

Hanford Site Revegetation Monitoring Report for Fiscal Year 2017



Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management
Contractor for the U.S. Department of Energy
under Contract DE-AC06-09RL14728



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April 2018

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Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management



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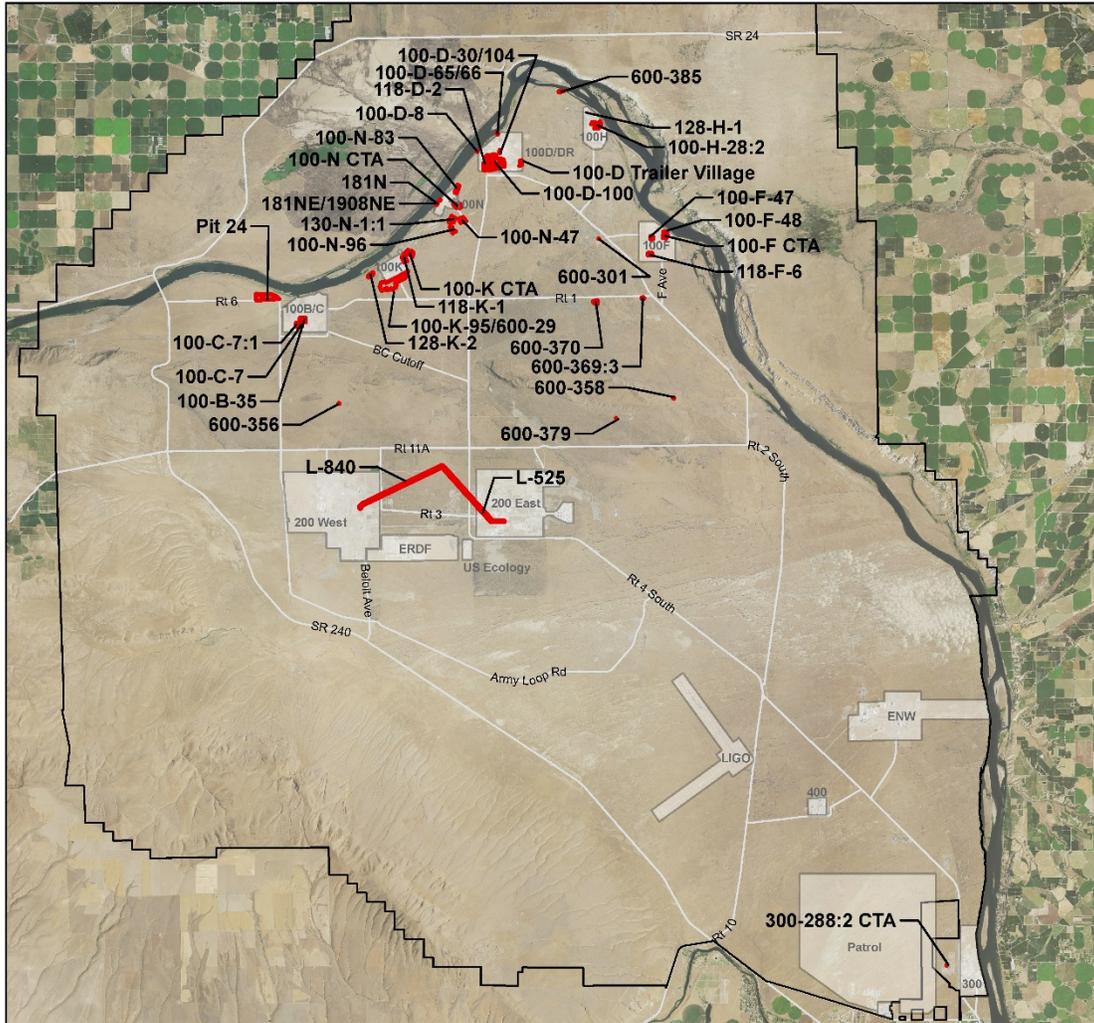
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1.0 INTRODUCTION

This report describes the monitoring of areas revegetated by the River Corridor Closure Contractor (RCCC) and CH2M Hill Plateau Remediation Company (CHPRC) that were monitored by Mission Support Alliance (MSA) in 2017. Site monitoring is a continuance of efforts performed by the RCCC from FY2008 through FY2017. This report contains data collected in 2017 documenting the success status of revegetation areas associated with the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* cleanup of National Priorities List waste sites at the Hanford Site in Richland, Washington. It contains vegetation monitoring data for 40 sites selected to be representative sites for areas planted between the years of FY2008 through FY2017.

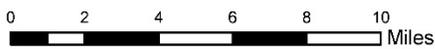
Monitoring efforts analyze the structure and composition of native and non-native plant species on representative revegetated sites over a 5-year period. This provides a data timeline in which remediation success can be evaluated and insight into which planting methods are most effective. Revegetation sites are considered successful if after 5 years they have a native shrub density of 600 plants/hectare (ha) (240 plants/acre) and total canopy cover of 25% or greater for native plants as specified in the *Hanford Site Revegetation Manual* (DOE/RL-2011-116, Rev. 1) and area specific revegetation plans (*Remedial Design Report/Remedial Action Work Plan for the 100 Area*, [DOE/RL-96-17, Rev. 6, Appendix H], *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* [DOE/RL-2005-93, Rev. 1, Appendix G], and *Remedial Design Report/Remedial Action Work Plan for the 300 Area* [DOE/RL-2001-47, Rev. 3, Appendix C]). If the structure and composition of a monitored revegetation site are determined to meet these success criteria by the fifth year, the site is considered “successful.” In addition to monitoring the representative sites, sites that were not originally monitored but are in the same area as representative sites that have failed to meet the success criteria may be monitored to evaluate the need for additional revegetation efforts in these areas. Each site monitored during 2017 is discussed in Section 3 of this report and contains a brief summary of the revegetation activities, monitoring efforts, and tabulated 2017 data.

This report provides fifth-year monitoring results for sites 100-C-7, 128-K-2, 600-29, 100-N-47, 181-N, 181-NE, 100-D-8, 100-D-65/66 and 128-H-1; fourth-year monitoring results for sites 100-C-7:1, 100-K-95, 118-D-2, 600-301, 600-369:3 and 600-370; third-year monitoring results for sites Pit 24, 130-N-1:1, 600-356 and 600-379; second-year monitoring for sites 100-B-35, 100-K Container Transfer Area (CTA), 100-N-96, 100-D-100, 100-H-28:2 and 600-358; and first-year monitoring for sites 100-N-83, 100-N CTA, 100 D Trailer Village, 600-385, 300-288:2 CTA, 200 Area Water Pipeline 1 (West) and 200 Area Water Pipeline 2 (East). Five additional sites (118-K-1, 100-F-47, 100-F-48, 100-F CTA and 118-F-6 Soil Staging Area [SSA]) that were not initially monitored after planting were monitored in 2017. These sites were planted over 5 years ago and are located in an area where other representative sites that were monitored over the 5-year period failed to meet the prescribed success criteria. These sites were monitored to determine if they meet the success criteria noted above and if not, to provide data that will be used to determine future revegetation strategies for the sites. The locations of the 40 sites monitored in 2017 are shown in Figure 1.

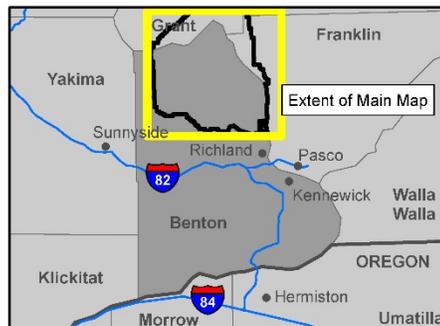


- Legend**
- 2017 Revegetation Monitoring Sites
 - Roads
 - Management Areas
 - Hanford Site Boundary

NOTE: Aerial Imagery, 2015, NAIP.



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Revegetation Monitoring Sites, 2017

Hanford Site, Benton County, WA

Figure 1. Map of Revegetation Sites Monitored in 2017.

2.0 METHODS

The 2017 revegetation monitoring consisted of a quantitative approach through repeated measurements to estimate canopy cover and frequency of occurrence of all plant species observed within a series of plot frames and counting of transplanted shrubs/trees within an established transect area to estimate density (plants/hectare [ha]) for the site. Shrub and tree species include big sagebrush (*Artemisia tridentata*), spiny hopsage (*Grayia spinosa*), antelope bitterbrush (*Purshia tridentata*), Wood's rose (*Rosa woodsii*), golden currant (*Ribes aureum*), black cottonwood (*Populus balsamifera*), narrowleaf willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), and redosier dogwood (*Cornus sericea*). Analyzed data collected using these methods allowed for estimated relative seral stages and general site progression, levels of change, and provided a perspective for long-term achievement of management objectives.

Frequency of occurrence and canopy cover measurements were obtained using the methods described in *Steppe Vegetation of Washington* (Daubenmire 1970). Canopy coverage is defined in Daubenmire (1970) as “the percentage of ground surface included in the vertical projection of a polygon drawn around the extremities of undisturbed foliage of a plant.” The plot-frame encompasses a 0.5-square meter area. The name and relative amount of ground cover for each rooted species within the confines of the plot-frame is documented for each plot-frame measurement. The total vegetation can exceed 100% with this method due to species overlapping when plot measurements are taken in densely vegetated areas. Depending on the size of the restoration site, a number of plot-frame measurements (13 to 250) were collected and analyzed to estimate canopy cover for each species present. Frequency was represented as the percentage of occurrences a species was observed within the given number of plot frames measured. For example, if a species was represented in 10 out of 25 plot frames, its frequency would be $10/25 \times 100 = 40\%$. The relative magnitude of a frequency rating in comparison to a canopy coverage rating provides an index of species distribution and its influence within a vegetation community. Species that were observed within a revegetated area but were not counted in a plot frame were recorded as occurrences and denoted as an “X” in the tables. Frequency of occurrence and canopy cover measurements were taken between April 27 and July 12, 2017. Listed Washington State noxious weed species identified within the monitoring areas are identified in the site monitoring result tables with their state class designation (e.g., A, B, or C). Washington State noxious weed classes are defined as:

“Noxious weed” is the traditional, legal term for invasive, non-native plants that are so aggressive they harm ecosystems or disrupt agricultural production. These plants crowd out the native species that fish and wildlife depend on. Washington State separates noxious weeds into three classifications. Class A noxious weeds are usually newcomers to Washington, and are generally rare. The goal is to completely eradicate them before they gain a foothold. Class B noxious weeds are widespread in some areas of the state, but limited or absent in other parts of the state. The goal is to prevent them from spreading into new areas, and to contain or reduce their population in already infested areas. Class C Noxious weeds are often widespread, or are of special interest to the agricultural industry. (NWCB 2017).

The evaluation of shrub density was determined through the establishment of stationary transect areas that are monitored annually over a 5-year period. In most cases, transects are 100 m

(328 ft) in length with offsets to either side of up to 5 m (16.4 ft); shorter (25 to 75 m [82 to 246 ft]) transects have been established at sites too small to support a 100-m transect. The number of live shrubs within the established transect area (typically a 1,000 m² area) was extrapolated to derive the shrub density for the site each year. For example, the 600-29 site in K Area has a 100-m transect with 5-m offsets that equates to a 1,000 m² transect area. A total of 61 native shrubs (big sagebrush) were recorded within the transect area in 2017. Using the conversion factor of 1 acre = 4,047 m², we can derive that the shrub density for the site in 2017 was 610 plants/ha (247 plants/acre [ac]), meeting the shrub cover success criteria of 600 plants/ha (240 plants/ac). Shrub transect monitoring occurred between March 27 and July 6, 2017.

Plant identifications in the 2017 monitoring efforts were conducted using the current nomenclature from the United States Department of Agriculture (USDA) PLANTS Database (USDA 2017). Appendix A of this report lists the current scientific and common names from the USDA database along with synonyms possibly used in previous revegetation monitoring reports from *Flora of the Pacific Northwest* (Hitchcock and Cronquist 1973) and/or *Vascular Plants of the Hanford Site* (Sackschewsky and Downs 2001).

3.0 MONITORING RESULTS

3.1 100 B/C AREA SITES

Four sites were monitored in the 100 B/C Area: 100-C-7, 100-C-7:1, Pit 24, and 100-B-35. The sites were revegetated in fiscal years (FY) 2013, 2014, 2015, and 2016, respectively. These sites were remediated to meet the objectives for interim closure as established in the *Remedial Design Report/Remedial Action Work Plan for the 100 Area* (100 Area RDR/RAWP) (DOE/RL-96-17) and in the *Interim Action Record of Decision for the 100-BC-1, 100-BC-2, 100-DR-1, 10-DR-2, 100-FR-1, 100-HR-1, 100-HR-2, 100-KR-1, 100-KR-2, 100-IU-2, 100-IU-6, and 200-CW-3 Operable Units, Hanford Site, Benton County, Washington* (Interim Action ROD) (EPA 1999). Revegetation efforts entailed broadcast seeding at approximately 16.8 kg/ha (15 lbs/ac) with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage.

3.1.1 100-C-7 Site (183-C Filter Building/Pumproom Facility and Demolition Waste)

The 100-C-7 site (Figure 2) was revegetated in FY 2013 and monitoring for the site was first conducted in 2013. Due to the large size of the site it was divided into two sections, the west area where the excavation took place and the east area where staging occurred. The substrate in both areas consists predominantly of cobbles with varying amounts of loamy sand and sandy loam.

Shrub monitoring transects were established in both areas in 2013. Fifth-year monitoring was conducted on May 2 and 3, 2017; the results show a shrub density of 1134 plants/ha (459 plants/ac) for the east portion of the site and 934 plants/ha (378 plants/ac) for the west portion of the site for an average shrub density of 1033 plants/ha (418 plants/ac) for the site overall, well above the shrub density success criteria of 600 plants/ha (240 plants/ac). Antelope bitterbrush were observed to be blooming in the west portion of the site. Shrub survival rate was over 100% of that observed in 2016.

Canopy cover data for the site was collected on May 2 and 3, 2017. Sitewide canopy cover averaged 27.8% with native cover representing 16.4% and invasive cover representing 13.8% (Table 1). This represents a slight increase of 1.8% in native cover from 2016 but does not meet the success criteria of 25% native cover within 5 years. Native grasses dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 8.5% cover represented 11.1% canopy cover, equating to nearly 40% of the total canopy cover present on the site. Bluebunch wheatgrass (*Pseudoroegneria spicata*) was the dominant species for the site overall followed by cheatgrass (*Bromus tectorum*) with 6.1% cover. Due to the large amount of cobble backfill used, the 25% native criteria cover may not be a realistic benchmark for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed in both the east and west areas of the site with less than 1% cover recorded and occurrence in 4.0% of the plot frames.

Table 1. Percent Canopy Cover and Frequency of Occurrence at the 100-C-7 Site in 2017. (2 Pages)

Species	West		East		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	-	-	0.3	12.0	0.2	6.0
<i>Artemisia tridentata</i> (big sagebrush)	3.1	12.0	3.0	20.0	3.1	16.0
<i>Bromus tectorum</i> ^a (cheatgrass)	3.4	96.0	8.8	92.0	6.1	94.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.7	8.0	X	X	0.4	4.0
<i>Draba verna</i> ^a (spring draba)	0.1	4.0	0.9	8.0	0.5	6.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	1.3	52.0	0.2	4.0	0.8	28.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	-	-	0.1	0.0	0.1	0.0
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X	X	X	X	X
<i>Erodium cicutarium</i> ^a (redstem stork's bill)	X	X	-	-	X	X
<i>Galium aparine</i> (stickywilly)	-	-	X	X	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X	-	-	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.4	16.0	1.7	68.0	1.1	42.0

**Table 1. Percent Canopy Cover and Frequency of Occurrence
at the 100-C-7 Site in 2017. (2 Pages)**

Species	West		East		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Lactuca serriola</i> ^a (prickly lettuce)	1.0	40.0	1.0	40.0	1.0	40.0
<i>Lamium amplexicaule</i> ^a (henbit deadnettle)	-	-	X	X	0.0	0.0
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X	0.1	4.0	0.1	2.0
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	-	-	0.2	8.0	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.9	56.0	2.7	88.0	2.3	72.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	10.8	96.0	6.2	72.0	8.5	84.0
<i>Purshia tridentata</i> (antelope bitterbrush)	2.6	8.0	-	-	1.3	4.0
<i>Salsola kali</i> ^a (Russian thistle)	2.5	100.0	2.5	100.0	2.5	100.0
<i>Sanguisorba minor</i> ^a (small burnet)	X	X	1.8	72.0	0.9	36.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.4	96.0	0.1	4.0	1.3	50.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	-	-	X	X	X	X
<i>Vulpia microstachys</i> (desert fescue)	X	X	0.2	8.0	0.1	4.0
ARTR recruits ^c	0.2	8.0	0.1	4.0	0.2	6.0
Crust	1.0	40.0	80.2	100.0	40.6	70.0
Soil	69.9	100.0	16.0	100.0	43.0	100.0
Litter	21.3	100.0	16.0	0.0	18.7	50.0
Total canopy cover (excludes crust/soil/litter)	30.4		25.2		27.8	
Total Native % Cover	19.9		12.8		16.4	
Change in Native % Cover from 2016	4.6		-1.1		1.8	
Total Invasive % Cover	10.5		17.1		13.8	
Change in Invasive % Cover from 2016	0.8		3.3		2.1	

^a Invasive species^b Washington State Classified Noxious Weed (class)^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames

- = species not observed



**Figure 2. The 100-C-7 Site in 2017. Top: Eastern Portion of the 100-C-7 Site in 2017.
Bottom: Western Portion of the 100-C-7 Site in 2017.**

3.1.2 100-C-7:1 Site (183-C Water Treatment Facility Head House Foundation)

The 100-C-7:1 site (Figure 3) was revegetated in FY 2014 and monitoring for the site was first conducted in 2014. Due to the large size of the site, it was divided into 10 areas with 1 stationary transect and 25 plot frames per area, totaling 10 stationary transects and 250 plot frames across the site. This is consistent with previous annual monitoring techniques. For the purposes of this report, the site was assessed based upon two treatment areas – areas within and directly adjacent to the excavation footprint (Areas 5, 6, and 9) and areas outside of the excavation footprint (Areas 1, 2, 3, 4, 7, 8, and 10). The site in general has a predominantly cobble substrate; however, areas within the excavation footprint have higher amounts of sand and loamy sand than the surrounding areas (outside of the excavation footprint), which have higher amounts of loam and sandy loam.

Ten shrub monitoring transects were established over the site in 2014. Fourth-year monitoring was conducted on May 3, 9, and 16, 2017; the results show a shrub density of 660 plants/ha (267 plants/ac) for the excavation footprint area, about 11% above the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub density outside of the excavation area was 469 plants/ha (190 plants/ac), about 21% below the shrub density success criteria of 600 plants/ha (240 plants/ac). The shrub density rate for the site overall was 526 plants/ha (213 plants/ac), about 11% below the the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub survival was about 98% of that observed in 2016.

Canopy cover data for the site was collected on May 3, 8, and 17, 2017. Sitewide canopy cover averaged 34.6% with native cover representing 9.3% and invasive cover representing 25.6% (Table 2). This represents a slight increase of 0.5% in native cover and 2.5% in invasive cover from 2016. This was the fourth year of monitoring for this site and with native cover still below 10% it is unlikely that the desired 25% native cover will develop within the next year; additional revegetation efforts designed to increase native grasses and forbs should be considered for this site. Native cover was comparable between the two areas of the site with 10.3% cover in the excavation footprint area and 8.8% outside of the excavation area. Invasive cover was substantially higher outside of the excavation area with 31.3% cover compared to 12.3% within the excavation. Cheatgrass (*Bromus tectorum*) was the dominant species with 17.6% canopy cover and occurrence in nearly 99% of the plot frames. The dominant native species was big sagebrush (*Artemisia tridentata*) with 2.9% canopy cover followed by Sandberg bluegrass (*Poa secunda*) with 2.4%.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed in both areas of the site with about 1% cover in each area and occurrence in about 14% of the plot frames.

**Table 2. Percent Canopy Cover and Frequency of Occurrence
at the 100-C-7:1 Site in 2017. (2 Pages)**

Species	Inside Excavation		Outside Excavation		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	-	-	0.0	0.6	0.0	0.4
<i>Achnatherum hymenoides</i> (Indian ricegrass)	2.4	62.7	0.8	21.1	1.3	33.6
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	-	-	X	X	X	X
<i>Artemisia tridentata</i> (big sagebrush)	2.2	14.7	3.2	12.6	2.9	13.2
<i>Astragalus purshii</i> (woollypod milkvetch)	-	-	X	X	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	6.6	98.7	22.3	98.9	17.6	98.8
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.7	13.3	1.0	14.9	0.9	14.4
<i>Descurcania pinnata</i> (western tansymustard)	X	X	0.0	0.6	0.0	0.4
<i>Draba verna</i> ^a (spring draba)	0.2	8.0	0.1	4.6	0.1	5.6
<i>Elymus elymoides</i> (squirreltail)	-	-	0.1	4.6	0.1	3.2
<i>Epilobium brachycarpum</i> (tall annual willowherb)	-	-	0.1	4.0	0.1	2.8
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.0	1.3	0.1	1.1	0.1	1.2
<i>Erigeron pumilus</i> (shaggy fleabane)	0.0	1.3	-	-	0.0	0.4
<i>Erodium cicutarium</i> ^a (redstem stork's bill)	0.0	1.3	0.1	5.1	0.1	4.0
<i>Galium aparine</i> (stickywilly)	-	-	0.0	1.7	0.0	1.2
<i>Hesperostipa comata</i> (needle and thread grass)	0.1	4.0	0.2	5.7	0.2	5.2
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.5	20.0	0.9	32.0	0.8	28.4
<i>Hordeum leporinum</i> ^a (hare barley)	-	-	X	X	X	X
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.0	1.3	0.5	21.1	0.4	15.2
<i>Lamium amplexicaule</i> ^a (henbit deadnettle)	0.1	2.7	0.2	6.9	0.1	5.6
<i>Linum lewisii</i> (prairie flax)	X	X	-	-	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	-	-	X	X	X	X
<i>Medicago sativa</i> ^a (alfalfa)	X	X	-	-	X	X
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X	0.4	5.7	0.3	4.0
<i>Penstemon acuminatus</i> (sharpleaf penstemon)	X	X	-	-	X	X
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	0.1	4.0	0.5	13.1	0.4	10.4
<i>Poa secunda</i> (Sandberg bluegrass)	2.4	88.0	2.4	66.3	2.4	72.8

**Table 2. Percent Canopy Cover and Frequency of Occurrence
at the 100-C-7:1 Site in 2017. (2 Pages)**

Species	Inside Excavation		Outside Excavation		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	2.5	45.3	1.1	20.0	1.5	27.6
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X	0.0	0.6	0.0	0.4
<i>Salsola kali</i> ^a (Russian thistle)	2.4	94.7	2.6	87.4	2.5	89.6
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.5	58.7	2.5	66.3	2.2	64.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.2	2.7	0.0	1.1	0.1	1.6
<i>Triticum aestivum</i> ^a (common wheat)	0.0	1.3	0.0	1.1	0.0	1.2
<i>Vulpia microstachys</i> (desert fescue)	0.6	25.3	0.2	7.4	0.3	12.8
ARTR recruits ^c	0.1	4.0	0.1	3.4	0.1	3.6
Crust	0.0	0.0	0.7	24.6	0.5	17.2
Soil	80.6	100.0	62.2	100.0	67.7	100.0
Litter	16.4	100.0	30.9	100.0	26.6	100.0
Total canopy cover (excludes crust/soil/litter)	22.6		39.7		34.6	
Total Native % Cover	10.3		8.8		9.3	
Change in Native % Cover from 2016	0.3		0.6		0.5	
Total Invasive % Cover	12.3		31.3		25.6	
Change in Invasive % Cover from 2016	3.0		2.2		2.5	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames

- = species not observed



Figure 3. The 100-C-7:1 Site in 2017. Top: Excavation footprint portion of the 100-C-7:1 Site in 2017. Bottom: Southeastern portion (outside of the excavation footprint) of the 100-C-7:1 Site in 2017.

