2021 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 2021, J.B. Lovelace & Associates conducted the annual habitat monitoring effort for the Salt River Ecosystem Restoration Project (SRERP). This phased habitat restoration project was initiated in 2013 and is being implemented throughout the Salt River watershed in the Eel River delta of coastal Humboldt County, California. The project is an on-going collaborative effort involving numerous stakeholders and project partners, and is being coordinated by the Humboldt County Resource Conservation District (HCRCD). Project goals include the restoration of historically impaired beneficial hydrological and ecological functions of the Salt River (a tributary to the lower Eel River), reduction of flooding in the surrounding community during high-flow events, and the creation and enhancement of historically more abundant estuarine and freshwater coastal wetland habitats.

Following completion of each project sub-phase, a suite of environmental parameters is being assessed over the course of respective 10-year monitoring periods to evaluate progress toward the realization of targeted restoration design criteria and to identify potential problems that may compromise the successful realization of identified goals. This 2021 habitat monitoring effort consisted of the mapping and evaluation of restored habitats, an assessment of invasive vegetation occurring throughout the SRERP footprint, and quantitative vegetation sampling to characterize the community composition and structural development of vegetation within specific habitats for evaluation against respective restoration success criteria.

Our mapping and analysis of restored habitats in 2021 indicate that all habitats of interest throughout the Phase 1 and Phase 2 restoration areas currently exceed respective minimum area (acreage) success thresholds. Results from our quantitative vegetation sampling in 2021 reflect the continued establishment and development of replanted (and volunteer) vegetation, as well as the initiation and continuation of expected vegetation successional processes within these habitats.

Woody riparian vegetation continues to establish and develop throughout most replanted SRERP riparian habitats, as well as in Salt River channel wetland habitats throughout the Phase 2 restoration area. Where previous (2019–2020) and recent (2021) sampling data reveal disproportionately low establishment of woody species in Phase 2B (Middle) riparian planting zones, however, additional supplemental revegetation efforts should be considered.

The abundance of native vegetation is increasing throughout most of the SRERP footprint and exceeded respective minimum percent cover thresholds in most regions sampled in 2021, but was deficient in two of thirteen sampling regions where a preponderance of invasive plants is establishing at the expense of native species. Invasive vegetation is also increasing in abundance throughout the majority of the SRERP area and current cover estimates exceed the eventual

final maximum cover success threshold (< 5%) in all thirteen of the regions sampled in 2021. If such trends continue unabated, we expect the abundance of this category of vegetation to continue to exceed the final maximum success threshold throughout the project footprint, potentially compromising the successful development of co-occurring native vegetation.

Corresponding exceptions to observed invasive species trends include varying decreases in the abundance of invasive vegetation between 2019–2021 in six of the oldest sampling regions within the SRERP, suggesting that the achievement of final invasive vegetation cover success criteria is ultimately attainable, particularly if potentially operative passive successional invasive vegetation control mechanisms are supplemented with proactive invasive species eradication efforts. In light of these results, we recommend the continued implementation of such efforts and the continuation of scheduled periodic quantitative vegetation assessments throughout the project area until it can be demonstrated that the abundance of invasive vegetation has been reduced to the extent required.

Despite continued favorable trajectories with respect to the development of projected habitats and native vegetation throughout much of the restoration project area, sustained and proportionate efforts to reduce and/or eradicate invasive vegetation documented during our 2021 fieldwork continue to be warranted. If not adequately addressed, the continued establishment and development of such undesirable vegetation has the potential to prevent the achievement of final success thresholds, potentially jeopardizing some of the long-term restoration goals for the project. We remain confident that if sufficient effort is dedicated to addressing invasive plant species occurrences in a timely manner, all respective success criteria can be satisfied, thereby achieving the various goals of this ambitious restoration project.

1.0 Introduction

The Salt River Ecosystem Restoration Project (SRERP) is a phased habitat restoration project being implemented throughout the Salt River watershed in the Eel River delta of coastal Humboldt County, California (Figure 1). The project was first initiated in 2013 and is an on-going collaborative effort involving numerous stakeholders and project partners, and is being coordinated by the Humboldt County Resource Conservation District (HCRCD).

The main focus of the watershed-scale restoration effort is to reduce periodic flooding of the adjacent agricultural community during high-flow events and restore beneficial fluvial, hydrological, and ecological functions to this significant tributary to the Eel River estuary whose watershed functions have been impaired due to historic channel alteration and excess sediment accretion.

Project goals include the reduction and management of upstream sediment sources; facilitation of sediment transport through the system; and the creation and enhancement of adjacent ecologically important coastal habitats that were historically more abundant throughout the region such as tidal salt marsh, brackish estuarine, and freshwater wetlands.

In order to ensure the overall success of the Salt River Ecosystem Restoration Project, a suite of monitoring programs was developed to periodically evaluate progress towards the realization of various identified restoration objectives. One such habitat monitoring program consists of periodic quantitative assessments of the development of targeted projected habitat types and associated vegetation characteristics. During the summer and autumn of 2021, J.B. Lovelace & Associates continued to assist the HCRCD in its fulfillment of Salt River Ecosystem Restoration Project monitoring requirements by conducting such quantitative assessments. That effort is the focus of this annual habitat monitoring report and our associated findings from 2021 are presented herein.

1.1 Regulatory Context & Monitoring Directives

An extensive planning and permitting process preceded the initiation of the SRERP and included the preparation of the *Salt River Ecosystem Restoration Habitat Mitigation and Monitoring Plan* (HMMP) (H.T. Harvey & Associates with Winzler & Kelly 2012). The HMMP was developed to help guide the restoration effort and to provide an assessment framework with which to gauge its efficacy. Among other elements, this framework includes directives for implementing a 10-year, post-restoration monitoring program upon completion of each phase and sub-phase with periodic quantitative assessments of specific habitat and vegetation parameters, to be compared against established success criteria, that track progress towards achieving specific restoration goals, as well as to identify and address any potential problems that could prevent the realization of such goals. Implementation of this monitoring program is also a requirement of the following project-related permits, certifications, and agreements:

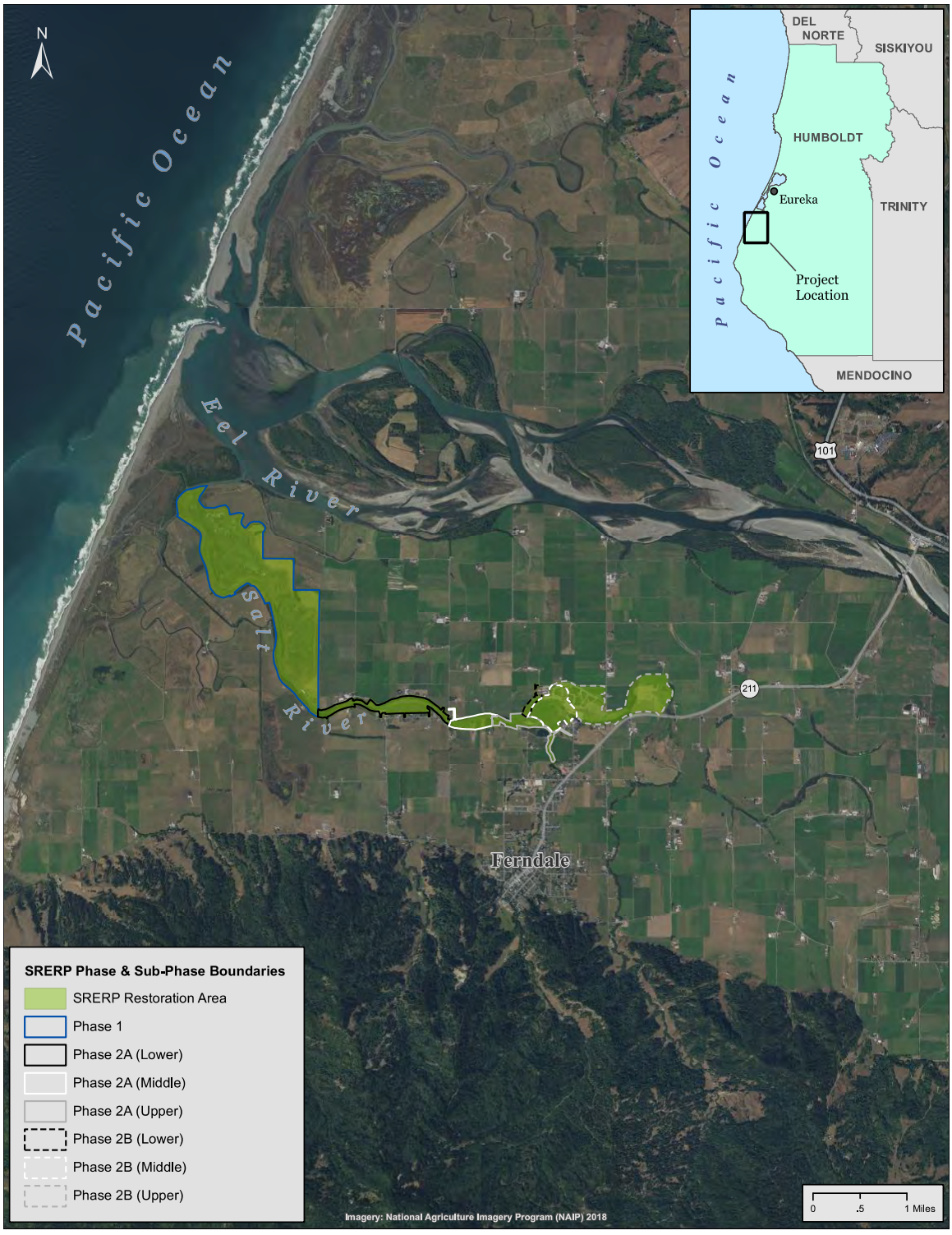

Figure 1. Salt River Ecosystem Restoration Project (SRERP) Location and Vicinity.

- *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);
- *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).

1.2 Previous Monitoring & Reporting

The habitat 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 during 2016–2020 was performed by J.B. Lovelace & Associates, and those efforts are described in respective annual habitat monitoring reports (J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b; respectively). This report provides documentation of the most recent habitat monitoring effort for the Salt River Ecosystem Restoration Project in 2021, and addresses the following specific tasks identified (Table 1) for the current monitoring year:

A. Habitat Area Analysis & Mapping

1. Phase 1 — Riverside Ranch Tidal Marsh Restoration Area:
    a. Riparian Habitats
2. Phase 2A (Lower) — Salt River Corridor Restoration Area:
    a. Riparian Habitats
3. Phase 2B (Middle) — Salt River Corridor Restoration Area:
    a. Riparian Habitats

Table 1. SRERP Habitat Monitoring Schedule[1] for Phase 1 & Phase 2. Bold text indicates the current monitoring year (2021).

Phase		SRERP Habitat Type	Monitoring Period & Schedule of Tasks[2]																	
			2013	2014	2015	2016	2017	2018	2019	2020	**2021**	2022	2023	2024	2025	2026	2027	2028	2029	2030
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"[6,7]			BC	BC	BC	C	BC	C	**BC**	C	BC	C						
		Riparian Planting Zones[8]			AC	BC	ABCD	C	ABCD	C	**ABC**	C	C	ABCD						
	(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[8]				AC	BC	ABCD	C	ABCD	**C**	ABC	C	C	ABCD					
	(Upper)	(Monitoring Year)						1	2	3	**4**	5	6	7	8	9	10			
		"Salt River Channel Wetlands" [6,9]						ABC	BC	BC	**C**	BC	C	C	C	C	C			
		Riparian Planting Zones[8,10]						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" [6,9]						ABC	BC	BC	**C**	BC	C	C	C	C	C			
		Riparian Planting Zones[8,10]						ABC	BC	ABCD	**C**	ABCD	C	ABC	C	C	ABCD			
	(Middle)	(Monitoring Year)							1	2	**3**	4	5	6	7	8	9	10		
		"Salt River Channel Wetlands" [6,9]							ABC	BC	**BC**	C	BC	C	C	C	C	C		
		Riparian Planting Zones[8,10]							ABC	BC	**ABCD**	C	ABCD	C	ABC	C	C	ABCD		
	(Upper)	(Monitoring Year)								1	**2**	3	4	5	6	7	8	9	10	
		"Salt River Channel Wetlands" [6,9]								ABC	**BC**	BC	C	BC	C	C	C	C	C	
		Riparian Planting Zones[8,10]								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 was 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 in the winter of 2013/2014 (HCRCD 2015a).
[6] Includes both elements (i.e., active channel and active bench) of both brackish and freshwater channel wetlands.
[7] Additional quantitative sampling suggested (J.B. Lovelace & Associates 2020) to continue to assess the abundance of invasive vegetation in regions of the SRERP footprint where such vegetation exceeded the final maximum threshold (i.e., <5%) in respective 5th monitoring years.
[8] Includes both replanted riparian forest areas and active riparian berms.
[9] Habitat area assessment is warranted in Salt River Channel Wetlands, given recent planting of these areas with woody species.
[10] 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.

B. Vegetation Percent Cover Sampling

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

2.0 Project Description

The first phase of the SRERP (i.e., Phase 1 — Riverside Ranch Tidal Marsh Ecosystem Restoration Project) was initiated in 2013 in the lower portion of the watershed near the Salt River's confluence with the Eel River estuary. Since that time, construction of multiple consecutive sub-phases of Phase 2 (the Salt River Corridor Restoration Project) has progressed upstream along the Salt River riparian corridor and the project is anticipated to continue until eventual completion in the vicinity of the Salt River's confluence with Williams Creek 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 2021 habitat monitoring effort, restoration construction had been completed throughout the Phase 1, Phase 2A (Lower, Middle, and Upper), and Phase 2B (Lower, Middle, and Upper) restoration areas (Table 2).

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, developed during the design phase of the project, and which can be found in Tables 5–7 of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012).

Table 2. SRERP Phases & Sub-Phases Completed Prior to Initiation of 2021 Habitat Monitoring Fieldwork.

SRERP Phase & Sub-Phase	Year Completed
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area	2013
Woody Riparian Revegetation*	2015
Phase 2A — Salt River Corridor Restoration Area	
Phase 2A (Lower)	2014
Phase 2A (Middle)	2015
Phase 2A (Upper)	2017
Phase 2B — Salt River Corridor Restoration Area	
Phase 2B (Lower)	2017
Phase 2B (Middle)	2018
Phase 2B (Upper)	2019

* Woody riparian revegetation efforts for Phase 1 were delayed until early 2015 due to unusually dry conditions during the winter of 2013/2014 (HCRCD 2015a).

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);
- *Humboldt County Resource Conservation District Salt River Ecosystem Project Revegetation: Riparian Tree/Shrub Planting Plans Phase Middle 2A-R3* (HCRCD 2016a);

- *Salt River Ecosystem Restoration Project Phase 2018 Revegetation As-Built Documentation* (HCRCD 2019a); and
- *Salt River Ecosystem Restoration Project Phase 2019 Revegetation As-Built Documentation* (HCRCD 2019b).

A general description of each of the project phases, respective revegetation efforts, restoration goals, and targeted or "projected" habitats for which 2021 monitoring requirements apply, is introduced here to provide supportive context for the 2020 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 and 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 (2021) 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 2021 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, 2019, 2022a, 2022b) 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 2020 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 2020 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 identified and addressed include salt marsh *sensu stricto*, brackish marsh *sensu stricto*, aquatic, and unvegetated mudflats.

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. In the context of the SRERP, salt marsh *sensu stricto* is considered to consist primarily of estuarine intertidal emergent wetland habitats as described in *Classification of Wetlands and Deepwater Habitats of the United States, Second Edition* (FGDC 2013).

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 (FGDC 2013) 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 *sensu stricto*, but that are exposed to intermediate water chemistry with increased salinity, determined in the field based on observations of their ability to support vegetation tolerant of such conditions. Brackish marsh *sensu stricto* habitats were not reseeded following the completion of construction based on the same rationale described for salt marsh *s.s.* habitats. Being subject to increased tidal influence, it is anticipated that the plant 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. These "aquatic" habitats variously consist of unconsolidated bottom, aquatic bed, and streambed subtidal; or unconsolidated shore intertidal; estuarine wetland habitats as described in FGDC (2013). Mudflats consist of predominantly unvegetated (i.e., <5% vegetative cover) areas subject to regular and periodic tidal inundation and ponding, and are considered to be unconsolidated shore intertidal estuarine wetland habitats (FGDC 2013).

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

The term "riparian vegetation" has traditionally been applicable to all vegetation associated with rivers or streams, regardless of a given species' growth form or "habit" (e.g., herbaceous plants, woody shrubs, woody vines, trees, etc.). However, an emergent semantical trend in the natural resource arena narrows the focus of "riparian vegetation" (sometimes even being distilled to the noun, "riparian") to apply specifically to the more obvious woody tree and shrub components of a given plant community. Much of the language in project-related documents for the SRERP appears to adopt this more restrictive convention. 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" (FGDC 2013).

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 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 (i.e., "replanted riparian forest" areas) 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 2021 habitat monitoring effort, all three sub-phase reaches (i.e., lower, middle, and upper) in both the Phase 2A and Phase 2B restoration areas 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 and 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 and 4).

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 restoration completed in 2017 consists of a ~0.25-mile section of restored Salt River channel, extending upstream from the upstream limit of Phase 2A (Upper) (Appendix A, Figures 1 and 5). Given that both Phase 2A (Upper) and Phase 2B (Lower) restoration reaches were completed during the same construction season in 2017, they are addressed together, in aggregate, for the purposes of our habitat monitoring efforts.

In 2018, Phase 2B (Middle) restoration proceeded upstream ~0.3 miles from the upstream extent of the Phase 2B (Lower) reach to reconnect the restored lower portions of the Salt River channel with an isolated segment of its historic channel in the vicinity of "Arlynda Corners" near the junction of Port Kenyon Road and Market Street (Appendix A, Figures 1 and 6). With completion of Phase 2A (Upper), and the lower and middle reaches of Phase 2B, historic channel connectivity and streamflow conveyance has been restored to both the Salt River and Francis Creek (within the SRERP footprint), both of which had become occluded, resulting in deviation from their respective original channels and flooding of the agricultural pastureland along Bertelsen Lane.

In 2019, Phase 2B (Upper) restoration proceeded upstream ~1 mile from the upstream extent of the Phase 2B (Middle) reach to a point approximately 600 feet north of the Salt River's undercrossing of Highway 211, and channel modifications also included the enhancement of an extensive overflow swale along the eastern edge of a retained stand of mature riparian forest (Appendix A, Figures 1 and 7).

Restoration activities associated with Phase 2 efforts focus on Salt River channel modifications as well as the creation and enhancement of adjacent riparian and seasonal freshwater wetland habitats extending beyond the immediate riparian corridor. 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, 2019a, 2019b). 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, 2017, 2018 and 2019 for the Phase 2A (Lower), Phase 2A (Middle), the combined Phase 2A (Upper)/Phase 2B (Lower), Phase 2B (Middle), and Phase 2B (Upper) restoration reaches, respectively.

Revegetation methods using "wetland plugs" and replanting of designated riparian planting zones (i.e., "active riparian berms" and "replanted riparian forest" areas) with woody riparian species occurred in late fall–winter and early spring of 2014/2015 for Phase 2A (Lower), 2015/2016 for Phase 2A (Middle), 2017/2018 for the combined Phase 2A (Upper)/Phase 2B (Lower), 2018/2019 for Phase 2B (Middle), and fall/winter of 2019 for Phase 2B (Upper) restoration reaches. Supplemental planting of woody riparian vegetation was also conducted in locations originally replanted with only herbaceous species throughout the Phase 2 restoration area in 2018 and 2019 in anticipation of the need to compensate for potential insufficiencies in the amount of total area planted with this vegetation component following unanticipated reductions in the availability of portions of the project area where replanting of woody riparian vegetation could occur (HCRCD pers. com.).

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 2014; HCRCD 2015b, 2015c, 2016a, 2019) for various restoration "habitat components" throughout respective 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 identified in the HMMP throughout the Phase 2 Salt River restoration corridor include both "brackish marsh" and "freshwater channel" "Salt River channel wetlands," seasonal (non-channel) wetlands, and riparian [forest] habitats. For the purposes of the 2020 habitat monitoring effort (and consistent with the approach used in preceding habitat monitoring efforts [J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b]), 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" as being part of the "Salt River channel wetland" system, having either/both "brackish marsh" and "freshwater channel" wetland components. Each of the habitats and relevant design components addressed in the 2021 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 Restoration Area consists of estuarine, riverine, and palustrine emergent wetland habitats (FGDC 2013), which support plant communities currently dominated by herbaceous species. Collectively, this system incorporates geomorphological diversity that beneficially influences the movement of sediment throughout the Salt River watershed, facilitates the establishment of wetland vegetation, and provides low-velocity refugia for aquatic organisms during high-flow events, in addition to foraging and breeding habitat for terrestrial wildlife and avian species during other times of the year.

Specific design features of these Salt River channel wetland habitats addressed in the SRERP habitat monitoring effort consist of "active channel" and "active bench" habitat components. The "active channel" refers to the primary wetted channel and immediately adjoining vegetated banks of both the Salt River and Francis Creek, which consistently convey streamflow throughout the year. The "active bench" is a dynamic alluvial geomorphological feature extending from the edges of the active channel, out to the upper extent 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, which receives flows exceeding bankfull channel capacity during high-flow events and facilitates deposition of sediments transported from upstream sources. Active bench areas were treated in the HMMP as emergent (i.e., herbaceous plant-dominated) wetland habitats and revegetation prescriptions for such areas did not include woody perennial plant species, though the eventual recruitment of a woody riparian component in these habitats as a result of natural successional processes was anticipated in the development of the HMMP.

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 have 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 transitions 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.

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 Salt River channel wetland system in the lower reach of the Phase 2A restoration area. 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, not just the active channel edge of Phase 2A (as presented in H.T. Harvey & Associates [2015]). 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) "brackish active channel" recognized in J.B Lovelace & Associates (2017, 2018, 2019, 2022a, 2022b) and in this current report.

Phase 2: "Seasonal (Non-Channel) Wetlands"

Seasonal (non-channel) wetlands within the SRERP footprint that extend beyond the immediately modified Salt River riparian corridor, or which lack obvious above-ground hydrological connectivity to the Salt River channel throughout most of the year, are identified in the HMMP as being predominantly herbaceous vegetation-dominated palustrine emergent wetland habitats. Such habitats within the vicinity typically occupy swales or other concave geomorphological features with a relatively shallow water table and serve a variety of beneficial ecological functions throughout the year such as aquifer recharge, flood mitigation, uptake and biofiltration of nutrients and contaminants, and by providing breeding, foraging, and refuge habitat for a diversity of wildlife species.

Phase 2: Riparian Habitats

Phase 2 restoration construction efforts necessitated the removal of some portions of pre-existing riparian forest, as had also occurred during Phase 1. Existing riparian forest 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.

In addition to the planned revegetation of aforementioned riparian planting zones, unanticipated reductions in the availability of portions of the middle and upper Phase 2B restoration reach where woody riparian revegetation efforts could occur prompted the subsequent supplemental planting of woody riparian species in some freshwater active bench and passive sediment management areas throughout the Phase 2 restoration area in 2018 and 2019.

Given that these subsequent woody species revegetation efforts will likely result in the eventual conversion of some restoration areas originally designed as herbaceous-vegetation-dominated wetland habitats or sediment management areas, we continue to treat all such areas as originally designated (i.e., active bench or sediment management area), while also separately quantifying supplemental woody species replanting areas (Section 4.1.2; Appendix A, Figures 3–7) for evaluation in the context of respective relevant success criteria.

Phase 2: Sediment Management Areas

"Sediment management areas" were designed as being discrete portions of active bench habitats where reduced streamflow velocity during high-flow events is expected to facilitate the deposition of transported sediments. Periodic removal of sediment from some of 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 have not been required in these portions of the restoration area.

2.3 Project Timeline and Monitoring Program Conformity

The implementation of this large-scale habitat restoration project is occurring over a longer period of time than initially envisioned during the development of the HMMP. This extended timeline has introduced some unanticipated temporal and logistical complexities, which, in turn affect the execution of the habitat monitoring program. In order to appropriately address these unexpected complexities while still adhering to the requirements detailed within the monitoring plan, we have undertaken certain minor adaptations in our approach, which we describe herein where pertinent.

One such necessary adaptation is reflected in the distinction between habitat types and corresponding sampling regions within the context of quantitative assessments discussed in Section 3.0. Because some specific SRERP habitats (i.e., brackish active channel, freshwater active channel, and freshwater active bench) and their respective monitoring task schedules have been partitioned by sub-phase boundaries (e.g., the Phase 2A [Lower] and [Middle] boundary, etc.) due to departures between execution of restoration segments and originally-conceived project timelines, we adopt the convention of designating the aggregated total sub-phase-wide portion(s) of a given habitat as that habitat type's "sampling region" for that respective combination of habitat type and sub-phase (e.g., the Phase 2A [Lower] active bench *sampling region* includes both brackish marsh and freshwater active bench *habitats*, the Phase 2A [Middle] active channel *sampling region* includes both brackish marsh and freshwater active channel *habitats,* the Phase 2A [Middle] active bench *sampling region* consists only of freshwater active bench *habitats* within the Phase 2A sub-phase restoration reach, etc.).

This approach allows for independent analysis of sub-phase-specific portions of sampled habitats, which can then be tracked and evaluated based on respective monitoring schedules and success criteria (driven by time-of-completion) and avoids additional complexity that would otherwise be associated with attempts to track the development of habitat variants within sub-phase restoration reaches (e.g., brackish and freshwater active bench habitat in the Phase 2A [Lower] restoration area, brackish and freshwater active channel habitat in the Phase 2A [Middle] reach, etc.). The primary drawback to this approach is reduced resolution when attempting to draw conclusions from results at the level of habitat sub-types (e.g., brackish vs. freshwater active bench 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.

3.0 Methods

Consistent with the schedule of monitoring requirements (Table 1) provided in the HMMP, the 2021 SRERP habitat monitoring effort consisted of three general tasks: field verification and mapping of the distribution and extent of specific habitats within respective portions of the SRERP project area, quantitative sampling within specific habitats to characterize the composition and structural development of 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 botanist Gabriel Goff. 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 2021) where updated taxonomic classification applies.

3.1 Habitat Mapping & Area Analysis

The HMMP schedule of monitoring tasks (Table 1) only explicitly requires the mapping and analysis of habitat area (acreage) for riparian planting zones in the Phase 1, Phase 2A (Lower), and Phase 2B (Middle) restoration areas in 2021. Although our efforts focused on these specific habitat types in 2021, additional opportunistic observations of changes in the extent of other adjoining SRERP habitat types were also recorded where encountered.

Existing SRERP habitat geographic information system (GIS) data, originally provided by the HCRCD and subsequently updated during the 2016–2020 monitoring efforts (J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b), were refined as necessary in 2021 to develop updated habitat maps reflecting current site conditions. Geographic field data were collected during fieldwork performed throughout August 9–22 and October 28, 2021 using Environmental Systems Research Institute's (ESRI) ArcGIS® Collector application operating on handheld iOS mobile devices paired with external Bad Elf Flex® or Surveyor® Global Navigation Satellite System (GNSS) receivers capable of ≤1 m accuracy (Bad Elf 2021). Updated habitat maps and resulting area (acreage) quantifications were then developed using recently collected geographic data, the most recent available satellite imagery (i.e., ESRI's World Imagery 2021, National Agriculture Imagery Program [NAIP] 2018, Google Earth 2021), and a combination of ESRI's ArcGIS® Online web application, and the following desktop software: ESRI's ArcGIS® and ArcMap™, and Google Earth (2021).

