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September 11, 2024

Mr. Sabrina (Alex) Birchfield
McKinley Mine Team Leader
USDI – Office of Surface Mining, Reclamation and Enforcement
PO Box 26065
Denver, CO 80225

Delivered via email to:
wbirchfield@osmre.gov

Re: McKinley Mine
Permit No. NM-0001K
Vegetation Management Unit 1 Final Bond Release and
Liability Release & Termination of Jurisdiction Application

Dear Mr. Birchfield:

Enclosed for OSMRE review is an application for final bond release on Permanent Program lands and full reclamation liability release and termination of jurisdiction on Initial Program lands in Vegetation Management Unit 1. There are approximately 928 acres associated with this application. CMI requests OSMRE's review and comment on the completeness and content of this application package to ensure that all necessary information is contained in the application document.

The initial submittal of the document on this date will be transmitted via a secure file transfer to download the documents referred above. A follow up submission will be made with the physical copy and six electronic copies of the report.

If you have any questions regarding this submittal, please contact me at (575) 586-7537 or Mary Siemsglusz at (314) 984-8800.

Sincerely,

Jeff Schoenbacher
McKinley Mine – Operations Lead
CEMREC

Mary Siemsglusz, P.E.
Vice President
WSP USA, Inc

Encl

McKinley Mine Permit No. NM-0001K
Vegetation Management Unit 1
Application for a Permanent Program Final Bond Release and
Initial Program Reclamation Liability Release & Termination of Jurisdiction

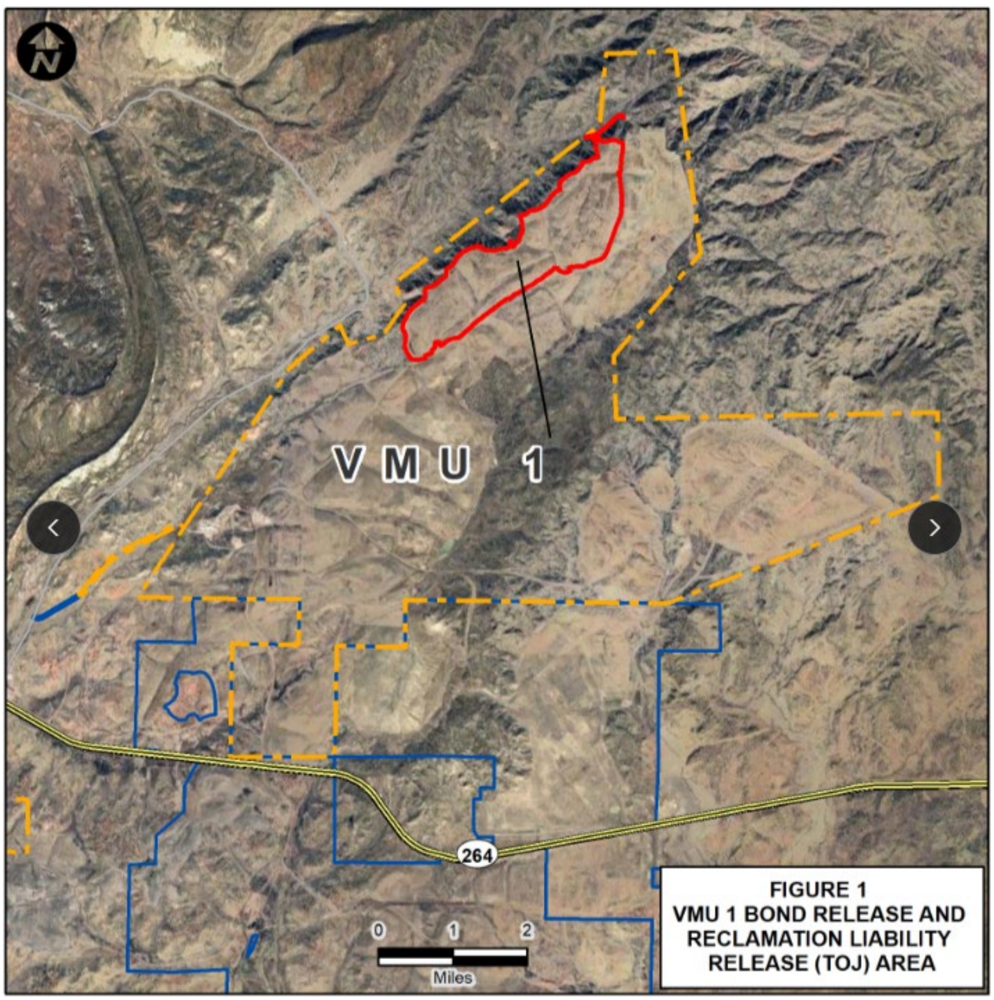
Submitted to:	The Office of Surface Mining Reclamation and Enforcement Western Region Office P.O. Box 25065 Denver, Colorado 80225-0065
Submitted by:	Chevron Environmental Management Company On behalf of Chevron Mining Inc. 6001 Bollinger Canyon Road, C-2144 San Ramon, CA 94583-2324
Prepared by:	WSP USA, Inc. 701 Emerson Road, Suite 250 Creve Coeur, Missouri, 63141
Date:	August 30, 2024

1.0 Overview

On behalf of Chevron Mining Inc. (CMI), the Chevron Environmental Management Company (CEMC) hereby submits this application for a Phase III bond release of Permanent Program Lands (PPL) and a reclamation liability release and termination of jurisdiction (TOJ) of Initial Program Lands (IPL) for reclaimed lands in Vegetation Management Unit 1 (VMU 1). The application includes a request for a Phase I, II and III bond release on two permanent impoundments in VMU 1. The associated performance bond reduction requested in this application is $1,562,000, as discussed in Section 12 of this document.

The lands are generally located in Areas 5 and 6 of the McKinley Mine. Figure 1 shows the location and configuration of VMU 1.

Figure 1: General Location of VMU 1



The McKinley Mine is permitted under Permit NM-0001K (the Permit). The McKinley Mine permittee is CMI (formerly the Pittsburg and Midway Coal Mining Co. [P&M]).

This application addresses bond release requirements under 30 CFR 800.40 (c) (3) and the Office of Surface Mining, Reclamation, and Enforcement's (OSMRE's) Permanent Program Phase III bond release guidance provided in the following document:

> Guideline to Bond Release Procedures for Permanent Program Lands, Indian Programs Branch, Western Region (OSMRE Bond Release Guideline) (OSMRE 2017).

The application demonstrates that the plant community is moving toward a desired successional trajectory to meet the intended postmining land use per 30 CFR 816.111 and the currently approved Permit. Reclamation was completed in conformance with the performance standards in 30 CFR 715 for IPL and 30 CFR 816 and the PP permit for PPL. The PPL reclamation also meets all applicable requirements of the performance standards in 30 CFR Part 810 through 828.

VMU 1 combines IPL and PPL in accordance with Section 6.5.1.2 of the Permit, and together as one logical unit must meet the Permit revegetation success standards, which they do, as discussed in this application. The lands constitute a bond release block as described in the OSMRE Bond Release Guideline. The period of extended responsibility of ten years for the PP lands has been met in accordance with 30 CFR 816.116. The IPL has been revegetated for decades well beyond the minimum two growing seasons for cover called for in 30 CFR 715.20 (f). In accordance with the OSMRE Bond Release Guideline, this application contains information that demonstrates revegetation success in any two years following Year 6 of the responsibility period, which is 2019 and 2023.

The application has been organized to address together both PPL and IPL application requirements as much as possible. The application follows this order of information: 2.0 Application Certification, 3.0 VMU 1 Location and Regulatory Acreages, 4.0 Brief History, 5.0 Access Roads, 6.0 Surface and Subsurface Water, 7.0 Erosion and Sediment Control, 8.0 Postmining Water-Containment Structures, 9.0 Postmining Land Use, 10. Revegetation, 11.0 Wildlife Habitat Enhancements, 12.0 Performance Bond, 13.0 Landowner Notification, 14.0 Newspaper Advertisement. Section 15.0 Supplemental Information for Initial Program Lands; this section includes information to make the reclamation liability release and TOJ IPL application complete.

2.0 Application Certification

An executed Application Certification is contained in Appendix A1, which certifies that all applicable reclamation activities have been completed in VMU 1 that are necessary for a Phase I, II and III for the impoundments, a Phase III bond release of the rest of the PPL, and a full reclamation liability release and TOJ of IPL. The document also states that these activities were done in accordance with applicable mine permits, reclamation requirements, and regulations, and consistent with the intent of the Act.

The Application certification includes a statement that there are no outstanding violations or cessation orders for the lands contained in this application.

3.0 VMU 1 Location and Regulatory Acreages

VMU 1 consists of 928 acres of land, all within the Navajo Reservation Boundary. The approximate center of VMU 1 is Latitude 35.707696 N, Longitude -108.941708 W. VMU 1, which consists of PPL and IPL as shown on Exhibit E1. Minor adjustments were made to the initial VMU 1 configuration for a polygon with a logical release boundary. Exhibit E2 shows the location of VMU 1 relative to the other McKinley Mine VMUs. Table T1 shows the VMU 1 acreage by regulatory category.

Table T1: VMU 1 by Regulatory Category (in acres).

Initial Program Lands	287
Permanent Program Lands	641
VMU 1 Total Acres	928
Two Permanent Impoundments (Included in Permanent Program Lands acreage above)	6.3

A USGS 7.5 Minute Quadrangle map (from the Window Rock Quadrangle) with the boundaries of VMU 1 depicted on it is provided on Exhibit E3.

4.0 Brief History

This VMU 1 configuration overlaps parts of two previous Phase I and II bond release applications on the PPL. The first application was the Areas 3 and 5 Phase I and Phase II Bond Release Application, which was initially submitted on August 22, 2019. The second application was the Area 6 Phase I and Phase II Bond Release Application, which was initially submitted on May 28, 2019. Both applications were approved through OSMRE correspondence dated January 29, 2020. There have been no previous applications for reclamation liability release and TOJ on the IPL. Exhibit E4 shows the

VMU 1 boundary superimposed over the previous Phase I and II bond release applications.
VMU 1 consists of lands in both Mining Area 5 and Mining Area 6. The general locations of the mining areas are labelled on Exhibit E4. Primary mining was done by dragline in Area 5, which proceeded from east to west. In Area 6, primary mining was also dragline proceeding from a westerly direction to the east.

The various reclamation phases through seeding were conducted contemporaneously with mining activities. Seeding began in the IPL in 1984 and in the PPL in 1991. More details on seeding may be found in the revegetation section below.

5.0 Access Roads

The Navajo Nation requested that two-track trails be the primary accesses for the postmining land users. Section 5.1.5 and 5.6.3.7 in the Permit contain details regarding configurations for the postmining road system in accordance with the Navajo Nation request. Annual updates to the currently active road system shown on Exhibit 5.1-4 are submitted to OSMRE for incorporation into the Permit. Exhibit 5.1-4 dated March 27, 2024, was used as the source of the road locations for the final postmining primary road system provided in this application. Exhibit E5 shows the final postmining primary road network in and around VMU 1. The location of the primary road network within VMU 1 has been certified by a professional engineer.

6.0 Surface and Subsurface Water

This section provides information regarding impacts to surface and subsurface water by lands in VMU 1. The VMU 1 lands are reclaimed and revegetated such that they are not contributing total suspended solids to streamflow or runoff outside the permit area. A detailed analysis is provided in Appendix A2 entitled, Vegetation Management Unit 1 Final Bond Release and Liability Release & Termination of Jurisdiction Application (Trihydro 2024), which also includes information on ground water. The data will also show that there is no alkaline or acid drainage coming from the reclaimed land.

Sedimentology and NPDES Outfalls

As stated in Section 5.7.4.3 of the Permit, extensive sediment-yield analyses have been done throughout the mine through paired watershed sampling and modelling that all demonstrated acceptable sediment yields for various reclaimed-land scenarios.

All outfalls at McKinley Mine are categorized under the EPA NPDES Western Alkaline Coal Mining (reclamation areas) standards, which focus on a sediment control plan (SCP) supported by modeling built around attaining sediment discharge levels that do not exceed pre-mining conditions. The primary attainment mechanism is monitoring of and compliance with Best Management Practices (BMPs). The BMPs for the reclaimed areas include the reconstructed landforms, the hydrologic structures (including terraces and downdrains, and armored channels), seeding and mulching, and revegetation. These BMPs are further augmented by the application of rock mulch in zones prone to higher levels of sheet erosion. Compliance is verified through collection of water monitoring data from outfall discharges and field inspections of the BMPs.

There is one NPDES outfall associated with VMU1: 011/DC 6-3. The location is shown on Exhibit 6.1-1, which is contained in Appendix A3. This outfall will be removed from the NPDES permit upon approval of this bond release application.

7.0 Erosion Control and Maintenance

Maintenance of structures and erosion has been conducted regularly during the liability period. Disturbance associated with the maintenance work was seeded and mulched.

8.0 Postmining Water-Containment Structures

This section contains support information for the design and function of permanent impoundments, small depressions (SDs), and reclamation channel pools (RCPs). Information regarding wildlife enhancements for these structures is provided in the Wildlife Habitat Enhancements section of this application.

Permanent Impoundments

The Navajo Nation requested that as many impoundments as possible be retained for the postmining land use (See Permit Appendix 5.6-B). To that end, VMU 1 has two permanent impoundments (PI) in this application: 5-1 and 5-2. The impoundments have been approved for retention by OSMRE and meet the requirements of 30 CFR 816.49 and the Permit. The impoundments were not included in Phase I or II applications since they were still temporary impoundments at the time. They are included in this application for Phase I, II and III bond release. The locations of these impoundments may be found in Exhibit E6.

Impoundment Design and Construction

The permanent impoundments were designed to be adequate for their intended use, and the water level will be sufficiently stable and capable of supporting grazing and wildlife, as discussed in Permit Section 5.7.3.4. Professional Engineer certified as-built drawings of the impoundments were submitted to OSMRE for incorporation into Permit Appendix 5.7-B. The impoundments were last inspected on May 9, 2024, and an impoundment report for each structure was certified on June 18, 2024. The volumes measured on May 9, 2024, are provided in Table T2, which includes the annual capacity loss from sedimentation and the expected life of the impoundments.

Table T2: Permanent Impoundment Summary

Impoundment	Volume (Ac-Ft)	Annual Capacity Loss (Ac-Ft)	Expected Life (Years)
5-1	18.82	0.25	>20
5-2	9.69	0.06	> 20

Impoundment Water Quality

The requirements for impoundment water quality may be found under 30 CFR 816.49 (b)(2). As discussed in Permit Section 5.6.3.4.3 Permanent Impoundment Water Quality, it was demonstrated that the water quality in these impoundments met the applicable water-quality standards for livestock watering.

Additional support information regarding the water quality demonstration for the permanent impoundments may be found in Appendix A2 (Trihydro 2024).

Small Depressions and Reclamation Channel Pools

VMU 1 has three small depressions (SD) (5 SD-1, 5 SD-2, and 5 SD-3) and three reclamation channel pools (RCP) (RCP 5-1, RCP 5-2, and RCP 5-3); the locations are shown on Exhibit E6. In accordance with 30 CFR 816.102 (h), the small depressions are compatible with the postmining land use, do not restrict normal access or constitute a hazard, conserve soil moisture, and promote revegetation and landscape diversity. The RCPs are constructed in drainage channels and are similar in function to small depressions.

9.0 Postmining Land Use

The IPL were reclaimed to rangeland for grazing, and the PPL have been reclaimed to a grazing and wildlife habitat postmining land use. As discussed below, both IPL and PPL together meet the revegetation success standards and are suitable for grazing and wildlife habitat.

10.0 Revegetation

After topdressing placement, the seedbed was scarified or ripped on the contour to a depth of about 8 to 12 inches. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, certified weed-free, long-stem, hay mulch, or straw was applied at a rate of about two tons per acre. The mulch was anchored 3 to 4 inches into the cover with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which tends to favor the establishment of cool-season grasses and shrubs. The approved seed mixes used at McKinley have varied over time but included both warm-season grasses and introduced and native cool-season grasses, introduced and native forbs, and shrubs. More detail by regulatory category (IPL or PPL) follows in the next two subsections.

PPL Revegetation

Final seeding was conducted after topdressing was applied. The PPL lands were mostly initially seeded from 1991-1996, with some small parcels done after that period. In 1998, there were 167.4 acres of interseeding to strengthen vegetation on land that had been previously seeded. Between 2007 and 2013, less than five acres were initially seeded. In limited areas, there was other reseeding or interseeding activity for areas that required erosion repair or that had low vegetation establishment. Seeding, reseeding, and interseeding activities are shown on Exhibit E7.

The permanent seed mix shown in Table 5.5-3 of the Permit (See Table T3 below) was the primary seed mix used based on the availability of the species listed. CMI worked with the seed supplier to substitute comparable species for unavailable seeds.

Table T3: Permanent Program Seed Mix

Table 5.5-3
McKinley Mine Permanent Seed Mix (OSM)

Common Name - Scientific Name	Bulk Total Mix % by WT	Bulk SubMix % by WT	Bulk Appl Rate Lbs/Ac	# Total Seeds/Lb	Bulk Appl Rate Seeds/Ac	% Purity	% Germination	Appl Rate PLS/Sq-Ft	Mix % by PLS/Sq-Ft	Application Rates & Mix% by PLS/sq-ft: Warm Season Grasses		Cool Season Grasses		Brush & Shrub		Forb/Legume Native		Forb/Legume Introduced	
DRILL SUBMIX																			
Western wheatgrass - Agropyron smithii	1.9%	3.7%	0.37	110,000	40,810	0.91	0.92	0.8	2.1%			0.8	2.1%						
Thickspike wheatgrass - Agropyron dasystachyum	1.3%	2.6%	0.26	154,000	39,270	0.97	0.87	0.8	2.0%			0.8	2.0%						
Streambank wheatgrass - Agropyron riparium	1.5%	3.0%	0.30	156,000	46,800	0.92	0.77	0.8	2.0%			0.8	2.0%						
Mountain brome - Bromus marginatus	2.1%	4.2%	0.42	90,000	37,800	0.91	0.99	0.8	2.1%			0.8	2.1%						
Arizona fescue - Fetuca arizonica	0.4%	0.8%	0.08	550,000	41,250	0.84	0.95	0.8	2.0%			0.8	2.0%						
Indian ricegrass - Oryzopsis hymenoides	2.6%	5.3%	0.53	141,000	74,025	0.96	1.00	1.6	4.3%			1.6	4.3%						
Sandberg bluegrass - Poa sandbergii	0.2%	0.4%	0.04	925,000	37,000	0.84	0.97	0.7	1.8%			0.7	1.8%						
Needle and Thread - Stipa comota	3.4%	6.8%	0.68	115,000	77,625	0.95	0.96	1.6	4.3%			1.6	4.3%						
Fourwing saltbush - Atriplex canescens	4.8%	9.5%	0.95	52,000	49,400	0.59	0.98	0.7	1.7%					0.7	1.7%				
Shadscale - Atriplex confertifolia	4.3%	8.7%	0.87	65,000	56,225	0.80	0.97	1.0	2.6%					1.0	2.6%				
Mat saltbush - Atriplex corrugata	4.2%	8.4%	0.84	60,000	50,400	0.60	0.94	0.7	1.7%					0.7	1.7%				
Trident saltbush - Atriplex tridentata	2.7%	5.3%	0.53	111,500	59,541	0.50	0.96	0.7	1.7%					0.7	1.7%				
Antelope bitterbrush - Purshia tridentata	19.7%	39.5%	3.95	15,000	59,175	0.93	1.00	1.3	3.3%					1.3	3.3%				
Blueflax - Linum lewisii	0.5%	1.0%	0.10	293,000	29,300	0.88	1.00	0.6	1.8%							0.6	1.6%		
Palmers penstemon - Penstemon palmeri	0.2%	0.4%	0.04	610,000	24,400	0.99	0.85	0.5	1.2%							0.5	1.2%		
Rocky Mtn. penstemon - Penstemon strictus	0.3%	0.5%	0.05	592,000	29,600	0.87	0.97	0.6	1.5%							0.6	1.5%		
Black-eyed susan - Rudbeckia hirta	0.1%	0.2%	0.02	1,710,000	25,650	0.94	1.00	0.6	1.5%							0.6	1.5%		
SUBMIX TOTAL	50.0%	100.0%			778,271			14.2	37.6%	0.0	0.0%	7.8	20.7%	4.2	11.2%	2.2	5.8%	0.0	0.0%
BROADCAST SUBMIX																			
Big bluestem - Andropogon gerardi	1.8%	3.7%	0.41	130,000	52,650	0.94	0.95	1.1	2.9%	1.1	2.9%								
Blue grama - Bouteloua gracilis	0.9%	1.8%	0.20	825,000	165,000	0.93	0.67	2.4	6.2%	2.4	6.2%								
Buffalograss - Buchloe dactyloides	4.2%	8.4%	0.93	56,000	51,800	0.92	0.99	1.1	2.9%	1.1	2.9%								
Switchgrass - Panicum virgatum	0.7%	1.4%	0.15	389,000	58,350	0.92	0.99	1.2	3.2%	1.2	3.2%								
Inland saltgrass - Distichilis stricta	0.6%	1.3%	0.14	520,000	72,800	0.84	0.82	1.1	3.0%	1.1	3.0%								
Galleta - Hilaria jamesii	5.9%	11.8%	1.30	159,000	206,541	0.89	0.56	2.4	6.3%	2.4	6.3%								
Alkali sacaton - Sporobolus airoides	0.3%	0.7%	0.08	1,758,000	131,850	0.91	1.00	2.8	7.3%	2.8	7.3%								
Silver sagebrush - Artemisia cana	2.1%	4.3%	0.47	850,000	399,500	0.79	0.12	0.9	2.3%					0.9	2.3%				
Fringed sagebrush - Artemisia frigida	0.1%	0.1%	0.01	4,536,000	49,896	0.78	0.95	0.9	2.3%					0.9	2.3%				
Black sagebrush - Artemisia nova	2.6%	5.2%	0.58	907,200	521,640	0.74	0.10	0.9	2.4%					0.9	2.4%				
Winterfat - Ceratoides lanata	12.6%	25.3%	2.77	56,700	157,116	0.60	0.80	1.7	4.6%					1.7	4.6%				
Cliffrose - Cowania mexicana	11.6%	23.2%	2.54	64,800	164,084	0.50	0.50	0.9	2.5%					0.9	2.5%				
White yarrow - Achellea millefolium	0.1%	0.2%	0.02	2,770,000	47,090	0.93	0.97	1.0	2.6%							1.0	2.6%		
Blanket flower - Gaillardia aristata	2.1%	4.2%	0.46	132,000	60,720	0.73	0.92	0.9	2.5%							0.9	2.5%		
Alfalfa - Medicago sativa	0.9%	1.8%	0.19	210,000	40,320	0.94	1.00	0.9	2.3%									0.9	2.3%
Sainfoin - Onobrychis viciaefolia	1.5%	3.0%	0.33	30,000	9,900	0.87	1.00	0.2	0.5%									0.2	0.5%
Prairie coneflower - Ratibida columnaras	0.2%	0.3%	0.04	1,230,000	43,050	0.83	0.96	0.8	2.1%							0.8	2.1%		
Globemallow - Sphaeralcea parvifolium	0.3%	0.7%	0.08	500,000	37,500	0.95	0.99	0.8	2.2%							0.8	2.2%		
Purple prairie clover - Petalostemum purpureum	0.8%	1.6%	0.18	210,000	36,750	0.95	1.00	0.8	2.1%							0.8	2.1%		
Strawberry clover - Trifolium fragiferum	0.6%	1.1%	0.13	300,000	37,500	0.96	1.00	0.8	2.2%							0.8	2.2%		
SUBMIX TOTAL	50.0%	100.0%	10.970		2,344,057			23.5	62.4%	12.0	31.8%	0.0	0.0%	5.3	14.1%	5.1	13.6%	1.1	2.8%
MIX TOTAL	100.0%				3,122,328			37.7	100.0%	12.0	31.8%	7.8	20.7%	9.5	25.3%	7.3	19.5%	1.1	2.8%

Revised 28-Feb-2000

Note: Purity and germination percentages are sample values and will change with each lot.

IPL Revegetation

Seeding and mulching followed topdressing. IPL lands were mostly seeded between 1984 and 1992, with reseeding of larger parcels done in 1987, 1991, and 1992. Appendix A4 contains drawings showing where and when these seedings occurred.

The seed mixes used varied over the years. While definitive records are not available for what was planted where, the Settlement Agreement B.8 Report-Volume I Revegetation report developed by the Pittsburg & Midway Coal Mining Co. (P&M (now CMI)) (SA B.8 Report) (P&M 1994) contained in Appendix 5.5-A of the Permit No. NM-0001K, has a table that summarizes the mixes that were used during the IP time period, which is provided in Table T4 below. Most of the IPL would have been initially seeded with the mixes shown during the 1980s. Interseedings and seeding of repaired areas in the more recent years were planted with mixes similar to those shown for the early 1990s. More recent interseeding and seeding of repair areas would have been done with the permanent seed mix in Table T3.

Table T4: Expected Seed Mixtures for IPL

	SPECIES Common Name - *Scientific Name*	MIX APPROVED BY YEAR			MIX PLANTED BY YEAR								
		spoil 73 75	topsoil 73 75	80	75	77	79	80-84	85	86-87	88 & 90	91	92
GRASSES	Alkali sacaton - *Sporobolus airoides*								●	●	●	●	●
	Sandberg bluegrass - *Poa sandbergii*								●	●	●	●	●
	Mountain brome - *Bromus marginatus*								●	●	●	●	●
	Smooth brome - *Bromus inermis*				●	●							
	Arizona fescue - *Festuca arizonica*								●	●	●		●
	Sheeps fescue - *Festuca ovina*											●	
	Galleta - *Hilaria jamesii*		●	●				●		●	●	●	●
	Blue grama - *Bouteloua gracilis*										●	●	●
	Sideoats grama - *Bouteloua curtipendula*			●			●	●	●	●	●	●	●
	Indian ricegrass - *Oryzopsis hymenoides*			●			●	●	●	●	●	●	●
	Mountain muhly - *Muhlenbergia montana*					●							
	Spike muhly - *Muhlenbergia wrightii*					●			●	●	●	●	●
	Sand dropseed - *Sporobolus cryptandrus*					●	●					●	●
	Crested wheatgrass - *Agropyron cristatum*	●	●		●	●							
	Intermediate wheatgrass - *Agropyron intermedium*			●				●					
	Pubescent wheatgrass - *Agropyron trichophorum*	●	●	●		●		●					
	Siberian wheatgrass - *Agropyron sibericum*	●	●		●	●							
	Slender wheatgrass - *Agropyron trichycautum*				●	●						●	
	Streambank wheatgrass - *Agropyron riparium*					●	●						
	Tall wheatgrass - *Agropyron elongatum*			●	●	●		●					
	Thickspike wheatgrass - *Agropyron dasystachyum*						●		●	●			
	Western wheatgrass - *Agropyron smithii*		●	●	●	●	●	●	●	●	●	●	●
SHRUBS	Fourwing saltbush - *Atriplex canescens*		●	●			●	●	●	●	●	●	●
	Shadscale - *Atriplex confertifolia*								●	●	●	●	●
	Winterfat - *Ceratoides lanata*			●				●	●	●	●	●	●
	Cliffrose - *Cowania mexicana*											●	●
	Utah serviceberry - *Amelanchier alnifolia*											●	●
	Skunkbush sumac - *Rhus trilobata*											●	●
FORBS	Alfalfa - *Medicago sativa*								●	●	●	●	●
	Black-eyed Susan - *Rudbeckia hirta*									●	●	●	●
	Blanket flower - *Gaillardia aristata*									●	●	●	●
	Blueflax - *Linum Lewisii*									●	●	●	●
	Purple prairie clover - *Petalostemum purpureum*											●	
	Red prairie coneflower - *Ratibida columnaris*											●	●
	Globemallow - *Sphaeralcea coccinea*								●	●	●		●
	Globemallow - *Sphaeralcea parvifolia*											●	
	Rocky Mtn. penstemon - *Penstemon strictus*								●	●	●	●	●
	Hooker evening primrose - *Oenothera hookeri*											●	
	Sainfoin - *Onobrychis viciaefolia*								●				
	Sulphur Flower - *Eriogonum umbellatum*									●			
	Yellow sweet clover - *Melilotus officinalis*				●	●							
	White yarrow - *Achillea millefolium*									●	●	●	●

Source: Settlement Agreement B.8 Report – Volume I: Revegetation

<u>Revegetation Success Standards</u>

Revegetation success standards are those provided in Table 5.5-1 of the Permit. There was a change to the revegetation success standards in 2023 through OSMRE-approved Permit Modification Number 23-03. The change in standards allowed for an improved and more accurate assessment of revegetation success. More information regarding and supporting this modification may be found in the Permit. Table T5 shows the revegetation success criteria that would be applicable for 2019 sampling data, and Table T6 shows the criteria for 2023 sampling results.

Table T5: Permanent Program Revegetation Success Standards for 2019 Sampling

Ground Cover	Total Ground Cover (Live Vegetation and Litter)		≥ 52%
	Perennial Vegetation Cover		≥ 24%
Diversity "Lifeform Statement	Perennial Grasses	All grasses	≥ 7% of cover
		Cool season	≥ 2 species, each ≥ 1.5% cover
		Warm season	≥ 2% contribution, ≥ 2 species, each ≥ 0.5% cover
	Perennial Forbs		≥ 3 species, combining for ≥ 1% relative cover.
	Shrubs	All shrubs	≥ 3% cover
		Any single species	≤ 70% relative total shrub cover
	Any single species (including weeds)		≤ 40% relative total vegetative cover
Production	Pounds/acre (air dry)		≥ 550 lbs/ac
Woody Plant Density			≥ 400/acre

Notes:
1) Success for cover, production, and stocking shall be ≥ 90% of the standard in accordance with 30 CFR 816.116 (a)(2).
2) Vegetative cover is foliar cover.
3) Production is above-ground biomass
4) Relative cover is the percent cover of a species divided by the total perennial cover of the sampling unit.

Table T6: Permanent Program Revegetation Success Standards for 2023 Sampling

Table 5.5-1: Revegetation Standards for McKinley Mine

Ground Cover	Total Ground Cover (Live Vegetation and Litter)		≥ 52%
	Perennial Vegetation Cover		≥ 24%
Diversity "Lifeform Statement"	Perennial Grasses	All grasses	≥ 7% cover
		Cool season	≥ 2 species, 1st species ≥ 5% relative perennial cover, 2nd species ≥ 2.5% relative perennial cover
		Warm season	≥ 2 species, 1st species ≥ 5% relative perennial cover, all other species combined ≥ 1.5% relative perennial cover
	Perennial Forbs		≥ 3 species, combining for ≥ 1% relative cover
	Shrubs	All shrubs	≥ 6% relative total perennial cover
		Any single species	≤ 70% relative total shrub density
	Any single species		≤ 40% relative total vegetative cover
Production	Pounds/acre (air dry)		≥ 550 lbs/ac
Woody Plant Density			≥ 400/acre

Notes:
1) Success for cover, production, and stocking shall be ≥ 90% of the standard in accordance with 30 CFR 816.116 (a)(2).
2) Total ground cover does not include noxious weeds.
3) Perennial vegetation cover is foliar cover from LPI, not including annuals and noxious weeds.
4) Relative cover is the percent cover of a species or functional group divided by the total vegetation cover.
5) Relative perennial cover is the total cover of a perennial species or perennial functional group divided by the total perennial cover (see below).
6) Total perennial cover includes shrubs, cactus, trees, perennial grasses and perennial forbs not including noxious species.
7) Relative total shrub density is the density of each woody species divided by the total woody plant density not including noxious weeds.
8) Production is above-ground biomass of forage species.

Revegetation Sampling
Vegetation sampling for bond release was conducted in 2019 through 2023. Many of the standards were met in a given year during the five years of sampling, but primarily production was not met in 2020, 2021 and 2022. All the standards, however, were met in 2019 and 2023, demonstrating that the revegetation success standards have been met in two growing seasons. Moreover, the longevity of the revegetation on the IPL that goes back 40 years shows the long-term resiliency of the vegetation. Vegetation sampling sites were selected that included IPL lands as called for in the Permit. The locations sampled, methodologies, and results may be found in the report entitled Vegetation Management Unit 1 (also referred to as O-VMU-1), Vegetation Success Monitoring, 2019 (Golder 2019) & 2023 (WSP 2023) in Appendix A5.

Sampling methodologies differed for some parameters in 2019 versus 2023 subsequent to approval by OSMRE of Permit Modification No. 23-03. The change in methodology allowed for better capture of data more representative of the revegetation conditions on the reclaimed land. More information regarding this change may be found in the Permit in Section 5.5. The reports detail what methodologies were used for the respective years of sampling.

Carrying Capacity

While there has been no formal grazing for carrying capacity demonstrations, this section contains information on the livestock carrying capacity for VMU 1. The calculations were based on an average of 30 days per month with a 50% utilization of the vegetation production values. Carrying capacity is in terms of the animal-unit-month (AUM), which is the amount of dry forage required by one animal unit for one month based on a forage allowance of twenty-six (26) pounds per day for a 1,000-pound cow either dry or with calf up to 6 months of age, or four (4) sheep or goats (MMD 2000).

Table T7 summarizes the carrying capacities calculated from VMU 1 forage production data collected in 2019 and 2023. The calculations were performed on both mean and median forage production values. The utility of these calculations can be assessed by comparing them to an acceptable range condition. To that end, the mine reclaimed soils best fit the NRCS range site description (RSD) for Shallow Savannah, and the carrying capacity for this RSD for a good range condition is 0.20 AUM/Ac (See SA B.8 Report in the Permit Appendix 5.5-A). The 2019 and 2023 forage production data for VMU 1 significantly exceed 0.20 AUM/AC, which supports that the intended postmining land use of grazing is met by the level of vegetation on the reclamation.

Table T7: VMU 1 Carrying Capacity Calculations for 2019 and 2023 Forage Production

	Forage Production lb/ac	Utilization	lb/ac	1 Cow usage lb/day	Forage days/ac	Days/Month	Months/Ac or % of month	AUM/Ac
19 VMU 1 Mean Forage	882	50.00%	441	26	16.96	30	0.5653846	0.57
19 VMU 1 Median Forage	674	50.00%	337	26	12.96	30	0.4320513	0.43
23 VMU 1 Mean Forage	771	50.00%	385.5	26	14.83	30	0.4942308	0.49
23 VMU 1 Median Forage	667	50.00%	333.5	26	12.83	30	0.4275641	0.43

<u>Weed Management</u>

Because the proposed Phase III bond release area plant community is moving toward a desired successional trajectory as per 30 CFR 816.111 and the currently approved Permit to meet the intended post-mine land use, continued ecologically-based invasive plant management practices have been employed. Various options for weed control are contained in the McKinley Mine Integrated Weed Management Plan (HMI 2018). The most effective tools from the weed management plan have been appropriately-timed herbicides and mechanical treatments, complemented with interseeding. The revegetation monitoring reports have not indicated that weeds have been problematic towards revegetation meeting revegetation success or the postmining land uses. Weeds are not included in measurements for revegetation success.

11.0 Wildlife Habitat Enhancements

Wildlife enhancements were completed in VMU 1 that included: application of the permanent seed mix (which contains species important for wildlife), creation of rock piles, enhanced shrub plantings in wildlife corridors, planting of materials beneficial to muledeer, construction of water-retaining structures (permanent impoundments, SDs and RCPs), riparian plantings, and wildlife fencing. Each of these categories is discussed below:

<u>Permanent Seed Mix</u>

The permanent seed mix contains species beneficial to wildlife for browse and cover. The mix includes important browse species, including shrubs such as Cliff rose or Antelope bitter brush, or a forb like Sainfoin. Shrubs such as Fourwing saltbush are also utilized for cover by small mammals, and even muledeer have been observed using it as cover.

Rock Piles

Rock piles to support wildlife habitat were constructed on both PPL and IPL. Rock piles were created from stones and boulders that became available during grading operations. The availability of suitably sized materials partially determined the number and distribution of these features. The rock features were generally constructed in piles or in elliptical shapes along the contour to maximize the surface area of each pile and facilitate topsoil replacement and revegetation operations. In some areas, rock was placed along the top or base of the slopes to simulate escarpment outcrops or ledge features. Shrub and/or tree planting was conducted to complement and augment the rock piles in some areas.

The rock piles range from about 20 to 400 square feet and from two to twelve feet high. The rock piles were constructed at an average density mine wide of about one per twenty acres of reclaimed land.

Permit Section 5.7.3.3 contains more details regarding rock piles. Exhibit E8 shows the rock pile locations.

Enhanced Shrub Planting in Wildlife Corridor

A wildlife corridor on permanent program lands was developed that extended from the north end of Area 6, south to Area 10 near State Highway 264; a part of that corridor extends through VMU 1. The corridor was established as a zone in which many of the supplemental plantings were done. Exhibit E8 shows the corridor.

The corridor has a permit requirement of 100 shrubs/acre comprising of at least four shrub species. The 100 shrubs/acre were to include plants established from the permanent seed mix, supplemental plantings, ad-mixes, and volunteer growth. As documented in Permit Section 5.7.3.2.1, this standard was met.

Muledeer plantings

Permit Section 5.7.3.2.3 contains a commitment to plant additional browse species beneficial to muledeer throughout the mine, which included sites in VMU 1. Table T8 (Table 5.5-1A from the Permit) shows the standard for the supplemental wildlife enhancement plantings.

This commitment was successfully completed and documented in the 2021 annual report. The report is entitled McKinley Mine: Mule Deer Additional Browse Species Planting Success (Golder 2022). Note that supplemental mule deer plantings also occurred as part of riparian plantings, as discussed in the next subsection.

Table T8: Permanent Program Requirements for Supplemental Wildlife and Pond/Riparian Plantings and Enhancements

Table 5.5-1a: Supplemental Wildlife and Pond/Riparian Plantings and Enhancements		
Supplemental Wildlife Enhancement Plantings	Supplemental perennial shrubs in proposed wildlife enhancement areas in accordance with Section 5.8.	≥ 4 target shrubs combining for ≥ 100 stems/acre; any single species ≤ 50%. Target species include Cliffrose, Antelope bitterbrush, Winterfat, Ephedra, ≤ 5% Rubber rabbitbrush, and other species approved by OSMRE.
Supplemental Pond/Riparian Enhancements	Enhancements at each pond/riparian area (i.e., fencing and riparian plantings), and weed control in accordance with Section 5.8.	Success will be based on detailed documentation demonstrating execution of planned enhancements, and documentation of the results of those efforts.

<u>Water-Retaining Structures and Riparian Plantings</u>

This section provides information on postmining water resources and associated riparian habitat enhancements. The term ponds is used in this subsection to broadly reference the permanent impoundments (PI), RCPs, and SDs. As stated earlier, VMU 1 contains two permanent impoundments (PI 5-1 and PI 5-2), 3 SDs (5 SD-1, 5 SD-2, and 5 SD-3) and 3 RCPs (RCP 5-11, RCP5-2, and RCP 5-3). These ponds are also part of a greater mine-wide network for access to water by wildlife (See Permit Section 5.8.3.4).

Ponds not only promote reclaimed-land diversity but also have conditions for riparian habitat establishment. To that end, a combination of riparian plantings was done that included live plantings and special seeding. The Permit (Appendix 5.8-B, Table 5.8-B1) lists the riparian species proposed for the plantings and the locations to be planted. Plantings were also done at other locations when there was an opportunity to do so. Table T8 (Table 5.5-1a from the Permit) lists the expectations around supplemental pond/riparian enhancements.

Table T9 in this application lists the kinds of plantings that were done at the ponds to demonstrate execution of the plan. This information was extrapolated from the 2022 and 2023 annual reports, which contain more details.

Table T9: Permanent Program Wildlife Enhancements Plan and Results Summary

	Cottonwood Live Poles	Coyote Willow Live Whips	Woods Rose Seedlings	Licorice Seedlings	Bulrush (From Seed)	Sedge (From Seed)	Pond AdMix (Seed)	Mule Deer Mix (Seed)	Wildlife Fence	Cattle Ramp
Structure										
PI 5-1	y	y	y		y	y	y	y	y	y
PI 5-2		y			y	y	y	y	y	y
RCP 5-1		y	y					y	y	
RCP 5-2		y	y	y				y	y	
RCP 5-3		y						y	y	
5 SD 1		Too dry to plant	y	y	y	y	y	y		
5 SD 2	Not identified for wildlife enhancement planting									
5 SD 3	Not identified for wildlife enhancement planting									
Note: Letter y indicates that the activity occurred in a pond as proposed in the permit										
	Green pattern indicates it was observed at a pond									
Survey Date: 8/28/24										

The results of the planting efforts are also shown in Table T9. The table identifies in a green pattern where live plantings were observed that survived, where there was expression of species from the various special seed mixes, or where there were occurrences of more mature target species that came from the permanent seed mix. Additional documentation regarding riparian plantings is provided in Appendix A6 that includes a more-detailed table, and photographs from each of the ponds.

IPL Plantings

There was a limited planting of Ponderosa pine that survived on IPL in Area 6 that were planted in the early 1990s, which brings added diversity to this older reclamation. The approximate planting location is shown on Exhibit E8.

Wildlife fencing

To promote the longevity of the riparian plantings and the utility of the ponds by wildlife, the Permit (Appendix 5.8-B, Table 5.8-B1) identified ponds to be fenced with wildlife-friendly fences (See Permit Section 5.8.3.4.2). In addition, to allow for controlled access to water by livestock, cattle ramps were installed in the PIs. Table T9 identifies which ponds had fences installed and which had cattle ramps constructed. Exhibit E8 shows these fenced structures and the acreage within the fenced areas.

12.0 Performance Bond

The current performance bond amount is shown on Table T10 for the remaining permanent program reclamation liability. There are two final costs to be deducted from the performance bond for VMU I at this last phase. The first bond deduction is for the cost to revegetate the reclaimed lands, which includes the acreage for the two impoundments. The other bond deduction is for the cost reserved in the bond to remove the impoundments. There is not bond associated with the SDs and RCPs.

The methodology for deducting the revegetation costs required factoring in that the performance bond is set up primarily by mining area. VMU 1 contains lands from different mining areas, and while prorating and tracking costs from each area could be done, it would be complex and difficult to follow in this application and in future applications for other Phase III bond releases.

Subsequently, the clearest and most supportable method to calculate the Phase III bond reduction is to multiply the number of PP acres in VMU 1 by the unit cost/acre to revegetate disturbed land from the bond assumptions. In a similar manner, the bond reduction for reclamation of the impoundments was calculated by multiplying the number of impoundments by the unit cost to remove each pond. The unit cost for pond reclamation included dewatering, backfilling, and grading.

The calculations for the bond reduction related to Phase III revegetation costs and ponds are provided in Appendix A7. The amount of bond to be released in this application and the remaining total bond are shown in Table T10. Approximately $83,000 of the total bond reduction is associated with Phase I and II costs for the pond removals.

Table T10: Performance Bond Summary

Current Total Bond Amount	Reclamation Bond Reduction	Remaining Total Bond
$53,921,545	$1,562,000	$52,359,545

13.0 Landowner Notification

The list of property owners and entities adjacent to the reclamation liability release area affected by this application is provided in Appendix A8. The appendix includes a typical copy of the notification letter with a map to be sent along with a list of recipients.

A copy of this application will be available for public inspection at the following locations:

Ms. Sabrina Alexander Birchfield
Western Region Office
Office of Surface Mining Reclamation and Enforcement
One Denver Federal Center, Building 41
Western Region Mine Plan Library
Lakewood, CO 80225-0065
Advance call required: WR Permitting Information Line 1-866-847-7362

The Navajo Nation Minerals Department – Office of Surface Mining Program
Window Rock Blvd
Window Rock, AZ 86515

County Clerk’s Office
McKinley County Courthouse
201 W. Hill Ave.
Gallup, NM 87301

14.0 Newspaper Advertisement

The reclamation liability release notice (and associated map) to be published in the local newspapers is provided in Appendix A9. The announcement will be published in both the Gallup Independent and Navajo Times for four consecutive weeks. Affidavits of publication from these newspapers will be sent to OSMRE.

