FREEPORT-McMoRan

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May 23, 2022

Certified Mail # 70201290000110357477

Mr. John Rhoderick, Deputy Director
New Mexico Environment Department
Water Protection Division
P.O. Box 5469
Santa Fe, New Mexico 87502

Dear Mr. Rhoderick:

Re: Smelter/Tailing Soils Investigation Unit - Chino AOC
Revised Vegetation Monitoring Report, Razorback Ridge IRA

Freeport-McMoRan Chino Mines Company (Chino) submits under separate cover the revised 5-year Vegetation Monitoring Report for the Razorback Ridge Interim Remedial Action Site (IRA), Smelter/Tailing Investigation Unit under the Chino Administrative Order on Consent (AOC). The report was revised in response to comments received from the New Mexico Environment Department (NMED) in a letter dated March 22, 2022. Chino received approval for their time extension request to make the requested edits from the NMED in an email dated April 18, 2022. The revised report and a document presenting responses to NMED comments were submitted today to Mr. David Mercer, NMED AOC Project Manager.

Please contact Ms. Pam Pinson at (575) 912-5213 if you have any questions regarding this quantitative vegetation survey report.

Sincerely,

Sherry Burt-Kested
Manager, Environmental Services

SBK:pp
20220523-002

C (via email):
David Mercer, NMED
Joseph Fox, NMED
Petra Sanchez, US EPA
DJ Ennis, MMD
Michael Steward, FCX
Benina Cerno, Chino

GOLDER
MEMBER OF WSP

REPORT

2019 Quantitative Vegetation Monitoring

Razorback Ridge - East Removal Borrow Area

Submitted to:

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May 23, 2022

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Executive Summary

The primary objective for revegetation of the East Removal Borrow Area is to limit wind and water erosion for remediated areas through the re-establishment of a native plant community. A quantitative vegetation survey of the site was conducted in October 2019 to document the progress of revegetation five years after completion of the IRA. Canopy cover, shrub density and diversity were measured and compared to the Reference Area technical guidance for Chino South Mine.

The revegetation efforts associated with the IRA at the Razorback Ridge Area are considered successful. An early-seral stage mixed grama-shrub community is well established across the East Removal Borrow Area. Mean total canopy cover in the fifth growing season is 38.4%, which is 65% of the Reference Area guidance for canopy cover. Shrub density was measure at about 2,000 stems/acre by both the belt transect and quadrat frequency methods, which is 60% of the shrub density for the Reference Area. Fifty-seven plant species that were not included in the reclamation seed mix were identified at the East Removal Borrow Area. Recruitment of native plant species into the reclaimed plant community demonstrates the process of ecological succession and the gradual establishment of self-sustaining ecosystem. Vegetation on the remediated site meets the diversity requirements for forbs and warm-season and cool/intermediate-season grasses but only had one woody plant species meeting the canopy cover requirement for diversity.

The reclaimed plant community provides significant canopy cover, while also providing both ecological and rangeland values to the area. No significant erosion issues were documented during the 5-year monitoring period, and the currently established plant community meets the overall objective as a best management practice for erosion control. Given the less than favorable precipitation during the vegetation establishment period and the condition of the plant community in 2019, the strong canopy cover in Year 5 demonstrates that the remediated site is resilient and self-sustaining that is approaching Chino's revegetation success standards and progressing toward the IRA objective to return the area to a post-mining beneficial use (i.e., wildlife habitat).

1.0 INTRODUCTION

Freeport McMoRan Chino Mines Company (Chino) conducted an interim remedial action (IRA) within the Smelter/Tailing Soil Investigations Unit (STSIU) at the Razorback Ridge Area in 2013 and 2014. Razorback Ridge is east of Lake One in areas adjacent to the Whitewater Creek Diversion Channel (Figure 1). The IRA fulfilled part the mitigation requirements within the Smelter/Tailing Soils Investigation Unit (STSIU) as part of an Administrative Order on Consent (AOC) with the New Mexico Environment Department (NMED 1994).

The STSIU IRA was performed at the Razorback Ridge Area where surface soils had been impacted by fallout from historical smelter emissions. The Razorback Ridge Area was originally identified for soil removal action in the Draft Interim Removal Action for the STSIU (BBL 2006) but was also designated as a future borrow area to close the historical Lake One and Slag Pile under Discharge Permit 1340 (DP-1340). The final IRA Work Plan (ARCADIS 2007) describes how impacted Razorback Ridge Area surface soils would be removed as borrow under DP-1340. The remediation plan for the area was not a formal AOC IRA plan but was part of the draft work plan for the Lake One and Slag Pile closure. The Razorback Ridge Area soil excavation and removal activities were reported in detail in the Lake One Construction Design Quality Assurance Report (EMC^2 2014). Post-excavation soil sampling and analysis were completed in accordance with the NMED approved STSIU Work Plan using X-ray fluorescence (XRF).

Pursuant to the commitments in the Razorback Ridge Supplemental Completion Report (Golder 2015), Chino performed quarterly qualitative vegetation and erosion monitoring of the remediated areas for four years after initial vegetation establishment. To fulfill the vegetation monitoring requirements described in the Completion Report, Chino retained Golder Associates USA Inc. (Golder) to conduct a quantitative vegetation survey of the East Removal Borrow portion of the Razorback Ridge Area to document the status of the revegetated area five years after seeding. This report coveys the results of the vegetation survey the East Removal Borrow Area conducted in 2019.

1.1 Background

The Razorback Ridge Area is located near the Town of Hurley east of the Lake One reclamation. The area is divided into two sub-areas noted as Razorback Ridge and the East Removal Borrow Area on Figure 2. The two areas are separated by the operational pipeline corridor and the Whitewater Creek Diversion Channel.

This area was characterized during the background investigation (Chino 1995) and the STSIU RI (SRK 2008) as having elevated copper concentrations. The remedial action objectives were specified in the Draft IRA Work Plan (BBL 2006) and the NMED-approved IRA Work Plan (ARCADIS 2007) for the STSIU soil removal. The objective of the IRA was to remove soils in areas with copper concentrations higher than 5,000 milligrams per kilogram (mg/kg). The area identified for soil removal in the Razorback Ridge Area was originally about 123 acres but under the Draft IRA Work Plan (BBL 2006) the perimeter was adjusted for areas that 1) were too steep to safely operate equipment, 2) overlapped the Lake One reclamation/borrow footprint, and 3) part of current operations.

Soil removal for the Razorback Ridge Area was performed from the first quarter of 2013 through June 2014 by Freeport-McMoRan Reclamation Services (FMRS) with confirmation sampling performed by Golder. Soils were excavated to a depth of approximately 12 inches down to 40 feet. Soil removal was accomplished using dozers and a loader. Large dozers pushed the soil to staging areas where it was loaded in haul trucks with the loader. Small dozers were used along excavation boundaries, around trees on the East Removal Borrow Area slope, and to achieve final grade following excavation activities. The upper foot of surface soil at the Razorback Ridge

and East Removal Borrow Area were considered impacted and used as construction fill for Lake One closure that was covered with clean soil material.

The final excavation area was approximately 94 acres. Confirmation sampling and analysis was performed at the East Removal Borrow Area February and March 2014 and on Razorback Ridge during September 2014 (Golder 2015). Analyses were conducted using XRF to verify that the RAC had been achieved by soil removal. Results from the confirmation sampling are found in the construction completion report (Golder 2015).

Following soil removal and confirmatory sampling, the site was seeded in June 2014, with the exception of an area that was still being used as a borrow source. Revegetation activities at the borrow source was completed in May 2015. All revegetation work was performed by FMRS. The seedbed was prepared by disking the soil surface to approximately 6 inches. Seeding was accomplished with a rangeland drill using a combined drill/broadcast process. The site was then mulched with straw at a rate of 2 tons per acre and crimped to protect the soil surface from erosion during the establishment phase. The seed mix and application rates for the remedial action are listed in Table 1 and are consistent with the Work Plan. Quarterly inspections were performed by Chino beginning in April 2015 for 4 years following seeding and mulching. The inspections confirmed that vegetation was sufficiently established for erosion control.

Table 1: Seed Mix Used for the Razorback Ridge Area

Scientific Name	Common Name	Code	Seasonality	Seeding Rate[1]
Grasses				
Achnatherum hymenoides	Indian ricegrass	ACHY	Cool	1.42
Elymus elymoides	Bottlebrush squirreltail	ELEL	Cool	1.21
Elymus lanceolatus ssp. psammophilus	Streambank wheatgrass	ELLAP	Cool	0.47
Bouteloua curtipendula	Sideoats grama	BOCU	Warm	1.09
Bouteloua gracilis	Blue grama	BOGR2	Warm	0.24
Leptochloa dubia	Green sprangletop	LEDU	Warm	0.48
Pleuraphis jamesii	James' galleta	PLJA	Warm	0.38
Sporobolus cryptandrus	Sand dropseed	SPCR	Warm	0.08
Forbs				
Dalea candida	White prairie clover	DACA	NA	0.18
Linum lewisii	Lewis flax	LILE	NA	0.16
Ratibida columnifera	Prairie coneflower	RACO3	NA	0.29
Shrubs				
Atriplex canescens	Four-wing saltbush	ATCA	NA	1.57
Calliandra eriophylla	Fairyduster	CAER	NA	0.03
Ericameria nauseosa	Rubber rabbitbrush	ERNA	NA	0.21
Krascheninnikovia lanata	Winterfat	KRLA	NA	0.55
			Total	**8.37**

Notes:
[1] Rate in pounds of pure live seed (PLS) per acre (lbs/ac)
NA = Not applicable

1.2 Objectives

The primary objective for revegetation of the Razorback Ridge Area is to limit erosion and provide dust control for remediated areas through the re-establishment of a native plant community. A secondary benefit of the reclamation is to establish wildlife habitat.

