2018 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

In the summer and fall of 2018, J.B. Lovelace & Associates conducted the annual habitat monitoring effort for the Humboldt County Resource Conservation District's 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 sequential series of phases throughout the Salt River corridor over the course of several years. Phases 1, Phase 2A (Lower), and Phase 2A (Middle) were completed prior to 2016, and restoration construction of Phase 2A (Upper) and Phase 2B (Lower) was completed in 2017. Implementation of this 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 over the course of 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 2018 annual habitat monitoring effort focused on all restoration areas completed as of the 2018 monitoring period (i.e., Phase 1, Phase 2A, and the lower reach of Phase 2B) and involved the mapping and analysis of restored habitats, quantitative vegetation sampling to characterize developing herbaceous and woody riparian vegetation within specific habitats, and an assessment of the extent of invasive vegetation occurring throughout the SRERP area.

Results from our 2018 fieldwork demonstrate that the Salt River Ecosystem Restoration Project has met or exceeded the respective success criteria for this monitoring year in all regions of the project area addressed. Specifically, mapping and analysis of restored habitats in the Phase 1 and Phase 2 restoration areas reflect only minor changes in the sizes and distributions of habitats previously addressed during respective preceding monitoring efforts, as well as the successful restoration of additional similar habitats in the recently completed Phase 2A (Upper) and Phase 2B (Lower) reaches. Although specific minimum area (acreage) success thresholds only exist for final monitoring years, the habitat types assessed in the 2018 habitat monitoring effort currently meet or exceed those final thresholds.

Quantitative vegetation sampling results reflect the continued establishment and development of native vegetation in all habitats sampled in 2018, and relevant success thresholds for minimum cover of native vegetation were exceeded in every case. Recent results also document the continued establishment and development of woody riparian vegetation throughout replanted riparian habitats in the Phase 2 – Salt River Corridor restoration area, including limited establishment of this vegetation type in active Salt River channel and bench habitats (i.e., "Salt River Channel Wetlands") not replanted with woody species.

Quantitative sampling of woody vegetation was not required in the Phase 1 – Riverside Ranch Tidal Marsh restoration area in 2018, and therefore, was not performed.

Unfortunately, both collected vegetation sampling data and incidental observations made during the 2018 habitat monitoring effort also confirm the continued establishment and spread of invasive and otherwise undesirable vegetation throughout the restoration project footprint. Invasive plants appear to be replacing non-native non-invasive vegetation throughout most sampled regions of the project area, and the continued spread of *Spartina densiflora* ("dense-flowered cord grass") within salt marsh habitats of the Phase 1 restoration area may also be contributing to the observed recent decline of native vegetation in that location. While the estimated abundance of non-native non-invasive plant species has decreased in all sampled habitats except salt marsh in Phase 1 and the active channel of the lower Phase 2A restoration area, invasive species abundance has again increased in every sampled habitat except the replanted riparian forest areas of the middle Phase 2A reach.

The required duration of the monitoring period for invasive vegetation differs across habitat types within the project area (i.e., either 5 or 10 years), and the first "final" assessment of invasive plant species abundance in the SRERP restoration area is scheduled to occur in 2019 for the Phase 2A [Lower] "salt river wetlands," which were constructed in 2014. As of the 2018 habitat monitoring effort, invasive plant species abundance exceeds eventual final (maximum) success criteria for this category of vegetation in all nine habitats sampled during this effort. In addition to *S. densiflora*, eradication of other noxious and highly-invasive species such as *Cortaderia jubata* ("pampas grass"), *Cytisus scoparius* ("Scotch broom"), and *Senecio jacobaea* ("tansy ragwort") should be prioritized, though extensive occurrences of *Helminthotheca echioides* ("bristly ox-tongue") and pervasive invasive grasses such as *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), and *Holcus lanatus* ("velvet grass") also warrant concern.

Despite the continued favorable trajectory with respect to the development of projected habitats and native vegetation thus far, sustained and proportionate efforts are warranted to reduce and/or eradicate non-native and invasive vegetation documented during our 2018 fieldwork throughout the SRERP restoration area. 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 some of the long-term restoration goals for the project. While these results indicate contrasting trends for the developing vegetation within the project footprint, 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 ambitious 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 2018 J.B. Lovelace & Associates participated in the restoration effort by assisting the HCRCD in the performance of required annual habitat 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 for each phase, 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);

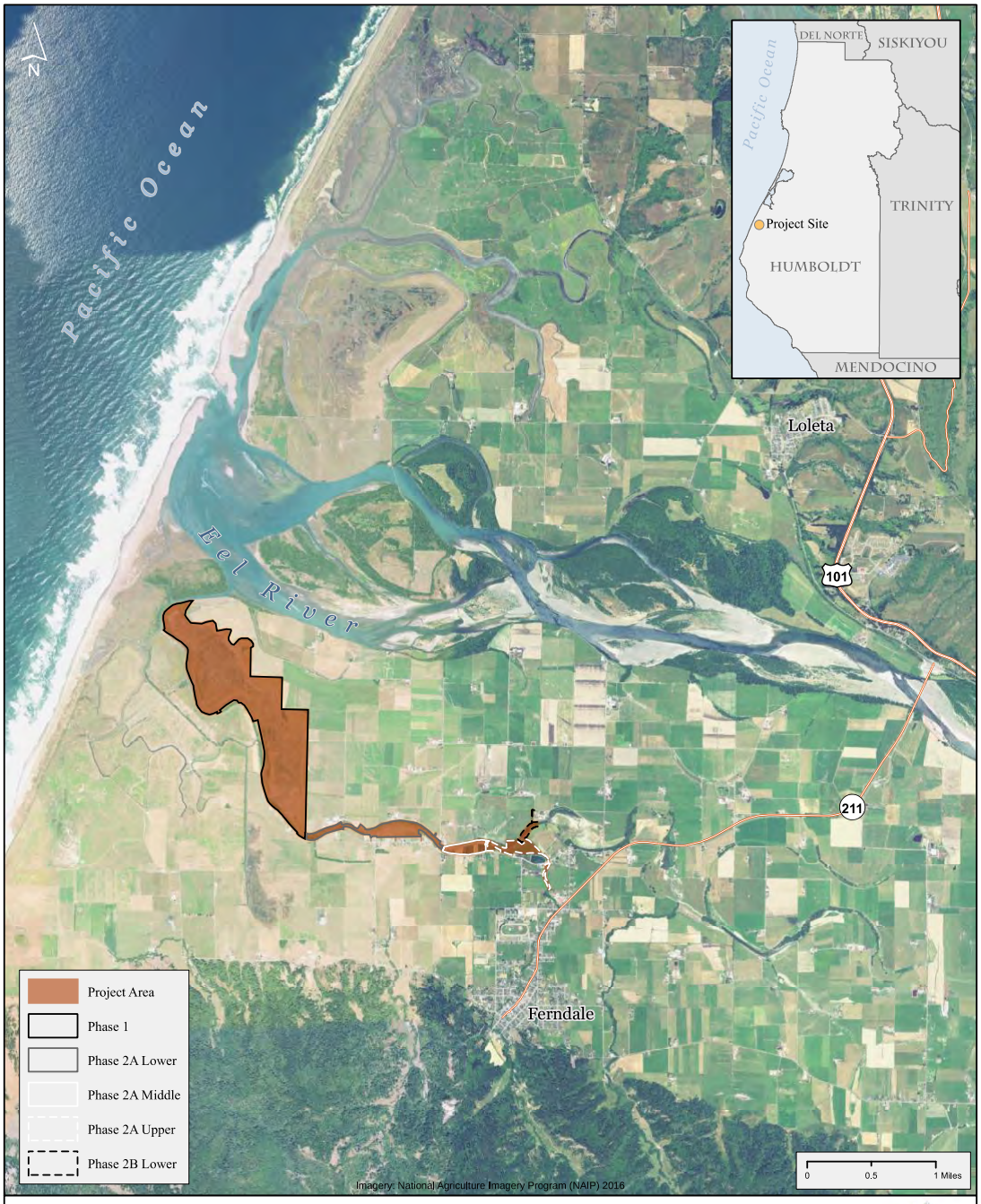

Figure 1. Salt River Ecosystem Restoration Project (SRERP) Vicinity
2018 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

- *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 monitoring schedule provided in the HMMP prescribes specific monitoring requirements for the various combinations of restored habitats, vegetation parameters, and monitoring years (Table 1). Habitat monitoring efforts conducted during the first two monitoring years (i.e., 2014 and 2015) were performed by H.T. Harvey & Associates and are documented 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). Habitat monitoring conducted in 2016 and 2017 was performed by J.B. Lovelace & Associates, and those efforts are described in *2016 Annual Habitat Monitoring Report for the Salt River Ecosystem Restoration Project* and *2017 Annual Habitat Monitoring Report for the Salt River Ecosystem Restoration Project* (J.B. Lovelace & Associates 2017 and 2018, respectively). The current report provides documentation of the most recent (2018) habitat monitoring effort for the Salt River Ecosystem Restoration Project, and addresses the specific tasks (Table 1) identified for the current monitoring year, which consist of the following:

A. Habitat Area Analysis & Mapping

1. Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
    a. "Tidal Salt & Brackish Marsh"
2. Phase 2A (Middle) – Salt River Corridor Restoration Area:
    a. Riparian Habitats
3. Phase 2A (Upper) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Habitats
4. Phase 2B (Lower) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Habitats

B. Vegetation Percent Cover Sampling

1. Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
    a. Salt Marsh *sensu stricto*
2. Phase 2A (Middle) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones
3. Phase 2A (Upper) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones
4. Phase 2B (Lower) – Salt River Corridor Restoration Area:
    a. Salt River Channel Wetlands
    b. Riparian Planting Zones

C. Invasive Vegetation Assessment

1. SRERP Restoration Area-Wide

D. Replanted Woody Riparian Vegetation Basal Area Assessment

1. Phase 2A (Middle) – Salt River Corridor Restoration Area:
    a. Riparian Planting Zones

2.0 Project Description

The SRERP is being carried out in multiple 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. At the initiation of the 2018 habitat monitoring effort, the following phases and sub-phases of the restoration effort had been completed:

- Phase 1,
- Phase 2A (Lower, Middle, & Upper), and
- Phase 2B (Lower)

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, which were developed during the design phase of the project and are provided in Tables 5-7 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

Table 1. SRERP Habitat Monitoring Schedule[1] for Phases 1 & Phase 2. Bold text indicates the current monitoring year (2018).

		Monitoring Period & Schedule of Tasks[2]														
Phase	**Habitat Type**	2013	2014	2015	2016	2017	**2018**	2019	2020	2021	2022	2023	2024	2025	2026	2027
Phase 1	(Monitoring Year)		1	2	3	4	**5**	6	7	8	9	10				
	High Marsh Ecotone[3]		BC	BC	BC	C	**BC**	C	BC	C	C	BC				
	"Tidal Salt & Brackish Marsh" [4]		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[5]			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"[6]			BC	BC	BC	**C**	BC	C	C	C	C	C			
	Riparian Planting Zones[7]			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"[6]				BC	BC	**BC**	C	BC	C	C	C	C	C		
	Riparian Planting Zones[7]				AC	BC	**ABCD**	C	ABCD	C	ABC	C	C	ABCD		
Phase 2A (Upper)	(Monitoring Year)						**1**	2	3	4	5	6	7	8	9	10
	"Salt River Channel Wetlands"[6,8]						**ABC**	BC	BC	C	BC	C	C	C	C	C
	Riparian Planting Zones[7,9]						**ABC**	BC	ABCD	C	ABCD	C	ABC	C	C	ABCD
Phase 2B (Lower)	(Monitoring Year)						**1**	2	3	4	5	6	7	8	9	10
	"Salt River Channel Wetlands"[6,8]						**ABC**	BC	BC	C	BC	C	C	C	C	C
	Riparian Planting Zones[7,9]						**ABC**	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 = Basal area assessment of replanted woody riparian vegetation
[3] Percent cover sampling in High Marsh Ecotone is not required in 2018 as suggested in J.B. Lovelace & Associates 2017 (HCRCD 2016c.)
[4] Percent cover sampling in "Tidal Salt & Brackish Marsh" is required specifically in salt marsh *sensu stricto* habitat only (HCRCD 2016c.)
[5] Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions (HCRCD 2015a).
[6] Includes both elements (i.e., active channel and active bench) of both brackish and freshwater channel wetlands.
[7] Includes both replanted riparian forest areas and active riparian berms.
[8] Habitat area assessment is warranted in Salt River Channel Wetlands, given recent planting of these areas with woody species.
[9] Percent cover assessment is warranted in Riparian Planting Zones, given that some areas recently planted with woody species also occur in historically designated Salt River Channel Wetlands.

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 broadcast seed applications. 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 2018 monitoring requirements apply, is introduced here to provide supportive context for the 2018 habitat monitoring effort. A more encompassing project description for the entire SRERP can be found in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

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 1 & 2).

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 were 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 Appendix A, Figure 1. Some ambiguities inherent in the originally conceived habitat descriptions have been found to complicate assessments of restoration "success." In this current (2018) effort, we carry forward the approach towards classification of the different projected habitat types and regions of the SRERP restoration area introduced during the 2016 habitat monitoring period (J.B. Lovelace & Associates 2017), which was proposed in an attempt to facilitate more appropriate comparisons of observed results against success criteria. Explanations for this approach are incorporated into our treatment of projected SRERP habitats relevant to the 2018 habitat monitoring effort, 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.

Subsequent investigations (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017 & 2018) 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 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 more 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, or provide context for, the 2018 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 for 2018 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* sensu stricto**

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 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 and/or brackish 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 quickly stabilize disturbed soils 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, we maintain 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 2 – Salt River Corridor Restoration

The second phase of the SRERP was initiated in 2014 following completion of Phase 1, and has progressed upstream from the Phase 1 – Riverside Ranch restoration area along the Salt River corridor as a sequential series of sub-phases. As of the 2018 habitat monitoring effort, all three reaches (i.e., lower, middle, and upper) of Phase 2A and the lower reach of Phase 2B have been completed. The distinction between "lower," "middle," and "upper" reaches of each sub-phase reflects the progression of completion of respective restoration efforts over the course of multiple construction seasons. The restoration goals and approach were consistent throughout.

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 1 & 3). The following year (2015), Phase 2A (Middle) restoration proceeded from the upstream terminus of the 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 1 & 4). More recently in 2017, restoration of the combined Phase 2A (Upper) & Phase 2B (Lower) restoration reaches resumed from the upstream limit of Phase 2A (Middle) to locations approximately 0.5 miles further up the Salt River channel, as well as ~0.5 miles up Francis Creek from its confluence with the Salt River. Specifically, Phase 2A (Upper) consists of the reach extending ~ 0.25 miles up the Salt River channel from the upstream limit of Phase 2A (Middle), and includes the entirety of the restored portion of Francis Creek. The Phase 2B (Lower) portion of the restoration completed in 2017 consists of the ~0.25-mile remainder of restored Salt River channel, extending upstream from the upstream limit of Phase 2A (Upper) (Appendix A, Figures 1 & 5). In the context of the 2018 habitat monitoring effort, Phase 2A (Upper) and Phase 2B (Lower) restoration reaches completed in 2017 are addressed as an aggregate.

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 2 project areas restored thus far were revegetated with appropriate species blends that correspond to six designated planting zones (i.e., brackish marsh, freshwater marsh, brackish active riparian berm, freshwater active riparian berm, brackish riparian forest, and freshwater riparian forest) following completion of construction (GHD 2015; HCRCD 2016b & 2018). Revegetation efforts were consistent with the aforementioned guidance documents and involved hydroseeding and broadcast application methods for seed blends, which were conducted in autumn of 2014, 2015, and 2017 for the Phase 2A (Lower), Phase 2A (Middle), and the combined Phase 2A (Upper) & Phase 2B (Lower) restoration reaches, respectively. Revegetation of designated areas with woody species and “wetland plugs” occurred in winter and spring of 2014/2015 for Phase 2A (Lower), 2015/2016 for (Phase 2A Middle), and 2017/2018 for the combined Phase 2A (Upper) & Phase 2B (Lower) restoration reaches.

2.2.1 Phase 2 Projected Habitats & Associated Habitat Components

Consistent with the first phase of the SRERP, Phase 2 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 2 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 2018 habitat monitoring effort (and consistent with the approach used in preceding habitat monitoring efforts [J.B. Lovelace & Associates 2017 & 2018]),

we refer to portions of the Phase 2 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 2018 habitat monitoring effort are identified and briefly described below.

Phase 2: "Salt River Channel Wetlands"

The "Salt River channel wetland" system associated with the Phase 2 – 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 2 are discussed separately in the "riparian habitats" section below. Specific features of these Salt River channel wetland habitats addressed in the 2018 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 gradual and variable due to variations in the geomorphology of the reconstructed channel, the dynamic nature of the associated hydrology, and the fact that the restored habitats are still developing. Findings from the 2018 effort reflecting the current distribution of brackish and freshwater habitats are presented in Section 4.0 (below) and Appendix A, Figures 3 & 4.

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 habitats). Consistent with that understanding, 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 any comparisons of habitat monitoring results across monitoring years, H.T. Harvey & Associates' (2015) use of "brackish marsh" corresponds specifically to the Phase 2A (Lower) "active channel" recognized in J.B Lovelace & Associates (2017 & 2018) and the current report.

Phase 2: Riparian Habitats

Performance of the Phase 2 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 2 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 2: 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 2018 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. Fieldwork was performed by J.B. Lovelace & Associates' Principal Environmental Scientist and plant ecologist, Brett Lovelace and staff biologists, Kaleb Goff and Sarah Hecocks. All botanical taxonomic nomenclature presented in this effort is consistent with *The Jepson Manual: Vascular Plants of California, Second Edition* (Baldwin et al. 2012) or the *Jepson eFlora* (Jepson Flora Project 2018) where updated taxonomical classification was warranted.

3.1 Habitat Mapping & Area Analysis

Existing SRERP habitat GIS data originally provided by the HCRCD and revised during the 2016 and 2017 monitoring efforts (J.B. Lovelace & Associates 2017 & 2018), were refined as necessary in 2018 to develop updated habitat maps reflecting current site conditions. These refinements were made using ArcMap® (ESRI) geographic information system (GIS) desktop software and the most recent satellite imagery (Google Earth 2018 and National Agriculture Imagery Program [NAIP] 2016), and were based on observations made during fieldwork performed between August 5-29 and November 12-16, 2018. Geographic field data were collected using a Trimble® Juno® global positioning system (GPS) device with ArcPad® software (ESRI). Habitat area (acreage) totals were calculated as part of this process, and the resulting maps are included in Appendix A as Figures 2-5.

The HMMP schedule of monitoring tasks (Table 1) only explicitly requires the analysis of habitat area (acreage) for Phase 1 "tidal salt & brackish marsh," Phase 2A (Middle) "riparian planting zones," and both "Salt River channel wetland" and "riparian planting zones" in the combined Phase 2A (Upper) & Phase 2B (Lower) restoration areas in 2018. Although the 2018 habitat mapping & area analysis effort focused on these specific habitat types, additional opportunistic observations of changes in the extent of other SRERP habitat types were also recorded where encountered. Habitat area success criteria established in the HMMP are included with respective 2018 habitat area analysis results in Table 6 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, Middle, and Upper) or Phase 2B (Lower) restoration efforts were implemented. In the absence of sub-phase-specific success criteria, respective thresholds were proportionately scaled 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

Two distinct quantitative sampling efforts were conducted in 2018 to analyze and characterize different aspects of the vegetation associated with specific habitats within the SRERP restoration area: vegetation percent cover sampling and replanted woody riparian vegetation basal area sampling. Both sampling efforts are described in detail below. Because some SRERP habitats (and associated monitoring task schedules) are partitioned due to project phasing (e.g., freshwater active bench habitat that extends through both Phase 2A [Lower] and Phase 2A [Middle] project areas, etc.), we adopt the convention of referring to partial, project phase-specific portions of a given habitat as their respective habitat type "sampling areas" (e.g., Phase 2A [Lower] active bench sampling area, Phase 2A [Middle] active bench sampling area, etc.). This allows for phase-specific portions of sampled habitats to be treated independently, to be tracked and evaluated based on respective monitoring schedules and success criteria, while minimizing the complexity of addressing various combinations of habitat types and monitoring schedule requirements. The primary drawback in this approach is reduced resolution when attempting to draw conclusions from results at the level of habitat variants (e.g., brackish vs. freshwater active berm habitat in the Phase 2A [Lower] restoration area, brackish vs. freshwater active channel habitat in the Phase 2A [Middle] reach, etc.). However, in light of the additional level of complexity inherent in tracking and evaluating each such iteration through "monitoring space," the aforementioned convention was determined to achieve the best compromise between simplicity and being most informative.

3.2.1 Vegetation Percent Cover Sampling

Vegetative percent cover data were collected during August 5-29, 2018 to characterize the vegetation within habitats where this task was scheduled to occur during the current monitoring year. Specific habitat "sampling areas" where vegetation percent cover sampling was performed in 2018 were:

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area

- Salt Marsh *sensu stricto*

Phase 2 – Salt River Corridor Restoration Area

Phase 2A (Middle)

Salt River Channel Wetlands

- Active Channel
- Active Bench

Riparian Planting Zones

- Replanted Riparian Forest
- Active Riparian Berm

Phase 2A (Upper)/Phase 2B (Lower)

Salt River Channel Wetlands

- Active Channel
- Active Bench

Riparian Planting Zones

- Replanted Riparian Forest
- Active Riparian Berm

Sampling Design & Data Collection

We used a stratified, randomized sampling approach to characterize the abundance, species composition, and structural composition of existing vegetation in each vegetation sampling area. The goal of such a sampling approach is to sufficiently distribute the collection of vegetation data 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. Based on power analyses of 2017 SRERP vegetation sampling data (J.B. Lovelace & Associates 2018), we used a minimum sample size (n = 32) that was determined to be sufficient to detect a "medium" effect size of 0.5 standard deviations (following Cohen 1988) between the observed sample means and their respective success criteria using a two-sided *t*-test, and assuming both 95% confidence and a statistical power of 80%.

Using updated SRERP habitat GIS data and ArcMap® software, each phase and sub-phase of the restoration area was partitioned into ecologically distinct vegetation 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 32 sampling plots throughout each of these sampling areas (Appendix A, Figures 6-8). Given that each sampling area is composed of multiple, geographically separated polygons, the 32 (n = 64 for Phase 1 salt marsh *sensu stricto*) sample

plots were randomly allocated throughout each sampling area, in quantities proportionate to the size (i.e., area) of each polygon. 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.

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) used in previous monitoring efforts (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017 & 2018) was also used during the 2018 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.

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).

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 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.

Data Analysis

Statistical methods used to analyze percent cover data collected in the 2018 habitat monitoring effort consisted of: 1) non-parametric bootstrap analyses to evaluate the precision of mean percent cover estimates for the various vegetation categories of interest, and 2) power analyses to assess the adequacy of the sample size for each vegetation sampling area and to provide sample size recommendations for the subsequent monitoring year. To the extent possible, we attempted to maintain consistency with methods employed in previous monitoring efforts (H.T. Harvey & Associates 2014 and 2015; J.B. Lovelace & Associates 2017 & 2018) to minimize any investigator-related discrepancies introduced in comparisons between results from different monitoring years.

At the sample plot level, absolute cover values 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

Table 3. SRERP Native Vegetation Sampling Success Criteria.[1] Bold text indicates the current monitoring year (2018). Missing values indicate monitoring years for which no habitat monitoring tasks are required for respective habitats.

			Percent Cover Native Plant Species Success Criteria (≥)														
Phase		**SRERP Habitat Type**	2013	2014	2015	2016	2017	**2018**	2019	2020	2021	2022	2023	2024	2025	2026	2027
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%			
	(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%		
	(Upper)	(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 2B	**(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%

[1] Adapted from Tables 8-10 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] 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 (2018). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

			Percent Cover Non-Native Non-Invasive Plant Species Success Criteria														
Phase		**SRERP Habitat Type**	2013	2014	2015	2016	2017	**2018**	2019	2020	2021	2022	2023	2024	2025	2026	2027
Phase 1		(Monitoring Year)		1	2	3	4	**5**	6	7	8	9	10				
		High Marsh Ecotone		–	–	–	–	**–**	–	–	–	–	<15%				
		Salt Marsh *sensu stricto*[2]		–	–	–	–	**–**	–	–	–	–	<15%				
		(Monitoring Year)			1	2	3	**4**	5	6	7	8	9	10			
		Replanted Riparian Forest[3]			–	–	–	**–**	–	–	–	–	–	<15%			
Phase 2A	**(Lower)**	(Monitoring Year)			1	2	3	**4**	5	6	7	8	9	10			
		"Salt River Channel Wetlands"[4,5]			–	–	–	**–**	<15%								
		Riparian Planting Zones			–	–	–	**–**	–	–	–	–	–	<15%			
	(Middle)	(Monitoring Year)				1	2	**3**	4	5	6	7	8	9	10		
		"Salt River Channel Wetlands"[4,5]				–	–	**–**	–	<15%							
		Riparian Planting Zones				–	–	**–**	–	–	–	–	–	–	<15%		
	(Upper)	(Monitoring Year)						**1**	2	3	4	5	6	7	8	9	10
		"Salt River Channel Wetlands"[4,5]						**–**	–	–	–	<15%					
		Riparian Planting Zones						**–**	–	–	–	–	–	–	–	–	<15%
Phase 2B	**(Lower)**	(Monitoring Year)						**1**	2	3	4	5	6	7	8	9	10
		"Salt River Channel Wetlands"[4,5]						**–**	–	–	–	<15%					
		Riparian Planting Zones						**–**	–	–	–	–	–	–	–	–	<15%

[1] Adapted from the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] 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 vegetation percent cover sampling is a requirement.

Table 5. SRERP Non-Native Invasive Vegetation Sampling Success Criteria.[1] Bold text indicates the current monitoring year (2018). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

			Percent Cover Non-Native Invasive Plant Species Success Criteria														
Phase		**SRERP Habitat Type**	2013	2014	2015	2016	2017	**2018**	2019	2020	2021	2022	2023	2024	2025	2026	2027
Phase 1		(Monitoring Year)		1	2	3	4	**5**	6	7	8	9	10				
		High Marsh Ecotone		–	–	–	–	**–**	–	–	–	–	<5%				
		Salt Marsh *sensu stricto*[2]		–	–	–	–	**–**	–	–	–	–	<5%				
		(Monitoring Year)			1	2	3	**4**	5	6	7	8	9	10			
		Replanted Riparian Forest[3]			–	–	–	**–**	–	–	–	–	–	<5%			
Phase 2A	(Lower)	(Monitoring Year)			1	2	3	**4**	5	6	7	8	9	10			
		"Salt River Channel Wetlands"[4,5]			–	–	–	**–**	<5%								
		Riparian Planting Zones			–	–	–	**–**	–	–	–	–	–	<5%			
	(Middle)	(Monitoring Year)				1	2	**3**	4	5	6	7	8	9	10		
		"Salt River Channel Wetlands"[4,5]				–	–	**–**	–	<5%							
		Riparian Planting Zones				–	–	**–**	–	–	–	–	–	–	<5%		
	(Upper)	(Monitoring Year)						**1**	2	3	4	5	6	7	8	9	10
		"Salt River Channel Wetlands"[4,5]						**–**	–	–	–	<5%					
		Riparian Planting Zones						**–**	–	–	–	–	–	–	–	–	<5%
Phase 2B	(Lower)	(Monitoring Year)						**1**	2	3	4	5	6	7	8	9	10
		"Salt River Channel Wetlands"[4,5]						**–**	–	–	–	<5%					
		Riparian Planting Zones						**–**	–	–	–	–	–	–	–	–	<5%

[1] Adapted from the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).
[2] 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 vegetation percent cover sampling is a requirement.

values for each. These sample plot category totals were then pro-rated with respect to corresponding sample plot "total vegetative cover" values to yield a set of mean cover values ranging from 0−100%, which summed to equal the total vegetative cover percentage. These pro-rated sample plot means for the various categories were then used to calculate respective mean estimates for each sampling area.