15.0 Supplemental Information for Initial Program Lands

<u>Backfilling and Grading</u>

Backfilling and grading were conducted in a manner that promoted stability, eliminated spoil piles, and blended into unmined land. A proposed postmining topographical map was not available for this application. Spoil was graded to at least a 3H:1V slope in accordance with the IP regulations. A topographical map showing the final configuration may be found on Exhibit 9; the exhibit also shows cross section locations of the topography. Cross sections of the final topography are provided on Exhibit 10.

Exhibit E11 is an isogram with a gradient analysis for the slopes throughout the reclaimed area. Slopes showing as greater than 30 percent are typically affiliated with drainages.

<u>Potentially Acid and Toxic Forming Materials (PATFM)</u>

The level of PATFM monitoring on the IPL is unknown, although the reclaimed land today does not show evidence of poor soil conditions or revegetation. There were, however, treatment plans to address PATFM and bare ground concerns on some land in Area 6. Details concerning those activities are provided in reports contained in Appendix A10.

<u>Topdressing</u>

Topsoil replacement would have been done in conformance with 30 CFR 715.16 (b) Topsoil Redistribution. Regraded land would have been scarified prior to the placement of topdressing. Topsoil would have been redistributed in a uniform thickness (typically a minimum of six inches) and in a manner that minimized the potential for compaction.

Topsoil depth checks were conducted at five locations on IPL lands. The locations included a diversity of topographical locations, which included the top of a hill, various slopes, and the base of a hill. Topsoil was found to be at least six inches at the locations tested, which supports that at least a six-inch topdressing was applied at the time as required. Successful revegetation after 40 years, as discussed below, also supports that there is good soil medium for vegetation throughout the area. The locations where topsoil depth checks were conducted are shown on Exhibit E12.

Drainage Control

Drainage control technologies were instituted to create a stable landform and to safely route the design storm runoff through the reclaimed areas and into adjacent undisturbed lands. Terraces and downdrains were constructed on the IPL to promote controlled drainage of runoff from the reclaimed land.

Drainage channels that concentrate flow were armored with riprap to control runoff and to promote a smooth transition into undisturbed drainages. Exhibit 6 shows the locations of primary hydrologic structures installed to control runoff and minimize erosion.

Sedimentology and Surface Water

This section provides information regarding impacts to surface water by IPL in VMU 1. The section also covers sedimentology since that is directly related to surface water quality.

Sediment yields from VMU 1 IPL are expected to be below pre-mining levels based on the reclaimed landform, mine-wide sediment-yield analysis, and the EPA watershed status. Regarding the reclaimed landform, VMU 1 IPL were reconstructed in a manner consistent with stable landforms, hydrologic structures have been constructed in accordance with standard practice on the rest of the mine, and the land has been seeded, mulched, and revegetated.

As stated in Section 5.7.4.3 in PP Permit No. NM-0001K, extensive sediment-yield analyses have been done throughout the mine through paired watershed sampling and modelling that all demonstrated acceptable sediment yields for various reclaimed-land scenarios.

16.0 Bibliography

Habitat Management Inc. December 2018. McKinley Mine Integrated Weed Management Plan.

McKinley Mine Permit No. NM-0001K, 2016. OSMRE McKinley Mine SMCRA Mining and Reclamation Permanent Program Permit.

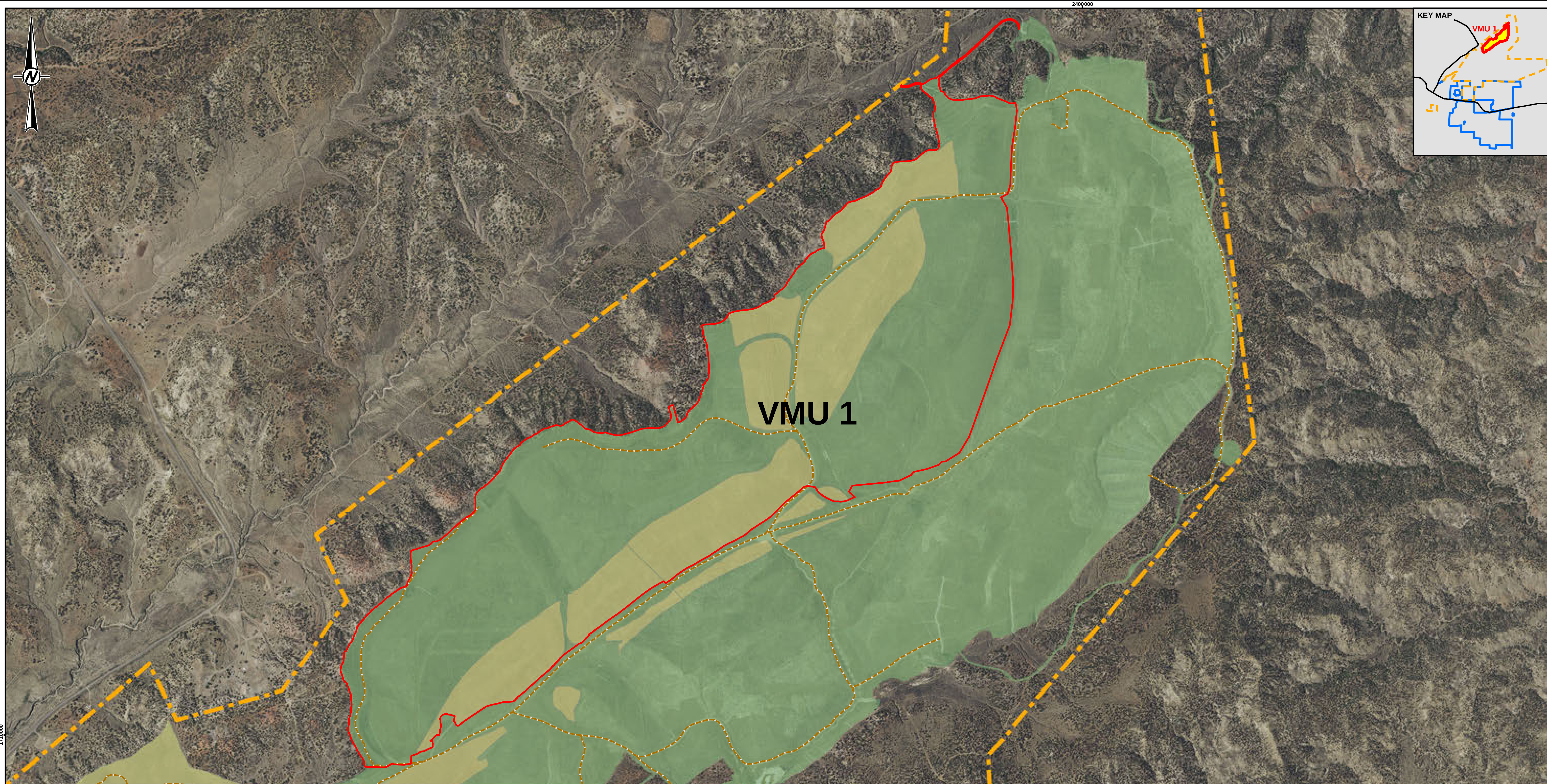
The Pittsburg & Midway Coal Mining Co (P&M). May 17,1994 Settlement Agreement B.8 Report-Volume I Revegetation Report.

Golder Associates Inc. 2020. Vegetation Management Unit 1, Vegetation Success Monitoring, 2019.

WSP USA Inc. 2024. Vegetation Management Unit 1, Vegetation Success Monitoring, 2023.

Trihydro Associates. 2024. Vegetation Management Unit 1 Final Bond Release and Liability Release & Termination of Jurisdiction Application.

Exhibits



LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- Initial Program Lands
- Permanent Program Lands
- OSMRE Permit Boundary
- Post-Mining Two-Track Trails

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Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron
Chevron Mining Inc.
McKINLEY MINE

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

CONSULTANT
wsp

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

TITLE
GENERAL LOCATION

PROJECT NO.	PHASE	REV.	FIGURE
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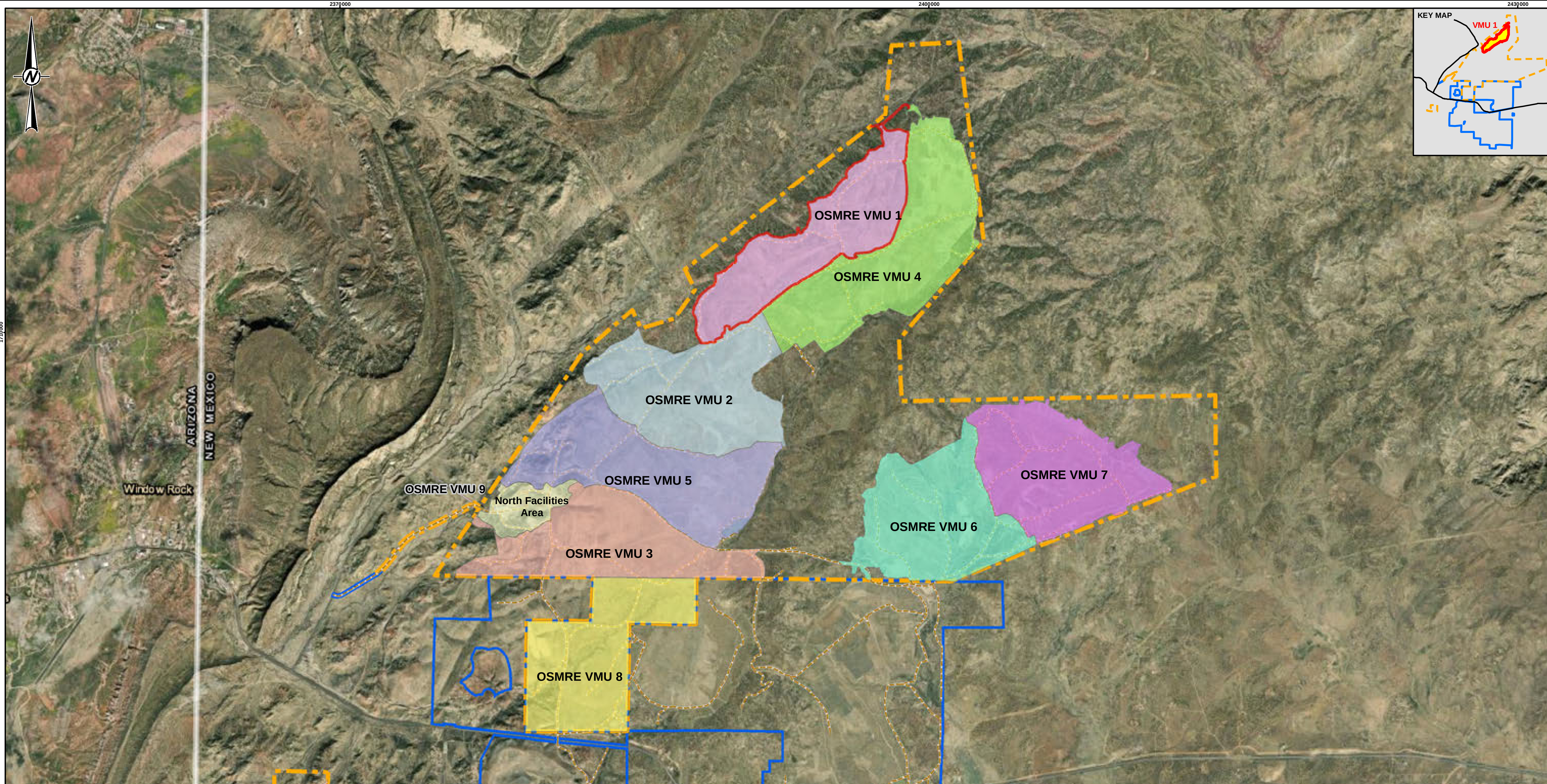

LEGEND

- OSMRE VMU 1
- OSMRE VMU 2
- OSMRE VMU 3
- OSMRE VMU 4
- OSMRE VMU 5
- OSMRE VMU 6
- OSMRE VMU 7
- OSMRE VMU 8
- OSMRE VMU 9
- OSMRE North Facilities Area
- OSMRE Permit Boundary
- MMD Permit Boundary
- Post-Mining Two-Track Trails

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Miles

NOTE(S)
1.

REFERENCE(S)
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2. SERVICE LAYER CREDITS: ESRI, HERE, GARMIN, (C) OPENSTREETMAP CONTRIBUTORS, AND THE GIS USER COMMUNITY
SOURCE: ESRI, MAXAR, EARTHSTAR GEOGRAPHICS, AND THE GIS USER COMMUNITY

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT
wsp

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
MCKINLEY MINE OSMRE VEGETATION MANAGEMENT UNITS

PROJECT NO.	PHASE	REV.	FIGURE
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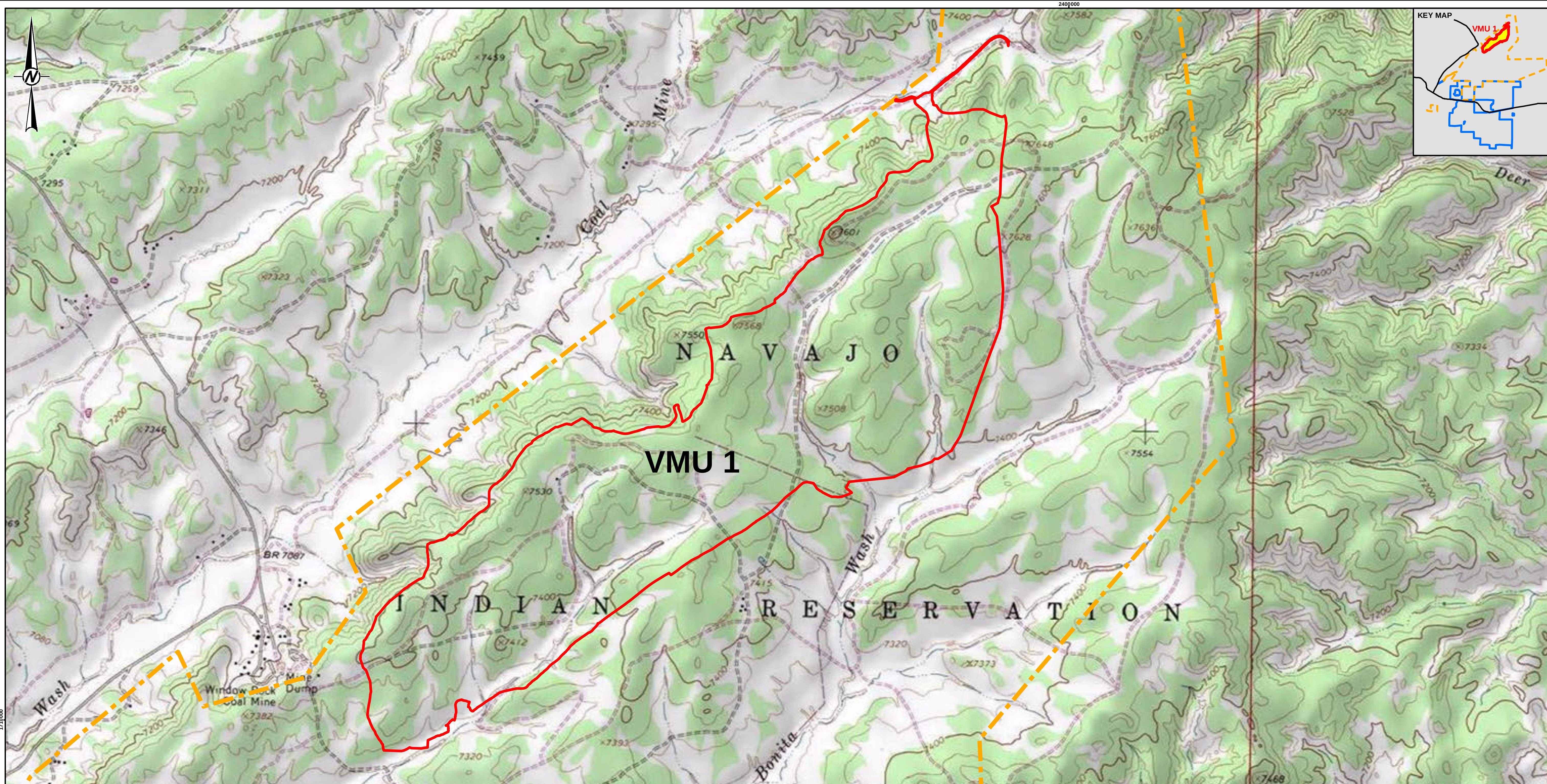

LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- OSMRE Permit Boundary

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Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET
2. SERVICE LAYER CREDITS: COPYRIGHT:© 2013 NATIONAL GEOGRAPHIC SOCIETY, I-CUBED

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT
wsp

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
USGS 7.5 MINUTE (24K) TOPOGRAPHIC MAP TSE BONITA SCHOOL QUADRANGE

PROJECT NO.	PHASE	REV.	FIGURE
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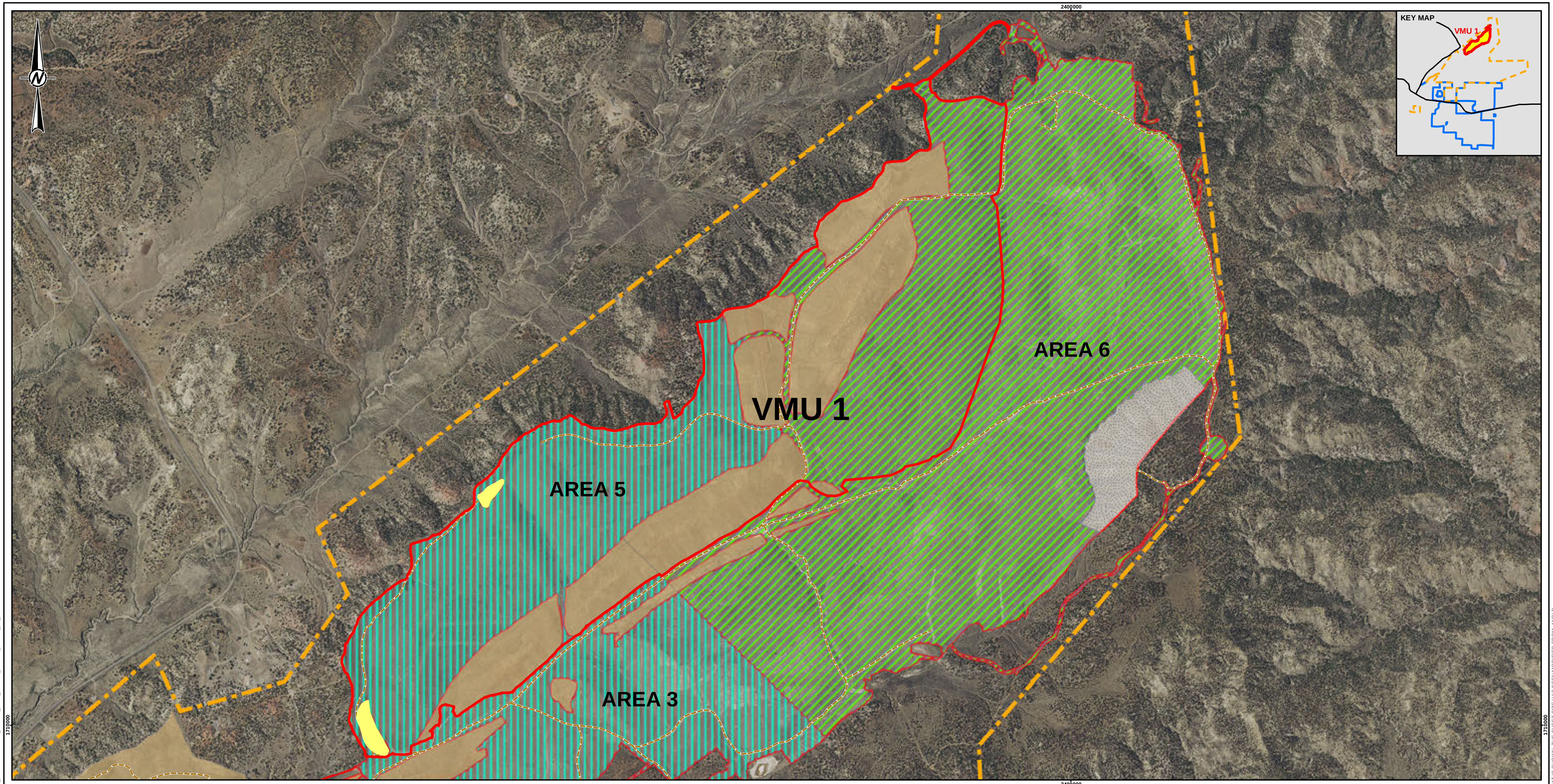

LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- Impoundments Not In Past Phase I and Phase II Bond Release Applications
- Areas 3 and 5 Phase I and II Bond Release Area Approved by OSMRE
- Area 6 Phase I and II Bond Release Area Approved by OSMRE
- Area 6 Phase I Bond Release Area Approved by OSMRE
- Initial Program Lands
- OSMRE Permit Boundary
- Post-Mining Two-Track Trails

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Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT
wsp

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
VMU 1 AND APPROVED PHASE I AND II
BOND RELEASE AREAS

PROJECT NO.	PHASE	REV.	FIGURE
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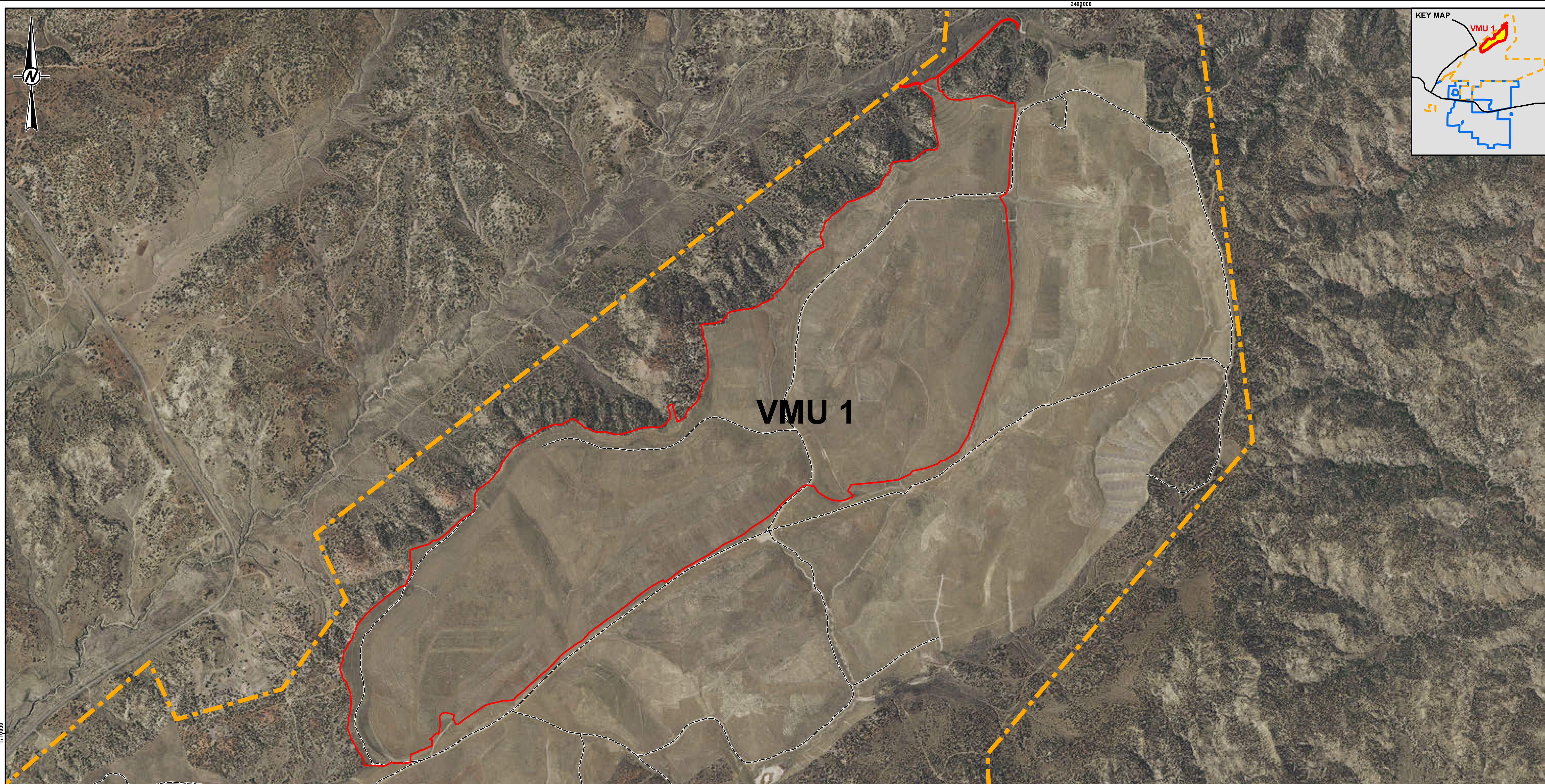

LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- OSMRE Permit Boundary
- Primary Roads (Post-Mining Two Track Trails)

SEAL

KYLE J KUTTER
NEW MEXICO
21519
PROFESSIONAL ENGINEER

08/30/24

I certify that the primary road locations shown within the VMU 1 boundary are correct to the best of my knowledge and belief.

0 | 2,000 | 4,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE AND RECLAMATION LIABILITY RELEASE (TOJ)

CONSULTANT

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

TITLE
PRIMARY ROADS

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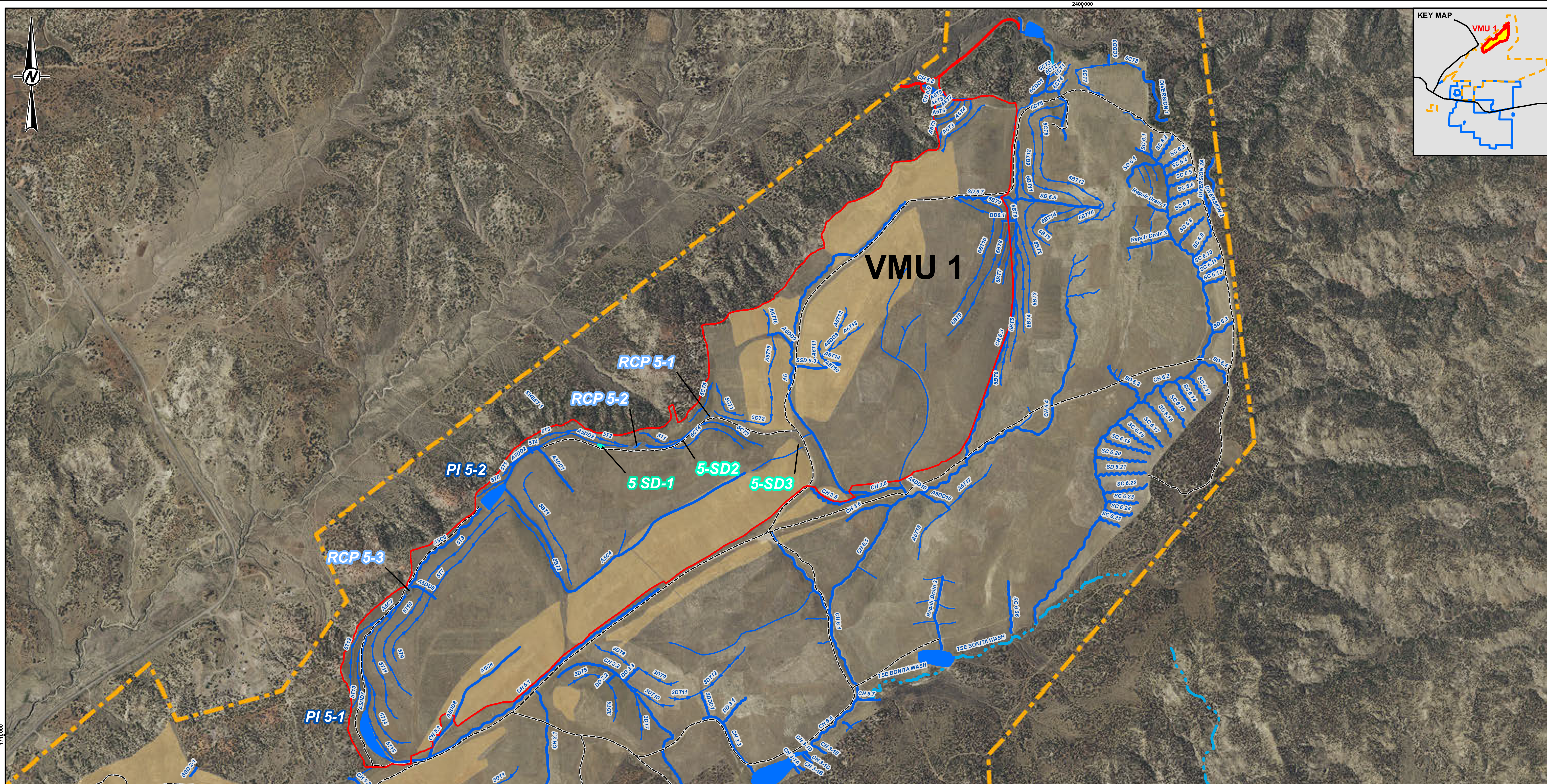


LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- Undisturbed Stream
- "CH" in label designates Channel; "DD" designates Downdrain
- Concentrated Flow Path/Terrace
- Permanent Impoundment (PI)
- Reclamation Channel Pool (RCP)
- Small Depression (SD)
- Initial Program Lands
- Post-Mining Two-Track Trails
- OSMRE Permit Boundary

SEAL

KYLE J KUTTER
NEW MEXICO
21519
PROFESSIONAL ENGINEER
08/30/24

I certify that the hydrologic structures shown within the VMU 1 boundary are correct to the best of my knowledge and belief.

0 2,000 4,000
Feet

CLIENT
Chevron Mining Inc.
McKINLEY MINE

CONSULTANT
WSP

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

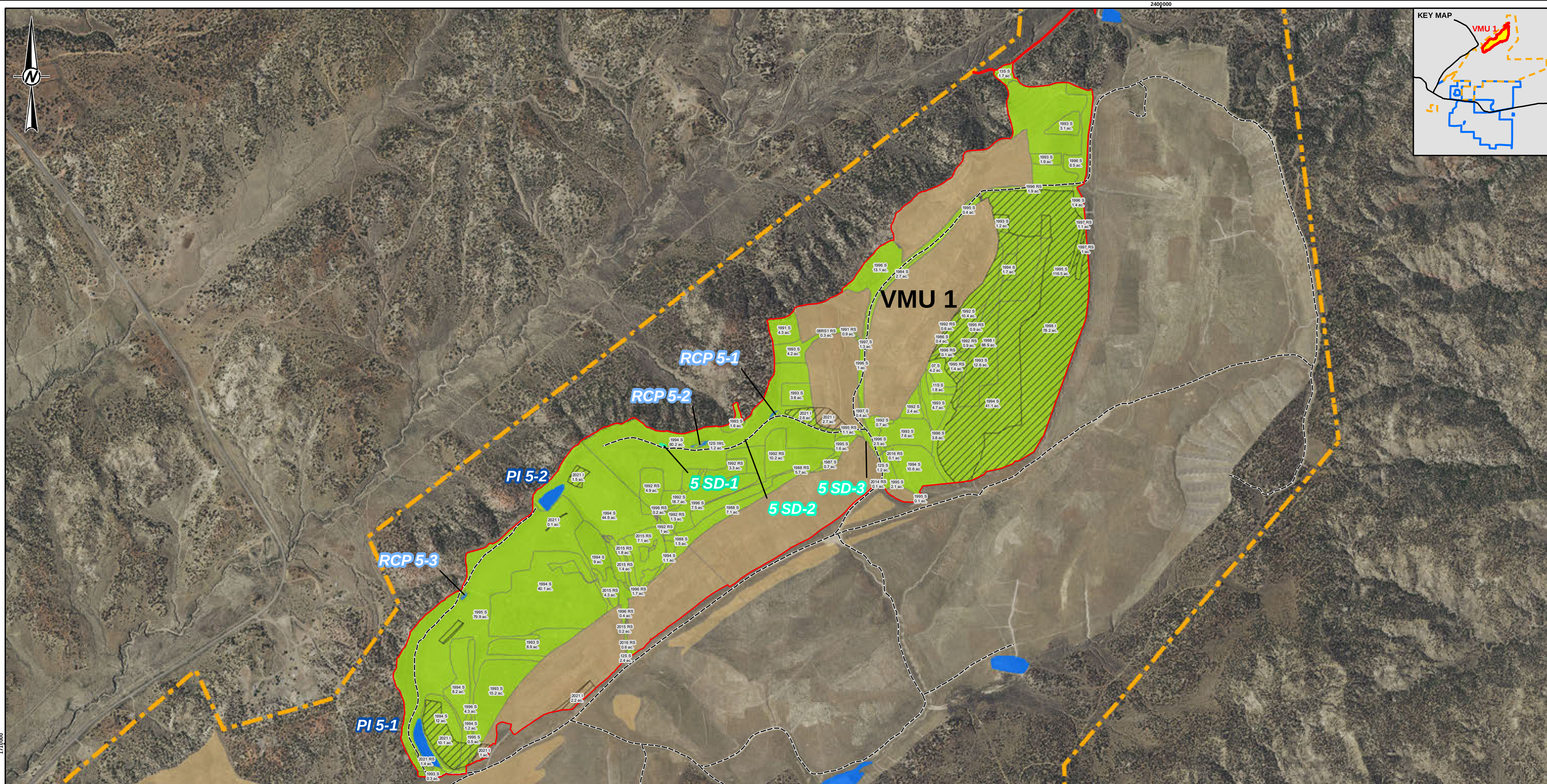
NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
HYDROLOGIC FEATURES

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	E6



LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- Seeding Year Seeded ("S") or Reseeded ("R") and Acreage
- Interseeded ("I")
- Initial Program Lands
- Permanent Impoundment (PI)
- Reclamation Channel Pool (RCP)
- Small Depression (SD)
- Post-Mining Two-Track Trails
- OSMRE Permit Boundary

0 2,000 4,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

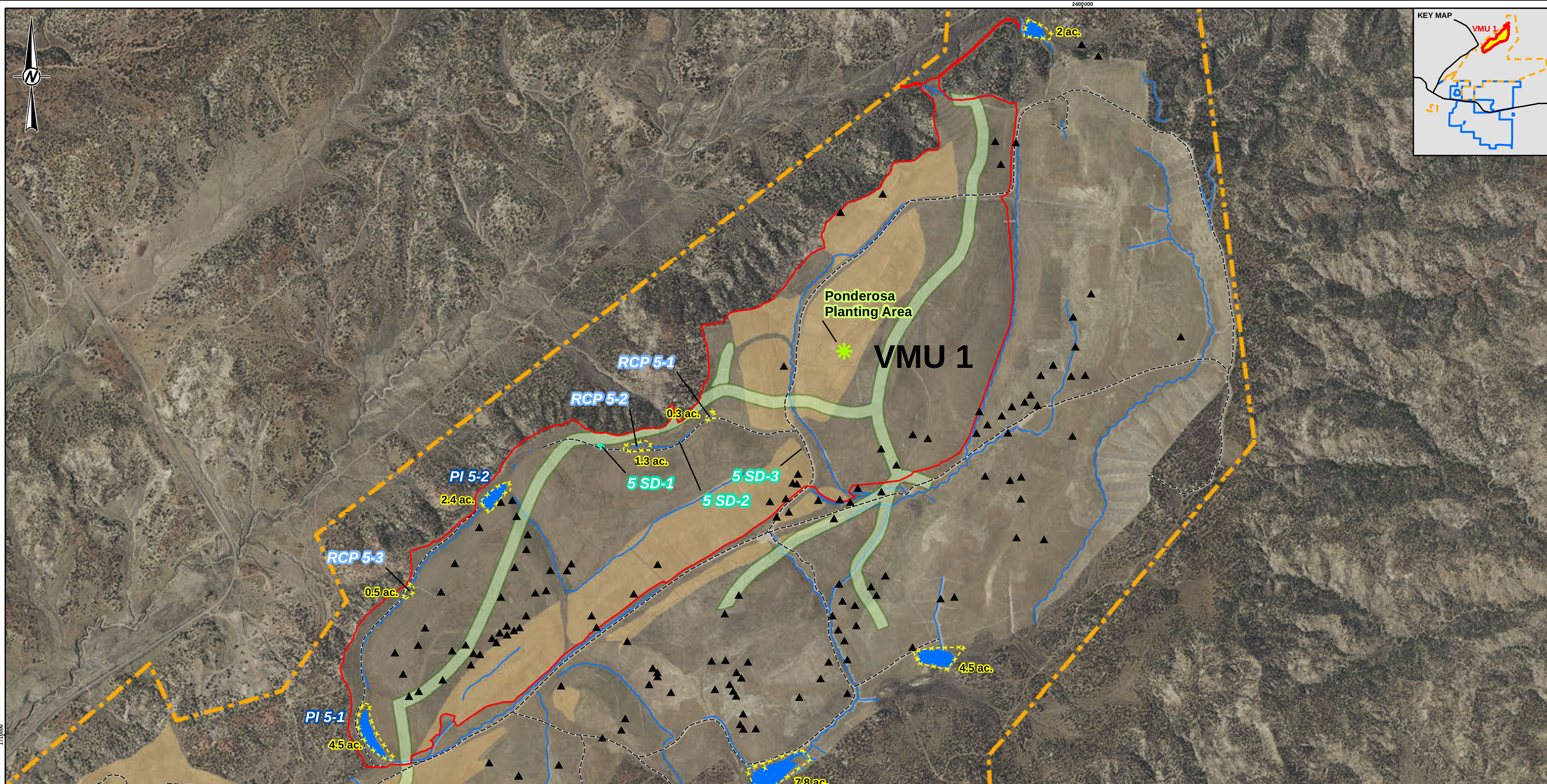
CONSULTANT

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
PERMANENT PROGRAM LANDS SEEDING

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	E7



LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- Wildlife Rock Pile
- Pre-2018 Planted Wildlife Corridors
- Installed Wildlife Fence (with Acreages)
- Channel
- Initial Program Lands
- OSMRE Permit Boundary
- Post-Mining Two-Track Trails

0 2,000 4,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

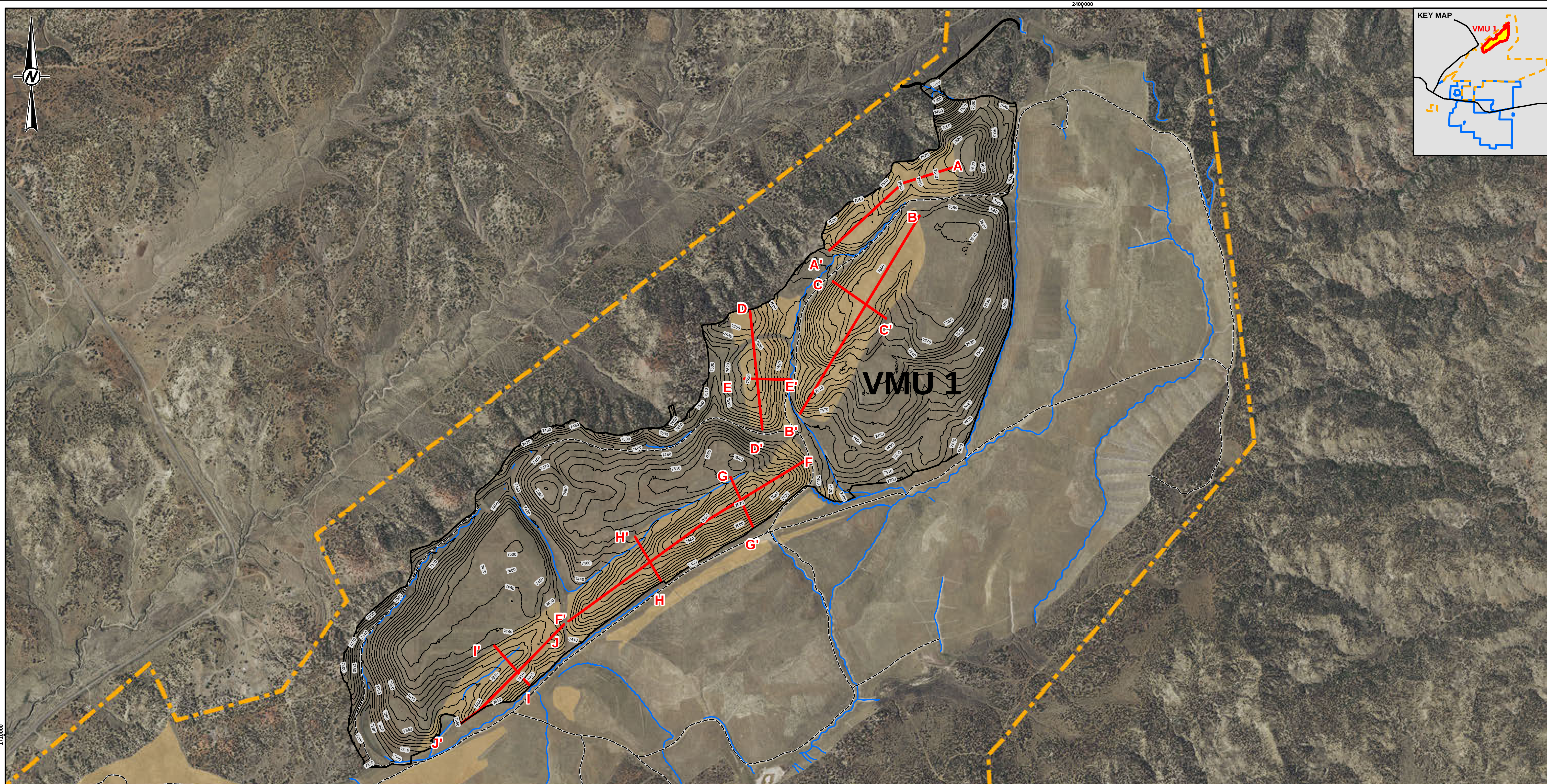
CONSULTANT
wsp

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE
AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
WILDLIFE ENHANCEMENTS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	E8



LEGEND

- VMU 1 Bond Release and Reclamation Liability Release (TOJ)
- Cross section
- Contour (ft)
- Channel
- Initial Program Lands
- OSMRE Permit Boundary
- Post-Mining Two-Track Trails