Per the Completion Report (Golder 2015), Chino is required to conduct a quantitative survey of revegetated areas and submit a report evaluating the site relative to Chino's *Vegetation Success Standards* (Appendix C, Mining and Minerals Division's [MMD] Revision 01-1 to Permit GR009RE). The post-mining land use (PMLU) for Chino Mine is wildlife habitat. Under MMD's guidance for a wildlife PMLU, total canopy cover, shrub density, and plant diversity are evaluated to determine vegetation success (Section 2). The western portion of the IRA, the Razorback Ridge sub-area, is a designated borrow site for cover materials for future closure activities associated with DP-1340. As such, the vegetation survey was limited to only the East Removal Borrow Area for compliance under the AOC.

The intent of this document is to detail the methods and results of the quantitative vegetation monitoring in the remediated areas at the East Removal Borrow Area. On October 4 and 5, 2019, Golder conducted a quantitative vegetation survey of the East Removal Borrow Area to evaluate the progress of the revegetation after five growing seasons. The survey covered approximately 37.5 acres.

2.0 SUCCESS CRITERIA

Revegetation of the Razorback Ridge Area was intended primarily to limit erosion and provide dust control for disturbed areas through re-establishment of a native plant community (Golder 2013). Reclamation success at AOC sites at Chino is evaluated by a reference area approach as described in the *Interim Technical Standards* (ITS, DBS&A 1999) and the *Closure/Closeout Plan* (CCP, Chino 2007). The reclamation success criteria were developed for reclaimed tailing areas and are based upon analysis of vegetation data collected in the Tailing Reference Area (Figure 1). Vegetation monitoring and data analysis procedures are described in Section 3.0.

Under the reference area approach, revegetation success criteria are established for the reclamation in proportion to a mature, native reference area. Reclaimed areas over mine waste are typically eligible for bond release 12 years after seeding. In such cases, both the reclaimed and reference areas are monitored to allow formal hypotheses testing to determine whether the success standards are met. The East Removal Borrow Area technically is not a formal reclamation site as only disturbed native ground was revegetated, nor is the revegetation expected to have fully progressed in just five years. Therefore, the Tailing Reference Area was not monitored as part this study. Benchmarks or technical guidance to evaluate the progress and success of the Razorback Ridge Area remediation were developed using reference area data collected as part of the ITS report (DBS&A 1999) and three quantitative monitoring reports for the Chino tailing reclamation (Golder 2018, 2019, and 2020). For this report, we averaged four years of canopy cover from 1-square meter quadrats and three years of belt transect shrub density data from the Tailing Reference Area to gauge interim vegetation establishment on the East Removal Borrow Area. The total canopy and shrub density averages for the Tailing Reference Area used for the technical guidance are as follows:

- 1998 – 54.1% total canopy, no belt transect (DBS&A 1999)
- 2017 – 89.0% total canopy, 3,237 stems/acre (Golder 2018)
- 2018 – 52.6% total canopy, 3,358 stems/acre (Golder 2019)

- 2019 – 64.6% total canopy, 2,981 stem/acre (Golder 2020)

Table 2 provides the reclamation success criteria for Chino and the technical guidance used to evaluate the Razorback Ridge Area vegetation status five years after seeding. In summary, revegetation efforts are considered successful when the canopy cover on the reclaimed facility is at least 70% of the reference area canopy cover. Average total canopy cover in the Tailing Reference Area since 1999 was 64.6%, making the success criterion 45.2%. Shrub density is considered adequate if it is a least 60% of the reference area. Average shrub density at the Tailing Reference Area was 3,193 stems per square acre (stems/acre) based on belt transect data collected since 2017 (shrub density was evaluated using a different method in 1999). Thus, the technical guidance for the Razorback Ridge Area IRA vegetation monitoring was set at 1,915 stems/acre.

Table 2: Chino Mine Reclamation Success Standards and Technical Guidance for the Razorback Ridge Area

Proportion of Reference Area			
Attribute	*Proportion*	*Reference Area*	*12-year Success Standard*
Canopy Cover	70%	64.6%	45.20%
Shrub Density (stems/acre)	60%	3,193	1,916
Plant Diversity Technical Guidance			
Plant Class	*Seasonality*	*Number of Species*	*Minimum Occurrence (% cover)*
Perennial grass	Warm	3	1
Perennial grass	Cool/Intermediate	1	0.5
Shrub	NA	2	1
Forb	NA	2	0.1

Notes:
NA - Not Applicable

Revegetation success also evaluates plant community composition in terms of plant form (grasses, forbs, and shrubs). Diversity is evaluated against numerical guidelines established in the ITS (DBS&A 1999) for different structural components of the vegetation (Table 2). In summary, the diversity guideline would be met if at least three warm season grasses and two shrubs each have cover levels of at least 1%, and one perennial, cool- or intermediate-season grass with a minimum cover level of 0.5%. In addition, two non-weedy forb species with a minimum cover level of at least 0.1% are required to meet the diversity guideline. Diversity is also demonstrated by evidence of colonization or recruitment of native plants from adjacent undisturbed areas (i.e., species that were not in the seed mix). Recruitment of native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem. Recruitment is evaluated by inventorying the total number plant species that occur in the reclamation in comparison to the original seed mix.

3.0 METHODS

Golder conducted the quantitative vegetation survey of the East Removal Borrow Area between October 4 and 5, 2019. Vegetation attributes were quantified using sampling methods approved by the MMD. Golder collected vegetation data using a systematic random sampling procedure employing a transect/quadrat system was used to select sample sites within the reclaimed area. A 50-square foot grid was imposed over the reclamation to delineate vegetation sample plots, and random points created in a geographic information system were used to select plots for vegetation sampling. The locations of vegetation plots for the East Removal Borrow Area were randomly selected using ESRI ArcMAP and are shown on Figure 2. In the field, the transect locations were

assessed in numerical order. If the transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Unsuitable transects were those that fell on or would intersect roads, drainage ways, or extend beyond the reclamation into native or areas not-representative of the reclamation. For the 2019 sampling, two primary transects were replaced by alternates because the primary transects extended beyond the reclamation into a talus slope and a drainage way.

Transects originated from the southeastern corner of the vegetation plot. Each transect was 30 meters (m) long in a dog leg pattern (Figure 3). Four 1-m^2 quadrats were located at pre-determined intervals along the transect for quantitative vegetation measurements. Each quadrat is considered an individual sample where measurements were made of total canopy cover, total basal cover, surface litter, surface rock fragments, and bare soil. Canopy and basal cover are also made on a species basis (see next section). Not all plant species observed during the quantitative vegetation monitoring are expected to occur in the sampling quadrats. Prior to and during formal sampling, the site was traversed on foot to inventory the plant community.

3.1 Vegetation and Ground Cover

Field scientists determined species canopy cover, total canopy cover, surface litter, surface rock fragments, and bare soil in each quadrat. Plant frequency was determined on a species-basis by counting the number of individual plants rooted in each quadrat. Percent area cards with a minimum resolution of 0.05 percent were used to increase accuracy and consistency of the measurements. Cover estimates less than 0.05 percent were entered as trace amounts.

Canopy cover is the percentage of quadrat area included in the vertical projection of the canopy (Daubenmire 1968). Canopy cover estimates made on the species basis may exceed 100 percent in individual quadrats where the vegetation overlaps (multi-layered canopies). In contrast, the sum of total canopy cover, surface litter, rock fragments, and bare soil does not exceed 100 percent. Relative canopy cover is presented to assess contributions of individual plant species cover and is calculated by dividing the percent canopy cover of a plant species by the mean total species canopy cover of the sampling unit.

Basal cover is the proportion of ground occupied by the crowns of grasses and rooting stems of forbs and shrubs. Like the total cover estimates, basal cover estimates do not exceed 100 percent. Basal cover is measured to understand decadal trends in plant community development but not used in the evaluation of reclamation success. Photographs of each transect and quadrat were taken to preserve a record of the conditions at the time of sampling.

3.2 Shrub Density

Shrub density, or the number of woody plants per area, was determined using a belt transect method (Bonham, 1989). Shrub density was determined from a 2-meter wide, 30-meter long belt transect along the perimeter of the dog-legged transect (Figure 3). Shrubs rooted in the belt transect were counted. Counts were made on a species basis. Shrub density was also calculated based on plant frequency data collected for each quadrat.

3.3 Plant Diversity

Plant diversity is assessed by comparing the number and average canopy cover for individual perennial species by life form found in the remediated East Removal Borrow Area to the technical standard developed for Chino (Section 2). The number of perennial grass (warm and cool seasons), perennial forb, and shrub species observed within the quadrats and their associated canopy cover levels were compared to the technical standard (Table 2).

3.4 Sample Adequacy

The number of samples required to characterize a particular vegetation attribute depends on the uniformity of the vegetation and the desired degree of certainty required for the analysis. Sample adequacy is the minimum number of samples required to estimate a parameter within a given level of precision (Cochran 1977) and must be met for classical null hypothesis testing for bond release comparisons (MMD 1999). In contrast, vegetation monitoring activities, like those performed at the East Removal Borrow Area, do not need to have this level of statistical rigor. Often it is impractical to achieve sample adequacy in vegetation monitoring studies and a minimum sample number approach is taken. MMD recognizes this limitation and has provided minimum sample sizes for various quantitative methods (MMD 1996).

