2016 Annual Habitat Monitoring Report
Salt River Ecosystem Restoration Project
Humboldt County, California

Prepared for the Humboldt County Resource Conservation District
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Summary

J.B. Lovelace & Associates assisted the Humboldt County Resource Conservation District by conducting the 2016 annual habitat monitoring effort for the Salt River Ecosystem Restoration Project (SRERP) near the Eel River estuary in Humboldt County, California. This watershed-scale habitat restoration project was initiated in 2013 and continues to be carried out in a series of phases throughout the Salt River corridor over the course of several years. As of this 2016 monitoring effort, Phase 1, Phase 2A (Lower), and Phase 2A (Middle) have been completed. Implementation of this ambitious restoration project is expected to restore beneficial hydrological and ecological functions to the Salt River (a tributary to the Eel River) as well as to restore historically more abundant tidal and freshwater wetland habitats within the restoration area. Following completion of each project phase, a suite of environmental parameters is assessed during a 10-year monitoring period to evaluate progress toward the development of targeted conditions and to anticipate and address potential problems that may compromise the successful attainment of restoration goals.

This 2016 annual habitat monitoring effort involved the mapping and analysis of restored habitats, quantitative vegetation sampling to characterize developing vegetation within specific habitats, and an assessment of the extent of invasive vegetation occurring throughout the SRERP area. Throughout this process the classification of some habitats types was revisited to provide additional clarification and more accurately represent developing conditions throughout the project area, as well as to better facilitate appropriate comparisons with restoration success criteria.

Our observations confirm the continued development of projected habitat types restored thus far, reflecting a favorable trajectory toward their persistence and the eventual realization of habitat restoration goals. Specific minimum area (acreage) success thresholds only exist for final monitoring years, yet all but one habitat type (i.e., “tidal salt & brackish marsh”) currently exceed those final thresholds. For various reasons described in this report, this habitat is expected to eventually achieve “successful” status.

Our quantitative vegetation sampling efforts yielded conflicting results. Where a comparative analysis of vegetation sampling results across monitoring years is possible, respective sampled areas indicate a positive trajectory of increasing establishment and development of native vegetation. Indeed, even in sampled habitats with the least amount of native vegetation, the observed percent cover of native species was greater than twice the minimum requirement for the current monitoring year. Similarly, nascent woody riparian vegetation also appears to be surviving and becoming established throughout sampled riparian planting zones, though replanting of woody species may become necessary in a portion of the Phase 1 restoration area, as well as along the active riparian berms in the Phase 2A (Lower) project reach.

Both invasive and non-native non-invasive plant species are also becoming well established throughout the SRERP project area. Specific success thresholds for both of these categories of vegetation only exist for final monitoring years (year 5 for “Salt River channel wetlands” and year 10 for all others), yet sampled habitats already exceed final maximum success criteria for these vegetation categories in all but one and four (of nine) sampled areas for invasive and non-native non-invasive vegetation, respectively. Of particular concern is the invasive salt marsh species, *Spartina densiflora* (“dense-flowered cord grass”), which continues to invade restored salt marsh habitat throughout the Phase 1 restoration area. A variety of other invasive plant species have also become successfully established and are spreading throughout the SRERP restoration area.

Immediate and appropriate efforts are warranted to reduce and/or eradicate non-native and invasive vegetation observed during the 2016 habitat monitoring effort. If not adequately addressed, the continued establishment and development of such undesirable vegetation is likely to prevent the achievement of final success thresholds for monitoring years 5 and 10, thereby jeopardizing stated long-term restoration goals for the project.

Domestic herbivores (i.e., cattle and goats) also present potential impediments to the successful establishment of native vegetation in the Phase 2A–Salt River corridor. Extensive hoof tracks and related channel bank erosion was observed in the middle Phase 2A restoration area over the course of this effort, and damage to numerous protective tree cages was also documented. Similarly, a small heard of goats associated with a residence adjacent to the Salt River channel corridor was observed during our fieldwork in the lower portion of this Phase 2A (Lower) restoration area. In each case, more effective livestock management would help to prevent impacts to vegetation and water quality due to these domestic herbivores.

These results indicate mixed trends for the developing habitats and associated vegetation throughout the Salt River Restoration Project area. However, if sufficient effort is dedicated to addressing invasive and other non-native plant species occurrences in a timely manner, all respective success thresholds can be met, thereby achieving the various goals of this restoration project.

1.0 Introduction

The Salt River Ecosystem Restoration Project (SRERP) is a phased watershed-scale habitat restoration project being implemented in the vicinity of the Eel River delta in coastal Humboldt County, California (Figure 1). Initiated in 2013, this collaborative effort is being coordinated by the Humboldt County Resource Conservation District (HCRCD) and involves numerous project partners. The primary focus of this restoration project is to restore beneficial fluvial, hydrological, and ecological functions to the Salt River (a tributary to the lower Eel River), as well as to restore historically more abundant adjacent coastal and floodplain wetland habitats. The project attempts to address compromised watershed functions resulting from historic channel alteration and excess sediment accretion throughout the Salt River watershed. Specific restoration goals include the reduction and management of upstream sediment sources, the facilitation of sediment transport through the system, and the creation of suitable conditions for the development and enhancement of ecologically important habitats such as tidal salt marsh, estuarine brackish, and freshwater wetlands. Accomplishing these goals is helping to reduce periodic flooding in the adjacent agricultural community during high-flow events, while simultaneously restoring regionally important coastal wetland habitats. During the summer of 2016 J.B. Lovelace & Associates participated in the restoration effort by assisting the HCRCD in the performance of required annual habitat and vegetation monitoring tasks.

1.1 Regulatory Context & Monitoring Directives

Preparation for the SRERP involved an extensive planning and permitting process. As part of this process, the *Salt River Ecosystem Restoration Habitat Mitigation and Monitoring Plan* (HMMP) (H.T. Harvey & Associates with Winzler & Kelly 2012) was developed to guide the restoration effort and to provide an assessment framework with which to gauge its efficacy. This framework includes directives for implementing a 10-year, post-installation monitoring program, during which time various environmental parameters are to be measured and compared against success criteria to track progress towards achieving specific restoration goals, and to identify and address any problems that could prevent the realization of such goals. Implementation of this monitoring program is also a requirement included in the following project-related permits, certifications, and agreements:

- *Biological Opinion and Formal Consultation on the Salt River Ecosystem Restoration Project, Humboldt County, California: File No. AFWO-11B0097-11F0249* (U.S. Department of Interior-U.S. Fish & Wildlife Service 2011);
- *Section 404 General Permit for the Salt River Ecosystem Restoration Project No. 2010-00282N* (U.S. Army Corps of Engineers 2012);
- *Water Quality Certification for the Humboldt County RCD – Salt River Ecosystem Restoration Project, WDID No. 1B10106NHU* (North Coast Regional Water Quality Control Board 2011);

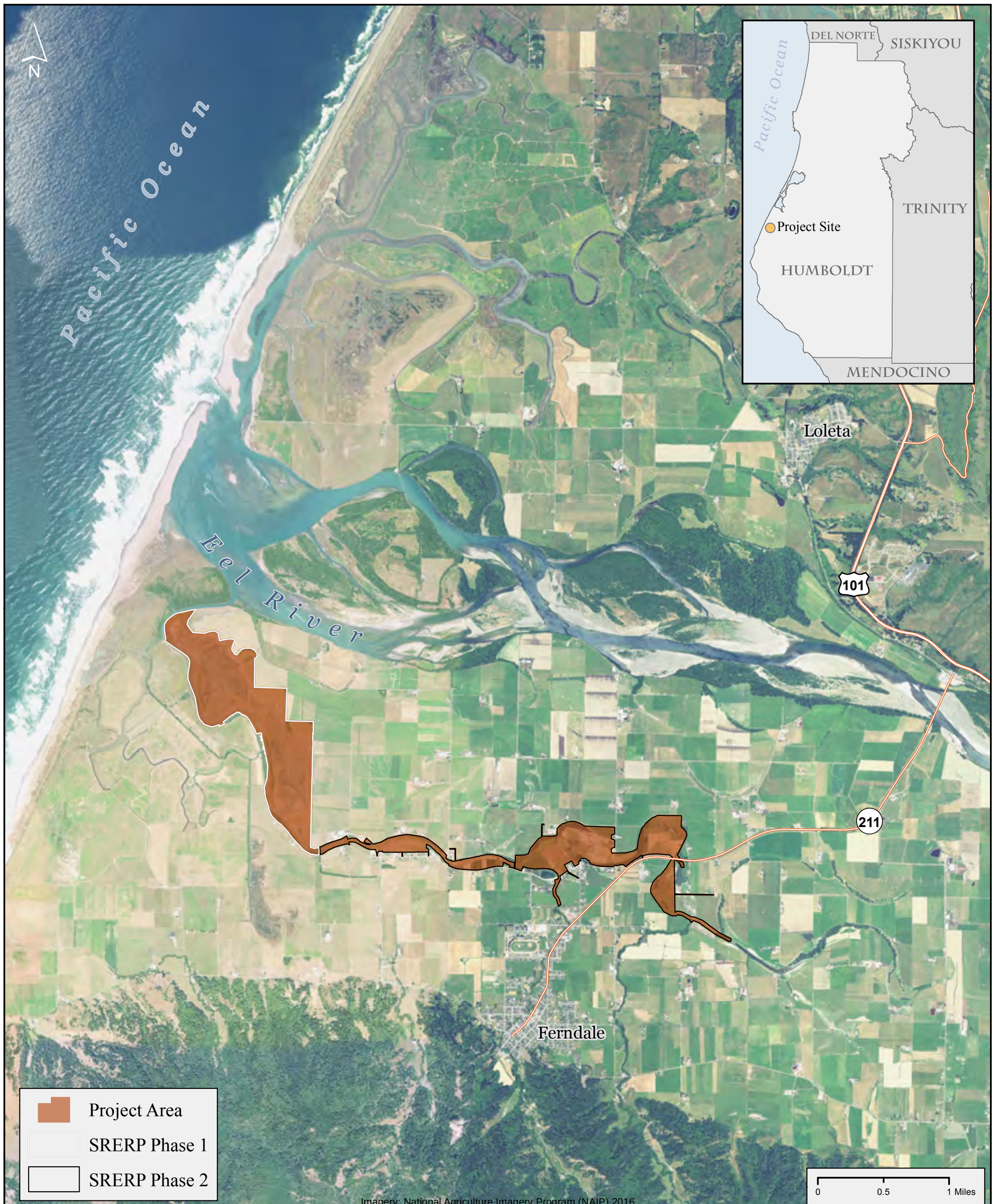

Figure 1. Salt River Ecosystem Restoration Project (SRERP) Vicinity
2016 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

- *Streambed Alteration Agreement Notification No. 1600-2011-0107-R1 Salt River, Francis Creek, Williams Creek, and Reas Creek* (California Department of Fish & Game 2012);
- *Humboldt County Resource Conservation District Conditional Use Permit Modification Case No. C-10-05M* for the Salt River Ecosystem Restoration Project (Humboldt County Department of Community Development Services 2011); and
- *Coastal Development Permit No. CDP-1-10-032* for the Salt River Ecosystem Restoration Project (California Coastal Commission 2012).

A quantitative assessment of the development of restored habitats and associated vegetation is an important component of this monitoring program, and is the focus of this annual habitat monitoring report.

1.2 Previous Monitoring & Reporting

The first two habitat monitoring efforts were performed by H.T. Harvey & Associates in 2014 and 2015, and are discussed in *Salt River Ecosystem Restoration Project (Phase 1): Vegetation Monitoring for the High Marsh Ecotone (Year 1) Final Report* (H.T. Harvey & Associates 2014) and *2015 Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project Final Report* (H.T. Harvey & Associates 2015), respectively. The monitoring schedule provided in the HMMP prescribes various monitoring requirements for the different combinations of restored habitats, vegetation parameters, and monitoring years (Table 1). Consistent with these prescriptions, the scope of the first two monitoring efforts (H.T. Harvey & Associates 2014 & 2015) only address the habitat area analysis and mapping, and vegetation sampling tasks for:

- the “high marsh ecotone” habitat in the Phase 1 restoration area in 2014; and
- both “high marsh ecotone” in the Phase 1 restoration area, and the edges of the active Salt River channel in the lower Phase 2A restoration area (referred to as “brackish marsh” in H.T. Harvey & Associates 2015), in 2015.

This current report provides documentation of the 2016 habitat monitoring effort for the Salt River Ecosystem Restoration Project, and addresses the expanded suite of projected habitats and monitoring requirements associated with this most recent monitoring effort.

2.0 Project Description

The SRERP is being implemented in two phases over the course of several years, beginning in the lower portion of the watershed near the Salt River’s confluence with the Eel River estuary, and progressing upstream to the vicinity of its confluence with Perry Slough near the toe of the coast range slope. The entire project area consists of approximately 7.7 miles of the Salt River channel and more than 800 acres of adjacent habitat. As of the 2016 habitat monitoring effort,

Table 1. SRERP Habitat Monitoring Schedule[1] for Phase 1 & Phase 2A. Bold text indicates the current monitoring year (2016).

Phase	Habitat Type	Monitoring Period & Schedule of Tasks[2]												
		2013	2014	2015	**2016**	2017	2018	2019	2020	2021	2022	2023	2024	2025
Phase 1	(Monitoring Year)		1	2	**3**	4	5	6	7	8	9	10		
	High Marsh Ecotone		BC	BC	**BC**	C	BC	C	BC	C	C	BC		
	"Tidal Salt & Brackish Marsh"		AC	C	**ABC**	C	ABC	C	ABC	C	C	ABC		
	(Monitoring Year)			1	**2**	3	4	5	6	7	8	9	10	
	Replanted Riparian Forest[3]			AC	**BC**	ABCD	C	ABCD	C	ABC	C	C	ABCD	
Phase 2A (Lower)	(Monitoring Year)			1	**2**	3	4	5	6	7	8	9	10	
	"Salt River Channel Wetlands"[4]			BC	**BC**	BC	C	BC	C	C	C	C	C	
	Riparian Planting Zones[5]			AC	**BC**	ABCD	C	ABCD	C	ABC	C	C	ABCD	
Phase 2A (Middle)	(Monitoring Year)				**1**	2	3	4	5	6	7	8	9	10
	"Salt River Channel Wetlands"[4]				**BC**	BC	BC	C	BC	C	C	C	C	C
	Riparian Planting Zones[5]				**AC**	BC	ABCD	C	ABCD	C	ABC	C	C	ABCD

[1] Adapted from Table 11 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] A = Habitat area (acreage) assessment
B = Percent vegetative cover assessment
C = Non-native invasive vegetation assessment
D = Diameter-at-breast-height (DBH) assessment of replanted woody riparian vegetation
[3] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish and freshwater channel wetlands.
[5] Includes both replanted riparian forest areas and active riparian berms.

the following phases and sub-phases of the restoration effort have been completed: Phase 1 and the first two sub-phases of Phase 2 (i.e., “Phase 2A [Lower]” and “Phase 2A [Middle]”).

Implementation of the SRERP involves extensive structural modifications to the Salt River channel system and adjacent floodplain wetland habitats in order to facilitate the enhancement of identified fluvial, hydrological, and ecological characteristics and functions. Extensive revegetation efforts follow completion of restoration construction activities in each phase and sub-phase of the project to stabilize disturbed soils and to re-establish suitable vegetative cover in the affected habitats. These efforts incorporate specific prescriptions for herbaceous and woody riparian species assemblages for each restoration area. These prescriptions were developed during the design phase of the project, and are provided in Tables 5-7 of the HMMP.

Herbaceous revegetation methods, which vary based on site conditions and desired species composition, include transplantation of propagated plant “plugs” as well as “hydroseeding,” seed-drilling, and broadcasting seed application methods. Additionally, in restoration areas designated for the re-establishment of woody riparian vegetation, young shrubs, tree saplings, and live cuttings are planted during the dormant season following restoration construction. Specific methodologies and technical specifications for these revegetation efforts are described in:

- *Humboldt County Resource Conservation District Salt River Ecosystem Project Riverside Ranch (Phase 1) Tidal Marsh Restoration Seed Application Plan* (GHD 2012a);
- *Seed and Mulch Application Plans and Technical Specifications Riverside Ranch (Phase 1) Tidal Marsh Restoration Salt River Ecosystem Restoration Project* (GHD 2012b);
- *Salt River Ecosystem Restoration Project Salt River Channel & Riparian Floodplain Corridor – Lower Phase 2A Restoration Planting Plans* (GHD with H.T. Harvey & Associates October 2014);
- *Salt River Ecosystem Restoration Project Phase 1 Revegetation As-Built Documentation* (HCRCD 2015a)
- *Humboldt County Resource Conservation District Salt River Ecosystem Project Revegetation: Wetland Plug Planting Plans Phase Middle 2A* (HCRCD 2015b);
- *Humboldt County Resource Conservation District Salt River Ecosystem Project Phase Middle 2A Riparian Planting Plans* (HCRCD 2015c); and
- *Humboldt County Resource Conservation District Salt River Ecosystem Project Revegetation: Riparian Tree/Shrub Planting Plans Phase Middle 2A-R3* (HCRCD 2016a).

A general description of each of the project phases, respective revegetation efforts, restoration goals, and targeted or “projected” habitats for which 2016 monitoring requirements apply, is introduced here to provide supportive context for the 2016 habitat monitoring effort. A more encompassing project description for the entire SRERP can be found in the HMMP.

2.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration

The first phase of the SRERP (Phase 1 – “Riverside Ranch Tidal Marsh Restoration Project”) was implemented in 2013 on property acquired by the California Department of Fish and Wildlife, historically known as “Riverside Ranch.” This ~440-acre Phase 1 restoration area, extends south (upstream) from its northern boundary near Salt River's confluence with Cutoff Slough and the Eel River, to the approximate location of the confluence between the Salt River and Reas Creek (Appendix A, Figures 2 & 3).

Phase 1 restoration increased the capacity of the Salt River channel through excavation and widening of much of its lower reach, and restored tidal connectivity throughout ~300 acres of the adjacent diked former tidelands by removing existing levees, excavating and grading reclaimed dairy pastureland, and developing a system of tributary channels throughout the Riverside Ranch restoration area. As part of Phase 1, a new 2.2 mile-long “setback levee” was also constructed around much of the eastern perimeter of the restored tidal habitat to prevent tidal inundation from extending beyond the restoration area, into adjacent agricultural pasturelands.

Approximately 2.5 miles of the Salt River channel and 2.8 miles of new and existing internal tributary channels were excavated and widened, and ~170,000 cubic yards of fill material was removed from reclaimed pastureland to achieve suitable topography, restoring tidal connectivity to these diked former tidelands. Restoration of tidal influence throughout this area has facilitated the development of important estuarine habitats historically more abundant throughout the region, such as tidal salt marsh and brackish wetlands, tidally influenced mudflats, and open water habitats, as well as associated and ecologically significant transitional zones or “ecotones.”

2.1.1 Phase 1 Projected Habitats

One of the primary goals of the SRERP is the creation and/or enhancement of specific targeted habitat types projected to be established by the completion of the restoration-monitoring period. These “projected habitat types” are described in the HMMP and depictions of those projected habitats that are relevant to the current effort have been reproduced here in Figure 2 (Appendix A). Some ambiguities inherent in the originally conceived habitat descriptions have been found to complicate assessments of restoration “success.” In this current (2016) effort we address the various habitat types in such a way as to better facilitate comparisons of observed results against success criteria. Explanations for our approach are incorporated into our treatment of projected habitats, below.

The single most extensive habitat type projected for the majority of the Phase 1 restoration area is variously referred to in the HMMP as either “tidal salt & brackish marsh” or “tidal salt marsh.” The remainder of the Riverside Ranch restoration area is partitioned into less extensive projected habitat types also central to the goals of the SRERP (i.e., aquatic, high marsh ecotone, and riparian forest), as well as some adjunct retained (e.g., “agricultural,” “developed,” etc.) and created (i.e., setback levees) features.

More recent investigations (H.T. Harvey & Associates 2014 & 2015, pers. obs.) of the region of the Phase 1 restoration area projected to become “tidal salt & brackish marsh”/“tidal salt marsh” have revealed substantial habitat complexity throughout this area, not reflected at the level of resolution invoked in the general assignment of “tidal salt & brackish marsh”/“tidal salt marsh” in the HMMP. Though much of this area does represent “true” salt marsh *sensu stricto* habitat, a complex system of aquatic tidal slough channels, unvegetated mudflats, and brackish wetlands also co-occur. This scenario presents potential confusion when attempting to evaluate restoration success using a comparison between observed salt marsh *sensu stricto* and a success criterion for the inconsistently labeled “tidal salt & brackish marsh” or “tidal salt marsh” area which actually represents a mosaic of different habitats (including salt marsh *sensu stricto*).

In an attempt to avoid further ambiguity and confusion, we have elected to use the slightly more inclusive habitat title, “tidal salt & brackish marsh,” (from the HMMP’s *Table 1. Land Use and Habitat Projections*) when referring to this original, projected aggregate habitat. We limit the use of specific terms such as “salt marsh” and “brackish marsh” to subordinate portions of the project area actually found to reflect characteristics typically associated with such habitat classifications (i.e., *sensu stricto*). Below, we briefly describe projected habitat types and relevant subordinate habitat components that directly relate to the 2016 habitat monitoring goals using this described approach to the organization of these habitat types. Other associated retained and/or created habitat features lacking monitoring requirements are not addressed.

Phase 1: “Tidal Salt & Brackish Marsh”
As described above, this habitat complex actually consists of a mosaic of distinct habitat types. For the purposes of conducting the appropriate annual habitat monitoring tasks for the Phase 1 restoration area, the habitat types considered include salt marsh *sensu stricto*, brackish marsh, aquatic, and mudflat habitats.

Salt Marsh **sensu stricto**
Extensive excavation and grading restored tidal influence throughout the majority of the Phase 1 area, with the intent of facilitating the re-establishment of tidal salt marsh habitat in this area. No reseeding efforts were conducted in these portions of the Phase 1 area subject to regular tidal inundation. It was anticipated that these areas would respond sufficiently with natural recruitment of native salt marsh species, whose propagules are predominantly dispersed by means of tidal mechanisms. “Salt Marsh” is classified as an estuarine emergent wetland habitat

in *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979).

Brackish Marsh

Substantial geomorphological modifications were not undertaken in portions of the Phase 1 restoration area that were already within an elevation range expected to experience regular tidal influence following adjacent excavation and grading activities. Over time, these predominantly palustrine emergent wetland (Cowardin et al. 1979) habitats (referred to as "wet grasslands" in H.T. Harvey & Associates 2015) are expected to undergo gradual conversion to either brackish marsh or salt marsh habitat in response to increased tidal influence resulting from restoration efforts. Phase 1 habitat types designated as "brackish marsh" are those habitats that have not been converted to salt marsh, but that are exposed to intermediate water chemistry with increased salinity, and that support vegetation tolerant of such conditions. Brackish marsh habitats were not reseeded following the completion of construction based on the same rationale described for salt marsh habitats. Being subject to tidal inundation, it is anticipated that the species composition in these areas will naturally transition during the conversion process.

Aquatic & Mudflat Habitat

"Aquatic" habitats consist of unvegetated and wetted portions of the active Salt River channel between its confluences with Reas Creek and Cutoff Slough, and all similar associated tidal slough tributary channels within the Phase 1 area. Mudflats consist of unvegetated areas, subject to regular and periodic tidal inundation and ponding. In the context of this habitat monitoring effort, "unvegetated" is defined as having <5% vegetative cover.

Phase 1: High Marsh Ecotone

The "high marsh ecotone" is an ecologically valuable habitat feature incorporated into the Phase 1 restoration design, and consists of a gradual incline constructed along the entire tidal slope of the new setback levee to create a broad transitional zone between the salt marsh *sensu stricto* wetland habitat and the (upland) setback levee itself. This transition zone was hydroseeded in September and October of 2013, following completion of Phase 1 construction with a seed prescription composed of native plant species considered suitable for such transitional conditions (H.T. Harvey & Associates with Winzler & Kelly 2012) and a sterile "wheatgrass" hybrid (*Elymus x Triticum*). Sterile hybrid seed is commonly used to achieve rapid soil stabilization in restoration of disturbed habitats due to its relatively vigorous germination and growth rates as well as its limited potential for reproduction. This seed blend was selected to achieve rapid soil stabilization initially, while simultaneously encouraging the establishment of a native flora consistent with similar native ecotonal communities in the region.

