National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Vegetation and Exotic Plant Management

2017 Annual Report For Bent's Old Fort NHS

Natural Resource Data Series NPS/BEOL/NRDS—2018/1173



ON THE COVER

View of Bent's Old Fort NHS. NPS Photo

Vegetation and Exotic Plant Management

2017 Annual Report For Bent's Old Fort NHS

Natural Resource Data Series NPS/SOPN/NRDS—2018/1173

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Executive Summary

This report is intended to be used in concert with the Vegetation and Exotic Plant Management Implementation Strategy for Bent's Old Fort NHS (Bent's Old Fort NHS 2016). The implementation strategy provides an overview of the initial reference conditions and direction and this report provides the results for 2017 as well as an annual update (adaptation) of the direction based on ongoing results. Reference conditions represent a combination of ecological and cultural values of the Bent's Old Fort NHS setting. The data used to determine condition of each vegetation unit relative to reference conditions is from the vegetation monitoring surveys conducted by the Southern Plains Network and Southern Plains Fire Group in accordance with Folts-Zettner et al. (2017). The primary management treatments during 2017 were mowing, herbicide, seeding and limited irrigation. Mowing was done to control exotic plants, particularly kochia. Most treatments were effective during the treatment year but long-term results remain to be determined. Of the 12 transects monitored in 10 management units, all transects had <25% cover of bare ground. Three transects each were in danger of developing monocultures and had >5% cover of high priority exotic species. Four transects each did not have over >50% native grasses expected for the unit, had >15% shrub cover, and >10% exotic plant cover. Five transects did not meet >50% native grass cover. Only three transects met the reference condition of having >15% native forb cover. 2017 management actions appear to be improving vegetation conditions as a whole, although several years of continuous management will be required to firmly establish these conditions. A Management Work Plan has been included for 2018.



NPS PHOTO

The Arch Wetland at Ben't Old Fort NHS.

1. Introduction and Background

This document is part of a collaborative effort including the Bent's Old Fort N.H.S, the Rocky Mountain Exotic Plant Management Program (RM EPMT), the Southern Plains Fire Group (SPFG), and the Southern Plains Network (SOPN). It is also intended to be used in concert with the Vegetation and Exotic Plant Management Implementation Strategy for Bent's Old Fort NHS (Bent's Old Fort NHS 2016), where the strategy provides an overview of the initial conditions and direction and this report provides the results for 2017 as well as an annual update (adaptation) of the direction based on ongoing results.

2. Methods

2.1. Spatial Units Used For Vegetation Management

Ecological sites form the primary units for restoration planning; however, within these sites there is variability in site history and current condition that result in differing starting points for the restoration process. These differing initial conditions in combination with their location and importance for interpreting the historical context of Bent's Old Fort may also result in differences in their respective priority for restoration. Thus, for restoration strategic planning we subdivided the primary units (ecological sites) into additional subunits (Figure 2.1-1.).

2.2. Vegetation Condition and Management

Overall objectives for vegetation management are presented in the Vegetation and Exotic Plant Management Implementation Strategy Bent's Old Fort NHS (2016). Success of a given vegetation objective is determined either by achieving the reference condition(s) (below) identified for a given objective or by a trajectory (trend) leading toward the corresponding reference condition within the specified time frame.

Effectiveness of Treatments

Effectiveness of treatments would typically be determined both qualitatively and quantitatively. 2015 was our first season of this approach and before treatment sampling was not available for most treatments. In 2017, treatments included mowing, herbicide, seeding and limited irrigation. All of the 2017 treatments were implemented by management unit but many were small scattered areas throughout the park. None of these treatments fell into our monitoring transects. Thus, qualitative assessments are the primary approach for evaluating treatment effectiveness in 2017.

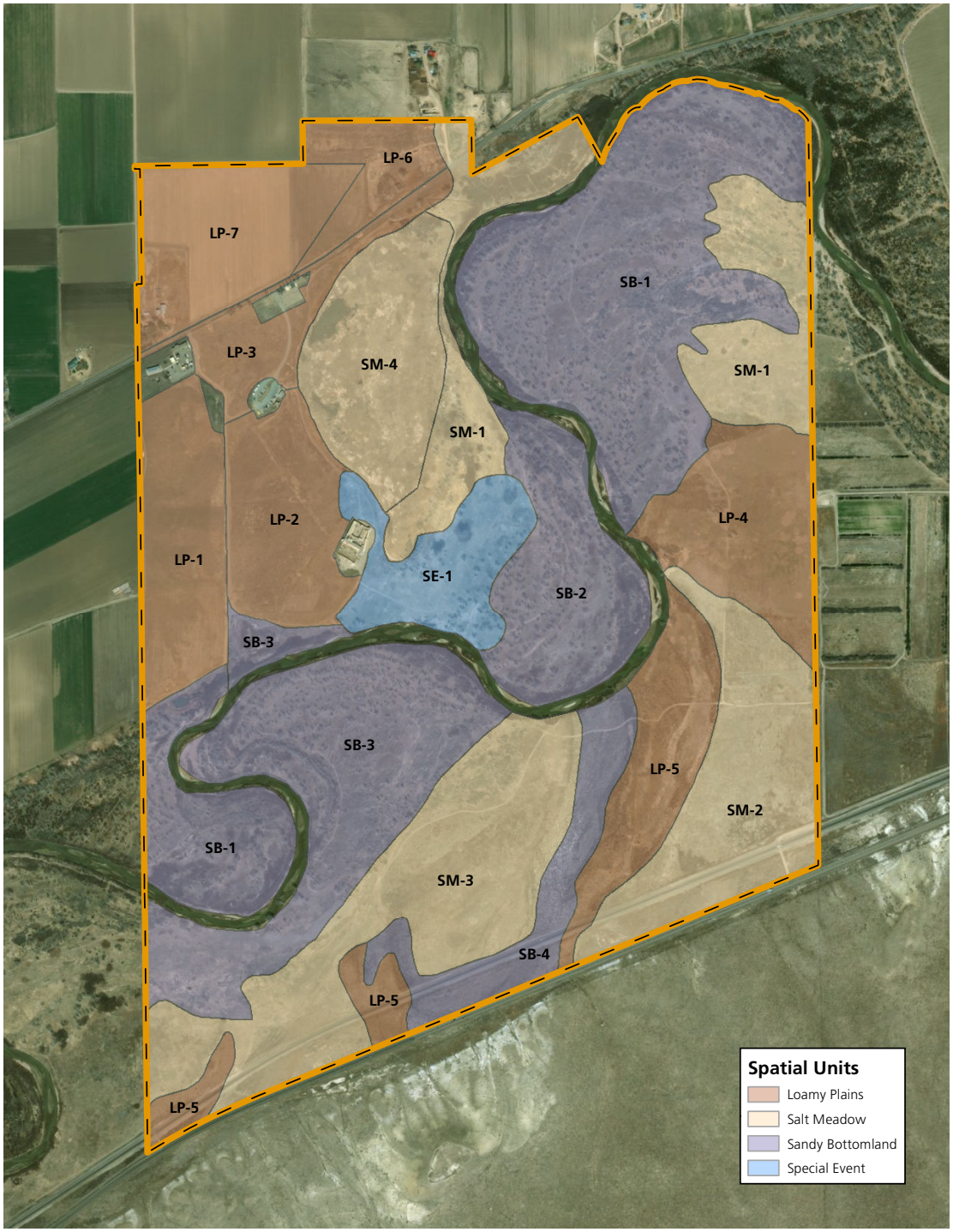


Figure 2.1-1. Spatial units used for the development of a vegetation and exotic plant management strategy at Bent's Old Fort NHS.

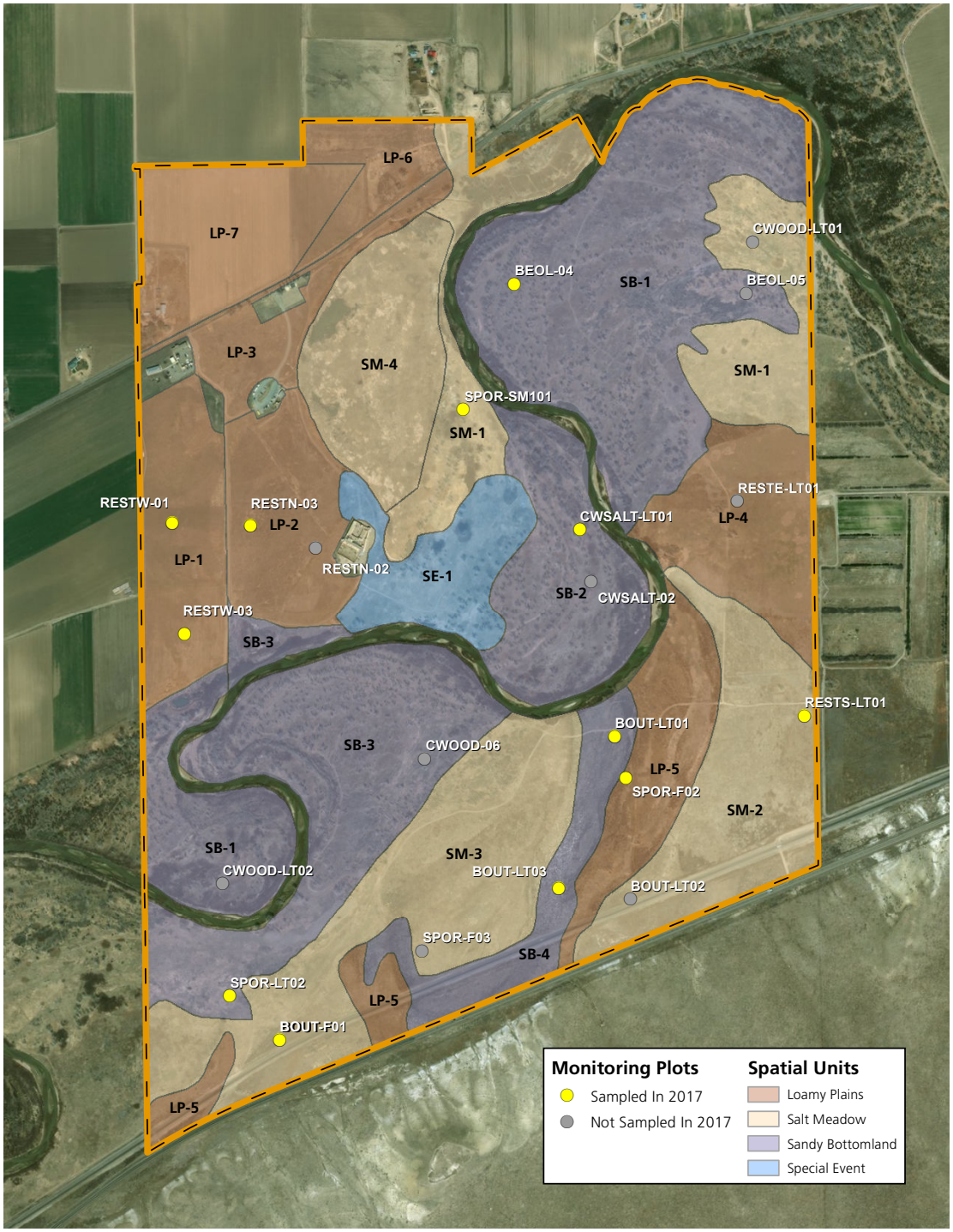


Figure 2.2-1. The grassland plots currently being sampled at Bent's Old Fort NHS.

Condition of Vegetation Units Relative to Reference Conditions

The data used to determine condition of each vegetation unit relative to reference conditions will be from the vegetation monitoring surveys conducted by the Southern Plains Network and Southern Plains Fire Group in accordance with Folts-Zettner et al. (2017). Transect locations for those data are presented below in Figure 2.2-1.

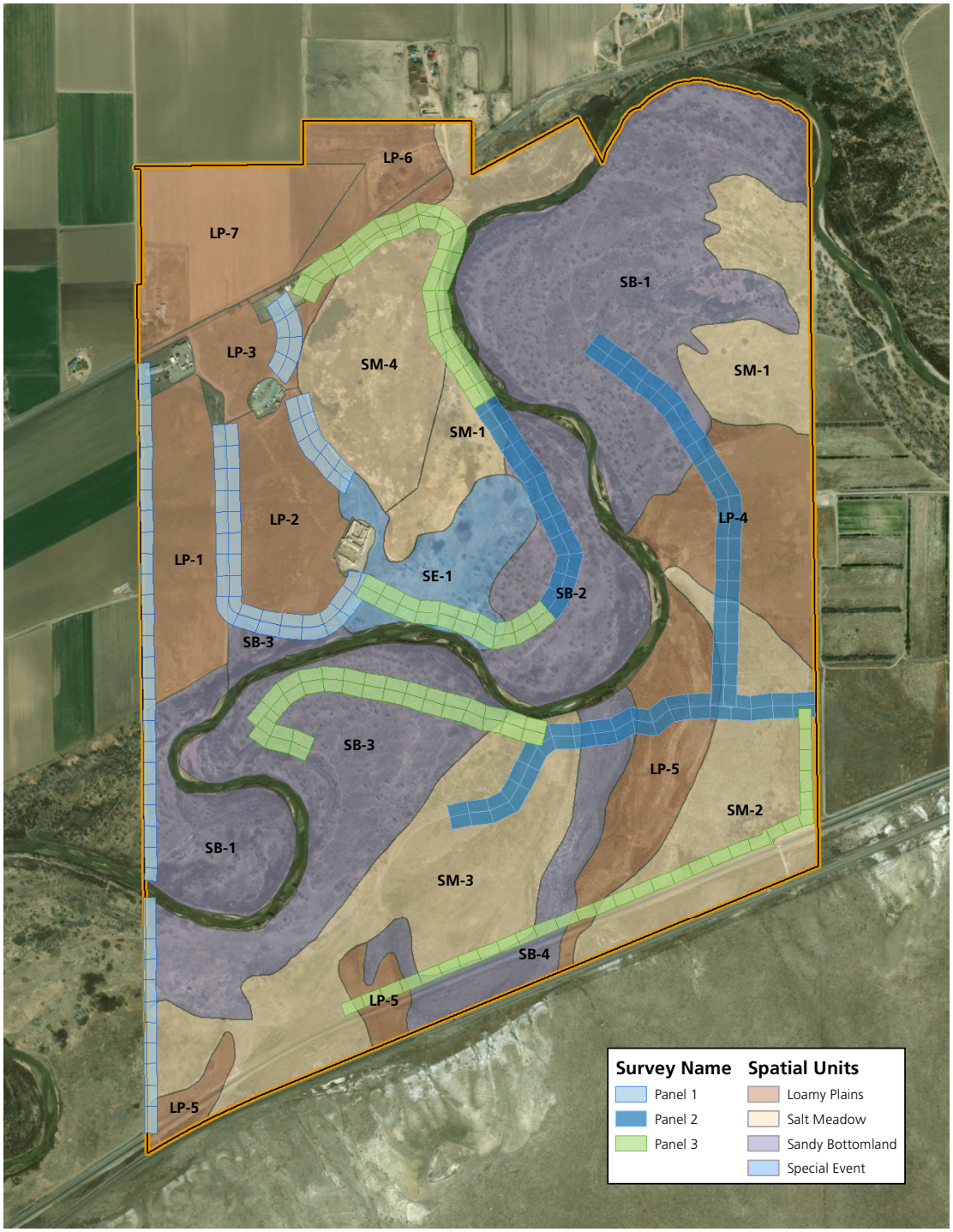


Figure 2.2-2. High risk vectors sampled at Bent's Old Fort NHS on a 3-year rotating basis.

