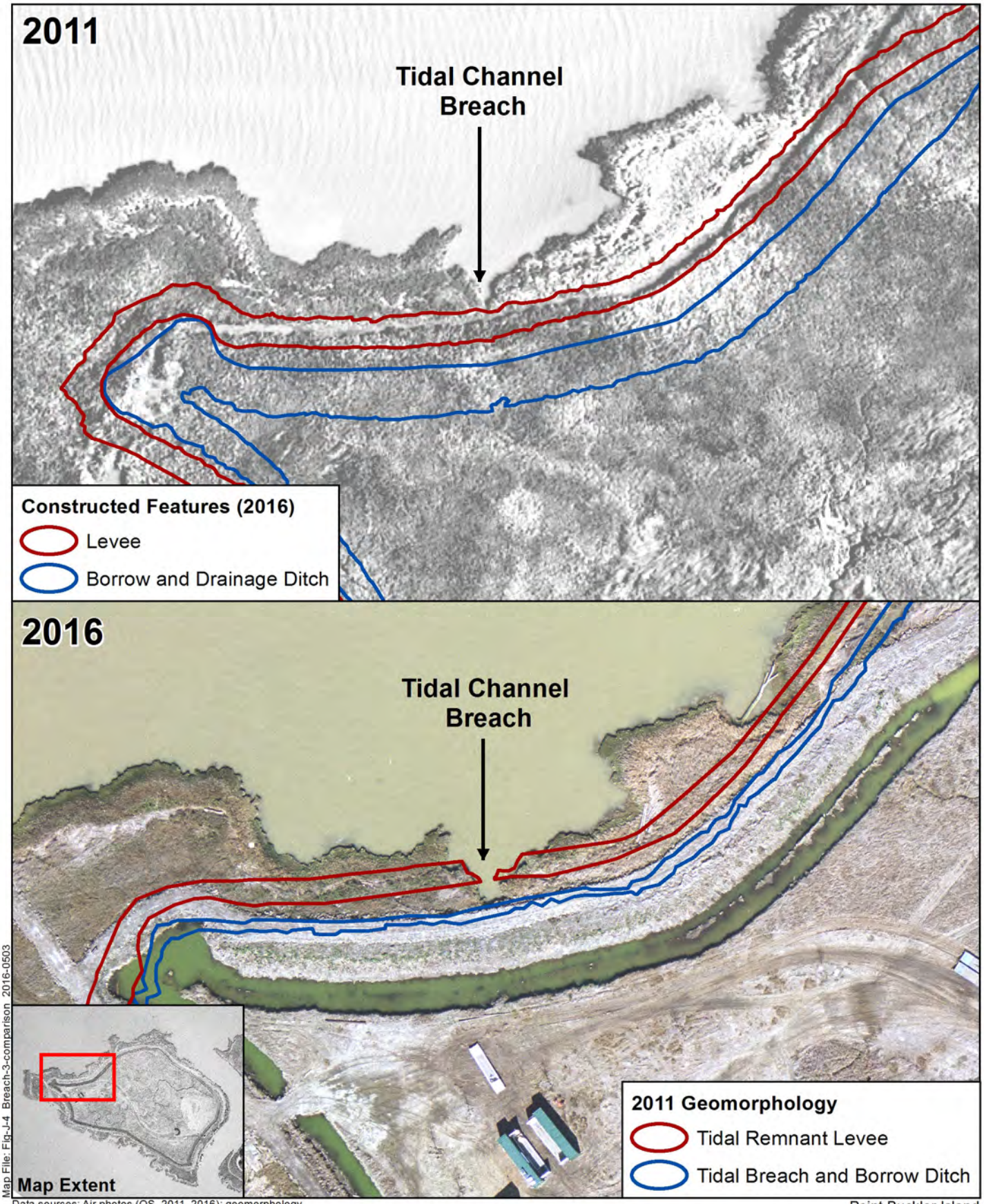
0 50 100 ft

0 15 30 m

Point Buckler Island
Solano County, CA

Figure J-3

Tidal Connectivity 2011 vs. 2016, Breach 2



Map File: Fig-J-4 Breach-3-comparison 2016-0503

Data sources: Air photos (QS, 2011, 2016); geomorphology (SE, 2016)

1:1,200 (1" = 100' at letter size)

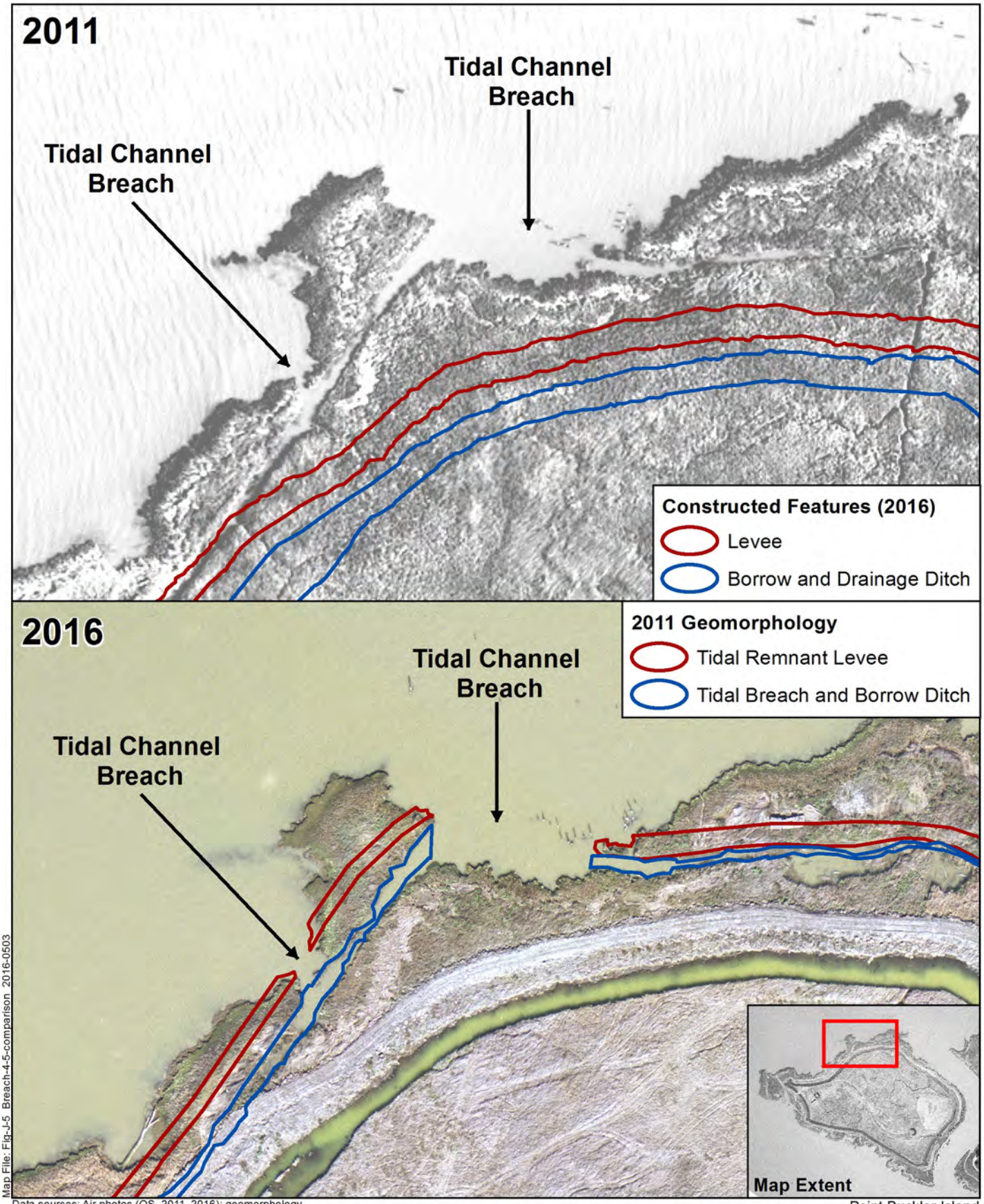
0 50 100 ft

0 15 30 m

Point Buckler Island
Solano County, CA

Figure J-4

Tidal Connectivity 2011 vs. 2016, Breach 3



Map File: Fig-J-5_Breach-4-5-comparison_2016-0503

Data sources: Air photos (QS, 2011, 2016); geomorphology (SE, 2016)

1:1,200 (1" = 100' at letter size)

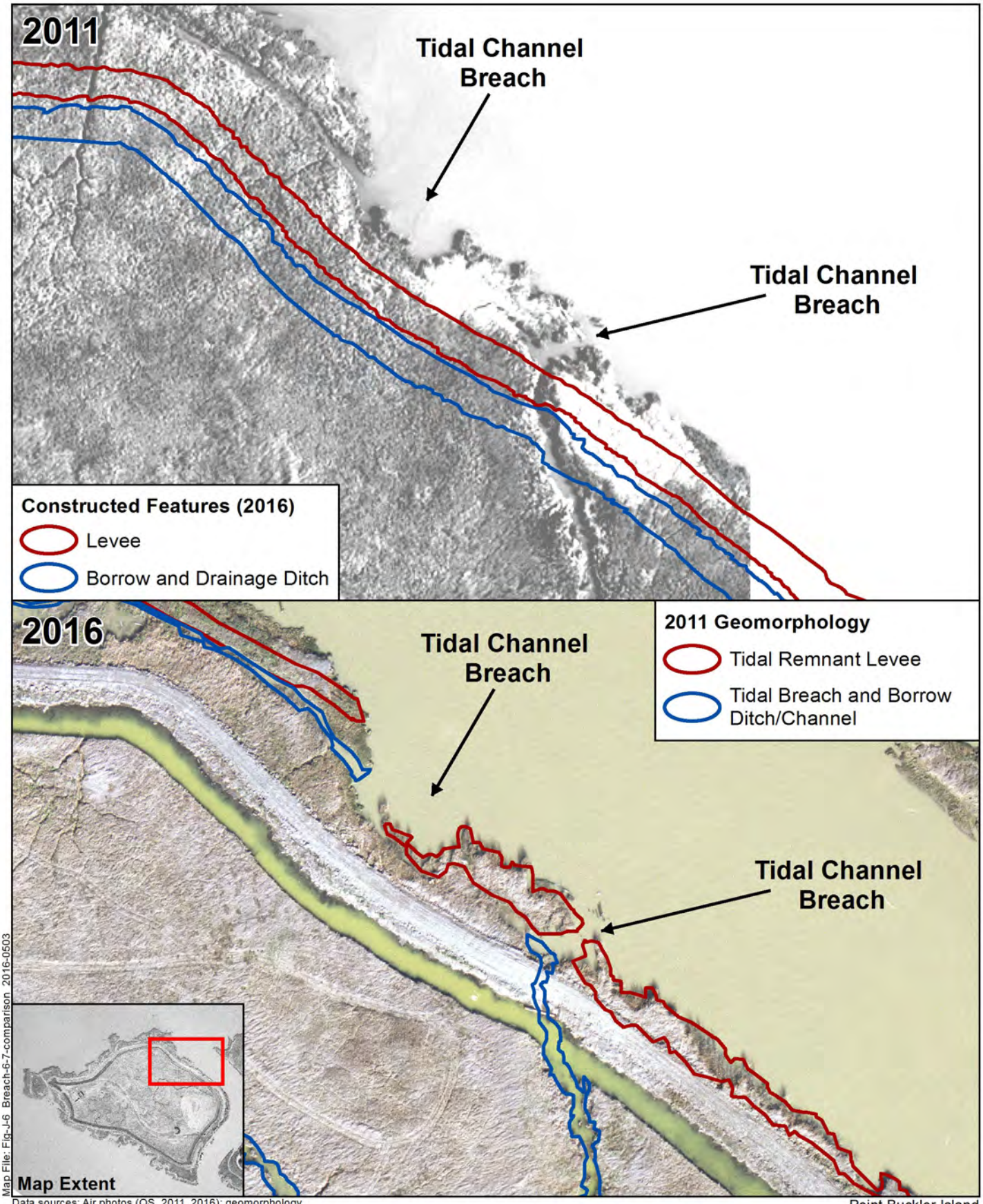
0 50 100 ft

0 15 30 m

Point Buckler Island
Solano County, CA

Figure J-5

Tidal Connectivity 2011 vs. 2016, Breaches 4 and 5



Map File: Fig-J-6 Breach-6-7-comparison 2016-0503

Data sources: Air photos (QS, 2011, 2016); geomorphology (SE, 2016)

1:1,200 (1" = 100' at letter size)

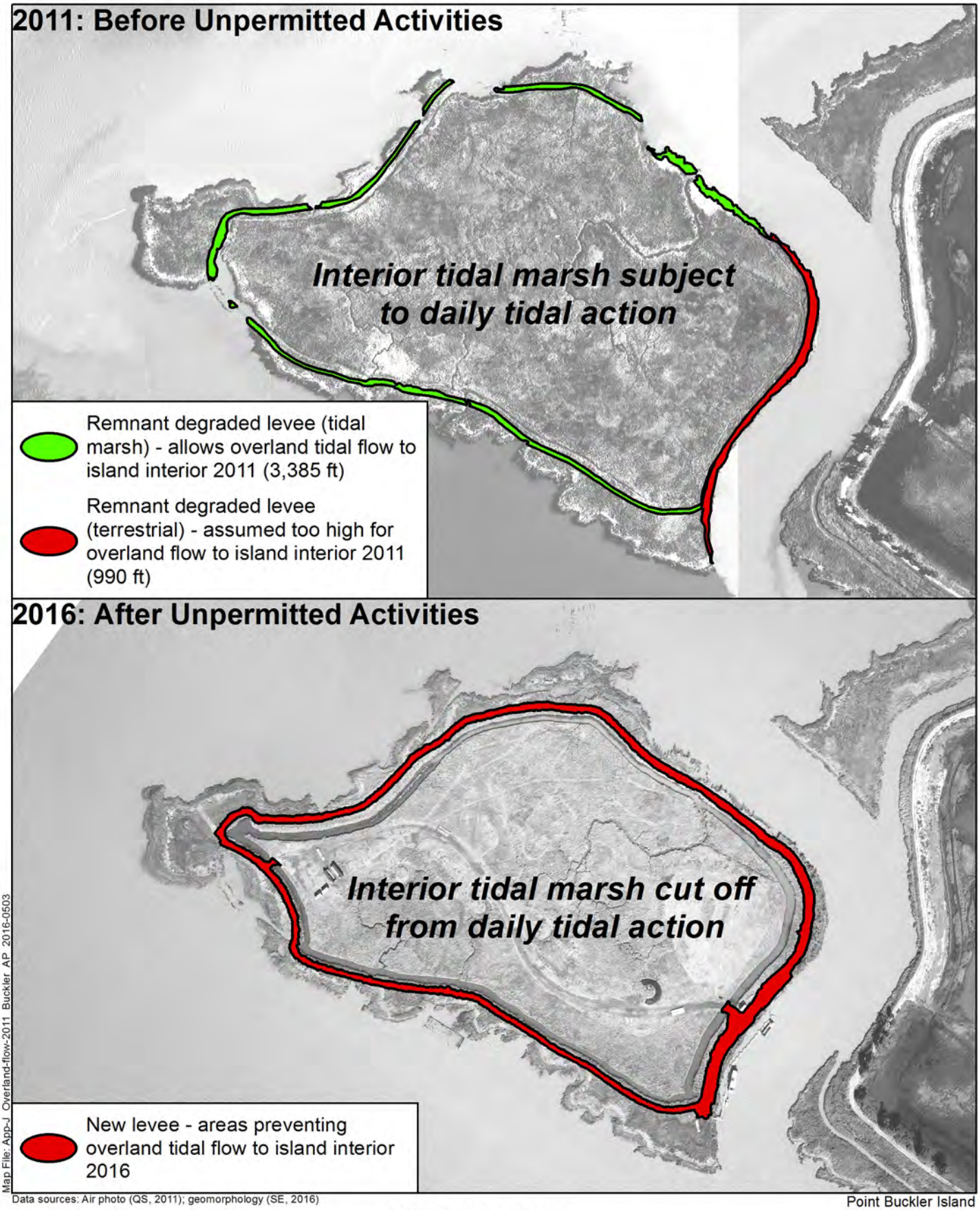
0 50 100 ft

0 15 30 m

Point Buckler Island
Solano County, CA

Figure J-6

Tidal Connectivity 2011 vs. 2016, Breaches 6 and 7



Map File: App-J_Overland-flow-2011_Buckler_AP_2016-0503

Data sources: Air photo (QS, 2011); geomorphology (SE, 2016)

1:4,800 (1" = 400' at letter size)

0 200 400 ft

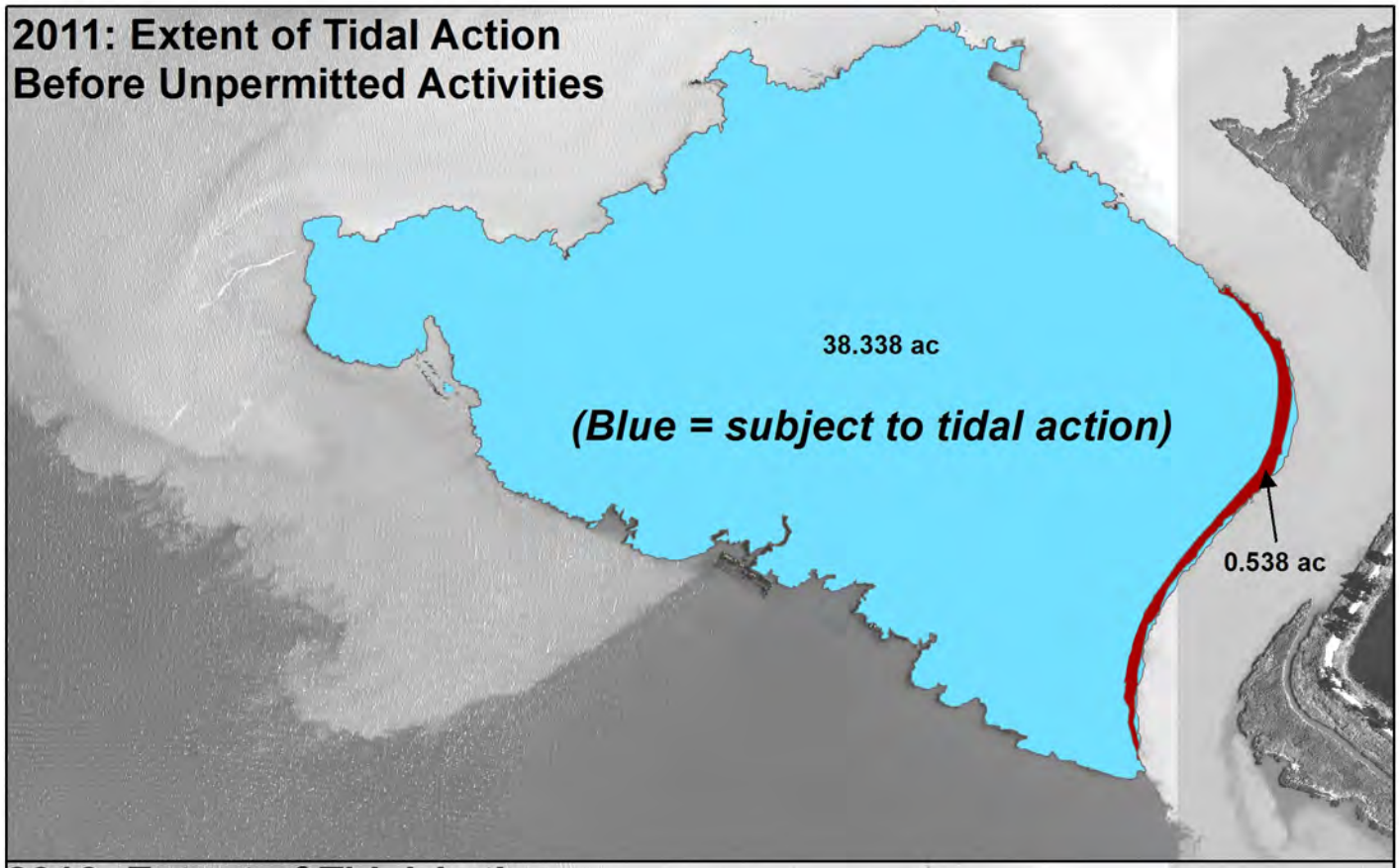
0 60 120 m

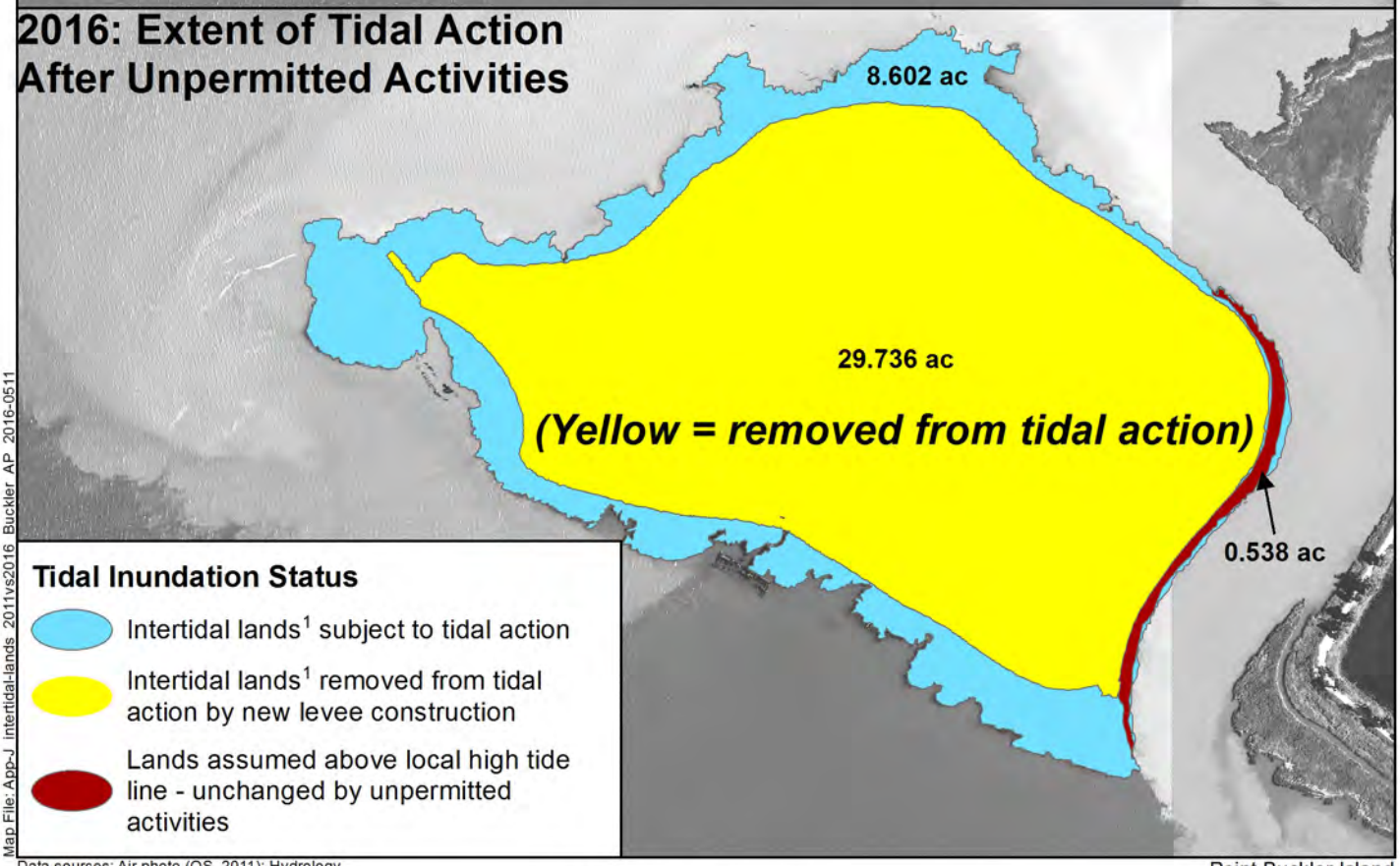
Point Buckler Island
Solano County, CA

Figure J-7

Base air photo: (Quantum Spatial) April 2011

Tidal Connectivity 2011 vs. 2016, Overland Flow





Map File: App-J_intertidal-lands_2011vs2016_Buckler_AP_2016-0511

Data sources: Air photo (QS, 2011); Hydrology (SE, 2016)

1:4,800 (1" = 400' at letter size)

0 200 400 ft

0 65 130 m

Point Buckler Island
Solano County, CA

Figure J-8

Loss of Lands Subject to Tidal Action, 2011 to 2016

[1]Lands below the local high tide line (8.2 ft NAVD88) prior to unpermitted activities

Base air photo: (Quantum Spatial) April 2011

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Appendix K Fill and Excavation in Wetlands and Waters Since 2011

K-1.0 Introduction

This appendix describes and quantifies the earthen fill and excavation and structural fill activities that took place between 2012 and 2016 at Point Buckler. These data are presented as follows:

- Figure K-1 shows the **relative proximity of the unpermitted levee to the 1985 remnant levee and borrow ditch**, in order to assess the extent to which new levee construction followed the path of the prior levee.
- Figure K-2 shows the **locations of constructed features relative to tidal wetlands and waters**, in order to assess jurisdictions in which work took place on Point Buckler between 2012 and 2016.
- Figure K-3 shows the **locations of structural fill** features placed at Point Buckler between 2012 and 2016.
- Figure K-4 shows the **temporal sequence of construction** of the new levee and borrow ditch, all of which took place during 2014.
- Figure K-5 through Figure K-40 **annotate each of the 36 aerial photographs** obtained for the time period 2012 to 2016, identifying for each time interval the status of unpermitted activities on Point Buckler.
- Table K-1 **documents the unpermitted work activities** for each of the 36 aerial photographs shown in Figure K-5 through Figure K-40.
- Table K-2 and Table K-3 **summarize the in-place cut and fill volumes**, respectively, for work on the tidal remnant levee, tidal marsh, and tidal borrow ditch and channels.
- Table K-4 summarizes the **area of each structural fill** item shown in Figure K-3.
- Table K-5 lists the length of new levee and new borrow and drainage ditch construction during each time interval in 2014, as shown in Figure K-4.

K-2.0 Analytical Methods

K-2.1 Aerial Photograph Interpretation and Activities Description Development

To evaluate the progress of unpermitted activities at Point Buckler, we obtained and compiled 36 aerial photographs representing the time period of May 19, 2012 to February 10, 2016 (Figure D-1 to Figure D-36). To ensure spatial comparability over time, we rectified all aerial photographs to common points and validated that the relic dock on the north side of the island and relic barge on the south side of the island were always aligned.

The footprints of the earthen fill and excavation activities and the structural fills were digitized from the February 10, 2016 aerial photograph, with the alignment of the new levee and borrow ditch also utilizing the March 2, 2016 topographic survey data. Calculations of fill and excavation areas were made from the spatial data utilizing ArcMap[9] software.

K-2.2 Excavation and Fill Volume Calculations

Calculations of in-place fill and excavation volumes – the difference between current and baseline elevations – were made by CLE Engineering utilizing AutoCAD[10] software. These volume calculations do not account for expansion of excavated soils, natural consolidation of placed fill, and compaction of placed fill. The specific methods are described in Appendix E and are summarized here.

The 2016 topographic elevations used for these calculations are shown in the Digital Elevation Model derived from the March 2, 2016 topographic survey (Figure F-12). To establish the pre-disturbance "baseline" elevations, we used a range of data (details are described fully in the cut-fill volume calculations data report from CLE Engineering, Appendix E):

- Elevations from the March 2, 2016 topographic survey were used for:
    - the tidal marsh outboard of the new levee
    - the undisturbed segments of the remnant levee
    - the undisturbed now-diked tidal marsh within the footprint of and interior to the new levee
- For the eastern remnant levee that was mapped in 2012 as supporting terrestrial vegetation by the California Department of Fish and Wildlife, we used the High Tide Line elevation (see Appendix I).
- For the tidal remnant borrow ditch for which no topographic data was obtained, calculations were made twice, one assuming no borrow ditch was present and the second assuming ditch invert elevations matched the inverts of the tidal channels within the site interior.

To develop the time steps of fill and excavation activities for the new levee and borrow ditch, we used the 12 aerial photographs of the time period in 2014 during which construction took place (Figure K-18 through Figure K-29).

Note regarding eastern terrestrial levee fill calculations: When we ran the cut-fill volume calculations, we found in some areas of the eastern terrestrial remnant levee that the 2016 levee height was below HTL which was our assumed elevation for the reaches of the remnant levee mapped as terrestrial vegetation in the CDFW 2012 vegetation map (Figure H-2). These locations either were below HTL before work began or were graded lower as part of overall levee construction. By assuming these areas were non-jurisdictional terrestrial lowlands, any fill placed would not be counted as wetlands fill. Since

[9] ESRI
[10] Autodesk

the area is small, the volumes small, and the assumption benefits the property owner, we elected to retain the assumed height above HTL and not to include areas with elevations below HTL as cut volume.

K-3.0 Timing of Key Work Activities

K-3.1 Alterations to the Property Were Relatively Small for the First Two Years Following Property Transfer, 2012 And 2013

During 2012, some paths were mowed across the site, three trenches had been excavated with the spoils placed atop the nearby tidal marsh surface, two dock pilings were installed in Andy Mason Slough, and two trailers were brought onto the property. Trenches were roughly the width of the future borrow and drainage ditch, varied in length from roughly two to five times their width, covered an area of about 0.5 acre, and excavated roughly 500-600 cubic yards of sediment. In 2013, some additional mowing took place, a wood pile was placed on the tidal marsh, and a small dock was installed at the pilings in Andy Mason Slough.

K-3.2 Major Levee and Borrow and Drainage Ditch Construction Took Place in 2014

By early February 2014, the small dock was replaced with a **large dock about 0.071 acre in size** in Andy Mason Slough (Figure K-3), construction equipment (crane, excavator and bulldozer) were mobilized to the site, and grading on the tidal marsh began (Figure K-18). Construction of the 4,700 feet of new levee to fully enclose the interior tidal marsh of Point Buckler, and its associated new borrow ditch, took place between February and October 2014, with completion by the end of October (Figure K-29, Table K-5). The first 1,400 feet of this new levee roughly followed the path of the remnant levee (which itself had long become tidal marsh), along the southern side of the property (Figure K-1). Field evidence of high marsh and marsh-upland transitional vegetation emerging through fill soils placed atop the tidal remnant levee further indicate the tidal marsh jurisdictional status of the tidal remnant levee (see Photo R-11 in Appendix R). The remaining 3,300 feet of new levee was built directly atop the tidal marsh outside the alignment of the old levee (Figure K-1). Some of the new levee was built on the remnant tidal borrow ditch (Figure K-1). **A total of about 16,000 cubic yards of tidal marsh soils were excavated to construct the new levee (Table K-3), which filled about 2.56 acres of tidal marsh and tidal channels and ditches (Table K-2).** One 2-foot diameter water control structure was installed in the southwest corner of the site, with flap gates at each end that can be manually opened (Photo K-1). At the end of 2014, two shipping containers and two platforms were brought to the island and placed on the now-diked tidal marsh (Figure K-30) (Photo K-2). A small section of tidal marsh was left unexcavated in the east, providing an access road across the borrow ditch between the new perimeter levee and the now-diked interior (Figure K-29).

K-3.3 2015 Saw More Limited Construction: Crescent Basin Excavation and Spoils Fill, Tree Planting, Mowing and Grading, Early Kite Surfing Facilities, Fill in Borrow Ditch, and Ramp to Water's Edge

Four small crescent-shaped basins about 0.21 acre in size were excavated on the island interior (Figure K-31 and Figure K-32, Photo K-4), about 10-12 trees were planted (all of which have died) (Figure K-32,

Photo K-4), mowing and grading took place in particular to establish a dirt road across the site, an equipment and "social" area were set up on the west side of the island with the shipping containers and two of the trailers (Figure K-3, Photo K-2, Photo K-3), **a small ramp about 0.04 acre in size** was built from the levee to the water's edge in the western tip of the island (Figure K-32), and **fill was placed into a section of the newly excavated borrow ditch about 0.03 acre in size** in the southwest corner to connect the west end of the island interior to the perimeter levee (Figure K-32). A third trailer was set up on the eastern side (Figure K-32), and at the time of the October 21, 2015 agency site visit, several goats were enclosed by a fence around this trailer (Photo K-5). At that site visit, the two shipping containers on the west side were set up for social use and eight numbered storage lockers.

K-3.4 The Final Major Work to Date Took Place in Early 2016: Extensive Kite Surfing Facilities, Helicopter Pads, and Some Small Items

These work activities are shown in Figure K-40 and Photo K-10. Three platforms were brought to the island and placed between the two shipping containers on the west side and both ends of the platforms raised, creating a wind-sheltered "patio" between the two shipping containers (Photo K-2). Four more platforms were brought to the island and set up in two pairs and painted with a large circled "H" – helicopter landing pads (Photo K-6). **These structures brought the total area of structural fill on the tidal marsh to 0.096 acre** (Table K-4, Figure K-3). The March 2, 2016 site visit also revealed that a gate was installed at the eastern borrow ditch road crossing (Photo K-7), and a second set of gates and pilings were stockpiled nearby, presumably for later installation at the second borrow ditch crossing at the west end (Photo K-8). These two gates would allow the goats to be released on the island interior without allowing them onto the new perimeter levee, presumably for the purpose of vegetation control. Additional kite surfing facilities were in place by early May 2016, including a wind-sheltered outdoor lounge between the two shipping containers (Photo K-9) and what appears to be **artificial turf roughly 0.15 acre size** on the now-diked tidal marsh covering for kite surfing and other outdoor activities (Photo K-10).

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

Photo Date	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														Figure No.
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	
5/19/2012	Open	Open	Open	Open	No	Yes	No	No	No	2 of 5	No	No	No	Pilings	K-5
	- Mowing west end, paths through marsh interior - Trench 1 in northwest and trench 4 in south excavated, fill placed on tidal marsh surface to north and south, respectively - Two pilings in place for future boat dock, Andy Mason Slough - New walkway out to bay, north end - All 7 breaches still open														
2012 (summer)	Open	Open	Open	Open	No	Yes	No	No	No	2 of 5	No	No	No	Pilings	K-6
	- Same as 5/19/2012 - Crane on east shoreline														
8/23/2012	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	2 Trailers	No	Pilings	K-7
	- Third trench NW2 excavated, fill placed on tidal marsh surface to north - Landing craft at west shore - Two trailers staged on tidal marsh, west end of island														
8/30/2012	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	2 Trailers	No	Pilings	K-8
	- Same as 8/23/2012														
9/1/2012	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	2 Trailers	No	Pilings	K-9
	- Same as 8/23/2012														
1/26/2013	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood pile	No	Pilings	K-10
	- Mowing on tidal marsh, northwest both sides of remnant borrow ditch - Landing craft not on island - Wood pile placed on tidal marsh surface, north side of trench NW1														
4/16/2013	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood, 2 trailers	No	Small dock	K-11
	- Same as 1/26/2013 - Small dock (~8ft x 37ft) east side in Andy Mason Slough, gangway to land														

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

Photo Date	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														Figure No.
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	
4/27/2013	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood, 2 trailers	No	Small dock	K-12
	- Same as 4/16/2013 - Crane on tidal marsh between dock and S trench														
6/1/2013	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood, 2 trailers	No	Small dock	K-13
	- Same as 4/27/2013 - Crane location not evident														
9/22/2013	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood, 2 trailers	No	Small dock	K-14
	- Same as 6/1/2013 - Landing craft at north shore														
10/11/2013	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood, 2 trailers	No	Small dock	K-15
	- Same as 9/22/2013 - Landing craft gone from island - Crane back in southeast														
12/21/2013	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood, 2 trailers	No	Small dock	K-16
	- Same as 10/11/2013														
1/12/2014	Open	Open	Open	Open	No	Yes	No	No	No	3 of 5	No	Wood, 2 trailers	No	Small dock	K-17
	- Same as 12/21/2013														
2/3/2014	Open	Open	Open	Open	No	Grading	No	No	No	3 of 5	No	Small dock	No	Large Dock	K-18
Construction begins to close tidal connectivity	***BEGINNING OF MAJOR EARTH WORK ON ISLAND*** - Large dock installed in Andy Mason Slough, gangway to island at south end - Grading on tidal marsh, in southeast corner on bay side of future levee - Equipment (bulldozer) on tidal marsh, southeast corner at grading area - Excavator and crane on tidal marsh, east side - Small dock moved onto tidal marsh in southeast corner														

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

Photo Date	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														Figure No.
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	
3/8/2014	Yes	Yes	No	Breach 1 closed	No	Yes	No	Yes	No	4 of 5	No	Docks, wood, 2 trailers	No	Large Dock	K-19
	MAJOR EARTH WORK UNDERWAY: ABOUT 25% OF LEVEE AND BORROW DITCH CONSTRUCTED, ONE BREACH CLOSED - 1,200 feet of new levee constructed atop tidal marsh, tidal remnant levee, and tidal waters; excavator working in new levee alignment: - Atop 1985 levee alignment: 0.185 ac, 566 cy - Atop marsh surface, interior to 1985 levee alignment: 0.331 ac, 773 cy - Atop remnant borrow ditch: 0.001 ac, 5 cy - 1,170 feet of new borrow ditch excavated from tidal marsh, tidal remnant levee, and tidal waters: - Atop marsh surface: 0.438 ac, 3289 cy - Atop remnant borrow ditch alignment: 0.148 ac, 566 cy - Atop remnant 1985 levee: 0.001 ac, 5 cy - Trench excavated east side														
3/24/2014	Yes	Breach 2 closed	Yes	Yes	No	Yes	No	Yes	No	5 of 5	Installed	Docks, wood, 2 trailers	No	Large Dock	K-20
	MAJOR EARTH WORK UNDERWAY: ABOUT 39% OF LEVEE AND BORROW DITCH CONSTRUCTED, SECOND BREACH CLOSED - 625 feet of new levee constructed atop tidal marsh, tidal remnant levee, and tidal waters; excavator working in new levee alignment: - Atop 1985 levee alignment: 0.059 ac, 183 cy - Atop marsh surface, interior to 1985 levee alignment: 0.224 ac, 648 cy - Atop remnant borrow ditch: 0.010 ac, 50 cy - 600 feet of new borrow ditch excavated from tidal marsh, tidal remnant levee, and tidal waters: - Atop marsh surface: 0.260 ac, 1737 cy - Atop remnant borrow ditch alignment: 0.037 ac, 162 cy - Atop remnant 1985 levee: 0.016 ac, 125 cy - Trench excavated southwest side, spoils placed onto tidal marsh in new levee alignment - Mowing on tidal marsh, west end of island - Water control structure assumed installed in southwest, in conjunction with new levee and borrow ditch construction														

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

Photo Date	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														Figure No.
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	
5/22/2014	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	Docks, wood, 2 trailers	No	Large Dock	K-21
	PROGRESS: ABOUT 45% OF LEVEE AND BORROW DITCH CONSTRUCTED - 300 feet of new levee constructed atop tidal marsh, tidal remnant levee, and tidal waters; excavator working on marsh surface: - Atop 1985 levee alignment: 0.044 ac, 55 cy - Atop marsh surface: 0.082 ac, 237 cy - Atop remnant borrow ditch: 0.024 ac, 162 cy - 185 feet of new borrow ditch excavated from tidal marsh, tidal remnant levee, and tidal waters: - Atop 1985 levee alignment: 0.001 ac, 4 cy - Atop marsh surface: 0.148 ac, 901 cy - Atop remnant borrow ditch alignment: 0.014 ac, 57 cy														
5/26/2014	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Docks, wood, 2 trailers	No	Large Dock	K-22
	PROGRESS: ABOUT 46% OF LEVEE AND BORROW DITCH CONSTRUCTED - 45 feet of new levee constructed atop tidal marsh and tidal waters; excavator working on marsh surface: - Atop marsh surface, interior to 1985 levee alignment: 0.019 ac, 61 cy - Atop remnant borrow ditch: 0.006 ac, 40 cy - 45 feet of new borrow ditch excavated from tidal marsh: - Atop marsh surface: 0.038 ac, 166 cy														
6/5/2014	Yes	Yes	Yes	Breach 3 closed	No	Yes	No	Yes	No	Yes	Yes	Docks, wood, 2 trailers	No	Large Dock	K-23
	PROGRESS: ABOUT 47% OF LEVEE AND BORROW DITCH CONSTRUCTED, THIRD BREACH CLOSED - 55 feet of new levee constructed atop tidal marsh and tidal waters; excavator working on marsh surface - Atop marsh surface, interior to 1985 levee alignment: 0.020 ac, 76 cy - Atop remnant borrow ditch: 0.009 ac, 66 cy - 75 feet of new borrow ditch excavated from tidal marsh: - Atop marsh surface: 0.057 ac, 252 cy - Landing craft not at island														

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

Photo Date	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														Figure No.
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	
7/10/2014	Yes	Yes	Yes	Yes	No	Grading	No	Yes	No	Yes	Yes	Trailer 3	No	Large Dock	K-24
	PROGRESS: ABOUT 54% OF LEVEE AND BORROW DITCH CONSTRUCTED - 315 feet of new levee constructed atop tidal marsh and tidal waters; excavator working on marsh surface: - Atop marsh surface, interior to 1985 levee alignment: 0.090 ac, 247 cy - Atop remnant borrow ditch: 0.053 ac, 323 cy - 315 feet of new borrow ditch excavated from tidal marsh: - Atop marsh surface: 0.265 ac, 1,113 cy - Grading on tidal marsh, west end - Trailer placed on tidal marsh fill southeast corner (third on site)														
8/6/2014	Yes	Breaches 4-7 closed			No	Yes	No	Yes	No	Yes	Yes	Docks, wood, 3 trailers	No	Large Dock	K-25
	PROGRESS: ABOUT 77% OF LEVEE AND BORROW DITCH CONSTRUCTED. FINAL FOUR BREACHES CLOSED - Breaches 4, 5, 6, and 7 closed -- **COMPLETES FILL IN ALL BREACHES TO DISCONNECT TIDAL CHANNEL CONNECTIVITY** - 1,105 feet of new levee constructed atop tidal marsh, tidal remnant levee, and tidal waters; excavator working on marsh surface, levee alignment: - Atop marsh surface, interior to 1985 levee alignment: 0.564 ac, 2,059 cy - Atop remnant 1985 levee: 0.003 ac, 1 cy - Atop remnant borrow ditch and tidal marsh channel: 0.012 ac, 80 cy - 1,060 feet of new borrow ditch excavated from tidal marsh and tidal waters: - Atop marsh surface: 0.577 ac, 3,642 cy - Atop marsh channel: 0.016 ac, 45 cy														
8/23/2014	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Docks, wood, 3 trailers	No	Large Dock	K-26
	PROGRESS: ABOUT 87% OF LEVEE AND BORROW DITCH CONSTRUCTED - 470 feet of new levee constructed atop tidal marsh and tidal waters; excavator working on marsh surface: - Atop marsh surface, interior to 1985 levee alignment: 0.289 ac, 1,057 cy - Atop remnant borrow ditch: 0.017 ac, 118 cy - 420 feet of new borrow ditch excavated from tidal marsh and tidal waters: - Atop marsh surface: 0.264 ac, 1,626 cy - Atop remnant borrow ditch: 0.003 ac, 13 cy - Trailers moved side-by-side west end														

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

Photo Date	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														Figure No.
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	
9/20/2014	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes	Yes	Docks, wood, 3 trailers	No	Large Dock	K-27
	- Same as 8/23/2014														
10/18/2014	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Docks, wood, 3 trailers	No	Large Dock	K-28
	PROGRESS: ABOUT 94% OF LEVEE AND BORROW DITCH CONSTRUCTED - 295 feet of new levee constructed atop tidal marsh and tidal waters; excavator working on marsh surface: - Atop marsh surface, interior to 1985 levee alignment: 0.175 ac, 643 cy - Atop remnant borrow ditch: 0.040 ac, 338 cy - 230 feet of new borrow ditch excavated from tidal marsh: - Atop marsh surface: 0.147 ac, 1,017 cy - Trench on east side filled for new levee														
10/29/2014	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Docks, wood, 3 trailers	No	Large Dock	K-29
	PROGRESS: LEVEE AND BORROW DITCH CONSTRUCTION COMPLETED - Eastern final segment of new levee and new borrow ditch completed - 300 feet of new levee constructed atop tidal marsh, tidal remnant levee, and tidal waters; excavator working on marsh surface: - Atop marsh surface, interior to 1985 levee alignment: 0.272 ac, 717 cy - Atop remnant 1985 levee alignment: 0.012 ac, 22 cy - Atop remnant borrow ditch: 0.010 ac, 59 cy - 330 feet of new borrow ditch excavated from tidal marsh and tidal waters: - Atop marsh surface: 0.217 ac, 1,332 cy - Atop remnant borrow ditch: 0.003 ac, 7 cy - Old boat dock moved to southeast corner onto tidal marsh surface														
12/31/2014	Levee completed					Yes	No	Yes	No	Yes	Yes	2 Containers, 2 platforms	No	Large Dock	K-30
	PROGRESS: STRUCTURAL FILL PLACED ON SITE - Two shipping containers on tidal marsh fill, southeast corner - Two platforms on tidal marsh, at east borrow ditch crossing - Bay vs. interior water exhibit distinctly different colors demonstrating absence of tidal connectivity to island interior														

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

Photo Date	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														Figure No.
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	
1/29/2015	Levee completed					Crescents	No	Yes	Yes	Yes	Yes	Multiple	No	Large Dock	K-31
	PROGRESS: STRUCTURAL FILL PLACED ON SITE, THREE OF FOUR CRESCENT BASINS EXCAVATED - Three of four crescent basins excavated on tidal marsh interior, spoils placed nearby on marsh surface - Fill atop marsh surface: 0.117 ac, 386 cy - Excavation atop marsh surface: 0.154 ac, 352 cy - Excavation atop tidal marsh channel: 0.012 ac, 16 cy - Additional equipment tracks across tidal marsh interior - Mowing and grading beginning on interior tidal marsh at west end, around areas where shipping containers later placed														
4/1/2015	Levee completed					Crescents	Yes	Yes	Yes	Yes	Yes	Ditch objects	Yes	Large Dock	K-32
After BCDC 1/30/2015 stop work notice *	***PROGRESS: INTERIOR MARSH GRADING, RAMP TO WATER'S EDGE WEST END, FOURTH CRESCENT BASIN EXCAVATED, TREES PLANTED, ROAD ACROSS NEW BORROW DITCH*** - Fourth crescent basin excavated, spoils placed nearby on tidal marsh surface: - Cut atop tidal marsh surface: 0.510 ac, 117 cy - Cut atop tidal marsh channel: 0.004 ac, 5 cy - Fill atop tidal marsh surface: 0.042 ac, 129 cy fill - Grading and mowing west interior tidal marsh - Fill in new borrow ditch for west ditch crossing road: 0.009 ac, 47 cy - Fill on tidal marsh west end for ramp to water's edge: 0.038 ac, 73 cy - Trees planted (at least ten trees) on tidal marsh - Third trailer set up on tidal marsh next to east levee (goat pen) - Shipping containers and two trailers moved to west side of interior tidal marsh plain - Objects (4) in new borrow ditch east side														
4/18/2015	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Multiple	Yes	Large Dock	K-33
	- Same as 4/1/2015 - Equipment moves around														
5/1/2015	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Multiple	Yes	Large Dock	K-34
	- Same as 4/18/2015 - Equipment moves around														

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
Photo Date	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	Figure No.
5/9/2015	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Multiple	Yes	Large Dock	K-35
	- Same as 5/1/2015 - Equipment moves around														
6/7/2015	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Multiple	Yes	Large Dock	K-36
	- Same as 5/9/2015 - Equipment moves around														
Summer 2015	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Multiple	Yes	Large Dock	K-37
	- Same as 6/7/2015 - Equipment moves around														
8/12/2015	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Multiple	Yes	Large Dock	K-38
	- Same as Summer 2015 - Equipment moves around														
11/19/2015	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Multiple	Yes	Large Dock	K-39
After BCDC stop work notice *	- **Northeast marsh mowed** - Equipment moves around														
2/10/2016	Levee completed					Yes	Yes	Yes	Yes	Yes	Yes	Structures	Yes	Large Dock	K-40
After BCDC stop work notice *	- Two helicopter pads placed on tidal marsh surface - Three wind break platforms placed on tidal marsh surface between shipping containers - Other platforms on tidal marsh interior near east helicopter pad - Equipment moved around														

** BCDC issued a written stop work notice on January 30, 2015*

Table K-1. Fill and Excavation Activities, Point Buckler, 2012 - 2016

	Fill and Excavation Activity Progress, 2012-2016 (see notes at end of table for numbered activity description)														
	Wetland and Waters Fill for Levee Construction					Other Wetland Fill		Excavation			Structural Fill in Wetlands and Waters				
	1	2	3	4	5	6	7	8-11	11,12	9,13	14	15	16	17	
Photo Date	On Remnant Levee	On Tidal Marsh	In Remnant Tidal Ditch	In Tidal Channel	In New Trench	Crescent Basin and Trench Spoils	Ramp to Water's Edge	Borrow Ditch	Crescent Basins	Trenches	Water Control Structure	Containers, Trailers, Heli Pads, etc.	Trees	Boat Dock	Figure No.