3.1.3 Pit 24 Site (600-253, Gravel Pit #24)

The Pit 24 site (Figure 4) was revegetated in FY 2015 and monitoring for the site was first conducted in 2015. Remediation efforts at the site included revegetation of the upland areas and creation of wetland habitat with establishment of associated aquatic and riparian vegetation (Figure 4). This provided for three distinct ecological areas (upland, riparian, and wetland). Previous revegetation monitoring has included data collection from 4 upland transects and 10 riparian area transects; data has not been collected from the wetland areas due to seasonal water fluctuations and in-water hazards. High water levels were present on the site through mid-July 2017, covering the established transects in the riparian area and a significant portion of Upland Transect 3; water also covered the riparian areas historically surveyed for canopy cover and a significant portion of Upland Area 3. Due to the persistent high water levels, no revegetation monitoring data was collected for the Pit 24 Riparian Area, Upland Transect 3, or Upland Area 3. Shrub survival data was collected from the other three upland transects and canopy cover data was collected from the accessible upland areas typically surveyed.

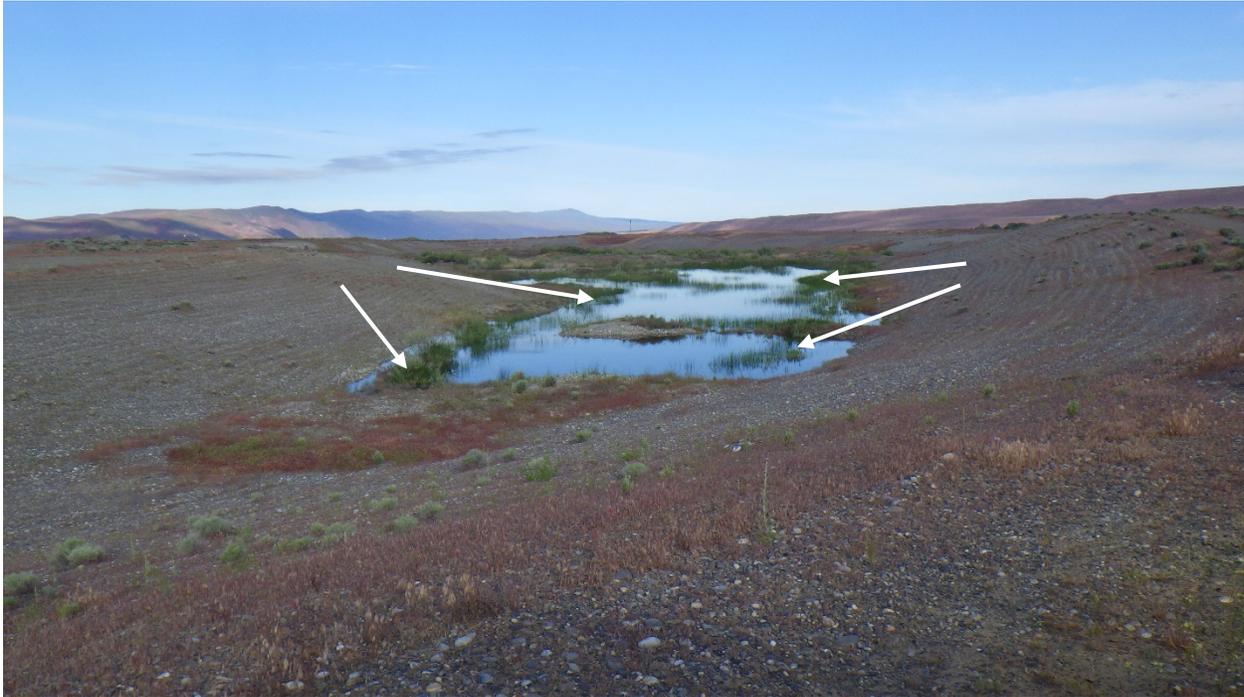


Figure 4. Overview of the Pit 24 Site in 2017. Looking West from the East End of the Site. The White Arrows Show Areas Where Established Riparian Transects were Under Water.

Upland shrub transects were established in 2015. Third-year monitoring for three of the four transects was conducted on May 18, 2017; the results show an overall shrub density of 665 plants/ha (269 plants/ac) for Upland Transects 1, 2, and 4, currently meeting the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub survival for the upland areas was 95% of that observed in 2016.

Canopy cover data for the accessible upland areas was collected on May 22, 2017. The upland canopy cover averaged 26.3% with native cover representing 9.2% and invasive cover representing 17.1% (Table 3). This represents a slight increase of 2.2% in native cover and 1.2% in invasive cover from 2016. Cheatgrass (*Bromus tectorum*) was the dominant species with 9.3% canopy cover and occurrence in 99% of the plot frames. Native grasses including Sandberg bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*) were the dominant native species with 2.5% and 2.3% canopy cover, respectively. Due to the large amount of cobble backfill used on this site, the 25% native cover within 5 years success criteria may not be a realistic benchmark.

Diffuse knapweed (*Centaurea diffusa*), common reed (*Phragmites australis*), and saltcedar (*Tamarix ramosissima*), all Washington State Class B noxious weeds, and reed canarygrass (*Phalaris arundinacea*), a Washington State Class C noxious weed, were present on the site. Diffuse knapweed was the most widespread with 1.5% cover and occurrence in 29% of the plot frames.

As in previous years, evidence of wildlife use of the area was observed. Waterfowl were noted on multiple occasions as were amphibians (frogs) and deer (Figure 5).

Table 3. Percent Canopy Cover and Frequency of Occurrence at Pit 24 Site (Upland Areas) in 2017. (3 Pages)

Species	Combined Upland Areas ^a	
	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	2.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.4	37.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.2	7.7
<i>Bromus tectorum</i> ^b (cheatgrass)	9.3	99.0
<i>Bunchgrasses</i> ^c	0.0	1.0
<i>Centaurea diffusa</i> ^d (diffuse knapweed) (B)	1.5	29.0
<i>Cornus sericea</i> (redosier dogwood)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	X	X
<i>Draba verna</i> ^b (spring draba)	0.3	10.0
<i>Elymus elymoides</i> (squirreltail)	0.1	2.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.3	11.7
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	0.4	14.0
<i>Erodium cicutarium</i> ^b (redstem stork's bill)	0.0	1.0
<i>Grayia spinosa</i> (spiny hopsage)	0.0	1.7
<i>Hesperostipa comata</i> (needle and thread grass)	0.6	12.0

**Table 3. Percent Canopy Cover and Frequency of Occurrence
at Pit 24 Site (Upland Areas) in 2017. (3 Pages)**

Species	Combined Upland Areas ^a	
	Average % Cover	Average % Frequency of Occurrence
<i>Holosteum umbellatum</i> ^b (jagged chickweed)	0.7	26.3
<i>Hordeum leporinum</i> ^b (hare barley)	0.3	1.7
<i>Lactuca serriola</i> ^b (prickly lettuce)	X	X
<i>Melilotus officinalis</i> ^b (sweetclover)	0.2	8.3
<i>Phalaris arundinacea</i> ^d (reed canarygrass) (C)	X	X
<i>Phragmites australis</i> ^d (common reed) (B)	0.0	1.7
<i>Poa bulbosa</i> ^b (bulbous bluegrass)	0.3	9.0
<i>Poa secunda</i> (Sandberg bluegrass)	2.5	76.7
<i>Populus balsamifera</i> (black cottonwood)	0.2	1.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	2.3	33.7
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	2.7
<i>Rosa woodsii</i> (Woods' rose)	X	X
<i>Salix exigua</i> (narrowleaf willow)	0.7	24.0
<i>Salsola kali</i> ^b (Russian thistle)	2.3	74.7
<i>Sisymbrium altissimum</i> ^b (tall tumbled mustard)	2.0	41.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	X	X
<i>Tamarix ramosissima</i> ^d (saltcedar) (B)	X	X
<i>Tragopogon dubius</i> ^b (yellow salsify)	0.1	2.0
<i>Triticum aestivum</i> ^b (common wheat)	X	X
<i>Verbascum thapsus</i> ^b (common mullein)	X	X
<i>Verbena bracteata</i> (bigbract verbena)	0.1	3.0
<i>Vulpia microstachys</i> (desert fescue)	0.2	7.7
ARTR recruits ^e	0.0	1.0
Crust	5.7	54.0
Soil	88.8	100.0
Litter	16.8	100.0
Total canopy cover (excludes crust/soil/litter)	26.3	
Total Native % Cover	9.2	
Change in Native % Cover from 2016	2.2	
Total Invasive % Cover	17.1	
Change in Invasive % Cover from 2016	1.2	

Table 3. Percent Canopy Cover and Frequency of Occurrence at Pit 24 Site (Upland Areas) in 2017. (3 Pages)

Species	Combined Upland Areas ^a	
	Average % Cover	Average % Frequency of Occurrence

^a No data was collected from Upland Area 3 in 2017 due to high water levels.

^b Invasive species

^c Bunchgrasses include *Pseudoroegneria spicata*, *Achnatherum hymenoides*, *Elymus elymoides*, *Sporobolus cryptandrus* and *Hesperostipa comata*

^d Washington State Classified Noxious Weed (class)

^e ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames

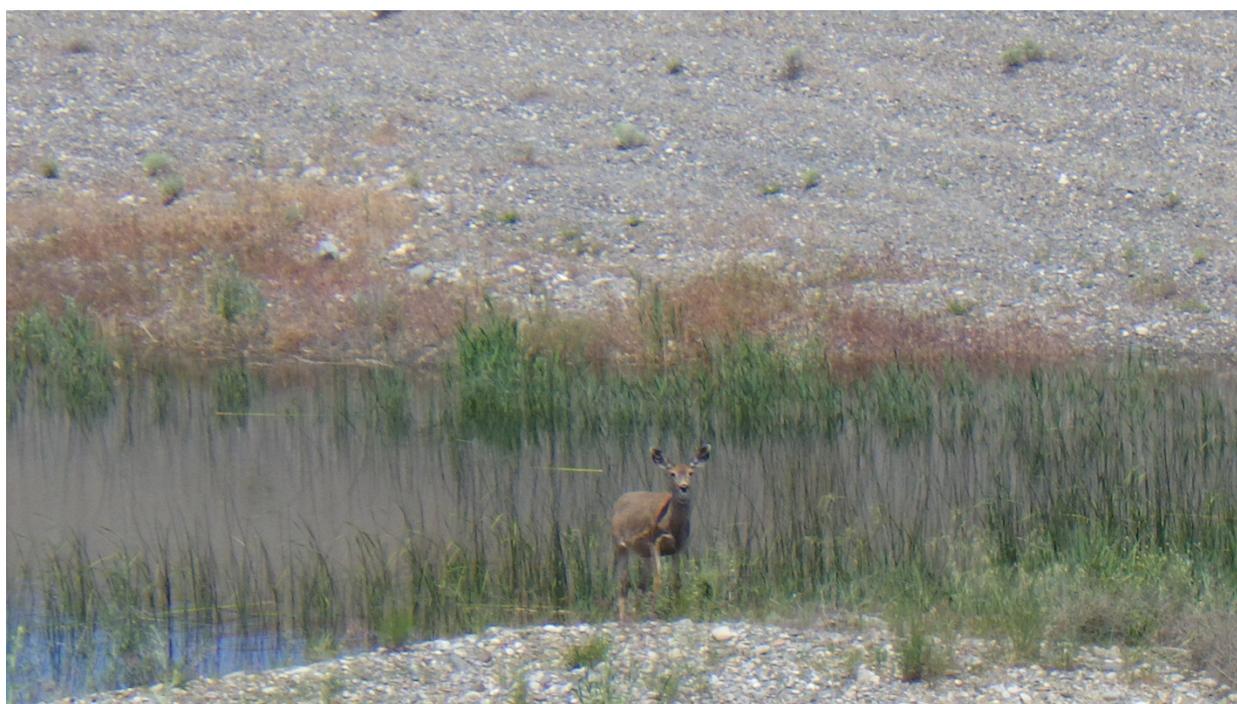


Figure 5. Wildlife Use at the Pit 24 Site in 2017.

3.1.4 100-B-35 Site (Electrical Substation)

The 100-B-35 site (Figure 6) was revegetated in FY 2016 and monitoring for the site was first conducted in 2016. The substrate for the site consists predominantly of cobbles with varying amounts of sandy loam.

A shrub monitoring transect was established for the site in 2016. Second-year monitoring was conducted on May 1, 2017; the results show a shrub density of 1129 plants/ha (457 plants/ac), well above the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 87.8% of that observed in 2016.

Canopy cover data for the site was collected on May 2, 2017. Canopy cover for the site was 19.8% with native cover representing 6.6% and invasive cover representing 13.2% (Table 4). This represents an increase of 3.4% in native cover and 8.8% in invasive cover from 2016. Native grasses, dominated by Sandberg bluegrass (*Poa secunda*) with 2.5% cover, represented 6.2% canopy cover, equating to over 30% of the total canopy cover present on the site. Tumble mustard (*Sisymbrium altissimum*) and Russian thistle (*Salsola kali*) were the dominant species for the site overall with 4.4% and 4.3%, respectively. Due to the large amount of cobble backfill used on this site, the 25% native cover within 5 years criteria may not be a realistic benchmark. Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site but was not recorded in any of the survey plots.

Table 4. Percent Canopy Cover and Frequency of Occurrence at the 100-B-35 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.5	60.0
<i>Artemisia tridentata</i> (big sagebrush)	0.3	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	2.8	92.0
Bunchgrasses ^c	0.5	20.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	X	X
<i>Draba verna</i> ^a (spring draba)	0.9	36.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	0.1	4.0
<i>Galium aparine</i> (stickywilly)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.3	12.0
<i>Hordeum leporinum</i> ^a (hare barley)	X	X
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.5	20.0
<i>Lamium amplexicaule</i> ^a (henbit deadnettle)	X	X
<i>Lomatium sp.</i> (desertparsley)	X	X
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	2.5	80.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.6	64.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> ^a (Russian thistle)	4.3	92.0
<i>Sisymbrium altissimum</i> ^a (tall tumbledustard)	4.4	96.0
<i>Vulpia microstachys</i> (desert fescue)	0.1	4.0
Crust	0.0	0.0
Soil	74.6	100.0

Table 4. Percent Canopy Cover and Frequency of Occurrence at the 100-B-35 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Litter	22.0	100.0
Total canopy cover (excludes crust/soil/litter)	19.8	
Total Native % Cover	6.6	
Change in Native Cover from 2016	3.4	
Total Invasive % Cover	13.2	
Change in Invasive % Cover from 2016	8.8	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c Bunchgrasses include *Pseudoroegneria spicata*, *Achnatherum hymenoides*, *Elymus elymoides*, *Sporobolus cryptandrus* and *Hesperostipa comata*

X = present but not counted in plot frames



Figure 6. The 100-B-35 Site in 2017.

3.2 100-K AREA SITES

Seven sites were monitored in the 100-K Area: 118-K-1 Burial Ground, 118-K-1 SSA, 128-K-2 Burn Pit, 128-K-2 SSA, 600-29, 100-K-95, and 100-K CTA. The 118-K-1 Burial Ground, 118-K-1 SSA, 128-K-2 Burn Pit, 128-K-2 SSA, and 600-29 sites were revegetated in FY 2013; the 100-K-95 site in FY 2014; and the 100-K CTA site in FY 2015. These sites were

remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE/RL-96-17) and in the Interim Action ROD (EPA 1999). Revegetation efforts entailed broadcast seeding at approximately 16.8 kg/ha (15 lbs/ac) with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage.

3.2.1 118-K-1 Burial Ground Site

The 118-K-1 Burial Ground site (Figure 7) was revegetated in FY 2013 and monitoring was first conducted for the site in 2016, 3 years after planting. The substrate for the site consists predominantly of cobbles with varying amounts of sandy loam.

Two shrub monitoring transects were established for the site in 2016 and were monitored on May 31, 2017; the results show a shrub density of 717 plants/ha (290 plants/ac), slightly above the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 97.3% of that observed in 2016.

Canopy cover data for the site was collected for the first time on May 30, 2017. Data was collected from a total of 35 plot frames; 10 from a relatively bare area in the southwestern portion of the site and 25 from the remainder of the site, which had a higher shrub component present. Canopy cover for the site averaged 30.6% with native cover representing 15.6% and invasive cover representing 15.1% (Table 5). Native grasses, dominated by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 4.8% cover, represented 9.0% canopy cover, equating to about 30% of the total canopy cover present on the site. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 7.8% cover followed by big sagebrush (*Artemisia tridentata*) with 5.6% cover. The 15.6% native cover does not meet the success criteria of 25% native cover within 5 years; additional revegetation efforts designed to increase native grasses and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% cover with occurrence in 14% of the plot frames.

**Table 5. Percent Canopy Cover and Frequency of Occurrence
at the 118-K-1 Burial Ground Site in 2017. (2 Pages)**

Species	Area 1 (S, bare)		Area 2 (NW, shrubby)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X	X	X	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.3	10.0	-	-	0.1	2.9
<i>Artemisia tridentata</i> (big sagebrush)	X	X	7.9	28.0	5.6	20.0
<i>Bromus tectorum</i> ^a (cheatgrass)	3.8	100.0	9.4	100.0	7.8	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.3	10.0	0.4	16.0	0.4	14.3
<i>Draba verna</i> ^a (spring draba)	2.3	90.0	0.7	28.0	1.1	45.7
<i>Elymus elymoides</i> (squirreltail)	0.5	20.0	1.4	16.0	1.1	17.1
<i>Epilobium brachycarpum</i> (tall annual willowherb)	-	-	0.4	16.0	0.3	11.4
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	-	-	0.2	8.0	0.1	5.7
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	2.0	80.0	1.9	76.0	1.9	77.1
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.8	30.0	1.2	48.0	1.1	42.9
<i>Lamium amplexicaule</i> ^a (henbit deadnettle)	-	-	0.1	4.0	0.1	2.9
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X	-	-	X	X
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	-	-	X	X	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	3.3	80.0	2.7	68.0	2.9	71.4
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.0	40.0	6.3	60.0	4.8	54.3
<i>Salsola kali</i> ^a (Russian thistle)	2.5	100.0	2.1	84.0	2.2	88.6
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.5	20.0	0.3	12.0	0.4	14.3
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.3	10.0	0.1	4.0	0.1	5.7
<i>Vulpia microstachys</i> (desert fescue)	X	X	0.2	8.0	0.1	5.7
ARTR recruits ^c	-	-	0.7	28.0	0.5	20.0
Crust	0.3	10.0	1.1	24.0	0.9	20.0
Soil	90.0	100.0	66.6	100.0	73.3	100.0
Litter	10.0	100.0	29.5	100.0	23.9	100.0
Total canopy cover (excludes crust/soil/litter)	17.3		35.3		30.6	
Total Native % Cover	5.0		19.8		15.6	
Total Invasive % Cover	12.3		16.2		15.1	

Table 5. Percent Canopy Cover and Frequency of Occurrence at the 118-K-1 Burial Ground Site in 2017. (2 Pages)

Species	Area 1 (S, bare)		Area 2 (NW, shrubby)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames

- = species not observed



Figure 7. The 118-K-1 Burial Ground Site in 2017. Top: Southwest (Bare) Portion of the 118-K-1 Burial Ground Site in 2017. Bottom: Shrubby Portion of the 118-K-1 Burial Ground Site in 2017.

3.2.2 118-K-1 Soil Staging Area Site

The 118-K-1 SSA site was revegetated in FY 2013 and monitoring was first conducted for the site in 2016, 3 years after planting. The substrate for the site consists of a mixture of sandy loam areas with some gravel and strips dominated by cobbles with varying amounts of sandy loam.

Two shrub monitoring transects were established for the site in 2016 and were monitored on May 31, 2017; the results show a shrub density of 381 plants/ha (154 plants/ac), well below the shrub density success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 100% of that observed in 2016.

Canopy cover data for the site was collected on May 30, 2017. Data was collected from a total of 25 plot frames. Canopy cover for the site was 47.3% with native cover representing 8.7% and invasive cover representing 38.6% (Table 6). This represents an increase of 4.3% in native cover and decrease of 19.9% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 4.3% cover followed by big sagebrush (*Artemisia tridentata*) with 4.1%. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 29.4% cover. The 8.7% native cover does not meet the success criteria of 25% native cover within 5 years. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% cover with occurrence in 8% of the plot frames.

Table 6. Percent Canopy Cover and Frequency of Occurrence at the 118-K-1 Soil Staging Area Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Artemisia tridentata</i> (big sagebrush)	4.1	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	29.4	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.2	8.0
<i>Draba verna</i> ^a (spring draba)	1.7	68.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	3.1	64.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	4.3	52.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Salsola kali</i> ^a (Russian thistle)	2.1	84.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.0	60.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
ARTR recruits ^c	0.1	4.0

Table 6. Percent Canopy Cover and Frequency of Occurrence at the 118-K-1 Soil Staging Area Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Crust	7.7	88.0
Soil	63.6	100.0
Litter	33.4	100.0
Total canopy cover (excludes crust/soil/litter)	47.3	
Total Native % Cover	8.7	
Change in Native Cover from 2016	4.3	
Total Invasive % Cover	38.6	
Change in Invasive % Cover from 2016	-19.9	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames

3.2.3 128-K-2 Burn Pit Site

The 128-K-2 Burn Pit site (Figure 8) was revegetated in FY 2013 and monitoring was first conducted for the site in 2016, 3 years after planting. The substrate for the site varies with some areas that are primarily cobbles with varying amounts of sandy loam and other areas that are primarily sandy loam with few cobbles.

A shrub monitoring transect was established for the site in 2016 and was monitored on May 23, 2017; the results show a shrub density of 800 plants/ha (324 plants/ac), well above the shrub success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 98.8% of that observed in 2016.

Canopy cover data for the site was collected on May 23, 2017. Data was collected from a total of 25 plot frames. Canopy cover for the site was 35.8% with native cover representing 11.1% and invasive cover representing 24.7% (Table 7). This represents a decrease of 8.7% in native cover and a decrease of 9.1% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 5.9% cover followed by big sagebrush (*Artemisia tridentata*) with 2.7%. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 16.9% cover. The 11.1% native cover does not meet the success criteria of 25% native cover within 5 years. Additional revegetation efforts designed to increase native grasses and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% cover with occurrence in 16% of the plot frames.

**Table 7. Percent Canopy Cover and Frequency of Occurrence
at the 128-K-2 Burn Pit Site in 2017.**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	2.7	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	16.9	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.9	16.0
<i>Draba verna</i> ^a (spring draba)	1.4	56.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.2	8.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	1.7	68.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	4.0
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	0.3	12.0
<i>Poa secunda</i> (Sandberg bluegrass)	5.9	80.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.7	28.0
<i>Salsola kali</i> ^a (Russian thistle)	2.5	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.8	32.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.1	4.0
<i>Vulpia microstachys</i> (desert fescue)	0.5	20.0
ARTR recruits ^c	0.1	4.0
Crust	2.1	24.0
Soil	69.9	100.0
Litter	24.3	100.0
Total canopy cover (excludes crust/soil/litter)	35.8	
Total Native % Cover	11.1	
Change in Native % Cover from 2016	-8.7	
Total Invasive % Cover	24.7	
Change in Invasive % Cover from 2016	-9.1	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 8. The 128-K-2 Burn Pit Site in 2017.