It is important to note that habitat area (acreage) success criteria provided in the HMMP represent total "phase-wide" acreage thresholds, inclusive of upstream areas where restoration has not yet occurred. The success thresholds provided do not reflect any partitioning into "sub-phase" quantities corresponding to the actual progression in which Phase 2A (Lower, Middle, and Upper) and/or Phase 2B (Lower, Middle, and Upper) restoration efforts were ultimately implemented.

In the absence of explicit sub-phase-specific success criteria, original "projected habitat" GIS data created during the development of the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) were appropriately partitioned along sub-phase boundaries to derive proportionately scaled respective area success thresholds for each relevant Phase 2 sub-phase habitat using ArcMap desktop software. These scaled habitat area success thresholds are presented alongside corresponding 2021 habitat area analysis results in Section 4.1 for purposes of evaluating the development of this component of the SRERP.

3.2 Quantitative Vegetation Analysis

Two distinct quantitative sampling efforts were conducted in 2021 to characterize the composition and structural development of the vegetation associated with specific habitats within the SRERP restoration area: percent cover sampling and basal area sampling of arborescent vegetation in riparian planting zones. Both sampling efforts are described in detail below.

3.2.1 Vegetation Percent Cover Sampling

Vegetative percent cover data were collected from August 9–14, 2021 to characterize the composition and structural development of the vegetation within habitats where this task was scheduled to occur during the current monitoring year. For the Phase 2A (Lower) restoration reach: although quantitative vegetation cover sampling was originally only scheduled to occur within the riparian planting zones in 2021, sampling was also carried out in Salt River channel wetland habitats of the same reach following recommendations made (J.B. Lovelace & Associates 2020) upon determining that invasive vegetation exceeded the respective maximum final cover success threshold in those latter habitats during the 2019 habitat monitoring effort. Specific habitat sampling regions where vegetation percent cover sampling occurred in 2021 consisted of:

Phase 1 — Riverside Ranch Tidal Marsh Restoration Area
- Replanted Riparian Forest

Phase 2 — Salt River Corridor Restoration Area

Phase 2A (Lower)

Salt River Channel Wetlands
- Active Channel
- Active Bench

Riparian Planting Zones
- Replanted Riparian Forest
- Active Riparian Berm

Phase 2B (Middle)

Salt River Channel Wetlands

- Active Channel
- Active Bench

Riparian Planting Zones

- Replanted Riparian Forest
- Active Riparian Berm

Phase 2B (Upper)

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, composition, and structural developmental stage of existing vegetation within each sampling region. 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 performed on the most recent preceding SRERP vegetation sampling data for respective habitat types (J.B. Lovelace & Associates 2022a, 2022b), we determined that a minimum sample size of n = 32 should 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%. In a few instances where variability in the vegetation was perceived to be greater, we increased the number of samples accordingly.

Using updated SRERP habitat GIS data and ArcMap desktop software, each phase and sub-phase of the restoration area was partitioned into ecologically distinct vegetation sampling regions of perceived relative homogeneity based on currently mapped restoration habitat design components. ArcMap desktop software was then used to randomly distribute sampling plots throughout each of these sampling areas (Appendix A, Figures 8–12). Given that most sampling regions are composed of multiple, geographically separated polygons, 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 center were then appropriately corrected and uploaded to a task-specific ArcGIS Online webmap, which was made accessible to survey personnel in the field for sample plot location using handheld mobile iOS devices paired with external Bad Elf GNSS receivers, and

running ESRI's ArcGIS Collector application. 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,
- invasive, or
- sterile "wheatgrass" hybrid (*Elymus* x *Triticum*);

as well as being:

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

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 ranging from 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 3) used in previous monitoring efforts (H.T. Harvey & Associates 2014 & 2015; J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b) was again used during the 2021 sampling fieldwork to assign a "cover class" to the visually estimated absolute percent cover for each species observed during sampling. Median percent cover values for the range associated with each cover class were then used in subsequent analyses. Although some precision is lost when using such a method, plant-cover abundance scales can be useful in long-term monitoring projects as they serve to reduce observer-based variation between observation periods.

The aforementioned vegetation data were collected using plot-specific field data forms created using ESRI's ArcGIS Survey123Connect desktop software, which were made accessible to survey personnel in the field using mobile devices

Table 3. 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).

equipped with ESRI's Survey123 for ArcGIS mobile application, via links embedded in respective vegetation survey plot layers accessed from ESRI's Collector mobile application. Completed data forms were then uploaded to ESRI's ArcGIS Survey123 web application for subsequent export, management, and analysis.

The relevant vegetation success criteria established in the HMMP consist of *minimum* percent cover thresholds for native species and *maximum* percent cover thresholds for both non-native non-invasive and invasive species. These criteria vary according to the different combinations of habitat type and monitoring year and are summarized below in Tables 4–6. Although no such "percent cover" success criteria are provided in the HMMP for vegetative structural developmental stages, 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 clarification does not alter the requirements established in the HMMP for monitoring the extent (acreage) of riparian habitat throughout the duration of the monitoring period.

Data Analysis

Statistical methods used to analyze percent cover data collected in the 2021 habitat monitoring effort consisted of: 1) non-parametric bootstrap analyses to evaluate the precision of mean percent cover estimates for the various combinations of sampling region and 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, 2015; J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b) 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 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, shrub, vine), 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 2021 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 95% 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 2021 sample sizes for each combination of sampling region where vegetation sampling was conducted and vegetation category for which success criteria are provided in the HMMP. They also serve to provide recommendations for initial sample sizes in subsequent vegetation sampling efforts in these same habitats. Initial calculations revealed that the sample sizes used in the 2021 vegetation percent cover sampling efforts continue to be 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.

Table 4. SRERP Native Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2021). Missing values indicate monitoring years for which no habitat monitoring tasks are required for respective habitats.

Phase		SRERP Habitat Type	Percent Cover Native Plant Species Success Criteria (≥)																	
			2013	2014	2015	2016	2017	2018	2019	2020	**2021**	2022	2023	2024	2025	2026	2027	2028	2029	2030
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%			
	(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%	

[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 in the winter of 2013/2014 (HCRCD 2015a).
[4] Includes both elements (i.e., active channel and active bench) of both brackish marsh and freshwater channel wetlands.

Table 5. SRERP Non-Native Non-Invasive Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2021). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

Phase		SRERP Habitat Type	Percent Cover Non-Native Non-Invasive Plant Species Success Criteria																	
			2013	2014	2015	2016	2017	2018	2019	2020	**2021**	2022	2023	2024	2025	2026	2027	2028	2029	2030
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%			
	(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%	

[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 in the winter of 2013/2014 (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 6. SRERP Invasive Vegetation Sampling Success Criteria.[1]
Bold text indicates the current monitoring year (2021). Missing values indicate monitoring years for which no success criteria have been specified (H.T. Harvey & Associates with Winzler & Kelly 2012).

Phase		SRERP Habitat Type	Percent Cover Non-Native Invasive Plant Species Success Criteria																	
			2013	2014	2015	2016	2017	2018	2019	2020	**2021**	2022	2023	2024	2025	2026	2027	2028	2029	2030
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%			
	(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%	

[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 in the winter of 2013/2014 (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.

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 2021 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 Arborescent Riparian Vegetation Basal Area Assessment

Consistent with the schedule of monitoring requirements (Table 1) provided in the HMMP, we conducted the first basal area sampling fieldwork in the Phase 2B (Middle) restoration reach on October 28, 2021. This effort serves to establish an initial baseline dataset for future comparison against results from subsequent years to further assess the structural development of vegetation within revegetated portions of the restoration area replanted with woody riparian plant species. Specific habitat sampling regions (and respective sample sizes) where basal area sampling was performed in 2021 consisted of:

Phase 2B (Middle) — Salt River Corridor Restoration Area:

Riparian Planting Zones

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

Sampling Design & Data Collection

We utilized the same aforementioned approach, using ArcMap desktop software for the creation of random percent cover sampling plots, to establish randomly distributed basal area sampling plot centroids throughout the sampling regions of the Phase 2B (Middle) restoration reach that had been replanted with woody vegetation. ArcMap was then used to create circular (10-meter radius) basal area sampling plots centered on each randomly located plot centroid. In this instance, due to fact that supplemental replanting of woody species in the freshwater active bench had occurred prior to the first basal area sampling effort in this restoration reach, the active bench sampling region was also included, along with the active riparian berm and replanted riparian forest sampling regions.

New basal area sampling plot GIS data for the Phase 2B (Middle) restoration reach were then appropriately corrected and uploaded to an ArcGIS Online webmap, which was made accessible to survey personnel in the field for sample plot location using the same mobile device and GNSS technology and software previously described herein. Basal-area-specific field data forms were created using ESRI's ArcGIS Survey123Connect desktop software, which were then accessed by field survey personnel as described previously for percent cover data collection and completed basal area data forms were uploaded to ESRI's

ArcGIS Survey123 web application for subsequent export, management, and analysis. Each customized data form allowed for the collection of the following data for all trees located within each plot that were ≥4.5 feet ("breast height") tall: diameter-at-breast-height (DBH), species, and geographic coordinates. Diameter measurements (in millimeters) 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 metric "diameter tape" depending on the size of the measured stem.

In instances where the circular basal area sampling plots extended outside of the boundaries of the targeted sampling regions, 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 narrow and sinuous habitat sampling areas along the riparian corridor of the Phase 2 — Salt River Corridor Restoration Area.) 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. For each sampling plot, the actual coinciding sampled area (in acres) of overlap between the sampling plot and target habitat was subsequently calculated using ArcMap to derive relativized tree-basal-area-per-unit-area-sampled values for use in generating summary statistics and performing comparative analyses.

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).

Data Analysis

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

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

Basal area measurements were then summed for each tree species within each sampling plot and divided by respective actual-plot-area-sampled to derive standardized values of basal-area-per-unit-area-sampled ("BAPA") (ft^2/acre) for each species at the sample plot, sampling region, and sub-phase level. Respective BAPA values were then used to characterize the species composition and basal area contributions of arborescent vegetation in habitats sampled in 2021. Summed raw basal area measurements are also provided in Appendix C.

3.3 Invasive Plant Species Assessment

Throughout the performance of habitat mapping and quantitative vegetation sampling fieldwork (i.e., August 9–22 and October 28, 2021), as well as during additional invasive vegetation-focused site visits, occurrences of invasive vegetation were documented using the aforementioned combination of GIS-software-enabled mobile device and external GNSS receiver technology. The resulting geographic data were then used (utilizing ArcMap software and the previously mentioned recent satellite imagery) to update maps developed over the course of the 2016–2019 habitat monitoring efforts (J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b) to reflect the most current knowledge of the distribution and extent of invasive vegetation occurring throughout the SRERP area. The resulting maps are included in Appendix A (Figures 15–22).

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 and [coarse] abundance of this species throughout the SRERP restoration area (Appendix A, Figures 15 and 16). 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 in Appendix A (Figures 17–22), 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, 2019, 2022a, 2022b) 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 the California Invasive Plant Council (Cal-IPC) (2021) 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 Cal-IPC (2021), are listed as "noxious weeds" by the California Department of Food & Agriculture (CDFA 2021), are listed as "federal noxious weeds" (USDA 2021), 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 (2021) 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 (2021), CDFA (2021), 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 & Associates 2014, 2015; J.B. Lovelace & Associates 2017, 2018, 2019, 2022a, 2022b). Both species are considered by some sources (USDA 2021; 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 obtained in 2021 reflect continued favorable trajectories with respect to the development of projected habitats and associated native vegetation throughout regions of the SRERP footprint addressed during the current effort, with the exception of the riparian planting zones of the Phase 2B (Middle) restoration reach. In these latter habitats, increasing abundance of invasive vegetation coincided with the failure of native vegetation to reach respective minimum cover thresholds established for 2021. Quantitative sampling results also indicate that these sampling regions continue to exhibit only limited establishment of woody riparian vegetation, three years after replanting efforts occurred in this portion of the restoration project area.

Although the abundance of invasive vegetation appears to be increasing throughout all sampled habitats in both the middle and upper Phase 2B restoration reaches as of our 2021 fieldwork, mean estimated cover of invasive plants has decreased between 2019–2021 in replanted riparian forest habitats of the Phase 1 restoration area, as well as in all four sampled habitats in the Phase 2A (Lower) restoration reach. These latter observations suggest that the

achievement of final invasive vegetation cover success criteria is ultimately attainable, particularly if continued and proportionate efforts to reduce and/or eradicate invasive vegetation documented during our 2021 fieldwork are applied. Specific results for the habitat mapping and area analysis, quantitative vegetation sampling, and invasive vegetation assessment aspects of the 2021 monitoring effort are provided in respective sections below.

4.1 Results of Habitat Mapping & Area Analysis

All habitat types for which final success criteria were established in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) exceeded their respective minimum acreage thresholds in 2021. While only certain habitat types required focused mapping and area analysis during the 2021 habitat monitoring effort (Table 1), given that the mapping of any one habitat boundary affects all adjoining habitat boundaries and corresponding areas (acreages), we summarize project-wide habitat area (acreage) totals and respective eventual final success criteria for all relevant SRERP habitats in Tables 7–11, and the observed distribution and extent of each habitat type and relevant associated restoration design components are depicted in Appendix A (Figures 1–7). Salient observations from the 2021 mapping effort and analysis are described below.

4.1.1 Phase 1 — Riverside Ranch Tidal Marsh Restoration Area

No significant changes have occurred in the extent and/or area of any Phase 1 habitats since the previous assessment in 2020 (J.B. Lovelace & Associates 2022b) and all monitored Phase 1 habitat types currently exceed their respective minimum area success thresholds (Table 7). Specifically for 2021, riparian forested areas continue to exceed their collective minimum areal success threshold by 8.92 acres, currently covering 47.94 acres (111% of the projected eventual acreage for this habitat type) (Table 7; Appendix A, Figures 1 and 2).

4.1.2 Phase 2 — Salt River Corridor Restoration Area

Phase 2: Salt River Channel Wetlands

As of the 2021 habitat monitoring effort, the current total area of Phase 2 Salt River channel wetlands is 31.53 acres, 13% (3.66 acres) greater than the proportionately scaled projected extent of this habitat category (27.87 acres) for this point in the implementation of the project (Table 8; Appendix A, Figures 1, 3–7). These consist of 3.79 acres (104% of the respective proportionately scaled projected restored habitat area) of Phase 2 brackish marsh wetland habitat and 27.74 acres (115% of the respective proportionately scaled projected restored habitat area) of Phase 2 freshwater and seasonal wetland habitats (Table 8; Appendix A, Figures 1, 3–7).

The only significant change in the extent and/or area of any Phase 2 Salt River channel wetland habitats since the previous assessment in 2020 (J.B. Lovelace & Associates 2022b) is limited to a 0.78 acre increase in the freshwater active bench habitat in the upper Phase 2B restoration reach. This increase reflects

Table 7. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area: Summary of 2021 Observed Habitat Area & Respective Success Criteria.

	Area (Acres)[1]			
			2021	
Habitats & Restoration Design Components	Projected[2]	Final Success Criteria[3]	Observed	% of Projected
High Marsh Ecotone	**12.38**	**≥11.14**	**34.74**	**281%**
"Tidal Salt & Brackish Marsh"[4]				
Salt Marsh Sensu Stricto	–	–	*204.74*	–
Mudflat[5]	*20.81*	*≥18.73*	*30.32*	*303%*
Aquatic[5]			*32.73*	
Brackish Marsh	–	–	*15.71*	–
Upland	–	–	*20.00*	–
"Tidal Salt & Brackish Marsh"[4] Total	**321.77**	**≥289.59**	**303.50**	**94%**
Riparian Habitat				
Existing Riparian Forest	–	–	*25.44*	–
Replanted Riparian Forest	–	–	*22.50*	–
Riparian Habitat Total	**43.36**	**≥39.02**	**47.94**	**111%**

[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 documented during the 2021 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 proportionately scaled 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).

refined mapping of restored active bench habitat along the eastern edge of the large stand of retained existing riparian forest within this recently restored reach (Appendix A, Figure 7). Brackish marsh wetland habitat does not occur upstream of the Phase 2A (Middle) restoration reach and, therefore, no further contributions of this habitat type have been documented since the 2016 habitat monitoring effort (J.B. Lovelace & Associates 2017).

Phase 2: Riparian Habitats

Riparian forest habitats cover 83.76 acres of the Phase 2 restoration area, 8% more than the proportionately scaled projected restored area for this habitat type (Table 9; Appendix A, Figures 1–7). These consist of 61.88 acres (Table 10) of retained existing riparian forest (36.36 acres) and original revegetated riparian planting zones (25.52 acres), as well as 21.89 acres of additional supplemental riparian planting areas replanted more recently (Table 11).

Table 8. SRERP Phase 2 — Salt River Corridor Restoration Area: Salt River Channel Wetlands. 2021 Summary of Restored Habitat Areas & Respective Success Criteria.

	Area (Acres)[1]			
			2021	
Habitats & Restoration Design Components	**Projected[2]**	**Final Success Criteria[3]**	**Observed**	**% of Projected**
Brackish Marsh Wetlands				
Brackish Active Channel				
Phase 2A (Lower)	–	–	2.10	–
Phase 2A (Middle)	–	–	0.12	–
Phase 2A (Upper)/2B (Lower)	–	–	0	–
Phase 2B (Middle)	–	–	0	–
Phase 2B (Upper)	–	–	0	–
Brackish Active Channel Total	–	–	*2.22*	–
Brackish Active Bench				
Phase 2A (Lower)	–	–	1.57	–
Phase 2A (Middle)	–	–	0	–
Phase 2A (Upper)/2B (Lower)	–	–	0	–
Phase 2B (Middle)	–	–	0	–
Phase 2B (Upper)	–	–	0	–
Brackish Active Bench Total	–	–	*1.57*	–
Brackish Marsh Wetlands Total	**3.64**	**≥3.28**	**3.79**	**104%**
Freshwater & Seasonal Wetlands				
Freshwater Active Channel				
Phase 2A (Lower)	–	–	0	–
Phase 2A (Middle)	–	–	0.26	–
Phase 2A (Upper)/2B (Lower)	–	–	1.21	–
Phase 2B (Middle)	–	–	0.62	–
Phase 2B (Upper)	–	–	1.65	–
Freshwater Active Channel Total	–	–	*3.74*	–
Freshwater Active Bench				
Phase 2A (Lower)	–	–	3.69	–
Phase 2A (Middle)	–	–	2.71	–
Phase 2A (Upper)/2B (Lower)	–	–	5.84	–
Phase 2B (Middle)	–	–	3.64	–
Phase 2B (Upper)	–	–	8.12	–
Freshwater Active Bench Total	–	–	*24.00*	–
Freshwater & Seasonal Wetlands Total	**24.23**	**≥21.81**	**27.74**	**115%**
Salt River Channel Wetlands Total	**27.87**	**≥25.08**	**31.53**	**113%**

[1] Missing values reflect "projected habitat" acreages not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly defined habitat components documented during the 2021 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.

Table 9. SRERP Phase 2 — Salt River Corridor Restoration Area: 2021 Summary of riparian planting area contributions to the total acreage of Phase 2 riparian forest habitats.

	Phase 2 Riparian Forest Habitat Area (Acres)[1]			
	Projected[2]	Final Success Criteria[3]	Observed	% of Projected
Existing Riparian Forest & Riparian Planting Zones	77.51	≥69.76	61.87	80%
Supplemental Riparian Planting Areas	–	–	21.89	–
Total	**77.51**	**≥69.76**	**83.76**	**108%**

[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 documented during the 2021 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 proportionately scaled 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.

Riparian planting zones include 15.97 acres of replanted riparian forest and 9.55 acres of replanted active riparian berm habitats (Table 10). Supplemental riparian planting areas (Table 11) consist of 19.75 acres of freshwater active bench Salt River channel wetland habitat (already included in Salt River channel wetland acreage quantifications presented previously herein[*]) and 2.14 acres of "passive sediment management areas," both of which were retroactively replanted with woody riparian vegetation in 2018–2019 to compensate for reductions in the availability of portions of the Phase 2B (Middle) restoration reach where replanting of woody riparian vegetation could occur.

The extent and total area of retained existing riparian forest and original riparian planting zone habitats distributed throughout the Phase 2A and Phase 2B (Lower, Middle, and Upper) restoration reaches has not changed substantively since our previous habitat mapping fieldwork in 2020 (J.B. Lovelace & Associates 2022b) though some changes to the mapped extent of supplemental riparian planting zones in the middle and upper Phase 2B restoration areas were made in 2021 (Table 10; Appendix A, Figures 3–7). Field documentation of recently installed permanent fencing in the middle Phase 2B restoration reach, which more clearly delineates portions of active bench habitats where supplemental replanting of woody riparian vegetation actually occurred in 2018–2019 resulted in a 0.84 acre decrease in the supplemental riparian planting zone total (Table 10; Appendix A, Figure 6). This decrease was, however, offset by increases (Δ +1.0 acres) in the mapped extent of freshwater active bench habitats within the

[*] It is worth noting that the 19.75 acres of Phase 2 freshwater active bench habitat retroactively replanted with woody riparian vegetation are being applied towards satisfaction of minimum areal success thresholds for both Salt River channel wetland and riparian forest habitats.

Table 10. SRERP Phase 2 — Salt River Corridor Restoration Area: Riparian Forest Habitats. 2021 Summary of Restored Habitat Areas &

	Area (Acres)[1]			
			2021	
Habitats & Restoration Design Components	**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)	–	–	*3.27*	–
Phase 2B (Middle)	–	–	*2.55*	–
Phase 2B (Upper)	–	–	*12.13*	–
Existing Riparian Forest Total	**–**	**–**	**36.36**	**–**
Riparian Planting Zones				
Replanted Riparian Forest				
Phase 2A (Lower)	–	–	8.24	–
Phase 2A (Middle)	–	–	3.47	–
Phase 2A (Upper)/2B (Lower)	–	–	2.89	–
Phase 2B (Middle)	–	–	0.74	–
Phase 2B (Upper)	–	–	0.63	–
Replanted Riparian Forest Total	–	–	*15.97*	–
Active Riparian Berms				
Phase 2A (Lower)	–	–	2.50	–
Phase 2A (Middle)	–	–	1.12	–
Phase 2A (Upper)/2B (Lower)	–	–	2.31	–
Phase 2B (Middle)	–	–	1.22	–
Phase 2B (Upper)	–	–	2.40	–
Active Riparian Berm Total	–	–	*9.55*	–
Riparian Planting Zone Total	–	–	**25.52**	–
Riparian Forest Habitat Total	**77.51**	**≥69.76**	**61.88**	**80%**

[1] Missing values reflect "projected habitat" acreages not specified in the HMMP (H.T. Harvey & Associates with Winzler & Kelly 2012) for the more narrowly defined habitat components documented during the 2021 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.

Phase 2B (Upper) reach which were also revegetated with woody species (Table 10; Appendix A, Figure 7). When combined, these revisions resulted in the net gain of 0.16 acres of supplemental riparian planting zone area (Table 11).

Table 11. SRERP Phase 2 — Salt River Corridor Restoration Area: Supplemental Riparian Forest Planting Areas. 2021 Quantitative summary of previously restored SRERP areas subsequently supplemented with woody riparian plants.

Habitats & Restoration Design Components	Replanted Area (Acres)
Phase 2A (Lower)	
Replanted Sediment Management Area	1.90
Replanted Freshwater Active Bench	2.23
Phase 2A (Lower) Total	*4.13*
Phase 2A (Middle)	
Replanted Sediment Management Area	0.24
Replanted Freshwater Active Bench	2.67
Phase 2A (Middle) Total	*2.91*
Phase 2A (Upper)	
Replanted Freshwater Active Bench	2.88
Phase 2A (Upper) Total	*2.88*
Phase 2B (Lower)	
Replanted Freshwater Active Bench	1.62
Phase 2B (Lower) Total	*1.62*
Phase 2B (Middle)	
Replanted Freshwater Active Bench	2.26
Phase 2B (Middle) Total	*2.26*
Phase 2B (Upper)	
Replanted Freshwater Active Bench	8.09
Phase 2B (Upper) Total	*8.09*
Phase 2 Totals	
Replanted Sediment Management Areas	**2.14**
Replanted Freshwater Active Bench	**19.75**
Phase 2 Total	**21.89**

4.2 Results of Quantitative Vegetation Analyses

4.2.1 Vegetation Percent Cover Sampling Results

Results from the 2021 vegetation percent cover sampling effort indicate that replanted (and volunteer) vegetation continues to establish and develop throughout sampled SRERP habitats. Sampling results also confirm the initiation and continuation of expected vegetation successional processes within these habitats. Findings presented below provide a current quantitative characterization of both the structural composition and native status of vegetation throughout sampling regions visited in 2021, as well as an evaluation of the abundance of specific categories of vegetation (i.e., native, non-native non-invasive, invasive, and the sterile wheatgrass hybrid [*Elymus* x *Triticum*]) as they relate to various relevant restoration success thresholds (Tables 4–6) established in the HMMP. A complete list of all plant species detected during our 2021 vegetation sampling fieldwork, along with their corresponding original (untransformed) absolute mean percent cover and frequency-of-occurrence values is provided in Appendix B.

Structural Composition

Total vegetative cover continues to approach or achieve 100% throughout portions of the SRERP area sampled in 2021 (Table 12; Appendix D, Figure 1). The lowest vegetative cover estimates observed in 2021 (i.e.; $\overline{x} = 87.7\%$, 95% CI [82.0, 91.6] and $\overline{x} = 90.8\%$, 95% CI [84.2, 94.2]) were from active channel sampling regions where periodic inundation and fluvial activity associated with these dynamic channel edge habitats contribute to an expected natural disturbance regime sufficient to maintain some unvegetated substrate. Total vegetative cover exceeded 94% in all other regions sampled in 2021 (Table 12; Appendix D, Figure 1).

Herbaceous Vegetation

The lowest abundance of herbaceous vegetation continues to be observed in more recently restored restoration reaches and/or either in active channel habitats subject to regular fluvial disturbance or in more well-developed riparian replanting zones (e.g., Phase 1, Phase 2A [Lower], etc.) where co-occurring developing shrub and tree canopies exert an increasingly competitive influence and are beginning to "shade out" the associated herbaceous stratum (Table 12). Mean percent cover estimates of herbaceous vegetation ranged from 43.0% (95% CI [31.9, 55.1]) in the Phase 2A (Lower) replanted riparian forest to 98.8% (95% CI [96.6, 99.6]) in the Phase 2B (Middle) active bench (Table 12).

Woody Shrub and Arborescent Vegetation

Woody riparian vegetation is established and developing throughout all sampled riparian planting zones and Salt River channel wetland habitats in 2021 (Table 12). For the most part, favorable patterns of increasing abundance and structural complexity of woody riparian vegetation continued to be observed during our 2021 monitoring fieldwork. In most instances, increasing cover of both shrub and tree strata appears to be directly related to the age of restoration sub-phases (i.e., older restoration areas exhibit greater cover of woody vegetation). One notable departure was evident throughout the Phase 2B (Middle) sampling regions, where low detections of woody vegetation was again documented for the third year in a row (Table 12).