Exotic Plant Occurrence Along High-Risk Vectors

Most exotics plant species become established by gaining a foothold then gradually expanding their invasion zone and seed bank. For this reason, SOPN monitors the early detection of exotic plant occurrence along selected high-risk vectors (i.e., areas along roads, trails, and boundaries where initial invasion is more likely to occur. This effort entails a sampling scheme that uses a three-year rotating panel design, whereby a a subset of the high risk vectors are surveyed each year (a panel) for three years, after which the areas surveyed are repeated. Detailed methods are described in Folts-Zettner et al. (2016), and the locations of vectors for BEOL are shown below in Figure 2.2-2. Exotic report and 2017 vector map can be found in Appendix B

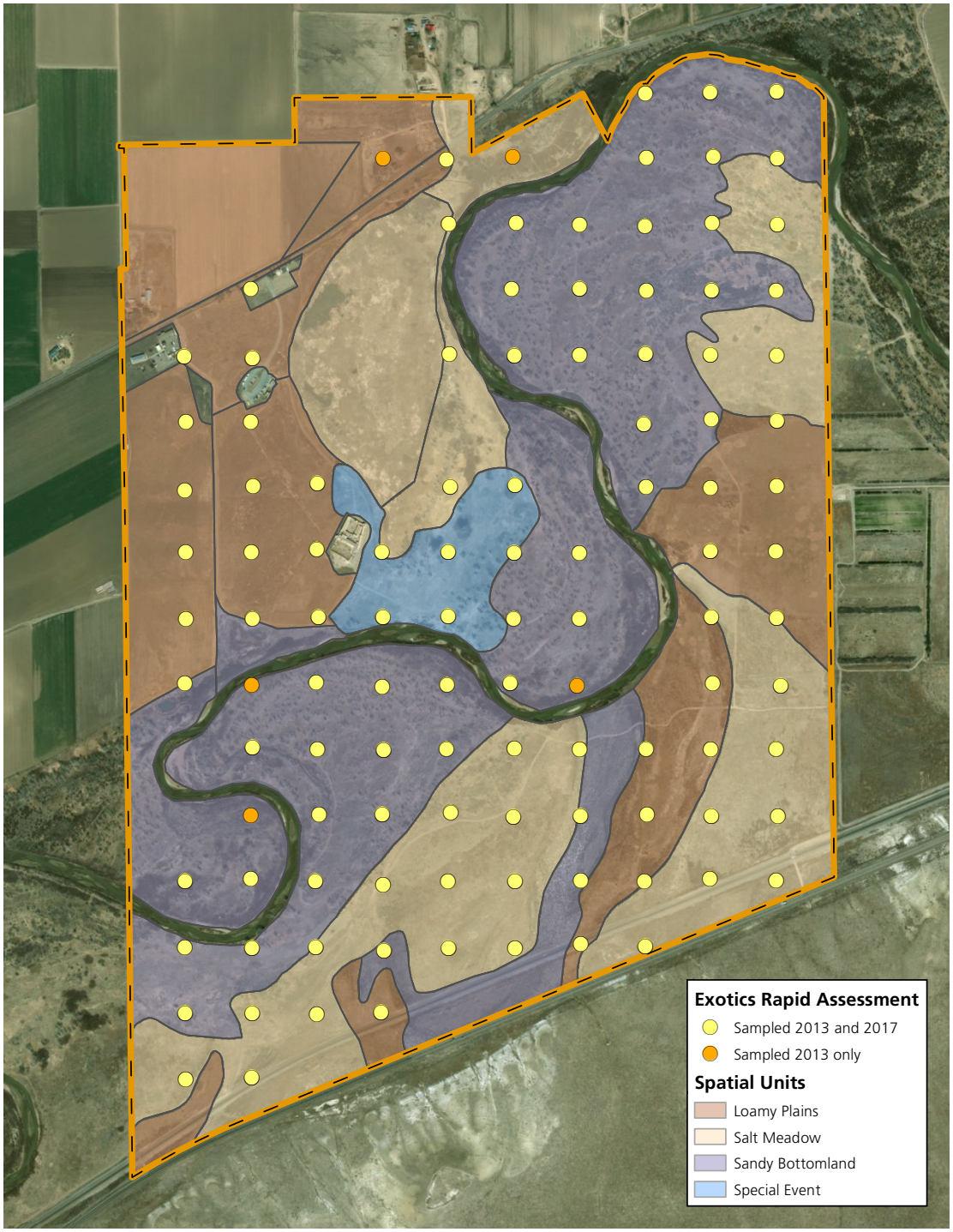


Figure 2.2-3. The exotic plant rapid assessment grid sampled in 2013 and 2017.

Park-wide Rapid Assessment of Exotic Plants

In addition to the monitoring described above, SOPN conducts a rapid assessment of exotic plants every 4 years using a systematic grid covering the entire park (Figure 2.2-3). The rapid assessment examines the occurrence of a subset of higher priority exotic species within a 10m radius of points on that grid. The presence and density class of each exotic species is recorded at each point in accordance with Folts-Zettner et al. (2016).

2.3. Reference Conditions For Bent's Old Fort NHS

We use the term reference conditions to describe our best estimate of resource conditions that are used as a reference point to evaluate the effectiveness of the vegetation management progress. There have been a myriad of terms and concepts centered on the idea of a resource state that management is trying to achieve. The term "desired condition" is commonly used within NPS as part of the planning process, including those documents undergoing the NEPA process. However, for our purposes, the term desired condition, as it has been used in NPS planning, is too broad and in many cases has uncertainty about very specific resource states that it would be premature to call the desired conditions, particularly in the context of NEPA compliance. Thus, one way to look at how we are using reference conditions here is as a tentative but measurable desired condition.

The reference conditions described below represent a combination of ecological and cultural values of the Bent's Old Fort Setting NHS setting. They are divided into two categories: (1) Historic Landscape, and (2) Ecological Integrity and Functioning. Tie to other planning

Historic Landscape

Overall Goal for the Historic Landscape: To maintain scenic quality and the ability to evoke a sense of place for the historic setting.

For Bent's Old Fort, the scenic and historic integrity of the viewshed overlap considerably. From the historic perspective, the reference condition is based on the overall feeling evoked from views as that of an expanse of prairie, the significant role of the Arkansas River and the dominant presence of the fort itself. The scenic quality of the viewshed is influenced primarily by anthropogenic "stuff". The historic connection goes beyond the scenic quality and includes the historic connections between landscape, particularly the River corridor and its cottonwoods, the cliffs, and the surrounding shortgrass prairie.

Historic Reference Conditions

HL1-Historic Landscape: The historic landscape including vegetation structure and viewshed is consistent with that of the 1833 to 1849 historic setting.

Ecological Integrity and Functioning

Landscape Scale Diversity

Overall Goal for Landscape Scale Diversity: The overall goal for landscape diversity at Bent's Old Fort NHS is for the landscape to reflect a combination of ecological and historic integrity. This integrity is comprised of two major vegetation zones, upland prairie intersected by riparian habitats, with local variation in the expression of these major types reflected by their local environments such as soils and moisture regimes.

Ecological Reference Conditions

EIF1-Landscape Diversity: *The landscape diversity at BEOL should generally correspond spatially to the variation expected for the primary ecological sites ecological sites described above and in NRCS (2013).*

EIF2-Native Grass Species Cover: *The grasslands at Bent's Old Fort NHS should be dominated (50% cover) by native grass species expected to occur given local site characteristics.*

EIF3-Native Grass Species Composition: *The grass species at Bent's Old Fort NHS should be species expected under the ecological conditions for a given site based on Ecological Site Descriptions, local records and local expertise. Within a given ecological site, >50% of the grass species cover should be native grass species expected to occur at the given local site.*

EIF4-Grass Species Monocultures: *To avoid monocultures, no individual species should occupy >85% cover within a given ecological site.*

EIF5-Grass Species Biodiversity: *The native species richness of grasses at Bent's Old Fort NHS should be at least 50% of the number of native species reported to occur within a given ecological site.*

EIF6-Native Forb Cover: *Although grassland sites should be dominated by native grass species, native forbs should occupy 15% ground cover. It should be noted that the process of restoring native prairies may have and initial temporary stage with < 10%, but there should be an ongoing process of introducing forbs as vegetation management continues.*

EIF7-Forb Species Biodiversity: *The native species richness of forbs at Bent's Old Fort NHS should be at least 50% of the number of native species reported to occur within a given ecological site.*

EIF8-Exotic Species Occurrence: *Ideally, there would be 100% native species, but exotic species should be maintained at <10% of the overall cover.*

EIF9-Exotic Species Trend: *There should be generally be a decreasing trend in the proportion of exotic plant species, but at least no net increase in the proportion of exotic to native species. Note: this reference condition will only be reported during periodic synthesis reports.*

EIF10- Exotic Species Priority: *Less than 5% of the exotic species should be those considered high priority as per the Bent's Old Fort NHS Natural Resource Condition Assessment (Struthers et al. 2013)(Figure 2.3-1).*

EIF11-Grassland Functional Groups: *To maintain the sense of place of prairie, upland grasslands should be dominated by grasses. Native shrubs and subshrubs (e.g., cacti & succulents) probably add diversity to grassland sites, but reflect ecological site conditions, but should not dominate the sites and typically constitute < 15% of the total cover in grasslands.*

EIF12-Riparian Bottomlands Overstory: *To maintain the sense of place of the site, with overstory dominated by stands of native cottonwoods within the sandy bottomland ecological sites.*

EIF13-Pollinator Habitat: *Floral resource abundance and availability is consistent with that expected for the ecological site and sufficient to support healthy populations of native pollinators.*

EIF14-Monarch Habitat: *The abundance, diversity and densities of native milkweeds are consistent with that expected for the ecological site and sufficient to support healthy populations of monarchs where appropriate.*

EIF15-Bare Ground: *The Amount and size of bare areas do not exceed that which would expose the site to excessive erosion, be expected for the ecological site, and does not exceed 25%.*

EIF16-Erosion: *That the presence of rills, gullies, or wind erosion does not exceed that which would naturally be expected for the ecological site and would generally be classified as none to slight.*

Table 2.3-1. Exotic species found within Bent's Old Fort NHS that are considered to have the most impact to native habitats throughout the Historic Site based upon combined measures. The logic for this determination can be found in Struthers et al. 2015).

Concern Level	Scientific Name	Common Name
Highest Concern	*Acroptilon repens*	Russian knapweed
	Bromus tectorum (and *var tectorum*)	Cheatgrass
	Convolvulus arvensis	Field bindweed
	Tamarix chinensis/ ramosissima	Saltcedar
High Concern	*Cirsium arvense*	Canada thistle
	Kochia scoparia (aka *Bassia scoparia*)	Kochia
	Lepidium latifolium	Broadleaf pepperweed
	Sorghum halepense	Johnsongrass

3. Results

3.1. Management Treatments

The Location of the primary vegetation/ exotic plant treatments that occurred at Bent's Old Fort during 2017 are shown in Figure 3.1-1, and described for each vegetation management unit in Table 3.1-1. The primary management treatments during 2017 were mowing, herbicide, seeding and limited irrigation. Mowing was primary done to control exotic plants, particularly kochia. Prescribed fire was not used during 2017 at Bent's Old Fort.



Figure 3.1-1. Location and type of primary vegetation management actions conducted at Bent's Old Fort NHS during 2017.

Table 3.1-1. The primary management actions conducted in each spatial unit at Bent's Old Fort NHS during 2017. Also shown are the goals, objectives and effectiveness, either qualitative or quantitative for each management action.

Spatial Unit	Management Action/ Treatment	Description of Treatment	Broader Goal or Purpose	Specific Objective	Effectiveness of Treatment	Recommended Change in Management (if any)
LP-1	Mowing	A small section mowed in March to control kochia. The entire section was mowed later. A small section in the area of the old bone yard was mowed again in fall of 2017 for cheatgrass control.	To facilitate establishment of grasses where natural recruitment is not expected	To remove seed heads of kochia and other exotic species and prevent the addition of seeds to the seed bank.	Qualitative Assessment is that exotics are less prevalent and that native grasses are becoming established	–
	Irrigation	Southern half of unit was irrigated April/May	To facilitate establishment of grasses where natural recruitment is not expected	To provide water to recently planted grasses when rainfall is lacking	Qualitative Assessment is that native grasses are becoming established	–
	Hay (Northern half)	Northern half of unit hayed in July	–	To mimic grazing	–	Lengthen intervals between haying
	Plugged	Native grass plugs transplnted on 1/4 acre in northern half of unit	To facilitate establishment of grasses where natural recruitment is not expected	To "head start" the establishment of desireable native grass species. Planted western wheatgrass and buffalograss	An estimated 75% of plugs lived through summer	–
	Herbicide	Sprayed roadside for Kochia and Russian thistle in June; field bindweed in August	To reduce the prevalence of exotic species and to facilitate establishment of native grasses.	To control exotic species and prevent the addition of seeds to the seed bank. To reduce competition between native and exotic species while native species are becoming established	Effective during treatment year. Long-term reduction to be determined.	–
LP-2	Herbicide	Sprayed in June for kochia and Russian thistle	To reduce the prevalence of exotic species and to facilitate establishment of native grasses.	To control exotic species and prevent the addition of seeds to the seed bank. To reduce competition between native and exotic species while native species are becoming established	Effective during treatment year. Long-term reduction to be determined.	–
LP-4	Herbicide	Sprayed in June for kochia and field bindweed	To reduce the prevalence of exotic species and to facilitate establishment of native grasses.	To control exotic species and prevent the addition of seeds to the seed bank. To reduce competition between native and exotic species while native species are becoming established	Effective during treatment year. Long-term reduction to be determined.	–
	Mowing	Mowed in July to prep for seeding	To facilitate establishment of grasses where natural recruitment is not expected	To remove seed heads of exotic species and prevent the addition of seeds to the seed bank and to prepare for seeding	Effective during treatment year. Long-term reduction to be determined.	–

Table 3.1-1. The primary management actions conducted in each spatial unit at Bent's Old Fort NHS during 2017. Also shown are the goals, objectives and effectiveness, either qualitative or quantitative for each management action.

Spatial Unit	Management Action/ Treatment	Description of Treatment	Broader Goal or Purpose	Specific Objective	Effectiveness of Treatment	Recommended Change in Management (if any)
LP-4 (cont.)	Seeding	Drilled grass seed with large seed drill/tractor in November. Planted western wheatgrass, buffalograss, sideoats grama	To facilitate establishment of grasses where natural recruitment is not expected	To reduce amout of bare ground and encourage establishment of native grasses	To be determined	–
LP-5	Herbicide	Sprayed in June for Russian thistle and puncturevine	To reduce the prevalence of exotic species and to facilitate establishment of native grasses.	To control exotic species and prevent the addition of seeds to the seed bank. To reduce competition between native and exotic species while native species are becoming established	Effective during treatment year. Long-term reduction to be determined.	–
LP-6	Mowing	In October to prep for archeology survey and seeding	To facilitate establishment of grasses where natural recruitment is not expected	To remove seed heads of exotic species and prevent the addition of seeds to the seed bank.	Effective during treatment year. Long-term reduction to be determined.	–
	Seeding	Northeast section drilled with native grass seed in November	To facilitate establishment of grasses where natural recruitment is not expected	To reduce amout of bare ground and encourage establishment of native grasses	To be determined	–
SB-1	Herbicide	Northern section sprayed for kochia	To reduce the prevalence of exotic species and to facilitate establishment of native grasses.	To control kochia and other exotic species and prevent the addition of seeds to the seed bank. To reduce competition between native and exotic species while native species are becoming established	Effective during treatment year. Long-term reduction to be determined.	–
SB-3	Mowing	Mowed 10 acres of kochia to control seed production in July/ August. Maintenance worker Ozzie.	To facilitate establishment of grasses where natural recruitment is not expected	To remove seed heads of exotic species and prevent the addition of seeds to the seed bank and to prep for seeding	Effective during treatment year. Long-term reduction to be determined.	–
	Seeding	Less than 3 acres in southwest corner of tamarisk eradication area Mowed dead kochia in November for seed bed preparation	To facilitate establishment of grasses where natural recruitment is not expected	To reduce amout of bare ground and encourage establishment of native grasses	To be determined	–
	Herbicide	Sprayed May/June for kochia in northern half of unit	To reduce the prevalence of exotic species and to facilitate establishment of native grasses.	To control exotic species and prevent the addition of seeds to the seed bank. To reduce competition between native and exotic species while native species are becoming established	Effective during treatment year. Long-term reduction to be determined.	–

Table 3.1-1. The primary management actions conducted in each spatial unit at Bent's Old Fort NHS during 2017. Also shown are the goals, objectives and effectiveness, either qualitative or quantitative for each management action.