The number of samples necessary to meet sample adequacy was calculated for total canopy cover and shrub density assuming the data were normally distributed using Snedecor and Cochran (1967).

$$N_{min} = \frac{t^2 s^2}{(\overline{x}D)^2}$$

Where N_{min} equals minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\overline{x}$ is the mean, and D is the desired level of accuracy, which is 10% of the mean. Sample adequacy is achieved when there is 90% confidence that the sample mean for total canopy cover is within 10% of the true population mean. The vegetation monitoring of the remediated site does not require or did not attempt to meet sample adequacy, though the number of samples necessary to meet sample adequacy is reported.

4.0 RESULTS

This section provides a summary of the precipitation regime since the East Removal Borrow Area was seeded and the results of the 2019 monitoring event. Vegetation attributes were measured at 20 quadrats along 5 randomly located transects within the remediated site (Figure 2). Work was performed on October 4 and 5, 2019. The tables in Appendix A summarize individual quadrat data and photographs of the quadrats are provided in Appendix B.

4.1 Precipitation

The amount and distribution of precipitation are important determinants for the progression of vegetation particularly during the establishment phases of reclamation. Once established, the precipitation dynamics affect the vegetation cover levels on a year-to-year basis, with grasses and forbs showing the most immediate affects.

The nearest precipitation gauge to the East Removal Borrow Area is about 4 miles southwest, near Pond 7. Cumulative annual precipitation in 2019 was 13.46 inches and was below the long-term average of 15.8 inches (Table 3). The growing season precipitation in 2019 was 5.49 inches and was also below the long-term average of 9.97 inches. While the total annual precipitation was above the regional average of about 16 inches at Ft. Bayard (WRCC 2019) in 2017, pronounced annual and seasonal precipitation deficits have been common in the region. Since seeding the site in 2014, growing season precipitation has been slightly to well below average for six of the last seven years, with 2017 being above average (Figure 4).

Table 3: Monthly, Seasonal, and Annual Precipitation for Pond 7

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Seasonal
2010	2.09	0.95	0.49	0.24	0.12	0.29	6.37	1.82	1.01	0.42	0.00	0.20	**14.00**	*9.61*
2011	0.01	0.05	0.00	0.00	0.00	0.09	1.64	3.58	0.66	0.51	0.92	3.08	**10.54**	*5.97*
2012	0.18	0.70	0.16	0.00	0.08	0.02	0.92	2.04	0.68	0.08	0.00	0.23	**5.09**	*3.74*
2013	0.56	0.00	0.00	0.04	0.00	0.00	3.80	1.92	1.75	0.00	0.78	0.74	**9.59**	*7.47*
2014	0.00	0.00	0.39*	0.24	0.00	1.14	1.49	1.70	4.98	1.57	0.21	0.61	**11.94**	*9.31*
2015	1.66	0.34	0.39	0.11	0.17	1.65	2.54	2.89	1.36	1.85	0.66	0.41	**14.03**	*8.61*
2016	0.58	0.13	0.01	0.51	0.13	0.42	1.59	2.60	1.07	0.15	3.82	1.60	**12.61**	*5.81*
2017	2.73	1.04	0.02	0.01	0.36	1.29	2.92	6.49	0.39	0.30	0.23	0.34	**16.12**	*11.45*
2018	0.07	1.50	0.01	0.00	0.00	1.09	2.87	0.49	1.96	2.38	0.18	1.34	**11.89**	*6.41*
2019	0.70	0.33	0.52	0.19	0.14	0.50	1.14	1.79	1.92	0.85	4.23	1.15	**13.46**	*5.49*
Fort Bayard**														
	0.88	0.85	0.68	0.38	0.47	0.82	3.32	3.30	2.06	1.24	0.75	1.05	**15.80**	*9.97*

Notes:
Seasonal = growing season is May through September
* Partial data for month
** Long-term average from Western Regional Climate Center

4.2 Canopy Cover

Canopy cover at the East Removal Borrow Area was less than the proportional cover requirement of 70% of the Reference Area (Table 4). Mean total canopy cover was 38.4% ± 7.7% (90% CI), which is about 59% of the Reference Area average total canopy cover (64.6%). Vegetation canopy cover in the 20 individual quadrats ranged from 3.3 to 77.5% (Appendix A, Table A1). Mean perennial canopy cover was 36.0% ± 8.0% (90% CI) and ranged from 2.7 to 79.2% in the individual quadrats. The ground cover components for the East Removal Borrow Area are displayed on Figure 5a and consists of 38.4% vegetation, 17.1% rock, 13.4% litter, and 31.1% bare soil. The calculated N_{min} for canopy cover was 88 samples (Table 4).

The proportional or relative canopy cover for the plant classes (annual grasses, perennial grasses, annual forbs, perennial forbs, and shrubs) is illustrated in Figure 5b for the East Removal Borrow Area. Perennial grasses contribute the most to vegetation canopy cover with a relative contribution of 62.2%. Sideoats grama (*Bouteloua curtipendula*), a warm-season perennial grass and spike dropseed (*Sporobolus contractus*) an intermediate season perennial grass, were the most abundant (Table 5). Perennial forbs represented 17.3% of the total relative canopy, with Wright's thimblehead (*Hymenothrix wrightii*) contributing the most canopy cover of the forb species recorded by the quadrats. Relative annual forb cover was 10.88% and included eight species, with New Mexico goosefoot (*Chenopodium neomexicanum*) contributing the most canopy cover. Relative shrub cover was 9.55% and included four species, with four-wing saltbush (*Atriplex canescens*) contributing the most canopy cover. Annual grasses contributed the least to canopy cover with 0.05% relative canopy cover on the reclamation.

Table 4: Summary Statistics for the East Removal Borrow Area

Vegetation Metric	East Removal Borrow Area	Chino Tailing Reference Area[4]
Total Canopy (%)		
Mean	38.4	64.6 (45.2)
Standard Deviation	20.9	
90% Confidence Interval	7.7	
N_{min}[1]	88	
Probability within true mean[2]	0.59	
Basal Cover (%)		
Mean	2.4	No Applicable Standard
Standard Deviation	1.6	
90% Confidence Interval	0.6	
N_{min}[1]	123	
Probability within true mean[2]	0.61	
Shrub Density (stems/acre) from Quadrats		
Mean	2,023	11,001 (6,600)
Standard Deviation	3,596	
90% Confidence Interval	1,323	
N_{min}[3]	944	
Probability within true mean[2]	0.78	
Shrub Density (stems/acre) from Belt Transect		
Mean	1,916	3,193 (1,916)
Standard Deviation	785	
90% Confidence Interval	577	
N_{min}[3]	76	
Probability within true mean[2]	0.53	

Notes:
[1] Minimum number of samples required to obtain 90% probability that the sample mean is within 10% of the population mean
[2] Probability the true value of the mean is within 10 percent of the mean for the sample size
[3] Minimum number of samples required at 80 percent level of confidence that the sample mean is within 10 percent of the population mean
[4] Reference Area total cover means are based on four years of data (see Section 2). Proportional success standard in parenthesis

4.3 Basal Cover

Basal cover associated with vegetation is a fraction of the total canopy cover and reflects the morphology of the predominant vegetation in the Chino Mine operational area (i.e., bunchgrasses, annual forbs, and shrubs). Although basal cover is not evaluated for revegetation success, it was measured to aid in ecological interpretations of a site on a decadal scale. Basal cover is an important attribute because it is less affected by annual climatic variations than canopy cover, and thus, provides a consistent basis for evaluating trends or changes in community structure over time.

The mean basal cover at the East Removal Borrow Area was 2.4% ± 0.6% (90% CI, Table 4). Vegetation basal cover in the individual quadrats (n=20) ranged from 0.1 to 5.7% (Appendix A, Table A2). The ground cover components on a basal basis for the East Removal Borrow Area are displayed on Figure 6a and consists of 2.4%

vegetation, 24.4% rock, 24.7% litter, and 48.5% bare soil. The calculated N_{min} for basal cover was 123 samples (Table 4).

The proportional or relative basal cover for the plant classes (annual grasses, perennial grasses, annual forbs, perennial forbs, and shrubs) is illustrated in Figure 6b for the East Removal Borrow Area. Basal cover on the reclamation is dominated by perennial grasses with almost 82% relative basal cover.

4.4 Shrub Density

Shrub density at the East Removal Borrow Area was equivalent the proportional shrub density requirement of 60% of the Reference Area (Table 4) as determined by the belt transect (n=5) but was less than the shrub frequency in the quadrats (n=20). Based on stem frequency in the quadrats, mean shrub density was 2,023 stems/ac on the reclamation and 11,001 stems/ac on the Reference Area. Four of the of the 14 woody plant species identified on the East Removal Borrow Area were captured in the quadrat data (Table 5). Mean shrub density determined by belt transects was 1,916 stems/ac on the reclamation which is equivalent to the 60% Reference Area standard (Table 4). Shrub density for the remediated East Removal Borrow Area is considered more than satisfactory at this stage of the reclamation. Nine shrub species were encountered in the belt transects with four-wing saltbush being the most frequently measured species (Appendix A, Table A4). The calculated N_{min} for shrub density on the East Removal Borrow Area was 944 samples for frequency data and 76 samples for the belt transects (Table 4).