Mean tree cover (Table 12) in sampled replanted riparian forest sampling regions ranged from 35.1% (95% CI [27.0, 43.1]) in the older Phase 2A (Lower) reach to as low as 1.3% (95% CI [0.2, 5.2]) in the Phase 2B (Middle) reach. In active riparian berm sampling regions, mean tree cover ranged from 20.3% (95% CI [13.6, 27.9]) in the older Phase 2A (Lower) reach to only 1.9% (95% CI [0.3, 5.9]) and 0.05% (95% CI [0, 0.1]) in the upper and middle Phase 2B restoration reaches, respectively. A similar pattern was observed with the abundance of woody shrubs (Table 12). Mean estimated cover of shrubs in sampled replanted riparian forest sampling regions ranged from 21.1% (95% CI [14.9, 27.7]) in the Phase 2A (Lower) restoration area to 0% in the Phase 2B (Middle) restoration reach.

Table 12. Structural Composition of Vegetation within 2021 Sampled Habitats. Mean percent cover estimates are in bold and associated 95% confidence intervals follow in brackets. 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	Vine
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area					
Replanted Riparian Forest (n=32)	**100.0** [N/A]	**67.7** [56.0, 77.1]	**20.1** [12.1, 32.0]	**12.2** [7.8, 17.8]	**0** [N/A]
Phase 2 – Salt River Corridor Restoration Area Channel Wetlands					
Phase 2A (Lower) — Salt River Channel Wetlands					
Active Channel (n=33)	**90.8** [84.2, 94.2]	**74.8** [66.0, 82.4]	**4.4** [1.9, 8.7]	**11.6** [6.4, 18.5]	**0** [N/A]
Active Bench (n=32)	**96.7** [93.9, 98.3]	**75.4** [66.6, 82.4]	**4.3** [1.5, 10.4]	**17.0** [10.7, 24.3]	**0** [N/A]
Phase 2A (Lower) — Riparian Planting Zones					
Replanted Riparian Forest (n=32)	**99.2** [95.9, 99.8]	**43.0** [31.9, 55.1]	**21.1** [14.9, 27.7]	**35.1** [27.0, 43.1]	**0** [N/A]
Active Riparian Berm (n=32)	**97.2** [93.9, 98.8]	**63.6** [54.8, 71.5]	**13.2** [8.2, 19.4]	**20.3** [13.6, 27.9]	**0** [N/A]
Phase 2B (Middle) — Salt River Channel Wetlands					
Active Channel (n=32)	**96.1** [92.0, 98.3]	**93.4** [88.9, 96.4]	**0** [N/A]	**2.7** [1.0, 6.9]	**0** [N/A]
Active Bench (n=32)	**99.8** [98.9,100.0]	**98.8** [96.6, 99.6]	**0.3** [0, 1.0]	**0.8** [0, 2.6]	**0** [N/A]
Phase 2B (Middle) — Riparian Planting Zones					
Replanted Riparian Forest (n=32)	**99.4** [97.8, 99.8]	**98.0** [94.5, 99.3]	**0** [N/A]	**1.3** [0.2, 5.2]	**0** [N/A]
Active Riparian Berm (n=32)	**99.1** [97.7, 99.5]	**98.4** [96.5, 99.3]	**0.6** [0, 2.6]	**0.05** [0, 0.1]	**0** [N/A]
Phase 2B (Upper) — Salt River Channel Wetlands					
Active Channel (n=32)	**87.7** [82.0, 91.6]	**77.4** [69.9, 83.4]	**3.1** [1.4, 6.4]	**7.1** [3.9, 12.2]	**0** [N/A]
Active Bench (n=32)	**95.5** [91.9, 97.5]	**91.0** [81.1, 95.5]	**4.4** [0, 13.3]	**0.1** [0, 10.2]	**0** [N/A]
Phase 2B (Upper) — Riparian Planting Zones					
Replanted Riparian Forest (n=32)	**100.0** [N/A]	**64.7** [55.7, 73.1]	**20.8** [15.1, 28.8]	**14.5** [9.3, 21.5]	**0** [N/A]
Active Riparian Berm (n=33)	**94.1** [89.9, 96.5]	**88.6** [82.5, 92.8]	**3.6** [1.3, 8.6]	**1.9** [0.3, 5.9]	**0** [N/A]

Outside of riparian planting zones, woody vegetation is also establishing in Salt River channel wetland habitats. Mean cover of establishing trees (Table 12) in active channel sampling regions ranged from 11.6% (95% CI [6.4, 18.5]) in the Phase 2A (Lower) restoration reach to 2.7% (95% CI [1.0, 6.9]) in Phase 2B (Middle) reach. In active bench sampling regions visited in 2021, estimated mean cover of trees reached a maximum of 17.0% (95% CI [10.7, 24.3]) in the Phase 2A (Lower) restoration reach, but was > 1% in both the upper and middle Phase 2B restoration area (Table 12).

Estimated mean cover of shrub species throughout both active channel and active bench sampling regions visited in 2021 ranged between 3.1% and 4.4% in the Phase 2A (Lower) and Phase 2B (Upper) restoration reaches, and was only barely present in the Salt River channel wetland habitats of the Phase 2B (Middle) restoration area (0.3%; 95% CI [0, 1.0] in the active bench) (Table 12).

Community Composition

Native Vegetation

Native vegetative cover exceeded respective minimum success thresholds (Table 4) in all habitats sampled in 2021 (Table 13; Appendix D, Figure 2) except in the Phase 2B (Middle) restoration area where native vegetation cover estimates for active riparian berm ($\overline{x} = 21.2\%$, 95% CI [13.7, 29.9]) and replanted riparian forest ($\overline{x} = 22.5\%$, 95% CI [15.7, 31.0]) sampling regions fell short of the ≥30% minimum cover threshold for that specific combination of vegetation type, restored habitat type, and monitoring year. Estimated native vegetative cover ($\overline{x} = 30.5\%$, 95% CI [21.2, 41.5]) in the active bench sampling region of the same restoration reach also barely exceeded the ≥30% minimum cover threshold for this third monitoring year for the Phase 2B (Middle) reach (Table 13; Appendix D, Figure 2). Similarly, estimated native vegetative cover in the Phase 1 replanted riparian forest sampling region ($\overline{x} = 60.8\%$, 95% CI [46.7, 72.9]) also barely exceeded the ≥60% minimum cover threshold for that specific combination of vegetation type, restored habitat type, and monitoring year (Table 13; Appendix D, Figure 2).

Non-Native Non-Invasive Vegetation

Mean percent cover sampling estimates for non-native non-invasive vegetation in 2021 (Table 13; Appendix D, Figure 3) ranged from 0.1 [95% CI = 0, 0.2] to 15.9 [95% CI = 9.8, 25.1] in replanted riparian forest habitats of the Phase 2A (Lower) and Phase 2B (Middle) restoration reaches, respectively. The latter case represented the only instance where mean percent cover of non-native non-invasive vegetation exceeded the eventual final maximum cover threshold for this category of vegetation in 2021 (Table 13; Appendix D, Figure 3), and we expect the ultimate satisfaction of this vegetation success criterion throughout the SRERP footprint.

Table 13. Summary of 2021 SRERP Quantitative Vegetation Percent Cover Sampling Results & Respective Success Criteria. Mean percent cover estimates are in bold and associated 95% confidence intervals follow in brackets.

	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	2021 Success Criteria[2]		Observed	Final Success Criteria[3]		Observed	Final Success Criteria[3]		Observed	
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area												
Replanted Riparian Forest (n=32)	**100.0** [N/A]	**60.8** [46.7, 72.9]	≥60%		**5.4** [3.0, 8.7]	<15%		**33.9** [22.9, 46.2]	<5%		**0** [N/A]	
Phase 2 — Salt River Corridor Restoration Area												
Phase 2A (Lower) — Salt River Channel Wetlands												
Active Channel (n=33)	**90.8** [84.2, 94.2]	**72.6** [64.3, 79.5]	≥50%		**1.3** [0.5, 3.1]	<15%		**16.8** [11.3, 25.1]	<5%		**0** [N/A]	
Active Bench (n=32)	**96.7** [93.9, 98.3]	**75.2** [65.9, 81.9]	≥50%		**0.6** [0, 2.0]	<15%		**20.9** [14.0, 30.9]	<5%		**0** [N/A]	
Phase 2A (Lower) — Riparian Planting Zones												
Replanted Riparian Forest (n=32)	**99.2** [95.9, 99.8]	**89.4** [79.6, 94.2]	≥60%		**0.1** [0, 0.2]	<15%		**9.8** [5.2, 19.8]	<5%		**0** [N/A]	
Active Riparian Berm (n=32)	**97.2** [93.9, 98.8]	**79.7** [74.3, 84.8]	≥60%		**1.3** [0.2, 5.6]	<15%		**16.2** [11.2, 22.2]	<5%		**0** [N/A]	
Phase 2B (Middle) — Salt River Channel Wetlands												
Active Channel (n=32)	**96.1** [92.0, 98.3]	**45.3** [35.1, 54.9]	≥30%		**6.9** [3.2, 13.7]	<15%		**43.8** [34.7, 53.9]	<5%		**0** [0, 0.1]	
Active Bench (n=32)	**99.8** [98.9, 100.0]	**30.5** [21.2, 41.5]	≥30%		**6.6** [3.7, 15.0]	<15%		**62.7** [52.1, 72.1]	<5%		**0** [0, 0.1]	
Phase 2B (Middle) — Riparian Planting Zones												
Replanted Riparian Forest (n=32)	**99.4** [97.8, 99.8]	**22.5** [15.7, 31.0]	≥30%		**15.9** [9.8, 25.1]	<15%		**61.0** [52.1, 69.2]	<5%		**0** [N/A]	
Active Riparian Berm (n=32)	**99.1** [97.7, 99.5]	**21.2** [13.7, 29.9]	≥30%		**9.9** [6.1, 15.7]	<15%		**67.9** [59.5, 75.6]	<5%		**0.2** [0, 0.6]	
Phase 2B (Upper) — Salt River Channel Wetlands												
Active Channel (n=32)	**87.7** [82.0, 91.6]	**53.2** [44.8, 61.2]	≥20%		**7.5** [4.2, 12.1]	<15%		**25.9** [19.1, 34.1]	<5%		**1.1** [0.1, 3.8]	
Active Bench (n=32)	**95.5** [91.9, 97.5]	**26.5** [18.7, 36.3]	≥20%		**11.1** [6.1, 19.1]	<15%		**57.4** [47.3, 67.6]	<5%		**0.5** [0.1, 1.7]	
Phase 2B (Upper) — Riparian Planting Zones												
Replanted Riparian Forest (n=32)	**100.0** [N/A]	**60.2** [50.0, 68.9]	≥15%		**7.2** [3.6, 13.9]	<15%		**32.5** [24.1, 41.8]	<5%		**0.1** [0, 0.4]	
Active Riparian Berm (n=33)	**94.1** [89.9, 96.5]	**29.9** [21.2, 39.3]	≥15%		**9.7** [6.3, 14.7]	<15%		**53.5** [44.6, 62.6]	<5%		**0.9** [0.3, 2.6]	

[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).

Invasive Vegetation

Mean percent cover of invasive vegetation exceeded the eventual final maximum cover threshold of <5% in every region sampled in 2021 (Table 13; Appendix D, Figure 4). Invasive vegetation cover estimates obtained in 2021 ranged from 9.8 [95% CI = 5.2, 19.8] in the replanted riparian forest habitat of the Phase 2A (Lower) restoration reach to 61.0 [95% CI = 52.1, 72.1] and 67.9 [95% CI = 59.5, 75.6] in the replanted riparian forest and active riparian berm (respectively) sampling regions of the Phase 2B (Middle) restoration reach where, as presented previously herein, native vegetation cover failed to reach the respective minimum cover threshold for 2021. Mean estimated cover of invasive vegetation increased sharply in all sampling regions of both the middle and upper Phase 2B restoration reaches in 2021, but decreased in this seventh monitoring year – and fourth vegetation sampling effort – in both the Phase 1 replanted riparian forest habitat and in all four sampling regions of the Phase 2A (Lower) restoration reach, as well as in the active riparian berm of the middle Phase 2A reach (Table 13; Appendix D, Figure 4). Additional analysis of invasive vegetation observed during the 2021 habitat monitoring effort is also provided in Section 4.3 (below).

Sterile Wheatgrass Hybrid (*Elymus* x *Triticum*)

The sterile "wheatgrass" hybrid (*Elymus* x *Triticum*) used in initial revegetation efforts to stabilize disturbed soils and reduce erosion upon completion of restoration construction continues to constitute only a small fraction ($\bar{x}$ < 1.5%) of vegetation encountered during sampling fieldwork (Table 13; Appendix D, Figure 5). Our observations continue to suggest that the influence of this plant on total vegetative cover or any other vegetation metric of interest to the monitoring effort is negligible and we expect it will continue to gradually be displaced over time by other vegetation, as intended.

4.2.2 Arborescent Riparian Vegetation Basal Area Sampling Results

Results from our 2021 riparian vegetation basal area sampling fieldwork establish a baseline dataset for the Phase 2B (Middle) restoration reach. In total, we sampled 0.67 acres (12%) of the total combined Phase 2B (Middle) replanted riparian forest, active riparian berm, and active bench sampling regions (5.6 acres) in 2021. While our results clearly reflect the expected incipient stage of recruitment and development of woody vegetation in this first sampling period for the Phase 2B (Middle) restoration area, measured basal area was significantly lower than anticipated. Only 35 saplings (representing six arborescent species) of sufficient height to be recorded were observed across all fifteen 2021 basal area sampling plots (Figure 2; Appendix A, Figure 8). These initial basal area sampling data further corroborate findings from our vegetation cover sampling efforts in this restoration reach previously described herein (Section 4.2.1).

Below, we provide standardized values of measured basal-area-per-unit-area-sampled ("BAPA") (ft^2/acre) for each tree species encountered within each region sampled in 2021 to characterize the species composition and basal area contributions of arborescent vegetation throughout the sampled habitats. Summed raw basal area measurements are provided in Appendix C and the

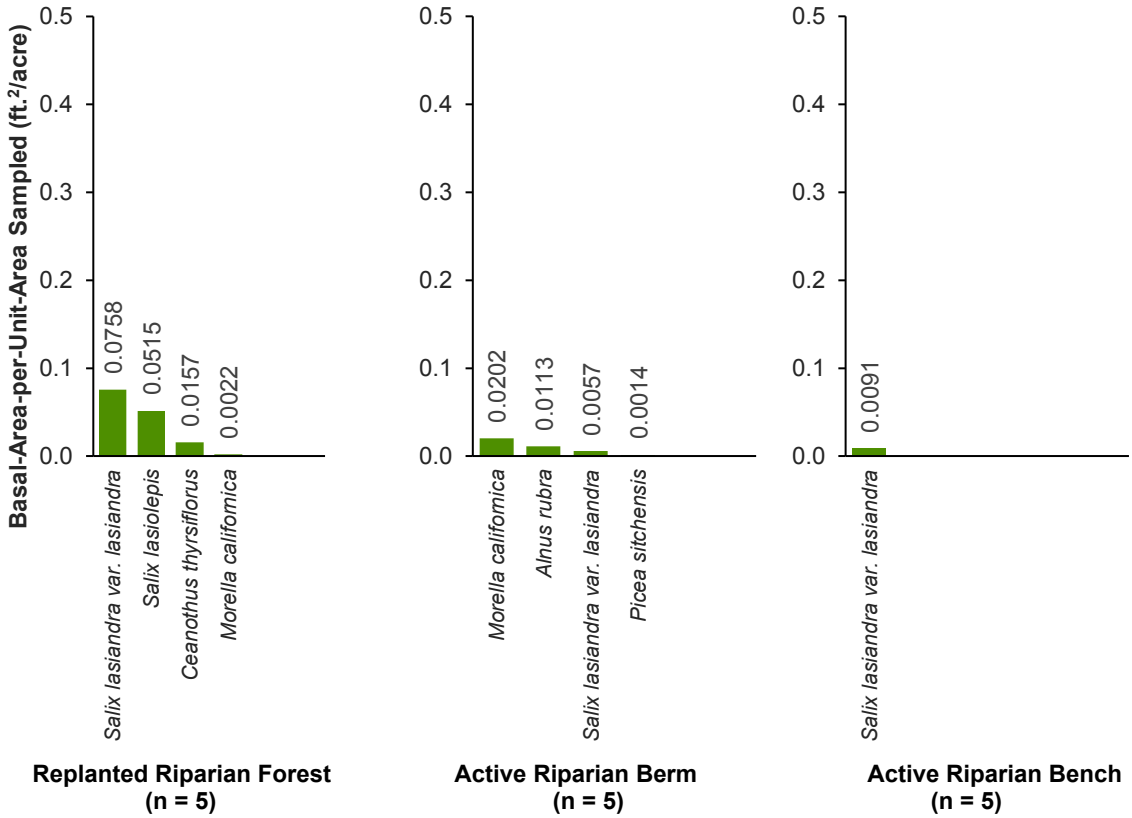

Figure 2. Basal area contributions of arborescent vegetation encountered in 2021 Phase 2B (Middle) basal area sample plots.

distribution of sampling plots and trees encountered during the 2021 sampling effort are depicted in Appendix A (Figure 8).

Replanted Riparian Forest

As part of our first basal area sampling effort for the Phase 2B (Middle) restoration reach, we sampled (n = 5) approximately 18% (0.13 acres) of the total (0.74 acres) replanted riparian forest sampling region in 2021. Observed contributions of arborescent riparian basal area in this sampling region are from (in decreasing order) *Salix lasiandra* var. *lasiandra* ("Pacific willow"), *Salix lasiolepis* ("arroyo willow"), *Ceanothus thyrsiflorus* ("blue blossom"), and *Morella californica* ("wax myrtle") (Figure 2; Appendix A, Figure 8).

Active Riparian Berm

In the active riparian berm sampling region of the Phase 2B (Middle) restoration reach, we sampled (n = 5) approximately 18% (0.22 acres) of the total area (1.22 acres) of this habitat design component in 2021. Contributions of arborescent basal area in this sampling region consist of (in decreasing order) *Morella californica* ("wax myrtle"), *Alnus rubra* ("red alder), *Salix lasiandra* ("Pacific willow"), and *Picea sitchensis* ("Sitka spruce") (Figure 2; Appendix A, Figure 8).

Active Bench

In the active bench habitat of the Phase 2B (Middle) restoration reach, we sampled (n = 5) approximately 9% (0.32 acres) of the total area (3.64 acres) of this habitat design component in 2021. The only basal area contributions in Phase 2B (Middle) active bench sampling region came from six individual *Salix lasiandra* var. *lasiandra* ("Pacific willow") saplings encountered in two of the sampling plots (Figure 2; Appendix A, Figure 8).

4.3 Invasive Plant Species Assessment

Results from the 2021 percent cover vegetation sampling effort discussed in Section 4.2.1 provide quantitative estimates (Table 13) of the current abundance of invasive vegetation in SRERP habitats sampled during 2021, and reveal that this category of vegetation currently exceeds the *eventual* final (maximum) cover success threshold (i.e., <5%) throughout. Additional incidental observations made during our recent habitat mapping analysis and basal area sampling fieldwork support these findings and also indicate the establishment, persistence, and/or development of substantial occurrences of invasive vegetation in regions of the SRERP project area where quantitative vegetation sampling did not occur in 2021 (Appendix A, Figures 9–16). In this section, we present invasive-plant-species-related findings from our 2021 habitat monitoring effort in order to facilitate strategic vegetation maintenance and eradication efforts targeting this problematic category of vegetation. Specifically, we report on the recently observed invasive species distributions throughout the Phase 1 and Phase 2 restoration areas and identify previously undocumented invasive species within the SRERP area.

The current distribution of invasive vegetation throughout the SRERP area is depicted in Appendix A (Figures 9–16). Where feasible, the distributions of individual species were mapped discretely. Where the distributions of multiple co-occurring invasive species overlap, the resulting mosaics are indicated as species "complexes." With increasing time following restoration execution, a consistent (and unsurprising) pattern of invasive vegetation community development is being encountered throughout the SRERP area during fieldwork: established invasive species occurrences are increasing in extent as well as (invasive) species diversity. In many cases, previously mapped single-species occurrences have developed into multi-species complexes and previously mapped complexes are either merging with other adjacent occurrences and/or complexes, or are diversifying to the extent that they are more accurately labeled as "Mixed Herbaceous Invasive Complex." This increasingly common phenomenon renders precise mapping of discrete invasive species distributions impractical in many cases, yet we do so where feasible.

It is important to note that findings presented in this current annual monitoring report specific to portions of the SRERP project area where no habitat monitoring tasks were scheduled for 2021 (Table 1), rely heavily on results from the previous habitat monitoring effort in 2020 (J.B. Lovelace & Associates 2022b) when such areas did receive more focused attention. Though such locations are

not specifically addressed in this narrative, relevant incidental observations documented in 2021 were used to update respective figures in Appendix A where applicable.

4.3.1 Phase 1 — Riverside Ranch Tidal Marsh Restoration Area

Spartina densiflora is still, far and away, the most dominant invasive species within the salt marsh habitat within the Phase 1 restoration area. The 2020 mapped distribution and [coarse] abundance of this species in this restoration area is reproduced here in Appendix A (Figure 9), and incidental observations made during the course of our 2021 assessment of the Phase 1 replanted riparian forest did not indicate the need for mapping refinements at that time.

Vegetation percent cover sampling results from the Phase 1 replanted riparian forest sampling region show a 9.8% decrease in the percent cover of invasive vegetation (Table 13; Appendix D, Figure 4) since the previous sampling effort was performed in 2019. *Agrostis stolonifera* ("creeping bent") continues to be the most abundant ($\overline{x} = 19.6\%$, *s* = 34.6; frequency of occurrence = 41%) invasive species in this sampling region (Appendix B), but both percent cover and frequency of occurrence of this invasive grass have decreased since 2019. Similar decreases in abundance were observed for other dominant invasives in the habitat such as *Holcus lanatus* ("velvet grass"), *Helminthotheca echioides* ("bristly ox-tongue"), *Lotus corniculatus* ("bird's-foot trefoil") and others, though (absolute) percent cover of *Conium maculatum* ("poison hemlock") increased to some extent and *Raphanus sativus* ("radish") — not detected in 2019 — was the second most abundant ($\overline{x} = 7.1\%$, *s* = 19.3; frequency of occurrence = 19%) invasive plant detected in this habitat during 2021 (Appendix B)

Additional observed notable changes in the Phase 1 restoration area (Appendix A, Figure 11) included the detection of additional occurrences of *Cirsium arvense* ("Canada thistle"), *Senecio jacobaea* ("tansy ragwort"), and *Helminthotheca echioides* ("bristly ox-tongue") in and along the access road through the replanted riparian forest habitat between the "N1" and "S1" tidal channels as well as a new occurrence of *Cortaderia jubata* ("pampas grass") along the access road on the setback berm in the eastern portion of the Phase 1 restoration area. In some other instances, portions of the broadly inclusive "Mixed Herbaceous Species Complex" have expanded to incorporate adjacent invasive species since the previous monitoring effort in 2020.

4.3.2 Phase 2 — Salt River Corridor Restoration Area

Invasive plant species previously documented throughout the Phase 2 restoration area (J.B. Lovelace & Associates 2017, 2018, 2019, 2022b) continue to persist in 2021, with some observed changes in their occurrence and distribution (Appendix A; Figures 10, 12–16) since previous respective habitat monitoring efforts. As described previously herein (Section 4.2.1), similar to patterns observed in the replanted riparian forest habitat of the Phase 1 restoration area, mean estimated cover of invasive vegetation decreased throughout all four sampling regions of the lower Phase 2A restoration reach and

the active riparian berm of the middle Phase 2A reach between 2019–2021. The magnitude of observed decrease was as small as 1.5% in the dynamic active channel habitat, but otherwise ranged from between 7.7% in active riparian berm habitats to 22.8% in the replanted riparian forest areas. In most cases, invasive species diversity increased within sampling regions while both measures of abundance, (absolute) cover and frequency of occurrence, decreased.

In the downstream portions of the Phase 2A (Lower) restoration area more directly subject to tidal influx and brackish water chemistry, the highly invasive *Spartina densiflora* ("dense-flowered cord grass") continues to become established and increase in abundance in brackish Salt River active channel and active bench wetland habitats.

Since the previous vegetation sampling effort occurred in this lower Phase 2A restoration reach in 2019, the frequency of occurrence of *S. densiflora* increased from 9% to 24% in the active channel sampling region where (absolute) percent cover also increased from 2.89% (*s* = 11.48) to 5.39% (*s* = 13.09) (Appendix B). Similarly, in brackish active bench habitats in this same restoration reach, the frequency of occurrence of *S. densiflora* increased from 6% to 22% and (absolute) percent cover also increased from 0.56% (*s* = 2.69) to 2.91% (*s* = 5.93) (Appendix B). The 2020 mapped distribution and [coarse] abundance of this species in lower Phase 2A restoration reach is reproduced here in Appendix A (Figure 10), and incidental observations made during the course of our 2021 assessment throughout the Phase 2 restoration area did not indicate the need for mapping refinements at that time. One additional invasive grass species, known from the Phase 1 region but previously undetected in the Phase 2 restoration area, was encountered in brackish active bench habitats of the lower Phase 2A reach: *Parapholis strigosa* ("hairy sickle grass") (Appendix A, Figure 12).

Further upstream and/or away from the active channel edge where freshwater contributions sufficiently dilute saline tidal hydrochemistry, the majority of the invasive vegetation throughout the freshwater portions of the Phase 2 — Salt River Corridor Restoration Area is transitioning from what appears, in the context of this restoration project, to be an early successional mixed assemblage of *Phalaris arundinacea* ("reed canary grass"), *Agrostis stolonifera* ("creeping bent"), *Holcus lanatus* ("velvet grass"), and *Ranunculus repens* ("creeping buttercup") to a varyingly more diverse invasive community that also typically includes *Lotus corniculatus* ("bird's-foot trefoil"), *Helminthotheca echioides* ("bristly ox-tongue"), *Dipsacus fullonum* ("wild teasel"), *Cirsium arvense* ("Canada thistle"), *Cirsium vulgare* ("bull thistle"), and others (Appendix A, Figures 12–16; Appendix B).

Glyceria declinata ("low manna grass") also continues to respond as an early successional invasive wetland plant within the Phase 2 area (Appendix A, Figures 18–22; Appendix B). This grass establishes widely throughout active channel, active bench, and to a lesser extent, active riparian berm habitats

following disturbance, but gradually becomes displaced by more competitive co-occurring species. Along active channel edge habitats subject to periodic fluvial disturbance, however, this species continues to persist. Such a pattern was observed in 2021 where the distribution of *G. declinata* had contracted from significant portions of the active berm and active bench habitats of the upper and middle Phase 2B restoration areas since the previous monitoring effort in 2020, though this species was still consistently observed along much of the active channel edge throughout these areas (Appendix A, Figures 15–16).