Fill and Excavation Descriptions

Earthen Fill in Tidal Wetlands and Tidal Waters for Diking

1 Earthen fill on remnant levee (tidal marsh surface), closing overland tidal connectivity
2 Earthen fill on tidal marsh surface, closing overland tidal connectivity
3 Earthen fill in tidal remnant borrow ditch, closing tidal channel connectivity
4 Earthen fill in tidal marsh channels (old levee breaches), closing tidal channel connectivity
5 Earthen fill in newly excavated trench

Earthen Fill in Tidal Wetlands for Other Purposes

6 Earthen fill on marsh surface, near crescent basins and trenches and in association with planted trees
7 Earthen fill on marsh surface, creating ramp from levee to water's edge

Excavation of Borrow Ditch

8 Excavation of tidal marsh plain
9 Excavation of tidal remnant borrow ditch (some also excavated for trenches)
10 Excavation of tidal remnant levee
11 Excavation of tidal marsh channel (some also excavated for crescent basins)

Excavation of Crescent Basins and Trenches

12 Excavation of tidal marsh plain for new crescent basins
13 Excavation of tidal marsh plain for five trenches near island perimeter, one of which was subsequently filled (Activity 5) and another became part of the borrow ditch (Activity 8)

Structural Fill

14 Installation of new water control structure in tidal wetlands and waters
15 Placement of shipping containers, trailers, helicopter pads, wind-break platforms, and other structures onto the island tidal marsh interior
16 Planting of trees on the island tidal marsh interior
17 Installation of pilings, floating boat dock, and fixed gangway on the eastern side of the island, in Andy Mason Slough

Shading Scheme

- Orange = activity completed during previous time
- Yellow = new earthen fill activity
- Red = levee breach newly closed
- Green = new structural fill activity
- Blue = no change from baseline

Table K-2. Earthen Fill Areas and In-Place Volumes in Tidal Wetlands and Waters, by Time and Placement Location

Fill Location and Time Interval [1]			Area	Volume			
Interval	Start Date	End Date	(ac)	(cy)			Notes
Remnant Levee							
T0-T1	2/3/2014	3/8/2014	0.338	773			Area includes 0.006 ac with no volume calculations[2]
T1-T2	3/8/2014	3/24/2014	0.059	183			
T2-T3	3/24/2014	5/22/2014	0.044	55			
T6-T7	7/10/2014	8/6/2014	0.004	1			
T10-T11	10/18/2014	10/29/2014	0.012	22			
	SUBTOTAL, Remnant Levee		**0.457**	**1034**			
Marsh Surface							
T0-T1	2/3/2014	3/8/2014	0.206	566			Area includes 0.022 ac with no volume calculations[2]
T1-T2	3/8/2014	3/24/2014	0.224	648			
T2-T3	3/24/2014	5/22/2014	0.082	237			
T3-T4	5/22/2014	5/26/2014	0.019	61			
T4-T5	5/26/2014	6/5/2014	0.020	76			
T5-T6	6/5/2014	7/10/2014	0.090	247			
T6-T7	7/10/2014	8/6/2014	0.564	2059			
T7-T8	8/6/2014	8/23/2014	0.290	1057			Area includes 0.001 ac with no volume calculations[2]
T9-T10	9/20/2014	10/18/2014	0.178	643			Area includes 0.002 ac with no volume calculations[2]
T10-T11	10/18/2014	10/29/2014	0.238	717			
T11-T12	10/29/2014	1/29/2015	0.117	386			Crescent basins 1-3
T12-T13	1/29/2015	4/1/2015	0.042	129			Crescent basin 4
T12-T13	1/29/2015	4/1/2015	0.038	73			Ramp from levee to water's edge, west end
	SUBTOTAL, Marsh Surface		**2.108**	**6900**			
Borrow Ditch and Channels[3]				**Average**	**Ditch**	**No Ditch**	
T0-T1	2/3/2014	3/8/2014	0.006	5	2	8	
T1-T2	3/8/2014	3/24/2014	0.009	50	25	76	
T2-T3	3/24/2014	5/22/2014	0.024	162	96	229	
T3-T4	5/22/2014	5/26/2014	0.006	40	24	56	
T4-T5	5/26/2014	6/5/2014	0.009	66	40	92	
T5-T6	6/5/2014	7/10/2014	0.053	323	175	472	
T6-T7	7/10/2014	8/6/2014	0.013	80	44	116	
T7-T8	8/6/2014	8/23/2014	0.017	118	71	164	
T9-T10	9/20/2014	10/18/2014	0.040	338	308	367	Includes area 5 on east side - fill of test trench (0.029 ac and 266 cy)
T10-T11	10/18/2014	10/29/2014	0.010	59	31	87	
T12-T13	1/29/2015	4/1/2015	0.009	47	47	0	Fill in constructed borrow ditch to create western crossing. "Ditch" volume used as its size readily estimated
	SUBTOTAL, Ditch and Channels		**0.196**	**1288**	**864**	**1666**	
TOTAL FILL			**2.761**	**9223**			

Notes:

1 *If no activity during a time interval, the "no data" values not shown.*

2 *Some new levee areas were not within Digital Elevation Model extent and thus no volumes could be calculated.*

3 *Borrow ditch and channel volume calculated as the average of two estimates of baseline conditions (assume no ditch, assume ditch invert matches surveyed interior channel invert 1.93 ft NAVD88).*

Table K-3. Excavation Areas and In-Place Volumes in Tidal Wetlands and Waters, by Time and Placement Location

Excavation Location and Time Interval [1]			Area	Volume			
Interval	Start Date	End Date	(ac)	(cy)			Notes
Remnant Levee							
T0-T1	2/3/2014	3/8/2014	0.001	5			
T1-T2	3/8/2014	3/24/2014	0.016	125			
T2-T3	3/24/2014	5/22/2014	0.001	4			
	SUBTOTAL, Remnant Levee		**0.019**	**133**			
Marsh Surface							
T0-T1	2/3/2014	3/8/2014	0.438	3289			Includes test trench cut on east side of site
T1-T2	3/8/2014	3/24/2014	0.260	1737			includes borrow ditch cut in western crossing
T2-T3	3/24/2014	5/22/2014	0.148	901			
T3-T4	5/22/2014	5/26/2014	0.038	166			
T4-T5	5/26/2014	6/5/2014	0.057	252			
T5-T6	6/5/2014	7/10/2014	0.264	1113			
T6-T7	7/10/2014	8/6/2014	0.578	3642			
T7-T8	8/6/2014	8/23/2014	0.264	1626			
T9-T10	9/20/2014	10/18/2014	0.117	1017			Does not include test trench on east side of site
T10-T11	10/18/2014	10/29/2014	0.217	1332			
T11-T12	10/29/2014	1/29/2015	0.154	352			Crescent basins 1-3
T12-T13	1/29/2015	4/1/2015	0.510	117			Crescent basin 4
	SUBTOTAL, Marsh Surface		**3.046**	**15544**			
Borrow Ditch and Channels [2]				**Average**	**No Ditch**	**Ditch**	
T0-T1	2/3/2014	3/8/2014	0.148	566	150	982	
T1-T2	3/8/2014	3/24/2014	0.037	162	57	266	
T2-T3	3/24/2014	5/22/2014	0.014	57	17	98	
T6-T7	7/10/2014	8/6/2014	0.020	45	1	89	
T7-T8	8/6/2014	8/23/2014	0.003	13	5	20	
T10-T11	10/18/2014	10/29/2014	0.003	7	0	15	
T11-T12	10/29/2014	1/29/2015	0.012	16	0	32	Crescent basins 1-3
T12-T13	1/29/2015	4/1/2015	0.004	5	0	11	Crescent basin 4
	SUBTOTAL, Ditch and Channels		**0.241**	**871**	**231**	**1511**	
TOTAL EXCAVATION			**3.305**	**16549**	**15909**	**17189**	

Notes:

1 *If no activity during a time interval, the "no data" values not shown.*

2 *Borrow ditch and channel volume calculated as the average of two estimates of baseline conditions (assume no ditch, assume ditch invert matches surveyed interior channel invert 1.93 ft NAVD88).*

Table K-4. Structural Fill Area

Structure Type	Area (acres)
Fill in Tidal Waters	
New dock in Andy Mason Slough	**0.071**
Fill in Tidal Wetlands	
Old dock (out of use, placed onto island)	0.007
Repurposed shipping containers (two)	0.016
Trailers (three)	0.012
Helicopter pads (two)	0.028
Windbreak platforms (three)	0.022
Miscellaneous platforms (two)	0.006
Wood pile	0.005
Total Fill in Tidal Wetlands	**0.096**
TOTAL WETLANDS AND WATERS FILL AREA	**0.167**
Fill in Terrestrial Lands	
New dock (gangway) on terrestrial lands	0.001
TOTAL STRUCTURAL FILL	**0.168**

Table K-5. Length of New Levee and Borrow and Drainage Ditch Construction by Time Interval

Time Interval	Start Date	End Date	Levee Length (ft)	Borrow and Drainage Ditch Length (ft)
T0-T1	2/3/2014	3/8/2014	1,200	1,170
T1-T2	3/8/2014	3/24/2014	625	600
T2-T3	3/24/2014	5/22/2014	300	185
T3-T4	5/22/2014	5/26/2014	45	45
T4-T5	5/26/2014	6/5/2014	55	75
T5-T6	6/5/2014	7/10/2014	315	315
T6-T7	7/10/2014	8/6/2014	1,105	1,060
T7-T8	8/6/2014	8/23/2014	470	420
T9-T10	9/20/2014	10/18/2014	295	230
T10-T11	10/18/2014	10/29/2014	300	330

Photo K-1. Water Control Structure
Photo by Stuart Siegel, 3/2/2016

Photo K-2. Repurposed Shipping Containers, Wind Break Platforms, and Trailers, West Side
Photo by Benjamin Martin, RWQCB, 3/2/2016

Photo K-3. Repurposed Shipping Containers and Wind Break Platforms, Detail
Photo by Dyan Whyte, RWQCB, 3/2/2016

Photo K-4. Crescent Basins with Planted Tree
Photo by Stuart Siegel, 3/2/2016

Photo K-5. Trailer with Goats
Photo by Stuart Siegel, 10/21/2015

Photo K-6. Helicopter Pad
Photo by Stuart Siegel, 3/2/2016

Photo K-7. Gate at East Borrow Ditch Crossing
Photo by Stuart Siegel, 3/2/2016

Photo K-8. Gate and Pilings Stockpiled for Assumed Future Installation
Photo by Stuart Siegel, 3/2/2016

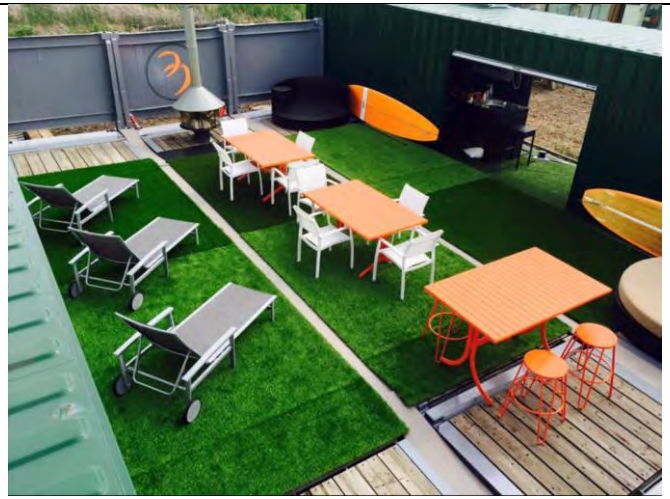

Photo K-9. Outdoor Sheltered Lounge and Shipping Container Indoor Lounge Facilities at Point Buckler
Source: https://www.facebook.com/pointbucklerclubVIP/photos_stream?ref=page_internal, accessed 4/26/2016

Photo K-10. Aerial View of Kite Surfing Lounge Facilities at Point Buckler
Source: https://www.facebook.com/pointbucklerclubVIP/photos_stream?ref=page_internal, accessed 4/26/2016

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Figure K-39. November 19, 2015 Tidal Connectivity, Fill and Excavation Activities (Digital Globe)

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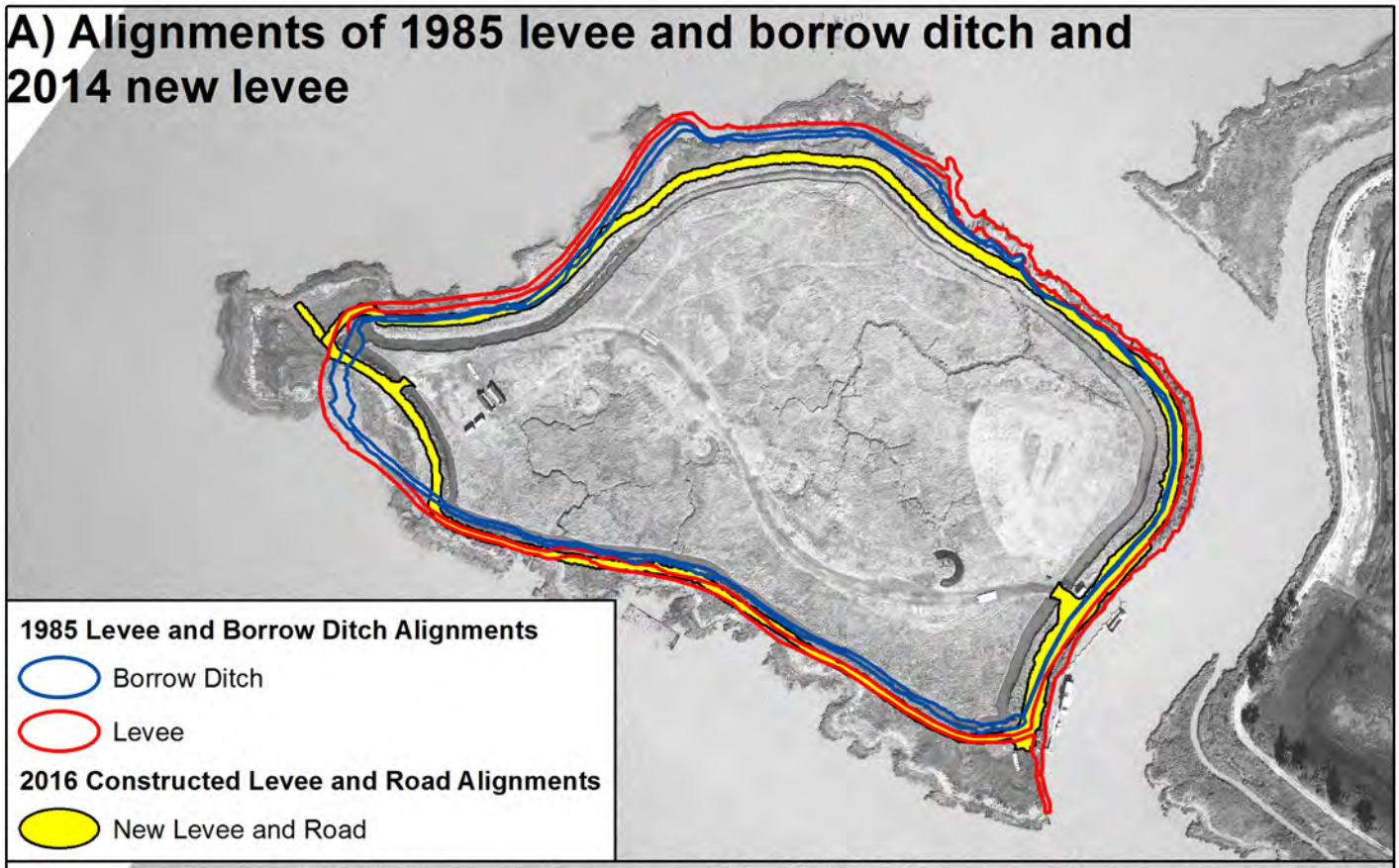
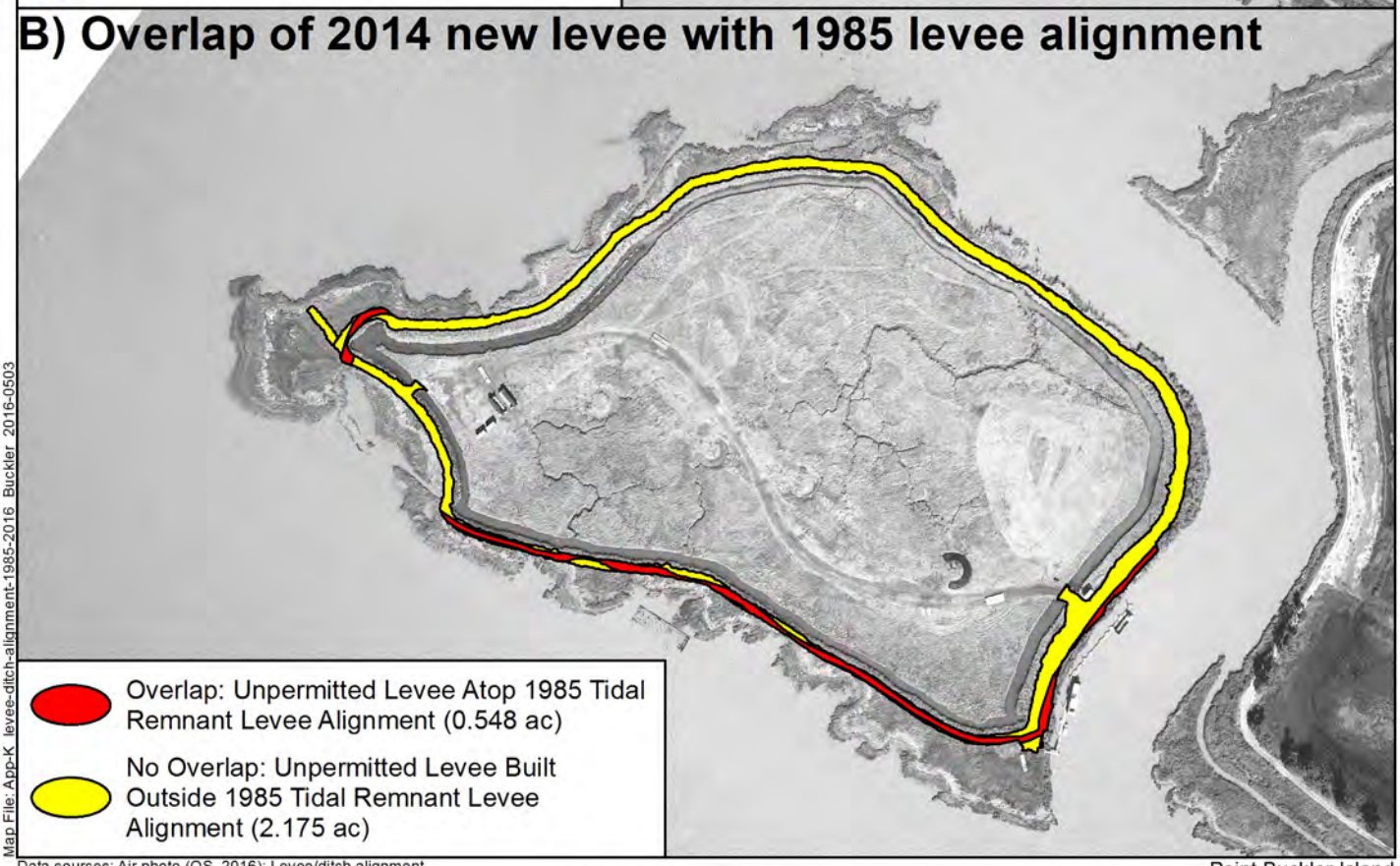




Map File: App-K_levee-ditch-alignment-1985-2016_Buckler_2016-0503

Data sources: Air photo (QS, 2016); Levee/ditch alignment (SE, 2016)

1:4,800 (1" = 400' at letter size)

0 200 400 ft

0 60 120 m

Point Buckler Island
Solano County, CA

Figure K-1

Unpermitted New Levee in Relation to 1985 Levee and Borrow Ditch

Base air photo: (Quantum Spatial) February 10, 2016

Tidal Wetland and Waters Fill for Levee

- 1 Old Wetland Levee to Levee (0.457 ac)
- 2 Marsh Plain to Levee (1.911 ac)
- 3 Remnant Ditch to Levee (0.140 ac)
- 4 Marsh Channel to Levee (0.017 ac)
- 5a Marsh Plain to Ditch to Levee (0.030 ac)

Tidal Wetland Fill for Other

- 5b Marsh Plain to Ditch to Crossing (0.009 ac)
- 5c Marsh Plain to Crossing (0.034 ac)
- 6 Marsh Plain to Trench Spoils (0.262 ac) / Crescent Spoils (0.164 ac)
- 7 Marsh Plain to Ramp (0.038 ac)

[1]Terrestrial levee extent based on CA Dept. of Fish and Wildlife 2012 vegetation mapping

Tidal Wetland and Waters Cut

- 8 Marsh Plain to Borrow Ditch (2.374 ac)
- 9 Remnant Ditch to Borrow Ditch (0.190 ac) / Trench (0.007 ac)
- 10 Old Wetland Levee to Borrow Ditch (0.019 ac)
- 11 Marsh Channel to Borrow Ditch (0.034 ac) / Crescent (0.019 ac)
- 12 Marsh Plain to Crescent (0.208 ac)
- 13 Marsh Plain to Trench (0.075 ac)

Fill in Non-Jurisdictional Areas

- Remnant Terrestrial Levee to Levee[1] (0.092 ac)

2016 DEM Boundary - areas falling outside boundary not included in cut/fill calculations

Map File: App-K cut-fill-conversions Buckler 2016-0511

Data sources: Air photo (QS, 2016); Cut-fill areas (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

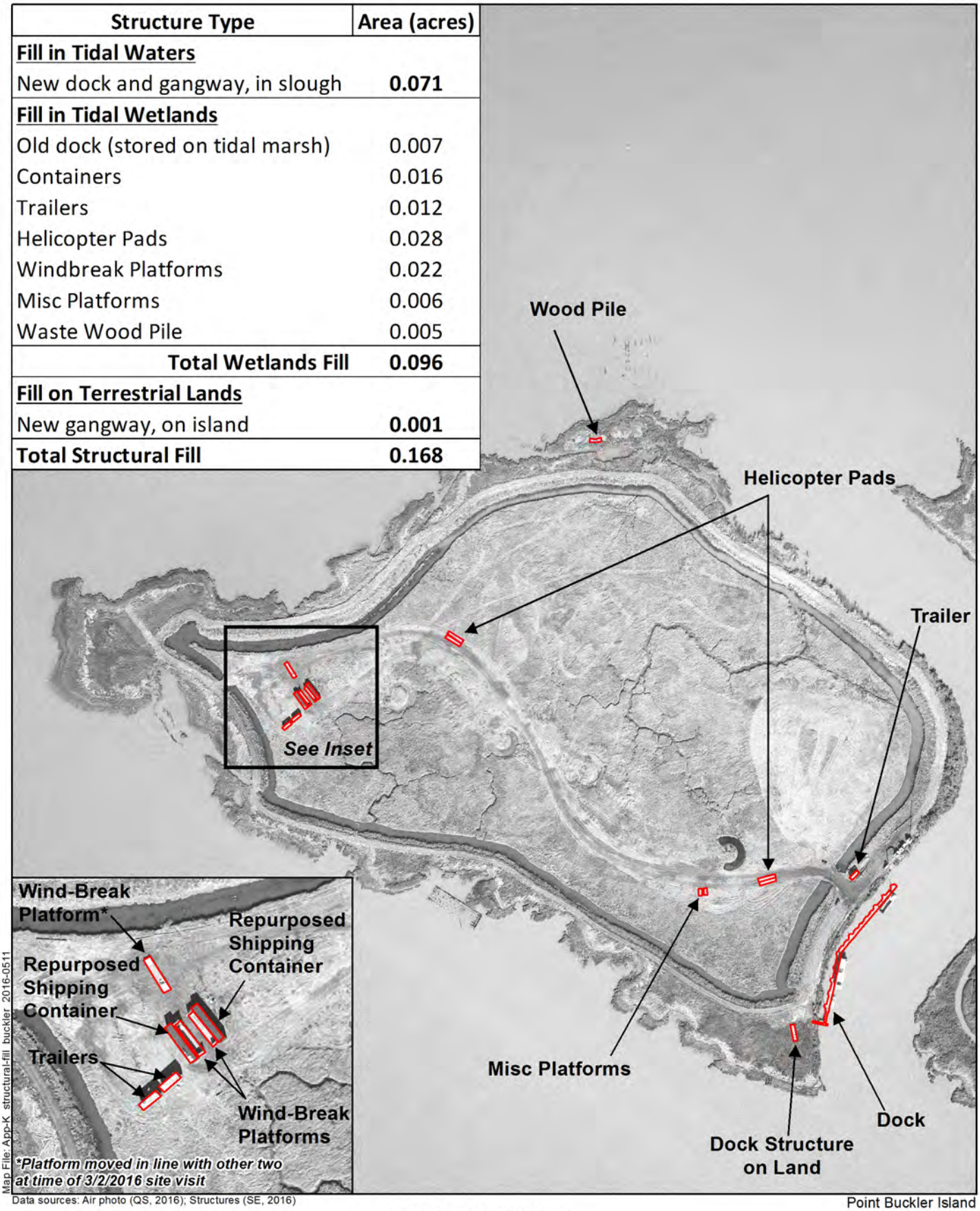
Point Buckler Island
Solano County, CA

Figure K-2

Unpermitted Cut and Fill Earthwork In Relation to 2011 Conditions

Base air photo: (Quantum Spatial) February 10, 2016

Structure Type	Area (acres)
Fill in Tidal Waters	
New dock and gangway, in slough	**0.071**
Fill in Tidal Wetlands	
Old dock (stored on tidal marsh)	0.007
Containers	0.016
Trailers	0.012
Helicopter Pads	0.028
Windbreak Platforms	0.022
Misc Platforms	0.006
Waste Wood Pile	0.005
Total Wetlands Fill	**0.096**
Fill on Terrestrial Lands	
New gangway, on island	**0.001**
Total Structural Fill	**0.168**



Map File: App-K structural-fill buckler 2016-0511

Data sources: Air photo (QS, 2016); Structures (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

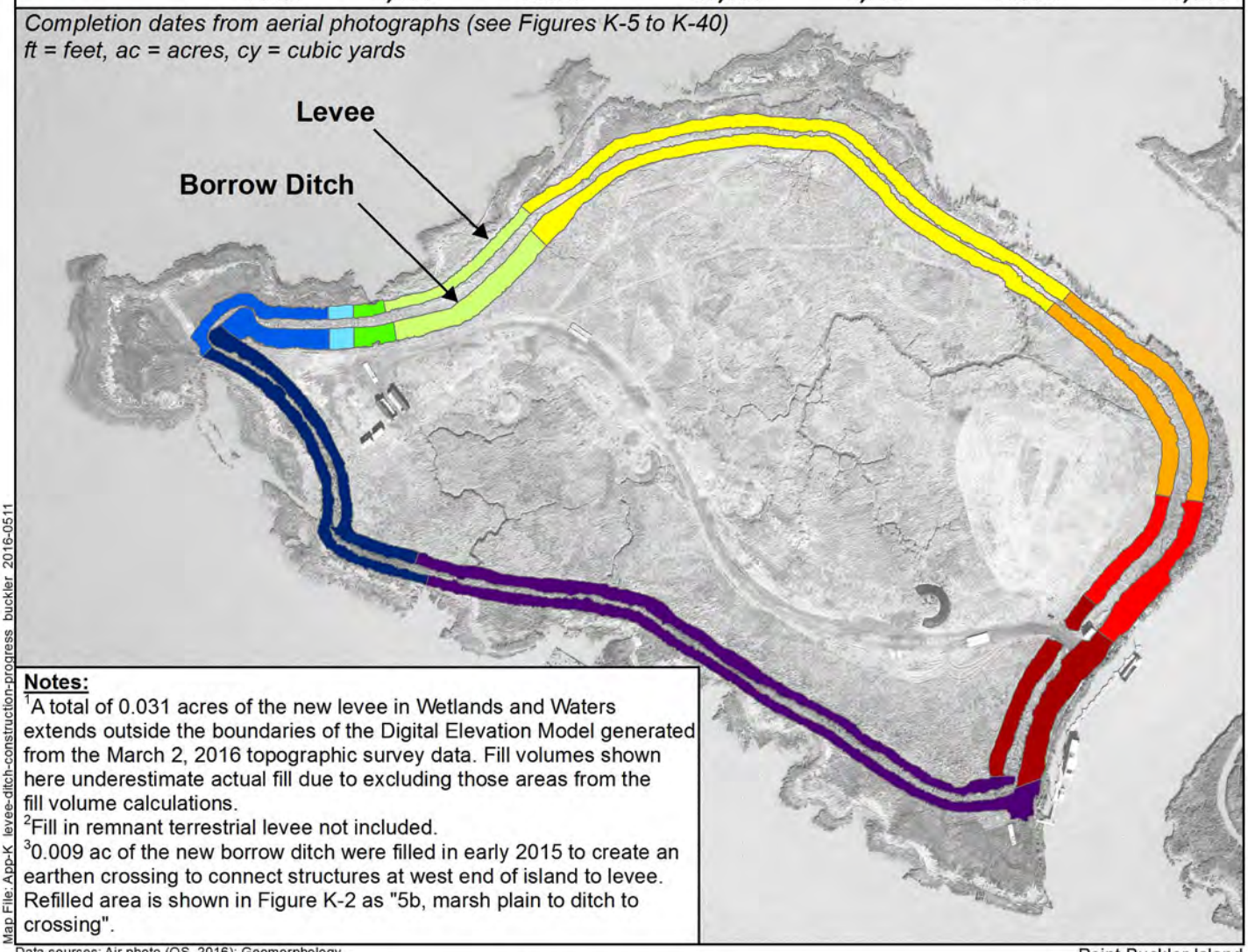
Figure K-3

Base air photo: (Quantum Spatial) February 10, 2016

Unpermitted Structural Fill

Date Completed by	Borrow Ditch in Wetlands and Waters			Levee in Wetlands and Waters		
	Length (ft)	Area (ac)	Cut Volume (cy)	Length (ft)	Area (ac)	Fill Volume (cy)
3/8/2014[1,2]	1,170	0.587	3,860	1,200	0.549	1,344
3/24/2014[3]	600	0.313	2,024	625	0.292	881
5/22/2014	185	0.163	962	300	0.150	454
5/26/2014	45	0.038	166	45	0.025	101
6/5/2014	75	0.057	252	55	0.029	142
7/10/2014	315	0.265	1,113	315	0.143	570
8/6/2014	1,060	0.598	3,687	1,105	0.581	2,140
8/23/2014	420	0.267	1,639	470	0.307	1,175
10/18/2014[1,2]	230	0.117	1,017	295	0.218	981
10/29/2014[1,2]	330	0.220	1,339	300	0.260	798
Total	**4,430**	**2.625**	**16,059**	**4,710**	**2.554**	**8,586**

Completion dates from aerial photographs (see Figures K-5 to K-40)
ft = feet, ac = acres, cy = cubic yards



Notes:
[1]A total of 0.031 acres of the new levee in Wetlands and Waters extends outside the boundaries of the Digital Elevation Model generated from the March 2, 2016 topographic survey data. Fill volumes shown here underestimate actual fill due to excluding those areas from the fill volume calculations.
[2]Fill in remnant terrestrial levee not included.
[3]0.009 ac of the new borrow ditch were filled in early 2015 to create an earthen crossing to connect structures at west end of island to levee. Refilled area is shown in Figure K-2 as "5b, marsh plain to ditch to crossing".

Map File: App-K_levee-ditch-construction-progress_buckler_2016-0511

Data sources: Air photo (QS, 2016); Geomorphology (SE, 2016)

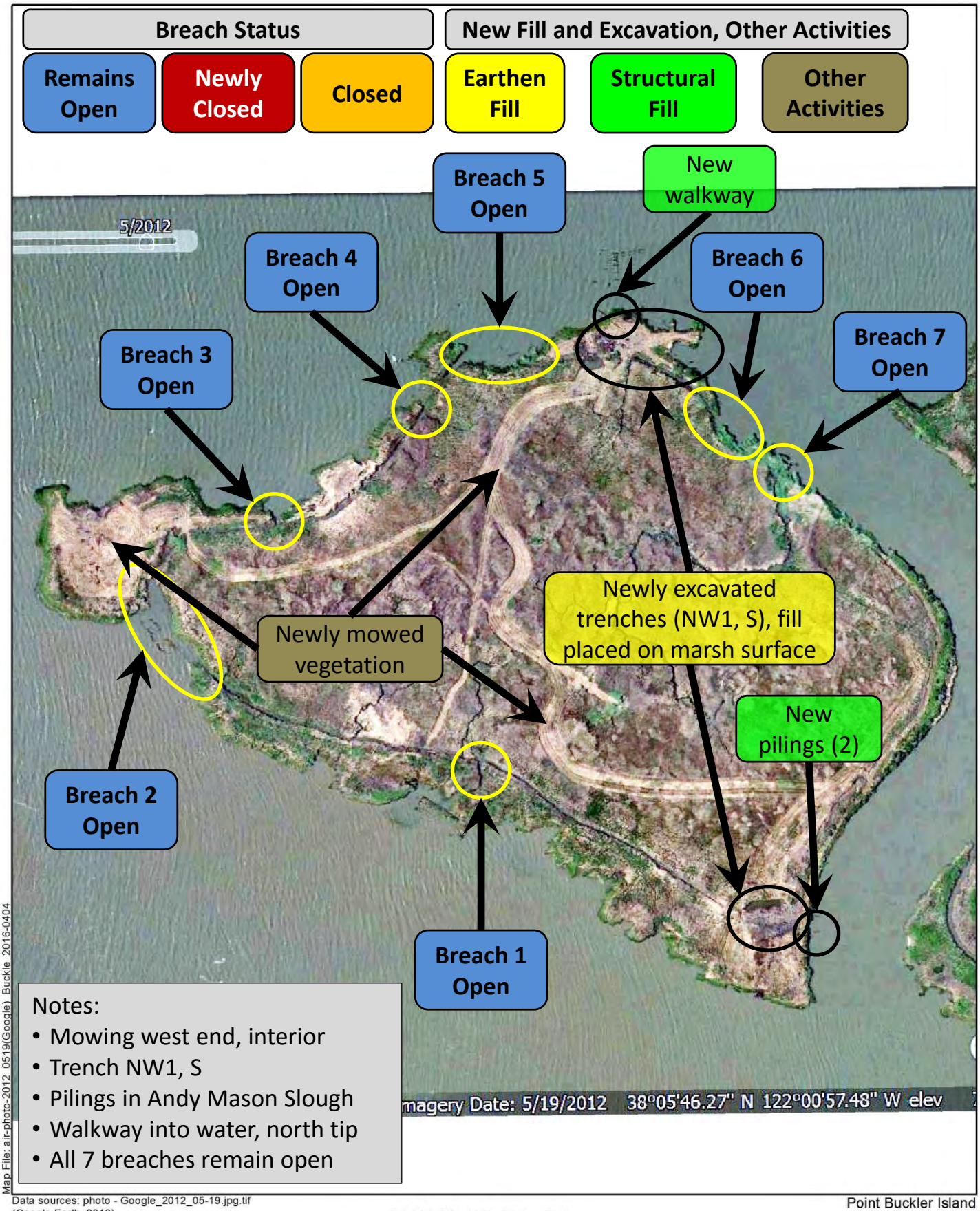
1:3,600 (1" = 300' at letter size)
0 150 300 ft
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-4

Base air photo: (Quantum Spatial) February 10, 2016

Levee and Borrow Ditch Construction Progress



Map File: air-photo-2012_0519(Google)_Buckle_2016-0404

Data sources: photo - Google_2012_05-19.jpg.tif
(Google Earth, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

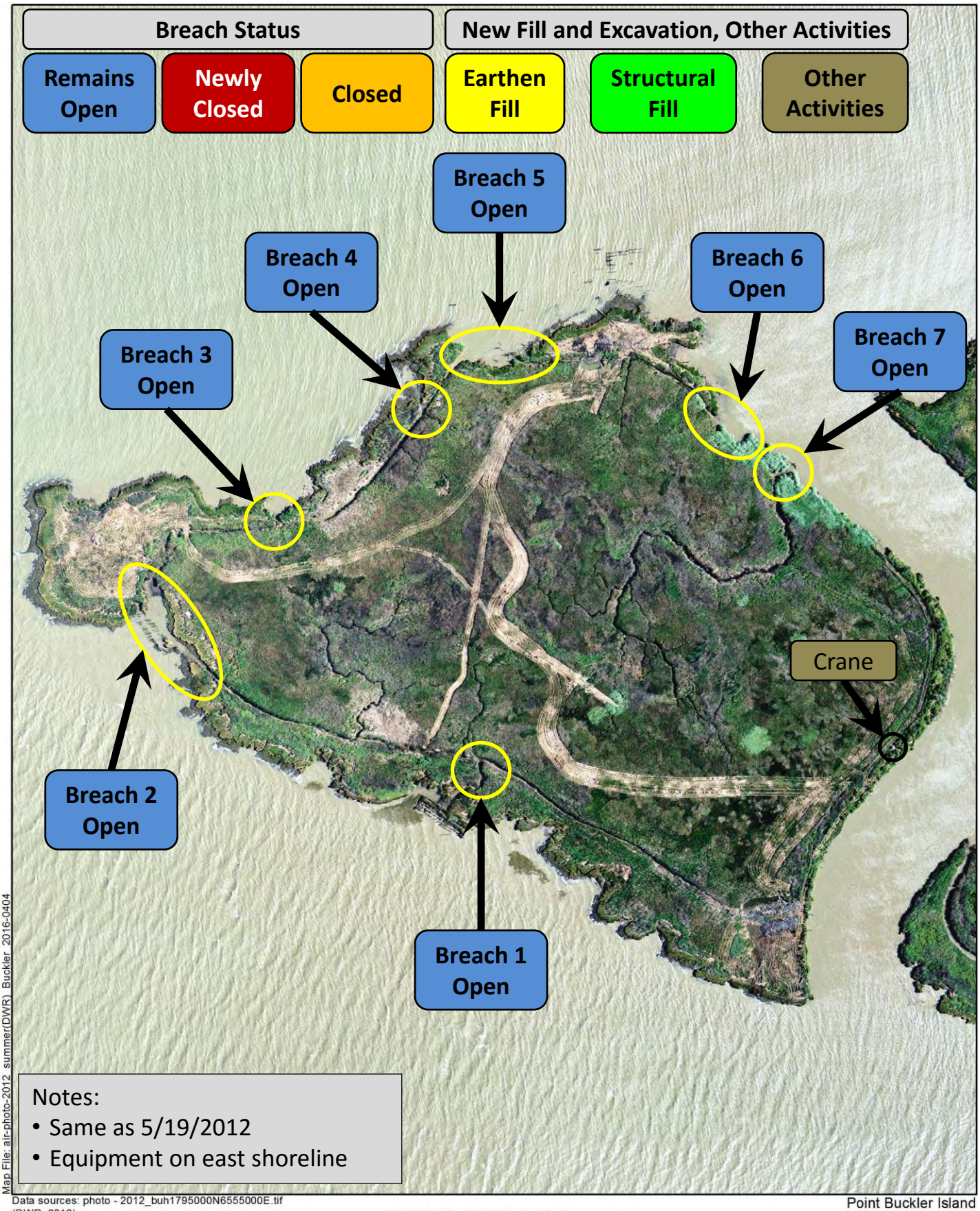
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-5

(Google Earth) May 19, 2012

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 5/19/2012
- Equipment on east shoreline

Map File: air-photo-2012_summer(DWR)_Buckler_2016-0404

Data sources: photo - 2012_buh1795000N6555000E.tif (DWR, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

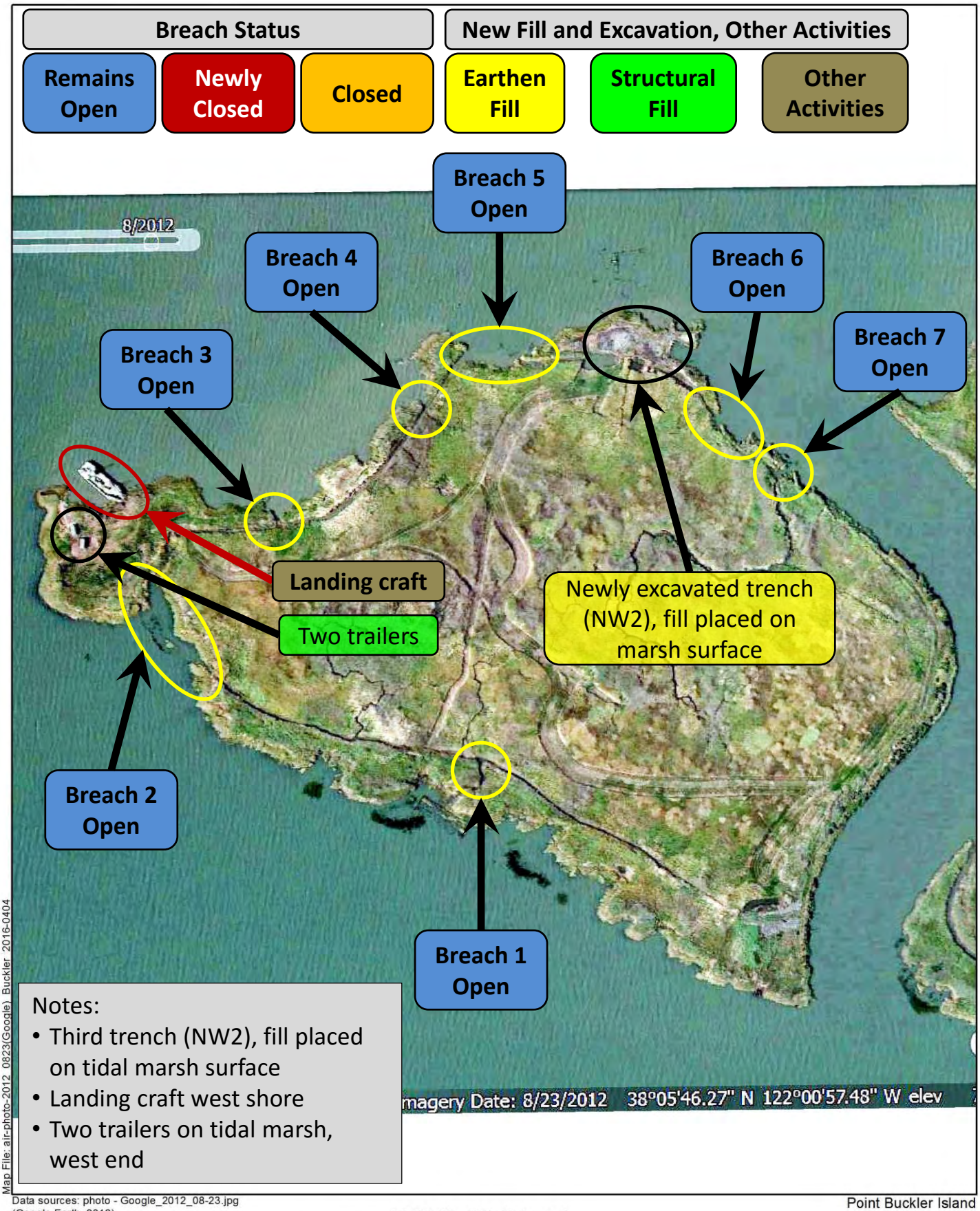
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-6

(DWR) Summer 2012

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2012_0823(Google) Buckler 2016-0404

Data sources: photo - Google_2012_08-23.jpg
(Google Earth, 2012)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

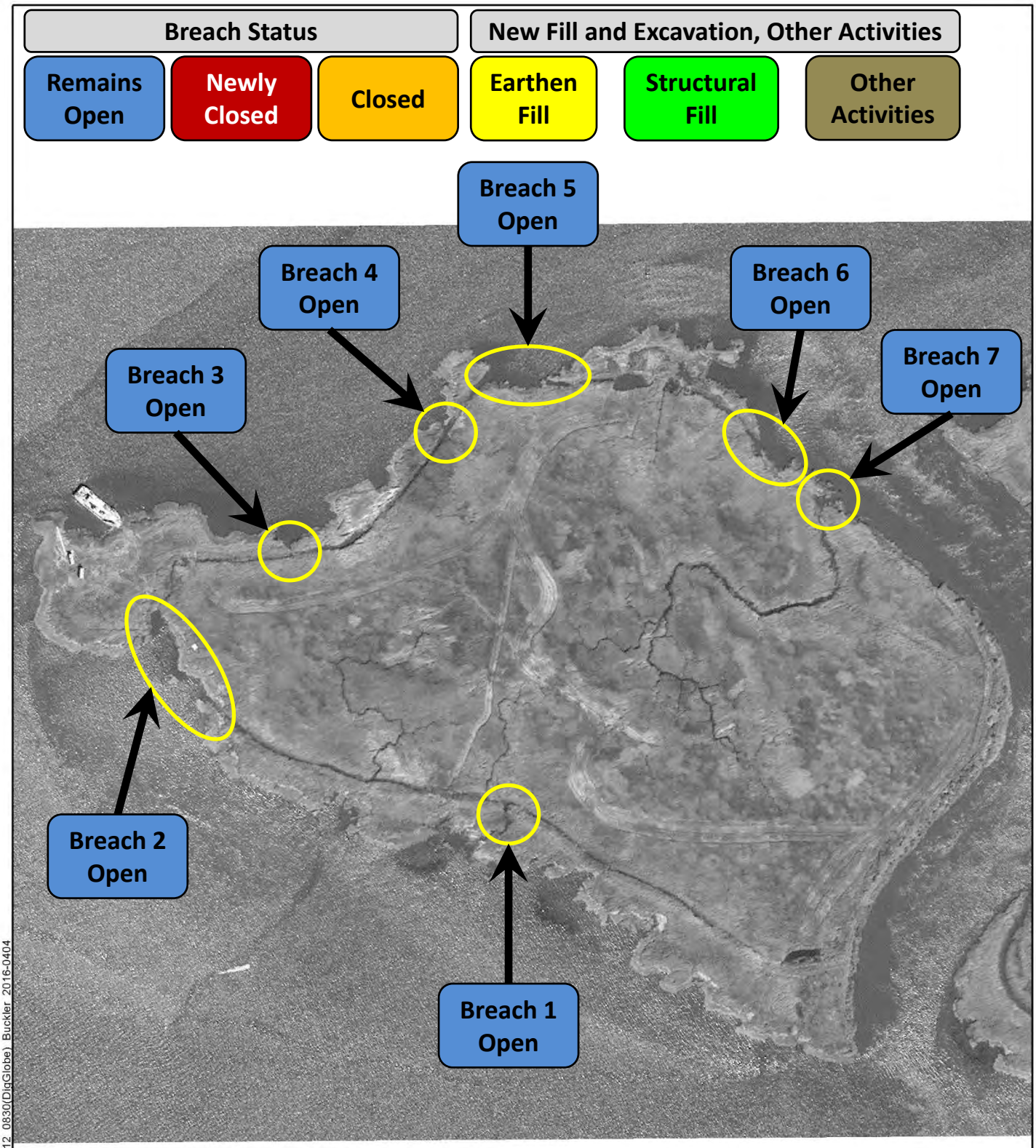
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-7

(Google Earth) August 23, 2012

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 8/23/2012

Map File: air-photo-2012_0830(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2012_08_30_19_36R1C1_cropped.tif
(Digital Globe, 2012)

1:3,600 (1" = 300' at letter size)

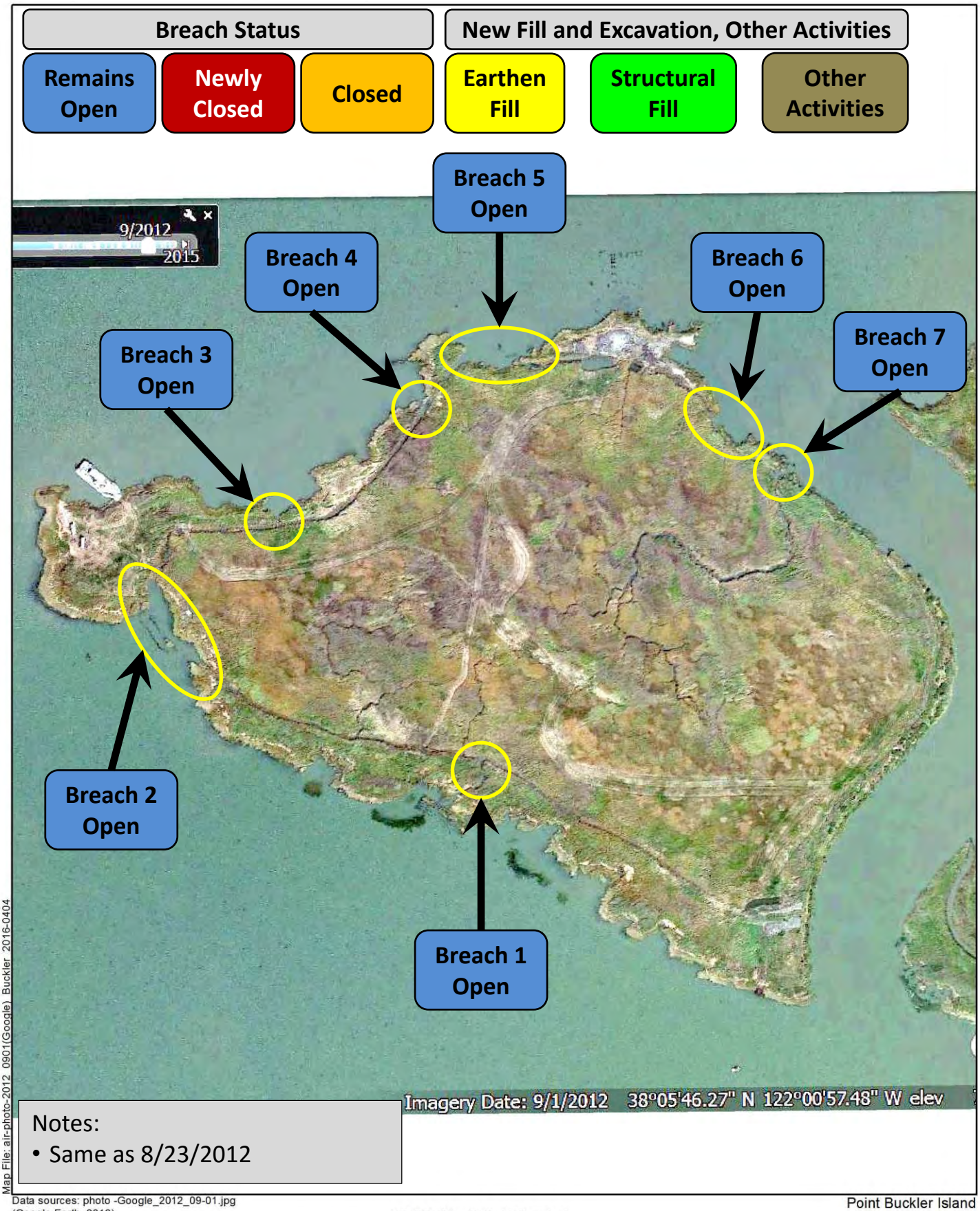
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-8

(Digital Globe) August 30, 2012
Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 8/23/2012

Map File: air-photo-2012_09901(Google)_Buckler_2016-0404

Data sources: photo -Google_2012_09-01.jpg
(Google Earth, 2012)

1:3,600 (1" = 300' at letter size)

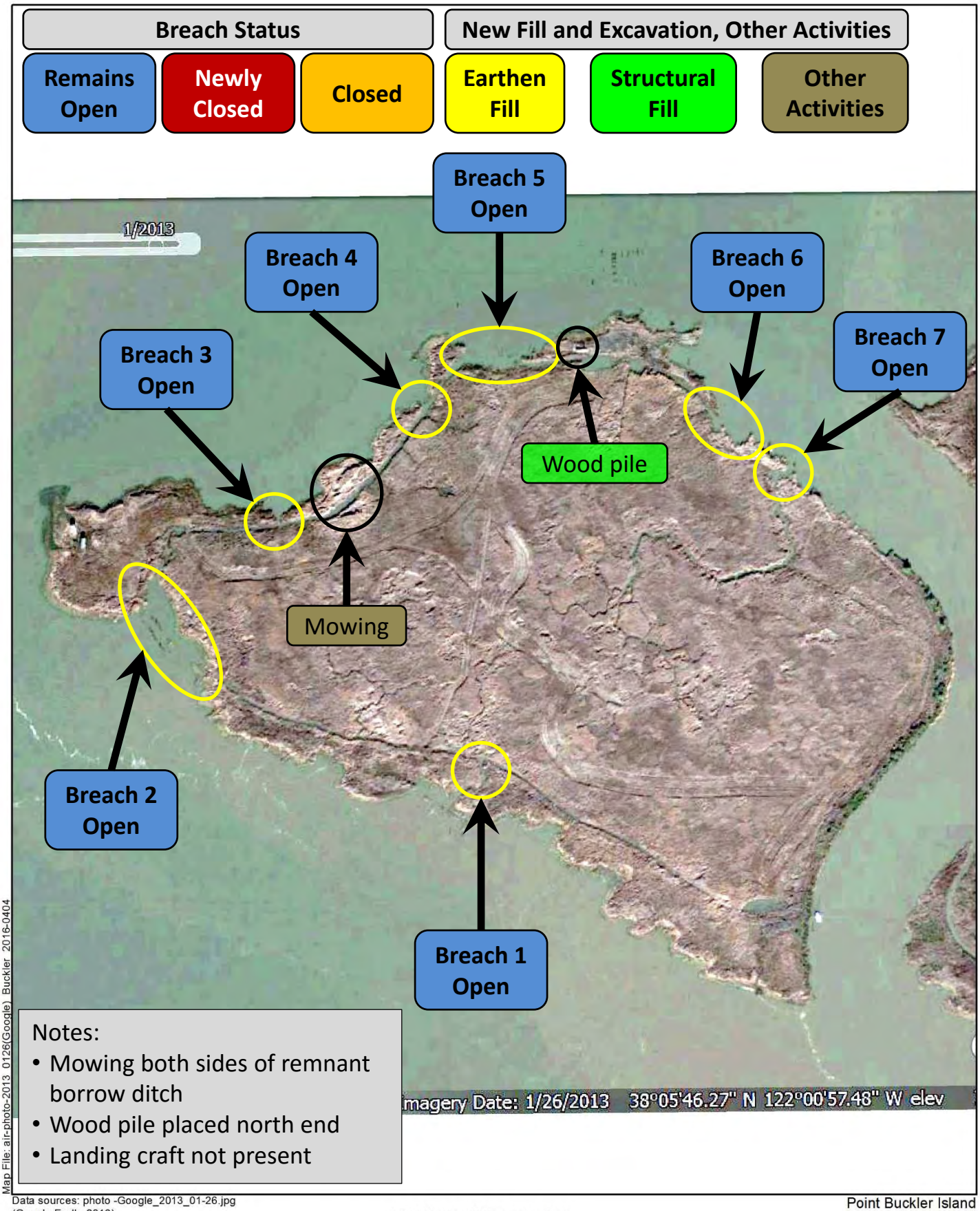
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-9