0 2,000 4,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

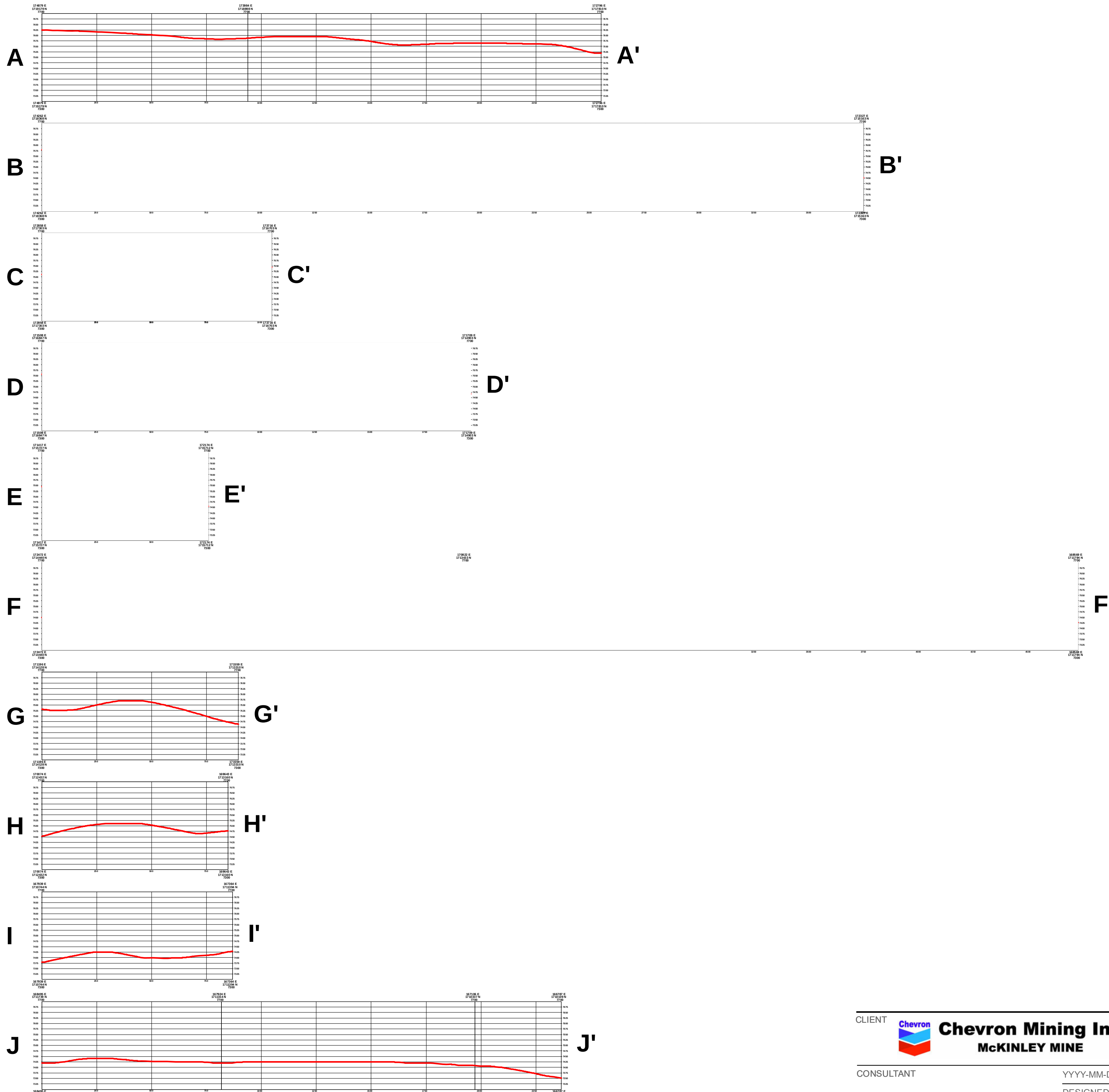
CONSULTANT
WSP

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

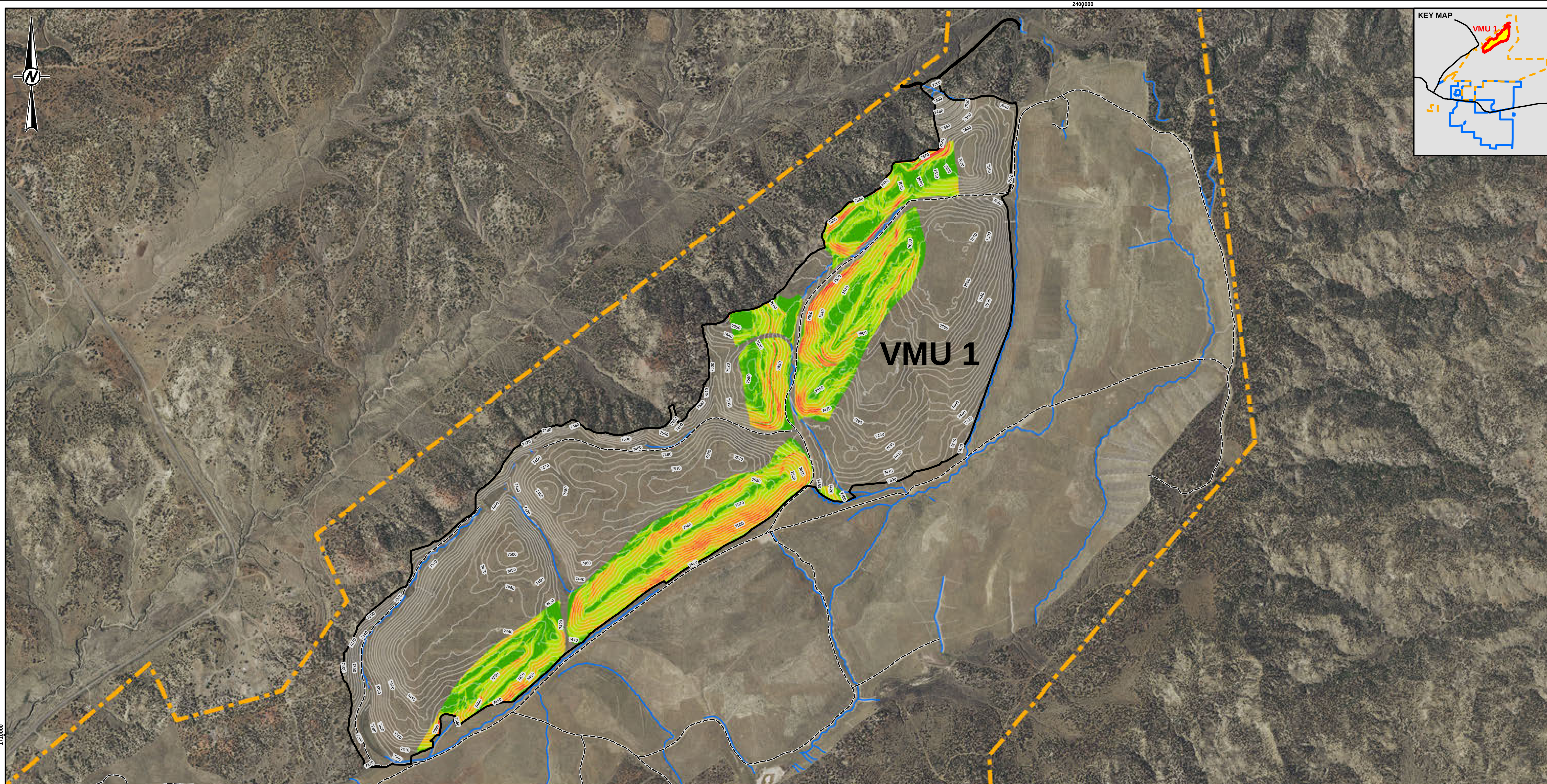
PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE AND RECLAMATION LIABILITY RELEASE (TOJ)

TITLE
IPL TOPOGRAPHY AND CROSS SECTION LOCATIONS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	E9



CLIENT	Chevron Mining Inc. McKINLEY MINE	PROJECT	VEGETATION MANAGEMENT UNIT 1 BOND RELEASE AND RECLAMATION LIABILITY RELEASE (TOJ)
CONSULTANT	YYYY-MM-DD: 2024-08-30	TITLE	IPL CROSS SECTION PROFILES
wsp	DESIGNED: -		
	PREPARED: HJ		
	REVIEWED: FR	PROJECT NO. 1338105302 / PHASE 0003	REV. A / FIGURE E10
	APPROVED: MS		



LEGEND

VMU 1 Bond Release and Reclamation Liability Release (TOJ)

Contour (ft)

Channel

OSMRE Permit Boundary

Post-Mining Two-Track Trails

Percent Slope

- 0 - 10%
- 11 - 20%
- 21 - 30%
- > 30%

0 2,000 4,000
Feet

NOTE(S)
1.

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT
Chevron Mining Inc.
McKINLEY MINE

PROJECT
VEGETATION MANAGEMENT UNIT 1 BOND RELEASE AND RECLAMATION LIABILITY RELEASE (TOJ)

CONSULTANT
wsp

YYYY-MM-DD	2024-08-30
DESIGNED	-
PREPARED	HJ
REVIEWED	FR
APPROVED	MS

TITLE
IPL SLOPE GRADIENT ANALYSIS

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	E11

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Appendix A1: Application Certification

McKinley Mine
Vegetation Management Unit 1
Permanent Program Final Bond Release
and
Initial Program Reclamation Liability Release and Termination of Jurisdiction Application

CERTIFICATION

Chevron Mining Inc. (CMI) certifies that all applicable reclamation activities have been accomplished in this application that are necessary for final bond release of Permanent Program lands and for a reclamation liability release and termination of jurisdiction of Initial Program lands in McKinley Mine Vegetation Management Unit 1 in accordance with the requirements of the Surface Mining Control and Reclamation Act, the regulatory program, and the approved reclamation plans.

There are no outstanding violations, cessation orders, or other Office of Surface Mining, Reclamation and Enforcement (OSMRE) enforcement actions on the lands subject to this release application.

Jeffery Schoenbacher
Operations Manager
Chevron Environmental Management Company (CEMC)

Date: August 29, 2024

State of New Mexico)
) SS
County of Taos)

Subscribed and sworn to before me, in my presence, this 29TH day of August, 2024, a Notary Public in and for the State of New Mexico.

Notary Public

ANNA C. MARTINEZ
Notary Public - State of New Mexico
Commission # 1058122
My Comm. Expires Jul 24, 2026

My Commission expires: July 24, 2026

Appendix A2: Groundwater and Surface Water Evaluation (Trihydro)

VEGETATION MANAGEMENT UNIT 1

FINAL BOND RELEASE AND

LIABILITY RELEASE & TERMINATION OF JURISDICTION APPLICATION

GROUNDWATER AND SURFACE WATER EVALUATION

CHEVRON MINING INC. – MCKINLEY MINE, NEAR GALLUP, NEW MEXICO

September 9, 2024

Project #: CHEVR-024-0030

SUBMITTED BY: Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

SOLUTIONS YOU CAN COUNT ON.
PEOPLE YOU CAN TRUST.

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1.0 INTRODUCTION

This report documents the surface water and groundwater assessment at the McKinley Mine (Mine), operated by Chevron Mining Inc., required for bond release. Portions of the McKinley Mine operate under the New Mexico Office of Surface Mining Reclamation and Enforcement (OSMRE) Permit No. NM-0001K and this report was prepared in accordance with OSMRE Guideline to Bond Release Procedures for Permanent Program Lands as well as the New Mexico Administrative Code (NMAC) 19.8.14.1412, Requirement to Release Performance Bonds. Requirements for Probable Hydrologic Consequences (PHC) and the Cumulative Hydrologic Impact Assessment (CHIA) are provided in OSMRE Permit NM-0001K, Section 3.4 and Appendix A of this report.

The Mine is located approximately 24 miles northwest of Gallup, New Mexico. The Mine began operations in the early 1960s and ceased operations in 2009. Since that time, the Mine has been in various phases of reclamation including grading to post-mine topography, placement of topsoil, and revegetation. A portion of the Mine, identified as Vegetation Management Unit 1 (VMU-1), is now eligible for bond release. Trihydro Corporation (Trihydro) began collecting and managing water quality and quantity data starting in October 2012. This report provides an evaluation of water data from 2013 through a portion of 2024 because data during this time period are representative of post-mining conditions and are the most complete dataset available.

This report includes information for surface and groundwater to support bond release including the following.

- A map with surface water monitoring stations and long-term groundwater monitoring wells. The map also shows National Pollutant Discharge Elimination System (NPDES) Permit No. NN0029386 outfalls affiliated with the proposed bond-release area and other nearby areas within the larger watershed containing VMU-1.
- Long-term groundwater and surface water monitoring data with comparison to baseline information, effluent standards and the approved PHC determination.

A summary of the hydrologic setting and protection requirements for the Mine are included in this report in Section 2.0. Section 3.0 reviews the long-term chemical and physical characteristics of surface water associated with the NPDES outfalls 010 and 013 as well as surface water monitoring sites Tse Bonita Wash (TBW) and Coal Mine Wash Tributary (CMWT) that receive waters from the VMU-1 area. Section 4.0 provides a review of the long-term chemical and physical characteristics of the two groundwater wells (Well 3A and MBR-2) located nearest to VMU-1.

2.0 HYDROLOGIC SETTING AND PROTECTION

2.1 GEOLOGIC SETTING AND CLIMATE

The Mine is located in the southwest corner of the San Juan Basin in a structural sub-basin known as the Gallup Sag. The San Juan Basin, which is roughly circular in shape, occupies much of northwestern New Mexico, a narrow strip of northeastern Arizona, and a small portion of southwestern Colorado. The basin is bordered on the north by the San Juan Mountains, on the east by the Nacimiento Uplift, on the south by several uplifts including the Lucero Uplift and Zuni Uplift, and on the west by the Defiance Monocline, which separates it from the Black Mesa Basin.

The sedimentary rocks in the San Juan Basin are predominantly of Mesozoic age with some Tertiary rocks outcropping in the central basin and some Paleozoic and Pre-Cambrian rocks upturned along the basin margins. The sediments increase in thickness toward the basin's center. The geology in the vicinity of Gallup and McKinley County is comprised of Middle to Upper Jurassic (175-145 million years old) and Quaternary (less than 1-million years old) rocks. Older rocks, the Triassic River deposits of the Chinle Group, are exposed in the plains to the south and Cretaceous rocks form the high ridges. The rock formations include sandstone, shale, limestone, coal, and mudstone.

The San Juan Basin is characterized by low surface relief. Most of the basin is a relatively featureless plain with wide shallow valleys and some low mesas and cuestas. Elevations in the area range from 5,000 feet above mean sea level (ft amsl) in the north to 7,000 ft amsl in the south. A prominent north-south trending range, the Chuska Mountains, occurs along the western part of the basin with elevations exceeding 9,500 ft amsl. The Mt. Taylor volcanic area, with elevations up to 10,000 ft amsl, occurs within the southeast corner of the basin. The margins of the basin are characterized by hogback ridges, which are associated with the tectonic uplifts defining the basin boundaries.

The majority of the Mine is located in the Puerco River Drainage Basin with a small portion of the mine located in the San Juan River Drainage. The main drainages or watersheds in the mine are the headwaters of Defiance Draw (DD) and its tributary, Defiance Draw Tributary (DDT), Tse Bonita Wash (TBW), Coal Mine Wash (CMW) and its tributary, Coal Mine Wash Tributary (CMWT), and an unnamed tributary to Black Creek. A small portion of the mine lease area is in the headwaters of Deer Springs Wash and Black Springs Wash (both in the San Juan River Drainage Basin). Of the drainage basins listed above, DD is the largest drainage basin with an area of 27.5 square miles. TBW is the drainage basin that encompasses the highest percentage within the mine boundary at 35.0%. The watersheds encompassing VMU-1 discharge surface water run-off to TBW and CMWT, and sampling locations for those drainages are shown on Figure 2-1.

As presented in Mine Permit No. NM-0001K, Section 3.4, groundwater resources within the mine fall into three main types: alluvial, bedrock, and aquifer. Alluvial and bedrock groundwater resources are discontinuous, of poor physical and chemical quality, and of limited extent. The first major deep aquifer is the Gallup Sandstone Aquifer (GSA). The aquifer lies well below the zone of mining impact and is overlain by several impermeable shale members. Most recharge to the Gallup Sandstone comes from the Chuska Mountains to the northwest of the Mine. In addition to these three types, groundwater may also be found in spoil material above bedrock. The groundwater monitoring wells nearest VMU-1 are bed rock monitoring well MBR2 and GSA well 3A. The location of these wells is depicted on Figure 2-1.

The Mine climate is semi-arid with an average annual precipitation of approximately 11 inches (in.) per year. More than half the annual precipitation typically falls during the months of July through October. Precipitation often occurs as rainfall from intense, localized thunderstorms that occur sporadically in the region. This can result in high suspended solids levels in the runoff. In addition, the soil chemistry and geomorphology contribute to the high levels of dissolved solids, salinity, and alkalinity. Within the general area of the mine, runoff due to precipitation events occurs in the form of surface runoff. Natural drainages or watersheds convey or temporarily store the runoff as it is routed to the Puerco River or San Juan River.

Precipitation data nearest to VMU-1 is reported from the precipitation monitoring stations at the mine, Rain 2, Rain 3, and Rain 6, as shown on Figure 2-1. These precipitation stations operate between mid-April and mid-November, and are shut down annually during the winter months.

Table 2-1 provides the monthly and annual precipitation data from the three precipitation stations for the 2013-2023 period. Average monthly precipitation between April and November at the three precipitation stations ranged from 0.23 in. in April to 1.54 in. in July during the 11-year evaluation period. On average, most of the precipitation is received between July and September. The month with the highest 1-month precipitation total was August 2022 with 3.77 in at Rain 2. Precipitation data are referenced throughout the report to help explain some of the observations presented for surface and groundwater stations.

2.2 HISTORICAL WATER QUALITY DATA

Groundwater resources within the Mine include alluvial, bedrock, Gallup Sandstone Aquifer, and spoil.

Alluvial groundwater is present in some fill and low-lying soils at the Mine. Wells penetrating the alluvial groundwater are designed to monitor the quality and quantity of shallow groundwater in alluvial valley-fill sediments.

Valley-fill sediments in the Mine area serve as a reservoir for meteoric water to reside. Because the area is semi-arid and annual precipitation is limited, the presence of alluvial groundwater is generally dependent on rainfall and, to a lesser extent, snowfall quantities.

In 1980, five bedrock wells (MBR1, MBR2, MBR3, MBR4, and MBR5) were installed approximately 50-feet (ft) below the Green Coal Seam to monitor groundwater below this unit. The Green Coal Seam was the lower-most recoverable coal seam at the mine. These monitoring wells, referred to as McKinley bedrock wells, were located in and around the major drainage watersheds throughout the mine. Three of the original five wells (MBR1, MBR3, and MBR4) were mined through and not replaced. The active bedrock monitoring wells include MBR2 and MBR5, with MBR-2 being in the vicinity of VMU-1. Well MBR2 lies just outside of the watershed containing VMU-1, as shown on Figure 2-1.

The original 1980 Geohydrology Associates Inc. (GAI) baseline groundwater report concluded that bedrock wells had little potential as a meaningful groundwater resource. The transmissivity of the bedrock deposits was less than 6 square feet per day (ft^2/day) and not capable of maintaining a sustained yield of 1 gallon per minute (gpm). Even though groundwater was present, none of the strata had sufficient continuity to be considered an aquifer. The findings from the 1980 GAI report and the discussions below indicate that minimal impacts to the quality and quantity of this resource by mining and reclamation operations have occurred.

Five water wells (1, 2, 3, 3A, and 4) have been completed in the Gallup Sandstone Aquifer throughout the Mine area. These wells were used as primary water sources for mine activities and reclamation. The wells now provide domestic water, dust-control water, or are monitoring wells. Because of the impermeability of the shale units overlying the Gallup Sandstone Aquifer and the geologic structure in the area, the Gallup Sandstone Aquifer can be under artesian conditions. Moreover, due to the presence of the overlying shales, there is no hydraulic connection between the underlying Gallup Sandstone and the mined strata. Gallup Sandstone Aquifer Well 3A is located near the bond release area and within the same, larger containing watershed.

Five spoil recharge wells (2G2, 4A, 9A, 9S, and 11) were constructed in the Mine area. Two spoil wells (4A and 9A on MMD lands) were installed in 1990; of these two wells, only 9A remains. Well 4A was not monitored after 2015 following approval by MMD to discontinue monitoring this well because the land at the well location had a full bond and liability release. Well 4A was abandoned October 29, 2018. In April 2013, three additional spoil recharge wells were constructed and designated as wells 2G2 (on OSMRE lands), 11, and 9S (on MMD lands). Spoil recharge wells were installed throughout the mine in reclaimed areas to determine chemical presence and groundwater properties. These wells were terminated at bedrock and their screens encompassed the spoil interval immediately above bedrock. Spoil Well 2G2 is the only spoil recharge well in the vicinity of VMU-1. Well 2G2 has had insufficient volume to sample since being installed in 2013 and has been dry since the third quarter of 2022.

Groundwater monitoring is required by MMD Permit Number 2016-02 and OSMRE Permit Number NM-0001K to be reported annually. The monitoring requirements were recently changed from quarterly to annually as per Permit Modification NM-0001K Mod 23-04 which was executed on February 21, 2024. The Mine began operations in the early 1960s, before the passage of the Surface Mine Control and Reclamation Act and other regulations governing coal mining on Indian lands. At that time, baseline surface and groundwater quality and quantity data were not required before mining. As a result, comparisons cannot be made with pre-mining watershed conditions of the Mine as a single unit. However, the 1980 GAI report, which was incorporated into the Mine permits, provides surface and groundwater quality and quantity data that can be referenced for evaluating trends since that time. There are no baseline groundwater data applicable to the Mine site.

Surface water has been monitored since the early 1980s through active and passive surface water monitoring stations, although the number and locations of stations have evolved over time. The currently monitored active, mine permit related surface water stations are located in and around the major drainage watersheds throughout the Mine and include the DD, TBW, DDT6, CMW, and CMWT watersheds. Station CMW is used to monitor flow and water quality from a relatively undisturbed drainage; the data from this station are used as background information and to contrast against other station data from disturbed watersheds.

2.3 APPLICABLE PROTECTION STANDARDS

2.3.1 SURFACE WATER COMPARISON

Stormwater runoff from the Mine drains through impoundments and/or hydraulic control structures before discharging into Defiance Draw, a tributary to the Puerco River segment from the Arizona border to the Gallup wastewater treatment plant in McKinley County. Data collected from the disturbed stations are compared to data collected at the undisturbed CMW station, which are considered background data. The comparison is used to determine impacts from mining activities.

2.3.2 NPDES REQUIREMENTS

The Mine operates under NPDES Permit No. NN0029386 which was last renewed July 1, 2017. A renewal application was submitted to the United States Environmental Protection Agency (USEPA) on December 27, 2021, and the Mine is currently operating under the current permit pending approval of the renewal application. As required under NPDES Permit No. NN0029386, the Mine submitted an updated Sediment Control Plan on September 5, 2017 and is currently awaiting approval. Until then, the Mine is operating under the current Sediment Control Plan dated March 15, 2013. All watersheds within the mine are classified as Western Alkaline, and in accordance with NPDES Permit No. NN0029386, reclamation inspections are conducted quarterly within the drainage basins associated with the Sediment Control Plan and inspection findings are summarized in quarterly reports. Additionally, discharge sampling is conducted at NPDES outfalls. There are several watersheds and NPDES outfalls located in the vicinity of VMU-1. Outfalls associated with VMU-1 and its larger containing watershed are shown on Figure 2-1. The Mine will continue conducting quarterly reclamation inspections and sampling discharge through final bond release.

2.3.3 GROUNDWATER PROTECTION STANDARDS

The Navajo Nation Environmental Protection Agency (NNEPA) does not have general groundwater protection standards. NNEPA groundwater standards appear to be tied to drinking water as part of the Navajo Nation Primary Drinking Water Regulations (NNPDWR) Appendix I, Underground Sources of Drinking Water on the Navajo Nation. The New Mexico Administrative Code (NMAC) provides groundwater standards to protect all groundwater of the State of New Mexico which has an existing total dissolved solids (TDS) concentration of 10,000 mg/l or less (also the case for the NNEPA standards), for present and potential future use as domestic and agricultural water supply (NMAC 20.6.2.3103).

Groundwater standards are numbers that represent the pH range and maximum concentrations of water contaminants in the groundwater which still allow for the present and future use of ground water resources. Groundwater standards from the NMAC will be used to compare the quality of groundwater at the McKinley Mine for this report. Quantitative criteria for these groundwater sources that correspond with available data from the Mine are listed below (NMAC 20.6.2.3103).

Analyte	Upper Limit (unless otherwise indicated)
pH	6.0-9.0 s.u.
Fluoride	1.6 mg/L
Nitrate as N	10 mg/L
Selenium	0.05 mg/L
Chloride	250 mg/L
Iron	1 mg/L
Manganese	0.2 mg/L
Sulfate	600 mg/L
TDS	1,000 mg/L
Zinc	10 mg/L

Criteria listed for chloride, iron, manganese, sulfate, TDS, zinc, and pH represent the maximum concentration for domestic water supply.

2.3.4 IMPOUNDMENT WATER QUALITY

There are two permanent impoundments in VMU-1: 5-1 and 5-2. Water quality for the McKinley Mine permanent impoundments located on OSMRE regulated lands was submitted via permit modification 20-02 and approved by OSMRE on April 15, 2020. The modification is based on a water quality assessment conducted by CDM Smith over a three-year period from 2012 through 2015. The findings from the CDM Smith study were documented in a report and included in the Permit Application Package. In response to the study, the NNEPA provided a letter containing their assessment of the report (RE: Final Review of McKinley Mine Impoundment Characterization (CDM Smith) Reports – Recommendations and Conclusions – April 7, 2016); the 2016 letter is found in Appendix 5.7-B2 of the mine permit. After review of the recommendations, the Navajo Nation President sent a letter requesting several impoundments remain as permanent (McKinley RE: Mine Impoundments – March 10, 2020) at the McKinley Mine. The 2020 letter is available upon request. Permanent impoundment water quality data derived from the impoundment water quality assessments, including 5-1 and 5-2, is available in Appendix 5.7-B2 of the mine permit.

2.4 PROTECTION OF HYDROLOGICAL BALANCE

The Mine permit includes preventative and remedial measures for any potential adverse hydrologic consequences identified in the PHC determination. The Permit includes sections on the PHC determination, groundwater and surface water monitoring plans, general plans to address possible hydrologic consequences, and a CHIA, as provided by the MMD/OSMRE. These items can be found in Section 3.4 of the currently approved mine permit. Related permit sections are summarized below. A copy of the active and approved Permit Section 3.4 is provided as Appendix A.

2.4.1 PHC DETERMINATION

The current and approved PHC determination is provided in Permit No. NM-0001K, Section 3.4.4. of Appendix A. The PHC first reviews the possible impacts of the impoundments on other surface waters, which are reviewed here for the purposes of a PHC update. Assumptions for and analysis of runoff to the impoundments and consumptive losses from the impoundments are provided. The impoundments have no negative impacts on regional water quantity and should enhance local property use for livestock and wildlife. The PHC also acknowledges and evaluates the possible impact from impoundment stormwater discharge on downstream water chemistry. Review of available data indicated identifiable impact as related to pre- and post-mine monitoring stations along Defiance Draw and its tributaries. Lastly, the PHC considers the possible impacts of the groundwater, located in the alluvial, bedrock, and Gallup Sandstone Aquifer. This last item will be further discussed in report Section 4.5.3.

2.4.1.1 SURFACE WATER QUANTITY

Surface water quantity may be increased on the reclaimed areas through the construction of small depressions and impoundments. These impoundments will be used to provide water for livestock and wildlife and to create small riparian habitats for small mammals, birds and reptiles. The amount of post-mining runoff as compared to the pre-mining runoff to the Puerco River drainage will be minimally diminished by the harvesting of the water in the impoundments and other riparian areas. This reduction of runoff is supported by the hydrologic model included in the Baseline/Background – Hydrologic Information Volume (BBHIV) of the permit application. However, the impact on the Puerco River drainage will be negligible due to the small percentage of the drainage area that the Mine comprises.

2.4.1.2 SURFACE WATER QUALITY

For a short time following reclamation of an area there may be a slight increase in the levels of total dissolved solids, sulfates, and other soluble elements in the overburden. This increase will eventually lessen as the runoff leaches the overburden. This potential slight increase is documented by the collection and analysis of surface water runoff during the permit term as described in Section 3.0. The long-term surface water PHC is described below.

Surface water physical quality will be improved through the stabilization of the reclamation areas and the construction of small depressions and impoundments. These actions will result in lower suspended solids and total settleable solids in the runoff from the disturbed areas. This is supported by the hydrologic models presented in the BBHIV of the Permit. The models show that the per-acre sediment yields from the mining and post-mining areas will be less than the pre-mining areas.

The Mine has been reclaimed with soils that meet suitability criteria that promote plant establishment. These soils, in combination with vegetation, would be expected to result in runoff with better effluent quality with regard to levels of dissolved solids, salinity, and alkalinity.

2.4.1.3 GROUNDWATER QUANTITY

2.4.1.3.1 GALLUP SANDSTONE AQUIFER

As discussed above, the Gallup Sandstone Aquifer is used as the primary source of water for the Mine and for the McKinley County area. This aquifer occurs 400 to 1,000 feet below the lowest coal seam to be recovered and has no local recharge features. The recharge area for this aquifer is located to the north of Mine in the Chuska Mountains. As noted in the Technical Analyses and Environmental Assessment performed by the OSMRE on Permit No. NM- 0001 B/3-1 OP there may be a small amount of drawdown due to usage associated with coal mining activities, but this drawdown is insignificant in comparison to the City of Gallup and Navajo Nation consumption impacts. The Permit contains information on the potentiometric surface of the Gallup Sandstone Aquifer.

2.4.1.3.2 ALLUVIAL AQUIFERS

As discussed above, the alluvial water is practically nonexistent, occurring generally in close proximity to the arroyos, and in direct relation to the rate and amount of runoff in the arroyo. This water soaks into the sides and bottoms of the arroyos during runoff events. This type of recharge occurs principally during snowmelt and the summer runoff season. Recharge through direct infiltration onto the rest of the alluvial fans located away from arroyos is very limited. The only instance where this type of groundwater will be affected by the mining operations is where alluvial areas are actually mined. The hydrologic impact on this groundwater source will be complete removal of the resource when encountered during mining. However, due to the limited areal extent of the resource, any impacts would be considered negligible.

2.4.1.3.3 BEDROCK AQUIFERS

As discussed above, the bedrock water quantity is minimal in extent, consisting only as small pockets of perched water in the various stratums being excavated in the mining process. The quantity and areal extent of these pockets of water are not of sufficient quantity or quality to be considered usable. This water is normally observed as seepage from the highwall or small amounts of water on the pit floor. The mining operation results in removal of this insignificant groundwater source.

2.4.1.4 GROUNDWATER QUALITY

<u>Gallup Sandstone Aquifer</u>

As is noted above in the discussions on groundwater quantity, there will be no impact by mining on the recharge zones of the Gallup Sandstone Aquifer. Due to this, there will also be no impact on the quality of the Gallup Sandstone Aquifer by the mining operations.

<u>Alluvial Aquifers</u>

The alluvial water quality, in undisturbed areas, will continue to be influenced primarily by the amount of runoff in the arroyos and characteristics of the soils in the area of infiltration. There will be minimal impacts on the quality of this resource by the mining operations.

Bedrock Aquifers

The bedrock water encountered during mining will be removed in the mining process. This removal will have no effect on the water present in areas not affected by mining. This is due to the low transmissivity associated with this type of water.

2.4.2 SURFACE AND GROUNDWATER MONITORING PLANS

Per Section 6.3.2.1 of the Permit, surface-water monitoring is conducted at five stations in the DD, TBW, DDT6, CMW, and CMWT watersheds at the mine. Groundwater monitoring is conducted from the following sources: alluvial groundwater, bedrock groundwater, Gallup Sandstone Aquifer, and spoil recharge groundwater. Sample analytes required by the permit include alkalinity, bicarbonate, boron, calcium, carbonate, cation-anion balance (or ion balance), chloride, fluoride, iron, magnesium, manganese, pH (lab and field), nitrate, phosphate, phosphorous, potassium, selenium, settleable solids, sodium and sodium absorption ratio (SAR), sulfate, total dissolved solids (TDS), total suspended solids (TSS), and zinc. Required analytes vary by water source.

2.4.3 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT (CHIA)

A CHIA was prepared by the OSMRE/MMD in 1995 for the Mine. The following summarizes possible surface and groundwater impacts/material damages concluded by the CHIA.

- Surface water use in the area is primarily stock watering with some irrigation. There are no permitted water rights holders downstream of the mining operation in the cumulative impact area. Indicator parameters related to hydrologic concerns in the basin are TDS and TSS concentrations.
- Cumulative impacts to the quantity of the flow in the Puerco River are insignificant.
- Cumulative impacts to the quality (TDS and TSS) of flows in the Puerco River are minimal and should not cause significant changes in baseline conditions. No material damage to the hydrologic balance is expected.
- Groundwater is an important source of water in the Gallup area. The major groundwater pumping centers are at the Santa Fe and Yah-ta-hey well fields, both completed in the Gallup Sandstone Aquifer and operated by the city of Gallup. Other users of the Gallup Sandstone Aquifer include the McKinley and Mentmore mines northwest of Gallup. Shallow groundwater is not widely used owing to the relatively poor quality and small well yields.
- Cumulative impacts related to groundwater quality are not expected. Groundwater quality in terms of TDS and sulfate has not been demonstrated to change significantly and the poor physical properties of the near-surface deposits are not greatly altered by mining.

- Groundwater quantity in the Gallup Sandstone Aquifer may be affected by the cumulative impacts of mining, particularly if declared water rights are fully used by the Mine. Calculations of water-level drawdowns indicate that the Yah-ta-hey well field could experience up to 3 feet of drawdown attributable to mining activities; this does not constitute material damage. No material damage, based upon a criterion of a decline of 25% of available head, is predicted as a result of surface coal mining

3.0 LONG-TERM MONITORING

VMU-1 is located in the Puerco River Drainage Basin, with possible influence on ephemeral and perennial streams. Surface water quality is monitored at four points downstream from VMU-1.

3.1 SURFACE WATER DATA

3.1.1 DISCHARGE DATA

There are two stream discharge sampling locations within VMU-1. Historical discharge data has been recorded since March 2019 at Outfall 010 (DC 1) and since September 2021 at Outfall 013 (SP 3-6). Sample data for both discharge locations is presented in Tables 3-1 and 3-2. For the purpose of comparing discharge water quality to downstream impacts, lab results are presented with relevant surface water protection standards. Analytes specific to discharge monitoring include aluminum, cyanide, gross alpha, and oil & grease. Cyanide and oil & grease typically return as non-detects and gross alpha varies. Gross alpha is typically higher at Outfall 010, though there is not a correlation between the two outfalls.

Water quality outcomes at discharge monitoring locations could potentially correlate with water quality observed at down-gradient stream monitoring stations (ISCO). For analytes sampled for discharge and stream monitoring, there appears to be correlations between Outfall 010 and the Coal Mine Wash Tributary ISCO as well as Outfall 013 and the Tse Bonita Wash ISCO. Discussion of stream water quality data is provided in Section 3.1.2.

- pH at both outfalls fluctuates between 7.6 and 8.1 (Appendix B-1A/B-2A).
- There are not enough data points for Outfall 010 between 2019 and 2022 to identify trends through that period, and August 2021 appears to be an outlier for many analytes including hardness, metals, TDS, TSS, and gross alpha. 2021 was an anomalous year for much of the surface water data available in the vicinity of VMU-1.
- Cyanide at Outfall 013 was not sampled above the laboratory limit of quantification and is not shown in temporal plots.
- Metal concentrations appear to increase over time for Outfall 010 (Appendix B-1B/B-2B) while concentrations are comparatively stable for Outfall 013, referring to aluminum, iron, and calcium.
- Related to concentrations of metals and biotoxicity is hardness. As can be seen in the tables and temporal plots discharge hardness is quite high, with Outfall 010 fluctuating in the 100 mg/L to 200 mg/L range (as $CaCO_3$) and Outfall 013 steady around 120 mg/L $CaCO_3$. Even with elevated concentrations of iron and selenium, hardness will reduce toxicity for aquatic life.

- Total solids are historically higher at Outfall 010 than Outfall 013. However, conductance is about the same in both streams and trends are similar as well, fluctuating around 250-300 µS/cm (Appendix B-1C/B-2C).
- Gross alpha is higher at Outfall 010 compared to Outfall 013, maximum results being 266 pCi/L and 66 pCi/L respectively. Typical activity is closer to, but still in exceedance of, surface water protection standards where detected (Appendix B-1D/B2-D). There are no significant impacts to Puerco River because of the ephemeral storm response and small loads by extension.

Permanent impoundments are not suspected to significantly impact surface water quality or regional hydrology. Of the eleven impoundments located in the watersheds containing VMU-1, nine are upstream from Outfall 010 and three are upstream from Outfall 013. These structures provide opportunistic water for livestock and wildlife and add diversity to the vegetation. Since they are small (less than one acre-ft), there would be minimal impact from small depressions to the water quantity leaving the mine. The small depressions do not pose any additional impacts to the PHC assessment in the Permit.

Furthermore, examination of the previously discussed analytical trends suggests that discharge water quality outcomes have remained relatively consistent. As for unstable analytes, the data examined in Section 3.1.2 indicate significant attenuation within the Mine boundary or just downstream in the case of CMWT. Overall, these trends support the presumption that impacts from mining and reclamation operations on surface waters are limited.

3.1.2 STREAM WATER QUALITY DATA

As mentioned above, there are two stream monitoring stations down-gradient of VMU-1, along Coal Mine Wash Tributary and along Tse Bonita Wash (Figure 2-1). Stream water quality data is available for both of these locations since July 2013. Required analyte data, standards, and exceedances are presented in Tables 3-3 and 3-4. Water quality is comparable between the two streams. Exceedances are limited to selenium and total dissolved solids.

From 2013 to 2022 water quality has generally improved in both streams, with most monitored analytes decreasing. Sulfate results were higher in CMWT during 2021 and 2022. There are other anomalies within decreasing trends for samples taken in 2018 and 2021. Refer to Appendix C for temporal plots of stream monitoring data. Lower constituent concentrations over time was expected as vegetation established in the area.

- pH in either stream fluctuates between 7.7 and 8.4. Field measurements are skewed high compared to lab results (Appendix C-1A/C-2A).

- Alkalinity in both streams is present as bicarbonate, as expected for solutions with a pH around 8 (Appendix C-1A/C-2A). Bicarbonate trends vary between streams. Higher alkalinity is beneficial for buffering acid in the stream.
    - Bicarbonate/alkalinity CMWT has decreased since 2013. Between Q3 2013 and Q4 2022 bicarbonate went from 129 mg/L $CaCO_3$ to 87.24 mg/L $CaCO_3$. Levels may rise and the 9-year maximum was 236 mg/L $CaCO_3$. (Table 3-3).
    - A gradual rise in bicarbonate/alkalinity was observed in TBW, with concentrations rising from 76.4 mg/L $CaCO_3$ in Q3 2013 to 101.4 mg/L $CaCO_3$ in Q4 2022 (Table 3-4).
- Carbonate in TBW was not sampled above the laboratory limit of quantification and is not shown in temporal plots. Carbonate was only detected in 3Q 2018 for CMWT (Appendix C-1A).
- Both streams have similar hardness as their upstream outfalls, CMWT with >100 mg/L $CaCO_3$ (Table 3-3) and TBW with >130 mg/L $CaCO_3$ (Table 3-4). Conserving hardness from upstream is good for reducing toxicity of metals to aquatic life.
- As seen in Appendices C-1B and C-2B, calcium concentrations fluctuate significantly. SAR levels depend largely on other cations concentrations rather than sodium concentrations. Cations concentrations monitored over the period of record have slightly decreased or stayed the same over time.
- Anion concentrations are plotted in Appendices C-1C and C-2C, with similar trends and ranges across constituents. Phosphate was below detection limits except between 2014 and 2018. Sulfate is the most prevalent anion, consistently measured exceeding other constituents by at least an order of magnitude.
- Sulfate concentrations have decreased in both streams from their respective historical maximums (Appendix C-1C/C-2C). From 151 mg/L (Aug. 2013) to 48 mg/L in CMWT and from >70 mg/L (July 2013/Aug. 2015) to roughly 20 mg/L in TBW.
- Iron and manganese concentrations for surface waters was increasing steadily before suddenly returning to pre-2015 levels (Appendix C-1D/C-2D). This changepoint occurred early 2021 for TSW and early 2022 for CMWT. Increases were greater in CMWT compared to TBW.
- Total solids (TDS and TSS) trends in TBW mimic iron and manganese trends identified above, whereas total solid concentrations were typically stable in CMWT (Appendix C-1E/C-2E). Settleable solids in both streams was extremely low.
- Two years returned extremely high suspended solids concentrations in CMWT, 2015 and 2021 (Appendix C1-E/C-2E). It is possible these are falsely inflated since conductance, dissolved solids, and settleable

solids results for the same events did not increase corresponding amounts. TDS, TSS, and settleable solids are not necessarily correlated, but they should be roughly proportional to one another (i.e. high erosion would mobilize settleable solids and leach soluble constituents into the water).

- All mercury detections were one or two orders of magnitude below the protection standard.
- Detections of selenium above the surface water protection standard were common among sampling events where the detection limit was below that standard (0.005 mg/L) (Appendix C-1F/C-2F). Suspected background concentrations of selenium in surface water (approximately 0.001 mg/L) are also lower than detected concentrations in both streams. No significant impacts to the Puerco River are anticipated because of ephemeral storm response and small loads by extension.

Examination of the previously discussed analytical trends suggests that stream water quality outcomes have improved or remained consistent since 2013 in both Coal Mine Wash Tributary and Tse Bonita Wash. Overall, these trends support the presumption that impacts from mining and reclamation operations on surface water are limited or insignificant. Geochemical parameters such as pH, alkalinity, and hardness also indicate stream water is resistant to such impacts and will protect aquatic life to an extent.

3.1.3 COMPARISON TO PROBABLE HYDROLOGIC CONSEQUENCES

The PHC determination (Permit Section 3.4.4) acknowledges the possible consequence of stormwater on downstream water chemistry. Full discussion of the surface water quality from each of the mine watersheds is included in the 2023 McKinley Mine Annual Hydrology Report (Trihydro 2024).

4.0 LONG-TERM GROUNDWATER MONITORING

Groundwater at the Mine is monitored from four sources: alluvial, bedrock, Gallup Sandstone Aquifer, and spoil. A summary of data for the four groundwater sources is provided below followed by a comparison of results to baseline water quality, regulatory standards, and the PHC, as applicable. Depth to water data for the groundwater sources are presented in Table 4-1. Tabulated water quality data for the groundwater sources are presented in Tables 4-2 and 5-3 with an assortment of temporal plots in Appendix D. Historical groundwater data tables include relevant groundwater protection standards for the reader's reference.

4.1 ALLUVIAL GROUNDWATER

Alluvial wells are located in and around major drainage watersheds throughout the Mine. Since water levels in these wells are dependent on direct precipitation, the depth to groundwater and the saturated thickness in wells vary to some degree based on rain and snowfall.

In 2016, OSMRE and MMD approved a permit modification to monitor only seven alluvial wells. Four of these wells have historically been considered recharging (DT2A, DT2B, TB2B2, and TB3D) whereas the remainder of the wells (CMC, D2C, and D3B2) have historically been dry. The alluvial wells being dry is consistent with the PHC. There are no alluvial wells in the vicinity of VMU-1.

4.2 GALLUP SANDSTONE AQUIFER

Five water wells (1, 2, 3, 3A, and 4) have been completed in the Gallup Sandstone Aquifer throughout the Mine area. These wells were used as primary water sources for mine activities and reclamation. The wells now provide domestic water, dust-control water, or are only monitored. Because of the impermeability of the shale units overlying the Gallup Sandstone Aquifer and the geologic structure in the area, the Gallup Sandstone Aquifer can be under artesian conditions. Moreover, due to the presence of the overlying shales, there is no hydraulic connection between the underlying Gallup Sandstone and the mined strata. GSA Well 3A is located southwest of VMU-1.

4.2.1 WATER LEVELS

Water level and saturated thickness are presented in Table 4-1 for Well 3A. Depth to groundwater in Well 3A has been variable since 2013 with corresponding decrease in saturated thickness.

4.2.2 WATER QUALITY

Sampling of Well 3A has been conducted quarterly for multiple parameters since the second half of 2015. Significant chemical parameters are included in the Groundwater Quality Summary 2015-2024 (Table 4-2). Appendix D-1 presents select temporal plots for Well 3A based on available 2015 to 2024 data.

Examination of the analytical data and temporal plots for the reporting period associated with Well 3A indicate the following.

- Alkalinity concentrations, expressed as bicarbonate, at Well 3A is generally stable as depicted on the temporal plot (Appendix D-1A).
- Nearly all the alkalinity present in Gallup Sandstone groundwater is attributable to bicarbonate, as carbonate is a relatively minor component. These results are expected given the slightly basic pH of groundwater (Appendix D-1A).
- Dissolved calcium concentrations are generally stable in Well 3A over the most recent 5-year period (Appendix D-1B). Variability in dissolved calcium during the period of 2015-2019 is more pronounced that 2019-2024 but is still relatively stable.
- Carbonate has consistently been reported below the laboratory limit of quantification and is not shown in the temporal plots.
- Chloride concentrations have remained relatively stable in Well 3A except for an outlier during October 2020 (Appendix D-1C).
- Fluoride concentrations in Well 3A have been mostly below laboratory limits of quantification during the 5-year reporting period (Appendix D-1C).
- Total hardness concentrations, expressed as $CaCO_3$, are generally stable in Well 3A with a normal range of 230-290 mg/l and an outlier of 338 mg/l during Q2 2015, as shown on the temporal plot (Appendix D-1A).
- Total iron concentrations were relatively stable at Well 3A during the reporting period, except for outlier high results for the Q3 2015, Q3 2021, and Q1 2024 (Appendix D-1D). Seasonal fluctuations associated with monsoonal events may have an effect on total iron content.
- The dissolved magnesium concentration plot for Well 3A shows a stable trend over the reporting period (Appendix D-1B).
- The temporal plot for total manganese shows a stable concentration trend at Well 3A (Appendix D-1D).