Spatial Unit	Management Action/ Treatment	Description of Treatment	Broader Goal or Purpose	Specific Objective	Effectiveness of Treatment	Recommended Change in Management (if any)
SE-1	Mowing	Mowed all in April	For Special Events	Visitor safety	n/a	–
SM-2	Herbicide	Sprayed in June for field bindweed and kochia	To reduce the prevalence of exotic species and to facilitate establishment of native grasses.	To control exotic species and prevent the addition of seeds to the seed bank. To reduce competition between native and exotic species while native species are becoming established	Effective during treatment year. Long-term reduction to be determined.	–
	Mowing	Mowed in July	To facilitate establishment of grasses where natural recruitment is not expected	To remove seed heads of exotic species and prevent the addition of seeds to the seed bank.	Effective during treatment year. Long-term reduction to be determined.	–
	Seeding	Drilled grass seed with large seed drill/tractor in November. Western wheatgrass, buffalograss, sideoats grama	To facilitate establishment of grasses where natural recruitment is not expected	To reduce amout of bare ground and encourage establishment of native grasses	To be determined	–

Table 3.2-1. Overall summary of reference conditions at Bent's Old Fort NHS for 2017. Cells in red with a red X indicate that the transect did not meet the reference condition. Cells in green wtih a green dot indicate that the transect did meet the reference condition.

Spatial Unit	Transect	Native Grass	Expected Grass	Monoculture	Native Forb	Exotics	Exotic-High Priority	Native Shrub	Bare Ground
LP-1	RESTW-01	•	•	•	X	X	X	•	•
LP-1	RESTW-03	X	•	•	X	X	X	•	•
LP-2	RESTN-03	•	•	•	X	X		•	•
LP-5	SPOR-F02	X	•	•	X	•	•	X	•
SB-1	BEOL-04	•	•	•	•	•	•	•	•
SB-2	CWSALT-LT01	•	X	•	•	•	•	X	•
SB-3	SPOR-LT02	•	X	•	X	•	•	•	•
SB-4	BOUT-LT01	•	•	X	X	•	•	X	•
SB-4	BOUT-LT03	X	•	•	X	•	•	•	•
SM-1	SPOR-SM101	•	•	X	X	•	•	•	•
SM-2	RESTS-LT01	X	X	•	•	X	X	•	•
SM-3	BOUT-F01	X	X	•	X	•	•	X	•

3.2. Condition of Vegetation Units Relative to Reference Conditions

Based on our monitoring results, the condition of each spatial unit relative to our reference conditions is shown in figures 3.2-1 to 3.2-17. An overall summary of reference conditions can be found in Table 3.2-1. Measurable reference conditions for the historic landscape, landscape diversity, pollinator habitat and monarch butterfly habitat are still being refined and are not shown in this report. Initial biodiversity information can be found in Appendix C.

Reference Condition EIF2 - Grassland Species Cover

Prairie or grassland habitats by definition are characterized as being dominated by grasses. The native grasses at BEOL are important to stabilize the loose soils of the flood plain and uplands, while buffering damage from flooding and wind erosion. All transects that have been visited multiple times continue to show an increase in native grass cover. Some of the transects lacking native grasses have been degraded due to historic land use and/or prairie dogs. The lack of native grass cover in many units at BEOL may reflect the need for some restoration efforts.

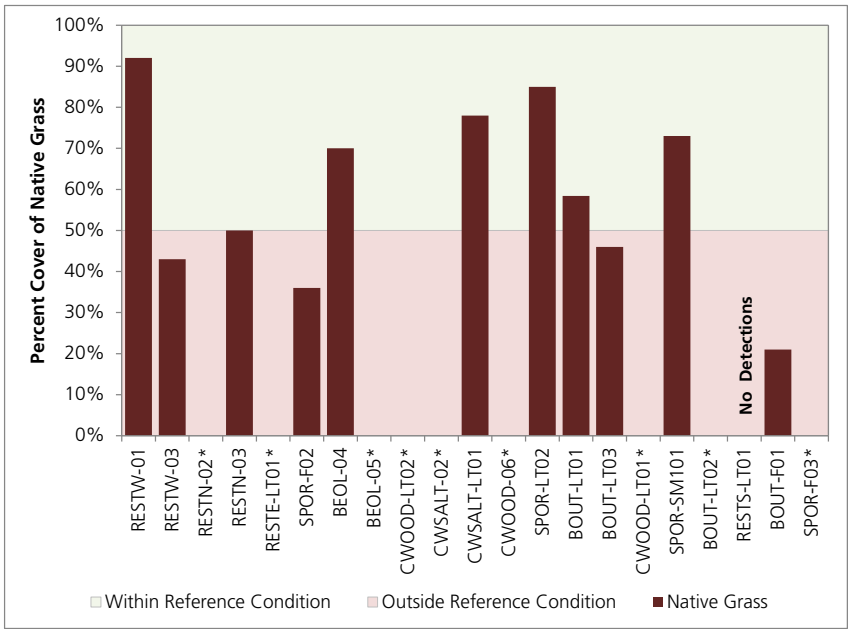


Figure 3.2-1. The percentages cover by native grasses on all of our monitoring plots. Bars within the green portion of the graph are within the reference condition of at least 50% cover by native grasses, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

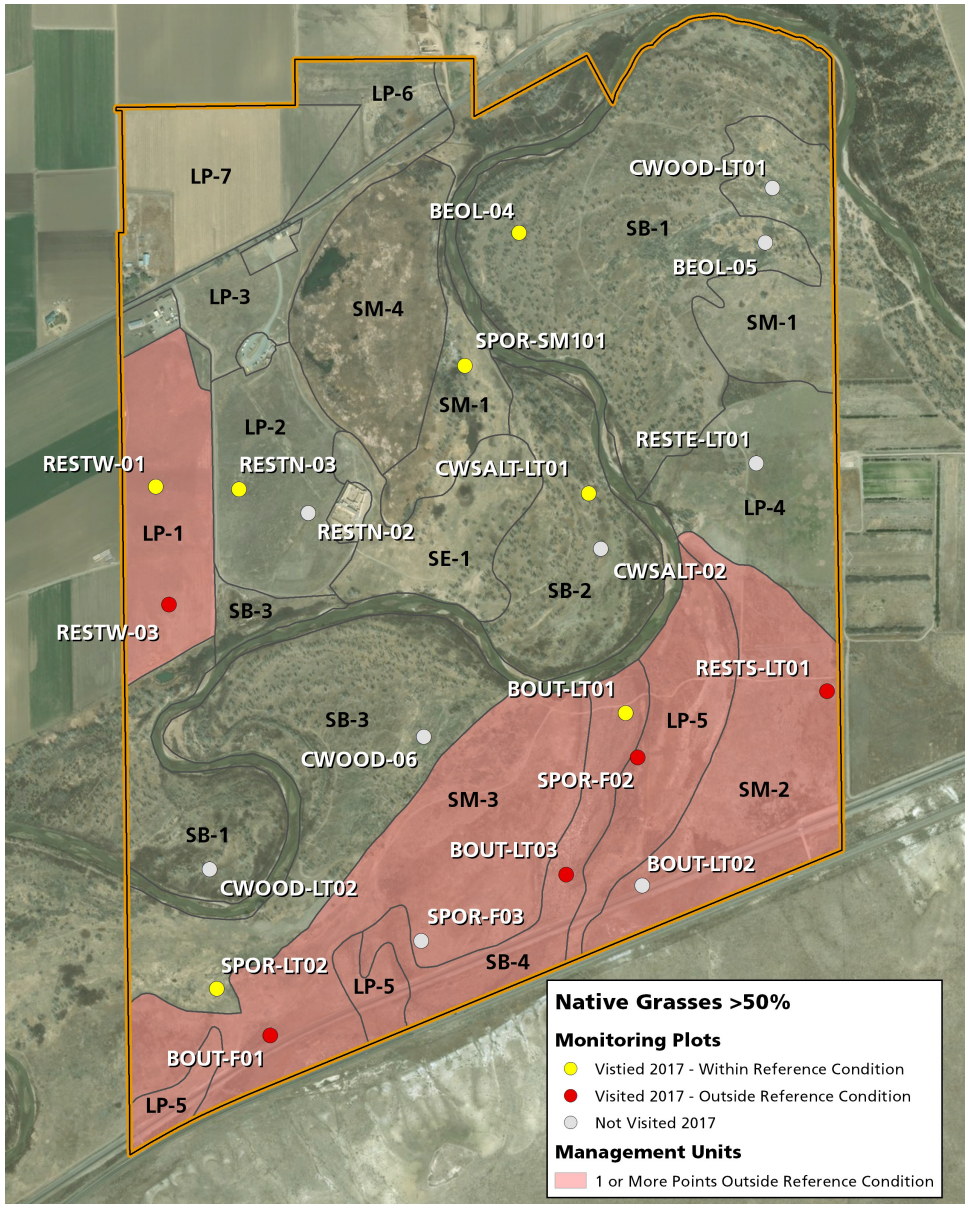


Figure 3.2-2. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the at least 50% cover by native grasses reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF3-Native Grass Species Composition

In addition to cover, we also consider which species are present relative to those expected for the site conditions. A suite of native grasses have been identified that should be present in each fully-realized (climax) plant community, based on Ecological Site Descriptions and local expertise. A variety of native grasses provides an ability to recover quickly from a disturbance and supplies diversity that supports a functioning habitat. BOUT-F01 is dominated by sand sage with a sparse understory of desired grasses. Reduction of shrub cover would allow grass to increase. Grass diversity is fluctuating between years, likely caused by environmental factors.

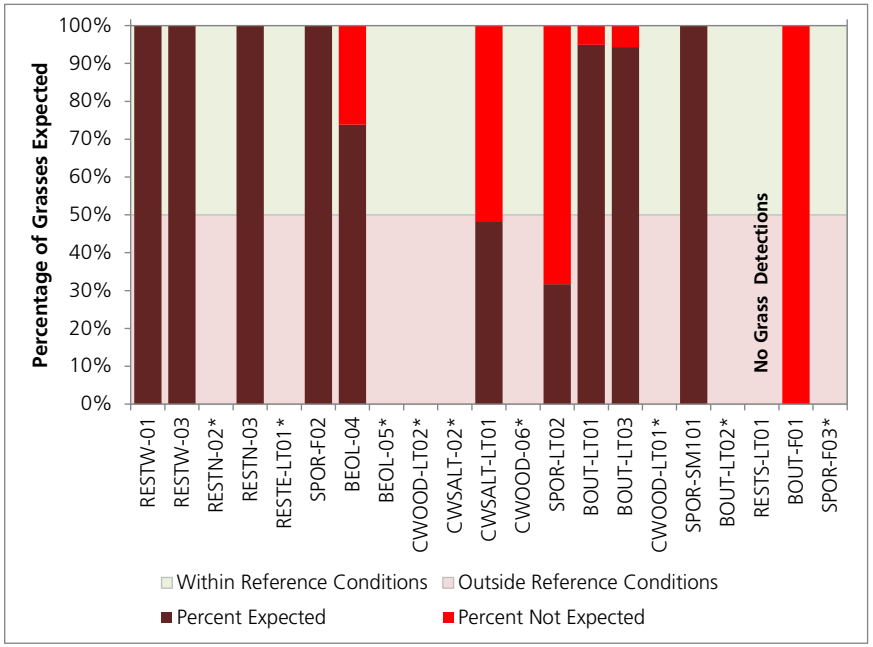


Figure 3.2-3 . The percentage grasses on our monitoring plots that are expected to occur at that site based on ecological site descriptions (NRCS 2011), local expertise, and county records. Bars within the green portion of the graph are within the reference condition of at least 50% cover by native grasses expected to occur at the site, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

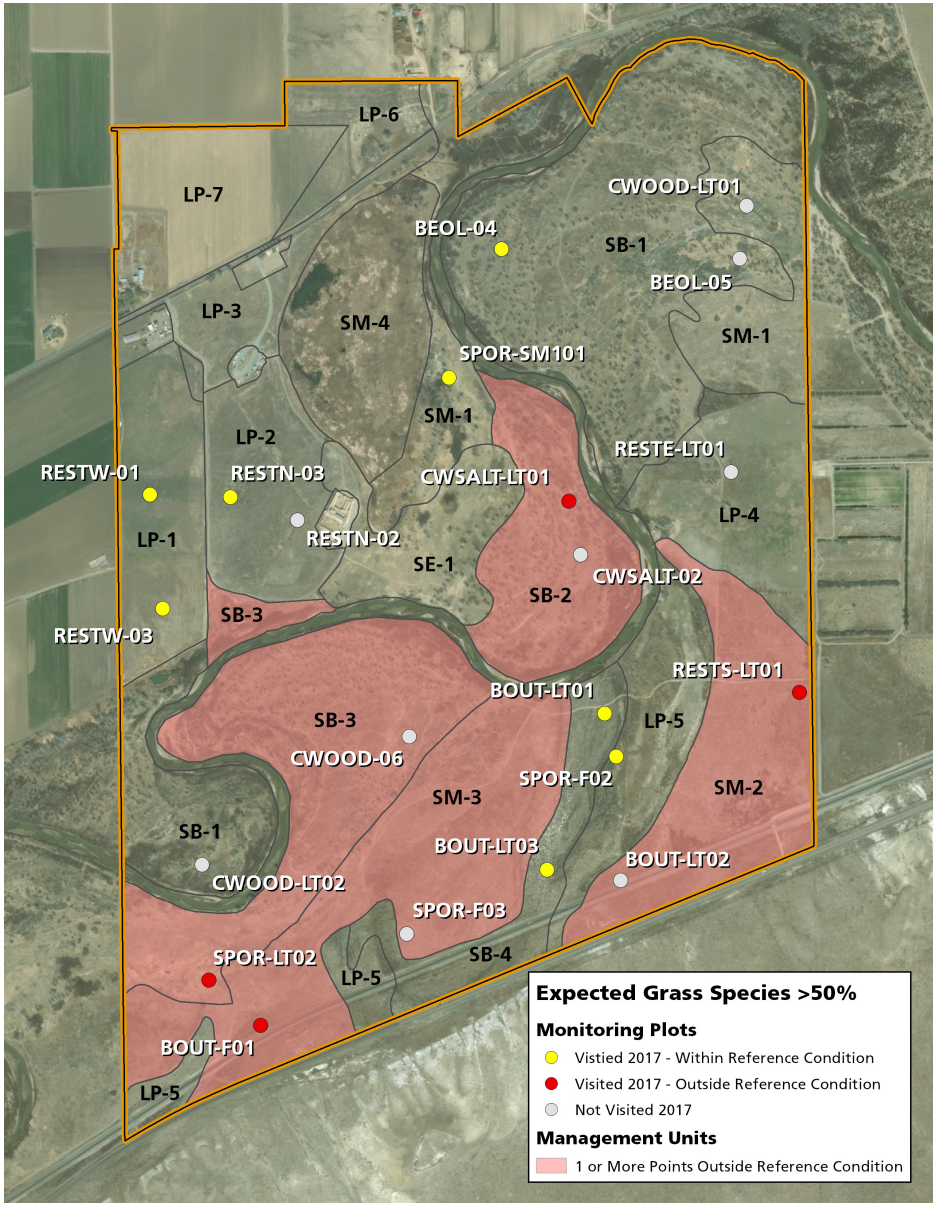


Figure 3.2-4 . Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the at least 50% cover by native grasses expected to occur reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF4-Grass Species Monocultures:

A monoculture occurs when a site is completely dominated by only one grass species. This can result in a lack of diversity, limited habitat quality, and vulnerability to disturbance, although the degree of concern varies depending on species and site characteristics. Three transects are outside of this reference condition (Figure 3.2-5 and Figure 3.2-6), all dominated by native rhizomatous grasses, which may preclude recruitment by other native species. SPOR-SM101 is dominated by inland saltgrass, RESTW-01 by western wheatgrass and BOUT-LT01 by blue grama. Other transects nearing the reference threshold are dominated by expected perennials and may improve grass diversity given time.