Typha latifolia ("broad-leaved cattail") is also associated with active channel edge, channel alcoves, and other slackwater environments (Appendix A, Figures 18–22; Appendix B) where continued growth and development has the potential to contribute to channel aggradation and occlusion. Five additional occurrences of *T. latifolia* were detected in the active bench habitats of the lower Phase 2A restoration reach in 2021 (Appendix A, Figure 13).

Much of the aforementioned invasive vegetation that occurs in the Phase 2 Salt River channel wetland habitats also extends into the adjacent, and often interdigitating, active riparian berm and replanted riparian forest areas along transitional gradients between these habitat components (Appendix A, Figures 12–16; Appendix B). These latter habitat components are situated at slightly higher elevations with marginally better drainage, and also support additional invasive species that are not found as frequently at lower elevations. Such species include *Helminthotheca echioides* ("bristly ox-tongue"), *Cirsium arvense* ("Canada thistle"), *Cirsium vulgare* ("bull thistle"), *Conium maculatum* ("poison hemlock"), *Senecio jacobaea* ("tansy ragwort"), *Rubus armeniacus* ("Himalayan blackberry"), *Silybum marianum* ("milk thistle"), *Hedera helix* ("English ivy"), *Cortaderia jubata* ("pampas grass"), and *Bromus tectorum* ("cheat grass"), among others (Appendix A, Figures 12–16; Appendix B).

Additional invasive species occurrences detected in these higher elevation habitats in 2021 included six additional occurrences of *Senecio jacobaea* ("tansy ragwort") observed in both active riparian berm and replanted riparian forest edge habitats, *Rubus armeniacus* ("Himalayan blackberry") in the active riparian berm of the Phase 2B (Middle) restoration reach, *Cortaderia jubata* ("pampas grass") in active riparian berm habitats of the upper Phase 2A and middle Phase 2B reaches, and *Hedera helix* ("English ivy") seedlings becoming established in the replanted riparian forest edge of the lower Phase 2A sampling region (Appendix A, Figures 12–16).

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

The invasive grass, *Phalaris arundinacea* ("reed canary grass"), continues to be present (Appendix A, Figures 11–16) and increasing in abundance throughout much of the SRERP area. This species was encountered in every sampling region we visited during our 2021 vegetation cover sampling effort (Table 14; Appendix A, Figures 11–16; Appendix B). *Phalaris arundinacea* was found to be

Table 14. Abundance of *Phalaris arundinacea* (reed canary grass) in 2021 SRERP Quantitative Vegetation Sampling Plots.

SRERP Habitat Sampling Areas	Varying Measures of Abundance of *Phalaris arundinacea* (reed canary grass)		
	Mean Percent Cover[1]	Frequency of Occurrence[2]	% of Total Invasive Vegetative Cover[3]
Phase 1 — Riverside Ranch Tidal Marsh Restoration Area			
Replanted Riparian Forest (n = 32)	**0.01** [0, 0.03]	3%	6%
Phase 2 — Salt River Corridor Restoration Area			
Phase 2A (Lower) — Salt River Channel Wetlands			
Active Channel (n = 33)	**1.0** [0.2, 2.5]	12%	11%
Active Bench (n = 32)	**7.5** [3.4, 15.4]	34%	56%
Phase 2A (Lower) — Riparian Planting Zones			
Replanted Riparian Forest (n = 33)	**3.6** [1.2, 11.5]	19%	51%
Active Riparian Berm (n = 32)	**6.5** [3.3, 11.7]	38%	79%
Phase 2B (Middle) — Salt River Channel Wetlands			
Active Channel (n = 32)	**29.6** [21.7, 39.9]	88%	97%
Active Bench (n = 32)	**14.8** [8.7, 24.9]	47%	36%
Phase 2B (Middle) — Riparian Planting Zones			
Replanted Riparian Forest (n = 32)	**11.9** [4.9, 24.7]	31%	25%
Active Riparian Berm (n = 32)	**24.7** [16.7, 34.5]	66%	53%
Phase 2B (Upper) — Salt River Channel Wetlands			
Active Channel (n = 32)	**13.3** [8.4, 20.0]	66%	70%
Active Bench (n = 32)	**38.5** [29.0, 49.5]	91%	93%
Phase 2B (Upper) — Riparian Planting Zones			
Replanted Riparian Forest (n = 32)	**7.7** [4.2, 14.0]	44%	39%
Active Riparian Berm (n = 33)	**26.4** [19.3, 35.6]	82%	72%

[1] Relativized mean percent cover estimates are in bold and associated 95% confidence intervals follow in brackets.
[2] Calculated as the number of sampling plots where *Phalaris arundinacea* occurred, divided by the total number of sampling plots in respective sampling regions.
[3] Calculated as the (relativized) mean percent cover of *Phalaris arundinacea* divided by the (relativized) mean cover of invasive vegetation in respective sampling regions.

least abundant in the Phase 1 replanted riparian forest habitat ($\overline{x} = 0.01\%$ (95% CI [0, 0.03]; frequency of occurrence = 3%) and was most abundant in the middle and upper Phase 2B restoration areas, where the species reached its greatest estimated cover ($\overline{x} = 38.5\%$, 95% CI [29.0, 49.5]) and frequency of occurrence (91%) in the active bench of the Phase 2B (Upper) restoration reach (Table 14; Appendix B).

The contribution of this species to total invasive species abundance in 2021 (calculated as a percentage of mean total invasive vegetative cover recorded in respective sampling regions), was as low as 6% of invasive vegetative cover in the Phase 1 replanted riparian forest sampling region, and otherwise ranged from comprising 11% of the invasive vegetation in the active channel of the Phase 2A (Lower) restoration reach to as much as 97% in the active channel in the Phase 2B (Middle) restoration area (Table 14; Appendix B).

5.0 Special Status Plant Species

During the course of our 2021 habitat monitoring fieldwork, additional incidental observations of two special status plant species (Table 15) were made in both the Phase 1 — Riverside Ranch and the lower Phase 2A — Salt River Corridor Restoration Areas: *Carex lyngbyei* ("Lyngbye's sedge") and *Angelica lucida* ("sea-watch"). Both species have been documented within the SRERP restoration area previously (J.B. Lovelace & Associates 2020, etc.) and continue to become established in restored coastal wetland habitats. *Carex lyngbyei* was encountered in regularly flooded portions of salt marsh *sensu stricto* and high marsh ecotone habitats in the Phase 1 restoration area (Appendix A, Figure 17) and in similar water regimes in brackish Salt River channel wetlands (both active channel and active bench) in the Phase 2A (Lower) restoration area (Appendix A, Figure 18). *Angelica lucida* was found in the Phase 1 restoration area in graminoid-dominated portions of replanted riparian forest habitat as well as at higher elevations within the high marsh ecotone (Appendix A, Figure 16). In the Phase 2A (Lower) restoration area, *A. lucida* was encountered in a few instances at higher elevations (i.e., less saline conditions) in brackish Salt River channel wetlands, as well as in both active riparian berms and in the graminoid-dominated understory along the periphery of replanted riparian forest habitats (Appendix A, Figure 18).

The primary threat to *Carex lyngbyei* identified within the SRERP project footprint is exclusion due to the continued establishment and spread of the invasive *Spartina densiflora* ("dense-flowered cord grass"). The other special status species, *Angelica lucida*, was primarily observed in habitats dominated by grasses such as *Deschampsia cespitosa* ("tufted hair grass"), and often along the peripheries of riparian planting zones. Gradual conversion of some of these areas to shaded riparian forests may lead to the eventual exclusion of some observed occurrences of *A. lucida*, though the only immediate threat to this species observed during our 2021 fieldwork continues to be potential grazing by goats along the northern bank of the Salt River in the lower Phase 2A restoration area.

It is important to emphasize that the distributions of these two species depicted in Appendix A (Figures 16–18) reflect incidental observations made during the performance of various habitat monitoring tasks. Focused, species-specific botanical surveys were not performed throughout the SRERP project area, and it

Table 15. Special Status Botanical Species Observed Incidentally within the SRERP Restoration Area in 2021.

	Carex lyngbyei **("Lyngbye's sedge")**	***Angelica lucida*** **("sea-watch")**
Family	Cyperaceae ("sedge family")	Apiaceae ("carrot family")
Federal Listing Status (ESA)[1]	None	None
State Listing Status (CESA)[2]	None	None
California Rare Plant Rank[3] (& Rank Description)	2B.2 (Rare or endangered in California, common elsewhere; fairly endangered in California)	4.2 Limited distribution in California; fairly endangered in California)
State Rank[3]	S3 (Vulnerable)	S3 (Vulnerable)
Global Rank[3]	G5 (Secure, considering populations outside of California)	G5 (Secure, considering populations outside of California)
Published[3] Known Threats	(Possibly) grazing, non-native plants, habitat disturbance	(Possibly) non-native plants
Observed Threats[4]	Grazing (domesticated goats & dairy cattle), Exclusion related to encroachment of *Spartina densiflora*	Grazing (domesticated goats)

[1] 50 CFR §17.12
[2] CCR, Title 14, §670.5
[3] CNPS (2021)
[4] Personal observation (2019–2021), from within the SRERP restoration area

is possible that additional occurrences of both aforementioned species, as well as possibly other special status species, may also occur elsewhere within the SRERP restoration area footprint.

6.0 Discussion & Recommendations

Results presented herein for the 2021 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, while simultaneously reinforcing the need for continued and proportionate invasive vegetation management actions to ensure that those goals are ultimately achieved. Specific considerations for each aspect of the 2021 habitat monitoring effort follow.

6.1 Habitat

Our findings from 2021 confirm the continued development of restored SRERP habitats, all of which are expected to continue to meet or exceed their respective

minimum area success thresholds indicated in the HMMP. Associated native vegetation appears to be establishing successfully throughout the majority of completed portions of the restoration footprint, suggesting reasonable potential for the eventual realization of targeted habitat conditions envisioned during the planning of the SRERP. However, established and increasingly abundant invasive vegetation throughout much of the SRERP restoration area does have the potential to exclude co-occurring native plants and substantially compromise the ecological value of some of these habitats.

6.2 Vegetation

Community Composition

The abundance of native vegetation continues to increase throughout portions of the SRERP area sampled in 2021 (Appendix D, Figure 2). However, such "trends" are weak in three of the four sampling regions of the Phase 2B (Middle) restoration reach and the application of such inference is limited in the Phase 2B (Upper) restoration reach with only two years of monitoring data available at the time of this writing. Where native vegetation failed to achieve respective minimum cover success thresholds in both riparian planting zone sampling regions of the Phase 2B (Middle) restoration reach in 2021 (Table 13; Appendix D, Figure 2), the abundance of invasive vegetation has consistently increased since vegetation sampling in these areas began in 2019 (Appendix D, Figure 4). The most significant example of the potential for exclusion of native SRERP vegetation by invasive species is the sustained decrease in native vegetation abundance in salt marsh habitats of the Phase 1 restoration area, coinciding with the increasing colonization of these same habitats by the invasive *Spartina densiflora* ("dense-flowered cord grass") (Appendix A, Figure 9; Appendix D, Figures 2 and 4), addressed in our previous annual monitoring report (J.B. Lovelace & Associates 2022b).

Where enough data are available to assess potential trends in the abundance of non-native non-invasive plants, this vegetation category appears to be decreasing throughout habitats sampled in 2021 (Appendix D, Figure 3). These observations seem to indicate a reasonable likelihood of maintaining percent cover of this category of vegetation below the final maximum threshold of <15% (Table 5), including in 2022 — the final monitoring year for which vegetation percent cover sampling was planned for the combined Phase 2A (Upper)/2B (Lower) restoration reach (Table 1).

The HMMP (H.T. Harvey & Associates with Winzler & Kelly. 2012) specifically addresses one such non-native non-invasive plant — the sterile "wheatgrass" hybrid (*Elymus* x *Triticum*), used in initial revegetation efforts to stabilize disturbed soils — and states that vegetative cover of this plant shall not count towards satisfaction of [native] vegetation success criteria. For this reason, this hybrid is being tracked separately during annual habitat monitoring efforts to gauge its contribution to the cover of sampled vegetation.

As mentioned previously herein, our 2021 sampling results indicate that this hybrid grass continues to constitute only a small fraction of vegetation encountered during sampling fieldwork and we expect it will continue to rapidly be displaced by other vegetation, as intended. In light of our repeated documentation of the expedient exclusion of this plant and it's lack of significant influence on vegetative cover throughout the SRERP footprint (Appendix D, Figure 5), we suggest that it no longer be separately assessed. Rather, we recommend including it among other non-native-non-invasive species in future habitat monitoring efforts.

Mean estimated cover of invasive vegetation increased sharply in all sampling regions of both the middle and upper Phase 2B restoration reaches in 2021 (Table 13; Appendix D, Figure 4), reflecting real and potential trends of increasing abundance of invasive species therein. In contrast, invasive vegetation cover decreased in this seventh monitoring year – and fourth vegetation sampling effort – in both the Phase 1 replanted riparian forest habitat and in all four sampling regions of the Phase 2A (Lower) restoration reach following previously increasing trends in almost all cases throughout the preceding sampling events (Table 13; Appendix D, Figure 4).

It is not yet clear whether the decrease in invasive species abundance observed in the latter (and older) five sampling regions in 2021 is an anomalous event along an otherwise increasing trajectory, whether it represents the attainment of a more or less "stable" plateau of abundance in these habitats, or rather, an inflection point, after which, a sustained decrease in abundance will occur (potentially driven by successional processes). Should invasive vegetation continue to decrease in abundance in these habitats, it may be possible to reduce areal cover of this category of vegetation over the next few years to the extent that the respective eventual final maximum invasive cover success criterion (i.e., <5%) is satisfied, particularly if proactive invasive species eradication efforts are implemented. However, in these sampling regions and elsewhere throughout the SRERP footprint, it is unlikely that the abundance of invasive vegetation will decrease to the extent that the final maximum success criterion will be satisfied within the respective 10-year habitat monitoring periods for each sub-phase unassisted.

In light of these results, we recommend the continued implementation of invasive species management efforts and the continuation of scheduled periodic quantitative vegetation assessments throughout the project area until it can be demonstrated that the abundance of the various categories of vegetation satisfy their respective final success criteria.

Structural Composition

Woody riparian vegetation continues to establish and develop throughout most riparian planting zones in the Phase 1 and Phase 2 restoration areas. Our 2021 field observations also reflect continued establishment of replanted and volunteer woody riparian vegetation in Salt River channel wetland habitats throughout the

Phase 2 restoration area as well. While the majority of the riparian vegetation encountered during our 2021 habitat monitoring fieldwork is the result of extensive revegetation efforts following restoration habitat modification, it is also apparent that volunteer recruitment from *in situ* propagule sources contributes to results reported herein.

The continued poor establishment of woody vegetation in replanted portions of the Phase 2B (Middle) restoration reach is evident from both our 2021 vegetation cover and basal area sampling results. Reasons for the deficient response of woody vegetation in this restoration reach are not entirely clear, though extended regional drought conditions and historic livestock-related mortality of young saplings are likely contributing factors. Local precipitation data (CDWR & USGS 2021) for the period between revegetation efforts in the Phase 2B (Middle) restoration reach and our 2021 habitat monitoring effort reflect consistent abnormally dry climatic conditions for the Humboldt Bay vicinity, where accumulated precipitation was only 66% and 59% of "normal" (NOAA 2021) for the 2019–2020 and 2020–2021 "water years"[†] (respectively).

Although no livestock-related impacts to replanted woody vegetation were observed in this reach during our 2021 fieldwork, livestock damage to replanted saplings was documented in this area during the preceding 2020 habitat monitoring effort (J.B. Lovelace & Associates 2022b). In light of the consistently low detections of woody species in this portion of the project area throughout the 2019–2021 sampling efforts, additional supplemental revegetation of woody species should be considered in order to achieve adequate cover of forested riparian vegetation during the monitoring period for this location.

Elsewhere in the restoration area, disturbances to developing vegetation from domestic livestock (i.e., cattle and/or goats) does continue to occur in both the lower Phase 2A restoration area as well as in the Phase 2B (Upper) reach. Associated vegetative impacts observed in 2021 included grazing, trampling, and soil disturbance, as well as browsing of riparian and understory vegetation within existing and replanted riparian forest habitats. In some cases, the latter form of disturbance is occurring in close proximity to observed occurrences of the special status plant species, *Angelica lucida* ("sea-watch") (Appendix A, Figure 18).

Impacts to establishing vegetation from livestock continue to have the potential to preclude the realization of final vegetation-related success criteria throughout the SRERP footprint if they are not effectively managed and/or prevented from entering the restoration area. Appropriate livestock management practices and maintenance of effective perimeter fencing around the restoration area will continue to help prevent adverse impacts to vegetation from domesticated herbivores.

[†] The "water year" is defined as the 12-month period from October 1–September 31 (USGS 2021).

One additional noteworthy impact to vegetation within riparian planting zones was observed in the Phase 2B (Upper) restoration reach in 2021. Here, at least 20 volunteer‡ *Alnus rubra* ("red alder") saplings were intentionally removed by mechanical means (i.e., chainsaws, bladed trimmers/brushcutters, and/or clearing saws) and cast aside. Such intervention has the potential to affect future quantitative assessments of restored riparian forested habitats.

We recommend the continuation of planned future quantitative vegetation sampling efforts to monitor the structural development of vegetation throughout portions of the restoration project area replanted with woody species, as well as the continued removal of browse-protection materials (e.g., wire cages, etc.) throughout the restoration area that are no longer necessary.

6.2.1 Recommended Sample Size

Adequate minimum sample sizes (n) produced from our power analyses varied with vegetation category and sampling region, with the greatest sample size required to satisfy our stated criteria (Section 3.2.1) being 31. Therefore, we continue to recommend a sample size 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 2016–2021 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.

6.3 Invasive Plant Species

Results from vegetation sampling fieldwork conducted as part of annual Salt River Ecosystem Restoration Project habitat monitoring efforts since 2014 continue to reflect increasing trends in the abundance of invasive vegetation throughout much of the SRERP footprint (Appendix D, Figure 4). As discussed previously in this annual monitoring report, invasive 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.

‡ Given the relative abundance of *Alnus rubra* ("red alder") in the SRERP vicinity and ample evidence of its establishment throughout the Phase 2 restoration footprint from *in situ* and adjacent propagule sources, this species has not intentionally been planted in the Phase 2B restoration area (Hansen pers. com.).

Although predicted eventual overstory shading and exclusion of invasive and undesirable vegetation by a developing riparian forest canopy is hoped to provide some degree of passive management in riparian planting zone habitats, substantial production and dispersal of invasive species propagules is likely to occur during the interim. Such successional phenomena may be a contributing factor in observed decreases in invasive vegetation in the older Phase 1 replanted riparian forest areas and all four sampling regions of the Phase 2A (Lower) restoration reach, but these observed decreases are recent and no causal relationship has been determined.

As discussed in previous annual monitoring reports (J.B. Lovelace & Associates 2017, etc.) significant off-site source populations of invasive species occur within the vicinity of the SRERP restoration area, and will continue to complicate 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). Various additional occurrences of invasive species are also established in agricultural areas adjacent to the Phase 2 — Salt River corridor restoration area.

Encouraging anecdotal observations of the effects of targeted grazing to manage an extensive occurrence of invasive grass species (e.g.; *Agrostis stolonifera* ["creeping bent"], *Phalaris arundinacea* ["reed canary grass"], *Holcus lanatus* ["velvet grass"], etc.) along the eastern edge of the setback levee in the Phase 1 restoration area to provide short-grass habitat for the Aleutian Cackling Goose (*Branta hutchinsii leucopareia*) were repeated in 2021 (pers. obs.). Initial observations described during our preceding habitat monitoring effort (J.B. Lovelace & Associates 2022b) suggested that this management action, while not leading to the eradication of any associated invasive species, likely contributes to a reduction in their reproductive potential.

Since 2020, expansion of the use of this management application to the vicinity of the historic Riverside Ranch dairy infrastructure has also substantially reduced the presence of other invasive species (*Conium maculatum* ["poison hemlock"], *Raphanus sativus* ["radish"], *Helminthotheca echioides* ["bristly ox-tongue"], *Dipsacus fullonum* ["wild teasel"], etc.) previously documented at this location in abundance (J.B. Lovelace & Associates 2017, etc.). Anecdotal observations of the vegetation in this latter area in 2021 indicate that the species composition is shifting more towards the invasive "*Phalaris-Agrostis-Holcus* Complex" present in this location prior to the initiation of the SRERP (pers. obs.). While, from a botanical perspective, this may simply represent the conversion of one invasive species complex to another, the latter vegetation type (when managed appropriately) is at least known to provide important migratory habitat for Aleutian

Cackling Goose (*Branta hutchinsii leucopareia*) as well as important breeding habitat for Savannah Sparrow (*Passerculus sandwichensis*) (pers. obs.), both California special status bird species.

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, invasive plant population potential increases by orders of magnitude. Coincident with such population increase comes a proportionate increase in the level of effort and expense required to adequately address invasive vegetation (Figure 3).

In light of such vegetation population dynamics, adequate invasive species management responses should be initiated as early as possible following detection, and should be biologically appropriate 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 rarely effective and do not reduce the need for additional efforts. Early and comprehensive responses typically result in more effective outcomes at reduced long-term expense to land managers, despite initial costs.

Future "final" evaluation intervals for the abundance of different vegetation categories (including invasive vegetation) throughout the SRERP are scheduled to occur every year (except 2026) during the period 2022–2029 (Tables 1, 4–6). Given the amount of time and effort required to implement invasive vegetation management strategies and gauge the resulting effects, any such efforts should be initiated as soon as possible in order to achieve the desired results within the required time periods. Invasive vegetation eradication efforts within the SRERP area should continue throughout respective 10-year monitoring periods as propagules from external sources attempt to become established and as *in situ* seed bank material continues to emerge. Although it is unrealistic to expect that latent invasive species propagules in the seed bank will be exhausted by the end of respective 10-year monitoring periods, invasive vegetation development and reproductive potential can be greatly reduced with sustained and dedicated effort. Indeed, however much progress is made towards successful eradication of invasive vegetation anywhere within the SRERP area will translate into a reduced need (and expense) for future invasive vegetation management attention elsewhere in the restoration project footprint (and beyond).

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

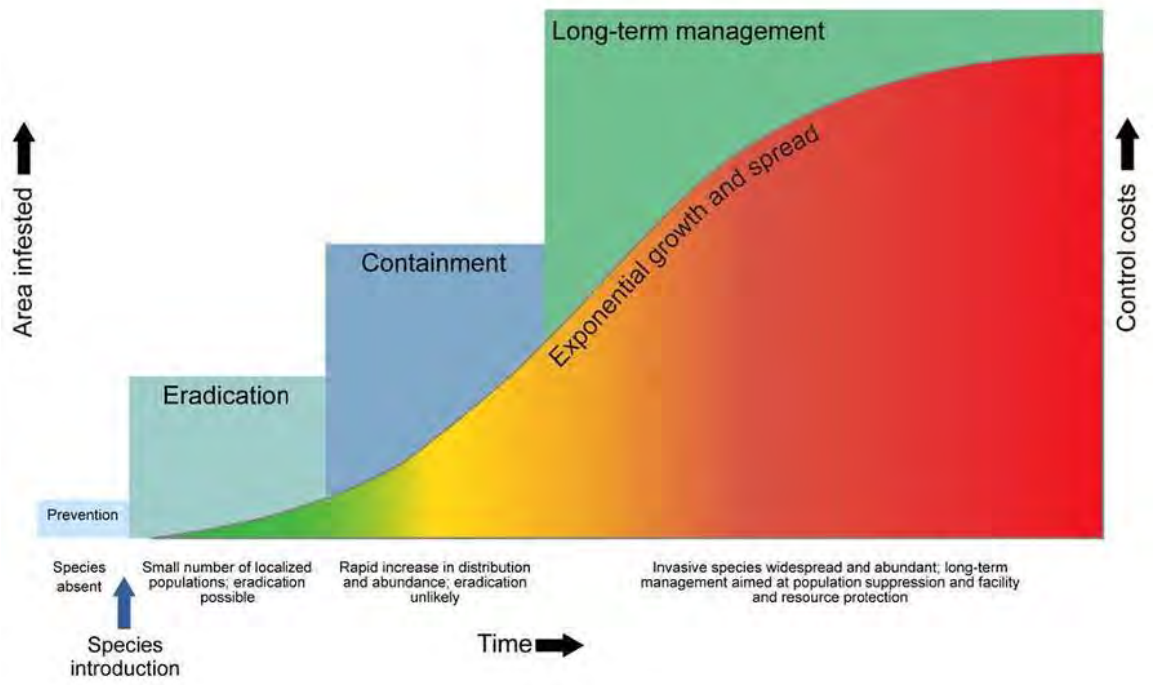

Figure 3. "The Invasion Curve." Sources: National Invasive Species Council; U.S. Department of Agriculture; National Park Service; U.S. Fish and Wildlife Service; Rodgers, L.; South Florida Water Management District; Department of Primary Industries; State of Victoria, Australia; and GAO. GAO 16–49.

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.; *Angelica lucida*, "sea-watch;" *Carex lyngbyei*, "Lyngbye's sedge"), or have the potential (e.g.; *Castilleja ambigua* ssp. *humboldtiensis*, "Humboldt Bay owl's-clover;" *Chlorophyron maritimum* ssp. *palustre*, "Point Reyes salty bird's-beak"; 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 a relevant examples of such an instance.

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.

We continue to recommend performance of scheduled annual percent cover sampling efforts and invasive vegetation assessments throughout the duration of the respective monitoring periods to track and evaluate the abundance of this category of vegetation, and thereby, the relative progress towards the attainment of core restoration goals for the Salt River Ecosystem Restoration Project. Should it appear that success thresholds may not be met, supplemental planting of native species should also be considered, concurrent with invasive vegetation management actions.