4.5 Diversity

In the fall of 2019, 72 species were identified in the reclaimed plant community on the East Removal Borrow Area (Table 5). With only 15 species in the seed mix (Table 1), these data indicate plant diversity is increasing in response to colonization of native species from the surrounding areas. Annual weedy species like cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola tragus*) occur at very low levels. In 2019, 46 species were captured in the 20 individual quadrats on the reclamation.

The vegetation on the East Removal Borrow Area meets the diversity requirements for warm-season grasses, cool/intermediate-season grasses, and forbs but not for shrubs. Four warm-season perennial grasses met the 1.0% cover diversity standard, including sideoats grama (8.6%), James' galleta (4.1%, *Pleuraphis jamesii*), blue grama (4.0%, *Bouteloua gracilis*), and green sprangeltop (3.7%, *Leptochloa dubia*) (Table 5). The intermediate season grass spike dropseed (4.3%) meets the diversity standard for one cool- or intermediate season grass with 0.5% cover. Without consideration for duration, 17 forbs exceed the 0.1% cover diversity standard for forb cover. Excluding annuals, the forbs with the greatest canopy cover are Wright's thimblehead (1.7%) and tanseyleaf tansyaster (1.5%, *Machaeranthera tanacetifolia*). Four-wing saltbush was the only shrub meeting the 1.0% canopy cover diversity standard, with canopy cover estimated at 3.5%. Other shrubs that contributed to canopy cover included soaptree yucca (0.4%, *Yucca elata*), with both broom snakeweed (*Gutierrezia sarothrae*), and threadleaf groundsel (*Senecio flaccidus*) contributing <0.1% each. Although four-wing saltbush is recorded as dominant, 14 woody plants are present on the reclamation in the East Removal Borrow Area. A representative photograph of the vegetation on the East Removal Borrow Area for 2019 is shown in Figure 7.

Table 5: Comprehensive Plant List, Vegetation Cover, and Density for the East Removal Borrow Area

Scientific Name	Common Name	Code	Average Vegetation Cover (%)			Density (plants/m²)[b]
			Canopy	Basal	Relative[a]	
Cool-Season Grasses						
Annual						
Bromus tectorum	Cheatgrass	BRTE	<0.1	<0.01	0.01	0.05
Perennial						
Achnatherum hymenoides	Indian ricegrass	ACHY	0.4	0.01	0.86	0.35
Elymus elymoides	Bottlebrush squirreltail	ELEL	--	--	--	--
Intermediate Season Grasses						
Perennial						
Sporobolus contractus	Spike dropseed	SPCO4	4.3	0.21	10.73	3.70
Sporobolus cryptandrus	Sand dropseed	SPCR	<0.1	<0.01	0.07	0.15
Warm-Season Grasses						
Annuals						
Aristida adscensionis	Six-weeks threeawn	ARAD	<0.1	<0.01	0.04	0.25
Bouteloua barbata	Sixweeks grama	BOBA2	--	--	--	--
Chloris virgata	Feather fingergrass	CHVI4	--	--	--	--
Perennial						
Aristida purpurea	Purple threeawn	ARPU	--	--	--	--
Aristida ternipes	Spidergrass	ARTE3	<0.1	0.02	0.23	0.40
Bothriochloa barbinodis	Cane bluestem	BOBA3	--	--	--	--
Bouteloua curtipendula	Sideoats grama	BOCU	8.6	0.77	21.34	13.45
Bouteloua gracilis	Blue grama	BOGR2	4.0	0.52	9.92	10.20
Dasyochloa pulchella	Low woollygrass	DAPU7	<0.1	<0.01	0.02	0.25
Leptochloa dubia	Green sprangletop	LEDU	3.7	0.22	9.01	5.50
Pleuraphis jamesii	James' galleta	PLJA	4.1	0.25	10.00	6.25
Setaria leucopila	Streambank bristlegrass	SELE6	--	--	--	--
Forbs						
Annual						
Amaranthus palmeri	Carelessweed	AMPA	<0.1	<0.01	0.22	0.20
Chenopodium neomexicanum	New Mexico goosefoot	CHNE	1.6	<0.01	3.95	0.05
Chamaesyce prostrata	Spurge	CHPR	0.2	<0.01	0.41	0.65
Eriogonum polycladon	Annual pink buckwheat	ERPO	0.4	<0.01	0.89	0.65
Heliomeris longifolia	Longleaf false goldeneye	HELO6	<0.1	<0.01	0.06	0.05
Heterotheca subaxillaris	Telegraph plant	HESU3	0.5	0.02	1.15	1.50
Machaeranthera gracilis	Slender goldenweed	MAGR	0.3	<0.01	0.73	1.80
Salsola tragus	Russian thistle	SATR	1.4	0.04	3.47	5.05
Annual/Biennial/Perennial						
Astragalus nuttallianus	Smallflowered milkvetch	ASNU4	<0.1	<0.01	0.19	0.10
Glandularia bipinnatifida	Dakota mock vervain	GLBI2	--	--	--	--
Annual/Biennial/Perennial						
Hymenothrix wrightii	Wright's thimblehead	HYWR	1.7	0.05	4.20	1.20
Machaeranthera canescens	Purple aster	MACA	--	--	--	--

Scientific Name	Common Name	Code	Average Vegetation Cover (%)			Density (plants/m^2)[b]
			Canopy	Basal	Relative[a]	
Machaeranthera tanacetifolia	Tanseyleaf tansyaster	MATA	1.5	0.03	3.71	3.95
Medicago sativa	Alfalfa	MESA	--	--	--	--
Mentzelia multiflora	Adonis blazingstar	MEMU	0.5	<0.01	1.15	0.20
Portulaca pilosa	Rose purslane	POPI3	<0.1	<0.01	0.19	0.10
Ranunculus species	Unknown buttercup	RANUN	--	--	--	--
Tragopogon dubius	Yellow salsify	TRDU	--	--	--	--
Perennial						
Astragalus mollissimus	Woolly locoweed	ASMO7	<0.1	<0.01	0.09	0.05
Astragalus parryi	Parry's milkvetch	ASPA13	<0.1	<0.01	<0.01	0.05
Chamaesyce albomarginata	Rattlesnake weed	CHAL11	0.3	<0.01	0.62	0.20
Chaetopappa ericoides	Rose heath	CHER	<0.1	<0.01	0.10	0.45
Cirsium species	Unknown thistle	CIRSI	<0.1	<0.01	0.12	0.05
Dalea candida	White prairie clover	DACA	--	--	--	--
Dalea lanata	Woolly prairie clover	DALA3	<0.1	<0.01	<0.01	0.05
Dalea nana	Dwarf dalea	DANA	<0.1	<0.01	0.20	0.15
Eriogonum racemosum	Redroot buckwheat	ERRA3	0.3	<0.01	0.62	0.25
Eriogonum wrightii	Bastardsage	ERWR	<0.1	<0.01	0.04	0.05
Hoffmannseggia glauca	Hog potato	HOGL2	0.3	<0.01	0.65	0.85
Linum lewisii	Lewis flax	LILE	0.4	0.05	0.86	0.05
Lotus wrightii	Wright's deervetch	LOWR	<0.1	<0.01	<0.01	0.05
Mirabilis linearis	Narrowleaf four-o'clock	MILI	0.6	<0.01	1.36	0.05
Ratibida columnifera	Prairie coneflower	RACO3	--	--	--	--
Senna bauhinioides	Twinleaf senna	SEBA3	0.7	0.10	1.64	1.25
Solanum douglasii	Greenspot nightshade	SODO	<0.1	<0.01	0.12	0.10
Solanum elaeagnifolium	Silverleaf nightshade	SOEL	0.2	<0.01	0.43	0.55
Sphaeralcea coccinea	Scarlet globemallow	SPCO	--	--	--	--
Sphaeralcea fendleri	Fendler's globemallow	SPFE	--	--	--	--
Sphaeralcea emoryi	Emory's globemallow	SPEM	<0.1	<0.01	0.03	0.05
Stephanomeria pauciflora	Skeleton weed	STPA4	--	--	--	--
Thelesperma megapotamicum	Hopi tea greenthread	THME	0.4	<0.01	1.00	11.25
Shrubs, Trees, and Cacti						
Artemisia ludoviciana	White sagebrush	ARLU	--	--	--	--
Atriplex canescens	Four-wing saltbush	ATCA	3.5	0.04	8.58	0.25
Baccharis salicifolia	Mule-fat	BASA4	--	--	--	--
Calliandra eriophylla	Fairyduster	CAER	--	--	--	--
Gutierrezia sarothrae	Broom snakeweed	GUSA	<0.1	<0.01	<0.01	0.10
Isocoma tenuisecta	Burroweed	ISTE2	--	--	--	--
Juniperus deppeana	Alligator juniper	JUDE2	--	--	--	--
Juniperus monosperma	Oneseed juniper	JUMO	--	--	--	--
Krascheninnikovia lanata	Winterfat	KRLA	--	--	--	--
Prosopis glandulosa	Honey mesquite	PRGL	--	--	--	--
Senecio flaccidus	Threadleaf groundsel	SEFL3	<0.1	<0.01	0.01	0.05

Scientific Name	Common Name	Code	Average			
			Vegetation Cover (%)			Density (plants/m^2)[b]
			Canopy	Basal	Relative[a]	
Ulmus pumila	Siberian elm	ULPU	--	--	--	--
Yucca elata	Soaptree yucca	YUEL	0.4	0.02	0.93	0.10
Zinnia grandiflora	Rocky Mountain zinnia	ZIGR	--	--	--	--
Cover Components						
Total Canopy Cover			38.4	2.44		
Rock			17.1	24.37		
Litter			13.4	24.71		
Bare Soil			31.1	48.48		

Notes:
[a] Relative Cover = percent canopy cover of a plant species divided by the mean total species canopy cover of the sampling unit
[b] 0.01 plants per square meter (plants/m^2) is equal to 40.5 stems per acre (plants/ac)
-- = observed on the site during monitoring, but not recorded in the quadrats

5.0 SUMMARY

The primary objective for revegetation of the East Removal Borrow Area is to limit wind and water erosion for remediated areas through the re-establishment of a native plant community. Golder conducted a quantitative vegetation survey of the site to document the progress of revegetation five years after completion of the IRA. Canopy cover, shrub density and diversity were measured and compared to the reference area technical guidance for Chino South Mine. This guidance is typically applied in 2 of the last 4 years of the 12-year liability period after seeding as part of demonstrating reclamation success.