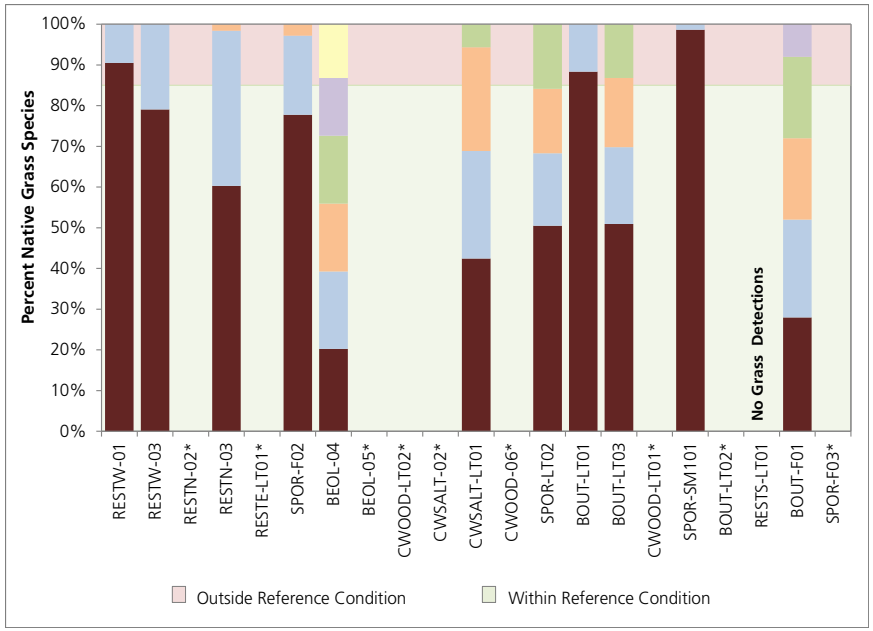


Figure 3.2-5. The percentage individual native grass species on our monitoring plots. Bars within the green portion of the graph are within the reference condition of no individual species having greater than 85% of cover by native grasses, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

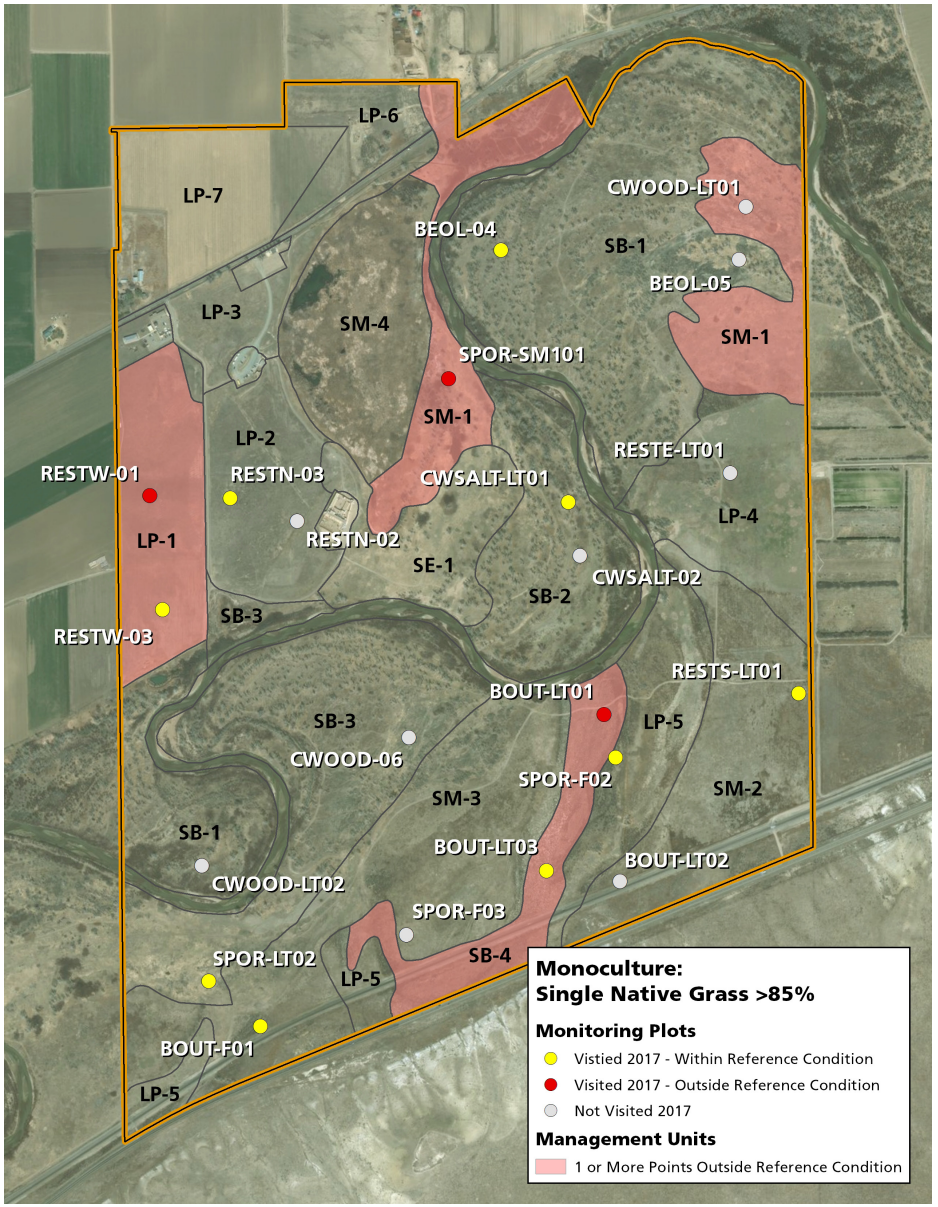


Figure 3.2-6. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no species having greateer than 85% cover by native grasses reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF6-Native Forb Cover

Native forbs are critical for healthy, diverse habitats – providing structure, nectar, pollen, seed and browse to the food-chain and visual interest to the visitor. Three sites met the reference condition. BEOL-04 had an abundance of western ragweed in 2017, CWSALT-LT01 showed an expansion of wild licorice; and RESTS-LT01 was dominated by a mixture of native and exotic forbs. In general, native forbs are greatly lacking in all areas of BEOL while exotic forbs thrive. Establishment of suitable annual and perennial forbs will likely be necessary to meet the reference condition in future years. However, such establishment requires careful planning because eradication approaches of exotic forbs is difficult to accomplish without simultaneously eradicating native forbs.

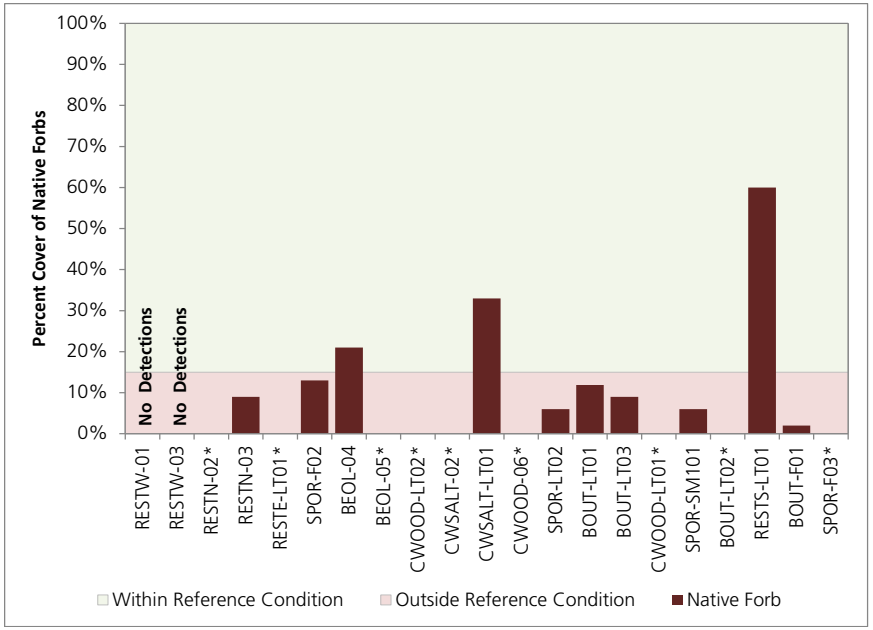


Figure 3.2-7. The percentage cover by native forbs on our monitoring plots. Bars within the green portion of the graph are within the reference condition of having at least 15% cover by native forbs, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

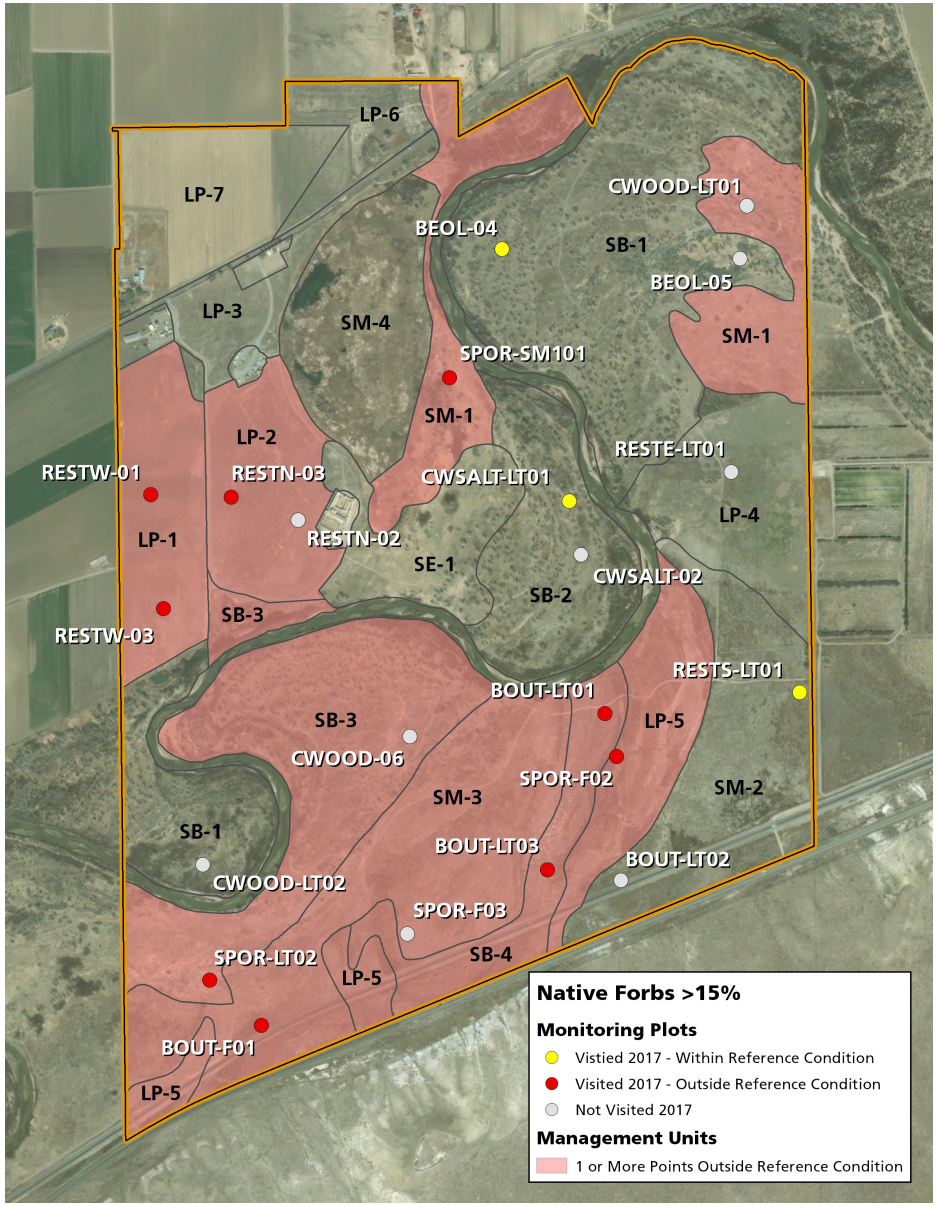


Figure 3.2-8. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the at least 15% cover by native forbs, reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF8-Exotic Species Occurrence:

Exotic species have become commonplace in the landscape with the potential to alter or replace native plant communities when populations become too dense. Restoring and maintaining the resilience of natural areas will discourage the presence of exotics. Kochia was found in all transects out-of-reference and field bindweed was found in all but RESTN-03, which did have prickly Russian thistle. All three species are difficult to control, although some success has been seen in carefully-timed mowing for kochia. Breaking the seed-bank cycle is likely the only method for controlling kochia.

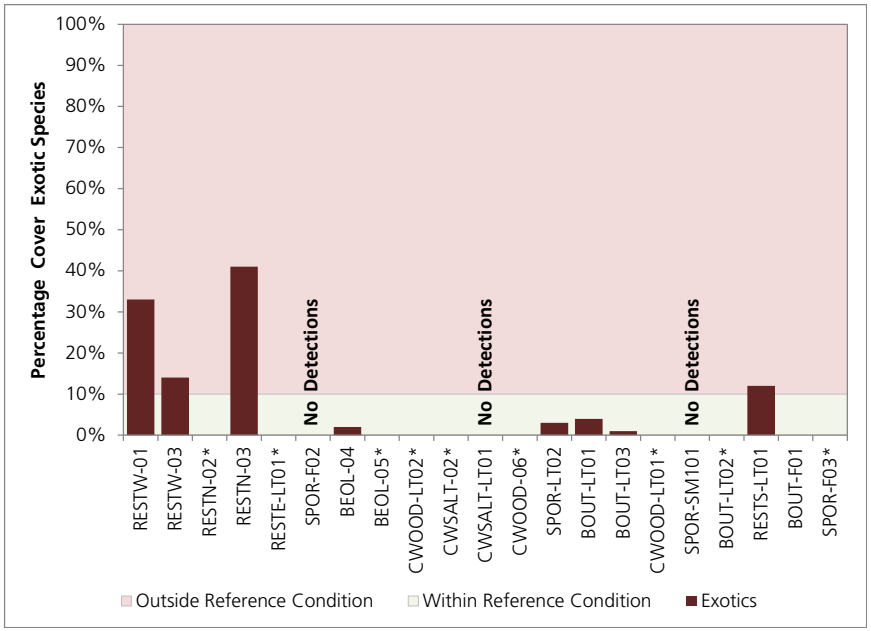


Figure 3.2-9. The percentage cover by exotic species on our monitoring plots. Bars within the green portion of the graph are within the reference condition of having no greater than 10% cover by exotic species, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

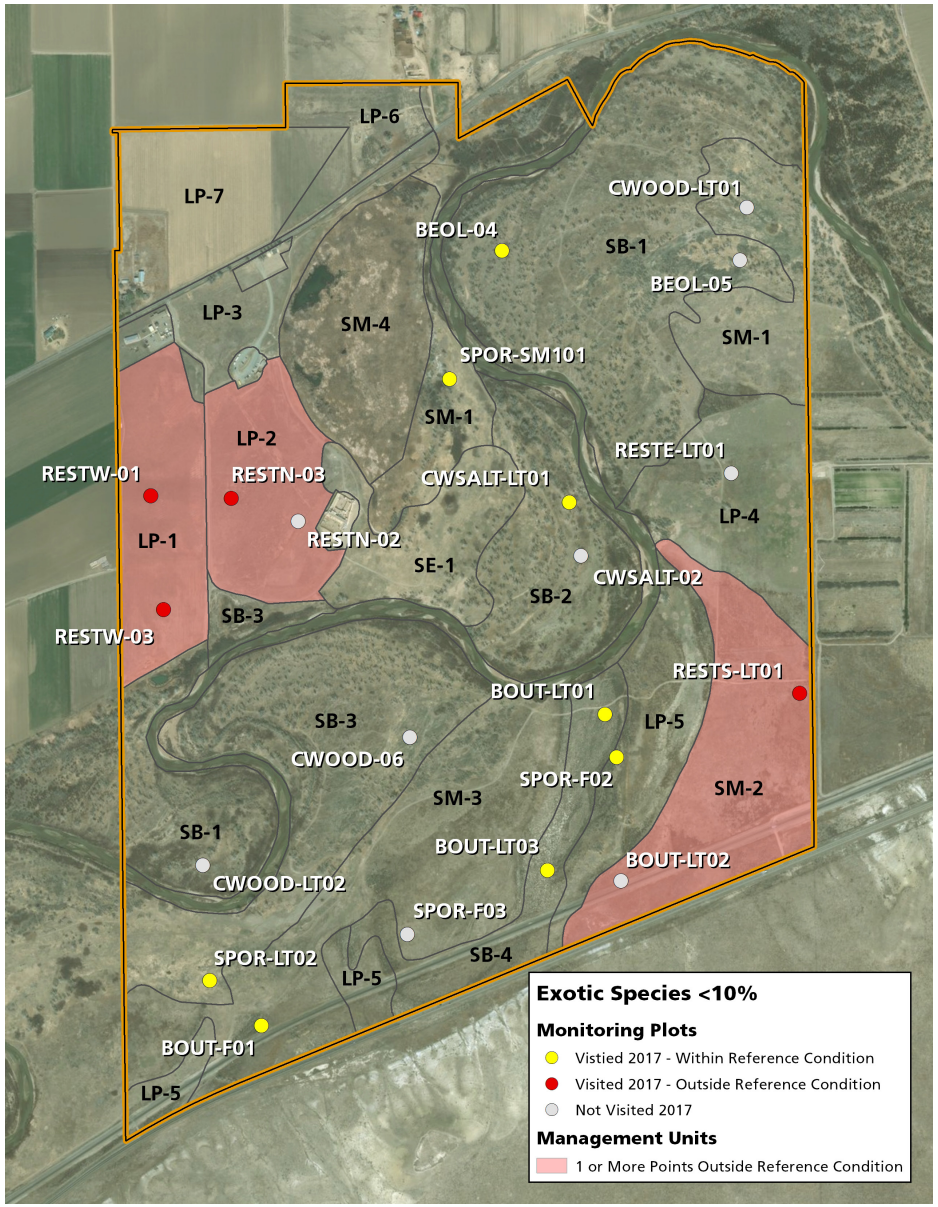


Figure 3.2-10 Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 10% cover by exotic species reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF10- Exotic Species Priority

Some exotic species are very difficult to control while others diminish with various treatments. Eight exotic species at BEOL have been identified as high priority exotics for their ability to alter plant communities combined with their difficulty of control. The sites exceeding the reference condition contain kochia and the perennial field bindweed (Figure 3.2-11 and Figure 3.2-12). As mentioned previously, mowing may provide a method of breaking the seed bank cycle for kochia. Field bindweed is very hard to control as it spreads from vegetative pieces. It is imperative to clean mowers after operating in bindweed areas to prevent spread.