- The lab measurements of pH in Well 3A typically fall within the 7.5 to 8.3 range and exhibit relatively stable or slightly decreasing trends during the reporting period (Appendix D-1A).
- Phosphate was not detected above the laboratory limit of quantification at Well 3A during the reporting period and is omitted from the plot.
- The temporal plot for dissolved potassium shows a stable concentration trend at Well 3A (Appendix D-1B).
- Dissolved sodium concentrations are stable and vary by relatively small amounts quarter to quarter (Appendix D-1B).
- Sulfate concentrations have been stable over the past 5 years (Appendix D-1C). Sulfate concentrations in Well 3A increased to a 5-year high during third quarter 2020.
- Some variability in TDS is exhibited during 2015-2016 (Appendix D-1C). However, the temporal plots for total dissolved solids at Well 3A does not indicate any significant concentration trend over the past 8 years.
- Turbidity values show slight increasing trend at Well 3A over the past 5 years (Appendix D1-E). Three outliers high in Q3 2015, Q3 2021 and Q1 2024 are exhibited in the temporal plot.

Examination of the previously discussed analytical trends suggests that water-quality concentrations have remained relatively consistent since 2013 at Well 3A. Overall, these trends support the presumption that impacts from mining and reclamation operations on groundwater have not occurred or are limited. Reductions in water levels in Well 3A are likely due to the prolonged drought conditions in the region (Table 2-1).

4.3 BEDROCK AQUIFER

In 1980, five bedrock wells (MBR1, MBR2, MBR3, MBR4, and MBR5) were installed approximately 50-feet (ft) below the Green Coal Seam to monitor groundwater below this unit. The Green Coal Seam was the lower-most recoverable coal seam at the mine. These monitoring wells, referred to as McKinley bedrock wells, were located in and around the major drainage watersheds throughout the mine. Three of the original five wells (MBR1, MBR3, and MBR4) were mined through and not replaced. The active bedrock monitoring wells include MBR2 and MBR5, with MBR2 being in the vicinity of VMU-1. Upon the ultimate stages of bond release, MBR2 will be plugged and abandoned in accordance with NMAC 19.27.4.30.C.1.

4.3.1 WATER LEVELS

Water level and saturated thickness are presented in Table 4-1 for MBR2. Depth to groundwater in MBR2 has been increasing since 2013 with corresponding decrease in saturated thickness.

4.3.2 WATER QUALITY

Sampling of MBR-2 has been conducted annually for multiple parameters. Significant chemical parameters are included in the Groundwater Quality Summary 2013-2024 (Table 4-3). Appendix D-2 presents select temporal plots for MBR-2 based on available 2013 to 2024 data. Please note that non-detections are not depicted on the temporal plots.

Examination of the analytical data and temporal plots for the reporting period associated with MBR2 indicate the following.

- Alkalinity is a useful parameter when discussing bicarbonate and carbonate trends below. Alkalinity and bicarbonate concentrations have been relatively stable at MBR2. Nearly all the alkalinity present in bedrock groundwater is attributable to bicarbonate as carbonate is a relatively minor component. These results were expected given the neutral to slightly basic pH of the groundwater. Field pH values have consistently ranged between 7.6 and 8.2 SU at MBR2 and has shown a generally inverse relationship to alkalinity over the reporting period as shown on the temporal plot in Appendix D-2A.
- Dissolved calcium, magnesium, sodium, and potassium are plotted together on the temporal plot in Appendix D-2B. Dissolved calcium, magnesium and potassium concentrations have been stable in MBR2 since 2013 with spikes in 2015 and 2021. Dissolved sodium concentrations indicate a slightly increasing trend since 2016.
- The calculated ion balance percentages have been consistently less than 6%, other than an anomalous value in October 2014 (Appendix D-2C).
- Chloride, fluoride, sulfate, and TDS are plotted together on the temporal plot in Appendix D-2D. Chloride and sulfate concentrations at MBR2 have been relatively stable since 2013. Fluoride and total dissolved solids concentrations at MBR2 have fluctuated during the reporting period but indicate a generally neutral trend.
- Total and dissolved iron and manganese are plotted together on the temporal plot in Appendix D-2E. Total and dissolved iron concentrations in MBR2 have varied between 2 and 12 mg/L since 2013 with most of the iron existing in the suspended phase since dissolved iron has often been non-detect. Total and dissolved manganese concentrations in MBR2 have varied between 1 and 4 mg/L since 2013 except for two anomalous concentrations in 2015 and 2021. Most years during the reporting period, the majority of manganese exists in the dissolved phase.

- Boron, zinc, phosphorus, selenium, and nitrate are plotted together on the temporal plot in Appendix D-2F. Boron concentrations have been relatively stable. The remaining analytes have only been detected above the detection limit intermittently during the report period.

Examination of the previously discussed analytical trends suggests that water-quality concentrations have remained relatively consistent since 2013 at Well MBR2. Overall, these trends support the presumption that impacts from mining and reclamation operations on groundwater have not occurred or are limited. Reductions in water levels in Well MBR2 are likely due to the prolonged drought conditions in the region (Table 2-1).

4.4 SPOIL GROUNDWATER

Five spoil recharge wells (2G2, 4A, 9A, 9S, and 11) were constructed in the Mine area. Two spoil wells (4A and 9A on MMD lands) were installed in 1990; of these two wells, only 9A remains. Well 4A was not monitored after 2015 following approval by MMD to discontinue monitoring this well because the land at the well location had a full bond and liability release. Well 4A was abandoned October 29, 2018. In April 2013, three additional spoil recharge wells were constructed and designated as wells 2G2 (on OSMRE lands in the vicinity of VMU-1), 11, and 9S (on MMD lands). Spoil recharge wells were installed throughout the mine in reclaimed areas to determine chemical presence and groundwater properties. These wells were terminated at bedrock and their screens encompassed the spoil interval immediately above bedrock. As shown on Table 4-1, water column thickness in Well 2G2 has been less than 1 ft since 2016.

4.5 ASSESSMENT OF SURFACE WATER DATA

4.5.1 COMPARISON TO BASELINE WATER QUALITY

There are no baseline surface water data from pre-mining condition available for comparison to current discharge or stream water quality data. Therefore, this comparison is not included in this report.

4.5.2 COMPARISON TO REGULATORY STANDARDS

Surface water quality of stream monitoring stations were assessed against the regulatory standards established for all surface waters of New Mexico (NMAC 20.6.4.900), specifically surface waters designated for livestock watering (LW) and wildlife habitat (WH). Tables 3-1 through 3-4 include these standards for easy comparison to water quality data. It is worth noting that standards are purely for reference in discharge water quality tables and do not apply for NPDES permitted outfalls. Exceedances in stream water quality data are indicated by bold values in Tables 3-3 and 3-4. Only the following monitored constituents are regulated for livestock watering and wildlife habitat waterbodies: chloride, cyanide, mercury, nitrate as nitrogen, pH, selenium, sulfate, and total dissolved solids. The CMWT and TBW monitoring locations had assorted exceedances for selenium and total dissolved solids with no other observed exceedances during the period of record.

4.5.3 COMPARISON TO PROBABLE HYDROLOGIC CONSEQUENCES

Data establish that surface waters have potential for contamination above livestock/wildlife standards and are not suitable for public drinking water by extension. However, data also show that there are no deleterious effects to watershed health of the Puerco River. Regional surface waters are also protected because of ephemeral flow patterns of the streams of interest and limited constituent loadings to downstream reaches as a result. Monitoring at NPDES outfalls and McKinley Mine surface water monitoring stations will cease upon final stages of bond release. NPDES outfalls will be removed from stormwater permit subsequent to Phase III approval and Termination of Jurisdiction.

4.6 ASSESSMENT OF GROUNDWATER DATA

4.6.1 COMPARISON TO BASELINE WATER QUALITY

There are no baseline groundwater data from pre-mining conditions available for comparison to current groundwater quality data. Therefore, this comparison is not included in this report.

4.6.2 COMPARISON TO REGULATORY STANDARDS

Water quality from the bedrock aquifer and Gallup Sandstone Aquifer were assessed against the regulatory standards established for the maximum allowable concentrations of groundwater of 10,000 mg/L TDS or less (NMAC 20.6.2.3103). Tables 4-2 and 4-3 include these standards at the bottom, allowing for easy comparison to groundwater quality data, with bolded values indicating exceedances. Only the following monitored constituents are regulated by the referenced standards: fluoride, nitrate as N, and selenium for human health standards and chloride, iron, manganese, sulfate, TDS, zinc, and pH for domestic water supply. As previously mentioned, Well 3A has fewer required analytes as a Gallup Sandstone Aquifer well. Well 3A had six observed exceedances for total iron (Table 4-2) and no other exceedances. Fluoride and TDS were observed in exceedance of 1,000 mg/L for every sampling event at MBR2 (Table 4-3). MBR2 also has reported exceedances for total iron (five times) and dissolved iron (Q4 2013).

4.6.3 COMPARISON TO PROBABLE HYDROLOGIC CONSEQUENCES

Data establish that bedrock groundwaters are of poor quality that cannot be used for beneficial purposes. Data also show, however, that they have had no deleterious effect on established surface or groundwater uses. Upon the final stages of bond release, wells will be transitioned to the Navajo Nation.

5.0 SURFACE AND GROUNDWATER ASSESSMENT SUMMARY

As required for bond release of long-term surface and groundwater monitoring, water quality and quantity data are provided in this report. Evaluation of the data was presented in two separate sections to confirm that mining activities at the McKinley Mine have not disturbed the hydrologic balance in or around the site. In each of the sections, data were assessed with respect to baseline data, regulatory standards, and the PHC determination, as applicable. The following provides a brief summary of those findings.

5.1 LONG-TERM ASSESSMENT OF SURFACE WATER

There are two NPDES outfalls along the boundary of VMU-1, Outfall 010 and Outfall 013, and one stream monitoring location downstream from each outfall, CMWT and TBW respectively (Figure 2-1). Discharge water quality analysis from the outfalls was not conclusive, though analytical trend analysis of surface water quality of CMWT and TBW indicate attenuation of impacts observed at either outfall. Comparison to surface water protection standards indicate repeated exceedances of selenium and TDS in both ephemeral streams. The overall findings conclude there are limited or no impacts to surface waters after mining and reclamation operations and there are no impacts to the PHC.

5.2 LONG-TERM ASSESSMENT OF GROUNDWATER

Near VMU-1 there is one bedrock well, MBR2, and one Gallup Sandstone Aquifer well, 3A. Comparison of groundwater quality data to protection standards indicate exceedances of various analytes. Well 3A has seven observed exceedances for total iron over the entire period of record. Meanwhile, MBR2 has five exceedances for total iron over the period of record, as well as excess concentrations of fluoride and TDS. There are no impacts from groundwater pursuant to the PHC.

6.0 REFERENCES

Geohydrology Associates, Inc. (GAI). 1980. Hydrology Study of the McKinley Mine.

National Pollutant Discharge Elimination System (NPDES) Permit No. NN0029386. 2017. July 1.

New Mexico Administrative Code (NMAC). 2022. Title 20, Environmental Protection Chapter 6, Water Quality Part 4: Standards for Interstate and Intrastate Surface Waters. April 23.

New Mexico Administrative Code (NMAC). 2017. Title 19, Natural Resources and Wildlife Chapter 27, Underground Water Part 4: Well Driller Licensing; Construction, Repair, and Plugging of Wells. June 30.

New Mexico Administrative Code (NMAC). 2007. Title 20, Environmental Protection Chapter 6, Water Quality Part 2: Ground and Surface Water Protection. June 1.

Trihydro Corporation (Trihydro). 2024. McKinley Mine – 2023 Annual Report Hydrology Section. February 27.

TABLES

TABLE 2-1. PRECIPITATION DATA, RAIN 2, RAIN 3, AND RAIN 6
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Month	2013			2014			2015			2016			2017		
	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)
January	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
February	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
March	0.00	0.00	0.00	--	--	--	--	--	--	--	--	--	--	--	--
April	0.26	0.28	0.18	0.06	0.08	0.02	0.52	0.57	0.54	1.26	0.99	0.82	0.17	0.20	0.20
May	0.01	0.04	0.04	0.11	0.34	0.29	1.51	1.8	0.71	0.68	1.21	1.54	0.58	0.72	0.75
June	0.23	0.19	0.13	0.00	0	0	1.98	1.77	2.12	0.22	0.06	0.02	0.14	0.45	0.29
July	2.22	3.39	3.05	1.70	1.9	1.6	3.15	3.61	2.66	0.78	0.99	0.96	2.22	1.62	2
August	2.12	2.89	2.35	0.56	0.61	1.14	1.41	3.06	2.12	2.08	2.71	2.04	0.71	0.11	0.4
September	3.05	2.51	2.27	2.15	1.87	1.78	0.50	0.44	0	1.46	1.63	1.52	0.87	0.5	1.19
October	0.70	0.69	0.74	0.18	0.21	0.23	1.08	1.36	0.92	0.63	0.56	0.38	0.21	0.33	0.19
November	0.32	0.33	0.33	0.02	0.03	0.02	0.92	0.86	0.70	0.44	0.44	0.51	0.02	0.02	0.02
December	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Total Annual Precipitation

Year	2013			2014			2015			2016			2017		
Apr-Nov (inches)	8.91	10.32	9.09	4.78	5.04	5.08	11.07	13.47	9.77	7.55	8.59	7.79	4.92	3.95	5.04

Notes:

-- - precipitation station not operating due to freezing temperatures

(green shading) Partial operating month

in - inches

Apr - April

Nov - November

TABLE 2-1. PRECIPITATION DATA, RAIN 2, RAIN 3, AND RAIN 6
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

	2018			2019			2020			2021			2022		
Month	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)	Rain 2 (in)	Rain 3 (in)	Rain 6 (in)
January	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
February	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
March	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
April	0.06	0.04	0.03	0.22	0.39	0.36	0.26	0.00	0.05	0.00	0.03	0.02	0.00	0.00	0.01
May	0.26	0.3	0.21	1.41	1.5	1.2	0.09	0.01	0.02	0.03	0.09	0.06	0.00	0	0
June	0.30	0.35	0.46	0.15	0.32	0	0.05	0.05	0.02	0.16	0.05	0.03	1.03	1.03	0.66
July	1.10	0.92	0.97	0.35	0.7	0.01	1.65	1.06	0.82	0.99	0.69	0.83	3.00	2.99	2.55
August	0.90	0.91	0.56	0.73	0.11	0.34	0.20	0.62	0.55	1.09	1.04	0.19	3.77	3.07	3.05
September	1.40	1.27	1.02	1.35	1.72	1.82	0.17	0.16	0.14	1.03	1.63	0.46	1.22	1.18	0.69
October	1.48	1.69	1.45	0.04	0.06	0.04	0.31	0.27	0.08	0.94	1.17	1.06	1.14	1.19	0.28
November	0.00	0.00	0.00	0.05	0.06	0.03	0.16	0.19	0.16	0.00	0.00	0.00	0.39	0.54	0.47
December	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Total Annual Precipitation

Year	2018			2019			2020			2021			2022		
Apr-Nov (inches)	5.50	5.48	4.70	4.30	4.86	3.80	2.89	2.36	1.84	4.24	4.70	2.65	10.55	10.00	7.71

Notes:

-- - precipitation station not operating due to freezing temperatures

(green shading) Partial operating month

in - inches

Apr - April

Nov - November

TABLE 2-1. PRECIPITATION DATA, RAIN 2, RAIN 3, AND RAIN 6
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Month	2023 Rain 2 (in)	2023 Rain 3 (in)	2023 Rain 6 (in)	Average (2013-2023) (in)	Maximum (2013-2023) (in)
January	--	--	--	--	--
February	--	--	--	--	--
March	--	--	--	--	--
April	0.00	0.01	0.00	0.23	1.26
May	0.48	0.84	1.49	0.56	1.80
June	0.09	0.22	0.22	0.39	2.12
July	0.08	0.26	0.07	1.54	3.61
August	3.08	2.93	1.97	1.50	3.77
September	0.44	0.54	0.49	1.17	3.05
October	0.09	0.08	0.05	0.60	1.69
November	0.00	0.00	0.00	0.21	0.92
December	--	--	--	--	--

Total Annual Precipitation

Year	2023		
Apr-Nov (inches)	4.26	4.88	4.29

Average (2013-2023)	Rain 2 Average (in)
6.19	6.27
Rain 3 Average (in)	**Rain 6 Average (in)**
6.70	5.61

Notes:

-- - precipitation station not operating due to freezing temperatures

(green shading) Partial operating month

in - inches

Apr - April

Nov - November

TABLE 3-1. HISTORICAL DISCHARGE DATA - OUTFALL 010
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Location	Date Sampled	Aluminum, Total (mg/L)	Calcium, Total (mg/L)	Cyanide, Total (mg/L)	Gross Alpha (pCi/L)	Hardness (mg/L $CaCO_3$)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Oil & Grease (mg/L)	pH, Lab (s.u.)	Selenium, Total (mg/L)	Solids, Total Dissolved (mg/L)	Solids, Total Suspended (mg/L)
Outfall 010/DC 1	3/2/2019	6.35	NM	ND(0.01)	12.7	83.6	4.92	NM	ND(5)	7.9	0.00073	264	158
Outfall 010/DC 1	8/2/2021	210	190	ND(0.005)	266	790	230	77	ND(9.84)	8	0.045	3,800	12,000
Outfall 010/DC 1	7/30/2022	87	39	ND(0.005)	30.9	150	35	12	31.3	7.97	0.0071	785	240
Outfall 010/DC 1	8/16/2022	19	36	ND(0.005)	11.5	130	8.3	8.5	ND(9.73)	8.2	0.0016	290	19
Outfall 010/DC 1	9/22/2022	17	39	ND(0.005)	ND(86)	140	17	11	ND(9.61)	7.98	0.0024	535	270
Outfall 010/DC 1	10/17/2022	5.5	38	ND(0.005)	ND(75.6)	130	5.7	9.3	ND(10)	8.1	ND(0.005)	274	38
Outfall 010/DC 1	2/21/2023	3.2	22	ND(0.01)	ND(84)	79	1.7	5.7	ND(9.83)	7.59	ND(0.001)	345	100
Outfall 010/DC 1	3/22/2023	15	29	ND(0.005)	ND(95.2)	110	10	9.3	ND(9.95)	8.06	0.0048	705	180
Outfall 010/DC 1	8/15/2023	36	44	ND(0.005)	61	170	35	14	ND(9.78)	7.74	0.0022	1,180	1,000
Outfall 010/DC 1	8/24/2023	99	73	ND(0.005)	249	320	100	35	NM	7.83	0.0066	ND(500)	6,600
Outfall 010/DC 1	10/18/2023	20	54	ND(0.005)	38.9	200	20	15	ND(9.76)	7.69	0.0017	460	970
Standard		-	-	0.0052	15	-	-	-	-	6 - 9	0.005	1,000	-

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
pCi/L - picocuries per liter, measure of radioactivity
s.u. - standard units

TABLE 3-2. HISTORICAL DISCHARGE DATA - OUTFALL 013
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Location	Date Sampled	Aluminum, Total (mg/L)	Calcium, Total (mg/L)	Cyanide, Total (mg/L)	Gross Alpha (pCi/L)	Hardness (mg/L $CaCO_3$)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Oil & Grease (mg/L)	pH, Lab (s.u.)	Selenium, Total (mg/L)	Solids, Total Dissolved (mg/L)	Solids, Total Suspended (mg/L)
Outfall 013/SP 3-6	9/27/2021	17	29	ND(0.005)	16.4	100	18	7.2	ND(9.87)	7.83	0.0067	600	190
Outfall 013/SP 3-6	7/27/2022	16	37	0.00621	8.18	120	6.4	7.7	ND(9.93)	7.93	0.0014	446	50
Outfall 013/SP 3-6	8/16/2022	32	32	ND(0.005)	13.8	110	15	6.7	ND(10.2)	8.03	0.0017	368	360
Outfall 013/SP 3-6	9/22/2022	29	33	ND(0.005)	65.9	120	31	10	504	7.85	0.0028	600	430
Outfall 013/SP 3-6	10/4/2022	12	33	ND(0.005)	ND (133)	110	12	7.2	ND(9.59)	8.04	0.0017	282	98
Outfall 013/SP 3-6	10/18/2022	9.1	32	ND(0.005)	13.9	110	9.8	7.2	ND(9.7)	7.83	0.0024	284	100
Outfall 013/SP 3-6	2/21/2023	1.6	22	ND(0.01)	3.89	74	1.1	4.4	ND(10.5)	7.62	0.0016	390	160
Outfall 013/SP 3-6	3/23/2023	0.57	40	ND(0.005)	ND	130	0.52	8.3	ND(9.8)	8.09	ND(0.001)	164	14
Outfall 013/SP 3-6	8/13/2023	15	33	ND(0.005)	46.9	120	20	8.4	ND(10.1)	7.78	0.0011	252	630
Outfall 013/SP 3-6	8/24/2023	19	34	ND(0.005)	32.2	120	24	9.1	ND(9.92)	7.79	0.0015	740	450
Standard		-	-	0.0052	15	-	-	-	-	6 - 9	0.005	1,000	-

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
pCi/L - picocuries per liter, measure of radioactivity
s.u. - standard units

TABLE 3-3. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity (mg/L $CaCO_3$)	Bicarbonate (mg/L $CaCO_3$)	Calcium, Total (mg/L)	Carbonate (mg/L $CaCO_3$)	Chloride (mg/L)	Hardness (mg/L $CaCO_3$)	Iron, Dissolved (mg/L)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Manganese, Dissolved (mg/L)	Manganese, Total (mg/L)	Mercury (mg/L)	Nitrogen Nitrate (mg/L)	pH, Lab s.u.	Phosphate (mg/L)
7/26/2013	129	129	169	ND(2)	3.8	NM	25.5	128	55.5	1.91	3.5	NM	0.75	8	NM
8/7/2013	82.5	82.5	62.6	ND(2)	11.6	NM	0.0445	42.2	21.4	0.007	0.694	NM	1.9	7.8	NM
9/23/2014	99.3	99.3	119	ND(2)	4.9	449	53.7	118	47.5	0.768	2.32	0.00092	1.2	8	6.6
9/29/2014	84.2	84.2	131	ND(2)	5.7	422	20.3	110	47.1	1.03	3.1	ND(0.0002)	1.3	8.2	7.8
6/13/2015	118	118	331	ND(2)	5.7	1,690	0.711	67.7	61.9	0.0074	6.66	0.0006	2.1	8	32.2
7/14/2018	276	236	247	40.2	5.8	1,490	51.3	155	91.3	1.11	5.53	0.0019	1.5	8.1	20.8
9/2/2018	128	122	65	ND(25)	4.5	154	34.4	52.7	23.5	0.858	1.11	ND(0.002)	1.8	8	5
7/30/2019	174	174	503	ND(8)	8.4	1,670	190	295	173	5.29	9.22	0.0028	0.87	8	25.2
8/6/2019	135	135	205	ND(8)	7.5	ND(2,000)	102	159	75	2.24	4.7	0.00021	1.6	8.1	14.5
7/12/2021	118.8	118.8	390	ND(2)	5.9	1,500	2.1	370	140	5.4	9	ND(0.0008)	2	7.99	ND(2.5)
8/2/2021	90.44	90.44	280	ND(2)	6.4	1,200	5.5	340	110	2.7	8.8	ND(0.0008)	1.9	8.08	ND(2.5)
7/30/2022	96.68	96.68	31	ND(2)	5.7	110	0.93	26	8.7	0.03	0.16	ND(0.0002)	1	7.98	ND(2.5)
8/17/2022	67.96	67.96	52	ND(2)	6.3	210	3.3	75	20	0.074	0.95	0.00021	1.4	8	ND(2.5)
9/22/2022	81.16	81.16	33	ND(2)	5	120	0.87	22	9.4	0.023	0.15	ND(0.0002)	0.76	7.9	ND(2.5)
10/17/2022	87.24	87.24	30	ND(2)	5.8	100	0.7	6	7.1	0.018	0.055	ND(0.0002)	ND(1)	7.97	ND(2.5)
Standard	-	-	-	-	250	-	-	-	-	-	-	0.01	10	6 - 9	-

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 3-3. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Phosphorus, Total (mg/L)	Potassium, Total (mg/L)	Selenium, Total (mg/L)	Sodium, Total (mg/L)	Total Dissolved Solids (mg/L)	Total Suspended Solids (mg/L)	Sulfate (mg/L)
7/26/2013	4.1	38.3	ND(0.02)	26.5	NM	NM	13.5
8/7/2013	0.877	17.1	ND(0.02)	52.3	**2,760**	1,770	151
9/23/2014	2.87	45.4	**0.0309**	28	254	8,550	11.7
9/29/2014	2.98	26.8	**0.0061**	29	682	6,640	20.9
6/13/2015	4.3	29.9	**0.0077**	29.5	254	30,000	70.3
7/14/2018	5.3	55.8	ND(0.05)	30.9	699	9,350	12.4
9/2/2018	1.25	20.2	ND(0.05)	15.2	408	2,700	18.5
7/30/2019	8.7	82.7	ND(0.05)	32.3	268	2,680	17.5
8/6/2019	4.45	36.4	ND(0.05)	33.1	**1,030**	6,780	35.5
7/12/2021	22	63	**0.035**	48	980	38,000	35
8/2/2021	12	51	**0.054**	33	**4,750**	16,000	34
7/30/2022	0.42	13	0.0025	23	494	150	40
8/17/2022	1.6	16	**0.012**	22	**1,060**	2,200	53
9/22/2022	0.46	11	0.0032	24	280	190	48
10/17/2022	0.17	8.3	0.0038	28	390	50	48
Standard	-	-	0.005	-	1,000	-	600

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 3-4. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity (mg/L $CaCO_3$)	Bicarbonate (mg/L $CaCO_3$)	Calcium, Total (mg/L)	Carbonate (mg/L $CaCO_3$)	Chloride (mg/L)	Hardness (mg/L $CaCO_3$)	Iron, Dissolved (mg/L)	Iron, Total (mg/L)	Magnesium, Total (mg/L)	Manganese, Dissolved (mg/L)	Manganese, Total (mg/L)	Mercury (mg/L)	Nitrogen Nitrate (mg/L)	pH, Lab (s.u.)
7/20/2013	76.4	76.4	176	ND(2)	3.5	NM	38.1	197	59.5	0.65	3.58	NM	0.66	7.8
7/29/2013	92.7	92.7	33.7	ND(2)	11.9	NM	0.0604	19.8	9.02	0.0194	0.222	NM	0.72	7.8
8/6/2013	79.6	79.6	85	ND(2)	3.7	NM	8.44	76.8	25.6	0.136	1.76	NM	0.42	7.7
9/29/2014	87.3	87.3	55.1	ND(2)	8	200	ND(0.2)	19.4	16.5	0.0014	0.348	ND(0.0002)	0.32	8
7/13/2015	76.1	76.1	48.1	ND(2)	4.4	201	0.0546	25.3	14.6	0.0056	0.342	0.000054	0.39	7.9
7/15/2015	79.4	79.4	44.3	ND(2)	3.2	179	0.311	28.3	13.5	0.004	0.485	0.00011	0.38	7.9
8/31/2015	127	127	60.6	ND(200)	3.2	225	0.137	41.7	18.8	0.0107	0.689	0.00028	0.37	8.4
7/24/2017	75.9	75.9	40.3	ND(5)	5	162	ND(0.2)	41.6	14.9	0.0033	0.514	0.00014	2.8	7.6
7/18/2018	127	116	169	ND(50)	3.6	554	53.1	97.9	45.2	1.44	3.85	0.00052	0.94	7.9
9/2/2018	103	103	58.1	ND(25)	4.1	151	10.4	64.3	19.5	0.139	0.951	ND(0.002)	1.3	7.7
7/12/2021	85.52	85.52	87	ND(2)	6	360	3.4	130	36	0.8	1.7	ND(0.0008)	ND(1)	7.9
7/24/2021	72.76	72.76	34	ND(2)	4.7	130	0.41	34	11	0.0084	0.33	ND(0.0008)	1.4	7.49
8/3/2021	87.64	87.64	41	ND(2)	ND(5)	160	0.78	38	13	0.04	0.33	ND(0.0008)	1.4	7.9
8/11/2021	67.76	67.76	180	ND(2)	ND(5)	690	5.8	23	61	1	4.9	ND(0.0008)	ND(1)	8
10/6/2021	89.68	89.68	35	ND(2)	4.7	120	0.35	10	7.7	0.014	0.1	ND(0.0002)	ND(0.5)	8.1
8/17/2022	86.04	86.04	40	ND(2)	2.5	150	4.3	49	13	0.16	0.52	ND(0.0002)	ND(0.5)	7.86
9/22/2022	86.6	86.6	42	ND(2)	ND(2.5)	160	2.1	63	14	0.14	0.51	ND(0.0002)	ND(0.5)	7.8
10/17/2022	101.4	101.4	36	ND(2)	2.6	130	1.4	15	8.9	0.056	0.19	ND(0.0002)	ND(1)	8
Standard	-	-	-	-	250	-	-	-	-	-	-	0.01	10	6 - 9

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 3-4. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Phosphate (mg/L)	Phosphorus, Total (mg/L)	Potassium, Total (mg/L)	Selenium, Total (mg/L)	Sodium, Total (mg/L)	Solids, Total Dissolved (mg/L)	Solids, Total Suspended (mg/L)	Sulfate (mg/L)
7/20/2013	NM	3.71	36.6	**0.0096**	37.8	574	13,700	142
7/29/2013	NM	3.6	9.69	ND(0.02)	18	**1,050**	8,300	70.4
8/6/2013	NM	1.52	16.7	ND(0.02)	19.5	**1,650**	4,200	62.5
9/29/2014	ND(0.31)	0.371	9.96	ND(0.02)	70.2	697	860	213
7/13/2015	1.2	0.454	10.1	ND(0.02)	33.6	370	663	111
7/15/2015	1.7	0.519	10.1	ND(0.02)	21.1	322	950	68.6
8/31/2015	2.4	0.725	12.8	ND(0.02)	17.9	470	2,770	71.2
7/24/2017	2.6	0.769	16.5	ND(0.02)	17.5	424	1,360	18.7
7/18/2018	7.9	2.54	27.7	ND(0.05)	14	**1,770**	6,700	9.8
9/2/2018	4.6	1.09	13.9	ND(0.05)	14.6	536	1,590	28.8
7/12/2021	ND(2.5)	3.4	28	**0.011**	14	700	5,900	17
7/24/2021	ND(2.5)	0.7	14	**0.0059**	16	920	250	26
8/3/2021	ND(2.5)	0.71	13	**0.0062**	18	**1,160**	520	32
8/11/2021	ND(5)	6.6	35	**0.029**	8.3	**1,600**	6,300	7.2
10/6/2021	ND(2.5)	ND(0.5)	7.8	0.0031	15	335	170	39
8/17/2022	ND(2.5)	0.87	13	0.0048	9	810	920	23
9/22/2022	ND(2.5)	0.67	13	**0.0051**	9.1	590	980	23
10/17/2022	ND(2.5)	0.27	8.5	0.0032	9.3	530	230	22
Standard	-	-	-	0.005	-	1,000	-	600

Abbreviations:
mg/L - milligrams per liter
mg/L $CaCO_3$ - milligrams per liter as calcium carbonate
ND - non-detect (detection limit in parentheses)
NM - not measured
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 4-1. ANNUAL WATER LEVEL SUMMARY
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

YEAR	WELL 3A, TD = 882 ft bmp		WELL MBR2, TD = 179.8 ft bmp		WELL 2G2, TD = 56.85 ft bmp	
	DTW ft bmp	Saturated Thickness ft	DTW ft bmp	Saturated Thickness ft	DTW ft bmp	Saturated Thickness ft
2013	NM	NM	132.84	47.63	54.59	2.26
2014	NM	NM	132.17	47.57	**54.68**	2.17
2015	NM	NM	132.23	46.57	**54.73**	2.12
2016	**702.98**	179.02	133.23	46.17	**55.79**	1.06
2017	**697.20**	184.80	133.63	46.12	**56.69**	0.16
2018	**719.15**	162.85	133.68	45.98	**56.73**	0.12
2019	**706.44**	175.56	133.82	45.98	**56.77**	0.08
2020	**697.20**	184.80	133.86	45.94	56.82	0.03
2021	**694.89**	187.11	138.62	41.18	**56.77**	0.08
2022	**700.67**	181.33	134.05	45.75	ND	0
2023	**711.06**	170.94	135.18	44.62	ND	0
2024	706.44	175.56	NM	NM	ND	0

Note:
1. Values in bold represent arithmetic means calculated from at least two measurements from the same year.

Abbreviations:
bmp - below measuring point
DTW - depth to water
ft - feet
ND - non-detect/dry well
NM - not measured

TABLE 4-2. WELL 3A HISTORICAL GROUNDWATER QUALITY DATA
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity mg/L CaCO3	Bicarbonate mg/L CaCO3	Calcium, Dissolved mg/L	Carbonate mg/L CaCO3	Chloride mg/L	Fluoride mg/L	Hardness mg/L CaCO3	Iron, Total mg/L	Magnesium, Dissolved mg/L	Manganese, Total mg/L	pH, Lab (s.u.)	Phosphate mg/L	Potassium, Dissolved mg/L	Sodium, Dissolved mg/L	Solids, Total Dissolved mg/L	Sulfate mg/L	Turbidity NTU
9/2/2015	207	207	73.9	ND(2)	4.6	ND(0.5)	264	**4.45**	12	0.101	8.3	ND(0.31)	2.8	43.1	402	102	28.4
11/3/2015	213	213	79.9	ND(2)	3.3	ND(0.5)	274	0.498	12.9	0.101	7.8	ND(0.31)	2.88	42.2	460	98.3	2.3
2/24/2016	215	215	77.9	ND(2)	3.9	ND(0.5)	295	**1.35**	12.5	0.116	8.1	ND(0.31)	2.76	40.1	423	86.8	8.5
5/24/2016	217	217	75.7	ND(2)	3.6	ND(0.5)	338	0.915	12.2	0.0984	8	ND(0.31)	2.7	39.1	408	96.5	3.7
9/14/2016	217	217	72	ND(5)	3.9	ND(0.5)	227	0.463	11.7	0.087	8	ND(0.31)	2.66	41.3	421	102	2.5
11/9/2016	221	221	70.8	ND(5)	4.1	ND(0.5)	246	0.318	11.4	0.0849	7.7	ND(0.31)	2.68	38.5	379	114	1.4
3/3/2017	221	221	75.6	ND(5)	4.4	ND(0.5)	267	0.841	12.6	0.0973	7.9	ND(0.31)	3.37	43.9	397	70.5	3.7
6/7/2017	215	215	77.5	ND(5)	3.4	ND(0.5)	251	0.499	12.5	0.0918	8	ND(0.31)	2.99	39.9	384	106	3.4
9/13/2017	211	211	70.2	ND(5)	4.3	0.3	232	0.528	11.9	0.0978	7.7	ND(0.31)	2.72	36.4	389	98	4
11/16/2017	218	218	69.9	ND(5)	4.3	ND(0.5)	234	0.503	11.5	0.0889	7.9	ND(0.31)	2.62	36.2	392	93.2	3.6
2/21/2018	212	212	75.7	ND(5)	4.1	ND(0.5)	240	0.433	12	0.0925	8	ND(0.31)	2.75	39.3	406	105	1.7
5/16/2018	207	207	76.8	ND(5)	4.4	0.45	219	0.309	12.5	0.0836	8	ND(0.31)	2.67	40.2	388	96.1	3.5
9/12/2018	220	220	72.1	ND(5)	3.4	ND(0.5)	231	**1.14**	11.6	0.123	8	ND(0.31)	2.84	44.2	384	73.5	12
11/15/2018	224	224	72.3	ND(5)	3.7	0.37	276	0.525	11.9	0.13	8.2	ND(0.31)	2.8	40.7	388	74.8	7.8
2/28/2019	220	220	79.2	ND(5)	3.9	ND(0.5)	232	0.337	12.7	0.0927	8.1	ND(0.31)	3.1	40.7	376	105	2.6
5/14/2019	217	217	77.4	ND(5)	3.9	ND(0.5)	235	0.336	12.1	0.0916	8	ND(0.31)	2.6	38.5	391	120	3.2
8/20/2019	222	222	77.7	ND(8)	4.4	ND(0.5)	266	0.368	12.7	0.0964	8	ND(0.31)	2.63	39.9	392	140	4.1
11/13/2019	219	219	71.3	ND(8)	3.9	ND(0.5)	285	0.593	11.8	0.0924	8.1	ND(0.31)	2.57	36.3	388	104	8.9
2/19/2020	215	215	74.8	ND(8)	4	ND(0.5)	277	**1.22**	12	0.0931	7.9	ND(0.31)	2.72	38	399	93.4	16
4/29/2020	217	217	74.7	ND(8)	3.9	ND(0.5)	268	0.754	12	0.09	8	ND(0.31)	2.63	42.1	398	133	10
9/9/2020	220	220	74	ND(8)	4.1	0.32	270	**1.1**	12	0.092	7.8	ND(0.31)	2.7	45	420	270	18
10/22/2020	220	220	73	ND(8)	3.6	ND(0.5)	290	0.55	11	0.093	7.9	ND(0.31)	2.9	38	390	93	9.3
1/26/2021	210	210	75	ND(8)	5.6	0.29	260	1	13	0.09	8	ND(0.31)	2.8	45	370	130	11
5/12/2021	219.6	219.6	76	ND(2)	3.4	ND(0.5)	240	0.91	12	0.095	7.73	ND(2.5)	2.7	45	401	97	8.1
8/10/2021	218.3	218.3	81	ND(2)	3	ND(0.5)	240	3.7	13	0.11	7.7	ND(2.5)	2.9	41	378	98	88
10/27/2021	218.1	218.1	75	ND(2)	3.6	ND(0.5)	240	0.6	12	0.085	7.93	ND(2.5)	2.5	37	387	100	5.4
2/10/2022	217.6	217.6	73	ND(2)	3.7	ND(0.5)	220	0.82	12	0.091	7.76	ND(2.5)	2.6	41	405	100	10
4/26/2022	219.1	219.1	77	ND(2)	3.4	0.23	230	0.96	12	0.09	7.81	ND(0.5)	2.5	47	409	100	8.5
12/7/2022	215.4	215.4	73	ND(2)	3.2	ND(0.5)	250	0.96	12	0.095	7.54	ND(2.5)	2.5	39	388	90	7.8
3/15/2023	222.4	222.4	73	ND(2)	3.3	ND(0.5)	240	**1.9**	12	0.1	7.83	ND(2.5)	2.6	37	404	93	16
5/24/2023	222.6	222.6	71	ND(2)	3.6	ND(0.5)	230	0.95	12	0.081	8.08	ND(2.5)	2.5	47	403	100	11
7/12/2023	221.6	221.6	76	ND(2)	3.4	ND(0.5)	240	0.7	12	0.096	7.78	ND(2.5)	2.6	44	378	97	6
10/18/2023	220.6	220.6	76	ND(2)	ND(5)	ND(1)	240	1.4	13	0.12	7.92	ND(5)	2.6	41	387	92	13
1/30/2024	217.1	217.1	75	ND(2)	3.4	ND(0.5)	230	4.3	12	0.14	7.74	ND(2.5)	2.4	38	384	92	50
Standard	-	-	-	-	250	1.6	-	1	-	0.2	6 - 9	-	-	-	1,000	600	-

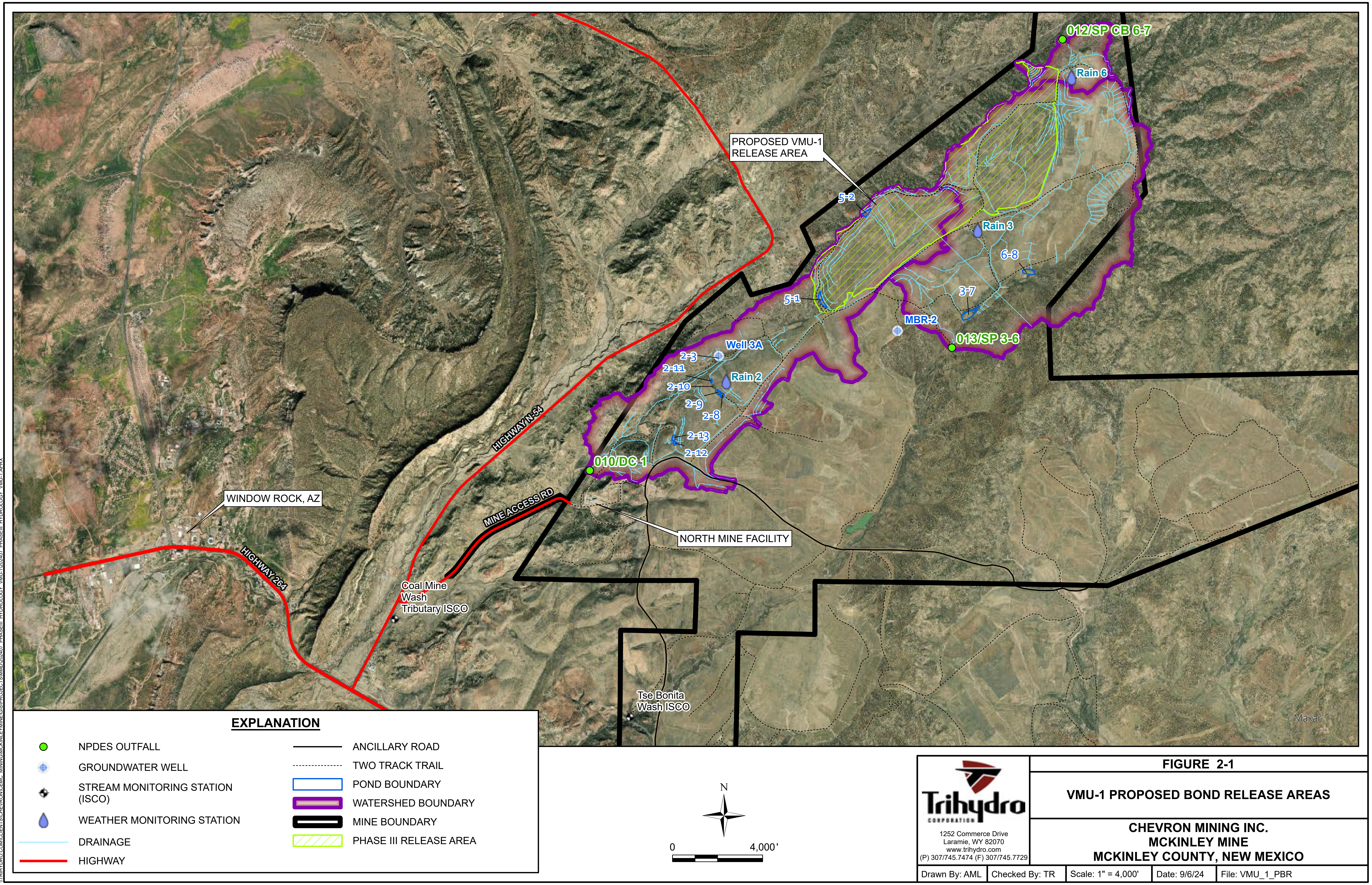
Abbreviations:
CaCO3 - calcium carbonate, molecular weight of 100.06 g
mg/L - milligrams per liter
ND - non-detect (detection limit in parentheses)
NTU - Nephelometric Turbidity Units
s.u. - standard units

TABLE 4-3. WELL MBR2 HISTORICAL GROUNDWATER QUALITY DATA
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

Date Sampled	Alkalinity mg/L CaCO3	Bicarbonate mg/L CaCO3	Boron, Total mg/L	Calcium, Total mg/L	Carbonate mg/L CaCO3	Chloride mg/L	Fluoride mg/L	Hardness mg/L CaCO3	Iron, Dissolved mg/L	Iron, Total mg/L	Magnesium, Total mg/L	Manganese, Dissolved mg/L	Manganese, Total mg/L	Nitrogen Nitrate mg/L	pH, Lab s.u.	Phosphate mg/L	Phosphorus, Total mg/L	Potassium, Total mg/L	Selenium, Total mg/L	Sodium, Total mg/L	Solids, Total Dissolved	Sulfate mg/L	Zinc, Total mg/L
11/12/2013	590	590	0.154	5.32	6.9	6.9	**5.4**	NM	**2.21**	**2.59**	1.8	0.0205	0.0214	ND(0.1)	7.9	ND(0.31)	0.0545	3.3	ND(0.02)	485	**1,520**	581	0.0108
10/22/2014	520	520	0.164	6.87	6.3	6.3	**4.3**	44.6	ND(0.2)	0.353	1.54	0.0205	0.023	ND(0.1)	7.9	ND(0.31)	0.0196	2.48	0.0069	544	**1,400**	595	0.0043
11/19/2015	539	539	0.173	6.77	7.1	7.1	**4.6**	36.6	ND(0.2)	**10.5**	3.93	0.0122	0.0606	ND(0.1)	7.6	ND(0.31)	0.135	5.77	ND(0.02)	490	**1,500**	562	0.0486
11/9/2016	564	564	0.159	5.14	7.7	7.7	**5.9**	25.2	ND(0.2)	**1.52**	1.6	0.0074	0.0172	0.055	7.9	ND(0.31)	0.0456	2.79	ND(0.02)	490	**1,400**	569	0.0079
11/15/2017	519	519	0.159	6.43	7.3	7.3	**4.7**	22.5	0.113	0.218	1.47	0.0322	0.0307	ND(0.1)	7.9	ND(0.31)	ND(0.1)	2.41	ND(0.02)	500	**1,660**	573	ND(0.02)
11/14/2018	519	519	0.161	7.06	6.9	6.9	**6.8**	18.6	ND(0.2)	0.313	1.53	0.0244	0.0262	ND(0.1)	7.9	ND(0.31)	ND(0.1)	2.33	ND(0.05)	498	**1,310**	595	ND(0.02)
11/13/2019	568	568	0.151	6.1	7.6	7.6	**5.2**	25.7	0.325	**3.07**	2.14	0.0129	0.0302	ND(0.1)	8.1	ND(0.31)	0.0809	3.84	ND(0.05)	511	**1,400**	542	0.0196
10/28/2020	510	510	0.17	6.7	7	7	**4.7**	27	ND(0.21)	0.068	1.5	0.022	0.022	0.1	8.2	ND(0.31)	ND(0.1)	2.4	ND(0.05)	510	**1,200**	590	ND(0.02)
10/27/2021	568.5	568.5	0.2	9.5	7.1	7.1	**4.9**	36	0.53	**4.3**	2.8	0.06	0.083	ND(0.5)	7.71	ND(2.5)	0.094	4.3	ND(0.005)	540	**1,600**	580	0.023
11/9/2022	576.6	576.6	0.17	5.4	6.7	6.7	**4.9**	20	ND(0.02)	1.1	1.6	0.011	0.018	ND(0.5)	7.78	ND(2.5)	0.16	2.9	ND(0.001)	520	**1,460**	540	ND(0.01)
10/17/2023	530.1	530.1	0.18	6	6.8	6.8	**4.6**	21	ND(0.02)	0.29	1.5	0.011	0.018	ND(0.5)	7.74	ND(2.5)	ND(0.05)	2.4	ND(0.001)	510	**1,510**	600	ND(0.01)
Standard	-	-	-	-	-	250	1.6	-	1	1	-	0.2	0.2	10	6 - 9	-	-	-	0.05	-	1,000	600	10

Abbreviations:
CaCO3 - calcium carbonate, molecular weight of 100.06 g
mg/L - milligrams per liter
ND - non-detect (detection limit in parentheses)
NTU - Nephelometric Turbidity Units
s.u. - standard units

FIGURES



Trihydro Corporation
1252 Commerce Drive
Laramie, WY 82070
www.trihydro.com
(P) 307/745.7474 (F) 307/745.7729

FIGURE 2-1

VMU-1 PROPOSED BOND RELEASE AREAS

CHEVRON MINING INC.
MCKINLEY MINE
MCKINLEY COUNTY, NEW MEXICO

Drawn By: AML	Checked By: TR	Scale: 1" = 4,000'	Date: 9/6/24	File: VMU_1_PBR

APPENDIX A

MCKINLEY MINE PERMIT SECTION 3.4, HYDROLOGY INFORMATION

- (108°56'40"; 35°41'38") 16.1 ac-ft/annum (File No. G-93)
- (108°54'35"; 35°40'52") 16.1 ac-ft/annum (File No. G-94)
- (SW¼, NW¼, SE¼ Sec 14, T16N, R20W) 16.1 ac-ft/annum (File No. G-95)
- (NW¼, SE¼, NW¼ Sec 9, T16N, R20W) Domestic/Sanitary (File No. G-258)

A search of the Office Of The State (NM) Engineer records indicates the following additional groundwater rights holders in the vicinity of McKinley Mine (Appendix 3.4-A):

- (NW¼, NE¼ Sec 3, T16N, R21W) (File No. G-160, M. Abukhalil, Domestic)
- (NE¼, NW¼, Sec 1, T16N, R21W) (File No. G-28, W. Bald, Domestic)
- (SE¼, NE¼, SE¼ Sec 11, T16N, R20W) (File No. G-51, C. Wilhelm, Stock)
- (NW¼, SE¼, SE¼ Sec 9, T16N, R20W) (File No. G-390, N. Murphy, Domestic)
- (NW¼, NW¼ Sec 9, T16N, R20W) (File No. G-976, B. Nicholson, Domestic)
- (NE¼, NE¼ Sec 7, T16N, R20W) (File No. G-131, C. Harris, Domestic/Stock)
- (SW¼, NW¼, SE¼ Sec 1, T16N, R20W) (File No. G-677, N. Nation, Domestic)

3.4.3 HYDROLOGIC MODELING

Appendix 3.4-E contains modeling information which characterizes and contrasts surface water quality and quantity for medium sized watersheds in undisturbed, disturbed, and reclaimed surficial conditions.