The revegetation efforts associated with the IRA at the Razorback Ridge Area are considered successful. An early-seral stage mixed grama-shrub community is well established across the East Removal Borrow Area. Based on the 2019 sampling, mean total canopy cover in the fifth growing season is 38.4%, which is 65% of the 12-year Reference Area guidance for canopy cover. Given the less than favorable precipitation during the vegetation establishment period and the condition of the plant community in 2019, the strong canopy cover demonstrates that the remediated plant community has resiliency and is expected to be self-sustaining over time. Shrub density was measure at about 2,000 stems/acre by both the belt transect and quadrat frequency methods, which is 60% of the shrub density for the Reference Area.

Fifty-seven plant species that were not included in the reclamation seed mix were identified at the East Removal Borrow Area. Recruitment of native plant species into the reclaimed plant community demonstrates the process of ecological succession and the gradual establishment of self-sustaining ecosystem. Vegetation on the remediated site meets the diversity requirements for forbs and warm-season and cool/intermediate-season grasses. Four warm-season, perennial grasses met the minimum occurrence of 1% canopy cover. One intermediate-season perennial grass met the cool/intermediate-season grass standard of 0.5%. Three biennial/perennial forbs met the minimum occurrence of 0.1% canopy cover. Only one woody plant species met the minimum 1% canopy cover threshold.

No significant erosion issues were documented during the 5-year monitoring period, and the currently established plant community meets the overall objective as a best management practice for erosion control. The reclaimed plant community provides significant canopy cover, while also providing both ecological and rangeland values to the area.

Results from the 2019 vegetation survey of the Razorback Ridge Area IRA indicate that revegetation efforts were successful and the Year 5 survey data demonstrate that the vegetation on the East Removal Borrow Area is performing well for this early stage of the reclamation. The site supports a viable vegetated cover that is approaching Chino's vegetation success standards for total canopy cover and diversity and progressing toward the IRA objective to return the area to a post-mining beneficial use (i.e., wildlife habitat). No additional vegetation monitoring is recommended as the interim remedial action for the remediated site will remain under the oversight of the Chino AOC and will be addressed and released under the STSIU's Record of Decision.

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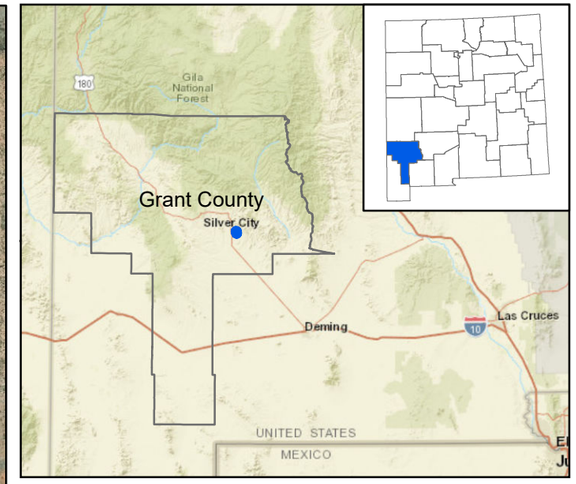
Figures



LEGEND

- Razorback Ridge Hillside Borrow Area
- East Removal Borrow Area
- Chino Tailing Impoundments
- Tailing Reference Area

0 2,200 4,400

FEET

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCES: ESRI, HERE, GARMIN, USGS, INTERMAP, INCREMENT P, NRCAN, ESRI JAPAN, METI, ESRI CHINA (HONG KONG), ESRI KOREA, ESRI (THAILAND), NGCC, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY

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PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1983

CLIENT
FREEPORT MCMORAN CHINO MINES COMPANY
RAZORBACK RIDGE AREA IRA
GRANT COUNTY, NEW MEXICO

PROJECT
2019 QUANTITATIVE VEGETATION MONITORING
RAZORBACK RIDGE AREA

TITLE
RAZORBACK RIDGE AREA SITE LOCATION

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-23
DESIGNED	DSW
PREPARED	GFD
REVIEWED	DR
APPROVED	TS

PROJECT NO.	CONTROL	REV.	FIGURE
19128014	A003	0	1

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RR19-T1(A)

RR19-T2(A)

RR19-T4

RR19-T5

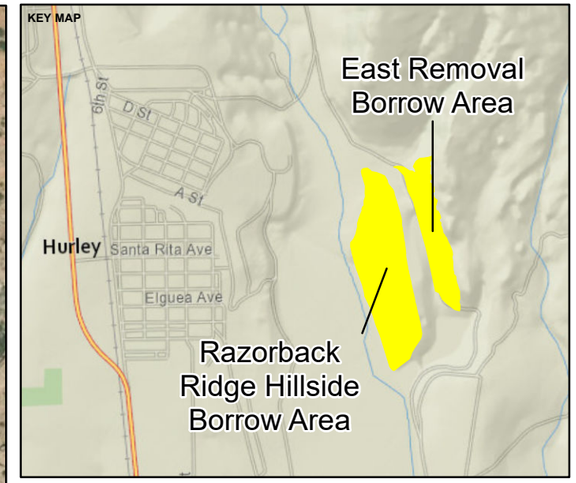
RR19-T2

Whitewater Creek Diversion

Lake One Reclamation

Razorback Ridge Hillside Borrow Area

KEY MAP



LEGEND

- Vegetation Monitoring Transects
- Razorback Ridge Hillside Borrow Area
- East Removal Borrow Area
- Lake One Reclamation

0 375 750

Feet

REFERENCE(S)

1. SERVICE LAYER CREDITS: SOURCE: ESRI, DIGITALGLOBE, GEOEYE, EARTHSTAR GEOGRAPHICS, CNES/AIRBUS DS, USDA, USGS, AEROGRID, IGN, AND THE GIS USER COMMUNITY
NATIONAL GEOGRAPHIC, ESRI, GARMIN, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, INCREMENT P CORP.

COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1983

CLIENT
FREEPORT MCMORAN CHINO MINES COMPANY
RAZORBACK RIDGE AREA IRA
GRANT COUNTY, NEW MEXICO

PROJECT
2019 QUANTITATIVE VEGETATION MONITORING
RAZORBACK RIDGE AREA

TITLE
RAZORBACK RIDGE AREA
VEGETATION TRANSECT LOCATIONS, 2019

CONSULTANT
GOLDER

YYYY-MM-DD	2020-04-23
DESIGNED	DSW
PREPARED	GFD
REVIEWED	DR
APPROVED	TS

PROJECT NO.	CONTROL	REV.	FIGURE
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Figure 3: Vegetation Plot, Transect, and Quadrat Layout