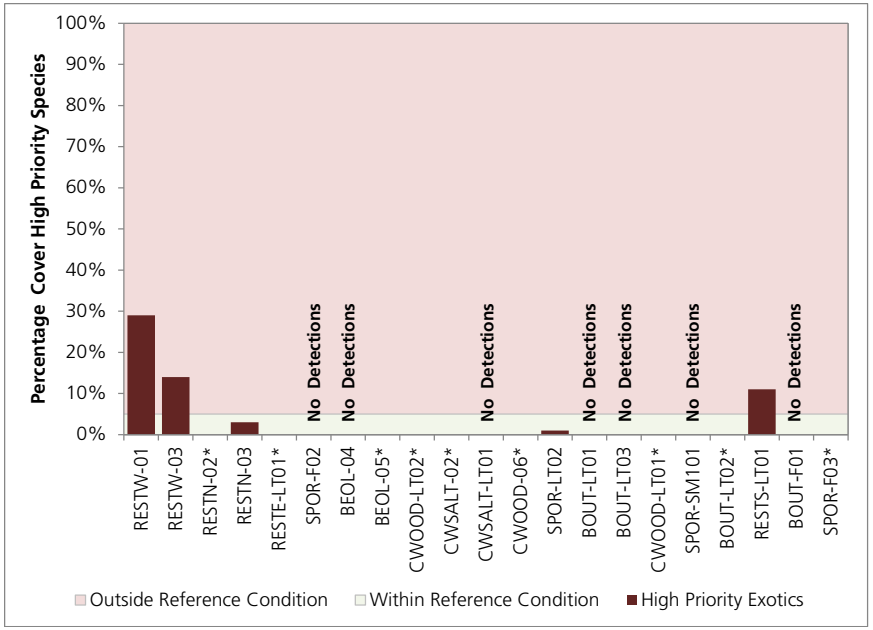


Figure 3.2-11. The percentage of exotic species on each monitoring plots that is considered a high priority species by the park (Struthers et al. 2015). Bars within the green portion of the graph are within the reference condition of having no greater than 5% of the exotic species that are considered high priority, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

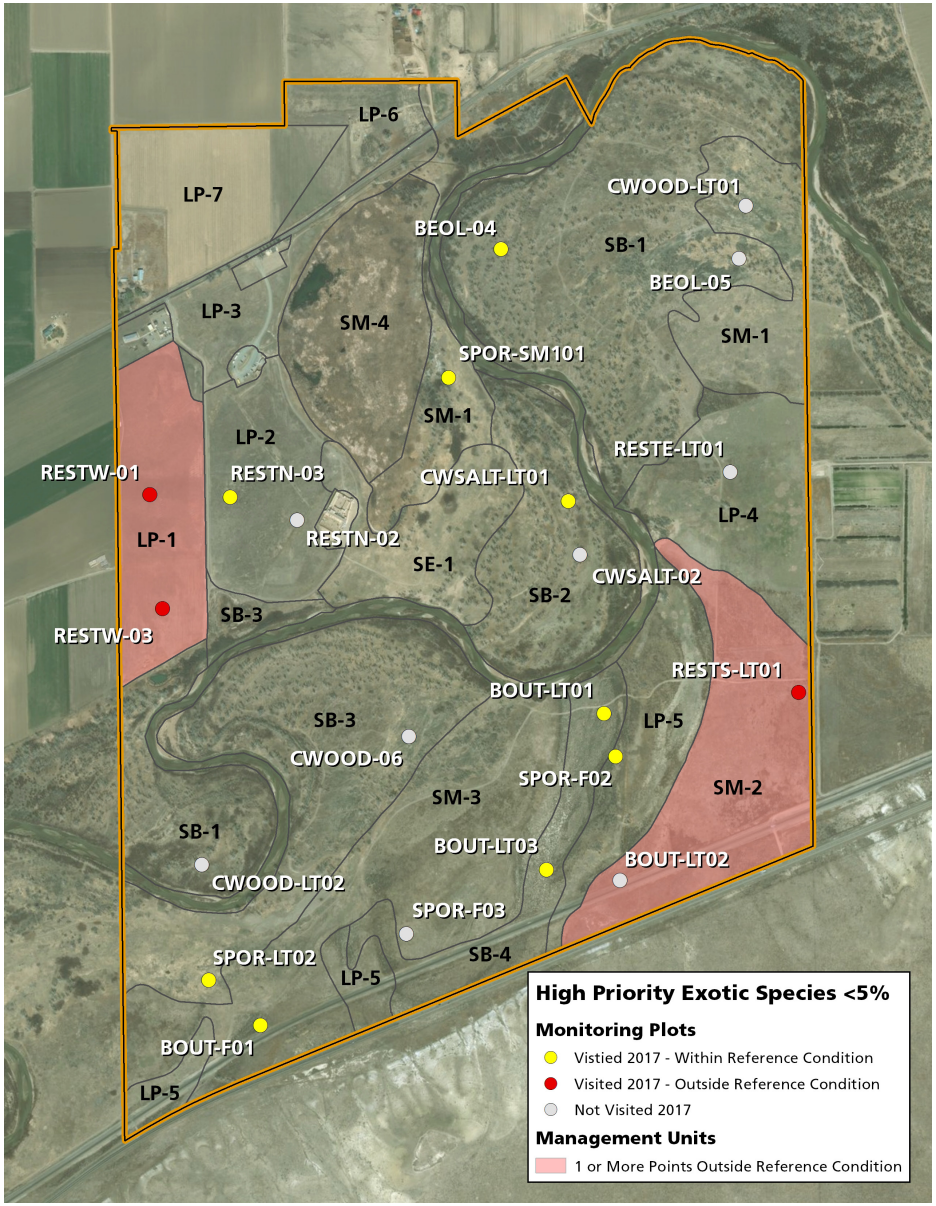


Figure 3.2-12. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 5% of the exotic species that are considered high priority reference condition. The individual plots outside the reference condition are shown in red.

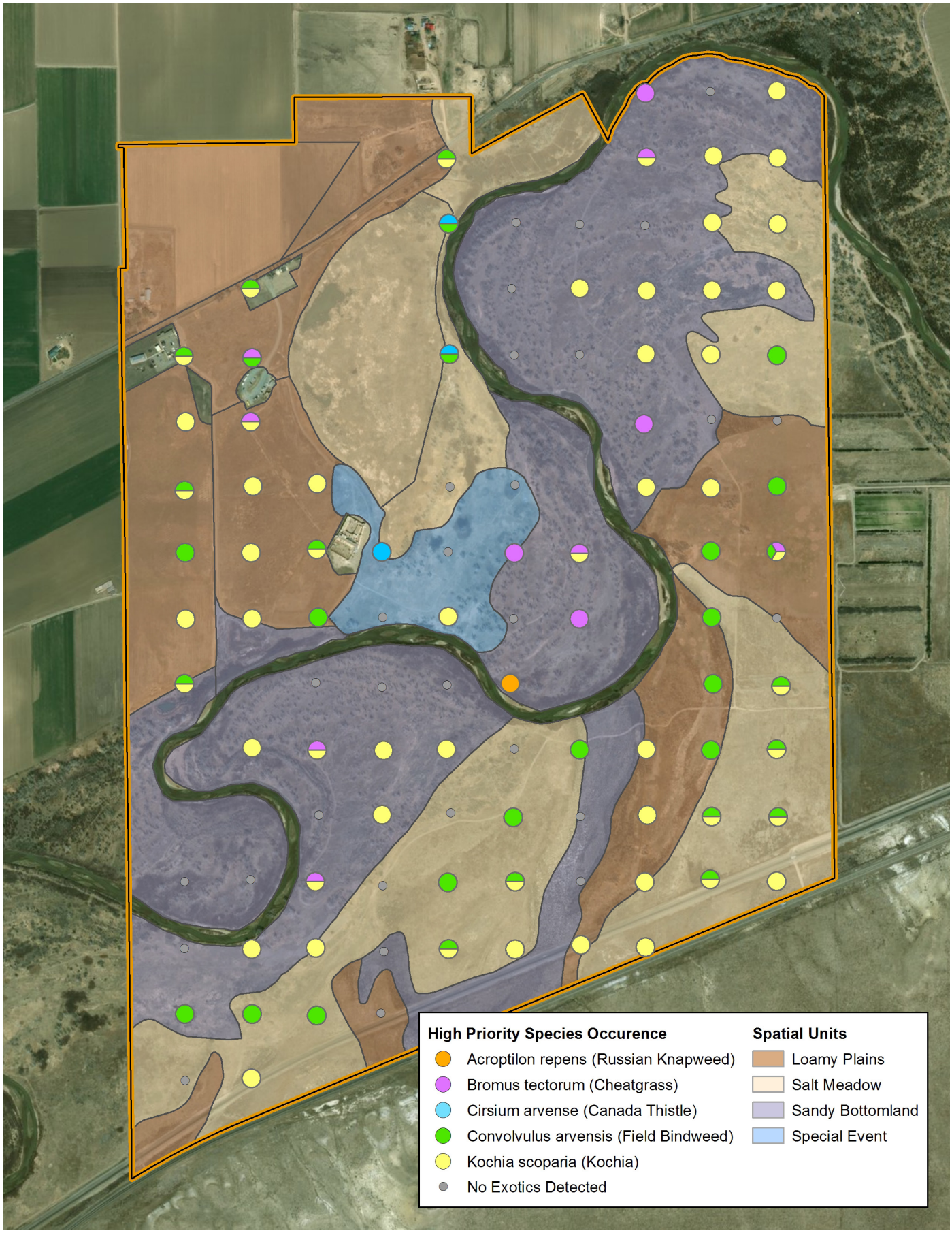


Figure 3.2-13. The distribution of high priority exotic species based on a rapid assessment grid survey conducted in 2017.

Reference Condition EIF11-Grassland Functional Groups

Shrubs and subshrubs (cactus, yucca) can be an important component of many habitats, offering food and shelter for wildlife and young plants. Too many shrubs, however, can invade and degrade a grassland, causing a change in the plant community. Three of the four sites exceeding the reference condition contain sand sagebrush that has become old and decadent. Treatment should be considered to reduce and refresh these shrubs to an acceptable level. Coyote willow is found in CWSALT-LT01, which is near the river. There are also areas that should have more diverse shrubs, indicating a need for re-establishment of missing shrub species (Figure 3.2-14 and Figure 3.2 15).

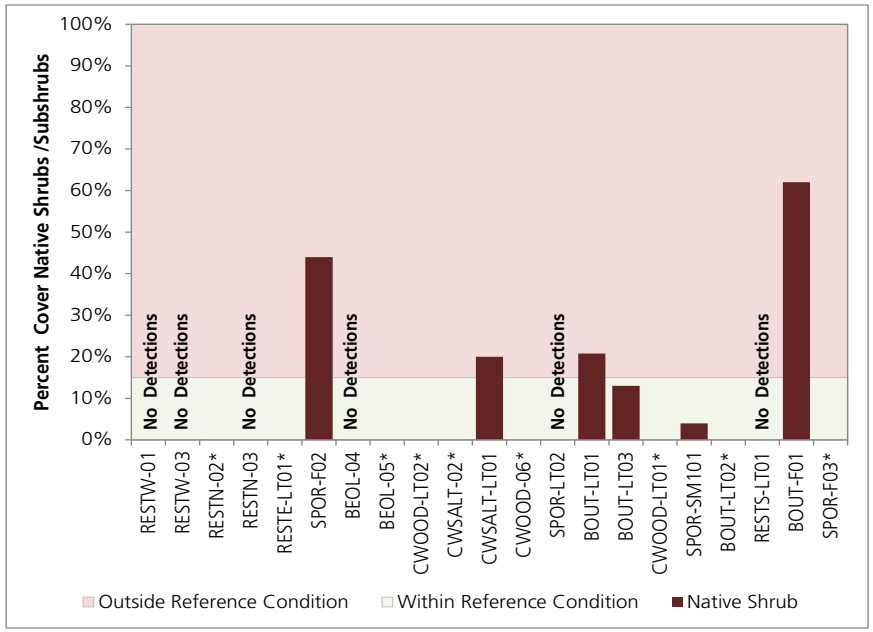


Figure 3.2-14. The percentage of cover by native shrubs on each monitoring plot. Bars within the green portion of the graph are within the reference condition of having no greater than 15% shrub cover, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

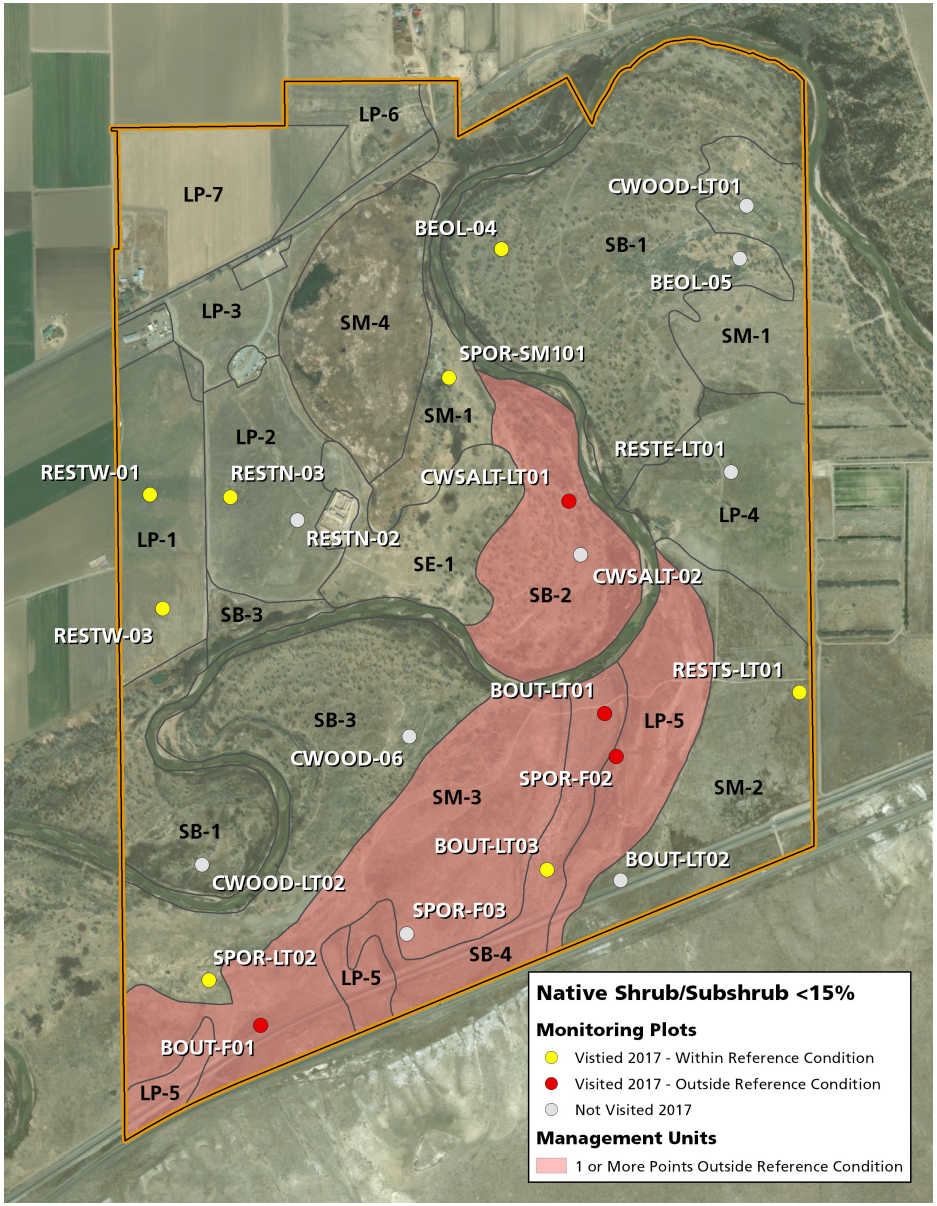


Figure 3.2-15. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 15% shrub cover reference condition. The individual plots outside the reference condition are shown in red.