3.2.4 128-K-2 Soil Staging Area Site

The 128-K-2 SSA site (Figure 9) was revegetated in FY 2013 and monitoring was first conducted for the site in 2013. The substrate for the site varies with some areas that are primarily cobbles with varying amounts of sandy loam and other areas that are primarily sandy loam with few cobbles.

Fifth-year shrub transect monitoring for the site was conducted on May 23, 2017; the results show a shrub density of 919 plants/ha (372 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 100 % of that observed in 2016.

Canopy cover data for the site was collected on May 23, 2017. Data was collected from a total of 25 plot frames. Canopy cover for the site was 55.7% with native cover representing 14.1% and invasive cover representing 41.6% (Table 8). This represents a decrease of 7.0% in native cover and a decrease of 25.9% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 7.4% cover followed by big sagebrush (*Artemisia tridentata*) with 6.3%. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 16.9% cover. The 14.1% native cover does not meet the success criteria of 25% native cover within 5 years. Additional revegetation efforts designed to increase native grasses and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% cover with occurrence in 4% of the plot frames.

**Table 8. Percent Canopy Cover and Frequency of Occurrence
at the 128-K-2 Soil Staging Area Site in 2017.**

Species	% Cover	% Frequency of Occurrence
<i>Artemisia tridentata</i> (big sagebrush)	6.3	24.0
<i>Bromus tectorum</i> ^a (cheatgrass)	32.8	96.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.1	4.0
<i>Draba verna</i> ^a (spring draba)	2.8	92.0
<i>Hesperostipa comata</i> (needle and thread grass)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	1.8	72.0
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	7.4	96.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Salsola kali</i> ^a (Russian thistle)	1.6	64.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.5	60.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.2	8.0
ARTR recruits ^c	0.1	4.0
Crust	1.9	0.0
Soil	43.7	100.0
Litter	44.9	100.0
Total canopy cover (excludes crust/soil/litter)	55.7	
Total Native % Cover	14.1	
Change in Native % Cover from 2016	7.0	
Total Invasive % Cover	41.6	
Change in Invasive % Cover from 2016	25.9	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 9. The 128-K-2 Soil Staging Area Site in 2017.

3.2.5 600-29 Site

The 600-29 site (Figure 10) was revegetated in FY 2013 and monitoring was first conducted for the site in 2016, three years after planting. The substrate for the site is a gravelly sandy loam.

A shrub monitoring transect was established for the site in 2016 and was monitored on May 30, 2017; the results show a shrub density of 610 plants/ha (247 plants/ac), meeting the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 93.3 % of that observed in 2016.

Canopy cover data for the site was collected on May 31, 2017. Data was collected from a total of 20 plot frames. Canopy cover for the site was 41.5% with native cover representing 27.0% and invasive cover representing 14.5% (Table 9). This represents an increase of 3.6% in native cover and a decrease of 8.1% in invasive cover from 2016. The dominant native species was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 12.3% cover; this was also the dominant species for the site overall. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 9.6% cover. The 27.0% native cover meets the success criteria of 25% native cover within 5 years. No additional revegetation efforts are recommended for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% cover with occurrence in 4% of the plot frames.

Table 9. Percent Canopy Cover and Frequency of Occurrence at the 600-29 Site in 2017.

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	1.5	10.0
<i>Astragalus succumbens</i> (Columbia milkvetch)	0.3	10.0
<i>Bromus tectorum</i> ^a (cheatgrass)	9.6	95.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.9	35.0
<i>Draba verna</i> ^a (spring draba)	0.8	30.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	3.0	20.0
<i>Hesperostipa comata</i> (needle and thread grass)	0.9	10.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.8	30.0
<i>Koeleria macrantha</i> (prairie Junegrass)	1.5	10.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.4	15.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.4	15.0
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	7.0	80.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	12.3	80.0
<i>Salsola kali</i> ^a (Russian thistle)	1.6	65.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.5	20.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.3	10.0
Crust	0.0	0.0
Soil	64.8	100.0
Litter	34.0	100.0
Total canopy cover (excludes crust/soil/litter)	41.5	
Total Native % Cover	27.0	
Change in Native % Cover from 2016	3.6	
Total Invasive % Cover	14.5	
Change in Invasive % Cover from 2016	-8.1	

^a Invasive species^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

- = species not observed



Figure 10. The 600-29 Site in 2017.

3.2.6 100-K-95 Site 100-K Tar Dump

The 100-K-95 site (Figure 11) was revegetated in FY 2014 and monitoring was first conducted for the site in 2014. The substrate for the site is characterized by loamy sand and sandy loam soils with varying amounts of scattered boulders with a few smaller areas of predominantly gravel substrate. For monitoring purposes, the site was previously broken down into Area 1 (non-strawed) and Area 2 (strawed).

Fourth-year shrub transect monitoring for the site was conducted on May 23, 2017; the results show a shrub density of 376 plants/ha (152 plants/ac) for Area 1 and 62 plants/ha (25 plants/ac) for Area 2, and 220 plants/ha (89 plants/ac) for the site overall, well below the success criteria of 600 plants/ha (240 plants/ac). Over 80% of the transplanted shrubs were lost within the first year (2014 to 2015); initial losses were significant in both Area 1 and Area 2 at about 68% and 96%, respectively. There has been a gradual decrease in shrub survival of less than 4% per year for the site since 2015.

Canopy cover data for the site was collected on May 25, 2017. Data was collected from a total of 50 plot frames; 25 plot frames from each area (Area 1 and Area 2). Canopy cover for the site overall averaged 69.1%, with 65.4% cover in Area 1 and 72.8% cover in Area 2. Native cover for the site overall was only 5.2%, with 4.1% in Area 1 and 6.3% in Area 2; this represents an overall decrease in native cover for the site overall of 6.9% from 2016 (Table 10). Invasive cover for the site overall was 63.9%, with 61.3% in Area 1 and 66.5% in Area 2; this represents an overall increase in invasive cover of 10.7% from 2016. The dominant native species was big sagebrush (*Artemisia tridentata*) with 3.1% cover; all other native species had less than 1% cover. The few native grasses observed on the site were most prevalent in the smaller gravelly area on the site vs. the loam-dominated substrate that covers most of the site.

(Figure 12). Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 55.4% cover and present in every plot frame. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was noted as present on the site but was not recorded in any of the plot frames.

Table 10. Percent Canopy Cover and Frequency of Occurrence at the 100-K-95 Site in 2017. (2 Pages)

Species	Area 1 (Nonstrawed)		Area 2 (Strawed)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0	0.7	8.0	0.4	6.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X	X	X	X	X
<i>Artemisia tridentata</i> (big sagebrush)	2.6	12.0	3.6	12.0	3.1	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	53.1	100.0	57.6	100.0	55.4	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	-	-	X	X	X	X
<i>Chondrilla juncea</i> ^b (rush skeletonweed) (B)	X	X	-	-	X	X
<i>Draba verna</i> ^a (spring draba)	2.3	84.0	2	80.0	2.1	82.0
<i>Elymus elymoides</i> (squirreltail)	X	X	-	-	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	-	-	X	X	X	X
<i>Erigeron pumilus</i> (shaggy fleabane)	-	-	X	X	X	X
<i>Erodium cicutarium</i> ^a (redstem stork's bill)	-	-	0.2	8.0	0.1	4.0
<i>Grayia spinosa</i> (spiny hopsage)	-	-	X	X	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	-	-	0.1	4.0	0.1	2.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	3.0	96.0	3	100.0	3.0	98.0
<i>Lomatium grayi</i> (Gray's biscuitroot)	0.1	4.0	-	-	0.1	2.0
<i>Microsteris gracilis</i> (slender phlox)	1.1	48.0	0.3	12.0	0.7	30.0
<i>Poa secunda</i> (Sandberg bluegrass)	0.1	4.0	1.6	24.0	0.9	14.0
<i>Salsola kali</i> ^a (Russian thistle)	1.1	40.0	1.9	76.0	1.5	58.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.8	76.0	1.8	72.0	1.8	74.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.0	4.0	X	X	0.0	2.0
Crust	1.9	52.0	3.3	52.0	2.6	52.0
Soil	58.0	100.0	35	100.0	46.5	100.0

Table 10. Percent Canopy Cover and Frequency of Occurrence at the 100-K-95 Site in 2017. (2 Pages)

Species	Area 1 (Nonstrawed)		Area 2 (Strawed)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Litter	37.0	100.0	63	100.0	50.0	100.0
Total canopy cover (excludes crust/soil/litter)	65.4		72.8		69.1	
Total Native % Cover	4.1		6.3		5.2	
Change in Native % Cover from 2016	-14.5		0.6		-6.9	
Total Invasive % Cover	61.3		66.5		63.9	
Change in Invasive % Cover from 2016	17.1		4.2		10.7	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

- = species not observed



Figure 11. The 100-K-95 Site in 2017.



Figure 12. 100-K-95 Site Plot Frame from Gravelly Area.

3.2.7 100-K Container Transfer Area Site

The 100-K CTA site (Figure 13) was revegetated in FY 2015 and monitoring was first conducted for the site in 2016. Due to the lack of shrubs observed on the site during initial monitoring in 2016, no shrub transect was established for the site.

Canopy cover data for the site was collected for the site on May 30, 2017. Data was collected from 20 plot frames. Canopy cover for the site was 38.4% with native cover representing 7.6% and invasive cover representing 30.8% (Table 11). This represents an increase of 3.8% in native cover and a decrease of 17.7% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 7.4% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 19.3% cover. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% cover with occurrence in 10% of the plot frames.

Table 11. Percent Canopy Cover and Frequency of Occurrence at the 100-K CTA Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Agoseris sp.</i> (agoseris)	X	X

Table 11. Percent Canopy Cover and Frequency of Occurrence at the 100-K CTA Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	19.3	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.3	10.0
<i>Draba verna</i> ^a (spring draba)	0.6	25.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	1.1	45.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.4	15.0
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	7.4	75.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.3	10.0
<i>Salsola kali</i> ^a (Russian thistle)	5.9	90.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	3.3	80.0
Crust	2.5	50.0
Soil	60.0	100.0
Litter	37.5	100.0
Total canopy cover (excludes crust/soil/litter)	38.4	
Total Native % Cover	7.6	
Change in Native Cover from 2016	3.8	
Total Invasive % Cover	30.8	
Change in Invasive % Cover from 2016	-17.7	

^a Invasive species^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 13. The 100-K Container Transfer Area Site in 2017.

3.3 100-N AREA SITES

Seven sites were monitored in the 100-N Area: 100-N-47, 181-N, 181-NE/1908-NE, 130-N-1:1, 100-N-96, 100-N-83, and 100-N CTA. The 100-N-47, 181-N, and 181-NE/1908-NE sites were revegetated in FY 2013; the 130-N-1:1 site in FY 2015; the 100-N-96 site in FY 2016; and the 100-N-83 and 100-N CTA sites in FY 2017. These sites were remediated to meet the objectives for interim closure as established in the 100N Area RDR/RAWP (DOE/RL-2005-93) and in the Interim Action ROD (EPA 2000a, 2000b). Site 100-N-96 had additional revegetation guidelines as stated in the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Historic Office, and the Advisory Council on Historic Preservation Regarding the Remediation of the 100-N-96 Waste Site* (DOE-RL et al. 2014). Sites 100-N-83 and 100-N CTA had additional revegetation guidelines as stated in the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Department of Archaeology and Historic Preservation Regarding Removal and Remedial Actions, Demobilization and Area Revegetation for the 100-N Area of the Hanford Site* (DOE-RL et al. 2015). Revegetation efforts entailed broadcast seeding at approximately 16.8 kg/ha (15 lbs/ac) with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny

hopsage, with the exception of site 100-N-96. Site 100-N-96 received varying planting ratios ranging from 60 to 75% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) of rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

In addition to the standard prescription of broadcast seeding and shrub planting listed above, the 181-N and 181-NE/1908-NE sites were planted with riparian species due to their location adjacent to the Columbia River. Riparian species planted at the sites included species such as black cottonwood (*Populus balsamifera*), narrowleaf willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), redosier dogwood (*Cornus sericea*), chokecherry (*Prunus virginiana*), Woods' rose (*Rosa woodsii*), and golden currant (*Ribes aureum*). Protective wire fencing was placed around the riparian plantings shortly after planting to reduce herbivory that was noted within days of planting in FY 2013. Monitoring staff noted during the summer of 2016 that many of the transplanted trees were growing through the protective fencing and recommended removal; removal was conducted for the two sites (181-N and 181-NE/1980-NE) in July 2016.

3.3.1 100-N-47 Site (Military Artillery Area)

The 100-N-47 site (Figure 14) was revegetated in FY 2013 and monitoring was first conducted for the site in 2013. The substrate for the site is characterized by sandy loam soils with varying amounts of gravel.

Fifth-year shrub transect monitoring for the site was conducted on June 6, 2017; the results show a shrub density of 440 plants/ha (178 plants/ac), well below the success criteria of 600 plants/ha (240 plants/ac). Over 50% of the transplanted shrubs were lost within the first year (2013 to 2014) but the number of surviving shrubs has remained consistent for the past three years.

Canopy cover data for the site was collected on June 6, 2017. Data was collected from 25 plot frames. Canopy cover for the site was 46.1% with 19.0% native cover and 27.1% invasive cover (Table 12). This represents a decrease of less than 1% in native cover and a decrease of 8.2% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 6.8% cover followed by big sagebrush (*Artemisia tridentata*) with 4.0% and bluebunch wheatgrass (*Pseudoroegneria spicata*) with 3.9%. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 23.0% cover. The 19.0% native cover does not meet the success criteria of 25% native cover within 5 years. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, and field bindweed (*Convolvulus arvensis*), a Washington State Class C noxious weed, were recorded at less than 1% cover each with both occurring in 8% of the plot frames.

Table 12. Percent Canopy Cover and Frequency of Occurrence at the 100-N-47 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	4.0	8.0

**Table 12. Percent Canopy Cover and Frequency of Occurrence
at the 100-N-47 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Bromus tectorum</i> ^a (cheatgrass)	23.0	100.0
<i>Calochortus macrocarpus</i> (sagebrush mariposa lily)	0.1	4.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.2	8.0
<i>Convolvulus arvensis</i> ^b (field bindweed) (C)	0.7	8.0
<i>Draba verna</i> ^a (spring draba)	0.5	20.0
<i>Erigeron pumilus</i> (shaggy fleabane)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.7	28.0
<i>Koeleria macrantha</i> (prairie Junegrass)	X	X
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	4.0
<i>Plantago patagonica</i> (woolly plantain)	1.9	20.0
<i>Poa secunda</i> (Sandberg bluegrass)	6.8	76.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.9	36.0
<i>Salsola kali</i> ^a (Russian thistle)	1.6	64.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.3	12.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	1.6	8.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.3	12.0
ARTR recruits ^c	0.2	8.0
Crust	0.1	4.0
Soil	48.6	100.0
Litter	49.4	100.0
Total canopy cover (excludes crust/soil/litter)	46.1	
Total Native % Cover	19.0	
Change in Native % Cover from 2016	-0.7	
Total Invasive % Cover	27.1	
Change in Invasive % Cover from 2016	-8.2	

^a Invasive species^b Washington State Classified Noxious Weed (class)^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 14. The 100-N-47 Site in 2017.

3.3.2 181-N Site

The 181-N site (Figure 15) was revegetated in FY 2013 and monitoring was first conducted for the site in 2013. The substrate for the site is characterized by cobbles with varying amounts of loamy sand.

This site is located adjacent to the Columbia River, which had higher than normal water levels through most of the 2017 growing season. The established transect area is located in the riparian area near the ordinary high water mark (OHWM); trees/shrubs monitored are riparian species including black cottonwood (*Populus balsamifera*), narrowleaf willow (*Salix exigua*), and redosier dogwood (*Cornus sericea*). Water covered the established transect area through June 2017 (Figure 16). Fifth year shrub transect monitoring for the site was conducted on July 6, 2017; the results show a shrub density of 2,318 plants/ha (938 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). This is a survival rate of 50.7% of what was initially documented in the transect area. Though the site currently exceeds the minimal success criteria for shrubs, it is unlikely that the majority of the saplings will survive due to herbivory (primarily from beaver [*Castor Canadensis*]). Field notes from the 2017 monitoring note that nearly all of the remaining black cottonwood saplings had been eaten down to ground level.

Canopy cover data for the site was collected on July 6, 2017. Data was collected from 15 plot frames. Consistent with previous years, monitoring was conducted between the OHWM and the toe of the main slope. As noted above, the Columbia River covered most of the area throughout the growing season. Canopy cover for the site overall was only 5.2%, down from over 20% in 2016; this decrease is likely the result of the unusually high water levels that covered much of the monitoring area through the majority of the growing season. The site had 3.3% native cover and 1.8% invasive cover (Table 13). Grasses and forbs accounted for less than 3% canopy cover.

The 3.3% native cover does not meet the success criteria of 25% native cover within 5 years. Native cover in 2015 and 2016 was recorded at 10.7% and 10.2%, respectively; while significantly less than the prescribed 25% native cover, this may be a more realistic goal considering the rocky substrate and water level fluctuations associated with the adjacent Columbia River.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site but was not recorded in any of the plot frames.

Table 13. Percent Canopy Cover and Frequency of Occurrence at the 181-N Site in 2017^a.

Species	% Cover	% Frequency of Occurrence
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Bromus tectorum</i> ^b (cheatgrass)	1.3	53.3
<i>Carex sp.</i> (sedge)	0.5	20.0
<i>Centaurea diffusa</i> ^c (diffuse knapweed) (B)	X	X
<i>Cornus sericea</i> (redosier dogwood)	1.0	6.7
<i>Lactuca serriola</i> ^b (prickly lettuce)	0.2	6.7
<i>Melilotus officinalis</i> ^b (sweetclover)	0.2	6.7
<i>Populus balsamifera</i> (black cottonwood)	0.2	6.7
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.5	20.0
<i>Salix exigua</i> (narrowleaf willow)	1.2	13.3
<i>Sisymbrium altissimum</i> ^b (tall tumbled mustard)	0.2	6.7
Crust	0.0	0.0
Soil	91.7	100.0
Litter	8.3	100.0
Total canopy cover (excludes crust/soil/litter)	5.2	
Total Native % Cover	3.3	
Change in Native % Cover from 2016	-6.9	
Total Invasive % Cover	1.8	
Change in Invasive % Cover from 2016	-8.7	

^a The area was under water through most of the growing season.

^b Invasive species

^c Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 15. The 181-N Site in July 2017.



Figure 16. The 181-N Site in June 2017. The Columbia River was Covering the Shrub Transect and Monitoring Area (between the arrows) Through Early July 2017.

3.3.3 181-NE/1908-NE Site

The 181-NE/1908-NE site (Figure 17) was revegetated in FY 2013 and monitoring was first conducted for the site in 2013. The substrate for the site is characterized by cobbles with varying amounts of loamy sand.

This site is located adjacent to the Columbia River, which had higher than normal water levels through most of the growing season in 2017. The established transect is located in the riparian area near the OHWM; trees/shrubs monitored are riparian species including black cottonwood (*Populus balsamifera*) and narrowleaf willow (*Salix exigua*). Water covered the established transect area through June 2017 (Figure 18). Fifth-year shrub transect monitoring for the site was conducted on July 6, 2017; the results show a shrub density of 3,284 plants/ha (1,329 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). This is a survival rate of 63.9% of what was initially documented in the transect area. Though the site currently exceeds the minimal success criteria for shrubs, it is unlikely that the majority of the saplings will survive due to herbivory (primarily from beaver [*Castor Canadensis*]). Field notes from the 2017 monitoring note that nearly all of the remaining black cottonwood saplings had been eaten down to ground level.

Canopy cover data for the site was collected on July 6, 2017. Data was collected from 25 plot frames. As noted above, the Columbia River covered most of the area throughout the growing season (Figure 17). Canopy cover for the site overall was only 14.3%, down slightly from over 18.5% in 2016. The site had 8.8% native cover and 5.5% invasive cover (Table 14); down 3.0% and 1.2%, respectively, from 2016. Bluebunch wheatgrass (*Pseudoroegneria spicata*) was the most dominant species for the site with 6.8% canopy cover. The 8.8% native cover does not meet the success criteria of 25% native cover within 5 years. Native cover in 2016 was recorded at 11.8%; while significantly less than the prescribed 25% native cover, this may be a more realistic goal considering the rocky substrate and water level fluctuations associated with the adjacent Columbia River.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site with less than 1% canopy cover and present in 16% of the plot frames. Field bindweed (*Convolvulus arvensis*), a Washington State Class C noxious weed, was also observed on the site with less than 1% canopy cover and present in 4% of the plot frames.

Table 14. Percent Canopy Cover and Frequency of Occurrence at the 181-NE/1908-N Site in 2017^a. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Bromus tectorum</i> ^b (cheatgrass)	2.5	60.0
<i>Carex sp.</i> (sedge)	0.1	4.0
<i>Centaurea diffusa</i> ^c (diffuse knapweed) (B)	0.9	16.0
<i>Convolvulus arvensis</i> ^c (field bindweed) (C)	0.1	4.0
<i>Draba verna</i> ^b (spring draba)	X	X

**Table 14. Percent Canopy Cover and Frequency of Occurrence
at the 181-NE/1908-N Site in 2017^a. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	4.0
<i>Holosteum umbellatum</i> ^b (jagged chickweed)	0.1	4.0
<i>Lactuca serriola</i> ^b (prickly lettuce)	1.2	48.0
<i>Poa secunda</i> (Sandberg bluegrass)	0.1	4.0
<i>Populus balsamifera</i> (black cottonwood)	1.3	12.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	6.8	56.0
<i>Ribes aureum</i> (golden currant)	X	X
<i>Salix exigua</i> (narrowleaf willow)	0.2	8.0
<i>Salsola kali</i> ^b (Russian thistle)	0.3	12.0
<i>Tragopogon dubius</i> ^b (yellow salsify)	X	X
<i>Triticum aestivum</i> ^b (common wheat)	0.2	8.0
<i>Ulmus pumila</i> ^b (Siberian elm)	0.1	4.0
<i>Verbascum thapsus</i> ^b (common mullein)	0.1	4.0
ARTR recruits ^d	0.1	4.0
Crust	0.0	0.0
Soil	0.0	0.0
Litter	0.0	0.0
Total canopy cover (excludes crust/soil/litter)	14.3	
Total Native % Cover	8.8	
Change in Native % Cover from 2016	-3.0	
Total Invasive % Cover	5.5	
Change in Invasive % Cover from 2016	-1.2	

^a The area was under water through most of the growing season.

^b Invasive species

^c Washington State Classified Noxious Weed (class)

^d ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 17. The 181-N Site in July 2017.



Figure 18. The 181-N Site in June 2017. The Columbia River was Covering the Shrub Transect and Much of the Monitoring Area (between the arrows) Through Early July 2017.

3.3.4 130-N-1:1 Site (183-N Northeastern Backwash Discharge Pond)

The 130-N-1:1 site (Figure 19) was revegetated in FY 2015 and monitoring was first conducted for the site in 2015. The substrate for the site is characterized predominantly by cobbles with some loamy sand in the south area (Area 1) and predominantly sandy loam in the north area (Area 2) with increased amounts of cobbles in the south portion of this area.