3.4.4 PROBABLE HYDROLOGIC CONSEQUENCES (PHC)

The PHC addresses existing mining areas and the new mining area referred to as the "East Wing." The addition of 1870 acres in the East Wing Revision does not alter any of the surface or groundwater parameters addressed in the PHC. To address the addition of the East Wing, a separate and detailed update follows this general PHC analysis.

The validity of the PHC for the existing mining areas and the East Wing is supported by surface and ground water sampling programs conducted by P&M since 1980, which verify the original assumptions of runoff quantity and quality in the PHC. Surface and groundwater monitoring data is submitted to the OSM quarterly and as part of the Annual Report. A collection of studies, which analyze the data for both surface and groundwater, further verify the validity of the basis for the PHC and are included in this PAP at Appendix 3.4-G for surface water and Appendix 3.4-H for ground water.

Data collected from the surface water sampling program includes small (1.2 - 6.1 acres), medium (188 - 235 acres) and large (5.7 - 27.5 square miles) paired watersheds. Quarterly ground water sampling results show a slight reduction in the sparse alluvial and bedrock aquifers, and confirm the stagnant nature and poor quality of the aquifers. Sampling of the Gallup Aquifer shows no reduction in pumping quantity other than ordinary well usage drawdown and no change in quality.

In summary, more surface water will be retained on the reclaimed areas resulting in a slight reduction in runoff to the Puerco River drainage. The quality of surface runoff from the reclaimed areas has been shown to improve due to lower suspended solids and total settleable solids. PATFM management will improve effluent levels of dissolved solids, salinity, and alkalinity. The ground water quantity will be reduced slightly in the alluvial and bedrock aquifers. There will be negligible impact on ground water quality in the alluvial and bedrock aquifers, and none in the Gallup Sandstone.

SURFACE WATER QUANTITY

Surface water quantity may be increased on the reclaimed areas through the construction of small impoundments. These impoundments will be used to provide water for livestock and wildlife and to create small riparian habitats for small mammals, birds and reptiles. The amount of postmining runoff as compared to the premining runoff to the Puerco River drainage will be diminished by the harvesting of the water in the impoundments and other riparian areas. This reduction of runoff is supported by the hydrologic model included in Appendix 3.4-E of this application. However, the impact on the Puerco River drainage will be negligible due to the small percentage of the drainage area that the McKinley Mine comprises.

SURFACE WATER QUALITY

For a short term following reclamation of an area there may be a slight increase in the levels of total dissolved solids, sulfates, and other soluble elements in the overburden. This increase will eventually lessen as the runoff leaches the overburden. This potential slight increase will be documented by the collection and analysis of surface water runoff during the permit term as described in Section 6.3. The long term surface water PHC is described below.

Physical Quality

Surface water physical quality will be improved through stabilization of the reclamation areas and the creation of post mining impoundments. These actions will result in lower TSS and T-Set-S in the runoff from the disturbed areas. The PHC is evaluated using hydrologic models contained in Appendix 3.4-E of the permit application, and through the collection of TSS and T-Set-S samples during flow events. The modeling indicated that per acre sediment yields from the mining and post-mining areas will be less than from the pre-mining areas. The analytical results indicate that the TSS concentrations from the disturbed watershed are consistently lower than the undisturbed watershed concentrations since monitoring began as documented in the Annual Hydrology Reports submitted to OSM. The following section provides a summary of the sediment yield modeling provided in Appendix 3.4.E.

The Area 6 total sediment yield from the 10-year, 24-hour precipitation event was estimated to be 415.4 tons, 472.3 tons, and 189.1 tons for the pre-mining, mining and reclamation, and post-mining evaluations, respectively. On a per acre basis, sediment delivery equates to 0.45 tons/acre, 0.41 tons/acres, and 0.16 tons/acre for the pre-mining, mining and reclamation, and post-mining disturbance phases, respectively.

The average per acre sediment loading for the pre-mining condition is higher than for the mining and reclamation or post-mining conditions. For the mining and reclamation conditions, low sediment volumes are generated from reclaimed areas with BTCA sediment control practices, while somewhat higher sediment volumes are generated from the graded spoils where BTCA practices were not implemented. Nevertheless, the worst-case mining and reclamation condition does not exceed the pre-mining condition's average sediment loading values.

The volume of the sediment generated during the post-mining disturbance phase (when all disturbed areas have received a BTCA sediment control treatment) is significantly lower than either the pre-mining or mining and reclamation conditions. This leads to the conclusion that once BTCA practices are fully implemented, sediment transport is significantly reduced at the Mine compared to pre-mining conditions.

The times to peak sediment loading were estimated to occur at 12.4 hours, 12.0 hours and 12.2 hours for the pre-mining, mining and reclamation, and post-mining disturbance phases, respectively. These represent the period between commencement of the storm event and the time the peak sediment loading will be realized in runoff waters. The time to peak sediment loading for the pre-mining model corresponds to the time of peak runoff. The time to peak loading for the mining and reclamation and post-mining condition occurs approximately one hour before peak runoff occurs.

The predicted runoff volumes from the 10-year, 24-hour precipitation event for the three disturbance phase conditions are as follows: Pre-mining = 0.0389 acre-feet per acre of watershed, Mining and Reclamation = 0.0338 acre-feet per acre of watershed, and Post-mining = 0.023 acre-feet per acre of watershed. On a per acre basis, the largest volume of runoff occurs from lands in the pre-mining condition. The BTCA practices of land imprinting, mulching and revegetation utilized during the mining and reclamation, and post-mining disturbance phases reduce the overland flow velocity. As flow velocity is reduced, the runoff has increased opportunity to infiltrate into the soil and further reduce the volume of overland flow. Reduction in flow in turn reduces runoff, sediment carrying capacity and sediment delivery. Thus, the regulatory objective of preventing the contributions of additional suspended solids is met through the BTCA practices designed to harvest water and enhance soil moisture conditions in reclaimed areas. Also, water harvesting acts to stimulate plant growth and development. Increased vegetation cover in turn acts to improve the hydrologic characteristics of reclaimed lands.

Chemical Quality

Surface water chemical quality will be unaffected or could possibly improve by minimizing the potential of runoff coming into contact with potentially acid or toxic materials (PATFM). These materials consist of those uncovered during the mining operations, native soil materials that of are poor quality, and naturally occurring exposed coal seams. The PATFM Management program which is discussed in Section 5.2 of this permit, will identify graded spoil areas that have acid or toxic materials present in or near the rooting zone. Areas identified through this program will be mitigated prior to revegetation. These actions will prevent the degradation of the surface water quality within the mine and improve the effluent levels of dissolved solids, salinity, and alkalinity.

GROUNDWATER QUANTITY

Gallup Sandstone Aquifer

As discussed above, the Gallup Sandstone Aquifer is used as the primary source of water for the mine and for the McKinley County area. This aquifer occurs 400 to 1,000 feet below the lowest coal seam to be recovered and has no local recharge features. The recharge area for this aquifer is located to the north of McKinley Mine in the Chuska Mountains.

P&M drilled it's first large scale water supply well in 1975 and began measurement of withdrawals from their four supply wells in 1986. The average rate of groundwater withdrawal for the Mine between 1986 and 2002 is 275 ac-ft/yr. Under the imposed pumping stress, the potentiometric surface (as defined by the Mines production wells) has sustained a maximum rate of decline of 3.1 ft/yr in Wells #1 and #3, a 14-foot rise at Well #2, and has remained stable at Well #3A (Tetra Tech EM Inc. 2003).

The potentiometric surface defined by Wells #2 and #3A suggest that water levels in much of the Mine area are stable or rising. This condition has resulted from less water production or use of Wells #2 and 3A over the last five years.

Measured drawdown of the potentiometric surface within the Gallup Sandstone aquifer is between 700 to 1,000 feet in some of the older wells in the Yah-ta-hey well field located east of the Mine (NWCOG, 1998). This is the primary source of water for the City of Gallup. The dramatic decline in local water levels is the result of low storage within the Gallup Sandstone and large pumping interferences between closely spaced production wells.

Under the current Mine water production schedule, the probable hydrologic consequence of continued pumping is minimal to non-existent. Annual water withdrawals at the Mine represent less than 5% of total groundwater withdrawals from the Gallup Sandstone aquifer in the region.

To further substantiate this information and to show current information pertaining to the Gallup Sandstone formation, P&M developed a revised structure map of the Gallup Sandstone formation. This map has been included in this application as Exhibit 3.4-1. It should be noted that this map supplements or supersedes information provided in Appendix 3.4-C pertaining to the Gallup Sandstone formation. The changes made in the Gallup Sandstone Structure map are based on information collected from the drill logs for the four Gallup Sandstone Aquifer wells in use at McKinley Mine, therefore only the information in the immediate vicinity of the Mine has been modified.

In addition, P&M has developed a map showing the potentiometric surface of the Gallup Aquifer (Exhibit 3.4-2). Elevations of the potentiometric surface of the Gallup Sandstone Aquifer reflect an estimate of current static water levels for the four Gallup Sandstone Aquifer wells in use at McKinley Mine. As with Exhibit 3.4-1, only the information in the immediate vicinity of the Mine has been modified.

The potentiometric surface depicted on Exhibit 3.4-2 of the Mine permit application shows that groundwater flows in an east-northeast direction in the vicinity of the Mine. The potentiometric surface slopes from the hogback located immediately west of the Mine toward a pronounced trough defined by the 6600-, 6500-, and 6400-foot contours. The trough appears to drain groundwater toward the northeast or San Juan Basin. Geohydrology Associates, Inc (1980) were the first investigators to identify the trough feature, which appears to still exist.

Alluvial Aquifers

As discussed above, alluvial water is practically nonexistent, occurring generally in close proximity to arroyos, and in direct relation to the rate and amount of runoff in the arroyos. Water soaks into the sides and bottoms of the arroyos during runoff events. This type of recharge occurs principally during snowmelt and the summer runoff season. The only instance where this type of groundwater will be affected by the mining operations, is where alluvial areas are actually mined. The hydrologic impact on this groundwater source will be complete removal of the resource when encountered during mining. However, due to the limited areal extent of the resource, any impacts would be considered negligible.

Bedrock Aquifers

Bedrock water quantity is minimal in extent, consisting only as small pockets of perched water in the various stratums. The quantity and areal extent of these pockets of water are not of sufficient quantity or quality to be considered significant. This water is normally observed as seepage from the highwall or small amounts of water on the pit floor. The mining operation results in removal of this insignificant groundwater source.

GROUNDWATER QUALITY

Gallup Sandstone Aquifer

As noted above in the discussion on groundwater quantity, there will be no impact by mining on the recharge zones of the Gallup Sandstone Aquifer. Therefore, there will be no impact on the quality of the Gallup Sandstone Aquifer by the mining operations.

Alluvial Aquifers

Alluvial water quality, in undisturbed areas, will continue to be influenced primarily by the amount of runoff in the arroyos and characteristics of the soils in the area of infiltration. There will be minimal impacts on the quality of this resource by the mining operations.

Bedrock Aquifers

The bedrock water encountered during mining will be removed in the mining process. This removal will have no effect on the water present in areas not affected by mining. This is due to the low transmissivity of the formations associated with this type of water.

PROBABLE HYDROLOGIC CONSEQUENCES EAST-WING UPDATE

The section contains a detailed East Wing update regarding the Probable Hydrologic Consequences from this operation. The update also provides the necessary background information to show that there are no adverse impacts to the hydrologic regime from current mining and nor any expected from East Wing operations. This information also serves to show that surface and ground water monitoring mechanisms are in place to maintain an active watch over the hydrologic behavior of the East Wing and the rest of the mine. In order to accomplish this update, it was necessary to discuss information collected over the years mine wide from surface and ground water monitoring program.

Surface Water Monitoring

Major Drainage results and comparisons

Surface water from major drainages has been monitored since the early 1980's through active surface water monitoring stations. Four stations (TBW, CMWT, DDT6, DD) collect samples that have disturbed-area watersheds. One station (CMW) collects samples from a relatively undisturbed channel. The CMW station data is used as background information to contrast against the other four stations. One additional station has been constructed in the East Wing (EW1). EW1 went online in 2001 and provides baseline information concerning the East Wing area.

Data from the disturbed-watershed monitoring stations was contrasted with information from the undisturbed-drainage monitoring station in the 2000 Annual Report. That data has been included here under Appendix 3.4-I. The data ranges from the early 1980's through 2000. The following parameters are summarized in the report, as agreed upon with OSM, and include: pH, TDS, TSS, dissolved selenium, total iron, and dissolved boron. The data collected for a given year has been averaged and graphed. The original data for the entire list of parameters tested are submitted quarterly and are on file with OSM.

In general, the contrasted data shows a high level of agreement for nearly all the stations for most of the parameters over many years. That is, the background levels did not markedly differ from the disturbed watershed values. In very few instances, did the disturbed exceed the background levels significantly.

Various factors can affect the level of agreement between any of the watersheds. Perhaps of highest consideration is the effect localized thunderstorms can have on each watershed. For example, a high runoff event in one watershed could dilute TDS and raise total suspended solids (TSS). A low runoff event in another watershed could record a more concentrated TDS and lower TSS. Subsequently, the comparability of the two watersheds could be difficult at times. Therefore, to help evaluate the data, standards will be referenced where possible to see how the overall water quality measures up.

The CHIA for McKinley Mine (1984) established a value of 5000 mg/L of total dissolved solids (TDS) that could constitute material damage. The value represents the maximum TDS concentration recommended for livestock or irrigation. In the mid-1980's, a few high TDS averages are observed for some of the disturbed watersheds. While the counterpart TDS from CMW were generally less, the TDS were still below the 5000 mg/L reference.

The CHIA (1984) established that very high concentrations of TSS would be expected. The graphs show that most of the time TSS were higher for the undisturbed wash versus the other four disturbed watersheds. TBW had no data recorded in 1989, subsequently, no valid comparisons can be made that year.

As expected, average pH for both undisturbed and disturbed watersheds were alkaline. Generally, there was relatively good agreement in pH between the undisturbed and disturbed watersheds. The graphs show that pH averages were above 7.0 and below 9.0; quite often, the undisturbed watershed had the higher pH.

The other three parameters of interest are total iron, dissolved selenium, and dissolved boron. Initial data shows that the values for total iron and selenium were higher the first few years of sampling before leveling off. In those instances the undisturbed drainage had the higher values. The total iron for CMW and CMWT seems artificially high, but there is no information available at this point to confirm the data. Subsequent data, however, reflects constant parallel values between the undisturbed and disturbed watersheds that are low.

Boron comes into play around 1991. While disturbed and undisturbed watershed data for dissolved boron values agree at times, other times they vary by up to 0.2 mg/L. The highest averages do not go above 0.4 mg/L, which is below the New Mexico Administrative Code standard for irrigation of 0.75 mg/L, and 5.0 mg/L for livestock watering.

The EW1 major drainage surface water monitoring station was constructed in late 2000, and data is available for 2001. This data is contained in Appendix 3.4-I. The station captures runoff from an undisturbed watershed that will be affected by the East Wing mining operations. Subsequently, this data will serve as baseline data to contrast against information gathered from the disturbed watershed.

The initial EW1 data for various key parameters is summarized in the Table 3.4-1. The maximum values (pH includes minimum) recorded are shown.

Table 3.4-1
East Wing Surface Water Monitoring Station Data

Parameter	pH	TDS (mg/L)	TSS (mg/L)	SAR	Sulfate (mg/L)	Total Iron (mg/L)	Boron (mg/L)
	7.78-8.84	320	83000	3025	104	100	0.2

In summary, no additional major drainage watershed monitoring stations are necessary to construct. The EW1 surface water monitoring station will provide adequate representation of the East Wing mining areas, and to the overall hydrologic regime.

Medium Drainage results and comparisons
There are three medium watershed-monitoring stations at McKinley Mine (DDT9, DDT10, and A12). All three monitoring stations are in the Defiance Draw watershed (the Defiance Draw drainage also includes the East Wing mining area watersheds). DDT9 and DDT10 are downstream from areas affected by mining. The A12 monitoring station is in an undisturbed watershed in Area 12 just southeast of the East Wing mining areas.

The 2000 annual report data from the three stations is provided in Appendix 3.4-I. The data represent average values for the runoff season. Detailed data for parameters in the 2000 annual report, plus all the other parameters tested were submitted to OSM via quarterly reports.

The graphs show consistent ranges of values for most years for the parameters shown for the undisturbed versus the disturbed watersheds. DDT9 shows a spike in total iron in 1998; however, nearly all the runoff to this location came from alluvial areas ahead of mining. Subsequently, it is difficult to quantify the spike. Most other years, there was good agreement with iron.

No additional medium-drainage monitoring stations are needed for the East Wing since the A12 monitoring station is already near the East Wing. Since the East Wing is in the Defiance Draw drainage, the three medium-drainage monitoring stations are adequate to characterize surface water from medium drainages into Defiance Draw.

Ground Water Monitoring

Alluvial wells

Alluvial well transects are located in various locations throughout the mine. The intent of the transects was to monitor valley-fill water resources. The transects are located in five drainage locations that include Tse Bonita Wash, Coal Mine Wash, and Defiance Draw.

These drainages have one or more transects. The Tse Bonita Wash (TB) transect consists of 6 wells at two transects (TB2 and TB3). The Coal Mine wash (CM) transect consists of 6 wells. The Defiance Draw Drainage (the largest of the drainage systems) consists of three transect locations: DT2 (4 wells), D2 (5 wells), and D3 (4 wells).

Well information for key parameters agreed to between OSM and P&M from the 2000 annual report is provided in Appendix 3.4-I. Data is collected quarterly from some wells, and annually from others. Quarterly data was averaged by year for the 2000 annual report. Detailed data for 2000 annual report parameters, and all the other parameters tested were submitted to OSM via quarterly reports. The appendix also includes information regarding what alluvial wells have been historically dry.

The wells nearest to the East Wing are the four DT2 wells located to the southwest in Area 11. Over the past 15 years, water levels in three of the wells have not changed significantly (the 4th well is dry). An overview of the key chemical parameters shows that these values have remained fairly constant with the values originally recorded in the wells. Occasional spikes do appear, but have been short-lived and probably related to precipitation levels.

As reported in the original baseline report done by Geohydrology Associates, Inc., (1980), there were no existing wells which tap the valley-fill deposits of Defiance Draw. It was concluded in the report that Defiance Draw valley-fill material did not constitute an aquifer.
Geohydrology Associates, Inc. (1980) did a water quality evaluation of the well samples using the drinking water standards available at that time from the U.S. Public Health Service. None of the samples met these drinking-water recommendations for sulfate or dissolved solids.

Monitoring over the years has not shown any changes that would negate the original evaluation. Since the remaining alluvial fills in the East Wing are also tributary to Defiance Draw, it is apparent that drilling more transects in these upper reaches of Defiance Draw would not provide information that is not already captured in the existing wells. Given the proximity of the DT2 wells to the East Wing, and the fact that there already exist three sets of transects in the Defiance Draw watershed, no additional transects are needed in the East Wing.

Bedrock wells

Five bedrock wells were drilled to a depth of about 50 feet below the Green coal. The holes were referred to as McKinley bedrock (MBR) wells and distributed around the lease. The five wells are referred to as MBR1, MBR2, MBR3, MBR4, and MBR5. MBR4, located in Area 9 (south of Highway 264) was mined through and not replaced.

Well information for key parameters agreed to between OSM and P&M from the 2000 annual report is provided in Appendix 3.4-I. The wells are sampled annually. Detailed data for 2000 annual report parameters, and all the other parameters tested were submitted to OSM via quarterly reports.

The original baseline report by Geohydrology Associates, Inc. (1980) concluded that the wells had little potential as meaningful groundwater resources. The transmissivity of the bedrock deposits were low, less than 6 ft^2/day and not capable of maintaining a constant discharge of 1 gallon per minute sustained yield. Also, even though ground water was present, none of the strata had sufficient continuity to be considered an aquifer.

Quality-wise, Geohydrology Associates, Inc.'s (1980) baseline work showed that the ground water that was there did not meet the recommended maximum drinking-water standards set by the U.S. Public Health Service. The total mineralization was more than twice the recommended standard, fluoride was three times above the standard for MBR 2 and 3, and sulfate values were above the standard (250 mg/L) for MBR 2 (325 mg/L).

The wells that provide the most useful information in assessing the existing and expected bedrock-hydrology of the East Wing are MBR2 and MBR3. MBR2 will be reviewed to see how it has behaved since mining has occurred around that site and because it is the second nearest well to the East Wing. MBR3 will be evaluated since it is located in the middle of the East Wing. The period 1995 – 2000 has been averaged and listed below and contrasted against the 1980 values in the baseline report, and the standards contained in The Safe Drinking Water Act.

Table 3.4-2
MBR2 and MBR3 Quality Evaluation (mg/L)

	Sulfate	TDS	Nitrate	Chloride	Iron	Fluoride
MBR2						
(95-00)	527	1458	0.3	13.3	0.5	5.1
1980	325	1136	0.4	6.4		5.5
MBR3						
(95-00)	120	1537	0.16	82.5	0.6	6.9
1980	70	1368	0.5	86		5.7
Standard	250	500	10	250	0.3	2.0

The data contrast shows that little has changed in either well. TDS and fluoride still remain unacceptably high in both wells. In MBR2, sulfate that was already above the threshhold, still remains above the threshold. Chloride did increase for MBR2, but still below the standard.

MBR3 shows little change from what was originally reported in the baseline assessment. Given that little has changed from the original 1980 evaluation, the need to keep MBR3 does not seem necessary. The well was originally determined to be a poor resource for ground water from a quantitative and qualitative perspective—nothing has changed to negate that finding. In conclusion, the well will be mined through and not replaced.

Gallup Sandstone Aquifer

The potential effect of mining on the Gallup Sandstone Aquifer is monitored through the sampling of four wells: Well 1, Well 2, Well 3, and Well 3A. As stated in the Geohydrology Associates, Inc. report (1980), the Gallup aquifer is under artesian conditions because of the impermeable shales above it. Data from the wells also had shown that transmissivity was quite variable from well to well.

The data from the 2000 annual report is included in Appendix 3.4-I. The data collected quarterly was averaged for each year for the annual report. The information shows key parameters that P&M and OSM agreed to include in the Annual Report. Detailed data for the 2000 annual report parameters, and for all the other parameters tested were submitted to OSM via quarterly reports.

The McKinley Mine CHIA (1984) contained initial information on total dissolved solids (TDS) that will be useful to evaluate. The CHIA states that total dissolved solids for the Gallup Sandstone Aquifer averaged 1,121 milligrams per liter (presumably the overall aquifer).

Data from the four McKinley Mine wells show that total dissolved solids from these wells had a better quality initially than the average aquifer value of 1,121 mg/L. None of the wells started out with TDS above 700 milligrams per liter. Over the years, TDS for some wells has gone up and down; however, the quality has generally improved or stayed about the same. By 2000, TDS for three of the wells were below 400 mg/L; the fourth well was just below 500 mg/L.

The same trending and conclusions can be made about sulfate values, which also have gone up and down over time. By 2000, sulfate values have either decreased, or stayed close to the original 1983 values.

Iron values have stayed low and fairly constant over the past ten years. One spike, however, is noted in 1990 for Well 1; this anomaly is likely a sample contamination or lab error since the other values were very low (seven times less than the spike) and had not changed very much the other 17 years. Some other high iron values were recorded in the late 1980's for the other wells; since then, however, iron values have stayed consistently low. For the most part, iron values for two wells have been less than the original values (wells 3 and 3A); iron values for the other two wells (1 and 2) have generally stayed near the originally-tested values.

Static water levels have generally increased or stayed close to the initial recorded levels according to the data. Subsequently, no problem is noted with well recharge.

In summary, the well data show that the character of the aquifer has changed little and generally improved. Therefore, it is concluded that mining at the McKinley Mine is not adversely impacting the Gallup Sandstone aquifer. No future impact of the Gallup Sandstone Aquifer is likely; the recharge zone is not located in the McKinley Mine area, and the aquifer lies below impermeable shales.

3.4.5 CHIA (SYNOPSIS)

The Cumulative Hydrologic Impact Assessment (CHIA), completed by the Radian Corporation for the Office of Surface Mining as part of the Technical Analyses and Environmental Assessment by OSMRE on Permit No. NM-0001B/3-10P, covers all of the areas to be mined by this application and is still valid. Included below is a brief synopsis of the conclusions of the CHIA:

- Surface water use in the area is primarily stock watering with some irrigation. There are no permitted water rights holders downstream of the mining operation in the cumulative impact area. Indicator parameters related to hydrologic concerns in the basin are total dissolved solids and total suspended solids (TSS) concentrations.
- Cumulative impacts to the quantity of the flow in the Puerco River are

APPENDIX B

OUTFALL SURFACE WATER QUALITY TEMPORAL PLOTS

B-1. HISTORICAL OUTFALL DATA - OUTFALL 010/DC1

- **B-1A. 010/DC-1 - pH AND HARDNESS**
- **B-1B. 010/DC1 - ALUMINUM, CALCIUM, IRON, MAGNESIUM, SELENIUM**
- **B-1C. 010/DC1 - TOTAL SOLIDS AND CONDUCTANCE**
- **B-1D. 010/DC1 - GROSS ALPHA AND OIL & GREASE**

B-2. HISTORICAL OUTFALL DATA - OUTFALL 013/SP 3-6

- **B-2A. 013/SP 3-6 - pH AND HARDNESS**
- **B-2B. 013/SP 3-6 - ALUMINUM, CALCIUM, IRON, MAGNESIUM, SELENIUM**
- **B-2C. 013/SP 3-6 - TOTAL SOLIDS AND CONDUCTANCE**
- **B-2D. 013/SP 3-6 - GROSS ALPHA AND OIL & GREASE**

APPENDIX B-1

HISTORICAL OUTFALL DATA - OUTFALL 010/DC1

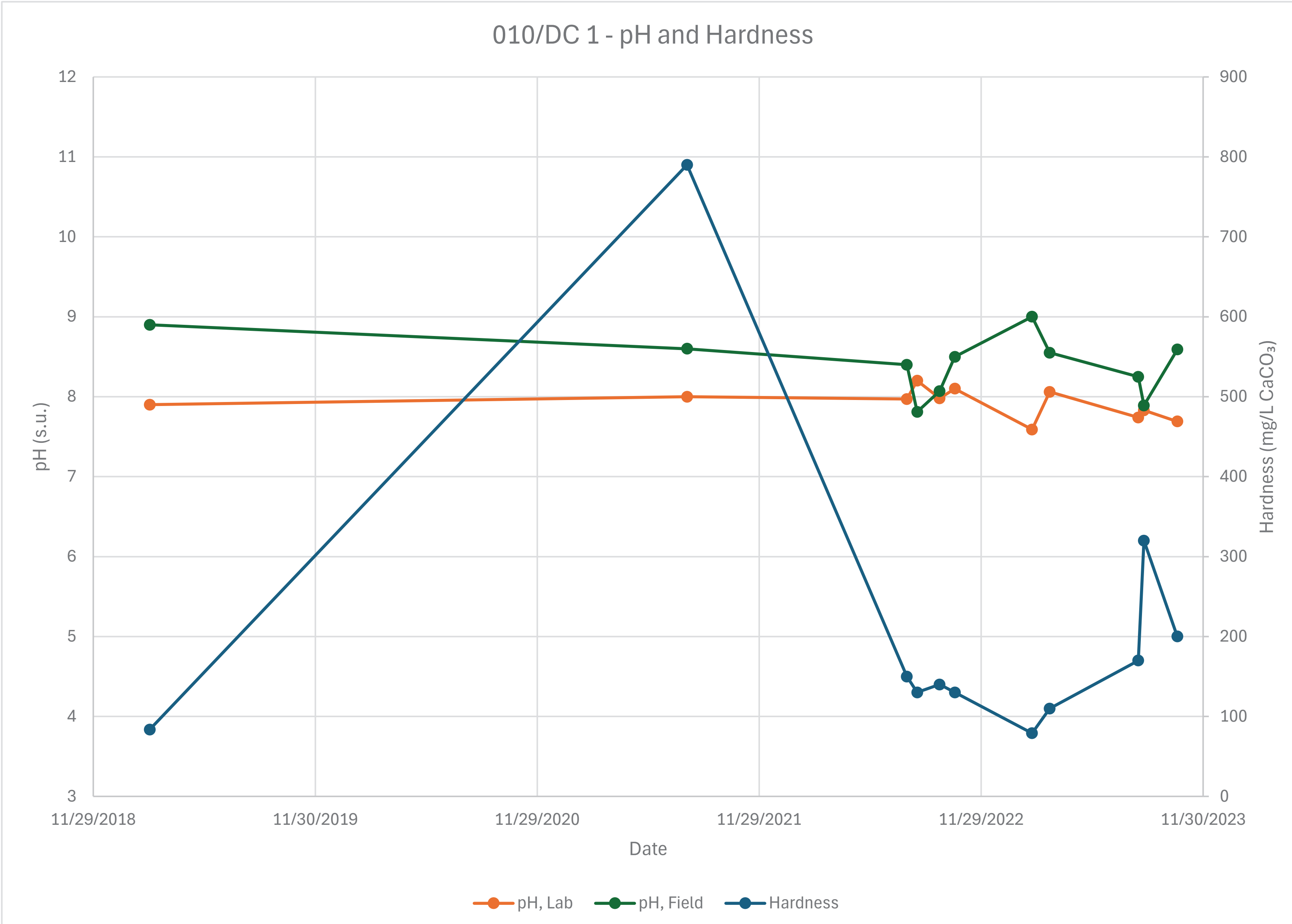
B-1A. 010/DC-1 - pH AND HARDNESS

B-1B. 010/DC1 - ALUMINUM, CALCIUM, IRON, MAGNESIUM, SELENIUM

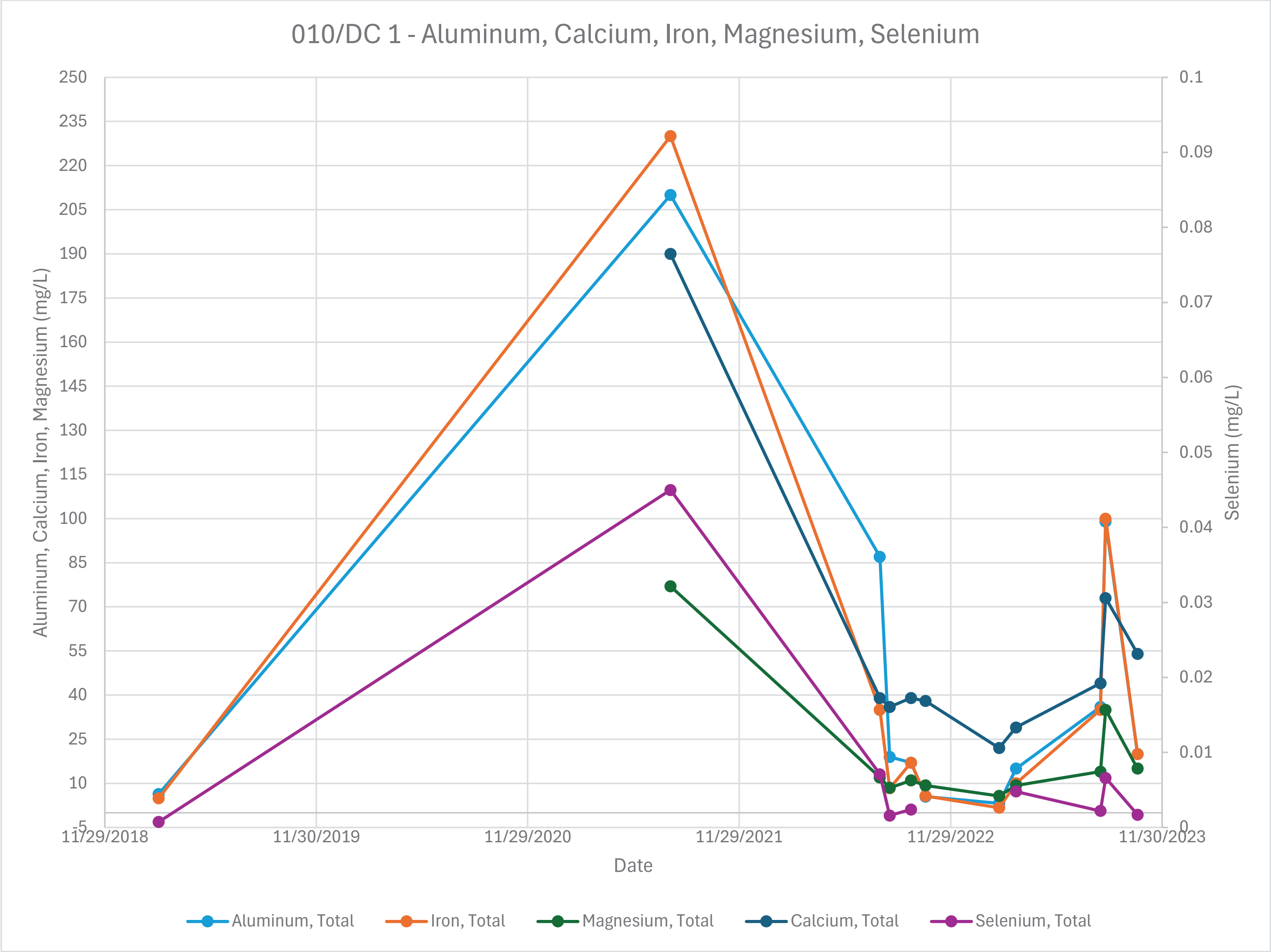
B-1C. 010/DC1 - TOTAL SOLIDS AND CONDUCTANCE

B-1D. 010/DC1 - GROSS ALPHA AND OIL & GREASE

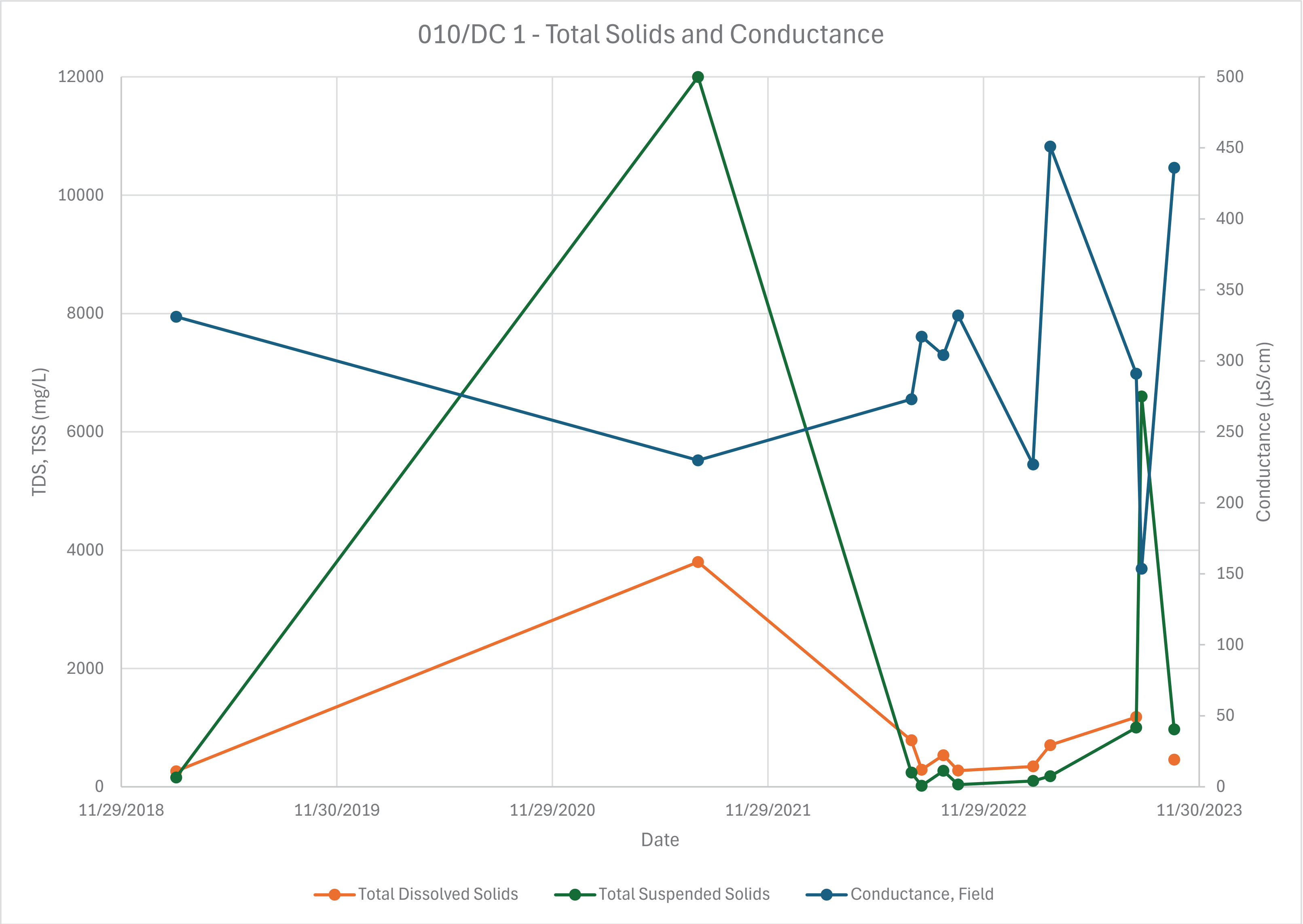
APPENDIX B-1A. HISTORICAL OUTFALL DATA - OUTFALL 010
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