Phase 1: Riparian Habitats

In the context of vegetation, the term "riparian" is traditionally understood to be inclusive of all types of plant species associated with rivers or streams, regardless of a species' growth form or "habit" (e.g., herbaceous plants, woody shrubs, woody vines, trees, etc.). Use of this adjective in project-related documents for the SRERP, however, appears to refer only to the woody component (trees, shrubs, and/or woody vines) of riparian vegetation under consideration. In an attempt to avoid potential confusion, the current 2016 monitoring report conforms to such usage; hereafter, "riparian" is used to indicate habitats generally recognized as being classified as "forested wetlands" and/or "scrub-shrub wetlands" (Cowardin et al. 1979).

Implementation of Phase 1 necessitated the removal of some stands of pre-existing willow (*Salix* spp.)-dominated riparian forest, though portions of this existing habitat type were retained wherever possible. Following completion of construction, woody riparian species were also replanted throughout suitable "riparian planting zones" of the Phase 1 project area to achieve identified restoration goals and to compensate for the project-related loss of this valuable habitat component. Suitable "riparian planting zones" consisted primarily of areas adjacent to the Salt River channel, and were typically contiguous with retained portions of pre-existing riparian forest. Due to exceptionally dry conditions occurring during the dormant planting season immediately following completion of construction (winter 2013/2014), replanting of Phase 1 woody riparian vegetation was instead delayed until the subsequent planting season in early 2015 (HCRCD 2015a). Riparian planting zones were also revegetated with suitable herbaceous species, following specifications provided in the aforementioned revegetation guidance documents.

2.2 Phase 2A – Salt River Corridor Restoration

The second phase of the SRERP (Phase 2) was initiated in 2014, following completion of Phase 1, and progressed upstream from the Phase 1 – Riverside Ranch restoration area. As of the 2016 habitat monitoring effort, the first two sub-phases of Phase 2 have been completed: "Phase 2A (Lower)" and "Phase 2A (Middle)." The distinction between "lower" and "middle" reaches reflects the progression of implementation of the respective restoration efforts, and the restoration goals and approach were consistent across both.

Phase 2A (Lower) was implemented in 2014. This restoration reach extends along the Salt River corridor, upstream from the southern-most limit of the Phase 1 project area, to a location approximately 200 feet upstream from the Dillon Road bridge crossing of the Salt River channel (Appendix A, Figures 2 & 4). The following year (2015), Phase 2A (Middle) restoration proceeded from the upstream terminus of Phase 2A (Lower) project reach, to a location approximately 0.4 linear miles upstream from the Dillon Road bridge, and ~1,000 feet northwest of the City of Ferndale's wastewater treatment facility (Appendix A, Figures 2 & 5).

Restoration activities associated with these initial Phase 2 efforts focus on Salt River channel modifications and restoration of immediately adjacent habitat within the riparian corridor. Future design elements proposed for subsequent

SRERP efforts further upstream include restoration of adjacent seasonal freshwater wetland habitats extending beyond the immediate riparian corridor (H.T. Harvey & Associates with Winzler & Kelly 2012). Salt River channel modifications involve excavation, widening, and recontouring to increase channel capacity, encourage conveyance of sediment through the system, and facilitate the development and maintenance of identified hydrologic and ecologic riparian habitat functions. Backwater alcoves, engineered log-jams, coarse woody debris, and other design features are also being incorporated into the channel during recontouring to increase channel morphological complexity and provide important habitat features for fish and other native aquatic species.

All disturbed portions of the Phase 2A project areas restored thus far were revegetated with appropriate species blends that correspond to five designated planting zones (i.e., brackish riparian forest, freshwater riparian forest, brackish active riparian berm, freshwater active riparian berm, and brackish marsh) following completion of construction (GHD 2015 and HCRCD 2016b). Revegetation efforts were consistent with the aforementioned guidance documents and involved hydroseeding and broadcast application methods for seed blends in autumn of 2015 and 2016 for Phases 2A (Lower) and (Middle), respectively. Revegetation of designated areas with woody species and “wetland plugs” occurred in winter and spring of 2014/2015 for Phase 2A (Lower), and 2015/2016 for (Phase 2A Middle).

2.2.1 Phase 2A Projected Habitats & Associated Habitat Components

Consistent with the first phase of the SRERP, Phase 2A restoration areas were designed, constructed, and revegetated with the intent to establish identified geomorphological and hydrological functions, and/or specific targeted or “projected” habitats. Different plant species assemblages were prescribed (H.T. Harvey & Associates with Winzler & Kelly 2012, GHD with H.T. Harvey & Associates October 2014, and HCRCD 2015b, 2015c, & 2016a) for various restoration “habitat components” throughout both reaches. These species compositions were developed based on a combination of restoration goals, various hydrological regimes, edaphic conditions, and/or other site-specific factors.

Projected habitat types within the Phase 2A Salt River restoration corridor identified in the HMMP include riparian habitats, “sediment management areas,” and two distinct types of wetland systems contiguous with the wetted Salt River channel: “brackish marsh” and “freshwater channel” wetlands. For the purposes of the 2016 habitat monitoring effort, we refer to portions of the Phase 2A Salt River corridor restoration area that are contiguous with the wetted Salt River channel, and are not otherwise classified as existing “riparian forest/scrub,” “riparian planting zones,” or “sediment management areas” to be part of the “Salt River channel wetland” system. This “Salt River channel wetland” system is composed of both “brackish marsh” and “freshwater” channel wetlands. Each of these habitats and relevant design components addressed in the 2016 habitat monitoring effort are identified and briefly described below.

Phase 2A: "Salt River Channel Wetlands"

The "Salt River channel wetland" system associated with the Phase 2A – Salt River corridor portion of the SRERP consists of estuarine, riverine, and palustrine emergent wetland habitats (Cowardin et al. 1979) that currently support predominantly herbaceous vegetation. Forested and scrub-shrub wetland habitats associated with Phase 2A are discussed separately in the "riparian habitats" section below. Specific features of these Salt River channel wetland habitats addressed in the 2016 habitat monitoring effort consist of active channel and active bench habitat components. A brief description of each component, as well as the hydrochemical gradient driving the transition from brackish marsh to freshwater wetland systems within the Phase 2A restoration area, follows.

Active Channel

The "active channel" represents the primary wetted Salt River channel that consistently conveys stream flow and sediment throughout the year. Although the immediate channel banks experience scouring during high-velocity flows, replanted and volunteer vegetation is established on the edges of the upper banks.

Active Bench

The "active bench" is a dynamic alluvial geomorphological feature extending from the edge of the active channel out to the upper reach of the Salt River corridor and adjacent Eel River floodplain. The active bench was designed to provide an interface between the active channel of the Salt River and the adjacent landscape, by accepting flows exceeding bankfull channel capacity during high-flow events, as well as receiving deposition of sediments transported from upstream sources. These wetland habitats provide for additional geomorphological diversity, sediment deposition, the establishment of wetland vegetation, low-velocity refugia for aquatic organisms during high-flow events, and foraging and breeding habitat for terrestrial wildlife and avian species during other times of the year.

Brackish Marsh & Freshwater Channel Wetland Habitats

Tidal influx and upstream freshwater contributions combine in the Phase 2A restoration area resulting in brackish hydrological conditions, particularly in the lower Phase 2A reach. Plant species tolerant of such intermediate water chemistry are expected to become established along the edges of the active Salt River channel and in adjacent active bench habitats exposed to tidal influence. With increasing distance upstream, and/or away from the active channel edge, the vegetation should transition into a plant community composed of species more typically adapted to freshwater conditions in response to this water chemistry gradient.

Tidal influence extends upstream in the Salt River active channel to a point approximately 600 feet upstream of the Dillon Road bridge (GHD with H.T. Harvey & Associates 2014), or ~400 feet upstream of the boundary between the “lower” and “middle” reaches of the Phase 2A restoration area. Beyond this point, the Salt River hydrological regime is understood to be a predominantly freshwater system. The actual transition between brackish and freshwater conditions of the adjacent active bench habitat is both variable and gradual due to variations in the geomorphology of the reconstructed channel, the dynamic nature of the associated hydrology, and the fact that the restored habitat is still in the early stages of development. Findings from the 2016 effort reflecting the current distribution of brackish and freshwater habitats are presented in Section 4.0 (below) and Appendix A.

Disambiguation of “Brackish Marsh”

The term “Brackish Marsh” has been used in the planning context of Phase 2 of the SRERP to refer to estuarine emergent wetland habitats expected to develop in the lower reach of the Phase 2A restoration area, including both aforementioned wetland design components associated with the Salt River channel (i.e., active channel and active bench). However, during the 2015 habitat monitoring effort (H.T. Harvey & Associates 2015), “brackish marsh” appears to be strictly limited to the active channel edge in the Phase 2A (Lower) reach, presumably relying on the basis of planting plans and associated revegetation prescriptions for a species assemblage suitable for such conditions (GHD with H.T. Harvey & Associates 2014). We anticipate, however, that tidal influence in the lower Phase 2A reach extends beyond the active channel edge, and into the adjacent active bench areas, particularly in the downstream region of this restoration reach.

Therefore, throughout the current 2016 habitat monitoring effort, we apply the term “brackish marsh wetlands” to all estuarine emergent wetland habitats subject to brackish hydrological conditions, (whether in reference to such habitats in the Phase 1 restoration area or to Phase 2A Salt River channel wetlands [i.e., active channel and/or active bench]), not just the active channel edge of Phase 2A. For purposes of comparison between 2015 and 2016 results, H.T. Harvey & Associates’ (2015) use of “brackish marsh” is equivalent to the Phase 2A (Lower) “active channel” discussed in this 2016 report.

Phase 2A: Riparian Habitats

Performance of the Phase 2A restoration activities necessitated the removal of some portions of pre-existing riparian forest, as had also occurred during Phase 1. This existing habitat was retained where possible, and woody riparian vegetation was replanted in suitable “riparian planting zones” during the subsequent dormant seasons for each project sub-phase to compensate for the loss of this habitat component as well as to achieve identified restoration goals. Riparian planting zones were also revegetated with suitable herbaceous species, following specifications provided in the aforementioned revegetation guidance documents.

Suitable Phase 2A riparian planting zones included both areas of “replanted riparian forest” along the upper riparian channel banks, contiguous with retained pre-existing riparian forest, as well as along the “active riparian berms.” “Active riparian berms” consist of linear, elevated channel edge design features that were constructed along specific portions of the interface between the edge of the active channel and the immediately adjacent active bench habitats. These active riparian berms serve as “natural” levees, provide bank stabilization, and are anticipated to eventually provide shading of the channel as well as underwater refugia for fish and other aquatic species.

Phase 2A: Sediment Management Areas

“Sediment management areas” are channel corridor restoration features designed to provide low-velocity locations for the deposition of transported sediments during high-flow events. Periodic removal of sediment from these areas is expected to address anticipated aggradation and to prevent channel occlusion. Given the anticipated periodic burial- and sediment removal-related disturbances in these sediment management areas, habitat-monitoring efforts are not required in these portions of the restoration area, and are not addressed further in this report.

3.0 Methods

Consistent with the schedule of monitoring requirements (Table 1) provided in the HMMP, the 2016 SRERP habitat monitoring effort consisted of three tasks: verification of habitat conditions to update maps of the distribution of specific habitats within respective portions of the SRERP project area, quantitative sampling within specific habitats to characterize the associated vegetation, and the documentation of invasive vegetation encountered during these efforts. Methods used to accomplish each of these tasks are described below.

On 7 July, 2016, J.B. Lovelace & Associates’ Principal Environmental Scientist and plant ecologist, Brett Lovelace, met with HCRD staff at the SRERP site for reconnaissance purposes and to discuss logistical considerations germane to the performance of the 2016 habitat monitoring effort. All subsequent fieldwork was conducted between 25 August and 10 September, 2016, and was performed by Brett Lovelace.

3.1 Habitat Mapping & Area Analysis

Updated habitat maps were developed to reflect current site conditions using ArcMap® (ESRI) geographic information system (GIS) desktop software and existing SRERP GIS data provided by the HCRCD. These existing data were compared with the most recent satellite imagery (Google Earth 2016 and National Agriculture Imagery Program [NAIP] 2016) and observations made during our 2016 fieldwork to revise the extent of respective habitats where changes had occurred. Recent field observations for map boundary verification purposes included geographic data collected using a Trimble® Juno® global positioning system (GPS) device with ArcPad® software (ESRI). The resulting maps are included in Appendix A as Figures 3-5. Upon completion of updated habitat maps, habitat area (acreage) totals were also calculated using ArcMap® software (ESRI).

Although the HMMP schedule of monitoring tasks only explicitly requires the analysis of habitat area (acreage) for Phase 1 “naturally recruiting salt marsh” and Phase 2 “riparian” habitats in 2016, additional pertinent habitat boundaries were also updated to facilitate quantitative sampling needs (described below), and respective habitat area (acreage) calculations were performed for these habitats as well. Our analysis of Phase 1 “tidal salt & brackish marsh” assumes the inclusion of all associated and more narrowly described subordinate habitats (i.e., salt marsh *sensu stricto*, brackish marsh, aquatic, mudflat, and upland) following guidance provided in HCRCD’s clarifying memorandum (*Memorandum: Salt River Ecosystem Restoration Project Habitat Mitigation and Monitoring Plan – Clarifications for Vegetation Monitoring*) to the California Coastal Commission (HCRCD 2016c).

Habitat area success criteria established in the HMMP are included with respective 2016 habitat area analysis results in Tables 6-8 for evaluation purposes. It is important to note that habitat area (acreage) success criteria provided in the HMMP for Phase 2 represent total “phase-wide” acreage thresholds (including upstream areas where restoration has not yet occurred), and do not reflect any partitioning into “sub-phase” quantities corresponding to the actual progression in which Phase 2A Lower and Middle restoration efforts were implemented. In the absence of sub-phase-specific success criteria, respective thresholds were proportionately extrapolated for each relevant Phase 2 sub-phase habitat using ArcMap® and appropriately truncated “projected habitat” GIS data created during the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

3.2 Quantitative Vegetation Analysis & Percent Cover Sampling

J.B. Lovelace & Associates also conducted a quantitative sampling effort to analyze and characterize the vegetation associated with specific habitats within the SRERP restoration area identified in the HMMP’s schedule of monitoring requirements, and following guidance provided in the aforementioned memorandum (HCRCD 2016c). Specific habitats where quantitative vegetation sampling occurred included: salt marsh *sensu stricto*, high marsh ecotone, and replanted riparian forest habitats in the Phase 1 restoration area; Salt River channel wetlands and riparian planting zone habitats in the Phase 2A Lower restoration area; and Salt River channel wetland habitats in the Phase 2A Middle restoration area. All botanical taxonomic nomenclature presented in this effort is consistent with *The Jepson Manual: Vascular Plants of California, Second Edition* (Baldwin et al. 2012).

3.2.1 Sampling Design & Data Collection

In each vegetation sampling area, we used a stratified, randomized sampling approach to collect percent cover data to characterize the abundance, species composition, and structural composition of existing vegetation. The goal of such a sampling approach is to sufficiently distribute the collection of vegetation measurements throughout sampling areas to provide the most accurate, quantitative characterization of the vegetative categories of interest throughout the site, while minimizing any pre-conceived bias on the part of the observer.

Using existing SRERP GIS data and ArcMap® software, each phase and sub-phase of the restoration area was partitioned into ecologically distinct sampling areas of perceived relative homogeneity; based on project reach, restoration habitat design components, revegetation prescriptions, and elevation strata. ArcMap® software was then used to randomly distribute sampling plot locations throughout each of these sampling areas (Figures 6-8) in quantities proportionate to the sample size per-unit-area determined to be sufficient for the habitats sampled during the 2015 sampling effort (H.T. Harvey & Associates 2015) (described below). Where single sampling areas (e.g., salt marsh *sensu stricto*, etc.) were composed of multiple, geographically distinct polygons, initially derived sample size quantities were partitioned and allocated proportionately, based on polygon size (area). In instances where sampling plot observations indicated a habitat type other than that assigned in the original GIS data, the sample plots and collected data were re-assigned to the appropriate habitat type, yielding sample sizes slightly greater or less than originally intended. (Such instances allowed for further refinement and appropriate adjustments to habitat boundaries as part of the associated habitat mapping and area analysis effort.)

Geographic coordinates for each randomly assigned sample plot location were then appropriately corrected and uploaded to the aforementioned GPS unit for location during fieldwork. Once sample plots were located in the field, a $1m^2$ sampling frame, or "quadrat," constructed from ¼-inch diameter PVC was then used to visually estimate:

- (total) percent vegetative cover, and
- (absolute) percent cover of each species present.

In order to evaluate these data against the success criteria for specific vegetative parameters, each observed plant species was categorized as:

- native,
- non-native non-invasive,
- non-native invasive, or
- sterile “wheatgrass” hybrid (*Elymus* x *Triticum*);

as well as being:

- herbaceous (an herb),
- arborescent (a tree), or a
- shrub.

Table 2. Modified Braun-Blanquet (1928) Plant-Cover Abundance Scale.[1]

Cover Class	Range of Percent Cover	Median (%)
r	<1 (single individual)	0.1
+	<1 (sporadic or few)	0.5
1	1–5	3.0
2	>5–25	15.0
3	>25–50	37.5
4	>50–75	62.5
5	>75–95	85.5
6	>95-100	97.5

[1] Source: H.T. Harvey & Associates 2015.

Percent cover data collected for each species reflected that species' *absolute* cover, which is distinct from *relative* cover. *Absolute* cover quantifies the entire aerial projection of each species (or any other vegetative category of interest) within the sample frame, regardless of any canopy overlap between different species. When measuring absolute cover, resulting cumulative cover values for sampled locations that exceed 100% for a given sample are not uncommon (Barbour et al. 1998, etc.). Absolute cover data are generally considered to allow for a broader range of analytical applications. In contrast, *relative* cover values always represent a proportion between 0-100%, and can be less informative due to reduced precision in addressing areas of overlapping vegetative canopy.

In an attempt to minimize any observer-related variation between monitoring efforts, the same "modified" Braun-Blanquet (1928) cover-abundance scale (Table 2) described in both the 2014 and 2015 monitoring efforts (H.T. Harvey & Associates 2014 & 2015, respectively) was also used during the 2016 sampling fieldwork to assign a "cover class" to the visually estimated absolute percent cover for each species observed during sampling. Median percent cover values for the range associated with each cover class were then used in subsequent analyses. Although some precision is lost when using such a method, plant-cover abundance scales can be useful in long-term monitoring projects as they serve to reduce observer-based variation between observation periods.

The vegetation success criteria specified in the HMMP consist of minimum percent cover thresholds for native species and maximum percent cover thresholds for both non-native non-invasive and non-native invasive species for the various combinations of habitat type and monitoring year. These criteria are summarized below in Tables 3-5. Although no such "percent cover" success criteria are specified for vegetative structural composition (other than related criteria for riparian habitat acreage), a characterization of the structural type of sampled vegetation in riparian planting zones was requested during a meeting

Table 3. SRERP Native Vegetation Sampling Success Criteria.[1] Bold text indicates the current monitoring year (2016). Missing values indicate monitoring years for which no habitat monitoring tasks are required for respective habitats.

Phase	SRERP Habitat Type	2013	2014	2015	**2016**	2017	2018	2019	2020	2021	2022	2023	2024	2025
		Percent Cover Native Plant Species Success Criteria (≥)												
Phase 1	(Monitoring Year)		1	2	**3**	4	5	6	7	8	9	10		
	High Marsh Ecotone		5%	15%	**30%**	–	40%	–	50%	–	–	60%		
	Salt Marsh *sensu stricto*[2]		–	–	**10%**	–	30%	–	50%	–	–	60%		
	(Monitoring Year)			1	**2**	3	4	5	6	7	8	9	10	
	Replanted Riparian Forest[3]			–	**15%**	30%	–	40%	–	60%	–	–	80%	
Phase 2A (Lower)	(Monitoring Year)			1	**2**	**3**	4	5	6	7	8	9	10	
	"Salt River Channel Wetlands"[4]			10%	**20%**	30%	–	50%						
	Riparian Planting Zones			–	**15%**	30%	–	40%	–	60%	–	–	80%	
Phase 2A (Middle)	(Monitoring Year)				**1**	2	3	4	5	6	7	8	9	10
	"Salt River Channel Wetlands"[4]				**10%**	20%	30%	–	50%					
	Riparian Planting Zones				**–**	15%	30%	–	40%	–	60%	–	–	80%

[1] Adapted from Tables 8-10 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] Vegetation sampling of "salt marsh" in the Phase 1 restoration area occurred in the more narrowly defined habitat area, as per guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[3] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish marsh and freshwater channel wetlands.

Table 4. SRERP Non-Native Non-Invasive Vegetation Sampling Success Criteria.[1] Bold text indicates the current monitoring year (2016). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

Phase	SRERP Habitat Type	Percent Cover Non-Native Non-Invasive Plant Species Success Criteria												
		2013	2014	2015	**2016**	2017	2018	2019	2020	2021	2022	2023	2024	2025
Phase 1	(Monitoring Year)		1	2	**3**	4	5	6	7	8	9	10		
Phase 1	High Marsh Ecotone		–	–	**–**	–	–	–	–	–	–	<15%		
Phase 1	Salt Marsh *sensu stricto*[2]		–	–	**–**	–	–	–	–	–	–	<15%		
Phase 1	(Monitoring Year)			1	**2**	3	4	5	6	7	8	9	10	
Phase 1	Replanted Riparian Forest[3]			–	**–**	–	–	–	–	–	–	–	<15%	
Phase 2A (Lower)	(Monitoring Year)			1	**2**	**3**	4	5	6	7	8	9	10	
Phase 2A (Lower)	"Salt River Channel Wetlands"[4,5]			–	**–**	–	–	<15%						
Phase 2A (Lower)	Riparian Planting Zones			–	**–**	–	–	–	–	–	–	–	<15%	
Phase 2A (Middle)	(Monitoring Year)				**1**	2	3	4	5	6	7	8	9	10
Phase 2A (Middle)	"Salt River Channel Wetlands"[4,5]				**–**	–	–	–	<15%					
Phase 2A (Middle)	Riparian Planting Zones				**–**	–	–	–	–	–	–	–	–	<15%

[1] Adapted from the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] Vegetation sampling of "salt marsh" in the Phase 1 restoration area occurred in the more narrowly defined habitat area, as per guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[3] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish marsh and freshwater channel wetlands.
[5] Although not explicitly specified in the HMMP, it is assumed that these criteria for non-native vegetation are intended for "Salt River channel wetlands," as they are for all other habitats where percent cover sampling is a requirement.

Table 5. SRERP Non-Native Invasive Vegetation Sampling Success Criteria.[1] Bold text indicates the current monitoring year (2016). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

Phase	SRERP Habitat Type	Percent Cover Non-Native Invasive Plant Species Success Criteria												
		2013	2014	2015	**2016**	2017	2018	2019	2020	2021	2022	2023	2024	2025
Phase 1	(Monitoring Year)		1	2	**3**	4	5	6	7	8	9	10		
Phase 1	High Marsh Ecotone		–	–	**–**	–	–	–	–	–	–	<5%		
Phase 1	Salt Marsh *sensu stricto*[2]		–	–	**–**	–	–	–	–	–	–	<5%		
Phase 1	(Monitoring Year)			1	**2**	3	4	5	6	7	8	9	10	
Phase 1	Replanted Riparian Forest[3]			–	**–**	–	–	–	–	–	–	–	<5%	
Phase 2A (Lower)	(Monitoring Year)			1	**2**	**3**	4	5	6	7	8	9	10	
Phase 2A (Lower)	"Salt River Channel Wetlands"[4,5]			–	**–**	–	–	<5%						
Phase 2A (Lower)	Riparian Planting Zones			–	**–**	–	–	–	–	–	–	–	<5%	
Phase 2A (Middle)	(Monitoring Year)				**1**	2	3	4	5	6	7	8	9	10
Phase 2A (Middle)	"Salt River Channel Wetlands"[4,5]				**–**	–	–	–	<5%					
Phase 2A (Middle)	Riparian Planting Zones				**–**	–	–	–	–	–	–	–	–	<5%

[1] Adapted from the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] Vegetation sampling of "salt marsh" in the Phase 1 restoration area occurred in the more narrowly defined habitat area, as per guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[3] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish marsh and freshwater channel wetlands.
[5] Although not explicitly specified in the HMMP, it is assumed that these criteria for non-native vegetation are intended for "Salt River channel wetlands," as they are for all other habitats where percent cover sampling is a requirement.

with project partners and the California Coastal Commission staff (HCRCD 2016c). During this same meeting it was also determined that quantitative vegetation sampling was not required within retained existing riparian habitat areas. This does not change the requirements established in the HMMP for monitoring the extent (acreage) of this habitat throughout the duration of the monitoring period.