The same procedure was also used to produce mean percent cover estimates for vegetative structural categories (i.e., herb, tree, and shrub) in riparian planting zones, as well as to address the individual contribution of *Phalaris arundinacea* ("reed canary grass") to the invasive component of vegetative cover throughout sampled habitats as requested by HCRCD staff (Hansen pers. comm.). All statistical analyses were performed using the statistical software program "R" (The R Foundation for Statistical Computing 2016) and specific methods used in the 2018 analyses of percent cover data are described below.

Nonparametric Bootstrap Analysis

Nonparametric 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 data described above. "Bootstrapping" provides a method of quantifying the uncertainty of an estimator (e.g., a sample mean, etc.) by repeatedly resampling (with replacement) the collected data at random. Each resampling event produces a corresponding sample mean, and the variability of these "bootstrap means" can be used to assess the uncertainty of the actual sample mean. In the present case, the BCa bootstrap was used to calculate confidence intervals for reported sample means. In this effort, we resampled each data set 100,000 times to produce confidence intervals for each combination of vegetative category of interest and sampled area.

Power Analyses

Power analyses were performed retrospectively to evaluate the adequacy of the 2018 sample size (n = 32 [64 for Phase 1 salt marsh *sensu stricto*]) for each habitat area where vegetation sampling was conducted. They also serve to provide recommendations for initial sample sizes in subsequent vegetation sampling efforts in these habitats. Initial calculations revealed that the sample sizes used in the 2018 vegetation percent cover sampling efforts were sufficient to detect both an effect size of 0.5 standard deviations and/or a difference of 20% between the observed estimated means and respective success criteria.

Based on these initial calculations, we ultimately performed power analysis calculations, assuming a two-sided *t*-test with 80% statistical power and a significance level of 0.05 (95% confidence) to be able to detect the more conservative effect size of a 20% difference between observed sample means and respective success criteria. In every instance, sample sizes associated with the 2018 sampling efforts for each sampled habitat type were determined to have

exceeded the minimum quantities necessary to detect the aforementioned 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.

3.2.2 Replanted Woody Riparian Vegetation Basal Area Assessment

During November 12-16, 2018 we also continued sampling efforts to assess the structural development of woody riparian vegetation in SRERP habitats replanted with such species, as specified in the HMMP schedule of monitoring tasks (Table 1). The goal of this aspect of vegetation sampling during the 2018 monitoring effort was to establish the first baseline dataset for the Phase 2A (Middle) restoration reach for future comparison against results from subsequent years, thereby providing a means with which to evaluate the development of this vegetation component throughout this portion of the restoration area.

Sampling Design & Data Collection

We utilized the same aforementioned approach for stratifying restoration sampling areas and creating random percent cover sampling plots (using ArcMap® GIS software and the Trimble GPS unit), to establish randomly-located basal area sampling plots throughout the Phase 2A (Middle) riparian planting zones (Appendix A, Figure 9) in the following quantities:

Phase 2A (Middle) – Salt River Corridor Restoration Area:

Riparian Planting Zones

- Replanted Riparian Forest (n=10)
- Active Riparian Berm (n=5)

Once random basal area sampling plot center coordinates were determined, ArcMap® software was then used to create circular (10-meter radius) sampling plots around each plot center. These GIS data were then appropriately corrected and uploaded to the Trimble GPS device for location in the field. Upon arriving at each basal area sampling plot, the diameter-at-breast-height (DBH) (in millimeters), species, and geographic coordinates were recorded for all trees located within the plot that were ≥4.5 feet ("breast height") tall. Diameter measurements were obtained for all tree stems at 4.5 feet above ground level (on the uphill side, where relevant) using either metric calipers or a "diameter tape" depending on the size of the measured stem.

Following direction from HCRCD staff (Hansen pers. comm.), individual plants were considered to be a "tree" if they were a species whose vegetative "habit" is described in relevant botanical literature (e.g., Baldwin et al. 2012; etc.) as being a tree at maturity. This criterion included young flexible saplings and excluded some woody species whose habit is described as being a "shrub" at maturity (even if such woody individuals encountered were robust and tall enough to have a diameter-at-breast-height).

In instances where the circular plots extended outside of the boundaries of the targeted sampling habitats, the aforementioned data were only collected for trees within the area of overlap between the sampling plot and target habitat; all trees outside of the combined area of overlap were ignored. (This was common in the more narrow and sinuous habitat sampling areas along the riparian corridor in the Phase 2 – Salt River corridor restoration area.) The actual coinciding sampled area of overlap between the sampling plot and target habitat was also calculated and recorded for each sampling plot using ArcMap® GIS software. In instances where basal area sampling plots extended into adjacent, retained "Existing Riparian Forest" habitat areas, no data were collected from trees in those retained habitats.

Data Analysis

All metric DBH measurements collected during fieldwork were subsequently converted to inches, and were then squared and multiplied by 0.005454 ("the forester's constant") to derive basal area values (measured in square-feet), otherwise expressed as:

$$\text{Basal area} = DBH^2 \times 0.005454$$

Resulting sampling plot measurements of both basal area and actual-plot-area-sampled were then summed to derive basal-area-per-unit-area-sampled totals for each tree species in each sampled habitat. These measurements were then extrapolated to produce projected estimates of total habitat- and phase-wide basal area for each species using respective habitat areas (acreages) obtained from current SRERP GIS data. Tabulated values for the resulting projected basal area estimates are provided in Section 4.0 to characterize the current developmental status of this vegetation type in sampled habitats.

This approach was chosen to provide the perceived best method of accurately characterizing this aspect (i.e., basal area) of the development and structural complexity of woody riparian vegetation throughout the restoration area, while also facilitating future comparisons with subsequent sampling efforts throughout the duration of the SRERP monitoring period.

Simple cumulative basal area totals are dependent upon the extent and orientation of sampled habitats, as well as sampling plot location with respect to the targeted habitats. If, in subsequent comparisons between monitoring years, these artifacts of sampling design are not controlled for, possible future changes in the extent or orientation of sampled riparian habitats and/or sampling plot placement alone could result in variations in the actual extent of area surveyed, and consequently, in the availability of woody vegetation actually sampled. Such possible scenarios could result in differing cumulative basal area measurements between monitoring years simply due to artifacts of sampling design alone.

For these reasons, cumulative raw basal area measurements may not allow for parallel comparisons across monitoring years and, therefore, could limit the

ability to draw meaningful conclusions about potential real changes in this vegetation type throughout the habitat monitoring period. Because our approach yields basal area estimates that are relativized and made proportionate to the actual area of sampled plots from which the original measurements were obtained, they have relatively broad utility in future comparisons across monitoring years.

3.3 Invasive Plant Species Assessment

Throughout the performance of habitat mapping and quantitative vegetation sampling fieldwork (i.e., August 5-29 and November 12-16, 2018), 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 update relevant maps developed over the course of the 2016 and 2017 habitat monitoring efforts (J.B. Lovelace & Associates 2017 & 2018, respectively) using ArcMap® software and the most recent satellite imagery (NAIP 2016) to reflect the most current knowledge of the distribution and extent of invasive species occurring throughout the SRERP area. The resulting maps are included in Appendix A (Figures 10-15).

Where feasible, the distributions of discrete invasive species were mapped separately, and in the case of the highly invasive salt marsh species, *Spartina densiflora* ("dense-flowered cord grass"), *Spartina*-specific figures were created to clearly depict updated observations of the distribution of this species throughout the SRERP restoration area (Appendix A, Figures 10 & 11). 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 represented. These species complexes are included in respective figures (Appendix A), and the most well represented species associated with each complex are also indicated.

Our categorization of plant species as being native, non-native non-invasive, and invasive generally conforms to that used in previous SRERP habitat monitoring efforts (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017 & 2018) in an attempt to maintain consistency throughout the duration of the entire SRERP monitoring period. Native plants are considered to be 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 (2018) 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."

Except as noted otherwise, our classification regards plant species encountered in the current habitat monitoring effort as being "invasive" if they are assigned a "high" invasive rating by the California Invasive Plant Council (Cal-IPC) (2018), are listed as "noxious weeds" by the California Department of Food & Agriculture (CDFA 2018), are listed as "federal noxious weeds" (USDA 2018), are considered invasive in the Humboldt County Weed Management Area (WMA) (2010), or otherwise warrant concern based on known or perceived potential for preventing the establishment of intended vegetation in the SRERP restoration area. Although some non-native plants detected in the current monitoring fieldwork regarded by the Cal-IPC (2018) as having "moderate" or "limited" invasive potential were considered invasive in the context of the SRERP restoration goals, other species classified similarly were not considered problematic in the context of the current effort, based on local species observations.

We also 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 neither is listed as invasive by Cal-IPC (2018) or the Humboldt County Weed Management Area (2010). 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 previous SRERP habitat monitoring efforts (H.T. Harvey and Associates 2014 & 2015; J.B. Lovelace & Associates 2017& 2018). Both species are considered by some sources (USDA 2018; etc.) 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.

4.0 Results

Results from the 2018 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 3-8). Baseline data collected in this most recent effort also reflect continued progress towards the successful development of woody riparian vegetation in the Phase 2 Salt River corridor restoration area. Recent results indicate a continued favorable trajectory with respect to the development of projected habitats and native vegetation thus far, however, immediate and proportionate efforts are warranted to reduce and/or eradicate non-native and invasive vegetation also documented during our 2018 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 in respective habitats, 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 2018 monitoring effort are provided in respective sections below.

4.1 Results of Habitat Mapping & Area Analysis

Results from the 2018 mapping and analysis of restored habitats in the Phase 1 and Phase 2 restoration areas (Tables 6-8) reflect only minor changes in the sizes and distributions of habitats previously addressed in respective preceding monitoring efforts (J.B. Lovelace & Associates 2017 & 2018). Mapping of recently restored habitats in the Phase 2A (Upper)/Phase 2B (Lower) restoration reach also occurred in 2018 and those results contribute to the increasing habitat acreage totals for the SRERP. All habitat types for which final success criteria were specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) currently exceed their respective final threshold acreages. Project-wide habitat area (acreage) totals and respective eventual final success criteria are summarized in Tables 6-8 and the observed distribution and extent of each habitat type, and relevant associated restoration design components, are depicted in Appendix A, Figures 2-5. Salient observations from the 2018 mapping effort and analysis are described below.

4.1.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration Area

Phase 1: "Tidal Salt & Brackish Marsh"

The broadly inclusive projected habitat complex, "tidal salt & brackish marsh," collectively covers 303.95 acres of the Phase 1 project area, slightly less (~95%) than the projected extent (321.7 acres) of this habitat complex, yet 14.42 acres greater than the final success threshold (Table 6). This reflects a 19.95-acre increase since the preceding analysis of this aggregate-habitat in 2016 (J.B. Lovelace & Associates 2017), which is primarily attributable to the inclusion of 19.5 acres of upland habitat comprising the setback berm along the northeastern edge of the Phase 1 restoration area, not included previously. "True" salt marsh *sensu stricto* habitat increased by 30.95 acres from 154.84 acres in 2016 to 185.79 acres in 2018, while mudflat habitat decreased proportionately from 74.61 acres in 2016 to 44.24 acres during the same period, reflecting the progressive conversion of unvegetated mudflat to vegetated salt marsh habitat. Focused analyses of Phase 1 high marsh ecotone and riparian habitats were not required in 2018 (Table 1) yet routine mapping updates to the Riverside Ranch Tidal Marsh Restoration Area indicate little to no recent changes in the extent of these habitats (Table 6; Appendix A, Figure 2).

4.1.2 Phase 2 – Salt River Corridor Restoration Area

Phase 2: Riparian Habitats

The extent of existing riparian forest and riparian planting zone habitats occurring within the Phase 2A (Lower) and Phase 2A (Middle) restoration areas have not changed substantially since preceding habitat mapping fieldwork. Results from

Table 6. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
Summary of 2018 Observed Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2018	
SRERP Habitat Type	Projected[2]	Final Success Criteria[3]	Observed	% of Projected
High Marsh Ecotone	**12.38**	**≥11.14**	**36.07**	**291%**
"Tidal Salt & Brackish Marsh"[4]				
Salt Marsh sensu stricto	–	–	*185.79*	–
Mudflat[5]	*20.80*	*≥18.72*	*44.24*	*390%*
Aquatic[5]			37.07	
Brackish Marsh	–	–	*16.69*	–
Upland	–	–	*20.16*	–
"Tidal Salt & Brackish Marsh"[4] Total	**321.70**	**≥289.53**	**303.95**	**95%**
Riparian Habitat				
Existing Riparian Forest	–	–	*20.45*	–
Replanted Riparian Forest	–	–	*22.91*	–
Riparian Habitat Total	**43.40**	**≥39.06**	**43.36**	**99%**

[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 2018 habitat monitoring effort.
[2] "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 (Appendix A, Figure 1).
[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).

our 2018 habitat mapping efforts in the recently completed Phase 2A (Upper)/Phase 2B (Lower) restoration area reveal the addition of 8.44 acres of riparian habitat to the SRERP total (Table 7). Specifically, this consists of 3.26 acres of retained existing riparian forest, 2.86 acres of replanted riparian forest, and 2.32 acres of replanted active riparian berm habitat. For those portions of the Phase 2 restoration area completed as of the 2018 monitoring effort, riparian habitats collectively total 42.16 acres, exceeding the extrapolated projected extent of this habitat (38.20 acres) by 10%. Respective acreages for each subordinate habitat component are provided in Table 7.

Phase 2: Salt River Channel Wetlands

Little to no changes have occurred to the extent of Salt River channel wetland habitats within the Phase 2A (Lower) and Phase 2A (Middle) restoration areas since preceding habitat mapping efforts were conducted. Recent mapping fieldwork in the Phase 2A (Upper)/Phase 2B (Lower) restoration areas document the addition of 6 acres of freshwater wetland habitat to the Phase 2 Salt River

Table 7. SRERP Phase 2 – Salt River Corridor Restoration Area: Riparian Habitats. Summary of 2018 Observed Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2018	
SRERP Habitat Type	Projected[2]	Final Success Criteria[3]	Observed	% of Projected
Existing Riparian Forest				
Phase 2A Lower	–	–	*11.52*	–
Phase 2A Middle	–	–	*6.89*	–
Phase 2A Upper/2B Lower	–	–	*3.26*	–
Existing Riparian Forest Total	**–**	**–**	**21.67**	**–**
Riparian Planting Zones				
Replanted Riparian Forest				
Phase 2A Lower	–	–	*8.22*	–
Phase 2A Middle	–	–	*3.47*	–
Phase 2A Upper/2B Lower	–	–	*2.86*	–
Replanted Riparian Forest Total	–	–	14.55	–
Active Riparian Berms				
Phase 2A Lower	–	–	*2.50*	–
Phase 2A Middle	–	–	1.12	–
Phase 2A Upper/2B Lower	–	–	*2.32*	–
Active Riparian Berm Total	–	–	5.94	–
Riparian Planting Zone Total	**–**	**–**	**20.49**	**–**
Riparian Habitat Total	**38.20**	**≥34.38**	**42.16**	**110%**

[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 2018 habitat monitoring effort.
[2] "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 (Appendix A, Figure 1).
[3] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5-10.

channel wetland habitat total. Accounting for subtle habitat boundary mapping refinements, the contribution of these recently restored Phase 2 areas brings the current total of Salt River channel wetlands to 15.01 acres, 35% (3.89 acres) greater than the extrapolated projected extent of this habitat category (11.12 acres). Respective acreages for respective subordinate habitat component are provided in Table 8.

Table 8. SRERP Phase 2 – Salt River Corridor Restoration Area: Salt River Channel Wetlands. Summary of 2018 Observed Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2018	
SRERP Habitat Type	Projected[2]	Final Success Criteria[3]	Observed	% of Projected
Brackish Marsh Wetlands				
Brackish Active Channel				
Phase 2A Lower	–	–	*2.07*	–
Phase 2A Middle	–	–	*0.12*	–
Phase 2A Upper/2B Lower	–	–	*0.00*	–
Brackish Marsh Active Channel Total	–	–	2.19	–
Brackish Active Bench				
Phase 2A Lower	–	–	*1.58*	–
Phase 2A Middle	–	–	*0.00*	–
Phase 2A Upper/2B Lower	–	–	*0.00*	–
Brackish Marsh Active Bench Total	–	–	1.58	–
Brackish Marsh Wetlands Total	**3.65**	**≥3.29**	**3.77**	**103%**
Freshwater Wetlands				
Freshwater Active Channel				
Phase 2A Lower	–	–	*0.00*	–
Phase 2A Middle	–	–	*0.26*	–
Phase 2A Upper/2B Lower	–	–	*1.16*	–
Freshwater Active Channel Total	–	–	1.42	–
Freshwater Active Bench				
Phase 2A Lower	–	–	*3.69*	–
Phase 2A Middle	–	–	*2.71*	–
Phase 2A Upper/2B Lower	–	–	*4.84*	–
Freshwater Active Bench Total	–	–	9.62	–
Freshwater Wetlands Total	**7.47**	**≥6.72**	**11.24**	**151%**
Salt River Channel Wetlands Total	**11.12**	**≥10.01**	**15.01**	**135%**

[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 2018 habitat monitoring effort.
[2] "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 (Appendix A, Figure 1).
[3] Defined (H.T. Harvey & Associates with Winzler & Kelly 2012) as achieving ≥90% of Projected Habitat quantities in Monitoring Years 5-10.

4.2 Results of Quantitative Vegetation Analyses

4.2.1 Vegetation Percent Cover Sampling Results

Results from the 2018 vegetation percent cover sampling effort (Tables 9 & 10) exceed all relevant success criteria for minimum cover of native vegetation (Table 3) for the 2018 monitoring year, indicating successful establishment of

native vegetation throughout the sampled portions of the SRERP restoration area thus far. The sampling area with the lowest percent cover values for both total and native vegetation throughout all habitats sampled during the 2018 effort was one of those most recently restored: the active riparian berm habitat component in the Phase 2A (Upper)/Phase 2B (Lower) restoration area. The mean cover estimate for total vegetation within this sampling area was 84.8%. All other sampled areas exhibited total vegetative cover estimates of 85% or greater. Mean estimated cover of native vegetation within the Phase 2A (Upper)/Phase 2B (Lower) active riparian berm sampling area was 24.2%, exceeding the required 10% for Salt River channel wetland habitats during the current monitoring year.

Non-native non-invasive and invasive vegetation, however, continue to exceed respective eventual final (maximum) cover thresholds (Tables 4 & 5) in many of the sampled areas in both Phase 1 and Phase 2 restoration areas (Table 9). Observed percent cover of non-native *non-invasive* vegetation was found to be in excess of the final maximum success threshold 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 4 of the 8 sampled habitats in the Phase 2 restoration area in 2018: the most recently completed Phase 2A (Upper)/Phase 2B (Lower) active channel ($\overline{x}$ = 20.2%), active bench ($\overline{x}$ = 31.7%), replanted riparian forest ($\overline{x}$ = 37.3%), and active riparian berm ($\overline{x}$ = 20.1%). Of the remaining four sampled Phase 2 habitats where observed vegetative cover was below the final maximum success threshold for non-native *non-invasive* vegetation, that of the Phase 2A (Middle) active bench sampling region was only slightly less so ($\overline{x}$ = 13.1%). Mean estimated vegetative cover for this category of vegetation was less than 9.2% in the remaining three sampled habitats in the Phase 2 restoration area as well as the salt marsh *sensu stricto* sampling region in the Phase 1 restoration area in 2018 (Table 9).

Similarly, mean estimated percent cover of *invasive* plant species continues to exceed 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 nine of the SRERP habitats sampled in 2018 (Table 9). As was reported in the 2017 habitat monitoring effort (J.B. Lovelace & Associates 2018), the lowest estimated mean percent cover of invasive vegetation observed during the recent 2018 sampling was again observed in the active channel sampling area of the Phase 2A (Middle) reach [$\overline{x}$ = 7.2%]. The remaining 2018 mean estimated invasive vegetation percent cover values ranged from 21.6% in the Phase 2A (Upper)/Phase 2B (Lower) active bench sampling area to 38.8% in the Phase 2A (Middle) replanted riparian forest (Table 9). The latter sampling area was also noted to have the greatest cover of invasive vegetation of those sampled in 2017 as well (J.B. Lovelace & Associates 2018).

Table 9. Summary of 2018 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	2018 Success Criteria[2]	Observed	Final Success Criteria[3]	Observed	Final Success Criteria[3]	Observed
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area								
Salt Marsh *sensu stricto* (n=64)	**94.8** (92.2, 96.6)	**58.0** (49.7, 65.7)	≥30%	**8.2** (4.9, 13.7)	<15%	**28.7** (21.7, 36.7)	<5%	**0.0** (NA)
Phase 2 – Salt River Corridor Restoration Area								
Phase 2A (Middle) – Salt River Channel Wetlands								
Active Channel (n=32)	**100.0** (NA)	**90.1** (85.9, 93.6)	≥30%	**2.6** (1.1, 4.9)	<15%	**7.2** (4.3, 10.9)	<5%	**0.0** (NA)
Active Bench (n=32)	**96.3** (92.6, 98.0)	**59.7** (48.9, 69.6)	≥30%	**13.1** (7.1, 21.9)	<15%	**23.5** (16.3, 32.6)	<5%	**0.0** (NA)
Phase 2A (Middle) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**98.9** (96.7, 99.7)	**51.0** (40.5, 62.2)	≥30%	**9.1** (4.9, 17.6)	<15%	**38.8** (28.6, 50.0)	<5%	**0.0** (NA)
Active Riparian Berm (n=32)	**99.4** (96.8, 99.8)	**68.9** (59.8, 76.7)	≥30%	**8.1** (4.3, 15.5)	<15%	**22.4** (16.8, 28.9)	<5%	**0.0** (NA)
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands								
Active Channel (n=32)	**93.0** (86.8, 96.3)	**43.0** (33.7, 52.6)	≥10%	**20.2** (14.7, 26.6)	<15%	**26.1** (20.1, 33.7)	<5%	**3.7** (2.3, 5.4)
Active Bench (n=32)	**85.0** (79.0, 89.2)	**28.5** (21.7, 36.7)	≥10%	**31.7** (24.2, 40.3)	<15%	**21.6** (16.3, 27.7)	<5%	**3.2** (1.8, 5.0)
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones								
Replanted Riparian Forest (n=32)	**95.8** (92.5, 97.7)	**28.9** (21.1, 38.1)	≥10%	**37.3** (28.3, 46.2)	<15%	**23.6** (18.0, 31.0)	<5%	**6.0** (4.0, 9.1)
Active Riparian Berm (n=32)	**84.8** (79.0, 89.5)	**24.2** (19.6, 29.5)	≥10%	**20.1** (14.7, 26.3)	<15%	**25.0** (18.1, 34.0)	<5%	**15.5** (11.7, 21.4)

[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).

The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) was only encountered in the most recently completed Phase 2A (Upper)/Phase 2B (Lower) restoration area, where it was documented in all four sampling regions, and ranged in mean estimated cover between 3.2%1–15.5% (Table 9).

Additional descriptions of specific results from each sampled area follows. Mean estimates provided for total vegetative percent cover reflect total (absolute) vegetative 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 percent cover values calculated from transformed data as described in Section 3.2 (above), except where indicated otherwise. Dominant and/or representative species documented in sample plots within each area are listed in decreasing order of frequency and/or percent cover.

Less frequently occurring species are omitted from these treatments, but a complete list of all plant species encountered in each sampling area during the 2018 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 Appendix A, Figures 6-8. Although invasive species encountered in each sampling area are mentioned here for those areas in which they occur, additional treatment of invasive vegetation observed throughout the entire Phase 1 and Phase 2 restoration areas is provided in Section 4.3 below.

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area

"Tidal Salt & Brackish Marsh"

Salt Marsh* sensu stricto *(n = 64)
Total vegetative cover in the salt marsh *sensu stricto* sampling area was 94.8%, an increase of 14.8% from 80% reported (J.B. Lovelace & Associates 2017) during the preceding sampling effort (2016) in this habitat. The majority of this vegetation was composed of herbaceous species ($\bar{x}$ = 94.4%), with the native shrub, *Baccharis pilularis* ssp. *consanguinea* ("coyote brush") contributing only 0.4% cover (Table 10).

The mean estimated percent cover of native vegetation in this habitat was 58.0%, still exceeding the (minimum) success criterion of 30% for the fifth year of monitoring for this Phase 1 habitat, but decreased by 8.9% from 66.9% reported in 2016 (J.B. Lovelace & Associates 2017). The majority of the native vegetation in this "true" salt marsh habitat consisted of *Salicornia pacifica* ("pickleweed") and *Distichlis spicata* ("salt grass"). Other representative native species encountered less frequently included *Bolboschoenus maritimus* ssp. *paludosus* ("saltmarsh bulrush"), *Triglochin striata* ("three-ribbed arrow-grass"),

Table 10. Structural Composition of Vegetation within 2018 Sampled Habitats. 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 Areas	Mean Percent Cover of Vegetation Categories of Interest			
	Total	Herb	Shrub	Tree
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area				
Salt Marsh *sensu stricto* (n=64)	**94.8** (97.8, 99.7)	**94.4** (91.8, 96.3)	**0.4** (0.0 , 1.3)	**0.0** NA
Phase 2 – Salt River Corridor Restoration Area				
Phase 2A (Middle) – Salt River Channel Wetlands				
Active Channel (n=32)	**100.0** NA	**97.8** (94.6, 99.2)	**1.1** (0.2 , 3.4)	**1.1** (0.3 , 3.4)
Active Bench (n=32)	**96.3** (92.6, 98.0)	**92.7** (88.3, 95.4)	**0.0** NA	**3.6** (1.9 , 7.2)
Phase 2A (Middle) – Riparian Planting Zones				
Replanted Riparian Forest (n=32)	**98.9** (96.7, 99.7)	**77.4** (66.5, 85.4)	**6.4** (3.4 ,	**15.2** (8.8 , 23.6)
Active Riparian Berm (n=32)	**99.4** (96.8, 99.8)	**85.5** (80.0, 89.7)	**2.9** (1.2 ,	**11.1** (6.7 , 17.0)
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands				
Active Channel (n=32)	**93.0** (86.8, 96.3)	**88.5** (81.1, 93.1)	**0.0** NA	**4.5** (2.1 , 8.7)
Active Bench (n=32)	**85.0** (79.0, 89.2)	**84.8** (79.0, 89.1)	**0.0** NA	**0.2** (0.04, 0.5)
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones				
Replanted Riparian Forest (n=32)	**95.8** (92.5, 97.7)	**91.7** (87.4, 94.7)	**0.8** (0.07, 2.8)	**3.3** (1.3 , 8.1)
Active Riparian Berm (n=32)	**84.8** (79.0, 89.5)	**79.3** (72.1, 85.5)	**1.2** (0.2 , 3.3)	**4.4** (2.1 , 8.4)

Eleocharis macrostachya (“spikerush”), *Spergularia marina* (“saltmarsh sand-spurrey”), *Jaumea carnosa* (“fleshy Jaumea”), *Juncus mexicanus* (“Mexican rush”), and *Triglochin maritima* (“common arrow-grass”).