Third-year shrub transect monitoring for the site was conducted on June 7, 2017. The results show a shrub density of 899 plants/ha (364 plants/ac) for Area 1 and 90 plants/ha (40 plants/ac) for Area 2; this equates to about 568 plants/ha (230 plants/ac) for the site overall, below the success criteria of 600 plants/ha (240 plants/ac). Over 90% of the transplanted shrubs in Area 2 were lost within the first year (2015 to 2016) and only 5 of the original 85 plants recorded along the transect remain.

Canopy cover data for the site was collected on June 7, 2017. Data was collected from 25 plot frames in each area. Canopy cover for the site overall was 33.5% with 8.6% native cover and 24.9% invasive cover (Table 15). This represents a slight increase of 1.3% in native cover and decrease of 4.0% in invasive cover from 2016. Total canopy cover for Area 1 was recorded at 20.7% with 11.3% native cover and 9.4% invasive cover. The dominant native species for Area 1 was Sandberg bluegrass (*Poa secunda*) with 5.0% cover followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) with 4.1% cover; the dominant invasive species was cheatgrass (*Bromus tectorum*) with 4.0% cover. The dominant native species for Area 2 was Sandberg bluegrass (*Poa secunda*) with 3.7% cover. Cheatgrass (*Bromus tectorum*), with 35.2% cover, was the dominant invasive species for Area 2 and for the site overall with average cover for the site at 19.6% and occurrence in every plot frame over both areas of the site. Additional revegetation efforts designed to increase native shrubs in Area 2, and grasses and forbs in both areas should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% cover occurring in 6% of the plot frames.

Table 15. Percent Canopy Cover and Frequency of Occurrence at the 130-N-1:1 Site in 2017. (2 Pages)

Species	Area 1 (cobble)		Area 2 (loamy sand)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X	X	X	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.0	20.0	0.1	4.0	0.6	12.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	-	-	1.1	24.0	0.6	12.0
<i>Artemisia tridentata</i> (big sagebrush)	1.0	20.0	0.6	4.0	0.8	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	4.0	100.0	35.2	100.0	19.6	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.7	8.0	0.1	4.0	0.4	6.0

Table 15. Percent Canopy Cover and Frequency of Occurrence at the 130-N-1:1 Site in 2017. (2 Pages)

Species	Area 1 (cobble)		Area 2 (loamy sand)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Draba verna</i> ^a (spring draba)	0.2	8.0	1.7	68.0	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	-	-	X	X	X	X
<i>Erodium cicutarium</i> ^a (redstem stork's bill)	-	-	X	X	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.1	4.0	0.1	4.0	0.1	4.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.9	36.0	2.1	84.0	1.5	60.0
<i>Hordeum leporinum</i> ^a (hare barley)	-	-	0.6	4.0	0.3	2.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.2	8.0	X	X	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	-	-	0.2	8.0	0.1	4.0
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X	-	-	X	X
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	-	-	X	X	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	5.0	100.0	3.7	88.0	4.4	94.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	4.1	44.0	-	-	2.1	22.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X	-	-	X	X
<i>Salsola kali</i> ^a (Russian thistle)	2.4	96.0	2.0	80.0	2.2	88.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.0	40.0	0.6	24.0	0.8	32.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	-	-	X	X	X	X
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X	-	-	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.1	4.0	X	X	0.1	2.0
Crust	0.0	0.0	0.0	0.0	0.0	0.0
Soil	69.8	100.0	64.9	100.0	67.4	100.0
Litter	30.2	100.0	34.1	100.0	32.2	100.0
Total canopy cover (excludes crust/soil/litter)	20.7		48.1		33.5	
Total Native % Cover	11.3		5.8		8.6	
Change in Native % Cover from 2016	2.5		0.1		1.3	
Total Invasive % Cover	9.4		42.3		24.9	
Change in Invasive % Cover from 2016	-0.2		-5.8		-4.0	

^a = Invasive species^b Washington State Classified Noxious Weed (class)

- = species not observed on site

X = present but not counted in plots



Figure 19. The 130-N-1:1 Site in 2017. Top: Area 1 – Predominantly Cobbles with Some Loamy Sand. Bottom: Area 2 – Predominantly Sandy Loam with More Cobbles in South Portion.

3.3.5 100-N-96 Site (Military Camp Disposal Pits)

The 100-N-96 site (Figure 20) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. The substrate for the site is characterized by loamy sand with varying amounts of gravel. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Historic Office, and the Advisory Council on Historic Preservation Regarding the Remediation of the 100-N-96 Waste Site* (DOE-RL et al. 2014), seeds from several native forbs were collected from the Hanford Site and broadcast on the site along with the standard native grass seed mix. Rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*) were also planted on this site along with the standard mix of big sagebrush, antelope bitterbrush, and spiny hopsage.

A 75-m (246-ft) shrub monitoring transect with approximately 3-m (9.8-ft) offsets was established for the site in 2016. Second-year monitoring was conducted for the site on June 6, 2017; the results show a shrub density of 534 plants/ha (216 plants/ac), below the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 80.0% of that recorded for the transect originally in 2016.

Canopy cover data for the site was collected on June 6, 2017. Canopy cover for the site was 34.7% with native cover representing 8.8% and invasive cover representing 25.9% (Table 16). This represents an increase of 4.9% in native cover from 2016 with invasive cover remaining basically the same. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 6.1% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 16.4%. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*) and rush skeletonweed (*Chondrilla juncea*), both Washington State Class B noxious weeds, were observed on the site with rush skeletonweed occurring in about 4% of the plot frames.

Table 16. Percent Canopy Cover and Frequency of Occurrence at the 100-N-96 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	1.0	20.0
<i>Artemisia tridentata</i> (big sagebrush)	0.7	8.0
<i>Bromus tectorum</i> ^a (cheatgrass)	16.4	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	X	X
<i>Chondrilla juncea</i> ^b (rush skeletonweed) (B)	0.6	4.0
<i>Draba verna</i> ^a (spring draba)	1.7	68.0
<i>Elymus elymoides</i> (squirreltail)	0.2	8.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X

**Table 16. Percent Canopy Cover and Frequency of Occurrence
at the 100-N-96 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Grayia spinosa</i> (spiny hopsage)	0.1	4.0
<i>Hesperostipa comata</i> (needle and thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	1.6	64.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.5	20.0
<i>Microsteris gracilis</i> (slender phlox)	0.2	8.0
<i>Poa secunda</i> (Sandberg bluegrass)	6.1	88.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.2	8.0
<i>Salsola kali</i> ^a (Russian thistle)	2.2	88.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.9	96.0
<i>Truticum sp.</i> ^a (wheat)	X	X
Crust	0.0	0.0
Soil	49.5	100.0
Litter	47.5	100.0
Total canopy cover (excludes crust/soil/litter)	34.7	
Total Native % Cover	8.8	
Change in Native % Cover from 2016	4.9	
Total Invasive % Cover	25.9	
Change in Invasive % Cover from 2016	0.2	

^a Invasive species^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 20. The 100-N-96 Site in 2017.

3.3.6 100-N-83 Site

The 100-N-83 site (Figure 21) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is characterized by sandy loam with varying amounts of gravel and cobbles. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Department of Archaeology and Historic Preservation Regarding Removal and Remedial Actions, Demobilization and Area Revegetation for the 100-N Area of the Hanford Site* (DOE-RL et al. 2015), seeds from several native forbs were collected from the Hanford Site and broadcast on the site along with the standard native grass seed mix.

Two 100-m (328-ft) shrub monitoring transects were established and monitored for the site on March 29, 2017; Transect 1 in the lower (south) portion of the site and Transect 2 in the upper (north) portion of the site. Big sagebrush (*Artemisia tridentata*), spiny hopsage (*Grayia spinosa*), and antelope bitterbrush (*Purshia tridentata*) were recorded along both transects. The shrub density for the lower area was 969 plants/ha (392 plants/ac) and 1,169 plants/ha (473 plants/ac); this equates to about 1,070 plants/ha (433 plants/ac) for the site overall, well above the success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected on June 6, 2017. Canopy cover was fairly consistent between the two areas (lower and upper) with 37.2% cover recorded for the lower area and 38.1% for the upper area; the average canopy cover for the site overall was 37.7% (Table 17). Native cover for the site averaged 3.6% with 4.6% recorded for the lower area and 2.6% recorded for the upper area. Although native vegetation coverage is low, 13 different native species were recorded for the site. Tarweed fiddleneck (*Amsinckia lycopsoides*) was the dominant native species with 2.0% cover in the lower area and 1.0% cover in the upper area.

Cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola kali*) were the dominant invasive species for the site overall with 13.5% and 13.1% average cover, respectively. This was first year monitoring for this site so no additional revegetation efforts are recommended at this time.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded at less than 1% in the lower area, occurring in about 12% of the plot frames there; it was not recorded in the upper area.

Table 17. Percent Canopy Cover and Frequency of Occurrence at the 100-N-83 Site in 2017. (2 Pages)

Species	Lower Area		Upper Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.2	8.0	0.6	4.0	0.4	6.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0	-	-	0.1	2.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	2.0	20.0	1.0	20.0	1.5	20.0
<i>Artemisia tridentata</i> (big sagebrush)	0.6	24.0	0.3	12.0	0.5	18.0
<i>Bromus tectorum</i> ^a (cheatgrass)	12.3	84.0	14.7	88.0	13.5	86.0
<i>Calochortus macrocarpus</i> (sagebrush mariposa lily)	-	-	X	X	X	X
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.8	12.0	-	-	0.4	6.0
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	0.1	4.0	-	-	0.1	2.0
<i>Chorispora tenella</i> ^a (crossflower)	X	X	-	-	X	X
<i>Draba verna</i> ^a (spring draba)	0.4	16.0	0.5	20.0	0.5	18.0
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0	-	-	0.1	2.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X	-	-	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.4	16.0	0.6	4.0	0.5	10.0
<i>Hordeum leporinum</i> ^a (hare barley)	-	-	0.1	4.0	0.1	2.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	4.0	0.1	4.0	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	-	-	0.1	4.0	0.1	2.0
<i>Matricaria recutita</i> ^a (German chamomile)	X	X	X	X	X	X
<i>Melilotus officinalis</i> ^a (sweetclover)	0.1	4.0	X	X	0.1	2.0
<i>Plantago patagonica</i> (woolly plantain)	-	-	0.1	4.0	0.1	2.0
<i>Poa secunda</i> (Sandberg bluegrass)	0.1	4.0	-	-	0.1	2.0
<i>Polygonum convolvulus</i> ^a (black bindweed)	-	-	X	X	X	X
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.4	56.0	0.4	16.0	0.9	36.0

**Table 17. Percent Canopy Cover and Frequency of Occurrence
at the 100-N-83 Site in 2017. (2 Pages)**

Species	Lower Area		Upper Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X	0.1	4.0	0.1	2.0
<i>Salsola kali</i> ^a (Russian thistle)	14.5	100.0	11.6	96.0	13.1	98.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	3.4	76.0	7.9	100.0	5.7	88.0
<i>Triticum sp.</i> ^a (wheat)	0.6	4.0	X	X	0.3	2.0
Crust	0.0	0.0	0.0	0.0	0.0	0.0
Soil	60.2	100.0	58.3	100.0	59.3	100.0
Litter	34.9	100.0	37.7	100.0	36.3	100.0
Total canopy cover (excludes crust/soil/litter)	37.2		38.1		37.7	
Total Native % Cover	4.6		2.6		3.6	
Total Invasive % Cover	32.6		35.5		34.1	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

- = species not observed



Figure 21. The 100-N-83 Site in 2017. Top: Area 1 (lower portion) of the 100-N-83 Site in 2017. Bottom: Area 2 (upper portion) of the 100-N-83 Site in 2017.

3.3.7 100-N Container Transfer Area Site

The 100-N CTA site (Figure 22) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is characterized by loamy sand with varying

amounts of cobbles and boulders. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office and the Washington State Department of Archaeology and Historic Preservation Regarding Removal and Remedial Actions, Demobilization and Area Revegetation for the 100-N Area of the Hanford Site* (DOE-RL et al. 2015), seeds from several native forbs were collected from the Hanford Site and broadcast on the site along with the standard native grass seed mix.

Two 100-m (328-ft) shrub monitoring transects was established and monitored for the site on March 28, 2017; Transect 1 in the lower (south) portion of the site and Transect 2 in the upper (north) portion of the site. Big sagebrush (*Artemisia tridentata*), spiny hopsage (*Grayia spinosa*), and antelope bitterbrush (*Purshia tridentata*) were recorded along both transects. The shrub density for the lower area was 810 plants/ha (328 plants/ac) and 541 plants/ha (219 plants/ac) for the upper area; this equates to a shrub density of 677 plants/ha (274 plants/ac) for the site overall, meeting the success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected on June 8, 2017. Canopy cover was fairly consistent between the two areas (lower and upper) with 17.7% cover recorded for the lower area and 20.6% for the upper area; the average canopy cover for the site overall was 19.2% (Table 18). Native cover for the site averaged 3.2% with 3.7% recorded for the lower area and 2.6% recorded for the upper area. Although native vegetation coverage is low, 10 different native species were recorded for the site. Bluebunch wheatgrass (*Pseudoroegneria spicata*) was the dominant native species with 2.9% cover in the lower area and 1.7% cover in the upper area, equating to an average coverage of 2.3% for the site overall and was recorded in about 82% of the plot frames. Russian thistle (*Salsola kali*) was the dominant invasive species for the site overall with 14.1% average cover. This was first year monitoring for this site so no additional revegetation efforts are recommended at this time.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed in the upper area but did not occur in any of the plot frames.

Table 18. Percent Canopy Cover and Frequency of Occurrence at the 100-N CTA Site in 2017. (2 Pages)

Species	Lower Area		Upper Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	-	-	0.2	8.0	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.2	8.0	-	-	0.1	4.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	-	-	0.1	4.0	0.1	2.0
<i>Artemisia tridentata</i> (big sagebrush)	0.4	16.0	X	X	0.2	8.0
<i>Bromus tectorum</i> ^a (cheatgrass)	-	-	0.1	4.0	0.1	2.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	-	-	X	X	X	X
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X	-	-	X	X

Table 18. Percent Canopy Cover and Frequency of Occurrence at the 100-N CTA Site in 2017. (2 Pages)

Species	Lower Area		Upper Area		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Coreopsis</i> sp. (tickseed)	X	X	-	-	X	X
<i>Hordeum leporinum</i> ^a (hare barley)	1.1	24.0	-	-	0.6	12.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	-	-	X	X	X	X
<i>Matricaria recutita</i> ^a (German chamomile)	X	X	X	X	X	X
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X	X	X	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	0.1	4.0	0.6	24.0	0.4	14.0
<i>Polygonum convolvulus</i> ^a (black bindweed)	X	X	X	X	X	X
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	2.9	96.0	1.7	68.0	2.3	82.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X	-	-	X	X
<i>Salsola kali</i> ^a (Russian thistle)	11.3	100.0	16.9	100.0	14.1	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.6	64.0	0.8	32.0	1.2	48.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.1	4.0	-	-	0.1	2.0
<i>Triticum</i> sp. ^a (wheat)	X	X	0.4	16.0	0.2	8.0
Crust	0.0	0.0	0.0	0.0	0.0	0.0
Soil	60.8	100.0	43.8	100.0	52.3	100.0
Litter	38.2	100.0	55.2	100.0	46.7	100.0
Total canopy cover (excludes crust/soil/litter)	17.7		20.6		19.2	
Total Native % Cover	3.7		2.6		3.2	
Total Invasive % Cover	14.1		18.2		16.2	

^a Invasive species^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

- = species not observed



Figure 22. The 100-N Container Transfer Area Site in 2017. Top: Area 1 (lower portion) of the 100-N CTA Site in 2017. Bottom: Area 2 (upper portion) of the 100-N CTA Site in 2017.

3.4 100-D AREA SITES

Six sites were monitored in the 100-D Area: 100-D-8, 100-D-65/66, 118-D-2, 100-D-30/104, 100-D-100 and 100-D Trailer Village. The 100-D-8 and 100-D-65/66 sites were revegetated in FY 2013, the 118-D-2 site in FY 2014, the 100-D-30/104 site in FY 2015, the 100-D-100 site in FY 2016, and the 100-D Trailer Village site in FY 2017. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE/RL-96-17) and in the Interim Action ROD (EPA 1999).

Revegetation efforts entailed broadcast seeding or hydroseeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) at approximately 15 lbs/ac. Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Areas with steep slopes were seeded by hydroseeding vs. broadcast seeding followed by mulch application. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage (with the exception of site 100-D-100). Sites planted in FY 2016 (100-D-100) received varying planting ratios ranging from 60 to 75% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) of rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

In addition to the standard prescription of broadcast seeding and shrub planting listed above, the 100-D-8 and 100-D-65/66 sites were planted with riparian species due to their location adjacent to the Columbia River. Riparian species planted at the sites included species such as black cottonwood (*Populus balsamifera*), narrowleaf willow (*Salix exigua*), peachleaf willow (*Salix amygdaloides*), redosier dogwood (*Cornus sericea*), chokecherry (*Prunus virginiana*), Woods' rose (*Rosa woodsii*), and golden currant (*Ribes aureum*). Protective wire cages were placed around the riparian plantings shortly after planting to reduce herbivory that was noted within days of planting in FY 2013. Monitoring staff noted during site monitoring in the summer of 2016 that many of the transplanted trees were growing through the protective cages and recommended their removal; removal was conducted for the two sites (100-D-8 and 100-D-65/66) in July 2016. Major damage from herbivory was noted at the site in August 2016. Nearly all of the transplanted black cottonwood trees at the two sites had suffered from beaver damage.

3.4.1 100-D-8 Site (105-DR Process Sewer Outfall)

The 100-D-8 site (Figure 23) was revegetated in FY 2013 and monitoring was first conducted for the site in 2013. This site has an upland portion with predominantly sandy loam with some gravel and an area adjacent to the Columbia River that is predominantly larger cobbles with varying amounts of sand, transitioning to a loamy sand with varying amounts of smaller cobbles and gravel.

This site is located adjacent to the Columbia River, which had higher than normal water levels through most of the 2017 growing season. The established transect is located in the riparian area near the OHWM; trees/shrubs monitored are riparian species including black cottonwood (*Populus balsamifera*), redosier dogwood (*Cornus sericea*), and narrowleaf willow (*Salix*

exigua). Water covered the riparian area and established transect through June 2017. Fifth-year tree/shrub transect monitoring for the site was conducted on July 5, 2017; the results show a shrub density of 714 plants/ha (289 plants/ac), meeting the success criteria of 600 plants/ha (240 plants/ac). This is a survival rate of only 10.5% of what was initially documented in the transect area in 2013. Over half of the remaining transplanted saplings (5 of 9) had significant herbivory (primarily from beaver [*Castor Canadensis*]). This riparian area along the river represents a relatively small portion of the site overall; no monitoring transects were established on the remainder of the site where the standard prescription of big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted. An evaluation of the shrub density in the upland portion of the site may be warranted to better evaluate the level of revegetation success for the site overall.

Canopy cover data for the site was collected on July 5, 2017. Data was collected from 25 plot frames; approximately 15 from the riparian area up to the toe of the slope and 10 from the upland portion of the site. As noted above, the Columbia River covered most of the riparian area of the site throughout the growing season. Canopy cover for the site overall was 29.1%, down from 43.2% in 2016. The site had 12.0% native cover, consistent with native cover in 2016; invasive cover was recorded at 17.1%, a decrease of 13.3% from 2016 (Table 19). Bluebunch wheatgrass (*Pseudoroegneria spicata*) was the most dominant native species for the site with 4.7% canopy cover followed by Sandberg bluegrass (*Poa secunda*) with 2.7%. The most dominant species for the site overall was cheatgrass (*Bromus tectorum*) with 13.0% cover. The 12.0% native cover does not meet the success criteria of 25% native cover within 5 years. Additional revegetation efforts designed to increase shrubs, native grasses, and forbs may need to be considered for this site. Due to water level fluctuations associated with the adjacent Columbia River and herbivory in the area, additional revegetation efforts in the riparian area portion of the site may not be feasible.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site with 1% canopy cover and present in 20% of the plot frames. Field bindweed (*Convolvulus arvensis*), a Washington State Class C noxious weed, was also observed on the site but did not occur in any of the plots.

Table 19. Percent Canopy Cover and Frequency of Occurrence at the 100-D-8 Site in 2017^a. (3 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia biennis</i> (biennial wormwood)	1.6	8.0
<i>Artemisia tridentata</i> (big sagebrush)	1.8	12.0
<i>Bromus tectorum</i> ^b (cheatgrass)	13.0	76.0
<i>Carex sp.</i> (sedge)	X	X
<i>Centaurea diffusa</i> ^c (diffuse knapweed) (B)	1.0	20.0
<i>Convolvulus arvensis</i> ^c (field bindweed) (C)	X	X

**Table 19. Percent Canopy Cover and Frequency of Occurrence
at the 100-D-8 Site in 2017^a. (3 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Coreopsis tinctoria</i> (golden tickseed)	0.1	4.0
<i>Cornus sericea</i> (redosier dogwood)	X	X
<i>Draba verna</i> ^b (spring draba)	0.6	24.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.7	8.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Erodium cicutarium</i> ^b (redstem stork's bill)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> ^b (jagged chickweed)	0.5	20.0
<i>Lactuca serriola</i> ^b (prickly lettuce)	0.2	8.0
<i>Morus alba</i> ^b (white mulberry)	X	X
<i>Phalaris arundinacea</i> ^c (reed canarygrass) (C)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	2.7	48.0
<i>Populus balsamifera</i> (black cottonwood)	X	X
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	4.7	48.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salix exigua</i> (narrowleaf willow)	X	X
<i>Salsola kali</i> ^b (Russian thistle)	1.5	60.0
<i>Sanguisorba minor</i> ^b (small burnet)	X	X
<i>Sisymbrium altissimum</i> ^b (tall tumbled mustard)	0.1	4.0
<i>Tragopogon dubius</i> ^b (yellow salsify)	X	X
<i>Triticum aestivum</i> ^b (common wheat)	0.1	4.0
<i>Ulmus pumila</i> ^b (Siberian elm)	0.1	4.0
<i>Verbascum thapsus</i> ^b (common mullein)	X	X
ARTR recruits ^d	0.2	8.0
Crust	0.0	0.0
Soil	65.8	100.0
Litter	33.2	100.0
Total canopy cover (excludes crust/soil/litter)	29.1	
Total Native % Cover	12.0	
Change in Native % Cover from 2016	-0.8	
Total Invasive % Cover	17.1	
Change in Invasive % Cover from 2016	-13.3	

Table 19. Percent Canopy Cover and Frequency of Occurrence at the 100-D-8 Site in 2017^a. (3 Pages)

Species	% Cover	% Frequency of Occurrence
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^a The lower areas of the site were under water through most of the growing season.

^b Invasive species

^c Washington State Classified Noxious Weed (class)

^d ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 23. The 100-D-8 Site in 2017. Top: 100-D-8 Site Lower Vegetation Area in 2017. Bottom: 100-D-8 Site Upper Vegetation Area in 2017.

3.4.2 100-D-65/66 Outfalls Site

The 100-D-65/66 Outfalls site (Figure 24) was revegetated in FY 2013 and monitoring was first conducted for the site in 2013. The substrate is a loamy sand with cobbles that transitions to predominantly larger cobbles in a riparian area along the Columbia River.