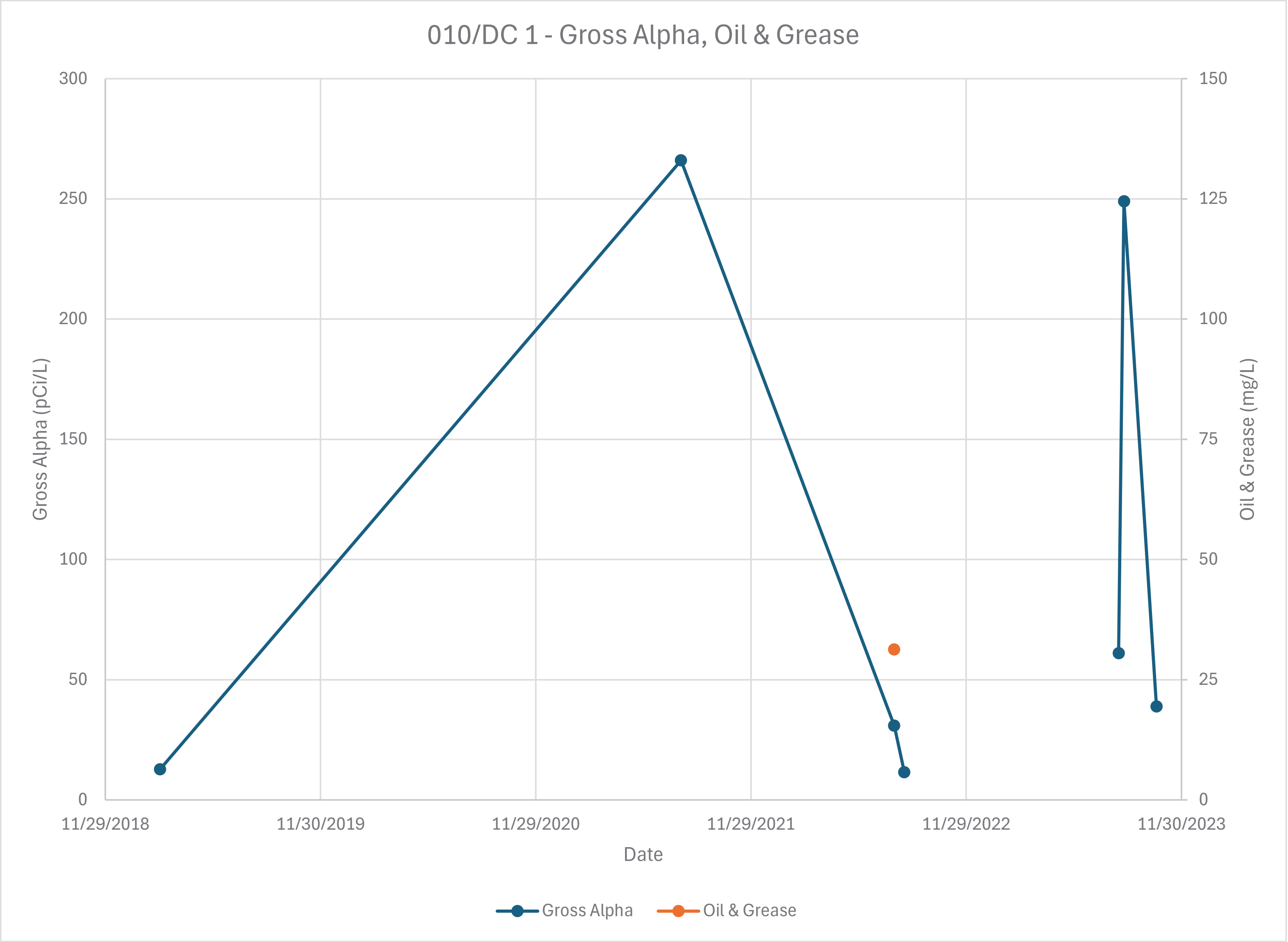
APPENDIX B-1B. HISTORICAL OUTFALL DATA - OUTFALL 010
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX B-1C. HISTORICAL OUTFALL DATA - OUTFALL 010
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



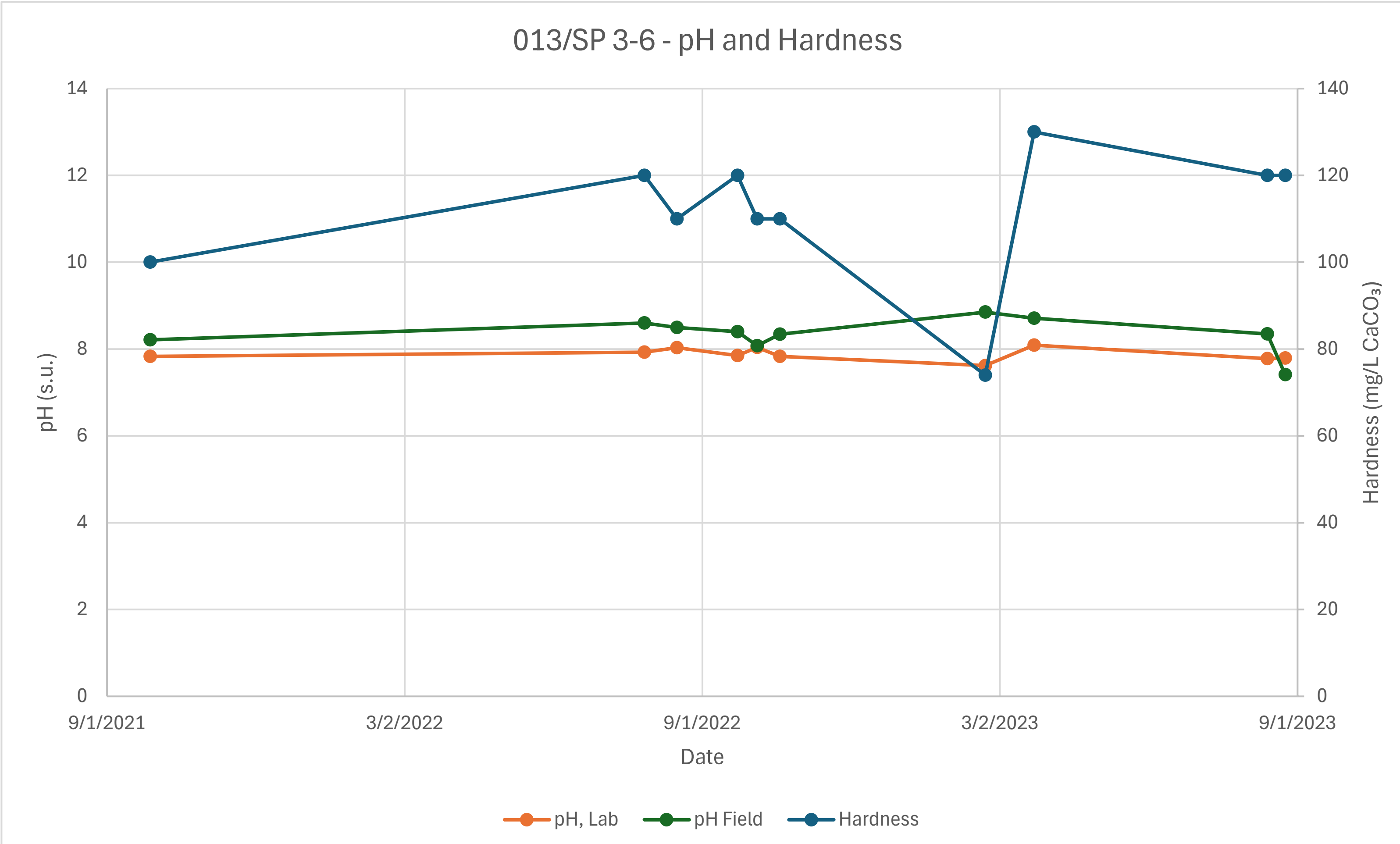
APPENDIX B-1D. HISTORICAL OUTFALL DATA - OUTFALL 010
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



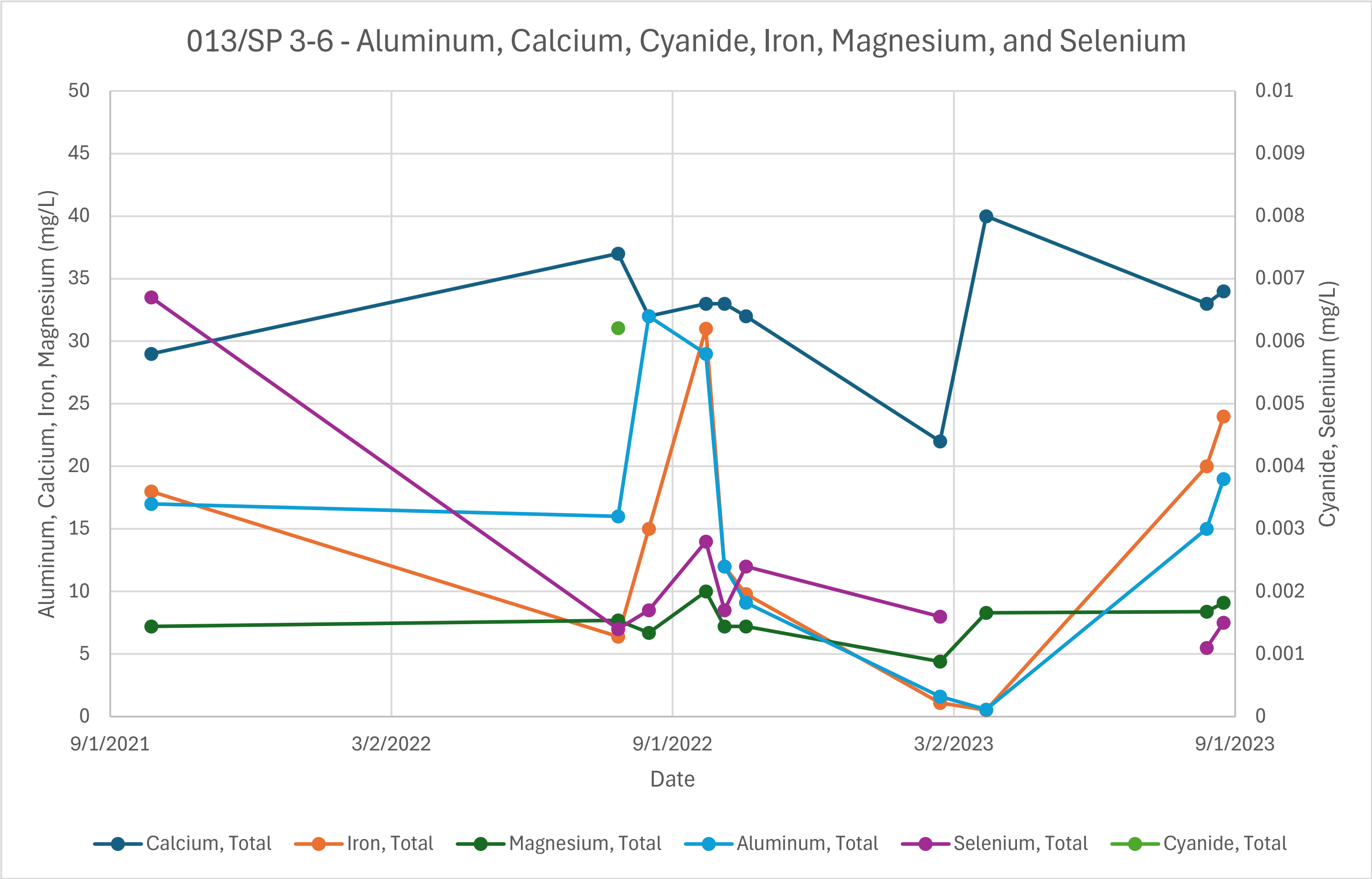
APPENDIX B-2

HISTORICAL OUTFALL DATA - OUTFALL 013/SP 3-6

APPENDIX B-2A. HISTORICAL OUTFALL DATA - OUTFALL 013
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX B-2B. HISTORICAL OUTFALL DATA - OUTFALL 013
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX B-2C. HISTORICAL OUTFALL DATA - OUTFALL 013
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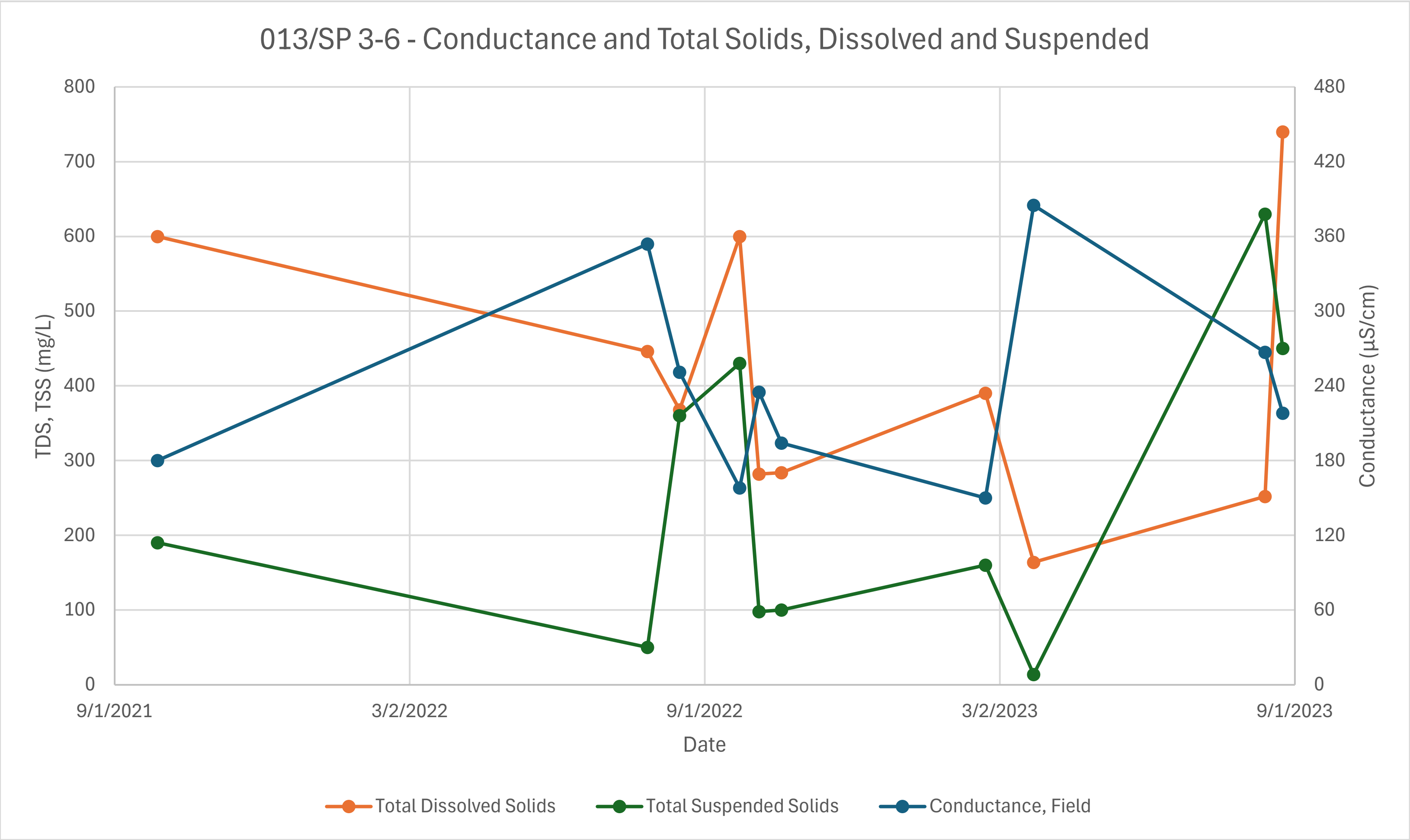
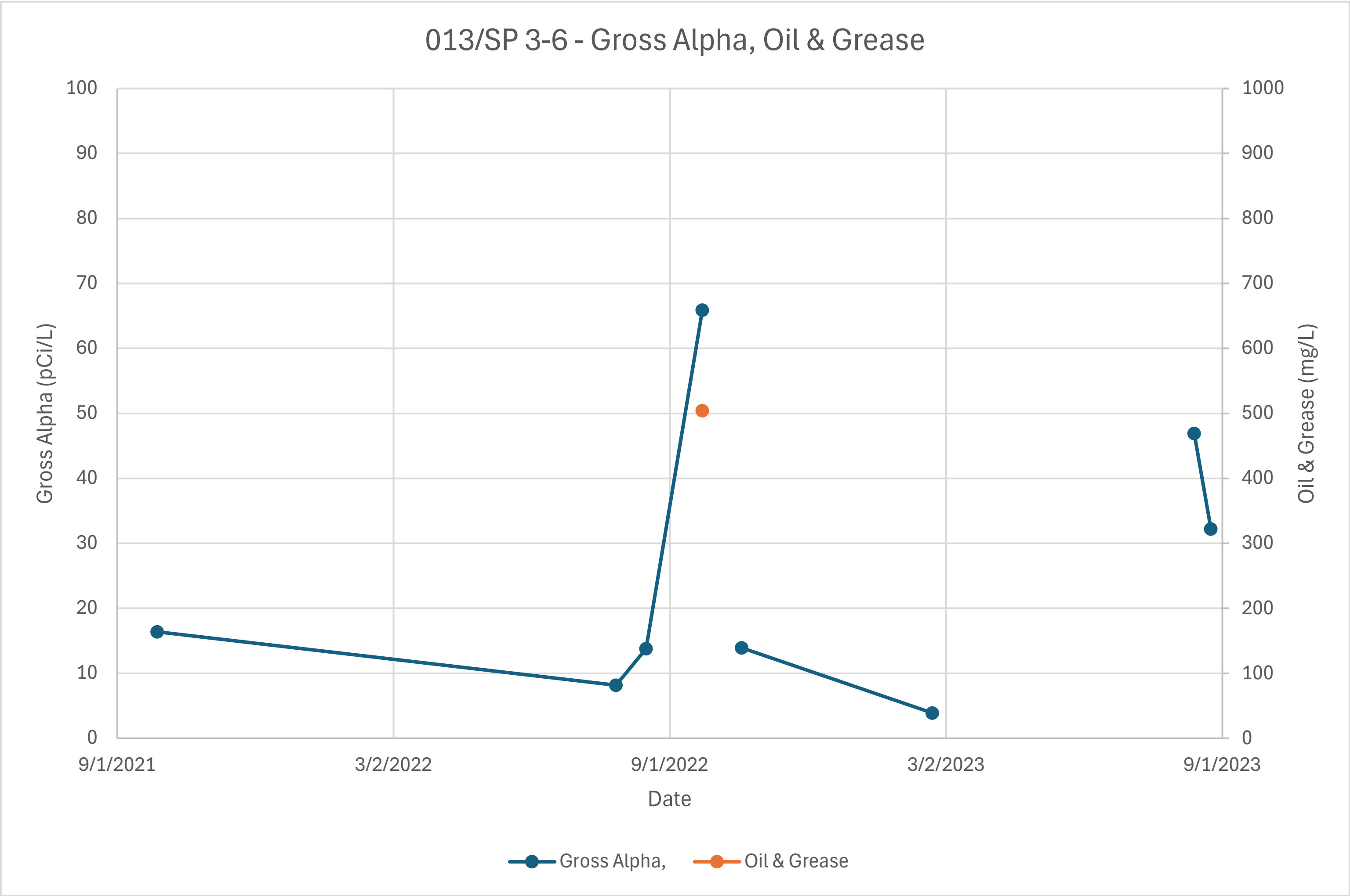
NEAR GALLUP, NEW MEXICO



APPENDIX B-2D. HISTORICAL OUTFALL DATA - OUTFALL 013
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C

ISCO STATION SURFACE WATER QUALITY TEMPORAL PLOTS

C-1. HISTORICAL ISCO STATION DATA - COAL MINE WASH TRIBUTARY (CMWT)

- C-1A. CMWT - BICARBONATE, CARBONATE, HARDNESS, AND pH
- C-1B. CMWT - CALCIUM, MAGNESIUM, POTASSIUM, SODIUM, AND SODIUM ABSORPTION RATION
- C-1C. CMWT - CHLORIDE, NITRATE, PHOSPHATE, PHOSPHORUS, AND SULFATE
- C-1D. CMWT - IRON AND MANGANESE
- C-1E. CMWT - CONDUCTANCE AND TOTAL SOLIDS
- C-1F. CMWT - MERCURY, SELENIUM, AND ION BALANCE

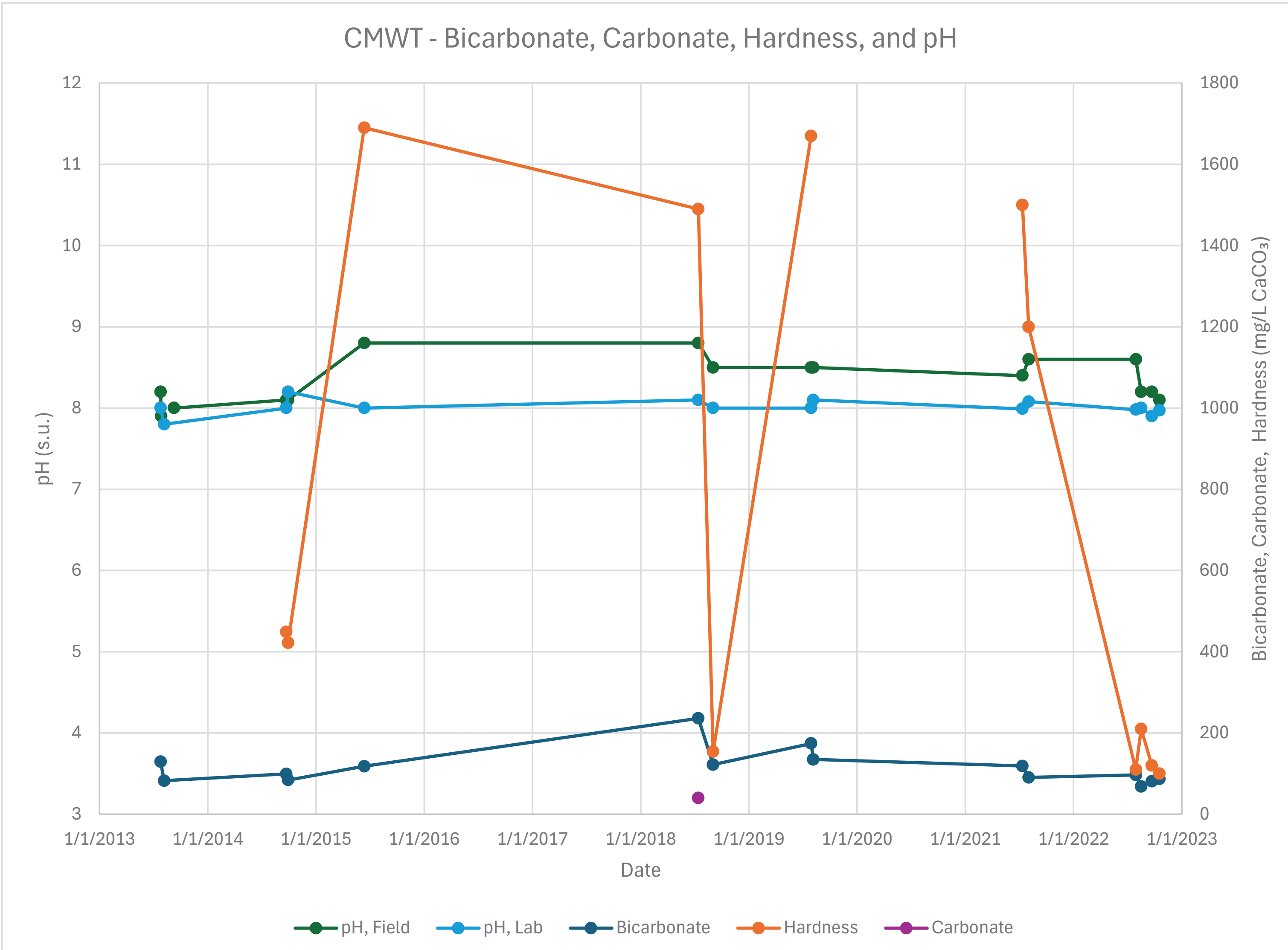
C-2. HISTORICAL ISCO STATION DATA - TSE BONITA WASH (TBW)

- C-2A. TBW - BICARBONATE, CARBONATE, HARDNESS, AND pH
- C-2B. TBW - CALCIUM, MAGNESIUM, POTASSIUM, SODIUM, AND SODIUM ABSORPTION RATION
- C-2C. TBW - CHLORIDE, NITRATE-NITROGEN, PHOSPHATE, PHOSPHORUS, AND SULFATE
- C-2D. TBW - IRON AND MANGANESE
- C-2E. TBW - CONDUCTANCE AND ION BALANCE
- C-2F. TBW - MERCURY, SELENIUM, AND TOTAL SOLIDS

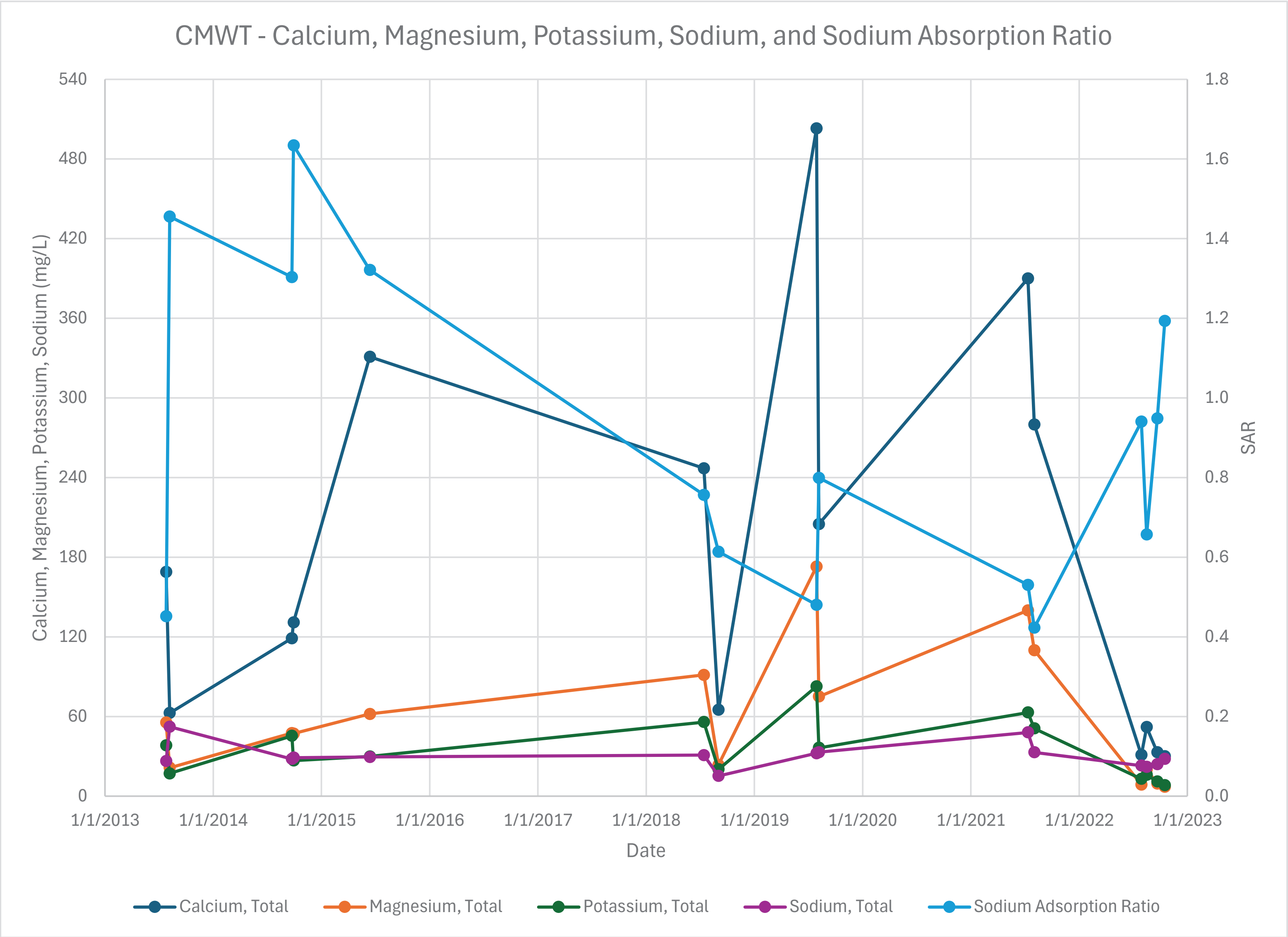
APPENDIX C-1

HISTORICAL ISCO STATION DATA - COAL MINE WASH TRIBUTARY (CMWT)

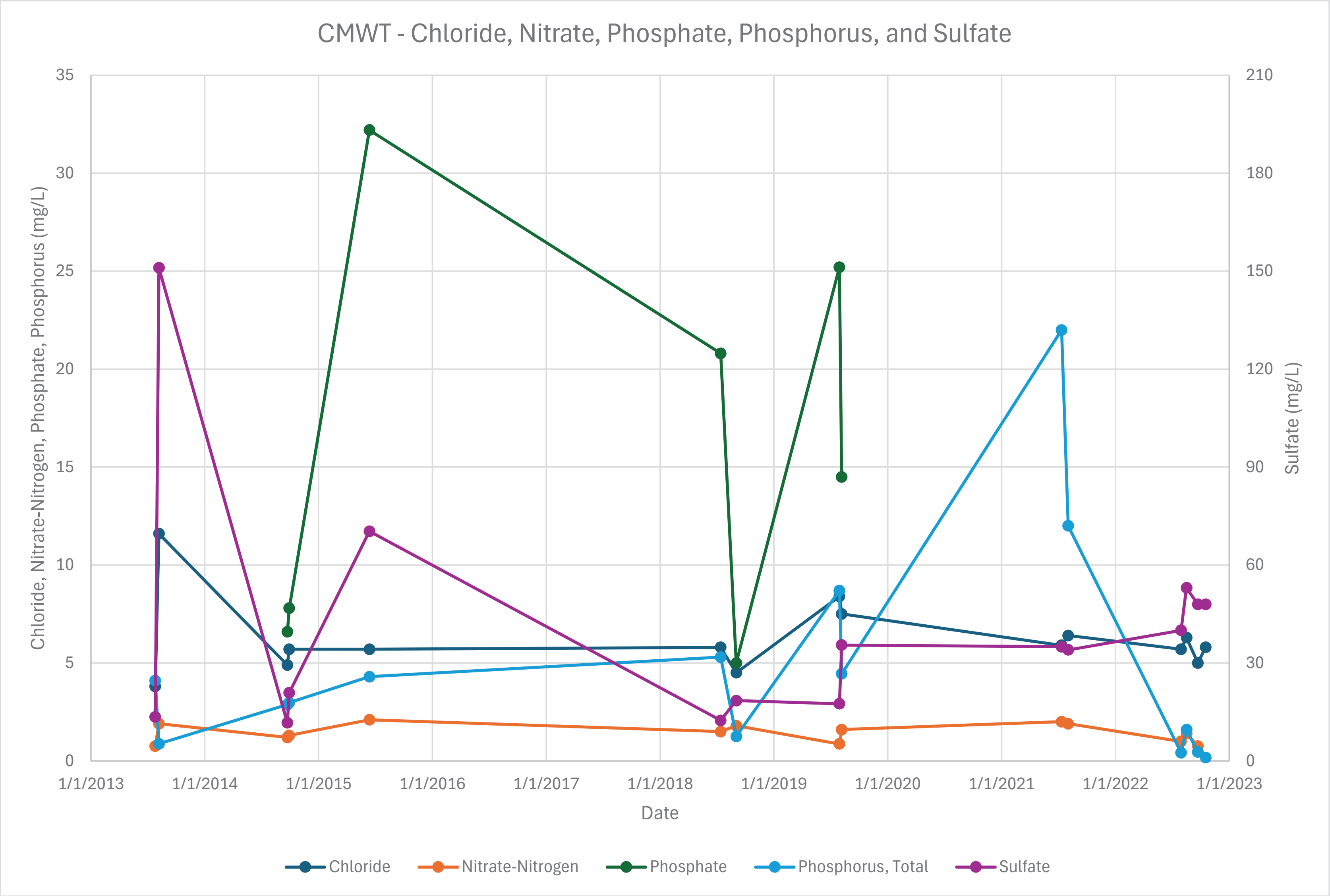
APPENDIX C-1A. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-1B. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

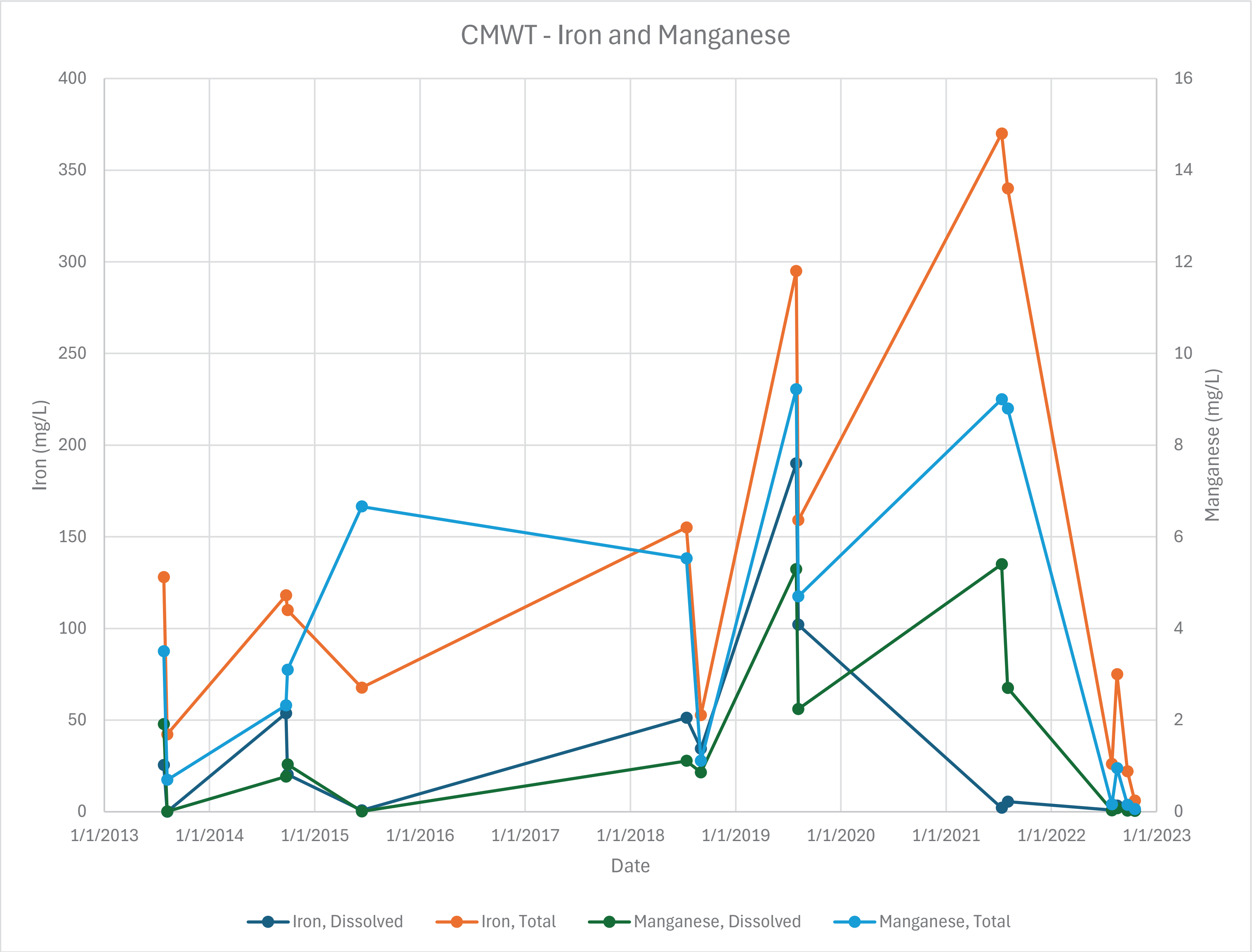


APPENDIX C-1C. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO

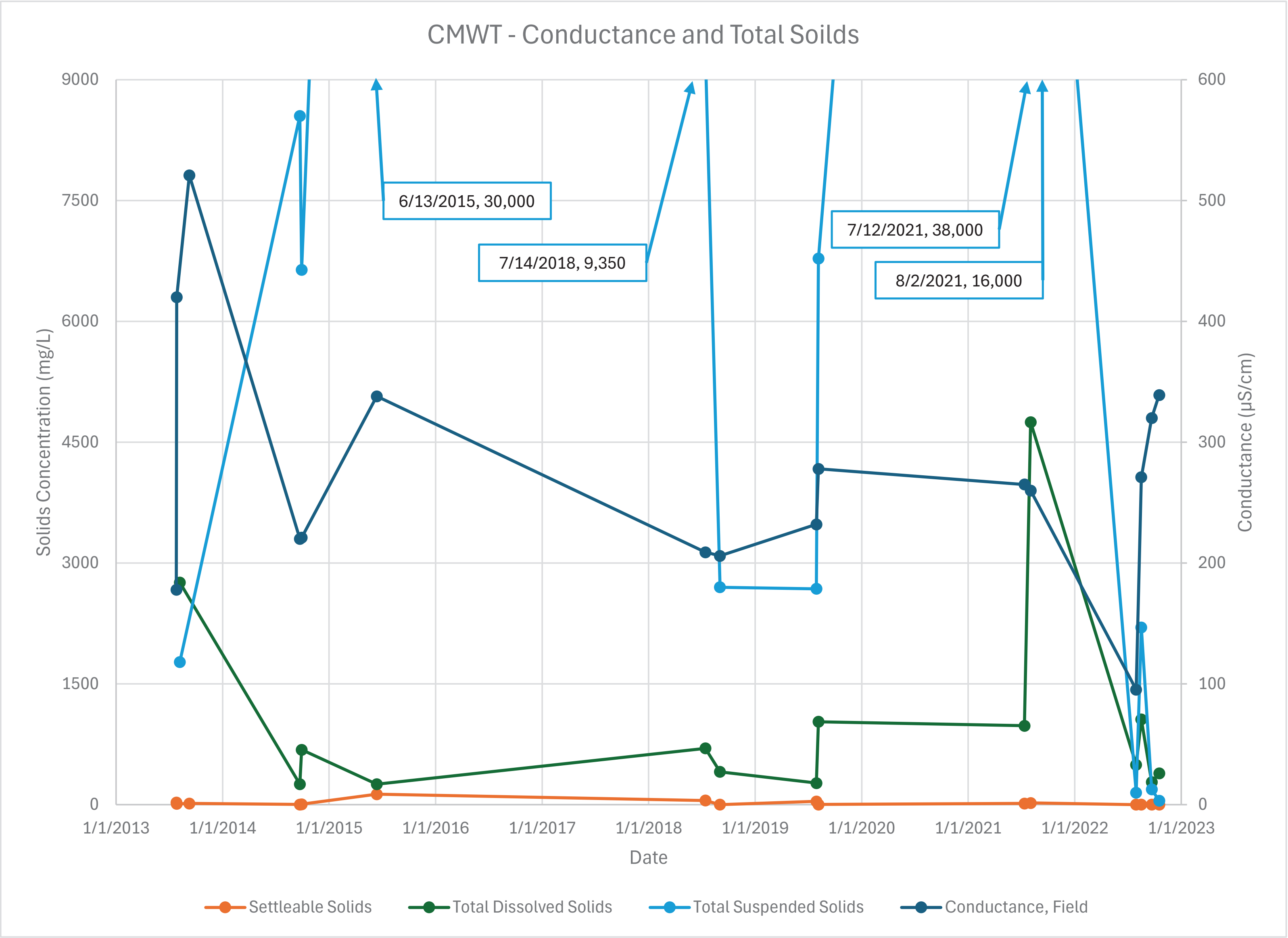


C-202409_SurfaceWaterData-PLOT_APP-C.xlsx

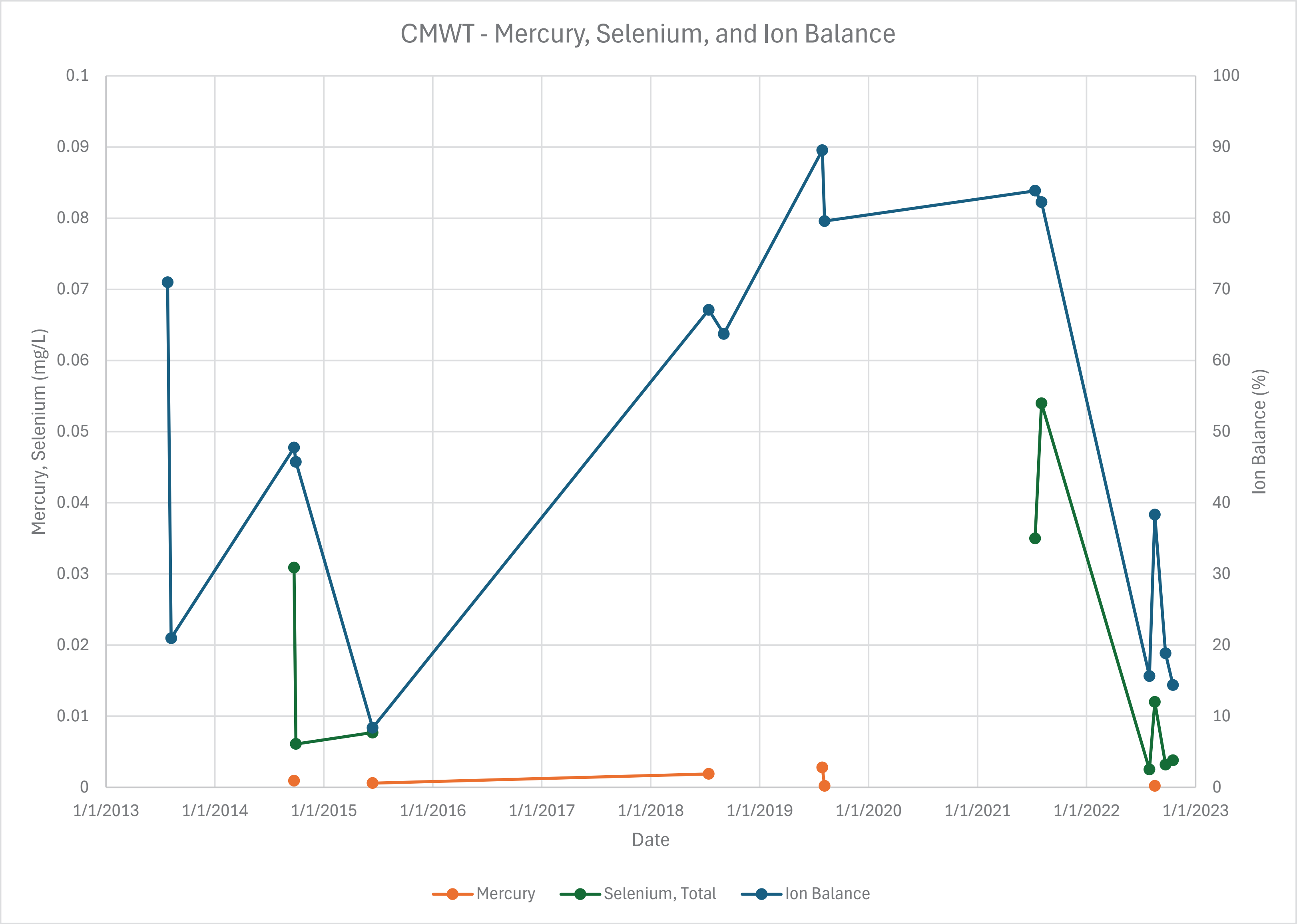
APPENDIX C-1D. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-1E. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-1F. HISTORICAL SURFACE WATER DATA - COAL MINE WASH TRIBUTARY (CMWT)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-2

HISTORICAL ISCO STATION DATA - TSE BONITA WASH (TBW)