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Salt River Ecosystem Restoration Project Figures

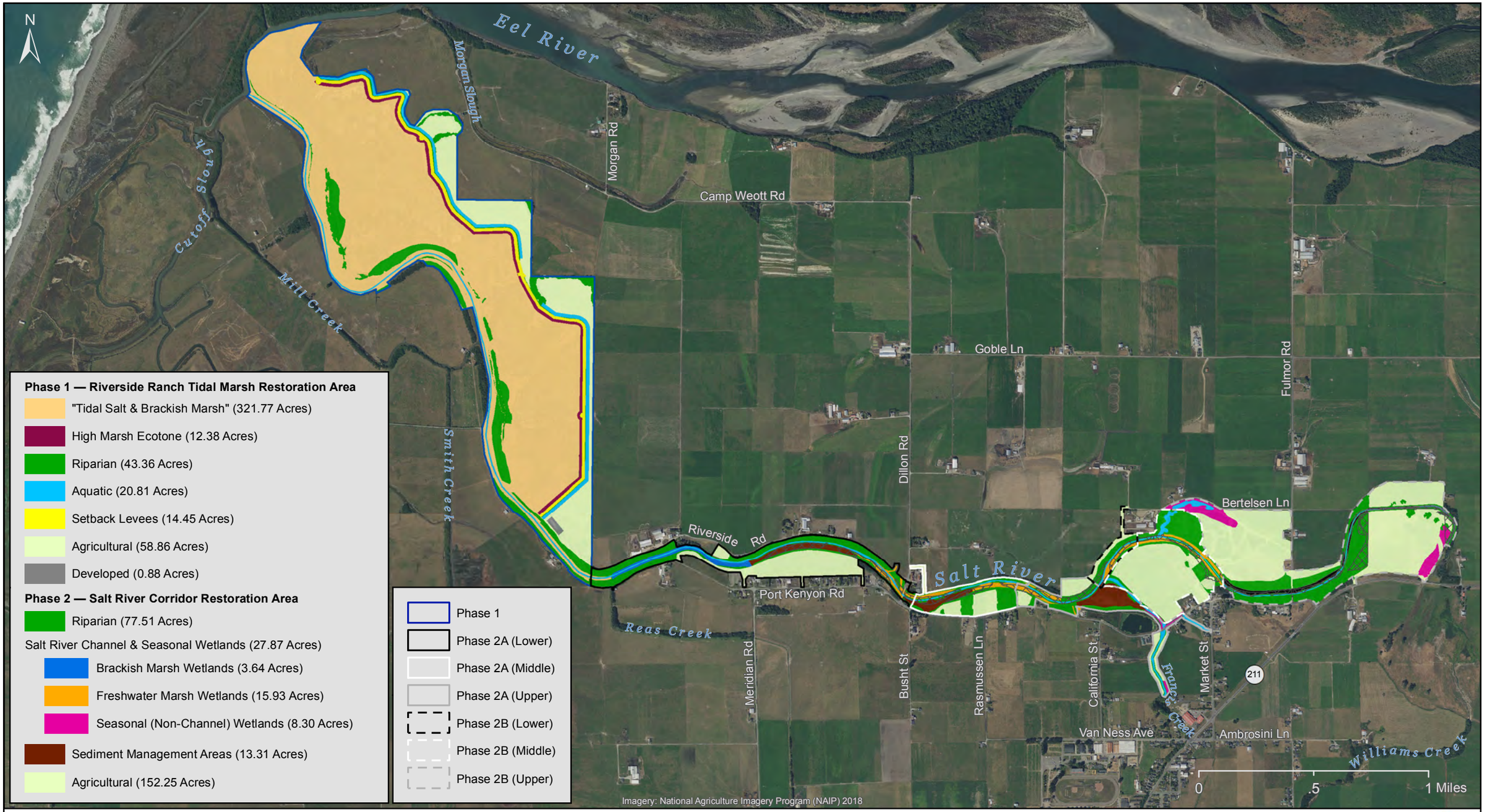

Figure 1. SRERP Projected Habitat Types (Adapted from: H.T. Harvey & Associates and Winzler & Kelly 2012)

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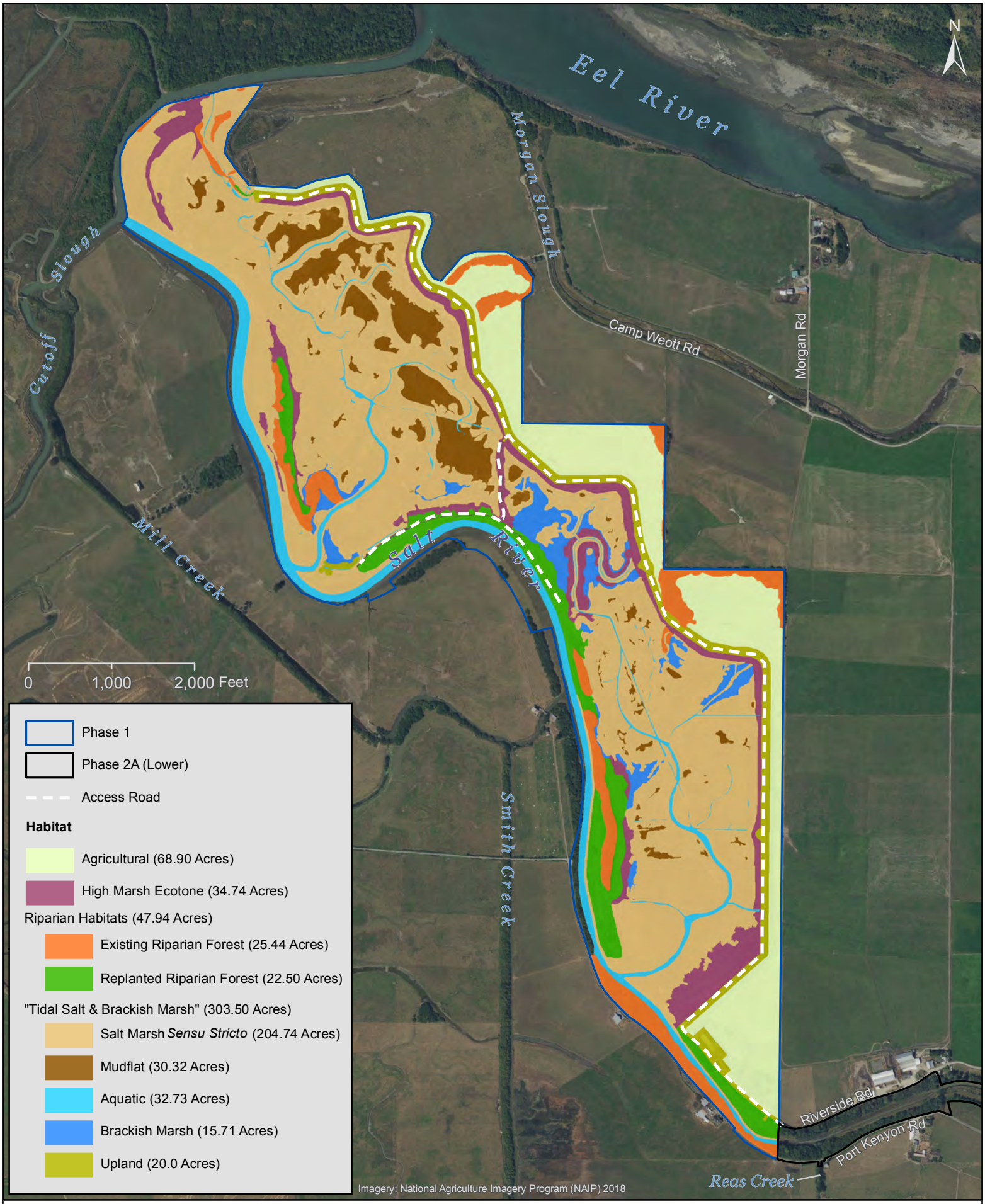

Figure 2. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area Habitats

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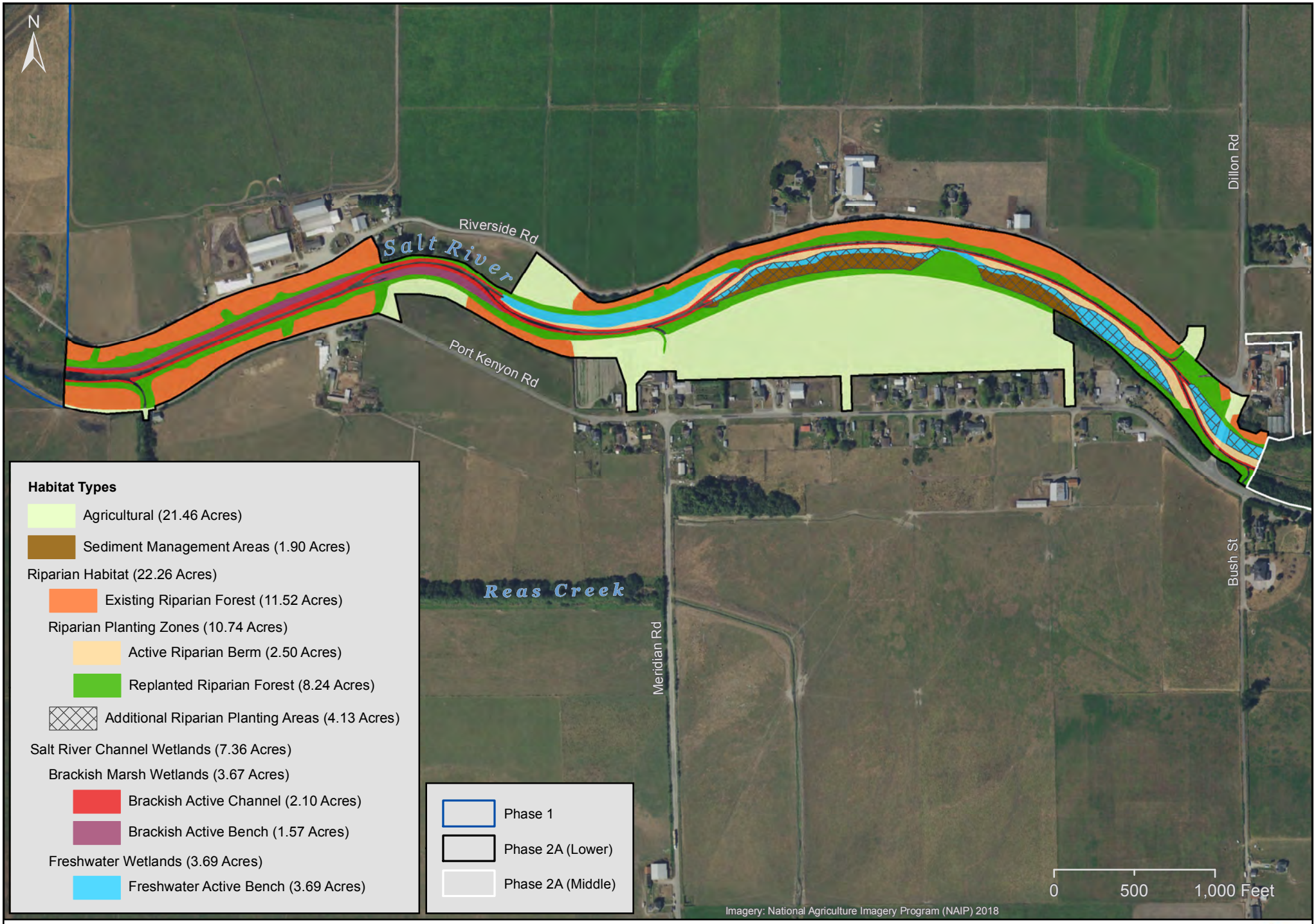

Figure 3. SRERP Phase 2A (Lower) — Salt River Corridor Restoration Area Habitats

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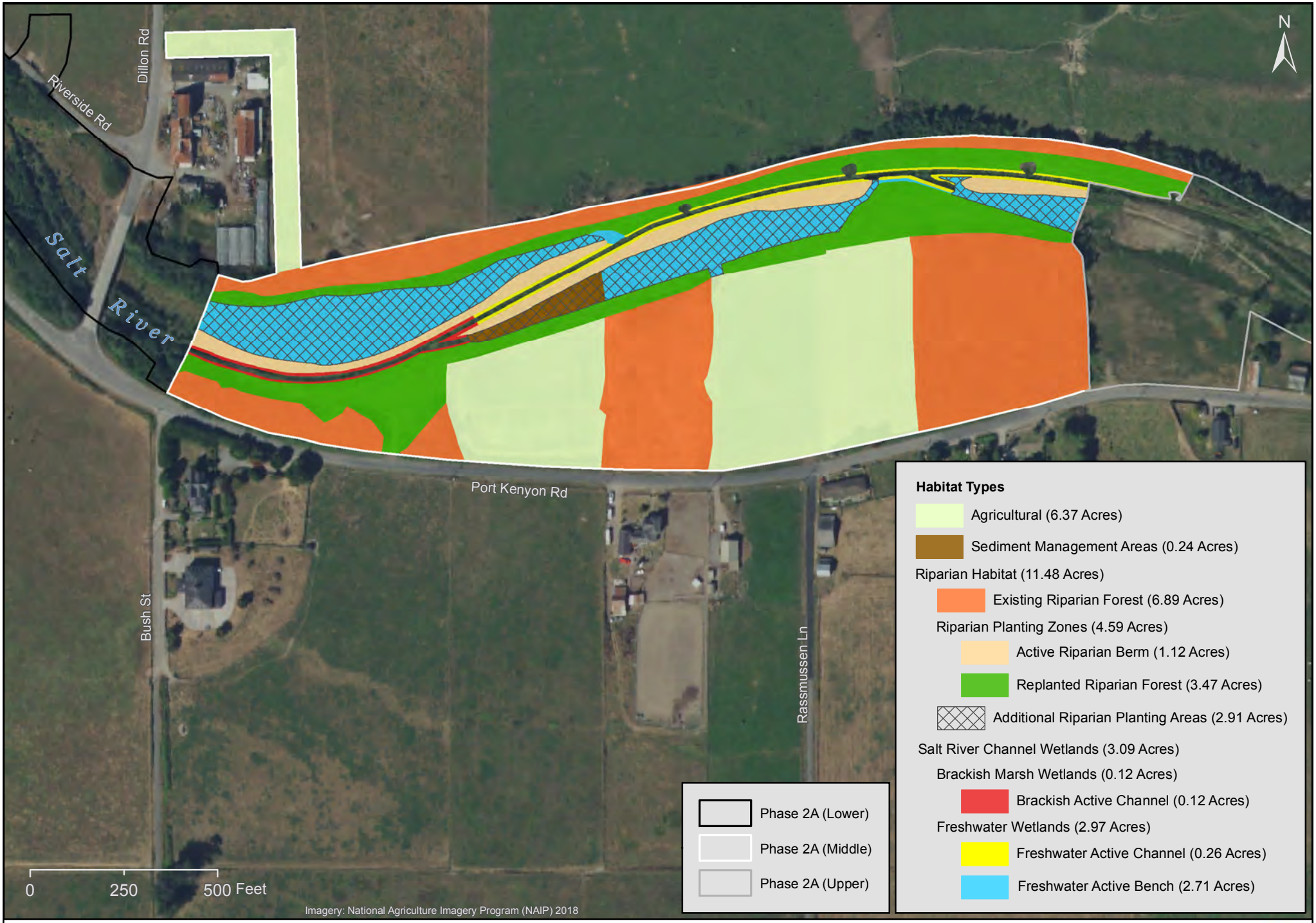

Figure 4. SRERP Phase 2A (Middle) — Salt River Corridor Restoration Area Habitats

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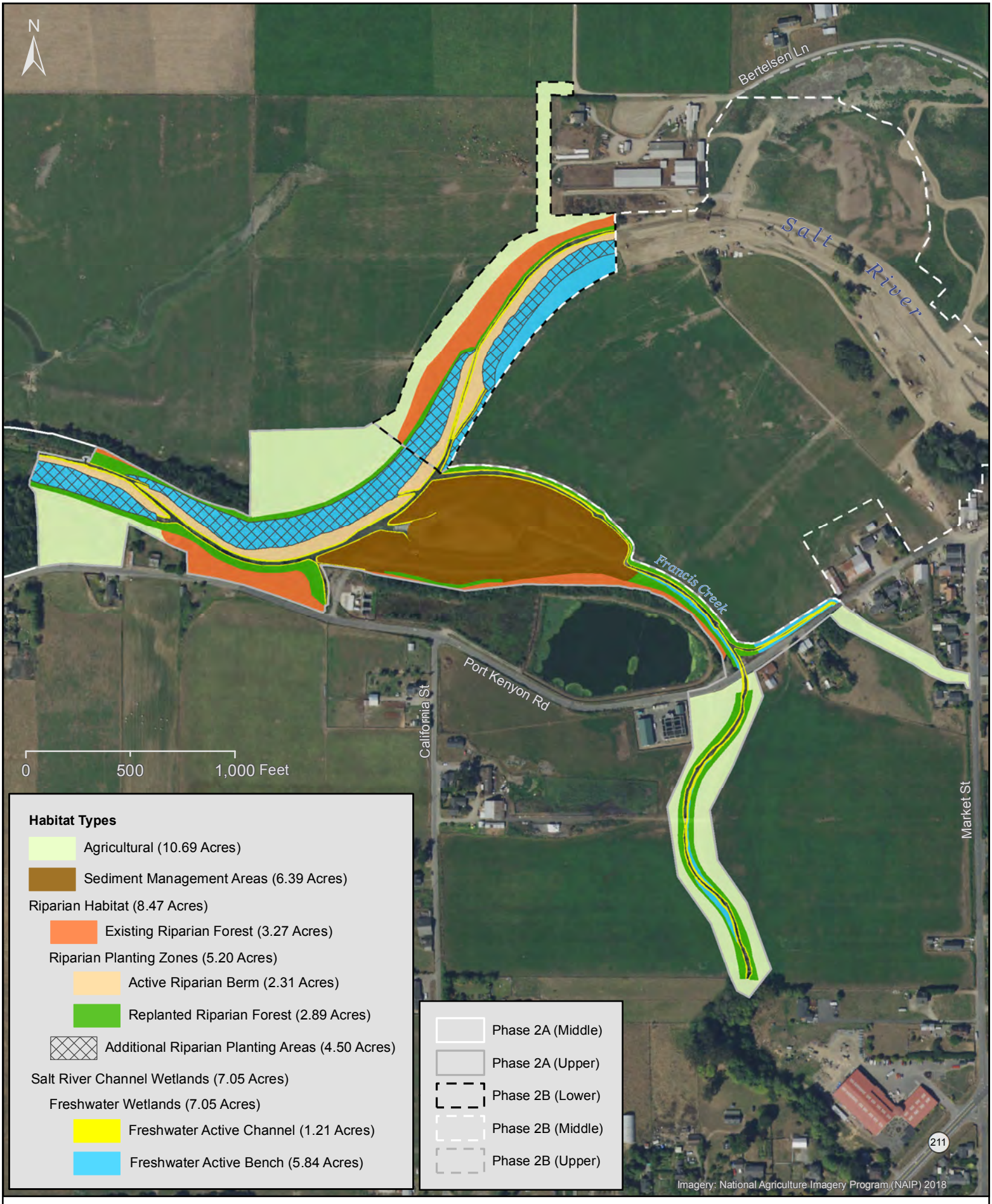

Figure 5. SRERP Phase 2A (Upper) & 2B (Lower) — Salt River Corridor Restoration Area Habitats

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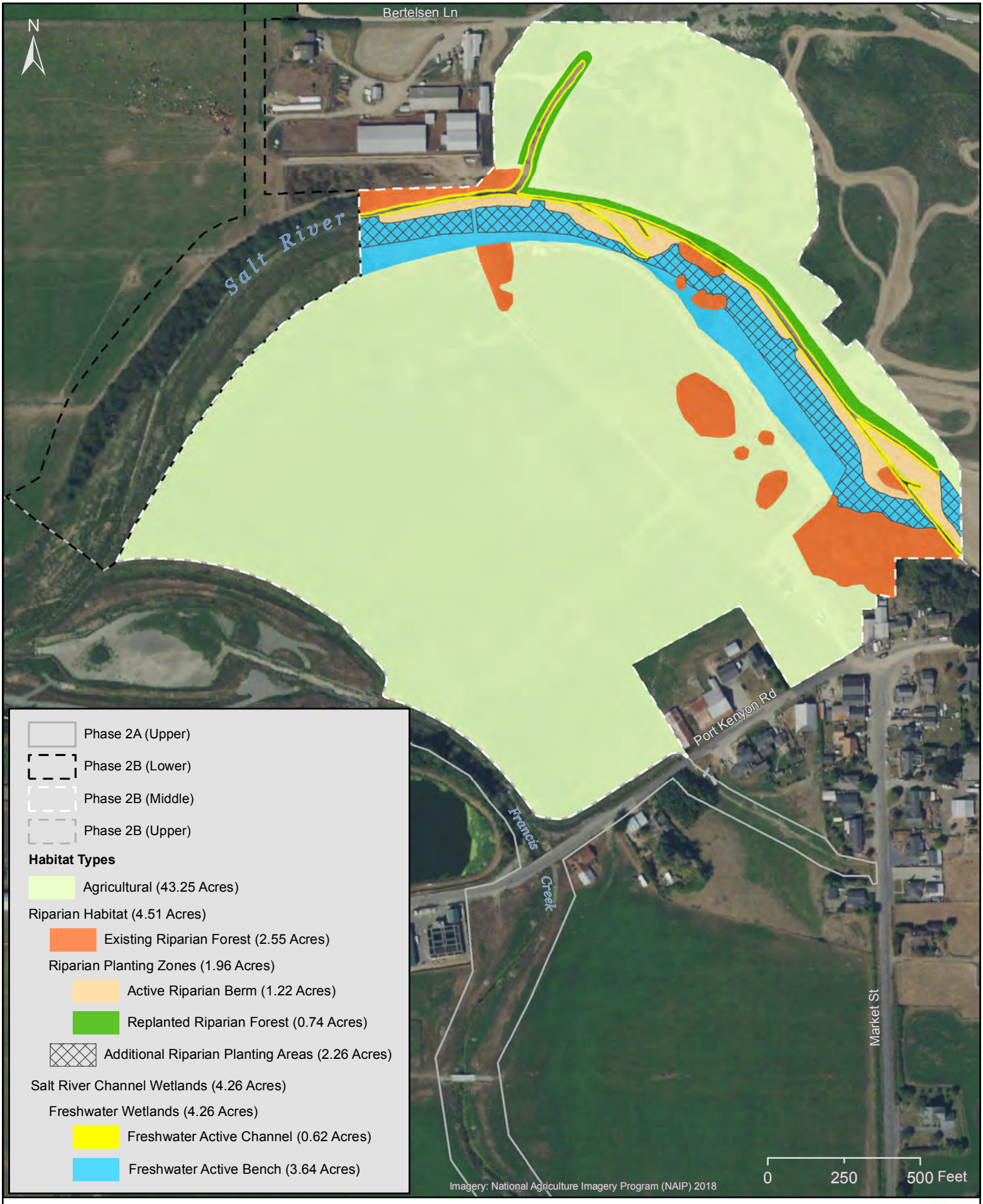

Figure 6. SRERP Phase 2B (Middle) — Salt River Corridor Restoration Area Habitats

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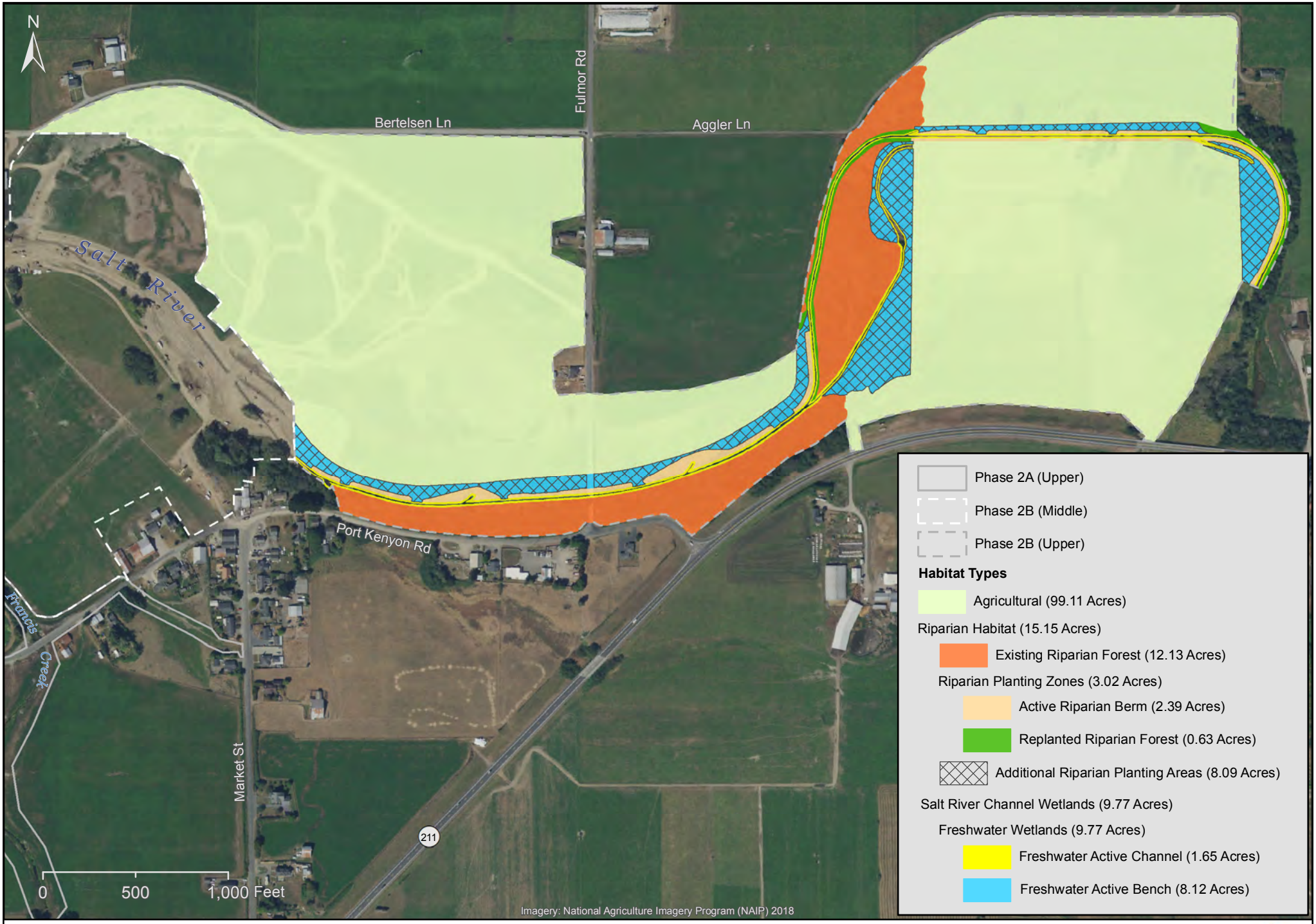