This site is located adjacent to the Columbia River, which had higher than normal water levels through most of the growing season in 2017. The established transect is located in the riparian area near the OHWM; trees/shrubs monitored are riparian species including black cottonwood (*Populus balsamifera*), redosier dogwood (*Cornus sericea*), narrowleaf willow (*Salix exigua*), and peachleaf willow (*Salix amygdaloides*). There are big sagebrush (*Artemisia tridentate*) within the transect zone (5 m [16.4 ft] to either side) but they were not included in the original data collection in 2013; only the riparian species listed above were recorded. Water covered portions of the riparian area and established transect through June 2017. Fifth-year tree/shrub transect monitoring for the site was conducted on July 5, 2017; the results show a shrub density of 161 plants/ha (65 plants/ac), well below the success criteria of 600 plants/ha (240 plants/ac). This is a survival rate of less than 10% of what was initially documented in the transect area in 2013. There has been a steady decrease in the survival rate of 30 to 50% per year over the 5-year monitoring period. The riparian area (where the transect is located) is regularly impacted by water level fluctuations in the adjacent Columbia River, as well as herbivory and Mule deer (*Odocoileus hemionus*) activity.

Canopy cover data for the site was collected on July 5, 2017. Data was collected from 25 plot frames. As noted above, the Columbia River covered most of the riparian area of the site throughout the growing season. Canopy cover for the site overall was 28.2%, down from 45.5% in 2016. The site had 16.5% native cover; native cover for the previous 3 years was around 25% (24.4% to 25%), indicating that the high water levels in 2017 may have contributed to the lower canopy cover recorded for the site this year. Invasive cover was recorded at 11.7%, a decrease of 8.8% from 2016 (Table 20). Bluebunch wheatgrass (*Pseudoroegneria spicata*) was the most dominant native species for the site with 7.0% canopy cover followed by big sagebrush (*Artemisia tridentate*) with 4.0%. The most dominant species for the site overall was cheatgrass (*Bromus tectorum*) with 8.4% cover. The 16.5% native cover reported for 2017 does not meet the success criteria of 25% native cover within 5 years; however, native cover was around 25% for the preceding 3 years indicating that under normal conditions (with normal water levels) the site would likely meet the 25% native cover success criteria. Due to water level fluctuations associated with the adjacent Columbia River, as well as herbivory and other wildlife impacts in the area, additional revegetation efforts in the riparian area portion of the site may not be feasible. An evaluation of the shrub density in the upland portion of the site may be warranted to better evaluate the level of revegetation success for the site overall.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, and field bindweed (*Convolvulus arvensis*), a Washington State Class C noxious weed, were observed on the site but did not occur in any of the plots. Common St. Johnswort (*Hypericum perforatum*) and reed canarygrass (*Phalaris arundinacea*), Washington State Class C noxious weeds, were recorded on the site with 1.2% and less than 1% cover, respectively.

**Table 20. Percent Canopy Cover and Frequency of Occurrence
at the 100-D-65/66 Outfalls Site in 2017^a. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.3	12.0
<i>Artemisia biennis</i> (biennial wormwood)	2.6	24.0
<i>Artemisia tridentata</i> (big sagebrush)	4.0	24.0
<i>Bromus arvensis</i> ^b (field brome)	0.1	4.0
<i>Bromus tectorum</i> ^b (cheatgrass)	8.4	64.0
<i>Centaurea diffusa</i> ^c (diffuse knapweed) (B)	X	X
<i>Convolvulus arvensis</i> ^c (field bindweed) (C)	X	X
<i>Coreopsis tinctoria</i> (golden tickseed)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.1	4.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.7	8.0
<i>Hypericum perforatum</i> ^c (common St. Johnswort) (C)	1.2	8.0
<i>Phalaris arundinacea</i> ^c (reed canarygrass) (C)	0.2	8.0
<i>Plantago lanceolata</i> ^b (narrowleaf plantain)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	0.3	12.0
<i>Populus balsamifera</i> (black cottonwood)	X	X
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	7.0	44.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salix exigua</i> (narrowleaf willow)	X	X
<i>Salsola kali</i> ^b (Russian thistle)	0.3	12.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	1.4	16.0
<i>Tragopogon dubius</i> ^b (yellow salsify)	X	X
<i>Triticum aestivum</i> ^b (common wheat)	X	X
<i>Ulmus pumila</i> ^b (Siberian elm)	1.0	20.0
<i>Verbascum thapsus</i> ^b (common mullein)	0.4	16.0
Crust	0.0	0.0
Soil	42.0	100.0
Litter	57.5	100.0
Total canopy cover (excludes crust/soil/litter)	28.2	
Total Native % Cover	16.5	
Change in Native % Cover from 2016	-8.5	
Total Invasive % Cover	11.7	

Table 20. Percent Canopy Cover and Frequency of Occurrence at the 100-D-65/66 Outfalls Site in 2017^a. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Change in Invasive % Cover from 2016	-8.8	

^a Portions of the site were under water for much of the growing season.

^b Invasive species

^c Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 24. The 100-D-65/66 Outfalls Site in 2017.

3.4.3 118-D-2 Site (100-D Burial Ground No. 2)

The 118-D-2 site (Figure 25) was revegetated in FY 2014 and monitoring was first conducted for the site in 2014. This is a larger site that was divided into three areas (east, southwest, and northwest) for monitoring purposes with 1 established transect in each area and data collected from 25 plot frames in each area. Substrates vary throughout the site with cobbles and varying amounts of sandy loam and loamy sand in the east and southwest areas and predominantly loamy sands in the northwest area.

Three shrub monitoring transects were established for the site in 2014. Fourth-year monitoring of the transects was conducted on June 19, 2017; the results show a shrub density of 86.5 plants/ha (35 plants/ac), well below the success criteria of 600 plants/ha (240 plants/ac). The majority of the transplanted shrubs (over 90%) were lost within the first year.

Canopy cover data for the site was collected on June 19, 2017. Average canopy cover for the site was 47.7% with native cover representing 8.2% and invasive cover representing 39.4%

(Table 21). This represents an increase of 3.8% in native cover from 2016 and a slight increase of 1.6% in invasive cover. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 3.6% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 32.3%. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*) and rush skeletonweed (*Chondrilla juncea*), both Washington State Class B noxious weeds, were recorded on the site at less than 1% and occurring in 1% to 3% of the plot frames.

Table 21. Percent Canopy Cover and Frequency of Occurrence at the 118-D-2 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.4	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.0	1.3
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.6	6.7
<i>Artemisia tridentata</i> (big sagebrush)	1.5	4.0
<i>Bromus tectorum</i> ^a (cheatgrass)	32.3	98.7
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.1	2.7
<i>Chondrilla juncea</i> ^b (rush skeletonweed) (B)	0.2	1.3
<i>Draba verna</i> ^a (spring draba)	1.2	46.7
<i>Elymus elymoides</i> (squirreltail)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erodium cicutarium</i> ^a (redstem stork's bill)	0.0	1.3
<i>Hesperostipa comata</i> (needle and thread grass)	0.0	1.3
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.8	30.7
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	4.0
<i>Lamium amplexicaule</i> ^a (henbit deadnettle)	0.0	1.3
<i>Lepidium perfoliatum</i> ^a (clasping pepperweed)	0.0	1.3
<i>Linum lewisii</i> (prairie flax)	X	X
<i>Melilotus officinalis</i> ^a (sweetclover)	0.1	2.7
<i>Poa secunda</i> (Sandberg bluegrass)	3.6	70.7
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.0	1.3
<i>Salsola kali</i> ^a (Russian thistle)	1.9	69.3
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.7	44.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.9	4.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.0	1.3
<i>Triticum aestivum</i> ^a (common wheat)	X	X

**Table 21. Percent Canopy Cover and Frequency of Occurrence
at the 118-D-2 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Vulpia microstachys</i> (desert fescue)	1.0	32.0
Crust	0.7	21.3
Soil	59.3	100.0
Litter	37.7	100.0
Total canopy cover (excludes crust/soil/litter)	47.7	
Total Native % Cover	8.2	
Change in Native % Cover from 2016	3.8	
Total Invasive % Cover	39.4	
Change in Invasive % Cover from 2016	1.6	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 25. The 118-D-2 Site in 2017. Top: Northwest Portion of 118-D-2 Site in 2017. Bottom: South Portion of the 118-D-2 Site in 2017.

3.4.4 100-D-30/104 Site (183-N Northeastern Backwash Discharge Pond)

The 100-D-30/104 site (Figure 26) was revegetated in FY 2015 and monitoring was first conducted for the site in 2015. This is a larger site that was divided into five areas (northwest-

north, northeast, southwest-south, south central, and southeast) for monitoring purposes with 1 established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly very cobbly loamy sands.

Five shrub monitoring transects were established for the site in 2015. Third-year monitoring for the site was conducted on June 12, 14, and 15, 2017; the results show a shrub density of 828 plants/ha (335 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was nearly 100 % of that observed in 2016.

Canopy cover data for the site was collected on June 14 and 15, 2017. Average canopy cover for the site was 19.0% with native cover representing 9.0% and invasive cover representing 10.0% (Table 22). This represents an increase of 3.3% in native cover from 2016 and a decrease of 3.8% in invasive cover. The dominant native species and dominant species for the site overall was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 3.7% cover followed by Sandberg bluegrass (*Poa secunda*) with 3.0% cover. Cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola kali*) were the dominant invasive species for the site with 3.0% cover each. Considering the shrub survival percentage of nearly 75% for the past 2 years, the lack of substantial cover by invasive species, and the amount of cobble backfill on the site, the 25% native canopy cover success criteria may need to be reconsidered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded on the site at less than 1% and occurring in 4% of the plot frames.

Table 22. Percent Canopy Cover and Frequency of Occurrence at the 100-D-30/104 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.0	0.8
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.9	20.8
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.4	9.6
<i>Bromus tectorum</i> ^a (cheatgrass)	3.0	93.6
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.2	4.0
<i>Draba verna</i> ^a (spring draba)	0.3	11.2
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	3.2
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.3	12.8
<i>Hesperostipa comata</i> (needle and thread grass)	0.2	3.2
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.3	11.2
<i>Hordeum leporinum</i> ^a (hare barley)	0.0	0.8
<i>Koeleria macrantha</i> (prairie Junegrass)	0.1	5.6
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.7	27.2
<i>Lamium amplexicaule</i> ^a (henbit deadnettle)	0.2	9.6

**Table 22. Percent Canopy Cover and Frequency of Occurrence
at the 100-D-30/104 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Leymus cinereus</i> (basin wildrye)	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.8
<i>Malva neglecta</i> ^a (common mallow)	X	X
<i>Melilotus officinalis</i> ^a (sweetclover)	0.7	22.4
<i>Poa secunda</i> (Sandberg bluegrass)	3.0	78.4
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.7	61.6
<i>Salsola kali</i> ^a (Russian thistle)	3.0	92.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.4	47.2
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.0	1.6
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.1	4.0
<i>Triticum aestivum</i> ^a (common wheat)	0.1	4.8
<i>Vulpia microstachys</i> (desert fescue)	0.1	4.0
Crust	0.0	0.0
Soil	58.3	100.0
Litter	39.3	100.0
Total canopy cover (excludes crust/soil/litter)	19.0	
Total Native % Cover	9.0	
Change in Native % Cover from 2016	3.3	
Total Invasive % Cover	10.0	
Change in Invasive % Cover from 2016	-3.8	

^a Invasive species^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 26. The 100-D-30/104 Site in 2017. Top: North Portion of the 100-D-30/104 Site in 2017. Bottom: South Portion of the 100-D-30/104 Site in 2017.

3.4.5 100-D-100 Site (Process Sewer, Unplanned Release 183-DR Railroad Tracks)

The 100-D-100 site (Figure 27) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. This is a larger site that was divided into three areas (north, central, and

south) for monitoring purposes with one established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly very cobbly loamy sands.

Three shrub monitoring transects were established for the site in 2016. Second-year monitoring was conducted on June 20, 2017; the results show a shrub density of 815 plants/ha (330 plants/ac) for the site overall, well above the success criteria of 600 plants/ha (240 plants/ac). Big sagebrush (*Artemisia tridentata*) was the most abundant with a total of 106 live plants recorded for the site followed by antelope bitterbrush (*Purshia tridentata*) with 56 live plants recorded. This is significant in that typically very few antelope bitterbrush survive through the first year after planting. Only one spiny hopsage (*Grayia spinosa*) was recorded along the transects, in the north area. Shrub survival was 97.6 % of that observed in 2016.

Canopy cover data for the site was collected on June 20, 2017. Average canopy cover for the site was 13.1% with native cover representing 5.5% and invasive cover representing 7.6% (Table 23). This represents an increase of less than 1% in native cover and of 1.4% in invasive cover from 2016. The dominant native species were Sandberg bluegrass (*Poa secunda*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and squirreltail (*Elymus elymoides*) with 1.9%, 1.8%, and 1.4% cover, respectively. Russian thistle (*Salsola kali*) and cheatgrass (*Bromus tectorum*) were the dominant invasive species for the site with 3.5% and 2.1% cover, respectively. Considering the high shrub survival percentage of nearly 98% for the first year (which is typically when the most substantial loss occurs), the lack of substantial cover by invasive species, and the amount of cobble backfill on the site, no additional revegetation efforts are suggested at this time.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site but was not recorded in any of the plot frames.

**Table 23. Percent Canopy Cover and Frequency of Occurrence
at the 100-D-100 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.7
<i>Bromus arvensis</i> ^a (field brome)	0.1	4.0
<i>Bromus tectorum</i> ^a (cheatgrass)	2.1	72.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	X	X
<i>Draba verna</i> ^a (spring draba)	0.1	2.7
<i>Elymus elymoides</i> (squirreltail)	1.4	57.3
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	2.7
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	0.0	1.3
<i>Hesperostipa comata</i> (needle and thread grass)	0.0	1.3
<i>Hordeum leporinum</i> ^a (hare barley)	0.2	6.7
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.3	12.0

**Table 23. Percent Canopy Cover and Frequency of Occurrence
at the 100-D-100 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Melilotus officinalis</i> ^a (sweetclover)	0.2	1.3
<i>Poa secunda</i> (Sandberg bluegrass)	1.9	74.7
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.8	52.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salsola kali</i> ^a (Russian thistle)	3.5	93.3
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.1	44.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.0	1.3
<i>Triticum aestivum</i> ^a (common wheat)	0.1	2.7
Crust	0.0	0.0
Soil	69.0	100.0
Litter	29.7	100.0
Total canopy cover (excludes crust/soil/litter)	13.1	
Total Native % Cover	5.5	
Change in Native % Cover from 2016	0.7	
Total Invasive % Cover	7.6	
Change in Invasive % Cover from 2016	1.4	

^a Invasive species^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

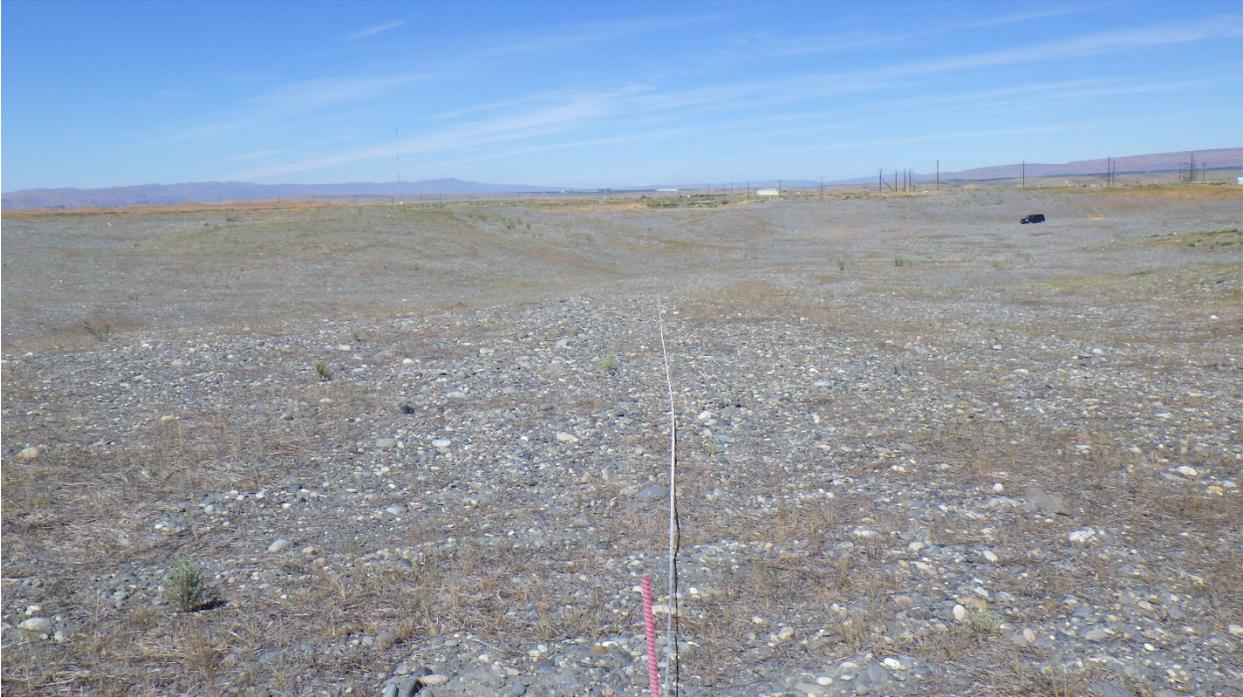


Figure 27. The 100-D-30/104 Site in 2017. Top: North Portion of the 100-D-100 Site in 2017. Bottom: Southeast Portion of the 100-D-100 Site in 2017.

3.4.6 100-D Trailer Village Site

The 100-D Trailer Village site (Figure 28) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is characterized predominantly by loamy sand with some scattered patches of gravel.

A 100-m (328-ft) shrub monitoring transect was established and monitored for the site on March 27, 2017; the results show a shrub density of 815 plants/ha (330 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). Big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were recorded along the transect for a total of 145 shrubs (112 big sagebrush, 32 antelope bitterbrush, and 1 spiny hopsage).

Canopy cover data for the site was collected on June 21, 2017. Total canopy cover for the site was 40.5% with 3.8% native cover and 36.8% invasive cover (Table 24). Indian ricegrass (*Achnatherum hymenoides*) was the most dominant native species with 1.8% and occurrence in 64% of the plot frames. Russian thistle (*Salsola kali*) was the dominant invasive species for the site with 31.8% cover and occurrence in every plot frame. Additional revegetation efforts designed to increase native grasses and forbs may need to be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded on the site with less than 1% cover occurring in 8% of the plot frames.

Table 24. Percent Canopy Cover and Frequency of Occurrence at the 100-D Trailer Village Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.8	64.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.4	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	1.6	12.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.3	8.0
<i>Elymus elymoides</i> (squirreltail)	0.4	12.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	4.0
<i>Matricaria recutita</i> ^a (German chamomile)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	0.4	12.0
<i>Polygonum convolvulus</i> ^a (black bindweed)	X	X
<i>Polypogon monspeliensis</i> ^a (annual rabbitsfoot grass)	0.1	4.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.8	40.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salsola kali</i> ^a (Russian thistle)	31.8	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.9	36.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X

Table 24. Percent Canopy Cover and Frequency of Occurrence at the 100-D Trailer Village Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Triticum sp.</i> ^a (wheat)	X	X
Crust	0.0	0.0
Soil	80.5	100.0
Litter	19.5	100.0
Total canopy cover (excludes crust/soil/litter)	40.5	0.0
Total Native % Cover	3.8	
Total Invasive % Cover	36.8	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 28. The 100-D Trailer Village Site in 2017.

3.5 100-H AREA SITES

Three sites were monitored in the 100-H Area: 128-H-1, 100-H-28:2, and 600-385. The 128-H-1 site was revegetated in FY 2013; the 100-H-28:2 site in FY 2016; and the 600-385 site in FY 2017. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE/RL-96-17) and in the Interim Action ROD

(EPA 1999). Site 600-385 had additional revegetation guidelines as stated in the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office, the Washington Department of Archaeology and Historic Preservation, and the Advisory Council on Historic Preservation Regarding the Remediation of Waste Site 600-385, and Removal of Miscellaneous Restoration Items SG4DH-169 and SG4DH-207 in the 100-D and 100-H Intermediary Area of the Hanford Site, Benton County, Washington (HCR#2011-100-083)* (DOE-RL et al. 2015).

Revegetation efforts entailed broadcast seeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) at approximately 16.8 kg/ha (15 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. Sites planted in FY 2016 (100-H-28:2) received varying planting ratios ranging from 60 to 75% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) of rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

3.5.1 128-H-1 Site Burn Pit

The 128-H-1 site (Figure 29) was revegetated in FY 2013 and monitoring was first conducted for the site in 2013. The substrate for the site is characterized by cobbles with varying amounts of loamy sand through most of the site transitioning to sandy loam with fewer cobbles in the upper (south) portion.

Fifth-year shrub transect monitoring for the site was conducted on June 12, 2017; the results show a shrub density of 899 plants/ha (364 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 100 % of that observed in 2016.

Canopy cover data for the site was collected for the site on June 12, 2017. Data was collected from 25 plot frames. Canopy cover for the site overall was 37.2% with 21.3% native cover and 15.9% invasive cover (Table 25). This represents an increase of 7.1% in native cover and decrease of 16.0% in invasive cover from 2016. The dominant native species was big sagebrush (*Artemisia tridentata*) with 8.3% cover followed by Sandberg bluegrass (*Poa secunda*) with 5.7%. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 11.2% cover.

The 21.3% native cover does not meet the success criteria of 25% native cover within 5 years and the 45.5% shrub survival does not meet the success criteria of 50% for transplanted shrubs after 5 years. A total of 45 transplanted shrubs were recorded along the transect in 2017. It is likely that native canopy cover of 25% or greater will be achieved within the next 1 to 2 years as the big sagebrush continue to mature and native species such as Munro's globemallow (*Sphaeralcea munroana*), rubber rabbitbrush (*Ericameria nauseosa*), and others continue to naturally propagate on the site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded on the site with less than 1% cover, occurring in 8% of the plot frames.

Table 25. Percent Canopy Cover and Frequency of Occurrence at the 128-H-1 Site in 2017.

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	1.4	16.0
<i>Artemisia tridentata</i> (big sagebrush)	8.3	28.0
<i>Bromus tectorum</i> ^a (cheatgrass)	11.2	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.2	8.0
<i>Draba verna</i> ^a (spring draba)	1.0	40.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	1.0	20.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.1	4.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.3	12.0
<i>Lepidium perfoliatum</i> ^a (clasping pepperweed)	0.3	12.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	0.3	12.0
<i>Poa secunda</i> (Sandberg bluegrass)	5.7	72.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.2	8.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> ^a (Russian thistle)	1.8	72.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.8	12.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	2.4	16.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.7	8.0
<i>Vulpia microstachys</i> (desert fescue)	0.4	16.0
ARTR recruits ^c	0.1	4.0
Crust	0.0	0.0
Soil	63.5	100.0
Litter	34.5	100.0
Total canopy cover (excludes crust/soil/litter)	37.2	
Total Native % Cover	21.3	
Change in Native % Cover from 2016	7.1	
Total Invasive % Cover	15.9	
Change in Invasive % Cover from 2016	-16.0	

^a Invasive species^b Washington State Classified Noxious Weed (class)^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 29. The 128-H-1 Burn Pit Site in 2017.