3.2.2 Data Analysis

Statistical methods used to analyze percent cover data collected in the 2016 habitat monitoring effort consisted of: 1) power analyses to asses the adequacy of sample sizes (“n”) within each vegetation sampling area and to provide sample size recommendations for the subsequent monitoring year, and 2) non-parametric bootstrap analyses to evaluate the precision of mean percent cover estimates for the various vegetation categories of interest. To the extent possible, we attempted to maintain consistency with methods employed in previous monitoring efforts (H.T. Harvey & Associates 2014 & 2015) to minimize any investigator-related discrepancies (statistical error) introduced in comparisons between results from different monitoring years. Methods used in the 2016 monitoring effort are described below.

At the sample plot level, mean estimates for the various categories of interest (i.e., native, non-native non-invasive, invasive, and hybrid) were calculated from summed Braun-Blanquet cover class median percent cover values for each vegetation category. These sample plot means for the various categories were then used to calculate respective mean estimates for each sampling area. The same procedure was used to produce mean percent cover estimates for the vegetative structural categories (i.e., herb, tree, and shrub) in riparian planting zones. Mean *total* percent cover of vegetation was simply calculated from summed sample plot values for this variable. All statistical analyses were performed using the statistical software program “R” (The R Foundation for Statistical Computing 2016).

Power Analyses

Transformation of collected sample data was necessary to satisfy two assumptions germane to a valid analysis of the adequacy of vegetation sample sizes. One fundamental assumption inherent in performing power analysis calculations requires that the mean sample distribution be “normally” distributed. Given that the data collected in 2016 were not normally distributed, arcsine-squareroot-transformation of collected data was warranted to yield continuous (unbounded) values, which more closely approximate a “normal” statistical sample distribution. Arcsine-squareroot transformation, however, assumes that subject values range between 0−1. To satisfy this requirement, mean absolute cover values for each vegetative category of interest described above were first “pro-rated” with respect to pertinent “total vegetative cover” values to yield relativized mean cover values ranging between 0−100%, thereby allowing for power analyses to be performed.

Two separate analyses of sample size adequacy were conducted. First, prior to the 2016 fieldwork, power analyses were performed using monitoring data produced in 2015 (H.T. Harvey & Associates 2015) to derive appropriate sample sizes for the two habitats addressed during that effort: high marsh ecotone in the Phase 1 area and the active channel (referred to as “brackish marsh” in H.T. Harvey & Associates 2015) in the Phase 2A (Lower) reach. These initial sample sizes served as preliminary estimates, from which sample sizes for all habitats associated with the 2016 sampling effort were extrapolated. Power analyses were also performed, retrospectively, following the 2016 data collection effort, to assess the adequacy of the 2016 sampling size for each habitat area where vegetation sampling was conducted. These analyses also served to provide recommendations for sample sizes for the subsequent monitoring year (2017).

In an attempt to maintain consistency with the previous monitoring effort (H.T. Harvey & Associates 2015), power analyses were initially performed using assumptions described in the HMMP. Although the descriptions provided therein were somewhat equivocal, they were interpreted to indicate that power analyses should assume 80% statistical power to detect an effect size equal to the difference between the observed mean percent cover of the category of interest and the relevant success criterion for each respective combination of habitat type and monitoring year, using a [two-sided] t-test and a significance level of 0.20 (80% confidence).

However, these analyses yielded sample sizes determined to be inadequate to sufficiently account for both within-habitat heterogeneity and the high likelihood of inter-annual “process error” (particularly in larger habitats). Due to these and other problems inherent in that approach, we ultimately performed respective power analysis calculations, instead, assuming 80% statistical power and a significance level of 0.05 (95% confidence) to be able to detect effect sizes of 0.5 standard deviations between respective sample means and relevant success criteria (representing a so-called “medium” effect size, as per Cohen 1988) using a two-sided t-test. Additional rationale is provided Section 5.2.1, below.

This latter suite of assumptions provides for an increased level of certainty that resulting sample sizes are sufficient to detect significant (and relevant) deviations between observed sample means and respective success criteria, while still being conservative with respect to the required level of effort. In every instance, sample sizes associated with the 2016 sampling efforts for each sampled habitat type were determined to have exceeded the minimum quantities necessary to detect significant (and meaningful) differences between observed mean estimates of percent cover for the various vegetative categories of interest and their respective monitoring year success criteria.

Nonparametric Bootstrap Analysis

Non-parametric bootstrap methods (Efron & Tibshirani 1993) were used to calculate 95% confidence intervals for observed mean percent cover estimates for each vegetative category of interest by applying the “BCa” approach (Efron

1987) to the pro-rated (but not arcsine-squareroot-transformed) data described above. Arcsine-squareroot data transformation was not necessary in this application. "Bootstrapping" provides a method of quantifying the variability between observations (e.g., sample means, etc.) within a dataset by repeatedly resampling (with replacement) the collected data at random. Each resampling event produces a corresponding sample mean, with the greater the number of replicate samples yielding an increased degree of precision in characterizing the variability inherent in the data set. This variability is then used to calculate confidence intervals for reported sample means. In this exercise, we resampled each data set 100,000 times to produce confidence intervals for each combination of vegetative category of interest and sampled area.

3.3 Invasive Plant Species Assessment

During the performance of site reconnaissance, habitat mapping, and quantitative vegetation sampling fieldwork, all encountered occurrences of invasive vegetation were documented using the aforementioned GPS device. The resulting geographic data were subsequently uploaded, appropriately corrected, and used to develop maps depicting the distribution and extent of invasive species observed throughout the SRERP area using ArcMap® software and the most recent satellite imagery (NAIP 2016). The resulting maps are included in Appendix A as Figures 9-12.

Where feasible, the distributions of discrete invasive species were mapped separately. In some instances, the distributions of multiple co-occurring species overlapped to produce such complex mosaics that mapping separate species was not practical in the context of this effort. In such instances, the resulting combined species distribution mosaics were mapped as species "complexes." These "complexes" were assigned titles referencing the most dominant invasive species genera. These species complexes are included in respective figures (Appendix A), and the most well represented species associated with each complex are also indicated.

Classification of plant species as native, non-native non-invasive, and invasive are consistent with the classification used in previous habitat monitoring efforts (H.T. Harvey & Associates 2014 & 2015) in an attempt to maintain consistency throughout the duration of the entire SRERP monitoring period. As referenced in these previous monitoring reports, this classification is largely based on designations assigned by the California Invasive Plant Council (Cal-IPC) (2014 & 2015, respectively) and the Humboldt County Weed Management Area (WMA) (2010). Except as noted otherwise, taxa encountered in the current habitat monitoring effort not addressed in these previous reports are considered "invasive" if assigned a "high" rating by Cal-IPC (2016). None of the species encountered in our fieldwork are listed as "federal noxious weeds" (USDA 2016).

Native plants are those "occurring naturally in an area, as neither a direct nor indirect consequence of human activity" (Baldwin et al. 2012). Non-native species are those introduced as a direct or indirect result of human activity. Non-native invasive plants are defined by Cal-IPC (2016) as non-native species threatening “wildlands“ by displacing and/or hybridizing with native species and/or likely to “alter biological communities, or alter ecosystem processes.”

Although not currently addressed as invasive by Cal-IPC (2016) or the Humboldt County Weed Management Area (2010), we include two native plant species in our treatment of invasive vegetation in this effort based on their potential for ecosystem-altering effects in this nascent, large-scale restoration project: *Phalaris arundinacea* (“reed canary grass”) and *Typha latifolia* (“broad-leaved cattail”). Although there is some ambiguity with respect to variation in the invasive potential of different populations of *P. arundinacea* (and the ability to distinguish between them in the field), both *P. arundinacea* and *Typha latifolia* are currently considered to be native in California. However, up until relatively recently, *Phalaris arundinacea* was not regarded as being native to California, and was considered invasive in both previous SRERP habitat monitoring efforts (H.T. Harvey and Associates 2014 & 2015). *Typha latifolia* has not previously been reported from the SRERP restoration area. Both species are considered by some sources to be invasive elsewhere due to their potential to alter ecosystem processes by becoming rapidly established and developing dense, monotypic stands which aggressively outcompete other species, and can result in sediment accretion and eventual channel occlusion and/or habitat conversion in some aquatic habitats.

Treatment of the invasive salt marsh species, *Spartina densiflora* (“dense-flowered cord grass“), warrants additional discussion. This invasive plant was encountered throughout much of the Phase 1 restoration area (Appendix A, Figure 9). However, due to the extent and complexity of this species’ distribution throughout the Riverside Ranch restoration area, high-resolution mapping was not feasible. Instead, all suitable habitat within the Phase 1 restoration area where *S. densiflora* was observed (i.e., salt marsh *sensu stricto*, mudflat, high marsh ecotone, brackish marsh, and replanted riparian forest) was mapped and classified into three abundance categories (i.e., low, moderate, and high), following methods described for conducting “regional” baseline mapping efforts of the distribution of this species throughout the Humboldt Bay region (Grazul & Rowland 2011). It is worthy of mention that these investigators documented an extensive occurrence of this species established along the Salt River channel within the Phase 1 restoration area prior to the initiation of the SRERP.

While these investigators attributed percent cover ranges to these three classes (1-25%, 26-60%, and 61-100%; respectively), we elected the use of less quantitatively specific classes to avoid confusion if inappropriately compared to results from the quantitative vegetation sampling efforts associated with the current effort. Instead, “low,” “moderate,” and “high” abundance classes indicated in Figure 9 (Appendix A) refer to our un-quantified estimation of the abundance of *S. densiflora* in each indicated region, based on our recorded field data and interpretation of satellite imagery during the mapping of this species. Wherever it was determined that *S. densiflora* occurred outside of the original habitat boundaries used to depict its extent, respective boundaries adjustments were made to accommodate the existing distribution of this species for this mapping effort.

4.0 Results

Results from the 2016 habitat monitoring effort demonstrate that the Salt River Ecosystem Restoration Project has met or exceeded the respective success criteria for this monitoring year in all phase and sub-phase portions of the project area (Tables 6-9). Though these results indicate a favorable trajectory with respect to the development of projected habitats and native vegetation thus far, immediate and appropriate efforts are warranted to reduce and/or eradicate non-native and invasive vegetation also documented during our 2016 fieldwork. If not adequately addressed, the continued establishment and development of such undesirable vegetation is likely to prevent the achievement of final success thresholds for monitoring years 5 and 10, thereby jeopardizing stated long-term restoration goals for the project. Specific results for the habitat mapping and area analysis, quantitative vegetation sampling, and invasive vegetation assessment aspects of the 2016 monitoring effort are provided in respective sections below.

4.1 Habitat Mapping & Area Analysis

Results from our 2016 habitat mapping and area analysis indicate continued favorable development of projected habitat types. Calculated area (acreage) totals and respective eventual final success criteria for each habitat type addressed in the 2016 habitat monitoring effort are summarized in Tables 6-8 and are discussed below. The observed distribution and extent of each habitat type, and relevant associated restoration design components, are depicted in Figures 3-5 (Appendix A).

4.1.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration

Current habitat area (acreage) totals and respective eventual final success criteria for each habitat type addressed in the Phase 1 restoration area are summarized in Table 6 and their observed distribution is depicted in Figure 3 (Appendix A).

Phase 1: "Tidal Salt & Brackish Marsh"

The broadly inclusive projected habitat complex, "tidal salt & brackish marsh," collectively covers 284 acres of the Phase 1 project area, slightly less (88%) than the projected habitat area extent of 321.7 acres for this habitat complex, and approximately the same size (283.4 acres) as calculated from reported data (H.T. Harvey & Associates 2015) for the same area in 2015. "True" salt marsh *sensu stricto* habitat increased from 145.93 acres in 2015 to 154.84 acres in 2016. This increase is attributed primarily to continued establishment of vegetation in previously unvegetated areas such as mudflats, and to a lesser

Table 6. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. Summary of 2016 Observed Habitat Areas & Respective Success Criteria.

SRERP – Phase 1 Habitat Type	Area (Acres)[1] Projected[2]	Final Success Criteria[3]	2016 Observed	2016 % of Projected
High Marsh Ecotone	**12.4**	**≥11.2**	**36.43**	**294%**
"Tidal Salt & Brackish Marsh"[4]				
Salt Marsh *sensu stricto*	–	–	154.84	–
Mudflat[5]	20.8	≥18.7	74.61	537%
Aquatic[5]			37.16	
Brackish Marsh	–	–	16.93	–
Upland	–	–	0.46	–
"Tidal Salt & Brackish Marsh"[4] Total	**321.7**	**≥289.5**	**284.00**	**88%**
Riparian Habitat				
Existing Riparian Forest	–	–	20.62	–
Replanted Riparian Forest	–	–	22.71	–
Riparian Habitat Total	**43.4**	**≥38.4**	**43.33**	**100%**

[1] Missing values reflect "projected habitat" acreages, which were not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly-defined habitat components identified during the 2016 habitat monitoring effort.
[2] Source: HMMP GIS data (H.T. Harvey & Associates with Winzler & Kelly 2012).
[3] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5-10.
[4] Acreage analysis of Phase 1 "Tidal Salt & Brackish Marsh" assumes the inclusion of all associated and more narrowly described habitats following guidance provided in HCRCD's clarifying memorandum to the California Coastal Commission (HCRCD 2016c).
[5] Aquatic and mudflat habitats are treated collectively ("Aquatic/Mudflat") in (H.T. Harvey & Associates with Winzler & Kelly 2012).

degree, the conversion of some discrete portions of habitat previously supporting woody riparian vegetation (i.e., "standing dead" [H.T. Harvey & Associates 2015]) to salt marsh following recent exposure to tidal influence.

The brackish marsh wetland habitat component currently constitutes16.93 acres of the Phase 1 restoration area, slightly more (3.22 acres) than the 13.71 acres of "wet grassland" reported in 2015 (H.T. Harvey & Associates 2015). This slight net increase reflects recent habitat boundary refinements, which included the incorporation of area on the north bank of the "N1" channel (the northern-most primary Salt River tributary channel in the Phase 1 project area), near its confluence with the Salt River, previously mapped as high marsh ecotone in 2015.

Phase 1 brackish marsh wetlands represent a transitional habitat occurring between true salt marsh *sensu stricto*, mudflat, or aquatic habitat below; and either high marsh ecotone or upland habitat above. Where it exists, this transitional habitat occurs within a narrow elevation stratum (6.8 – 8.8 feet North American Vertical Datum 1988 [NAVD88]), as determined during an elevation survey of this habitat type performed as part of the 2016 monitoring effort at the request of the California Coastal Commission (HCRCD 2016c).

“Mudflat” and “aquatic” habitats are treated collectively in the HMMP with respect to assessing restoration success. Our recent mapping efforts revealed that these habitats collectively comprise 111.8 acres of the Riverside Ranch restoration area, which far exceeds (537%) the 20.8-acre projected habitat area extent indicated in the HMMP.

The bulk of this excess represents mudflats intended to eventually become vegetated by native salt marsh species through natural recruitment. In fact, as described above, continued establishment of native salt marsh vegetation in mudflat habitats between 2015 and 2016 explains the observed 8.25-acre decrease in the extent of this habitat type (from 82.86 acres to 74.61 acres) during this time period. Consistent with reports from the 2015 habitat monitoring effort (H.T. Harvey & Associates 2015), mudflats were observed to consist predominantly of unvegetated areas (i.e., <5% vegetative cover) subject to extensive tidal inundation and ponding. Although mudflats were defined and mapped as being unvegetated by vascular plants, the macroalgal species, *Vaucheria longicaulis* var. *macounii* (Blum) was commonly observed to occur in these habitats throughout the Phase 1 project area.

“Aquatic” habitats compose 37.16 acres of the Phase 1 restoration area, as mapped during the 2016 habitat monitoring effort. Reported acreage for this habitat type (52.1 acres) from the 2015 habitat monitoring effort (H.T. Harvey & Associates 2015) is assumed to have been erroneous, based both on the magnitude of the discrepancy between 2015 and 2016 results, as well as our review of 2015 geographic mapping data provided by HCRCD that reveal an area value for aquatic habitat (38.44 acres) which much more closely approximates measurements made during the 2016 effort. The 1.28 acre difference between 2016 measurements of aquatic habitat and corresponding mapping data for 2015 are attributable to subtle boundary refinements made during the 2016 effort, and are considered insignificant in the context of the restoration project.

Finally, no changes were observed in the extent of the discrete portion of “upland” habitat on the south side of the confluence between the Salt River and “N1” channel during the 2016 monitoring effort.

Phase 1: High Marsh Ecotone

The high marsh ecotone habitat type currently composes 36.4 acres of the Phase 1 restoration area. Although our observations reveal a 0.6-acre net decrease in the extent of this habitat type since 2015, the current extent far exceeds (294%) the extent of projected habitat area for this habitat specified in the HMMP. In addition to the aforementioned reclassification of area mapped as high marsh ecotone in 2015 to brackish marsh wetland, another noteworthy change in the distribution of the high marsh ecotone also occurred along the northern edge of the access road spur, which parallels the Salt River channel, just upstream of its confluence with the "N1" channel. This access spur road bisects a portion of a replanted riparian forest, which was incorrectly mapped as high marsh ecotone in 2015 (H.T. Harvey & Associates 2015). With the exception of the nascent and establishing woody component of the vegetation in this area, it otherwise resembles the adjacent and contiguous high marsh ecotone. However, in light of the intended restoration goals for this location and the observed continued survivorship of associated replanted woody vegetation, the common habitat boundary was modified to expand the replanted riparian forest area, thereby reducing the mapped extent of high marsh ecotone, which more accurately reflects conditions observed during our fieldwork.

Phase 1: Riparian Habitats

Total Phase 1 riparian habitat area (43.3 acres) continues to exceed the respective projected habitat extent (42.7 acres) specified in the HMMP by 2%, though the extent of some of these riparian habitats appears to have decreased slightly between 2015 and 2016. Existing riparian forested habitat decreased from 25.55 to 20.62 acres over this time period due to a combination of habitat boundary refinements and limited reductions of existing riparian forest in locations where tidal influence appears to have resulted in some tree mortality.

Despite the previously mentioned recent reclassification of a small portion of high marsh ecotone to "replanted riparian forest," the total Phase 1 replanted riparian forest area decreased slightly between 2015 and 2016 from 23.49 to 22.71 acres. This net decrease reflects minor boundary refinements as well as observed mortality of replanted Sitka spruce (*Picea sitchensis*) trees in a portion of replanted riparian forest located on the north bank of the "N1" channel, near its confluence with the Salt River.

4.1.2 Phase 2 – Salt River Corridor Restoration

Current habitat area (acreage) totals and respective eventual final success criteria for each habitat type addressed in the Phase 2A restoration area are summarized in Tables 7 and 8 and their observed distribution is depicted in Figures 4 and 5 (Appendix A).

Phase 2A: Salt River Channel Wetlands

The "Salt River channel wetland" system distributed throughout the Phase 2A (Lower and Middle) restoration area collectively totals 10.56 acres, exceeding the combined stated (3.7 acres of brackish marsh wetlands) and extrapolated (4.3 acres of freshwater wetlands) projected habitat extent of 8.0 acres for this region of the project area by 32%. The extent of the Phase 2A brackish marsh channel wetland habitat (3.8 acres) exceeds the projected habitat extent by 2% and Phase 2A freshwater channel wetland habitat (6.8 acres) exceeds its respective extrapolated projected habitat extent by 58%.

Table 7. SRERP Phase 2A – Salt River Corridor Restoration Area: Salt River Channel Wetlands. Summary of 2016 Observed Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2016	
SRERP – Phase 2A Habitat Type	**Projected[2,3]**	**Final Success Criteria[4]**	**Observed**	**% of Projected**
Brackish Marsh Wetlands				
Brackish Active Channel				
Phase 2A Lower	–	–	2.06	–
Phase 2A Middle	–	–	0.12	–
Brackish Active Bench				
Phase 2A Lower	–	–	1.60	–
Phase 2A Middle	–	–	0	–
Brackish Marsh Wetlands Total	**3.7**	**≥3.3**	**3.78**	**102%**
Freshwater Wetlands				
Freshwater Active Channel				
Phase 2A Lower	–	–	0	–
Phase 2A Middle	–	–	0.26	–
Freshwater Active Bench				
Phase 2A Lower	–	–	3.75	–
Phase 2A Middle	–	–	2.77	–
Freshwater Wetlands Total	**4.3**	**≥3.9**	**6.78**	**158%**
Salt River Channel Wetlands Total	**8.0**	**≥7.2**	**10.56**	**132%**

[1] Missing values reflect "projected habitat" acreages, which were not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly-defined habitat components identified during the 2016 habitat monitoring effort.
[2] Adapted from HMMP GIS data (H.T. Harvey & Associates with Winzler & Kelly 2012).
[3] "Projected Habitat" acreage quantities for those habitats either not recognized as discrete areas in H.T. Harvey & Associates with Winzler & Kelly (2012), or for partial portions of habitats which extend beyond phase and/or sub-phase boundaries, were extrapolated from "Projected Habitat" GIS data used in the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), and which are depicted in Figure 2.
[4] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5-10.

Phase 2A: Riparian Habitats

Existing riparian forest and riparian planting zone habitats occurring throughout the entire Phase 2A (Lower and Middle) restoration area collectively total 33.45 acres, exceeding the extrapolated projected extent of this habitat (26.2 acres) by 28%. Of this observed total, 22.01 acres occur in the Phase 2A (Lower) area, a 13% increase from the 19.51 acres reported from the previous monitoring year (H.T. Harvey & Associates 2015). This observed increase is primarily due to the inclusion of active riparian berms (2.44 acres) in the current 2016 habitat monitoring effort, which were not included in the aforementioned 2015 analysis. The remaining 11.44 acres of Salt River riparian corridor riparian habitat occur in the Phase 2A (Middle) restoration reach, and consist of 6.65 acres of existing riparian forest, 3.7 acres of replanted riparian forest, and 1.09 acres of active riparian berms.

Table 8. SRERP Phase 2A – Salt River Corridor Restoration Area: Riparian Habitats. Summary of 2016 Observed Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2016	
SRERP – Phase 2A Habitat Type	**Projected[2,3]**	**Final Success Criteria[4]**	**Observed**	**% of Projected**
Existing Riparian Forest				
Phase 2A Lower	–	–	11.52	–
Phase 2A Middle	–	–	6.65	–
Riparian Planting Zones				
Replanted Riparian Forest				
Phase 2A Lower	–	–	8.05	–
Phase 2A Middle	–	–	3.70	–
Active Riparian Berms				
Phase 2A Lower	–	–	2.44	–
Phase 2A Middle	–	–	1.09	–
Riparian Habitat Total	**26.2**	**≥23.7**	**33.45**	**128%**

[1] Missing values reflect “projected habitat” acreages, which were not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly-defined habitat components identified during the 2016 habitat monitoring effort.
[2] Adapted from HMMP GIS data (H.T. Harvey & Associates with Winzler & Kelly 2012).
[3] “Projected Habitat” acreage quantities for those habitats either not recognized as discrete areas in H.T. Harvey & Associates with Winzler & Kelly (2012), or for partial portions of habitats which extend beyond phase and/or sub-phase boundaries, were extrapolated from “Projected Habitat” GIS data used in the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), and which are depicted in Figure 2.
[4] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5-10.

4.2 Quantitative Vegetation Analysis & Percent Cover Sampling

Results from the 2016 quantitative vegetation assessment and percent cover sampling effort (Tables 9 & 10) exceed all relevant success criteria for minimum cover of native vegetation (Table 3) for the 2016 monitoring year. However, the presence of invasive plant species warrants the initiation of immediate and on-going management efforts to reduce and/or eliminate these occurrences if respective final success thresholds for monitoring years 5 and 10 are to be met.

The sampling area yielding the lowest percent cover values for both total and native vegetation throughout all habitats sampled during the 2016 effort was the active bench habitat design feature in the most recently restored Phase 2A (Middle) reach. The mean cover estimate for total vegetation within this sampling area was 61%. All other sampled areas exhibited total vegetative cover estimates in excess of 79%. Mean estimated cover of native vegetation within the Phase 2A (Middle) active bench sampling area was 42%, substantially greater than the required 10% for that area during the current monitoring year. These observations indicate successful establishment of native vegetation throughout the sampled portions of the SRERP restoration area thus far.