Figure 7. SRERP Phase 2B (Upper) — Salt River Corridor Restoration Area Habitats

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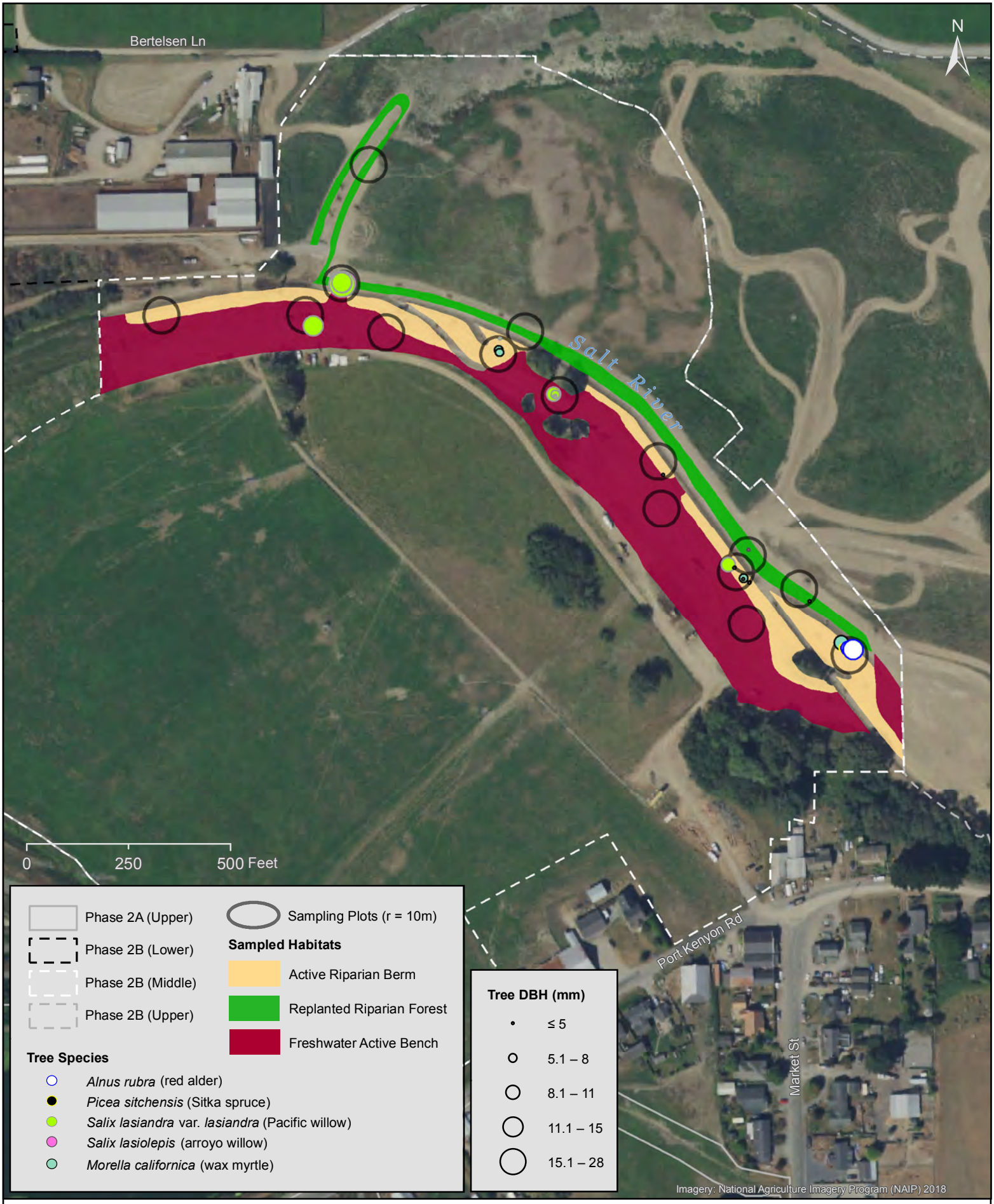

Figure 8. SRERP Phase 2B (Middle) — Salt River Corridor Restoration Area Replanted Arborescent Riparian Vegetation Basal Area Sampling Plots

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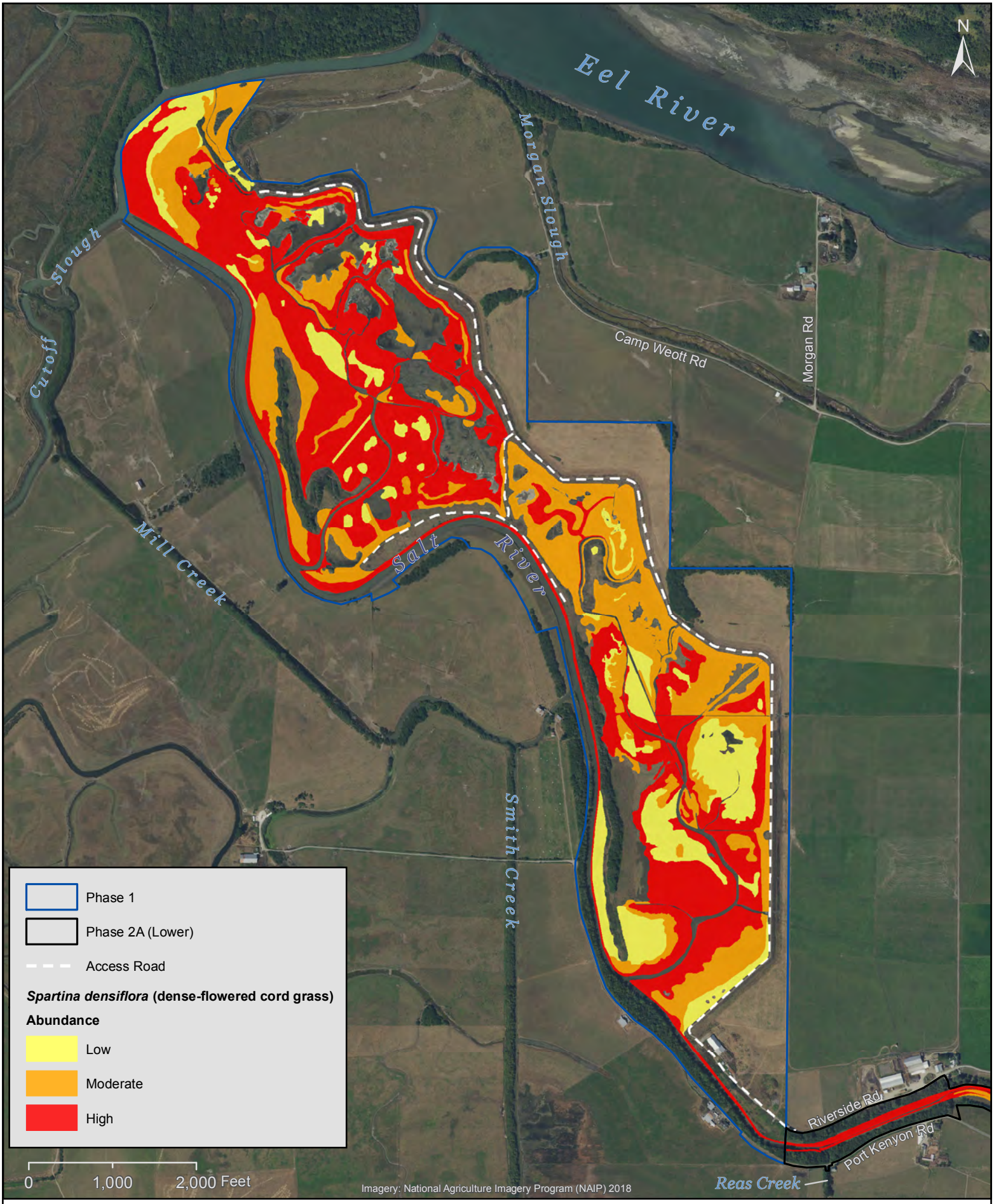

Figure 9. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area
Invasive *Spartina densiflora* ("dense-flowered cord grass)
2021 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

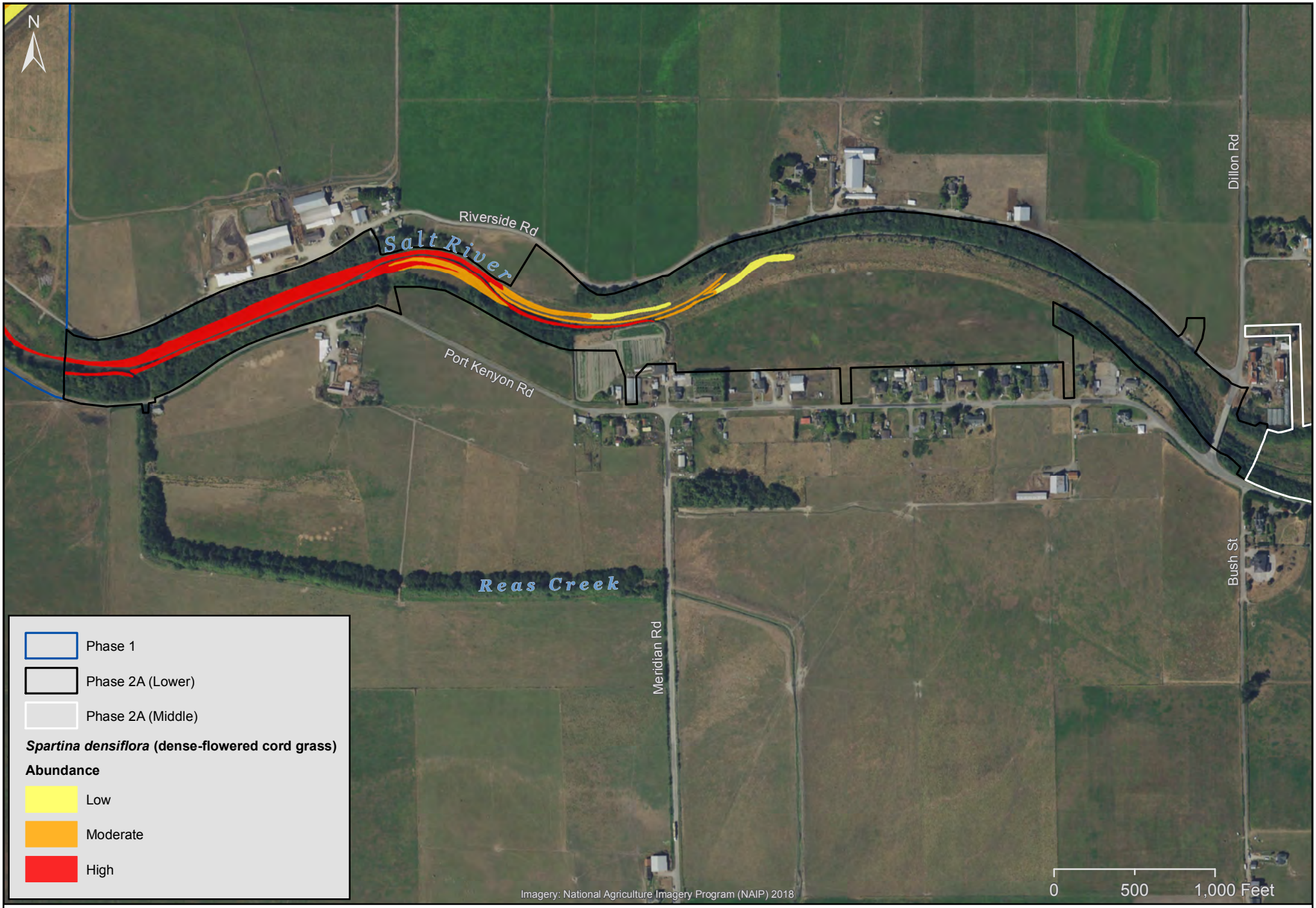

Figure 10. SRERP Phase 2A (Lower) — Salt River Corridor Restoration Area
Invasive *Spartina densiflora* ("dense-flowered cord grass)

2021 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

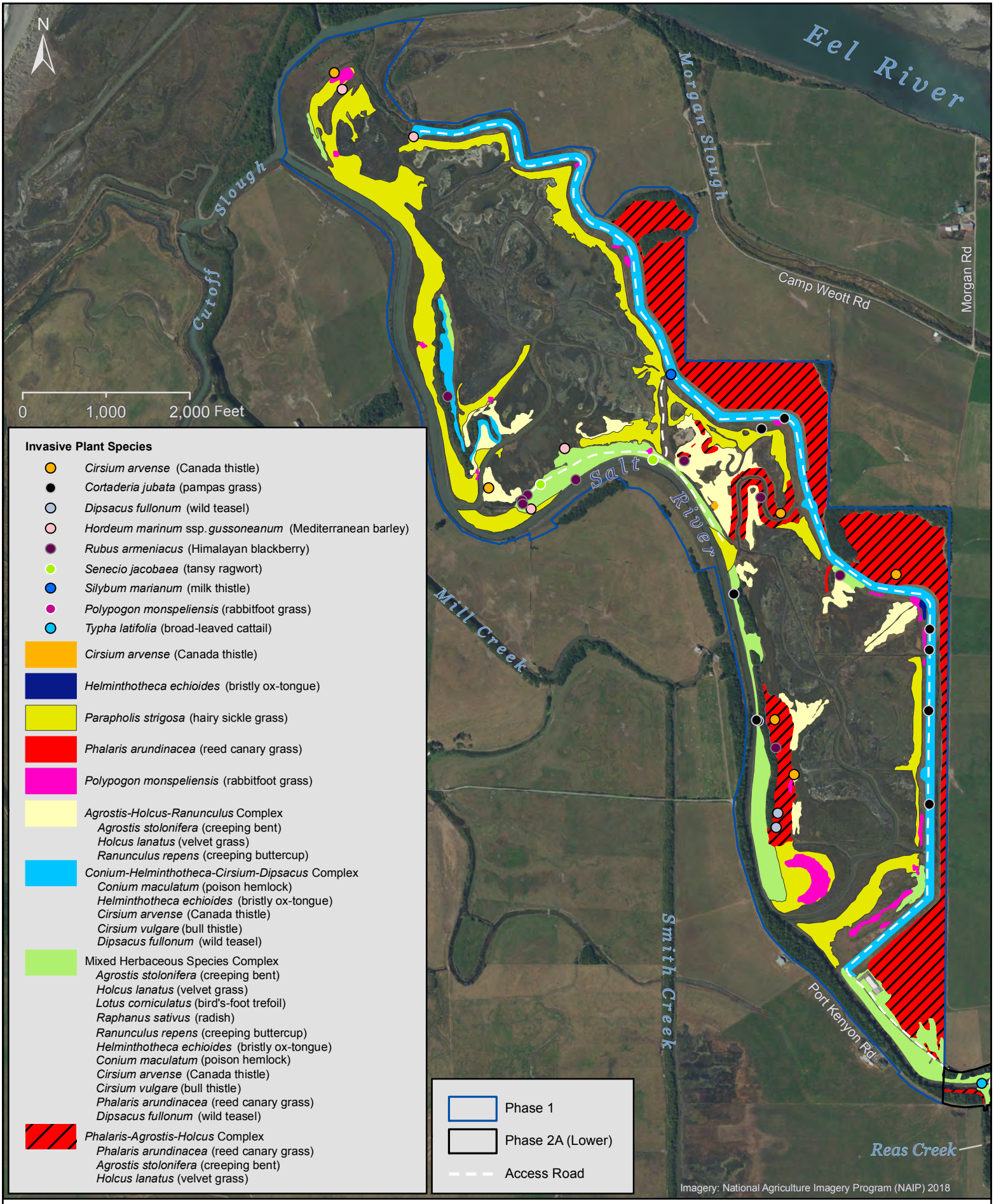

Figure 11. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area Invasive Plant Species

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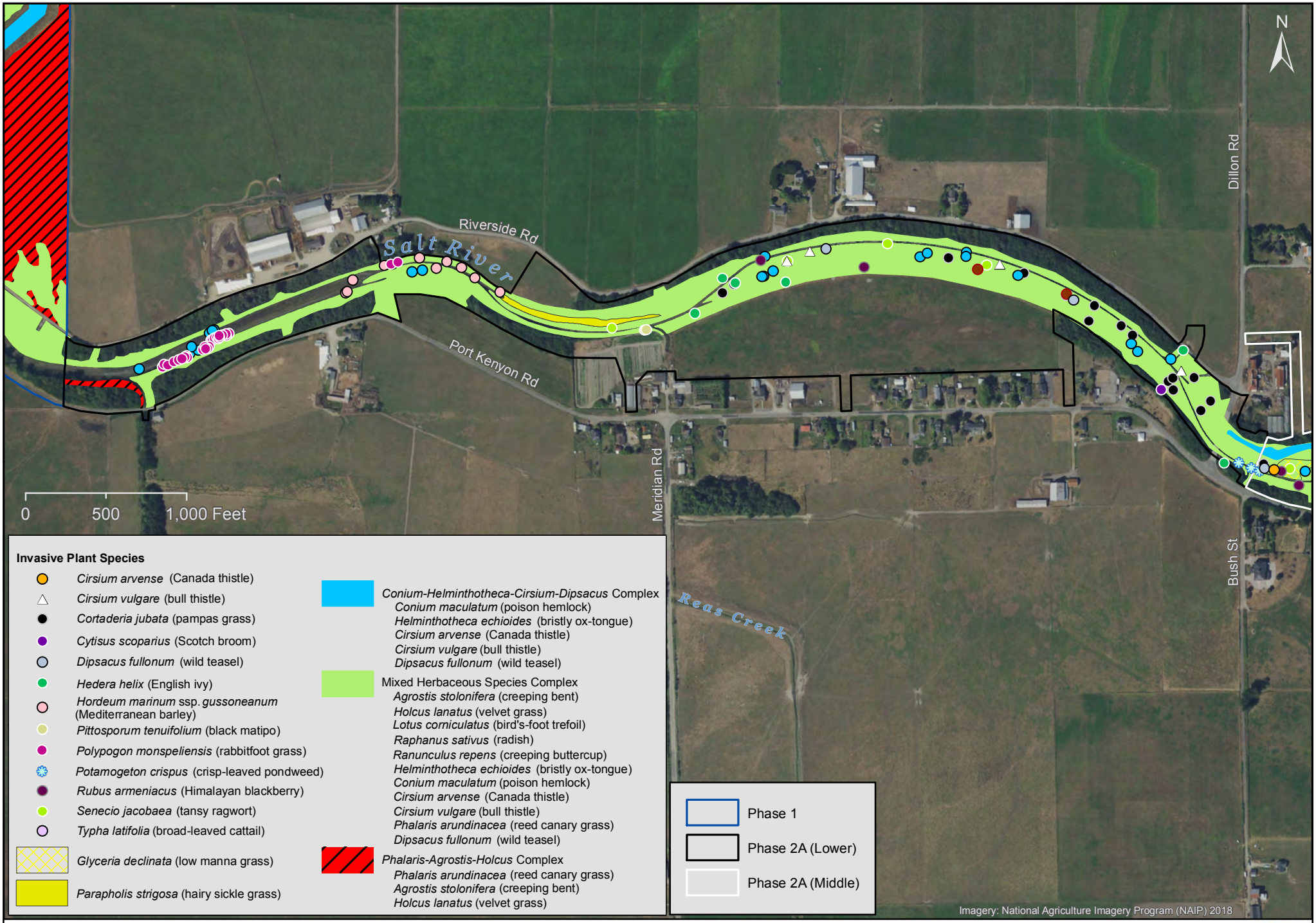

Figure 12. SRERP Phase 2A (Lower) — Salt River Corridor Restoration Area Invasive Plant Species

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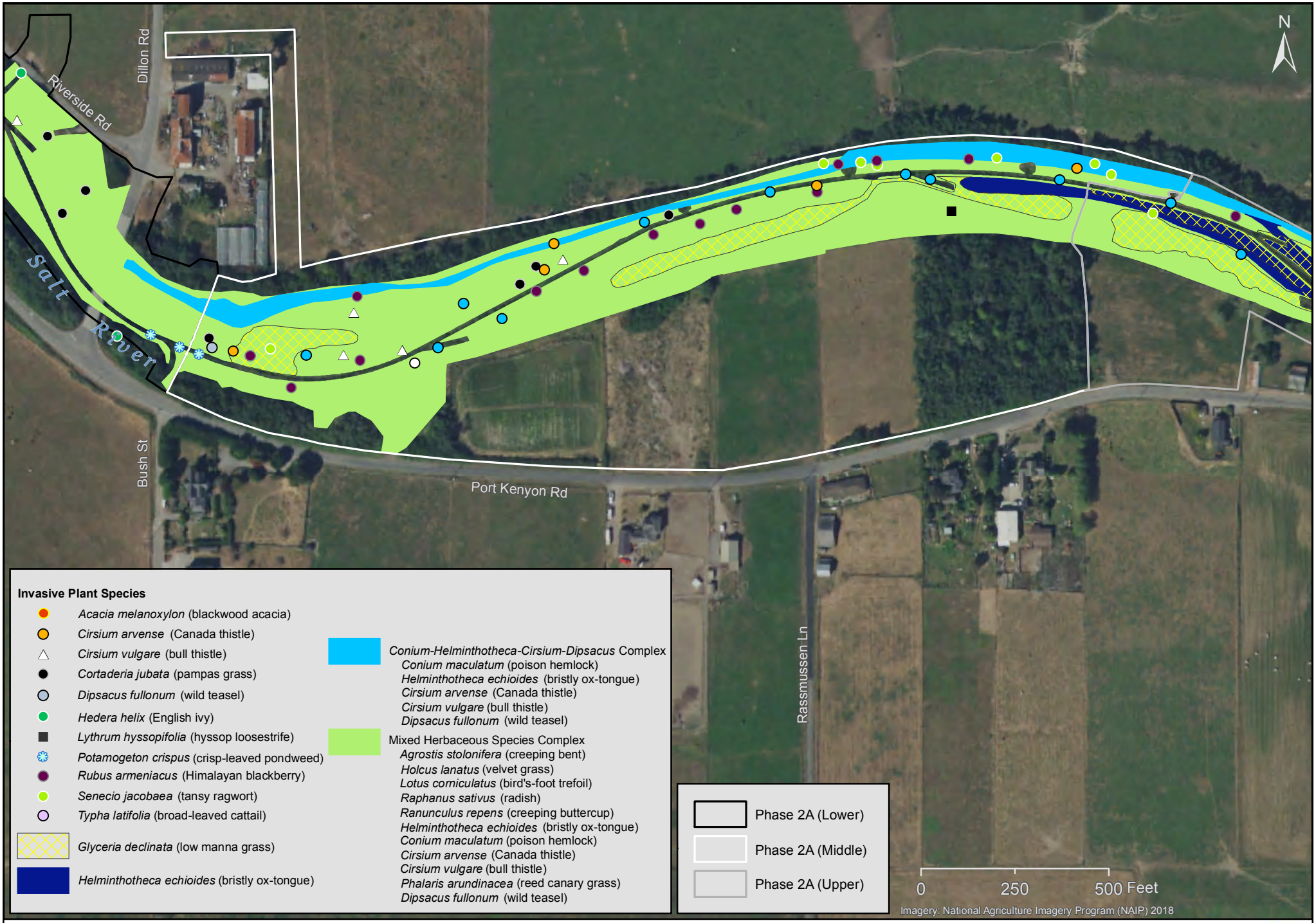

Figure 13. SRERP Phase 2A (Middle) — Salt River Corridor Restoration Area Invasive Plant Species

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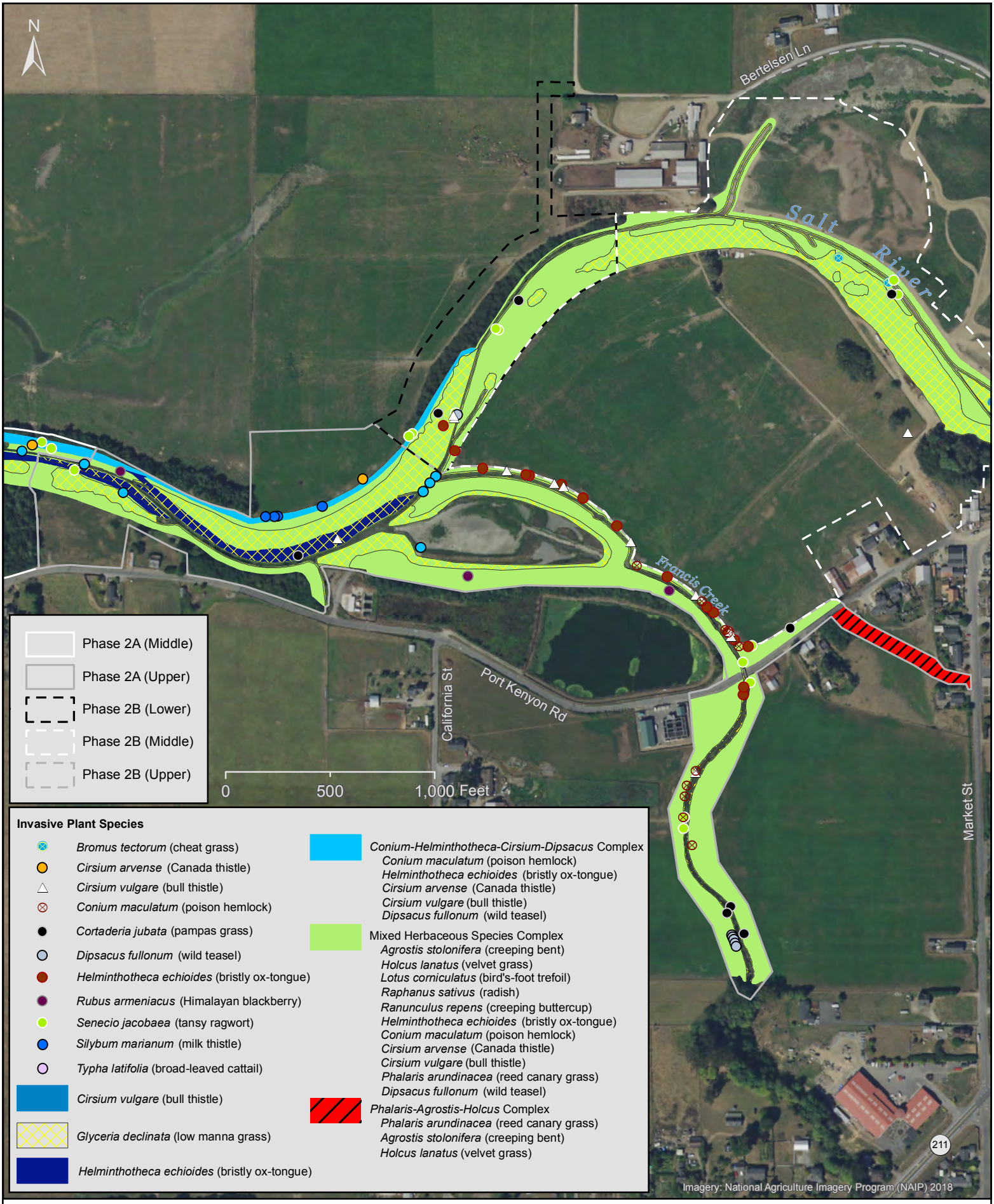

Figure 14. SRERP Phase 2A (Upper) & 2B (Lower) — Salt River Corridor Restoration Area Invasive Plant Species