Although not a dominant species, the rare *Carex lyngbyei* (“Lyngbye’s sedge”) was also observed in 2% of sampled plots in this habitat. *Carex lyngbyei* is an herbaceous hydrophytic plant species classified by the California Native Plant Society (CNPS 2018) 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 observed in salt marsh *sensu stricto* sampling plots in 2018 was 8.2%, less than the final maximum success threshold for this vegetation category, and consisted of *Cotula coronopifolia* (“brass-buttons”) and *Atriplex prostrata* (“fat-hen”). The mean

estimated cover of invasive vegetation was 28.7%, an increase of 22.1% from 6.6% reported from the preceding sampling effort (J.B. Lovelace & Associates 2017). This increase is attributable primarily to continued establishment and development of *Spartina densiflora* ("dense-flowered cord grass"), which was the second most abundant plant species detected in this habitat in 2018, occurring in 75% of sampled plots (n=64). Other invasive plants observed during sampling within salt marsh *sensu stricto* habitat included *Agrostis stolonifera* ("creeping bent"), *Parapholis strigosa* ("hairy sickle grass"), *Polypogon monspeliensis* ("rabbitfoot grass"), and *Lotus corniculatus* ("bird's-foot trefoil") (see also Figure 3, below).

Phase 2 – Salt River Corridor Restoration Area

Phase 2A (Middle) Salt River Channel Wetlands

Phase 2A (Middle) Active Channel (n = 32)

Total vegetative cover in the Phase 2A (Middle) active channel sampling area was 100%. The majority of this vegetation was composed of herbaceous species ($\bar{x}$ = 97.8%), though the establishment of some trees ($\bar{x}$ = 1.1%) and shrubs ($\bar{x}$ = 1.1%) is occurring (Table 10). Woody plant species encountered in the Phase 2A (Middle) active channel sampling effort included *Alnus rubra* ("red alder"), *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Salix sitchensis* ("Sitka willow"), and *Rubus ursinus* ("California blackberry").

Mean estimated cover of native vegetation was 90.1%, far exceeding the minimum success criterion of 30% for this third 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"), *Equisetum telmateia* ssp. *braunii* ("giant horsetail"), *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), *Cyperus eragrostis* ("nutsedge"), *Eleocharis macrostachya* ("spikerush"), *Epilobium ciliatum* ssp. *watsonii* ("Watson's willow-herb"), *Juncus hesperius* ("coast rush"), *Carex obnupta* ("slough sedge"), *Deschampsia cespitosa* ("tufted hairgrass"), *Juncus balticus* ssp. *ater* ("Baltic rush"), *Juncus effusus* ssp. *pacificus* ("Pacific rush"), *Stachys ajugoides* ("hedgenettle"), *Veronica americana* ("American brooklime"), *Oenanthe sarmentosa* ("water parsley"), *Bolboschoenus maritimus* ssp. *paludosus* ("saltmarsh bulrush"), and the aforementioned woody species.

Mean estimated percent cover of non-native non-invasive vegetation in this habitat was 2.6% (less than the final [maximum] success threshold of 15%), and largely consisted of *Rumex conglomeratus* ("clustered dock"), though other species were also observed to a lesser degree. The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) was not encountered in this sampling area during vegetation sampling of this habitat component in 2018.

Mean estimated cover of invasive vegetation was 7.2% (slightly greater than the final [maximum] success threshold of 5%), and consisted of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Helminthotheca echioides* ("bristly ox-tongue"), *Ranunculus repens* ("creeping buttercup"), and *Cirsium arvense* ("Canada thistle") (see also Figure 4, below).

Phase 2A (Middle) Active Bench (n = 32)

The mean estimated total vegetative cover in the Phase 2A (Middle) active bench sampling region was 96.3%, with the majority ($\overline{x}$ = 92.7%) of the vegetation in this area being composed of herbaceous species (Table 10). The remaining 3.6% of the vegetative cover consisted of *Salix lasiandra* ssp. *lasiandra* ("Pacific willow"), *Salix sitchensis* ("Sitka willow"), and *Alnus rubra* ("red alder") seedlings and/or saplings.

The mean estimated cover of native vegetation in this habitat was 59.7%, exceeding the minimum success criterion of 30% for this third year of monitoring for this area. Native species consisted primarily of herbaceous taxa such as *Scirpus microcarpus* ("panicled bulrush"), *Deschampsia cespitosa* ("tufted hairgrass"), *Hordeum brachyantherum* ("meadow barley"), *Oenanthe sarmentosa* ("water parsley"), *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), *Equisetum arvense* ("common horsetail"), *Juncus hesperius* ("coast rush"), *Epilobium ciliatum* ssp. *watsonii* ("Watson's willow-herb"), and *Juncus balticus* ssp. *ater* ("Baltic rush"), in addition to the woody species mentioned above.

Mean estimated cover of non-native non-invasive vegetation was 13.1% (only slightly less than the final [maximum] success threshold of 15%), and included *Trifolium fragiferum* ("strawberry clover"), *Festuca perennis* ("rye grass"), *Trifolium repens* ("white clover"), and *Hypochaeris radicata* ("hairy cat's-ears"), though other species were also observed to a lesser degree. The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) was not encountered in this sampling area during vegetation sampling of this habitat component in 2018.

The mean estimated cover of invasive vegetation was 23.5%, exceeding the final (maximum) success threshold of 5%, and consisted of *Agrostis stolonifera* ("creeping bent"), *Phalaris arundinacea* ("reed canary grass"), *Ranunculus repens* ("creeping buttercup"), *Typha latifolia* ("broad-leaved cattail"), *Holcus lanatus* ("velvet grass"), *Helminthotheca echioides* ("bristly ox-tongue"), and *Lotus corniculatus* ("bird's-foot trefoil") (see also Figure 6, below).

Phase 2A (Middle) Riparian Planting Zones

Phase 2A (Middle) Active Riparian Berm (n = 32)

Estimated total vegetative cover of the Phase 2A (Middle) active riparian berm was 99.4%. Although most of this vegetation was composed of herbaceous species ($\overline{x}$ = 85.5%), the continued establishment of trees ($\overline{x}$ = 11.1%) and

shrubs ($\overline{x}$ = 2.9%) was observed during recent sampling efforts (Table 10; see also Appendix A, Figure 9).

The mean estimated cover of native vegetation was 68.9% exceeding the minimum success criterion of 30% for this third year of monitoring for this area. Native vegetation was composed primarily of herbaceous taxa such as *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), *Equisetum telmateia* ssp. *braunii* ("giant horsetail"), *Scirpus microcarpus* ("panicled bulrush"), *Deschampsia cespitosa* ("tufted hairgrass"), *Juncus hesperius* ("coast rush"), *Hordeum brachyantherum* ("meadow barley"), *Stachys ajugoides* ("hedge-nettle"), *Epilobium ciliatum* ssp. *watsonii* ("Watson's willowherb"), and *Equisetum arvense* ("common horsetail"); though woody species such as *Alnus rubra* ("red alder"), *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Salix sitchensis* ("Sitka willow"), *Sequoia sempervirens* ("coast redwood"), *Picea sitchensis* ("Sitka spruce"), *Salix hookeriana* ("coastal willow"), *Populus trichocarpa* ("black cottonwood"), *Thuja plicata* ("western red cedar"), *Rubus ursinus* ("California blackberry"), and *Morella californica* ("California wax myrtle") 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 8.1% (less than the final [maximum] criterion of 15%), and the species composition of this vegetation category included *Trifolium repens* ("white clover"), *Rumex conglomeratus* ("clustered dock"), and *Festuca perennis* ("rye grass"), in addition to other less abundant species. The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) was not encountered in this area during vegetation sampling of this habitat component in 2018.

Mean estimated cover of invasive plant species observed in this restoration design feature was 22.4% (substantially greater than the final [maximum] success threshold), and consisted of *Helminthotheca echioides* ("bristly ox-tongue"), *Phalaris arundinacea* ("reed canary grass"), *Lotus corniculatus* ("bird's-foot trefoil"), *Agrostis stolonifera* ("creeping bent"), *Ranunculus repens* ("creeping buttercup"), *Mentha pulegium* ("pennyroyal"), *Holcus lanatus* ("velvet grass"), *Cirsium vulgare* ("bull thistle"), and *Rubus armeniacus* ("Himalayan blackberry") (see also Figure 8, below).

Phase 2A (Middle) Replanted Riparian Forest (n = 32)

Total vegetative cover in the Phase 2A (Middle) replanted riparian forest sampling area was 98.9%. The majority of the vegetation in this sampling area was composed of herbaceous species ($\overline{x}$ = 77.4%), though a robust woody riparian cohort of trees ($\overline{x}$ = 15.2%) and shrubs ($\overline{x}$ = 6.4%) continues to develop (Table 10; see also Appendix A, Figure 9).

Mean estimated cover of native vegetation in this middle Phase 2A restoration area was 51.0%, exceeding the minimum success criterion of 30% for this third

year of monitoring for this habitat. Dominant native herbaceous species included *Oenanthe sarmentosa* ("water parsley"), *Deschampsia cespitosa* ("tufted hairgrass"), *Equisetum telmateia* ssp. *braunii* ("giant horsetail"), *Scirpus microcarpus* ("panicled bulrush"), *Hordeum brachyantherum* ("meadow barley"), *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), *Stachys ajugoides* ("hedgenettle"), *Juncus effusus* ssp. *pacificus* ("Pacific rush"), and *Equisetum arvense* ("common horsetail"). Native shrub species consisted of *Rubus ursinus* ("California blackberry"), *Rosa californica* ("California rose"), *Rubus spectabilis* ("salmonberry"), *Morella californica* ("California wax myrtle"), and *Lonicera involucrata* ssp. *ledebourii* ("twinberry"). Establishing native tree species consisted of *Salix hookeriana* ("coastal willow"), *Alnus rubra* ("red alder), *Salix sitchensis* ("Sitka willow"), and *Salix lasiolepis* ("arroyo willow").

The estimated mean cover of non-native non-invasive plant species in this habitat was 9.1%, less than the final (maximum) success threshold of 15%. The species composition of this vegetative category encountered in the Phase 2A (Middle) reach consisted primarily of *Festuca perennis* ("rye grass"), *Trifolium repens* ("white clover"), *Hypochaeris radicata* ("hairy cat's-ears"), and *Calystegia silvatica* ssp. *disjuncta* ("large bindweed"), though other such species were also encountered to a lesser extent. The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) was not encountered in this area during vegetation sampling of this habitat component in 2018.

Mean estimated cover of invasive vegetation in this area was 38.8%, substantially greater than the final (maximum) success criterion of 5%, and consisted of *Agrostis stolonifera* ("creeping bent"), *Helminthotheca echioides* ("bristly ox-tongue"), and *Phalaris arundinacea* ("reed canary grass"), with lesser amounts of *Holcus lanatus* ("velvet grass"), *Ranunculus repens* ("creeping buttercup"), *Cirsium arvense* ("Canada thistle"), *Conium maculatum* ("poison hemlock"), *Lotus corniculatus* ("bird's-foot trefoil"), *Cirsium vulgare* ("bull thistle"), *Mentha pulegium* ("pennyroyal"), *Senecio jacobaea* ("tansy ragwort"), and *Rubus armeniacus* ("Himalayan blackberry") (see also Figure 9, below).

Phase 2A (Upper)/Phase 2B (Lower) Salt River Channel Wetlands

Phase 2A (Upper)/Phase 2B (Lower) Active Channel (n = 32)
The total estimated vegetative cover in the Phase 2A (Upper)/Phase 2B (Lower) active channel was 93.0%. Most of this vegetation was composed of herbaceous species ($\overline{x}$ = 88.5%), though some tree saplings ($\overline{x}$ = 4.5%) are also becoming established in some locations (Table 10).

Mean estimated cover of native vegetation was 43.0%, exceeding the minimum success criterion of 10% for the first year of monitoring for this Phase 2 habitat. Dominant native herbaceous species documented in this sampling region include *Hordeum brachyantherum* ("meadow barley"), *Scirpus microcarpus* ("panicled

bulrush"), *Juncus hesperius* ("coast rush"), *Deschampsia cespitosa* ("tufted hairgrass"), *Oenanthe sarmentosa* ("water parsley"), *Alopecurus geniculatus* ("water foxtail"), *Elymus glaucus* ("western wild rye"), *Cyperus eragrostis* ("nutsedge"), *Juncus effusus* ssp. *pacificus* ("Pacific rush"), *Festuca rubra* ("red fescue"), *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), *Juncus bufonius* var. *occidentalis* ("toad rush"), and *Equisetum telmateia* ssp. *braunii* ("giant horsetail"). Native *Alnus rubra* ("red alder"), *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Salix sitchensis* ("Sitka willow"), and *Salix hookeriana* ("coastal willow") tree saplings were also observed in this channel habitat.

The mean estimated percent cover of non-native non-invasive vegetation in the Phase 2A (Upper)/Phase 2B (Lower) active channel sampling region in 2018 was 20.2%, exceeding the final (maximum) success criterion of 15%. Species in this vegetative category observed in this sampling area consisted of *Festuca perennis* ("rye grass"), *Trifolium repens* ("white clover"), *Atriplex prostrata* ("fat-hen"), *Rumex conglomeratus* ("clustered dock"), and *Festuca arundinacea* ("tall fescue"), though other such species were also encountered to a lesser degree. Mean estimated percent cover of the sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) in this habitat feature was 3.7%.

Mean estimated cover of invasive vegetation documented in this recently completed restoration area was 26.1%, which is well above the final (maximum) success criterion of 5%. Invasive species observed along the Phase 2A (Upper)/Phase 2B (Lower) active channel edge during the 2018 effort included *Glyceria declinata* ("low manna grass"), *Phalaris arundinacea* ("reed canary grass"), *Holcus lanatus* ("velvet grass"), *Agrostis stolonifera* ("creeping bent"), *Ranunculus repens* ("creeping buttercup"), *Helminthotheca echioides* ("bristly ox-tongue"), *Mentha pulegium* ("pennyroyal"), *Cirsium vulgare* ("bull thistle"), and *Lotus corniculatus* ("bird's-foot trefoil") (see also Figure 5, below).

Phase 2A (Upper)/Phase 2B (Lower) Active Bench (n = 32)

Estimated mean total vegetative cover in the Phase 2A (Upper)/Phase 2B (Lower) active bench sampling area was 85.0%. The vast majority of this plant community was composed of herbaceous species ($\overline{x}$ = 84.8%), though occasional tree seedlings and/or saplings ($\overline{x}$ = 0.2%) were also encountered.

The mean estimated percent cover of native vegetation in this habitat was 28.5%, exceeding the minimum success criterion of 10% for this first year of monitoring for this area. Dominant native herbaceous plant species encountered in this Phase 2 bench habitat consisted of *Hordeum brachyantherum* ("meadow barley"), *Deschampsia cespitosa* ("tufted hairgrass"), *Elymus glaucus* ("western wild rye"), *Juncus bufonius* var. *occidentalis* ("toad rush"), *Alopecurus geniculatus* ("water foxtail"), *Juncus hesperius* ("coast rush"), *Festuca rubra* ("red fescue"), *Persicaria lapathifolia* ("willow weed"), and *Oenanthe sarmentosa* ("water

parsley"). Native woody species consisted of *Alnus rubra* ("red alder"), *Fraxinus latifolia* ("Oregon ash"), and *Salix lasiandra* var. *lasiandra* ("Pacific willow").

Mean estimated cover of non-native non-invasive vegetation was 31.7%, approximately twice the final (maximum) success criterion of 15%, and included *Trifolium repens* ("white clover"), *Festuca perennis* ("rye grass"), *Trifolium fragiferum* ("strawberry clover"), *Plantago major* ("English plantain"), *Atriplex prostrata* ("fat-hen"), *Echinochloa crus-galli* ("barnyard-millet"), and *Trifolium dubium* ("little hop clover"), though similar species were encountered to a lesser extent. Mean estimated percent cover of the sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) in this habitat feature was 3.2%.

Mean estimated cover of invasive vegetation in this sampling area was 21.6%, exceeding the final (maximum) success criterion of 5%, and consisted of *Phalaris arundinacea* ("reed canary grass"), *Glyceria declinata* ("low manna grass"), *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), *Helminthotheca echioides* ("bristly ox-tongue"), *Mentha pulegium* ("pennyroyal"), *Lotus corniculatus* ("bird's-foot trefoil"), *Ranunculus repens* ("creeping buttercup"), and *Polypogon monspeliensis* ("rabbitfoot grass") (see also Figure 7, below).

Phase 2A (Upper)/Phase 2B (Lower) Riparian Planting Zones

Phase 2A (Upper)/Phase 2B (Lower) Active Riparian Berm (n = 32)
Estimated total vegetative cover of the Phase 2A (Upper)/Phase 2B (Lower) active riparian berm was 84.8%. The majority of this vegetation was composed of herbaceous species ($\overline{x}$ = 79.3%), though some trees ($\overline{x}$ = 4.4%) and shrubs ($\overline{x}$ = 1.2%) are becoming established in some locations (Table 10).

The mean estimate of native plant cover was 24.2%, exceeding the assumed minimum success criterion of 10% for this first year of monitoring for this area. Native herbaceous vegetation was composed primarily of *Hordeum brachyantherum* ("meadow barley"), with lesser amounts of *Oenanthe sarmentosa* ("water parsley"), *Potentilla anserina* ssp. *pacifica* ("Pacific silverweed"), and *Stachys ajugoides* ("hedge-nettle"). Native shrub species consisted of *Morella californica* ("California wax myrtle"), and *Sambucus racemosa* var. *racemosa* ("red elderberry") and establishing native tree species consisted of *Alnus rubra* ("red alder"), *Picea sitchensis* ("Sitka spruce"), *Thuja plicata* ("western red cedar"), and *Populus trichocarpa* ("black cottonwood").

The mean estimated percent cover of non-native non-invasive vegetation in the active riparian berm was 20.1%, greater than the final (maximum) criterion of 15%, and the species composition included *Festuca perennis* ("rye grass"),

Festuca arundinacea (“tall fescue”), and *Raphanus sativus* (“radish”), in addition to other less abundant species. Mean estimated percent cover of the sterile “wheatgrass” hybrid (*Elymus* x *Triticum*) in this habitat feature was 15.5%.

The mean estimated percent cover of invasive plant species observed in this restoration design feature was 25.0%, well above the final (maximum) success threshold, and consisted of *Helminthotheca echioides* (“bristly ox-tongue”), *Phalaris arundinacea* (“reed canary grass”), *Holcus lanatus* (“velvet grass”), *Glyceria declinata* (“low manna grass”), *Lotus corniculatus* (“bird’s-foot trefoil”), *Agrostis stolonifera* (“creeping bent”), *Cirsium vulgare* (“bull thistle”), and *Ranunculus repens* (“creeping buttercup”) (see also Figure 10, below).

Phase 2A (Upper)/Phase 2B (Lower) Replanted Riparian Forest (n = 32)
Total vegetative cover in the Phase 2A (Upper)/Phase 2B (Lower) replanted riparian forest sampling area was 95.8%. The bulk of this vegetation was composed of herbaceous species ($\overline{x}$ = 91.7%), though our sampling results also document a nascent and developing riparian forest cohort, with both tree ($\overline{x}$ = 3.3%) and shrub ($\overline{x}$ = 0.8%) components (Table 10).

Mean estimated cover of native vegetation in this Phase 2 restoration area was 28.9%, exceeding the assumed minimum success criterion of 10% for this first year of monitoring of this habitat. Dominant native herbaceous species included *Equisetum telmateia* ssp. *braunii* (“giant horsetail”), *Hordeum brachyantherum* (“meadow barley”), *Deschampsia cespitosa* (“tufted hairgrass”), *Scirpus microcarpus* (“panicled bulrush”), *Elymus glaucus* (“western wild rye”), *Festuca rubra* (“red fescue”), *Oenanthe sarmentosa* (“water parsley”), *Stachys ajugoides* (“hedgenettle”), and *Juncus hesperius* (“coast rush”). Establishing native woody species included *Rubus ursinus* (“California blackberry”), *Picea sitchensis* (“Sitka spruce”), *Salix hookeriana* (“coastal willow”), *Salix lasiolepis* (“arroyo willow”), *Salix sitchensis* (“Sitka willow”), *Alnus rubra* (“red alder”), *Salix lasiandra* var. *lasiandra* (“Pacific willow”), *Abies grandis* (“grand fir”), *Populus trichocarpa* (“black cottonwood”), and *Sequoia sempervirens* (“coast redwood”).

The estimated mean cover of non-native non-invasive plant species in this habitat was 37.3%, more than twice the final (maximum) success threshold of 15%. The species composition of this vegetative category encountered here in this recently constructed Phase 2 reach consisted primarily of *Festuca perennis* (“rye grass”), *Trifolium repens* (“white clover”), *Festuca arundinacea* (“tall fescue”), *Raphanus sativus* (“radish”), *Rumex conglomeratus* (“clustered dock”), *Calystegia silvatica* ssp. *disjuncta* (“large bindweed”), *Polygonum aviculare* ssp. *depressum* (“prostrate knotweed”), *Atriplex prostrata* (“fat-hen”), and *Senecio minimus* (“coastal burnweed”), though other such species were also encountered to a lesser extent. Mean estimated percent cover of the sterile “wheatgrass” hybrid (*Elymus* x *Triticum*) in this habitat feature was 6.0%.

Mean estimated cover of invasive vegetation in this sampling region was 23.6%, substantially greater than the final (maximum) success criterion of 5%, and consisted of *Holcus lanatus* ("velvet grass"), *Helminthotheca echioides* ("bristly ox-tongue"), *Agrostis stolonifera* ("creeping bent"), *Phalaris arundinacea* ("reed canary grass"), *Cirsium vulgare* ("bull thistle"), *Lotus corniculatus* ("bird's-foot trefoil"), *Ranunculus repens* ("creeping buttercup"), *Glyceria declinata* ("low manna grass"), *Conium maculatum* ("poison hemlock"), and *Dipsacus fullonum* ("wild teasel") (see also Figure 11, below).

4.2.2 Replanted Woody Riparian Vegetation Basal Area Sampling Results

Results from our 2018 basal area sampling efforts confirm the vigorous growth and development of replanted (and likely volunteer) woody riparian vegetation within the middle Phase 2A restoration area (Table 11; Appendix A, Figure 9). Ultimately, we directly sampled ~15% (0.71 acres) of the total combined area (4.62 acres) of the two SRERP riparian planting zones addressed during the 2018 endeavor. Projected results for each sampled habitat are provided below and raw basal area measurements (not extrapolated to habitat- and/or phase-wide estimates) are provided in Appendix C.

Phase 2A (Middle) – Salt River Corridor Restoration Area

Replanted Riparian Forest

In the Phase 2A (Middle) replanted riparian forest sampling area, we directly sampled (n = 10) approximately 15% (0.51 acres) of the total habitat area (3.50 acres). Projected total basal area for the replanted riparian forest habitat was 24.66 ft^2, representing ~93% of the total projected basal area (26.65 ft^2) for the Phase 2A (Middle) restoration reach in 2018. The greatest contributions to woody riparian basal area in the Phase 2A (Middle) replanted riparian forest were from *Salix sitchensis* ("Sitka willow"), *Alnus rubra* ("red alder), and *Salix hookeriana* ("coastal willow"), though *Salix lasiandra* var. lasiandra ("Pacific willow"), *Morella californica* ("California wax myrtle"), *Populus trichocarpa* ("black cottonwood"), *Picea sitchensis* ("Sitka spruce"), and *Sequoia sempervirens* ("coast redwood") also contributed to a lesser extent.

Active Riparian Berm

In the active riparian berm sampling area, we directly sampled (n = 5) approximately 18% (0.20 acres) of the total habitat area (1.12 acres). The projected basal area for this restoration design feature was 1.99 ft^2, representing ~7% of the total projected basal area (26.65 ft^2) documented from the Phase 2A (Middle) restoration reach in 2018. Most of the basal area in the active riparian berm habitat was attributed to *Alnus rubra* ("red alder), though lesser contributions from *Salix sitchensis* ("Sitka willow"), *Populus trichocarpa* ("black cottonwood"), *Sequoia sempervirens* ("coast redwood"), *Morella californica* ("California wax myrtle"), *Baccharis pilularis* ssp. *consanguinea* ("coyote brush"), *Lonicera involucrata* ssp. *ledebourii* ("twinberry"), and *Salix hookeriana* ("coastal willow") were also recorded.

Table 11. Summary of 2018 SRERP Replanted Woody Riparian Vegetation Basal Area Sampling Results. Basal area values represent projected totals for each tree species observed in each habitat sampled in 2018.

	(Projected*) Basal Area (ft^2)		
	Phase 2A (Middle) – Salt River Corridor Restoration Area		
Tree Species	**Replanted Riparian Forest (3.50 acres) (n = 10)**	**Active Riparian Berm (1.12 acres) (n = 5)**	**Total§ (4.62 acres)**
Salix sitchensis (Sitka willow)	12.7061	0.4600	13.1661
Alnus rubra (red alder)	9.6257	1.4214	11.0471
Salix hookeriana (coastal willow)	2.0207	0.0024	2.0231
Populus trichocarpa (black cottonwood)	0.0714	0.0798	0.1512
Salix lasiandra var. *lasiandra* (Pacific willow)	0.1198	0.0026	0.1224
Morella californica (California wax myrtle)	0.0816	0.0052	0.0868
Sequoia sempervirens (coast redwood)	0.0159	0.0053	0.0212
Picea sitchensis (Sitka spruce)	0.0196	0	0.0196
Baccharis pilularis ssp. *consanguinea* (coyote brush)	0	0.0039	0.0039
Lonicera involucrata ssp. *ledebourii* (twinberry)	0	0.0039	0.0039
Total	**24.6608**	**1.9845**	**26.6453**

* Projected total basal area values were derived from basal-area-per-unit-area-sampled measurements collected during 2018 quantitative vegetation sampling efforts, extrapolated to habitat- and phase-wide estimates based on respective habitat areas (acreages) obtained from current SRERP GIS data.

§ All SRERP restoration areas addressed during the 2018 basal area sampling effort

4.3 Invasive Plant Species Assessment

Results from the 2018 percent cover vegetation sampling effort discussed above provide quantitative estimates (Table 9) of the current abundance of invasive vegetation in SRERP habitats sampled during 2018. A comparison of results from such sampling efforts throughout the four-year period between 2015-2018 (where data exist) continue to indicate increasing trends in the abundance of invasive vegetation in all sampled habitats, with the possible exception of the replanted riparian forest habitat in the middle Phase 2A restoration reach, where cover of invasive vegetation appears to have decreased slightly between 2017-2018 (Figure 2). A similar observation was noted in the active bench habitat of the same restoration reach between the 2016 and 2017 monitoring efforts (J.B. Lovelace & Associates 2018), yet the invasive vegetative cover in the latter sampling region has increased again over the course of the last year (Figure 2).

No procedures were applied to test the statistical significance of these apparent "trends," and confidence in them is somewhat limited by both the width of the various corresponding confidence intervals (Table 9) and the limited number of monitoring years for which data exist. However, additional incidental observations made during our 2018 habitat mapping analysis and basal area sampling fieldwork corroborate these patterns and indicate similar increases in invasive vegetation in regions of the SRERP project area where percent cover vegetation sampling did not occur in 2018. With some exceptions (described herein), recent findings include both increases in the extent and abundance of previously identified invasive plant occurrences (J.B. Lovelace & Associates 2017 & 2018), as well as the identification of new occurrences, reflecting an overall sustained increase in the establishment and abundance of invasive vegetation throughout the SRERP restoration area.

These recent findings are described below. Invasive plant species abundance and composition data resulting from quantitative sampling efforts (where they occurred) are also presented in Figures 3-11 to providing increased resolution to facilitate strategic vegetation maintenance and eradication efforts targeting this problematic vegetation category. The current distribution of invasive vegetation throughout the SRERP area is depicted in Appendix A, Figures 10-15). 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."