Reference Condition EIF15-Bare Ground

The presence of bare ground is necessary for recruitment of new plants, shelter for small mammals and insects, and proper water infiltration. Too much bare, unprotected ground invites erosion (wind or water) and exotic invasion to degrade a plant community. All sites monitored in 2017 at BEOL meet the reference condition for bare ground (Figure 3.2-16 and Figure 3.2 17).

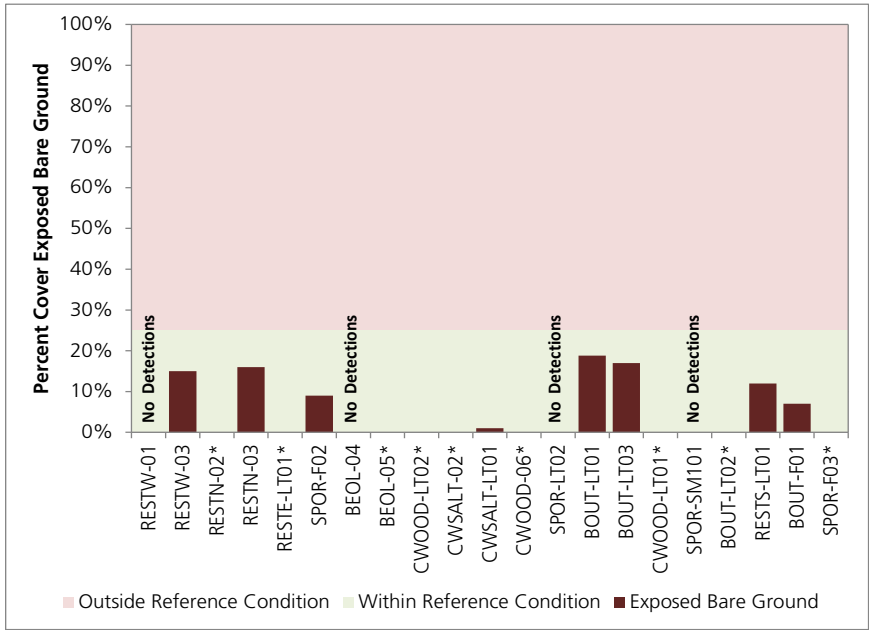


Figure 3.2-16. The percentage of cover by bare ground on each monitoring plot. Bars within the green portion of the graph are within the reference condition of having no greater than 25% bare ground cover, whereas bars in the red portion are outside the reference condition. Plots marked with an "*" were not sampled during 2017, but are part of our overall sample in other years.

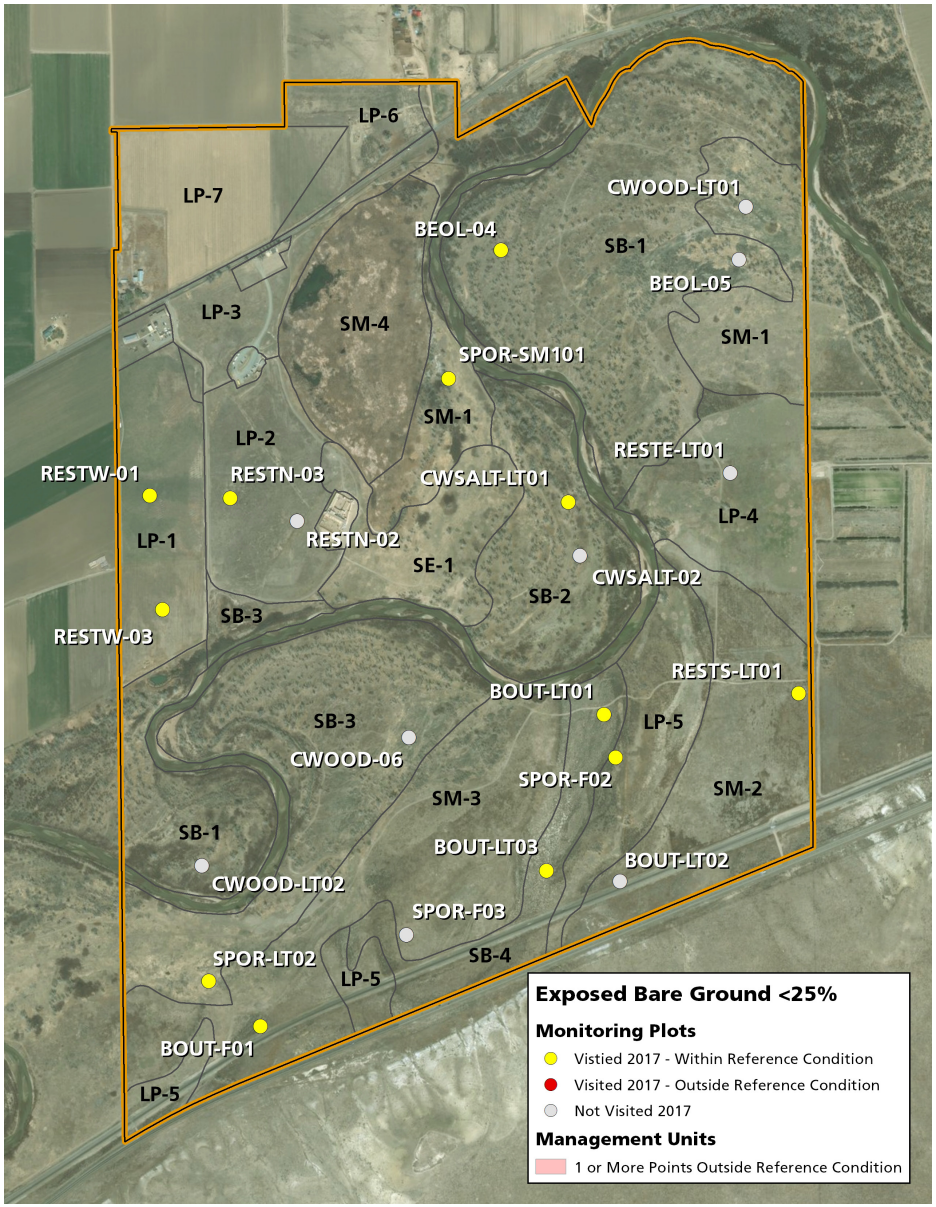


Figure 3.2-17. Monitoring plots shown in relation to vegetation management units. Units shaded in red have one or more plots that are outside the no greater than 25% bare ground cover reference condition. The individual plots outside the reference condition are shown in red.

4. Discussion And Adaptation

Conditions at Bent's Old Fort NHS (BEOL) is generally a tale of water – too much and not enough. The environment is semi-arid so upland vegetation is is water-limited and can be sparse in areas that do not receive supplemental water. However, the park is bi-sected by the Arkansas River, which can flood in the springtime. In Spring of 2015, a major flood occurred on the Arkansas and inundation was prolonged for many weeks. This resulted in sparsely vegetated areas that are slowly recovering. Floods also bring exotic plant propagules that settle out in newly denuded areas. As a site re-establishes its native rhizomatous grasses, these exotics are usually crowded out.

Mowing and herbicide treatments are the major tools used at BEOL for vegetation management. Mowing is used to decrease the biomass of exotic plants and when carefully timed in relation to seed-set can reduce exotic populations. A follow-up herbicide treatment can then be used several weeks later to control re-sprouts and new seedlings. Spot treatment with herbicide is also employed to control whitetop (*Lepidium draba*) and field bindweed (*Convolvulus arvensis*). These treatment strategies appear to be making a difference. Plans are to continue follow-up treatments in the original areas and to expand the treatment areas when possible.

Seeding is being used in several areas requiring restoration. These sites are drill-seeded using the "Bents" seed mix in the fall. Results have been mixed when depending solely on natural moisture. When supplemental irrigation is used, the results are much better. Efforts are underway to rehabilitate an old well on the south side of the park to enable more supplemental water use on re-seeded fields.

A large, long-term restoration site below the Administration building produced good healthy grass many years, thanks primarily to supplemental water. The field has been hayed several times in the past decade to provide fodder for the park's livestock. Supplemental water is now being withdrawn from this area and haying will cease until it can be determined that this area can successfully return to a natural water regime. A second area to the south of this site is now undergoing restoration efforts and receiving irrigation.

Transplanting of grass plugs is new to BEOL and there are plans to plant forb islands in the future. Similar efforts at Sand Creek Massacre site, with similar conditions, have been successful and it is hoped this success can be replicated.

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Appendix A: 2018 Tentative Workplan

Spatial Unit	Desired Condition with Departures	Management Treatment Used	Description of Treatment	Effectiveness of Treatment	Recommended Change in Management (if any)
LP-1	Improve conditions for growth of desired native grasses	Mowing	Mow tall kochia to reduce competition and improve light penetration for native plants	–	–
	Increase cover of native grasses and reduce bare ground	Seeding	Seed native grasses in bare spots to increase biodiversity and stabilize soil, particularly in NW corner and Southern portion of unit	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spot treat patches of field bindweed and kochia	–	–
	Facilitate establishment of grasses where natural recruitment is not expected	Irrigation	Water for NE corner and Southern portion of unit to encourage seed germination and growth	–	–
LP-2	Increase cover of native grasses and reduce bare ground	Seeding	Seed native grasses in bare spots to increase biodiversity and stabilize soil	–	–
	Improve conditions for growth of desired native grasses	Mowing	Mow tall kochia to reduce competition and improve light penetration for native plants	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spot treat patches of field bindweed and kochia	–	–
LP-3	–	–	No treatment planned	–	–
LP-4	–	–	No treatment planned	–	–
LP-5	Improve conditions for growth of desired native grasses	Mowing	Mow tall kochia to reduce competition and improve light penetration for native plants	–	–
LP-6		Mowing	To provide visibility for Archeology survey	–	–
SB-1	Reduce populations of high priority exotic plants	Herbicide	Cut and spray for tamarisk resprouts	–	–
	Improve conditions for growth of desired native grasses	Mowing	Mow tall kochia to reduce competition and improve light penetration for native plants	–	–
	Increase cover of native grasses and reduce bare ground	Seeding	Seed native grasses in bare spots to increase biodiversity and stabilize soil	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spot treat patches of field bindweed	–	–
SB-2	Reduce populations of high priority exotic plants	Herbicide	Spot treat patches of Russian knapweed	–	–

Spatial Unit	Desired Condition with Departures	Management Treatment Used	Description of Treatment	Effectiveness of Treatment	Recommended Change in Management (if any)
SB-3	Reduce fire risk in cottonwood gallery by reducing piles of downed wood	Chipping	Chip piles with rental or commercial equipment. Use chips for mulch in retoration areas	–	Propose low impact fire in area for 2019 to reduce remaining fuels
	Increase cover of native grasses and reduce bare ground	Seeding / Plugs	Seed and/or plug native grasses in bare spots to increase biodiversity and stabilize soil	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spot treat patches of Russian knapweed	–	–
	Reduce populations of high priority exotic plants	Herbicide	Cut and spray for tamarisk resprouts	–	–
	Reduce populations of high priority exotic plants	Herbicide	Spray unit for kochia and field bindweed	–	–
	Improve conditions for growth of desired native grasses	Mowing	Mow tall kochia to reduce competition and improve light penetration for native plants	–	–
SB-4	Improve conditions for growth of desired native grasses	Mowing	Mow tall kochia to reduce competition and improve light penetration for native plants	–	–
SE-1	Special Use area	Mowing	Mow for Special Events to provide for visitor safety	–	–
SM-1			No treatment planned	–	–
SM-2	Facilitate establishment of grasses where natural recruitment is not expected	Irrigation	Provide water to recently planted grasses when rainfall is lacking. Use tank to haul water.	–	–
SM-3	Increase cover of native grasses and reduce bare ground	Seeding / Plugs	Seed and/or plug native grasses in bare spots to increase biodiversity and stabilize soil	–	–
	Improve conditions for growth of desired native grasses	Mowing	Mow tall kochia to reduce competition and improve light penetration for native plants	–	–
SM-4	Reduce populations of high priority exotic plants	Herbicide	Spot treat patches of Canada thistle	–	–

Appendix B: Exotics Field Summary

Presented is summary data from 2017 exotics monitoring. The first table contains a list of the exotic species detected and the overall number of blocks in which they were found. The subsequent tables provides a similar breakdown by transect monitored. The block map depicts the individual blocks monitored, while the grid map names each point on the grid (summary presented in the report). These maps can be used with corresponding detailed data found on IRMA (https://irma.nps.gov/DataStore/).

Start Date: 6/26/2017 End Date: 6/29/2017

Total Blocks Surveyed: 228

Approx. Length Surveyed (m): 9050

Field Crew: Jonathin Horsley,
Kaitlin O'Brien

Vectors Surveyed: BEOL Condition Assessment Points
E&S_BOUNDARY
LOOP_TRAIL
S_OXBOW_RD
W_TAM_RD

Transects Surveyed:

BEOL_EX_301	total # blocks =	36
BEOL_EX_302	total # blocks =	20
BEOL_EX_303	total # blocks =	36
BEOL_EX_304	total # blocks =	29
BEOL_EX_NRCA	total # points =	107

Species Found Along All Vectors and Transects

Scientific Name	Common Name	Primary Growth Habit	Duration	Total Blocks
Acroptilon repens	russian knapweed	Forb/Herb	Perennial	1
Asparagus officinalis	garden asparagus	Forb/Herb	Perennial	31
Bromus arvensis	field brome	Graminoid	Annual	1
Bromus inermis	smooth brome	Graminoid	Perennial	9
Bromus japonicus	japanese brome	Graminoid	Annual	2
Bromus tectorum	cheatgrass	Graminoid	Annual	35
Chenopodium album	common lambsquarters	Forb/Herb	Annual	9
Cirsium arvense	canada thistle	Forb/Herb	Perennial	17
Convolvulus arvensis	field bindweed	Vine	Perennial	69
Echinochloa crus-galli	barnyardgrass	Graminoid	Annual	2
Euphorbia dentata	toothed spurge	Forb/Herb	Annual	1
Kochia scoparia	kochia	Forb/Herb	Annual	111
Lactuca serriola	prickly lettuce	Forb/Herb	Annual	34
Lactuca tatarica	blue lettuce	Forb/Herb	Perennial	1
Medicago sativa	alfalfa	Forb/Herb	Perennial	1
Melilotus albus	white sweetclover	Forb/Herb	Annual	2
Melilotus officinalis	yellow sweetclover	Forb/Herb	Perennial	5
Rumex crispus	curley dock	Forb/Herb	Perennial	10
Salsola tragus	prickly russian thistle	Forb/Herb	Annual	16

Species Found Along All Vectors and Transects (continued)

Scientific Name	Common Name	Primary Growth Habit	Duration	Total Blocks
Sorghum halepense	johnsongrass	Graminoid	Perennial	3
Tamarix ramosissima	saltcedar	Shrub	Perennial	1
Thinopyrum intermedium	intermediate wheatgrass	Graminoid	Perennial	8
Tragopogon dubius	western salsify	Forb/Herb	Annual	20
Tribulus terrestris	puncturevine	Forb/Herb	Annual	1
Typha angustifolia	narrowleaf cattail	Graminoid	Perennial	15
Ulmus pumila	siberian elm	Tree	Perennial	1