C-2A. TBW - BICARBONATE, CARBONATE, HARDNESS, AND pH

C-2B. TBW - CALCIUM, MAGNESIUM, POTASSIUM, SODIUM, AND SODIUM ABSORPTION RATION

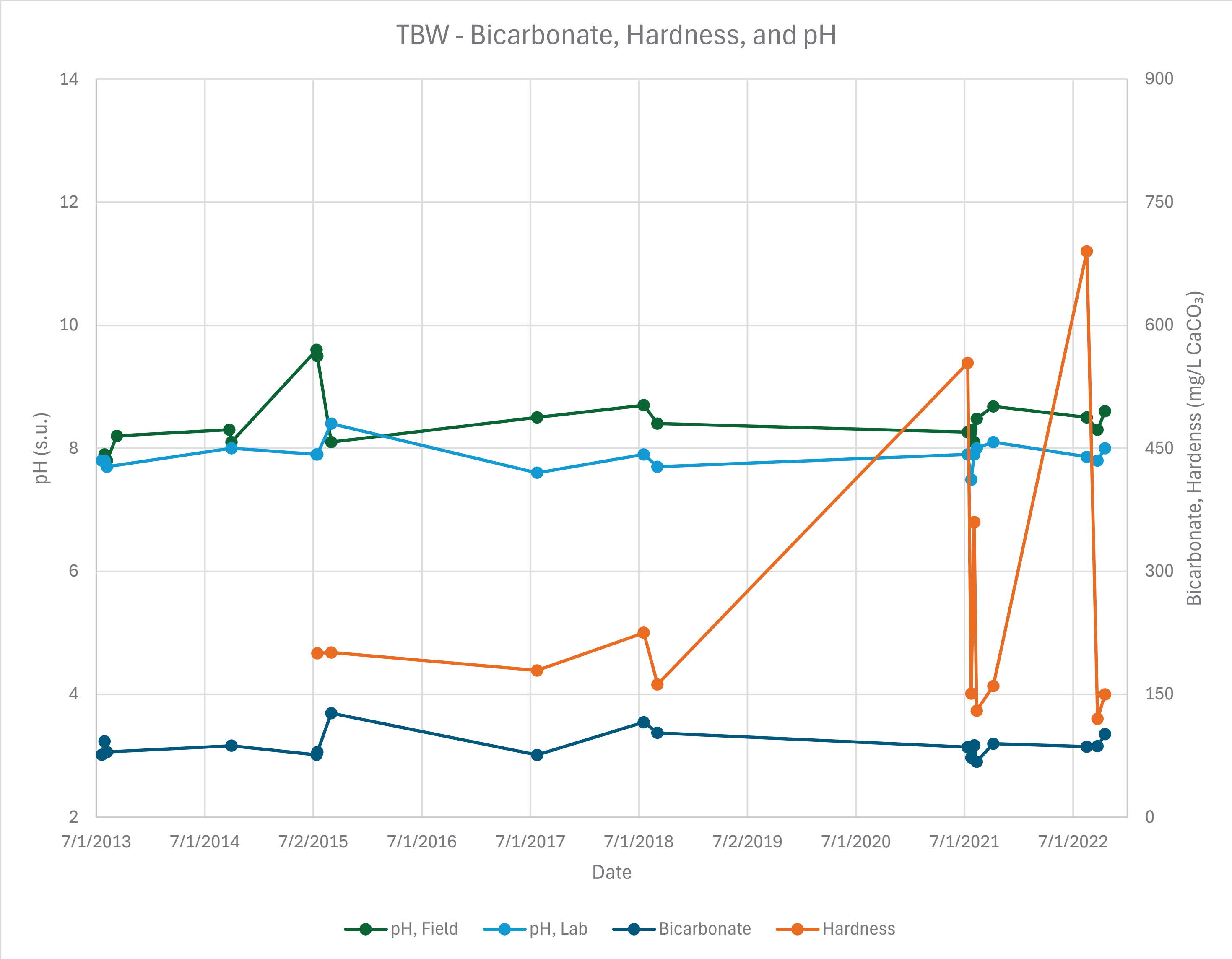
C-2C. TBW - CHLORIDE, NITRATE-NITROGEN, PHOSPHATE, PHOSPHORUS, AND SULFATE

C-2D. TBW - IRON AND MANGANESE

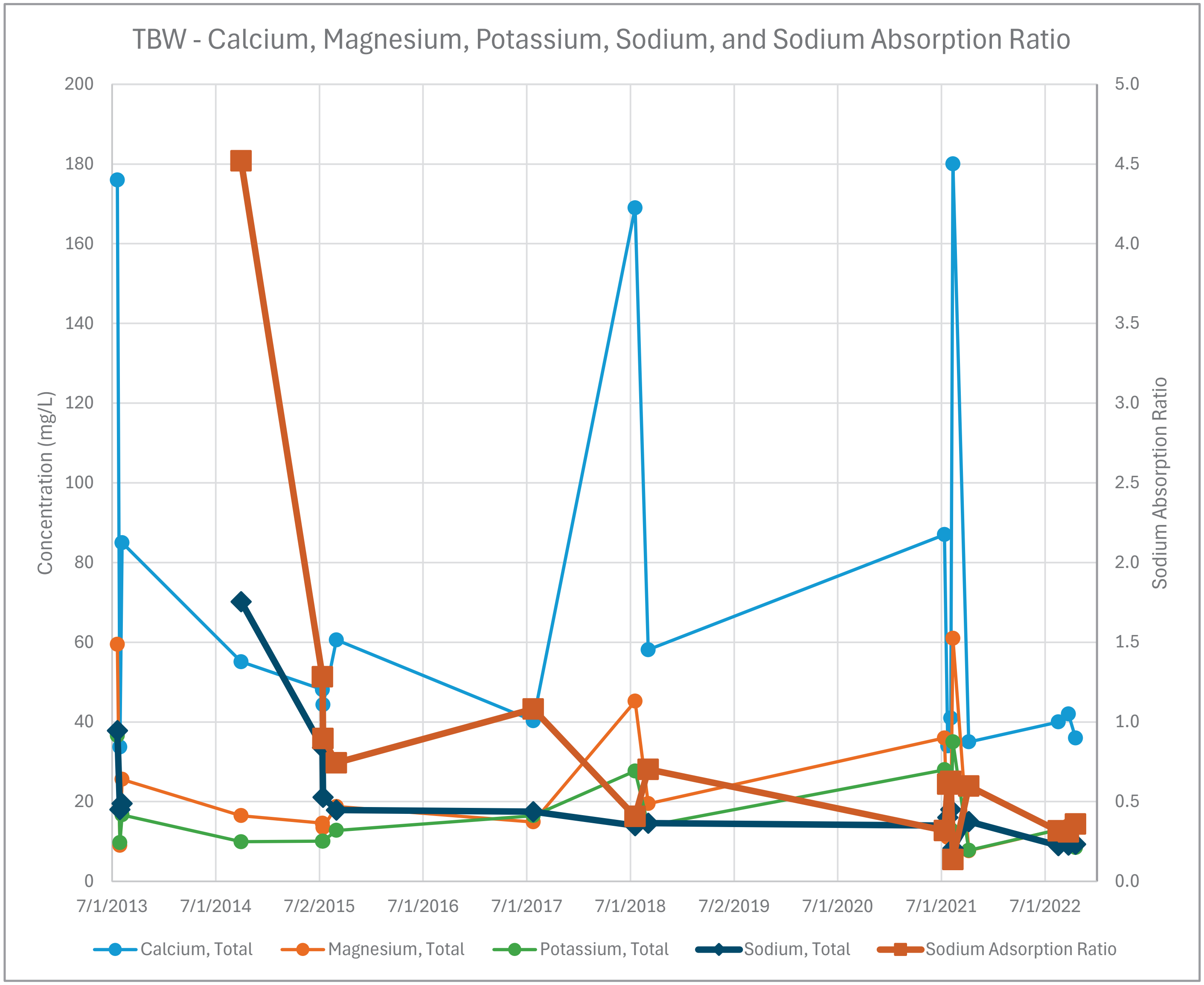
C-2E. TBW - CONDUCTANCE AND ION BALANCE

C-2F. TBW - MERCURY, SELENIUM, AND TOTAL SOLIDS

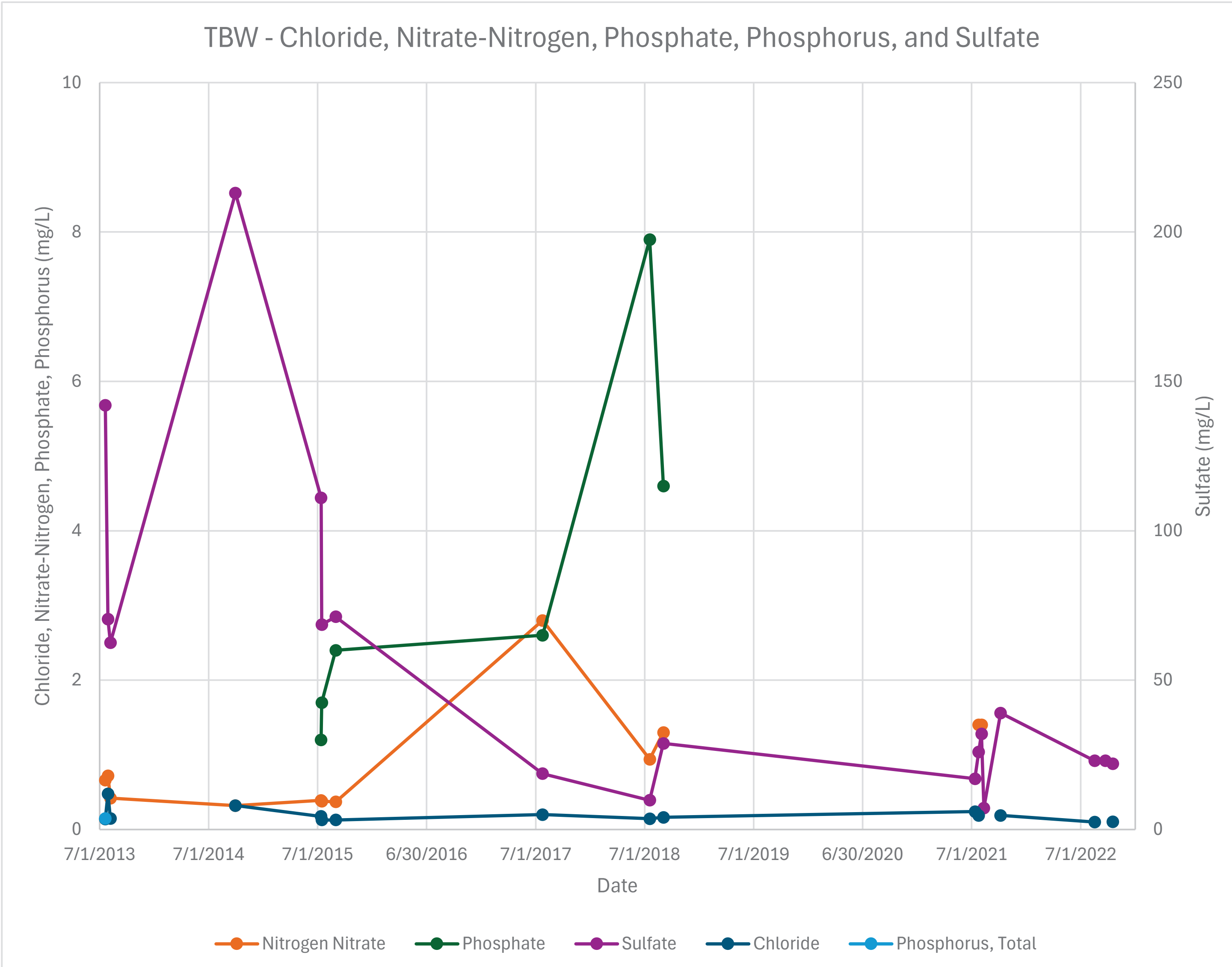
APPENDIX C-2A. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



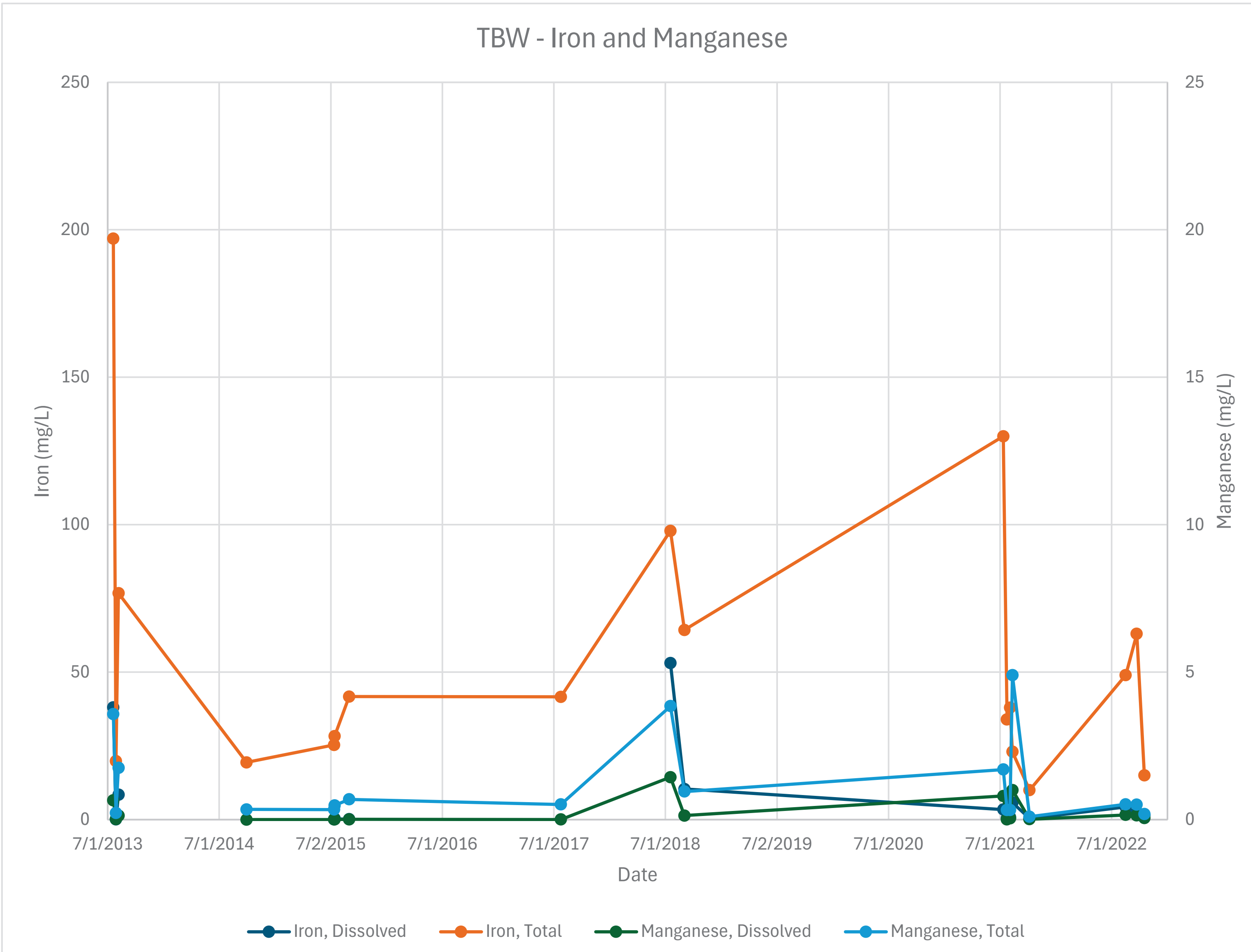
APPENDIX C-2B. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



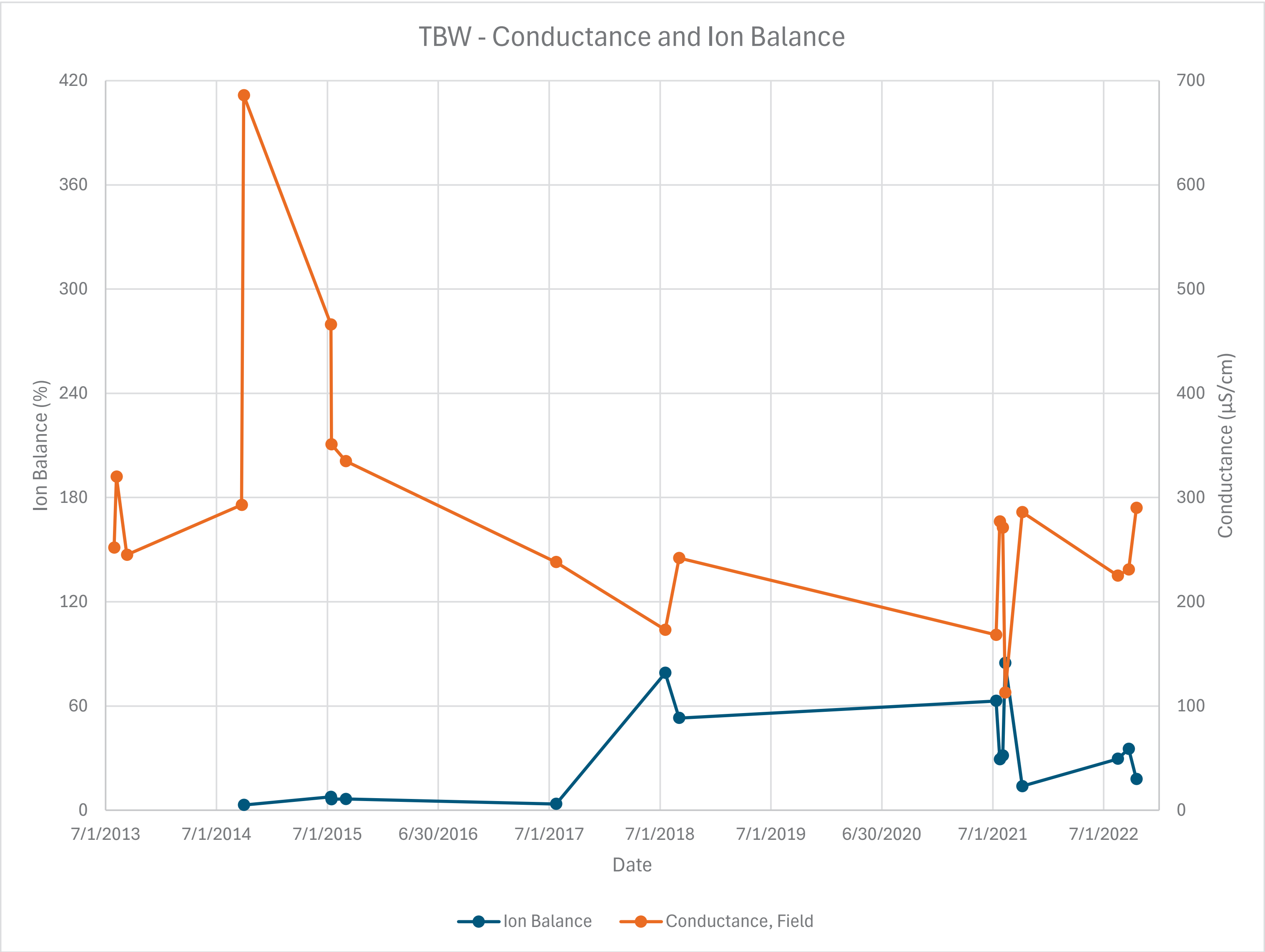
APPENDIX C-2C. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



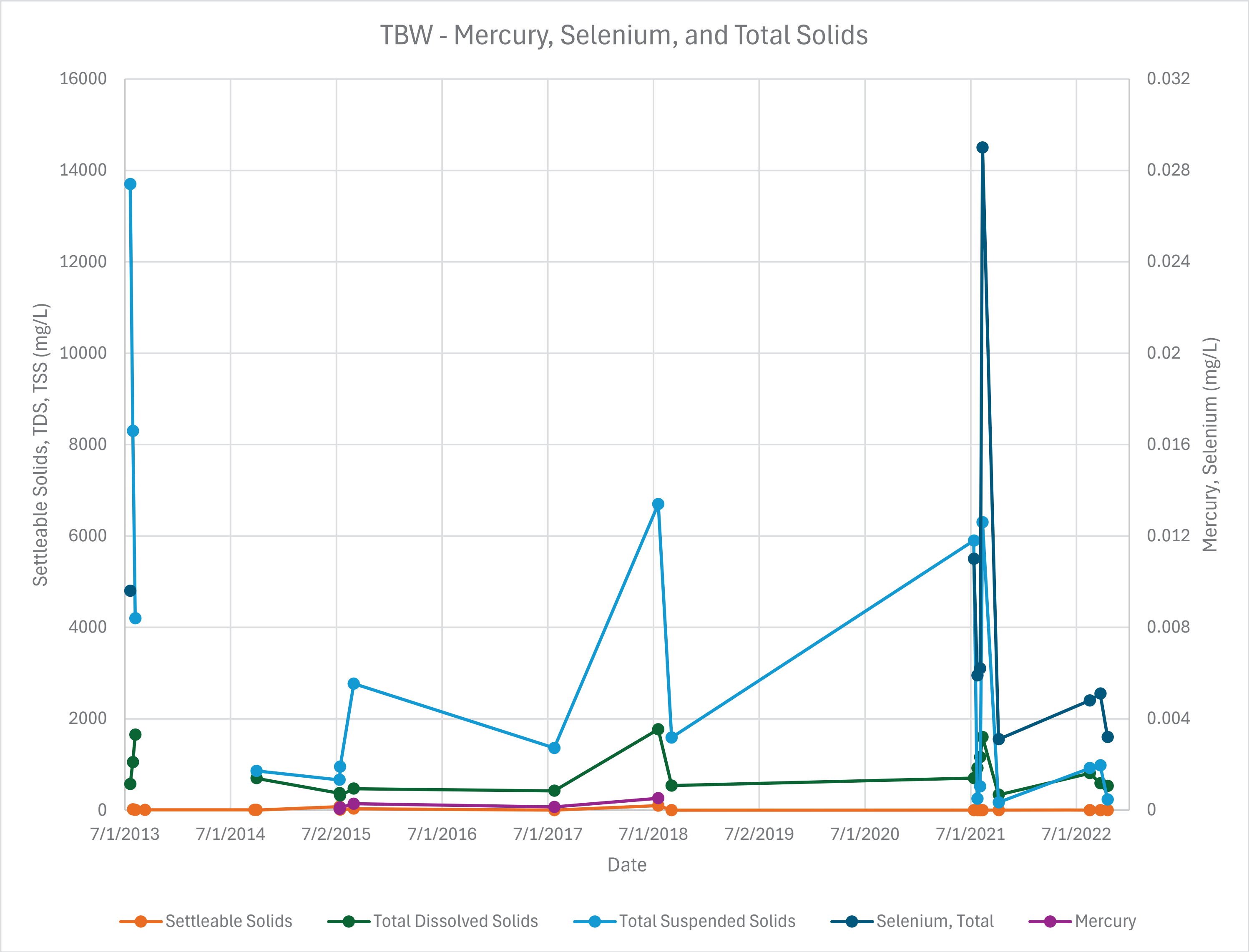
APPENDIX C-2D. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-2E. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-2F. HISTORICAL SURFACE WATER DATA - TSE BONITA WASH (TBW)
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX D

GROUNDWATER QUALITY DATA

D-1. HISTORICAL GROUNDWATER DATA - GALLUP SANDSTONE AQUIFER WELL 3A

- D-1A. WELL 3A - BICARBONATE, HARDNESS, AND pH
- D-1B. WELL 3A - CALCIUM, MAGNESIUM, POTASSIUM AND SODIUM
- D-1C. WELL 3A - CHLORIDE, FLUORIDE, SULFATE, TDS
- D-1D. WELL 3A - IRON AND MANGANESE
- D-1E. WELL 3A - TURBIDITY

D-2. HISTORICAL GROUNDWATER DATA - BEDROCK MONITORING WELL MBR2

- D-2A. MBR2 - BICARBONATE, CARBONATE, HARDNESS, AND pH
- D-2B. MBR2 - CALCIUM, MAGNESIUM, POTASSIUM AND SODIUM
- D-2C. MBR2 - CHLORIDE, FLUORIDE, SULFATE, TDS
- D-2D. MBR2 - IRON AND MANGANESE
- D-2E. MBR2 - BORON, NITRATE-NITROGEN, SELENIUM, PHOSPHORUS, AND ZINC
- D-2F. MBR2 - CONDUCTANCE AND ION BALANCE

APPENDIX D-1

HISTORICAL GROUNDWATER DATA - GALLUP SANDSTONE AQUIFER WELL 3A

D-1A. WELL 3A - BICARBONATE, HARDNESS, AND pH

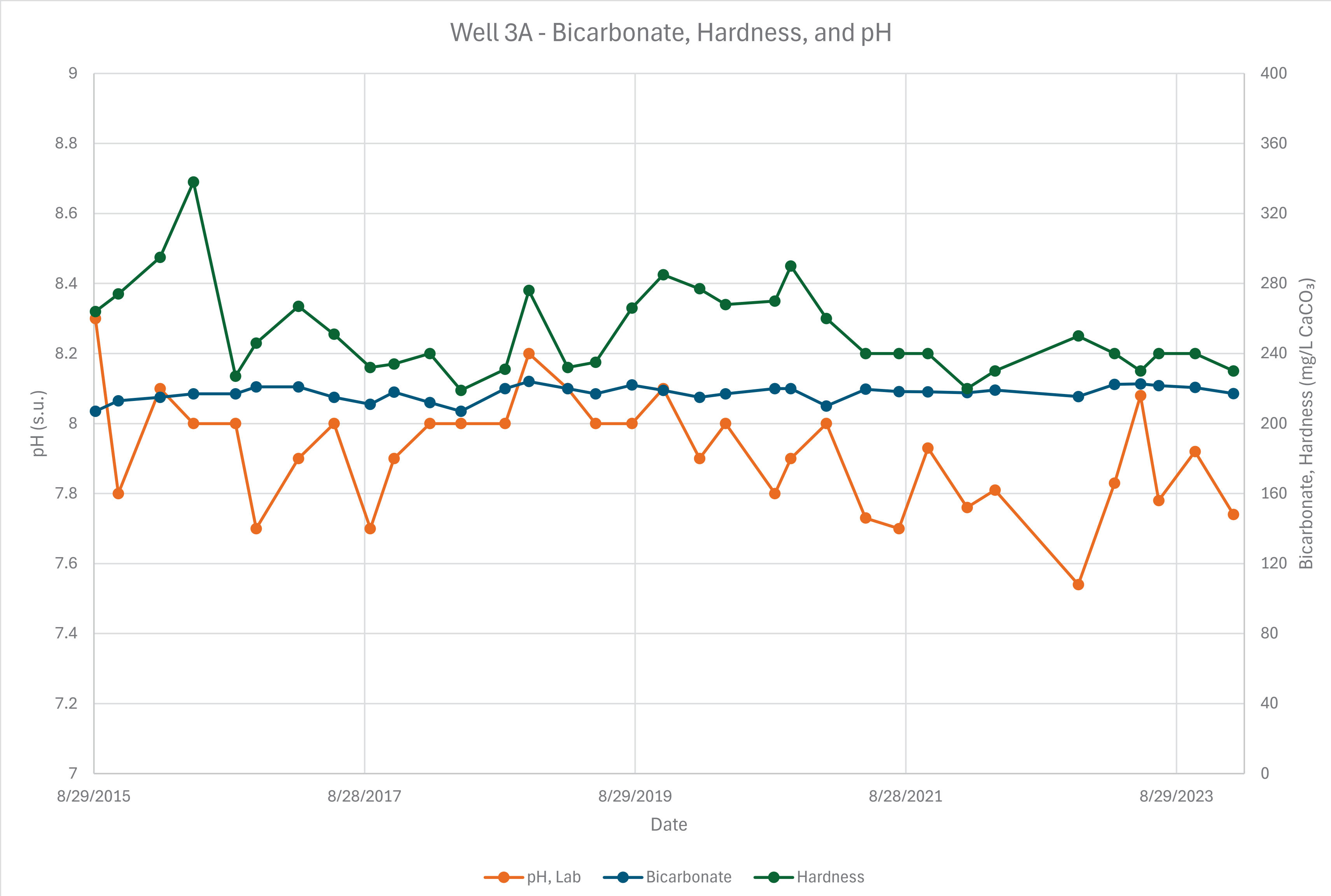
D-1B. WELL 3A - CALCIUM, MAGNESIUM, POTASSIUM AND SODIUM

D-1C. WELL 3A - CHLORIDE, FLUORIDE, SULFATE, TDS

D-1D. WELL 3A - IRON AND MANGANESE

D-1E. WELL 3A - TURBIDITY

APPENDIX D-1A. HISTORICAL GROUNDWATER DATA - WELL 3A
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX D-1B. HISTORICAL GROUNDWATER DATA - WELL 3A
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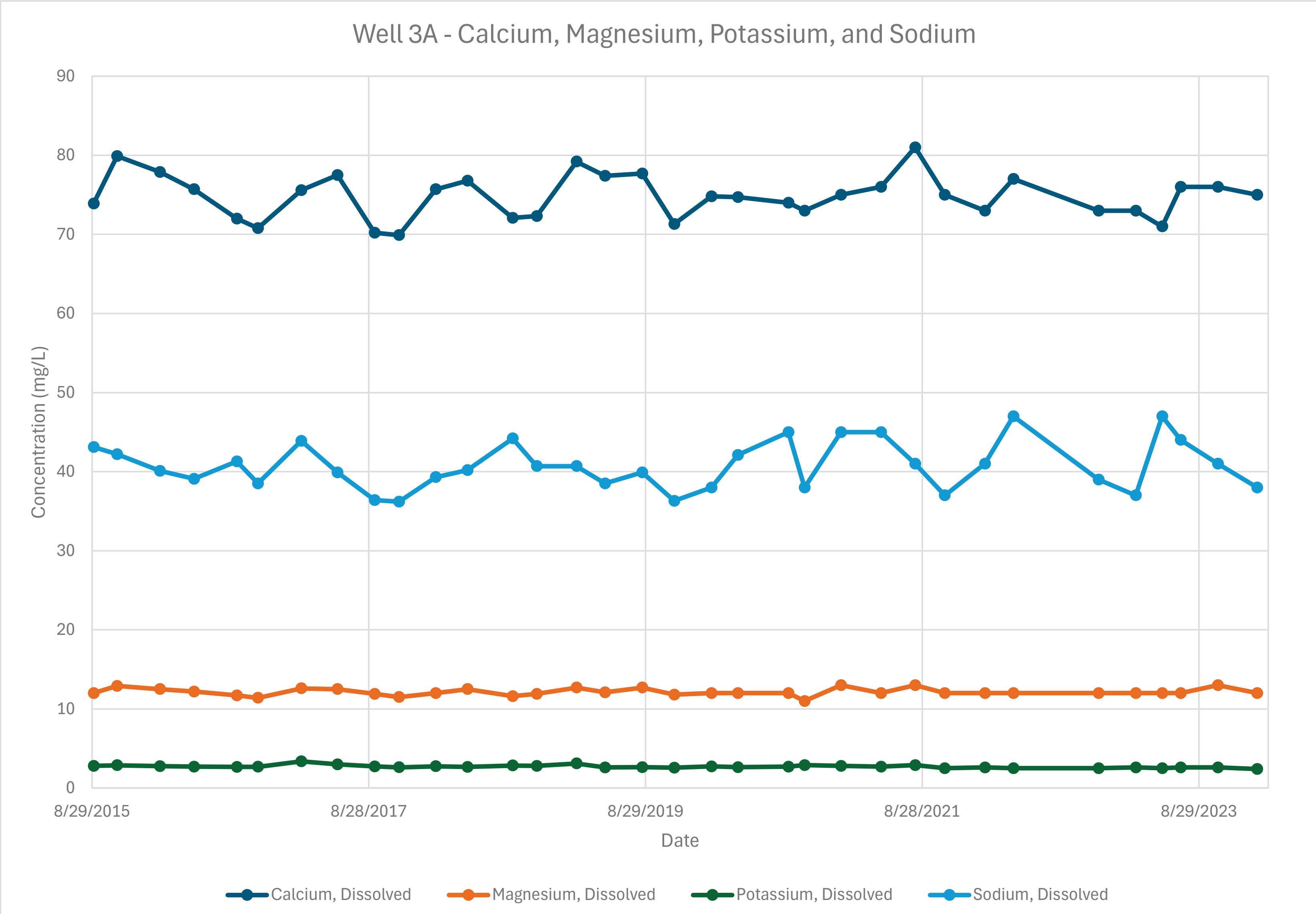
NEAR GALLUP, NEW MEXICO



APPENDIX D-1C. HISTORICAL GROUNDWATER DATA - WELL 3A
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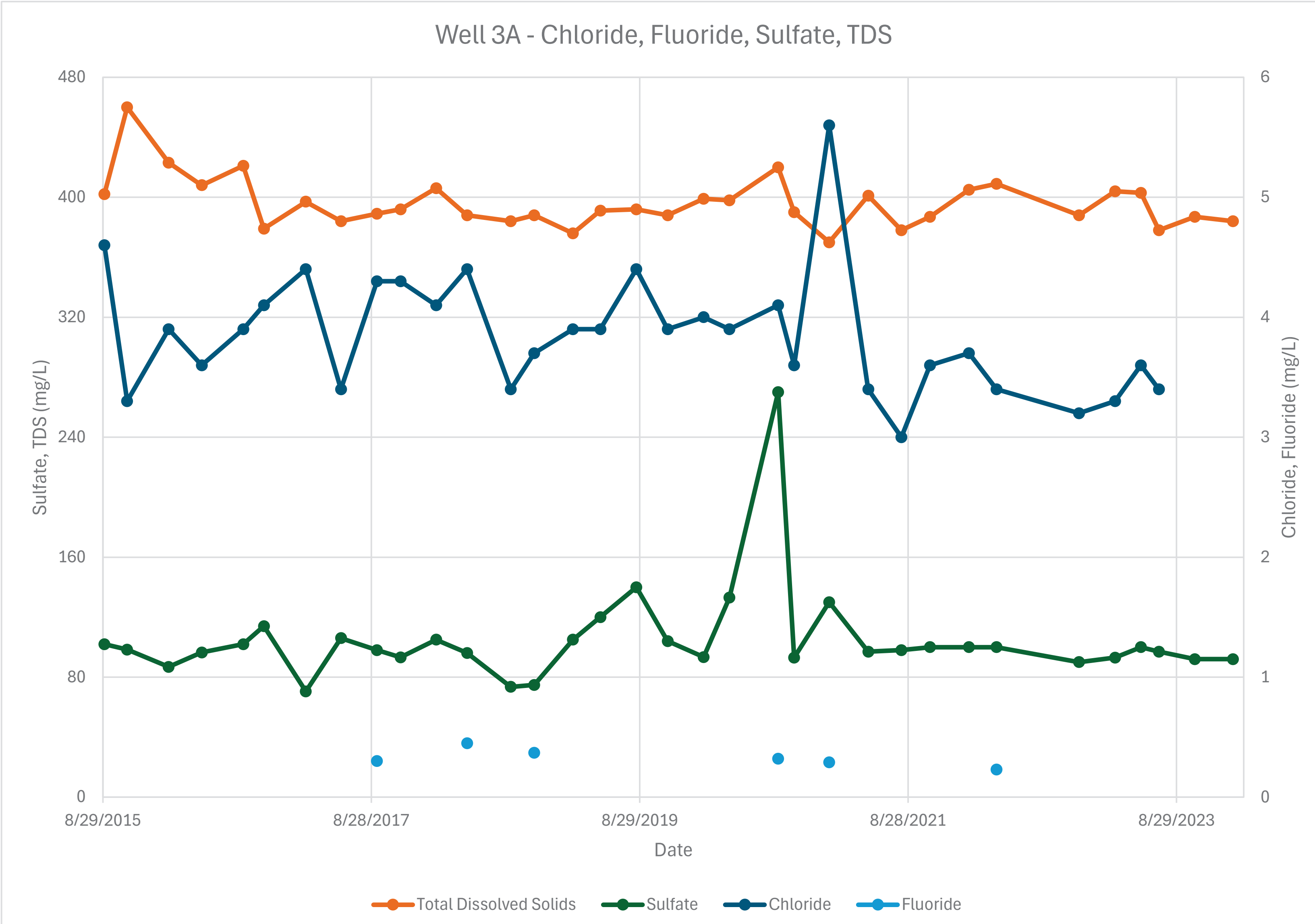
NEAR GALLUP, NEW MEXICO



APPENDIX D-1D. HISTORICAL GROUNDWATER DATA - WELL 3A
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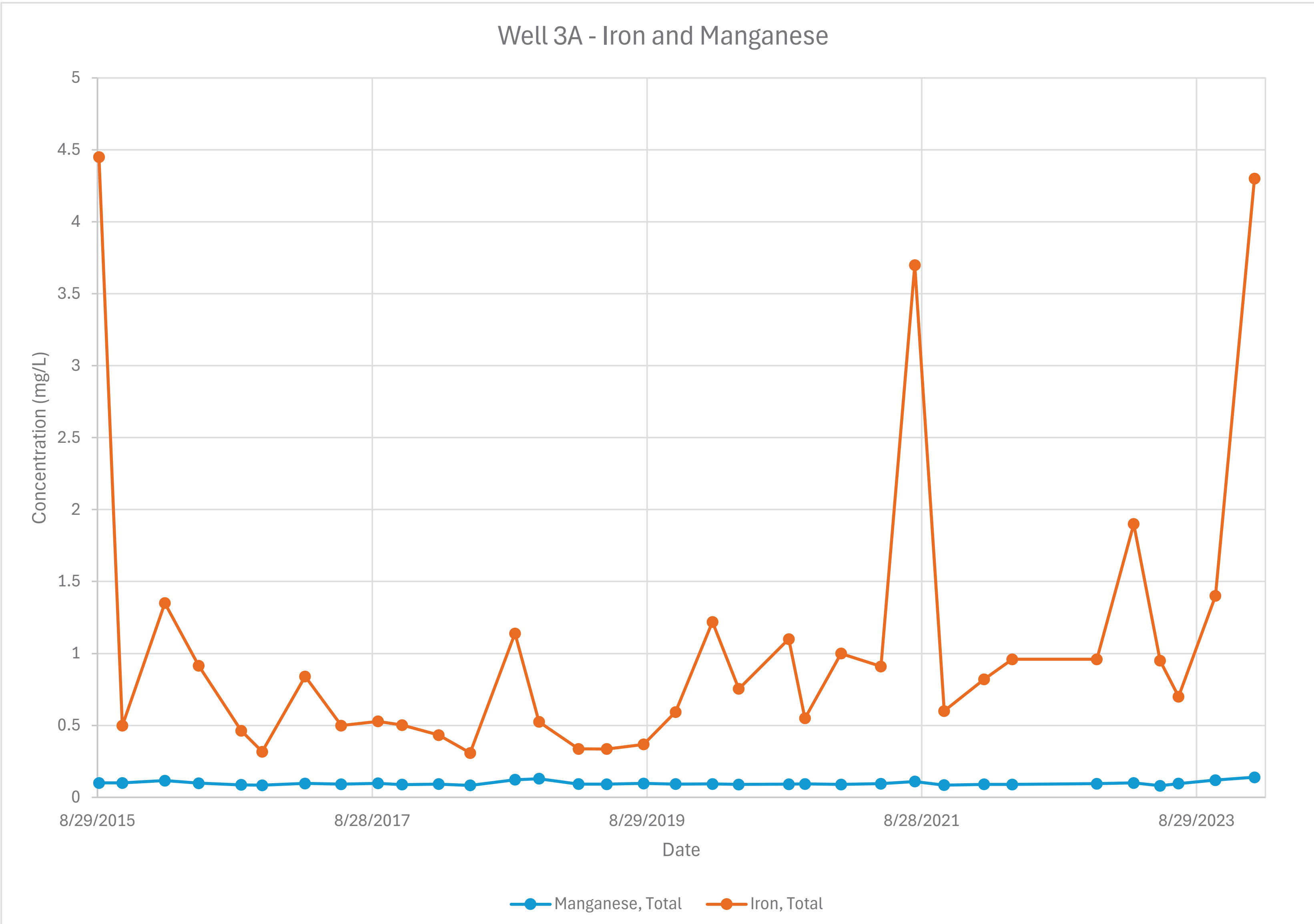
NEAR GALLUP, NEW MEXICO