(Google Earth) September 1, 2012
Tidal Connectivity, Fill and Excavation



Notes:
- Mowing both sides of remnant borrow ditch
- Wood pile placed north end
- Landing craft not present

Map File: air-photo-2013_0126(Google)_Buckler_2016-0404

Data sources: photo -Google_2013_01-26.jpg
(Google Earth, 2013)

1:3,600 (1" = 300' at letter size)

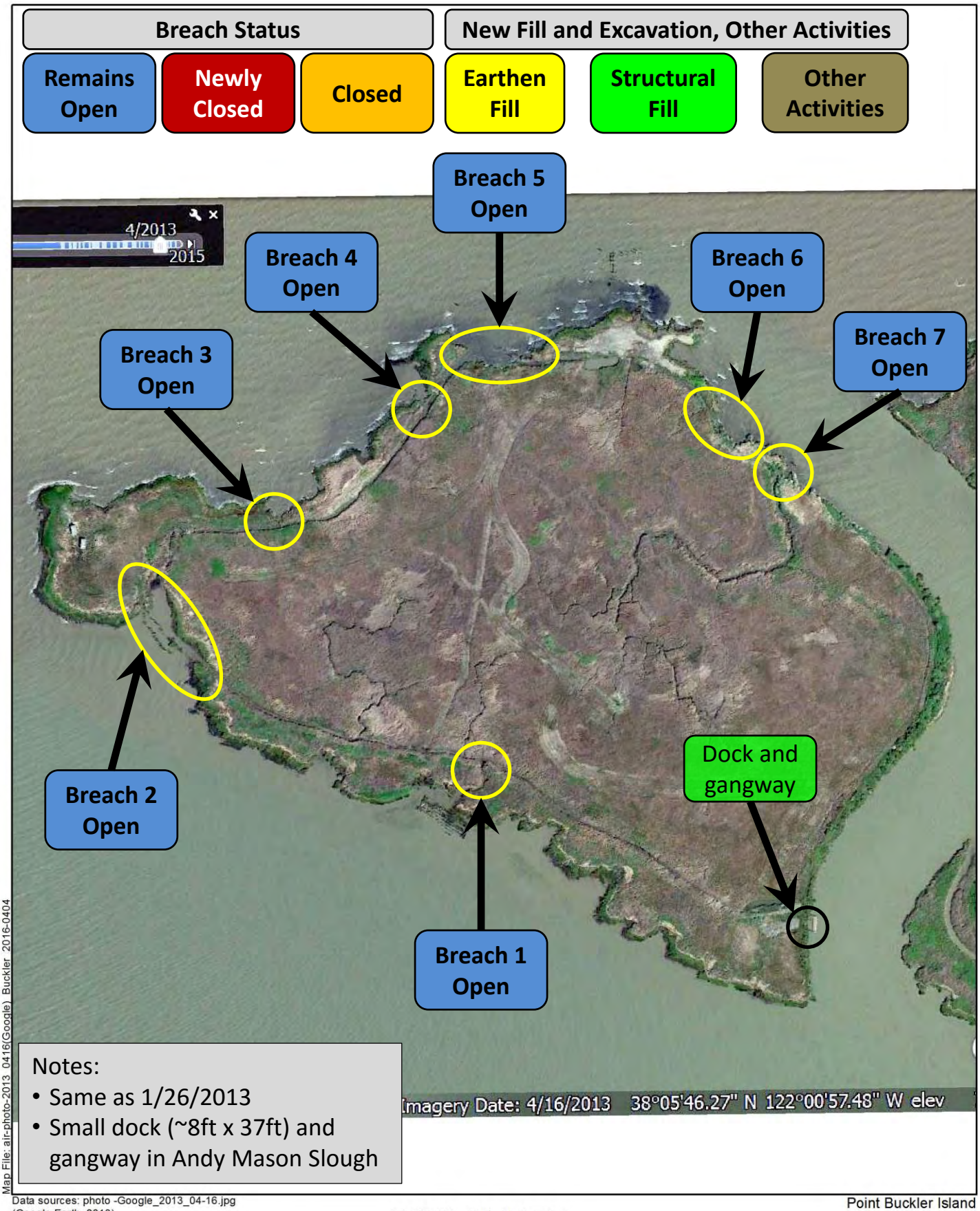
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-10

(Google Earth) January, 26 2013
Tidal Connectivity, Fill and Excavation



Notes:
- Same as 1/26/2013
- Small dock (~8ft x 37ft) and gangway in Andy Mason Slough

Map File: air-photo-2013_0416(Google) Buckler 2016-0404

Data sources: photo -Google_2013_04-16.jpg
(Google Earth, 2013)

1:3,600 (1" = 300' at letter size)

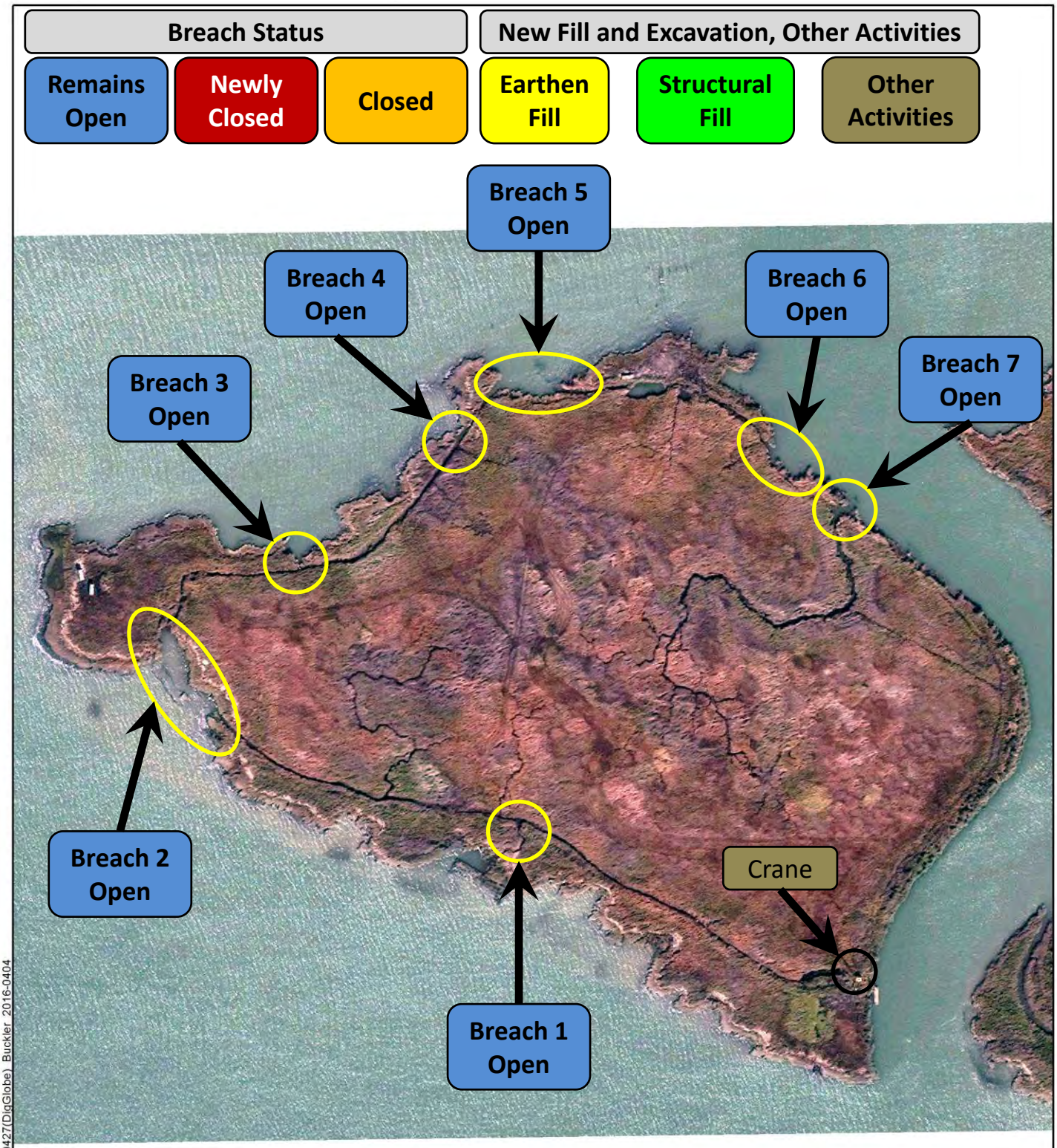
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-11

(Google Earth) April 16, 2013
Tidal Connectivity, Fill and Excavation



Notes:
- Same as 4/16/2013
- Crane in southeast

Map File: air-photo-2013_0427(DigGlobe)_Buckler_2016-0404

Data sources: photo -2013_04_27_1943_UTC_R1C1_Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

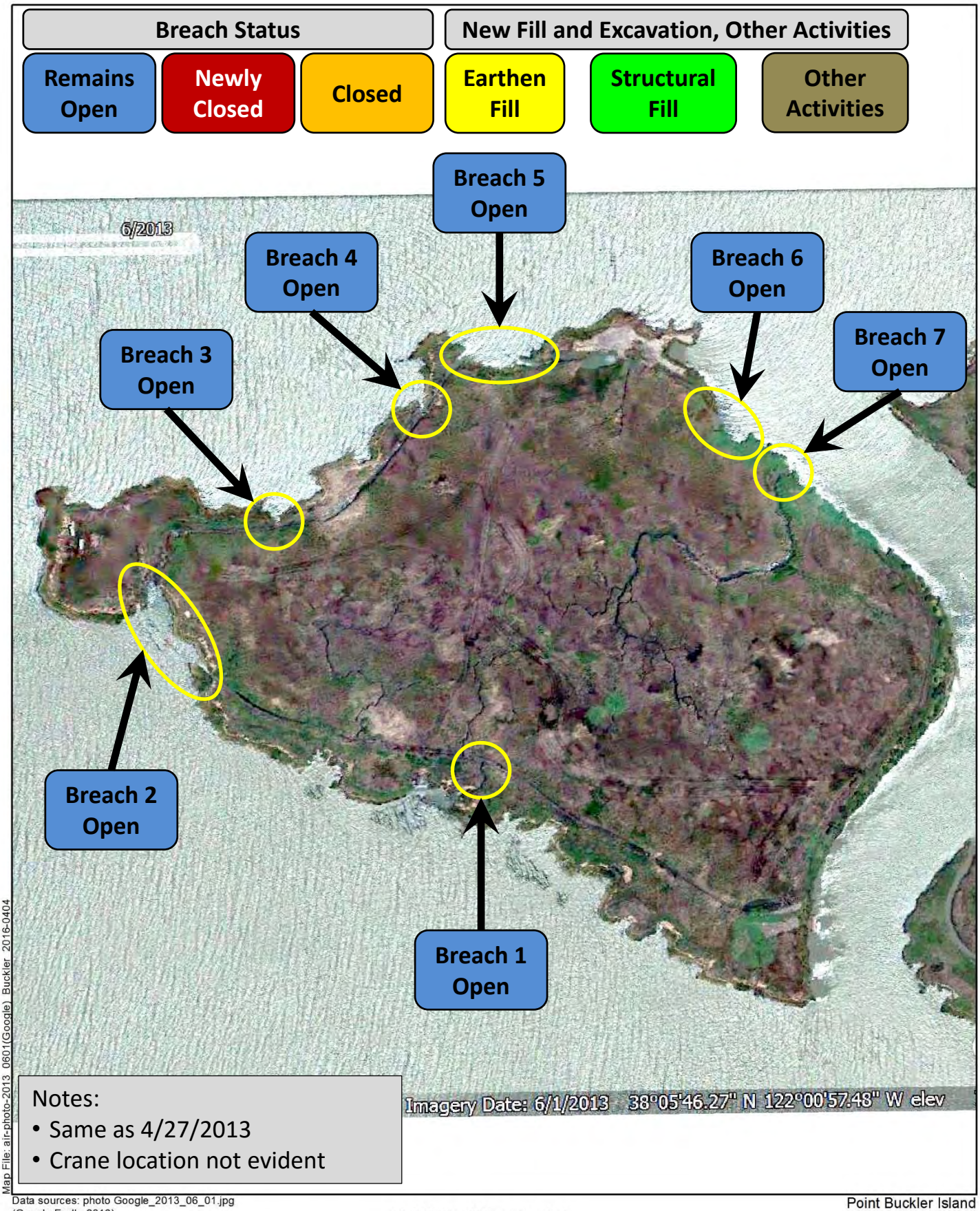
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-12

(Digital Globe) April 27, 2013
Tidal Connectivity, Fill and Excavation



Notes:
- Same as 4/27/2013
- Crane location not evident

Map File: air-photo-2013_0601(Google) Buckler 2016-0404

Data sources: photo Google_2013_06_01.jpg
(Google Earth, 2013)

1:3,600 (1" = 300' at letter size)

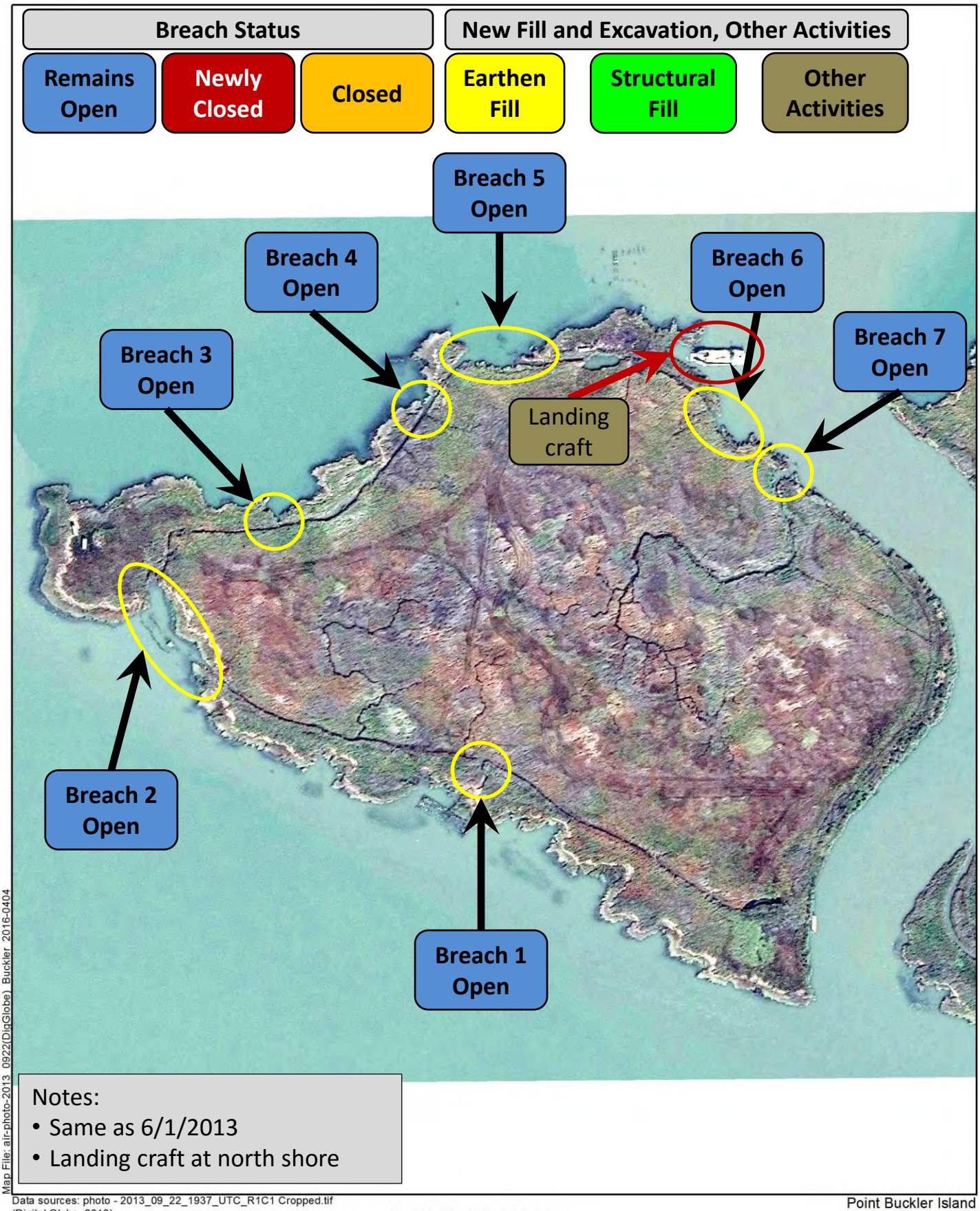
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-13

(Google Earth) June 1, 2013
Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 6/1/2013
- Landing craft at north shore

Map File: air-photo-2013_0922(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2013_09_22_1937_UTC_R1C1 Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

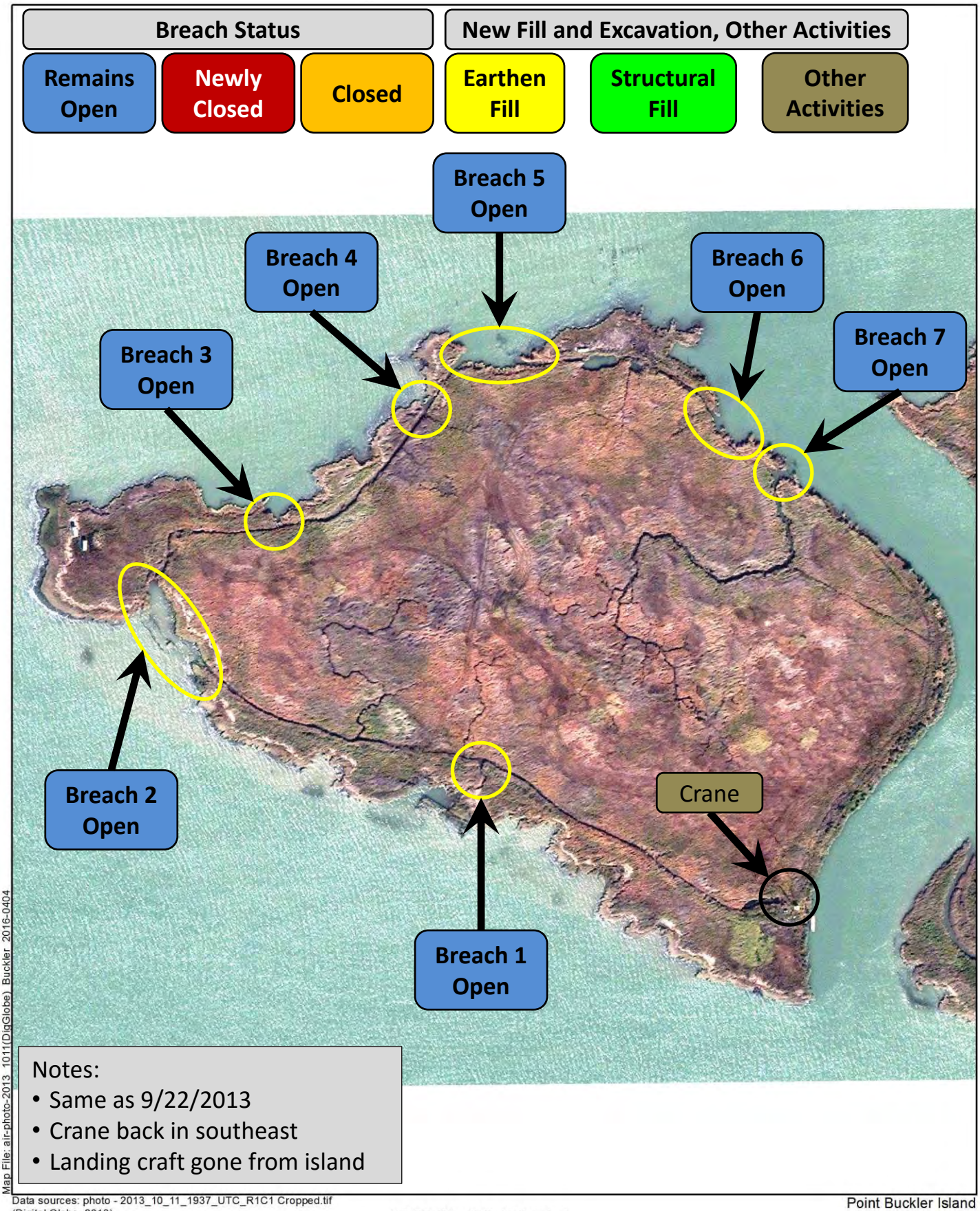
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-14

(Digital Globe) September 22, 2013
Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 9/22/2013
- Crane back in southeast
- Landing craft gone from island

Map File: air-photo-2013_1011(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2013_10_11_1937_UTC_R1C1 Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

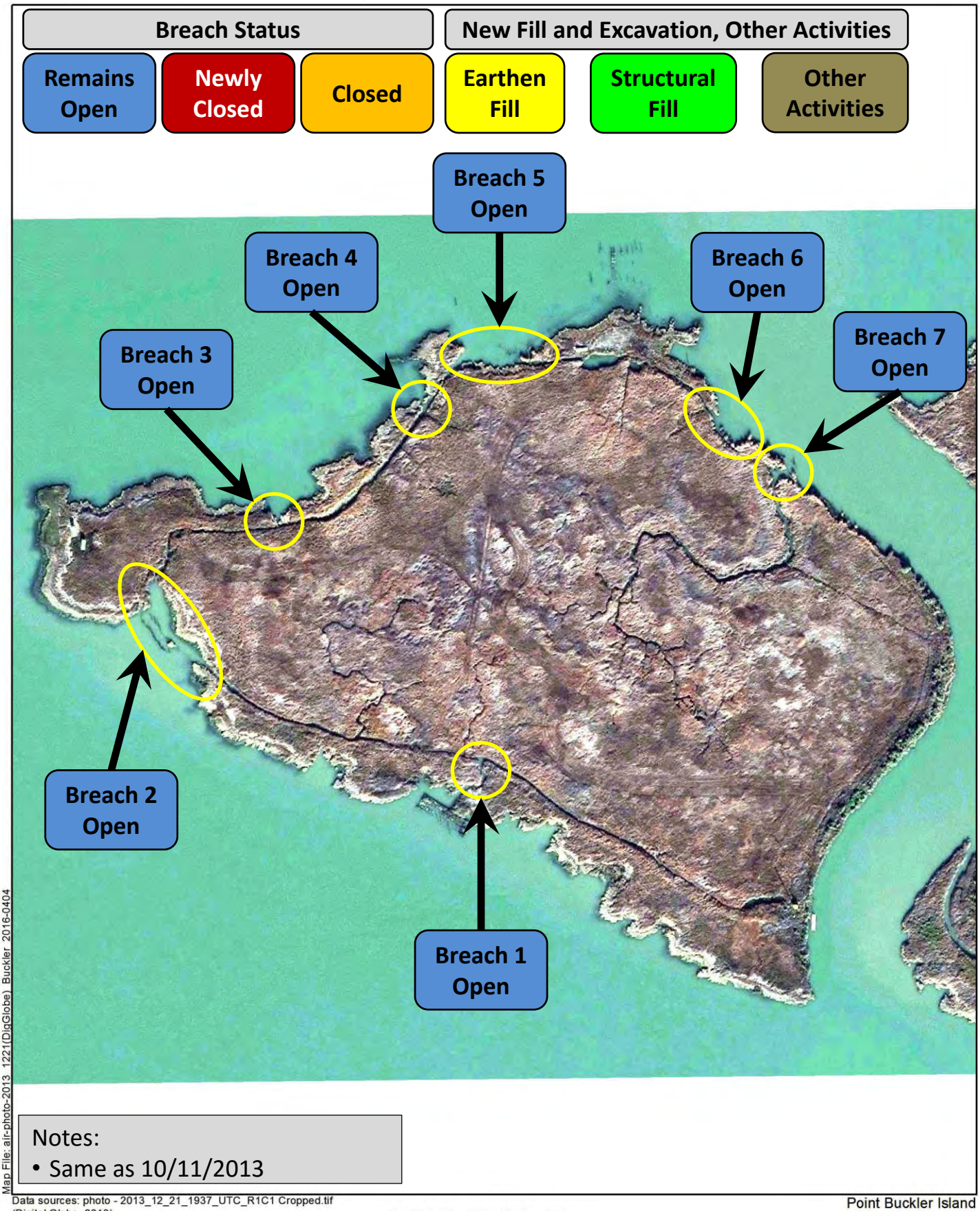
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-15

(Digital Globe) October 11, 2013
Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 10/11/2013

Map File: air-photo-2013_1221(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2013_12_21_1937_UTC_R1C1 Cropped.tif
(Digital Globe, 2013)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

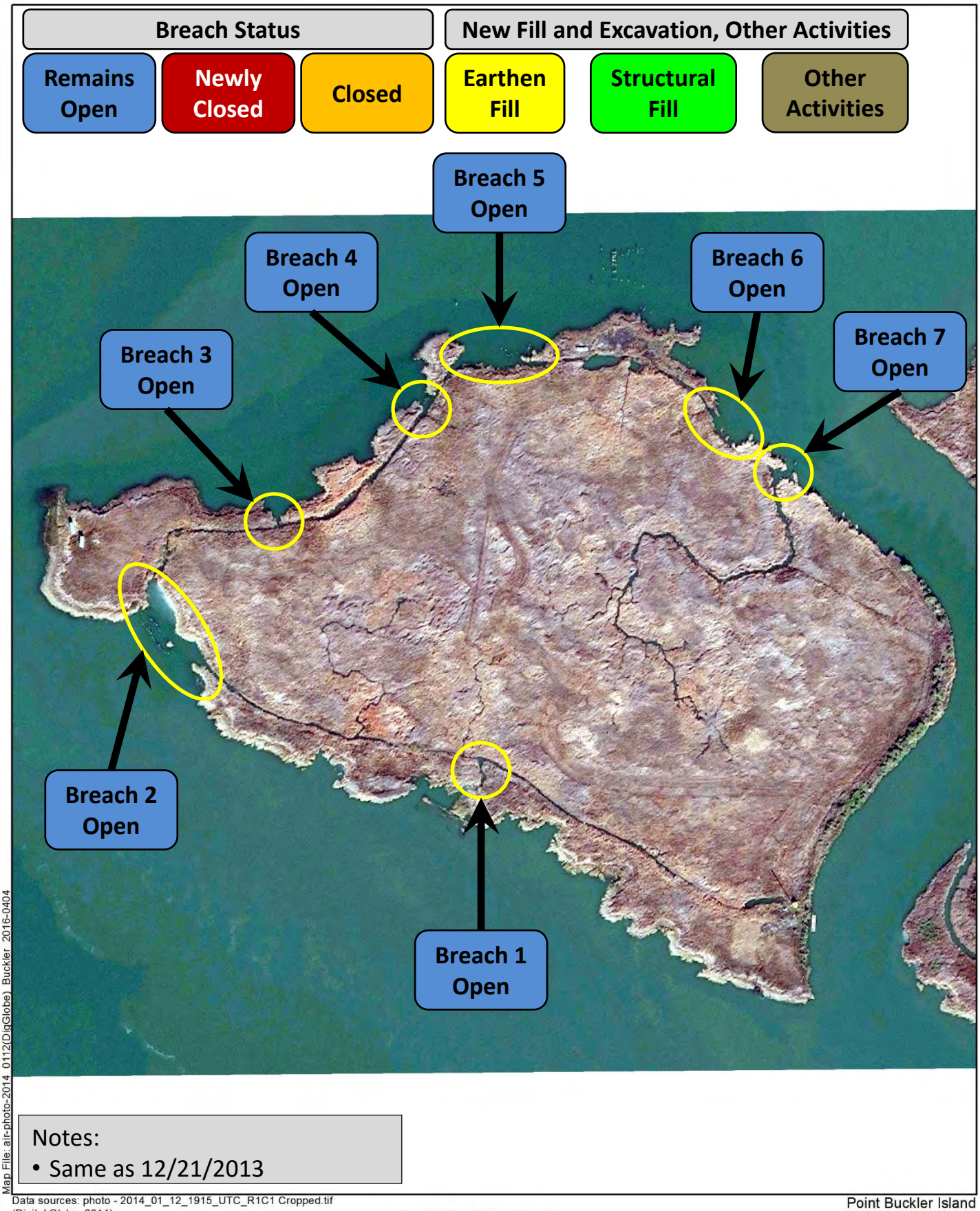
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-16

(Digital Globe) December 21, 2013

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 12/21/2013

Map File: air-photo-2014_0112(DigGlobe) Buckler 2016-0404

Data sources: photo - 2014_01_12_1915_UTC_R1C1 Cropped.tif
(Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

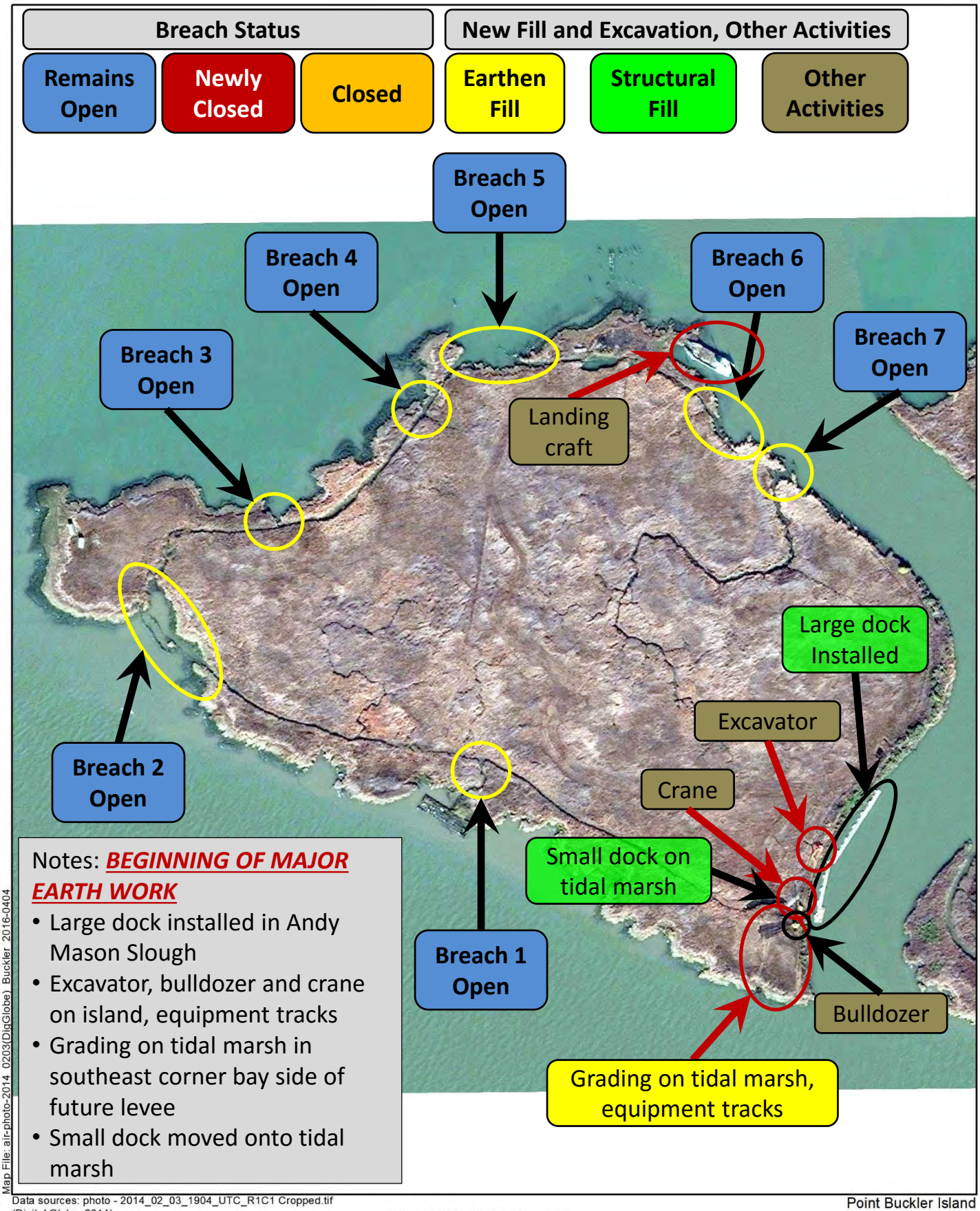
0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-17

(Digital Globe) January 12, 2014
Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2014_0203(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_02_03_1904_UTC_R1C1 Cropped.tif (Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

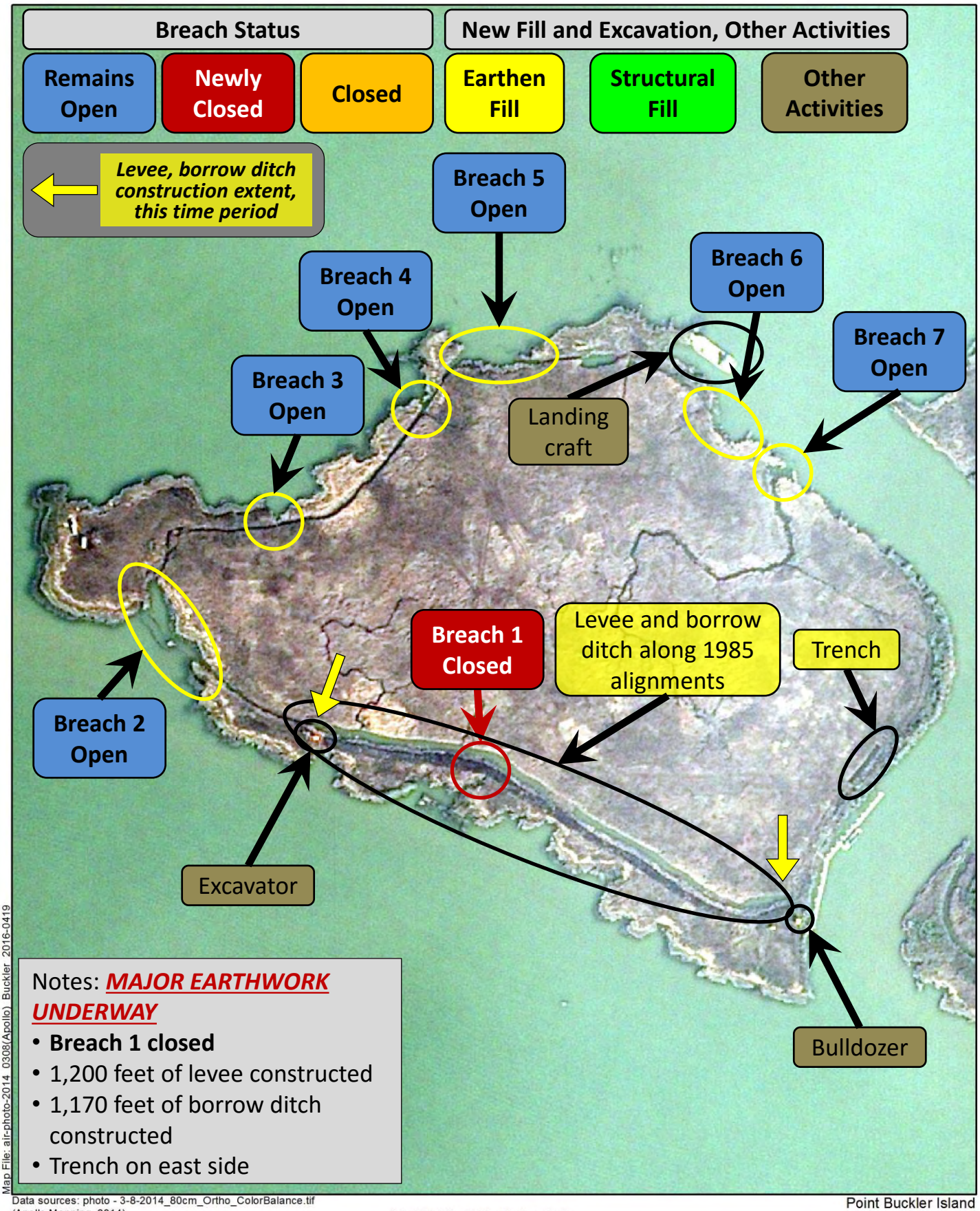
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-18

(Digital Globe) February 3, 2014

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2014_0308(Apollo)_Buckler_2016-0419

Data sources: photo - 3-8-2014_80cm_Ortho_ColorBalance.tif (Apollo Mapping, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

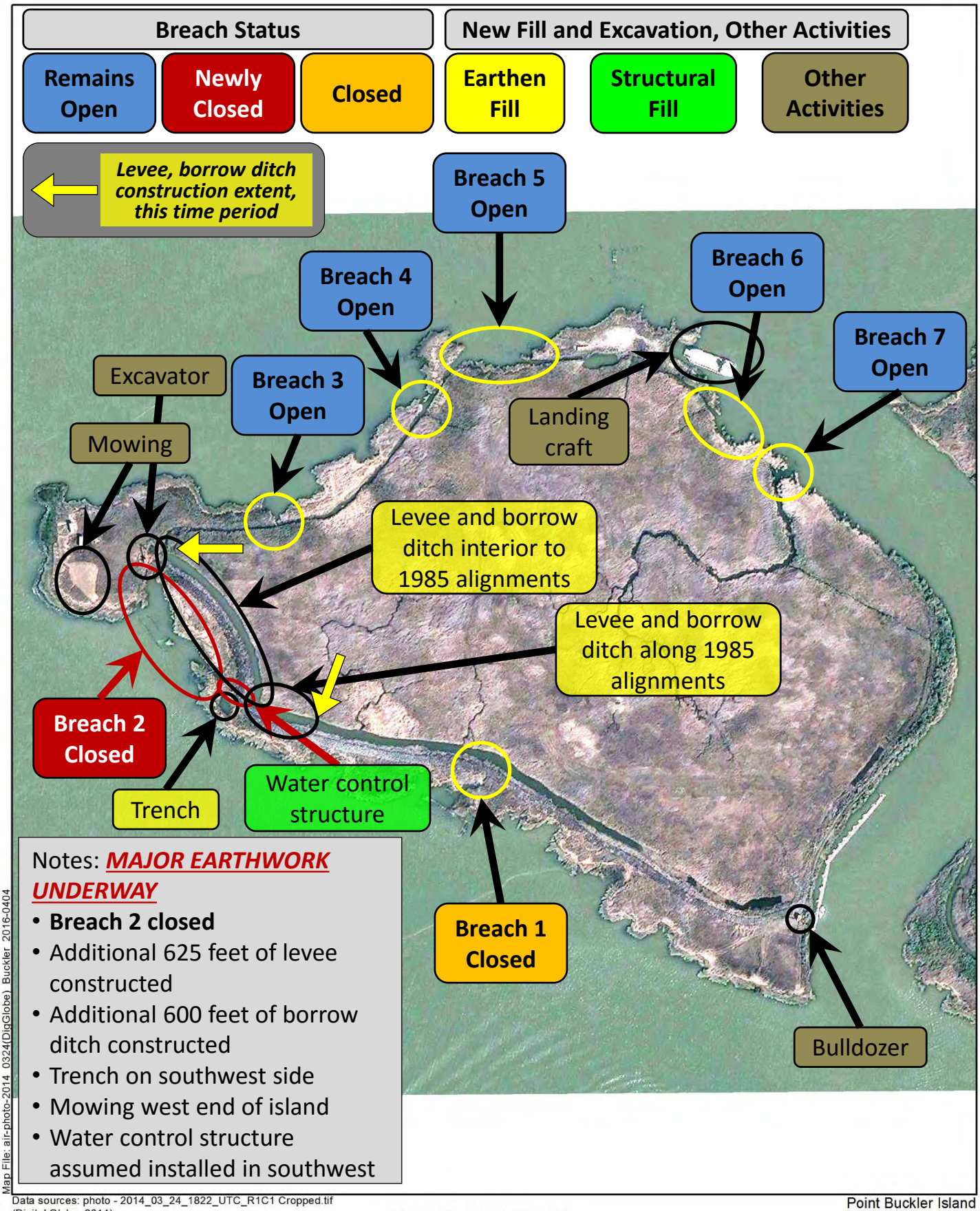
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-19

(Apollo Mapping) March 8, 2014

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2014_0324(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_03_24_1822_UTC_R1C1 Cropped.tif (Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

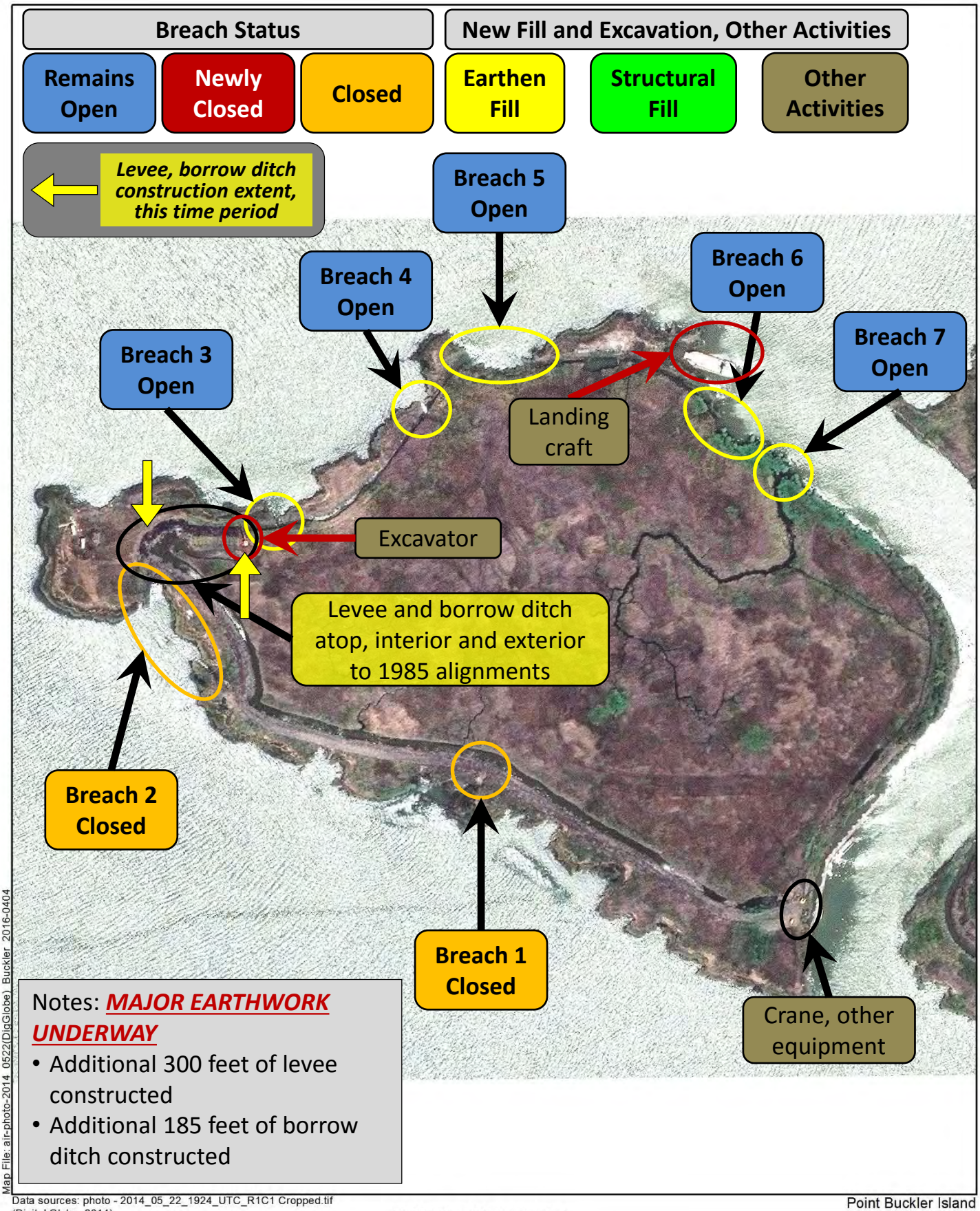
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-20

(Digital Globe) March 24, 2014

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2014_0522(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_05_22_1924_UTC_R1C1 Cropped.tif (Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

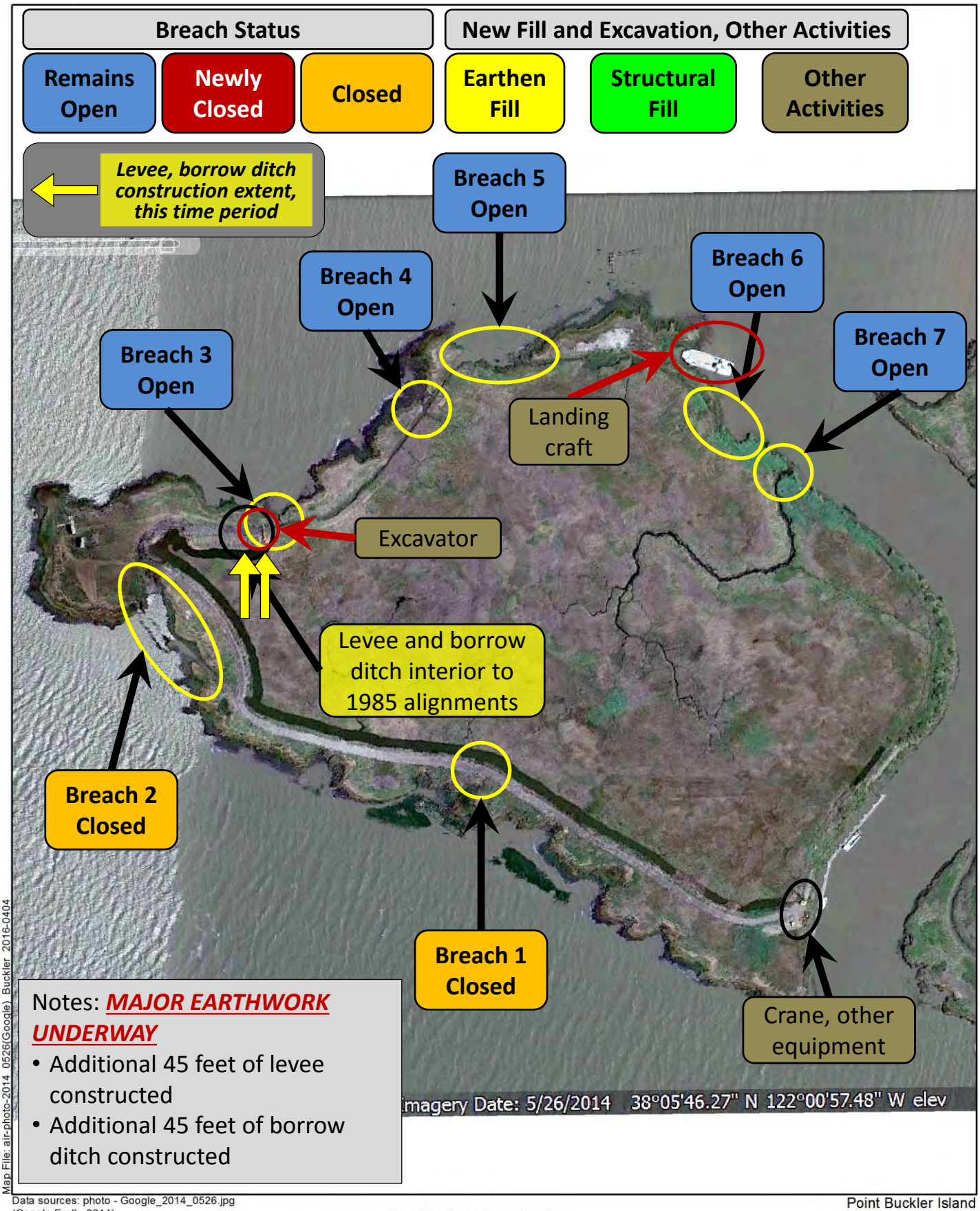
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-21

(Digital Globe) May 22, 2014

Tidal Connectivity, Fill and Excavation Activities



Notes: ***MAJOR EARTHWORK UNDERWAY***

- Additional 45 feet of levee constructed
- Additional 45 feet of borrow ditch constructed

Map File: air-photo-2014_0526(Google)_Buckler_2016-0404

Data sources: photo - Google_2014_0526.jpg (Google Earth, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