Species Found Along Vectors and Transects (only transects with exotics are listed):

Vector: LOOP_TRAIL
Transect: BEOL_EX_301

Scientific Name	Common Name	# of Blocks With Species
Bromus inermis	smooth brome	5
Bromus tectorum	cheatgrass	9
Chenopodium album	common lambsquarters	1
Cirsium arvense	canada thistle	14
Convolvulus arvensis	field bindweed	16
Echinochloa crus-galli	barnyardgrass	2
Kochia scoparia	kochia	17
Lactuca serriola	prickly lettuce	14
Medicago sativa	alfalfa	1
Melilotus officinalis	white sweetclover	1
Melilotus officinalis	yellow sweetclover	4
Rumex crispus	curley dock	8
Sorghum halepense	johnsongrass	3
Tragopogon dubius	western salsify	3
Typha angustifolia	narrowleaf cattail	15

Vector: S_OXBOW_RD
Transect: BEOL_EX_302

Scientific Name	Common Name	# of Blocks With Species
Acroptilon repens	russian knapweed	2
Asparagus officinalis	garden asparagus	10
Bromus inermis	smooth brome	1
Bromus tectorum	cheatgrass	6
Convolvulus arvensis	field bindweed	5
Kochia scoparia	kochia	4
Tamarix ramosissima	saltcedar	1
Tragopogon dubius	western salsify	9
Ulmus pumila	siberian elm	1

Vector: W_TAM_RD
Transect: BEOL_EX_303

Scientific Name	Common Name	# of Blocks With Species
Asparagus officinalis	garden asparagus	17
Bromus inermis	smooth brome	1
Bromus tectorum	cheatgrass	6
Chenopodium album	common lambsquarters	6
Kochia scoparia	kochia	8
Lactuca serriola	prickly lettuce	5
Lactuca tatarica	blue lettuce	1
Salsola tragus	prickly russian thistle	1
Thinopyrum intermedium	intermediate wheatgrass	6
Tragopogon dubius	western salsify	2

Vector: E&S_BOUNDARY
Transect: BEOL_EX_304

Scientific Name	Common Name	# of Blocks With Species
Bromus japonicus	japanese brome	1
Bromus tectorum	cheatgrass	3
Convolvulus arvensis	field bindweed	17
Euphorbia dentata	toothed spurge	1
Kochia scoparia	kochia	28
Lactuca serriola	prickly lettuce	4
Salsola tragus	prickly russian thistle	3
Thinopyrum intermedium	intermediate wheatgrass	1
Tragopogon dubius	western salsify	3

Vector: BEOL Condition Assessment Points
Transect: BEOL_EX_NRCA

Scientific Name	Common Name	# of Blocks With Species
Acroptilon repens	russian knapweed	1
Asparagus officinalis	garden asparagus	4
Bromus arvensis	field brome	1
Bromus inermis	smooth brome	2
Bromus japonicus	japanese brome	1
Bromus tectorum	cheatgrass	11
Chenopodium album	common lambsquarters	2
Cirsium arvense	canada thistle	3
Convolvulus arvensis	field bindweed	31
Kochia scoparia	kochia	54
Lactuca serriola	prickly lettuce	11
Melilotus officinalis	white sweetclover	1
Melilotus officinalis	yellow sweetclover	1
Rumex crispus	curley dock	2
Salsola tragus	prickly russian thistle	12
Thinopyrum intermedium	intermediate wheatgrass	1
Tragopogon dubius	western salsify	3
Tribulus terrestris	puncturevine	1

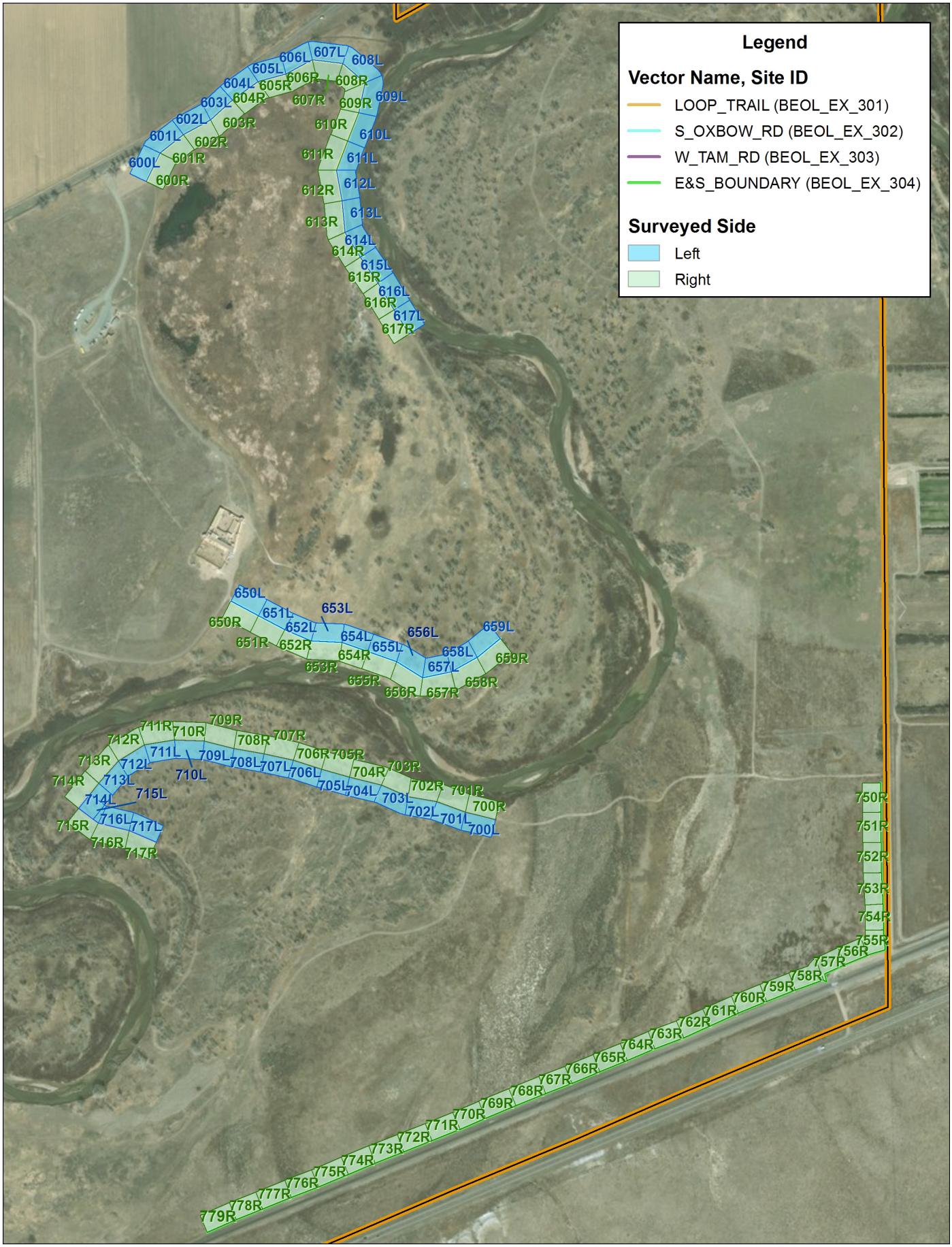


Figure B-1. Exotic monitoring transects visited at Bent's Old Fort NHS during 2017.

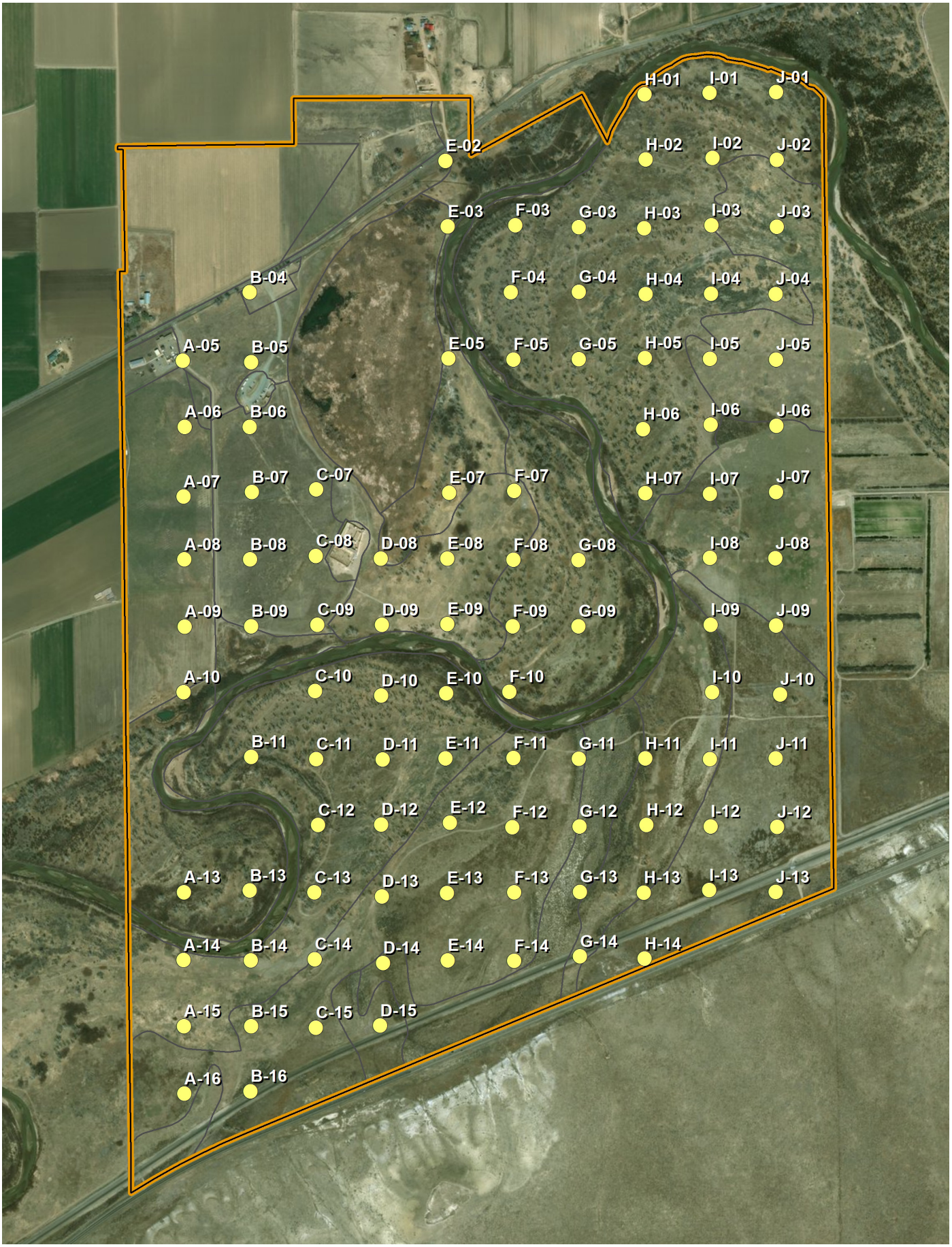


Figure B-2. Exotic rapid assessment points visited at Bent's Old Fort NHS during 2017.

Appendix C: Biodiversity (Rapid Assessment Average Cover)

Community biodiversity is measured in 10 random satellite plots within 100-meters of the transect (Location Name). The cover class (listed at bottom) for that plant in each plot (Cover Sum) is presented, along with the average cover for the community (Average Cover). Points Detected provides the number of plots (N=10) in which each species was detected.

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
BEOL-04	APOCAN	Apocynum cannabinum	hemp dogbane	1	1	1
BEOL-04	ASCSUB	Asclepias subverticillata	horsetail milkweed	7	5	1.4
BEOL-04	ASTBIS	Astragalus bisulcatus	two-grooved milkvetch	2	2	1
BEOL-04	CHEPRA	Chenopodium pratericola	desert goosefoot	2	2	1
BEOL-04	CONCAN	Conyza canadensis	canada horseweed	1	1	1
BEOL-04	DESSOP	Descurainia sophia	flixweed	2	2	1
BEOL-04	DISSPI	Distichlis spicata	inland saltgrass	2	2	1
BEOL-04	ELYCAN	Elymus canadensis	canada wildrye	3	1	3
BEOL-04	ELYELY	Elymus elymoides	bottlebrush squirreltail	5	4	1.25
BEOL-04	EUPDEN	Euphorbia dentata	toothed spurge	1	1	1
BEOL-04	EUPGLY	Euphorbia glyptosperma	rib-seed sandmat	3	3	1
BEOL-04	HELANN	Helianthus annuus	common sunflower	6	5	1.2
BEOL-04	HELPET	Helianthus petiolaris	prairie sunflower	3	3	1
BEOL-04	HESCOM	Hesperostipa comata	needle and thread	3	2	1.5
BEOL-04	HOPOBT	Hopia obtusa	vine mesquite	18	6	3
BEOL-04	KOCSCO	Kochia scoparia	kochia	2	2	1
BEOL-04	LACSER	Lactuca serriola	prickly lettuce	2	2	1
BEOL-04	LEPDEN	Lepidium densiflorum	common pepperweed	1	1	1
BEOL-04	MELOFF	Melilotus officinalis	yellow sweetclover	1	1	1
BEOL-04	OPUPHA	Opuntia phaeacantha	brwnspine pricklypear cactus	1	1	1
BEOL-04	PASSMI	Pascopyrum smithii	western wheatgrass	14	6	2.33
BEOL-04	RAYANN	Rayjacksonia annua	viscid tansyaster	1	1	1
BEOL-04	SALTRA	Salsola tragus	prickly russian thistle	3	3	1
BEOL-04	SPHCOC	Sphaeralcea coccinea	scarlet globemallow	6	4	1.5
BEOL-04	SPOAIR	Sporobolus airoides	alkali sacaton	3	3	1
BEOL-04	SPOCRY	Sporobolus cryptandrus	sand dropseed	5	4	1.25
BEOL-04	SYMERI	Symphyotrichum ericoides	white heath aster	2	2	1
BEOL-04	SYMOCC	Symphoricarpos occidentalis	western snowberry	3	1	3
BEOL-04	TRADUB	Tragopogon dubius	western salsify	1	1	1
BOUT-F01	ACHHYM	Achnatherum hymenoides	indian ricegrass	1	1	1
BOUT-F01	ARIPUR1	Aristida purpurea	purple threeawn	1	1	1
BOUT-F01	ARTFIL	Artemisia filifolia	sand sagebrush	21	6	3.5
BOUT-F01	BOUGRA	Bouteloua gracilis	blue grama	7	4	1.75
BOUT-F01	DISSPI	Distichlis spicata	inland saltgrass	1	1	1
BOUT-F01	ERIBEL	Erigeron bellidiastrum	western fleabane	2	2	1
BOUT-F01	EUPGLY	Euphorbia glyptosperma	rib-seed sandmat	5	5	1
BOUT-F01	HELANN	Helianthus annuus	common sunflower	7	6	1.17
BOUT-F01	HESCOM	Hesperostipa comata	needle and thread	3	3	1
BOUT-F01	HOPOBT	Hopia obtusa	vine mesquite	1	1	1