4.3.1 Phase 1 – Riverside Ranch Tidal Marsh Restoration Area

Invasive plant species occurrences documented within the Phase 1 restoration area during the 2016 and 2017 habitat monitoring efforts (J.B. Lovelace & Associates 2017 & 2018) were located again during our recent 2018 fieldwork, and either continue to persist or have increased in abundance (Figure 2) and/or extent (Appendix A, Figures 10 & 12). Updated descriptions of invasive species occurrences observed throughout the Phase 1 restoration area during our 2018

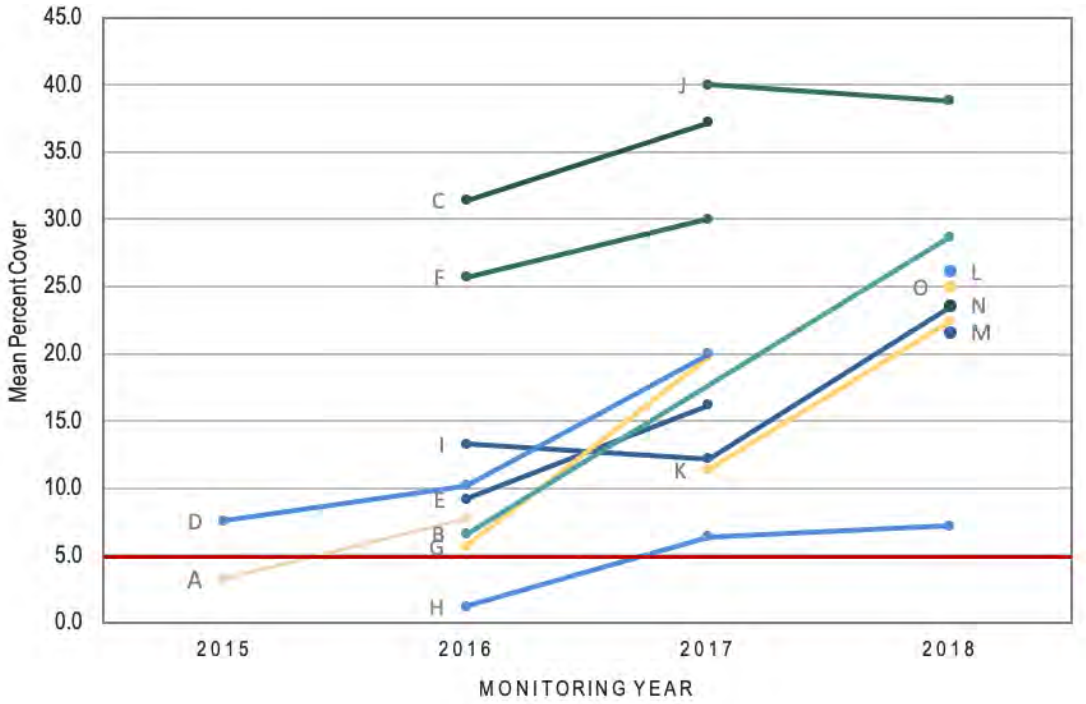

Figure 2. Estimated Mean Percent Cover of Invasive Species (2015-2018). Sources: H.T. Harvey & Associates (2015); J.B. Lovelace & Associates (2017& 2018); this current effort. The final (maximum) cover threshold (i.e., 5%) is indicated in red. Vegetation sampling regions are indicated as follows:

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area
- A: High Marsh Ecotone
- B: Salt Marsh *sensu stricto*
- C: Replanted Riparian Forest

Phase 2 – Salt River Corridor Restoration Area

Phase 2A (Lower) – Salt River Channel Wetlands
- D: Active Channel
- E: Active Bench

Phase 2A (Lower) – Riparian Planting Zones
- F: Replanted Riparian Forest
- G: Active Riparian Berm

Phase 2A (Middle) – Salt River Channel Wetlands
- H: Active Channel
- I: Active Bench

Phase 2A (Middle) – Riparian Planting Zones
- J: Replanted Riparian Forest
- K: Active Riparian Berm

Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands
- L: Active Channel
- M: Active Bench

Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones
- N: Replanted Riparian Forest
- O: Active Riparian Berm

fieldwork follow below, and measures of the abundance and distribution of individual invasive species encountered in habitats where vegetation sampling efforts were conducted (i.e., salt marsh *sensu stricto*) are presented in Figure 3. The non-native grass species, *Parapholis strigosa* ("hairy sickle grass"), which was encountered during the 2016, 2017, and 2018 habitat monitoring efforts but not originally treated as "invasive" is also addressed here.

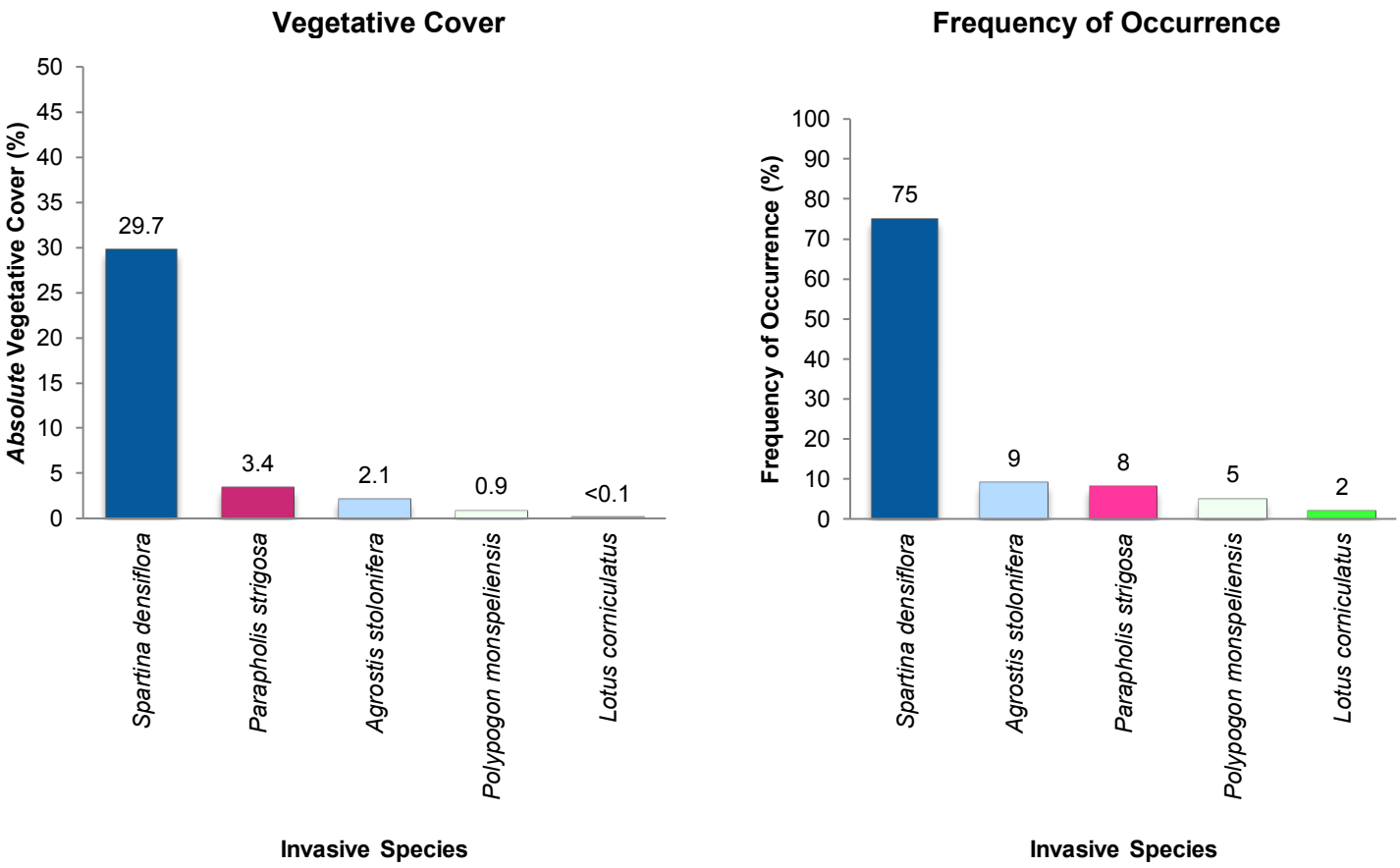

Figure 3. Invasive Vegetation Species Composition. Phase 1 – Riverside Ranch Tidal Marsh Restoration Area: Salt Marsh *sensu stricto*. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 64) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

Parapholis strigosa (Hairy Sickle Grass)

Parapholis strigosa ("hairy sickle grass") is not identified as invasive or "noxious" by the California Invasive Plant Council (2018), California Department of Food & Agriculture (2018), or U.S. Department of Agriculture (USDA 2018). However, this species is included in the Humboldt County Weed Management Area list (2010) as warranting consideration and monitoring, and is addressed as an invasive species in the context of the 2018 SRERP habitat monitoring effort given its potential to be invasive in coastal habitats within the Humboldt Bay and Eel River delta region (Leppig pers. comm.; Wheeler pers. comm.). This grass species was observed to be fairly abundant where it occurs within the Phase 1 restoration area (Appendix A, Figure 12): typically, in relatively higher elevations in salt marsh *sensu stricto* habitat, as well as in portions of high marsh ecotone.

***Spartina densiflora* (Dense-Flowered Cord Grass)**
Previously documented (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017 & 2018) occurrences of the "noxious" (CDFA 2018) and highly invasive salt marsh species, *Spartina densiflora* ("dense-flowered cord grass") continue to develop in tidal wetland and brackish riparian habitats throughout the Riverside Ranch restoration area (Appendix A, Figure 10). Such development includes growth and maturation of individual plants, "infill" within areas previously populated only sparsely, and the expansion and coalescence of pre-existing occurrences. Continued establishment of new occurrences in previously un-colonized habitats was also apparent during our 2018 fieldwork. As was described in previous annual habitat monitoring reports (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017 & 2018) this species continues to present significant potential for failure to achieve the relevant restoration success criteria in the Phase 1 project area.

***Cortaderia jubata* (Pampas Grass)**
Occurrences of the "noxious" (CDFA 2018) *Cortaderia jubata* ("pampas grass") identified along the setback levee and in replanted riparian forest habitat near the edge of Salt River channel during the 2016 & 2017 habitat monitoring efforts (J.B. Lovelace & Associates 2017 & 2018, respectively) were still present during our 2018 fieldwork (Appendix A, Figure 12). No new occurrences of this species were encountered in the Phase 1 restoration area.

***Polypogon monspeliensis* (Rabbitfoot Grass)**
Previously identified (J.B. Lovelace & Associates 2017 & 2018) occurrences of *Polypogon monspeliensis* ("rabbitfoot grass") on the tidal plain along the north side of the "S1" tributary channel near its confluence with the Salt River, and at similar elevations in the High Marsh Ecotone habitat along the setback levee, were still present during our 2018 fieldwork (Appendix A, Figure 12), with only minor observed changes in their distribution. No new occurrences of this species were encountered in the Phase 1 restoration area.

***Conium-Helminthotheca-Cirsium-Dipsacus* Complex**
Where it was observed (Appendix A, Figure 12), the previously described (J.B. Lovelace & Associates 2018) "*Conium-Helminthotheca-Cirsium* Complex" was found to co-occur with *Dipsacus fullonum* ("wild teasel") with sufficient regularity to warrant modification of its title to reflect inclusion of that species. This revised complex of invasive plant species dominated by *Conium maculatum* ("poison hemlock"), *Helminthotheca echioides* ("bristly ox-tongue"), *Cirsium vulgare* ("bull thistle"), and *Dipsacus fullonum* ("wild teasel") continues to persist along the 2.2-mile-long setback levee constructed along the eastern edge of the Phase 1 restoration area. The invasive *Silybum marianum* ("milk thistle") and *Foeniculum vulgare* ("fennel"), identified during the 2017 monitoring effort, also persist in this location, growing adjacent to the access road extending along the top of this levee.

Within the Riverside Ranch Tidal Marsh Restoration Area, the *Conium-Helminthotheca-Cirsium-Dipsacus* Complex also occurs along the common boundary between brackish marsh, salt marsh, and riparian habitats in two additional locations near the confluence of the Salt River and its "N1" tributary channel: on the north side of the "N1 channel" where previously identified in 2017 (J.B. Lovelace & Associates 2018), and south of the "N1 channel," between the access road and a tidally-influenced side channel where continued plant community development has revealed its distinction from the adjacent "Mixed Herbaceous Invasive Complex (described below).

***Agrostis-Holcus-Ranunculus* Complex**

Performance of habitat monitoring tasks in 2018 revealed only negligible changes in the extent of the brackish marsh habitat and co-occurring *Agrostis-Holcus-Ranunculus* Complex in the Riverside Ranch restoration area from observations made in 2017 (J.B. Lovelace & Associates 2018). This complex comprises the dominant plant community in the brackish marsh wetland habitats within the Phase 1 restoration area, and although some native species also occur in this habitat type, the associated species composition is 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 within the restored portions of the Phase 1 restoration area, though the extent of this species is indicated independently in Appendix A (Figure 12).

***Phalaris-Agrostis-Holcus* Complex**

The extensive invasive species complex dominated by *Phalaris arundinacea* ("reed canary grass") and *Agrostis stolonifera* ("creeping bent") that was identified along the northeastern edge of the setback levee in the Phase 1 restoration area in 2017 (J.B. Lovelace & Associates 2018) is still present (Appendix A, Figure 12), though a grazing regime intended to provide short-grass Aleutian Cackling Goose (*Branta hutchinsii leucopareia*) habitat has since been initiated, and is expected to help reduce the development and spread of the aforementioned invasive species in this location. The title of this complex has also been updated to include *Holcus lanatus* ("velvet grass"), which is also consistently present in this vegetation assemblage.

Mixed Herbaceous Invasive Complex

As described in the 2017 annual habitat monitoring report (J.B. Lovelace & Associates 2018) the diverse assemblage of invasive species comprising the "Mixed Herbaceous Invasive Complex" includes varying proportions of *Agrostis stolonifera* ("creeping bent"), *Ranunculus repens* ("creeping buttercup"), *Holcus lanatus* ("velvet grass"), *Lotus corniculatus* ("bird's-foot trefoil"), *Helminthotheca echioides* ("bristly ox-tongue"), *Cirsium arvense* ("Canada thistle"), *Conium maculatum* ("poison hemlock"), *Convolvulus arvensis* ("bindweed"), *Phalaris arundinacea* ("reed canary grass"), *Cirsium vulgare* ("bull thistle"), *Glyceria declinata* ("low manna grass"), *Raphanus sativus* ("radish"), and *Dipsacus fullonum* ("wild teasel"). This complex continues to occur throughout the riparian

planting zones along the eastern bank of the Salt River channel in the central and southern portions of the Phase 1 restoration area, as well as in the adjacent disturbed agricultural areas along the access road in the vicinity of the historic dairy infrastructure. During 2018 fieldwork, an additional, smaller occurrence was also located along the previous location of a historic berm in the northern portion of the Phase 1 restoration area, opposite the confluence of Salt River and Cutoff Slough (Appendix A, Figure 12).

Additional Observed Invasive Plant Species
Previously identified (J.B. Lovelace & Associates 2017 & 2018) occurrences of *Rubus armeniacus* ("Himalayan blackberry"), *Cirsium arvense* ("Canada thistle"), *Helminthotheca echioides* ("bristly ox-tongue"), *Phalaris arundinacea* ("reed canary grass"), and *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley") were still present during our 2018 fieldwork (Appendix A, Figure 12). No new discrete occurrences of these species were encountered in the Phase 1 restoration area in 2018.

4.3.2 Phase 2 – Salt River Corridor Restoration Area
Invasive plant species previously documented within the Phase 2A (Lower) and Phase 2A (Middle) restoration areas (J.B. Lovelace & Associates 2017 & 2018) continued to persist in 2018 with some observed changes in their occurrence and distribution (Appendix A; Figures 11, 13-15) since the 2017 habitat monitoring effort. Three additional invasive plants, not previously identified in the Phase 2 restoration area, were also encountered during 2018 fieldwork: *Lythrum hyssopifolia* ("hyssop loosestrife"), *Rubus armeniacus* ("Himalayan blackberry"), and *Silybum marianum* ("milk thistle") (Appendix A, Figures 14 & 15).

The majority of the invasive vegetation throughout the Phase 2 – Salt River corridor restoration area continues to consist of a mixed assemblage of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), and *Holcus lanatus* ("velvet grass"); which extends throughout the active channel, bench, and riparian berm habitats, as well as along the adjacent woody riparian fringe and in contiguous canopy gaps (Appendix A, Figures 13-15). Though the extent of this revised complex was not observed to have changed significantly over the past year, both the frequency of occurrence and estimated percent cover for all three species either remained constant or increased in every Phase 2 sampling area where data were available for comparison (J.B. Lovelace & Associates 2018; Appendix B, herein), with the exception of *Phalaris arundinacea* ("reed canary grass") in the replanted riparian forest habitat of the Phase 2A (Middle) reach. In this single habitat sampling area, both the frequency of occurrence and estimated mean percent cover of *P. arundinacea* decreased over the past year. Additional analysis of this species is presented in Section 4.3.3, below.

Consistent associations between habitat components and invasive species in the lower and middle Phase 2A portions of the Salt River corridor restoration area also extend upstream into the recently constructed Phase 2A (Upper) and Phase

2B (Lower) restoration reaches. Observations of invasive vegetation occurrences made during the 2018 annual habitat monitoring effort throughout the Phase 2 restoration area are described below, organized by restoration habitat component (though areas of overlap are indicated where relevant). Measures of the abundance and distribution of individual invasive species associated with these habitat components are also presented in Figures 4-11 for respective vegetation sampling regions where sampling was conducted in 2018 (i.e., salt river channel wetland habitats and riparian planting zones in the Phase 2A [Middle] and Phase 2A [Upper]/Phase2B [Lower] restoration reaches). Species which were not encountered in vegetation sampling plots (and are, therefore, not represented in Figures 4-11), but were observed during the performance of other habitat monitoring tasks, are depicted in Appendix A, Figures 14 & 15.

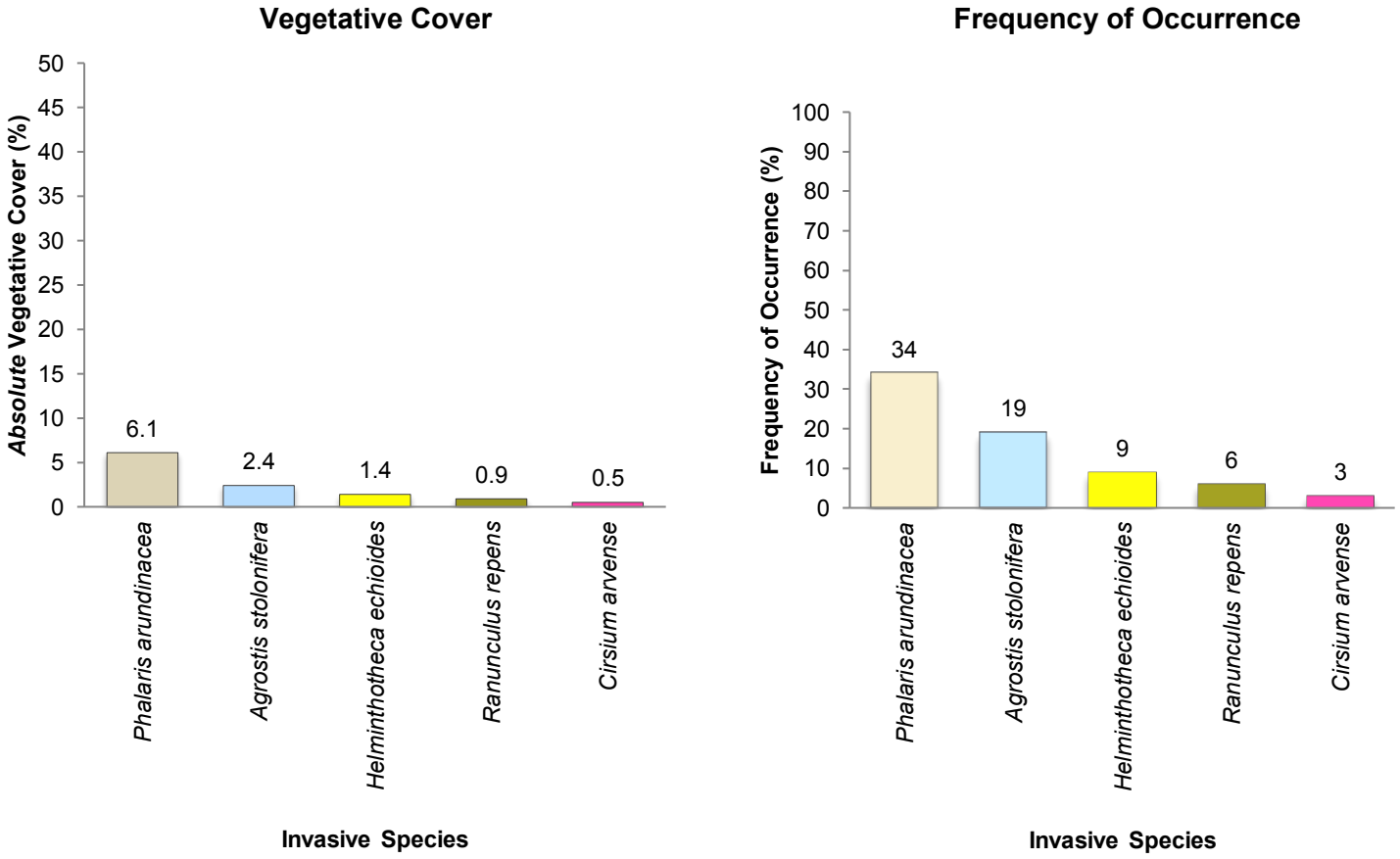

Figure 4. Invasive Vegetation Species Composition. Phase 2A (Middle) – Salt River Corridor Restoration Area: Active Channel. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

Salt River Channel Wetlands

In the downstream portions of the Phase 2A (Lower) restoration area more directly subject to tidal influx and brackish water chemistry, *Polypogon monspeliensis* ("rabbitfoot grass"), *Hordeum marinum* ssp. *gussoneanum* ("Mediterranean barley"), and the highly invasive *Spartina densiflora* ("dense-flowered cord grass") continue to become established and more abundant in brackish active channel and active bench habitats (Appendix A, Figures 11 & 13). With increasing distance upstream, away from the active channel edge, and/or where other freshwater contributions sufficiently reduce saline hydrochemistry, freshwater active channel and active bench habitats support extensive areas of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), and *Glyceria declinata* ("low manna grass"), as well as discrete occurrences of *Typha latifolia* ("broad-leaved cattail") *Cirsium vulgare* ("bull thistle"), and *Lythrum hyssopifolia* ("hyssop loosestrife") (Appendix A, Figures 13-15). Other invasive species occurring to a lesser extent

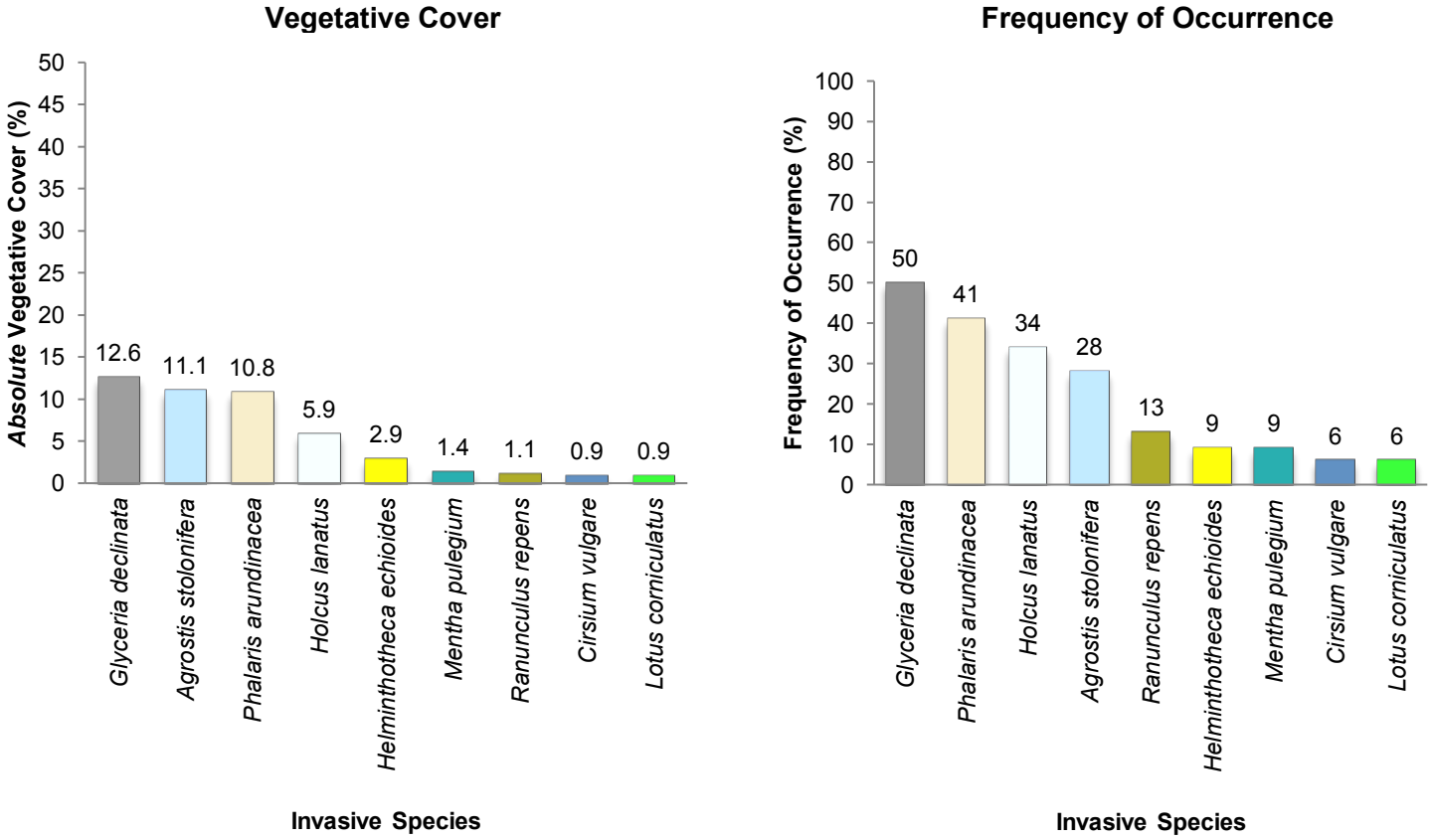

Figure 5. Invasive Vegetation Species Composition. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Active Channel. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

in these Salt River channel wetlands include *Helminthotheca echioides* ("bristly ox-tongue"), *Ranunculus repens* ("creeping buttercup"), *Cirsium arvense* ("Canada thistle"), *Mentha pulegium* ("pennyroyal"), and *Lotus corniculatus* ("bird's-foot trefoil") (Figures 4-7).