3.5.2 100-H-28:2 Site Process Sewer Area

The 100-H-28:2 site (Figure 30) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. This is a larger site that was divided into two areas (north and south) for monitoring purposes with 1 established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly gravel and cobbles with varying amounts of loamy sand.

Two shrub monitoring transects were established for the site in 2016. Second-year monitoring for the site was conducted on June 12, 2017; the results show a shrub density of 1,000 plants/ha (405 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). Big sagebrush (*Artemisia tridentata*) is the most abundant with a total of 79 live plants recorded for the site followed by antelope bitterbrush (*Purshia tridentata*) with 1 live plant recorded. Shrub survival was 97.6 % of that observed in 2016.

Canopy cover data for the site was collected on June 12, 2017. Average canopy cover for the site was 18.0% with native cover representing 10.5% and invasive cover representing 7.5% (Table 26). This represents an increase of 6.7% in native cover and a decrease of 5.9% in invasive cover from 2016. The dominant native species was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 4.0% cover followed by squirreltail (*Elymus elymoides*) with 3.5% cover. Russian thistle (*Salsola kali*) and cheatgrass (*Bromus tectorum*) were the dominant invasive species for the site with 3.0% and 2.4% cover, respectively. Considering the high shrub survival percentage of nearly 98% for the first year (which is typically when the most substantial

loss occurs), the lack of substantial cover by invasive species, and the amount of cobble backfill on the site, no additional revegetation efforts are suggested at this time.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded on the site with less than 1% cover, occurring in 6% of the plot frames.

**Table 26. Percent Canopy Cover and Frequency of Occurrence
at the 100-H-28:2 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	2.00
<i>Artemisia tridentata</i> (big sagebrush)	0.2	8.0
<i>Agropyron cristatum</i> ^a (crested wheatgrass)	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	2.4	86.0
Bunchgrasses ^c	0.1	2.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.2	6.0
<i>Draba verna</i> ^a (spring draba)	0.2	6.0
<i>Elymus elymoides</i> (squirreltail)	3.5	80.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	2.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.7	18.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.1	2.0
<i>Hordeum leporinum</i> ^a (hare barley)	X	X
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.3	10.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Melilotus officinalis</i> ^a (sweetclover)	0.4	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.7	68.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	4.0	90.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	2.0
<i>Salsola kali</i> ^a (Russian thistle)	3.0	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.2	36.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	2.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.1	4.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
<i>Verbascum thapsus</i> ^a (common mullein)	X	X
Crust	0.0	0.0
Soil	60.7	100.0

**Table 26. Percent Canopy Cover and Frequency of Occurrence
at the 100-H-28:2 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
Litter	39.3	100.0
Total canopy cover (excludes crust/soil/litter)	18.0	
Total Native % Cover	10.5	
Change in Native % Cover from 2016	6.7	
Total Invasive % Cover	7.5	
Change in Invasive % Cover from 2016	-5.9	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c Bunchgrasses include *Sporobolus cryptandrus*, *Pseudoroegneria spicata*, *Koeleria macrantha*, *Achnatherum hymenoides*, *Hesperostipa comata*, and *Elymus elymoides*

X = present but not counted in plot frames



Figure 30. The 100-H-28:2 Site in 2017. Top: North Portion of the 100-H-28:2 Site in 2017. Bottom: South Portion of the 100-H-28:2 Site in 2017.

3.5.3 600-385 Site Dump Site

The 600-385 site (Figure 31) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. The substrate for the site is characterized by loamy sand with varying amounts

of gravel. In keeping with the *Memorandum of Agreement (MOA) Between the U.S. Department of Energy, Richland Operations Office, the Washington Department of Archaeology and Historic Preservation, and the Advisory Council on Historic Preservation Regarding the Remediation of Waste Site 600-385, and Removal of Miscellaneous Restoration Items SG4DH-169 and SG4DH-207 in the 100-D and 100-H Intermediary Area of the Hanford Site, Benton County, Washington (HCR#2011-100-083)* (DOE-RL et al. 2015), seeds from several native forbs were collected from the Hanford Site and broadcast on the site along with the standard native grass seed mix.

One 100-m (328-ft) shrub monitoring transect was established and monitored for the site on March 27, 2017; the results show a density of 729 plants/ha (295 plants/ac). This currently meets the success criteria of 600 plants/ha (240 plants/ac), however, it is extremely low for the first year of monitoring. Big sagebrush (*Artemisia tridentata*) and spiny hopsage (*Grayia spinosa*) were recorded along the transect for a total of 73 shrubs (70 big sagebrush and 3 spiny hopsage).

Canopy cover data for the site was collected on June 12, 2017. Data was collected from 25 plot frames. Canopy cover for the site overall was 48.7% with 7.7% native cover and 41.0% invasive cover (Table 27). The dominant native species was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 5.7% cover. Russian thistle (*Salsola kali*) was the dominant invasive species for the site with 32.5% cover and occurrence in every plot frame. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Rush skeletonweed (*Chondrilla juncea*), a Washington State Class B noxious weed, was recorded at less than 1% cover for the site, occurring in about 8% of the plot frames.

Table 27. Percent Canopy Cover and Frequency of Occurrence at the 600-385 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.1	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.5	20.0
<i>Artemisia tridentata</i> (big sagebrush)	0.3	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	1.0	40.0
<i>Chenopodium album</i> (lambsquarters)	0.1	4.0
<i>Chondrilla juncea</i> ^b (rush skeletonweed) (B)	0.7	8.0
<i>Chorispora tenella</i> ^a (crossflower)	0.1	4.0
<i>Hordeum leporinum</i> ^a (hare barley)	0.4	16.0
<i>Leymus cinereus</i> (basin wildrye)	1.0	40.0
<i>Melilotus officinalis</i> ^a (sweetclover)	0.2	8.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	5.7	88.0
<i>Raphanus raphanistrum</i> ^a (wild radish)	X	X
<i>Salsola kali</i> ^a (Russian thistle)	32.5	100.0

Table 27. Percent Canopy Cover and Frequency of Occurrence at the 600-385 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	6.1	64.0
Crust	0.0	0.0
Soil	51.2	100.0
Litter	39.8	100.0
Total canopy cover (excludes crust/soil/litter)	48.7	
Total Native % Cover	7.7	
Total Invasive % Cover	41.0	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 31. The 600-385 Site in 2017.

3.6 100-F AREA SITES

Four sites were monitored in the 100-F Area: 118-F-6 SSA, 100-F-47, 100-F-48, and 100-F CTA. The 118-F-6 SSA was revegetated in FY 2009; the 100-F-47, 100-F-48, and 100-F CTA sites were revegetated in FY 2012. These sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE/RL-96-17) and

in the Interim Action ROD (EPA 1999). Revegetation efforts entailed broadcast seeding at approximately 16.8 kg/ha (15 lbs/ac) with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. These sites were not initially monitored after planting. Monitoring was first conducted for the sites in 2016, over 7 years after initial planting for the 118-F-6 SSA site and over 4 years after planting for the other three sites (100-F-47, 100-F-48, and 100-F CTA). Monitoring was conducted in 2017 to determine if the sites met the revegetation success criteria of 600 plants/ha (240 plants/ac) for native shrubs and 25% native canopy cover at 5 years after planting.

3.6.1 118-F-6 Soil Staging Area Site

The 118-F-6 SSA site (Figure 32) was revegetated in FY 2009 and monitoring was first conducted for the site in 2016. The substrate for the site is a sandy loam with varying amounts of gravel and cobbles. No shrub transect was established for the site in 2016 due to the scarcity of shrubs observed on the site.

Canopy cover data for the site was collected on June 27, 2017. Data was collected from a total of 15 plot frames. Canopy cover for the site was 18.7% with native cover representing 4.5% and invasive cover representing 14.2% (Table 28). This represents a decrease of 6.3% in native cover and of 14.5% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 4.0% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 5.0% cover. The 4.5% native cover does not meet the success criteria of 25% native cover within 5 years. With less than 20% total canopy cover for the site after 7 years, it is unlikely that 25% native canopy cover is an achievable goal for this site due to the makeup of the substrate or other unknown factors; however, additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site but was not recorded in any of the plot frames.

Table 28. Percent Canopy Cover and Frequency of Occurrence at the 118-F-6 Soil Staging Area Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	5.0	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	X	X
<i>Draba verna</i> ^a (spring draba)	1.2	46.7
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.2	6.7

**Table 28. Percent Canopy Cover and Frequency of Occurrence
at the 118-F-6 Soil Staging Area Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	3.0	86.7
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	1.3	20.0
<i>Poa secunda</i> (Sandberg bluegrass)	4.0	93.3
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	X	X
<i>Salsola kali</i> ^a (Russian thistle)	2.5	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.2	46.7
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.2	6.7
<i>Vulpia microstachys</i> (desert fescue)	0.2	6.7
Crust	4.2	66.7
Soil	86.3	100.0
Litter	13.7	100.0
Total canopy cover (excludes crust/soil/litter)	18.7	
Total Native % Cover	4.5	
Change in Native % Cover from 2016	-6.3	
Total Invasive % Cover	14.2	
Change in Invasive % Cover from 2016	-14.5	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 32. The 118-F-6 Soil Staging Area Site in 2017.

3.6.2 100-F-47 Site (151-F Substation)

The 100-F-47 site (Figure 33) was revegetated in FY 2012 and monitoring was first conducted for the site in 2016. The substrate for the site is primarily gravel and cobble backfill with varying amounts of loamy sand.

A shrub monitoring transect was established for the site in 2016 and was monitored on June 27, 2017; the results show a shrub density of 979 plants/ha (396 plants/ac), well above the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 97.0 % of that observed in 2016.

Canopy cover data for the site was collected on June 27, 2017. Data was collected from a total of 25 plot frames. Canopy cover for the site was 22.9% with native cover representing 10.8% and invasive cover representing 12.1% (Table 29). This represents a decrease of 2.0 % in native cover and of 42.7% in invasive cover from 2016. The dominant native species was bluebunch wheatgrass (*Pseudoroegneria spicata*) with 3.5% cover followed by Sandberg bluegrass (*Poa secunda*) and rubber rabbitbrush (*Ericameria nauseosa*) with 2.4% cover each. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 6.8% cover. The 10.8% native cover does not meet the success criteria of 25% native cover within 5 years. With less than 25% total canopy cover for the site after 5 years, it is unlikely that 25% native canopy cover is an achievable goal for this site due to the makeup of the substrate or other unknown factors; however, additional revegetation efforts designed to increase native grasses and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site with 1.5% cover and occurrence in 20% of the plot frames.

**Table 29. Percent Canopy Cover and Frequency of Occurrence
at the 100-F-47 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	2.1	20.0
<i>Bromus tectorum</i> ^a (cheatgrass)	6.8	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	1.5	48.0
<i>Descurcania pinnata</i> (western tansymustard)	X	X
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.1	4.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	2.4	20.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.1	4.0
<i>Holodiscus discolor</i> (oceanspray)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.4	12.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.6	20.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	0.3	16.0
<i>Poa secunda</i> (Sandberg bluegrass)	2.4	88.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.5	60.0
<i>Salsola kali</i> ^a (Russian thistle)	2.1	84.0
<i>Sanguisorba minor</i> ^a (small burnet)	X	X
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.4	12.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Triticum aestivum</i> ^a (common wheat)	0.1	4.0
ARTR recruits ^c	X	X
Crust	0.0	4.0
Soil	68.1	100.0
Litter	31.9	100.0
Total canopy cover (excludes crust/soil/litter)	22.9	
Total Native % Cover	10.8	
Change in Native % Cover from 2016	-2.0	
Total Invasive % Cover	12.1	
Change in Invasive % Cover from 2016	-42.7	

Table 29. Percent Canopy Cover and Frequency of Occurrence at the 100-F-47 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
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^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 33. The 100-F-47 Site in 2017.

3.6.3 100-F-48 Site (184-F Coal Pit Debris Dump Site)

The 100-F-48 site (Figure 34) was revegetated in FY 2012 and monitoring was first conducted for the site in 2016. The substrate for the site is primarily loamy sand with varying amounts of gravel and cobbles.

A shrub monitoring transect was established for the site in 2016 and was monitored on June 21, 2017; the results show a shrub density of 479 plants/ha (194 plants/ac), well below the success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 100% of that observed in 2016.

Canopy cover data for the site was collected on June 21, 2017. Data was collected from a total of 25 plot frames. Canopy cover for the site was 36.3% with native cover representing 13.3% and invasive cover representing 23.0% (Table 30). This represents an increase of 9.1% in native cover and decrease of 26.7% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 7.0% cover followed by big sagebrush (*Artemisia tridentata*) with 4.0% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species

with 15.6% cover. The 13.3% native cover does not meet the success criteria of 25% native cover within 5 years. Additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*) and broadleaved pepperweed (*Lepidium latifolium*), Washington State Class B noxious weeds, were present on the site. Diffuse knapweed had 1.3% cover and occurrence in 24% of the plot frames; broadleaved pepperweed was observed at one location on the site but was not recorded in any of the plot frames.

Table 30. Percent Canopy Cover and Frequency of Occurrence at the 100-F-48 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.0	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.3	8.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	4.0	20.0
<i>Bromus tectorum</i> ^a (cheatgrass)	15.6	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	1.3	24.0
<i>Descurcania pinnata</i> (western tansymustard)	0.8	4.0
<i>Draba verna</i> ^a (spring draba)	0.4	20.0
<i>Elymus elymoides</i> (squirreltail)	X	X
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erodium cicutarium</i> ^a (redstem stork's bill)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.0	4.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.9	36.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	X	X
<i>Lepidium latifolium</i> ^a (broadleaved pepperweed)	X	X
<i>Lepidium perfoliatum</i> ^a (clasping pepperweed)	X	X
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	7.0	76.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	1.1	16.0
<i>Salsola kali</i> ^a (Russian thistle)	2.1	88.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.8	12.0
<i>Vulpia microstachys</i> (desert fescue)	0.0	4.0
ARTR recruits ^c	X	X
Crust	2.9	44.0
Soil	59.3	100.0

Table 30. Percent Canopy Cover and Frequency of Occurrence at the 100-F-48 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Litter	38.3	100.0
Total canopy cover (excludes crust/soil/litter)	36.3	
Total Native % Cover	13.3	
Change in Native % Cover from 2016	9.1	
Total Invasive % Cover	23.0	
Change in Invasive % Cover from 2016	-26.7	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 34. The 100-F-48 Site in 2017.

3.6.4 100-F Site Container Transfer Area Site

The 100-F CTA site (Figure 35) was revegetated in FY 2012 and monitoring was first conducted for the site in 2016. The substrate for the site is primarily gravel and cobble backfill with varying amounts of loamy sand.

A shrub monitoring transect was established for the site in 2016 and was monitored on June 27, 2017; the results show a shrub density of 640 plants/ha (259 plants/ac), meeting the

success criteria of 600 plants/ha (240 plants/ac). Shrub survival was 98.5 % of that observed in 2016.

Canopy cover data for the site was collected on June 27, 2017. Data was collected from a total of 25 plot frames. Canopy cover for the site was 21.9% with native cover representing 9.6% and invasive cover representing 12.3% (Table 31). This represents a decrease of 1.1% in native cover and of 23.1% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 6.1% cover. Cheatgrass (*Bromus tectorum*) was the dominant invasive species with 6.8% cover. The 9.6% native cover does not meet the success criteria of 25% native cover within 5 years. With less than 25% total canopy cover for the site after 5 years, it is unlikely that 25% native canopy cover is an achievable goal for this site due to the makeup of the substrate or other unknown factors; however, additional revegetation efforts designed to increase native grasses and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was present on the site with less than 1% cover and occurrence in 4% of the plot frames.

Table 31. Percent Canopy Cover and Frequency of Occurrence at the 100 F CTA Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	1.5	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	6.8	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.1	4.0
<i>Draba verna</i> ^a (spring draba)	0.3	8.0
<i>Elymus elymoides</i> (squirreltail)	0.3	8.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.8	8.0
<i>Grayia spinosa</i> (spiny hopsage)	0.9	8.0
<i>Hesperostipa comata</i> (needle and thread grass)	0.0	4.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.8	28.0
<i>Lepidium perfoliatum</i> ^a (clasping pepperweed)	0.1	4.0
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	6.1	92.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.0	4.0
<i>Salsola kali</i> ^a (Russian thistle)	3.8	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.5	20.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.1	4.0
Crust	2.9	32.0

Table 31. Percent Canopy Cover and Frequency of Occurrence at the 100 F CTA Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
Soil	74.8	100.0
Litter	24.0	100.0
Total canopy cover (excludes crust/soil/litter)	21.9	
Total Native % Cover	9.6	
Change in Native % Cover from 2016	-1.1	
Total Invasive % Cover	12.3	
Change in Invasive % Cover from 2016	-23.1	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 35. The 100-F CTA Site in 2017

3.7 100-IU-2 AND 100-IU-6 AREA SITES

Six sites were monitored in the 100-IU-2/100-IU-6 Area: 600-301, 600-369:3, 600-370, 600-356, 600-379, and 600-358. The 600-301, 600-369:3, and 600-370 sites were revegetated in FY 2014; the 600-356 and 600-379 sites in FY 2015; and the 600-358 site in FY 2016. These

sites were remediated to meet the objectives for interim closure as established in the 100 Area RDR/RAWP (DOE/RL-96-17) and in the Interim Action ROD (EPA 1999).

Revegetation efforts entailed broadcast seeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) at approximately 16.8 kg/ha (15 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,235 to 1,600 plants/ha (500 to 650 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage. Site 600-358 had a varied ratio of transplanted shrubs with 60 to 70% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*). Sites planted in FY 2016 (600-358) received varying planting ratios ranging from 60 to 75% big sagebrush, 5 to 15% antelope bitterbrush, 10 to 30% spiny hopsage, and approximately 1% (cumulatively) of rubber rabbitbrush (*Ericameria nauseosa*) and yellow rabbitbrush (*Chrysothamnus viscidiflorus*).

3.7.1 600-301 Site (White Bluffs Sanitary Sewer Pipelines)

The 600-301 site (Figure 36) was revegetated in FY 2014 and monitoring was first conducted for the site in 2014. The substrate for the site is characterized by sand and loamy sand with a small amount of intermixed cobbles.

Fourth-year shrub transect monitoring for the site was conducted on May 31, 2017; the results show a shrub density of only 49 plants/ha (20 plants/ac), well below the success criteria of 600 plants/ha (240 plants/ac). Over 97% of the transplanted shrubs were lost within the first year (2014 to 2015) when only 1 of 103 recorded big sagebrush and 3 of 45 recorded spiny hopsage remained.

Canopy cover data for the site was collected on May 31, 2017. Data was collected from 25 plot frames. Canopy cover for the site was 53.2% with 9.0% native cover and 44.2% invasive cover (Table 32). This represents a slight increase of 1.2% in native cover and increase of 13.4% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 5.2% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 23.0% cover. Though this site is still within the 5-year window for successful establishment of 25% native cover, it is obvious that criteria will not be met within the next year and additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site but was not recorded in any of the plot frames.

**Table 32. Percent Canopy Cover and Frequency of Occurrence
at the 600-301 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.6	4.0
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.9	16.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	38.6	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	0.7	8.0
<i>Draba verna</i> ^a (spring draba)	0.5	20.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.3	12.0
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.2	8.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	1.3	52.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	4.0
<i>Lepidium perfoliatum</i> ^a (clasping pepperweed)	0.1	4.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Plantago patagonica</i> (woolly plantain)	0.7	8.0
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	5.2	72.0
<i>Salsola kali</i> ^a (Russian thistle)	1.7	68.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.9	56.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	X	X
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.2	8.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
ARTR recruits ^c	X	X
Crust	1.0	20.0
Soil	51.1	100.0
Litter	45.0	100.0
Total canopy cover (excludes crust/soil/litter)	53.2	
Total Native % Cover	9.0	
Change in Native % Cover from 2016	1.7	
Total Invasive % Cover	44.2	
Change in Invasive % Cover from 2016	13.4	

Table 32. Percent Canopy Cover and Frequency of Occurrence at the 600-301 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.6	4.0

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 36. The 600-301 Site in 2017.

3.7.2 600-369:3 Site (Dump Area)

The 600-369:3 site (Figure 37) was revegetated in FY 2014 and monitoring was first conducted for the site in 2014. The substrate for the site is characterized by an inner area of predominantly cobbles with varied amounts of loamy sand and an outer area of predominantly sandy loam with few cobbles.

Fourth-year shrub transect monitoring for the site was conducted on June 1, 2017; the results show a shrub density of 689 plants/ha (279 plants/ac), meeting the success criteria of 600 plants/ha (240 plants/ac). Nearly half (45%) of the shrubs were lost in the first year but the site appears to have stabilized since that time, current shrub survival was 100 % of that observed in 2016.

Canopy cover data for the site was collected on June 1, 2017. Data was collected from 15 plot frames in the inner area and 15 plot frames in the outer area. Average canopy cover for the site overall was 39.9% with 5.6% native cover and 34.3% invasive cover (Table 33). This represents

an increase of 2.2% in native cover and of 5.8% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 3.6% cover and occurrence in 100% of the inner area plots and 86.7% of the outer area plots. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 23.0% cover; it occurred in all of the plot frames but had substantially higher cover in the outer area than in the inner (46.2% cover in outer vs. 8.3% cover in the inner). Though this site is still within the 5-year window for successful establishment of 25% native cover, it appears that criteria will not be met within the next year and additional revegetation efforts designed to increase native grasses and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*) and rush skeletonweed (*Chondrilla juncea*), Washington State Class B noxious weeds, were observed on the inner area site but was not recorded in any of the plot frames.

Table 33. Percent Canopy Cover and Frequency of Occurrence at the 600-369:3 Site in 2017. (2 Pages)

Species	Area 1 (Inner)		Area 2 (Outer)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X	-	-	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	X	X	-	-	X	X
<i>Artemisia tridentata</i> (big sagebrush)	2.0	13.3	1.0	6.7	1.5	10.0
<i>Bromus tectorum</i> ^a (cheatgrass)	8.3	100.0	46.2	100.0	27.3	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	X	X	-	-	X	X
<i>Chaenactis douglasii</i> (Douglas' dustymaiden)	X	X	-	-	X	X
<i>Chondrilla juncea</i> ^b (rush skeletonweed) (B)	X	X	-	-	X	X
<i>Draba verna</i> ^a (spring draba)	0.5	20.0	1.7	66.7	1.1	43.3
<i>Elymus elymoides</i> (squirreltail)	0.2	6.7	0.2	6.7	0.2	6.7
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X	X	X	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	0.2	6.7	-	-	0.1	3.3
<i>Hesperostipa comata</i> (needle and thread grass)	0.3	13.3	-	-	0.2	6.7
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	1.7	66.7	4.2	100.0	2.9	83.3
<i>Lycium barbarum</i> ^a (matrimony vine)	-	-	X	X	0.0	0.0
<i>Poa secunda</i> (Sandberg bluegrass)	4.2	100.0	3.0	86.7	3.6	93.3
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.2	6.7	-	-	0.1	3.3
<i>Salsola kali</i> ^a (Russian thistle)	2.2	86.7	2.0	80.0	2.1	83.3
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X	2.0	80.0	1.0	40.0

Table 33. Percent Canopy Cover and Frequency of Occurrence at the 600-369:3 Site in 2017. (2 Pages)

Species	Area 1 (Inner)		Area 2 (Outer)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Crust	0.0	0.0	0.0	0.0	0.0	0.0
Soil	81.5	100.0	57.2	100.0	69.3	100.0
Litter	17.0	100.0	39.5	100.0	28.3	100.0
Total canopy cover (excludes crust/soil/litter)	19.7		60.2		39.9	
Total Native % Cover	7.0		4.2		5.6	-
Change in Native % Cover from 2016	1.8		2.5		2.2	
Total Invasive % Cover	12.7		56.0		34.3	
Change in Invasive % Cover from 2016	3.4		8.3		5.8	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames

-- = species not observed on site



Figure 37. The 600-369:3 Site in 2017.