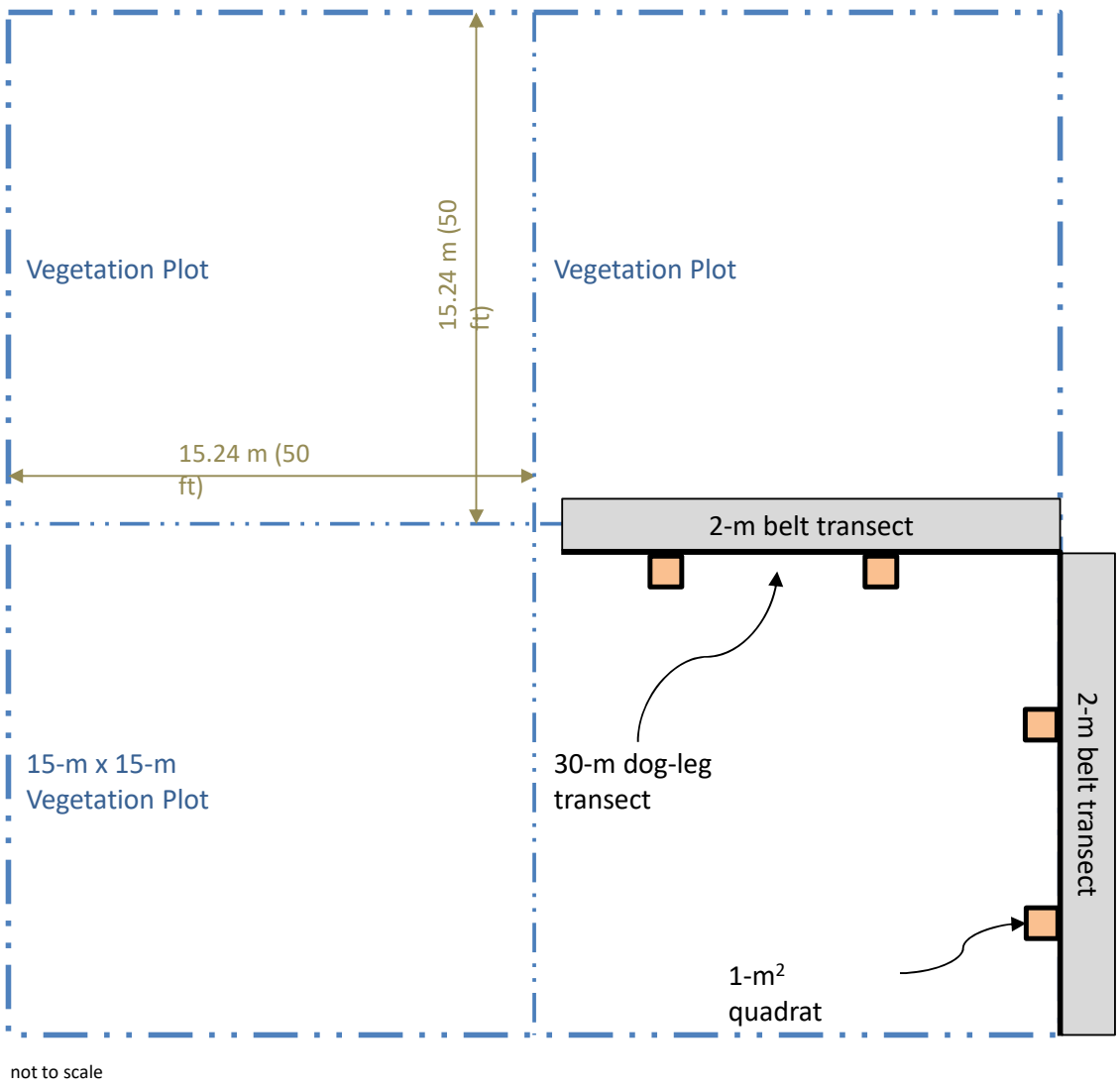
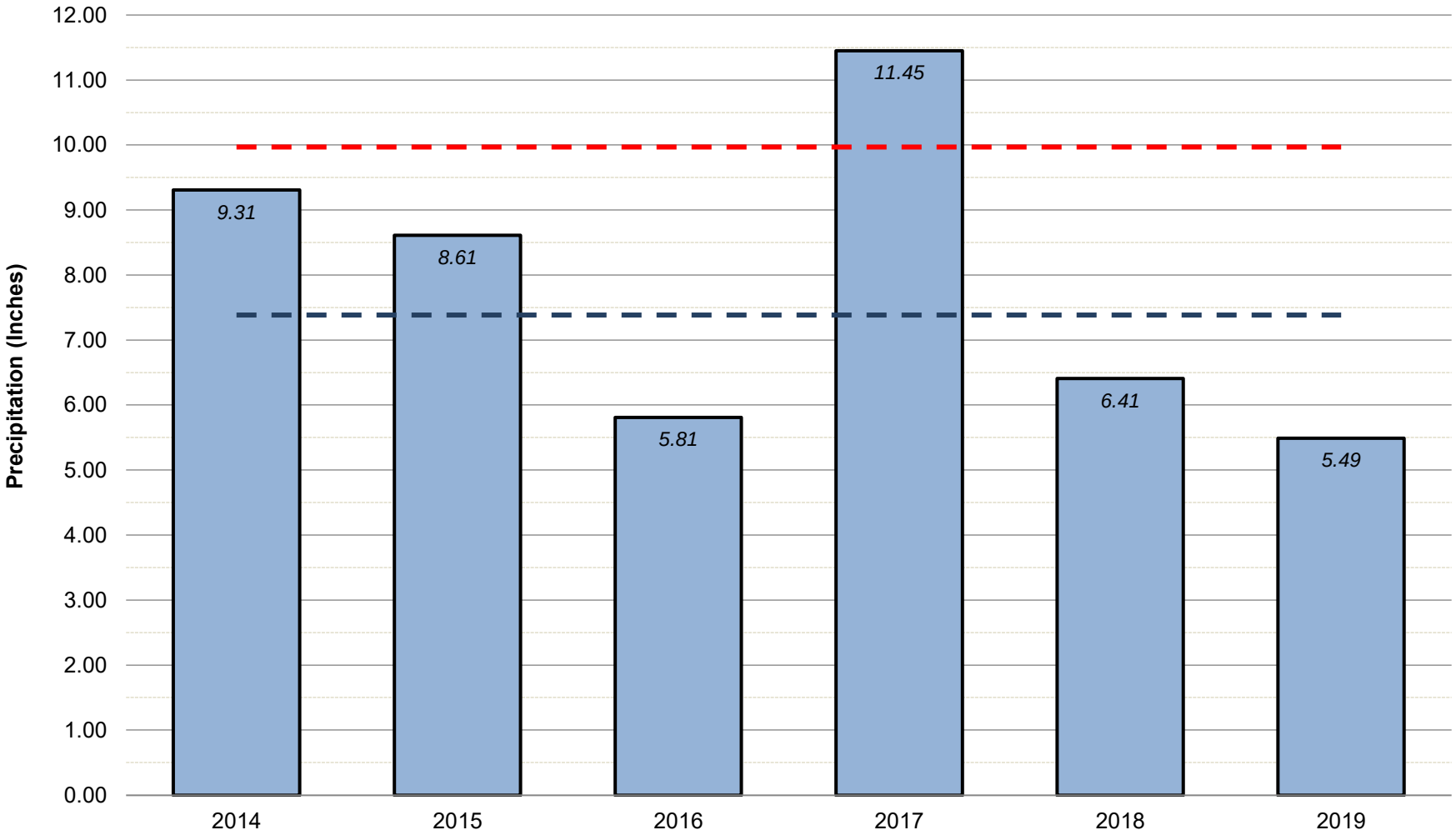


Figure 4: Growing Season Precipitation (2014-2019)



Notes:
Fort Bayard Average Based on 1897 - 2006
Pond 7 Average Based on 2010 - 2019

Figure 5: Vegetation Canopy Cover Components and Proportional Canopy Cover by Plant Class

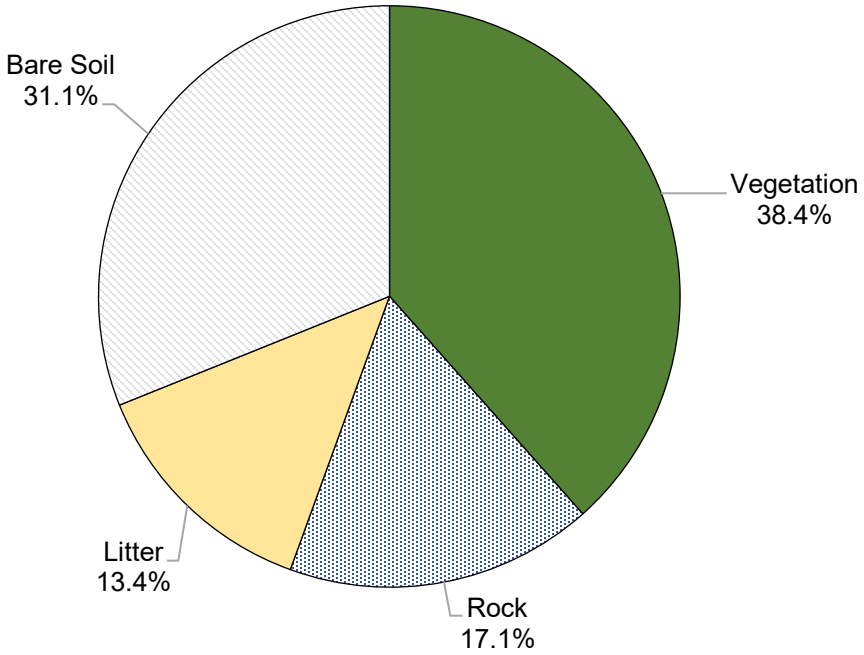


Figure 5a: Canopy Cover Components

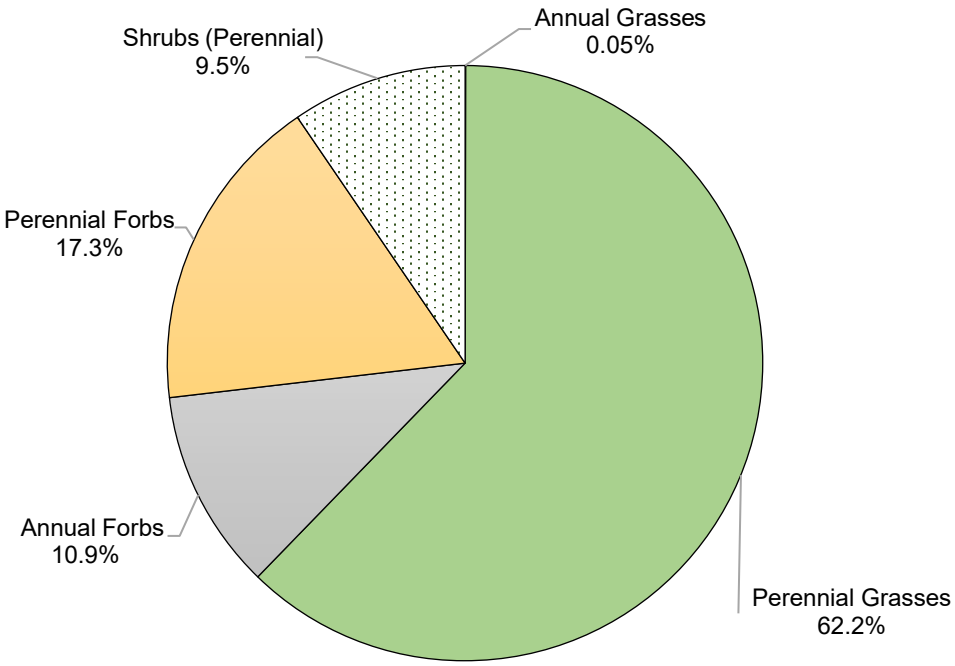


Figure 5b: Proportional Canopy Cover by Plant Class

Figure 6: Vegetation Basal Cover Components and Proportional Basal Cover by Plant Class