Despite these encouraging results, both non-native non-invasive and invasive vegetation were found to exceed respective eventual final (maximum) cover thresholds (Tables 4 & 5) specified in the HMMP in many of the sampled areas in both Phase1 and Phase 2A restoration areas (Table 9). Non-native non-invasive vegetation was observed to be in excess of eventual final (maximum) success criteria for this vegetative category (i.e., <15% by monitoring year 5 for Salt River channel wetlands and monitoring year 10 for all other habitats [Table 4]) in some sampled habitats in both the Phase 1 (i.e., $\bar{x}$=15.1% in the high marsh ecotone and $\bar{x}$=21.6% in the replanted riparian forest) and Phase 2A (Lower) restoration areas (i.e., $\bar{x}$=17.4% in the active bench and $\bar{x}$=30.1% in the active riparian berm).

Similarly, mean estimated cover of invasive plant species currently exceeds eventual final (maximum) success criteria for this category of vegetation (i.e., <5% by monitoring year 5 for Salt River channel wetlands, and monitoring year 10 for all other habitats [Table 5]) in all sampled habitats except for the recently restored Phase 2A (Middle) active channel sampling area (Table 9). The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) was only encountered in Phase 2A restoration areas during our fieldwork, with maximum estimated mean cover (2.4%) of this plant being documented in the active riparian berm sampling area in the lower Phase 2A reach (Table 9).

Additional descriptions of specific results from each sampled area follows; respective sample sizes ("n") are indicated for each. Where parallel sampling efforts were conducted in both 2015 and 2016, comparisons with results from the previous monitoring year (H.T. Harvey & Associates 2015) are included. Mean estimates provided for total vegetative cover reflect total (absolute) vegetative

Table 9. Summary of 2016 SRERP Quantitative Vegetation (Percent Cover) Sampling Results & Respective Success Criteria. Mean percent cover estimates are in bold and associated 95% confidence intervals follow in parentheses.

	Mean Percent Cover for Vegetation Categories of Interest							
	Total Vegetation[1]	Native Vegetation		Non-Native Non-Invasive Vegetation		Invasive Vegetation		Sterile Hybrid Wheatgrass[1]
SRERP Habitat Sampling Area	Observed	Observed	2016 Success Criteria[2]	Observed	Final Success Criteria[3]	Observed	Final Success Criteria[3]	Observed
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area								
High Marsh Ecotone (n=116)	**89.7** (87.0, 91.6)	**67.0** (62.7, 70.8)	≥30%	**15.1** (11.7, 18.3)	<15%	**7.7** (5.6, 10.4)	<5%	**0.0** (NA)
Replanted Riparian Forest (n=50)	**97.0** (95.0, 98.2)	**44.1** (34.4, 53.7)	≥15%	**21.6** (15.1, 29.9)	<15%	**31.4** (24.5, 39.9)	<5%	**0.0** (NA)
Salt Marsh *sensu stricto* (n=219)	**80.0** (75.8, 83.6)	**66.9** (62.6, 70.9)	≥10%	**6.5** (4.8, 8.7)	<15%	**6.6** (4.7, 9.1)	<5%	**0.0** (NA)
Phase 2 – Salt River Corridor Restoration Area								
Phase 2A (Lower) – Salt River Channel Wetlands								
Active Channel (n=29)	**79.7** (68.9, 87.6)	**56.9** (45.8, 67.4)	≥20%	**12.6** (7.7, 21.3)	<15%	**10.2** (5.2, 18.4)	<5%	**0.0** (NA)
Active Bench (n=50)	**79.9** (72.5, 85.7)	**53.1** (44.1, 62.0)	≥20%	**17.4** (11.5, 24.9)	<15%	**9.2** (5.4, 15.2)	<5%	**0.2** (0.0, 0.9)
Phase 2A (Lower) – Riparian Planting Zones								
Active Riparian Berm (n=32)	**93.0** (87.1, 96.5)	**54.8** (43.4, 65.6)	≥15%	**30.1** (21.0, 40.8)	<15%	**5.7** (3.0, 10.7)	<5%	**2.4** (1.0, 4.7)
Replanted Riparian Forest (n=43)	**97.9** (95.1, 99.1)	**63.8** (54.3, 71.9)	≥15%	**8.1** (5.1, 14.3)	<15%	**25.7** (18.6, 34.7)	<5%	**0.3** (0.0, 0.8)
Phase 2A (Middle) – Salt River Channel Wetlands								
Active Channel (n=18)	**87.2** (81.3, 91.7)	**81.0** (74.0, 87.3)	≥10%	**4.8** (2.3, 8.0)	<15%	**1.2** (0.0, 4.4)	<5%	**0.3** (0.0, 0.8)
Active Bench (n=24)	**61.0** (50.0, 71.5)	**42.0** (34.5, 50.5)	≥10%	**5.6** (3.0, 10.1)	<15%	**13.3** (8.5, 20.2)	<5%	**0.2** (0.1, 0.9)

[1] No specific success criteria are indicated in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

[2] Adapted from Tables 8-10 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

[3] Must be achieved by the final monitoring year for each respective habitat sampling area (i.e., Year 5 for Salt River Channel Wetlands or Year 10 for all others) (H.T. Harvey & Associates with Winzler & Kelly 2012).

cover. Mean estimates provided for all other vegetative categories of interest (i.e.; native, non-native non-invasive, invasive, and hybrid; as well as structural categories for riparian planting zones) represent relativized means based on respective total vegetative cover values calculated from transformed data as described in Section 3.2, above. Descriptions of dominant and/or representative species documented in sample plots for each area are listed in decreasing order of frequency and percent cover, except where noted otherwise. Less frequently occurring species are omitted from these treatments, but are included in Appendix B.

A complete list of all plant species encountered in each sampling area during the 2016 vegetation sampling effort and the associated original (untransformed) absolute mean cover values for each, are provided in Appendix B. The distributions of vegetation sampling plots for each sampled area are depicted in Figures 6-8. Although invasive species encountered in each sampling area are mentioned here for those areas in which they occur, additional discussion of invasive vegetation observed throughout the entire Phase 1 and Phase 2A restoration areas is provided in Section 4.3 below.

4.2.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration

"Tidal Salt & Brackish Marsh"

Salt Marsh *sensu stricto* (n=219)

Estimated mean total salt marsh *sensu stricto* vegetative cover was 80%. The mean estimated percent cover of native vegetation in this habitat was 66.9%, far exceeding the success criterion of 10% for the third year of monitoring for this Phase 1 habitat. The vast majority of the vegetation in this "true" salt marsh habitat consisted of two native species, *Salicornia pacifica* ("pickleweed") and *Distichlis spicata* ("salt grass"). Other representative native species encountered less frequently included *Juncus effusus* ssp. *pacificus* ("Pacific rush"), *Jaumea carnosa* ("fleshy Jaumea"), *Spergularia marina* ("saltmarsh sand-spurrey"), *Triglochin striata* ("three-ribbed arrow-grass"), and *Triglochin maritima* ("common arrow-grass").

Although not a dominant species, the rare *Carex lyngbyei* ("Lyngbye's sedge") was also observed in 3% of sampled plots in this habitat. *Carex lyngbyei* is an herbaceous hydrophytic plant species classified by the California Native Plant Society (CNPS 2016) as "fairly endangered in California," but "more common elsewhere" (i.e., CNPS' rare plant rank of 2B.2). Despite its regional rarity, this species commonly occurs along tidal slough channel banks and similar habitats in the lower Salt River watershed and elsewhere in the Humboldt Bay region.

Mean estimated cover of non-native non-invasive vegetation was only 6.5%, though two such species, *Cotula coronopifolia* ("brass-buttons") and *Atriplex prostrata* ("fat-hen"), were the fourth and fifth most abundant species encountered in this habitat. The mean estimated cover of invasive vegetation detected in salt marsh *sensu stricto* sampling plots was 6.6%, which consisted primarily of *Spartina densiflora* ("dense-flowered cord grass"), detected in 30% of sampled plots (n=219) in this habitat. Additional invasive plants observed during sampling salt marsh *sensu stricto* included *Agrostis stolonifera* ("creeping bent"), *Polypogon monspeliensis* ("rabbitfoot grass"), and *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley"). These latter three species were observed primarily at higher elevations within this habitat type where it transitions to either brackish marsh or high marsh ecotone.

High Marsh Ecotone (n=116)

Estimated total vegetative cover in the high marsh ecotone was 89.7%, reflecting an increase from 60% reported from the previous monitoring year (H.T. Harvey & Associates 2015). Mean estimated cover of native vegetation was 67%, an increase from 40.9% in 2015, and exceeds the success criterion of 30% for the third year of monitoring for this Phase 1 habitat. Dominant native plant species documented in this habitat include *Deschampsia cespitosa* ("tufted hairgrass"), *Salicornia pacifica* ("pickleweed"), *Hordeum brachyantherum* ("meadow barley"), *Spergularia marina* ("saltmarsh sand-spurrey"), and *Distichlis spicata* ("salt grass").

The mean percent cover estimate for non-native non-invasive vegetation in this transitional habitat in 2016 ($\overline{x}$=15.1%) continues to hover at the final (maximum) success threshold (i.e., <15%), reflecting no significant change since the 2015 sampling effort (H.T. Harvey & Associates 2015), which reported a mean of 15.7% for this same parameter. The observed plant species composition of this type of vegetation in the high marsh ecotone consists primarily of *Cotula coronopifolia* ("brass-buttons"), *Atriplex prostrata* ("fat-hen"), and *Festuca perennis* ("rye grass"), though other such species were also encountered to a lesser extent.

Mean estimated cover of invasive vegetation has increased over the past year from 3.3% reported in 2015 (H.T. Harvey & Associates 2015) to 7.7%, exceeding the final (maximum) success threshold of 5%. The most prevalent invasive species observed during recent sampling include *Polypogon monspeliensis* ("rabbitfoot grass"), *Agrostis stolonifera* ("creeping bent"), *Spartina densiflora* ("dense-flowered cord grass") (detected in 16% of sampled plots [n=116]), *Lotus corniculatus* ("bird's-foot trefoil"), *Helminthotheca echioides* ("bristly ox-tongue"), and *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley"), though other similarly-classified species also occur here in lesser quantities, particularly along the toe of the slope of the adjacent constructed setback levee.

Replanted Riparian Forest (n=50)

Total estimated vegetative cover in the Phase 1 replanted riparian forest was 97%. Our analysis of the varying contribution of different vegetative structural categories, or vegetative "habits" revealed that the vegetation in this area was composed predominantly of herbaceous species ($\overline{x}$=87.3%), followed by lesser proportions of shrub ($\overline{x}$=6.7%) and tree ($\overline{x}$=3.0%) components (Table 10).

Table 10. Structural Composition of 2016 SRERP Riparian Planting Zone Vegetation. Mean percent cover estimates are in bold and associated 95% confidence intervals follow in parentheses. No specific success criteria exist for vegetative structural categories (H.T. Harvey & Associates with Winzler & Kelly 2012).

SRERP Habitat Sampling Area (Riparian Planting Zones)	Mean Percent Cover of Vegetation Categories of Interest: Total		Herb		Shrub		Tree	
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area								
Replanted Riparian Forest (n=50)	**97.0**	(95.0, 98.2)	**87.3**	(78.2, 92.3)	**6.7**	(2.7, 15.8)	**3.0**	(1.2, 6.7)
Phase 2 – Salt River Corridor Restoration Area								
Phase 2A (Lower)								
Active Riparian Berms (n=32)	**93.0**	(87.3, 96.5)	**91.6**	(86.3, 95.1)	**0.9**	(0.06, 2.7)	**0.6**	(0, 1.7)
Replanted Riparian Forest (n=43)	**97.9**	(95.1, 99.1)	**77.5**	(71.3, 83.0)	**4.7**	(2.6, 7.4)	**15.7**	(11.0,21.3)

Mean estimated cover of native vegetation in this Phase 1 habitat type was 44.1%, exceeding the success criterion of 15% for the second year of monitoring for this habitat. Dominant native herbaceous species encountered in the Phase 1 replanted riparian forest include *Deschampsia cespitosa* ("tufted hairgrass"), *Hordeum brachyantherum* ("meadow barley"), *Equisetum arvense* ("common horsetail), *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), Epilobium *ciliatum* ssp. *watsonii* ("Watson's willowherb"), and *Oenanthe sarmentosa* ("water parsley"). Native shrub species included *Rubus ursinus* ("California blackberry"), *Lonicera involucrata* ssp. *ledebourii* ("twinberry"), and *Rubus parviflorus* ("thimbleberry"). Young native tree sapling species consisted of *Salix lasiolepis* ("arroyo willow"), *Pinus contorta* ssp. *contorta* ("shore pine"), and *Picea sitchensis* ("Sitka spruce").

The mean estimated percent cover of non-native non-invasive vegetation for this habitat was 21.6%, exceeding the final (maximum) success threshold (i.e., ≤15%). The observed species composition of this vegetative category in the Phase 1 replanted riparian forest consists primarily of *Festuca perennis* ("rye grass"), *Plantago lanceolata* ("English plantain"), *Atriplex prostrata* ("fat-hen"), *Rumex conglomeratus* ("clustered dock"), *Polypogon interruptus* ("ditch beard grass"), and *Trifolium pretense* ("red clover") though other such species were also encountered less frequently.

Mean estimated invasive vegetative cover was 31.4%, substantially greater than the final (maximum) success criterion of 5%, and consisted of *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), *Lotus corniculatus* ("bird's-foot trefoil"), *Raphanus sativus* ("radish"), *Ranunculus repens* ("creeping buttercup"), *Helminthotheca echioides* ("bristly ox-tongue"), *Conium maculatum* ("poison hemlock"), *Cirsium arvense* ("Canada thistle"), *Spartina densiflora* ("dense-flowered cord grass"), *Cirsium vulgare* ("bull thistle"), *Phalaris* *arundinacea* (“reed canary grass”), *Dipsacus fullonum* (“wild teasel”), *Convolvulus arvensis* (“bindweed”), *Polypogon monspeliensis* (“rabbitfoot grass”), and *Rubus armeniacus* (“Himalayan blackberry”).

4.2.2 Phase 2 – Salt River Corridor Restoration

Phase 2A (Lower) Salt River Channel Wetlands

Phase 2A (Lower) Active Channel (n=29)

Total estimated vegetative cover in the Phase 2A (Lower) active channel was 79.7%, reflecting an increase from the 54.5% reported in 2015 from the same habitat (referred to as “brackish marsh” in H.T. Harvey & Associates 2015). Mean estimated cover of native vegetation was 56.9%, an increase from 37.5% in 2015, and which exceeds the success criterion of 20% for the second year of monitoring for this Phase 2 habitat. Dominant native herbaceous species documented in this dynamic habitat include *Deschampsia cespitosa* (“tufted hairgrass”), *Grindelia stricta* var. *platyphylla* (“marsh gumplant”), *Scirpus microcarpus* (“panicled bulrush”), *Hordeum brachyantherum* (“meadow barley”), *Salicornia pacifica* (“pickleweed”), and *Juncus balticus* ssp. *ater* (“Baltic rush”). Native *Alnus rubra* (“red alder”) and *Salix lasiandra* var. *pacifica* (“Pacific willow”) tree seedlings/saplings were also observed becoming established in this channel habitat.

The mean estimated percent cover of non-native non-invasive vegetation in the Phase 2A (Lower) active channel habitat in 2016 was 12.6%, an increase from the reported estimate ($\bar{x}$=7.7%) from the 2015 sampling effort (H.T. Harvey & Associates 2015), but still less than the final (maximum) success criterion of 15%. Vegetation in this category observed in this region of the Phase 2A restoration area consisted of *Trifolium repens* (“white clover”), *Atriplex prostrata* (“fat-hen”), *Plantago major* (“common plantain”), *Trifolium fragiferum* (“strawberry clover”), *Festuca perennis* (“rye grass”), *Vicia hirsuta* (“hairy vetch”), and *Cotula coronopifolia* (“brass-buttons”), though other such species were also encountered to a lesser degree.

Mean estimated cover of invasive vegetative has increased over the past year, from 7.6% reported in 2015 (H.T. Harvey & Associates 2015) to 10.2%, exceeding the final (maximum) success criterion of 5%. Invasive species observed along the Phase 2A (Lower) active channel edge during the 2016 effort included *Agrostis stolonifera* (“creeping bent”), *Phalaris arundinacea* (“reed canary grass”), *Holcus lanatus* (“velvet grass”), *Helminthotheca echioides* (“bristly ox-tongue”), *Polypogon monspeliensis* (“rabbitfoot grass”), *Ranunculus repens* (“creeping buttercup”), *Hordeum marinum* ssp. *gussoneanum* (“Mediterranean barley”), *Lotus corniculatus* (“bird’s-foot trefoil”), *Mentha pulegium* (“pennyroyal”), *Typha latifolia* (“broad-leaved cattail”), and two occurrences of *Spartina densiflora* (“dense-flowered cord grass”). Although the sterile “wheatgrass” hybrid (*Elymus* x *Triticum*) was detected in 2015, it was not encountered in this sampling area during vegetation sampling of this habitat component in 2016.

Phase 2A (Lower) Active Bench (n=50)
Estimated mean total vegetative cover in the Phase 2A (Lower) active bench area was 79.9%. The mean estimated percent cover of native vegetation in this habitat was 53.1%, exceeding the success criterion of 20% for this second year of monitoring for this area. Native vegetation included both woody and herbaceous components. Dominant native herbaceous plant species in this lower bench habitat consisted of *Deschampsia cespitosa* ("tufted hairgrass"), *Scirpus microcarpus* ("panicled bulrush"), *Bolboschoenus maritimus* ssp. *paludosus* ("saltmarsh bulrush"), *Hordeum brachyantherum* ("meadow barley"), *Juncus balticus* ssp. *ater* ("Baltic rush"), *Grindelia stricta* var. *platyphylla* ("marsh gumplant"), and *Oenanthe sarmentosa* ("water parsley"). Native woody vegetation consisted of *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Alnus rubra* ("red alder"), and *Salix lasiolepis* ("arroyo willow") tree species as well as *Rubus ursinus* ("California blackberry") and *Rubus spectabilis* ("salmonberry").

Mean estimated cover of non-native non-invasive vegetation was 17.4%, greater than the final (maximum) success criterion of 15%, and included *Trifolium repens* ("white clover"), *Cotula coronopifolia* ("brass-buttons"), *Trifolium fragiferum* ("strawberry clover"), *Festuca perennis* ("rye grass"), *Rumex crispus* ("curly dock"), *Atriplex prostrata* ("fat-hen"), *Rumex conglomeratus* ("clustered dock"), and *Plantago major* ("common plantain").

Mean estimated percent cover of invasive vegetation was 9.2%, exceeding the final (maximum) success criterion of 5%, and consisted primarily of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Polypogon monspeliensis* ("rabbitfoot grass"), *Lotus corniculatus* ("bird's-foot trefoil"), *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley"), and a single occurrence of *Typha latifolia* ("broad-leaved cattail"). Mean estimated percent cover of the sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) in this habitat component was 0.2%.

Phase 2A (Lower) Riparian Planting Zones
Phase 2A (Lower) Replanted Riparian Forest (n=43)
Total vegetative cover in the Phase 2A (Lower) replanted riparian forest was 97.9%. Our analysis of the varying contribution of different vegetative structural categories revealed that this area was composed predominantly of herbaceous species ($\overline{x}$=77.5%), followed by lesser proportions of tree ($\overline{x}$=15.7%) and shrub ($\overline{x}$=4.7%) components (Table 10).

Mean estimated cover of native vegetation in this lower Phase 2A restoration area was 63.8%, exceeding the success criterion of 15% for the second year of monitoring for this habitat. Dominant native herbaceous species included *Deschampsia cespitosa* ("tufted hairgrass"), *Scirpus microcarpus* ("panicled bulrush"), *Oenanthe sarmentosa* ("water parsley"), *Juncus balticus* ssp. *ater* ("Baltic rush"), *Hordeum brachyantherum* ("meadow barley"), *Urtica dioica* ("stinging nettle"), *Epilobium ciliatum* ssp. *watsonii* ("Watson's willowherb"), and *Equisetum arvense* ("common horsetail"). Native shrub species consisted of

Rubus ursinus (“California blackberry”), *Grindelia stricta* var. *platyphylla* (“marsh gumplant”), *Rubus spectabilis* (“salmonberry”), *Rubus parviflorus* (“thimbleberry”), *Lonicera involucrata* ssp. *ledebourii* (“twinberry”), and *Rosa californica* (“California rose”). Establishing native tree species consisted of *Salix lasiolepis* (“arroyo willow”), *Alnus rubra* (“red alder), and *Picea sitchensis* (“Sitka spruce”).

The estimated mean cover of non-native non-invasive plant species in this habitat was 8.1%, less than the final (maximum) success threshold of 15%. The species composition of this vegetative category encountered here in this lower Phase 2A reach consisted primarily of *Trifolium fragiferum* (“strawberry clover”), *Rumex conglomeratus* (“clustered dock”), *Trifolium repens* (“white clover”), *Festuca perennis* (“rye grass”), and *Vicia hirsuta* (“hairy vetch”), though other such species were also encountered to a lesser extent.

Mean estimated cover of invasive vegetation was 25.7%, substantially greater than the final (maximum) success criterion of 5%, and consisted of *Phalaris arundinacea* (“reed canary grass”), *Ranunculus repens* (“creeping buttercup”), *Agrostis stolonifera* (“creeping bent”), *Cirsium vulgare* (“bull thistle”), *Helminthotheca echioides* (“bristly ox-tongue”), *Holcus lanatus* (“velvet grass”), *Mentha pulegium* (“pennyroyal”), *Lotus corniculatus* (“bird’s-foot trefoil”), *Convolvulus arvensis* (“bindweed”), *Conium maculatum* (“poison hemlock”), *Raphanus sativus* (“radish”), and the woody vine, *Hedera helix* (“English ivy”). Mean estimated percent cover of sterile “wheatgrass” hybrid (*Elymus* x *Triticum*) of this habitat component was only 0.3%.

Phase 2A (Lower) Active Riparian Berm (n=32)
Estimated total vegetative cover of the Phase 2A (Lower) active riparian berm was 93%. Our analysis of the vegetative structural categories in this area revealed that it was composed predominantly of herbaceous species ($\bar{x}$=91.6%), with only minor contributions of tree ($\bar{x}$=0.6%) and shrub ($\bar{x}$=0.9%) components (Table 10).

The mean estimate of native plant cover was 54.8%, exceeding the success criterion of 15% for this second year of monitoring for this area. Native vegetation was composed primarily of herbaceous taxa such as *Deschampsia cespitosa* (“tufted hairgrass”), *Hordeum brachyantherum* (“meadow barley”), *Cyperus eragrostis* (“nutsedge”), *Scirpus microcarpus* (“panicled bulrush”), *Elymus glaucus* (“wild rye”), *Grindelia stricta* var. *platyphylla* (“marsh gumplant”), *Juncus balticus* ssp. *ater* (“Baltic rush”), *Epilobium ciliatum* ssp. *watsonii* (“Watson’s willowherb”), *Festuca rubra* (“red fescue”), *Stachys ajugoides* (“hedge-nettle”), and *Potentilla anserina* ssp. *pacifica* (“Pacific silverweed”); though woody species such as *Alnus rubra* (“red alder”), *Picea sitchensis* (“Sitka spruce”), *Rubus spectabilis* (“salmonberry”), and *Baccharis pilularis* (“coyote brush”) were also observed to be establishing in this area as well.

The mean estimated percent cover of non-native non-invasive vegetation in the active riparian berm was 30.1%, exceeding the final (maximum) criterion of 15%, and the species composition included *Trifolium fragiferum* ("strawberry clover"), *Trifolium repens* ("white clover"), *Festuca perennis* ("rye grass"), *Plantago major* ("common plantain"), *Hypochaeris radicata* ("hairy cat's-ears"), and *Rumex conglomeratus* ("clustered dock") in addition to other less abundant species.

Mean estimated cover of invasive plant species observed in this restoration design feature was 5.7% (approximating the final [maximum] success threshold), and consisted of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Cirsium vulgare* ("bull thistle"), *Holcus lanatus* ("velvet grass"), *Mentha pulegium* ("pennyroyal"), *Cortaderia jubata* ("pampas grass"), *Helminthotheca echioides* ("bristly ox-tongue"), *Lotus corniculatus* ("bird's-foot trefoil"), and a single occurrence of *Typha latifolia* ("broad-leaved cattail"). Mean estimated percent cover of the sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) in this habitat feature was 2.4%.