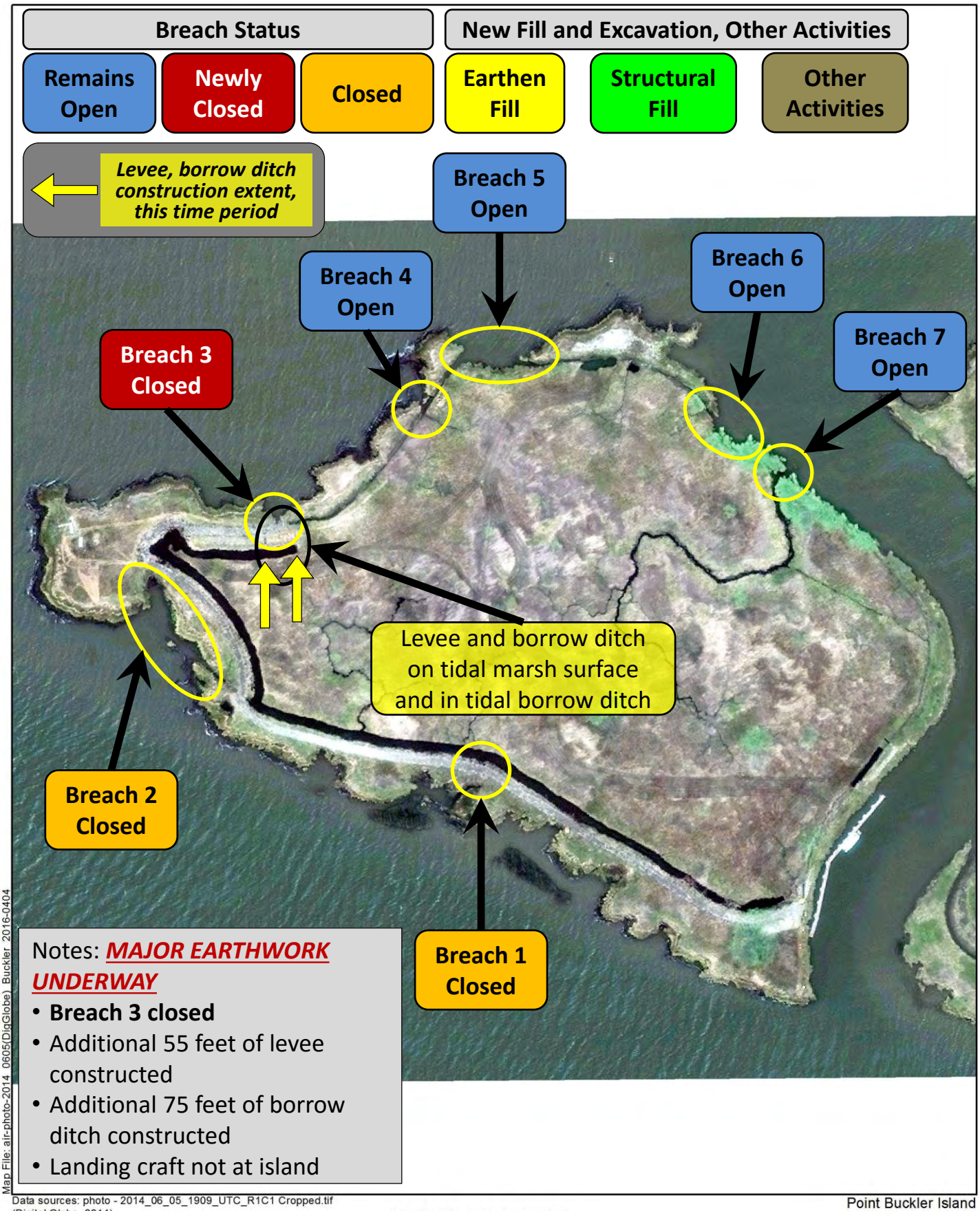
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-22

(Google Earth) May 26, 2014

Tidal Connectivity, Fill and Earthwork Activities



Map File: air-photo-2014_0605(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_06_05_1909_UTC_R1C1 Cropped.tif (Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

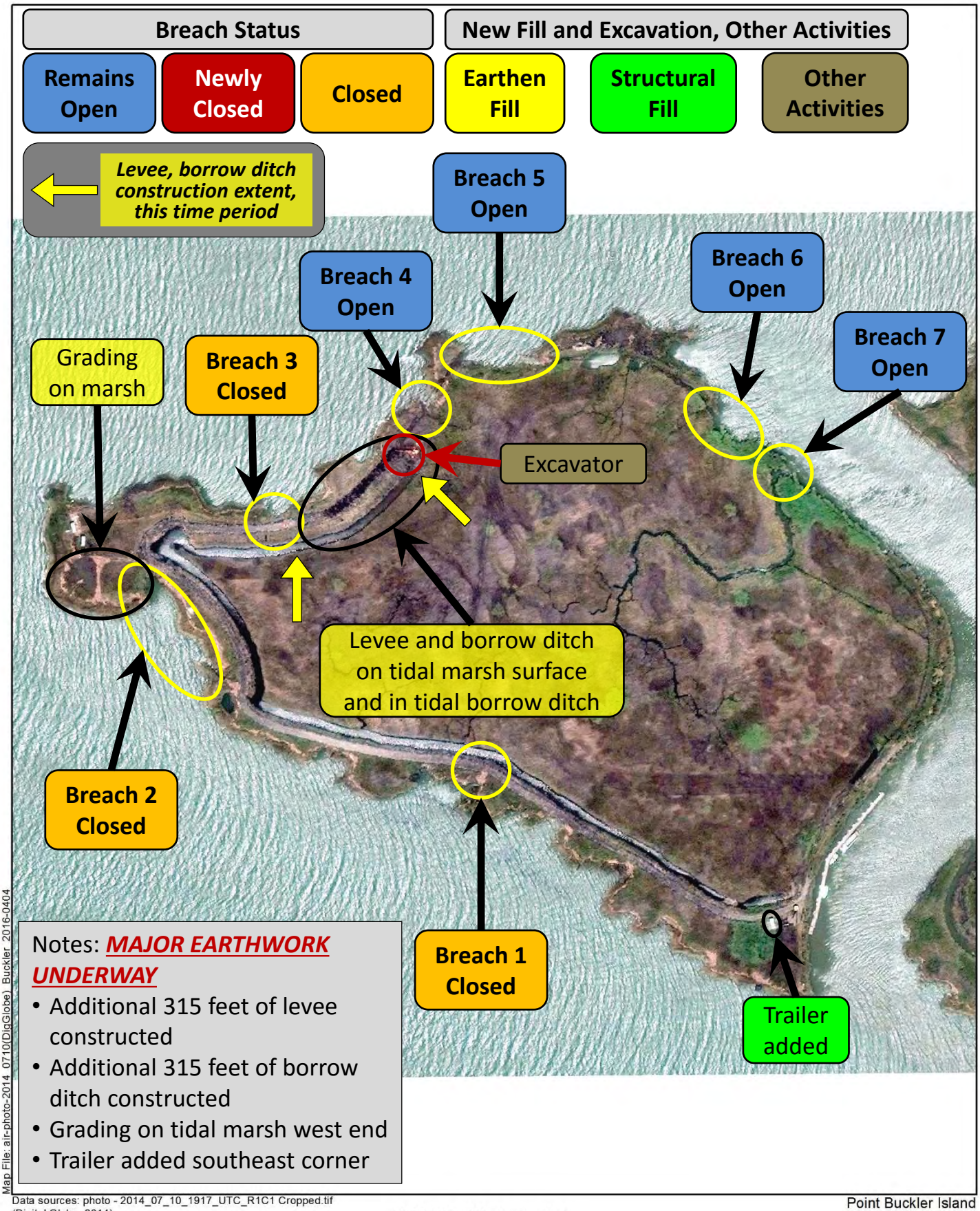
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-23

(Digital Globe) June 5, 2014

Tidal Connectivity, Fill and Earthwork Activities



Map File: air-photo-2014_0710(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_07_10_1917_UTC_R1C1 Cropped.tif (Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

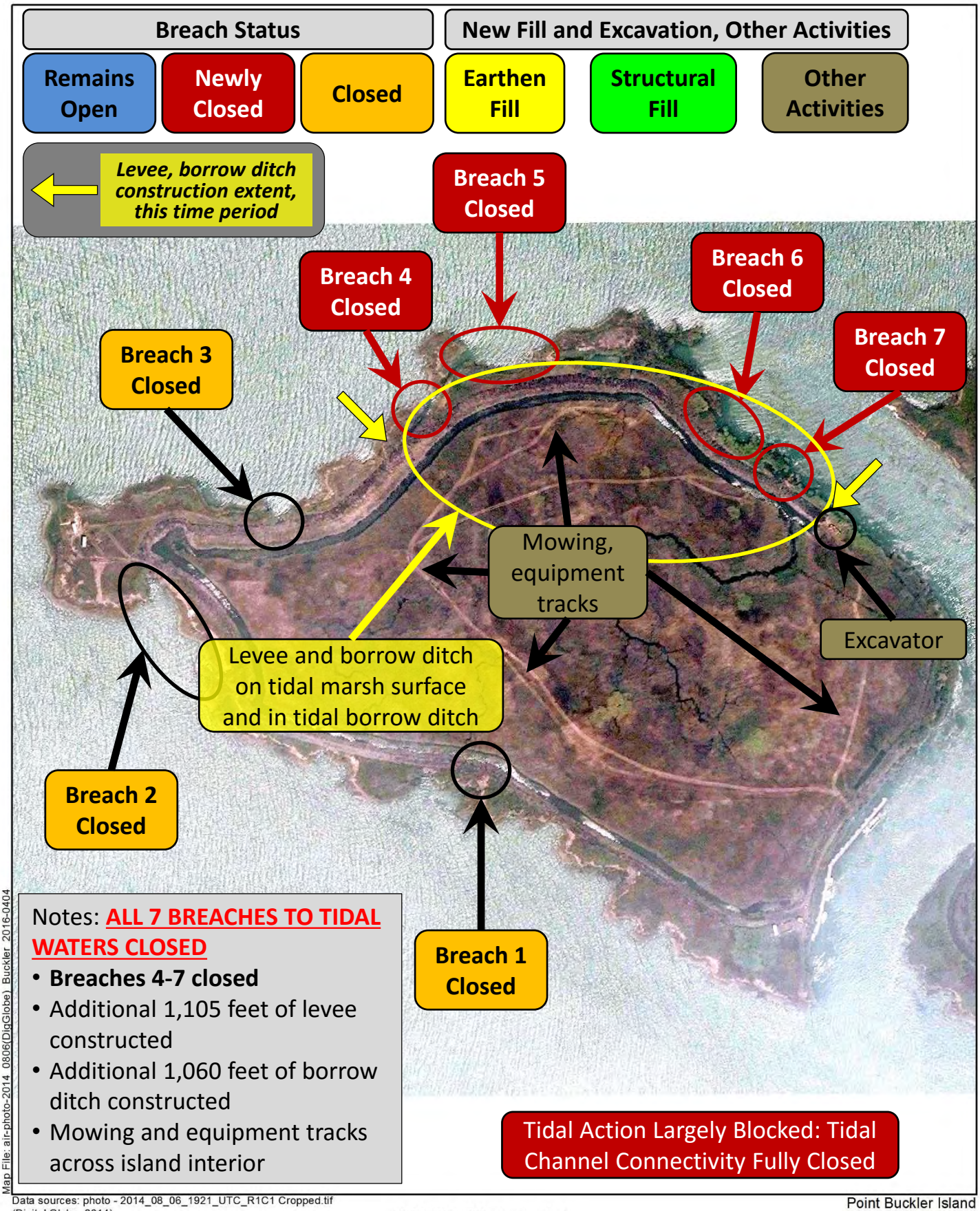
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-24

(Digital Globe) July 10, 2014

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2014_0806(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2014_08_06_1921_UTC_R1C1 Cropped.tif (Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

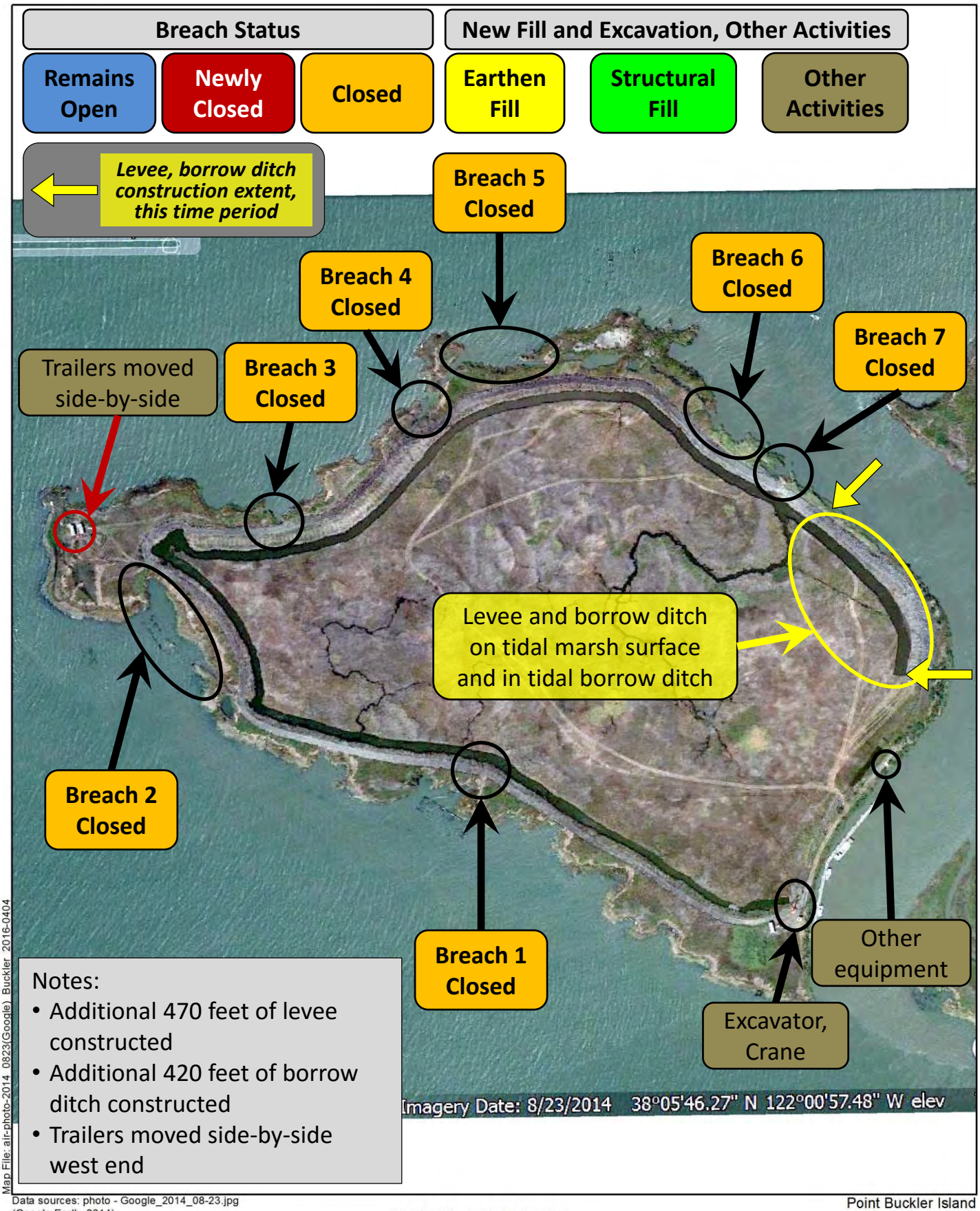
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-25

(Digital Globe) August 6, 2014

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Additional 470 feet of levee constructed
- Additional 420 feet of borrow ditch constructed
- Trailers moved side-by-side west end

Map File: air-photo-2014_0823(Google)_Buckler_2016-0404

Data sources: photo - Google_2014_08-23.jpg (Google Earth, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

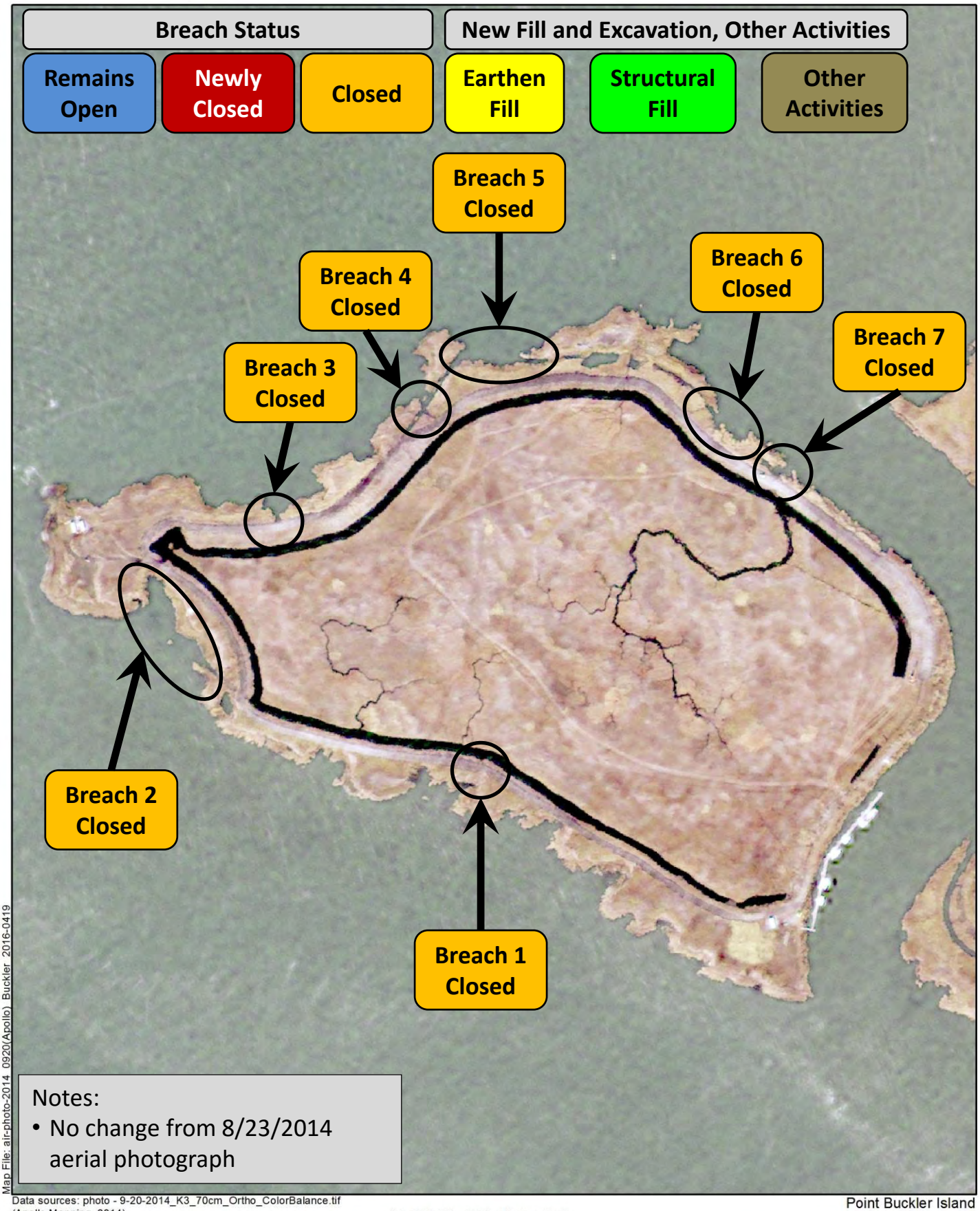
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-26

(Google Earth) August 23, 2014

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2014_0920(Apollo)_Buckler_2016-0419

Data sources: photo - 9-20-2014_K3_70cm_Ortho_ColorBalance.tif (Apollo Mapping, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-27

(Apollo Mapping) September 20, 2014
Tidal Connectivity, Fill and Excavation Activities

Map File: air-photo-2014_1018(Apollo)_Buckler_2016-0419

Data sources: photo - 10-18-2014_K3_70cm_Ortho_ColorBalance.tif (Apollo Mapping, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

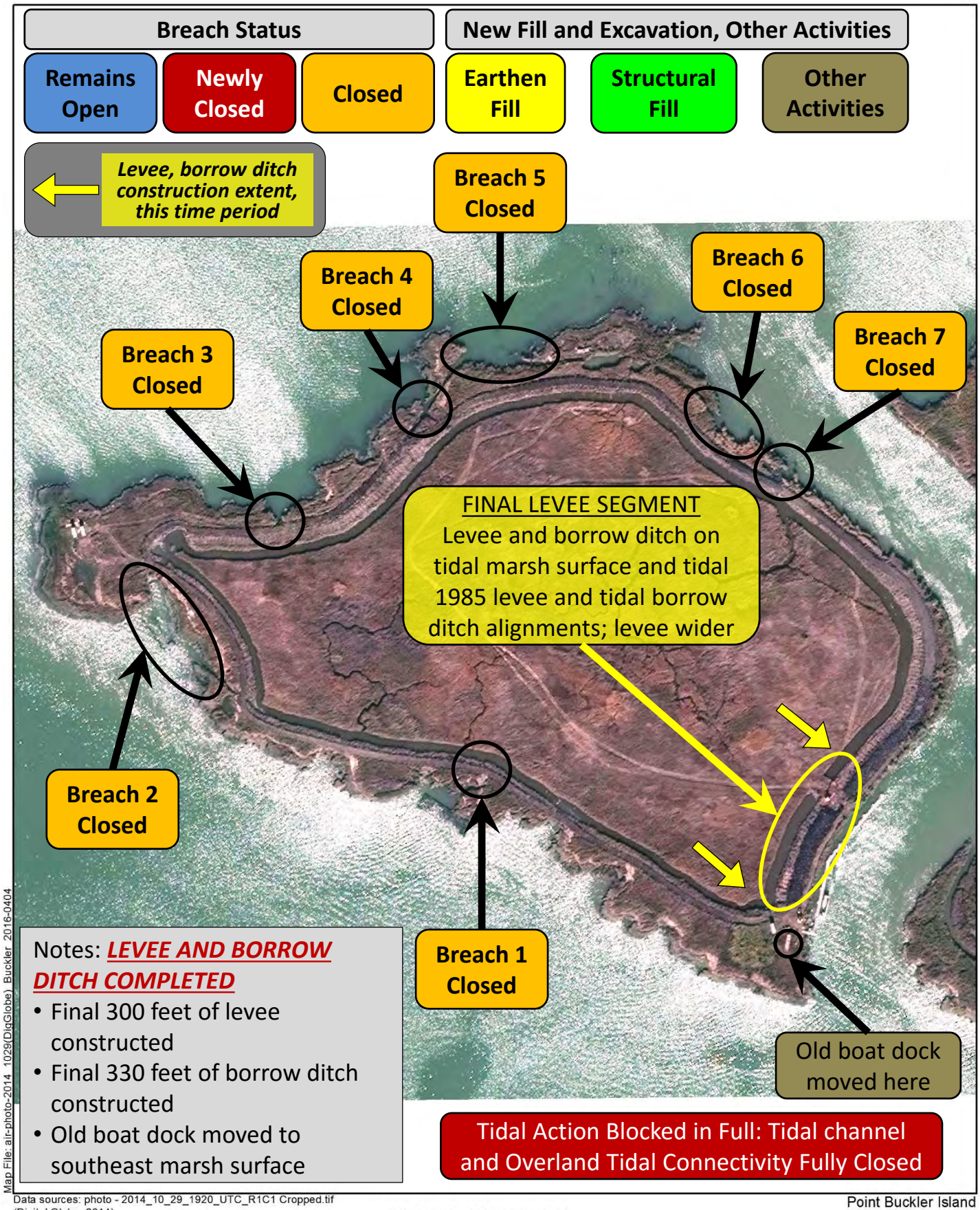
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-28

(Apollo Mapping) October 18, 2014

Tidal Connectivity, Fill and Excavation Activities



Data sources: photo - 2014_10_29_1920_UTC_R1C1 Cropped.tif (Digital Globe, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

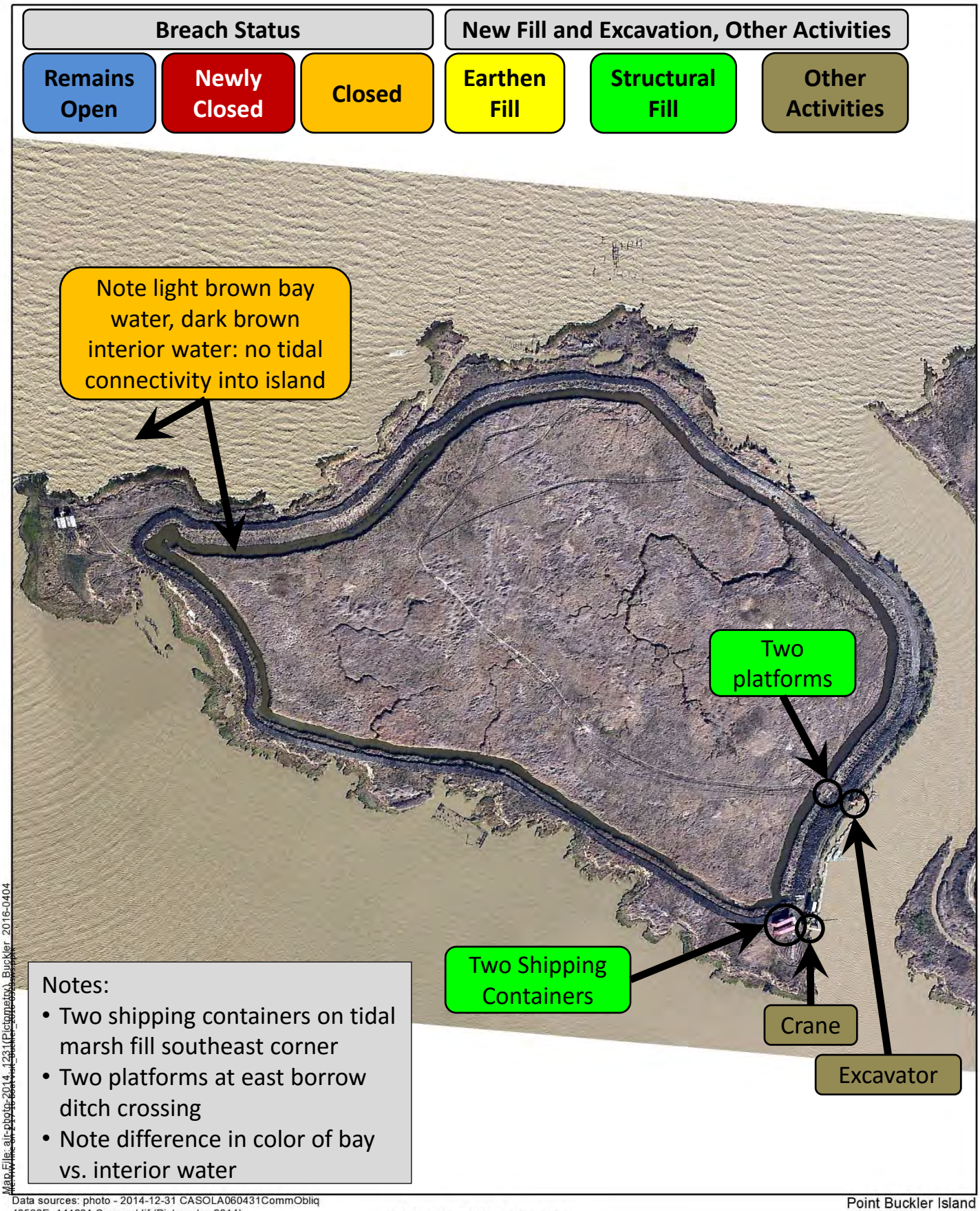
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-29

(Digital Globe) October 29, 2014

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2014_1231(Pictometry) Buckler 2016-0404

Data sources: photo - 2014-12-31 CASOLA060431CommObliq
48560E_141231 Cropped.tif (Pictometry, 2014)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

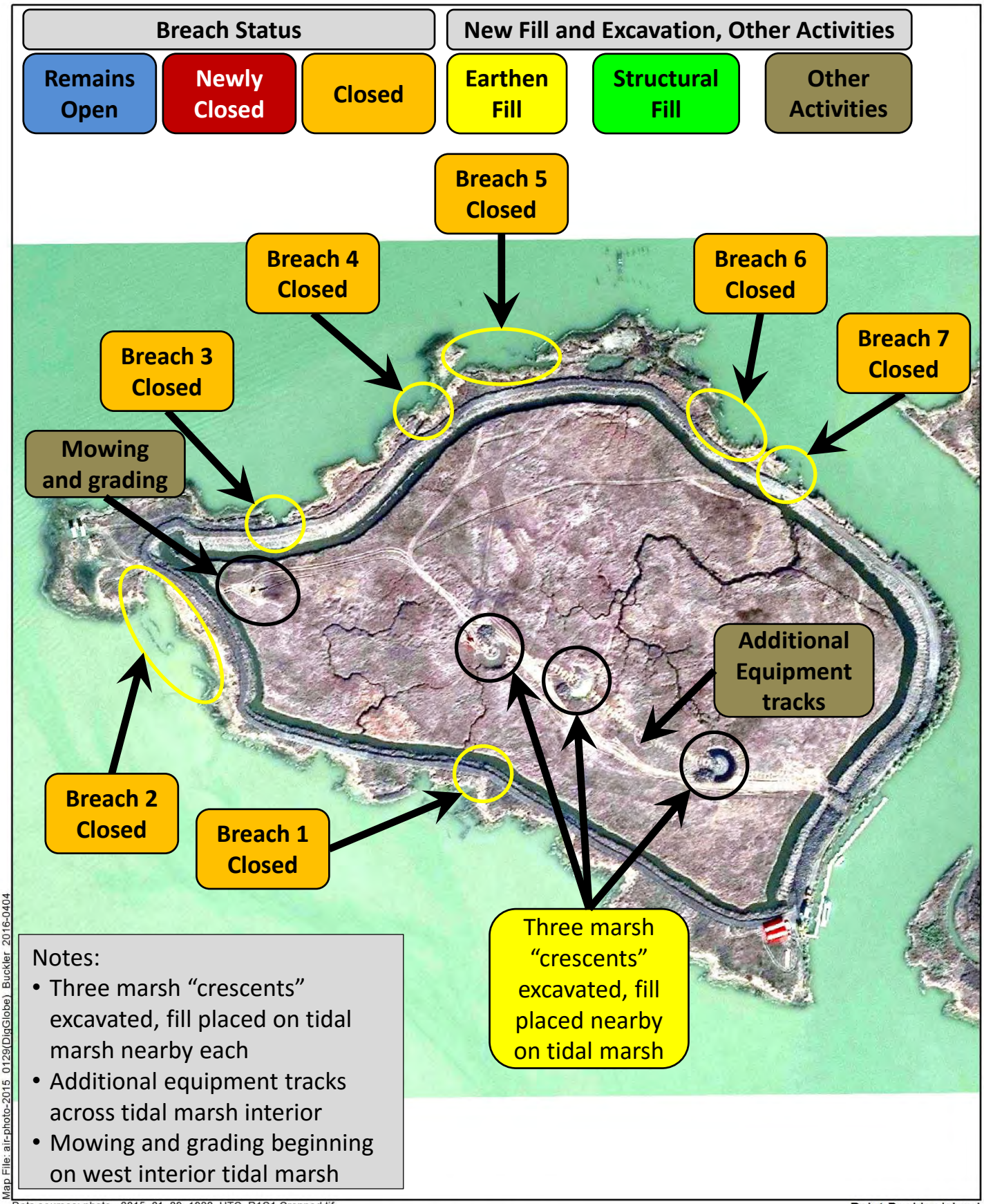
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-30

(Pictometry) December 31, 2014

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2015_0129(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_01_29_1922_UTC_R1C1 Cropped.tif (Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

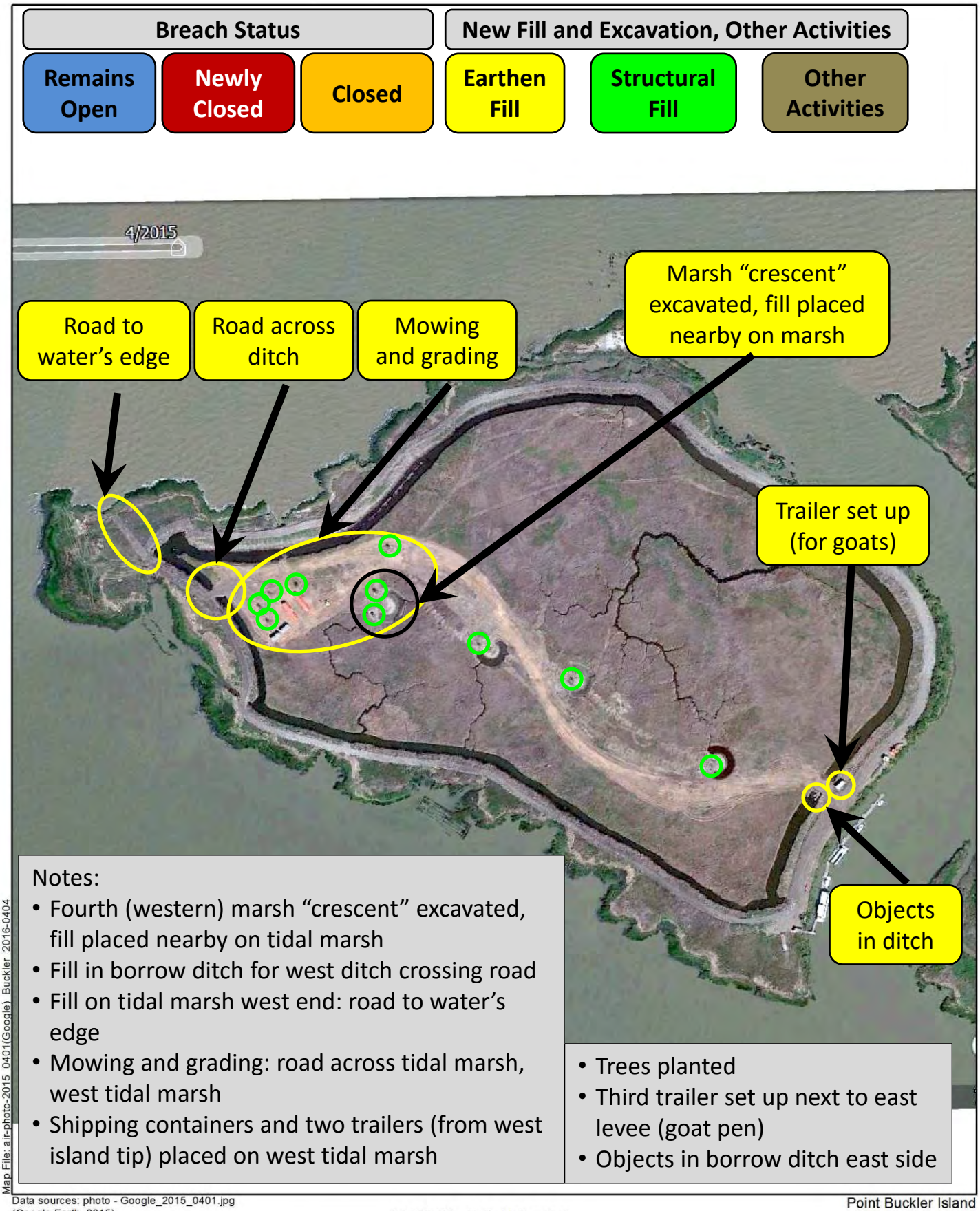
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-31

(Digital Globe) January 29, 2015

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2015_0401(Google)_Buckler_2016-0404

Data sources: photo - Google_2015_0401.jpg
(Google Earth, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

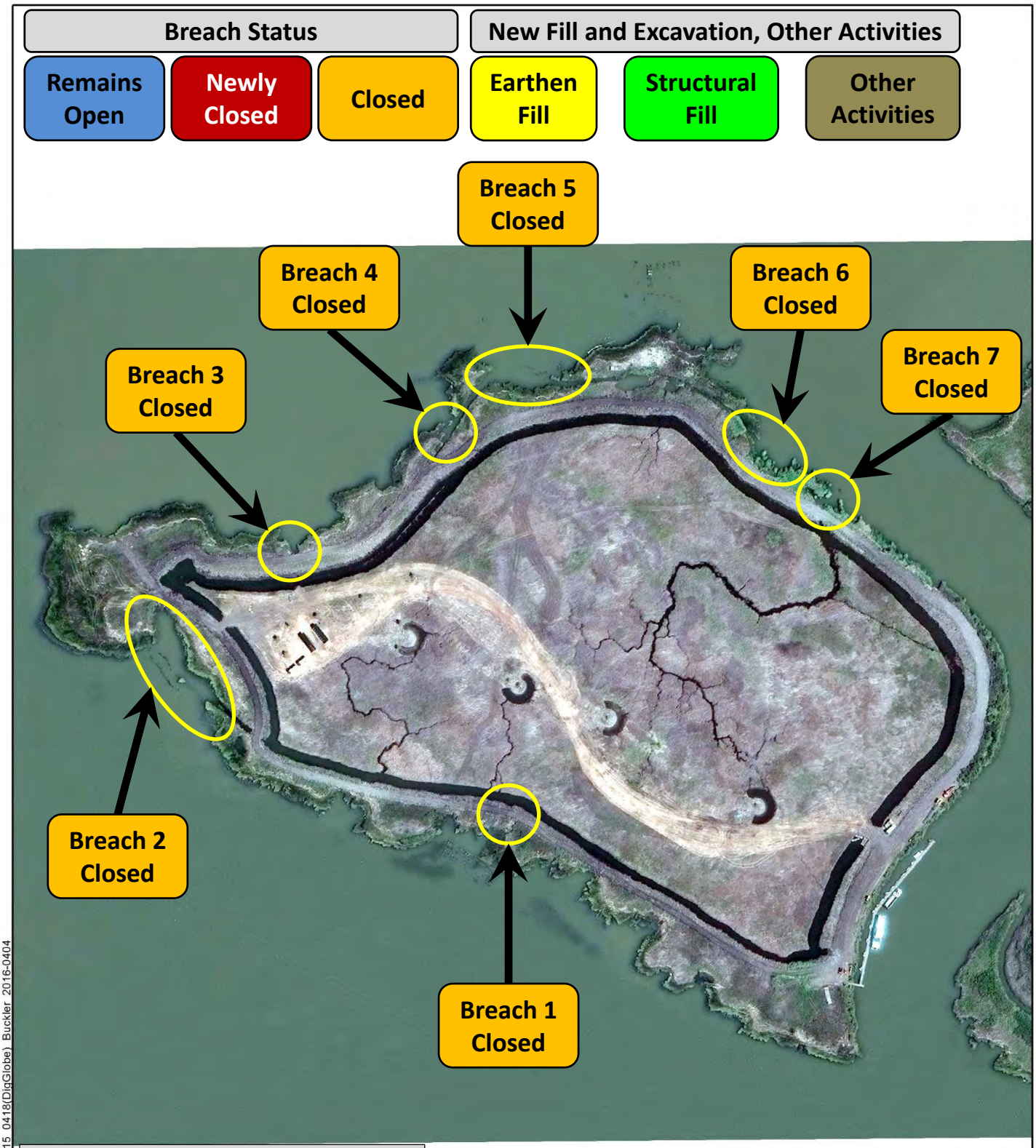
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-32

(Google Earth) April 1, 2015

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 4/1/2015
- Equipment moves around

Map File: air-photo-2015_0418(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_04_18_1911_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

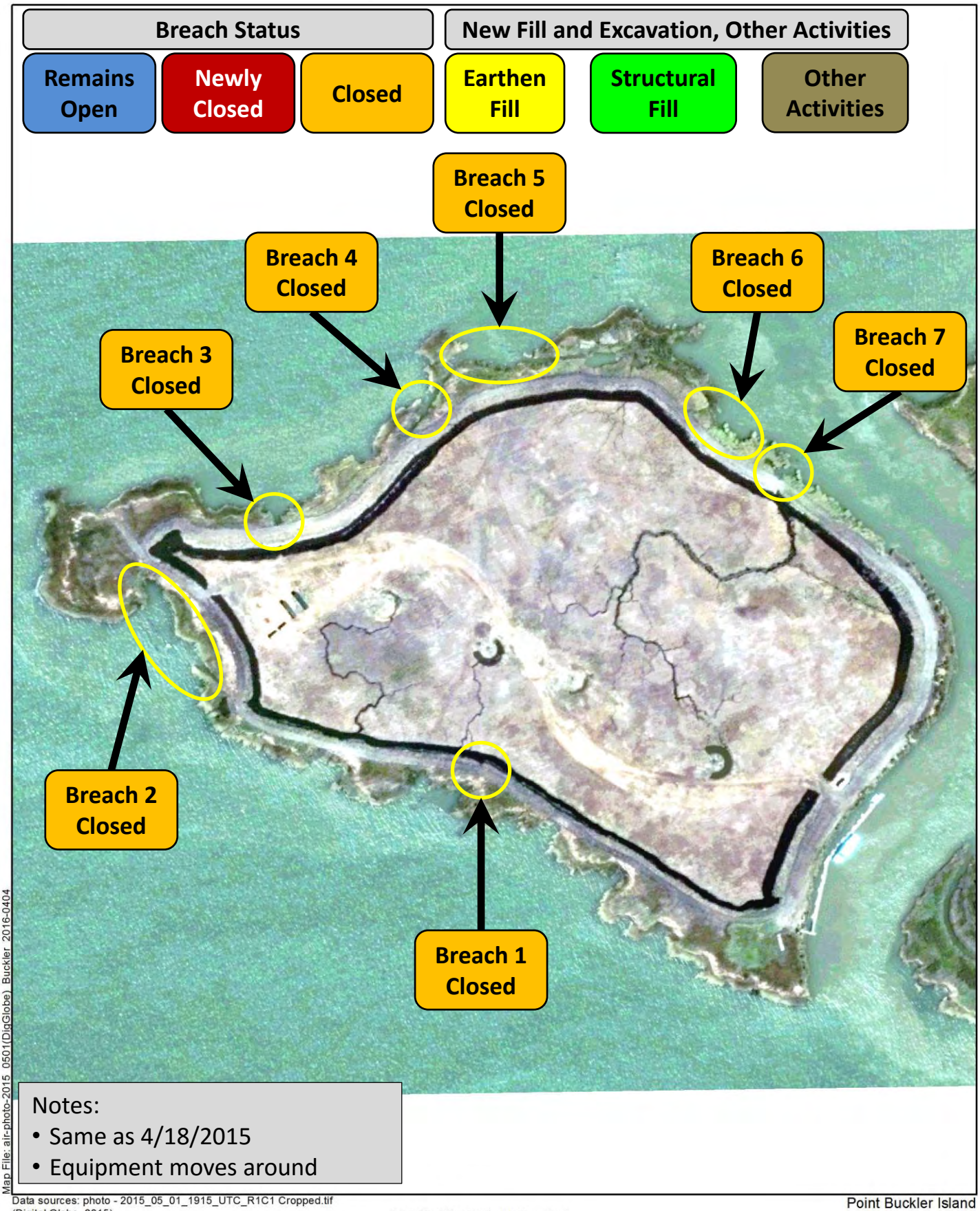
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-33

(Digital Globe) April 18, 2015

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 4/18/2015
- Equipment moves around

Map File: air-photo-2015_0501(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_05_01_1915_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

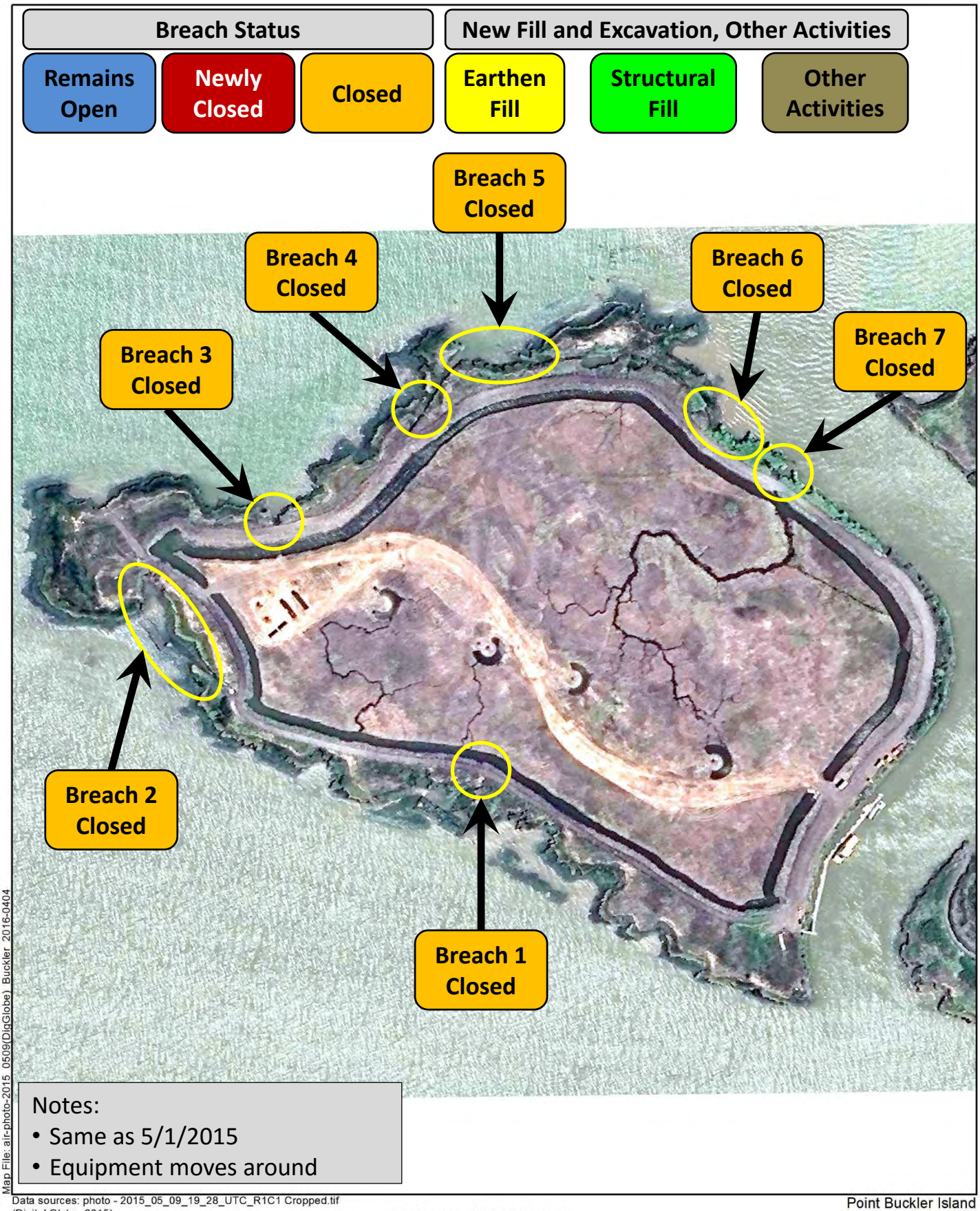
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-34

(Digital Globe) May 1, 2015

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as 5/1/2015
- Equipment moves around

Map File: air-photo-2015_0509(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_05_09_19_28_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

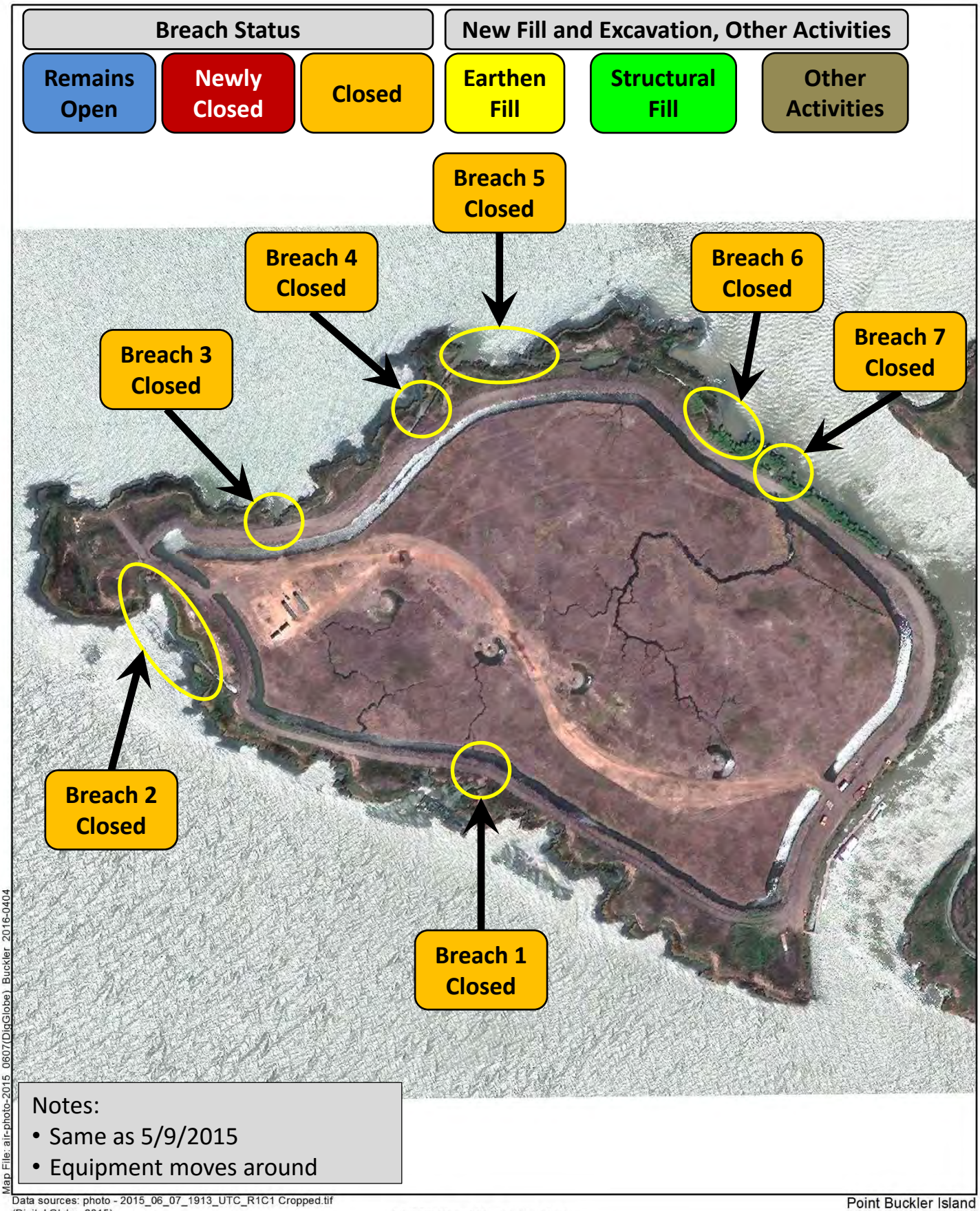
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-35

(Digital Globe) May 9, 2015

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2015_0607(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_06_07_1913_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