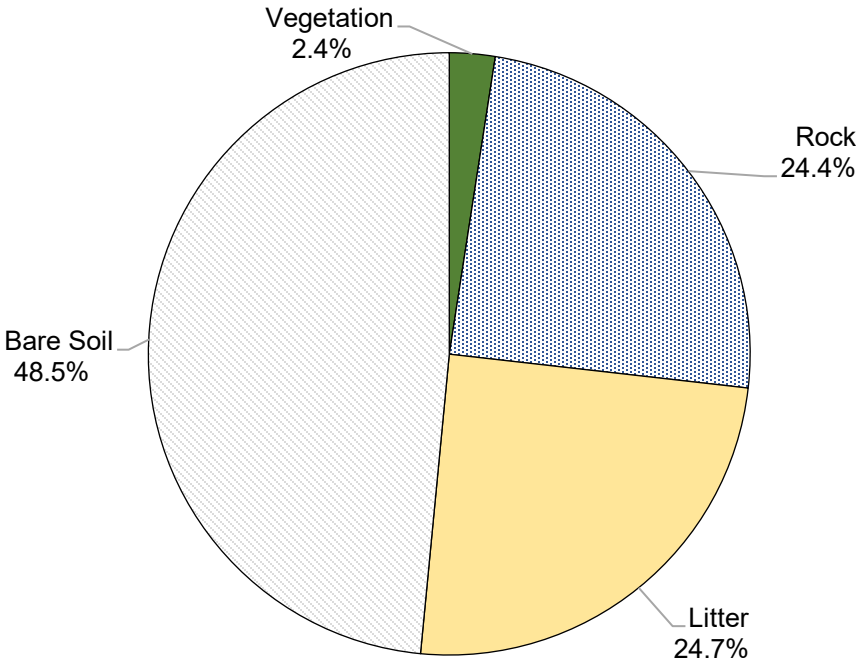


Figure 6a: Basal Cover Components

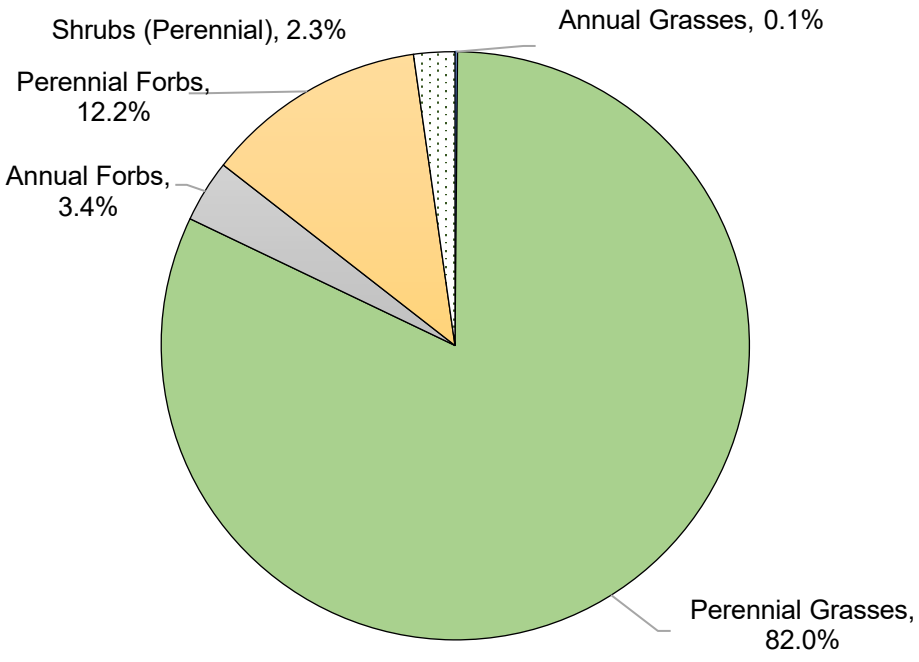


Figure 6b: Proportional Basal Cover by Plant Class

Figure 7: Typical Vegetation in the East Removal Borrow Area, October 2019

APPENDIX A

Vegetation Quadrat Data

Table A1: East Removal Borrow Area Canopy Cover (%)

Transect	RR19-T1(A)				RR19-T2				RR19-T2(A)				RR19-T4				RR19-T5			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																				
Annuals																				
ARAD	--	--	--	--	--	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1
Perennials																				
ACHY	4.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0
ARTE3	--	1.0	--	--	--	--	--	--	0.9	--	--	--	--	--	--	--	--	--	--	--
BOCU	7.0	--	4.5	8.0	--	--	--	--	44.0	36.5	3.0	10.0	13.8	--	--	26.0	--	--	--	20.0
BOGR2	--	9.3	1.0	--	--	--	--	--	19.5	28.5	--	7.0	7.1	--	--	--	--	--	--	8.0
DAPU7	--	--	--	--	--	0.2	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--
LEDU	1.5	5.8	32.0	--	--	--	--	--	--	--	--	--	2.0	3.4	18.0	--	--	2.4	8.0	--
PLJA	--	0.3	4.5	--	--	--	--	--	6.5	1.5	23.0	3.0	34.5	5.7	--	--	--	--	2.0	--
SPCO4	--	--	--	--	52.5	3.4	2.5	--	--	--	17.0	--	--	--	--	--	11.5	--	--	--
SPCR	--	--	--	--	0.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																				
Annual																				
AMPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.3	--	--	0.5
CHNE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	32.0	--	--	--	--	--
CHPR	--	--	--	--	2.0	1.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERPO	0.2	--	--	--	--	--	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5
HESU3	--	--	--	--	1.2	0.1	8.0	--	--	--	--	--	--	--	--	--	--	--	--	--
MAGR	--	--	--	--	2.8	0.9	2.0	--	--	0.3	--	--	--	--	--	--	--	--	--	--
SATR	20.0	--	--	T	--	--	--	--	--	--	--	--	--	5.9	--	--	0.8	0.7	--	0.8
Annual/Biennial																				
MATA	--	--	T	0.2	--	--	2.0	2.0	8.3	--	--	4.0	--	0.3	7.0	--	--	--	0.4	6.0
Annual/Perennial																				
ASNU4	--	--	--	--	--	1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POPI3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.5	0.1	--	--
Annual/Biennial/Perennial																				
HYWR	--	--	--	--	--	1.0	7.0	26.0	--	--	--	--	--	--	--	--	--	--	--	--
MEMU	9.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennial																				
ASMO7	--	--	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ASPA13	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL11	--	--	--	--	--	--	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--
CHER	0.9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CIRSI	--	--	--	--	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DALA3	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DANA	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERRA3	--	--	--	--	--	--	5.0	--	--	--	--	--	--	--	--	--	--	--	--	--
ERWR	--	--	--	--	--	--	--	--	--	--	--	--	--	0.4	--	--	--	--	--	--
HOGL2	--	--	--	--	3.8	--	--	1.0	--	--	--	--	--	--	--	--	--	--	--	0.5
LILE	--	--	--	--	--	--	--	7.0	--	--	--	--	--	--	--	--	--	--	--	--
LOWR	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MILI	--	--	--	--	11.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SEBA3	--	--	--	--	--	2.3	11.0	--	--	--	--	--	--	--	--	--	--	--	--	--
SODO	--	--	--	--	--	--	--	1.0	--	--	--	--	--	--	--	--	--	--	--	--
SOEL	--	0.2	0.3	--	--	0.3	1.5	--	--	1.3	--	--	--	--	--	--	--	--	--	--
SPEM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--
THME	--	--	--	--	7.0	1.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrubs, Trees, and Cacti																				
ATCA	--	--	--	7.0	--	--	--	--	--	--	--	28.0	7.5	--	--	--	27.0	--	--	--
GUSA	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SEFL3	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
YUEL	--	--	--	--	--	7.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																				
Perennial Cover	22.7	16.5	43.2	15.2	74.9	18.9	34.1	37.0	79.2	67.8	43.0	52.0	64.9	9.7	25.0	26.0	40.0	2.7	10.4	37.5
Total Vegetation Cover	42.5	16.0	41.0	15.0	74.5	21.2	48.0	35.0	77.5	57.4	42.0	48.0	63.0	15.3	53.0	26.0	40.5	3.3	10.4	39.0
Rock	2.5	29.5	4.0	12.0	0.5	52.0	12.0	10.0	11.5	2.4	22.0	6.0	7.5	68.0	18.0	25.0	8.0	1.4	50.0	0.0
Litter	38.5	3.6	27.0	25.0	24.0	8.3	2.0	0.0	8.5	11.0	35.0	8.0	2.0	1.3	20.0	15.0	27.0	1.8	9.0	0.5
Bare Soil	16.5	51.0	28.0	48.0	1.0	18.5	38.0	55.0	2.5	29.2	1.0	38.0	27.5	15.5	9.0	34.0	24.5	93.5	30.7	60.5