Phase 2A (Middle) Salt River Channel Wetlands

Phase 2A (Middle) Active Channel (n=18)

Total vegetative cover in the Phase 2A (Middle) active channel sampling area was 87.2%. Mean estimated cover of native vegetation was 81%, far exceeding the success criterion of 10% for this first year of monitoring for this Phase 2 habitat. Dominant native species observed in this region of the active Salt River channel included *Scirpus microcarpus* ("panicled bulrush"), *Hordeum brachyantherum* ("meadow barley"), *Juncus balticus* ssp. *ater* ("Baltic rush"), *Deschampsia cespitosa* ("tufted hairgrass"), *Cyperus eragrostis* ("nutsedge"), *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), *Juncus effusus* ssp. *pacificus* ("Pacific rush"), *Festuca rubra* ("red fescue"), *Epilobium ciliatum* ssp. *watsonii* ("Watson's willowherb"), and *Carex obnupta* ("slough sedge"). Abundant seedlings of naturally recruiting *Salix lasiandra* var. *pacifica* ("Pacific willow"), *S. lasiolepis* ("arroyo willow"), and *Alnus rubra* ("red alder") were also observed establishing along the edges of the Phase 2A (Middle) active channel.

Mean estimated percent cover of non-native non-invasive vegetation in this habitat was 4.8% (less than the final [maximum] success threshold of 15%), and consisted primarily of *Trifolium repens* ("white clover"), *Atriplex prostrata* ("fat-hen"), *Sonchus asper* ssp. *asper* ("prickly sow thistle"), and *Rumex crispus* ("curly dock"), though other similarly categorized species were also encountered to a lesser extent.

Mean estimated cover of invasive vegetation was 1.2% (less than the final [maximum] success threshold of 5%), and consisted of *Phalaris arundinacea* ("reed canary grass") and *Ranunculus repens* ("creeping buttercup"). Mean estimated percent cover of sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) in this habitat component was only 0.3%.

Phase 2A (Middle) Active Bench (n=24)
Finally, the mean estimated total vegetative cover in the Phase 2A (Middle) active bench area was 61%. The mean estimated percent cover of native vegetation in this habitat was 42%, exceeding the success criterion of 10% for this first year of monitoring for this area. Native species consisted primarily of herbaceous taxa such as *Juncus balticus* ssp. *ater* ("Baltic rush") *Equisetum arvense* ("common horsetail"), *Oenanthe sarmentosa* ("water parsley"), and *Alopecurus geniculatus* ("water foxtail"), though young *Salix sitchensis* ("Sitka willow") saplings were also observed in this area during the recent sampling effort.

Mean estimated cover of non-native non-invasive vegetation was 5.6% (less than the final [maximum] success threshold of 15%), and was composed of *Rumex conglomeratus* ("clustered dock"), *Festuca perennis* ("rye grass"), *Trifolium fragiferum* ("strawberry clover"), and *Trifolium repens* ("white clover").

The mean estimated cover of invasive vegetation was 13.3%, exceeding the final [maximum] success threshold of 5%, and consisted primarily of *Glyceria declinata* ("low manna grass"), *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Ranunculus repens* ("creeping buttercup"), *Holcus lanatus* ("velvet grass"), and *Helminthotheca echioides* ("bristly ox-tongue"). Mean estimated percent cover of sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) of this habitat component was 0.2%.

4.3 Invasive Plant Species Assessment
Results from the 2016 vegetation sampling effort discussed above provide quantitative estimates of the extent of invasive vegetation in sampled SRERP habitats. Additional observations made during initial site reconnaissance and habitat mapping analysis fieldwork confirm the establishment and development of invasive vegetation throughout the SRERP project area, both in unsampled locations within sampled habitats as well as other regions of the restoration area where sampling was not required in 2016. These invasive species occurrences are described below and their distribution throughout the SRERP area is depicted in Figures 9-12 (Appendix A). Where feasible, the distributions of single species were mapped discretely. Where the distributions of multiple co-occurring invasive species overlap, the resulting mosaics are indicated as species "complexes." Finally, although the invasive *Lythrum hyssopifolia* ("hyssop loosestrife") was reported by previous investigators (H.T. Harvey & Associates 2015), this species was not detected during our 2016 fieldwork.

4.3.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration
Invasive plant species were observed throughout the Phase 1 restoration area. The highly invasive *Spartina densiflora* ("dense-flowered cord grass") continues to invade and become established throughout salt marsh, mudflat, high marsh ecotone, and (along the edges of) riparian habitats. *Spartina densiflora* and a variety of other invasive species pose substantial risk of eventual failure to meet the invasive species success criterion (i.e., <5% cover in respective final

monitoring years) specified in the HMMP. Invasive species identified in the Riverside Ranch Tidal Marsh restoration area are described below and depicted in Figures 9 & 10 (Appendix A).

Spartina densiflora (Dense-Flowered Cord Grass)

The extent to which the invasive species, *Spartina densiflora* ("dense-flowered cord grass"), has become established in salt marsh, mudflat, and high marsh ecotone habitats at Riverside Ranch, presents significant potential for failure to achieving the relevant restoration success criteria in the Phase 1 project area. As was noted during the both previous monitoring efforts (H.T. Harvey & Associates 2014 & 2015) this species continues to become well established in both vegetated salt marsh and tidal mudflat habitats, as well as along the mesic edge of the high marsh ecotone, brackish marsh, and riparian habitats. The estimated absolute mean cover of *S. densiflora* ($\overline{x}$=7.18%) in "true" salt marsh *sensu stricto* habitat (Appendix B) likely under-represents the extent of this invasive plant throughout the Phase 1 project area. The frequency of occurrence of this species in this sampled area alone (30%, n=219) better reflects this species' abundance, though *S. densiflora* was also encountered extensively outside of sampled plots both in sampling areas and elsewhere in the Phase 1 and Phase 2A (Lower) restoration project areas (Appendix A, Figures 9 & 11).

Areas where *S. densiflora* was observed to be most abundant included dense stands along the Salt River and "S1" tributary (i.e., the southern-most dominant tidal tributary to the Salt River, just downstream from it's confluence with Reas Creek) channels and adjoining salt marsh habitats, as well as along the upper margins of internal tidal habitats where existing vegetation and edaphic features provide sufficient surface structural complexity to retain tidally-distributed propagules (and which experience less prolonged inundation). Areas observed to exhibit the least abundance appear to represent portions of the "advancing front" of colonization by this species, areas furthest removed from tidal incursion, and/or areas otherwise less favorable for this species.

Conium-Helminthotheca-Cirsium Complex

Most of the 2.2-mile-long setback levee constructed along the eastern edge of the Phase 1 restoration area supports an extensive complex of invasive plant species (Appendix A, Figure 10). Dominant among these are *Conium maculatum* ("poison hemlock"), *Helminthotheca echioides* ("bristly ox-tongue"), and *Cirsium vulgare* ("bull thistle"). The invasive *Cortaderia jubata* ("pampas grass") was also encountered along the access road that extends along the top of the most of the length of this levee. The species composition currently found along this design feature is consistent with the pre-construction vegetation observed in the portion of the restoration area from which much of the material to construct this levee was "borrowed" (pers. obs.). It is assumed that this invasive species complex originated from propagules in the seed bank used in levee construction.

This geomorphic feature will continue to be a significant invasive species propagule source (with obvious implications for the surrounding landscape), particularly given the combination of its elevation and the fact that wind is the primary dispersal mechanism for the invasive species observed. Use of the access road also increases the potential for dispersal of invasive propagules (both from and to the SRERP restoration area).

Additional limited occurrences of this invasive species complex were also encountered along the common boundary between brackish marsh, salt marsh, and riparian habitats on the north side of the "N1" channel, near its confluence with the Salt River.

Agrostis-Holcus-Ranunculus Complex

The brackish marsh wetland habitats within the Phase 1 restoration area support both native and non-native vegetation. Throughout much of these areas, however, the species composition was dominated by the invasive *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), and *Ranunculus repens* ("creeping buttercup"). *Phalaris arundinacea* ("reed canary grass") also occurs in some portions of brackish marsh habitat, though the extent of this species is indicated independently in Figure 10 (Appendix A), with respect to brackish marsh habitat.

This complex represents the remnants of the retained pre-restoration species composition of the historically seeded and grazed diked former tideland habitat that has not yet converted to salt marsh, and is not likely to pose substantial problems to the final success of the SRERP. While it is not yet clear if such conversion will eventually occur, these habitats are, for the most part, bounded by relatively more saline hydrochemistry, which is likely to effectively limit significant expansion of this complex.

Mixed Herbaceous Invasive Complex

The riparian planting zones within the Phase 1 restoration area support both native and non-native vegetation. Invasive plant species are, however, a dominant component of the vegetation throughout much of the riparian planting zone area in the southern half of the Phase 1 restoration area along the northern and eastern bank of the Salt River channel, as well as in the adjacent disturbed agricultural habitat along the access road in the vicinity of the historic dairy infrastructure (Appendix A, Figure 10).

The invasive species comprising this diverse assemblage consist (in varying proportions) of *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), *Lotus corniculatus* ("bird's-foot trefoil"), *Raphanus sativus* ("radish"), *Ranunculus repens* ("creeping buttercup"), *Helminthotheca echioides* ("bristly ox-tongue"), *Conium maculatum* ("poison hemlock"), *Cirsium arvense* ("Canada thistle"), *Cirsium vulgare* ("bull thistle"), *Phalaris arundinacea* ("reed canary grass"), and *Dipsacus fullonum* ("wild teasel").

The degree to which the invasive species in this complex have become established, particularly in the Phase 1 riparian planting zone habitats, warrants attention and appropriate management efforts. Quantitative vegetation sampling results from the Phase 1 riparian planting zone (Table 9) indicate that one-quarter to one-third ($\bar{x}$=31.4%) of the vegetative cover in these areas consists of invasive species (most of which are those represented by this species complex). Although eventual understory shading by a developing riparian forest canopy is hoped to provide some degree of passive management of invasive and undesirable vegetation in these habitats, given the protracted period over which this is predicted to occur substantial production and dispersal of invasive species propagules is likely. Failure to implement adequate management efforts during the initial years of establishment and development may allow for observed invasive vegetation to outcompete planted vegetation. preventing the ultimate realization of this restoration goal and requiring significant additional effort and expense.

Additional Observed Invasive Plant Species

Additional more "pure" occurrences of *Rubus armeniacus* ("Himalayan blackberry"), *Cirsium arvense* ("Canada thistle"), *Helminthotheca echioides* ("bristly ox-tongue"), *Phalaris arundinacea* ("reed canary grass"), *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley"), *Polypogon monspeliensis* ("rabbitfoot grass"), and *Cortaderia jubata* ("pampas grass") were also documented in the Riverside Ranch restoration area (Appendix A, Figure 10).

Two isolated occurrences of *Rubus armeniacus* ("Himalayan blackberry") occur in the central region of Riverside Ranch. One of these was located in an elevated hummock of brackish marsh habitat, just west of the segment of the access road that bisects Riverside Ranch, and the other is along the eastern edge of a retained existing stand of riparian forest in the western portion of the project area. In this same location, a slightly elevated region of riparian planting zone that adjoins the retained existing riparian forest supports an occurrence of ruderal vegetation, which includes the invasive, C*irsium arvense* ("Canada thistle").

Discrete stands of *Helminthotheca echioides* ("bristly ox-tongue") were identified within the high marsh ecotone, adjacent to the setback levee (in addition to contributing to the aforementioned *Conium*-*Helminthotheca*-*Cirsium* and "mixed herbaceous invasive" complexes). These likely originated from the same seed source previously mentioned.

Similarly, in addition to contributing to the aforementioned *Agrostis*-*Holcus*-*Ranunculus* and "mixed herbaceous invasive" complexes, discrete stands of *Phalaris arundinacea* ("reed canary grass") were observed in brackish marsh, existing riparian, and riparian planting zone habitat types in the Phase 1 restoration area. These occurrences revealed contrasting observations, likely reflecting different stages of establishment. Stands in the brackish marsh habitat were relatively dense and better developed, whereas observed individuals in the riparian planting zones consisted of sporadic individuals with fewer culms. The latter probably reflect more recently arrived individuals at an earlier stage in establishment than those observed in Phase 1 brackish marsh habitats.

Of the additional invasive "grasses," sporadic occurrences of *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley") and *Polypogon monspeliensis* ("rabbitfoot grass") were observed within the high marsh ecotone habitat type and along the zone of transition between it and salt marsh *sensu stricto*. Finally, *Cortaderia jubata* ("pampas grass") was encountered in two locations in the Phase 1 restoration area: the aforementioned location on the setback levee, and in the high marsh ecotone, adjacent to the setback levee, in the central region of the Riverside Ranch.

4.3.2 Phase 2 – Salt River Corridor Restoration

The majority of the invasive vegetation in the Phase 2A – Salt River corridor restoration area consists of the mixed associations of the following invasive grass species: *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), *Spartina densiflora* ("dense-flowered cord grass"), *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley"), and *Cortaderia jubata* ("pampas grass"). The latter three species are limited to isolated occurrences in the brackish active channel and bench (*S*. *densiflora* and *H*. *marinum* ssp. *gussoneanum*) and the active riparian berm (*C*. *jubata*) habitats in the lower Phase 2A restoration reach. Other, less abundant herbaceous invasive species also associated with these invasive grasses (as described in Section 4.2.2 and presented in Appendix B) are discussed here only if determined to significantly contribute to the potential failure to meet respective final restoration success criteria. The extent of invasive species and invasive species complexes in the Phase 2A restoration area are depicted in Figures 11 & 12 (Appendix A).

The most extensive distribution of invasive species in this portion of the restoration area consists of a mixed assemblage of *Phalaris arundinacea* ("reed canary grass") and *Agrostis stolonifera* ("creeping bent"), which extends throughout the Phase 2A active channel, bench, and riparian berm habitats, as well as along the adjacent woody riparian fringe and in contiguous canopy gaps. The abundance of these species within this mapped complex (Appendix A, Figures 11 & 12) ranged from sparsely distributed and sporadic in the middle Phase 2A active channel and bench habitats to being much more established and well developed in similar habitats in the lower Phase 2A reach, as well as along SRERP boundaries and/or the margin of retained riparian habitat throughout the Phase 2A restoration area. The invasive *Glyceria declinata* ("low manna grass") also co-occurs with the *Phalaris-Agrostis* complex in the freshwater active bench portion of the middle Phase 2A restoration reach (Appendix A, Figure 12). *Glyceria declinata* ("low manna grass") was observed sporadically throughout these low-lying bench habitats, occasionally in areas with otherwise sparse vegetative cover.

Additional, invasive species documented in the Phase 2A restoration area include narrow, linear areas supporting species previously described for the “mixed herbaceous invasive complex” along the south channel bank in the lower Phase 2A reach, as well as a mixed *Helminthotheca echioides* (“bristly ox-tongue”)-*Cirsium vulgare* (“bull thistle”) “complex” along the interface between retained existing riparian forest, and both the restored replanted riparian forest and active bench habitats in the middle Phase 2A reach. Remaining invasive plant species encountered in the Phase 2A restoration area consisted of a single observation of *Hedera helix* (“English ivy”) in the lower Phase 2A replanted riparian forest (Appendix A, Figure 11) and isolated occurrences of *Typha latifolia* (“broad-leaved cattail”) in active channel, bench, and active riparian berm habitats in both lower and middle reaches of the Phase 2A restoration area (Appendix A, Figures 11 & 12).

5.0 Discussion & Recommendations

Results presented herein for the 2016 SRERP habitat monitoring effort provide evidence of successful progress towards the attainment of long-term restoration goals and identify the pressing need for appropriate invasive vegetation management actions to ensure that those goals are ultimately achieved. Although the system’s “response” to restoration efforts at this relatively early stage in the SRERP monitoring period has not yet met some of the “final” success criteria (i.e., achievement of the minimum area [acreage] threshold for the Phase 1 “tidal salt & brackish marsh” habitat, and having greater than the maximum percent cover thresholds for non-native non-invasive and invasive vegetation in some sampling areas) results from the current effort do document “attainment” of stated minimum success thresholds specified for the 2016 SRERP monitoring period.

While this is encouraging, it is also important to recognize that monitoring results provide “snapshot” perspectives along an ecological continuum. Clearly, the intent in requiring a monitoring period duration of 5-10+ years after installation relies on the assumption that habitat development is dynamic, and not necessarily linear. Actual conditions may develop progressively, inversely, otherwise, or not at all. At the complex temporal interface between anthropogenic project planning and the dynamic ecosystem continuum, a 5- to10-year period does allow for some ability to evaluate whether “restoration” has, indeed been achieved, and/or to identify and attempt to correct potential threats to the attainment of the restored state. So, while there is good reason to believe that the various final success criteria will be achieved, we generally recommend continuing to perform monitoring efforts throughout the duration of the monitoring period as required in the monitoring schedule provided in the HMMP (except in rare instances where noted otherwise).

5.1 Habitat

Our observations confirm the establishment and continued development of projected habitats restored thus far, reflecting a favorable trajectory toward their persistence and the eventual realization of targeted conditions envisioned during the planning of the SRERP. With the exception of the “tidal salt & brackish marsh” habitat complex that collectively comprises the bulk of the Phase 1 restoration area, all other habitats addressed during 2016 exceed *final* minimum area success thresholds in this third, second, and first monitoring year for Phases 1, 2A (Lower), and 2A (Middle); respectively.

In the greater context of the SRERP, the 2% area-deficit (i.e., 6 acres) of the Phase 1 “tidal salt & brackish marsh” habitat complex is not considered significant. Some portion of the considerable area surplus (25.43 acres in excess of the 11-acre final threshold) of the partially contiguous high marsh ecotone habitat most likely represents area that accounts for this slight deficit. Given the recognized valuable ecological benefits of the transitional high marsh ecotone, which were the basis for the deliberate inclusion of this habitat type in the design of the SRERP, the acreage surplus of the high marsh ecotone is not considered to be at odds with the overall goals of this restoration project.

The size and extent of the “tidal salt & brackish marsh” habitat complex are unlikely to change to a significant degree over the course of the monitoring period given that this habitat complex currently occupies most of the available surface area within the elevation stratum in the project area that is subject to the tidal regime that is the primary influence driving the distribution of the subordinate habitat types that compose it. Most encouraging with regard to this habitat complex is the continued expansion of its primary subordinate habitat component, “true” salt marsh *sensu stricto*.

Current measurements of the collective aquatic and mudflat components of this habitat complex are substantially greater than targeted. Collectively they occupy 537% of their final minimum success threshold. It is assumed that the bulk of this excess is attributable to the mudflat component, given the limited extent of potential variation expected of the aquatic channel system that constitutes “aquatic” habitat. As described herein, these mudflats are effectively unvegetated by definition, and while they support virtually no salt marsh vegetation, they are not without ecological value. During the course of our fieldwork, we observed an abundance of crustaceans and tidally inundated burrows being used as crustacean refugia throughout these mudflat habitats. Various wading and shorebirds were regularly observed foraging and hunting in these mudflats and they appear to provide productive habitat for a variety of aquatic and terrestrial wildlife species.

All Phase 2A habitat types addressed during the 2016 habitat monitoring effort reflected calculated areas (acreages) in excess of projected habitat areas associated with GIS data used in the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012). In light of the favorable development of restored habitats associated with the Phase 2A restoration area thus far, it is anticipated that this development will continue without significant departure in the size and/or extent of the habitats addressed in the habitat monitoring effort. We continue to recommend performance of habitat mapping and area (acreage) analysis in respective monitoring years, consistent with the schedule of monitoring tasks described in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

5.2 Vegetation

Our analysis of the current state of the development of vegetation throughout the SRERP restoration areas yielded conflicting observations. Where a comparative analysis of quantitative sampling results across monitoring years (2014-2016) was possible, respective sampled areas indicate increasing establishment (i.e., percent cover) throughout. Evidence of the continued establishment and development of a native species-dominated flora throughout most of the areas restored thus far is also encouraging. Indeed, even in the three sampled habitats with the least observed native vegetative cover (i.e., Phase 1 replanted riparian forest, and Phase 2A [Lower] active bench and active riparian berm) the observed cover of native vegetation was greater than twice the minimum requirement specified in the HMMP for this primary (biotic) measure of the success of the restoration efforts.

Vegetation in the high marsh ecotone in the Phase 1 area has now been quantitatively analyzed for three consecutive years. Collectively, results from this period demonstrate that the intended vegetation in this habitat is successfully establishing at a rate far exceeding respective success thresholds. On this basis, there appears to be little need to perform quantitative vegetation sampling in this habitat at the next scheduled occasion in 2018 (monitoring year 5). Forgoing this monitoring task until the subsequent scheduled occasion in 2020 (monitoring year 7) should be sufficient to assess the continued development of vegetation in this habitat type. Continued analysis and mapping of the extent of this habitat, as well as the annual assessment of invasive vegetation should, however, continue as scheduled. If, during the course of performing these latter monitoring tasks prior to 2020, incidental observations of this habitat indicate a departure from the stated trend, quantitative sampling should be re-initiated (though this is not anticipated).

The lowest estimates of total and native vegetative cover observed during the 2016 fieldwork were in the active bench habitat in the middle Phase 2A restoration reach. Less plant cover is to be expected in this area given that it is the most recently restored, and associated vegetation is still in the early stages of becoming established. Observed disturbance to developing vegetation in this, and the lower reach of the Phase 2A restoration area, resulting from domestic herbivores (i.e., cattle and goats) entering the restoration area from adjacent properties has the potential to prevent native vegetation from becoming successfully established in this portion of the restoration area. Extensive hoof tracks and related channel bank erosion was documented in the middle Phase 2A restoration area during the 2016 fieldwork. Damage to numerous protective tree cages was also observed and as many as six individual steers/heifers were witnessed in this reach on several different field visits over the course of habitat monitoring. Similarly, a small heard of goats associated with a residence adjacent to the Salt River channel corridor was observed during our fieldwork in the lower portion of this Phase 2A (Lower) restoration area. In each case, more effective livestock management practices and maintenance of perimeter fencing around private agricultural properties adjacent to the restoration area would help to prevent impacts to vegetation and water quality due to these domestic herbivores.

For the most part, young woody species planted in respective riparian planting zones throughout the SRERP restoration area appear to continue to survive and develop, though a noteworthy instance of mortality of young planted *Picea sitchensis* ("Sitka spruce") trees was observed in the Phase 1 restoration area, on the north bank of the "N1" channel. Supplemental replanting in this location should be considered. The relatively low contribution of woody plant species observed in sampled riparian planting zones throughout is to be expected given the age of the planted individuals and limited aerial cover contribution of the young sapling canopy. With time, the contribution of woody riparian vegetative cover is expected to increase. Observed native recruitment of woody riparian seedlings throughout the Phase 2A Salt River channel corridor is also expected to further contribute to the woody structural component of the vegetation in this portion of the restoration area. Future quantitative sampling of these habitats should continue as scheduled in order to ensure the continued favorable development of the woody vegetative component of these habitats.

5.2.1 Recommended Sample Size

We recommend continued quantitative vegetation sampling in subsequent monitoring years, as specified in the schedule of monitoring tasks described in the HMMP, with the single noted exception of high marsh ecotone as discussed above. To develop the most appropriate sample size for these future efforts, we recommend using our alternative approach, introduced in Section 3.2.2. and further discussed below.

The suggested methods provided in the HMMP for performing power analyses impose a differing "burden of proof" for different habitats based on the considerable variation in differences between observed sample means and success criteria from one habitat to another. Although the power and size of the tests are shared, the effect size to detect real discrepancies between observations and success thresholds differs. It would seem more reasonable, instead, to evaluate the relative success or failure to meet the SRERP restoration goals by applying a common magnitude of deviation from established success thresholds. Towards such an end, Cohen (1988) proposed the use of "small," "medium," and/or "large" (e.g., 0.2, 0.5, 0.8, etc.) effect sizes based on standardized units (in this case, standard deviations of observed sample means) to apply a common "burden of proof" across all responses being assessed.

Our initial power calculations, using the assumptions stated in the HMMP (which included an 80% confidence level) yielded sample sizes so low (e.g., salt marsh *sensu stricto* n=5, etc.) they were determined to be insufficient to adequately evaluate habitat conditions being addressed, particularly in larger habitats/sampling areas. Such small sample sizes yielded from these initial attempts present a high likelihood of failure to identify both within-habitat variability and/or (and possibly correlated) “inter-annual process error.”