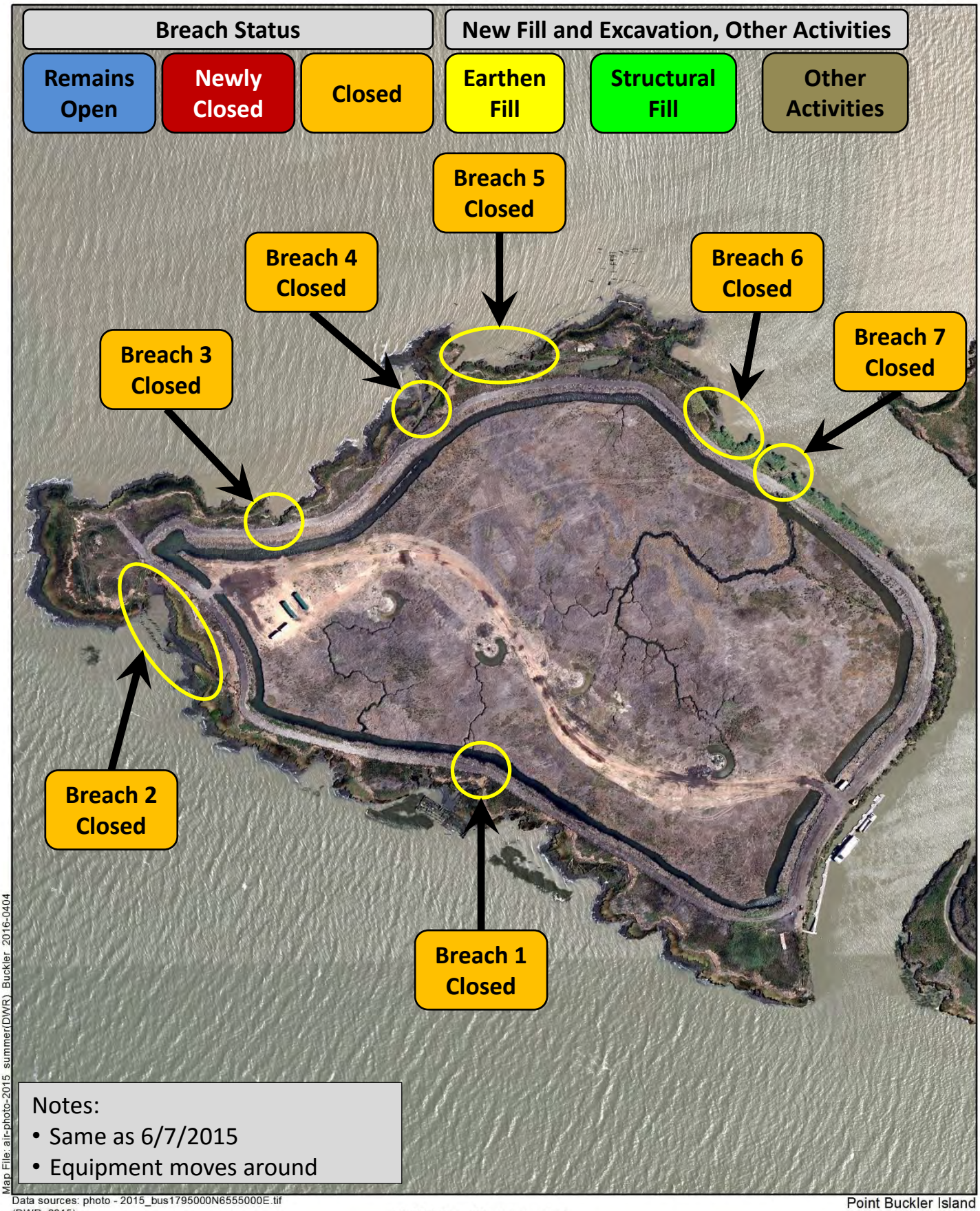
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-36

(Digital Globe) June 7, 2015

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2015_summer(DWR)_Buckler_2016-0404

Data sources: photo - 2015_bus1795000N6555000E.tif (DWR, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

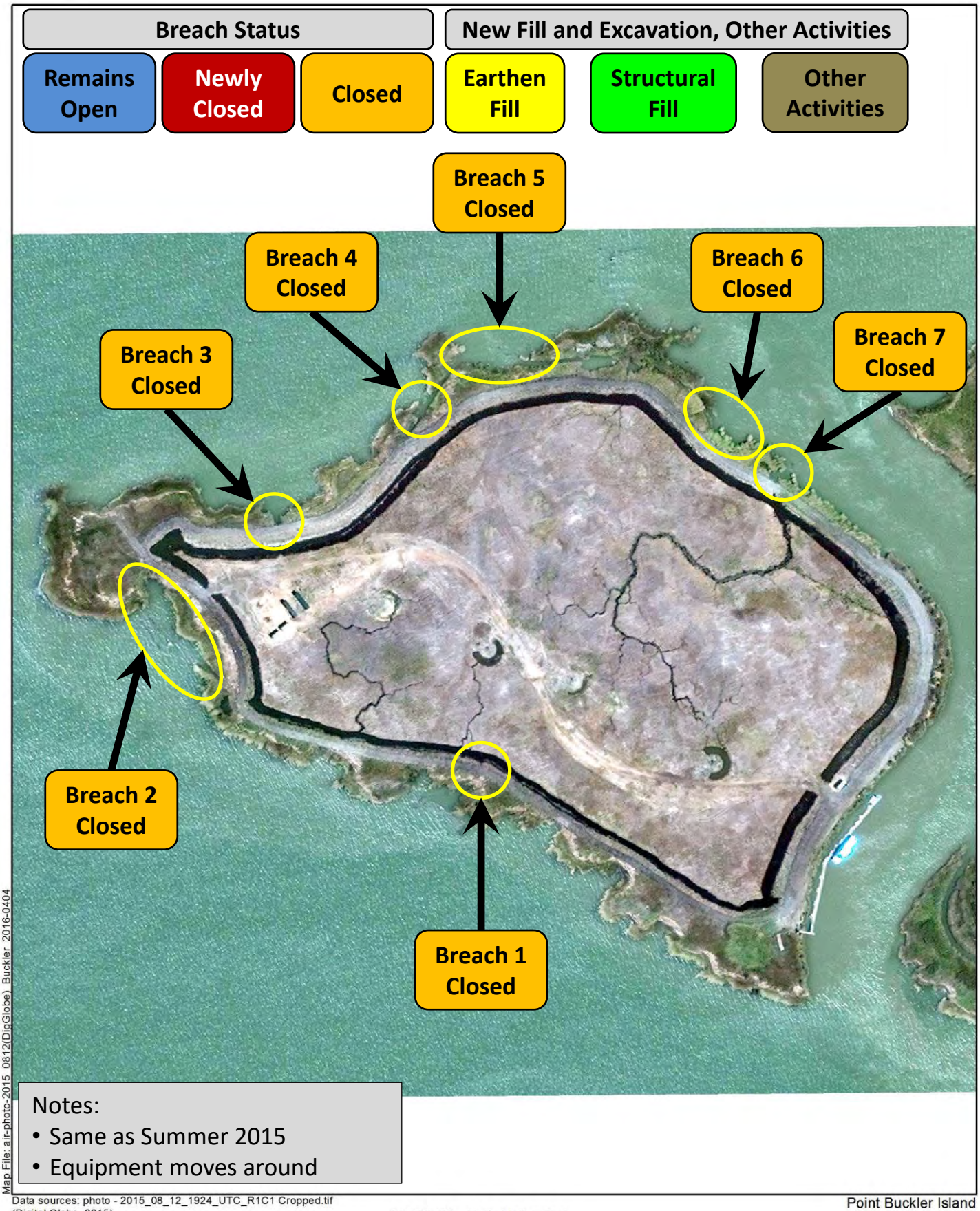
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-37

(DWR) Summer 2015

Tidal Connectivity, Fill and Excavation Activities



Notes:
- Same as Summer 2015
- Equipment moves around

Map File: air-photo-2015_0812(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_08_12_1924_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

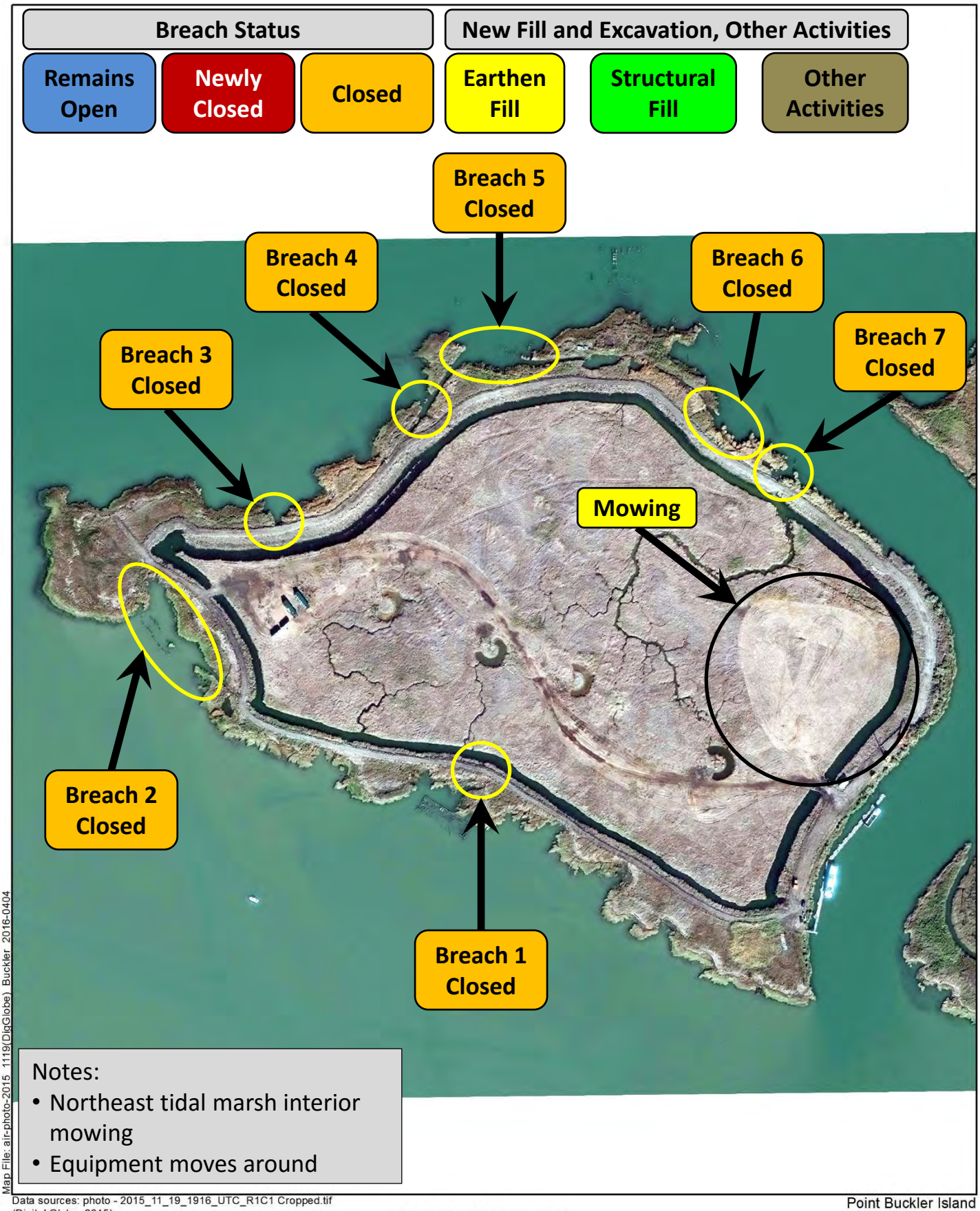
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-38

(Digital Globe) August 12, 2015

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2015_1119(DigGlobe)_Buckler_2016-0404

Data sources: photo - 2015_11_19_1916_UTC_R1C1 Cropped.tif
(Digital Globe, 2015)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

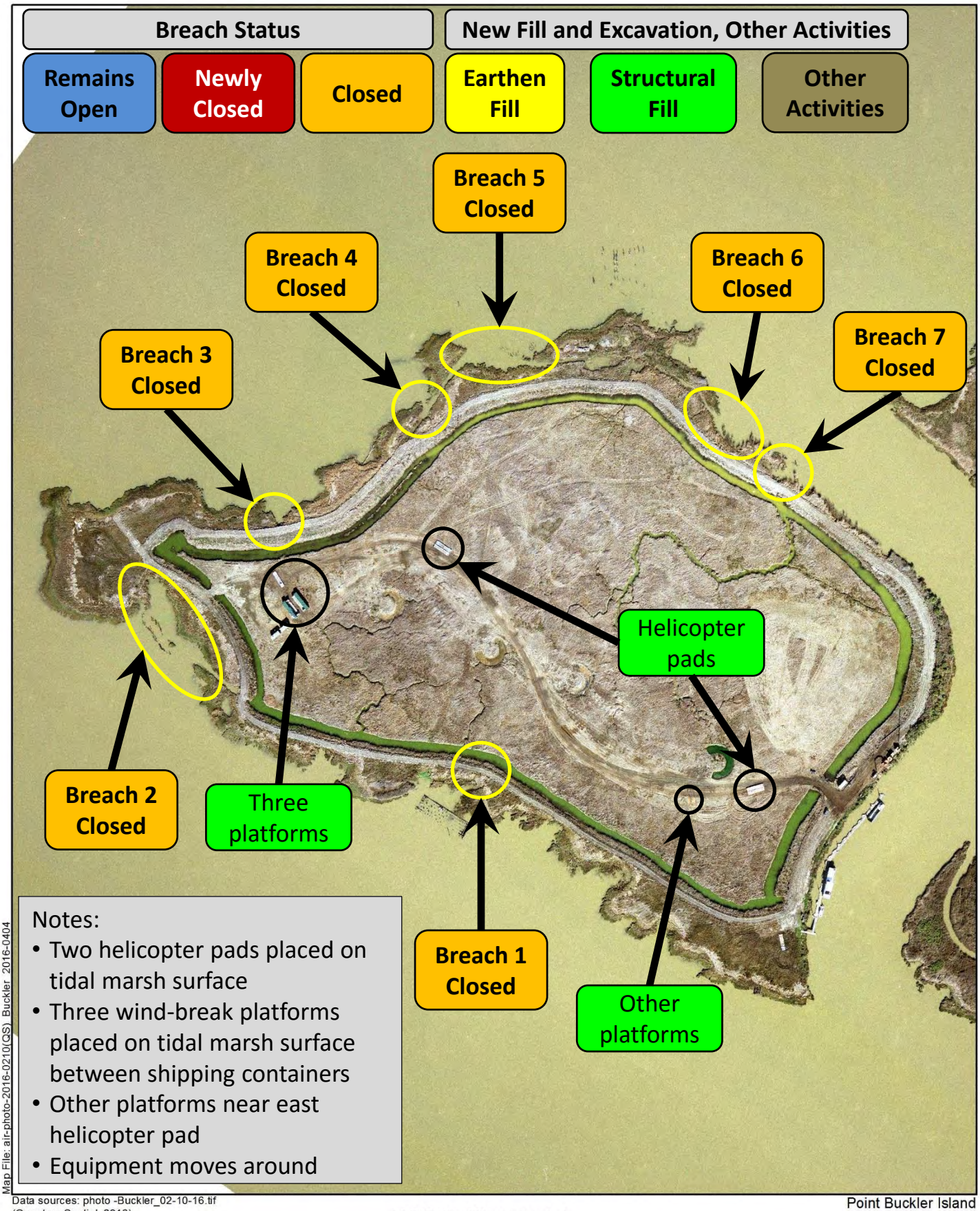
0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-39

(Digital Globe) November 19, 2015

Tidal Connectivity, Fill and Excavation Activities



Map File: air-photo-2016-0210(QS) Buckler 2016-0404

Data sources: photo -Buckler_02-10-16.tif
(Quantum Spatial, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure K-40

(Quantum Spatial) February 10, 2016

Tidal Connectivity, Fill and Excavation Activities

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Appendix L Wetlands Drainage Since 2011

L-1.0 Introduction and Summary

The construction of new perimeter levees and the parallel interior borrow and drainage ditch, including earthen dams across tidal channels and the installation of water control structures, has significantly altered the hydrology, vegetation, and ecology of Point Buckler Island wetlands. Consistent and strong evidence from direct field observations (see March 2, 2016 field photographs in Appendix R), aerial photograph series (Appendix D), documentary records (Appendix H), and comparison to observed site conditions in May 2003 (Appendix S) converges on the conspicuous outcome of perennial drainage of marsh within Point Buckler Island and its consequent adverse impacts to beneficial uses. Marsh drainage and the mass dieback of pre-diking marsh vegetation since construction of levees, ditches, and operable water control structures at Point Buckler stands in marked contrast to both the adjacent tidal fringing fresh-brackish marshes, and nearby diked, managed (non-tidal) Suisun marshes during the same (drought) time period (2014-2016).

The site visit of March 2, 2016 revealed that the island's cover was dominated by extensive standing dead litter (plant material, in this case bulrushes, cattails, and tules), with only sparse, short cover of living local reed and Baltic rush populations (Appendix H, Appendix R photos R-8, 9). The island interior was dominated by dead, decaying dry marsh vegetation, and exhibited no evidence of surface soil saturation or flooding over winter like the nearby Simmons Island duck clubs, even after the "average" rainfall on the 2015-2016 winter. Mass dieback of the obligate dominant marsh vegetation on Point Buckler was unique to the site, and was not found in either the adjacent fringing tidal marshes or contemporary managed non-tidal marshes of Simmons Island or Grizzly Island, despite the extreme drought affecting all of these sites since 2011 that began to diminish during the 2015-2016 winter (Appendix R photos R-2, 10). The adjacent fringing tidally flooded marsh outside the perimeter levees supported green, live tule and cattail shoots over 2-3 feet tall, intermixed with persistent standing leaf litter from the previous growing season (Appendix R photos R-1, 5, 6). These observed conditions in the interior of Point Buckler in March 2016 stand in marked contrast to observed conditions in May 2003 when the site was open to daily tidal action (Figure G-13): at that time, the site interior supported dense stands of tidally flooded bulrush and cattail, and ditch water turbidity and color exhibited high suspended sediment concentrations of tan-gray bay mud (fine mineral suspended sediment that rapidly precipitates in non-turbulent, low-energy conditions) (Appendix S).

Instead, on the March 2, 2016 site visit, multiple species of weeds and native plants typically occurring in high brackish marsh/terrestrial transition zones or high marsh banks of Suisun Marsh were found to occur in extensive colonies throughout the drained marsh interior's cover of dead standing plant litter (Table L-1, Appendix R photo R-16). Upland, high marsh and transition zone species appeared to be

establishing vigorously in drained marsh soils (Appendix R photos R-15, 16) that formerly supported "obligate" emergent marsh species that occur only in permanently flooded or saturated soils. Deciduous upland ornamental trees were planted in early 2015 around the newly excavated crescent basins, which is consistent with expectations of permanent soil drainage. No native or cultivated non-native trees occur or could survive in tidal or seasonally flooded brackish soils of Suisun Marsh. The planted trees were in fact long dead by the time of the March 2, 2016 site visit (Appendix R photo R-17).

Water levels in the interior borrow and drainage ditch remained essentially static during the March 2, 2016 field visit, and did not drop as the tide receded that afternoon, documenting the disconnection of the borrow and drainage ditch to direct tidal connectivity (). Further, water levels in the borrow and drainage ditch, which typically correlate with groundwater levels or active water management, stood significantly more than 1 foot lower than the adjacent banks (Appendix R photos R-8e, f; R-14c-d; R-16 d; Figure L-3). Groundwater levels measured in five soil pits on March 2, 2016 at locations spread around the interior confirmed that marsh groundwater ranged from 0.85 ft to 1.54ft below ground surface in late winter (Figure L-3). The salinity of most groundwater samples taken in late winter was significantly higher than contemporary bay and channel salinity, and exceeded normal summer high channel salinity levels (Table L-2). The exposed, barren, emergent banks of the crescent basins also exhibited water drawdown in late winter more than two feet below the top of banks. Excavated banks of the crescent basins exhibited deposition of local iron oxide films, and water exhibited elevated salinity and visual and olfactory evidence of iron sulfide accumulation and oxidation products (rusty red iron oxide films and associated acid sulfates) (Appendix R photo R-20).

The soil series description for Joice Muck (**Ja**), one of the major soil types mapped for the island (SCS 1977), states that although management of levees and tide gates alters the water table of Joice Muck soils, it is generally less than 30 inches below the surface in midsummer, and near the surface in winter. On the March 2, 2016 late winter site visit, however, groundwater was well below the surface, despite a normal winter rainfall (10.33 inches of rain had fallen to date at nearby Concord Naval Weapons Station, out of 16.67 inches by May 2016 which matches the local annual average rainfall, Figure L-2) and extensive flooding of Simmons Island clubs.

All field evidence from soil, groundwater, and vegetation was consistent with atypical year-round drainage of Point Buckler Island. There was no evidence of any recent or past managed flooding for waterfowl habitat or typical Suisun Marsh managed non-tidal marsh vegetation in the island interior. Water management appears to consist of year-round drainage and a lack of periodic, seasonal flooding of the interior diked marsh. The permanent drainage has resulted in the mass dieback of former dominant obligate (OBL) emergent marsh vegetation (tule, cattail, and bulrush), and triggered vegetation succession to species of lowland mesic (FAC [facultative wetland] and UPL [upland]) plants,[11]

[11] Wetland plant indicator status is determined by the 2014 National Wetland Plant List developed by the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, Environmental Protection Agency, and Natural Resources Conservation Service. Status definitions are as follows:

- Obligate wetland (OBL). Almost always occurs in wetlands

including colonial spread of noxious invasive perennial pepperweed (*Lepidium latifolium*), which is intolerant of prolonged, deep seasonal flooding. Drainage has also resulted in the early stages of acid sulfate soil formation and probable irreversible soil subsidence and carbon release from aerobic[12] microbial decomposition of soil organic matter.

L-2.0 Aerial Photographic Evidence of Drainage

A preliminary review of aerial images of the island taken before and after completion of the new levee and closure of all seven pre-existing levee breaches between February and October 2014 (see Appendix K) revealed an apparent change in the island vegetation color and pattern: specifically, a shift from prevalent summer-green vegetation to a prevalent conspicuous grayish vegetation signature (typical of a high proportion of standing dead leaf litter) in the winter dormant season that anomalously persisted through the summer growing season.

L-3.0 Field Evidence and Interpretation of Long-Term Marsh Drainage

L-3.1 Relict Moribund Populations and Standing Litter

The most conspicuous and extensive evidence of multi-year marsh drainage under non-tidal conditions within interior Point Buckler Island is the mass dieback of the former dominant marsh vegetation mapped by CDFW and CDWR from 2002-2012, in association with currently drained wetland soils (Table L-1). On March 2, 2016, the dominant vegetation cover of the marsh interior of the levees was composed primarily of dead standing litter of threesquare bulrush (*Schoenoplectus americanus*), cattail (*Typha* spp., mostly *T. latifolia* identified from remnants), and smaller amounts of dead tule (*S. acutus*), with very low-vigor, low-density surviving remnants of the bulrush and cattail (Appendix R photo R-8). Extensive areas of low-vigor, low-density Baltic rush (*Juncus balticus*) with dominant cover of dead shoots, and low-density patches of saltgrass (*Distichlis spicata*) occur primarily on the north and northwest plain of the island interior. Relatively small, short (< 1 m high) patches of reed (*Phragmites australis*) are also present. The relative abundance of persistent dead standing litter compared with sparse new growth confirmed the vegetative composition and dieback of these stands. By contrast, the exterior tidal marsh stands of these species exhibited green, vigorous shoots at high density on the March 2, 2016 site visit.

L-3.2 Current Plant Community Consists of Species Intolerant of Perennial Flooding or Soil Waterlogging (Marsh) and of Planted Ornamental Trees

Vigorous populations of plant species typically found in upland, high marsh, and marsh edge habitats (relatively high drainage environments with infrequently flooded or saturated soils) were observed in

- Facultative wetland (FACW). Usually occur in wetlands, but may occur in non-wetlands
- Facultative (FAC). Occur in wetlands or non-wetlands
- Facultative upland (FACU). Usually occur in non-wetlands, may occur in wetlands
- Obligate upland (UPL). Almost never occur in wetlands

[12] Requiring oxygen; soils that are drained of water generally contain oxygen.

the broad interior diked plains of the island where the mass dieback of obligate emergent marsh plant dominants was observed (Table L-1, Appendix R photos R-15, R-16). The pattern and distribution of these species, their life-histories (annual, perennial), and ecological tolerances provide evidence of perennial drainage and the absence of ecologically significant long-term seasonal flooding. The colonization of the marsh dieback areas by annual and perennial plant species tolerant of mesic (moist, drained) soil conditions, but intolerant of prolonged flooding or soil waterlogging (conditions found in tidal marsh and in Suisun diked managed wetlands), also provides strong evidence of absence of flooding and waterlogging during the last winter and previous growing season. Important indicator species are reviewed below.

Sow thistle, *Sonchus oleraceus*. Within the diked marsh plain, among standing dead litter of bulrush (*Schoenoplectus americanus* – OBL) and cattail (*Typha* spp. – OBL), widespread, scattered individuals of sow-thistle were observed in the seedling, vegetative juvenile, and transitional stage (pre-flowering, rapid shoot growth and flower bud stage) (Appendix R photo R-15). Leaf morphology confirmed the species was the annual non-native invasive broadleaf weed, *S. oleraceus* (UPL) and not *S. asper* (FAC). The occurrence of vigorous specimens of this upland species in a tidal or diked, non-tidal Suisun Marsh in winter or spring is anomalous. *S. oleraceus* seedlings cannot tolerate or survive prolonged submergence or soil saturation over winter in the seedling stage. The widespread occurrence of vigorous growing and pre-flowering *S. oleraceus* indicates that the soils they occupy were neither flooded nor waterlogged (prolonged saturated, anaerobic[13] conditions that define wetland soils) for ecologically significant periods over the last (2015-2016) winter.

Ornamental deciduous tree plantings (dead/species unidentifiable). There are no deciduous tree species, native or non-native, that can tolerate estuarine marsh environments or diked non-tidal Suisun Marsh water management regimes. Only one tree in California is physiologically capable of surviving prolonged flooding or saturation with brackish water: red river gum, *Eucalyptus camaldulensis* (Appendix R photo R-18), old windbreak plantings of which are widespread in Suisun Marsh levees. All other trees in Suisun Marsh require drained non-saline to alkaline soils and are restricted to levees; they are excluded from brackish marshes and from marsh interior surfaces. Suisun levee riparian trees include domestic plums, black walnuts, and native willows.

New ornamental deciduous and apparently nursery-grown trees were planted in early 2015 (see Table K-1) next to each excavated crescent basin, on raised, filled ground that appears to be clayey/peaty spoils excavated from the crescent basins (Appendix R photo R -17). Planted trees were protected from possible goat browsing by a cylinder of wire fencing. Other trees, apparently the same species, were planted around structures at the west end of the island. Trees next to the crescent basins were long dead: the bark had dried, peeling and flaking around the entire tree, exposing desiccated underbark; twigs were dry and crisp (Appendix R photos R-17d-e). Soil and groundwater salinities (Table L-2) were too high (lethal) for the long-term survival of any ornamental or native tree, although the leafless trees

[13] Without oxygen; soils that are saturated/waterlogged for extended periods of time generally lack oxygen.

with stem dieback planted at the west end of the island still had some live trunk bark. The planting of deciduous ornamental trees either indicates an intention to drain and desalinize soils at the planting locations, a commitment of resources to futile plantings, or basic unfamiliarity of soil requirements for trees. Considered within the context of the mass dieback of perennial obligate marsh vegetation and the post-diking spread of mesic, high marsh, and upland species, planting of ornamental or shade trees is consistent with an intention to permanently drain the marsh and convert it to non-wetland, non-saline soil conditions in support of non-wetland land uses.

Creeping or alkali wildrye, *Elymus triticoides* *(*syn*. Leymus triticoides).* Another anomalous species occurring with high vigor and locally high population density is creeping wildrye. In the San Francisco Estuary and Suisun Marsh, this native clonal (creeping) perennial grass species typically occupies (or dominates) the ecotone (transition zone) between high tidal marsh and lowland terrestrial soils, or adjacent terrestrial lowland grasslands and diked baylands, including levees (Baye *et al.* 2000, Baye 2000, Whitcraft *et al*. 2011, Grewell *et al.* 2014.). It does not occur in the interior marsh plains of Suisun Marsh or in perennially saturated or flooded managed local marshes that are occupied by cattail, bulrush, or tule vegetation. Large, linear, vigorous green (live) colonies of creeping wildrye were found at Point Buckler locally dominating vegetation along the top of recently excavated perimeter borrow and drainage ditch banks, primarily on the south side of the island (Appendix R photo R-16). Most were single-species dominant stands. Creeping wildrye was also observed in local abundance on the remnant old levee at the east end of the island, associated with California rose and coyote-brush (Appendix R phot R-11), species that also occur in drained upland, riparian, or wetland transition zones. The large extent and high density and vigor of borrow and drainage ditch-bank linear colonies of creeping wildrye indicate rapid colonization and spread after the 2014 levee and borrow and drainage ditch construction. This species establishes only infrequently from seed, and relies primarily on clonal spread for population increase. It does not tolerate prolonged flooding or saturation by brackish water when subject to competition with taller flood-tolerant emergent marsh plants such as tule, cattail, or bulrush. It is likely that pre-existing local remnant populations from the tidal remnant levee opportunistically colonized the well-drained ditch banks (with steeper groundwater drawdown gradients, and salt leaching), in the absence of sustained competition from tule, cattail, and bulrush that was dying back due to excessive drainage and moisture stress.

Suisun Marsh gumplant*, Grindelia x paludosa*. Suisun Marsh gumplant is a tall non-clonal perennial subshrub (semi-woody shrub), and a naturally occurring endemic back-cross hybrid closely related to its parent species, *G. stricta* var. *angustifolia* (marsh gumplant). Mature (flowering, tall) plants take more than one year to establish from seed. Gumplant normally occurs in Suisun Marsh in the relatively well-drained high tidal marsh bordering channels, ditches, levees, and it is a FAC wetland indicator species. It is not a component of the regularly flooded lower or middle tidal marsh zone community, nor frequently saturated/flooded tule-cattail-bulrush marsh associations of managed non-tidal Suisun Marsh (Baye *et al.* 2000, Baye 2000, Baye and Grewell 2011, Whitcraft *et al*. 2011, Grewell *et al.* 2014.). Suisun Marsh gumplant has spread extensively at Point Buckler as robust individuals widely distributed over and rapidly colonizing areas of marsh plain vegetation dieback covered in dead standing litter of obligate

(OBL) tule-cattail-bulrush marsh (Appendix R photo R -16). Gumplant is most abundant and vigorous near banks of the new borrow and drainage ditch and adjacent benches between new levee and borrow and drainage ditch. The wide distribution of mature plants and juveniles over the diked marsh plain indicates that more than one year of relatively high marsh drainage, free from prolonged seasonal flooding, has occurred.

Perennial pepperweed, *Lepidium latifolium*. The most abundant live vegetation of the marsh interior is composed of vigorous, discontinuous colonies of perennial pepperweed (*Lepidium latifolium*) spreading through the former bulrush and cattail vegetation. Perennial pepperweed was observed in pre-flowering growth stages and vegetative rosettes emerging through dense standing litter of dead cattail and bulrush (Appendix R photo R-12). It has also clonally spread via roots into the dredge spoils (mud, peat) placed in between the new levee and borrow and drainage ditch, and the lower edges and slopes of the new levee (Appendix R photo R-14).

Perennial pepperweed is a noxious invasive species of floodplains, high tidal marsh edges and plains, levees, and diked seasonally drained brackish marshes around the San Francisco Estuary and Suisun Marsh, where it often forms dominant stands (Baye *et al*. 2000, Baye 2000, Baye and Grewell 2011, Grewell et al. 2014, Whitcraft *et al.* 2011, Reynolds and Boyer 2010). It can also tolerate higher salinity and moisture stress in the San Francisco Estuary (Reynolds and Boyer 2010), relative to seasonally flooded tule/cattail marsh with significantly taller canopies and higher density. Perennial pepperweed is not a significant or dominant component of low tule/cattail dominated Suisun tidal or non-tidal marshes, but it does colonize some high tidal marsh plains otherwise dominated by threesquare bulrush (*Schoenoplectus americanus*) in Suisun Marsh. At Point Buckler, all observed mass dieback areas were colonized by perennial pepperweed, either as frequent, large colonies (advanced invasion), or small, widely spaced colonies (incipient invasion) (Appendix R photo R-12).

Perennial pepperweed was the dominant live marsh vegetation type over most of the diked interior marsh observed during the March 2, 2016 inspection, even though it was only starting late winter vegetative growth (shoot height mostly 2 ft or less). Perennial pepperweed is the only widely occurring plant with high vigor along new levee slopes, where it is apparently spreading in the absence of competition. Its abundance was greatest in disturbed benches (elevations raised by deposition of excavated sediment) between the new levee and borrow and drainage ditch, where drainage and elevation were relatively higher, and soil and leaf litter were disturbed (exposing mineral soil favorable for seedling establishment of perennial pepperweed). It was often associated with gumplant, but was always much more extensive and abundant than gumplant.

Perennial pepperweed has a very distinct signature in aerial photographs taken during the growing season (spring-summer), especially color infrared or color photos in spring when it is in flower. No color aerial photographs of Point Buckler Island prior to 2014 exhibited vegetation pattern or color signatures consistent with extensive or dominant populations of perennnial pepperweed in the island's interior marsh, or on levees or marsh edges (see Appendix A). Aerial photographs exhibiting dense

accumulations of standing leaf litter in areas mapped by CDFW/CDWR as dominated by *Schoenoplectus* spp. (tule/bulrush) or cattail indicate a very low potential for perennial pepperweed. Perennial pepperweed was not found to be frequent or abundant in any of the fringing tidal marshes around the island (outboard of the new levees) on March 2, 2016. The rapid and extensive spread of perennial pepperweed on Point Buckler island appears to be associated causally with widespread marsh drainage and disturbance, consistent with factors known to facilitate its invasion (Reynolds and Boyer 2010).

Table L-1. Live Plant Species Observed at Point Buckler on March 2, 2016

Plant species	Wetland Indicator status	Tidal fringing marsh – (sub-habitats)	Interior diked wetland	Perimeter ditch bed & bank	New perimeter levee	Old levee remnant (E)
**Achillea millefolium*[1]	FACU *marsh*]	-	R	-	-	-
Artemisia douglasiana	FAC	R (high marsh below levee toe)	-	-	-	-
Ambrosia psilostachya	FACU	R (*cln* - high marsh below levee toe)	-	-	R (high marsh to levee toe)	-
Atriplex prostrata	FACW	O (drift-line)	+	-	+	-
Baccharis glutinosa	FACW	O (high marsh)				
Baccharis pilularis		-	-	-	-	C, LD
Chenopodium chenopodioides	FACW	-	LA (seedling only)	-	-	-
Cotula coronopifolia	OBL	+	+	-	+	-
**Deschampsia cespitosa* subsp. *beringensis*[4]	FACW*	C (wave-scoured peat, marsh turf)	-	-	-	-
Distichlis spicata	FAC	O	O	-	-	-
Elymus triticoides[3]	FAC	R (high marsh below levee toe)	LD (ditch top of bank, linear colonies)	[see interior diked wetland]	[see tidal fringing marsh]	LA (east end)
Euthamia occidentalis	FACW	O (high marsh)	-	-	-	-
Frankenia salina	FACW	O	+	-	-	-
Grindelia x paludicola	FACW	O (high marsh)	C	-	-	-
Hydrocotyle ranunculoides	OBL	R – LA (drift deposited)	-	-	-	-
Isolepis cernua	OBL	C/LD (wave-scoured peat, marsh turf)	-	-	-	-
Jaumea carnosa	OBL	O, LA (high marsh)	-	O, LA (top ditch bank only)	R (outboard slope toe)	-
Juncus balticus	FACW	C /LD	O/LD	-	-	-
Lepidium latifolium	FAC	O	VC/LD	-	C (toe, slope)	-
Lilaeopsis masonii	OBL	C/LD (wave-scoured peat, marsh turf)	-	-	-	-
Myriophyllum spicatum	OBL	-	-	R (*dep* - North ditch	-	-

Plant species	Wetland Indicator status	Tidal fringing marsh – (sub-habitats)	Interior diked wetland	Perimeter ditch bed & bank	New perimeter levee	Old levee remnant (E)
Phragmites australis	C-LA	C-LA	C – *dep.*	-	R – LD	-
Poaceae *(grass family)* unidentified annual grass juveniles			R, LA – relict channel bank crest			
Rosa californica	FAC	R, LA (southwest)	-	-	-	C, LD
Ruppia maritima	OBL	-	(C-ditch) LC	-	-	-
Sarcocornia pacifica	OBL	O	O, LA	-	-	-
Schoenoplectus acutus	OBL	VC-LD	[+, *dep*.]	-	-	-
Schoenoplectus americanus	OBL	VC-LD	[+, *dep*.]	-	-	-
Sonchus oleraceus	UPL	R	C	-	-	-
Spartina alterniflora x foliosa	OBL	R	-	-	-	-
Stachys albens	OBL	R	-	-	-	-
Triglochin concinna	OBL	+	-	-	-	-
Typha sp. *(T. latifolia* frequent*)*	OBL	C-LA	[+, *dep*.]	-	-	-

Distribution, rank abundance, and rank frequency of populations within landscape units. (Not reporting species of dead vegetation, relict standing litter):

FREQUENCY RANKS

R - rare (single or <5 localities)
O - occasional (fewer than 10 localities detected)
C – common (widespread in vegetation type, >>10 localities)
VC – very common (present in most of vegetation type)
LC – locally common (common within occasional patches)
+ present, frequency low but not discriminated between O or R
- Not observed

ABUNDANCE RANKS

S – Sparse (low density/low percentage cover) < 1% general
A – Abundant (high cover or biomass) > 5% - 20% general
LA – Locally abundant (patch high cover/biomass) >20% local (<100 m^2)
D – Dominant to co-dominant (extensive majority of cover or biomass) >30% general within stratum
LD- Locally Dominant (patch dominance) >30% local (<100 m^2) within stratum
Cln - clonal spread from adjacent vegetation
dep. – depauperate specimen(s) (moribund, stunted)
Sub-habitats within landscape units are noted in parentheses (high marsh, drift-line, levee toe, wave-scoured peat)
Notes: Wetland Indicator Status - source: USACE Arid West Wetland Plant List 2014
1 – Achillea millefolium: Arid West list does not account for distinct wetland (brackish marsh) ecotypes of this species in the San Francisco Estuary
2 –*Elymus triticoides* – Arid West manual retains genus Leymus for this species; differs from The Jepson Manual 2nd ed.
3 – *Grindelia* x*paludicola* - Apparently included within *G. stricta* in Arid West wetland plant list
4 – *Deschampsia cespitosa* – distinct subspecies are not recognized in Arid West manual; listed with alternate spelling *D. caespitosa*. In Suisun Marsh and the California coast, subspecies *beringensis* in fact occurs only in wetlands, as explicitly indicated in its habitat description of the Jepson Manual 2nd edition.

* Arid West Manual indicator status does not reflect subspecies or variety rank in The Jepson Manual 2nd ed.; local taxa or ecotypes differ from species in frequency occurring in wetlands in San Francisco Estuary.

L-3.3 Soils and Groundwater

The island's interior soils were investigated by surface observations and excavation of pits to depths below contact with shallow groundwater on March 2, 2016. All interior island marsh surfaces, other than excavated crescent basins, were drained and free of standing water. Near-surface soil saturation was observed in low-relief depressions along the central pathway of vehicle tracks, but even these areas supported a film of rusty-red iron oxide films and very white fine evaporated crystals (salty, but possibly containing precipitated calcium sulfate [gypsum] in addition to sea salts) on matted leaf litter. The presence of oxidized iron and fine capillary evaporite deposits on leaf litter (Appendix R photo R-19) indicates that surface exposure to air in late winter was prolonged (weeks) rather than recent (days).

Groundwater depth and salinity, pH – Eleven test pits up to 2 ft deep clustered at four locations were dug on the interior marsh plain. They filled with groundwater either slowly (seepage from pit walls) or very rapidly (piping through soil through channels formed by old tule roots), reaching stable groundwater surface positions after about 5-20 minutes. Salinity, dissolved oxygen, and pH measurements were performed by Regional Water Quality Control Board staff with a YSI 6600 multi-parameter sonde. The YSI 6600 was calibrated 3 times: the day before measurements, at the beginning of the day of measurements, and the day after measurements were taken (RWQCB 2016). Preliminary (refractometer) measurements of salinity were performed by Siegel Environmental crews.

Groundwater salinities were consistently highly elevated relative to adjacent tidal waters, and relative to even typical summer salinity ranges in Suisun Marsh tidal channels. Table L-2 shows groundwater salinities. Salinities ranged from to 15.1 to 19.0 parts per thousand (ppt) in the groundwater test pits. In contrast, open tidal bay salinity adjacent to the island (measured as reference on the same day) ranged from 3.2-3.4 ppt. Groundwater salinity exceeded that of the interior perimeter ditch water salinity (8.2-13.5 ppt) and the interior relict tidal channel (13.2-14.0 ppt), which are subject to dilution in the winter (from rainfall and tidal overtopping of levees), as well as evaporation and concentration. For comparison, this observed late *winter* range of marsh groundwater salinity is approximately twice the typical maximum *summer* salinity (season of evaporative salt concentration) of tidal waters in central Suisun Marsh. Salinity in the range of 20-30 ppt is more typical of the annual maxima of tidal waters in San Pablo Bay and San Francisco Bay in summer, rather than Suisun Marsh in winter. Marsh soil porewater salinity in the 20-30 ppt (polyhaline) range is associated with pickleweed-saltgrass-cordgrass salt marsh vegetation or (closer to 20 ppt) pickleweed-alkali bulrush brackish marsh vegetation in the San Francisco Estuary (Baye *et al*. 2000).

The observed elevated groundwater salinity within Point Buckler would be expected from cumulative evaporation in the absence of both tidal flushing and non-tidal managed flooding and drainage. Elevated marsh soil groundwater salinity would *not* be expected if the club's water management had included a

typical Suisun Marsh managed wetland flood-up and drainage cycle to flush accumulated soil salts from the previous summer(s), a management operation which is typically performed in late January to early February each year (USBR et al. 2011). The 1984 Club 801 management plan prescribed flood-drain water management for alkali-bulrush, which requires spring flood-drain cycles within 30 days to minimize soil salt accumulation, and fall flooding to suppress the survival of mowed tules and for open water habitat maintenance. Adjacent Simmons Island managed marshes on March 2, 2016 supported tall, green growth of cattail, tule and reed vegetation – species intolerant of a sustained salinity range of 20-30 ppt.

Groundwater surface elevations ranged from 3.54 ft to 4.39 ft NAVD88 on the March 2, 2016 site visit. Surface water elevations in the new borrow and drainage ditch was 3.29 ft NAVD88 on March 2, 2016. Thus, interior groundwater surface elevations ranged from 0.25 ft to 1.10 ft above the new borrow and drainage ditch elevations, indicating drainage from the interior marsh to the perimeter ditch. Groundwater surface elevations were 0.85 to 1.54 ft below ground surface on March 2, 2016 (Figure L-3).

Low groundwater elevations in winter are anomalous for Suisun non-tidal (managed) marshes and tidal marshes alike. The representative soil series description for Joice Muck, the soil type mapped in the center of the island (Figure H-4), states that groundwater typically occurs *at or above the soil surface in winter*, and *less than 30 inches below the surface in mid-summer*, depending on the drainage operation of tide gates (SCS 1977: 33). Groundwater depths below the ground surface observed *in late winter* instead were in the range of *mid-summer* depths, when tide gates are operated to drain marshes. Thus, for the marsh soil type even under tide gate operation, the island appears to have excessively low groundwater.

Table L-2. Salinity Readings at Point Buckler Island on March 2, 2016

Sample Location	Salinity (parts per thousand) by Sample Depth	
	Near Surface	At Depth
Interior Sample Locations		
Ground-water[1]	15.1 - 19.0	
Crescent Basins[2]	12.9 - 13.5	13.0 - 17.2
Perimeter Borrow Ditch[3]	8.2 - 12.9	12.8 - 13.5
Gate Interior (Inboard of Gate)[4]	12.5	12.6
Interior [formerly tidal] channel[5]	13.2	13.5 - 14.0
Exterior Sample Locations		
Tidal Slough (Outboard of Gate)[6]	7.0	10.8
Mouth of Channel[7]	4.6	6.5
Open Bay[8]	3.2 - 3.4	3.2 - 3.3

Source: Regional Water Quality Control Board, Point Buckler Inspection Report, April 19, 2016.

Notes on sample locations (see locations in Figure L-4):

1) *Sampled at five soil test pits, see locations in Figure L-3*

2) *Sampled at all four crescent basins*
3) *Sampled at multiple locations in new borrow and drainage ditch*
4) *Sampled within a few feet of the interior side of the water control structure (tide gate)*
5) *Sampled*
6) *Sampled within a few feet of the exterior side of the water control structure (tide gate)*
7) *Sampled at the mouth of the short tidal channel that connects the tide gate to the open bay*
8) *Sampled offshore in open bay waters from boat*

Perimeter borrow and drainage ditch water quality and salinity gradients relative to exterior tidal waters. Interior now-diked marsh drainage into the perimeter ditch appears to result in a relatively long residence time for drainage water in the ditch compared with tidal channel waters outside the site. This residence time is sufficient to allow phytoplankton densities to achieve high turbidity (cloudiness) and a conspicuous olive green "pea soup" [chlorophyll] appearance (Appendix R photos R-8 e-f, R-16b, R-21e) even in late winter. A long residence time is also indicated by significantly elevated salinity in the ditch relative to open estuarine bay water, and vertical stratification of salinity (low mixing) in the ditch (Table L-1).[14] Surface water salinity in the new borrow and drainage ditch ranged from 8.2 to 12.9 ppt near the water surface to 12.8-13.5 ppt in deeper ditch waters. These elevated salinity concentrations are biologically significant when compared to the salinity of waters in the adjacent open bay, measured at 3.2-3.4 ppt. The turbidity of water of non-tidal brackish ditches, maintained by (green algae) phytoplankton in water with long residence times, contrasts with the unstable tan-gray turbidity of resuspended bay mud (fine clay-silt mineral sediment, oxidized colors) in tidal water, maintained by turbulence of wind-waves and tidal currents (see Appendix S).

The elevated salinity of perimeter ditch drainage water is likely due in part to the evaporative concentration of salts in ditch waters with long residence times, as well as subsurface seepage inflows from interior marsh groundwater, which had highly elevated salinities of 15.1 to 19.0 ppt.

Interior marsh drainage water discharges from the water control structure are evidently associated with a localized salinity gradient (Table L-1). Ditch water salinity at the interior of the gate was measured at 12.5 ppt near the surface and 12.6 ppt at depth (sample location T2, Figure L-4), while the exterior tidal channel connecting to the gate exhibited salinity at low tide ranging from 7.0 near the surface to 10.8 ppt at depth immediately below the point of discharge (sample location T1, Figure L-4). Salinity at the mouth of the channel open to the bay was diluted to 4.6 ppt near the surface to 6.5 ppt at depth (sample location T3, Figure L-4), but was evidently still stratified and substantially higher than the open bay salinity (sample location SB-1, Figure L-4) of 3.2-3.4 ppt. This indicates that higher salinity discharges from the ditches are incompletely diluted and mixed even at the tidal channel mouth at low tide in late winter, when salt concentrations of ditch water are expected to be significantly lower than in the summer peak evaporation season.

[14] When waters are stratified (layered) by salinity, saltier (higher density) waters sink to the bottom, while fresher (lower density) waters float to the top.

Perimeter borrow and drainage ditch bank iron oxide films. Observation of the banks of the new perimeter borrow and drainage ditch on March 2, 2016 revealed dry soil in the upper half of the unvegetated, bare vertical bank, and a mix of moist to saturated soil surfaces in the lower half of the bank. The moist to saturated bank soils were gray, consistent with clay subsoils of the Joice Muck series. The upper half of the bank soil surface exhibited red-brown iron oxide staining, indicative of iron sulfide-enriched soils persistently exposed to aerobic (oxidizing) environments associated with drainage and exposure to the air, resulting in the production of iron oxide and acid sulfates (Appendix R photo R-21).[15] The strongest rust color was associated with the exposure of concentrated zones of plant roots, which supply organic matter (carbon) to fuel the microbial reduction of iron sulfide when soils are saturated and anaerobic, and where oxygen diffusion occurs through porous root tissues during and prior to drainage. The production of iron sulfide, and its oxidation to iron oxide and acid sulfates (soil acidification) upon drainage is a characteristic feature of Joice Muck soil series (SCS 1977; Appendix R photo R-22), and is a global problem of soil and ecological degradation where sulfidic estuarine marsh soils are subject to reclamation and drainage (Cook et al. 2000, Smith and Melville 2004).

L-3.4 Surface Water and Soils in Excavated Crescent Basins

There were four C-shaped crescent basins excavated along the central axis of the island in January 2015 (Table K-1), some of which had duck decoys floating or beached on the shore. The water surfaces were low relative to the top of excavated banks, exposing a vertical drawdown zone of barren (unvegetated) bank for approximately 1-2 ft. The banks exhibited iron oxide films, indicating the oxidation of iron sulfide (Appendix R photo R-20).[16] The color of the water in the crescent basins ranged from brown to black with plumes of cloudy white suspended materials (Appendix R photos R-20 g-i). Black water appeared to be due to suspended iron sulfide sediment, indicated by very strong sulfidic odors detectible at a distance as well as upon direct sampling. White suspended plumes were likely sulfur-reducing bacteria. Brown water was likely due to suspended iron oxide-containing fine sediment and organic matter, commonly observed in managed Suisun Marsh ditches along Grizzly Island Road and Simmons Island levee roads (Appendix R photo R-22). Crescent basin salinities ranged from 12.9-17.2 ppt (Table L-2), indicating elevated salinity that is excessive for winter conditions in Suisun Marsh managed wetlands. There are no drainage outlets to enable salts to be drained or flushed except via slow infiltration through fine-grained soils. The very small channels (which were tidal channels before the new levee construction) have very shallow inverts relative to the basin inverts, so do not serve a drainage function. Daytime sampling, during active phytoplankton and cyanobacterial mat photosynthesis (generation of oxygen), precluded sampling of night-time minimum dissolved oxygen levels in the water column (when phytoplankton and cyanobacteria consume oxygen). The presence of jet-black iron sulfide sediments on the beds of two crescent basins indicated a high potential for strong oxygen sinks, and abrupt declines in near-bed dissolved oxygen concentrations.

[15] In waterlogged/saturated marsh soils, the low/absent levels of dissolved oxygen (anaerobic conditions) force certain microbes to use sulfur as an electron receptor, resulting in the formation of black iron sulfides. When these soils are drained and exposed to air, the iron sulfides oxidize and turn into iron oxides (rust). This conversion of iron sulfide to iron oxide also releases sulfuric acid, which increase the acidity (lowers pH) of the surrounding soils and waters.

[16] The iron sulfides originally formed during higher water stands, when soils were waterlogged and anaerobic.

The 1984 Club 801 management plan (SCS 1984) prescription for maintaining waterfowl-attractive open pond areas did not recommend excavation of undrained depressions in the marsh plain, or cessation of flood-drain cycles in fall, winter, and spring. The 1984 management plan recommended mowing tall emergent marsh followed by flooding – a sequence of events that effectively "drowns" and inhibits regeneration of tules and cattails.

L-4.0 Summary and Conclusions

Point Buckler Island exhibits strong and conspicuous evidence of exceptionally prolonged drainage, and an absence of seasonal managed flooding schedules typical of Suisun Marsh managed wetlands and prescribed in the 1984 management plan for the property. Drainage appears to be perennial, cumulative, and ecologically significant. It is causally associated with mass dieback of obligate wetland plants (tule-cattail-bulrush). Tule-bulrush marsh was documented to dominate the lower marsh on the island since as recently as 2003, and tule-bulrush-cattail-reed dominated marsh was mapped over almost the entire island from 2000-2012. Conversion of that vegetation to standing dead litter, associated with the rapid invasion of broadleaf wetland weeds, upland weeds, and native high marsh plants, is strong direct evidence that drainage has taken place and shifted the island vegetation to an alternate state away from wetlands and toward non-wetlands. The marsh drainage trends appear to be persistent and progressive: despite a return to average winter rainfall in the 2015-2016 winter after four years of drought, upland weeds, as well as native and non-native high and transition zone plants, overwintered and grew to pre-flowering stages among dead former tule-bulrush-cattail marsh vegetation. Observed March 2, 2016 highly elevated winter groundwater salinity, and exceptionally depressed groundwater elevations for the time of year, are consistent with permanent marsh drainage and lack of salt leaching from managed flood-drain cycles. Drainage ditches with low water levels relative to the interior marsh surface and groundwater levels appear to maintain permanent positive drainage of the marsh plain to the new perimeter borrow and drainage ditch. Turbid, green water with significantly elevated salinity in winter in the new borrow and drainage ditch indicates a lack of periodic flood-drain management or episodic tidal flows that would otherwise flush salts and microalgae from the ditches. Iron oxide films on the upper ditch banks also indicate prolonged low water levels in the ditches.