2021 Annual Quantitative Habitat Monitoring for the Salt River Ecosystem Restoration Project

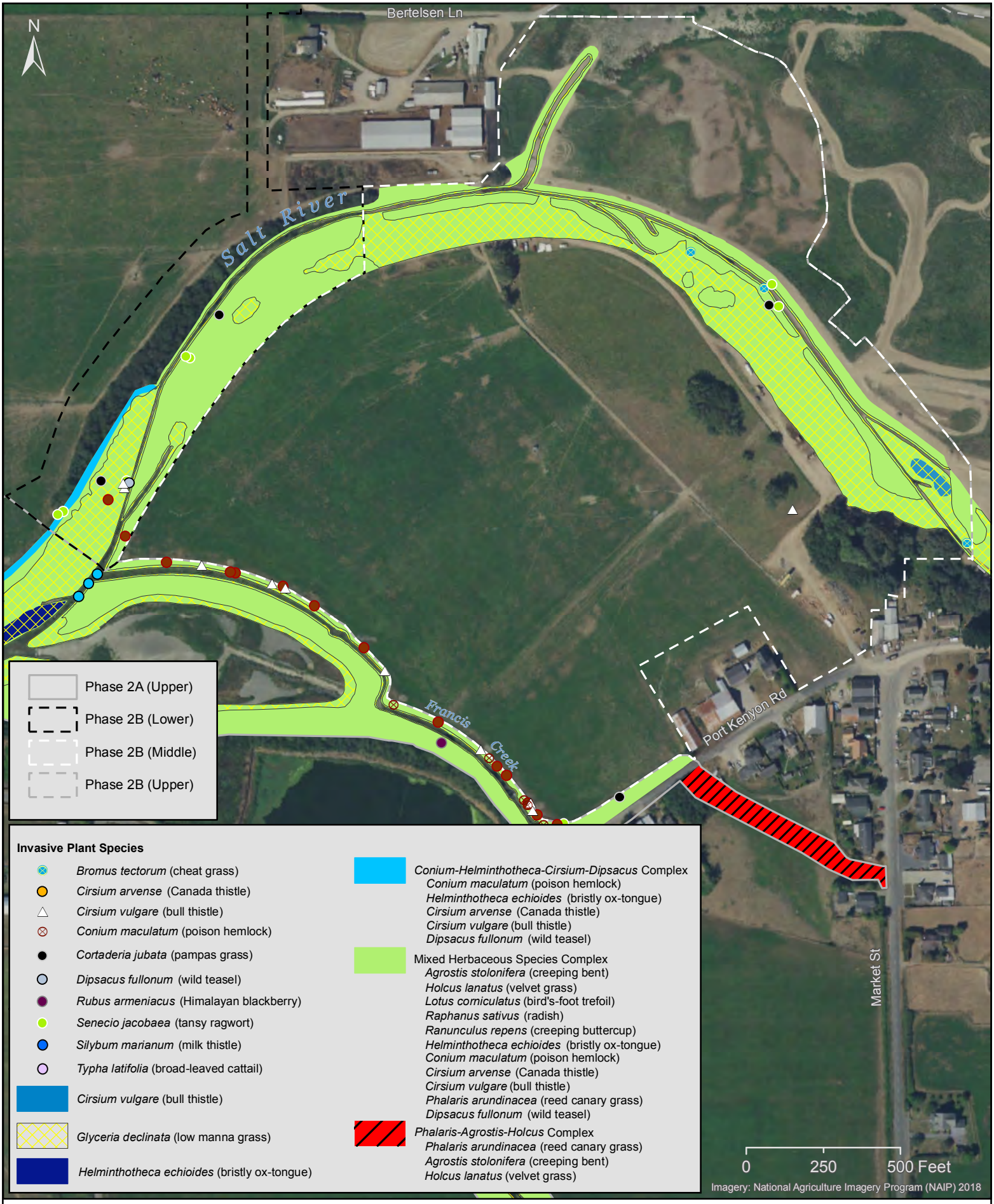

Figure 15. SRERP Phase 2B (Middle) — Salt River Corridor Restoration Area Invasive Plant Species

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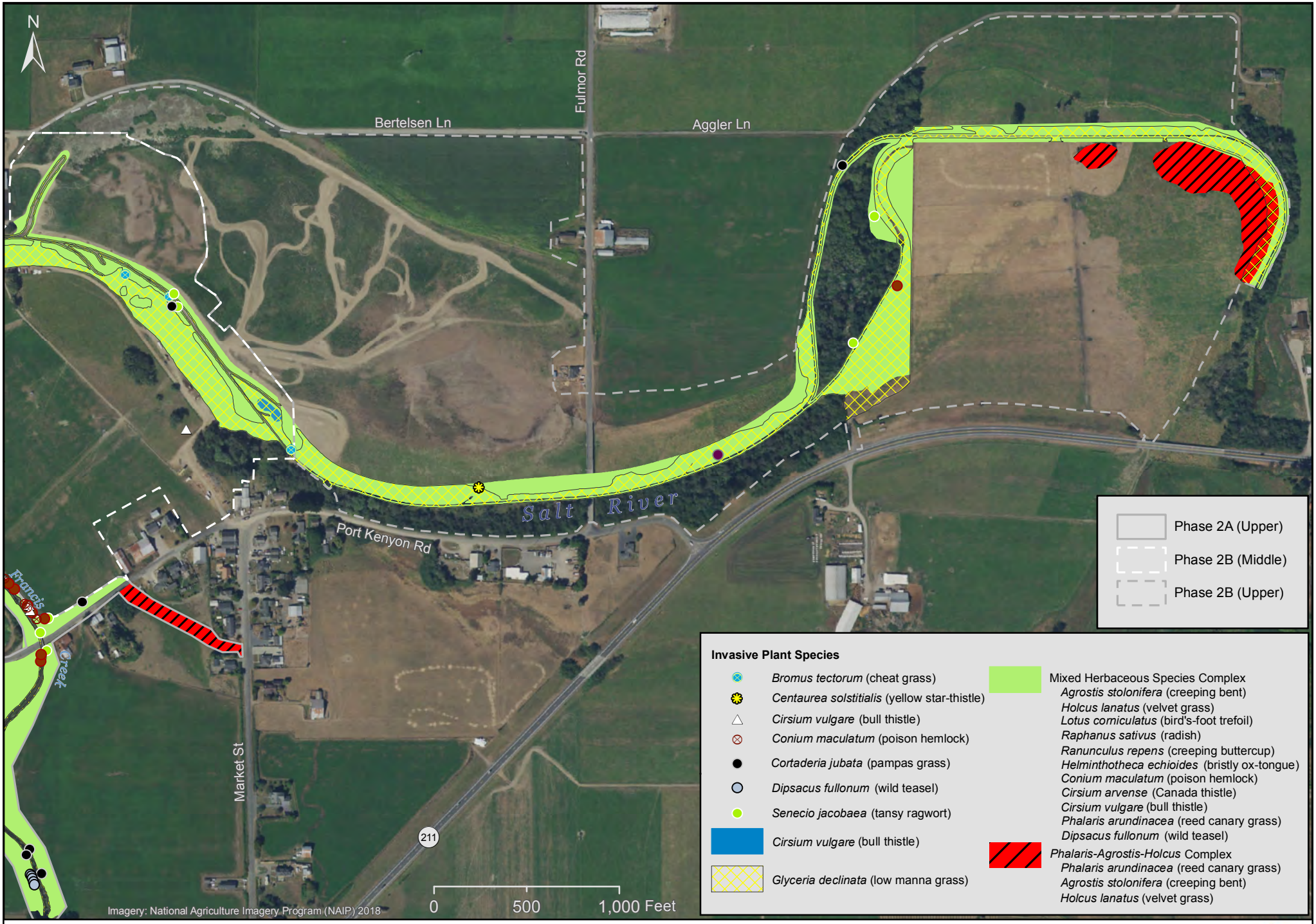

Figure 16. SRERP Phase 2B (Upper) — Salt River Corridor Restoration Area Invasive Plant Species

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Figure 17. SRERP Phase 1 — Riverside Ranch Tidal Marsh Restoration Area Special Status Plant Species

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Figure 18. SRERP Phase 2A (Lower) — Salt River Corridor Restoration Area Special Status Plant Species

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Appendix B

2021 SRERP Vegetation Cover Sampling Results

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Oenanthe sarmentosa	0.28	4.55	15.42
Equisetum telmateia ssp. *braunii*	0.25	14.03	29.66
Deschampsia cespitosa	0.25	9.16	18.83
Symphyotrichum chilense	0.13	6.27	19.34
Potentilla anserina ssp. *pacifica*	0.13	3.70	15.38
Epilobium ciliatum ssp. *watsonii*	0.09	0.20	0.74
Grindelia stricta	0.06	1.64	7.06
Juncus hesperius	0.06	0.94	3.69
Achillea millefolium	0.06	0.56	2.69
Angelica lucida	0.03	0.47	2.65
Eleocharis macrostachya	0.03	0.47	2.65
Salicornia pacifica	0.03	0.47	2.65
Urtica dioica	0.03	0.47	2.65
Stachys ajugoides	0.03	0.09	0.53
Equisetum arvense	0.03	0.02	0.09
Distichlis spicata	0.03	0.00	0.02
Shrub Species			
Rubus ursinus	0.47	27.14	37.76
Rosa californica	0.06	2.34	9.22
Rubus spectabilis	0.03	1.17	6.63
Morella californica	0.03	0.47	2.65
Baccharis pilularis	0.03	0.09	0.53
Tree Species			
Alnus rubra	0.25	9.86	19.46
Picea sitchensis	0.16	2.67	7.75
Salix hookeriana	0.09	4.30	14.06
Pinus contorta ssp. *contorta*	0.09	1.41	4.44
Salix lasiolepis	0.03	2.67	15.11
Salix sitchensis	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Cynosurus cristatus	0.19	2.39	7.41
Plantago lanceolata	0.16	1.59	4.44
Rumex conglomeratus	0.09	1.03	3.70
Atriplex prostrata	0.06	0.56	2.69
Dactylis glomerata	0.03	1.17	6.63
Rumex crispus	0.03	0.09	0.53
Vicia hirsuta	0.03	0.09	0.53
Vicia sativa ssp. *nigra*	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.41	19.59	34.58
Raphanus sativus	0.19	7.14	19.26
Conium maculatum	0.19	5.75	18.51

Phase 1 – Riverside Ranch Tidal Marsh Restoration Area:
Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Invasive Species (Continued)			
Herbaceous Species (Continued)			
Holcus lanatus	0.19	4.25	12.95
Helminthotheca echioides	0.16	1.22	3.72
Ranunculus repens	0.13	6.67	21.03
Dipsacus fullonum	0.09	2.89	11.48
Lotus corniculatus	0.09	1.03	3.70
Cirsium arvense	0.09	0.95	3.69
Convolvulus arvensis	0.03	0.47	2.65
Spartina densiflora	0.03	0.09	0.53
Phalaris arundinacea	0.03	0.02	0.09

Phase 2A (Lower) – Salt River Corridor Restoration Area: Active Channel (n = 33)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.58	15.62	20.07
Triglochin maritima	0.33	11.30	20.73
Grindelia stricta	0.33	8.82	17.96
Salicornia pacifica	0.27	7.59	17.29
Potentilla anserina ssp. *pacifica*	0.24	5.00	10.21
Carex lyngbyei	0.21	4.59	15.34
Scirpus microcarpus	0.18	6.97	17.20
Bolboschoenus maritimus ssp. *paludosus*	0.15	6.53	19.09
Carex obnupta	0.15	6.21	20.01
Oenanthe sarmentosa	0.09	3.48	12.67
Schoenoplectus pungens var. *longispicatus*	0.06	1.59	6.95
Distichlis spicata	0.06	0.91	3.63
Stachys mexicana	0.03	1.89	10.88
Equisetum telmateia ssp. *braunii*	0.03	0.45	2.61
Juncus balticus ssp. *ater*	0.03	0.45	2.61
Petasites frigidus var. *palmatus*	0.03	0.45	2.61
Scrophularia californica ssp. *californica*	0.03	0.45	2.61
Shrub Species			
Rubus ursinus	0.24	9.33	21.33
Tree Species			
Alnus rubra	0.27	18.39	32.56
Salix hookeriana	0.15	5.85	18.34
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium repens	0.09	1.00	3.65
Atriplex prostrata	0.06	0.09	0.52
Rumex conglomeratus	0.03	0.45	2.61
Cotula coronopifolia	0.03	0.09	0.52
Plantago major	0.03	0.09	0.52
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.36	11.85	23.12
Spartina densiflora	0.24	5.39	13.09
Ranunculus repens	0.12	2.82	9.33
Phalaris arundinacea	0.12	1.82	4.97
Helminthotheca echioides	0.09	1.00	3.65
Holcus lanatus	0.09	0.64	2.68
Raphanus sativus	0.06	0.91	3.63
Polypogon monspeliensis	0.06	0.55	2.65
Senecio jacobaea	0.03	0.45	2.61

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

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.53	16.92	23.34
Scirpus microcarpus	0.38	16.28	29.08
Oenanthe sarmentosa	0.28	11.55	25.43
Triglochin maritima	0.25	9.53	18.82
Salicornia pacifica	0.19	3.84	9.88
Bolboschoenus maritimus ssp. *paludosus*	0.16	2.67	7.75
Juncus balticus ssp. *ater*	0.13	5.55	16.52
Grindelia stricta	0.13	3.70	15.38
Potentilla anserina ssp. *pacifica*	0.09	1.03	3.70
Carex lyngbyei	0.06	1.64	7.06
Epilobium ciliatum ssp. *watsonii*	0.06	0.56	2.69
Carex obnupta	0.03	1.95	11.05
Distichlis spicata	0.03	0.47	2.65
Equisetum telmateia ssp. *braunii*	0.03	0.47	2.65
Juncus effusus ssp. *pacificus*	0.03	0.47	2.65
Schoenoplectus pungens var. *longispicatus*	0.03	0.47	2.65
Shrub Species			
Rubus ursinus	0.22	7.67	19.38
Tree Species			
Alnus rubra	0.38	21.77	35.09
Salix lasiolepis	0.13	4.06	12.99
Salix lasiandra var. *lasiandra*	0.13	2.58	7.76
Salix hookeriana	0.09	3.22	12.69
Non-Native Non-Invasive Species			
Herbaceous Species			
Rumex conglomeratus	0.06	0.56	2.69
Atriplex prostrata	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.34	11.69	23.86
Agrostis stolonifera	0.31	12.75	23.79
Spartina densiflora	0.22	2.91	5.93
Raphanus sativus	0.09	2.52	11.27
Helminthotheca echioides	0.09	1.27	6.63
Polypogon monspeliensis	0.06	0.56	2.69
Typha latifolia	0.03	0.47	2.65
Holcus lanatus	0.03	0.09	0.53

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

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.66	33.69	35.23
Juncus balticus ssp. *ater*	0.34	6.89	11.75
Equisetum telmateia ssp. *braunii*	0.25	10.34	23.70
Scirpus microcarpus	0.19	6.13	18.58
Oenanthe sarmentosa	0.16	6.36	19.31
Juncus effusus ssp. *pacificus*	0.09	1.41	4.44
Potentilla anserina ssp. *pacifica*	0.09	1.03	3.70
Festuca rubra	0.06	3.14	15.26
Grindelia stricta	0.06	2.42	11.28
Stachys ajugoides	0.06	0.94	3.69
Cyperus eragrostis	0.03	0.47	2.65
Helenium puberulum	0.03	0.47	2.65
Deschampsia cespitosa	0.66	33.69	35.23
Shrub Species			
Baccharis pilularis	0.25	14.08	26.72
Rubus ursinus	0.22	7.64	21.72
Physocarpus capitatus	0.13	2.20	7.43
Rubus parviflorus	0.06	3.14	15.26
Rubus spectabilis	0.03	0.47	2.65
Tree Species			
Alnus rubra	0.53	32.17	37.76
Picea sitchensis	0.09	2.52	11.27
Salix lasiandra var. *lasiandra*	0.06	4.63	18.43
Salix sitchensis	0.06	1.64	7.06
Non-Native Non-Invasive Species			
Herbaceous Species			
Senecio minimus	0.06	2.05	11.04
Sonchus asper ssp. *asper*	0.06	0.10	0.53
Rumex conglomeratus	0.03	0.09	0.53
Vicia hirsuta	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.38	12.77	24.33
Helminthotheca echioides	0.19	6.41	15.31
Agrostis stolonifera	0.16	5.31	15.64
Raphanus sativus	0.13	2.98	11.47
Holcus lanatus	0.13	2.20	7.43
Cirsium vulgare	0.06	0.94	3.69
Lotus corniculatus	0.06	0.03	0.12

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

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.41	17.08	28.15
Scirpus microcarpus	0.38	13.27	25.70
Oenanthe sarmentosa	0.28	6.75	16.67
Juncus balticus ssp. *ater*	0.16	7.52	21.07
Carex obnupta	0.13	1.13	3.71
Stachys ajugoides	0.09	2.52	11.27
Equisetum telmateia ssp. *braunii*	0.09	1.73	7.06
Juncus effusus ssp. *pacificus*	0.06	1.64	7.06
Juncus hesperius	0.06	0.94	3.69
Potentilla anserina ssp. *pacifica*	0.06	0.56	2.69
Angelica lucida	0.03	0.47	2.65
Grindelia stricta	0.03	0.47	2.65
Shrub Species			
Rubus ursinus	0.56	31.28	36.25
Baccharis pilularis	0.06	3.84	16.31
Lonicera involucrata var. *ledebourii*	0.03	1.95	11.05
Rubus parviflorus	0.03	1.95	11.05
Ribes sanguineum var. *glutinosum*	0.03	0.47	2.65
Rubus spectabilis	0.03	0.47	2.65
Physocarpus capitatus	0.03	0.09	0.53
Tree Species			
Salix hookeriana	0.47	27.97	38.34
Alnus rubra	0.47	24.69	33.70
Salix lasiolepis	0.16	7.45	21.78
Salix sitchensis	0.06	3.14	15.26
Picea sitchensis	0.06	1.64	7.06
Salix lasiandra var. *lasiandra*	0.03	2.67	15.11
Non-Native Non-Invasive Species			
Herbaceous Species			
Sonchus asper ssp. *asper*	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Agrostis stolonifera	0.28	5.25	10.30
Phalaris arundinacea	0.19	5.02	15.69
Helminthotheca echioides	0.16	1.05	3.70
Ranunculus repens	0.09	0.58	2.69
Raphanus sativus	0.06	1.19	6.63
Holcus lanatus	0.03	0.47	2.65

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

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Potentilla anserina ssp. *pacifica*	0.63	18.33	21.93
Deschampsia cespitosa	0.50	24.20	30.49
Oenanthe sarmentosa	0.16	4.53	13.11
Equisetum telmateia ssp. *braunii*	0.16	1.22	3.72
Hordeum brachyantherum	0.13	2.98	11.47
Eleocharis macrostachya	0.09	3.22	12.69
Cyperus eragrostis	0.06	0.94	3.69
Juncus patens	0.06	0.94	3.69
Epilobium ciliatum ssp. *watsonii*	0.06	0.56	2.69
Alopecurus geniculatus	0.03	1.95	11.05
Juncus effusus ssp. *pacificus*	0.03	1.95	11.05
Scirpus microcarpus	0.03	1.95	11.05
Festuca rubra	0.03	0.47	2.65
Juncus balticus ssp. *ater*	0.03	0.47	2.65
Equisetum arvense	0.03	0.09	0.53
Tree Species			
Salix lasiandra var. *lasiandra*	0.09	1.03	3.70
Salix sitchensis	0.06	0.56	2.69
Salix hookeriana	0.03	2.67	15.11
Alnus rubra	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Rumex conglomeratus	0.16	1.59	4.44
Trifolium fragiferum	0.09	2.11	7.44
Plantago major	0.09	0.66	2.72
Trifolium repens	0.06	3.91	15.37
Alisma lanceolatum	0.03	2.67	15.11
Atriplex prostrata	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.88	42.67	34.63
Mentha pulegium	0.22	3.56	9.64
Agrostis stolonifera	0.16	5.16	12.70
Festuca perennis	0.13	3.36	11.67
Helminthotheca echioides	0.13	2.98	11.47
Lotus corniculatus	0.13	2.58	7.76
Raphanus sativus	0.09	2.52	11.27
Holcus lanatus	0.09	2.44	9.21
Ranunculus repens	0.03	0.47	2.65
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.03	0.09	0.53

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

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.53	32.13	34.84
Hordeum brachyantherum	0.38	6.28	10.42
Cyperus eragrostis	0.03	0.47	2.65
Juncus patens	0.03	0.47	2.65
Oenanthe sarmentosa	0.03	0.47	2.65
Potentilla anserina ssp. *pacifica*	0.03	0.47	2.65
Elymus glaucus ssp. *virescens*	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium fragiferum	0.34	6.98	17.75
Rumex conglomeratus	0.09	1.03	3.70
Tree Species			
Salix babylonica	0.06	1.64	7.06
Invasive Species			
Herbaceous Species			
Festuca perennis	0.81	41.34	33.07
Agrostis stolonifera	0.69	18.53	18.45
Phalaris arundinacea	0.47	22.73	32.48
Lotus corniculatus	0.19	2.77	7.73
Holcus lanatus	0.09	3.61	15.39
Raphanus sativus	0.03	1.95	11.05
Mentha pulegium	0.03	0.47	2.65
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.0\3	0.09	0.53

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

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.38	12.89	20.60
Hordeum brachyantherum	0.28	9.30	18.11
Stachys ajugoides	0.09	5.08	16.45
Equisetum telmateia ssp. *braunii*	0.03	0.47	2.65
Potentilla anserina ssp. *pacifica*	0.03	0.47	2.65
Epilobium ciliatum ssp. *watsonii*	0.03	0.09	0.53
Juncus effusus ssp. *pacificus*	0.03	0.09	0.53
Shrub Species			
Lonicera involucrata var. *ledebourii*	0.03	0.47	2.65
Morella californica	0.03	0.47	2.65
Ceanothus thyrsiflorus	0.03	0.09	0.53
Tree Species			
Picea sitchensis	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Bromus catharticus	0.25	4.08	8.49
Trifolium fragiferum	0.22	5.09	13.19
Rumex conglomeratus	0.16	3.05	8.05
Sonchus asper ssp. *asper*	0.16	1.13	3.71
Daucus carota	0.03	0.47	2.65
Trifolium repens	0.03	0.47	2.65
Festuca arundinacea	0.03	0.09	0.53
Senecio minimus	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.66	36.16	36.77
Festuca perennis	0.59	27.56	32.80
Lotus corniculatus	0.50	9.89	13.59
Raphanus sativus	0.31	10.20	23.11
Agrostis stolonifera	0.25	7.97	14.87
Helminthotheca echioides	0.25	2.95	7.70
Holcus lanatus	0.22	4.69	10.21
Conium maculatum	0.06	0.94	3.69
Mentha pulegium	0.06	0.94	3.69
Cirsium vulgare	0.03	0.09	0.53
Polypogon monspeliensis	0.03	0.09	0.53
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.03	0.47	2.65

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

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.31	11.27	22.00
Equisetum telmateia ssp. *braunii*	0.22	6.89	17.51
Hordeum brachyantherum	0.22	5.47	13.30
Elymus glaucus ssp. *virescens*	0.16	1.59	4.44
Potentilla anserina ssp. *pacifica*	0.16	1.59	4.44
Stachys ajugoides	0.09	1.41	4.44
Alopecurus geniculatus	0.06	2.42	11.28
Eleocharis macrostachya	0.06	1.64	7.06
Scirpus microcarpus	0.06	0.94	3.69
Bromus carinatus	0.03	0.47	2.65
Juncus effusus ssp. *pacificus*	0.03	0.47	2.65
Cyperus eragrostis	0.03	0.09	0.53
Tree Species			
Salix sitchensis	0.03	1.95	11.05
Salix hookeriana	0.03	0.47	2.65
Salix lasiandra var. *lasiandra*	0.03	0.09	0.53
Thuja plicata	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium fragiferum	0.28	11.50	22.56
Rumex conglomeratus	0.19	2.06	5.02
Bromus catharticus	0.13	1.50	4.44
Vicia hirsuta	0.09	6.89	23.21
Plantago major	0.06	1.27	6.63
Atriplex prostrata	0.03	2.67	15.11
Cotula coronopifolia	0.03	0.47	2.65
Plantago lanceolata	0.03	0.47	2.65
Sonchus asper ssp. *asper*	0.03	0.47	2.65
Trifolium pratense	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Lotus corniculatus	0.56	18.58	25.41
Festuca perennis	0.47	18.78	27.44
Holcus lanatus	0.44	17.53	26.68
Agrostis stolonifera	0.34	13.84	23.21
Phalaris arundinacea	0.31	15.36	31.57
Helminthotheca echioides	0.31	6.38	12.73
Raphanus sativus	0.16	6.02	16.57
Mentha pulegium	0.09	1.73	7.06
Polypogon monspeliensis	0.06	0.56	2.69
Conium maculatum	0.03	0.47	2.65

Phase 2B (Upper) – Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.84	42.06	26.79
Hordeum brachyantherum	0.34	3.95	6.52
Elymus glaucus ssp. *virescens*	0.25	2.17	5.00
Oenanthe sarmentosa	0.22	2.91	5.93
Juncus patens	0.13	2.58	7.76
Cyperus eragrostis	0.09	1.41	4.44
Equisetum telmateia ssp. *braunii*	0.06	2.42	11.28
Juncus balticus ssp. *ater*	0.06	0.94	3.69
Juncus effusus ssp. *pacificus*	0.06	0.94	3.69
Scirpus microcarpus	0.06	0.56	2.69
Stachys ajugoides	0.06	0.56	2.69
Calamagrostis nutkaensis	0.03	0.47	2.65
Epilobium ciliatum ssp. *watsonii*	0.03	0.47	2.65
Festuca rubra	0.03	0.47	2.65
Potentilla anserina ssp. *pacifica*	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.25	6.98	17.48
Tree Species			
Alnus rubra	0.25	9.27	23.20
Salix lasiandra var. *lasiandra*	0.09	1.03	3.70
Populus trichocarpa	0.06	1.27	6.63
Salix hookeriana	0.03	1.17	6.63
Salix lasiolepis	0.03	0.09	0.53
Salix sitchensis	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Rumex conglomeratus	0.28	3.47	6.24
Trifolium repens	0.16	3.05	8.05
Senecio minimus	0.06	0.94	3.69
Vicia hirsuta	0.03	1.95	11.05
Alisma lanceolatum	0.03	1.17	6.63
Festuca arundinacea	0.03	0.47	2.65
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.66	18.14	23.52
Ranunculus repens	0.44	6.88	13.22
Festuca perennis	0.16	1.97	5.03
Helminthotheca echioides	0.16	1.97	5.03
Mentha pulegium	0.16	1.22	3.72
Agrostis stolonifera	0.13	1.88	5.04
Holcus lanatus	0.09	1.41	4.44
Lotus corniculatus	0.06	0.94	3.69
Cirsium vulgare	0.03	0.47	2.65

Phase 2B (Upper) – Salt River Corridor Restoration Area: Active Channel (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (*s*)
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	**0.13**	**1.05**	**3.70**

Phase 2B (Upper) – Salt River Corridor Restoration Area: Active Bench (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.59	19.89	25.54
Hordeum brachyantherum	0.47	11.75	19.57
Elymus glaucus ssp. *virescens*	0.09	0.28	0.89
Stachys mexicana	0.03	1.95	11.05
Shrub Species			
Rubus ursinus	0.06	6.09	23.98
Tree Species			
Alnus rubra	0.03	0.09	0.53
Non-Native Non-Invasive Species			
Herbaceous Species			
Trifolium repens	0.22	2.91	5.93
Rumex conglomeratus	0.16	4.16	12.97
Trifolium fragiferum	0.13	5.17	16.43
Trifolium pratense	0.09	1.41	4.44
Vicia hirsuta	0.03	1.95	11.05
Plantago lanceolata	0.03	0.47	2.65
Rumex crispus	0.03	0.47	2.65
Plantago major	0.03	0.09	0.53
Senecio minimus	0.03	0.09	0.53
Trifolium hybridum	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.91	53.14	36.51
Agrostis stolonifera	0.38	8.84	15.25
Festuca perennis	0.22	6.20	16.52
Helminthotheca echioides	0.16	3.05	8.05
Holcus lanatus	0.16	2.34	5.53
Mentha pulegium	0.13	4.06	12.99
Lotus corniculatus	0.13	3.33	15.24
Ranunculus repens	0.13	0.75	2.75
Cirsium vulgare	0.06	2.42	11.28
Dipsacus fullonum	0.06	0.94	3.69
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.13	0.75	2.75