“Inter-annual process error” refers to variation that occurs on a year-to-year basis (e.g., seasonal anomalies such as exceptionally wet or dry years, drought, floods, etc.). Failure to account for such error may obscure actual long-term restoration response trends. Similarly, although at the conceptual level, habitats are typically envisioned as being homogeneous ecotypes, some degree of within-habitat variability almost always exists. Small sample sizes consistent with those resulting from the aforementioned calculations are likely to fail to capture existing within-habitat heterogeneity present in *in situ* conditions, even though sample plot locations were randomly assigned. Although the small sample sizes initially obtained were “statistically significant” (on the basis of the assumptions used) they also suggest relatively low within-habitat variability in the data from which they were calculated. This minimal degree of suggested variability was determined to be inconsistent with field observations made during habitat mapping.

Finally the significance level of 0.20 (80% confidence), suggested in the HMMP, is less than typical standard convention of 0.05 (95% confidence), and contributed to the production of small sample sizes initially obtained. Little rational was provided for such a low level of significance and is substantially liberal, so as to be potentially inaccurate and uninformative with respect to describing the response of vegetation to restoration efforts, in light of established success criteria set forth in the HMMP.

Our suggested approach assumes 80% statistical power with a significance level of 0.05 (95% confidence) to be able to detect an effect size of 0.5 standard deviations between respective sample means and relevant success criteria using a two-sided t-test. This approach applies a common “burden of proof” and provides for an increased level of certainty that the resulting sample size is sufficient to detect significant and relevant deviations between observed sample means and respective success criteria, while still being conservative with respect to the required level of effort. This sample size is also considered sufficient to account for potential within-habitat heterogeneity and year-to-year variability.

Sample sizes produced during our power analyses are provided in Table 11 below. We include results for “small” (0.2 SD), “medium” (0.5 SD), and “large” (0.8 SD) effect sizes for purposes of comparison. Our recommended approach of using a “medium” effect size of 0.5 standard deviations, produced a common sample size (n) of 32 as a conservative, but reasonable initial sample size for use

Table 11. Recommended Initial Sample Sizes for a Range of Effect Sizes.[1]

Effect Size[2]	Sample Size (n)
Small (0.2 SD)	197
Medium (0.5 SD)	32
Large (0.8 SD)	13

[1] Derived from power analyses using the following assumptions: 80% statistical power and a significance level of 0.05 (95% confidence) to detect effect sizes of 0.8, 0.5, and 0.2 standard deviations between respective observed sample means and relevant success criteria (H.T. Harvey & Associates with Winzler & Kelly 2012) using a two-sided t-test.

[2] Following Cohen (1988)

in the subsequent quantitative sampling effort. It is important to recognize that suggested sample sizes are "starting points," and their adequacy to address variability in future data sets should be assessed retrospectively, using similar methods.

5.3 Invasive Plant Species

Although 2016 quantitative sampling results demonstrate the general increase in vegetation establishment, they also indicate that despite the observed increase in native species cover, both non-native non-invasive and invasive plant species are also (independently) contributing to this increase throughout the SRERP project area. As discussed previously, invasive and non-native non-invasive plant species pose real threats to the near- and long-term success of the SRERP given the extent to which such unfavorable vegetation has already become established, and the observed increasing trend in establishment and development of both plant species categories.

To address this threat, we recommend that immediate and aggressive invasive vegetation management efforts be initiated and repeated as necessary until future monitoring results demonstrate a sustained decreasing trend in the observed extent and abundance of invasive species throughout the SRERP area to a level that will meet established respective success criteria. Such efforts should prioritize those species identified and discussed in Section 4.3. We also recommend continuing to conduct annual assessments to evaluate both the extent of invasive vegetation throughout the SRERP project area and the effectiveness of applied invasive species management efforts.

Significant off-site source populations of non-native and invasive species do occur within the vicinity of the SRERP restoration area, and will undoubtedly complicate non-native and invasive vegetation management efforts at the site through continued contribution of propagules unless these occurrences are also managed effectively. The most obvious of these include an extensive occurrence of *Spartina densiflora* ("dense-flowered cord grass") on the western bank of the lower Salt River channel that is part of a larger population found throughout the

Eel River estuary (Grazul & Rowland 2011), and a large occurrence of *Phalaris arundinacea* (“reed canary grass”) extending along the northeastern edge of the setback levee in the Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. Although not addressed as part of the current habitat monitoring effort, the latter occurrence is established within a peripheral portion of the CDFW-owned, “Riverside Ranch” property intended to be grazed to provide short-grass Cackling Goose (*Branta hutchinsii*) habitat. Currently, however, this area is not being actively managed due to complications associated with grazing lease negotiations (HCRCD pers. com.).

The rate of plant reproduction is most often exponential, particularly for successfully invasive “pioneering” species, and many reproduce both by sexual (e.g., seeds, etc.) and asexual methods (e.g., spreading by rhizomes, fragmentation, clonal reproduction, etc.). With every successful reproductive cycle, the invasive plant population potential increases by orders of magnitude. Coinciding with such increases, a proportionate level of effort and expense are required to adequately address such invasive vegetation.

For these reasons, sufficient invasive species management responses should be initiated as early as possible following detection, and should be appropriately implemented to manage the species being addressed. In order to be successful, management actions typically need to be repeated (i.e., multiple times each year, for successive years), sustained, and monitored to ensure that they are effective. Ill-conceived or incomplete attempts are frequently ineffective and ultimately do not result in a reduced need for continued efforts. Most often, early and comprehensive responses result in more effective outcomes at reduced long-term expense to land managers, despite the extent of costs initially.

Where substantial occurrences of invasive species exist within the SRERP restoration area, efforts should continue despite the reduction and/or cessation of on-site propagule production, as *in situ* seed bank material continues to emerge and propagules from external sources arrive and establish. It is unlikely that all latent invasive species propagules in the existing seed bank will be exhausted by the end of the 10-year monitoring period. However, with sustained and dedicated effort, invasive vegetation development, flower production, seed maturation, and subsequent dispersal can be greatly reduced to minimize both the establishment of new individuals and minimize further contributions to the seed bank at the site and in the surrounding landscape.

With continued time and the reduction in significant (restoration-related) soil disturbance events, there will also be fewer favorable opportunities for invasive seed germination and establishment. This reduction in disturbance regimes that favor invasive plant establishment, coupled with dedicated invasive species management efforts should contribute to reducing invasive species abundance throughout the SRERP area to below the final maximum success thresholds.

Effective invasive species management efforts require proper planning and must address various seasonal considerations. The typical phenology and reproductive biology for each targeted species should be evaluated to identify the best time(s) of year to implement appropriate management methods, as well as the number of repetitions during the species' development that management tasks should be performed to produce the desired results. Planning for management efforts should also take into consideration their potential impacts on other, associated sensitive biological resources.

Invasive species management efforts should target specific species and minimize impacts to co-occurring native vegetation. Care should be taken in areas where special status plant species are known (i.e., *Carex lyngbyei*, "Lyngbye's sedge"), or have the potential (e.g., *Castilleja ambigua* ssp. *humboldtiensis*, "Humboldt Bay owl's-clover;" etc.), to occur in order to avoid causing adverse impacts to such species as a result of eradication efforts.

Invasive species management efforts should also incorporate a strategy to avoid causing adverse impacts to breeding birds. There is often substantial overlap between the optimum timing for invasive vegetation management efforts and the breeding season of resident and migratory bird species. Included among these are species with protective conservation status, for which suitable breeding habitat exists within the SRERP restoration area (pers. obs.). Appropriate planning can help minimize and/or avoid prevent invasive vegetation management-related impacts to breeding birds.

Non-native non-invasive vegetation also appears to present some challenge to eventual attainment of respective final success thresholds within some sampled areas. Consistent with the rationale described above, significant ground disturbance associated with vegetation management efforts would likely favor the establishment of invasive species. Such actions should, therefore, be avoided if possible during management of invasive and non-native non-invasive plant species. Ideally, the application of species-specific manual management methods (e.g., mowing, weed-whacking, etc.) would encourage native vegetation to outcompete non-native non-invasive vegetation to the extent that respective success thresholds are met. Continued sampling in respective habitats should be carried out as scheduled to assess the condition of this category of vegetation. Should it appear that success thresholds will not be met, supplemental planting of native species should also be considered.

5.4 Seasonal Considerations

Finally, due to a combination of logistical considerations, the 2016 fieldwork was performed comparatively late (August-September) for what is generally considered to be the "floristically appropriate" season for the region. Conducting botanical fieldwork outside of (or near the limits of) seasonally appropriate periods presents the risk of failing to accurately measure important vegetative variables of interest (e.g., percent cover, etc.) and/or of collecting data that, when compared across years, may provide inaccurate conclusions if data were collected during different periods within respective years. Indeed, performing fieldwork “too early” or “too late” may even result in the failure to detect some species altogether.

This may have been the case with respect to the invasive species, *Lythrum hyssopifolia* (“hyssop loosestrife”), which was reported from 2015 (H.T. Harvey & Associates 2015), but was not detected in the 2016 effort. Review of the phenology of this species indicates that its blooming period extends from May through August. It is, therefore, possible that this species still occurs within the SRERP restoration area, but was not detected due to the time period in which our fieldwork was performed. Such considerations should be taken into account when planning for invasive species management efforts, both to properly identify invasive species in need of removal as well as special status botanical species that may co-occur with invasive species where management actions are being considered. Although complications may arise from comparisons of data collected during different timeframes, future habitat monitoring efforts for the SRERP should be conducted earlier in the floristic season (e.g., May-July), which will necessitate earlier initiation of solicitations to qualified entities for such work to be performed.

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Appendix A

Salt River Ecosystem Restoration Project Figures

Figure 2. SRERP Projected Habitat Types
(Adapted from H.T. Harvey & Associates with Winzler & Kelly 2012)

Figure 3. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Habitats

Figure 4. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Habitats

Figure 5. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Habitats

Figure 6. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Vegetation Sampling Plot Locations

Figure 7. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Vegetation Sampling Plot Locations

Figure 8. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Vegetation Sampling Plot Locations

Figure 9. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive *Spartina densiflora* ("dense-flowered cord grass")

Figure 10. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive Plant Species

Figure 11. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

Figure 12. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Invasive Plant Species

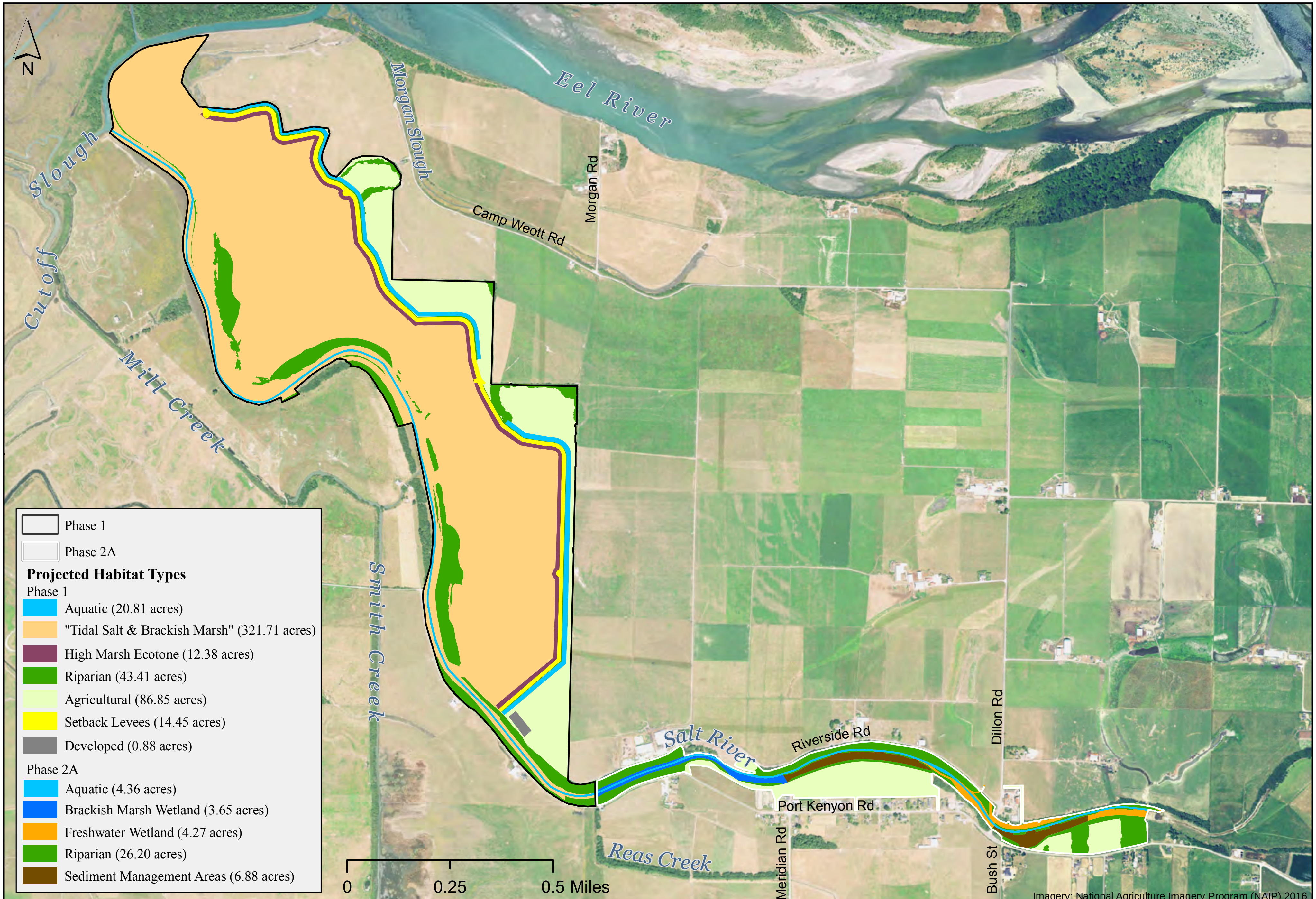

Figure 2. SRERP Projected Habitat Types (Adapted from: H.T. Harvey & Associates and Winzler & Kelly 2012)

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Salt River Ecosystem Restoration Project

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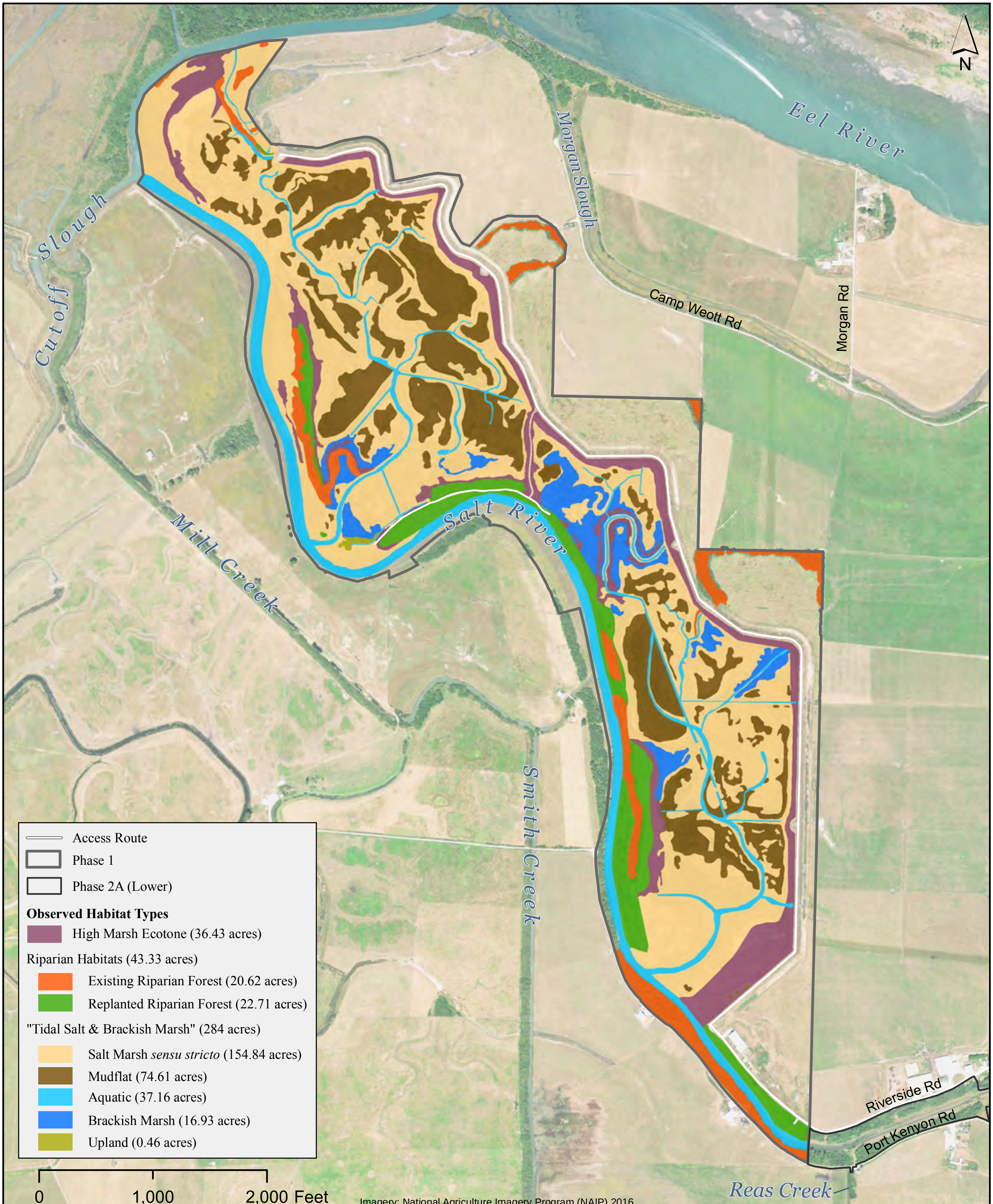

Figure 3. SRERP Phase 1 - Riverside Ranch Tidal Marsh Restoration Area Observed Habitats

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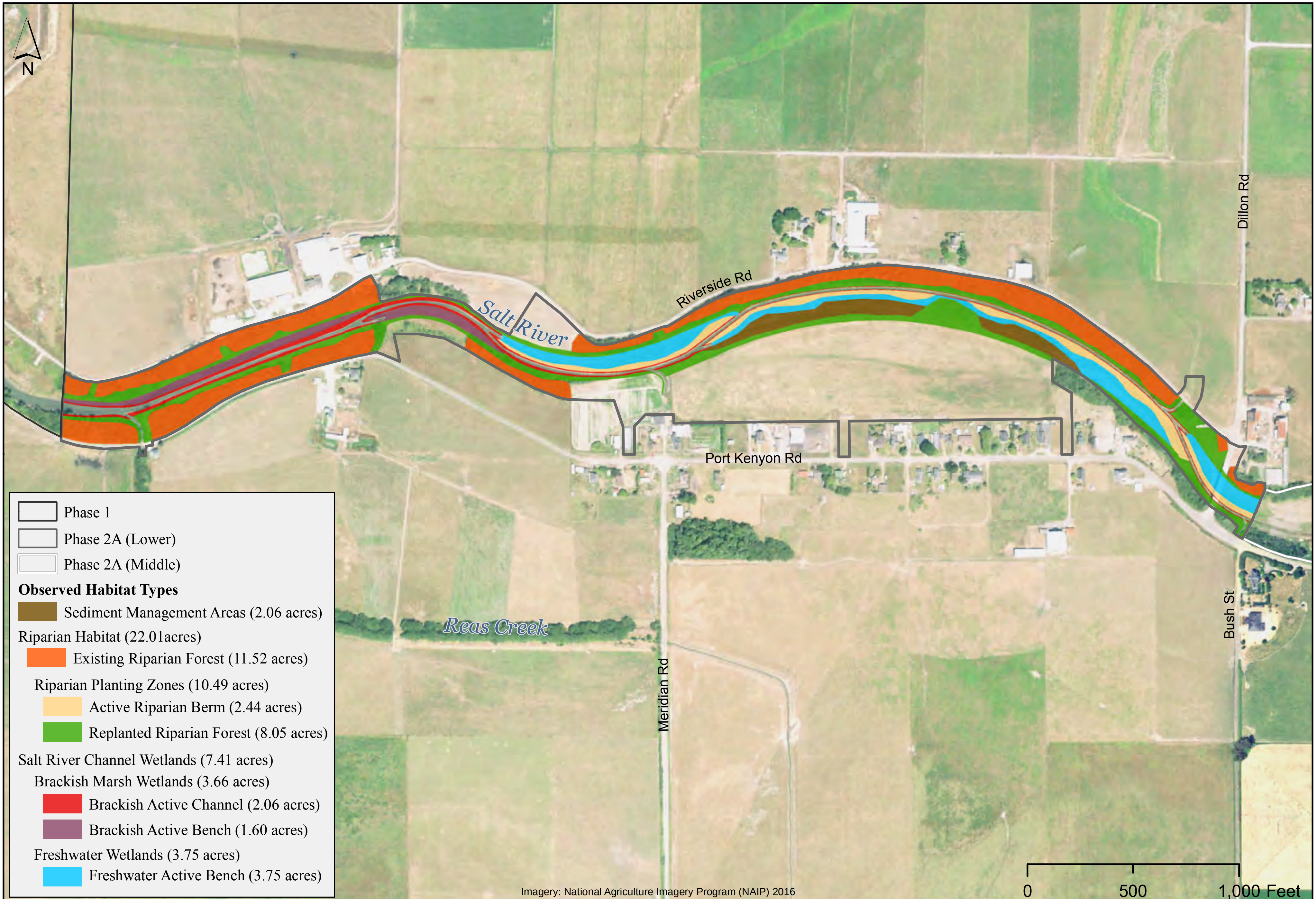

Figure 4. SRERP Phase 2A (Lower) - Salt River Corridor Restoration Area Observed Habitats

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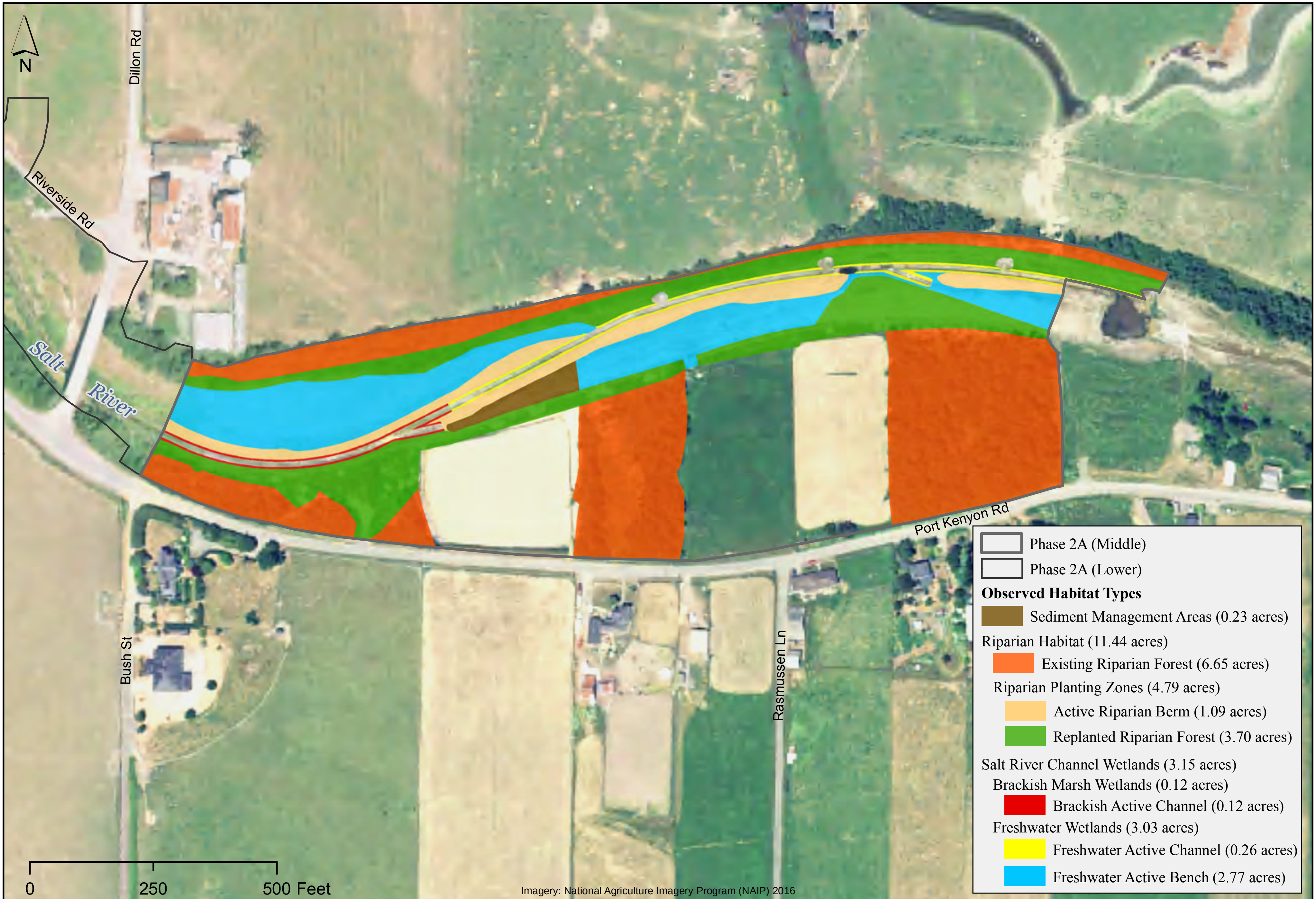