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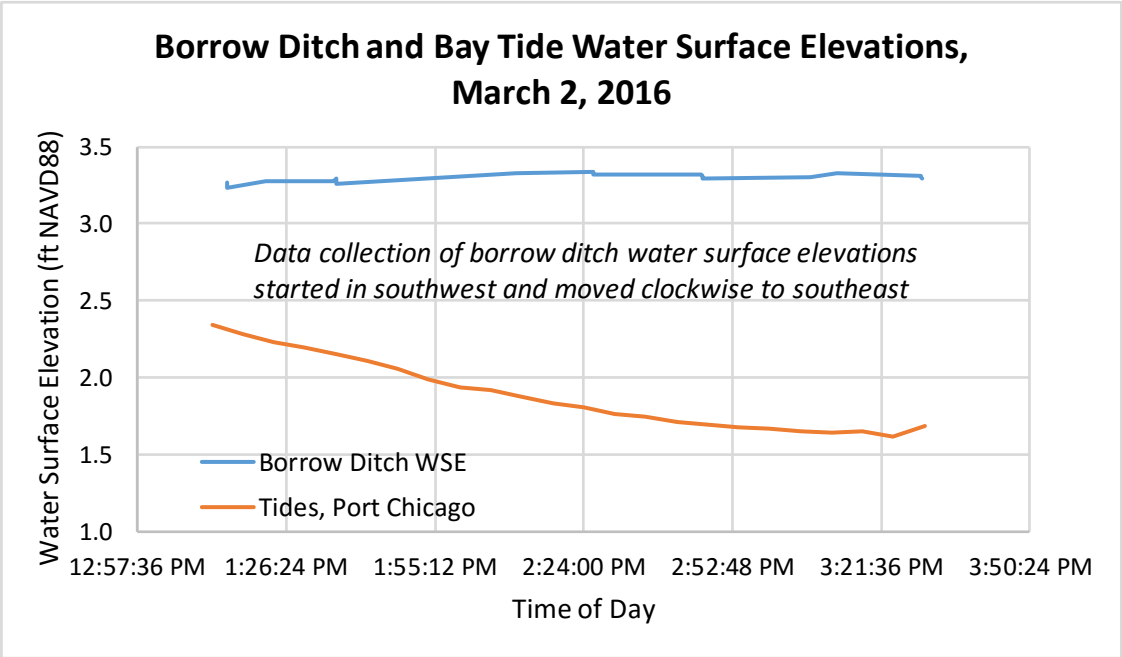


Figure L-1. Borrow and Drainage Ditch and Bay Tide Water Surface Elevations, March 2, 2016

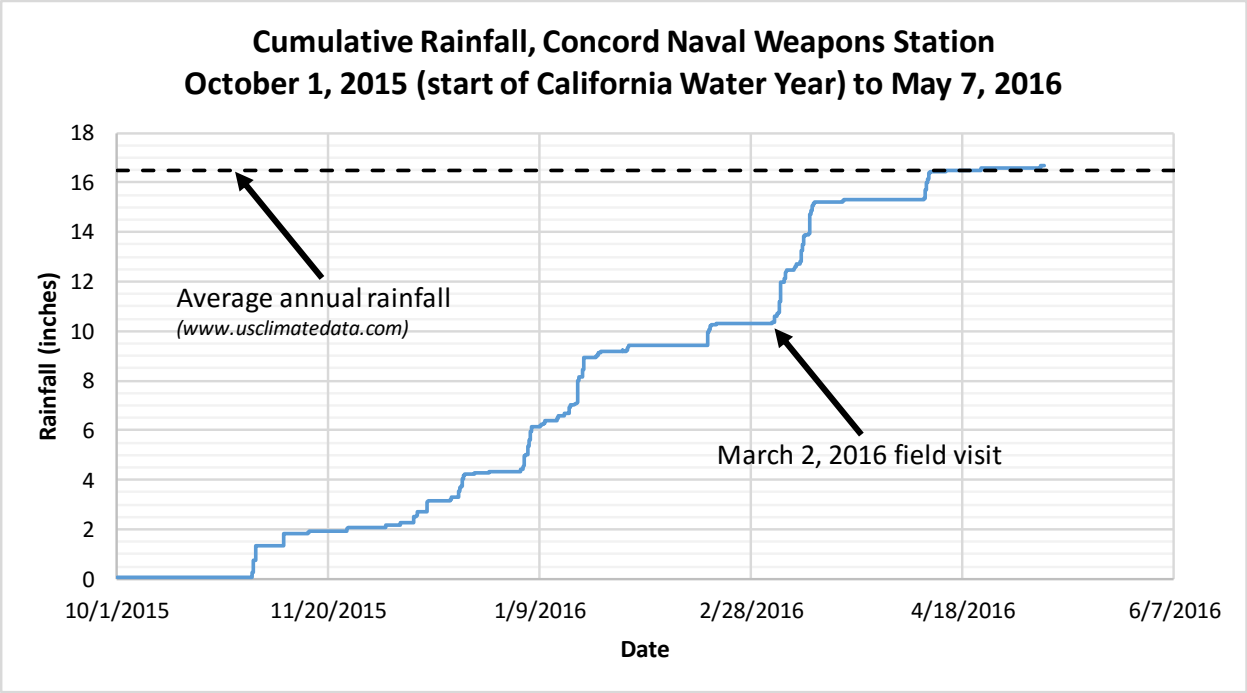
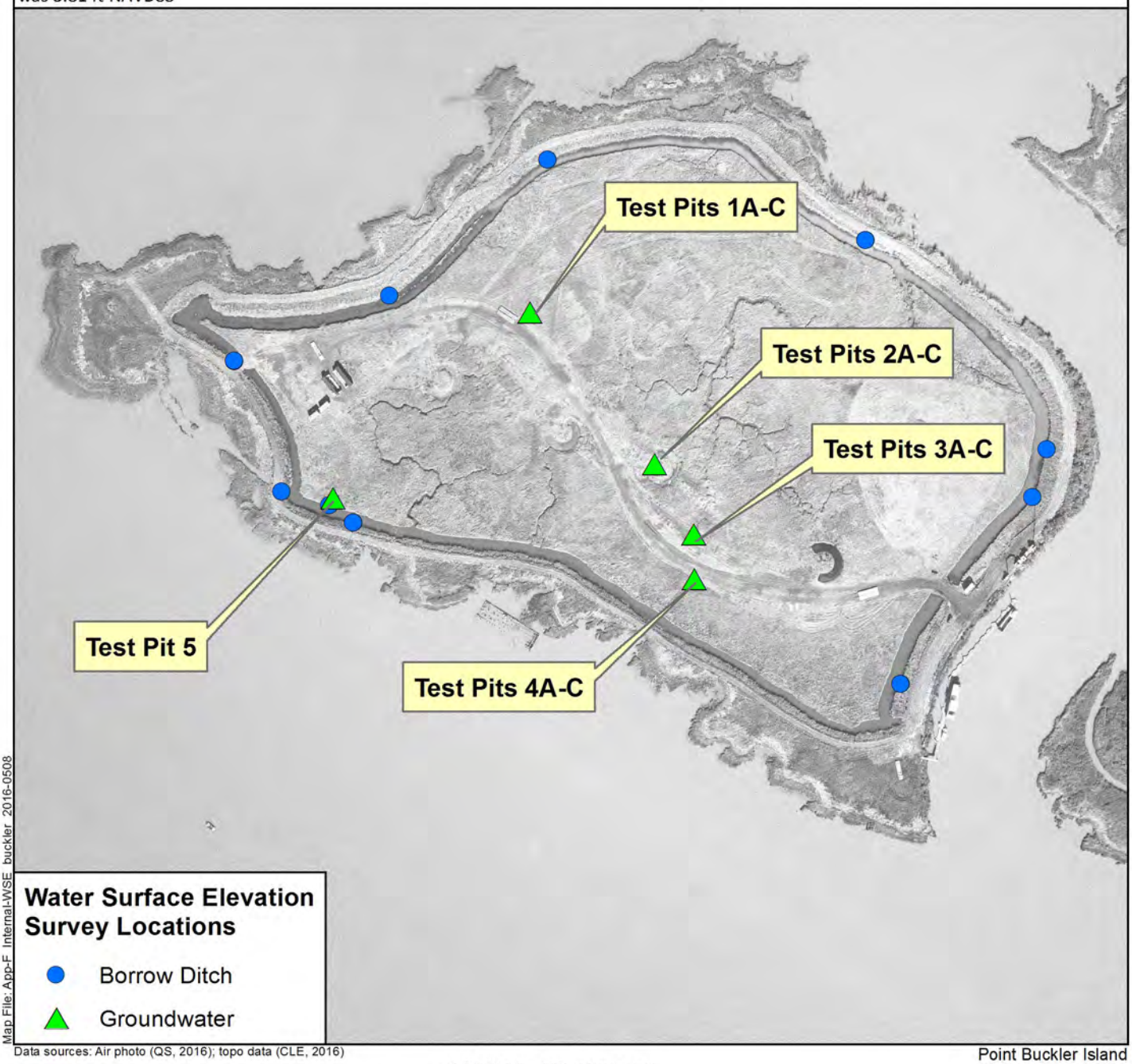


Figure L-2. Winter 2015-2016 Rainfall, Nearby Concord Naval Weapons Station
Source: California Data Exchange Center, Station WSF, accessed 5/7/2016

Water Surface Elevation Statistics	Borrow Ditch	Test Pits 1A-C[1]	Test Pits 2A-C[1]	Test Pits 3A-C[1]	Test Pits 4A-C[1]	Test Pit 5[2]
Avg Elevation (ft NAVD88)	**3.29**	**4.05**	**3.54**	**3.58**	**4.39**	**4.30**
Min Elevation (ft NAVD88)	3.16	3.93	3.46	3.41	4.37	4.30
Max Elevation (ft NAVD88)	3.33	4.15	3.64	3.86	4.43	4.30
St. Deviation (ft)	0.04	0.11	0.09	0.24	0.03	--
Number of Measurements	19	3	3	3	3	1
Avg Ground Surface Elevation (ft NAVD88)	--	5.32	5.09	4.43	5.35	5.54

[1]Groundwater levels allowed to stabilize for over 1 hour before surveying - elevation reported is water surface

[2]Groundwater levels did not stabilize - elevation reported is top of saturated soil zone, water surface elevation in pit at time of survey was 3.81 ft NAVD88



Map File: App-F_Internal-WSE_buckler_2016-0508

Data sources: Air photo (QS, 2016); topo data (CLE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure L-3

March 2, 2016 Water Surface Elevation Locations and Data

Base air photo: (Quantum Spatial) February 10, 2016

Exhibit B - Water Quality Measurements: Methods and Observations
Point Buckler Island, March 2, 2016

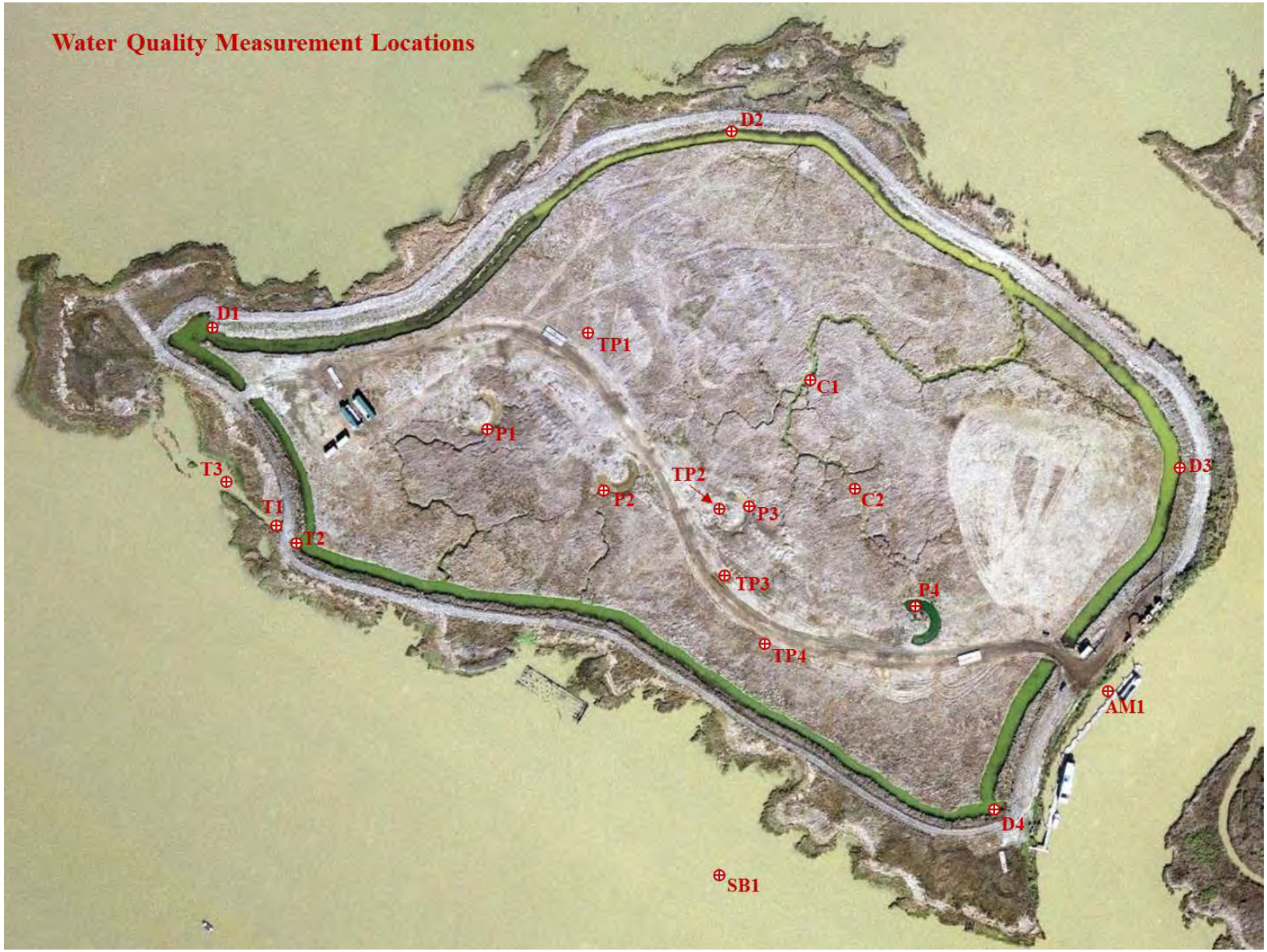


Figure B1. Map of Point Buckler Island identifying where water quality measurements were taken on March 2, 2016.
The base map is a natural color, aerial photograph captured by Quantum Spatial (https://quantumspatial.com/) on February 10, 2016.

Source: Regional Water Quality Control Board,
April 19, 2016 Inspection Report

Figure L-4. Water Quality Sample Locations

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Appendix M Jurisdiction: McAteer-Petris Act and Suisun Marsh Preservation Act

M-1.0 Introduction

The San Francisco Bay Conservation and Development Commission (BCDC) has jurisdiction at Point Buckler under two statutes: the McAteer-Petris Act and the Suisun Marsh Preservation Act. This appendix delineates the extent of each of these jurisdictions and delineates the location and extent of unpermitted activities that have taken place within these jurisdictions.

M-2.0 Method of Determining Jurisdictional Extent

Three data sources were used to establish jurisdictional extents: (1) land surface elevations as determined by the March 2, 2016 topographic survey (Appendix E, Appendix F), (2) tidal datums (Appendix I), and (3) the location of the terrestrial portion of the remnant levee as mapped by the 2012 CDFW vegetation data set (Figure H-2). Table M-1 shows the elevation ranges applied to these jurisdictions.

M-3.0 McAteer-Petris Act

M-3.1 Geographic Extent and Types of Jurisdiction

The McAteer-Petris Act establishes the BCDC "bay" jurisdiction to include "all sloughs, and specifically, the **marshlands** lying between mean high tide and five feet above mean sea level; **tidelands** (land lying between mean high tide and mean low tide); and **submerged lands** (land lying below mean low tide)" (emphasis added) (California Government Code §66610(a)).

M-3.2 Regulated Activities

Within this jurisdictional area, the McAteer-Petris Act empowers BCDC "to issue or deny permits, after public hearings, for any proposed project that involves placing fill, extracting materials or **making any substantial change in use of any water, land or structure** within the area of the commission's jurisdiction" (California Government Code §66632) (emphasis added).

M-3.3 McAteer-Petris Act Jurisdiction Over Point Buckler: Regulated Geographic Areas and Unauthorized Activities

A total of 38.339 acres of Point Buckler Island are subject to McAteer-Petris Act jurisdiction (Figure M-1, Table M-1). For the purposes of this assessment, 0.538 acre of the eastern terrestrial remnant levee (see Appendix H) is assumed to be at elevations greater than five feet above mean sea level, or 8.66 ft NAVD88. In practice, it is likely that the eastern remnant levee was at elevations below that value. However, without adequate baseline data, we have proceeded with the stated assumption which is to the benefit of the property owner.

The activities at Point Buckler are a "substantial change in use", as they converted a tidal marsh into a diked area, have actively drained the newly diked marsh, and have installed facilities in support of an advertised kite surfing club[17]. These activities have substantially adversely impacted the functions of the property as a diked or tidal marsh (see Appendix Q).

Figure M-2 shows the unpermitted work activities undertaken between 2012 and 2016. Table M-2 presents the areas of these activities, separately for earthen fill (3.021 ac), structural fill (0.096 ac on tidelands/marshlands and 0.071 ac on submerged lands), excavation (2.925 ac), and excavation with subsequent fill (0.039 ac). The diking and draining of tidal marsh on Point Buckler has caused a substantial change in use of 29.739 acres of tidal marsh (Figure J-8).

M-4.0 Suisun Marsh Preservation Act

The Suisun Marsh Preservation Act (SMPA) of 1974 and the Suisun Marsh Protection Plan (SMPP) completed in 1976 and enacted by the Legislature into the SMPA in 1977 establishes a broad suite of land use policies and programs to preserve the integrity and assure continued wildlife use" of the Suisun Marsh. In Part II, "Findings and Policies: Environment" Finding 4 and "Land Use and Marsh Management" Finding 1, the SMPP states that: "Tidal marsh is an important habitat for many wildlife species, including the endangered salt marsh harvest mouse and the Suisun shrew. Tidal marshes also contribute to the maintenance of water quality in the SF Bay." "Land Use and Marsh Management" Policy 3 of the SMPP states that: "The tidal marshes in the primary management area should be preserved."

M-4.1 Geographic Extent and Types of Jurisdiction

The Suisun Marsh Preservation Act (SMPA) of 1974 and the Suisun Marsh Protection Plan (SMPP) certified in 1976 established two management areas within Suisun Marsh: the "Primary Management Area" of Suisun applies to all lands below the 10-foot NGVD29 contour, and the "Secondary Management Area" of Suisun Marsh applies to all lands above the 10-foot NGVD29 contour. The **primary management area means water-covered areas, tidal marsh, diked-off wetlands, seasonal marsh, and lowland grassland** specified on the map identified in Section 16 of that chapter of the Statutes of the 1977-78 Regular Session enacting this division (California Public Resources Code §29102).

The Legislature established joint land use policies for Suisun Marsh with adoption of the SMPA (California Public Resources Code §29008). The Legislature established that the Suisun Marsh Protection Plan is a more specific application of the general, regional policies of the San Francisco Bay Plan prepared under the McAteer-Petris Act and administered by BCDC, and is an appropriate supplement to those policies because of the unique characteristics of the policies of both the San Francisco Bay Plan and the Suisun Marsh. Therefore, the Legislature established that the appropriate policies of both the San Francisco Bay Plan and the Suisun Marsh Protection Plan shall apply within any area that is within

[17] https://www.facebook.com/pointbucklerclubvip

BCDC jurisdiction, and that is also within Suisun Marsh, except where the San Francisco Bay Plan and the Suisun Marsh Protection Plan may conflict. If a conflict occurs in a specific instance, the Legislature established that policies of the Suisun Marsh Protection Plan shall control.

M-4.2 Regulated Activities

Under the SMPA, BCDC regulates activities within the primary management zone and Solano County, following adoption of its Local Protection Program, regulates activities within the secondary management zone. Under the Suisun Marsh Preservation Act, a marsh development permit is required for development projects anywhere in the marsh (California Public Resources Code §29xxx). BCDC is required to issue a marsh development permit if it finds that the proposed project is consistent with either the provisions of the Suisun Marsh Preservation Act and the Suisan Marsh Protection Plan or the certified Local Protection Program.

"Development" in Suisun Marsh is defined as (California Public Resources Code §29114):

> (a) "Development" means on land, or in or under water, the **placement or erection of any solid material or structure**; **discharge or disposal of any dredged material** or of any gaseous, liquid, solid, or thermal waste; **grading, removing, dredging**, mining, or extraction of any materials; **change in the density or intensity of use of land**, including, but not limited to, subdivision pursuant to Subdivision Map Act (commencing with Section 66410 of the Government Code), and any other division of land including lot splits, except where the land division is brought about in connection with the purchase of such land by a public agency for public recreational use; change in the intensity of use of water or in access thereto; **construction, reconstruction, demolition, or alteration of the size of any structure**, including any facility of any private, public, or municipal utility; and the **removal or harvesting of major vegetation** other than for agricultural purposes.
>
> (b) "Development" does not include either a change in the intensity of use of water or the removal or harvesting of major vegetation where such change, removal, or harvesting is to maintain or improve wildfowl habitat and does not have a significant, adverse effect on other fish and wildlife resources in the marsh.

No marsh development permit is required for any development specified in the component of the local protection program prepared by the Suisun Resource Conservation District and certified by the Commission pursuant to Section 29415 (California Public Resources Code §29501.5). This provision applies to managed wetlands in Suisun Marsh with an approved Individual Management Plan (IMP) that remains in full force and effect.

M-4.3 Suisun Marsh Preservation Act Jurisdiction Over Point Buckler: Regulated Geographic Areas and Unauthorized Activities

Point Buckler is located within the Primary Management Area and thus is subject to BCDC regulatory oversight. A total of 38.877 acres of Point Buckler Island are subject to Suisun Marsh Preservation Act

jurisdiction (Figure M-1, Table M-1). Development of Individual Management Plans (IMPs) for all the privately owned duck clubs (diked managed wetlands) in Suisun Marsh was required under the SMPA (California Public Resources Code §29412.5). The Suisun Marsh Management Plan (SMMP), prepared by the Suisun Resource Conservation District and certified by BCDC in 1980 as part of the Solano County Local Protection Program for Suisun Marsh, incorporated the IMP requirement.

By the mid-1980s, the U.S. Soil Conservation Service had prepared IMPs for all of the roughly 150 privately owned duck clubs (diked managed wetlands) in Suisun Marsh, and BCDC had approved them. These IMPs allowed a duck club to carry out routine maintenance work (e.g., levee repairs, water control structure repairs) and wetland management activities (e.g., vegetation mowing, disking, burning) for the specific purpose of promoting desirable waterfowl habitats, without the need for further regulatory authorization from BCDC. Work activities beyond the scope authorized through each IMP required separate regulatory authorization from BCDC.

The SMPA defines managed wetlands as follows (California Public Resources Code § 29105, emphasis below added):

> Managed wetlands means those **diked areas in the marsh in which water inflow and outflow is artificially controlled or in which waterfowl food plants are cultivated, or both**, to enhance habitat conditions for waterfowl and other water-associated birds, wildlife, or fish, regardless of whether such areas are used for hunting or fishing or non-consumptive uses such as nature study, photography, and similar passive wildlife activities, or a combination of both such consumptive and non-consumptive uses.

Key to this managed wetland definition is the artificial control of water inflow and outflow. Both the IMPs and the Regional General Permits allow for maintenance and repair of levees and water control structures to allow for artificial control of water inflow and outflow. When such infrastructure no longer functions, water inflows and outflows cannot me managed, and the property is no longer a managed wetland. When failures occur to such infrastructure, land owners clearly have a reasonable amount of time to carry out repairs and continue operating as diked, managed wetlands. In the case of Point Buckler, 18 years had elapsed between the failure of the site's water control infrastructure in 1993 and property transfer in 2011, and another 3 years elapsed before the new levee was built in 2014. A 21-year lapse clearly extends well beyond "a reasonable amount of time" to carry out repairs. **Consequently, the Club 801 IMP was no longer applicable, the site was a tidal marsh, development activities at Point Buckler no longer were exempt from requiring a Marsh Development Permit from BCDC, all unpermitted activities since 2011 required BCDC authorization, and the SMPP land use policies applicable to the protection and preservation of tidal marshes are applicable.**

Figure M-2 shows the unpermitted work activities undertaken between 2012 and 2016. Table M-2 presents the areas of these activities, separately for earthen fill (3.113 ac), structural fill (0.168 ac), excavation (2.925 ac), and excavation with subsequent fill (0.039 ac).

Table M-1. Areas of BCDC Jurisdictions

Elevation Range	Area (ac)	Jurisdiction Type	
		McAteer-Petris Act	Suisun Marsh Preservation Act
5ft above mean sea level to ~12.6 ft NAVD88	0.538	None	Primary Management Area
Mean high water to 5ft above mean sea level	7.711	Marshlands	
Mean low water to mean high water	30.628	Tidelands	
Total area	**38.877**	**38.339 ac**	**38.877 ac**

Table M-2. Areas of Unpermitted Activities in BCDC Jurisdiction

Activity Type	Area (acres)
Earthen fill	
Tidelands and Marshlands (MPA)[1], Primary Management Area (SMPA)	3.021
Primary Management Area (SMPA)[2] only	0.092
Total Earthen Fill (MPA, SMPA)[2]	**3.113**
Structural fill	
Tidelands and Marshlands (MPA), Primary Management Area (SMPA)	0.096
Primary Management Area (SMPA) only	0.001
Submerged Lands (MPA), Primary Management Area (SMPA)	0.071
Total Structural Fill (MPA, SMPA)	**0.168**
Excavation	
Tidelands and Marshlands (MPA), Primary Management Area (SMPA)	2.925
Total Excavation (MPA, SMPA)	**2.925**
Excavation then fill	
Tidelands and Marshlands (MPA), Primary Management Area (SMPA)	0.039
Total Excavation then Fill (MPA, SMPA)	**0.039**
Substantial Change in Use	
Conversion of Tidelands and Marshlands to Diked Wetlands	29.739
Total Substantial Change in Use (MPA)	**29.739**

Notes:

1) *MPA = McAteer-Petris Act jurisdiction*
2) *SMPA = Suisun Marsh Preservation Act jurisdiction (primary management area for Point Buckler)*
3) *Inadequate data available to determine whether the remnant 1985 levee along the eastern edge of the island, which the 2012 CDFW vegetation map shows as supporting terrestrial vegetation, is marshlands or non-jurisdictional uplands.*

List of Figures

Figure M-1. Bay Conservation and Development Commission Jurisdiction, Pre-Alteration Conditions

Figure M-2. Unpermitted Activities within Bay Conservation and Development Commission Jurisdiction

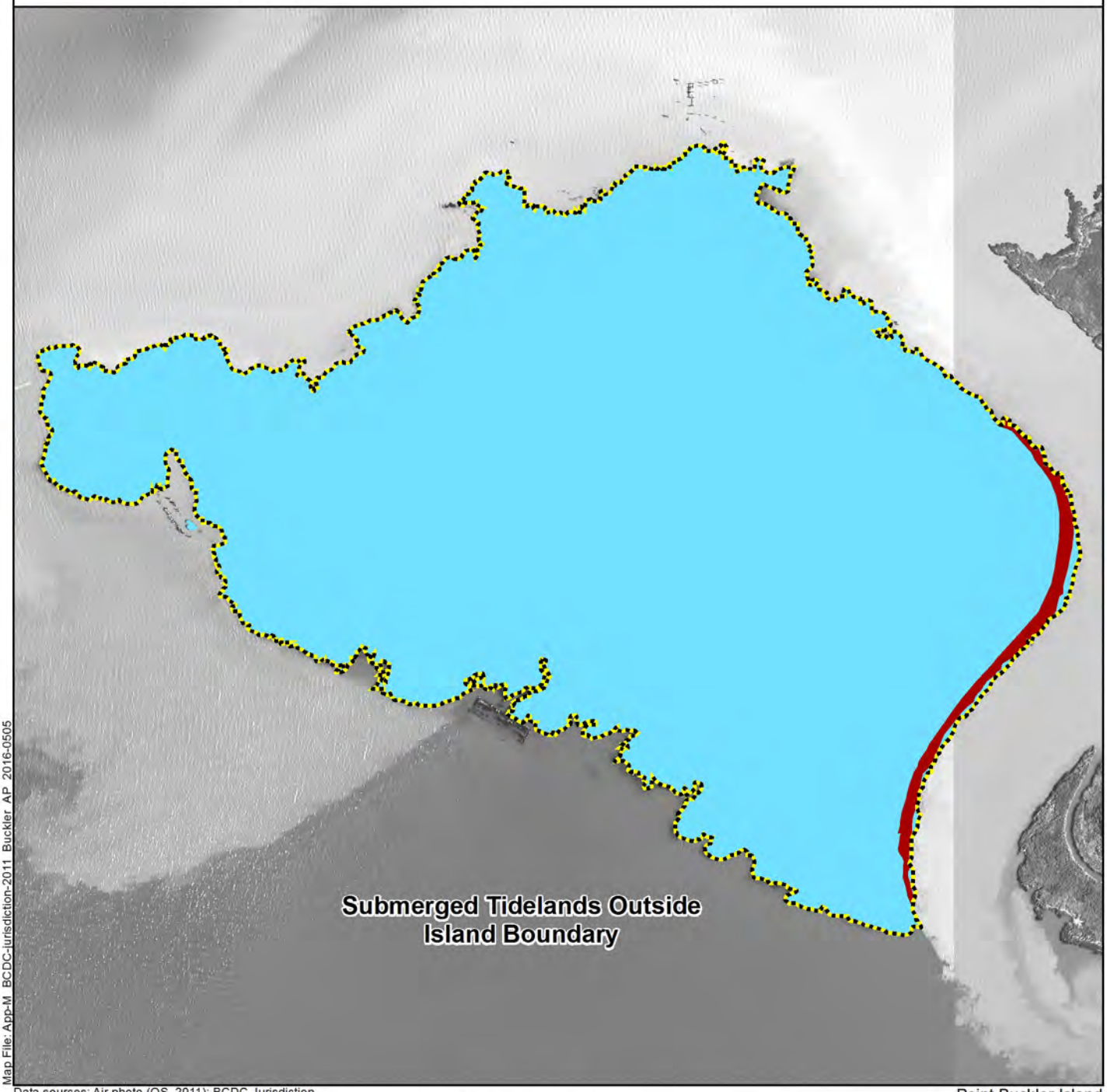
McAteer-Petris Act Jurisdiction

Tidelands (30.628 ac) and Marshlands (7.711 ac)
- Tidelands = lands between MLW and MHW.
- Marshlands = lands between MHW and 5 ft above MSL

Possible Non-Jurisdictional Terrestrial (0.538 ac)
- Lands that may have been > 5 ft above MSL.

Suisun Marsh Preservation Act Jurisdiction

SMPA Jurisdiction (entire island)
- All lands below 10 ft NGVD29 contour (~12.6 ft NAVD88)



Map File: App-M_BCDC-Jurisdiction-2011_Buckler_AP_2016-0505

Data sources: Air photo (QS, 2011); BCDC Jurisdiction (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure M-1

Bay Conservation and Development Commission Jurisdiction, 2011 Conditions

Base air photo: (Quantum Spatial) April 2011

Earthwork

Excavation

- Excavation in Tidelands/Marshlands[1] (2.925 ac)

Fill

- Fill in Tidelands/Marshlands[1] (3.021 ac)
- Fill in Terrestrial Lowlands[2] (0.092 ac)

Excavation then Fill

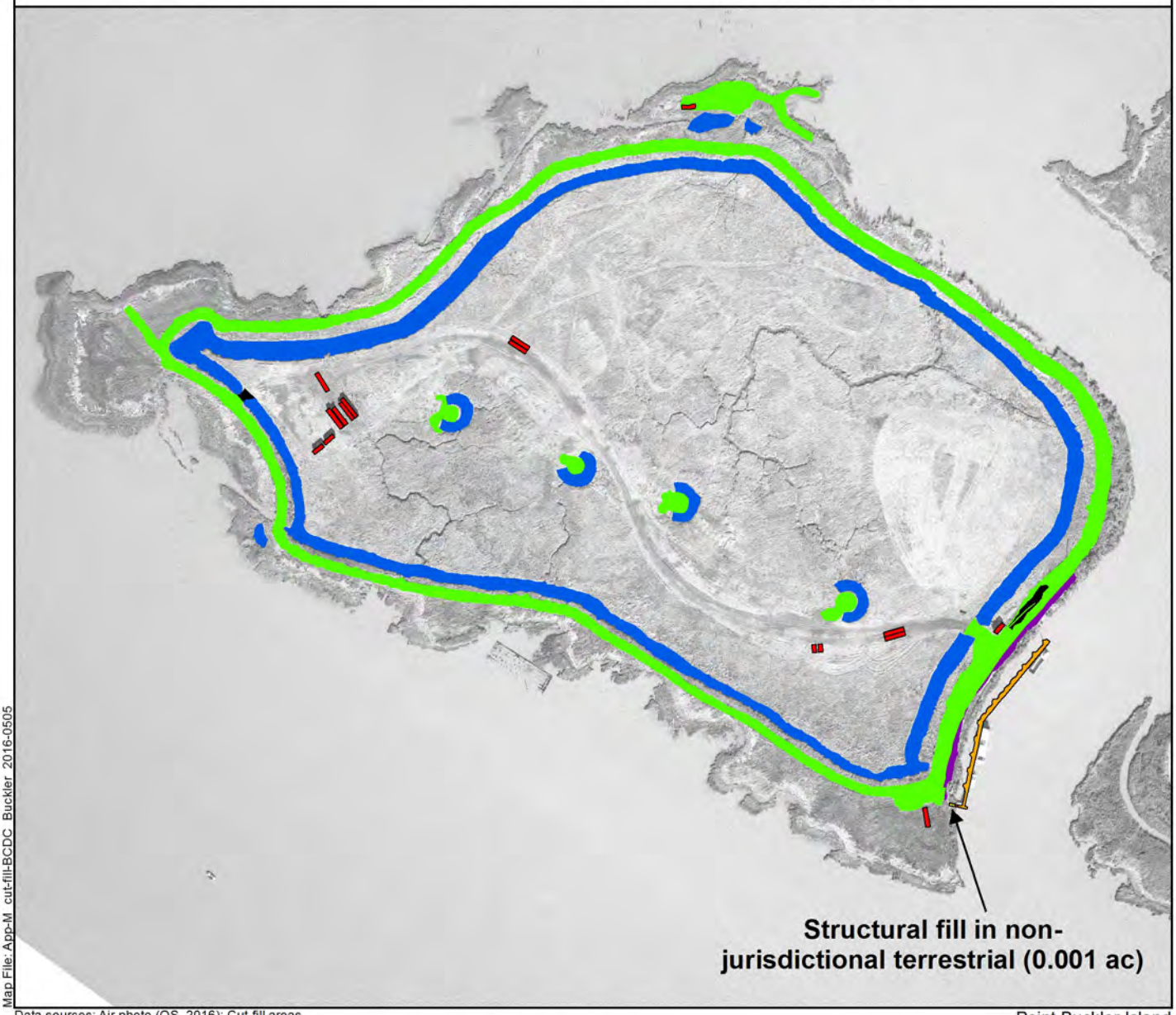
- Excavation then Fill in Tidelands/ Marshlands[1] (0.039 ac)

Structures

- Fill in Tidelands/Marshlands[1] (0.096 ac)
- Fill in Terrestrial Lowlands[2] (0.001 ac)
- Fill in Submerged Lands[1] (0.071 ac)

[1]Suisun Marsh Preservation Act Primary Management Area jurisdiction also applies to these areas of McAteer-Petris Act jurisdiction

[2]These terrestrial areas, all below 10ft NGVD29 (~12.6ft NAVD88) elevation, are within Suisun Marsh Preservation Act Primary Management Area jurisdiction but are not within McAteer-Petris Act jurisdiction



Map File: App-M cut-fill-BCDC Buckler 2016-0505

Data sources: Air photo (QS, 2016); Cut-fill areas (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure M-2

Base air photo: (Quantum Spatial) February 10, 2016

Unpermitted Activities within Bay Conservation and Development Commission Jurisdiction

Appendix N Jurisdiction: Rivers and Harbors Act Section 10 and Clean Water Act Section 404

N-1.0 Introduction

This appendix provides analysis of Clean Water Act Section 404 and Rivers and Harbors Act of 1899 Section 10 jurisdiction applied to Point Buckler Island. It addresses the scope of geographic jurisdiction at Point Buckler Island before and after the unpermitted construction activities, and impacts in jurisdictional areas associated with unauthorized levee construction, ditch excavation, discharge of dredged and fill material, construction and installation of structures, and other work and activities from 2012 to 2016. It also analyzes changes in jurisdiction that could potentially result from unauthorized activities that altered the hydrology and topography of the island.

N-2.0 Clean Water Act Jurisdiction

N-2.1 Section 404 Geographic Extent

Tidal waters (33 CFR §328.3(f)), including navigable waterbodies such as San Francisco Bay and its tidal tributaries and waterways, are definitively "waters of the United States" under Section 404 of the Clean Water Act (33 CFR §328.3). The vertical and horizontal boundaries of Clean Water Act jurisdiction in tidal estuaries are established by the elevation and position of the "high tide line" (33 CFR §§328.3(d)) (Figure N-1). The high tide line is defined as an empirical shoreline mark established by water fluctuations, indicated by physical shoreline characteristics including bank shelving (erosional scarps or benches), soil or substrate discontinuities, litter and debris deposits, destruction of shoreline terrestrial vegetation, "or other appropriate means" for the shoreline setting and context (33 §CFR 328.3(d)). Section 404 jurisdiction may include, but is not limited to, special aquatic sites such as "wetlands" (see Section N-2.4, below). The field and analytical methodology for the high tide line physical jurisdictional analysis in this report is presented in Appendix I. It was based on analysis of tides and water levels of a proximate tide gauge station, and measurement of site-specific field indicators of tidal litter and debris lines, erosional shelving, and discontinuities in vegetation and substrates.

N-2.2 Section 404 Regulated Activities

Section 404 regulates "discharges of dredged or fill material" into waters of the United States (33 CFR §323.1(d-e)). Fill material means any material used for the primary purpose of either replacing an aquatic area with dry land, or changing the bottom elevation of any waterbody. It generally includes the building of any structure or impoundment (dam, sill, weir, etc.) requiring earthen materials (sediment, soil, rock) for construction, development fills for <u>recreational</u>, industrial, <u>commercial</u>, residential, <u>or other</u> uses; <u>dams, dikes or levees</u>, artificial islands, beach nourishment, or shoreline armoring (33 CFR §323.1(f), emphasis added).

N-2.3 Section 404 Relevant Exemptions and Their Limitations

Dredged and fill material does not include earthen discharges from cultivation of food or fiber production in established, ongoing, normal agriculture, or from established, normal, ongoing forestry; bringing an area into agriculture or forestry (or bringing it into cultivation after a fallow period that is not part of an established operation) does not exempt otherwise regulated 404 discharges (33 CFR §323.4(a)(1)). Similarly, if an agricultural land has been idle or fallow so long that modifications to the hydrological regime are necessary to resume operations, it is not subject to exemptions under Section 404. Section 404-regulated dredged material also does not include "*de minimus*" incidental soil movement during "normal" dredging (33 CFR §323.1(d)).

Discharges that are otherwise regulated under Section 404 may be exempt from regulation if they are "maintenance" of currently serviceable structures such as dikes, dams, levees, groins, riprap, etc. If a structure is not "currently serviceable" (not performing basic functions; requiring reconstruction or rehabilitation or repair to achieve function), it is not subject to exemption under Section 404, but "emergency reconstruction of recently damaged parts" (after a "reasonable amount of time", normally no more than 1 year after emergency damage) is included in the scope of the exemption. Exempt maintenance does not include any modification that changes the character, scope, or size of the original fill design (33 CFR §324(a)(2)).

The general limitation for Section 404 exemptions is that any discharges incidental to them are regulated if they are part of an activity that would convert Section 404 jurisdictional areas to new land uses, where the flow, circulation, or reach of Section 404 waters would be reduced. A conversion of Section 404 wetlands to non-wetlands (or waters to non-waters of the U.S.) is a non-exempt "change in use" that recaptures Section 404 jurisdiction from exemption (33 CFR §323.4(c)).

N-2.4 Special Aquatic Sites

Some areas within Section 404 jurisdiction have special legal status as "special aquatic sites" (40 CFR §230.3(q-l), 40 CFR §230.10(a)(3)), including "wetlands" (40 CFR §230.4(t)). Wetlands are defined in regulation and in technical manuals approved by EPA and USACE[18]. By definition, wetlands are vegetated by plants typically adapted for life in saturated soil conditions, and are saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of wetland plants under normal circumstances. "Normal circumstances" do not include unauthorized, non-exempt, regulated activities that change wetland hydrology, soils, or vegetation or bring an area into new land uses, including drainage or conversion to non-wetlands. The presence of special aquatic sites affects the evaluation procedures under the Section 404(b)(1) permit guidelines.

[18] 1987 Corps of Engineers Wetland Delineation Manual, 2006 Corps of Engineers Arid West Supplement.

N-2.5 Section 404 Jurisdiction Over Point Buckler Island: Regulated Geographic Areas and Unauthorized Activities

All areas on Point Buckler Island surfaces below the elevation of the High Tide Line (determined to be 8.2 ft NAVD88; Appendix I) subject to ebb and flow of the tide, including but not limited to wetlands, were under Clean Water Act Section 404 jurisdiction prior to completion of the unpermitted construction activities.

Clean Water Act Section 404 jurisdiction is established by hydrology in tidal or non-tidal diked, managed wetland conditions at Point Buckler Island. Section 404 jurisdiction at Point Buckler is generally bounded in normal circumstances by the High Tide Line in tidal conditions. Historically, Clean Water Act jurisdiction also existed at Point Buckler within bounds of Ordinary High Water lines (former normal circumstances of typical Suisun Marsh duck club flood-drain management) or wetland jurisdiction (3-parameter vegetation, soil, hydrology indicators).

During documented periods of levee reconstruction, rehabilitation and maintenance through the mid-1980s, when tides were excluded and the island interior was converted to non-tidal managed waterfowl marsh, the island interior covered with obligate wetland plants (tule and bulrush species), and periodically flooded as part of normal water management. The island marshes in that condition would meet contemporary Section 404 wetland criteria, even without tidal flows. Similarly, areas mapped by CDFW/CDWR as dominated by tule, cattail, or bulrush associations (obligate wetland plants) (Figure H-2) in soils mapped by SCS (Figure H-4) as Joice Muck (hydric soil) or Tidal Marsh (hydric soil and wetland hydrology; SCS 1977) would meet contemporary Section 404 wetland criteria regardless of whether wetland hydrology were tidal or nontidal.

The summer-fall aerial photographic data show green colors in areas mapped by CDFW/CDWR as tule-bulrush marsh (Figure H-2) in synchrony with adjacent fringing tidal marsh, rather than straw or gray colors indicating dry season senescence or dieback in synchrony with neighboring seasonally drained non-tidal marsh conditions. These data provide strong phenological evidence of tidal marsh hydrology during the CDFW/CDWR vegetation mapping period (seasonal biological development), prior to 2014 levee construction. Progressive wave erosion of the outer tidal marsh shoreline up to and through levees (Figure G-22), exposing interior ditches and channels to tidal flows from the bay after levee maintenance ceased (Figure G-21), provides additional confirmation that the interior Point Buckler tidal marsh phenology signal in aerial photographs was indeed due to tidal flows and overtopping of breached, eroded and subsided derelict levees. Both scenarios, tidal or non-tidal, indicate extensive, prevalent Section 404 jurisdiction over all parts of the island except the eastern remnant levee with vegetation mapped as co-dominant facultative to terrestrial shrubs, California rose and coyote-brush (Appendix H, Figure H-2). Therefore, fills associated with all the unpermitted activities are regulated under Section 404.

The construction of new levees fails the limited "maintenance" exemption at 33 CFR §323.4(a)(2) for multiple reasons:

- It fails the "currently serviceable structures" requirement, because levees were derelict (lacked maintenance history under Suisun Resources Conservation District regional permits) and broken by unrepaired large breaches for 21 years, and therefore not in a "serviceable" condition to manage non-tidal marshes (Appendix G).
- It fails "emergency reconstruction" because the timing of levee construction did not occur within a "reasonable" time after levee breaches were evident in aerial photographs from the late 1980s to early 1990s without interruption (Appendix G).
- It fails the "original fill design" and exclusion of "modification that changes the character, scope, or size of the original fill design" requirements and restrictions:
    - First, the configuration of the new levee does not occur consistently within the footprint of the original levee (see Figure K-1), because shoreline erosion has removed parts of the island where the old levee occurred, and the new levee fills former ditches. Thus the size and scope of the new levee are not limited to the antecedent levee, and so the new levee construction fails to meet the requirements of the maintenance exemption.
    - Second, there was no evidence that any of the levee followed an "original fill design" – no typical cross-sections or elevations conforming to either the SRCD regional permit including permitted levee repairs, or any designs specific to Point Buckler. On the contrary, landowner's consultant (AWR 2015 Figures 1-2) stated that the alignment (footprint) of the new levee and ditch extended beyond the original alignment.
    - Third, the fill ramp extending from the levee to the non-structural boat landing (not a dike) at the west end of the island has no antecedent; it is entirely new fill, beyond the scope of original fill designs and purposes. Similarly, the fills adjacent to the crescent basins (mounds planted with ornamental trees) and fills in the bench between the new levee and new borrow and drainage ditch, and fills from early test trenches are themselves new.
- None of the ditching and diking was associated with an ongoing farming operation, so no 404 agricultural exemptions apply. The antecedent condition of the island was derelict, unmanaged marsh for over two decades, and the dereliction of the island was not part of a "fallow" management cycle.
- Finally, the activity as a whole has the apparent purpose of converting the island Section 404 jurisdictional areas into a use to which it was not previously subject, where the flow and reach of U.S. waters has been impaired by the activity. The intention to drain the island interior tidal marsh is indicated by the planting of multiple salt-intolerant, wetland-intolerant nursery stock trees protected by horse fencing (Appendix L). In other words, the conversion of a derelict waterfowl hunting club under seasonally flooded wetland management and later tidally flooded marsh conditions, into a drained, partially mowed, vehicle-tracked, degraded wetland used for

new types of recreational uses (including publicly advertised watercraft recreation), eliminates the applicability of any exemption.

The excavation of borrow ditches and ponds in tidal wetlands, including *de minimus* incidental sediment backfall, is not regulated *per se* under Section 404. It is, however, regulated under Section 10 of the Rivers and Harbors Act of 1899 (see Section N-3.0, below).

N-3.0 Rivers and Harbors Act jurisdiction

N-3.1 Geographic and Activity Jurisdiction

Like Clean Water Act Section 404, Rivers and Harbors Act (RHA) Section 10 jurisdiction applies to tidal waterbodies (subject to ebb and flow of the tide), making them navigable in law (33 CFR §329.4). It differs from CWA Section 404 jurisdiction in applying not just to discharges of dredged or fill material, but to all work or structures and activities, and up to the elevation and geographic boundary limit of Mean High Water, rather than the High Tide Line. Section 10 RHA jurisdiction applies laterally over the entire surface of the waterbody, and is not extinguished by later actions (like dams and dikes) or events (like shoaling) that may impede or even destroy navigable capacity (33 CFR §329.4). In other words, dikes and dams that cut off tides do not eliminate Section 10 jurisdiction; "historical" Section 10 jurisdiction exists, for example in unfilled diked portions of former tidelands below the original contemporary elevation (prior to subsidence and sea level rise) of Mean High Water. Artificial channels that extend the reach of tidal waters are regulated as Section 10 RHA waters, including private lands (33 CFR §329.8(a), 33 CFR §329.9(a)). RHA Section 10 jurisdiction is relatively permanent.

N-3.2 Section 10 Jurisdiction Over Point Buckler Island: Regulated Geographic Areas and Unauthorized Activities

Only the areas of tidal channel, tidal mudflat, and tidal marsh below the elevation of Mean High Water (MHW), subject to ebb and flow of the tides, would fall under Section 10 geographic jurisdiction at Point Buckler. Levees and high marsh above MHW would not fall within Section 10 jurisdiction. Nearshore boat dock construction in tidal waters is fully regulated (all work and structures) under Section 10.

Excavation within the island interior below MHW would extend Section 10 jurisdiction in those instances where that excavation was within or directly connected to pre-existing intertidal unvegetated ditches that were connected to tidal breaches that were artificially dammed and diked beginning in February 2014. Such extension of Section 10 jurisdiction applies to the entirety of the new borrow and drainage ditch, which connected to pre-existing intertidal unvegetated ditches and channels that were artificially dammed and diked beginning in February 2014. Section 10 jurisdiction extension also applies to three of the four crescent basins excavated in late 2014 and early 2015 were excavated in part from pre-existing intertidal unvegetated tidal marsh channels that were connected to tidal breaches that were closed in 2014. Unauthorized diking and damming cannot and did not eliminate Section 10 jurisdiction in the antecedent tidal ditches and channels within the island; Section 10 jurisdiction extends laterally to the entire surface of the navigable (in law) waterbody and is not eliminated by tidal obstructions. 33 CFR §329.4, §329.8. §329.13.

The excavation of basins or ditches across, or connecting to, areas that were subject to tidal influence below MHW prior to unauthorized diking, however, extend and expand the surface of the Section 10 waterbody to the "improved" navigable-in-law areas that were subsequently diked. The new ditches and crescent basins that overlapped with pre-existing tidal ditches and channels fall under "improved" conditions of artificial waterbodies in bays/estuaries (33 CFR §329.8, 33 CFR §329.12(2)(b)) which depends on the waterbody connected (extension of the surface, like a canal). The extension of Section 10 jurisdiction into expanded areas below MHW connected to antecedent tidal channels and ditches is not affected by artificial (especially unauthorized) barriers to tidal flows (33 CFR §329.10). The intact marsh areas above MHW were not subject to Section 10 at the time of diking and excavation, but they were brought into Section 10 jurisdiction during excavation and connection to Section 10 jurisdictional areas: Section 10 jurisdiction follows the MHW line extension, even if an artificial barrier cuts off the ebb and flow (33 CFR §329.4, §329.8, §329.10).

The excavation of the borrow and drainage ditch and crescent basins, where they are connected to [now-diked] tidal breaches and ditches that are pre-existing Section 10 jurisdiction, expanded Section 10 jurisdiction to areas newly below MHW (continuous water surface and bed), just as dredging of a tidal marina or harbor into high tidal marsh or fast land expands the reach of Section 10 jurisdiction. The entire new perimeter borrow/drainage ditch is therefore subject to Section 10 jurisdiction (33 CFR §329.8(a)-(b)). Section 10 jurisdiction was not extinguished in any of the original borrow ditches, including those portions of antecedent borrow ditches that were subsequently dredged for borrow material or filled for new levee.