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
BOUT-F01	KOCSCO	Kochia scoparia	kochia	10	8	1.25
BOUT-F01	LEPID	Lepidium	pepperweed	1	1	1
BOUT-F01	LYGJUN	Lygodesmia juncea	rush skeletonplant	1	1	1
BOUT-F01	MACTAN	Machaeranthera tanacetifolia	tansyleaf tansyaster	1	1	1
BOUT-F01	MENNUD	Mentzelia nuda	bractless blazingstar: bractless stickleaf	2	1	2
BOUT-F01	OENSUF1	Oenothera suffrutescens	scarlet guara	1	1	1
BOUT-F01	PASSMI	Pascopyrum smithii	western wheatgrass	2	2	1
BOUT-F01	SALEXI	Salix exigua	coyote willow	1	1	1
BOUT-F01	SPHCOC	Sphaeralcea coccinea	scarlet globemallow	1	1	1
BOUT-F01	SPOAIR	Sporobolus airoides	alkali sacaton	2	2	1
BOUT-F01	SPOCRY	Sporobolus cryptandrus	sand dropseed	2	2	1
BOUT-F01	SYMERI	Symphyotrichum ericoides	white heath aster	1	1	1
BOUT-LT01	ACHHYM	Achnatherum hymenoides	indian ricegrass	2	2	1
BOUT-LT01	ARTFIL	Artemisia filifolia	sand sagebrush	14	6	2.33
BOUT-LT01	ASCSUB	Asclepias subverticillata	horsetail milkweed	2	2	1
BOUT-LT01	ASTMIS1	Astragalus missouriensis	missouri milkvetch	1	1	1
BOUT-LT01	BOTLAG	Bothriochloa laguroides	silver bluestem	13	7	1.86
BOUT-LT01	BOUGRA	Bouteloua gracilis	blue grama	18	9	2
BOUT-LT01	CHEPRA	Chenopodium pratericola	desert goosefoot	1	1	1
BOUT-LT01	DESILL1	Desmanthus illinoensis	illinois bundleflower	1	1	1
BOUT-LT01	ELYELY	Elymus elymoides	bottlebrush squirreltail	1	1	1
BOUT-LT01	ERISTR	Erigeron strigosus	rough fleabane	9	7	1.29
BOUT-LT01	EUPGLY	Euphorbia glyptosperma	rib-seed sandmat	4	4	1
BOUT-LT01	EUPPRO	Euphorbia prostrata	prostrate sandmat	2	2	1
BOUT-LT01	HELANN	Helianthus annuus	common sunflower	10	10	1
BOUT-LT01	HESCOM	Hesperostipa comata	needle and thread	4	2	2
BOUT-LT01	IPOLAX	Ipomopsis laxiflora	iron ipomopsis	2	2	1
BOUT-LT01	KOCSCO	Kochia scoparia	kochia	1	1	1
BOUT-LT01	LEPVIR	Lepidium virginicum	virginia pepperweed	3	3	1
BOUT-LT01	LYGJUN	Lygodesmia juncea	rush skeletonplant	1	1	1
BOUT-LT01	MACTAN	Machaeranthera tanacetifolia	tansyleaf tansyaster	1	1	1
BOUT-LT01	OENSUF1	Oenothera suffrutescens	scarlet guara	3	3	1
BOUT-LT01	OPUPHA	Opuntia phaeacantha	brwnspine pricklypear cactus	3	2	1.5
BOUT-LT01	PHYVIR1	Physalis virginiana	lanceleaf groundcherry	1	1	1
BOUT-LT01	RAYANN	Rayjacksonia annua	viscid tansyaster	2	2	1
BOUT-LT01	SALTRA	Salsola tragus	prickly russian thistle	3	3	1
BOUT-LT01	SPHCOC	Sphaeralcea coccinea	scarlet globemallow	1	1	1
BOUT-LT01	SPOCRY	Sporobolus cryptandrus	sand dropseed	15	9	1.67
BOUT-LT01	SYMERI	Symphyotrichum ericoides	white heath aster	4	4	1
BOUT-LT01	TRAOCC	Tradescantia occidentalis	prairie spiderwort	1	1	1
BOUT-LT01	VERBRA1	Verbena brasiliensis	brazillian vervain	1	1	1
BOUT-LT01	XANSPI	Xanthisma spinulosum	lacy tansyaster	1	1	1
BOUT-LT03	ARIPUR1	Aristida purpurea	purple threeawn	1	1	1

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
BOUT-LT03	ARTFIL	Artemisia filifolia	sand sagebrush	2	2	1
BOUT-LT03	BOTLAG	Bothriochloa laguroides	silver bluestem	5	1	5
BOUT-LT03	BOUGRA	Bouteloua gracilis	blue grama	15	5	3
BOUT-LT03	CONCAN	Conyza canadensis	canada horseweed	1	1	1
BOUT-LT03	DISSPI	Distichlis spicata	inland saltgrass	6	4	1.5
BOUT-LT03	ELYELY	Elymus elymoides	bottlebrush squirreltail	2	2	1
BOUT-LT03	EUPDEN	Euphorbia dentata	toothed spurge	1	1	1
BOUT-LT03	EUPGLY	Euphorbia glyptosperma	rib-seed sandmat	5	5	1
BOUT-LT03	EUPPRO	Euphorbia prostrata	prostrate sandmat	3	3	1
BOUT-LT03	HELANN	Helianthus annuus	common sunflower	10	7	1.43
BOUT-LT03	HESCOM	Hesperostipa comata	needle and thread	2	2	1
BOUT-LT03	HOPOBT	Hopia obtusa	vine mesquite	5	1	5
BOUT-LT03	KOCSCO	Kochia scoparia	kochia	11	7	1.57
BOUT-LT03	MUHASP	Muhlenbergia asperifolia	alkali muhly	4	1	4
BOUT-LT03	PSOTEN	Psoralidium tenuiflorum	slimflower scurfpea	2	2	1
BOUT-LT03	RAYANN	Rayjacksonia annua	viscid tansyaster	3	3	1
BOUT-LT03	SALTRA	Salsola tragus	prickly russian thistle	6	6	1
BOUT-LT03	SCHSCO	Schizachyrium scoparium	little bluestem	1	1	1
BOUT-LT03	SOLROS	Solanum rostratum	buffalobur	1	1	1
BOUT-LT03	SPHCOC	Sphaeralcea coccinea	scarlet globemallow	1	1	1
BOUT-LT03	SPOCRY	Sporobolus cryptandrus	sand dropseed	8	6	1.33
BOUT-LT03	SYMERI	Symphyotrichum ericoides	white heath aster	2	2	1
BOUT-LT03	SYMFAL	Symphyotrichum falcatum	white prairie aster	1	1	1
BOUT-LT03	TRADUB	Tragopogon dubius	western salsify	1	1	1
CWSALT-LT01	ASCSPE	Asclepias speciosa	showy milkweed	4	2	2
CWSALT-LT01	ASCSUB	Asclepias subverticillata	horsetail milkweed	1	1	1
CWSALT-LT01	DISSPI	Distichlis spicata	inland saltgrass	7	5	1.4
CWSALT-LT01	ELYCAN	Elymus canadensis	canada wildrye	1	1	1
CWSALT-LT01	EUPGLY	Euphorbia glyptosperma	rib-seed sandmat	2	2	1
CWSALT-LT01	GLYLEP	Glycyrrhiza lepidota	wild licorice	12	4	3
CWSALT-LT01	HELANN	Helianthus annuus	common sunflower	2	2	1
CWSALT-LT01	KOCSCO	Kochia scoparia	kochia	5	3	1.67
CWSALT-LT01	LACSER	Lactuca serriola	prickly lettuce	1	1	1
CWSALT-LT01	PASSMI	Pascopyrum smithii	western wheatgrass	18	6	3
CWSALT-LT01	PHYVIR1	Physalis virginiana	lanceleaf groundcherry	1	1	1
CWSALT-LT01	POPDEL	Populus deltoides	plains cottonwood	3	1	3
CWSALT-LT01	SALEXI	Salix exigua	coyote willow	7	2	3.5
CWSALT-LT01	SPOAIR	Sporobolus airoides	alkali sacaton	12	4	3
RESTN-03	ASTMIS1	Astragalus missouriensis	missouri milkvetch	1	1	1
RESTN-03	BOUDAC	Bouteloua dactyloides	buffalograss	11	8	1.38
RESTN-03	BOUGRA	Bouteloua gracilis	blue grama	2	2	1
RESTN-03	CHEPRA	Chenopodium pratericola	desert goosefoot	2	2	1
RESTN-03	CRYCRA	Cryptantha crassisepala	thicksepal cryptantha	6	6	1
RESTN-03	DESSOP	Descurainia sophia	flixweed	2	2	1
RESTN-03	ERISTR	Erigeron strigosus	rough fleabane	1	1	1
RESTN-03	EUPGLY	Euphorbia glyptosperma	rib-seed sandmat	4	4	1

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
RESTN-03	EUPPRO	Euphorbia prostrata	prostrate sandmat	2	2	1
RESTN-03	HELANN	Helianthus annuus	common sunflower	1	1	1
RESTN-03	HORPUS	Hordeum pusillum	little barley	22	9	2.44
RESTN-03	KOCSCO	Kochia scoparia	kochia	7	7	1
RESTN-03	LACSER	Lactuca serriola	prickly lettuce	1	1	1
RESTN-03	LAPOCC	Lappula occidentalis	flatspine sticktight	7	5	1.4
RESTN-03	PSOTEN	Psoralidium tenuiflorum	slimflower scurfpea	1	1	1
RESTN-03	QUILOB	Quincula lobata	purple groundcherry	2	2	1
RESTN-03	SALTRA	Salsola tragus	prickly russian thistle	19	10	1.9
RESTN-03	SOLROS	Solanum rostratum	buffalobur	3	3	1
RESTN-03	SPOCRY	Sporobolus cryptandrus	sand dropseed	22	10	2.2
RESTS-LT01	ASCSUB	Asclepias subverticillata	horsetail milkweed	1	1	1
RESTS-LT01	ASTBIS	Astragalus bisulcatus	two-grooved milkvetch	5	3	1.67
RESTS-LT01	CHEBER	Chenopodium berlandieri	pitseed goosefoot	1	1	1
RESTS-LT01	CONARV	Convolvulus arvensis	field bindweed	10	9	1.11
RESTS-LT01	DESSOP	Descurainia sophia	flixweed	1	1	1
RESTS-LT01	ELYELY	Elymus elymoides	bottlebrush squirreltail	3	3	1
RESTS-LT01	HELANN	Helianthus annuus	common sunflower	5	5	1
RESTS-LT01	KOCSCO	Kochia scoparia	kochia	10	7	1.43
RESTS-LT01	POPDEL	Populus deltoides	plains cottonwood	1	1	1
RESTS-LT01	RATTAG	Ratibida tagetes	green mexican hat	12	4	3
RESTS-LT01	SALTRA	Salsola tragus	prickly russian thistle	8	6	1.33
RESTS-LT01	SPHANG	Sphaeralcea angustifolia	copper globemallow	2	1	2
RESTS-LT01	SPHCOC	Sphaeralcea coccinea	scarlet globemallow	11	9	1.22
RESTS-LT01	SYMERI	Symphyotrichum ericoides	white heath aster	8	3	2.67
RESTS-LT01	SYMFAL	Symphyotrichum falcatum	white prairie aster	5	1	5
RESTW-01	BOUGRA	Bouteloua gracilis	blue grama	1	1	1
RESTW-01	CONARV	Convolvulus arvensis	field bindweed	24	9	2.67
RESTW-01	KOCSCO	Kochia scoparia	kochia	7	3	2.33
RESTW-01	LACSER	Lactuca serriola	prickly lettuce	2	2	1
RESTW-01	PASSMI	Pascopyrum smithii	western wheatgrass	48	10	4.8
RESTW-01	PHYVIR1	Physalis virginiana	lanceleaf groundcherry	1	1	1
RESTW-01	TRADUB	Tragopogon dubius	western salsify	1	1	1
RESTW-03	BOUDAC	Bouteloua dactyloides	buffalograss	3	3	1
RESTW-03	BOUGRA	Bouteloua gracilis	blue grama	3	2	1.5
RESTW-03	CONARV	Convolvulus arvensis	field bindweed	14	5	2.8
RESTW-03	KOCSCO	Kochia scoparia	kochia	9	8	1.13
RESTW-03	LACSER	Lactuca serriola	prickly lettuce	1	1	1
RESTW-03	PASSMI	Pascopyrum smithii	western wheatgrass	32	8	4
RESTW-03	RAYPHY	Rayjacksonia phyllocephala	camphor daisy	1	1	1
RESTW-03	SPOCRY	Sporobolus cryptandrus	sand dropseed	5	5	1
SPOR-F02	ARTFIL	Artemisia filifolia	sand sagebrush	17	5	3.4
SPOR-F02	BOTLAG	Bothriochloa laguroides	silver bluestem	2	1	2
SPOR-F02	BOUCUR	Bouteloua curtipendula	sideoats grama	3	2	1.5
SPOR-F02	BOUGRA	Bouteloua gracilis	blue grama	2	2	1
SPOR-F02	CHEPRA	Chenopodium pratericola	desert goosefoot	1	1	1

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

Location Name	Species Code	Scientific Name	Common Name	Cover Sum	Points Detected (N=10)	Avgerage Cover
SPOR-F02	CONARV	Convolvulus arvensis	field bindweed	1	1	1
SPOR-F02	CONCAN	Conyza canadensis	canada horseweed	2	2	1
SPOR-F02	CROTEX	Croton texensis	texas croton	1	1	1
SPOR-F02	DISSPI	Distichlis spicata	inland saltgrass	4	2	2
SPOR-F02	ELYELY	Elymus elymoides	bottlebrush squirreltail	2	2	1
SPOR-F02	EUPPRO	Euphorbia prostrata	prostrate sandmat	4	4	1
SPOR-F02	HELANN	Helianthus annuus	common sunflower	2	1	2
SPOR-F02	HELPET	Helianthus petiolaris	prairie sunflower	4	4	1
SPOR-F02	HOPOBT	Hopia obtusa	vine mesquite	14	4	3.5
SPOR-F02	KOCSCO	Kochia scoparia	kochia	6	2	3
SPOR-F02	PHYLON	Physalis longifolia	longleaf groundcherry	2	2	1
SPOR-F02	RAYANN	Rayjacksonia annua	viscid tansyaster	2	2	1
SPOR-F02	SALTRA	Salsola tragus	prickly russian thistle	5	4	1.25
SPOR-F02	SPHCOC	Sphaeralcea coccinea	scarlet globemallow	10	6	1.67
SPOR-F02	SPOCRY	Sporobolus cryptandrus	sand dropseed	9	5	1.8
SPOR-F02	SYMERI	Symphyotrichum ericoides	white heath aster	7	3	2.33
SPOR-LT02	ASTMIS1	Astragalus missouriensis	missouri milkvetch	1	1	1
SPOR-LT02	CHEBER	Chenopodium berlandieri	pitseed goosefoot	1	1	1
SPOR-LT02	CONARV	Convolvulus arvensis	field bindweed	6	3	2
SPOR-LT02	DISSPI	Distichlis spicata	inland saltgrass	26	8	3.25
SPOR-LT02	HELANN	Helianthus annuus	common sunflower	4	4	1
SPOR-LT02	HOPOBT	Hopia obtusa	vine mesquite	5	1	5
SPOR-LT02	PASSMI	Pascopyrum smithii	western wheatgrass	23	6	3.83
SPOR-LT02	PHYVIR1	Physalis virginiana	lanceleaf groundcherry	1	1	1
SPOR-LT02	RAYANN	Rayjacksonia annua	viscid tansyaster	2	2	1
SPOR-LT02	SPOAIR	Sporobolus airoides	alkali sacaton	2	2	1
SPOR-SM101	AF	N/A	annual forb	1	1	1
SPOR-SM101	ASCSUB	Asclepias subverticillata	horsetail milkweed	8	3	2.67
SPOR-SM101	ASCVIR1	Asclepias viridis	green antelope horn milkweed	1	1	1
SPOR-SM101	CARPRA	Carex praegracilis	clustered field sedge	6	2	3
SPOR-SM101	CONARV	Convolvulus arvensis	field bindweed	3	1	3
SPOR-SM101	DISSPI	Distichlis spicata	inland saltgrass	33	8	4.13
SPOR-SM101	ELYCAN	Elymus canadensis	canada wildrye	4	1	4
SPOR-SM101	ELYELY	Elymus elymoides	bottlebrush squirreltail	6	2	3
SPOR-SM101	GLYLEP	Glycyrrhiza lepidota	wild licorice	4	3	1.33
SPOR-SM101	HELANN	Helianthus annuus	common sunflower	4	4	1
SPOR-SM101	HOPOBT	Hopia obtusa	vine mesquite	5	2	2.5
SPOR-SM101	LACSER	Lactuca serriola	prickly lettuce	4	4	1
SPOR-SM101	PASSMI	Pascopyrum smithii	western wheatgrass	9	3	3
SPOR-SM101	SYMFAL	Symphyotrichum falcatum	white prairie aster	6	2	3

Cover Classes: 1=1-10% Cover, 2=11-20% Cover, 3=21-30% Cover, 4=31-60% Cover, 5=61-100% Cover

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
U.S. Department of the Interior

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