Figure 5. SRERP Phase 2A (Middle) - Salt River Corridor Restoration Area Observed Habitats

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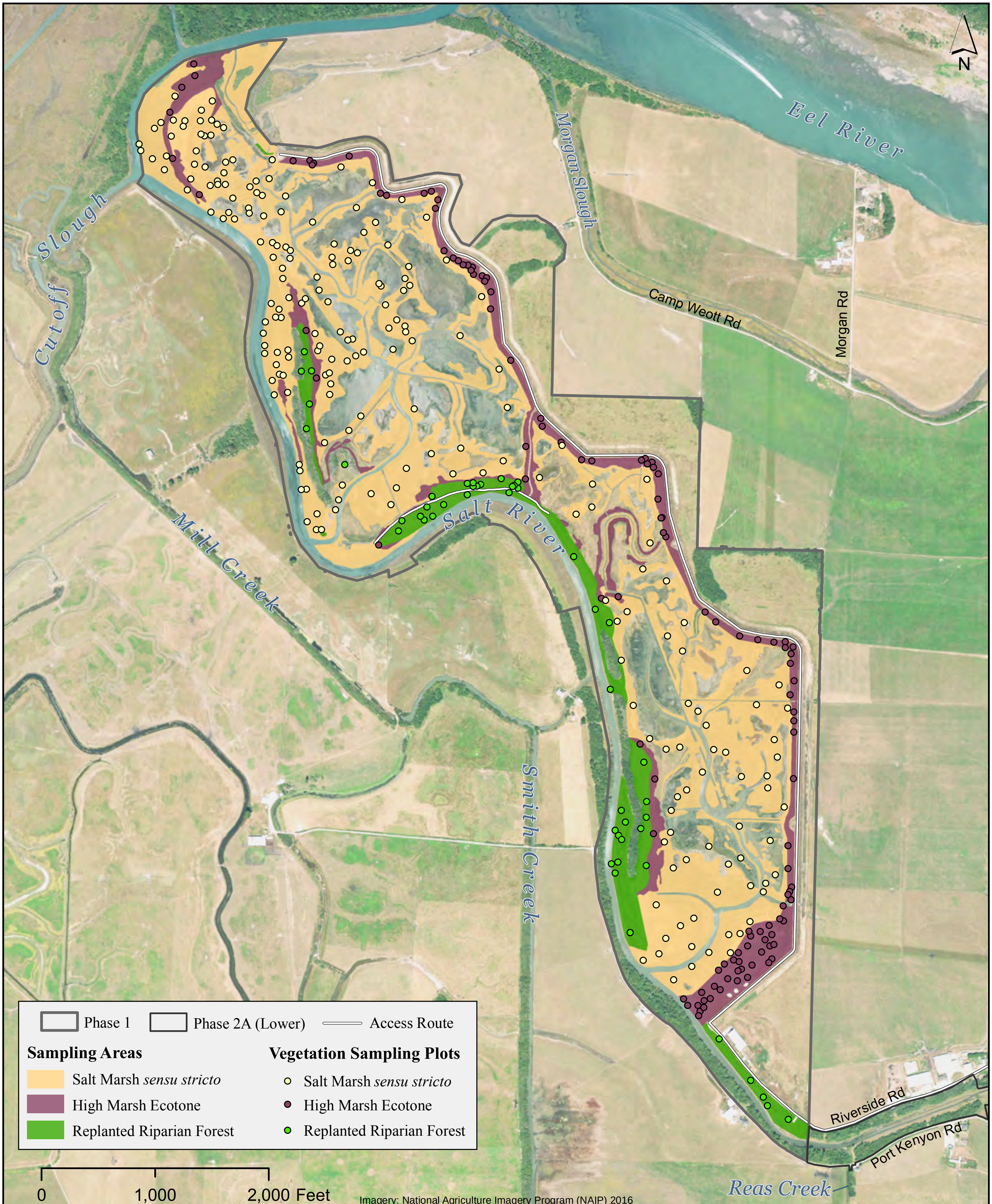

Figure 6. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Vegetation Sampling Plot Locations

2016 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

J.B. LOVELACE & ASSOCIATES

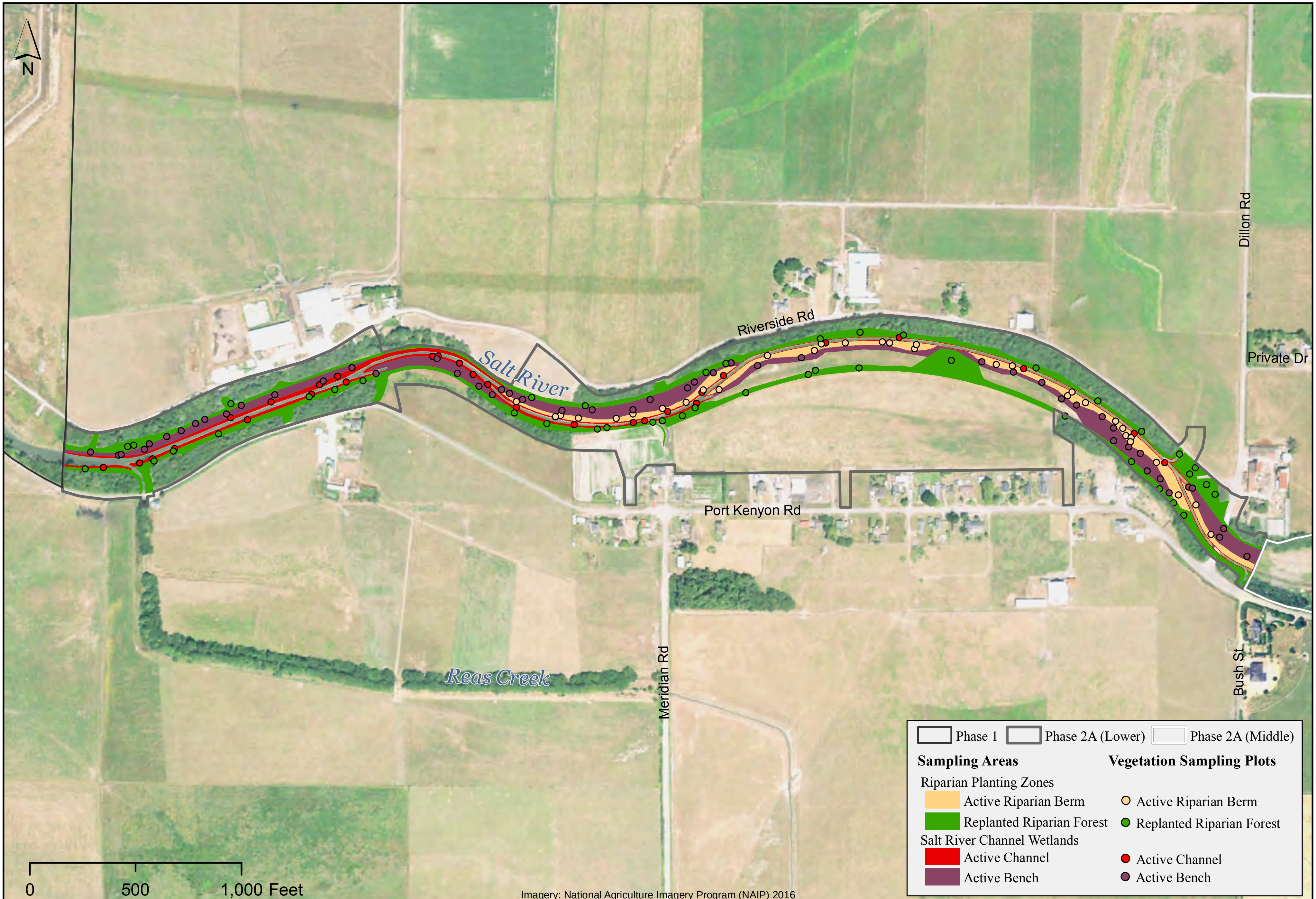

Figure 7. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Vegetation Sampling Plot Locations

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Salt River Ecosystem Restoration Project

Figure 8. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Vegetation Sampling Plot Locations

2016 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

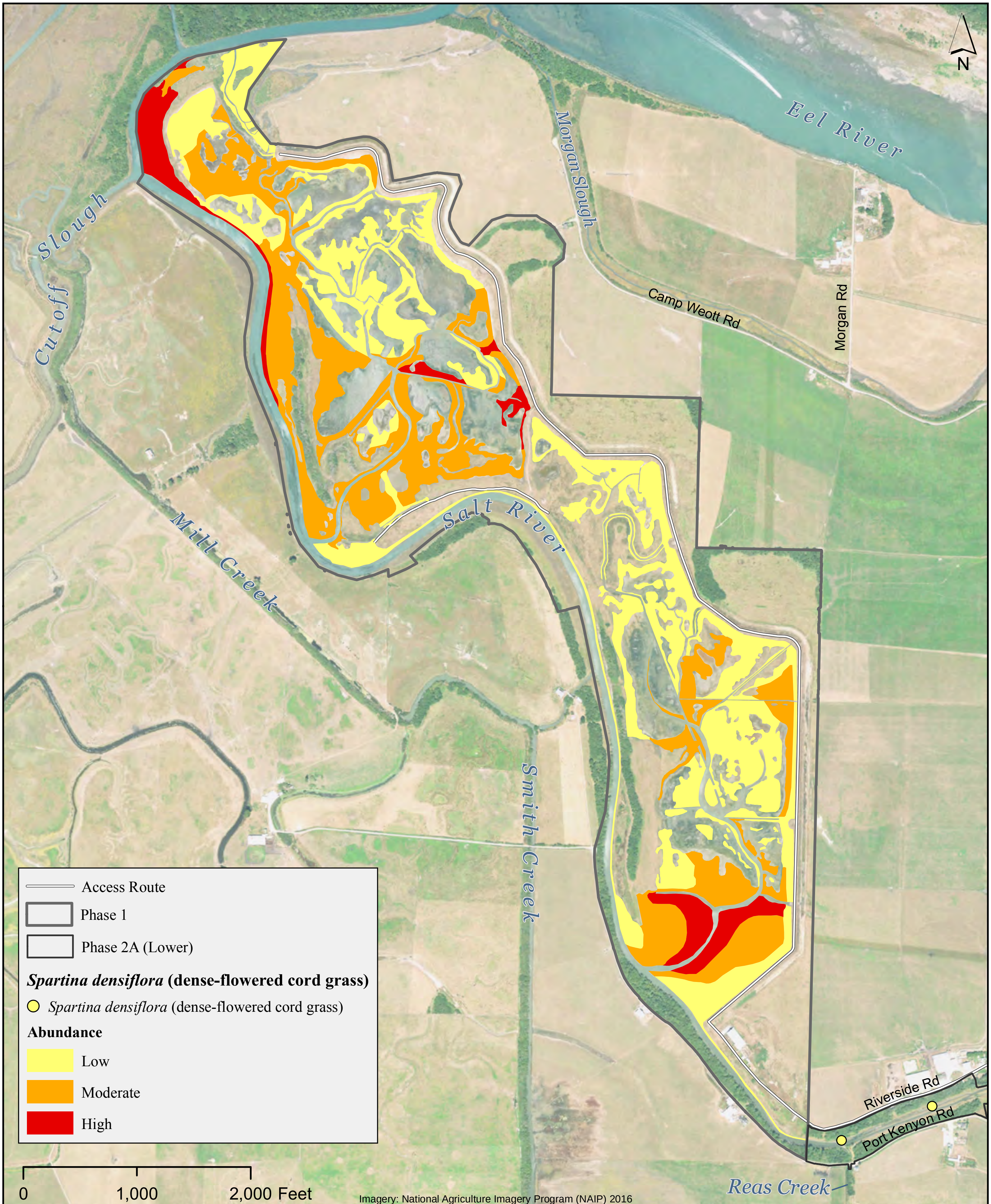

Figure 9. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive *Spartina densiflora* (dense-flowered cord grass)

2016 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

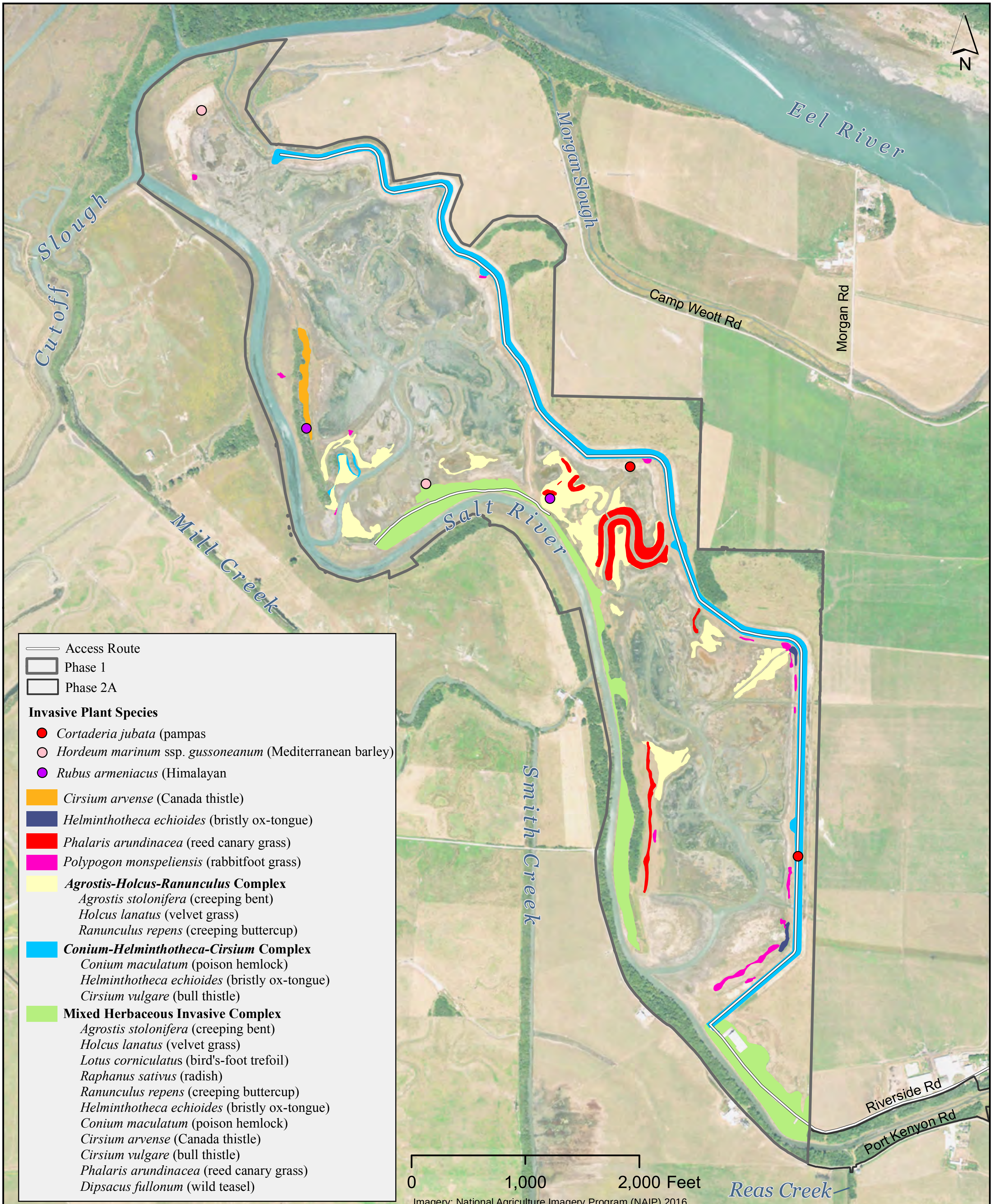

Figure 10. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive Plant Species

2016 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

J.B. LOVELACE & ASSOCIATES

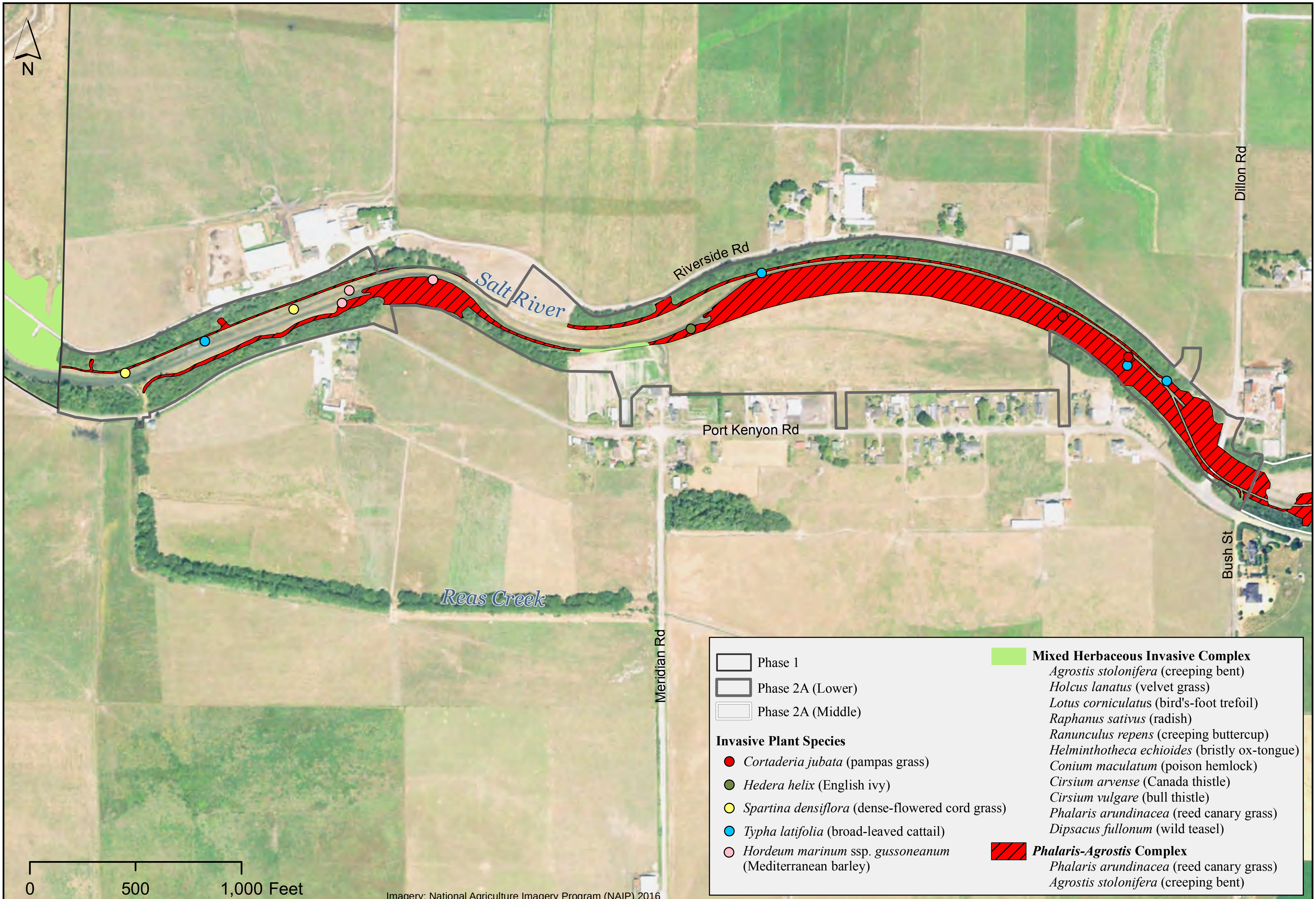

Figure 11. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

2016 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

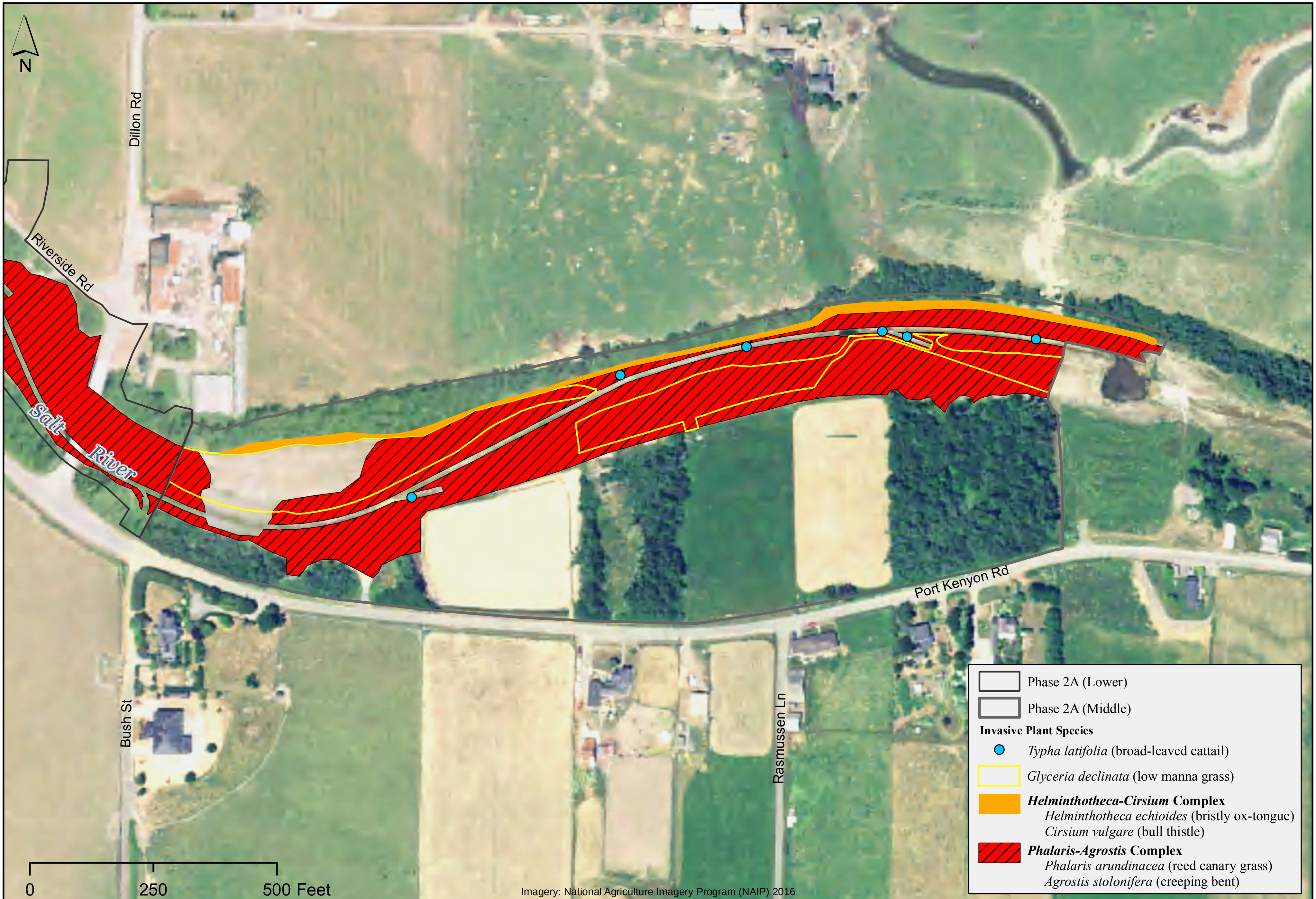

Figure 12. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Invasive Plant Species

2016 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

Appendix B

SRERP Quantitative Vegetation Sampling Results

(Taxa in bold represent species with special status conservation protections.)

SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. Salt Marsh *sensu stricto* Mean (Absolute) Vegetative Cover (n=219).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Shrubs			
Baccharis pilularis "coyote brush"	<1	<0.01	<0.01
Herbs			
Salicornia pacifica "pickleweed"	74	45.28	36.78
Distichlis spicata "salt grass"	39	25.47	37.73
Juncus effusus ssp. *pacificus* "Pacific rush"	6	2.93	13.44
Jaumea carnosa "fleshy Jaumea"	6	1.97	8.61
Spergularia marina "saltmarsh sand-spurrey"	11	1.93	6.64
Triglochin striata "three-ribbed arrow-grass"	3	1.37	9.57
Triglochin maritima "common arrow-grass"	6	1.06	6.79
Eleocharis macrostachya "spikerush"	2	0.80	6.84
Hordeum brachyantherum "meadow barley"	5	0.66	3.00
Carex lyngbyei **"Lyngbye's sedge"**	3	0.64	4.77
Deschampsia cespitosa "tufted hairgrass"	3	0.19	1.48
Bolboschoenus maritimus ssp. *paludosus* "saltmarsh bulrush"	1	0.15	1.44
Non-Native Non-Invasive Species			
Herbs			
Cotula coronopifolia "brass-buttons"	23	4.24	10.98
Atriplex prostrata "fat-hen"	16	3.61	13.03
Parapholis strigosa "sickle grass"	5	0.79	4.31
Festuca perennis "rye grass"	<1	0.01	0.20
Invasive Species			
Herbs			
Spartina densiflora "dense-flowered cord grass"	30	7.18	20.32
Agrostis stolonifera "creeping bent"	5	1.87	10.25
Polypogon monspeliensis "rabbitfoot grass"	5	0.25	1.78
Hordeum marinum ssp. *gussoneanum* "Mediterranean barley"	<1	0.07	1.01

SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. High Marsh Ecotone Mean (Absolute) Vegetative Cover (n=116).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Shrubs			
Rubus ursinus "California blackberry"	1	0.13	1.39
Herbs			
Deschampsia cespitosa "tufted hairgrass"	75	38.82	36.25
Salicornia pacifica "pickleweed"	53	16.60	23.86
Hordeum brachyantherum "meadow barley"	62	14.01	19.11
Spergularia marina "saltmarsh sand-spurrey"	34	4.76	10.94
Distichlis spicata "salt grass"	11	2.95	11.58
Jaumea carnosa "fleshy Jaumea"	3	0.70	4.91
Grindelia stricta var. *platyphylla* "marsh gumplant"	3	0.41	2.40
Carex lyngbyei "Lyngbye's sedge"	1	0.13	1.39
Bolboschoenus maritimus ssp. *paludosus* "saltmarsh bulrush"	2	0.01	0.05
Epilobium ciliatum ssp. *watsonii* "Watson's willowherb"	1	<0.01	0.05
Potentilla anserina ssp. *pacifica* "Pacific silverweed"	2	<0.01	0.01
Non-Native Non-Native Species			
Herbs			
Cotula coronopifolia "brass-buttons"	46	9.92	16.32
Atriplex prostrata "fat-hen"	39	5.38	14.61
Festuca perennis "rye grass"	17	2.87	10.40
Cynosurus cristatus "crested dogtail grass"	1	0.32	3.48
Plantago lanceolata "English plantain"	2	0.26	1.96
Trifolium fragiferum "strawberry clover"	2	0.13	1.39
Sonchus asper ssp. *asper* "prickly sow thistle"	1	0.13	1.39
Rumex conglomeratus "clustered dock"	3	0.03	0.29
Plantago major "common plantain"	1	<0.01	0.05
Rumex crispus "curly dock"	2	<0.01	0.01

SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. High Marsh Ecotone Mean (Absolute) Vegetative Cover (n=116).

Species	**Frequency (%)**	**$\bar{x}$ Cover (%)**	**SD (%)**
Invasive Species			
Herbs			
Polypogon monspeliensis “rabbitfoot grass”	36	4.48	11.17
Agrostis stolonifera “creeping bent”	21	3.07	9.11
Spartina densiflora “dense-flowered cord grass”	16	1.35	6.25
Lotus corniculatus “bird’s-foot trefoil”	12	0.70	3.06
Holcus lanatus “velvet grass”	2	0.35	3.49
Raphanus sativus “radish”	3	0.14	1.39
Hordeum marinum ssp. *gussoneanum* “Mediterranean barley”	1	0.03	0.28
Conium maculatum “poison hemlock”	2	0.01	0.05
Helminthotheca echioides “bristly ox-tongue”	1	<0.01	0.05
Mentha pulegium “pennyroyal”	1	<0.01	0.05

SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. Replanted Riparian Forest Mean (Absolute) Vegetative Cover (n=50).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Trees			
Salix lasiolepis “arroyo willow”	6	2.55	14.02
Pinus contorta ssp. *contorta* “shore pine”	2	1.71	12.09
Picea sitchensis “Sitka spruce”	8	1.20	4.11
Shrubs			
Rubus ursinus “California blackberry”	22	7.48	22.54
Lonicera involucrata ssp. *ledebourii* “twinberry”	2	0.30	2.12
Rubus parviflorus “thimbleberry”	2	0.30	2.12
Herbs			
Deschampsia cespitosa “tufted hairgrass”	46	27.55	36.28
Equisetum arvense “common horsetail”	12	4.61	15.80
Hordeum brachyantherum “meadow barley”	24	3.33	7.39
Potentilla anserina ssp. *pacifica* “Pacific silverweed”	6	2.30	10.37
Epilobium *ciliatum* ssp. *watsonii* “Watson’s willowherb”	6	1.35	6.00
Oenanthe sarmentosa “water parsley”	8	1.20	4.11
Symphyotrichum chilense “Pacific Aster”	4	0.60	2.97
Grindelia stricta var. *platyphylla* “marsh gumplant”	4	0.36	2.15
Achillea millefolium “yarrow”	2	0.30	2.12
Juncus balticus ssp. *ater* “Baltic rush”	2	0.30	2.12
Salicornia pacifica “pickleweed”	2	0.06	0.42
Spergularia marina “saltmarsh sand-spurrey”	2	0.06	0.42
Non-Native Non-Invasive Species			
Herbs			
Festuca perennis “rye grass”	32	11.59	24.59
Plantago lanceolata “English plantain”	14	6.09	20.58
Atriplex prostrata “fat-hen”	24	3.99	13.59
Rumex conglomeratus “clustered dock”	32	3.20	6.00
Polypogon interruptus “ditch beard grass”	4	1.55	9.05

SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. Replanted Riparian Forest Mean (Absolute) Vegetative Cover (n=50).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Trifolium pretense "red clover"	6	1.35	6.00
Rumex crispus "curly dock"	6	0.60	2.97
Trifolium fragiferum "strawberry clover"	4	0.31	2.12
Aira caryophyllea "silver hair grass"	2	0.30	2.12
Cotula coronopifolia "brass-buttons"	2	0.30	2.12
Hypochaeris radicata "hairy cat's-ears"	2	0.30	2.12
Plantago major "common plantain"	6	0.18	0.72
Invasive Species			
Herbs			
Agrostis stolonifera "creeping bent"	48	10.59	19.12
Holcus lanatus "velvet grass"	28	5.02	11.34
Lotus corniculatus "bird's-foot trefoil"	26	4.99	13.77
Raphanus sativus "radish"	2	4.12	12.98
Ranunculus repens "creeping buttercup"	16	4.01	11.80
Helminthotheca echioides "bristly ox-tongue"	24	3.42	8.56
Conium maculatum "poison hemlock"	14	3.13	13.31
Cirsium arvense "Canada thistle"	6	1.35	6.00
Spartina densiflora "dense-flowered cord grass"	2	0.75	5.30
Cirsium vulgare "bull thistle"	4	0.60	2.97
Phalaris arundinacea "reed canary grass"	4	0.60	2.97
Dipsacus fullonum "wild teasel"	4	0.36	2.15
Convolvulus arvensis "bindweed"	6	0.32	2.12
Polypogon monspeliensis "rabbitfoot grass"	4	0.31	2.12

SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area. Active Channel Mean (Absolute) Vegetative Cover (n=29).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Trees			
Alnus rubra "red alder"	14	2.43	7.78
Salix lasiandra var. *lasiandra* "Pacific willow"	14	1.14	3.88
Salix sitchensis "Sitka willow"	3	0.52	2.79
Herbs			
Deschampsia cespitosa "tufted hairgrass"	83	34.09	30.48
Grindelia stricta var. *platyphylla* "marsh gumplant"	48	12.62	19.89
Scirpus microcarpus "panicled bulrush"	34	7.97	17.38
Hordeum brachyantherum "meadow barley"	34	6.72	10.86
Salicornia pacifica "pickleweed"	21	4.50	11.75
Juncus balticus ssp. *ater* "Baltic rush"	10	3.57	16.01
Juncus effusus ssp. *pacificus* "Pacific rush"	7	1.03	3.87
Stachys ajugoides "hedge-nettle"	7	0.62	2.82
Carex obnupta "slough sedge"	3	0.52	2.79
Cyperus eragrostis "nutsedge"	3	0.52	2.79
Eleocharis macrostachya "spikerush"	3	0.52	2.79
Glehnia littoralis ssp. *leiocarpus* "American Glehnia"	3	0.52	2.79
Oenanthe sarmentosa "water parsley"	3	0.02	0.09
Non-Native Non-Invasive Species			
Herbs			
Trifolium repens "white clover"	21	7.93	18.18
Atriplex prostrata "fat-hen"	34	2.92	5.69
Plantago major "common plantain"	14	2.34	7.79
Trifolium fragiferum "strawberry clover"	10	1.55	4.65
Festuca perennis "rye grass"	7	1.03	3.87
Vicia hirsuta "hairy vetch"	7	1.03	3.87
Cotula coronopifolia "brass-buttons"	14	0.83	2.88
Rumex conglomeratus "clustered dock"	7	0.53	2.78

SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area. Active Channel Mean (Absolute) Vegetative Cover (n=29).

Species	**Frequency (%)**	**$\bar{x}$ Cover (%)**	**SD (%)**
Festuca arundinacea *"tall Fescue"*	3	0.10	0.56
Rumex crispus "curly dock"	3	0.02	0.09
Invasive Species			
Herbs			
Agrostis stolonifera "creeping bent"	21	5.10	13.68
Phalaris arundinacea "reed canary grass"	17	4.00	13.46
Holcus lanatus "velvet grass"	14	1.66	4.65
Helminthotheca echioides "bristly ox-tongue"	10	1.14	3.88
Polypogon monspeliensis "rabbitfoot grass"	7	1.03	3.87
Ranunculus repens "creeping buttercup"	10	0.72	2.85
Hordeum marinum ssp. *gussoneanum* "Mediterranean barley"	3	0.52	2.79
Lotus corniculatus "bird's-foot trefoil"	3	0.52	2.79
Mentha pulegium "pennyroyal"	3	0.52	2.79
Spartina densiflora "dense-flowered cord grass"	3	0.02	0.09

SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area. Active Bench Mean (Absolute) Vegetative Cover (n=50).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Trees			
Salix lasiandra var. *lasiandra* "Pacific willow"	14	3.11	9.98
Alnus rubra "red alder"	8	0.98	3.64
Salix lasiolepis "arroyo willow"	4	0.37	2.18
Shrubs			
Rubus ursinus "California blackberry"	6	1.13	5.73
Rubus spectabilis "salmonberry"	2	0.31	2.14
Herbs			
Deschampsia cespitosa "tufted hairgrass"	69	30.64	30.59
Scirpus microcarpus "panicled bulrush"	37	10.22	20.31
Bolboschoenus maritimus ssp. *paludosus* "saltmarsh bulrush"	18	4.09	11.91
Hordeum brachyantherum "meadow barley"	27	3.95	7.79
Juncus balticus ssp. *ater* "Baltic rush"	16	2.91	7.31
Grindelia stricta var. *platyphylla* "marsh gumplant"	16	2.20	5.30
Oenanthe sarmentosa "water parsley"	12	2.00	6.63
Veronica americana "American brooklime"	4	0.78	5.36
Potentilla anserina ssp. *pacifica* "Pacific silverweed"	6	0.62	3.00
Festuca rubra "red fescue"	4	0.61	3.00
Salicornia pacifica "pickleweed"	4	0.61	3.00
Elymus glaucus "wild rye"	4	0.37	2.18
Bolboschoenus maritimus ssp. *paludosus* "saltmarsh bulrush"	2	0.31	2.14
Cyperus eragrostis "nutsedge"	2	0.31	2.14
Epilobium ciliatum ssp. *watsonii* "Watson's willowherb"	2	0.31	2.14
Equisetum arvense "common horsetail"	2	0.31	2.14
Juncus effusus ssp. *pacificus* "Pacific rush"	2	0.31	2.14
Non-Native Non-Invasive Species			
Herbs			
Trifolium repens "white clover"	14	7.42	21.21
Cotula coronopifolia "brass-buttons"	22	5.93	14.62

SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area. Active Bench Mean (Absolute) Vegetative Cover (n=50).

Species	**Frequency (%)**	**$\bar{x}$ Cover (%)**	**SD (%)**
Trifolium fragiferum "strawberry clover"	8	2.65	10.62
Festuca perennis "rye grass"	8	2.14	7.95
Rumex crispus "curly dock"	6	2.11	12.35
Atriplex prostrata "fat-hen"	18	1.91	4.96
Rumex conglomeratus "clustered dock"	12	1.59	4.59
Plantago major "common plantain"	8	0.93	3.63
Invasive Species			
Herbs			
Phalaris arundinacea "reed canary grass"	37	6.69	15.25
Agrostis stolonifera "creeping bent"	14	3.57	11.00
Polypogon monspeliensis "rabbitfoot grass"	8	0.68	3.02
Lotus corniculatus "bird's-foot trefoil"	4	0.61	3.00
Hordeum marinum ssp. *gussoneanum* "Mediterranean barley"	4	0.04	0.29
Erosion-Control Hybrid			
Elymus x *Triticum* "wheatgrass hybrid"	4	0.32	2.14

SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area. Replanted Riparian Forest Mean (Absolute) Vegetative Cover (n=43).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Trees			
Salix lasiolepis "arroyo willow"	42	16.63	27.76
Alnus rubra "red alder"	27	8.11	16.39
Picea sitchensis "Sitka spruce"	9	1.33	4.32
Shrubs			
Rubus ursinus "California blackberry"	16	4.33	11.13
Rubus spectabilis "salmonberry"	9	1.83	6.62
Rubus parviflorus "thimbleberry"	4	1.67	7.82
Lonicera involucrata ssp. *ledebourii* "twinberry"	2	0.33	2.24
Rosa californica "California rose"	2	0.33	2.24
Herbs			
Deschampsia cespitosa "tufted hairgrass"	67	24.84	30.78
Scirpus microcarpus "panicled bulrush"	29	10.26	21.61
Oenanthe sarmentosa "water parsley"	36	8.86	15.38
Juncus balticus ssp. *ater* "Baltic rush"	16	3.83	10.07
Hordeum brachyantherum "meadow barley"	20	3.23	7.57
Grindelia stricta var. *platyphylla* "marsh gumplant"	9	2.33	8.28
Urtica dioica "stinging nettle"	2	1.90	12.75
Epilobium ciliatum ssp. *watsonii* "Watson's willowherb"	6	1.74	4.76
Equisetum arvense "common horsetail"	11	1.67	4.77
Stachys ajugoides "hedge-nettle"	4	0.34	2.24
Veronica Americana "American brooklime"	4	0.34	2.24
Anaphalis margaritacea "pearly everlasting"	2	0.33	2.24
Carex leptopoda "slender-footed sedge"	2	0.33	2.24
Elymus glaucus "wild rye"	2	0.33	2.24
Glehnia littoralis ssp. *leiocarpus* "American Glehnia"	2	0.33	2.24
Juncus effusus ssp. *pacificus* "Pacific rush"	2	0.33	2.24
Potentilla anserina ssp. *pacifica* "Pacific silverweed"	2	0.33	2.24

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Carex obnupta "slough sedge"	2	0.07	0.45
Non-Native Non-Invasive Species			
Herbs			
Trifolium fragiferum "strawberry clover"	7	2.56	10.92
Rumex conglomeratus "clustered dock"	20	2.14	5.14
Trifolium repens "white clover"	13	2.00	5.16
Festuca perennis rye grass"	11	1.90	6.62
Vicia hirsuta "hairy vetch"	2	0.83	5.59
Daucus carota "Queen Anne's lace"	4	0.67	3.13
Centaurium tenuiflorum "slender centuary"	2	0.33	2.24
Plantago lanceolata "English plantain"	2	0.33	2.24
Plantago major "common plantain"	2	0.33	2.24
Invasive Species			
Woody Vines			
Hedera helix "English ivy"	2	0.07	0.45
Herbs			
Phalaris arundinacea "reed canary grass"	51	16.37	24.75
Ranunculus repens "creeping buttercup"	27	6.06	12.70
Agrostis stolonifera "creeping bent"	16	5.39	14.04
Cirsium vulgare "bull thistle"	13	4.61	14.25
Helminthotheca echioides "bristly ox-tongue"	2	2.17	14.53
Holcus lanatus "velvet grass"	11	1.90	6.62
Mentha pulegium "pennyroyal"	7	1.50	6.32
Lotus corniculatus "bird's-foot trefoil"	2	0.83	5.59
Convolvulus arvensis "bindweed"	4	0.40	2.27
Conium maculatum "poison hemlock"	2	0.33	2.24
Raphanus sativus "radish"	2	0.33	2.24
Erosion-Control Hybrid			
Elymus x *Triticum* "wheatgrass hybrid"	2	0.33	2.24

SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area. Active Riparian Berm Mean (Absolute) Vegetative Cover (n=32).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Trees			
Alnus rubra "red alder"	3	0.50	2.74
Picea sitchensis "Sitka spruce"	3	0.50	2.74
Shrubs			
Rubus spectabilis "salmonberry"	7	1.00	3.81
Baccharis pilularis "coyote brush"	3	0.14	0.55
Herbs			
Deschampsia cespitosa "tufted hairgrass"	87	42.02	32.80
Scirpus microcarpus "panicled bulrush"	17	9.55	26.03
Hordeum brachyantherum "meadow barley"	27	5.10	10.45
Elymus glaucus "wild rye"	17	2.85	7.98
Grindelia stricta var. *platyphylla* "marsh gumplant"	13	2.75	8.00
Epilobium ciliatum ssp. *watsonii* "Watson's willowherb"	10	1.10	3.82
Festuca rubra "red fescue"	7	1.00	3.81
Stachys ajugoides "hedge-nettle"	7	1.00	3.81
Potentilla anserina ssp. *pacifica* "Pacific silverweed"	7	0.60	2.77
Cyperus eragrostis "nutsedge"	7	1.00	3.81
Juncus balticus ssp. *ater* "Baltic rush"	3	1.25	6.85
Equisetum arvense "common horsetail"	3	0.50	2.74
Oenanthe sarmentosa "water parsley"	3	0.50	2.74
Juncus effusus ssp. *pacificus* "Pacific rush"	3	0.10	0.55
Non-Native Non-Invasive Species			
Herbs			
Trifolium fragiferum "strawberry clover"	43	17.97	16.84
Trifolium repens "white clover"	33	11.83	18.57
Festuca perennis "rye grass"	27	7.92	17.08
Plantago major "common plantain"	20	3.35	8.26
Rumex conglomeratus "clustered dock"	17	1.60	4.57

SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area.
Active Riparian Berm Mean (Absolute) Vegetative Cover (n=32).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Hypochaeris radicata "hairy cat's-ears"	10	1.10	3.82
Festuca arundinacea "tall fescue"	3	0.50	2.74
Invasive Species			
Herbs			
Phalaris arundinacea "reed canary grass"	23	2.88	7.97
Agrostis stolonifera "creeping bent"	10	2.00	5.19
Cirsium vulgare "bull thistle"	10	1.10	3.82
Holcus lanatus "velvet grass"	3	0.50	2.74
Lotus corniculatus "bird's-foot trefoil"	3	0.50	2.74
Mentha pulegium "pennyroyal"	3	0.50	2.74
Cortaderia jubata "pampas grass"	3	0.10	0.55
Helminthotheca echioides "bristly ox-tongue"	3	0.10	0.55
Erosion-Control Hybrid			
Elymus x *Triticum* "wheatgrass hybrid"	23	3.10	6.08

SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area. Active Channel Mean (Absolute) Vegetative Cover (n=18).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Trees			
Salix lasiandra var. *lasiandra* "Pacific willow"	28	2.53	5.74
Alnus rubra "red alder"	6	0.83	3.54
Herbs			
Scirpus microcarpus "panicled bulrush"	100	39.67	29.44
Hordeum brachyantherum "meadow barley"	83	21.25	14.38
Juncus balticus ssp. *ater* "Baltic rush"	50	15.28	21.07
Deschampsia cespitosa "tufted hairgrass"	56	8.92	10.24
Cyperus eragrostis "nutsedge"	44	6.67	7.67
Potentilla anserina ssp. *pacifica* "Pacific silverweed"	17	2.50	5.75
Juncus effusus ssp. *pacificus* "Pacific rush"	6	2.08	8.84
Festuca rubra "red fescue"	17	1.83	4.84
Epilobium ciliatum ssp. *watsonii* "Watson's willowherb"	22	1.06	3.55
Carex obnupta "slough sedge"	11	1.00	3.56
Oenanthe sarmentosa "water parsley"	6	0.17	0.71
Juncus bufonius "toad rush"	6	0.03	0.12
Equisetum arvense "common horsetail"	6	0.01	0.02
Non-Native Non-Invasive Species			
Herbs			
Trifolium repens "white clover"	22	2.67	5.72
Atriplex prostrate "fat-hen"	39	1.81	4.81
Sonchus asper ssp. *asper* "prickly sow thistle"	22	1.06	3.55
Rumex crispus "curly dock"	6	0.83	3.54
Rumex conglomeratus "clustered dock"	11	0.19	0.71
Festuca perennis "rye grass"	6	0.17	0.71
Echinochloa crus-galii "barnyard grass"	6	0.03	0.12

SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area. Active Channel Mean (Absolute) Vegetative Cover (n=18).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Invasive Species			
Herbs			
Phalaris arundinacea "reed canary grass"	6	0.83	3.54
Ranunculus repens "creeping buttercup"	11	0.33	0.97
Erosion-Control Hybrid			
Elymus x *Triticum* "wheatgrass hybrid"	11	0.33	0.97

SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area. Active Bench Mean (Absolute) Vegetative Cover (n=24).

Species	Frequency (%)	$\bar{x}$ Cover (%)	SD (%)
Native Species			
Trees			
Salix lasiandra var. *lasiandra* “Pacific willow”	17	1.88	5.07
Salix sitchensis “Sitka willow”	4	<0.01	0.02
Herbs			
Hordeum brachyantherum “meadow barley”	100	22.60	13.03
Deschampsia cespitosa “tufted hairgrass”	50	7.88	11.28
Scirpus microcarpus “panicled bulrush”	33	6.88	11.47
Juncus balticus ssp. *ater* “Baltic rush”	17	6.46	17.77
Equisetum arvense “common horsetail”	17	5.42	14.83
Oenanthe sarmentosa “water parsley”	33	3.88	6.59
Alopecurus geniculatus “water foxtail”	17	2.00	5.06
Potentilla anserina ssp. *pacifica* “Pacific silverweed”	17	0.88	3.12
Epilobium ciliatum ssp. *watsonii* “Watson’s willowherb”	21	0.69	3.05
Cyperus eragrostis “nutsedge”	4	0.63	3.06
Non-Native Non-Invasive Species			
Herbs			
Rumex conglomeratus “clustered dock”	21	2.00	5.05
Festuca perennis “rye grass”	13	1.88	5.07
Trifolium fragiferum “strawberry clover”	13	1.88	5.07
Trifolium repens “white clover”	13	0.88	3.13
Sonchus asper ssp. *asper* “prickly sow thistle”	4	<0.01	0.02
Taraxacum officinale “common dandelion”	4	<0.01	0.02
Invasive Species			
Herbs			
Glyceria declinata “low manna grass”	33	5.44	9.45
Phalaris arundinacea “reed canary grass”	29	4.71	9.32
Agrostis stolonifera “creeping bent”	17	2.50	5.71
Ranunculus repens “creeping buttercup”	13	1.38	4.24

SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area. Active Bench Mean (Absolute) Vegetative Cover (n=24).

Species	Frequency (%)	$\overline{x}$ Cover (%)	SD (%)
Holcus lanatus “velvet grass	8	1.25	4.23
Helminthotheca echioides “bristly ox-tongue”	4	0.63	3.06
Erosion-Control Hybrid			
Elymus x *Triticum* “wheatgrass hybrid”	17	0.69	3.05