N-4.0 Summary of Unpermitted Activities in Jurisdictional Areas

At Point Buckler, a total of 38.338 acres of lands are subject to Clean Water Act Section 404 jurisdiction, of which 1.072 acres are also subject to Rivers and Harbors Act Section 10 jurisdiction (Table N-1, Figure N-2). This acreage comprises wetlands (37.266 acres) and Waters of the U.S. (1.072 acres). The construction activities included excavation of the new borrow and drainage ditch on 2.615 acres of tidal marsh with the excavation footprint connecting to areas of pre-existing Section 10 RHA jurisdiction, which extends the Section 10 jurisdiction into the newly excavated areas (Table N-1, Figure N-3).

The areal extents of fill and excavation activities are shown in Table N-2 and Figure N-3. Fill activities are shown in relation to the types of jurisdictional areas in which they took place, and by fill type (earthen fill, structural fill). The total acreage of fill is 3.227 acres. Excavation activities are similarly shown in relation to the types of jurisdictional areas in which they took place. Excavation took place over a total of 2.925 acres.

Table N-1. U.S. Army Corps of Engineers Jurisdiction, Baseline and Post-Construction

	Jurisdiction Extent (acres)		
Jurisdiction Type	**Baseline**	**Post-Construction**	**Change**
Navigable Waters (Section 10, RHA[1]) Waters of the United States (Section 404, CWA[2])	1.072	1.072	0
Wetlands[3] (Section 404, CWA)	37.266	34.651	- 2.615
Navigable Waters (Section 10, RHA) Wetlands (Section 404, CWA)[3]	0.000	2.615	+ 2.615
Total Jurisdiction	**38.338**	**38.338**	**0**
Non-jurisdictional terrestrial lowlands[4]	0.528	0.528	0

Notes:

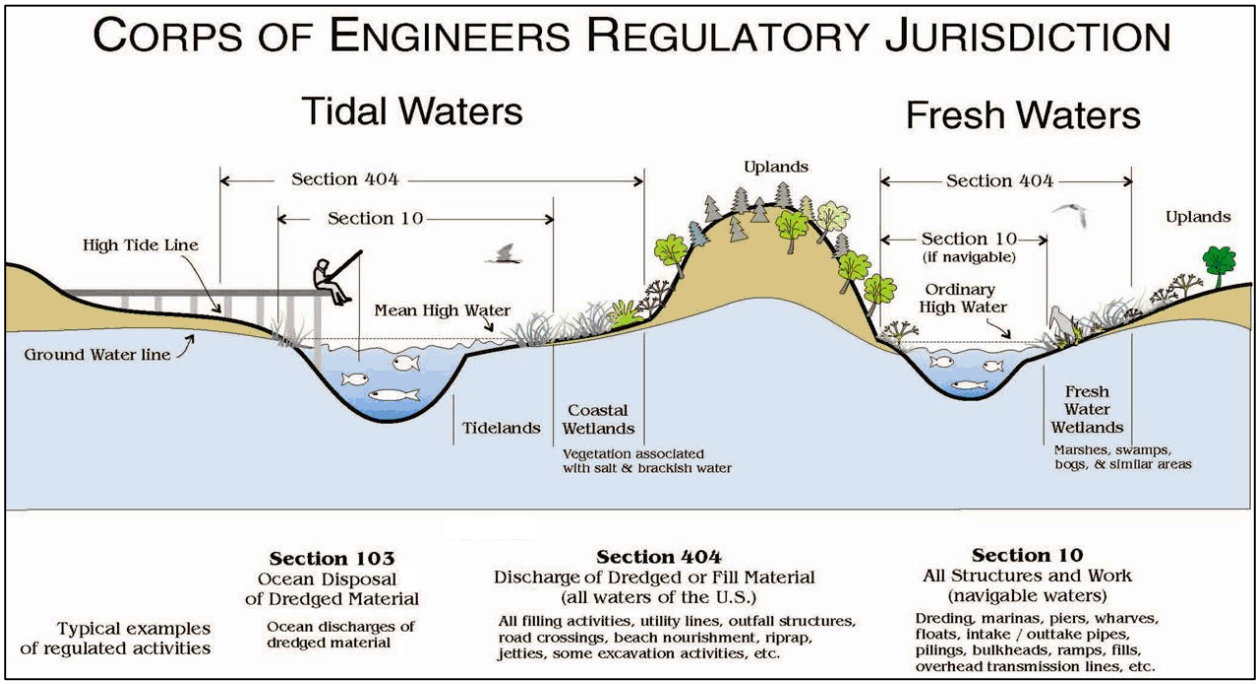
1. *RHA = Rivers and Harbors Act of 1899, as amended*
2. *CWA = Clean Water Act of 1972, as amended*
3. *Excavation of the new borrow and drainage ditch and three of four crescent basins connected to pre-existing Section 10 navigable waters, thereby extending the Section 10 jurisdiction into these newly excavated areas. These areas retain their original Section 404 Wetlands jurisdiction.*
4. *Non-jurisdictional extent assumed, defined based on terrestrial vegetation in the 2012 California Department of Fish and Wildlife Suisun Marsh vegetation dataset*

Table N-2. Unpermitted Work Activities within in U.S. Army Corps of Engineers Jurisdiction

Activity Description	Area (acres)
FILL, Section 10, Rivers and Harbors Act[1]	
Earthen fill in navigable waters	0.156
Structural fill in navigable waters	0.071
Earthen fill into newly excavated Navigable Waters[3]	0.039
Total Fill in Section 10, RHA	**0.266**
Fill, Section 404, Clean Water Act[2]	
Earthen fill into Wetlands and Waters of the U.S.	3.060
Structural fill	0.167
Total Fill in Section 404, CWA	**3.227**
Fill, by Type (Sec 10 and Sec 404)	
Earthen fill	3.060
Structural fill	0.167
TOTAL FILL	**3.227**
Excavation, Section 10, Rivers and Harbors Act	
Excavation within remnant borrow ditch and tidal channels	0.250
Total Excavation in Section 10, RHA	**0.250**
Excavation, Section 404, Clean Water Act	
Excavation within remnant borrow ditch and tidal channels	0.250
Newly established Sec 10: excavation within tidal marsh connected to pre-existing Sec 10	2.615
Excavation within tidal marsh not connected to pre-existing Sec 10	0.060
Total Excavation in Section 404, CWA	**2.925**

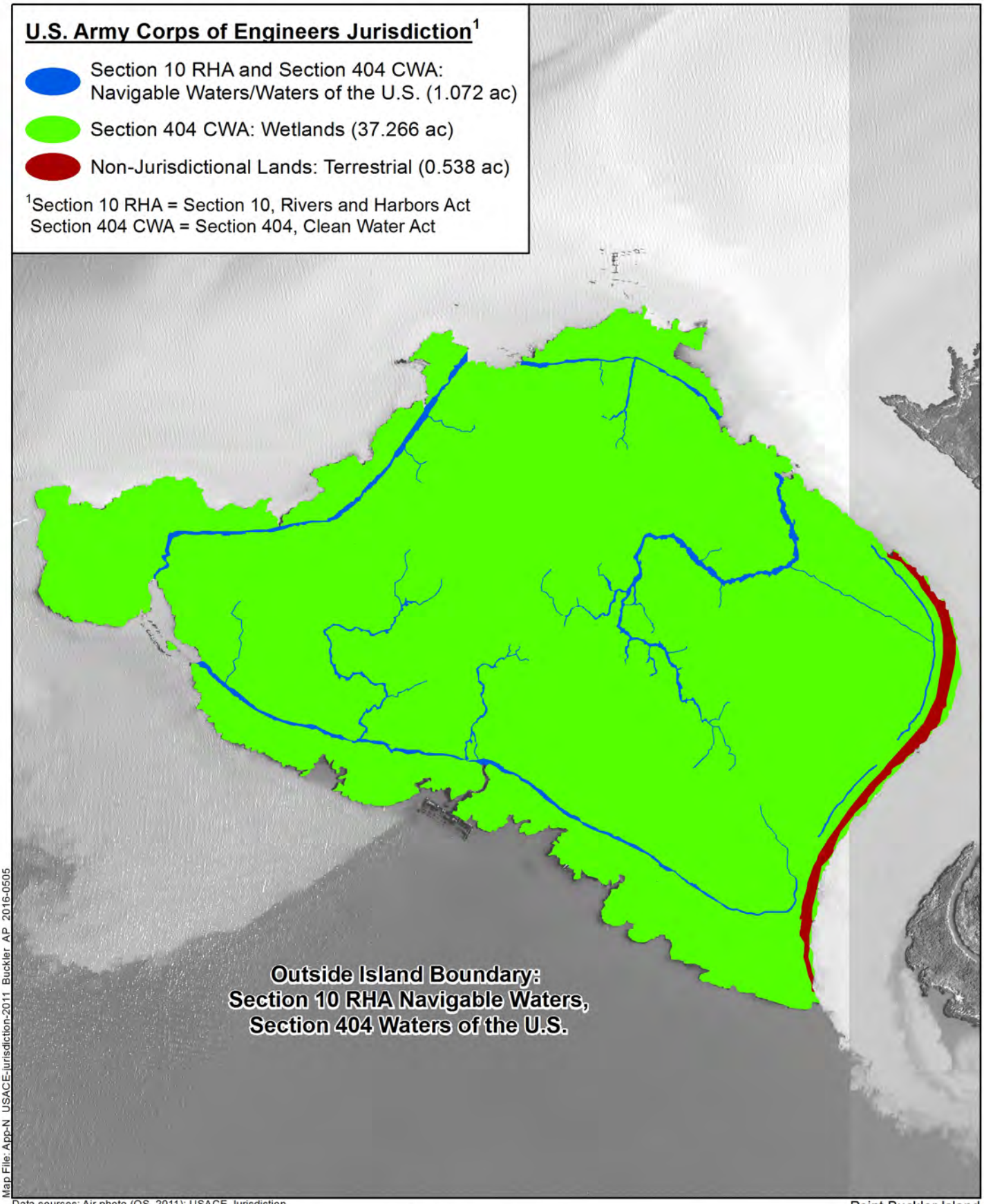
Notes:

1. *Section 10, Rivers and Harbors Act of 1899, as amended*
2. *Section 404, Clean Water Act of 1972, as amended*
3. *Represents fill of the eastern test trench for the new levee and western crossing of the borrow and drainage ditch.*



http://www.spn.usace.army.mil/Missions/Regulatory/JurisdictionDeterminations.aspx

Figure N-1. Corps of Engineers Regulatory Jurisdiction



Map File: App-N_USACE-Jurisdiction-2011_Buckler_AP_2016-0505

Data sources: Air photo (QS, 2011); USACE Jurisdiction (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure N-2

U.S. Army Corps of Engineers Jurisdiction: 2011 Conditions (Pre-Alteration)

Base air photo: (Quantum Spatial) April 2011

Earthwork

Excavation

- Excavation in Sec 10 Navigable Waters/Sec 404 Waters of the U.S. (0.250 ac)
- Excavation in Sec 404 Wetlands, newly establishes Sec 10 Navigable Waters (2.615 ac)
- Excavation in Sec 404 Wetlands (0.060 ac)

Fill

- Fill in Sec 10 Navigable Waters / Sec 404 Waters of the U.S. (0.156 ac)
- Fill in Sec 404 Wetlands (2.865 ac)
- Fill in Non-Jurisdictional Terrestrial Uplands (0.092 ac)

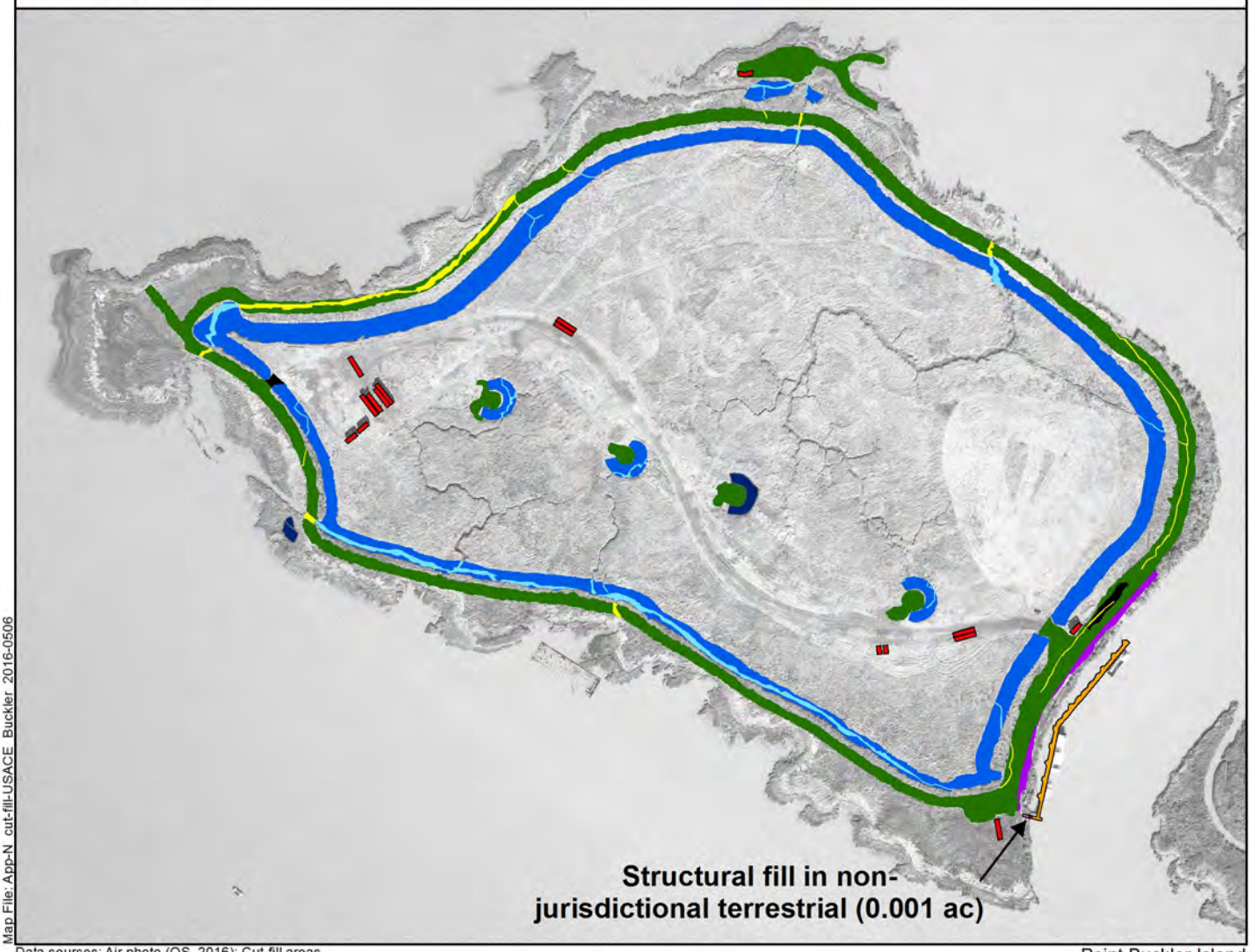
Excavation then Fill

- Excavation in Sec 404 Wetlands, Fill in Sec 404 Wetlands / Sec 10 Navigable Waters (0.039 ac)

Structures

- Fill in Sec 10 Navigable Waters / Sec 404 Waters of the U.S. (0.071 ac)
- Fill in Sec 404 Wetlands (0.096 ac)
- Fill in Non-Jurisdictional Terrestrial Uplands (0.001 ac)

Note:
Sec 10 = Section 10, Rivers and Harbors Act
Sec 404 = Section 404, Clean Water Act



Map File: App-N cut-fill-USACE Buckler 2016-0506

Data sources: Air photo (QS, 2016); Cut-fill areas (SE, 2016)

1:3,600 (1" = 300' at letter size)

0 150 300 ft

0 50 100 m

Point Buckler Island
Solano County, CA

Figure N-3

Base air photo: (Quantum Spatial)
February 10, 2016

Unpermitted Activities within U.S. Army Corps of Engineers Jurisdiction

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Appendix O Jurisdiction: Porter-Cologne Water Quality Control Act

The Porter-Cologne Water Quality Control Act, as amended through January 2016, defines "waters of the State" to be "any surface water or groundwater, including saline waters, within the boundaries of the State" (California Water Code Section 13050(e)). All "Waters of the United States" under the federal Clean Water Act (see Appendix N) are also "Waters of the State"[19]. The absence of isolated wetlands and other types of Waters of the State not subject to federal jurisdiction at Point Buckler means that the more expansive jurisdiction under the Porter-Cologne Water Quality Control Act, relative to the Clean Water Act, is not necessary to apply. Figure N-2, which shows Waters of the United States, thus equivalently represents Waters of the State. Areas of unpermitted work within "Waters of the State" are the same as for work within "Waters of the United States" and are shown in Figure N-3.

[19] http://www.waterboards.ca.gov/sanfranciscobay/certs.shtml

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Appendix P An Assessment of Adverse Effects on Beneficial Uses Related to Listed Fish Species by Point Buckler Tidal Marsh Diking and Closure from Daily Tidal Connectivity

Prepared by: Bruce Herbold, Ph.D.
Date: April 19, 2016

> "Another important characteristic of the Estuary is the fresh, brackish, and salt water marshes around the Bay's margins. These highly complex communities are recognized as vital components of the Bay system's ecology. Most marshes around the Bay have been destroyed through filling and development. The protection, preservation, and restoration of the remaining marsh communities are essential for maintaining the ecological integrity of the Estuary"
>
> *SWRCB Basin Plan*.

P-1.0 Problem and Context

The 38 acres of tidal wetlands on Point Buckler had previously been connected to the surrounding tidal waters of Suisun Bay through seven channels and via overland flow around all but the eastern side of the island. Construction of a new levee took place between February and October 2014, closing the seven connection channels by August 2014 and the overland flow by October 2014. Closure of these channel and overland flow connections blocked all access to the tidal wetlands and its tidal channels and ditches by fish in the surrounding waterways. Also blocked was all movement of material, particularly potential food items produced in the tidal wetlands, from being exported to the waterways. The harm to beneficial uses began when the first channel was closed and continues through to the present, diked conditions.

Suisun Bay, including Pt. Buckler, is designated critical habitat for three listed species: the resident Delta Smelt (*Hypomesus transpacificus*) that is listed as threatened under both the state and federal Endangered Species acts, the Central California Coast population segment of Steelhead (*Oncorhynchus mykiss*) that is listed as threatened under both the state and federal Endangered Species acts, and the southern population segment of Green Sturgeon (*Acipenser medirostris*) that is listed as threatened under the federal Endangered Species Act. Suisun Bay, including Pt. Buckler, also is within the habitat range of the Longfin Smelt (*Spirinchus thaleichthys*) that is listed as threatened under state law. Suisun Bay lies between the ocean and the spawning grounds of two runs of endangered Chinook Salmon

(*Oncorhynchus tshawytscha*) winter-run and spring-run, so it lies along their only migratory pathway and is part of their critical habitat. Similarly, all Central Valley populations of the endangered Central Coast population of Steelhead Trout (*Oncorhynchus mykiss*) must migrate through Suisun Bay. The listed Green Sturgeon (*Acipenser medirostris*) also must pass through Suisun Bay to get to the Sacramento River, one of its only three known spawning grounds. All Central Valley populations of fall-run salmon, the most abundant run of Chinook remaining in the Central Valley, must also pass through Suisun Bay. The health of fall run salmon is important not only for its importance to recreational and commercial fishing, but also because it makes up, on average, 78% of the diet of the endangered southern population of Orcas[20]. The decline of Chinook Salmon as food is considered a major threat to the orca's continued existence.

P-2.0 Life History Summary of the Five Fish Species of Concern for this Project

Delta smelt generally spawn and die at one year of age. They are restricted largely to Suisun Bay and the western Delta, they are generally less than 100 cm long, steely blue, and eat plankton. Their capture rates in sampling programs showed a severe, but variable, decline in the early 1980s. This decline led to their listing as threatened in 1993. Their population abundance indices rebounded somewhat in the late 1990s, but then plummeted after 2000 (Sommer et al. 2007). Their abundance indices in 2015 were the lowest of 46 years of sampling. Changes in food and habitat, combined with entrainment in the water export facilities, are the major factors associated with their decline. A comprehensive view of their ecology was published recently (Baxter et al. 2015)[21].

Longfin smelt generally spawn and die at two years of age. They are distributed throughout the estuary, and some are found off-shore. Their indices of abundance of young fish are closely correlated with the amount of freshwater outflow to the bay in each spring, so the greater frequency and severity of lower springtime outflows in the last 40 years has reduced their populations. Delta outflows have been reduced due to greater water exports from the Delta over the last 40 years, which is believed to have had an impact on their abundance. Recent unpublished work indicates that Longfin Smelt spawn in tidal channels adjacent to Suisun bay, when salinities are low (Lenny Grimaldo, Pers. Comm.). A recent review summarizes most of the knowledge of their biology (Baxter 2015)[22].

Salmon and steelhead are highly valued sport and commercial species that may live many years, although fishing pressure has resulted in most successful spawning being done by adults of about three years of age. Salmon runs are named for the season the adults migrate into freshwater and the Central Valley supports four different runs, more than any other river system. Salmon spawn and die, but a variable fraction of spawning steelhead return to the ocean to grow and spawn again in later years.

[20] http://www.nmfs.noaa.gov/pr/pdfs/recovery/whale_killer.pdf
[21] http://www.water.ca.gov/iep/docs/Delta_Smelt_MAST_Synthesis_Report_January%202015.pdf
[22] http://baylandsgoals.org/wp-content/uploads/2015/10/BEHGU_3.1_CaseStudy_LongfinSmelt.pdf

Although the research on these economically important and geographically widespread species is voluminous, two excellent overviews are: Central Valley salmonid biology for the Central Valley is covered in Williams 2006[23]. Juvenile salmonid biology in the estuary is addressed by Williams 2012[24].

Green Sturgeon are remarkably long-lived, maturing at 15-20 years and the oldest aged specimen was 42 years old. The Sacramento population was identified in 2006 as a distinct genetic unit and more critically endangered than their northern counterparts. Spawning occurs in freshwater and most adults return to the ocean to grow and spawn again. Juveniles remain in fresh and estuarine waters for about 18 months. Green sturgeon biology is not well known because they are rare and wide-ranging, but a good overview of Sacramento green sturgeon is in Klimley et al. 2015[25].

P-4.0 Likely Impacts on Migratory Rare and Commercial Species

Point Buckler is located at the western end of Suisun Cutoff and the south-eastern end of Grizzly Bay. On Point Buckler's north-western side, Andy Mason Slough provides another route from Suisun Cutoff to Grizzly Bay. Thus, it lies at the point of access for young salmonids to the tidal wetland edges of Grizzly Bay as they move from the Sacramento and San Joaquin rivers. Young salmon migrate through fresher water habitats mostly along the littoral, or edge, habitats. If we assume that half of the outmigrating salmon are on each side of the confluence as they enter Suisun Bay, then those young fish that do not cross Suisun Cutoff or the Stockton Deepwater Ship Channel are likely to pass Point Buckler. Freshwater and brackish tidal wetland habitats provide foraging opportunities for outmigrating juvenile salmonids. Young salmonids generally feed in tidal wetland channels, especially in fresher water before making their final migration through San Pablo Bay and Central Bay on their way to the ocean. The closure of access at all seven points to the internal channels of Point Buckler, therefore likely blocked young salmon from accessing feeding grounds that they would have previously used, and the current diked condition continues to block this access. "*Uses of water that support habitats necessary for migration"* is central to the beneficial use of fish migration (MIGR). Blockage of access to feeding habitats is therefore an impact on that beneficial use. Because three of the salmonid taxa are listed as threatened under both federal and state law, such detrimental impacts on their migration necessarily affects the preservation of rare and endangered species (RARE). Because the remaining taxon is the basis of a both commercial and sport fisheries the detrimental impacts affect the beneficial use of Commercial Fisheries and Sport Fisheries (COMM). Tidal wetland habitats are productive of both aquatic invertebrates and insects that drop from overhanging vegetation. Both are important food sources for salmonids, particularly for feeding in the shallow tidal wetland channels that infiltrate the emergent vegetation (Herbold et al. 2014).

[23] http://escholarship.org/uc/item/21v9x1t7
[24] http://escholarship.org/uc/item/96f2t9xw
[25] http://escholarship.org/uc/item/7892b2wp

Shallow tidal wetland habitats also provide refuge from predation from larger predatory fish, and can even reduce the abundance of medium sized predators within the tidal wetland because they are preferred over the small salmonids as food for wading birds (Baltz et al. 1998)

Point Buckler is located on Suisun Cut, the channel that connects Grizzly and Honker bays. Suisun Cut is also called "Big Cut" on some angling information sites (which refer to the channel between Roe and Ryer islands as "Suisun Cut.)" In Suisun Bay, hydrodynamic conditions are driven, except under extreme floods, by tidal effects and so don't vary from year to year. As shown in Figure 1, both channels are of greater hydrodynamic complexity than the surrounding waters of Grizzly and Honker bays. Hydrodynamic complexity often characterizes successful fishing spots, which seems to be true here. For example, on one popular fishing site recently, a daily report was posted that "Zach Medina, former deckhand for Rich Tipton on the Lucky Strike, was with my son Josh on Saturday, and Medina was entrusted with Tipton's secret concoction for salmon roe. He caught and released up to 25 sturgeon in the Big Cut"[26]. The daily reports on such fishing sites are transient data, but successful fishing for striped bass and sturgeon is often reported from the vicinity of Point Buckler, indicating a consistent presence of predatory fish in the area.

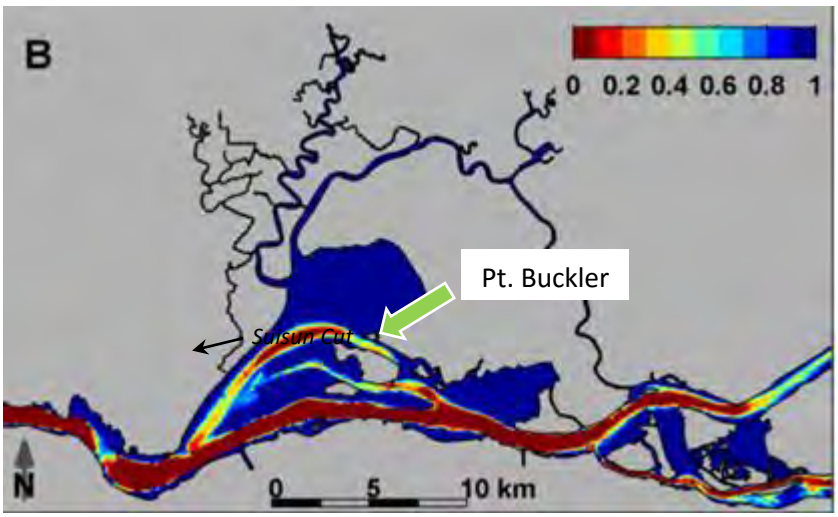

Figure P-1. Mean Depth-Averaged Water Velocity in Suisun Bay
Note the high variability in the channel south of Point Buckler (from Bevar et al. 2016).

By blocking access to the interior tidal wetland habitats of Point Buckler, the closure of the seven channel access points therefore probably eliminated, and continues to probably eliminate, a last freshwater and brackish feeding ground for outmigrating salmonids and simultaneously exposed them to higher risk of predation by blocking their access to a shallow water refuge.

[26] http://www.usafishing.com/delta.html (2/5/2016)

Green sturgeon are bottom-oriented in their habitat and their feeding, but the factors affecting growth and survival of green sturgeon juveniles in the estuary is not well known. Radio-tagging of individuals show that they behave differently in areas of high currents vs low velocity areas (Kelly et al. 2007; Kelly and Klimley 2009). Green sturgeon occur in the vicinity of Point Buckler and there are, as shown in Figure 1, a rich assortment of velocities in the area. But in my opinion, there is little evidence of a mechanism to associate harm to green sturgeon with the closure of access to the interior of Point Buckler.

P-5.0 Likely impacts on Estuarine Habitat and Rare and Endangered fish

Delta Smelt are most consistently captured in the large flat expanses of Grizzly and Honker bays. The survey data are from the California Department of Fish and Wildlife (DFW) Fall Midwater Trawl (FMWT). These data are collected from September through December and were collected in all but two years since sampling began in 1969. Data from the same months in the year-round DFW Bay Study have been collected continuously since 1980. Figure 2 is taken from Bevar et al. 2016 showing the four quartiles of Delta Smelt catch, the most frequent quartile of catch consists largely of those stations in the open waters of the bays, and the second quartile consists of those stations in Suisun Channel and at the confluence. Thus, Point Buckler is immediately adjacent to the most regularly occupied parts of Delta Smelt habitat and the channel connecting them.

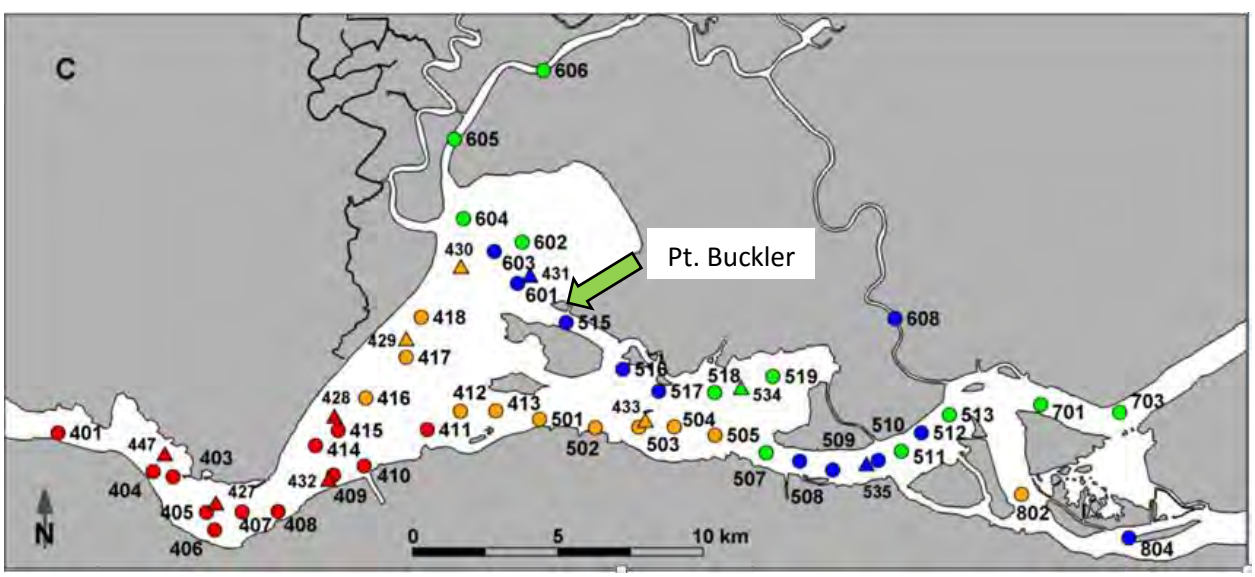

Figure P-2. Location of Most Consistent Delta Smelt Captures in Two DFW Sampling Programs for the Months of September-December

FMWT stations are designated by circles and Bay Study stations are shown as triangles and slightly smaller text. Stations are colored based on an equal number of stations in quartile with green being the most consistent quartile of sites of smelt capture, blue being the quartile above the median, yellow being the quartile below the median and red being the least frequent sites of occurrence.

Unlike salmonids or sturgeon, both Delta and Longfin smelt are pelagic species. Delta Smelt are seldom collected in vegetated tidal wetlands or the tidal channels within them and are unlikely to have occurred in any great numbers on Point Buckler before the channel access points were closed. However, there is growing evidence that growth and survival of Delta Smelt juveniles and subadults may be food-limited (Kimmerer 2002; Baxter et al. 2015). This evidence has been part of the basis for efforts to develop new tidal wetlands to augment productivity within the estuary. However, many of the new tidal wetlands contain such small volumes of water and are so far removed from the areas usually occupied by Delta Smelt that they are unlikely to have much of an impact (Herbold et al. 2014). Point Buckler is immediately adjacent to the open water habitats usually occupied by Delta Smelt, so flux of material from the interior tidal wetlands of Point Buckler would have a better chance of benefitting Delta Smelt than many of the restoration projects being pursued. Of course, elimination of the hydraulic connection of Point Buckler tidal wetlands with the open water habitats occupied by Delta Smelt eliminates any such benefit (thereby degrading the beneficial use of Estuarine Habitat and Rare Species protection). Any such negative impact would be proportionally greater due to the coincident timing of the Pt. Buckler tidal marsh closure with the record lowest indices of Delta Smelt abundance in 2014 and 2015. That harm continues to the present, diked conditions at Point Buckler.

The population of Longfin Smelt is more dispersed than Delta Smelt so augmentation of their food supply is less likely to be affected by the contribution of productivity from Point Buckler. There is also no evidence that they suffer food limitation as there is for Delta Smelt. However, recent surveys have contradicted the general assumption that Longfin Smelt spawn only in the western Delta. Lenny Grimaldo (pers. comm. 2/10/2016) has reported finding abundant Longfin Smelt larvae in the previously unsampled tidal channels surrounding Suisun Bay. These larvae were so young and in such great abundance that Dr. Grimaldo estimates they could not have been transported from elsewhere, but must have been spawned onsite. Point Buckler was not included in the survey, but is similar to the sampled channels. Thus, isolation of the Point Buckler tidal wetlands from the open waters of Suisun Bay would have reduced, and continues to reduce, the capacity to support the beneficial use of SPWN.

P-6.0 Significance of tidal marsh loss

Considerable effort is underway to restore tidal wetland habitats to improve fish populations that rely on the Delta and Bay. Although there is little data to evaluate the effectiveness of tidal wetland restoration for fish in the delta (Brown 2003), benefits for salmon have been shown in other watersheds (e.g., Roegner et al. 2011). At any site, benefits are more likely to accrue to fish onsite or nearby, rather than through any trophic cascade to distant habitats (Herbold et al. 2014). Point Buckler is well located to provide benefits to all juvenile salmonids as they transit Suisun Bay, to juvenile and subadult Delta Smelt which feed regularly in immediately adjacent areas, and possibly to Longfin Smelt spawning. Therefore, just as location is crucial to real estate values, the value of linking natural tidal wetland habitat at Point Buckler to its surroundings is likely greater than restoration of similar habitat less ideally situated.

Literature

(including citations to relevant publications about salmon that are not cited in the above report. Citations from above are in **boldface font**)

Armstrong, J.B., D.D. Schindler, C.P. Ruff, G.T. Brooks, K.E. Bentley, and C.E. Torgersen. 2013. Diel horizontal migration in streams: juvenile fish exploit spatial heterogeneity in thermal and trophic resources. Ecology, 94: 2066-2075.

Baker P.F. and J.E. Morhardt. 2001. Survival of Chinook salmon smolts in the Sacramento-San Joaquin Delta and Pacific Ocean. Fish Bulletin 2: 163-182.

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Appendix Q An Assessment of Adverse Effects on Beneficial Uses Related to Listed Wildlife Species, Estuarine Marsh, and Other Ecological Effects of Tidal Marsh Diking, Fill and Perennial Drainage

Q-1.0 Scope of analysis

This analysis examines the direct and indirect effects from the 2012-2016 unpermitted activities ("unpermitted project" for the purposes of this analysis only) at Point Buckler on the site's beneficial uses related to estuarine tidal marsh and rare and endangered species and on other ecological effects. For impact analysis purposes, the "existing conditions" in 2011 – including the long-term ecological and geomorphic trends and processes leading up to 2011 – represent baseline conditions which are described in detail in Appendix H. Though this analysis does not consider impacts to or deviation from the prescriptive Annie Mason Club Individual Management Plan (IMP of 1984) that has long been not applicable, where relevant, impacts of the 2012-2016 unpermitted activities on the prescriptive standards of that plan for waterfowl management are noted.

This analysis examines impacts of the 2012-2016 unpermitted construction activities and of the water and vegetation management activities. It considers both *short-term direct impacts* and *longer-term indirect impacts* resulting from the hydrological and ecological effects, particularly within the context of drainage activities (Appendix L) that did not conform to the 1984 IMP or related typical marsh management regimes in Suisun. The 2012-2016 unpermitted construction activities consist of constructing a new perimeter levee that terminated tidal exchange between the bay and the island interior tidal marsh (constructed in 2014), a new borrow and drainage ditch from which levee construction material was derived and once constructed now serves to drain the island interior (constructed in 2014), fill for a ramp to the water's edge at the west end, excavating interior crescent basins and placing spoils as fill on the tidal marsh interior, excavating trenches exterior to the new levee and placing spoils on the tidal marsh, fill in newly excavated trenches and borrow ditch, and import and placement of numerous structures, apparently to support kite surfing activities as advertised on Facebook[27]. Separately, property management activities consist of wetlands drainage, vegetation mowing, vehicle tracking, and possible goat grazing (based on presence of goats on the island and one of two gates installed on the road connecting the island interior to the levee on the east side and a second gate staged on site that if installed on the second road connecting the island interior to the levee at the west side would make the island interior a penned area for the goats).

[27] https://www.facebook.com/pointbucklerclubvip

This impact analysis integrates all the preceding appendices of this report, which describe specific wetland impacts, all within in the context of Beneficial Uses of Waters of the State identified in the Basin Plan for San Francisco Bay (RWQCB 2015) and the factual determinations of the Clean Water Act Section 404(b)(1) Guidelines (USEPA 2010). The impact analysis perspectives are informed by the San Francisco Bay Area Wetland Ecosystem Habitat Goals Project (1999), its Species and Communities Profiles companion volume (2000), and the recent Baylands Ecosystem Habitat Goals Update (2016) addressing climate change, as well as the USFWS Recovery Plan for Tidal Marsh Ecosystems of Central and Northern California (2013), the Suisun Marsh Plan (2011), and the Delta Plan (2013).

Q-2.0 Summary of Baseline Conditions

In summary, the "existing condition" of Point Buckler Island at the time of the unpermitted project was a tidal brackish marsh island with significant long-term shoreline erosion due primarily to wave action along the southwest, west, and north shorelines. Levee instability (breaching, erosion, subsidence) and tidal reconnection of relict ditches and natural antecedent tidal channels and tidal overland flow across much of the relict levee caused the formerly diked brackish marsh to revert to tidal brackish marsh repeatedly since the 1970s. The most recent re-establishment of full daily tidal action due to natural processes degrading and breaching the perimeter levee had taken place by 1993, following a 1985 major levee repair endeavor after the Club Individual Management Plan was prepared and approved in 1984. The exceptions to this pattern are the wave-sheltered east shoreline levee remnant along Andy Mason Slough which retained terrestrial and limited high marsh-terrestrial transition vegetation, and the subsided levee remnant along the island's southern shoreline, which retained a mix of tidal marsh and limited high marsh-terrestrial transitional vegetation (Appendices G, H, I). Tidal marsh vegetation gradients existed between the wave-impacted edges of the island, which supported low, turfy brackish marsh vegetation, to the island interior dominated by wave-sheltered tall, dense bulrush, tule, cattail, and reeds. The primary productivity and plant species diversity of the analogous fringing tidal marsh along adjacent Simmons Island (nearby reference site) appears to be high, and similar to the pre-project Point Buckler Island (based on existing outboard tidal marsh and remnants within the diked area).

Q-3.0 Estuarine Wetlands (Tidal Marsh)

Q-3.1 Direct Impacts of Construction and Excavation on Tidal Marsh Habitat

A total **fill of 3.06 acres of tidal marsh habitat including its associated tidal channels and ditches** was filled by the construction activities of the unpermitted project, involving placement of approximately **9,200 cubic yards of fill**, and another **0.10 acre of structural fill was placed on tidal marsh**, for a **total of 3.16 acres of fill on tidal marsh fill and its associated tidal channels and ditches** (Table Q-1, Figure K-2, Figure K-3, Table K-2). The construction activities accounting for this fill includes the new levee, new ramp to the water's edge, new borrow ditch crossing, and the spoils from excavating crescent basins and trenches, all of which together directly converted tidal brackish marsh into unvegetated, drained fill

substrate. So long as the levees are maintained to prevent tidal action, the direct destruction of marsh is not self-correcting over time. In addition, the direct burial by fill and marsh drainage has resulted in significant irreversible impacts to estuarine marsh and other beneficial uses that are effectively permanent and cannot be mitigated on site to less-than-significant levels by any project activity or mitigation measure.

Both the tidal and non-tidal side slopes of the new levee appear to have remained nearly barren for the roughly two years since construction, instead of becoming colonized by high brackish marsh vegetation or terrestrial weeds. This barren condition is likely due to persistent high acid sulfate soil conditions resulting from the oxidation of abundant iron sulfide in the excavated marsh subsoil (peaty muck, clay muck) used for levee construction.[28] Natural vegetation establishment on the barren levee slopes is likely to be slow, and may not occur for over 5 years if the cause is growth inhibition from acid sulfate soils. The levee top is maintained barren by vehicle traffic and active maintenance, and will not revert to high marsh unless the levee is abandoned (cessation of maintenance), removed, or modified to revegetate.

A total of **2.39 acres of tidal marsh habitat and 0.23 acre of tidal channels and ditches was excavated** by the construction activities of the unpermitted project, for a **total of 2.62 acres of excavated tidal marsh and tidal channels and ditches**, involving approximately **16,550 cubic yards of excavated sediment** (Table Q-1, Figure K-4, Table K-3). The construction activities that accounted for this excavation included the new borrow and drainage ditch, trenches, and crescent basins. The excavation of tidal marsh soil is a significant direct net loss of tidal marsh, due to the conversion of tidal marsh to shallow non-tidal open water habitat. The excavation of tidal channels and ditches converted one aquatic habitat (unvegetated tidal substrate) to another aquatic habitat (shallow submerged, unvegetated diked substrate), with significant new wetland loss.

The condition of the shallow aquatic habitat in the crescent basins in March 2015 was severely degraded: iron sulfide sediment and sulfur-reducing bacterial plumes dominated two basins with very shallow water and partially emergent beds, while filamentous algae and iron oxide films dominated the eastern basin. The quality of the shallow aquatic habitat in the new borrow and drainage ditch is also poor, supporting phytoplankton (green algae) but no submerged native aquatic vegetation. Remnants of floating detached (not rooted) submerged aquatic vegetation in the northern reach of the new borrow and drainage ditch appear to be moribund, non-native *Myriophyllum spicatum*. The degraded water quality of the basins and borrow and drainage ditch apparently provides little or no value for waterfowl. No waterfowl tracks or foraging disturbance tracks (dabbling) were observed in any of the basins, and no waterfowl food plants were observed in the bed or banks of any of the basins. Thus, the conversion

[28] In waterlogged/saturated marsh soils, the low/absent levels of dissolved oxygen (anaerobic conditions) force certain microbes to use sulfur as an electron receptor, resulting in the formation (called *reduction*) of black iron sulfides. When these soils are drained and exposed to air, the iron sulfides *oxidize* and turn into iron oxides (rust). This conversion of iron sulfide to iron oxide generates sulfuric acid, which increases the acidity (lowers pH) of the surrounding soils and waters.

of high quality, productive tidal marsh to bacterial and algal communities of the borrow and drainage ditch and crescent basins to degraded aquatic habitats indicates a significant net loss of wetland and aquatic habitat value.

Because the new borrow and drainage ditch is non-tidal, sedimentation is negligible. No brackish marsh vegetation has colonized the ditch's steep banks, which exhibit iron oxide films that are characteristic of acid sulfate soil conditions following drainage of sulfidic estuarine marsh soils. Unlike tidal ditches, the non-tidal borrow and drainage ditch is unable to revert to marsh as long as the perimeter levees and current water management regime (perennial drainage, absence of normal flood-drain cycles from fall to spring, non-implementation of the water management schedule prescribed in the Club IMP) are maintained.

The placement of excavated fill over and tracking by construction equipment on tidal marsh between the outer edge of the new borrow and drainage ditch and the interior toe of the new levee buried existing marsh vegetation, and triggered an extensive new colonization of wetland weeds (see Invasive Plant Species, below), primarily perennial pepperweed (*Lepidium latifolium*). The filled and equipment-tracked bench between the new borrow and drainage ditch and new levee has been directly degraded significantly by fill disturbance, and is indirectly degraded by perennial marsh drainage. The acreage impact of aggressive pepperweed invasion is apparently progressive (indicated by age-structure of pepperweed colonies and high plant vigor observed) and ongoing; it is not a static, discrete acreage value.

The placement of permanent structures on the formerly tidal, now-diked marsh inside the perimeter levee displaces tidal marsh by either obstructing plant growth (platforms, pads) or causing excessive shading (buildings). Areas beneath these structures are either barren of vegetation or support negligible marsh vegetation. The acreage of direct impacts of structures on tidal marsh is 0.095 ac.

The direct impacts of vegetation-modifying activities, including vehicle pathway tracking across newly diked marsh, possible goat grazing, and mowing/disking, are essentially the indirect significant impacts of marsh diking and draining. The ability of fresh-brackish tidal marsh vegetation to regenerate after disturbances such as mowing, disking, or grazing is limited by the severe physiological stress of perennial marsh soil drainage in both the dormant and growing seasons. Thus, the impacts on vegetation directly via vegetation modification, and indirectly via perennial drainage, cannot be distinguished. Approximately **3.8 acres of direct vegetation impacts** by vehicle path tracks and structural facilities including recent placement of artificial turf at the far west wend of the island between the lounge and storage shipping containers (see Photo 2 in the Technical Report) and the ditch crossing road have largely denuded the substrate of vegetation (bare mud and plant litter). Another **approximately 2.0 acres of vegetation removal** on interior now-diked tidal marsh has been mowed and grazed (but not vehicle-tracked).

The **direct 6.155 acres of impacts to tidal marsh habitats** resulted from unpermitted fill and excavation activities are severe and pervasive. In all directly impacted areas, tidal marsh habitat structure and primary productivity are either completely eliminated or reduced to negligible levels. Similarly, the secondary productivity of tidal estuarine waters from the export of plant litter/detritus[29] from the island's interior is practically eliminated by diking and draining. The wildlife habitat functions (*e.g.*, foraging, nesting, high tide flood refuge) within the island's formerly tidal interior marsh are eliminated or extremely degraded to negligible levels by conversion of tidal marsh to levee, non-tidal ditch, and non-tidal seasonal basin.

Table Q-1. Impact Areas

Activity Type	Area (acres)
EARTHEN FILL[1]	
Fill for New Levee	
On tidal remnant levee (1)	0.457
On tidal marsh plain (2)	1.911
In tidal channel and tidal ditch (3,4)	0.157
In trenches excavated from tidal marsh (5a)	0.030
Total Levee Fill	**2.555**
Fill for Other Purposes, Interior to New Levee	
Crossings of borrow ditch (5b, 5c)	0.043
Spoils from crescent basins (6)	0.164
Total Other Fill, Interior to New Levee	**0.207**
Fill for Other Purposes, Exterior to New Levee	
Spoils from trenches (6)	0.262
Ramp to water's edge (7)	0.038
Total Other Fill, Exterior to New Levee	**0.300**
TOTAL EARTHEN (SOIL) FILL	**3.062**
STRUCTURAL FILL[2]	
Structures on the Tidal Marsh	0.096
Boat dock in Andy Mason Slough	0.071
TOTAL STRUCTURAL FILL	**0.167**
TOTAL FILL	***3.229***
EXCAVATION	
Excavation for Borrow Ditch	
On marsh plain (8)	2.374

[29] "Litter" refers specifically to dead plant material; "detritus" refers generally to organic debris.

Activity Type	Area (acres)
In remnant borrow ditch (9)	0.190
On tidal remnant levee (10)	0.019
In tidal channels (11)	0.034
Total Borrow Ditch Excavation	**2.617**
Excavation for Other Purposes, Interior to New Levee	
In tidal channels, for borrow ditch and crescent basins (11)	0.019
On the marsh, for crescent basins (12)	0.208
Total Other Excavation, Interior to New Levee	**0.227**
Excavation for Other Purposes, Exterior to New Levee	
In remnant borrow ditch (9)	0.007
On tidal marsh, for trenches (13)	0.075
Total Other Excavation, Exterior to New Levee	**0.082**
TOTAL EXCAVATION	***2.926***
TOTAL FILL AND EXCAVATION	**6.155**
Vegetation Impacts	
Vehicle paths and kite surfing facilities	~3.8
Mowing and possible grazing	~2.0
TOTAL VEGETATION IMPACTS	***~5.8***

[1] *Number of each activity corresponds to locations shown in Figure K-2*

[2] *Structural fill locations shown in Figure K-3*

Q-3.2 Indirect, Long-Term Impacts of Fill, Excavation and Vegetation Removal on Tidal Marsh Habitats and its Functions

The indirect effects of the unpermitted activities are highly significant, adverse, and pervasive within the island interior: they are systemically expressed throughout the entire marsh area presently enclosed by dikes and drained year-round. Unlike managed waterfowl marshes in adjacent Simmons Island clubs, and unlike the water management prescription for the 1984 Annie Mason Point Club IMP, the diked interior of Point Buckler Island has been subjected to perennial drainage, with strong evidence that no cyclic flooding and draining has occurred from fall to spring (Appendix L).

Q-3.2.1 Indirect Vegetation Impacts

The most obvious and significant indirect impact of diking and perennial drainage on pre-project tidal marsh is the mass dieback of marsh vegetation (Appendix L). There is no ecologically significant primary production in the formerly robust populations of tules, cattails, and bulrushes within the diked marsh. Only the accumulated masses of leaf litter indicate the extent and degree of the tidal marsh's former productivity. The drainage and exclusion of periodic tidal flows have killed most of the marsh vegetation and apparently prevented its regeneration.

Equally significant is the vegetation succession triggered by the dieback of dominant fresh-brackish tidal marsh vegetation and perennial soil drainage following diking: the widespread colonization of dieback areas by noxious, invasive, non-native perennial pepperweed (*Lepidium latifolium*). The vegetation succession in progress is likely to result in the long-term dominance of perennial pepperweed over most of the island interior. This would significantly increase weed (seed) invasion pressure on the island's remaining fringing tidal marsh (as well as tidal marsh on nearby islands) by providing a major new local seed dispersal source. The high vigor of perennial pepperweed colonies, coupled with their extensive distribution across the island interior, makes their dominance practically inevitable under existing conditions projected into the foreseeable future. This change is a significant adverse impact to wetland habitat quality both on- and off-site.

In addition, vegetation succession to high marsh plant communities (gumplant, pickleweed, saltgrass), upland weeds (sow-thistle), and some transition zone species (creeping wildrye) is in progress in many areas of marsh dieback, particularly in the vicinity of ditch and channel banks within the now-diked marsh. The high marsh and weed assemblage has significantly lower habitat value for fish and wildlife than the tidal marsh it replaced.

Increased soil salinity (due to perennial drainage and the absence of tidal or managed flushing of salts from marsh soils) coupled with artificially decreased soil moisture in plant root zones is likely to maintain very low marsh vegetation growth and productivity relative to pre-project conditions. This is a long-term significant adverse impact to wetland productivity. Elevated groundwater salinity and low elevations of groundwater in the diked interior of the site during winter are also significant adverse indirect impacts of diking and drainage. Groundwater is normally at or above the ground surface in both diked and tidal marshes in winter, when it is also normally at low salinity levels. The project has resulted in significant degradation of both soil and groundwater quality at Point Buckler Island following the elimination of tidal hydrology. Significant degradation of soil and groundwater quality is exacerbated byfailure to perform prescribed Club IMP water management prescriptions, or any of the typical water management regimes for Suisun Marsh duck clubs, after diking.