Although the invasive grass, *Glyceria declinata* ("low manna grass"), has become well established throughout active channel and active bench habitats in the recently constructed Phase 2A (Upper) and Phase 2B (Lower) restoration reaches, the distribution (Appendix A, Figures 14-15), and abundance of this species continues to decrease in the Phase 2A (Middle) reach, as was observed between 2016 and 2017 (J.B. Lovelace & Associates 2018). Previously identified (J.B. Lovelace & Associates 2017 & 2018) occurrences of *Typha latifolia* ("broad-leaved cattail") continue to persist and develop where they have become established in Salt River channel wetland habitats, and five new occurrences

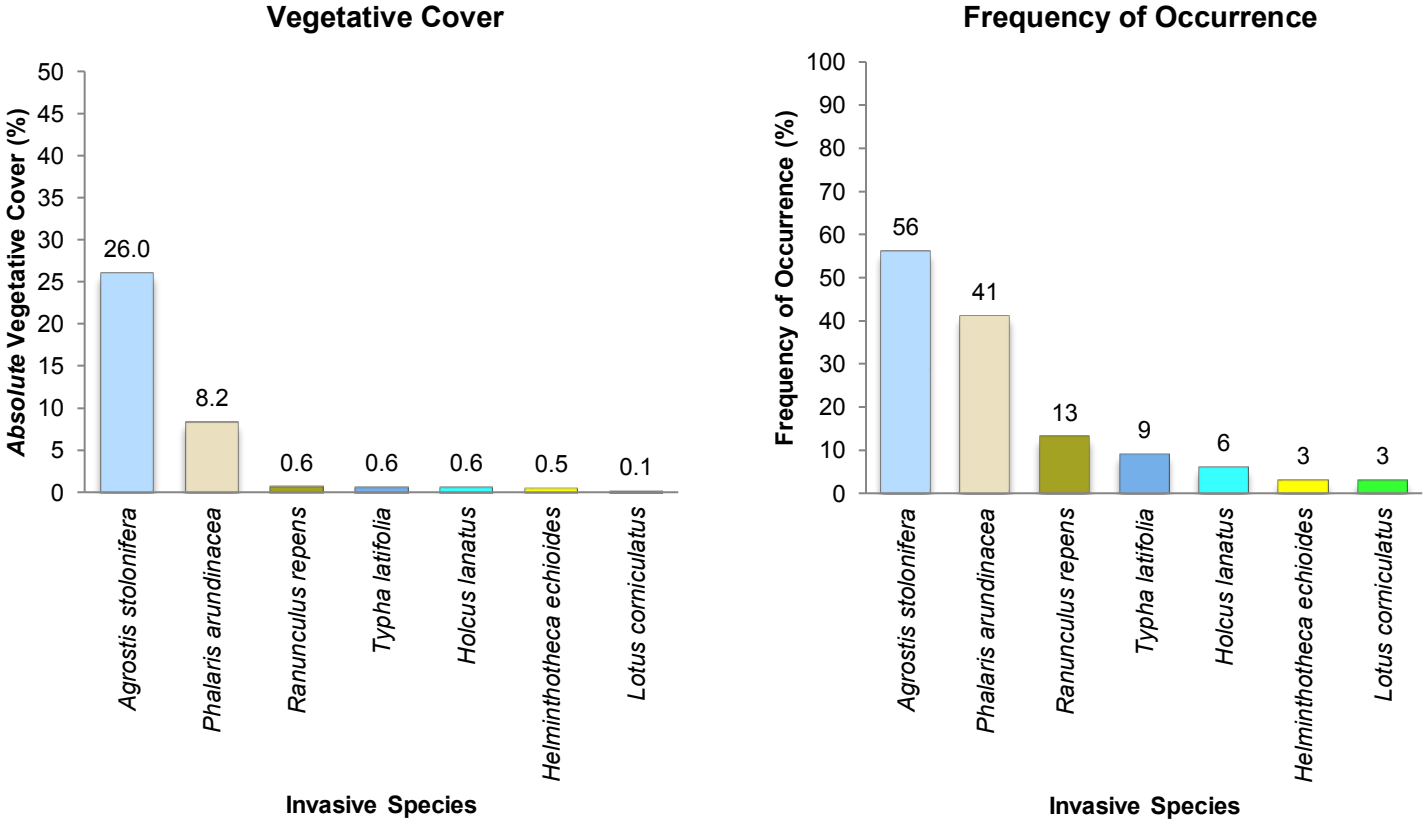

Figure 6. Invasive Vegetation Species Composition. Phase 2A (Middle) – Salt River Corridor Restoration Area: Active Bench. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

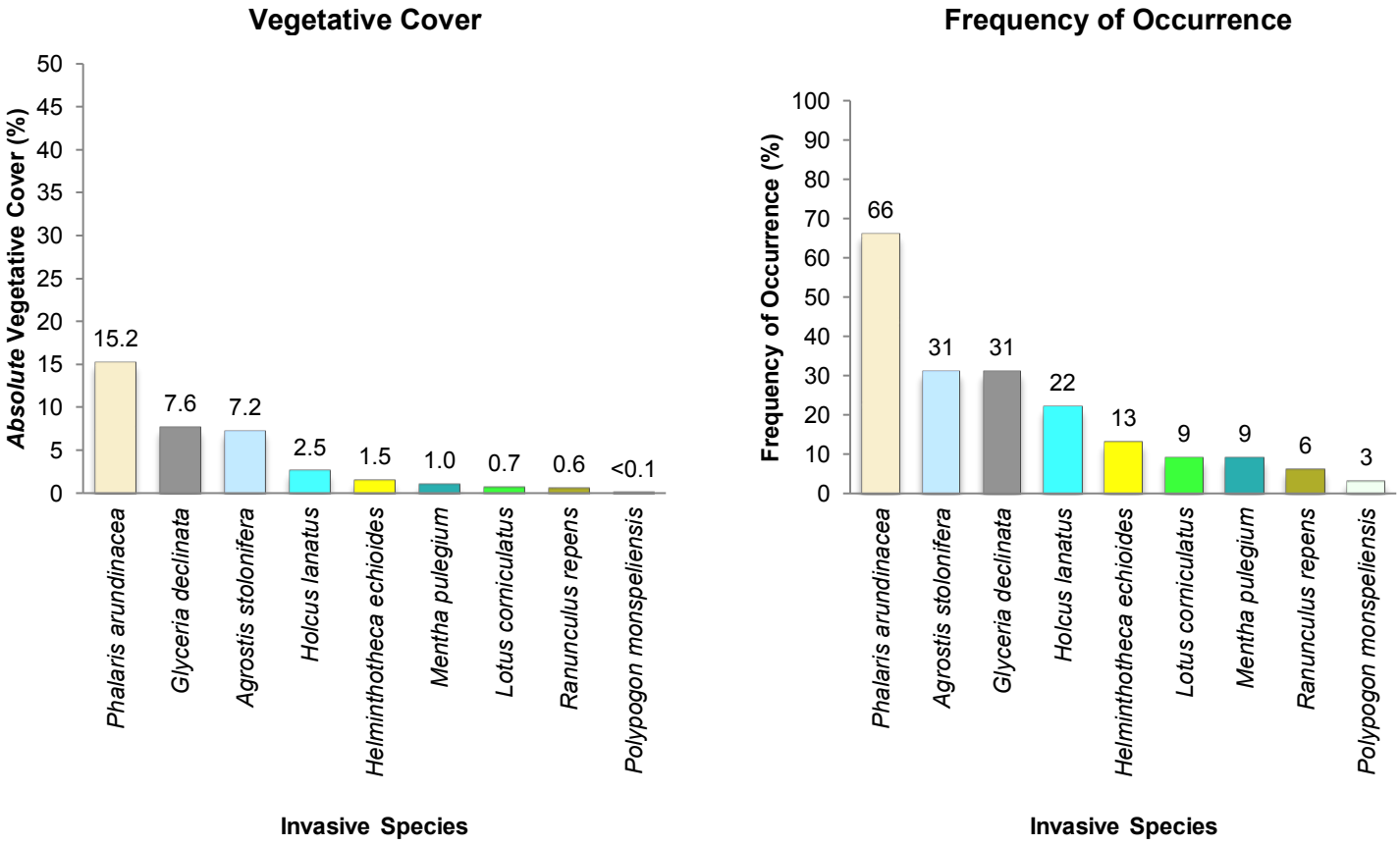

Figure 7. Invasive Vegetation Species Composition. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Active Bench. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

were identified in the active channel habitat of the recently constructed Phase 2A (Upper) restoration area (Appendix A, Figure 13-15). Additional new invasive plant species occurrences in Salt River channel wetland habitats consist of *Cirsium vulgare* ("bull thistle") and *Lythrum hyssopifolia* ("hyssop loosestrife"), which were encountered in the active bench habitat component of the middle Phase 2A restoration reach during 2018 monitoring fieldwork (Appendix A, Figure 14).

Riparian Planting Zones

In some cases, the distributions of invasive species and/or invasive species complexes described from Salt River Channel Wetland habitats also extend into adjacent active riparian berm and replanted riparian forest areas along transitional gradients between these habitat components. Otherwise, these riparian planting zone habitats support a somewhat different suite of invasive

vegetation, being situated at slightly higher elevations with marginally better drainage.

Active Riparian Berms

Active riparian berm habitats support invasive vegetation assemblages most similar to Salt River Wetland habitats, given their typically intermediate position between active channel and active bench habitat components. While invasive species in common include *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), *Glyceria declinata* ("low manna grass"), *Helminthotheca echioides* ("bristly ox-tongue"), *Cirsium vulgare* ("bull thistle"), *Cirsium arvense* ("Canada thistle"), *Mentha pulegium* ("pennyroyal"), *Lotus corniculatus* ("bird's-foot trefoil"), *Ranunculus repens* ("creeping buttercup"), and *Typha latifolia* ("broad-leaved cattail"), active riparian

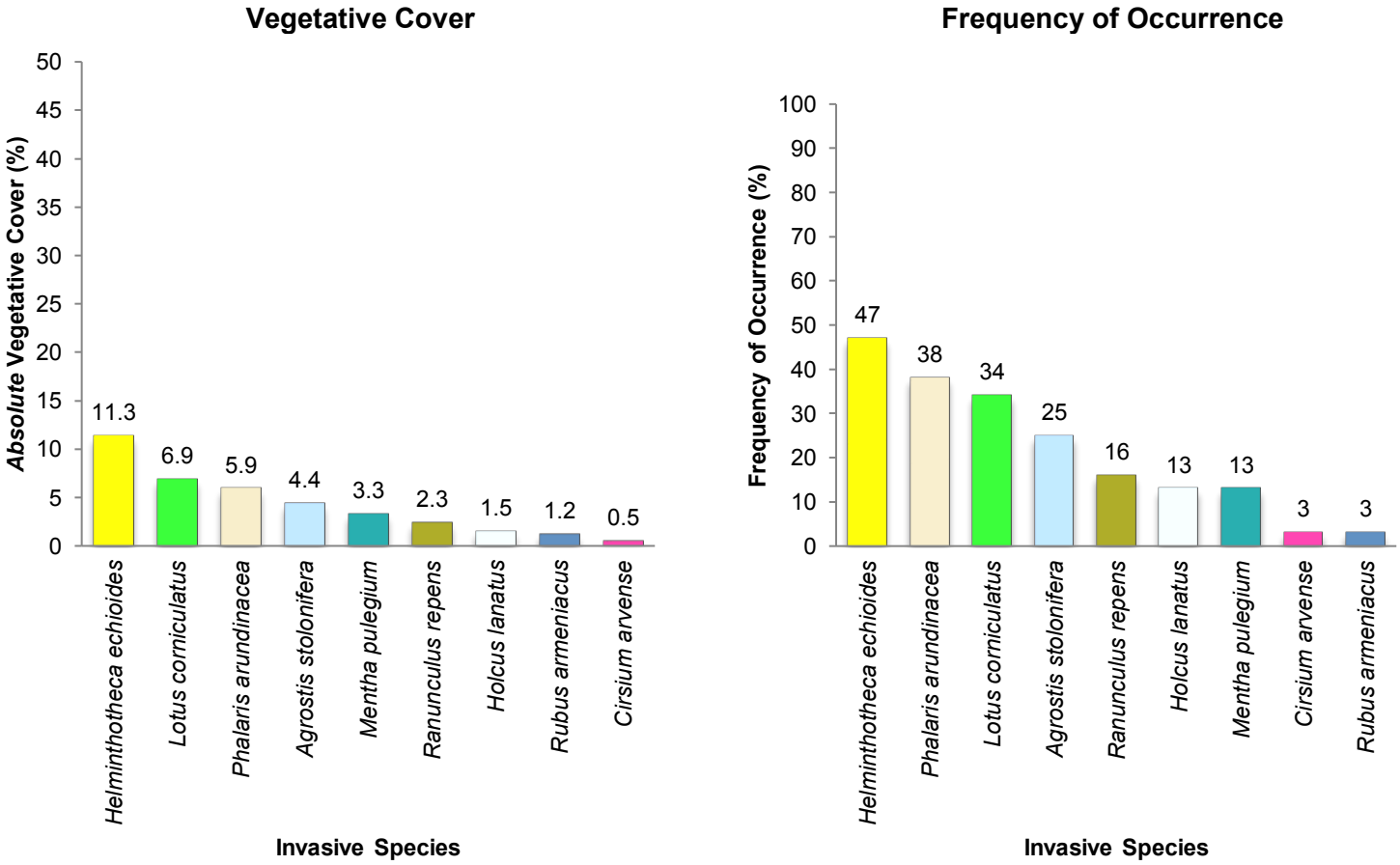

Figure 8. Invasive Vegetation Species Composition. Phase 2A (Middle) – Salt River Corridor Restoration Area: Active Riparian Berm. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

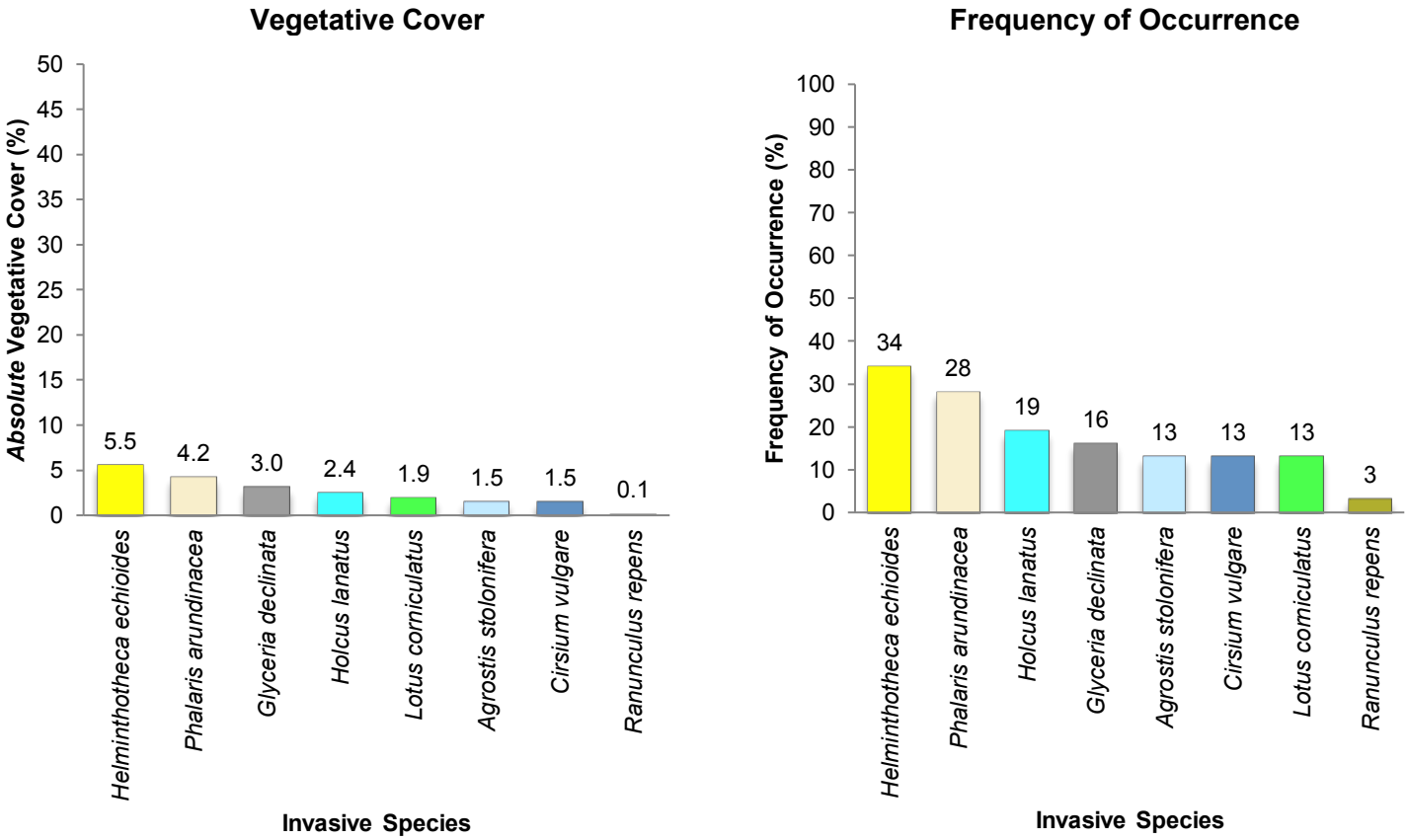

Figure 9. Invasive Vegetation Species Composition. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Active Riparian Berm. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

berm features also support extensive areas of abundant *Helminthotheca echioides* ("bristly ox-tongue"), as well as discrete occurrences of *Crocosmia* x*crocosmiiflora* ("montbretia"), *Dipsacus fullonum* ("wild teasel"), *Rubus armeniacus* ("Himalayan blackberry"), and the highly invasive and "noxious" (CDFA 2018) *Cortaderia jubata* ("pampas grass") (Figures 8 & 9; Appendix A, Figures 13-15).

Replanted Riparian Forest

The ubiquitous invasive grass species, *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), and *Holcus lanatus* ("velvet grass") are also well established throughout the replanted riparian forest habitats of the Phase 2 restoration area, as are *Helminthotheca echioides* ("bristly ox-tongue"), *Cirsium vulgare* ("bull thistle"), *Conium maculatum* ("poison hemlock"), *Dipsacus*

fullonum (“wild teasel”), *Ranunculus repens* (“creeping buttercup”), *Lotus corniculatus* (“bird’s-foot trefoil), and *Mentha pulegium* (“pennyroyal”) (Figures 10 & 11; Appendix A, Figures 13-15). As was described for the Phase 1 restoration area (above), the “*Helminthotheca-Cirsium* Complex” reported from replanted riparian forest habitats in the Phase 2A (Middle) restoration reach in 2017 (J.B. Lovelace & Associates 2018) has since been modified to include *Conium maculatum* (“poison hemlock”) and *Dipsacus fullonum* (“wild teasel”) in light of how consistently these plants were observed to co-occur.

In 2018, this updated *Conium-Helminthotheca-Cirsium-Dipsacus* Complex was found to extend beyond the Phase 2A (Middle) reach, into the replanted riparian forest habitats of the recently constructed Phase 2A (Upper) and Phase 2B (Lower) restoration areas (Appendix A, Figures 14-15). Discrete occurrences of

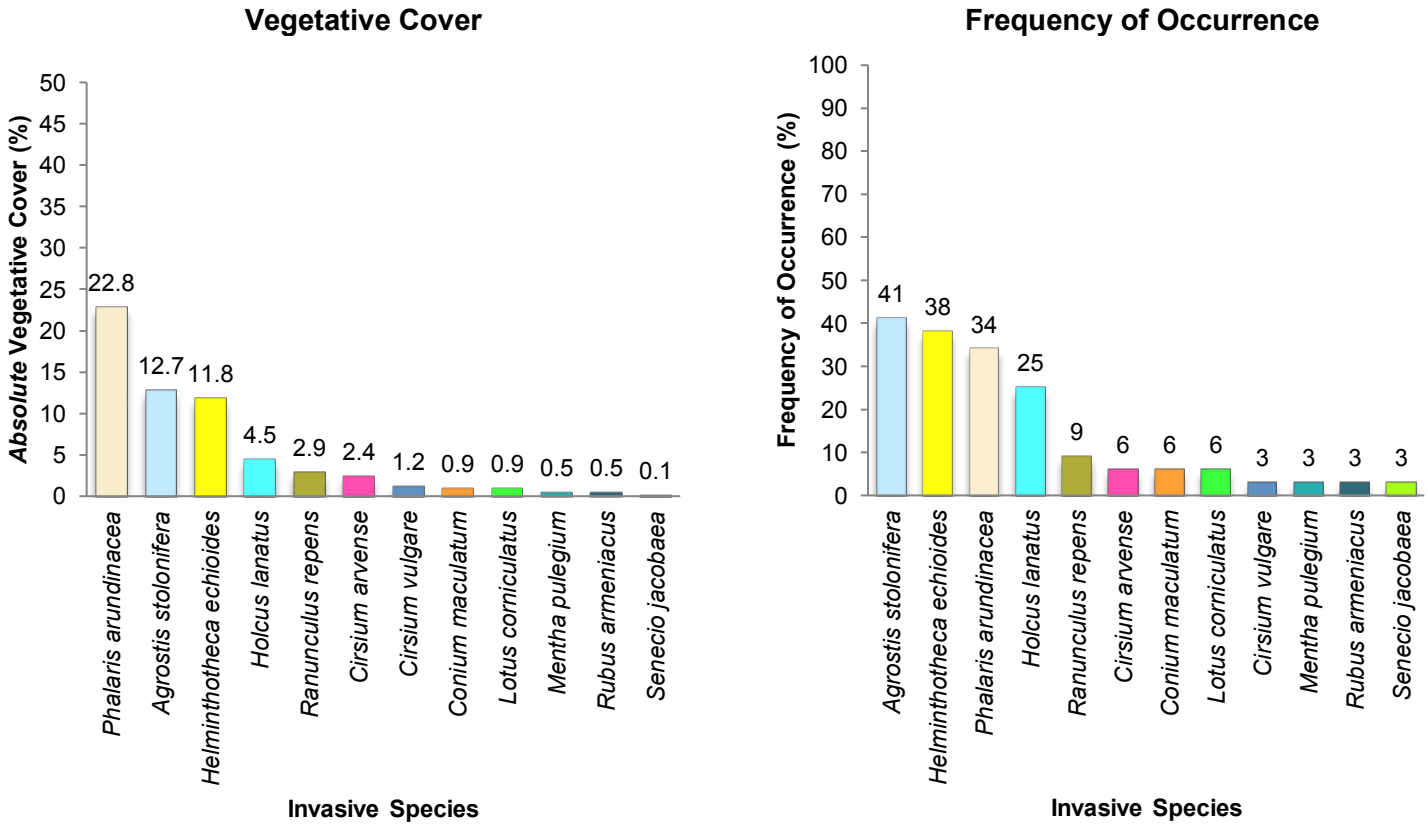

Figure 10. Invasive Vegetation Species Composition. Phase 2A (Middle) – Salt River Corridor Restoration Area: Replanted Riparian Forest. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

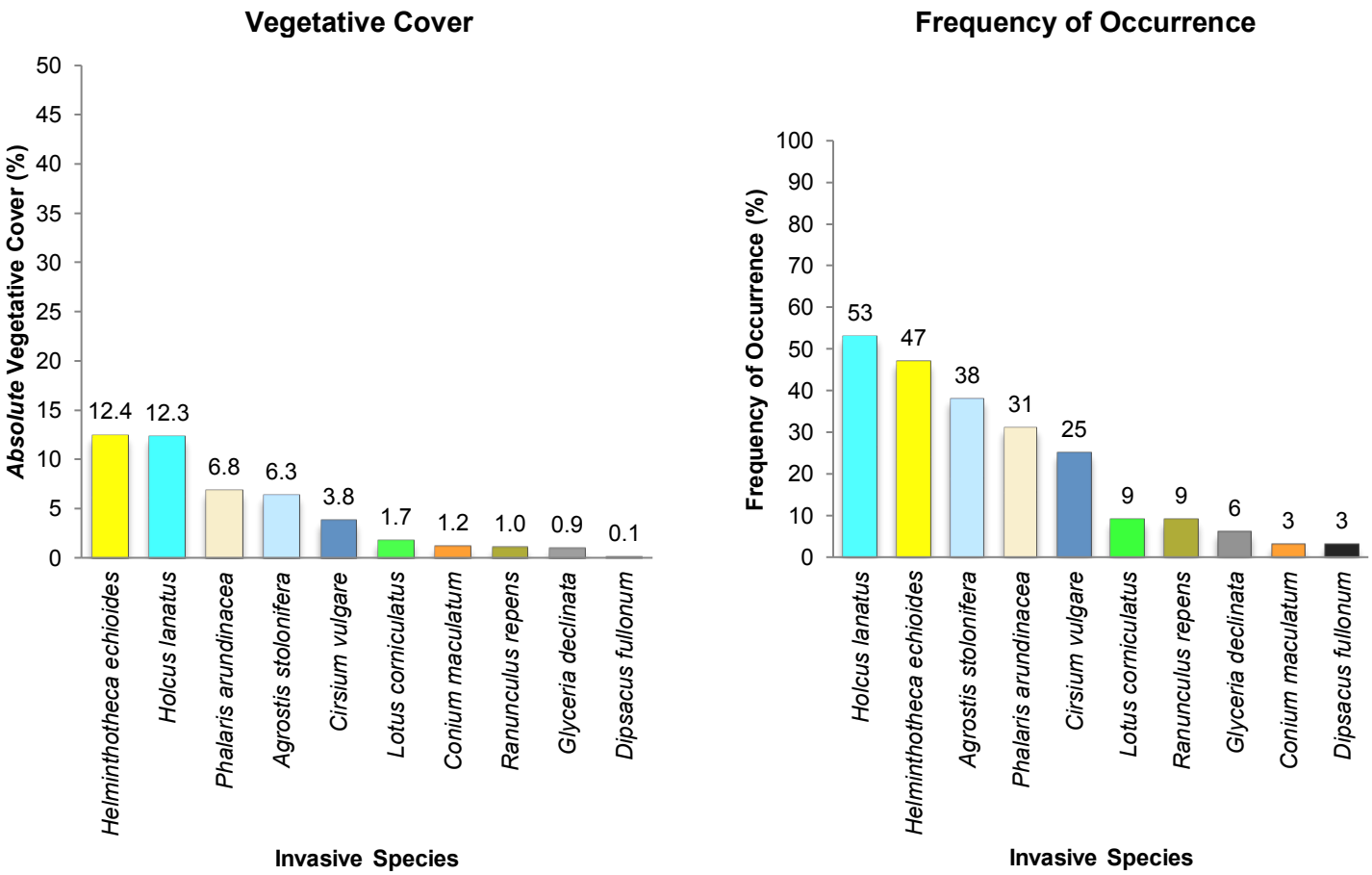

Figure 11. Invasive Vegetation Species Composition. Phase 2A (Upper)/Phase 2B (Lower) – Salt River Corridor Restoration Area: Replanted Riparian Forest. Vegetative cover values indicate original mean estimated *absolute* percent cover of each species observed within sampling plots (n = 32) prior to transformation of data to yield an estimate of the total *relative* cover of invasive species throughout the sampling area. Frequency of occurrence values reflect the percentage of sampling plots in this sampling area, within which each species was detected.

Helminthotheca echioides ("bristly ox-tongue") and *Cirsium vulgare* ("bull thistle") that were observed to be distinct and separate from the aforementioned invasive species complex during recent monitoring fieldwork are also indicated in Appendix A, Figures 13-15. Other invasive plant species documented within replanted riparian forest habitats within the Phase 2 restoration area include *Cirsium arvense* ("Canada thistle"), *Silybum marianum* ("milk thistle"), *Hedera helix* ("English ivy"), *Cytisus scoparius* ("Scotch broom"), *Rubus armeniacus* ("Himalayan blackberry"), *Cortaderia jubata* ("pampas grass"), and *Senecio jacobaea* ("tansy ragwort").