Phase 2B (Upper) – Salt River Corridor Restoration Area: Active Riparian Berm (n = 33)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.45	18.05	24.38
Hordeum brachyantherum	0.45	12.42	18.00
Elymus glaucus ssp. *virescens*	0.09	1.36	4.38
Stachys ajugoides	0.03	1.14	6.53
Stachys mexicana	0.03	1.14	6.53
Epilobium ciliatum ssp. *watsonii*	0.03	0.45	2.61
Shrub Species			
Rubus ursinus	0.12	3.26	11.50
Morella californica	0.03	1.89	10.88
Ribes sanguineum var. *glutinosum*	0.03	0.45	2.61
Lonicera involucrata var. *ledebourii*	0.03	0.09	0.52
Tree Species			
Alnus rubra	0.06	3.03	12.51
Thuja plicata	0.03	0.45	2.61
Populus trichocarpa	0.03	0.09	0.52
Non-Native Non-Invasive Species			
Herbaceous Species			
Rumex conglomeratus	0.21	3.86	8.41
Trifolium fragiferum	0.12	2.82	9.33
Trifolium repens	0.09	2.80	11.32
Senecio minimus	0.09	2.05	7.33
Vicia hirsuta	0.06	1.59	6.95
Bromus catharticus	0.03	0.45	2.61
Festuca arundinacea	0.03	0.45	2.61
Sonchus asper ssp. *asper*	0.03	0.45	2.61
Lepidium didymum	0.03	0.09	0.52
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.82	38.58	32.18
Holcus lanatus	0.39	9.27	14.52
Helminthotheca echioides	0.39	8.67	15.04
Festuca perennis	0.33	8.48	15.13
Agrostis stolonifera	0.21	4.55	10.09
Mentha pulegium	0.21	3.50	8.17
Lotus corniculatus	0.09	1.36	4.38
Cirsium vulgare	0.06	2.27	9.09
Ranunculus repens	0.06	0.18	0.73
Raphanus sativus	0.03	1.89	10.88
Dipsacus fullonum	0.03	0.45	2.61
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.15	1.47	4.38

Phase 2B (Upper) – Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Native Species			
Herbaceous Species			
Deschampsia cespitosa	0.63	24.02	31.50
Hordeum brachyantherum	0.16	1.59	4.44
Stachys mexicana	0.13	3.28	9.70
Stachys ajugoides	0.13	2.58	7.76
Oenanthe sarmentosa	0.13	1.88	5.04
Elymus glaucus ssp. *virescens*	0.13	1.13	3.71
Festuca rubra	0.09	4.38	15.48
Epilobium ciliatum ssp. *watsonii*	0.09	1.41	4.44
Equisetum telmateia ssp. *braunii*	0.06	0.56	2.69
Juncus effusus ssp. pacificus	0.06	0.56	2.69
Veronica americana	0.03	0.09	0.53
Shrub Species			
Rubus ursinus	0.81	33.81	31.12
Baccharis pilularis	0.03	0.09	0.53
Tree Species			
Alnus rubra	0.31	10.91	23.60
Salix sitchensis	0.22	7.30	19.35
Salix lasiandra var. *lasiandra*	0.06	3.14	15.26
Salix lasiolepis	0.03	2.67	15.11
Populus trichocarpa	0.03	1.17	6.63
Salix hookeriana	0.03	1.17	6.63
Picea sitchensis	0.03	0.47	2.65
Non-Native Non-Invasive Species			
Herbaceous Species			
Rumex conglomeratus	0.28	2.34	4.98
Atriplex prostrata	0.09	2.44	9.21
Trifolium repens	0.06	0.94	3.69
Trifolium fragiferum	0.03	2.67	15.11
Senecio minimus	0.03	1.17	6.63
Solanum nigrum	0.03	1.17	6.63
Senecio glomeratus	0.03	0.09	0.53
Invasive Species			
Herbaceous Species			
Phalaris arundinacea	0.44	12.70	22.35
Holcus lanatus	0.31	16.34	26.29
Conium maculatum	0.25	7.36	17.52
Festuca perennis	0.13	3.69	12.84
Helminthotheca echioides	0.13	2.58	7.76
Mentha pulegium	0.13	1.50	4.44
Cirsium vulgare	0.06	1.64	7.06
Ranunculus repens	0.06	1.64	7.06
Agrostis stolonifera	0.03	1.17	6.63
Dipsacus fullonum	0.03	0.47	2.65
Leucanthemum vulgare	0.03	0.47	2.65
Lotus corniculatus	0.03	0.47	2.65

Phase 2B (Upper) – Salt River Corridor Restoration Area: Replanted Riparian Forest (n = 32)

Species	Frequency (1.0 = 100%)	Abundance ($\bar{x}$ % Cover)	Standard Deviation (s)
Invasive Species (Continued)			
Herbaceous Species (Continued)			
Polypogon monspeliensis	0.03	0.47	2.65
Raphanus sativus	0.03	0.09	0.53
Cortaderia jubata	0.03	0.00	0.02
Shrub Species			
Rubus armeniacus	0.03	0.47	2.65
Erosion Control Hybrid			
Herbaceous Species			
Elymus x *Triticum*	0.06	0.19	0.74

Summary Table of Arborescent Riparian Vegetation

Basal Area Sampling Measurements in 2021

Appendix C

Summary Table of 2021 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 2021. Acreage values reflect summed sampling plot area within respective sampling regions.

	Measured Basal Area (ft^2)			
	Phase 2B (Middle) — Salt River Corridor Restoration Area			
Tree Species	**Replanted Riparian Forest (0.13 acres) (n = 5)**	**Active Riparian Berm (0.22 acres) (n = 5)**	**Active Bench (0.32 acres) (n = 5)**	**Total (0.67 acres)**
Salix lasiandra var. *lasiandra* (Pacific willow)	0.0100	0.0012	0.0029	0.0141
Salix lasiolepis (arroyo willow)	0.0068	0	0	0.0068
Morella californica (California wax-myrtle)	0.0003	0.0044	0	0.0047
Alnus rubra (red alder)	0	0.0025	0	0.0025
Ceanothus thyrsiflorus ssp. *thyrsiflorus* (blue blossom)	0.0021	0	0	0.0021
Picea sitchensis (Sitka spruce)	0	0.0003	0	0.0003
Total	**0.0191**	**0.0084**	**0.0029**	**0.0305**

Summary of the Abundance of Monitored Vegetation Categories throughout the Salt River Ecosystem Restoration Project: 2014–2021

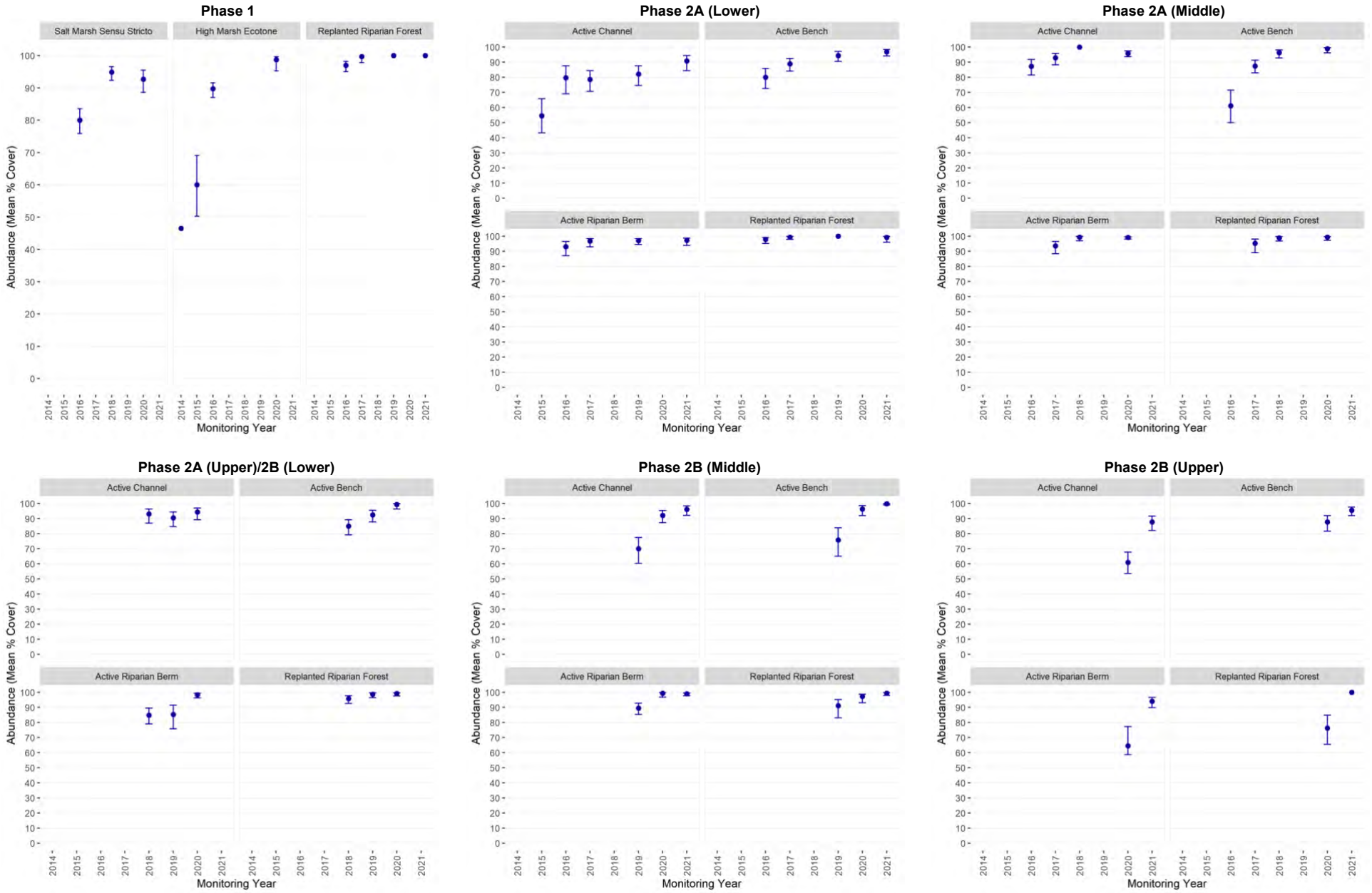

Figure 1. Estimated Total Vegetative Cover throughout the Salt River Ecosystem Restoration Project (SRERP): 2014–2021. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. No confidence interval was provided for mean total vegetative cover in the high marsh ecotone during the 2014 habitat monitoring effort (H.T. Harvey & Associates 2014).

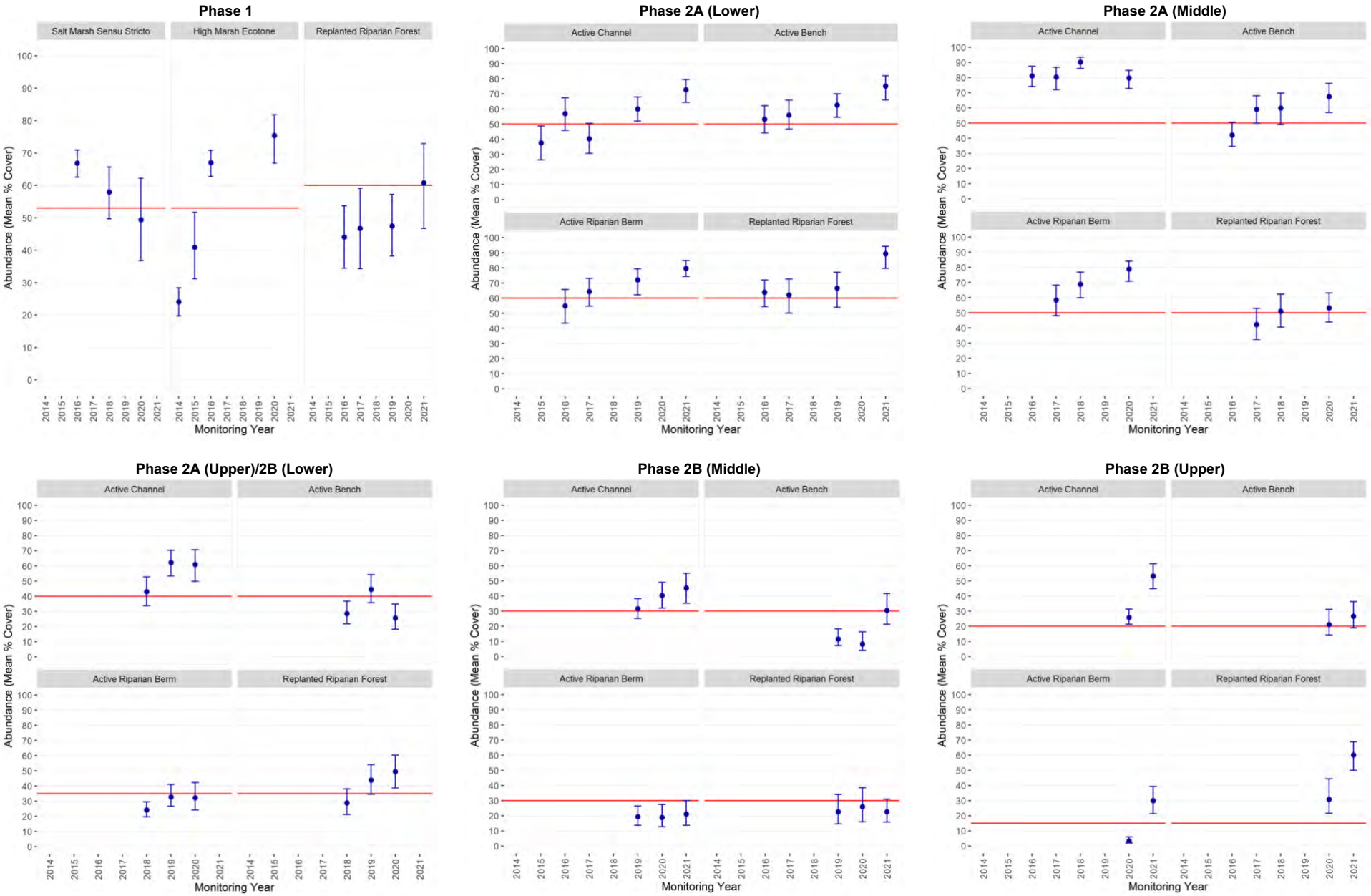

Figure 2. Estimated Abundance of Native Vegetation throughout the Salt River Ecosystem Restoration Project (SRERP): 2014–2021. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. Horizontal red lines indicate respective *minimum* percent cover success thresholds for native vegetation in each sampling region during the 2021 vegetation sampling effort.

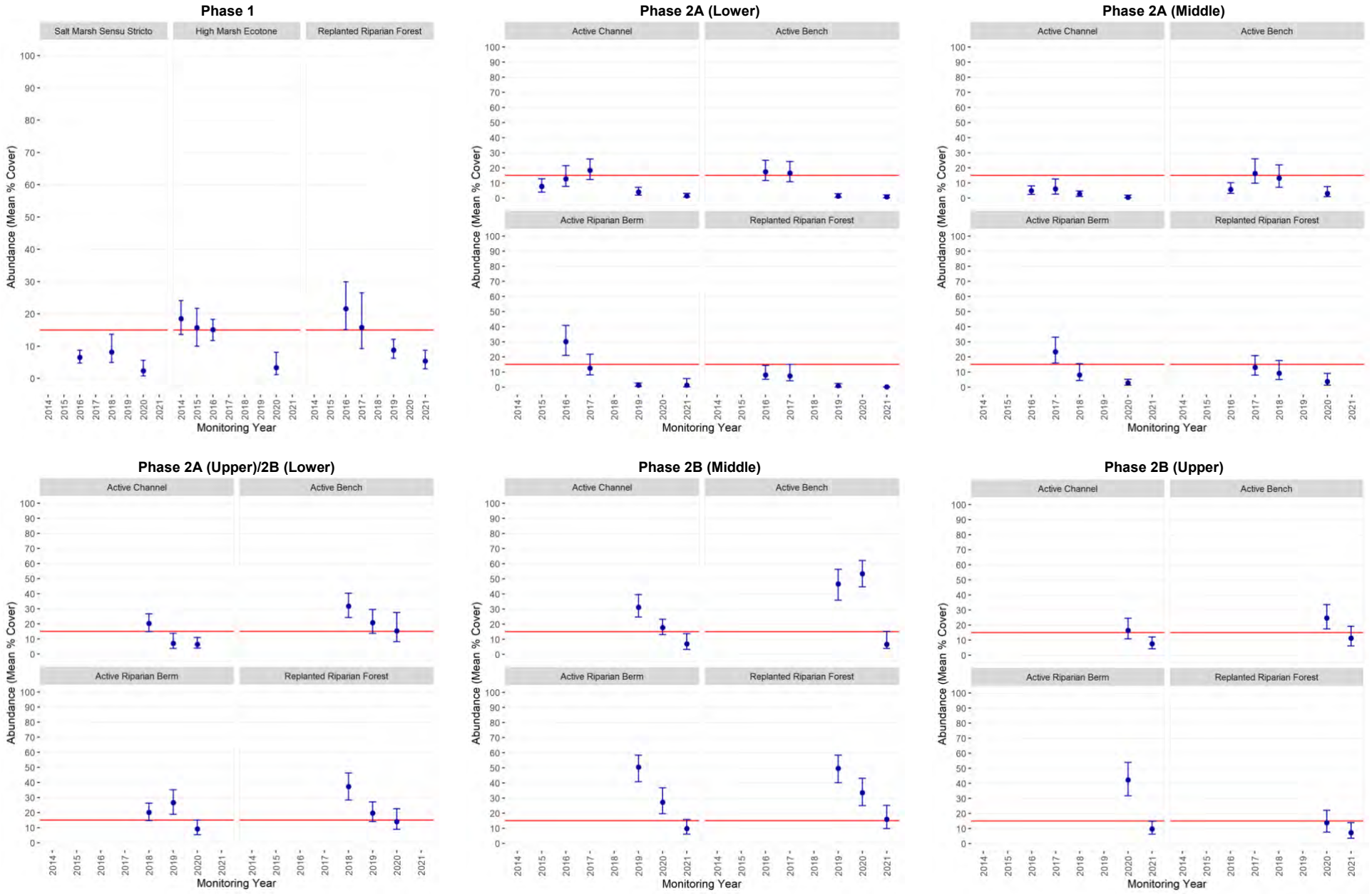

Figure 3. Estimated Abundance of Non-Native Non-Invasive Vegetation throughout the Salt River Ecosystem Restoration Project (SRERP): 2014–2021. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. Horizontal red lines indicate the final *maximum* percent cover success threshold for non-native non-invasive vegetation (i.e., < 15%) throughout the Salt River Ecosystem Restoration Project area.

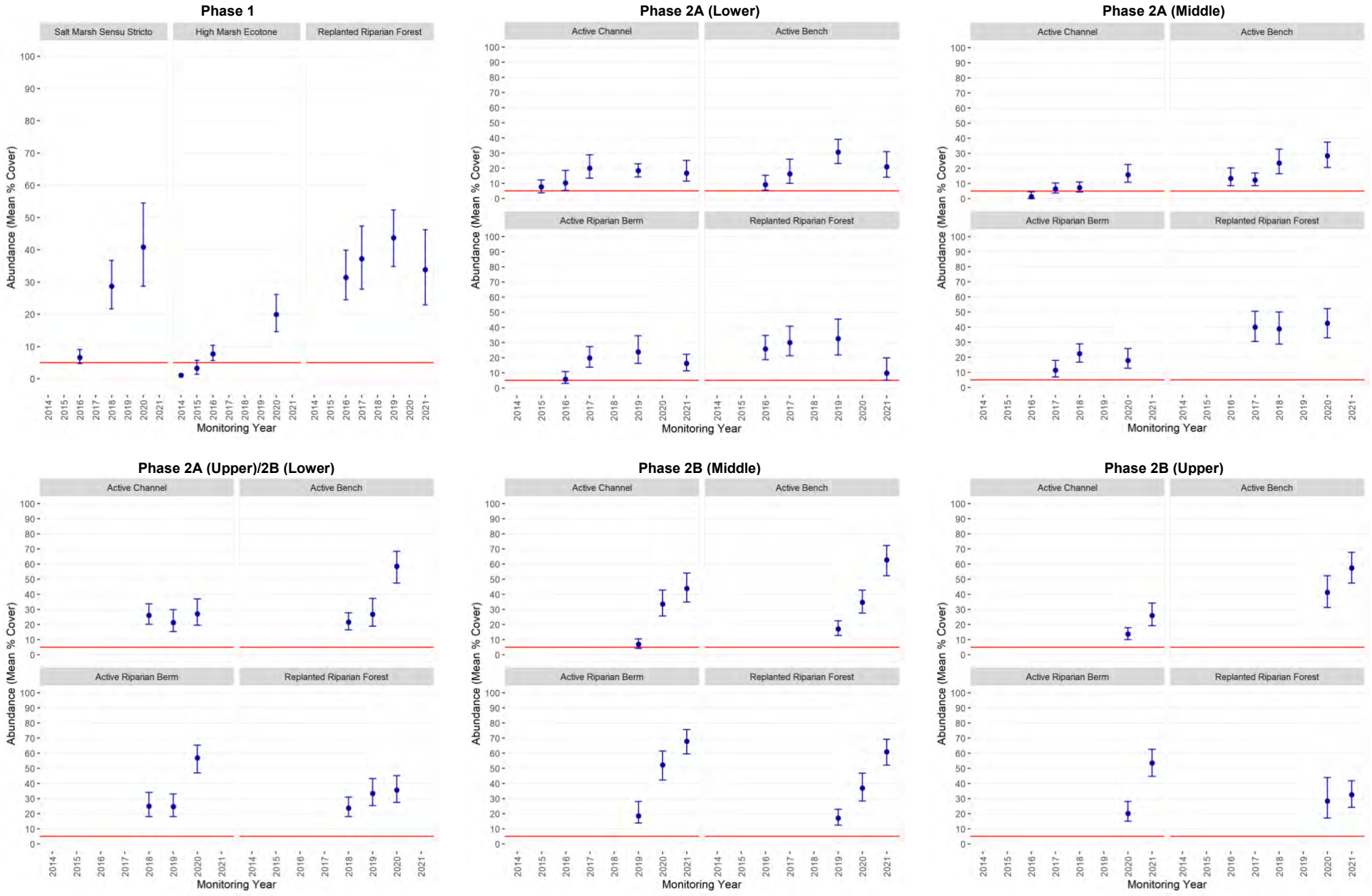

Figure 4. Estimated Abundance of Invasive Vegetation throughout the Salt River Ecosystem Restoration Project (SRERP): 2014–2021. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. Horizontal red lines indicate the final *maximum* percent cover success threshold for invasive vegetation (i.e., < 5%) throughout the Salt River Ecosystem Restoration Project area.

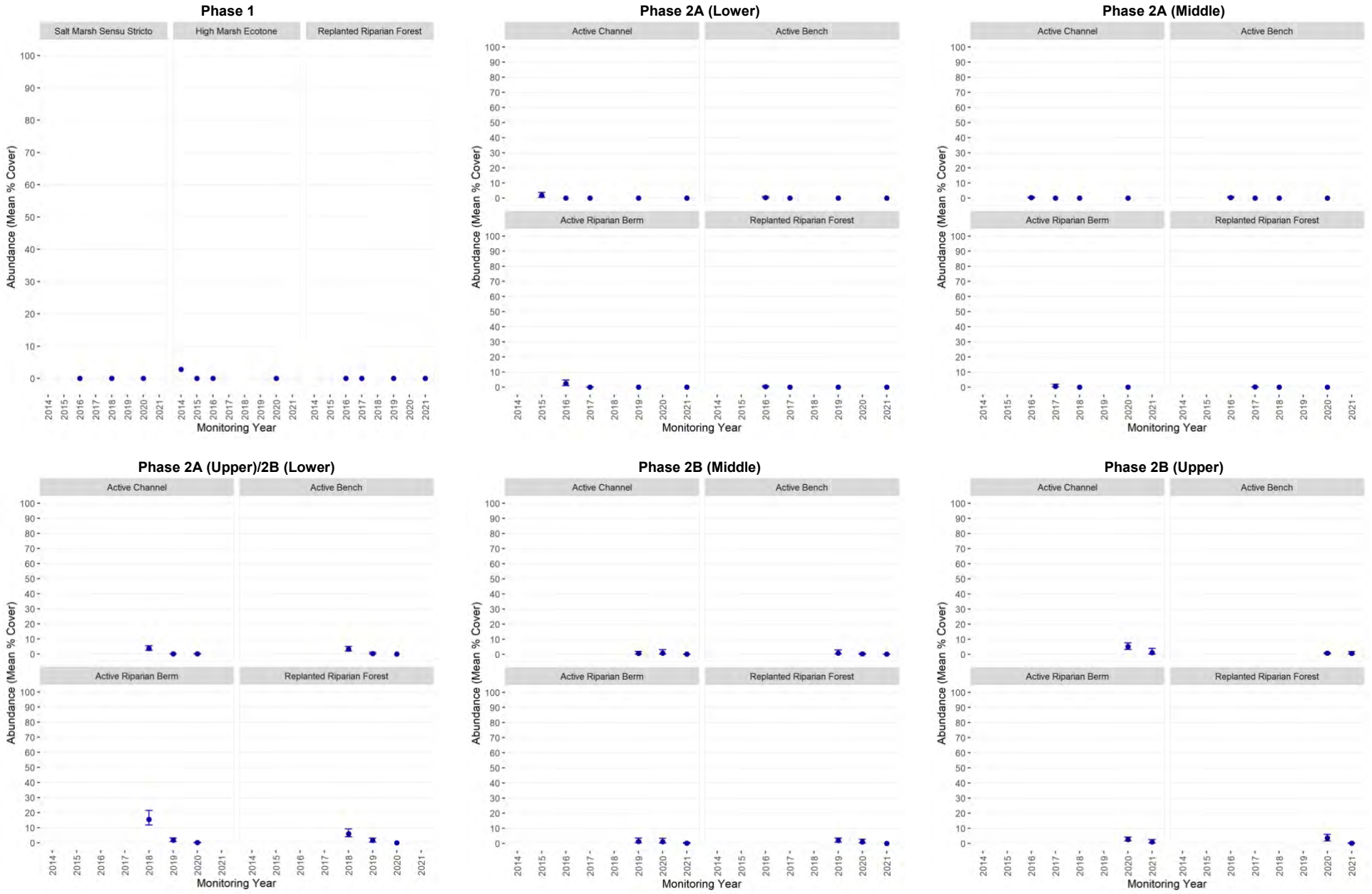

Figure 5. Estimated Abundance of the Erosion Control "Wheatgrass" (*Elymus* x *Triticum*) Hybrid throughout the Salt River Ecosystem Restoration Project (SRERP): 2014–2021. Error bars reflect 95% confidence intervals for respective sample means where such values were greater than zero and less than 100. No confidence interval was provided for mean vegetative cover of the "wheatgrass" (*Elymus* x *Triticum*) hybrid in the high marsh ecotone during the 2014 habitat monitoring effort (H.T. Harvey & Associates 2014).