3.7.3 600-370 Site (Dump Area)

The 600-370 site (Figure 38) was revegetated in FY 2014 and monitoring was first conducted for the site in 2014. The substrate for the site is characterized by sand with varied amounts of cobbles and small boulders.

Fourth-year shrub transect monitoring for the site was conducted on May 1, 2017; the results show a shrub density of 680 plants/ha (275 plants/ac), meeting the success criteria of 600 plants/ha (240 plants/ac). Over half (55%) of the shrubs were lost in the first year but the site appears to have stabilized since that time, current shrub survival was 95.8 % of that observed in 2016.

Canopy cover data for the site was collected on April 27, 2017. Data was collected from 25 plot frames. Canopy cover for the site was 38.8% with 5.6% native cover and 33.2% invasive cover (Table 34). This represents an increase of 3.5% in native cover and 9.4% in invasive cover from 2016. The dominant native species was big sagebrush (*Artemisia tridentata*) with 3.2% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 23.0% cover. Though this site is still within the 5-year window for successful establishment of 25% native cover, it is unlikely that criteria will be met within the next year and additional revegetation efforts designed to increase native grasses and forbs should be considered for this site. In addition, due to the sand-dominated substrate and amount of cobbles and boulders on the site, the 25% native cover criteria may not be an achievable goal for this site.

No listed Washington State Class B noxious weeds were observed on the site.

Table 34. Percent Canopy Cover and Frequency of Occurrence at the 600-370 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Aliciella leptomeria</i> (sand gilia)	X	X
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.3	12.0
<i>Artemisia tridentata</i> (big sagebrush)	3.2	28.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Brassica sp</i> ^a (mustard)	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	23.0	96.0
<i>Chorispora tenella</i> ^a (crossflower)	X	X
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Cryptantha circumscissa</i> (cushion cryptantha)	0.1	4.0
<i>Draba verna</i> ^a (spring draba)	1.6	64.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.1	4.0
<i>Eriogonum niveum</i> (snow buckwheat)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	4.6	88.0
<i>Lamium amplexicaule</i> ^a (henbit deadnettle)	0.1	4.0

Table 34. Percent Canopy Cover and Frequency of Occurrence at the 600-370 Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	1.7	28.0
<i>Psoraleidium lanceolatum</i> (lemon scurfpea)	0.2	8.0
<i>Salsola kali</i> ^a (Russian thistle)	2.2	68.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.6	64.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
ARTR recruits ^b	X	X
Crust	0.0	0.0
Soil	68.0	100.0
Litter	15.1	100.0
Total canopy cover (excludes crust/soil/litter)	38.8	
Total Native % Cover	5.6	
Change in Native % Cover from 2016	3.5	
Total Invasive % Cover	33.2	
Change in Invasive % Cover from 2016	9.4	

^a Invasive species

^b ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 38. The 600-370 Site in 2017.**3.7.4 600-356 Site (Dump Area)**

The 600-356 site (Figure 39) was revegetated in FY 2015 and monitoring was first conducted for the site in 2014. The substrate for the site is predominantly cobbly sandy loam.

Third-year shrub transect monitoring for the site was conducted on May 17, 2017; no transplanted shrubs were observed along the transect, consistent with the transect data recorded for 2016. A total of 78 transplanted shrubs (68 big sagebrush [*Artemisia tridentata*], 8 antelope bitterbrush [*Purshia tridentata*], and 2 spiny hopsage [*Grayia spinosa*]) were documented along the transect when it was first installed in 2015; no live shrubs have been documented in the transect area since then.

Canopy cover data for the site was collected on May 17, 2017. Data was collected from 25 plot frames. Canopy cover for the site was 50.0% with 7.4% native cover and 42.6% invasive cover (Table 35). This represents an increase of 2.6% in native cover and increase of 18.0% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 3.2% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 34.8% cover. Though this site is only in its third year of monitoring, the successful establishment of 25% native cover is unlikely within the next 2 years and additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was observed on the site but was not recorded in any of the plot frames.

**Table 35. Percent Canopy Cover and Frequency of Occurrence
at the 600-356 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.3	32.0
<i>Allium ascalonicum</i> ^a (wild onion)	0.1	4.0
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0
<i>Balsamorhiza careyana</i> (Carey's balsamroot)	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	34.8	96.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	X	X
<i>Descurcania pinnata</i> (western tansymustard)	1.5	4.0
<i>Draba verna</i> ^a (spring draba)	1.8	72.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	8.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	0.3	12.0
<i>Erigeron pumilus</i> (shaggy fleabane)	0.1	4.0
<i>Erodium cicutarium</i> ^a (redstem stork's bill)	1.3	32.0

**Table 35. Percent Canopy Cover and Frequency of Occurrence
at the 600-356 Site in 2017. (2 Pages)**

Species	% Cover	% Frequency of Occurrence
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.3	12.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	1.0	40.0
<i>Hordeum leporinum</i> ^a (hare barley)	0.1	4.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.3	12.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Poa bulbosa</i> ^a (bulbous bluegrass)	0.3	12.0
<i>Poa secunda</i> (Sandberg bluegrass)	3.2	68.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.3	12.0
<i>Salsola kali</i> ^a (Russian thistle)	1.6	64.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.3	52.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
Crust	0.1	4.0
Soil	51.7	100.0
Litter	40.8	100.0
Total canopy cover (excludes crust/soil/litter)	50.0	
Total Native % Cover	7.4	
Change in Native % Cover from 2016	2.6	
Total Invasive % Cover	42.6	
Change in Invasive % Cover from 2016	18.0	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

X = present but not counted in plot frames



Figure 39. The 600-356 Site in 2017.

3.7.5 600-379 Site (Burn Area)

The 600-379 site (Figure 40) was revegetated in FY 2015 and monitoring was first conducted for the site in 2015. The substrate for the site is predominantly sandy loam with varying amounts of small cobbles.

No shrub transect has been established for the site due to its small size.

Canopy cover data for the site was collected on May 17, 2017. Data was collected from 13 plot frames. Canopy cover for the site was 85.2% with 2.1% native cover and 83.1% invasive cover (Table 36). This represents a slight increase of 0.2% in native cover and an increase of 6.4% in invasive cover from 2016. The dominant native species was Sandberg bluegrass (*Poa secunda*) with 1.0% cover. Cheatgrass (*Bromus tectorum*) was the dominant species for the site overall with 64.4% cover. Though this site is only in its third year of monitoring, the successful establishment of 25% native cover is unlikely within the next 2 years and additional revegetation efforts designed to increase native shrubs, grasses, and forbs should be considered for this site.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded with 1.3% cover for the site and occurrence in 15.4% of the plot frames.

Table 36. Percent Canopy Cover and Frequency of Occurrence at the 600-379 Site in 2017.

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	X	X
<i>Bromus tectorum</i> ^a (cheatgrass)	64.4	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	1.3	15.4
<i>Chrysothamnus viscidiflorus</i> (yellow rabbitbrush)	X	X
<i>Cryptantha circumscissa</i> (cushion cryptantha)	0.2	7.7
<i>Draba verna</i> ^a (spring draba)	3.1	84.6
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	7.7
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Erysimum asperum</i> (western wallflower)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	8.7	84.6
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.4	15.4
<i>Phlox longifolia</i> (longleaf phlox)	0.4	15.4
<i>Poa secunda</i> (Sandberg bluegrass)	1.0	38.5
<i>Salsola kali</i> ^a (Russian thistle)	5.6	69.2
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	X	X
ARTR recruits ^c	X	X
Crust	0.0	0.0
Soil	27.3	100.0
Litter	49.0	100.0
Total canopy cover (excludes crust/soil/litter)	85.2	
Total Native % Cover	2.1	
Change in Native % Cover from 2016	0.2	
Total Invasive % Cover	83.1	
Change in Invasive % Cover from 2016	6.4	

^a Invasive species^b Washington State Classified Noxious Weed (class)^c ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 40. The 600-379 Site in 2017.

3.7.6 600-358 Site (Gable Mountain Fringe Dump Area)

The 600-358 site (Figure 41) was revegetated in FY 2016 and monitoring was first conducted for the site in 2016. The substrate for the site is characterized by loamy sand with some gravel through the revegetated roadway and predominantly gravel with varying amounts of loamy sand in the dump area at the north end of the roadway. In addition to the standard native grass seed mix that was broadcast over the site, seeds from several native forbs were collected from the Hanford Site and hand seeded on the site. This site is surrounded by mature native vegetation that should promote natural recovery of the site.

A 100-m (328-ft) shrub monitoring transect was established along the roadway portion of the site in 2016 and second-year shrub transect monitoring for the site was conducted on June 1, 2017; the results show a shrub density of 534 plants/ha (216 plants/ac), below the success criteria of 600 plants/ha (240 plants/ac). Over half of the shrubs recorded initially in the transect area were lost in this first year.

Canopy cover data for the site was collected for the site on June 1, 2017. Data was collected from 25 plot frames. Canopy cover for the site overall was 25.5% with 12.7% native cover and 12.8% invasive cover (Table 37). The dominant native species was squirreltail (*Elymus elymoides*) with 4.2% followed by bluebunch wheatgrass (*Pseudoroegneria spicata*) and Sandberg bluegrass (*Poa secunda*) with 3.7 % and 3.1%, respectively. Cheatgrass (*Bromus tectorum*) was the dominant invasive species for the site with 8.6% cover. Additional revegetation efforts designed to increase native shrubs should be considered for this site.

No listed Washington State Class B noxious weeds were observed on the site.

Table 37. Percent Canopy Cover and Frequency of Occurrence at the 600-358 Site in 2017.

Species	% Cover	% Frequency of Occurrence
<i>Achillea millefolium</i> (common yarrow)	0.2	8.0
<i>Artemisia tridentata</i> (big sagebrush)	0.3	12.0
<i>Bromus tectorum</i> ^a (cheatgrass)	8.6	92.0
<i>Cryptantha circumscissa</i> (cushion cryptantha)	0.1	4.0
<i>Draba verna</i> ^a (spring draba)	1.0	40.0
<i>Elymus elymoides</i> (squirreltail)	4.2	72.0
<i>Eriogonum vimineum</i> (wickerstem buckwheat)	X	X
<i>Grayia spinosa</i> (spiny hopsage)	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	0.6	24.0
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.4	16.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.4	16.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	0.1	4.0
<i>Microsteris gracilis</i> (slender phlox)	0.1	4.0
<i>Poa secunda</i> (Sandberg bluegrass)	3.1	64.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	3.7	88.0
<i>Purshia tridentata</i> (antelope bitterbrush)	0.1	4.0
<i>Salsola kali</i> ^a (Russian thistle)	2.1	84.0
<i>Sisymbrium altissimum</i> ^a (tall tumblemustard)	0.3	12.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	X	X
<i>Vicia</i> sp. (vetch)	X	X
<i>Vulpia microstachys</i> (desert fescue)	0.1	4.0
ARTR recruits ^b	0.1	4.0
Crust	0.0	0.0
Soil	21.0	100.0
Litter	74.0	100.0
Total canopy cover (excludes crust/soil/litter)	25.5	
Total Native % Cover	12.7	
Change in Native % Cover from 2016	10.0	
Total Invasive % Cover	12.8	
Change in Invasive % Cover from 2016	7.7	

^a Invasive species^b ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 41. The 600-358 Site in 2017. Top: Roadway Portion of the 600-358 Site in 2017. Bottom: Dump Area Portion of the 600-358 Site in 2017.

3.8 300 AREA SITES

The 300-288:2 site was the only 300 Area site monitored. The site was remediated to meet the objectives for interim closure as established in the 300 Area RDR/RAWP (DOE/RL-2001-47, Rev. 3 and DOE/RL-2014-13-ADD1) and in the Interim Action ROD (EPA 1999).

Revegetation efforts entailed broadcast seeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), bluebunch wheatgrass (*Pseudoroegneria spicata*), squirreltail (*Elymus elymoides*), needle-and-thread grass (*Hesperostipa comata*), and prairie Junegrass (*Koeleria macrantha*) at approximately 20.2 kg/ha (18 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the site at approximately 1,730 plants/ha (700 plants/ac) with a mix of approximately 75% sagebrush, 15% bitterbrush, and 10% spiny hopsage.

3.8.1 300-288:2 Container Transfer Area Site

The 300-288:2 CTA site (Figure 42) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. This is a larger site that was divided into two areas (east and west) for monitoring purposes with 1 established transect in each area and data collected from 25 plot frames in each area. Substrates at the site are predominantly sandy loam with varying amounts of cobbles.

Two 100-m (328-ft) shrub monitoring transects with 5-m (16.4-ft) offsets to each side were established for the site in 2017, one in the west portion of the site and another in the east. First-year monitoring of the transect area was conducted on March 28, 2017. A total of 142 shrubs were recorded along the west transect and 140 shrubs along the east transect. Big sagebrush (*Artemisia tridentata*) was the most abundant with 127 plants along the west transect and 132 plants along the east transect. Spiny hopsage (*Grayia spinosa*) were recorded along both transects with 10 recorded for the west transect and 8 recorded for the east transect; antelope bitterbrush (*Purshia tridentate*) were also recorded along the west transect with 5 plants noted. This equates to shrub density of 1,411 plants/ha (571 plants/ac) for the site overall, well above the success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected on June 29, 2017. Average canopy cover for the site was 17.6% with native cover representing 4.5% and invasive cover representing 13.1% (Table 38). Native bunchgrasses (*Pseudoroegneria spicata*, *Achnatherum hymenoides*, *Elymus elymoides*, *Poa secunda*, *Sporobolus cryptandrus*, and *Hesperostipa comata*) accounted for 3.0% of the native cover. Russian thistle (*Salsola kali*) was the dominant invasive species for the site with 10.4% cover. Cheatgrass (*Bromus tectorum*) was noticeably scarce on the site with less than 1% cover recorded for the east portion of the site and none recorded for the west portion.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, and Canada thistle (*Cirsium arvense*), a Washington State Class C noxious weed, were recorded on the site. Diffuse knapweed was observed in the plot frames and had less than 1% cover and occurrence in 2% of the plot frames; the Canada thistle was observed on the site but was not recorded in any of the plot frames.

**Table 38. Percent Canopy Cover and Frequency of Occurrence
at the 300-288:2 CTA Site in 2017. (2 Pages)**

Species	Area 1 (east)		Area 2 (west)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.1	4.0	X	X	0.1	2.0
<i>Ambrosia acanthicarpa</i> (flatspine bur ragweed)	X	X	-	-	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.1	4.0	0.3	12.0	0.2	8.0
<i>Bromus tectorum</i> ^a (cheatgrass)	0.7	28.0	-	-	0.4	14.0
<i>Bunchgrasses</i> ^c	3.0	100.0	3.0	100.0	3.0	100.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.1	4.0	-	-	0.1	2.0
<i>Chenopodium album</i> (lambsquarters)	0.1	4.0	0.1	4.0	0.1	4.0
<i>Cirsium arvense</i> ^b (Canada thistle)(C)	X	X	X	X	X	X
<i>Descurcania pinnata</i> (western tansymustard)	X	X	-	-	X	X
<i>Elymus elymoides</i> (squirreltail)	0.2	8.0	X	X	0.1	4.0
<i>Grayia spinosa</i> (spiny hopsage)	0.1	4.0	X	X	0.1	2.0
<i>Helianthella uniflora</i> (oneflower helianthella)	X	X	X	X	X	X
<i>Hesperostipa comata</i> (needle and thread grass)	-	-	0.1	4.0	0.1	2.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.2	8.0	0.2	8.0	0.2	8.0
<i>Lepidium perfoliatum</i> ^a (clasping pepperweed)	0.1	4.0	-	-	0.1	2.0
<i>Medicago sativa</i> ^a (alfalfa)	-	-	X	X	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	0.4	16.0	0.8	32.0	0.6	24.0
<i>Polygonum aviculare</i> ^a (prostrate knotweed)	0.2	8.0	-	-	0.1	4.0
<i>Polygonum convolvulus</i> ^a (black bindweed)	-	-	X	X	X	X
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.2	8.0	0.1	4.0	0.2	6.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X	0.1	4.0	0.1	2.0
<i>Raphanus raphanistrum</i> ^a (wild radish)	-	-	0.1	4.0	0.1	2.0
<i>Salsola kali</i> ^a (Russian thistle)	12.7	100.0	8.0	100.0	10.4	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	2.0	60.0	1.5	60.0	1.8	60.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.1	4.0	0.2	8.0	0.2	6.0
<i>Triticum sp.</i> ^a (wheat)	0.3	12.0	X	X	0.2	6.0
Crust	0.0	0.0	0.0	0.0	0.0	0.0
Soil	72.0	100.0	56.1	100.0	64.1	100.0

Table 38. Percent Canopy Cover and Frequency of Occurrence at the 300-288:2 CTA Site in 2017. (2 Pages)

Species	Area 1 (east)		Area 2 (west)		Entire Site	
	% Cover	% Frequency of Occurrence	% Cover	% Frequency of Occurrence	Average % Cover	Average % Frequency of Occurrence
Litter	25.1	100.0	42.0	100.0	33.6	100.0
Total canopy cover (excludes crust/soil/litter)	20.6		14.5		17.6	
Total Native % Cover	4.3		4.7		4.5	
Total Invasive % Cover	16.3		9.8		13.1	

^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c Bunchgrasses include *Pseudoroegneria spicata*, *Achnatherum hymenoides*, *Elymus elymoides*, *Poa secunda*, *Sporobolus cryptandrus* and *Hesperostipa comata*

X = present but not counted in plot frames

-- = species not observed on site



Figure 42. The 300-288:2 Site in 2017.

3.9 200 AREA SITES

An export water line was installed and the disturbed areas revegetated in 2016. Per the *Site-Specific Revegetation Plan for the Export Water Pipeline* (MSA 2016), revegetation efforts entailed broadcast seeding with a mixture of native grasses including Sandberg bluegrass (*Poa secunda*), Indian ricegrass (*Achnatherum hymenoides*), and needle-and-thread grass (*Hesperostipa comata*) at approximately 10.9 kg/ha (9.75 lbs/ac) combined with a native forb mix of a minimum of four species at approximately 0.45kg/ha (0.4 lbs/ac). Broadcast seeding areas were topped with a straw mulch that was crimped into the soil surface. Shrub species including big sagebrush (*Artemisia tridentata*), antelope bitterbrush (*Purshia tridentata*), and spiny hopsage (*Grayia spinosa*) were transplanted on the sites at approximately 1,482 plants/ha (600 plants/ac) with a mix of approximately 66% sagebrush, 17% bitterbrush, and 17% spiny hopsage. For monitoring purposes the area was divided into two sites, the 200-West (L-840) Export Water Pipeline site and the 200-East (L-525) Export Water Pipeline site.

3.9.1 200-West (L-840) Export Water Pipeline Site

The 200-West (L-840) Export Water Pipeline site (Figure 43) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. This is a larger site that was divided into 5 areas for monitoring purposes with data collected from 20 plot frames in each area and 1 transect at the southwest end of the site. Substrates for the site are sandy loams to loamy sands with varied amounts of gravel and cobble.

A 100-m (328-ft) shrub monitoring transect with 5-m (16.4-ft) offsets to each side was established for the site in 2017. First-year monitoring of the transect area was conducted on March 29, 2017. A total of 89 shrubs were recorded along the transect. Big sagebrush (*Artemisia tridentata*) was the most abundant with 58 plants followed by antelope bitterbrush (*Purshia tridentata*) with 25 plants and spiny hopsage (*Grayia spinosa*) with 6 plants. This equates to shrub density of 890 plants/ha (360 plants/ac), meeting the success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected on July 11, 2017. Average canopy cover for the site overall was 42.6% with native cover representing 5.2% and invasive cover representing 37.4% (Table 39). Indian ricegrass (*Achnatherum hymenoides*) was the dominant native species for the site with 1.5% cover. Russian thistle (*Salsola kali*) was the dominant invasive species for the site with 32.3% cover.

Diffuse knapweed (*Centaurea diffusa*), a Washington State Class B noxious weed, was recorded with less than 1% cover for the site and occurrence in 1% of the plot frames.

Table 39. Percent Canopy Cover and Frequency of Occurrence at the 200 West (L-840) Export Water Pipeline Site in 2017. (3 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	1.5	58.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	0.0	1.0
<i>Artemisia tridentata</i> (big sagebrush)	0.2	6.0
<i>Astragalus purshii</i> (woollypod milkvetch)	0.0	1.0

Table 39. Percent Canopy Cover and Frequency of Occurrence at the 200 West (L-840) Export Water Pipeline Site in 2017. (3 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Bromus tectorum</i> ^a (cheatgrass)	4.3	63.0
<i>Bunchgrasses</i> ^c	1.2	46.0
<i>Centaurea diffusa</i> ^b (diffuse knapweed) (B)	0.0	1.0
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	0.1	5.0
<i>Draba verna</i> ^a (spring draba)	0.1	3.0
<i>Elymus elymoides</i> (squirreltail)	0.2	8.0
<i>Epilobium brachycarpum</i> (tall annual willowherb)	0.2	7.0
<i>Ericameria nauseosa</i> (rubber rabbitbrush)	X	X
<i>Eriogonum niveum</i> (snow buckwheat)	0.2	8.0
<i>Helianthella uniflora</i> (oneflower helianthella)	X	X
<i>Holosteum umbellatum</i> ^a (jagged chickweed)	0.0	1.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.2	8.0
<i>Machaeranthera canescens</i> (hoary tansyaster)	X	X
<i>Matricaria recutita</i> ^a (German chamomile)	0.0	1.0
<i>Melilotus officinalis</i> ^a (sweetclover)	X	X
<i>Poa secunda</i> (Sandberg bluegrass)	0.8	32.0
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Salsola kali</i> ^a (Russian thistle)	32.3	100.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	0.4	16.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.1	4.0
<i>Sporobolus cryptandrus</i> (sand dropseed)	0.2	4.0
<i>Tragopogon dubius</i> ^a (yellow salsify)	0.0	1.0
<i>Vulpia microstachys</i> (desert fescue)	0.2	6.0
ARTR recruits ^d	0.3	11.0
Crust	0.0	0.0
Soil	58.2	100.0
Litter	39.8	100.0
Total canopy cover (excludes crust/soil/litter)	42.6	
Total Native % Cover	5.2	
Total Invasive % Cover	37.4	

Table 39. Percent Canopy Cover and Frequency of Occurrence at the 200 West (L-840) Export Water Pipeline Site in 2017. (3 Pages)

Species	% Cover	% Frequency of Occurrence
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^a Invasive species

^b Washington State Classified Noxious Weed (class)

^c Bunchgrasses include *Pseudoroegneria spicata*, *Achnatherum hymenoides*, *Elymus elymoides*, *Sporobolus cryptandrus*, *Poa secunda* and *Hesperostipa comata*

^d ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 43. The 200-West (L-840) Export Water Pipeline Site in 2017. Top: View to the Southwest from the Central Portion of the L-840 Export Water Pipeline Site in 2017. Bottom: View to the Northeast from the Central Portion of the L-840 Export Water Pipeline Site in 2017.