Of the eighteen occurrences of *Senecio jacobaea* ("tansy ragwort") identified in both active riparian berm and replanted riparian forest habitats throughout the Phase 2A (Middle) restoration area during the 2017 habitat monitoring fieldwork

(J.B. Lovelace & Associates 2018), only two are believed to have persisted in 2018, presumably due to being destroyed immediately after documentation during the former monitoring effort. Three new occurrences of this species were located in replanted riparian forest habitats in this same approximate vicinity during 2018, resulting in a total of five occurrences within the Salt River corridor restoration area (Appendix A, Figure 14). Little change was observed in the distributions of the former six species in this habitat component with the exception of the appearance of four *Rubus armeniacus* ("Himalayan blackberry") occurrences in the Phase 2A (Middle) restoration area and three new occurrences of *Cirsium arvense* ("Canada thistle"): two in the Phase 2A (Middle) restoration reach and one in the Phase 2A (Upper) reach (Appendix A, Figures 14-15).

4.3.3 Species-Specific Analysis: *Phalaris arundinacea* (Reed Canary Grass)

Although *Phalaris arundinacea* ("reed canary grass") was incidentally observed in various habitats within the Phase 1 restoration area during our 2018 fieldwork (Appendix A, Figure 12), this species was not encountered in the salt marsh *sensu stricto* sampling region during the associated vegetation sampling efforts (Table 12). Elsewhere in the SRERP restoration area, however, (as in the surrounding landscape throughout the Eel River delta) this vigorous grass continues to be fairly pervasive. In the Phase 2 restoration area, *P. arundinacea* was detected in vegetation sampling plots with frequencies of occurrence varying between 28%-66%, and with estimated mean cover ranging from 4.2% in the Phase 2A (Upper)/Phase 2B (Lower) active riparian berm sampling region to 22.8% in the replanted riparian forest of the middle Phase 2A restoration reach (Table 12). When calculated as a percentage of total invasive vegetative cover recorded in respective sampling regions, *P. arundinacea* comprised as little as 15% of all invasive vegetative cover in the Phase 2A (Upper)/Phase 2B (Lower) replanted riparian forest component to as much as 54% of the invasive vegetation component in the active channel habitat of the middle Phase 2A restoration reach (Table 12).

5.0 Discussion & Recommendations

Results presented herein for the 2018 habitat monitoring effort provide evidence of continued successful progress towards the attainment of some of the long-term restoration goals for the Salt River Ecosystem Restoration Project and reinforce the pressing need for continued and proportionate invasive vegetation management actions to ensure that those goals are ultimately achieved. All habitats addressed during the 2018 habitat monitoring effort reflect successful achievement of respective success criteria identified for both the extent of habitat area and the abundance (i.e., percent cover) of established native vegetation for the current monitoring year. At the same time, all SRERP habitats in which fieldwork occurred in 2018 currently support non-native and invasive vegetation at levels that will, in most cases, be difficult to reduce to the extent required (H.T. Harvey & Associates with Winzler & Kelly 2012) by respective "final" monitoring years (as early as the subsequent monitoring period in 2019 for the

lower Phase 2A restoration area [Tables 4 & 5]) unless immediate and extensive management efforts are initiated.

While there is reason to be optimistic that the various final success criteria will ultimately be achieved, we recommend escalating and augmenting strategies and methods to manage the increasing populations of invasive vegetation throughout the SRERP restoration area as soon as possible, and continuing to perform on-going monitoring efforts throughout the duration of the respective monitoring periods, to track and evaluate relative progress towards achieving the restoration goals of the project.

Table 12. Abundance of *Phalaris arundinacea* (reed canary grass) in 2018 SRERP Quantitative Vegetation Sampling Plots.

	Varying Measures of Abundance of *Phalaris arundinacea* (reed canary grass)		
SRERP Habitat Sampling Areas	**Mean Percent Cover[1]**	**Frequency of Occurrence[2]**	**% of Total Invasive Vegetative Cover[3]**
Phase 1 – Riverside Ranch Tidal Marsh Restoration Area			
Salt Marsh *sensu stricto* (n=64)	**0.0** NA	0%	0%
Phase 2 – Salt River Corridor Restoration Area			
Phase 2A (Middle) – Salt River Channel Wetlands			
Active Channel (n=32)	**6.1** (2.0, 7.9)	34%	54%
Active Bench (n=32)	**8.2** (3.1, 11.0)	41%	23%
Phase 2A (Middle) – Riparian Planting Zones			
Replanted Riparian Forest (n=32)	**22.8** (8.8, 29.2)	34%	37%
Active Riparian Berm (n=32)	**5.9** (2.0, 7.0)	38%	16%
Phase 2A (Upper)/Phase 2B (Lower) – Salt River Channel Wetlands			
Active Channel (n=32)	**10.8** (3.6, 12.2)	41%	23%
Active Bench (n=32)	**15.2** (5.9, 13.0)	66%	42%
Phase 2A (Upper)/Phase 2B (Lower) – Riparian Planting Zones			
Replanted Riparian Forest (n=32)	**6.8** (1.3, 7.1)	31%	15%
Active Riparian Berm (n=32)	**4.2** (2.3, 9.2)	28%	21%

[1] Mean percent cover estimates are in bold and associated 95% confidence intervals follow in parentheses.

[2] Calculated as the number of sampling plots where *Phalaris arundinacea* occurred, divided by the total number of sampling plots (n) in respective sampling regions.

[3] Calculated as the mean percent cover of *Phalaris arundinacea* divided by the summed mean cover of all invasive vegetation in respective sampling regions.

5.1 Habitat

Our findings from 2018 confirm the 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. Aside from the progressive gradual conversion of unvegetated mudflats to vegetated salt marsh *sensu stricto* habitat in the Phase 1 restoration area, no other significant changes were observed in the extent of the habitats addressed during 2018. We recommend continued future 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

The development of vegetation throughout the SRERP restoration area continues to exhibit somewhat conflicting trajectories. Where a comparative analysis of quantitative sampling results across monitoring years (2014-2018) was possible, results from respective sampled areas reflect increasing establishment (i.e., total absolute percent cover) throughout. This pattern was also observed for the native component of the vegetation, with noted exceptions described previously in the 2017 annual monitoring report (J.B. Lovelace & Associates 2018) (i.e., decreases in native vegetative cover in the active channel habitat in both Phase 2A [Lower and Middle] restoration areas and the replanted riparian forest in the lower Phase 2A reach), as well as in salt marsh *sensu stricto* habitats in the Phase 1 restoration area where native vegetation has decreased between 2016-2018.

As described in J.B. Lovelace & Associates (2018), the former apparent decreases in native vegetation in the Salt River corridor restoration area are likely due to a combination of dynamic riparian processes (both hydrologic and geologic) and competition from *Phalaris arundinacea* ("reed canary grass") and other non-native species (both invasive and non-invasive). The latter decrease in native vegetative cover within the Riverside Ranch Tidal Marsh Restoration Area is primarily attributable to the progressive displacement of the nascent native salt marsh flora by the rapidly encroaching invasive plant, *Spartina densiflora* ("dense-flowered cord grass"). Despite these findings, all habitats sampled in 2018 satisfied respective success criteria for the current monitoring year, and continue to be dominated by native plant species.

Some disturbance to developing vegetation from domestic herbivores (i.e., cattle and goats) entering the restoration area from adjacent properties continues to occur in both the lower and middle reaches of the Phase 2A Salt River corridor restoration area. This is despite the recent installation of new perimeter fencing in some areas where bank erosion and fence-wire spacing still allow for smaller animals (e.g., calves, young steers/heifers, etc.) to pass from adjacent pasturelands into the SRERP restoration area. Fortunately, disturbances observed in 2018 continue to be less severe than those reported from 2016 (J.B. Lovelace & Associates 2017), though impacts to establishing vegetation

from livestock continue to have the potential to preclude the realization of final vegetation-related success criteria throughout the SRERP restoration area if allowed access. Appropriate livestock management practices and maintenance of effective perimeter fencing around private agricultural properties adjacent to the restoration area will continue to help prevent impacts to vegetation and water quality due to these domestic herbivores.

Woody riparian vegetation continues to develop and become established throughout riparian planting zones in the Phase 2 – Salt River corridor restoration area addressed in 2018. Our 2018 field data also reflect limited nascent establishment of woody riparian vegetation in both active channel and active bench habitats (i.e., "Salt River Channel Wetlands") throughout the Phase 2 restoration area as well. While the majority of the riparian vegetation encountered during habitat monitoring fieldwork is the result of extensive revegetation efforts following restoration habitat modification, it was also apparent that volunteer recruitment from *in situ* propagule sources is also occurring and contributing to our results.

Quantitative vegetation percent cover and basal area sampling data from the Phase 2 (Middle) restoration area during the period between 2017-2018 (J.B. Lovelace & Associates 2018, present effort) provide evidence of increasing abundance and structural development of native riparian trees and shrubs. The most well represented woody species in these areas are *Alnus rubra* ("red alder"), *Salix sitchensis* ("Sitka willow"), *Salix lasiandra* var. *lasiandra* ("Pacific willow") and *Salix hookeriana* ("coastal willow"), followed by lesser proportions of other native hardwood and conifer tree species.

A more diverse suite of woody species is becoming established in the riparian planting zones of the Phase 2A (Upper)/Phase 2B (Lower) restoration reach, with *Picea sitchensis* ("Sitka spruce"), *Alnus rubra* ("red alder"), *Salix sitchensis* ("Sitka willow"), *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Salix hookeriana* ("coastal willow"), *Salix lasiolepis* ("arroyo willow"), and *Populus trichocarpa* ("black cottonwood") being most well represented, yet also including new species not yet documented during habitat monitoring efforts, such as *Abies grandis* ("grand fir") and *Fraxinus latifolia* ("Oregon ash"). It is anticipated that continued growth and development of observed woody vegetation will result in the successful attainment of projected structural characteristics throughout the Phase 2 Salt River corridor restoration area.

5.2.1 Recommended Sample Size

The larger sample size (n = 64) used in the salt marsh *sensu stricto* habitat within the Phase 1 restoration area was greater than required, as indicated from our power analyses. However, due to the significantly larger size of this area (and the inherent potential for greater environmental variability), this sample size is perceived as being appropriately conservative for this specific region of the SRERP restoration area.

Elsewhere in the SRERP restoration area, we recommend continuing to use a sample size (n) of 32 in the subsequent vegetation percent cover sampling effort. This sample size appears to have adequately addressed the variability in the vegetation encountered thus far in the 2016, 2017, and 2018 quantitative sampling efforts, both when relying on the assumptions proposed in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012), as well as when applying a common "burden of proof" (i.e., Cohen's [1988] "medium" effect size, as described in J.B. Lovelace & Associates 2017) and more stringent level of confidence (i.e., 95%, rather than 80%). It is important to recognize, however, that our suggested sample size is a "starting point," and its adequacy to address variability in future data sets should continue to be assessed retrospectively, during each habitat monitoring endeavor to ensure collection of adequate sample data.

5.3 Invasive Plant Species

Invasive plant species continue to become more abundant throughout the SRERP restoration area and are, as in the case of *Spartina densiflora* ("dense-flowered cord grass") in the Riverside Ranch Tidal Marsh Restoration Area, beginning to displace native vegetation in some areas. As discussed previously (J.B. Lovelace & Associates 2017 & 2018, this document), invasive and otherwise undesirable plant species pose real threats to the near- and long-term success of the Salt River Ecosystem Restoration Project given the extent to which such unfavorable vegetation continues to become established, particularly in light of the reported increasing trends in the establishment and development of such vegetation. To address this threat the HCRCD, in coordination with the Bear River Band of the Rohnerville Rancheria, initiated invasive species management efforts in portions of the Phase 2 – Salt River corridor restoration area in September of 2018 (Hansen pers. comm.).

We recommend the continuation of such efforts, and emphasize the need for them to be both proportionate and robust, and be repeated as necessary until future monitoring results demonstrate a sustained decreasing trend in the observed extent and abundance of invasive species throughout the SRERP restoration area to a level that will meet established respective success criteria. We also recommend continuing to conduct annual assessments to evaluate the effectiveness of applied invasive species management efforts and their effect on the distribution and abundance of invasive vegetation throughout the SRERP project area.

Although eventual overstory shading by a developing riparian forest canopy is hoped to provide some degree of passive management of invasive and undesirable vegetation in riparian planting zone habitats, given the protracted period over which this is predicted to occur, substantial production and dispersal of invasive species propagules is likely during such a time period. Failure to implement adequate management efforts during the initial years of establishment and development of invasive species may allow for invasive vegetation to outcompete native and/or planted vegetation, preventing the ultimate realization

of this restoration goal and requiring significant additional effort and expense, as has occurred in other long-term riparian habitat restoration projects in inland regions of California (Silveira pers. comm.).

Significant off-site source populations of non-native and invasive species occur within the vicinity of the SRERP restoration area, and will continue to 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 the large occurrence of the *Agrostis-Phalaris-Holcus* invasive species complex, which extends along the northeastern edge of the setback levee in the Phase 1 – Riverside Ranch Tidal Marsh Restoration Area. Fortunately, the initiation of a managed grazing regime to provide short-grass habitat for Aleutian Cackling Goose (*Branta hutchinsii leucopareia*) in the latter area has been initiated since the 2017 habitat monitoring effort and is expected to help reduce the development and spread of the invasive grass species associated with that location.

The rate of plant reproduction is 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, proportionate 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 respective 10-year monitoring periods. 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. Indeed, however much progress is made towards successful eradication of invasive vegetation in the Phase 1 and Phase 2 portions of the SRERP restoration area will likely ultimately translate into a reduced need (and expense) of future invasive vegetation management attention in upstream regions of the SRERP restoration area.

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. The earliest "final" assessment periods for invasive vegetation in the SRERP come to bear in 2019 and 2020, in the Phase 2A (Lower) and (Middle) restoration areas (respectively). Given the amount of effort and time required to implement management strategies and gauge the resulting effects, such efforts should be initiated as soon as possible in order to achieve the desired results within the required time periods.

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. Management efforts targeting *Spartina densiflora* ("dense-flowered cord grass") in the Phase 1 salt marsh and Phase 2A (Lower) brackish marsh habitats are relevant examples of such instances.

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 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 floristically-sensitive portion of the 2018 fieldwork was performed comparatively late (August) 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. 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).

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Appendix A

Salt River Ecosystem Restoration Project Figures

Figure 1. SRERP Projected Habitat Types

Figure 2. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Habitats

Figure 3. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Habitats

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

Figure 5. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Habitats

Figure 6. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Quantitative Vegetation Sampling Plots

Figure 7. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots

Figure 8. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots

Figure 9. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Replanted Woody Riparian Vegetation Basal Area Sampling Plots

Figure 10. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive *Spartina densiflora* ("dense-flowered cord grass")

Figure 11. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Invasive *Spartina densiflora* ("dense-flowered cord grass")

Figure 12. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive Plant Species

Figure 13. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

Figure 14. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Invasive Plant Species

Figure 15. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

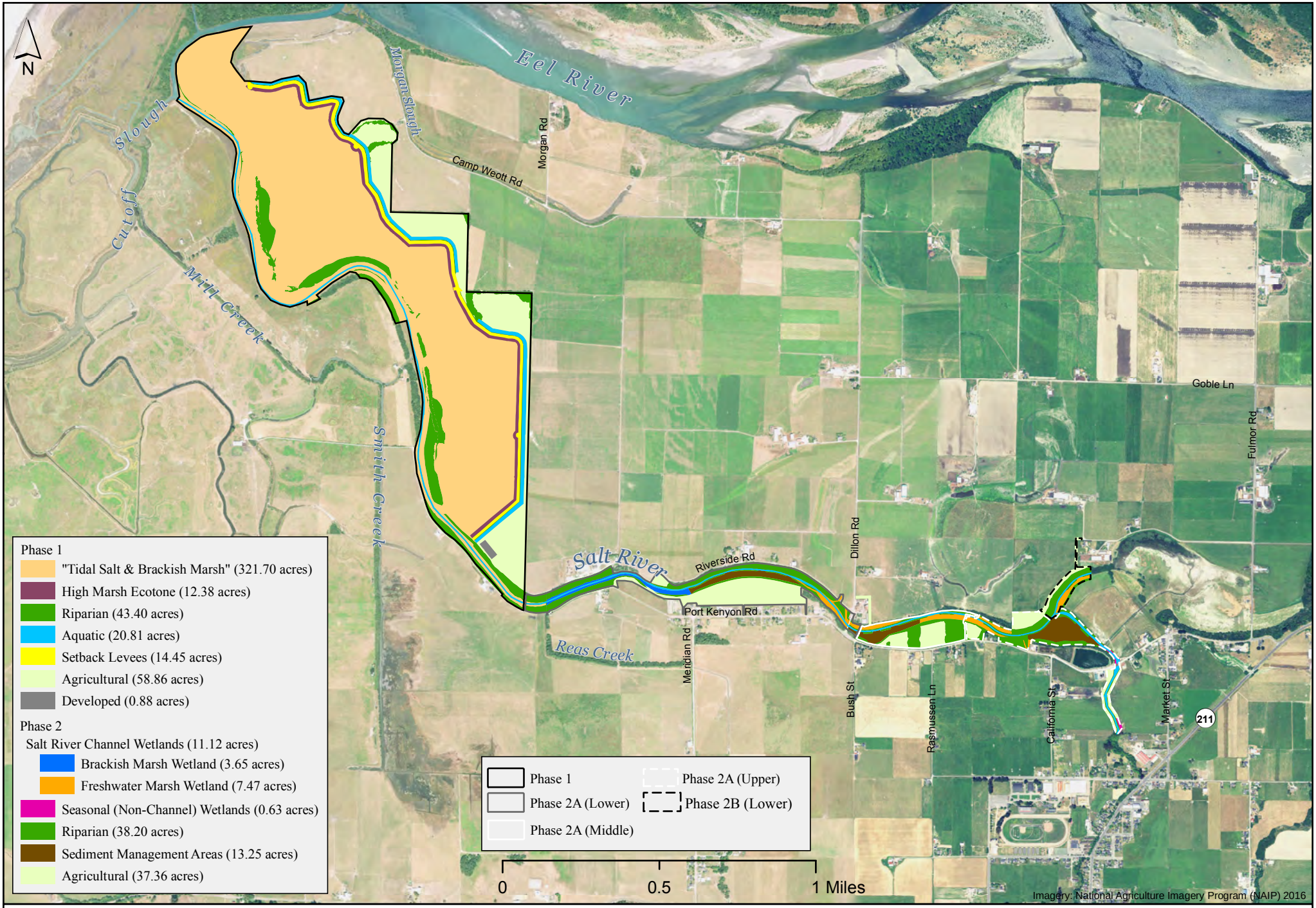

Figure 1. SRERP Projected Habitat Types (Adapted From: H.T. Harvey & Associates and Winzler & Kelly 2012)

2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

J.B. LOVELACE & ASSOCIATES

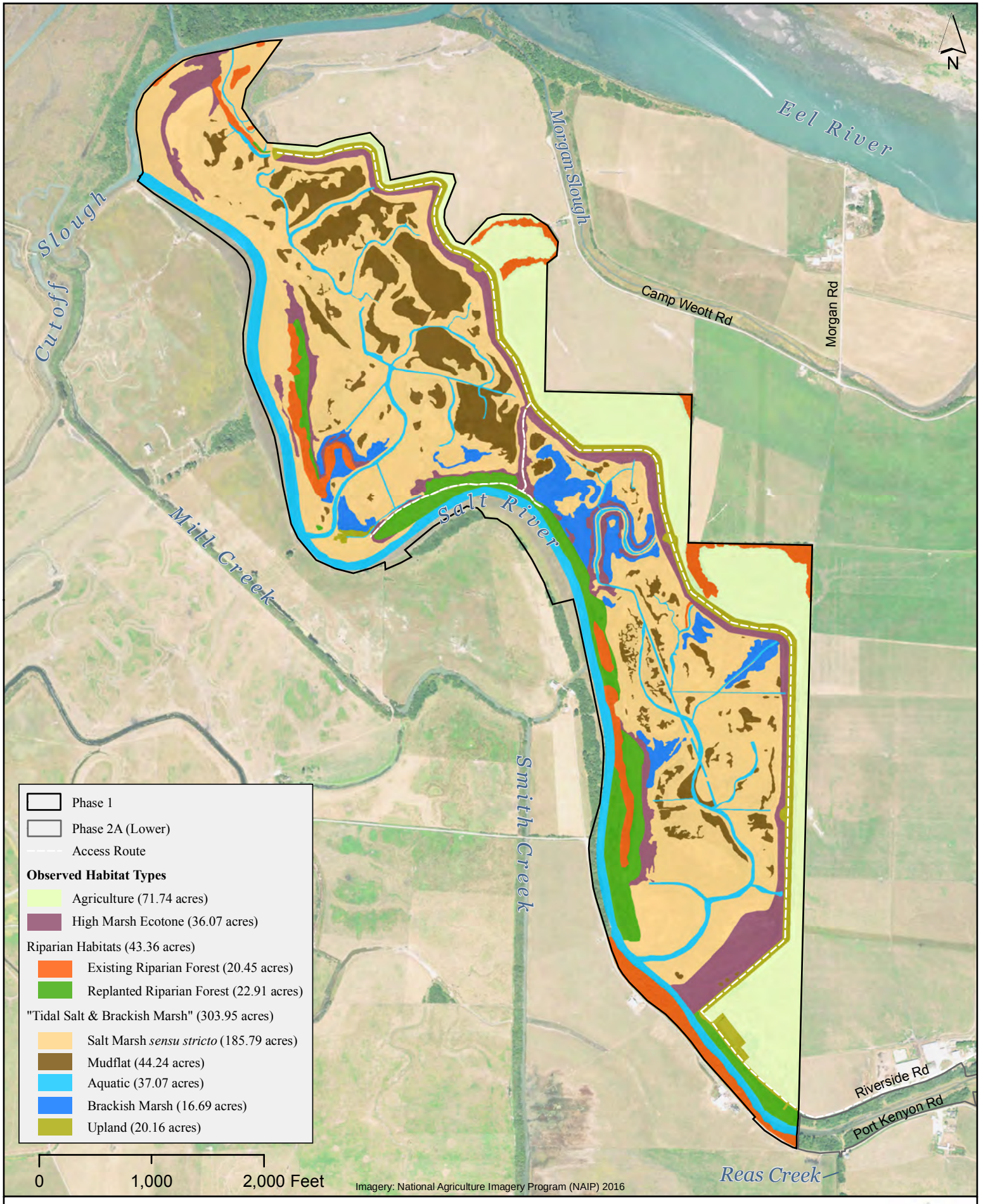

Figure 2. SRERP Phase 1 - Riverside Ranch Tidal Marsh Restoration Area Habitats

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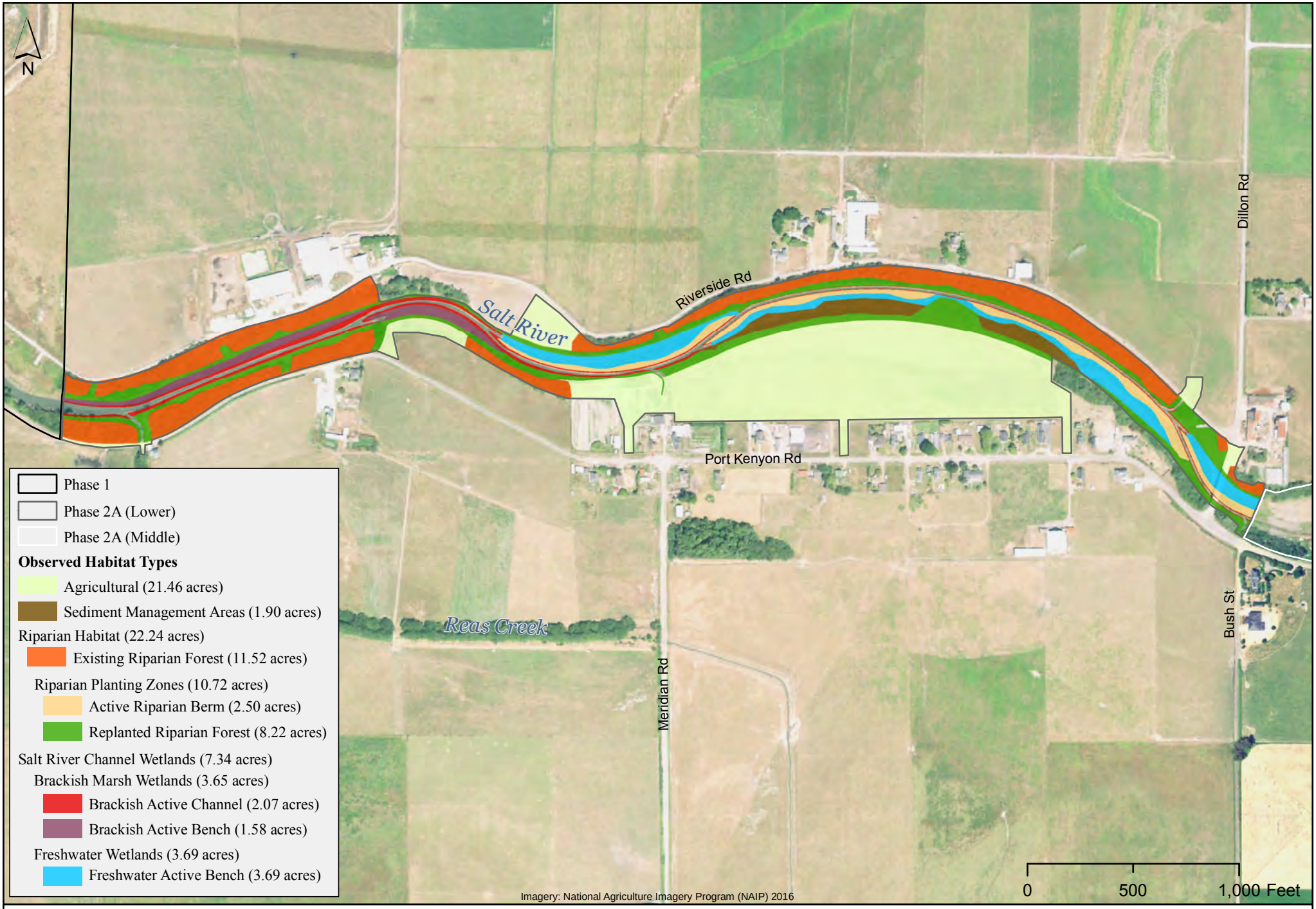