The number of native plant species capable of tolerating the site's drained, saline, non-tidal soils is very low, and it is further reduced by competition with perennial pepperweed. Even non-tidal managed waterfowl marshes are likely to maintain higher native species diversity (albeit low) than the degraded, drained interior now-diked marsh at Point Buckler. This is a long-term significant adverse impact to native plant species diversity.

Q-3.2.2 Indirect Soil and Substrate Impacts

Soils within the marsh's newly leveed interior are indirectly but significantly impacted by diking and perennial drainage. The long-term effects of perennial drainage (reclamation) on high sulfide estuarine

marsh soils is acid sulfate soil formation, as indicated for Joice Muck soil series (Appendix L). Soil conditions in the now-diked marsh are likely to deteriorate as soil organic matter decomposition rates increase under aerobic, drained conditions above the (drawn down) ground water table, increasing acid sulfate levels. The subsidence resulting from decomposition of soil organic matter (high in Joice Muck) is likely to progressively increase under existing conditions projected into the foreseeable future. Reversing marsh subsidence is difficult and slow under non-tidal conditions even with favorable water management for waterfowl; only non-tidal tule marsh management has much potential to mitigate soil subsidence due to drainage[30]. Elevated soil and groundwater salinity is likely to inhibit marsh vegetation growth that would otherwise help offset accelerated soil organic matter decomposition under drained conditions. The resilience of the island's wetlands is significantly reduced by converting tidal marsh to non-tidal marsh, and is exacerbated by perennial drainage of the marsh plain.

Tidal exclusion by dikes essentially eliminates tidal sedimentation (deposition of suspended fine mineral sediment on marsh surfaces) that contributes to marsh accretion. Marsh accretion by tidal sediment deposition is essential if tidal marsh substrate elevations are to keep pace with sea level rise. Conversion of the pre-project tidal marsh to diked marsh reduces the landscape-scale resilience of the island to accelerated sea level rise.

Q-3.2.3 Indirect Impacts on Special-Status Wildlife

The northern subspecies of salt marsh harvest mouse (*Reithrodontomys raviventris halicoetes*; Federally and State endangered; fully protected species, California Fish and Game Code) may have occurred on the Island prior to diking and marsh dieback. The island supported dominant tall fresh-brackish tidal marsh vegetation, with canopy structure (cover) above tidal flooding elevations. This habitat structure has been confirmed to support large populations of salt marsh harvest mouse in the "mainland" Suisun Marsh. The status of salt marsh harvest mouse on the Island prior to the project, however, is unknown. If they were present, the mass dieback of diked and drained brackish marsh vegetation, and the construction of levees and ditches, would likely have a severe adverse impact on SMHM populations, and would likely have caused or contributed to "take" and local extirpation on the Island.

Potentially suitable habitat for California black rails (*Laterallus jamaicensis coturniculus*; fully protected species, California Fish and Game Code) likely existed on the Island prior to diking and drainage of the project. This is indicated by persistent degraded remnant stands of high marsh (saltgrass and Baltic rush) at the northeast end of the Island interior, and small colonies of pickleweed, near large former stands of dense, tall bulrush and tule. The population status of black rails on the island prior to the project, however, is unknown. If they were present, the mass dieback of diked and drained brackish marsh

[30] The challenges of subsidence reversal in organic peat soils are evident throughout Suisun Marsh and the Sacramento – San Joaquin Delta, particularly in the latter where there are extensive areas of open water (e.g., Big Break, Frank's Tract, portions of Sherman Island) that were formerly tidal marsh. These areas subsided so much while leveed and drained that upon levee failure and the reintroduction of tidal flows, elevations could not recover – so they persist as open water, even nearly 90 years later as is the case at Sherman Island and 80 years later as is the case at Big Break.

vegetation, and the construction of levees and ditches, would likely have a severe adverse impact on California black rails, and would likely have caused or contributed to "take" and local extirpation on the Island.

California Ridgway's rail (*Rallus obsoletus;* Federally and State endangered; fully protected species, California Fish and Game Code) habitat potential on the Island prior to the project would have likely been limited and marginal in quality, and near the eastern range limit of the species. One colony of hybrid cordgrass (*Spartina alterniflora* x *foliosa*), however, was found on the north shore tidal marsh along a tidal channel with mud banks, and this species and structure is known to be attractive foraging and high tide refuge habitat for the species. It is possible that vagrant or dispersing juvenile Ridgway's rails may have utilized the island as foraging habitat, but breeding would be unlikely in the site's dense, tall tule, cattail, and bulrush habitat. If they were present, the project would likely have caused or contributed to "take" of Ridgway's rail.

Salt marsh yellowthroat (*Geothlypis trichas sinuosa*) and Suisun song sparrow (*Melospiza melodia samuelisis*) are state species of concern. They are perching birds that occur in Suisun Marsh, and are likely to have found suitable habitat in the derelict pre-project levee riparian scrub vegetation and tidal tule-cattail-bulrush marsh. The mass dieback of tidal marsh vegetation caused by the project, and the disturbances of grading levees, would have caused significant adverse impacts to salt marsh common yellowthroats and Suisun song sparrows at the time of construction, as well as long-term adverse impacts to their habitats post-project.

Q-3.2.4 Indirect Impacts on General Wetland Wildlife

The degradation of tidal marsh vegetation habitat structure (marsh dieback; perennial pepperweed invasion and succession) likely resulted in degraded wildlife habitat for waterfowl, passerines birds, and mammals including river otters. Potential nesting habitat for dabbling ducks likely existed in dense mats or rafts of tule, cattail, and bulrush litter above high tide levels along the island's edge and interior. Foraging habitat also likely existed for dabbling ducks (many species) and wading birds (snowy egrets, Great egrets, Great Blue Herons) in the tidal ditches and channels of the Island. The project likely significantly reduced suitable habitat quality (cover, reduced productivity of preferred wetland plant seed species, reduced productivity of chironomid[31] larvae) for waterfowl and wading birds. The crescent basins exhibited severely degraded water, sediment, and vegetation quality for waterfowl, relative to tidal marsh and also relative to prescribed alkali-bulrush managed marsh of the Club IMP.
River otters were observed in nearshore waters around the island during the March 2, 2016 field inspection, and otter paths from firm intertidal muds to the levee top were observed at the north shore of the Island. Foraging habitat and cover for otters within the island interior marshes were severely degraded by project construction and activities that resulted in mass marsh dieback.

[31] Chironomids are small flies; their larvae are a favored food of waterfowl and shorebirds.

The mass dieback of marsh vegetation may have increased foraging habitat quality for some raptors such as harriers and kites, but there is no evidence of abundant small mammal populations on the diked island to support raptor foraging. Perennial pepperweed invasion of the island is likely to reduce foraging habitat quality for raptors in the long-term.

Q-3.2.5 Indirect Impacts on Special-Status Plants

The fringing tidal marsh outside the new levees supports widespread, abundant, patchy but extensive colonies of Mason's lilaeopsis (*Lilaeopsis masonii*), a creeping low perennial tidal marsh forb that is treated as a CEQA special-status species, but is not State or Federally listed. Mason's lilaeopsis is also widespread along the edges of adjacent Simmons Island. The ramp to the water's edge at the west end of the island extending from the levee likely destroyed colonies of Mason's lilaeopsis, which occur in the tidal marsh turf near the outboard edge of tidal marsh along both sides of the ramp. This is a likely significant impact. The occurrence of Mason's lilaeopsis in the interior of the marsh prior to diking is unknown, but it is likely to have occurred at low frequency and density. All such populations would have been destroyed by diking and conversion to drained/non-tidal conditions.

The island is unlikely to have supported populations of endangered Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*) or soft bird's-beak (*Chloropyron molle* subsp. *molle*) in high tidal marsh habitat exposed to erosive wave action at Point Buckler, but no surveys were made prior to fill and excavation in tidal marsh habitat. Delta tule pea (*Lathyrus jepsonii* var. *jepsonii*) may have occurred along riparian scrub habitat (California rose, coyote brush) along disturbed areas of the eastern levee, but this is unlikely, given the apparent absence of local populations along neighboring Simmons Island at the time of the March 3 field inspection.

Q-3.2.5 Indirect Impacts on Special-Status Fish

Impacts to special status fish species are addressed in Appendix P and summarized here.

Delta smelt (*Hypomesus transpacificus*) are pelagic (open water) Federally listed endangered estuarine fish, and may be significantly indirectly affected by a reduction in the availability or abundance of prey (food items) that may limit growth and reproduction. Suisun Bay including Pt. Buckler is designated critical habitat for Delta smelt, and trawl data indicates that offshore waters are the most regularly occupied parts of Delta smelt habitat (Appendix P). The availability and abundance of prey items in nearshore pelagic habitat of Delta smelt is likely related to the productivity of tidal marsh detritus and the transport of this detritus from interior tidal creeks to nearby pelagic estuarine habitats. The tidal channel network within the island was dammed by levees and water control structures, and the interior tidal marsh primary productivity was severely impacted by marsh dieback due to drainage and diking. Therefore, the project may have resulted in potential significant indirect impacts to Delta smelt.

Listed salmonids (Chinook salmon, *Oncorhynchus tshawytscha*; Central coast steelhead, *Oncorhynchus mykiss*) also have critical habitat designated at Point Buckler in Suisun Bay. The Island's location along the pathway of outmigrating young salmonids from the Sacramento and San Joaquin rivers makes the secondary productivity (invertebrates dependent on tidal marsh detrital food sources) of the island's tidal marshes important. Young salmon migrate through fresh-brackish tidal marshes at the edges of open water habitats. Again, the availability and abundance of prey items in marsh edges is related to the productivity of tidal marsh detritus transported by interior tidal marsh creeks to their mouths. The tidal channel network within the Island was dammed by levees and water control structures, and the interior tidal marsh primary productivity was severely impacted by marsh dieback due to drainage and diking. The damming of tidal creek and ditch mouths by levees also precluded direct access of (former) tidal channels by salmonids for foraging. Therefore, there is high potential for significant indirect impacts of the project to listed outmigrating juvenile salmonids around the Island.

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Appendix R March 2, 2016 Field Photographs

Photographs R-1 through R-22 were taken and annotated by Peter Baye. These March 2, 2016 photos are of interior and exterior conditions at Point Buckler and of reference conditions at nearby Simmons Island and Grizzly Island.

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APPENDIX R

Photographs of Point Buckler Island Wetlands and Suisun Marsh Reference Sites
March 2, 2016

R-1 OUTER TIDAL MARSH – POINT BUCKLER ISLAND

Fringing tidal marsh, Point Buckler Island, March 2, 2016. (a-b) wave-cut scarp in peaty marsh soil on south shore, with perennial sod-forming creeping ground layer vegetation formed primarily by Mason's

lilaeopsis (*Lilaeopsis masonii*) and club-rush (*Isolepis cernuua*), and Baltic rush (*Juncus balticus*) in active growth (bright green), and clumps of hairgrass (*Deschampisa cespitosa* subsp. *beringiensis*). Taller cattail (*Typha latifolia*) with green leafy shoots over 0.5 m high are evident beside the standing cattail leaf litter of the previous growing season, and behind the actively growing turf. (c) detail of vegetative Mason's lilaeopsis turf, with some Baltic rush live shoots. (d) tidal reed marsh (*Phragmites australis*) on north shore, with vigorous, dense live green shoots in active growth. (e-f). North shore fringing tidal marsh gradient, with mix of brackish marsh turf (Mason's lilaeopsis, club-rush, Baltic rush, hairgrass) and taller emergent marsh (cattail, threesquare bulrush – *Schoenoplectus americanus*) and tule (*S. acutus*) back from the scarp edge, where wave energy and scour is less severe.

R-2 REFERENCE FRINGING TIDAL MARSH – ADJACENT SIMMONS ISLAND

Fringing tidal marsh of western Simmons Island across from Point Buckler Island, along Suisun Cutoff (Suisun Bay). The same general tidal marsh assemblages are found here: a mix of brackish marsh turf (Mason's lilaeopsis, club-rush, Baltic rush, hairgrass) and taller emergent marsh (cattail, threesquare bulrush – *Schoenoplectus americanus*), reed (*Phragmites australis*) and tule (*S. acutus*) back from the scarp edge, where wave energy and scour is less severe.

R-3 LEVEE DAM FILLS OBSTRUCTING TIDAL CHANNEL FLOWS; NONTIDAL MARSH IMPOUNDMENT

New levee segments dam antecedent tidal creek mouths and breaches, impounding marsh and obstructing daily tidal ebb and flood of the tides into interior Point Buckler marshes. (a) Levee dam across north shore breach, with direct wave and tidal action on the outer levee bank; note tension cracks of incipient slump block. (b) Levee dam across south shore tidal breach, with wave-cut vertical

bank and wave/tide-deposited litter above the levee crest. (c) Levee dam across south shore breach, viewed from bay. (d) Levee dam across north shore breach, viewed from bay. (e-f) recent vehicle tracks and recent dried mud fill placed over exposed, erosional shore of north shore levee dam.

R- 4 PERIMETER LEVEE OBSTRUCTING TIDAL OVERMARSH FLOWS; NONTIDAL MARSH IMPOUNDMENT

New levee segments bordering outer tidal marsh obstruct high tide overmarsh flows from bay across tidal marsh surfaces, diking and impounding the island marsh interior. Tule wrack accumulation (a) against the outer levee slope above the marsh elevation, and on top of the levee (b) indicates restriction of tidal flow and wave action across the marsh surface during higher (spring) tides, in addition to channelized tidal flow restriction by levee dams.

R-5 PERIMETER LEVEE FILL; BURIAL OF TIDAL MARSH VEGETATION AND SOIL

New levee fills bury clonal perennial tidal marsh vegetation. (a-b) blocks and clods of marsh peat are discharged over tidal marsh vegetation, with their tops remaining barren. (b-c) Reed, Baltic rush and threesquare bulrush growth through the toe of levee fills, emerging from shallow burial. Perennial pepperweed is the only plant colonizing the levee spoils from the top. (e-f) Threesquare bulrush, cattail, and tule are buried and partially emerge at the toe of levee fills, north shore (e) and south shore (f).

R- 6 PERIMETER LEVEE TOE: BURIAL AND EMERGENCE OF TIDAL MARSH VEGETATION

Cattail (*Typha latifolia*) emerges through the shallowest depths of burial by levee fills at the levee toe, while levee fill remains barren, both at top (vehicle road) and side-slopes (peat/marsh soil blocks) after multiple growing seasons since deposition.

R- 7 WEST END BOAT ACCESS RAMP FILL OVER TIDAL MARSH

The fill ramp extending from the new levee at the extreme SW end buries tidal marsh soil and vegetation. (a) view of ramp to west shore. (b) soil pit in center of ramp contacts buried marsh soil horizon and litter layer, with intact (little decay; cuticle and vascular structure remain) horizontal cattail, tule, and threesquare bulrush shoots concentrated at contact. (c) same buried marsh soil horizon and intact shoot litter layer at edge of fill along tidal marsh. (e-f) direct burial of tidal marsh by marsh soil and peat blocks displaced from top and sides of ramp, spilling into marsh.

R-8 INTERIOR ISLAND NON-TIDAL MARSH VEGETATION DIEBACK; DRAINED DIKED MARSH

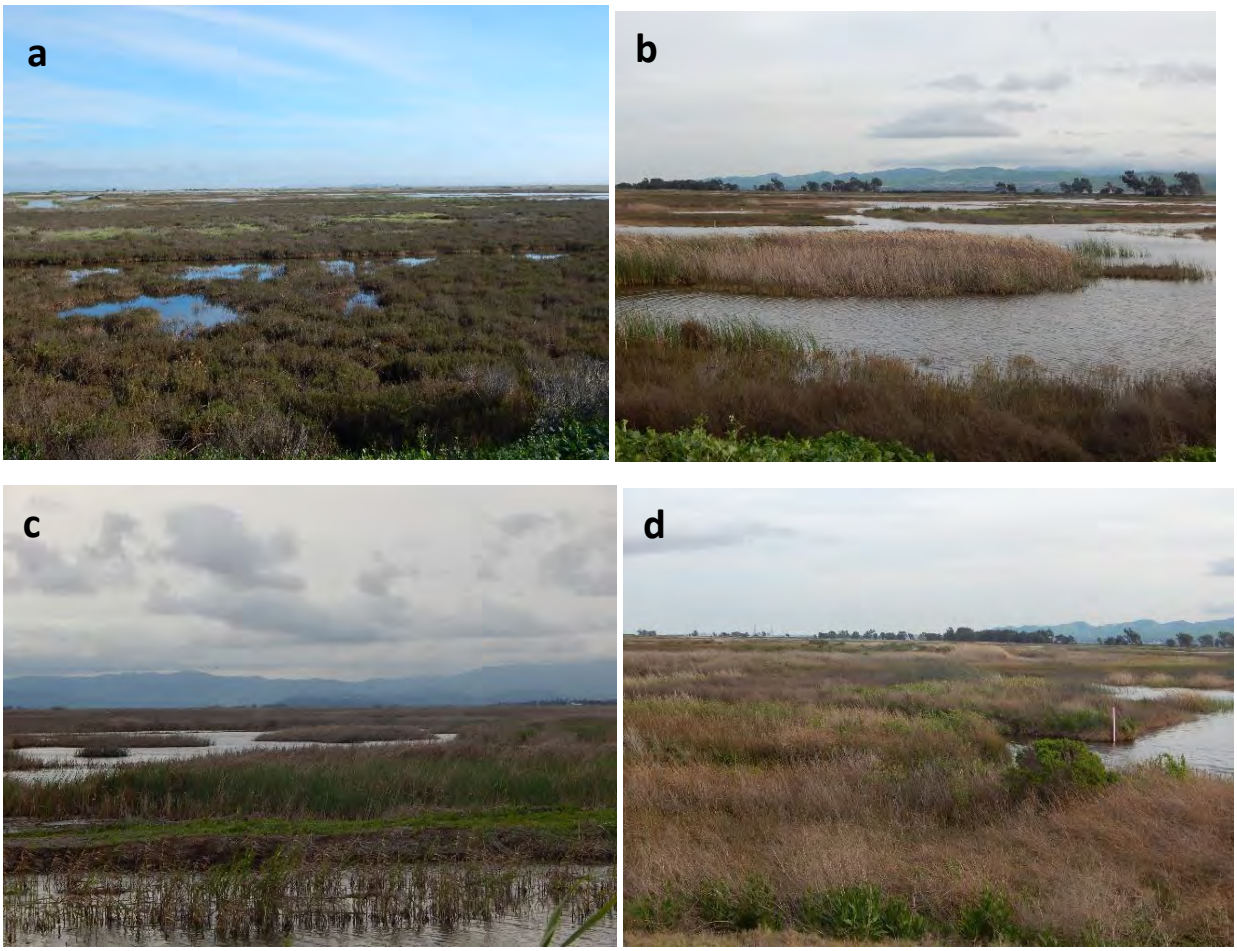
Interior non-tidal marsh drainage and dieback of antecedent marsh, converting live marsh to mass dieback zones of dead standing shoot litter, with incipient colonization by high marsh and terrestrial transition zone weeds (invasive species) and native high marsh plants. (b-c) massive dieback of cattail (*Typha latifolia*) and threesquare bulrush (*Schoenoplectus americanus*), with isolated survival of stunted

(<0.2 m high) shoots compared with growth in adjacent tidal marsh (>0.6 m high) (d) massive dieback of threesquare bulrush (Schoenoplectus americanus) with little or no regeneration of even stunted live shoots. (b) high density litter and low density, low vigor shoots of threesquare bulrush and Baltic rush (Juncus balticus), with incipient colonization by salt-tolerant, relatively flood-intolerant but drought-tolerant pickleweed (Sarcocornia pacifica). (e-f) massive dieback of cattails, rush, and bulrush along ditch banks, with live green vegetation limited to sporadic colonization by high marsh gumplant (Grindelia x paludosa) and perennial pepperweed. Note distance between ditch water surface below top of bank, and oxidized (rusty brown) drained zone below marsh surface; ditch water approximates groundwater depth, and rusty brown soil colors indicate depth of drainage through marsh root zone. Adjacent tidal marsh soil saturation depth is near zero (near surface), and managed Simmons Island non-tidal marsh winter soils are saturation at the surface or submerged.

R-9 COMPARISON: ADJACENT PAIRED TIDAL AND DRAINED NONTIDAL MARSH FLANKING PERIMETER LEVEE

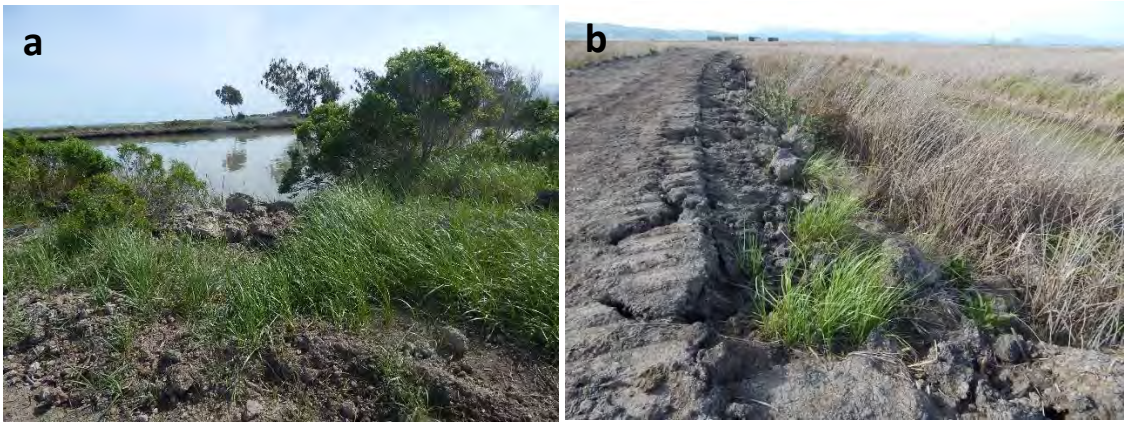
Live green cattail growth in tidal marsh side of perimeter levee (a) contrasts with adjacent diked, drained marsh with dead standing cattail litter on non-tidal interior side of levee (b) at the southeast shore. Paired photographs, viewed to west, SE perimeter levee. Live tall emerging shoots of cattail stand among previous year's standing litter on tidal marsh side (a), and dead cattail marsh (no visible emerging shoots) are evident on interior nontidal side (right), where perennial pepperweed colonies (bright green) are establishing at the interior non-tidal toe of levee.

R-10 SIMMONS AND GRIZZLY ISLAND FLOODED MARSH SIMULTANEOUS WITH POINT BUCKLER ISLAND DRAINAGE



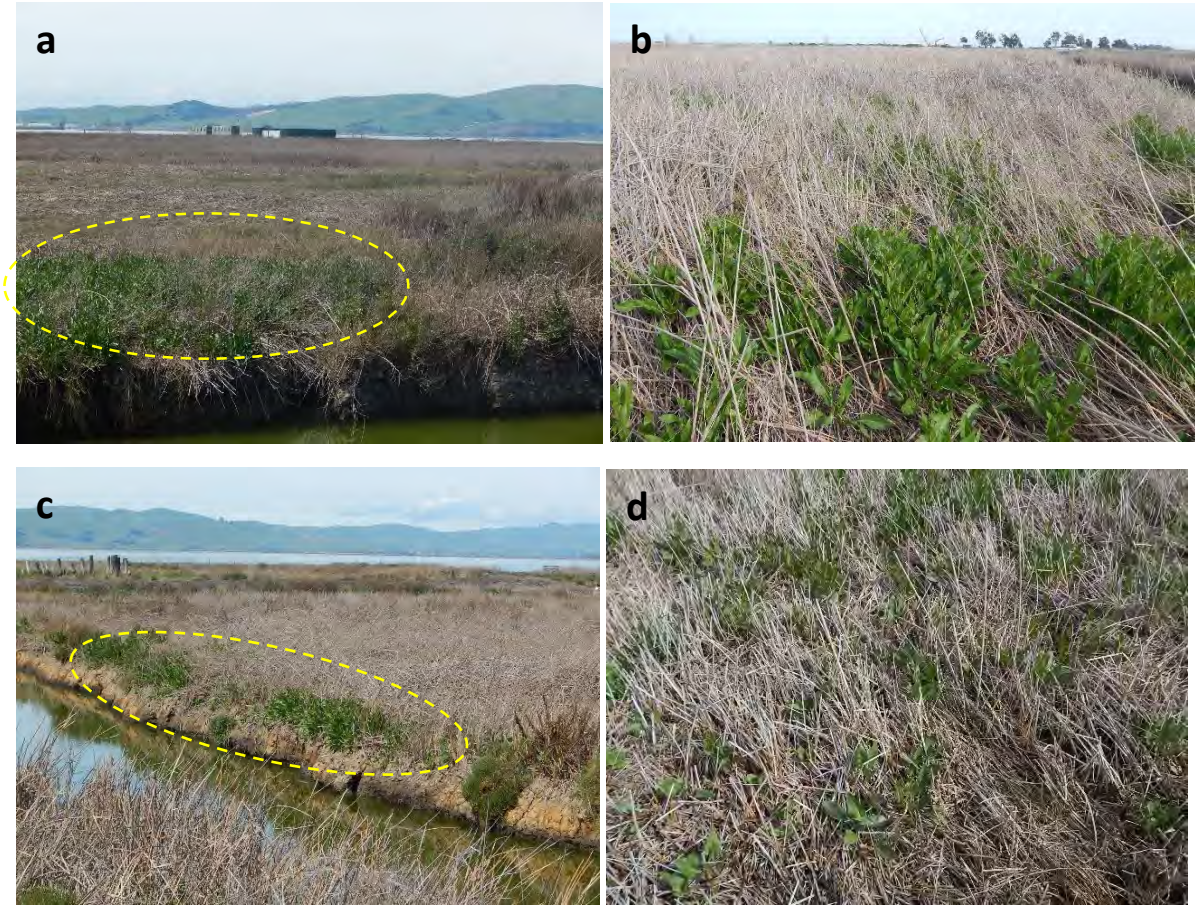
Prevalent shallow flooded managed marsh conditions on Simmons Island and Grizzly Island in variable marsh wetland types at time of March 2, 2016 Point Buckler Island inspection. (a) Flooded non-tidal pickleweed marsh. (b) Flooded non-tidal mixed tule, cattail, and pickleweed marsh. (c) Flooded cattail and reed marsh, exhibiting green cattail shoots up to 3 ft above water surface. (d) Flooded mixed bulrush, rush, tule, reed, cattail, and pickleweed. All managed nontidal marshes observed on Grizzly Island and Simmons Island en route to Point Buckler (from Grizzly Island Road) were saturated to flooded, and supported live, emergent green shoots of obligate bulrush, tule, reed, cattail marsh plants.

R-11 BURIAL AND REGENERATION OF HIGH MARSH/TERRESTRIAL TRANSITION ZONE PLANTS



Graded levee soils locally support clonal populations of species normally restricted to the terrestrial transition zones of high tidal marshes and levees, indicating locations where levee fills either overlapped with the footprint of antecedent levees with local topography above Mean Higher High Water, or where levee fills entrained soils from such areas. Creeping wildrye (*Elymus triticoides*) appears in large, dense stands along levee fills only on the east end of the island (a), near stands of terrestrial scrub (coyote-brush, *Baccharis pilularis*, and California rose, *Rosa californica*). (b) Small semi-circular patchy colonies of creeping emerge through levee fill only locally non-tidal levee slope on south shore of island. These contrast with linear colonies along south shore interior ditch banks (R-15, c-d).

R-12 PERENNIAL PEPPERWEED COLONIZATION OF DRAINED AND UNFILLED NONTIDAL MARSH



Extensive colonies of noxious, non-native invasive high brackish marsh/terrestrial transition zone plant, perennial pepperweed (*Lepidium latifolium*) occur throughout drained, diked Point Buckler marsh dieback zones even where there is no evidence of fill placement or intensive ground disturbance. Colonies are especially abundant along drained ditch banks, but also occur in interior flats, in the absence of significant competition by dense, tall canopies of former bulrush, cattail, and tule marsh, and in the absence of prolonged marsh submergence. Pepperweed is vigorous, in pre-flowering bolting (rapid shoot elongation) development phase.

R-13 VEHICLE TRACK BARRENS; DESTRUCTION OF MARSH VEGETATION

Repeated vehicle passes across the drained interior island, along a central E-W pathway, island has apparently denuded marsh substrate of above-ground vegetation and compacted wetland soils. Marsh plant leaf litter is embedded in vehicle track muds, but no short emerging shoots of any perennial vegetation was detected among recent vehicle tracks, in contrast with marsh dieback areas with above-ground standing litter lacking recent vehicle tracks.

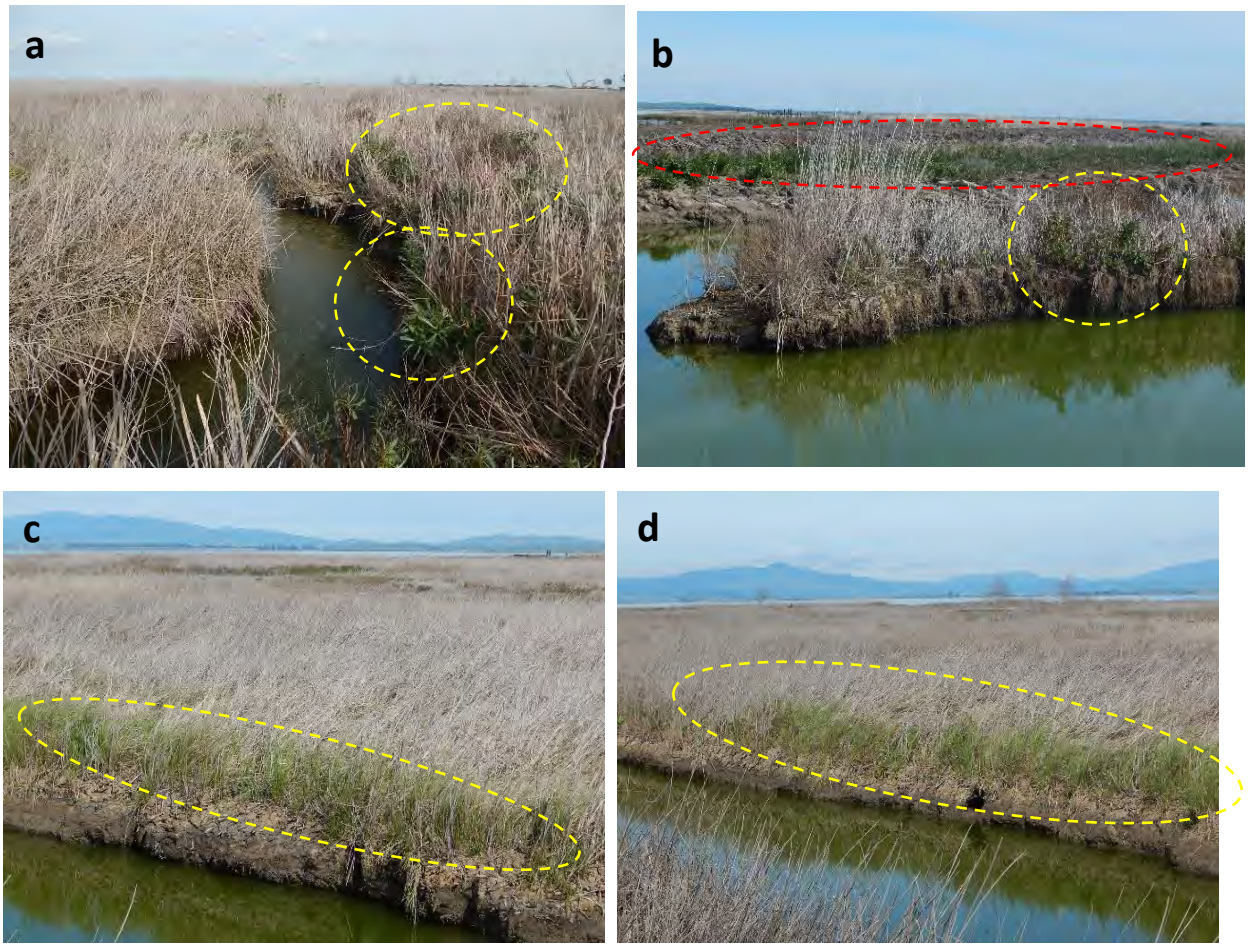
R-14 PERENNIAL PEPPERWEED COLONIZATION OF DRAINED AND FILLED NONTIDAL MARSH

Perennial pepperweed (*Lepidium latifolium*) colonies are most abundant to dominant in drained, disturbed, fill areas within diked and drained marsh. (a) Colonies are widespread in mowed, disturbed flats near structures. (b) Robust colony on fill pad next to constructed crescent pond (colonization of pond excavation spoils spread as fill, surrounding planted ornamental tree). (c) Dominance of pepperweed colonies is prevalent on bench fill between new levee and borrow/drainage ditch along north shore, and west end (d).

R-15 UPLAND WEED COLONIZATION OF INTERIOR NONTIDAL MARSH DIEBACK AREAS

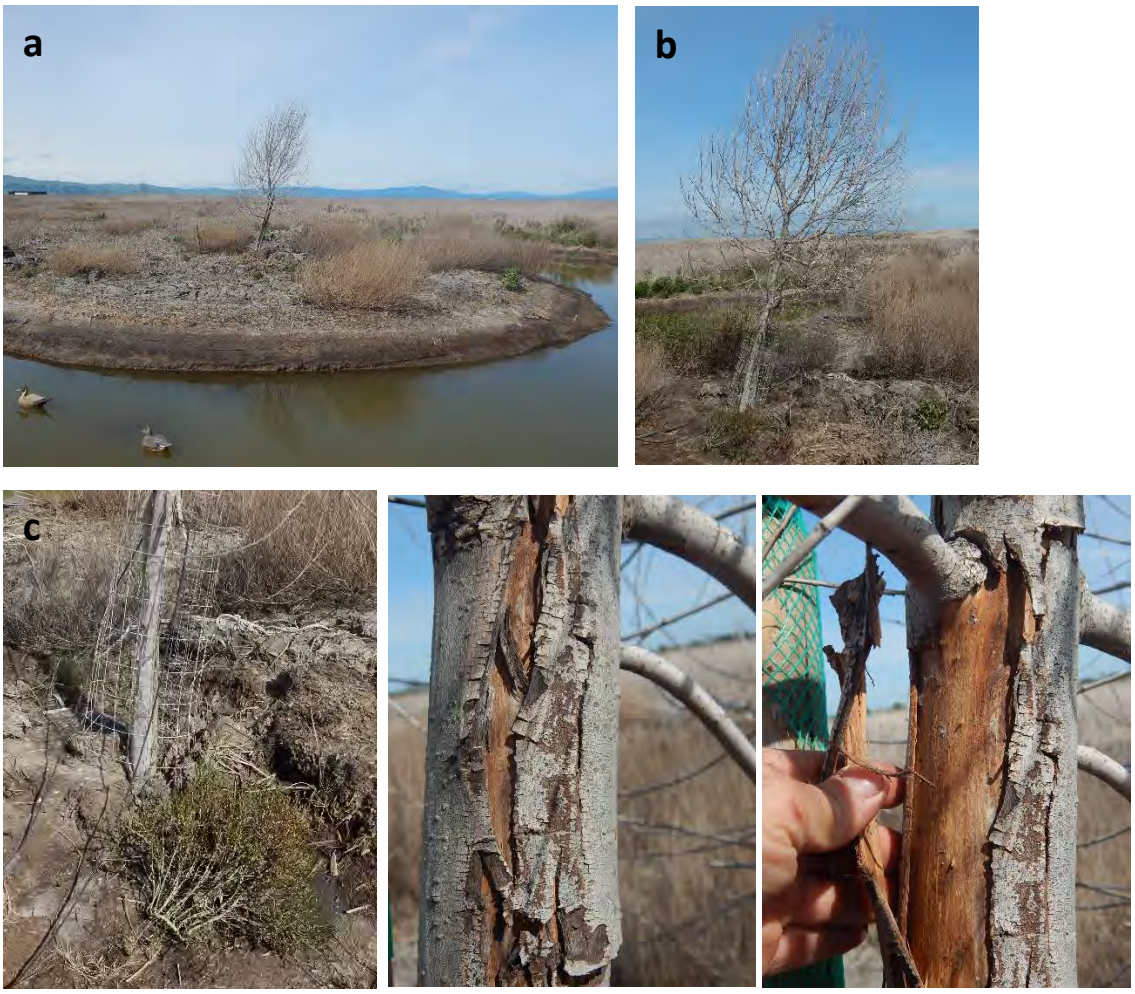
Sow-thistle (*Sonchus oleraceus*), annual upland weeds intolerant of prolonged flooding or soil saturation, growing in late winter among marsh dieback areas among (a) dead cattail (*Typha* sp.) litter and live saltgrass (*Distichlis spicata*), (b) mats of threesquare bulrush (*Schoenoplectus americanus*) litter and sparse regenerating shoots of bulrush; (c) dieback litter of bulrush and sparse regenerating shoots of reed (*Phragmites australis*); and (d), among dense litter mats and sparse, short regenerating shoots of bulrush. The sow-thistle in (d) is already producing flowerheads in bud stage on elongating (bolting) shoots, indicating survival and growth over winter rainfall season when the non-tidal threesquare bulrush marsh (dominant litter of dieback zone here) would normally be flooded or saturated. Sow-thistle juveniles like these were detected at low to moderate density across the entire island interior. A subset of plants was identified as *S. oleraceus* by the shape of the clasping basal leaf lobes (auricles) and terminal lobes.

R-16 WETLAND/TERRESTRIAL TRANSITION ZONE PLANT COLONIZATION OF DRAINED NONTIDAL MARSH DIEBACK AREAS



(a) Gumplant (*Grindelia* x *paludosa*), a typically a high tidal marsh species, colonizes drained interior non-tidal marsh zone bordering interior relict (diked) tidal creek banks and bank edges of excavated borrow/drainage ditch (b) Gumplant locally colonizes unfilled marsh bank at ditch edge (yellow dash delineated), in contrast with extensive invasive perennial pepperweed colony on new filled bench between new levee and ditch (red dash delineated, background). (c-d) Creeping wildrye (*Elymus triticoides*), a terrestrial transition zone plant species, forms a narrow linear clonal colony in drained marsh (bulrush, cattail dieback zone) at top of bank along southern borrow/drainage ditch. These are likely established from seedlings that subsequently spread clonally. Creeping wildrye is otherwise excluded from intertidal brackish marsh except at terrestrial edges.

R-17 ORNAMENTAL TREE PLANTING AND DIEBACK



Planted ornamental trees – Point Buckler Island Interior. (a) Setting of ornamental tree planting: local fill (pond excavation marsh soil) in center of crescent formed by excavated pond. The tree is surrounded by dead annual salt-tolerant weeds from previous growing season (*Atriplex prostrata, Chenopodium chenopodioides*). (b-c) Dead tree with robust salt-tolerant pickleweed growing at its base in saline drained mud. (d-e). Peeled crisp-dry dead outer bark, exposing dry, dead underbark and wood, showing long duration of seasoned dry dead wood on tree planted in saline soil.

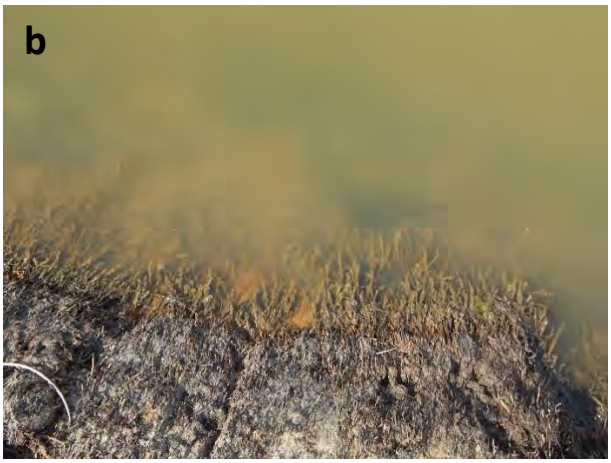
R-18 SUISUN MARSH LEVEE RED RIVER GUM TREES

In contrast with the deciduous (and dead) ornamental upland salt-intolerant trees planted on Point Buckler island, non-native tree adapted to high brackish groundwater and wetland conditions flourish in Suisun Marsh: *Eucalyptus camalduensis*, Red River gum, widespread and persistent from old plantings along Grizzly Island interior levees. Right: growing on low levee adjacent to non-tidal pickleweed marsh. March 2016.

R-19 SURFACE SOIL LITTER MATS: CAPILLARY SALT EVAPORITE DEPOSITS AND IRON OXIDE STAINING

Bulrush leaf litter with vascular fibers stained rusty red-brown with iron oxide (a, b), located in depressions apparently aligned with vehicle tire ruts (c), dotted with small crystals of salt evaporites from capillary (wicking) movement of soil moisture. Salt evaporation pan formation with salt films and iron oxide films is typical of brackish shallow marsh pools with organic soils, alternating between iron sulfide production during prolonged saturation, and salt concentration and iron oxidation during prolonged periods of drainage (oxygenated soil conditions).

R-20 CRESCENT PONDS WATER AND HABITAT QUALITY

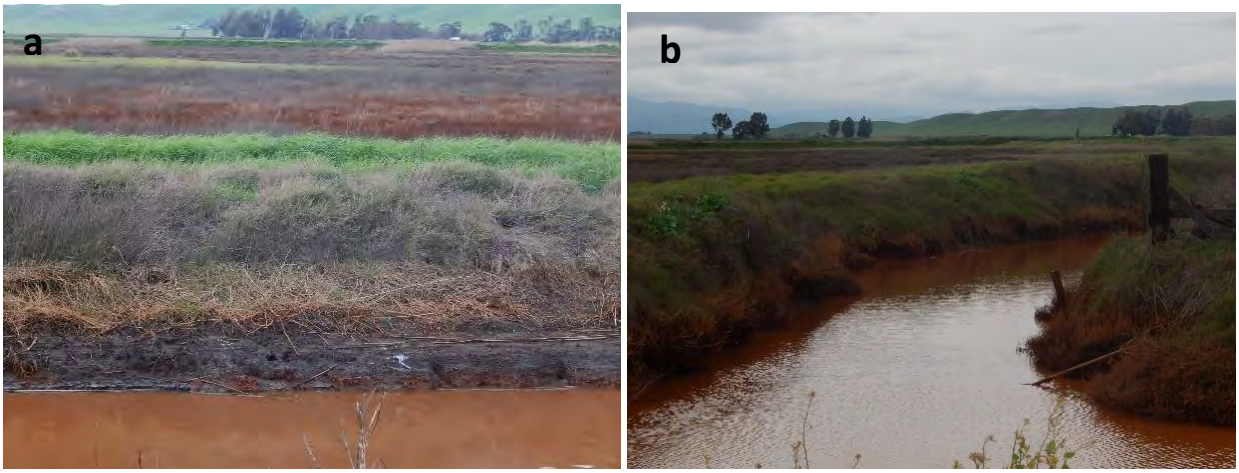


Water quality and quantity in excavated crescent ponds in late winter exhibits conspicuous and strong visual indicators of degradation. (a-b). Western crescent pond has barren, unvegetated banks (no fringing marsh or cover), no submerged aquatic vegetation, and water levels over 0.3 m below the top of bank in the winter rainy season when most Suisun managed marshes are saturated or flooded. Rusty iron oxide films on filamentous algae cover remnant dead roots on excavated banks. (c-d) low water levels, jet-black iron sulfide (with very strong hydrogen sulfide “rotten egg” scent), and iridescent water surface films of native sulfur (elemental sulfur monolayer; product of extreme sulfide reduction) occur over bed of interior crescent pond. (d-e) drawn-down pond in winter exposes colonies of native submerged aquatic vegetaion, *Ruppia maritima*, at the start of its growing season when it depends on submergence; leaf surfaces are coated with algae and iron oxide sediment. Surrounding bed is black with iron sulfide and cloudy with white sulfur-reducing archaebacterial plumes. (g-i) extreme iron sulfide (black) sediment concentration at bed surface of drawn-down pond, forming rusty red oxidized deposits of iron oxide on exposed muds, and concentrating white foamy colonies of sulfur-reducing archaebacteria.

R-21 IRON OXIDE DEPOSITION ON DRAINED SULFIDIC SOIL SURFACES, DITCH BANKS

Heavy iron oxide staining (reddish, rusty-brown sediment film) on ditch banks (a-b) results from aerobic (drained) oxidation of concentrated reduced iron sulfides originally produced under anaerobic (saturated, organic-rich) soil conditions. The concentration of iron oxide deposits in drained Joice muck and tidal marsh soils indicate high potential for acid sulfate conditions. Not all marsh soils exposed to drainage concentrate iron sulfides: (c-d) organic peaty soils in new levees, apparently excavated from upper marsh soil horizons (high peat content and fine root density) retain very dark gray-black soil colors and values after drainage, lacking iron oxide accumulation. (e) Soil pipes formed in excavated new ditch banks leach and transport iron sulfides and form rich plumes of iron oxide upon exposure to air. Fibrous litter also “wicks” (capillary transport) iron sulfide and concentrates iron oxide formation.

R-22 COMPARISON: IRON OXIDE PRODUCTION DURING DRAWDOWN OF SUISUN MANAGED MARSH



Heavy deposition of iron oxide film on dead marsh vegetation and ditch banks, turbid iron oxide sediment in ditch water; acid sulfate soil indicators associated with flood-drain management on soils with excessive sulfide accumulation. These iron oxide sediment deposits and channel water turbidity do not occur in tidal marshes. Grizzly Island, March 2016.

Appendix S May 28, 2003 Field Photographs

Photographs S-1 through S-22 were taken by Stuart Siegel. These May 28, 2003 photos are of interior and levee breach conditions at Point Buckler at Breach 7 on the northeast side of the island (Figure G-21). Figure S-1 shows the location of each photograph and the direction the photograph is facing. The base aerial photograph in Figure S-1 was taken in summer 2003 by the Department of Water Resources, within a few months of the field photographs, and thus helps interpret the extent and species of the tidal marsh vegetation within the site interior and on the tidal remnant levee.

These photographs show four tidal marsh plant species in emergent brackish marsh: threesquare bulrush (*Schoenoplectus americanus*) and cattail (*Typha* spp.) in the interior tidal marsh and the tidal remnant levee supporting a mix of hardstem tule (*Schoenoplectus acutus*) and common reed (*Phragmites australis*). California rose (*Rosa californica*) is shown on higher (transition zone) levee remnants. Note the turbid tan-grey water indicating suspended fine mineral sediment in the tidal sloughs.

PHOTO 1. *View into interior tidal marsh at northeastern levee breach, tidal remnant levee visible either side of the breach. Photo from the north looking south.*

PHOTO 2. *View into interior tidal marsh and tidal remnant levee to west of breach, at northwest breach. Photo from the north looking southwest.*

PHOTO 3. *View into interior tidal marsh and tidal remnant levee to east of breach, at northwest breach. Photo from the north looking southeast.*

PHOTO 4. *View of remnant northern dock and northern island tip, photo from the east looking west.*

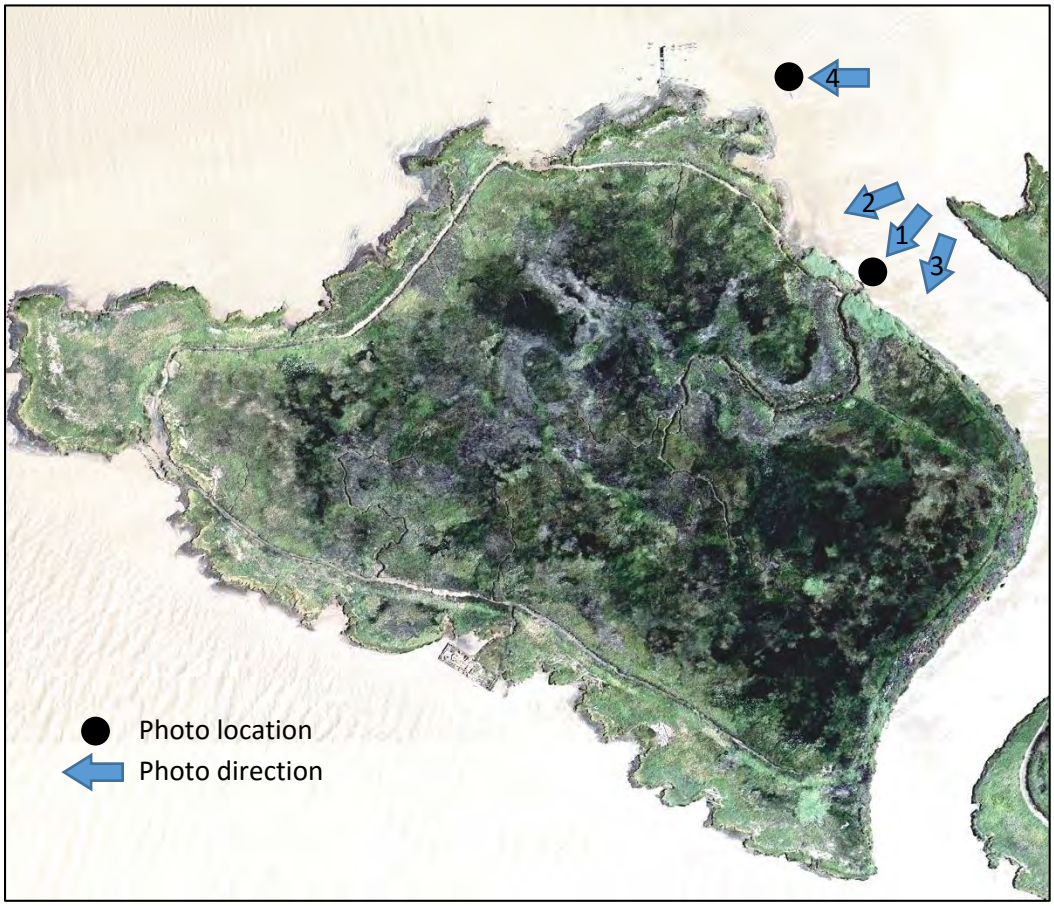


Figure S-1. Locations and Directions of May 28, 2003 Field Photographs
Aerial Photograph Date and Source: Summer 2003, Department of Water Resources

To provide an important context, below is a contrast of the color of the "ditch" water at Point Buckler on March 2, 2016 (panel A and B, Appendix R photos R-8 e and f) with green, algae-laden stagnant water, at a nearby Grizzly Island typical Suisun Marsh managed wetland in late winter (Appendix R photo R-22a) with brown turbid iron oxide water, and the same interior water bodies when they were tidal sloughs (Photo 1 above) with its tan-brown fine mineral sediment.

Photo A (March 2, 2016 Point Buckler)

Photo B (March 2, 2016 Point Buckler)

Photo C (March 2016 Grizzly Island)

Photo D (May 28, 2003 Point Buckler)

Figure S-2. Comparison of Water Color May 2003 tidal vs. March 2, 2016 Diked at Point Buckler and at Reference Suisun Marsh Diked Managed Wetland March 2016