1.1.1 200-East (L-525) Export Water Pipeline Site

The 200-East (L-525) Export Water Pipeline site (Figure 44) was revegetated in FY 2017 and monitoring was first conducted for the site in 2017. This is a larger site that was divided into 5 areas for monitoring purposes with data collected from 20 plot frames in each area and 1 transect at the northwest end of the site. Substrates for the site are sandy loams to loamy sands with varied amounts of gravel and cobbles.

A 100-m (328-ft) shrub monitoring transect with 5-m (16.4-ft) offsets to each side was established for the site in 2017. First-year monitoring of the transect area was conducted on March 29, 2017. A total of 94 shrubs were recorded along the transect. Big sagebrush (*Artemisia tridentata*) was the most abundant with 66 plants followed by antelope bitterbrush (*Purshia tridentata*) with 24 plants and spiny hopsage (*Grayia spinosa*) with 4 plants. This equates to shrub density of 1,567 plants/ha (634 plants/ac), success criteria of 600 plants/ha (240 plants/ac).

Canopy cover data for the site was collected on July 11, 2017. Average canopy cover for the site overall was 22.1% with native cover representing 3.7% and invasive cover representing 18.4% (Table 40). Native bunchgrasses (*Pseudoroegneria spicata*, *Achnatherum hymenoides*, *Elymus elymoides*, *Poa secunda*, *Sporobolus cryptandrus*, and *Hesperostipa comata*) accounted for 2.1% of the native cover. Russian thistle (*Salsola kali*) was the dominant invasive species for the site with 16.0% cover.

No listed Washington State Class B noxious weeds were observed on the site.

Table 40. Percent Canopy Cover and Frequency of Occurrence at the 200 West (L-525) Water Pipeline Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Achnatherum hymenoides</i> (Indian ricegrass)	0.7	26.0
<i>Amsinckia lycopsoides</i> (tarweed fiddleneck)	X	X
<i>Artemisia tridentata</i> (big sagebrush)	0.2	8.0
<i>Bromus tectorum</i> ^a (cheatgrass)	1.3	31.0
<i>Bunchgrasses</i> ^c	1.4	57.0
<i>Chenopodium leptophyllum</i> (narrowleaf goosefoot)	X	X
<i>Draba verna</i> ^a (spring draba)	0.1	2.0
<i>Elymus elymoides</i> (squirreltail)	0.0	1.0
<i>Eriogonum niveum</i> (snow buckwheat)	0.2	9.0
<i>Grayia spinosa</i> (spiny hopsage)	0.1	2.0
<i>Helianthella uniflora</i> (oneflower helianthella)	0.0	1.0
<i>Lactuca serriola</i> ^a (prickly lettuce)	0.1	3.0
<i>Linum lewisii</i> (prairie flax)	0.1	2.0
<i>Melilotus officinalis</i> ^a (sweetclover)	0.1	2.0

Table 40. Percent Canopy Cover and Frequency of Occurrence at the 200 West (L-525) Water Pipeline Site in 2017. (2 Pages)

Species	% Cover	% Frequency of Occurrence
<i>Poa secunda</i> (Sandberg bluegrass)	0.6	25.0
<i>Polypogon monspeliensis</i> ^a (annual rabbitsfoot grass)	X	X
<i>Pseudoroegneria spicata</i> (bluebunch wheatgrass)	0.1	4.0
<i>Purshia tridentata</i> (antelope bitterbrush)	X	X
<i>Salsola kali</i> ^a (Russian thistle)	16.0	98.0
<i>Sisymbrium altissimum</i> ^a (tall tumbled mustard)	1.0	23.0
<i>Sphaeralcea munroana</i> (Munro's globemallow)	0.2	6.0
<i>Triticum sp.</i> ^a (wheat)	0.1	2.0
ARTR recruits ^d	0.1	4.0
Crust	0.0	0.0
Soil	62.5	100.0
Litter	35.8	100.0
Total canopy cover (excludes crust/soil/litter)	22.1	
Total Native % Cover	3.7	
Total Invasive % Cover	18.4	

^a Invasive species^b Washington State Classified Noxious Weed (class)^c Bunchgrasses include *Pseudoroegneria spicata*, *Achnatherum hymenoides*, *Elymus elymoides*, *Sporobolus cryptandrus*, *Poa secunda* and *Hesperostipa comata*^d ARTR recruits = *Artemisia tridentata* plants that are coming in naturally (were not planted)

X = present but not counted in plot frames



Figure 44. The 200-East (L-525) Export Water Pipeline Site in 2017. Top: View to the Northwest from the Central Portion of the 200-East Export Waterline Site in 2017. Bottom: View to the Southeast from the Central Portion of the 200-East Export Waterline Site in 2017.

4.0 SUMMARY

Revegetation of remediated and disturbed sites on the Hanford Site is performed to support the U.S. Department of Energy Richland Operations Office goal of meeting cleanup and revegetation requirements mandated in the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980*. Revegetation and monitoring activities of remediated and disturbed sites on the Hanford Site are conducted in accordance with the *Hanford Site Revegetation Manual* (DOE/RL-2011-116, Rev. 1, 2013), area specific revegetation plans (*Remedial Design Report/Remedial Action Work Plan for the 100 Area*, [DOE/RL-96-17, Rev. 6, Appendix H], *Remedial Design Report/Remedial Action Work Plan for the 100-N Area* [DOE/RL-2005-93, Rev. 1, Appendix G], and *Remedial Design Report/Remedial Action Work Plan for the 300 Area* [DOE/RL-2001-47, Rev. 3, Appendix C] and other area and/or site specific guidance such as Mitigation Action Plans and Memorandums of Agreement.

Landscapes within semi-arid climates take decades or even centuries to reestablish naturally to functional and sustainable ecosystems after disturbances. The Hanford Site presents many challenges to revegetation efforts due to its complex shrub-steppe ecosystem, decades of natural and anthropogenic disturbances, widespread invasive species (e.g., cheatgrass, *Bromus tectorum* and Russian thistle, *Salsola kali*) and limited fill material that often has a high percentage of rock (gravel and cobbles). It is also important to realize that habitats within a landscape may differ significantly from one another. Not all plants grow in the same soil or climatic conditions. A prescription that is successful for one site may not work for another. Factors such as substrate, moisture, adjacent topography and species composition, prescribed species and application rates, seasonal timing for planting, and proper planting and seeding techniques all influence the success of a particular revegetation site.

MSA is responsible for monitoring and evaluating Hanford Site revegetation sites previously restored by the RCCC and CHPRC. MSA's goal through revegetation monitoring is to ensure the success of the restoration process. As described in this report, this is accomplished by conducting annual monitoring of representative revegetated sites to provide quantitative data (shrub density and canopy cover percentages) that can be used to evaluate trends, individual site success or failure, and provide insight regarding the effectiveness of different planting strategies for different conditions. Sites that are not meeting the prescribed success criteria are evaluated to determine if additional revegetation efforts need to be implemented to achieve success.

A total of 40 revegetated sites were monitored by MSA in 2017 (Table 41). Five of the sites monitored (118-K-1, 100-F-47, 100-F-48, 100-F CTA and 118-F-6 Soil Staging Area [SSA]) were not monitored initially after planting but were monitored in 2016 and 2017 to assess additional revegetation needs. These sites are located in areas where other representative sites that were monitored over the 5-year period failed to meet the prescribed success criteria, indicating other sites in the area may not be meeting the success criteria. Monitoring for each site entailed documentation of native shrubs (sagebrush, *Artemisia tridentata*, antelope bitterbrush, *Purshia tridentata* and spiny hopsage, *Grayia spinosa*) within established transect areas and documentation of native and invasive canopy cover percentages and frequency of occurrence for each species observed on the site. For each site monitored, these data were evaluated against the success criteria of 600 plants/ha (240 plants/ac) for native shrub density and 25% native cover (shrubs, grasses, forbs combined).

Over 50% of the sites (25 of 40) monitored in 2017 are currently meeting the shrub success criteria of 600 plants/ha [240 plants/ac]. Only one site, 600-29, met both the native canopy cover criteria of 25% or greater with 27.0% native cover and the shrub density criteria of 600 plants/ha (240 plants/ac) with 610 plants/ha (247 plants/ac). No other sites had native cover of 25% or greater. In order to possibly meet the prescribed success criteria of 25% or greater native cover and shrub density of 600 plants/ha (240 plants/ac) additional revegetation efforts will be required at nearly all of the sites monitored in 2017. Many of the sites have a substrate of predominantly gravel and cobbles that may never achieve 25% native ground cover; average total canopy cover (native and invasive combined) for these sites was relatively low (around 20%) compared to sites with soil-dominated substrates where total canopy cover averaged around 40%. Sites with a gravel or cobble dominated substrates generally had a comparable percentage of native cover and invasive cover, about 10% each. Monitored sites with sand or loam dominated substrates had about 40% total canopy cover but invasive cover was substantially higher than native cover with about 35% invasive cover to 7% native cover. Another factor to consider is that many sites are surrounded by areas dominated by cheatgrass (*Bromus tectorum*) and other invasive forbs that compete with the establishment of native grasses and forbs.

Washington State listed noxious weeds were observed on 37 of the 40 sites monitored in 2017. Diffuse knapweed (*Centaurea diffusa*), a Class B noxious weed, was the most common, occurring on 36 of the sites. Canopy cover from listed noxious weeds was 1.5% or less for all of the sites.

Table 41. 2017 Revegetation Monitoring Summary (4 pages)

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Recommendations/Notes
B/C Area Sites					
100-C-7	FY 2013	5	607	16.4	None - less than 25% native cover BUT native cover is > invasive cover and native species vs. invasive species is 50/50. Substrate is predominantly cobbles.
100-C-7:1	FY 2014	4	213	9.3	Replant (shrubs/grasses/forbs) in areas of low shrub/high cheatgrass concentrations (less rocky areas).
Pit 24 (Upland)	FY 2015	3	269	9.2	Treat noxious weeds (knapweed, salt cedar), recorded in >25% of plots in 2017.
100-B-35	FY 2016	2	457	6.6	Continue to monitor.
K Area Sites					
118-K-1 BG ^a	FY 2013	5	297	15.6	Replant (shrubs/grasses/forbs) in southwest (bare) portion of the site.
118-K-1 SSA ^a	FY 2013	5	154	8.7	Rework entire site (avoiding established shrubs where possible).

Table 41. 2017 Revegetation Monitoring Summary (4 pages)

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Recommendations/Notes
128-K-2 SSA	FY 2013	5	372	14.1	Supplemental forb plantings recommended to increase native canopy cover. No supplemental shrub planting recommended.
128-K-2 Burn Pit ^a	FY 2013	5	324	11.1	Supplemental forb plantings recommended to increase native canopy cover. No supplemental shrub planting recommended.
600-29 ^a	FY 2013	5	247	27.0	None - meeting success criteria. Possibly treat noxious weeds (knapweed).
100-K-95	FY 2014	4	89	5.2	Rework entire site (avoiding established shrubs where possible).
100-K CTA ^a	FY 2015	3	N/A	7.6	Rework entire site.
N Area Sites					
100-N-47	FY 2013	5	178	19.0	Supplemental shrub planting in low density areas.
181-N	FY 2013	5	938	3.3	None - less than 25% native cover BUT native cover has consistently been equal to or slightly higher than invasive cover and native species vs. invasive species has consistently been 50/50 or higher. Substrate is predominantly cobbles and water levels fluctuate in the area due to close proximity to the river.
181-NE/1908-NE	FY 2013	5	1329	8.8	None - less than 25% native cover BUT native cover has consistently been higher than invasive cover and native species vs. invasive species has consistently been ~50/50. Substrate is predominantly cobbles and water levels fluctuate in the area due to close proximity to the river.
130-N-1:1	FY 2015	3	230	8.6	Rework the loamy strips from electrical towers to the site.
100-N-96	FY 2016	2	216	8.8	Rework entire site. Soil nutrient analyses prior to planting to determine if fertilizer is needed. Site is surrounded by cheatgrass dominated areas with few if any shrubs.
100-N-83	FY 2017	1	433	3.6	Continue to monitor.
100-N CTA	FY 2017	1	274	3.2	Continue to monitor.

Table 41. 2017 Revegetation Monitoring Summary (4 pages)

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Recommendations/Notes
D Area Sites					
100-D-8	FY 2013	5	289	12.0	Check upland shrub density, supplemental shrub planting if <240/ac.
100-D-65/66	FY 2013	5	65	16.5	None - less than 25% native cover BUT native cover has consistently been ~30% higher than invasive cover and native species vs. invasive species has consistently been ~50/50 or higher. Substrate is predominantly cobbles and water levels fluctuate in the area due to close proximity to the river.
118-D-2	FY 2014	4	35	8.2	Rework entire site.
100-D-30/104	FY 2015	3	336	9.0	Continue to monitor.
100-D-100	FY 2016	2	330	5.5	Continue to monitor.
100-D Trailer Village	FY 2017	1	587	3.8	Continue to monitor.
H Area Sites					
128-H-1	FY 2013	5	364	21.3	None - less than 25% native cover BUT native cover is ~30% higher than invasive cover and native species vs. invasive species has consistently been ~50/50 or higher.
100-H-28:2	FY 2016	2	404	10.5	None - continue to monitor.
600-385	FY 2017	1	295	7.7	None - continue to monitor.
F Area Sites					
118-F-6 SSA ^a	FY 2009	9	N/A	4.5	Total rework was done in FY2018 (Dec/Jan). Continue to monitor.
100-F-47 ^a	FY 2012	6	396	10.8	Supplemental shrub planting was done in FY2018 (Dec/Jan). Possibly treat noxious weeds (recorded in >45% of plots in 2017).
100-F-48 ^a	FY 2012	6	194	13.3	Supplemental shrub planting was done in FY2018 (Dec/Jan). Possibly treat noxious weeds (recorded in >20% of plots in 2017).
100-F CTA ^a	FY 2012	6	259	9.6	Total rework was done in FY2018 (Dec/Jan). Continue to monitor.
600 Area Sites					

Table 41. 2017 Revegetation Monitoring Summary (4 pages)

Site	Year Planted	Monitoring Year	Shrub Density (goal >240 plants/ac)	Native Canopy Cover % (goal >25)	Recommendations/Notes
600-301	FY 2014	4	20	9.0	Rework or supplement entire site.
600-369:3	FY 2014	4	279	5.6	Continue to monitor - less than 25% native cover but unlikely that is achievable due to extensive cheatgrass presence in the surrounding areas.
600-370	FY 2014	4	275	5.6	Hand seeding and/or transplanting forbs. Continue to monitor.
600-356	FY 2015	3	0	7.4	Rework or supplement entire site.
600-379	FY 2015	3	N/A	2.1	Rework entire site (avoiding established shrubs where possible). Add forbs (e.g., phlox, yarrow, cryptantha) to seed mix.
600-358	FY 2016	2	216	12.7	Supplemental shrub planting in roadway portion of site. Establish transect in waste site portion to evaluate shrub density, supplemental planting if below 240 plants/ac criteria.
300 Area Sites					
300-288:2	FY 2017	1	570	1.0	Continue to monitor.
200 Area Sites					
L-840 200 W Export Water Pipeline	FY 2017	1	360	5.2	Continue to monitor.
L-525 200 E Export Water Pipeline	FY 2017	1	634	3.7	Continue to monitor.

^a Site was not monitored initially after planting

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APPENDIX A

2017 REVEGETATION MONITORING TAXONOMY LIST

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APPENDIX A
2017 REVEGETATION MONITORING TAXONOMY LIST

2017 Revegetation Monitoring Taxonomy List. (5 Pages)

Current Scientific Name (USDA 2017)	Synonyms (Hitchcock and Cronquist 1973; Sackschewsky and Downs 2001)	Common Name (USDA 2017)	Native or Introduced	Washington State Noxious Weed Class (A, B, or C)
<i>Achillea millefolium</i>		common yarrow	Native	
<i>Achnatherum hymenoides</i>	<i>Oryzopsis hymenoides</i>	Indian ricegrass	Native	
<i>Agoseris sp.</i>		agoseris	Native	
<i>Agropyron cristatum</i>		crested wheatgrass	Introduced	
<i>Aliciella leptomeria</i>	<i>Gilia leptomeria</i>	sand gilia	Native	
<i>Allium ascalonicum</i>		wild onion	Introduced	
<i>Ambrosia acanthicarpa</i>		flatspine bur ragweed	Native	
<i>Amsinckia lycopsoides</i>	<i>Benthamia lycopsoides</i>	tarweed fiddleneck	Native	
<i>Artemisia biennis</i>		biennial wormwood	Native	
<i>Artemisia tridentata</i>		big sagebrush	Native	
<i>Astragalus purshii</i>		woollypod milkvetch	Native	
<i>Astragalus succumbens</i>		Columbia milkvetch	Native	
<i>Balsamorhiza careyana</i>		Carey's balsamroot	Native	
<i>Brassica sp</i>		mustard	Introduced	
<i>Bromus arvensis</i>	<i>Bromus japonicus</i>	field brome	Introduced	
<i>Bromus tectorum</i>		cheatgrass	Introduced	
<i>Calochortus macrocarpus</i>		sagebrush mariposa lily	Native	
<i>Carex sp.</i>		sedge	Native	
<i>Centaurea diffusa</i>		diffuse knapweed	Introduced	B
<i>Chaenactis douglasii</i>		Douglas' dustymaiden	Native	
<i>Chenopodium album</i>		lambsquarters	Native	

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<i>Chenopodium leptophyllum</i>	<i>Chenopodium album</i>	narrowleaf goosefoot	Native	
<i>Chondrilla juncea</i>		rush skeletonweed	Introduced	B
<i>Chorispora tenella</i>		crossflower	Introduced	
<i>Chrysothamnus viscidiflorus</i>		yellow rabbitbrush	Native	
<i>Cirsium arvense</i>		Canada thistle	Introduced	C
<i>Convolvulus arvensis</i>		field bindweed	Introduced	C
<i>Coreopsis sp.</i>		tickseed	Native	
<i>Coreopsis tinctoria</i>	<i>Coreopsis atkinsoniana</i>	golden tickseed	Native	
<i>Cornus sericea</i>	<i>Cornus stolonifera</i>	redosier dogwood	Native	
<i>Cryptantha circumscissa</i>		cushion cryptantha	Native	
<i>Descurcania pinnata</i>		western tansymustard	Native	
<i>Draba verna</i>		spring draba	Introduced	
<i>Elymus elymoides</i>	<i>Sitanion hystrix</i>	squirreltail	Native	
<i>Epilobium brachycarpum</i>	<i>Epilobium paniculatum</i>	tall annual willowherb	Native	
<i>Ericameria nauseosa</i>	<i>Chrysothamnus nauseosus</i>	rubber rabbitbrush	Native	
<i>Erigeron pumilus</i>		shaggy fleabane	Native	
<i>Eriogonum niveum</i>		snow buckwheat	Native	
<i>Eriogonum vimineum</i>		wickerstem buckwheat	Native	
<i>Erodium cicutarium</i>		redstem stork's bill	Introduced	
<i>Erysimum asperum</i>	<i>Cheirinia aspera</i>	western wallflower	Native	
<i>Galium aparine</i>		stickywilly	Native	
<i>Grayia spinosa</i>	<i>Atriplex spinosa</i>	spiny hopsage	Native	
<i>Helianthella uniflora</i>		oneflower helianthella	Native	

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<i>Hesperostipa comata</i>	<i>Stipa comata</i>	needle and thread grass	Native	
<i>Holodiscus discolor</i>		oceanspray	Native	
<i>Holosteum umbellatum</i>		jagged chickweed	Introduced	
<i>Hordeum leporinum</i>		hare barley	Introduced	
<i>Hypericum perforatum</i>		common St. Johnswort	Introduced	C
<i>Koeleria macrantha</i>		prairie Junegrass	Native	
<i>Lactuca serriola</i>		prickly lettuce	Introduced	
<i>Lamium amplexicaul</i>		henbit deadnettle	Introduced	
<i>Lepidium latifolium</i>	<i>Cardaria latifolia</i>	broadleaved pepperweed	Introduced	B
<i>Lepidium perfoliatum</i>		clasping pepperweed	Introduced	
<i>Leymus cinereus</i>		basin wildrye	Native	
<i>Linum lewisii</i>		prairie flax	Native	
<i>Lomatium grayi</i>		Gray's biscuitroot	Native	
<i>Lomatium sp.</i>		desertparsley	Native	
<i>Lycium barbarum</i>		matrimony vine	Introduced	
<i>Machaeranthera canescens</i>		hoary tansyaster	Native	
<i>Malva neglecta</i>		common mallow	Introduced	
<i>Matricaria recutita</i>		German chamomile	Introduced	
<i>Medicago sativa</i>		alfalfa	Introduced	
<i>Melilotus officinalis</i>	<i>Melilotus alba</i>	swetclover	Introduced	
<i>Microsteris gracilis</i>		slender phlox	Native	
<i>Morus alba</i>		white mulberry	Introduced	
<i>Penstemon acuminatus</i>		sharp-leaf penstemon	Native	

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<i>Phalaris arundinacea</i>		reed canarygrass	Introduced	C
<i>Phlox longifolia</i>		longleaf phlox	Native	
<i>Phragmites australis</i>		common reed	Introduced	B
<i>Plantago lanceolata</i>		narrowleaf plantain	Introduced	
<i>Plantago patagonica</i>		woolly plantain	Native	
<i>Poa bulbosa</i>		bulbous bluegrass	Introduced	
<i>Poa secunda</i>	<i>Poa sandbergii</i>	Sandberg bluegrass	Native	
<i>Polygonum aviculare</i>		prostrate knotweed	Introduced	
<i>Polygonum convolvulus</i>		black bindweed	Introduced	
<i>Polypogon monspeliensis</i>		annual rabbitsfoot grass	Introduced	
<i>Populus balsamifera</i>	<i>Populus trichocarpa</i>	black cottonwood	Native	
<i>Prunus virginiana</i>		chokecherry	Native	
<i>Pseudoroegneria spicata</i>	<i>Agropyron spicatum</i>	bluebunch wheatgrass	Native	
<i>Psoraleidium lanceolatum</i>	<i>Psoralea lanceolata</i>	lemon scurfpea	Native	
<i>Purshia tridentata</i>		antelope butterbrush	Native	
<i>Raphanus raphanistrum</i>		wild radish	Introduced	
<i>Ribes aureum</i>		golden currant	Native	
<i>Rosa woodsii</i>		Woods' rose	Native	
<i>Salix amygdaloides</i>		peachleaf willow	Native	
<i>Salix exigua</i>		narrowleaf willow	Native	
<i>Salsola kali</i> ^a		Russian thistle	Introduced	
<i>Sanguisorba minor</i>	<i>Poterium sanguisorba</i>	small burnet	Introduced	
<i>Sisymbrium altissimum</i>		tall tumbled mustard	Introduced	

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<i>Sphaeralcea munroana</i>		Munro's globemallow	Native	
<i>Sporobolus cryptandrus</i>		sand dropseed	Native	
<i>Tamarix ramosissima</i>		saltcedar	Introduced	B
<i>Tragopogon dubius</i>		yellow salsify	Introduced	
<i>Triticum aestivum</i>		common wheat	Introduced	
<i>Triticum sp.</i>		wheat	Introduced	
<i>Ulmus pumila</i>		Siberian elm	Introduced	
<i>Verbascum thapsus</i>		common mullein	Introduced	
<i>Verbena bracteata</i>		bigbract verbena	Native	
<i>Vicia sp.</i>		vetch	Native	
<i>Vulpia microstachys</i>	<i>Festuca microstachys</i>	desert fescue	Native	

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