Figure 3. SRERP Phase 2A (Lower) - Salt River Corridor Restoration Area Habitats

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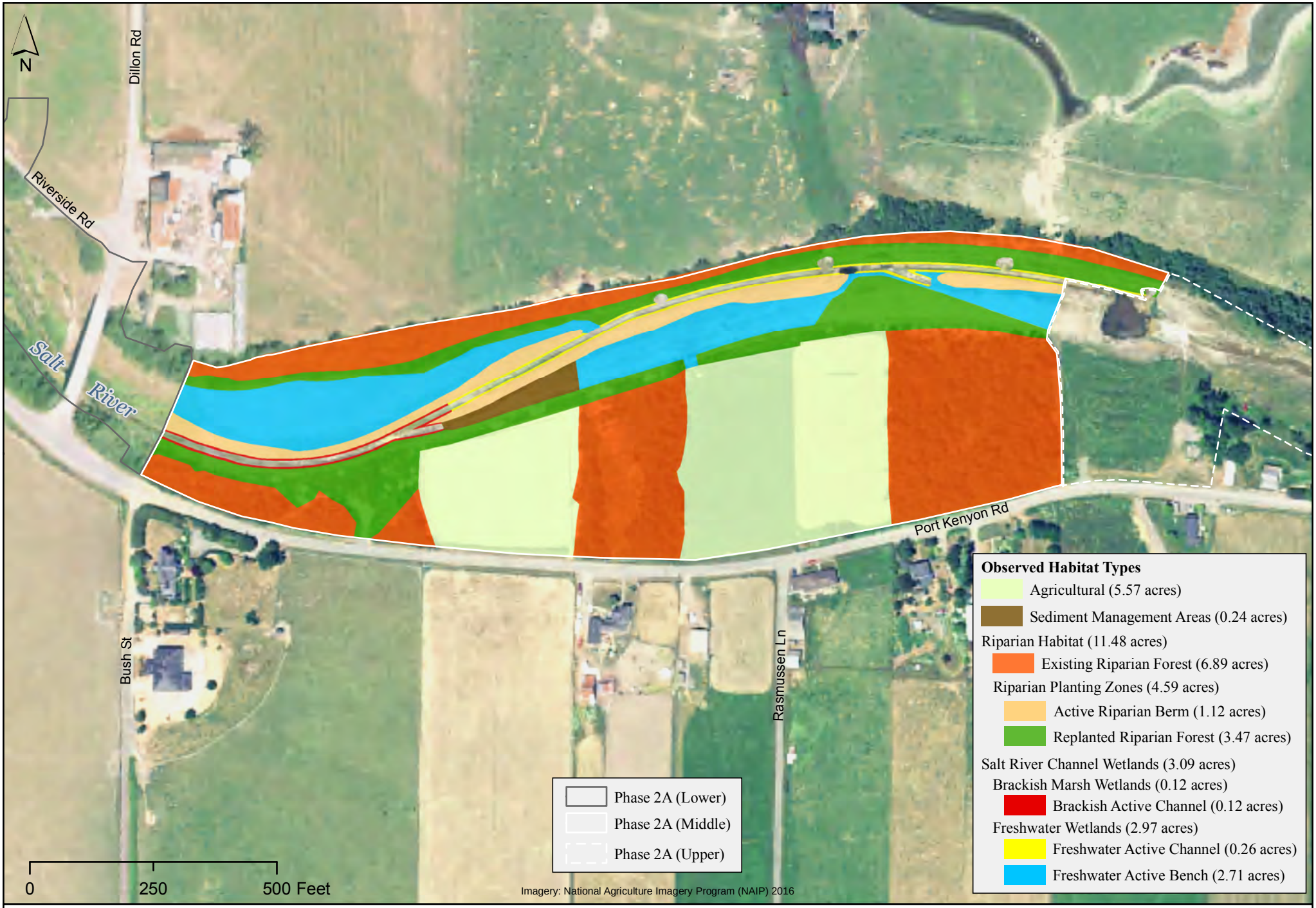

Figure 4. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Habitats

2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

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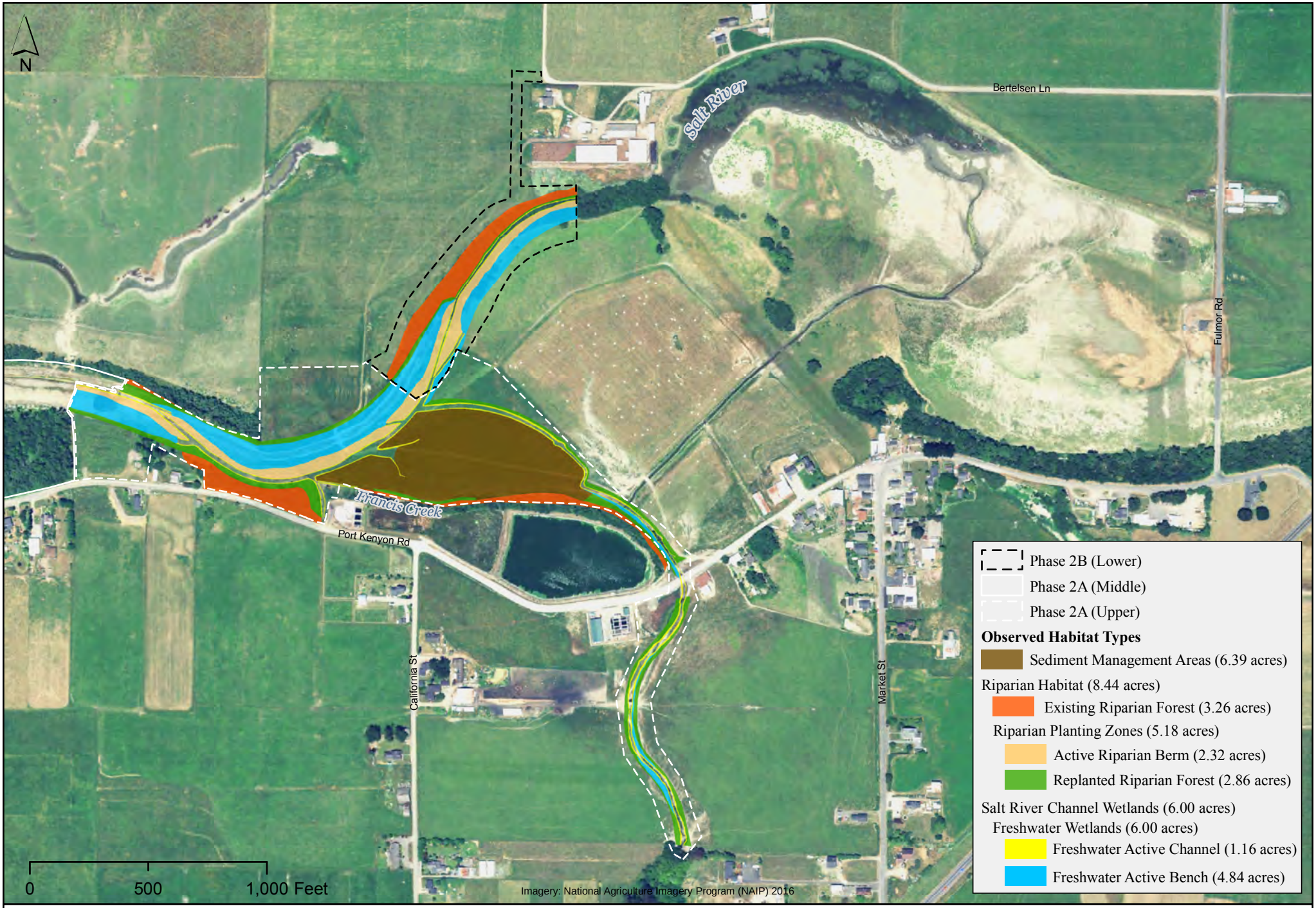

Figure 5. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Habitats

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Figure 6. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Quantitative Vegetation Sampling Plots

2018 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

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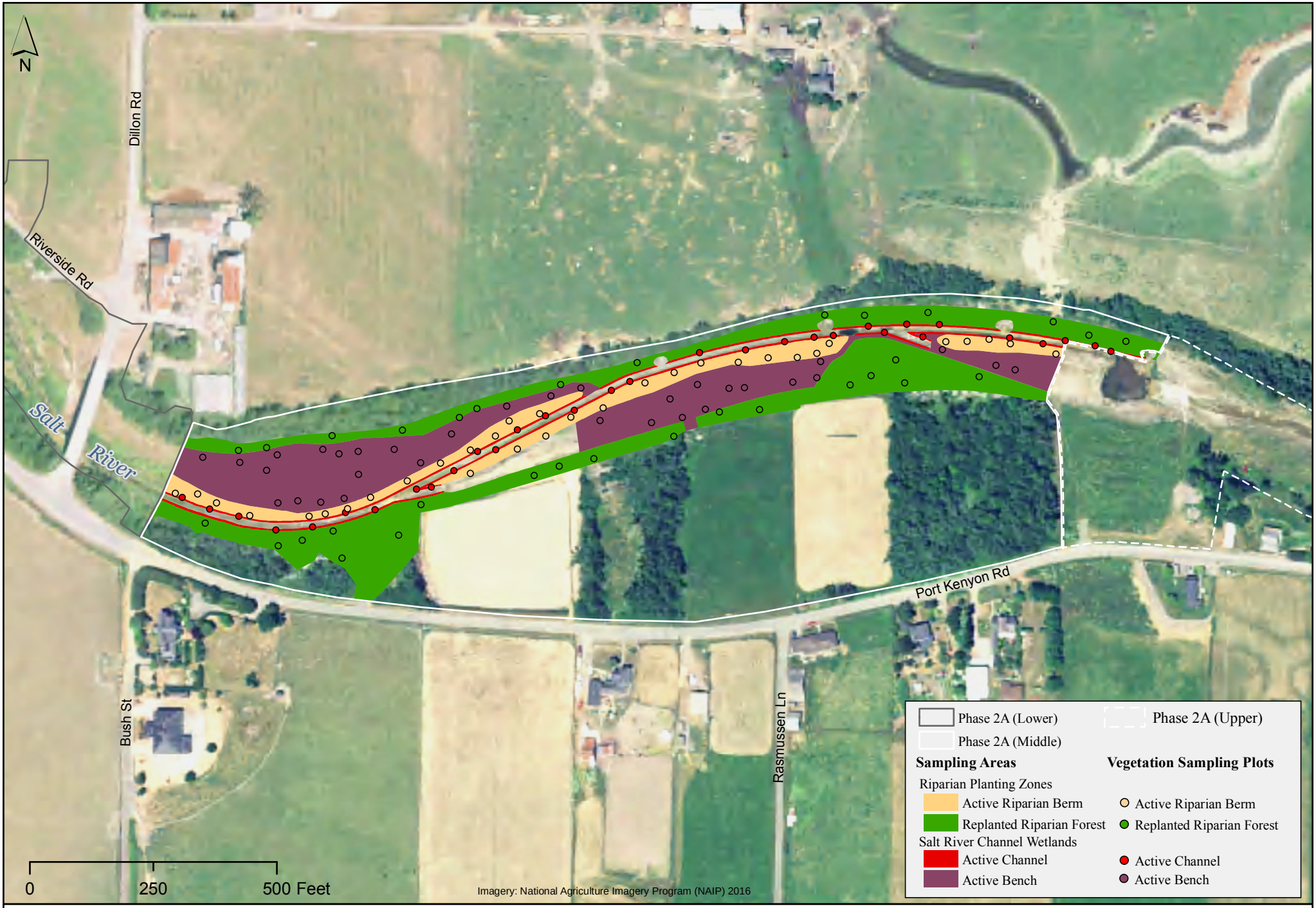

Figure 7. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots

2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

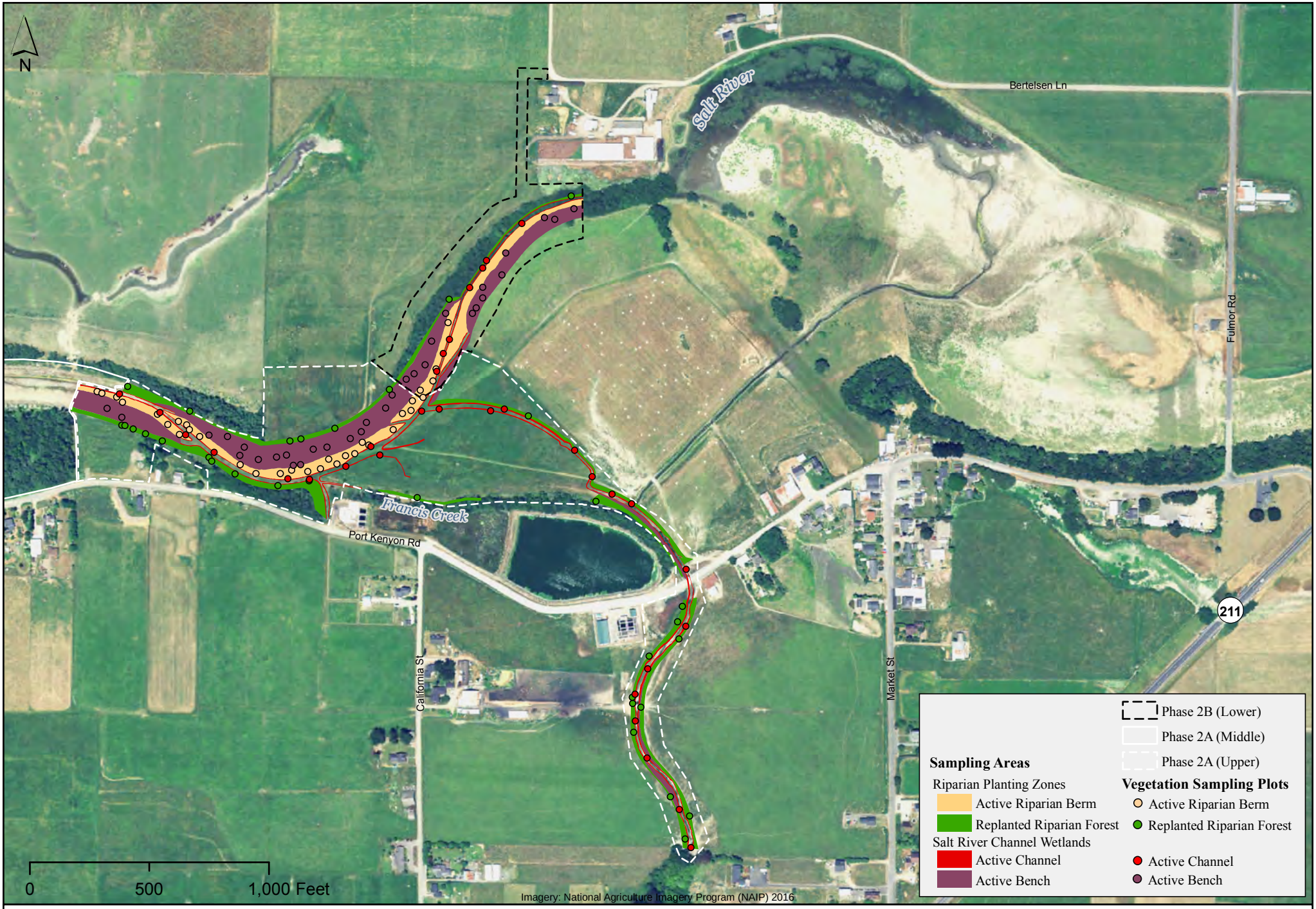

Figure 8. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Quantitative Vegetation Sampling Plots

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Figure 9. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area
Replanted Woody Riparian Vegetation Basal Area Sampling Plots

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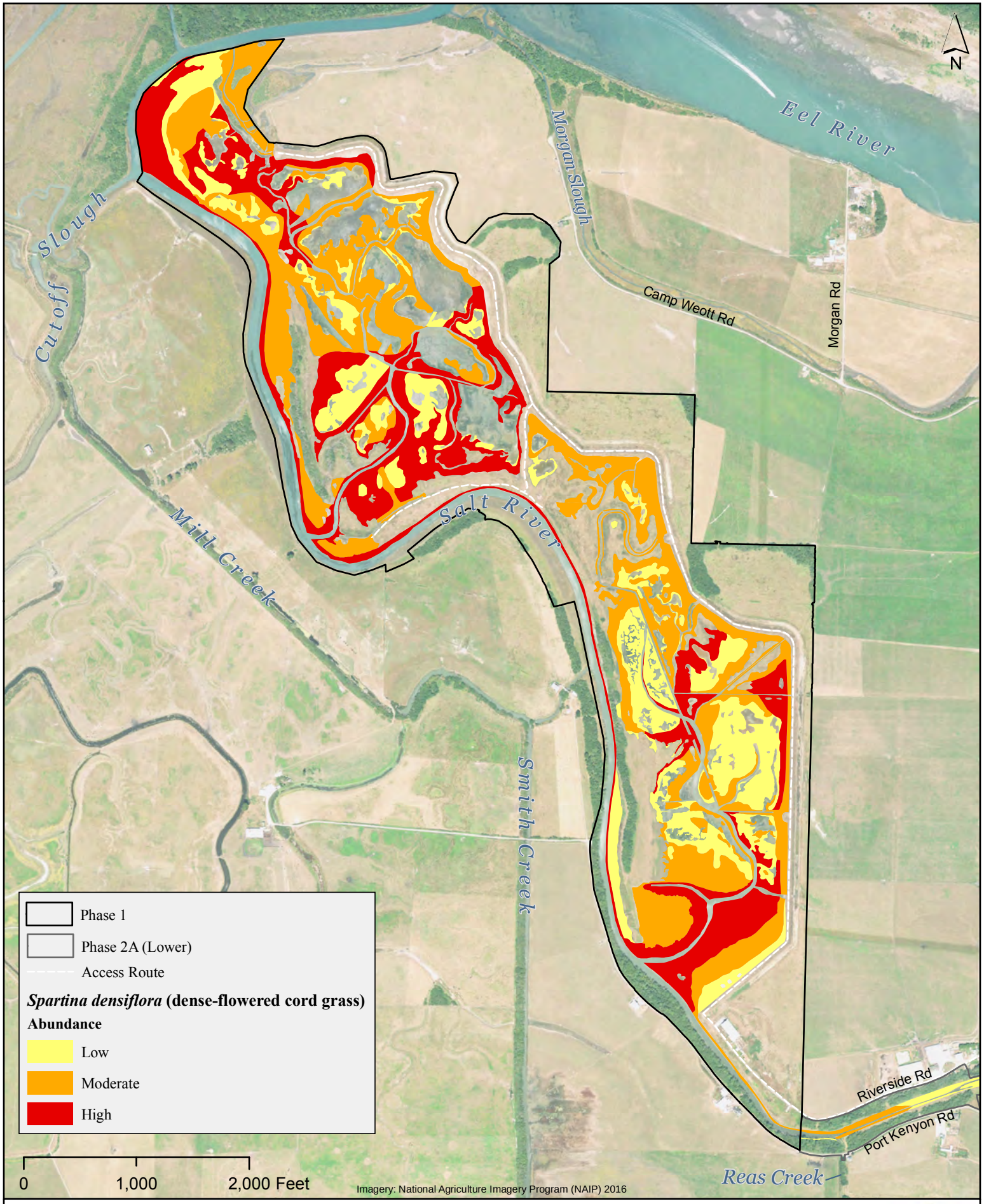

Figure 10. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area
Invasive *Spartina densiflora* ("dense-flowered cord grass")

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Salt River Ecosystem Restoration Project

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Figure 11. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area
Invasive *Spartina densiflora* ("dense-flowered cord grass")
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Salt River Ecosystem Restoration Project

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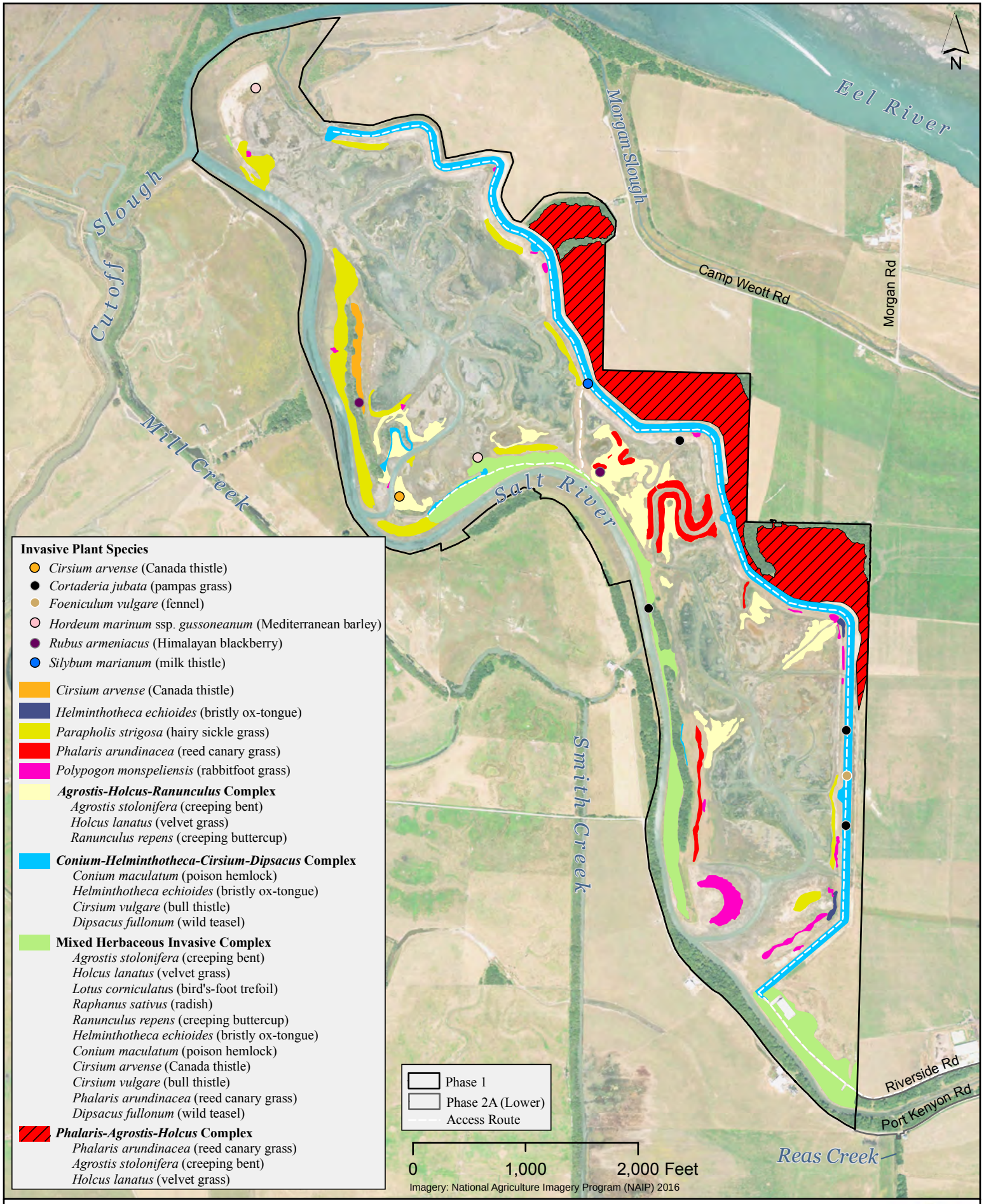

Figure 12. SRERP Phase 1 – Riverside Ranch Tidal Marsh Restoration Area Invasive Plant Species

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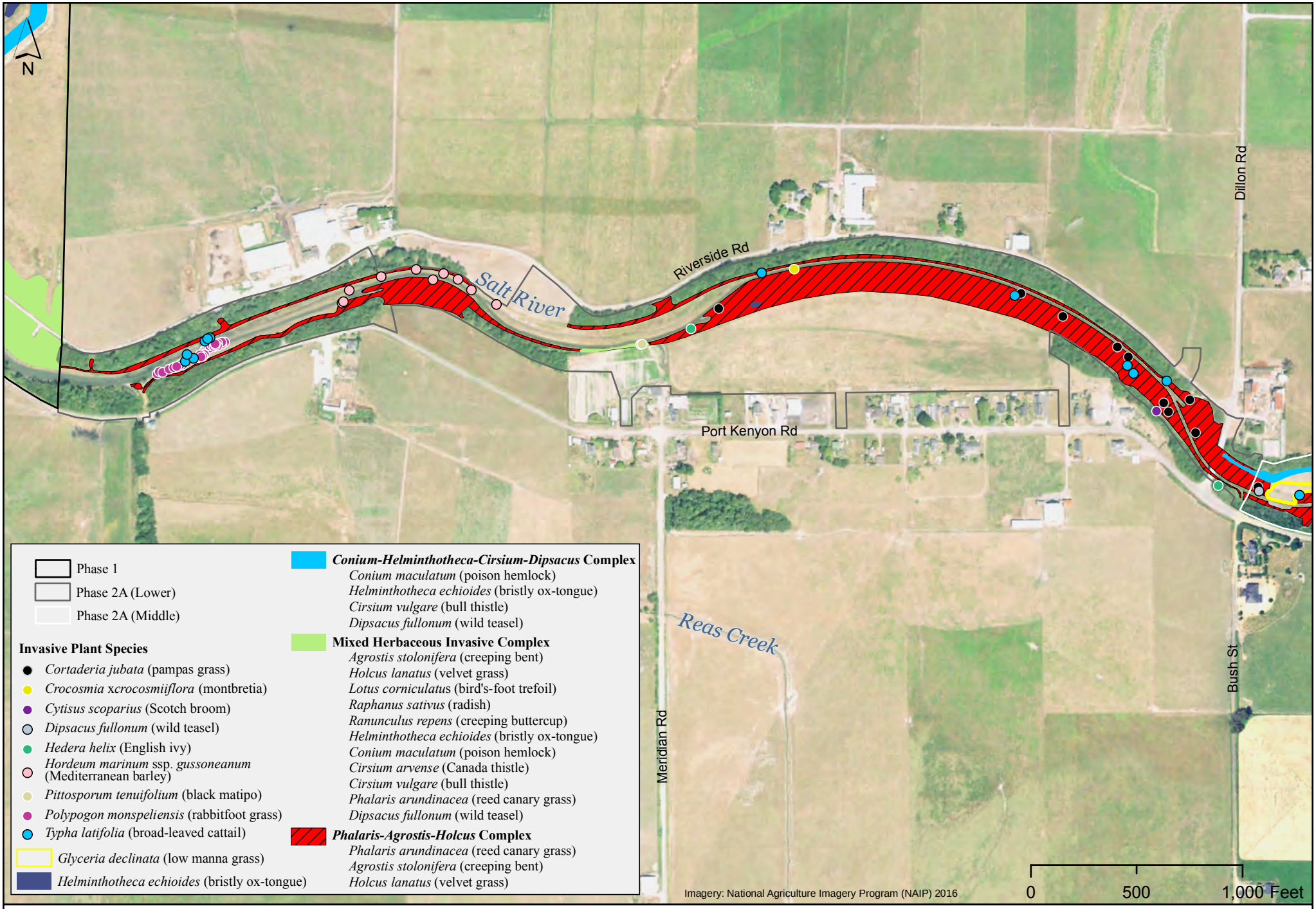