Notes:
Species codes defined in Table 5

Table A2: East Removal Borrow Area Basal Cover (%)

Transect	RR19-T1(A)				RR19-T2				RR19-T2(A)				RR19-T4				RR19-T5			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																				
Annuals																				
ARAD	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T
Perennials																				
ACHY	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10
ARTE3	--	0.20	--	--	--	--	--	--	0.15	--	--	--	--	--	--	--	--	--	--	--
BOCU	1.00	--	0.30	1.50	--	--	--	--	2.50	1.70	0.10	2.00	1.30	--	--	3.00	--	--	--	2.00
BOGR2	--	2.00	0.10	--	--	--	--	--	2.80	2.35	--	1.00	1.30	--	--	--	--	--	--	0.75
DAPU7	--	--	--	--	--	0.05	T	--	--	--	--	--	--	--	--	--	--	--	--	--
LEDU	0.10	0.15	3.00	--	--	--	--	--	--	--	--	--	0.20	0.40	0.40	--	--	T	0.20	--
PLJA	--	0.05	0.30	--	--	--	--	--	0.12	0.25	2.00	0.10	1.65	0.35	--	--	--	--	0.20	--
SPCO4	--	--	--	--	1.75	0.05	T	--	--	--	2.00	--	--	--	--	--	0.30	--	--	--
SPCR	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																				
Annual																				
AMPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	T
CHNE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10	--	--	--	--	--
CHPR	--	--	--	--	T	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERPO	T	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T
HESU3	--	--	--	--	0.05	T	0.30	--	--	--	--	--	--	--	--	--	--	--	--	--
MAGR	--	--	--	--	0.05	T	T	--	--	0.08	--	--	--	--	--	--	--	--	--	--
SATR	0.55	--	--	T	--	--	--	--	--	--	--	--	--	0.05	--	--	0.05	T	--	T
Annual/Biennial																				
MATA	--	--	T	T3	--	--	0.10	0.01	0.10	--	--	0.05	--	T	0.20	--	--	--	T	0.10
Annual/Perennial																				
ASNU4	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POPI3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10	T	--	--
Annual/Biennial/Perennial																				
HYWR	--	--	--	--	--	T	T	1.00	--	--	--	--	--	--	--	--	--	--	--	--
MEMU	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennial																				
ASMO7	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ASPA13	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL11	--	--	--	--	--	--	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--
CHER	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CIRSI	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DALA3	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DANA	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERRA3	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--
ERWR	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--
HOGL2	--	--	--	--	0.05	--	--	T	--	--	--	--	--	--	--	--	--	--	--	T
LILE	--	--	--	--	--	--	--	1.00	--	--	--	--	--	--	--	--	--	--	--	--
LOWR	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MILI	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SEBA3	--	--	--	--	--	T	2.00	--	--	--	--	--	--	--	--	--	--	--	--	--
SODO	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--
SOEL	--	T	T	--	--	T	T	--	--	T	--	--	--	--	--	--	--	--	--	--
SPEM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--
THME	--	--	--	--	0.10	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrubs, Trees, and Cacti																				
ATCA	--	--	--	0.20	--	--	--	--	--	--	--	0.10	0.10	--	--	--	0.30	--	--	--
GUSA	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SEFL3	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--
YUEL	--	--	--	--	--	0.35	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																				
Total Vegetation Cover	2.00	2.43	3.85	1.77	2.17	0.78	2.73	2.08	5.67	4.41	4.10	3.25	4.55	0.86	0.70	3.00	0.78	0.12	0.43	3.12
Rock	9.00	32.50	7.00	15.00	7.00	61.50	14.00	25.00	37.00	4.50	28.00	8.00	16.50	71.50	55.00	30.00	13.50	1.35	51.00	0.05
Litter	54.00	6.00	30.00	30.00	51.00	3.75	6.00	1.00	41.00	26.00	66.80	18.00	34.00	3.85	30.00	18.00	58.00	1.85	13.00	2.00
Bare Soil	35.00	59.07	59.15	53.23	39.83	33.97	77.27	71.92	16.33	65.09	1.10	70.75	44.95	23.79	14.30	49.00	27.72	96.68	35.57	94.84

Notes:
Species codes defined in Table 5

Table A3: East Removal Borrow Area Frequency (counts)

Transect	RR19-T1(A)				RR19-T2				RR19-T2(A)				RR19-T4				RR19-T5			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																				
Annuals																				
ARAD	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
Perennials																				
ACHY	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
ARTE3	--	7	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
BOCU	19	--	5	8	--	--	--	--	62	85	4	9	37	--	--	33	--	--	--	7
BOGR2	--	45	3	--	--	--	--	--	19	112	--	10	7	--	--	--	--	--	--	8
DAPU7	--	--	--	--	--	4	1	--	--	--	--	--	--	--	--	--	--	--	--	--
LEDU	3	22	12	--	--	--	--	--	--	--	--	--	4	17	14	--	--	9	29	--
PLJA	--	2	10	--	--	--	--	--	11	15	30	4	33	13	--	--	--	--	7	--
SPCO4	--	--	--	--	41	11	2	--	--	--	17	--	--	--	--	--	3	--	--	--
SPCR	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																				
Annual																				
AMPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	1
CHNE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
CHPR	--	--	--	--	3	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERPO	1	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
HESU3	--	--	--	--	3	11	16	--	--	--	--	--	--	--	--	--	--	--	--	--
MAGR	--	--	--	--	4	23	5	--	--	4	--	--	--	--	--	--	--	--	--	--
SATR	74	--	--	2	--	--	--	--	--	--	--	--	--	15	--	--	5	2	--	3
Annual/Biennial																				
MATA	--	--	1	2	--	--	9	10	18	--	--	8	--	2	21	--	--	--	1	7
Annual/Perennial																				
ASNU4	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POPI3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--
Annual/Biennial/Perennial																				
HYWR	--	--	--	--	--	4	1	19	--	--	--	--	--	--	--	--	--	--	--	--
MEMU	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennial																				
ASMO7	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ASPA13	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL11	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--
CHER	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CIRSI	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DALA3	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DANA	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERRA3	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--
ERWR	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
HOGL2	--	--	--	--	9	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--
LILE	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
LOWR	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MILI	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SEBA3	--	--	--	--	--	5	20	--	--	--	--	--	--	--	--	--	--	--	--	--
SODO	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--
SOEL	--	3	3	--	--	1	1	--	--	3	--	--	--	--	--	--	--	--	--	--
SPEM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
THME	--	--	--	--	4	221	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrubs, Trees, and Cacti																				
ATCA	--	--	--	1	--	--	--	--	--	--	--	1	1	--	--	--	2	--	--	--
GUSA	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SEFL3	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
YUEL	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
Species codes defined in Table 5

Table A4: East Removal Borrow Area Belt Transect Data

East Removal Borrow Area						
	Transect	RR19-T1(A)	RR19-T2	RR19-T2(A)	RR19-T4	RR19-T5
Species Code	ATCA	20	2	26	5	7
	BRCA	--	--	--	1	--
	CAER	1	--	--	9	--
	GUSA	23	8	--	--	1
	ISTE2	1	--	--	--	--
	PRGL	--	1	1	--	2
	SEFL3	3	14	--	6	1
	YUEL	--	1	--	3	2
	ZIGR	--	--	--	--	4

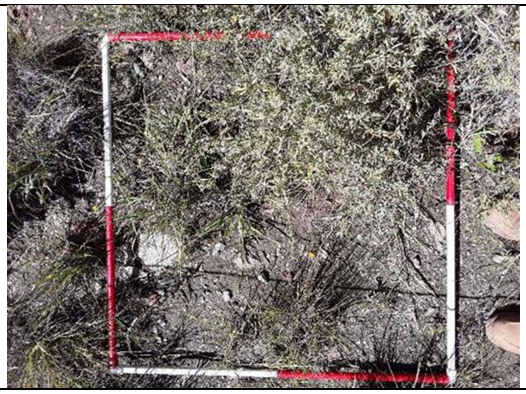
Notes:

Code	Scientific Name	Common Name
ATCA	*Atriplex canescens*	Four-wing saltbush
BRCA	*Brickellia californica*	California brickellbush
CAER	*Calliandra eriophylla*	Fairyduster
GUSA	*Gutierrezia sarothrae*	Broom snakeweed
ISTE2	*Isocoma tenuisecta*	Burroweed
PRGL	*Prosopis glandulosa*	Honey mesquite
SEFL3	*Senecio flaccidus*	Threadleaf groundsel
YUEL	*Yucca elata*	Soaptree yucca
ZIGR	*Zinnia grandiflora*	Rocky Mountain zinnia

APPENDIX B

Vegetation Quadrat Photos

East Removal Borrow Area Vegetation Quadrat Photos, 2019	
	
RR19-T1(A) Q-1	RR19-T1(A) Q-2
	
RR19-T1(A) Q-3	RR19-T1(A) Q-4
	
RR19-T2 Q-1	RR19-T2 Q-2
	
RR19-T2 Q-3	RR19-T2 Q-4

	
RR19-T2(A) Q-1	RR19-T2(A) Q-2
	
RR19-T2(A) Q-3	RR19-T2(A) Q-4
	
RR19-T4 Q-1	RR19-T4 Q-2
	
RR19-T4 Q-3	RR19-T4 Q-4

	
RR19-T5 Q-1	RR19-T5 Q-2
	
RR19-T5 Q-3	RR19-T5 Q-4

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