Figure 13. SRERP Phase 2A (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

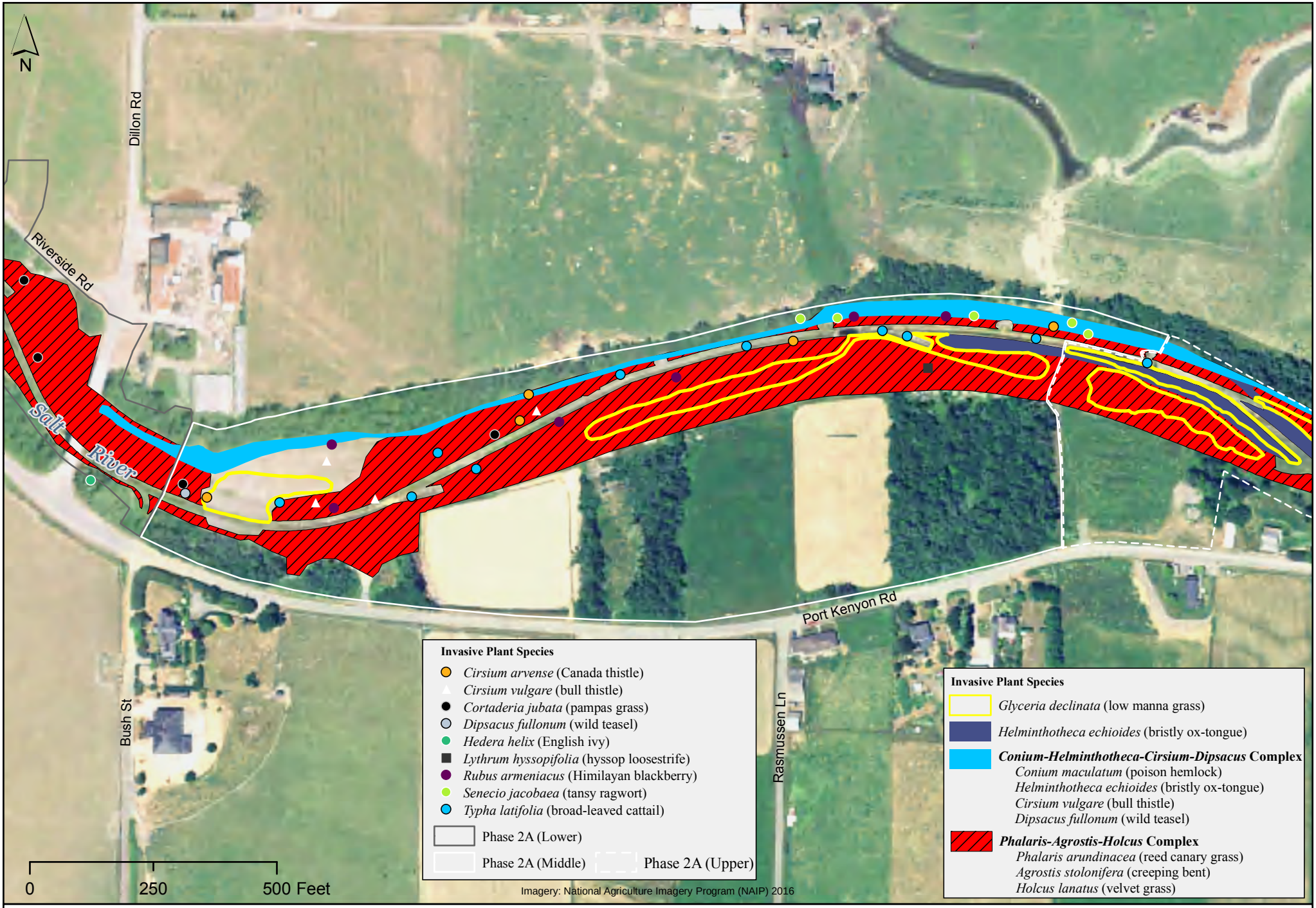

Figure 14. SRERP Phase 2A (Middle) – Salt River Corridor Restoration Area Invasive Plant Species

2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

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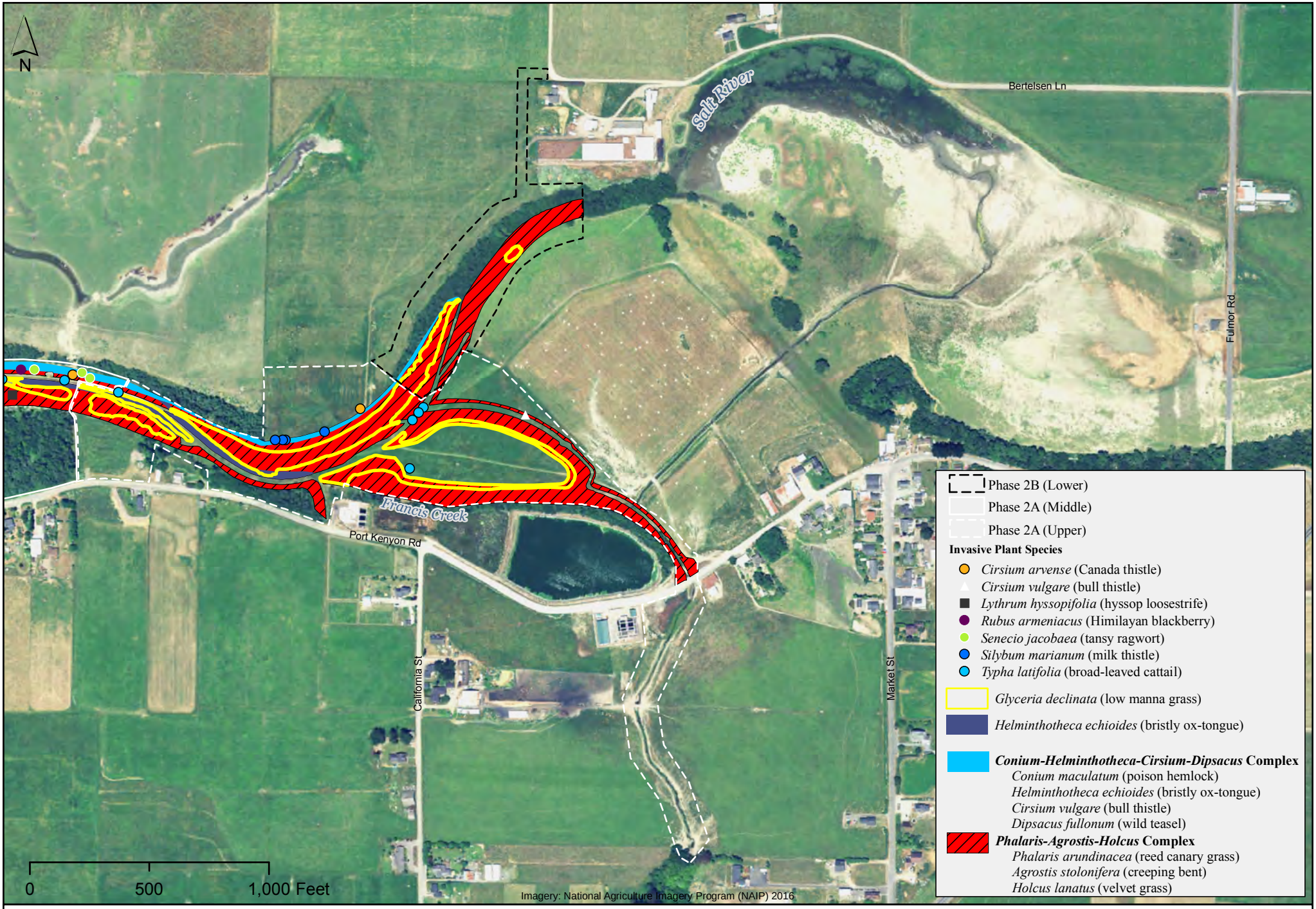

Figure 15. SRERP Phase 2A (Upper) & 2B (Lower) – Salt River Corridor Restoration Area Invasive Plant Species

2018 Annual Quantitative Habitat Monitoring for the
Salt River Ecosystem Restoration Project

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Appendix B

2018 SRERP Quantitative Vegetation Sampling Results

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

Phase 1 - Riverside Ranch Tidal Marsh Restoration Area:
Salt Marsh *sensu stricto* (n = 64)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Salicornia pacifica	0.72	40.47	37.82
Distichlis spicata	0.22	12.67	28.39
Bolboschoenus maritimus ssp. *paludosus*	0.19	10.51	25.44
Triglochin striata	0.09	1.89	9.19
Eleocharis macrostachya	0.08	0.95	3.66
Spergularia marina	0.08	0.38	1.96
Jaumea carnosa	0.05	2.16	11.71
Juncus mexicanus	0.05	1.80	9.20
Triglochin maritima	0.05	0.48	2.63
Potentilla anserina ssp. *pacifica*	0.03	0.24	1.88
Deschampsia cespitosa	0.02	0.23	1.88
Hordeum brachyantherum	0.02	0.23	1.88
Carex lyngbyei	**0.02**	**0.05**	**0.38**
Grindelia stricta var. *stricta*	0.02	0.01	0.06
Shrub Species			
Baccharis pilularis ssp. *consanguinea*	0.02	0.59	4.69
Non-Native Non-Invasive Species			
Herbaceous Species			
Cotula coronopifolia	0.41	7.33	15.51
Atriplex prostrata	0.14	3.34	12.08
Invasive Species			
Herbaceous Species			
Spartina densiflora	0.75	29.66	36.41
Agrostis stolonifera	0.09	2.13	9.34
Parapholis strigosa	0.08	3.37	14.00
Polypogon monspeliensis	0.05	0.87	5.03
Lotus corniculatus	0.02	0.05	0.38

Phase 2A (Middle) - Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Scirpus microcarpus	0.94	70.36	28.53
Equisetum telmateia ssp. *braunii*	0.53	10.45	17.16
Potentilla anserina ssp. *pacifica*	0.53	6.84	7.36
Cyperus eragrostis	0.38	7.03	10.60
Eleocharis macrostachya	0.31	5.39	8.98
Epilobium ciliatum ssp. *watsonii*	0.25	3.00	5.90
Juncus hesperius	0.22	6.89	17.51
Carex obnupta	0.19	3.14	8.03
Deschampsia cespitosa	0.19	3.14	8.03
Juncus balticus ssp. *ater*	0.16	3.75	9.90
Juncus effusus ssp. *pacificus*	0.09	2.89	11.48
Stachys ajugoides	0.09	1.41	4.44
Veronica americana	0.09	1.41	4.44
Oenanthe sarmentosa	0.06	0.94	3.69
Bolboschoenus maritimus ssp. *paludosus*	0.03	1.17	6.63
Bromus carinatus	0.03	0.47	2.65
Persicaria lapathifolia	0.03	0.47	2.65
Schoenoplectus pungens var. *longispicatus*	0.03	0.47	2.65
Hordeum brachyantherum	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.09	1.41	4.44
Tree Species			
Alnus rubra	0.09	1.73	7.06
Salix lasiandra var. *lasiandra*	0.09	0.28	0.89
Salix sitchensis	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Rumex conglomeratus	0.13	1.88	5.04
Atriplex prostrata	0.03	0.47	2.65
Festuca perennis	0.03	0.47	2.65
Raphanus sativus	0.03	0.47	2.65
Sonchus oleraceus	0.03	0.47	2.65
Trifolium repens	0.03	0.47	2.65
Bromus hordeaceus	0.03	0.09	0.53
Veronica anagallis-aquatica	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.344	6.141	11.59
Agrostis stolonifera	0.188	2.438	5.518
Helminthotheca echioides	0.094	1.406	4.442
Ranunculus repens	0.063	0.938	3.689
Cirsium arvense	0.031	0.469	2.652

Phase 2A (Middle) - Salt River Corridor Restoration Area: Active Bench (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Scirpus microcarpus	0.59	31.27	35.64
Deschampsia cespitosa	0.53	21.20	28.04
Hordeum brachyantherum	0.38	4.88	6.97
Oenanthe sarmentosa	0.34	6.97	13.40
Potentilla anserina ssp. *pacifica*	0.25	2.63	5.48
Equisetum arvense	0.19	1.94	7.04
Juncus hesperius	0.16	5.23	14.25
Epilobium ciliatum ssp. *watsonii*	0.09	1.41	4.44
Juncus balticus ssp. *ater*	0.06	1.64	7.06
Equisetum telmateia ssp. *braunii*	0.06	0.94	3.69
Cyperus eragrostis	0.06	0.56	2.69
Juncus effusus ssp. *pacificus*	0.03	1.17	6.63
Gnaphalium palustre	0.03	0.02	0.09
Tree Species			
Salix lasiandra var. *lasiandra*	0.19	2.44	5.52
Salix sitchensis	0.13	3.36	11.67
Alnus rubra	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium fragiferum	0.25	14.33	28.91
Festuca perennis	0.16	1.97	5.03
Trifolium repens	0.13	3.69	12.84
Hypochaeris radicata	0.06	0.94	3.69
Bromus hordeaceus	0.03	0.09	0.53
Rumex conglomeratus	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.56	26.00	31.22
Phalaris arundinacea	0.41	8.23	14.33
Ranunculus repens	0.13	0.59	2.68
Typha latifolia	0.09	0.58	2.69
Holcus lanatus	0.06	0.56	2.69
Helminthotheca echioides	0.03	0.47	2.65
Lotus corniculatus	0.03	0.09	0.53

Phase 2A (Middle) - Salt River Corridor Restoration Area: Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Potentilla anserina ssp. *pacifica*	0.78	10.92	8.28
Equisetum telmateia ssp. *braunii*	0.69	28.16	28.98
Scirpus microcarpus	0.63	23.94	26.73
Deschampsia cespitosa	0.38	6.33	9.16
Juncus hesperius	0.25	7.36	17.52
Hordeum brachyantherum	0.22	2.91	5.93
Stachys ajugoides	0.19	3.52	8.30
Epilobium ciliatum ssp. *watsonii*	0.19	2.06	5.02
Equisetum arvense	0.16	1.22	3.72
Juncus bolanderi	0.03	0.47	2.65
Juncus effusus ssp. *pacificus*	0.03	0.47	2.65
Equisetum hymale	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.13	1.88	5.04
Morella californica	0.06	0.94	3.69
Tree Species			
Alnus rubra	0.22	8.38	20.05
Salix lasiandra var. *lasiandra*	0.16	1.97	5.03
Salix sitchensis	0.13	3.36	11.67
Sequoia sempervirens	0.06	2.42	11.28
Picea sitchensis	0.06	0.94	3.69
Salix hookeriana	0.06	0.94	3.69
Populus trichocarpa	0.03	1.17	6.63
Thuja plicata	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium repens	0.19	5.00	13.21
Rumex conglomeratus	0.09	1.41	4.44
Festuca perennis	0.06	1.64	7.06
Calystegia silvatica ssp. *disjuncta*	0.06	0.94	3.69
Hypochaeris radicata	0.06	0.94	3.69
Plantago major	0.06	0.94	3.69
Centaurium tenuiflorum	0.03	0.47	2.65
Festuca arundinacea	0.03	0.47	2.65
Rumex crispus	0.03	0.47	2.65
Senecio minimus	0.03	0.47	2.65
Taraxacum officinale	0.03	0.47	2.65
Bromus hordeaceus	0.03	0.09	0.53

Phase 2A (Middle) - Salt River Corridor Restoration Area: Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Invasive Species			
Herbaceous Species			
Helminthotheca echioides	0.47	11.31	18.41
Phalaris arundinacea	0.38	5.91	10.31
Lotus corniculatus	0.34	6.89	11.75
Agrostis stolonifera	0.25	4.41	10.01
Ranunculus repens	0.16	2.34	5.53
Mentha pulegium	0.13	3.28	9.70
Holcus lanatus	0.13	1.50	4.44
Cirsium arvense	0.03	0.47	2.65
Shrub Species			
Rubus armeniacus	0.03	1.17	6.63

Phase 2A (Middle) - Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Oenanthe sarmentosa	0.34	6.59	13.34
Deschampsia cespitosa	0.31	12.67	22.92
Equisetum telmateia ssp. *braunii*	0.31	9.00	18.22
Scirpus microcarpus	0.25	9.31	20.89
Hordeum brachyantherum	0.19	2.06	5.02
Potentilla anserina ssp. *pacifica*	0.16	2.67	7.75
Stachys ajugoides	0.13	1.88	5.04
Juncus effusus ssp. *pacificus*	0.03	1.95	11.05
Equisetum hymale	0.03	1.17	6.63
Achillea millefolium	0.03	0.47	2.65
Cyperus eragrostis	0.03	0.47	2.65
Elymus glaucus	0.03	0.47	2.65
Equisetum arvense	0.03	0.47	2.65
Juncus balticus ssp. *ater*	0.03	0.47	2.65
Juncus hesperius	0.03	0.47	2.65
Juncus patens	0.03	0.47	2.65
Carex obnupta	0.03	0.09	0.53
Epilobium ciliatum ssp. *watsonii*	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.34	8.39	17.46
Rosa californica	0.03	1.17	6.63
Rubus spectabilis	0.03	1.17	6.63
Morella californica	0.03	0.47	2.65
Lonicera involucrata var. *ledebourii*	0.03	0.09	0.53
Tree Species			
Salix hookeriana	0.25	18.86	35.83
Alnus rubra	0.25	6.98	17.48
Salix sitchensis	0.03	2.67	15.11
Salix lasiolepis	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.16	4.17	15.49
Trifolium repens	0.13	1.88	5.04
Hypochaeris radicata	0.09	1.41	4.44
Calystegia silvatica ssp. *disjuncta*	0.06	2.42	11.28
Plantago lanceolata	0.06	0.94	3.69
Trifolium fragiferum	0.06	0.94	3.69
Plantago major	0.06	0.56	2.69
Rumex conglomeratus	0.06	0.56	2.69
Mentha spicata	0.03	0.47	2.65
Raphanus sativus	0.03	0.47	2.65
Solanum nigrum	0.03	0.47	2.65
Bromus hordeaceus	0.03	0.09	0.53
Shrub Species			
Rubus ulmifolius var. *anoplothyrsus*	0.03	0.47	2.65

Phase 2A (Middle) - Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Non-Native Non-Invasive Species			
Tree Species			
Salix babylonica	0.03	1.17	6.63
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.41	12.70	23.17
Helminthotheca echioides	0.38	11.75	20.91
Phalaris arundinacea	0.34	22.81	35.94
Holcus lanatus	0.25	4.45	8.70
Ranunculus repens	0.09	2.89	11.48
Cirsium arvense	0.06	2.42	11.28
Conium maculatum	0.06	0.94	3.69
Lotus corniculatus	0.06	0.94	3.69
Cirsium vulgare	0.03	1.17	6.63
Mentha pulegium	0.03	0.47	2.65
Senecio jacobaea	0.03	0.09	0.53
Shrub Species			
Rubus armeniacus	0.03	0.47	2.65

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.63	18.73	23.95
Scirpus microcarpus	0.50	20.67	32.18
Juncus hesperius	0.22	7.69	21.14
Deschampsia cespitosa	0.16	3.75	9.90
Oenanthe sarmentosa	0.16	1.97	5.03
Alopecurus geniculatus	0.13	2.58	7.76
Elymus glaucus	0.13	1.88	5.04
Cyperus eragrostis	0.13	1.50	4.44
Juncus effusus ssp. *pacificus*	0.13	1.50	4.44
Festuca rubra	0.09	2.81	9.48
Potentilla anserina ssp. *pacifica*	0.09	1.03	3.70
Juncus bufonius var. *occidentalis*	0.09	0.66	2.72
Equisetum telmateia ssp. *braunii*	0.06	2.42	11.28
Equisetum arvense	0.06	0.94	3.69
Alisma triviale	0.06	0.56	2.69
Spergularia macrotheca var. *macrotheca*	0.03	1.17	6.63
Eleocharis macrostachya	0.03	0.47	2.65
Petasites frigidus var. palmatus	0.03	0.47	2.65
Veronica americana	0.03	0.47	2.65
Tree Species			
Alnus rubra	0.25	5.89	14.26
Salix lasiandra var. *lasiandra*	0.09	2.81	9.48
Salix sitchensis	0.09	1.03	3.70
Salix hookeriana	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.50	15.52	25.09
Trifolium repens	0.38	12.91	22.26
Atriplex prostrata	0.16	3.45	11.65
Rumex conglomeratus	0.16	1.97	5.03
Festuca arundinacea	0.09	1.41	4.44
Plantago lanceolata	0.06	0.94	3.69
Hypochaeris radicata	0.06	0.56	2.69
Trifolium dubium	0.06	0.56	2.69
Juncus bufonius var. *congestus*	0.03	0.47	2.65
Polygonum aviculare ssp. *depressum*	0.03	0.47	2.65
Rumex crispus	0.03	0.47	2.65
Trifolium pratense	0.03	0.47	2.65
Bromus hordeaceus	0.03	0.09	0.53
Solanum nigrum	0.03	0.09	0.53

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Invasive Species			
Herbaceous Species			
Glyceria declinata	0.50	12.59	19.39
Phalaris arundinacea	0.41	10.78	19.70
Holcus lanatus	0.34	5.86	9.08
Agrostis stolonifera	0.28	11.09	22.56
Ranunculus repens	0.13	1.13	3.71
Helminthotheca echioides	0.09	2.89	11.48
Mentha pulegium	0.09	1.41	4.44
Cirsium vulgare	0.06	0.94	3.69
Lotus corniculatus	0.06	0.94	3.69
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.50	6.75	7.43

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Active Bench (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.75	31.25	29.21
Deschampsia cespitosa	0.19	2.81	5.95
Elymus glaucus	0.13	1.88	5.04
Juncus bufonius var. *occidentalis*	0.13	1.88	5.04
Alopecurus geniculatus	0.13	1.50	4.44
Juncus hesperius	0.09	1.41	4.44
Festuca rubra	0.06	0.94	3.69
Persicaria lapathifolia	0.06	0.94	3.69
Oenanthe sarmentosa	0.06	0.56	2.69
Scirpus microcarpus	0.06	0.19	0.74
Cyperus eragrostis	0.03	0.09	0.53
Tree Species			
Alnus rubra	0.03	0.09	0.53
Fraxinus latifolia	0.03	0.09	0.53
Salix lasiandra var. *lasiandra*	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium repens	0.56	21.17	29.09
Festuca perennis	0.56	14.94	20.00
Trifolium fragiferum	0.22	8.77	23.19
Plantago major	0.16	1.97	5.03
Atriplex prostrata	0.13	2.58	7.76
Echinochloa crus-galli	0.09	1.41	4.44
Trifolium dubium	0.09	1.03	3.70
Erigeron sumatrensis	0.06	0.94	3.69
Vicia sativa ssp. *nigra*	0.06	0.94	3.69
Calystegia silvatica disjuncta	0.03	0.47	2.65
Festuca arundinacea	0.03	0.47	2.65
Lepidium didymum	0.03	0.47	2.65
Polygonum aviculare ssp. *depressum*	0.03	0.47	2.65
Raphanus sativus	0.03	0.47	2.65
Rumex conglomeratus	0.03	0.47	2.65
Bromus hordeaceus	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.66	15.22	19.80
Glyceria declinata	0.31	7.58	14.43
Agrostis stolonifera	0.31	7.20	14.39
Holcus lanatus	0.22	2.53	5.50
Helminthotheca echioides	0.13	1.50	4.44
Mentha pulegium	0.09	1.03	3.70
Lotus corniculatus	0.09	0.66	2.72
Ranunculus repens	0.06	0.56	2.69
Polypogon monspeliensis	0.03	0.02	0.09

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Active Bench (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.41	4.97	6.93

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area:
Active Riparian Berm (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Hordeum brachyantherum	0.84	14.72	10.53
Oenanthe sarmentosa	0.03	0.09	0.53
Potentilla anserina ssp. *pacifica*	0.03	0.09	0.53
Stachys ajugoides	0.03	0.09	0.53
Shrub Species			
Morella californica	0.09	1.03	3.70
Sambucus racemosa	0.03	0.09	0.53
Tree Species			
Alnus rubra	0.25	1.50	3.73
Picea sitchensis	0.09	1.03	3.70
Thuja plicata	0.06	0.94	3.69
Populus trichocarpa	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.66	10.17	8.76
Festuca arundinacea	0.13	1.88	5.04
Raphanus sativus	0.09	1.41	4.44
Rumex crispus	0.06	0.19	0.74
Atriplex prostrata	0.03	0.47	2.65
Calystegia silvatica disjuncta	0.03	0.47	2.65
Echinochloa crus-galli	0.03	0.47	2.65
Erigeron sumatrensis	0.03	0.47	2.65
Solanum nigrum	0.03	0.47	2.65
Bromus hordeaceus	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Helminthotheca echioides	0.34	5.48	8.94
Phalaris arundinacea	0.28	4.17	8.46
Holcus lanatus	0.19	2.44	5.52
Glyceria declinata	0.16	3.05	8.05
Lotus corniculatus	0.13	1.88	5.04
Agrostis stolonifera	0.13	1.50	4.44
Cirsium vulgare	0.13	1.50	4.44
Ranunculus repens	0.03	0.09	0.53
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.84	11.11	8.05

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area:
Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Native Species			
Herbaceous Species			
Equisetum telmateia ssp. *braunii*	0.50	21.06	30.93
Hordeum brachyantherum	0.47	8.44	10.56
Deschampsia cespitosa	0.25	2.63	5.48
Scirpus microcarpus	0.13	4.78	16.50
Elymus glaucus	0.13	1.50	4.44
Festuca rubra	0.09	1.41	4.44
Oenanthe sarmentosa	0.06	1.64	7.06
Stachys ajugoides	0.06	0.94	3.69
Juncus hesperius	0.03	2.67	15.11
Lupinus latifolius var. *latifolius*	0.03	0.47	2.65
Spergularia macrotheca var. *macrotheca*	0.03	0.47	2.65
Shrub Species			
Rubus ursinus	0.09	1.73	7.06
Tree Species			
Picea sitchensis	0.06	0.56	2.69
Salix hookeriana	0.03	2.67	15.11
Salix lasiolepis	0.03	1.17	6.63
Salix sitchensis	0.03	1.17	6.63
Alnus rubra	0.03	0.47	2.65
Salix lasiandra var. *lasiandra*	0.03	0.47	2.65
Abies grandis	0.03	0.09	0.53
Populus trichocarpa	0.03	0.09	0.53
Sequoia sempervirens	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Festuca perennis	0.66	22.39	24.18
Trifolium repens	0.56	25.66	30.88
Festuca arundinacea	0.19	2.81	5.95
Raphanus sativus	0.19	2.39	7.41
Rumex conglomeratus	0.16	3.38	9.68
Calystegia silvatica ssp. *disjuncta*	0.16	2.34	5.53
Polygonum aviculare ssp. *depressum*	0.09	2.89	11.48
Atriplex prostrata	0.06	2.42	11.28
Senecio minimus	0.06	0.94	3.69
Erigeron sumatrensis	0.03	0.47	2.65
Hypochaeris radicata	0.03	0.47	2.65
Linum bienne	0.03	0.47	2.65
Matricaria chamomilla	0.03	0.47	2.65
Plantago major	0.03	0.47	2.65
Rumex crispus	0.03	0.47	2.65
Trifolium fragiferum	0.03	0.47	2.65
Trifolium pratense	0.03	0.47	2.65
Vicia hirsuta	0.03	0.47	2.65
Bromus hordeaceus	0.03	0.09	0.53

Phase 2A (Upper)/2B (Lower) - Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	SD
Invasive Species			
Herbaceous Species			
Holcus lanatus	0.53	12.31	19.40
Helminthotheca echioides	0.47	12.44	18.22
Agrostis stolonifera	0.38	6.33	9.16
Phalaris arundinacea	0.31	6.80	17.37
Cirsium vulgare	0.25	3.75	6.60
Lotus corniculatus	0.09	1.73	7.06
Ranunculus repens	0.09	1.03	3.70
Glyceria declinata	0.06	0.94	3.69
Conium maculatum	0.03	1.17	6.63
Dipsacus fullonum	0.03	0.09	0.53
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.56	11.33	13.90

Summary Table of 2018 Replanted Woody Riparian Vegetation

Basal Area Sampling Measurements

Summary Table of 2018 SRERP Replanted Woody Riparian Vegetation Basal Area Sampling Measurements. Basal area values represent summed total basal area measurements for each tree species observed in each habitat sampled in 2018.

	Measured Basal Area (ft^2)		
	Phase 2A (Middle) – Salt River Corridor Restoration Area		
Tree Species	**Replanted Riparian Forest (3.50 acres) (n = 10)**	**Active Riparian Berm (1.12 acres) (n = 5)**	**Total[§] (4.62 acres)**
Salix sitchensis (Sitka willow)	1.8503	0.0807	1.9310
Alnus rubra (red alder)	1.4017	0.2494	1.6511
Salix hookeriana (coastal willow)	0.2952	0.0004	0.2956
Populus trichocarpa (black cottonwood)	0.0104	0.0140	0.0244
Salix lasiandra var. *lasiandra* (Pacific willow)	0.0174	0.0004	0.0179
Morella californica (California wax myrtle)	0.0119	0.0009	0.0128
Sequoia sempervirens (coast redwood)	0.0023	0.0009	0.0032
Picea sitchensis (Sitka spruce)	0.0028	0	0.0028
Baccharis pilularis ssp. *consanguinea* (coyote brush)	0	0.0007	0.0007
Lonicera involucrata ssp. *ledebourii* (twinberry)	0	0.0007	0.0007
Total	**3.5921**	**0.3482**	**3.9402**

[§] All SRERP restoration areas addressed during the 2018 basal area sampling effort