APPENDIX D-1E. HISTORICAL GROUNDWATER DATA - WELL 3A
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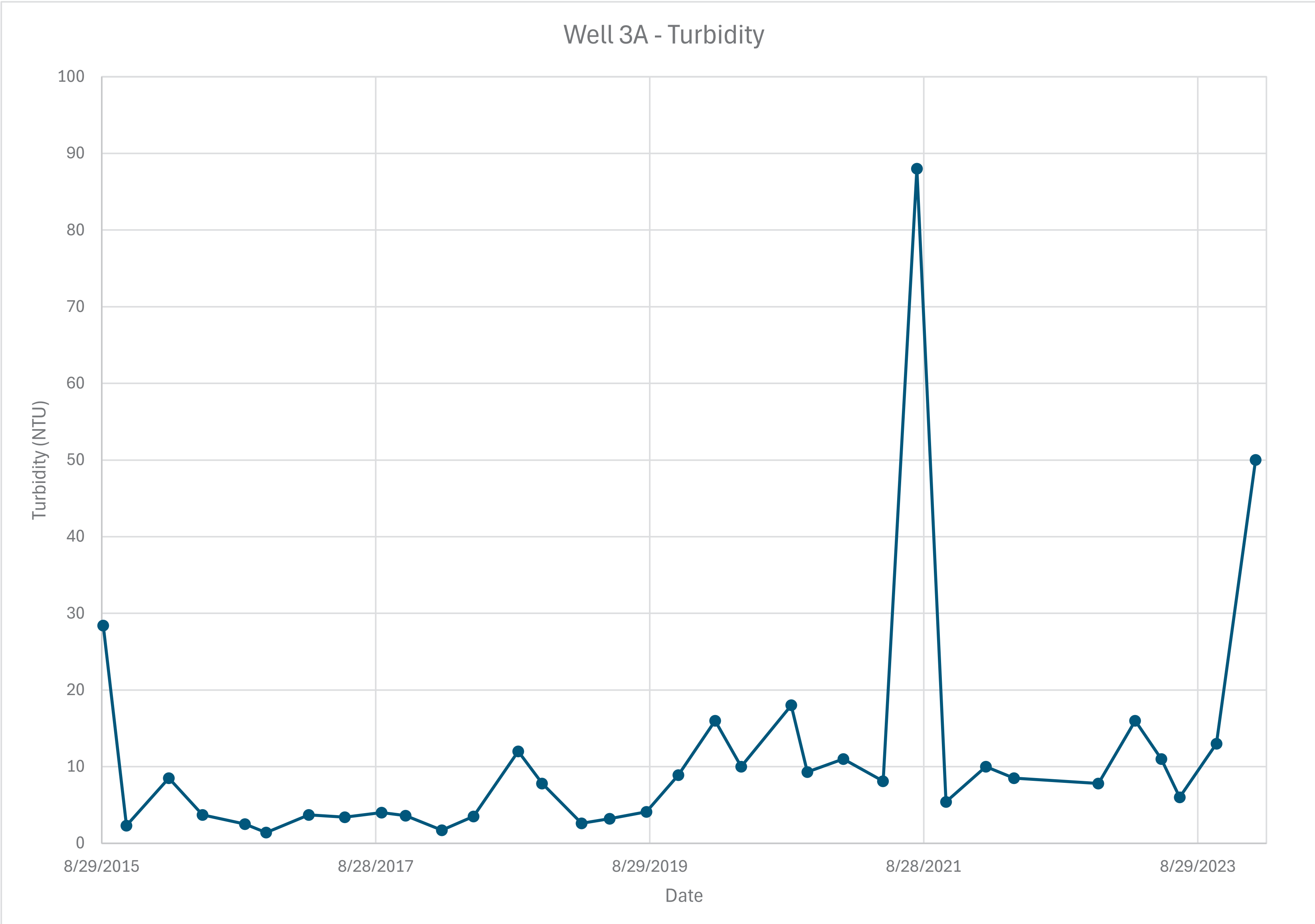
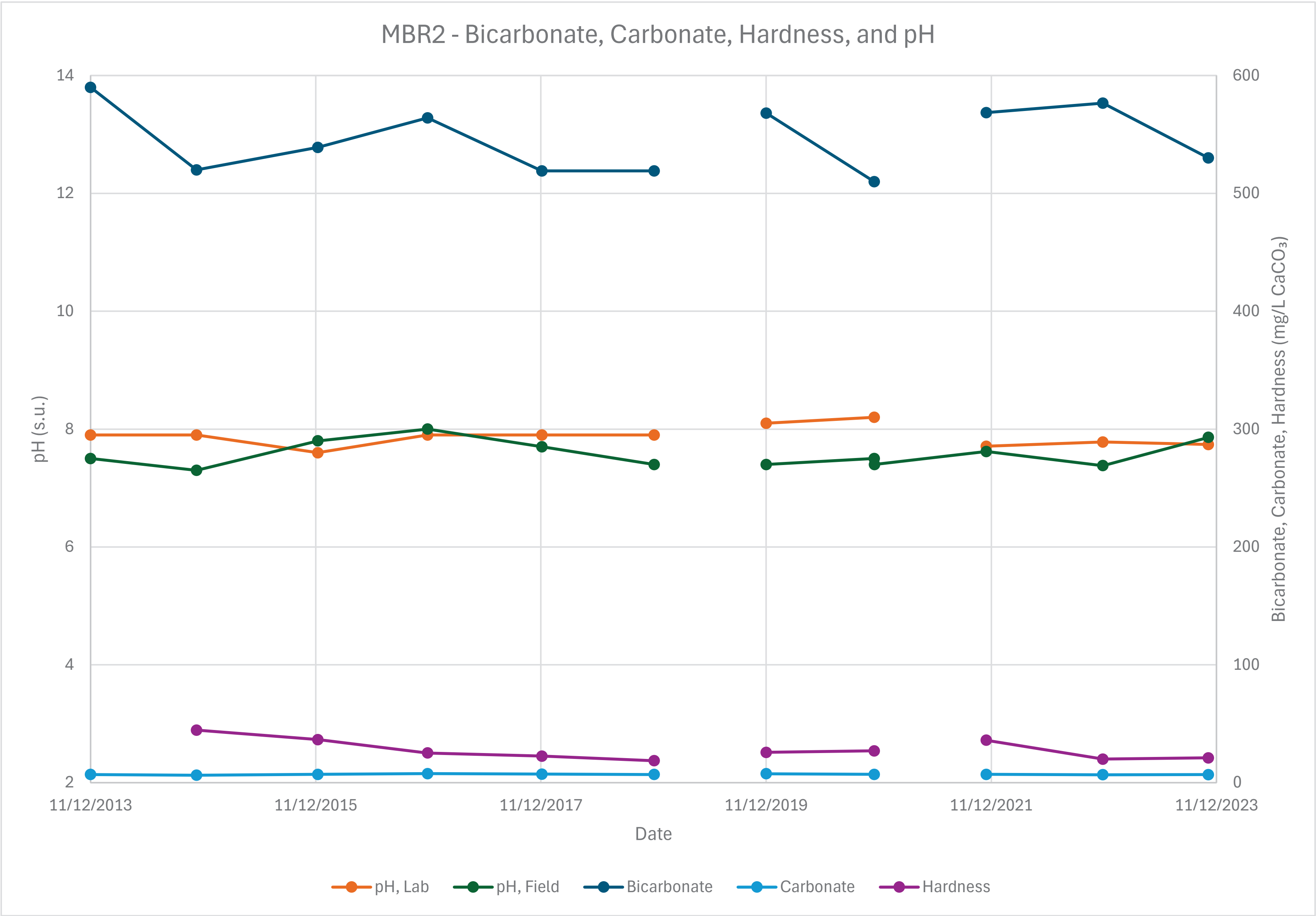
NEAR GALLUP, NEW MEXICO



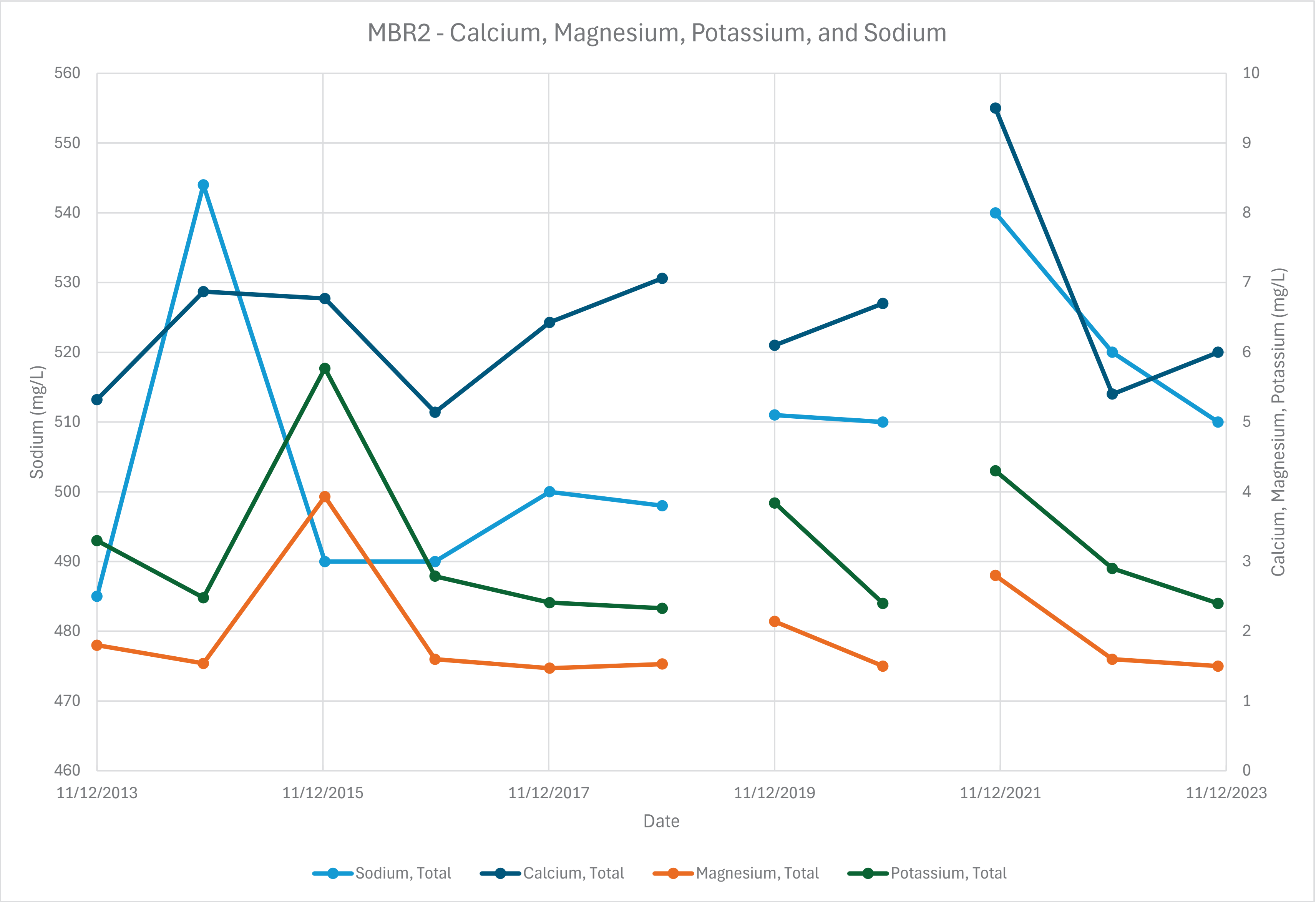
APPENDIX D-2

HISTORICAL GROUNDWATER DATA - BEDROCK MONITORING WELL MBR2

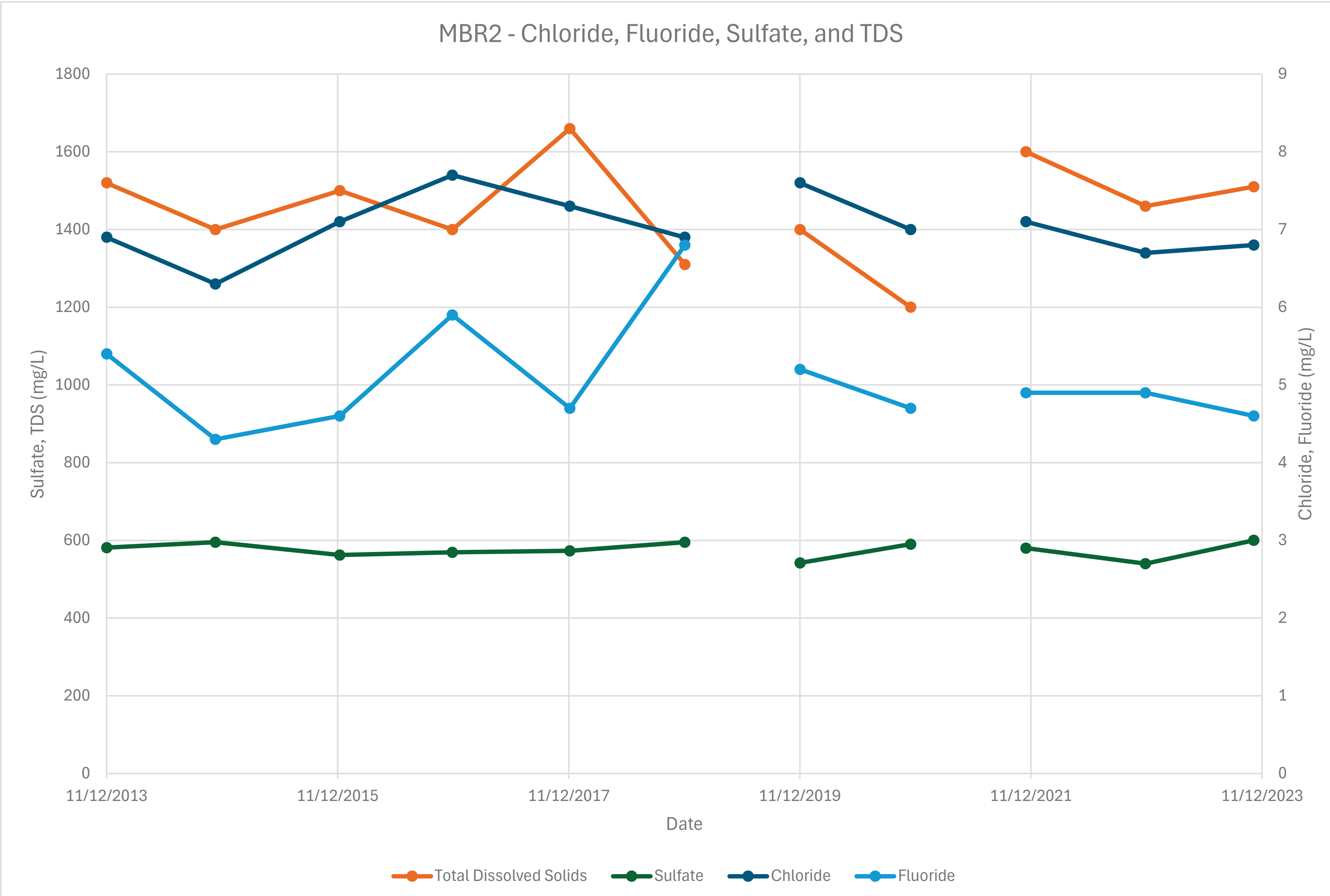
APPENDIX D-2A. HISTORICAL GROUNDWATER QUALITY - MBR2
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



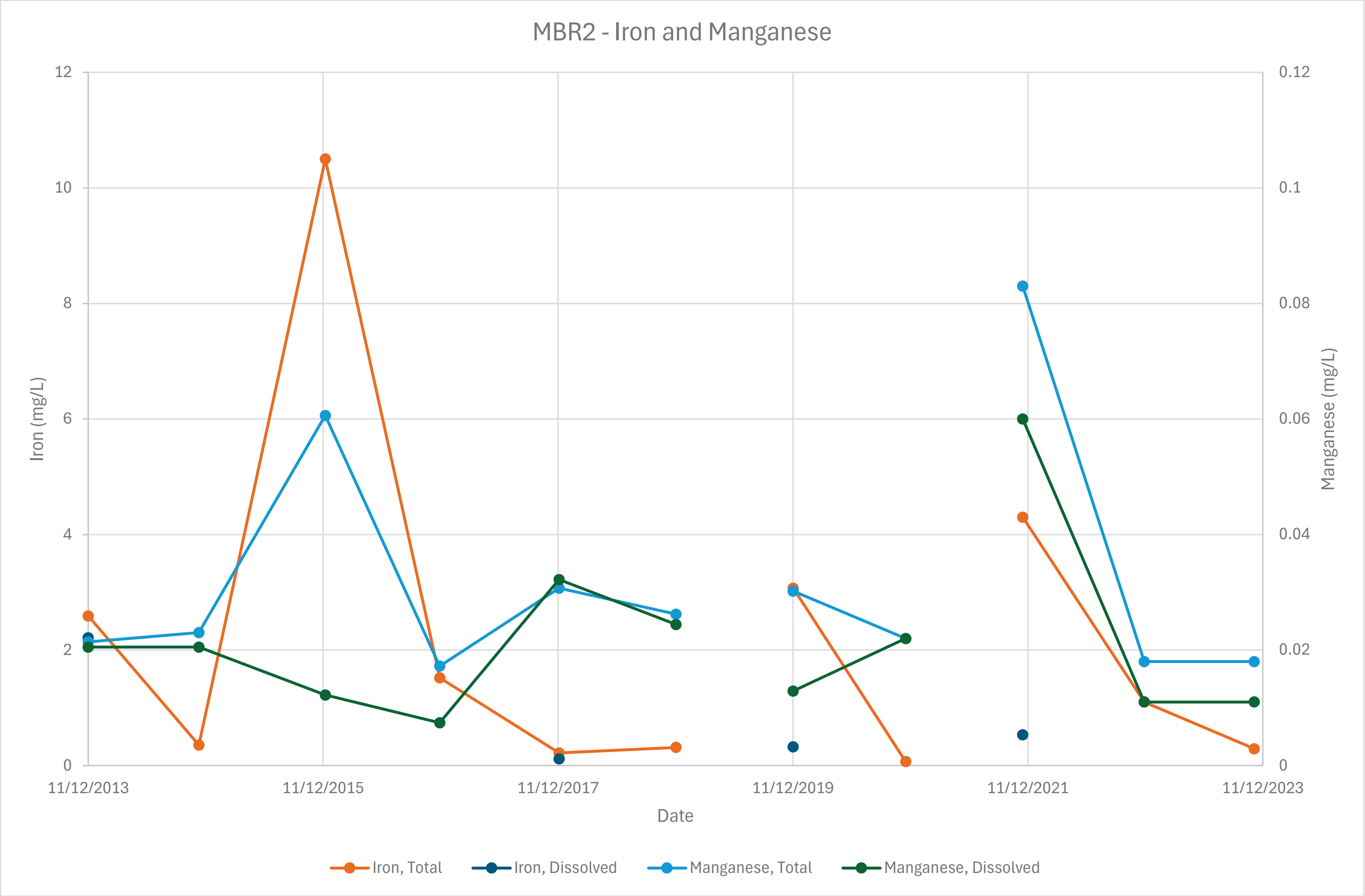
APPENDIX D-2B. HISTORICAL GROUNDWATER QUALITY - MBR2
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX D-2C. HISTORICAL GROUNDWATER QUALITY - MBR2
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX D-2D. HISTORICAL GROUNDWATER QUALITY - MBR2
CHEVRON MINING, INC, McKINLEY MINE
NEAR GALLUP, NEW MEXICO



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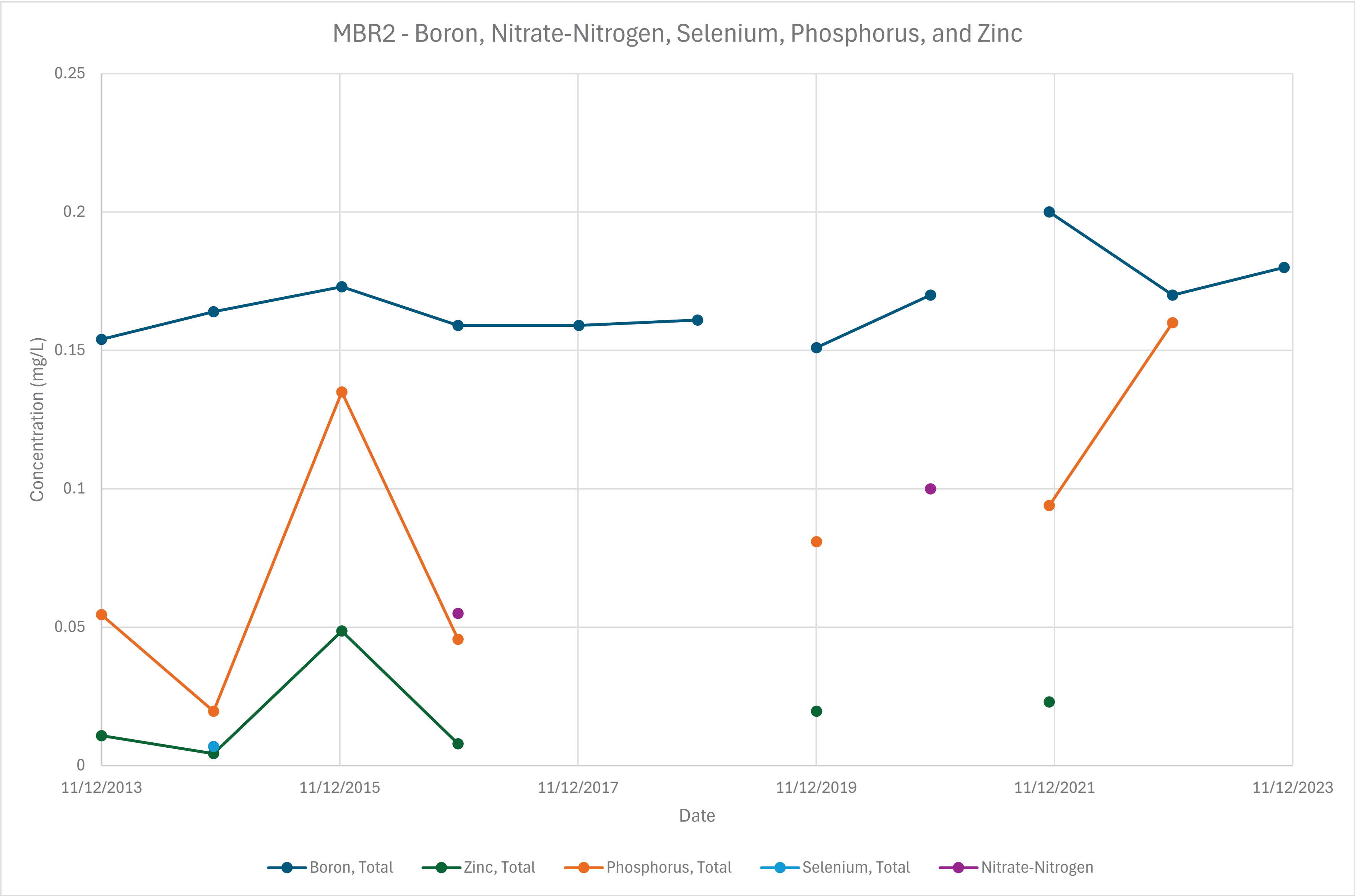
NEAR GALLUP, NEW MEXICO



APPENDIX D-2F. HISTORICAL GROUNDWATER QUALITY - MBR2
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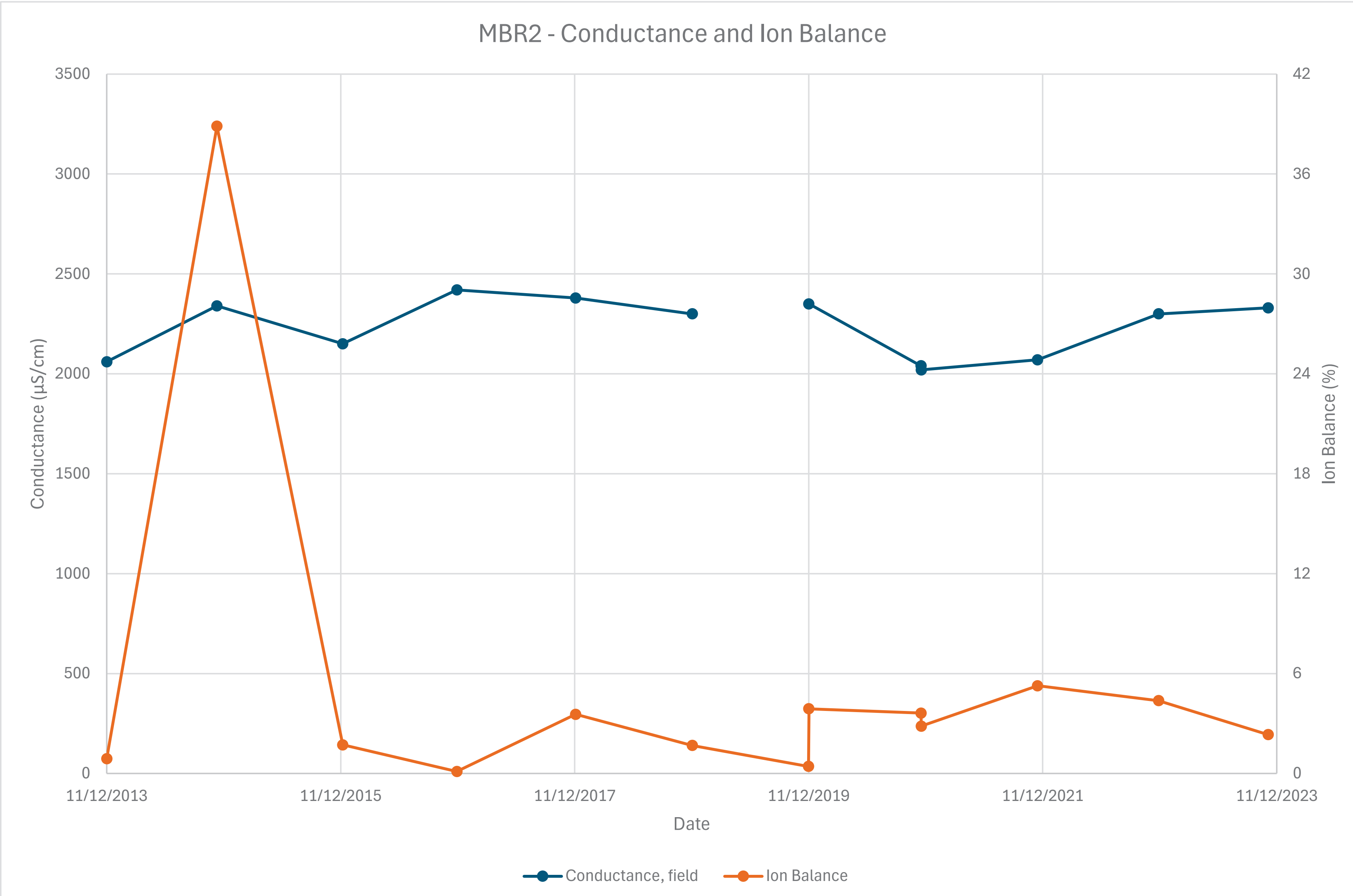
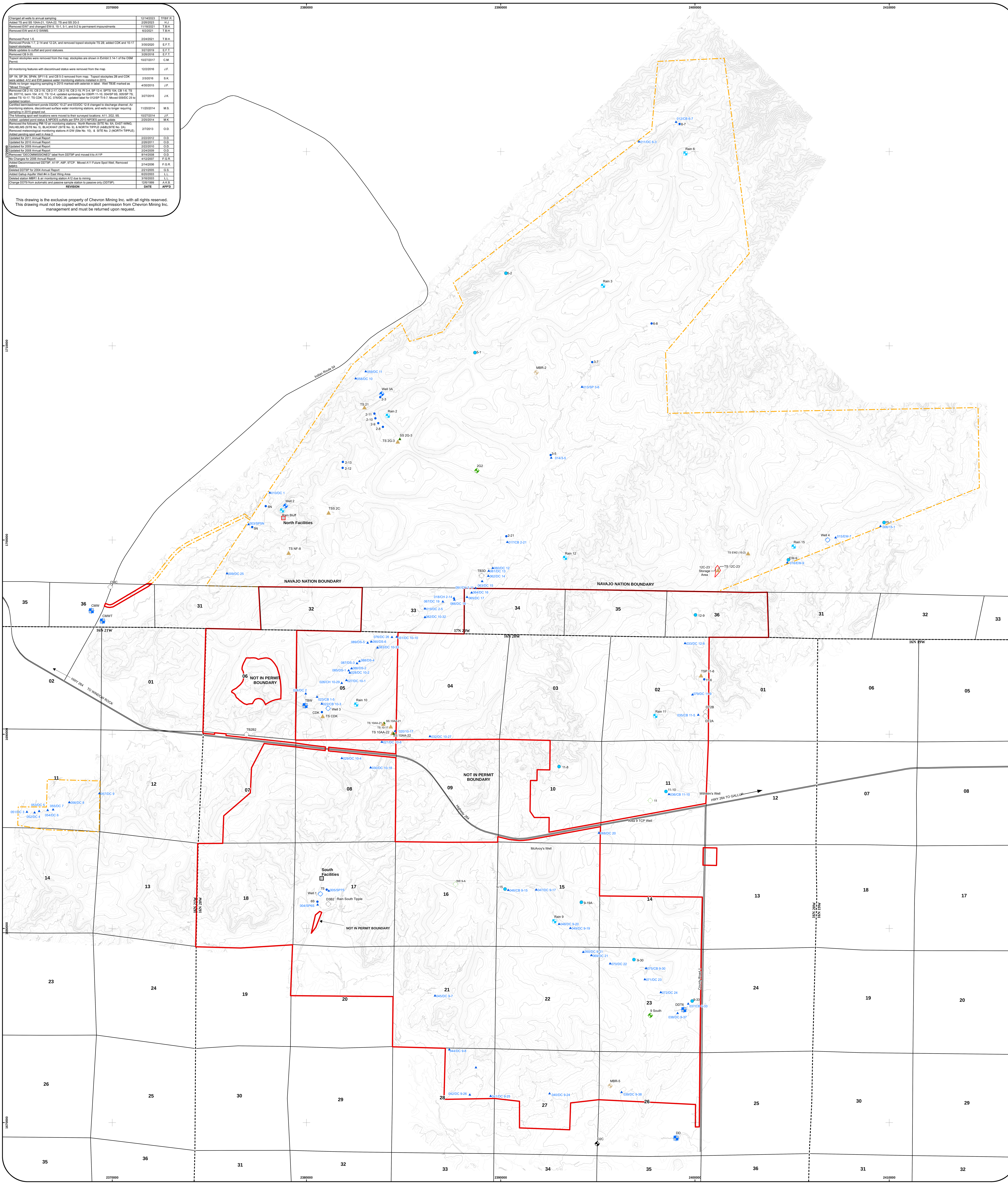
NEAR GALLUP, NEW MEXICO



Appendix A3: Environmental Monitoring and Outfalls Map



REVISION	DATE	APP'D
Changed all wells to annual sampling	12/14/2023	TFB\F.R.
Added TS and SS 10AA-21, 10AA-22, TS and SS 2G-3	2/26/2023	H.J
Removed EW7 and changed EW-9, 15-1, 5-1, and 5-2 to permanent impoundments	11/18/2021	T.B.H.
Removed EW and A12 SWMS.	6/2/2021	T.B.H.
Removed Pond 1-5.	2/24/2021	T.B.H.
Removed Ponds 1-7, 2-14 and 12-2A, and removed topsoil stockpile TS 2B; added CDK and 10-17 topsoil stockpiles.	3/30/2020	E.F.T.
Made updates to outfall and pond statuses.	3/27/2019	E.F.T.
Removed CB 9-35.	3/26/2018	E.F.T.
Topsoil stockpiles were removed from the map; stockpiles are shown in Exhibit 3.14-1 of the OSM Permit.	10/27/2017	C.M.
All monitoring features with discontinued status were removed from the map.	12/2/2016	J.F.
SP 1N, SP 3N, SP4N, SP11-9, and CB 5-3 removed from map. Topsoil stockpiles 2B and CDK were added. A12 and EW passive water monitoring stations installed in 2015.	2/3/2016	S.K.
Wells no longer requiring sampling in 2015 marked with asterisk in label. Well TB3E marked as "Mined Through".	4/30/2015	J.F.
Removed CB 2-15, CB 2-16, CB 2-17, CB 2-18, CB 2-19, PI 3-4, SP 12-4, SPTS 104, CB 1-6, TS 96, DDT10, berm 104, A12, TS 12-4; updated symbology for 036/PI 11-10, 004/SP 6S, 005/SP 7S; added TS 10-17, TS CDK, TS 2C, 076/DC 26; updated label for 012/SP TI 6-7; Moved 009/DC 25 to updated location.	3/27/2015	J.K.
Certified berm/sediment ponds 032/DC 10-27 and 033/DC 12-8 changed to discharge channel; Air monitoring stations, discontinued surface water monitoring stations, and wells no longer requiring sampling in 2015 grayed out.	11/20/2014	M.S.
The following spoil well locations were moved to their surveyed locations: A11, 2G2, 9S.	10/27/2014	J.F.
Added: updated pond status & NPDES outfalls per EPA 2013 NPDES permit update.	2/25/2014	M.K.
Removed the following PM-10 air monitoring stations: North Remote (SITE No. 6A, EAST-WING, WILHELMS (SITE No. 5), BLACKHAT (SITE No. 9), & NORTH TIPPLE (A&B)(SITE No. 2A). Removed meteorological monitoring stations A12W (Site No. 10), & SITE No. 2 (NORTH TIPPLE). Added pending spoil well in Area 2.	2/7/2013	O.D.
Updated for 2011 Annual Report	2/22/2012	O.D.
Updated for 2010 Annual Report	2/26/2011	O.D.
Updated for 2009 Annual Report	2/22/2010	O.D.
Updated for 2008 Annual Report	2/24/2009	O.D.
Removed "DECOMMISSIONED" label from DDT9P and moved it to A11P	8/14/2008	O.D.
No Changes for 2006 Annual Report	4/12/2007	F.G.R.
Added Decommissioned DDT9P, A11P, A9P, 9TCP. Moved A11 Future Spoil Well, Removed MBR3.	2/14/2006	F.G.R.
Deleted DDT9P for 2004 Annual Report	2/21/2005	G.S.
Added Gallup Aquifer Well #4 in East Wing Area	6/20/2003	L.L.
Deleted station MBR1 & air monitoring station A12 due to mining	3/16/2003	L.L.
Change DDT9 from automatic and passive sample station to passive only (DDT9P).	12/6/1999	A.K.B.

LEGEND

- MMD Permit Boundary
- OSM Permit Boundary
- Well - Alluvial, Annually Monitored
- Well - Bedrock, Annually Monitored
- Well - Spoil Wells, Annually Monitored
- Well - Gallup Aquifer, Annually Monitored
- Stream Monitor - Major Drainage
- Weather Monitor
- NPDES Outfall
- Sediment/Temporary Impoundment
- Permanent Impoundment
- Topsoil Stockpile
- Subsoil Storage
- North Facilities
- South Facilities

Township Number

- 001
- Section
- Public Road
- Major Surface Contour (25 ft. Interval)
- Minor Surface Contour (5 ft. Interval)

N

Chevron Mining Inc.
McKINLEY MINE

EXHIBIT 6.1-1
ENVIRONMENTAL MONITORING FACILITIES

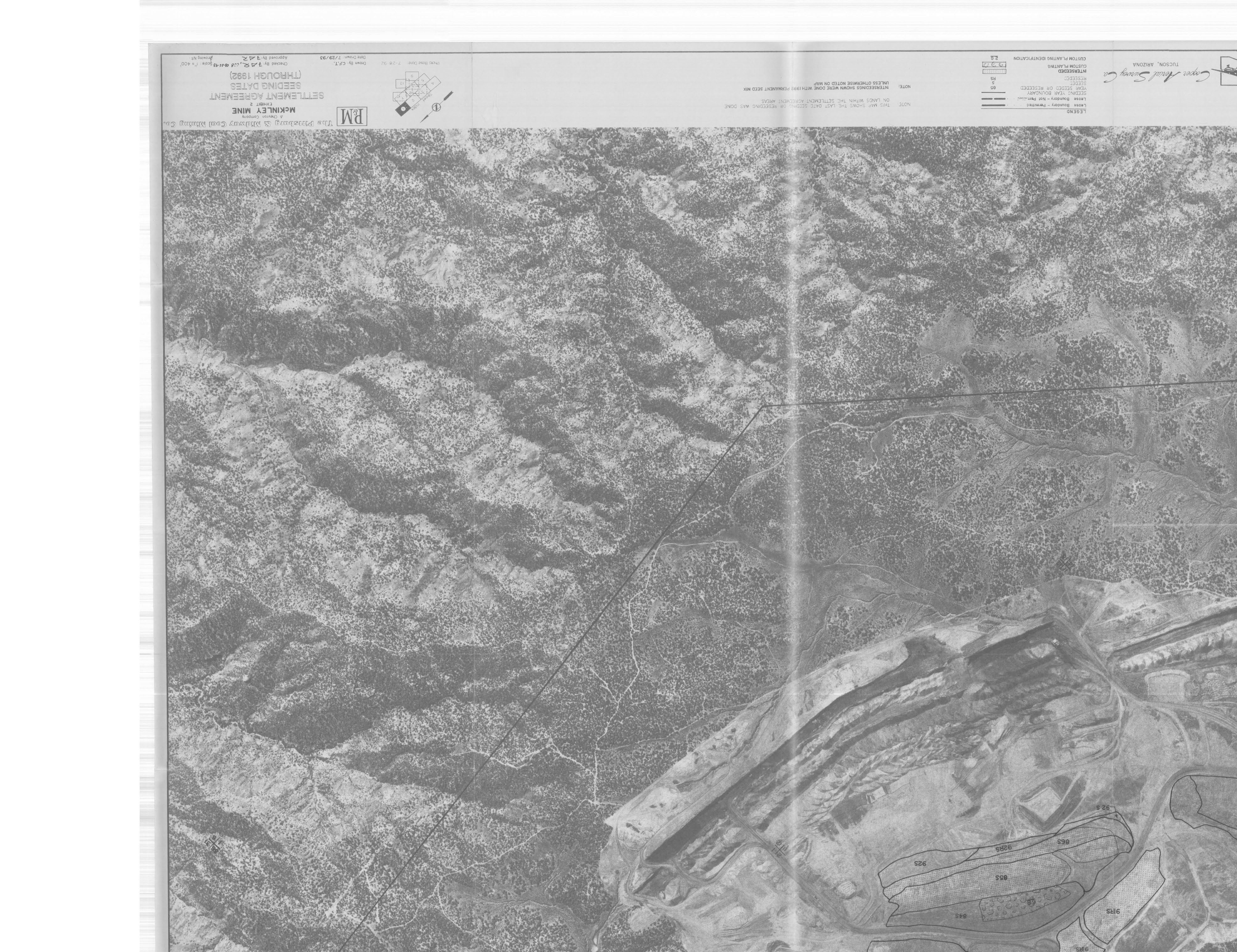
Last Revision Date: 12/14/2023
Date Drawn: 02/12/2016

Drawn By: H.J./TFB
Checked By: K.J.K.
Approved By: M.S.

Scale: 1" = 1250'

0 750 1,500 3,000 Feet

Appendix A4: Initial Program Lands Seeding



REVISION	Date	App'd By

Cooper Aerial Survey Co.
TUCSON, ARIZONA

LEGEND

Lease Boundary – Permitted	(heavy solid line)
Lease Boundary – Not Permitted	(heavy dashed line)
SEEDING YEAR BOUNDARY	(thin solid line)
YEAR SEEDED OR RESEEDED	85
SEEDED	S
RESEEDED	RS
INTERSEEDED	(dotted box)
CUSTOM PLANTING	(box with shrub symbols)
CUSTOM PLANTING IDENTIFICATION	2 G

NOTE: THIS MAP SHOWS THE LAST DATE SEEDING OR RESEEDING WAS DONE ON LANDS WITHIN THE SETTLEMENT AGREEMENT AREAS.

NOTE: INTERSEEDINGS SHOWN WERE DONE WITH 1992 PERMANENT SEED MIX UNLESS OTHERWISE NOTED ON MAP

Sheet Index

Photo Base Date: 7-28-92

P&M

The Pittsburg & Midway Coal Mining Co.
A Chevron Company
McKINLEY MINE
EXHIBIT 2
SETTLEMENT AGREEMENT
SEEDING DATES
(THROUGH 1992)

Drawn By: C.F.T.
Date Drawn: 7/29/93
Checked By: FAR, CJB 08-05-93
Approved By: FAR
Scale: 1" = 400'
Drawing No.

REVISION	Date	App'd By

Cooper Aerial Survey Co.
TUCSON, ARIZONA

LEGEND

Lease Boundary – Permitted	
Lease Boundary – Not Permitted	
SEEDING YEAR BOUNDARY	
YEAR SEEDED OR RESEEDED	85
SEEDED	S
RESEEDED	RS
INTERSEEDED	
CUSTOM PLANTING	
CUSTOM PLANTING IDENTIFICATION	2G

NOTE THIS MAP SHOWS THE LAST DATE SEEDING OR RESEEDING WAS DONE ON LANDS WITHIN THE SETTLEMENT AGREEMENT AREAS

NOTE INTERSEEDINGS SHOWN WERE DONE WITH 1992 PERMANENT SEED MIX UNLESS OTHERWISE NOTED ON MAP

Sheet Index

P&M The Pittsburg & Midway Coal Mining Co.
A Chevron Company

McKINLEY MINE
EXHIBIT 2

SETTLEMENT AGREEMENT
SEEDING DATES
(THROUGH 1992)

Photo Base Date: 7-28-93
Drawn By: C.F.T.
Date Drawn: 7/29/93
Checked By: F.A.R., jb 08-05-93
Approved By: F.A.R.
Scale: 1" = 400'
Drawing №

Appendix A5: Revegetation Monitoring Reports

REPORT

Vegetation Management Unit 1 Vegetation Success Monitoring, 2023

Submitted to:

Chevron Mining Inc. - McKinley Mine

24 Miles NW HWY 264

Mentmore, NM 87319

Submitted by:

WSP USA Inc.

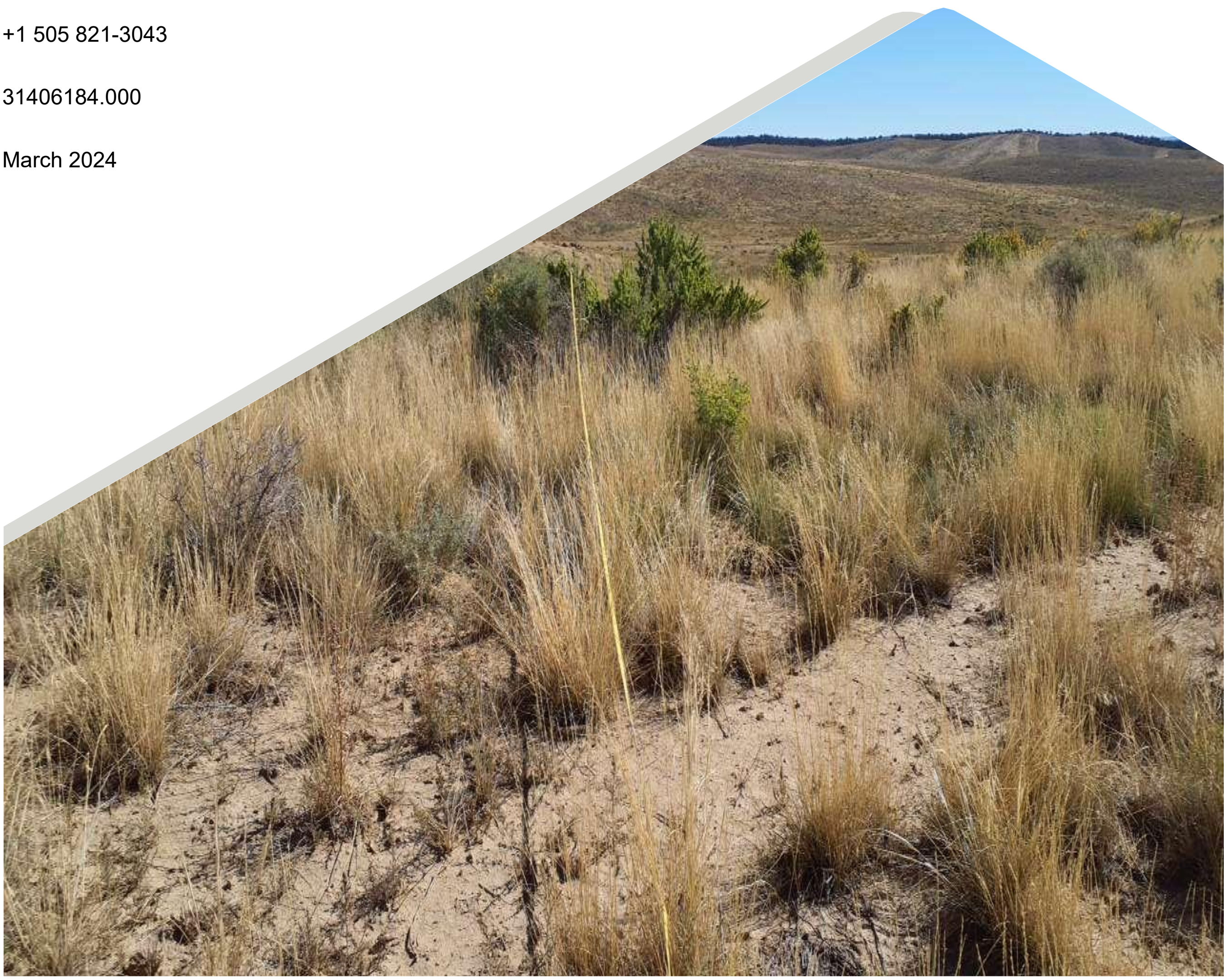
2440 Louisiana Boulevard NE, Suite 400,

Albuquerque, New Mexico, USA 87110

+1 505 821-3043

31406184.000

March 2024



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TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

Mining at the McKinley Mine ceased in 2009 and reclamation of remaining support facilities (e.g., impoundments, roads, etc.) is nearing completion. Reclamation practices have been applied at the McKinley Mine under various programs since at least the early 1970s. Chevron Mining Inc. (CMI) is assessing the vegetation in reclaimed areas in anticipation of future bond and liability release. CMI understands the importance of returning the mined lands to productive traditional uses in a timely manner. To qualify for release, the increment, or permit area as a whole, must meet the Permit No. NM-0001K (2016) (the Permit) permanent-program revegetation-success criteria as shown in Table 1 of this report. In general, the lands must be in a condition that is as good as or better than the pre-mine conditions, stable, and capable of supporting the designated postmining land uses of grazing and wildlife. WSP USA, Inc. (WSP) was retained to monitor and assess the vegetation relative to the established vegetation success standards.

This report documents the vegetation community attributes collected in 2023 in O-VMU-1 and compares them to the Permit's vegetation-success criteria. Section 1 includes the introduction and a general overview. Section 2 describes the vegetation monitoring methods that were used in 2023. Section 3 presents the results of the assessment with respect to total ground cover, perennial vegetation cover, forage production, woody plant density (shrub density), and composition and diversity. Section 4 is a summary of the results for O-VMU-1 with emphasis on vegetation success.

The 2023 sampling program was conducted and evaluated in accordance with the updated monitoring methods and revegetation success standards contained in Permit Modification Number 23-03. More details beyond what is already discussed throughout this report may be found in the Permit.

1.1 Vegetation Management Unit 1

This report presents results from 2023 quantitative vegetation monitoring conducted in Vegetation Management Unit 1 (O-VMU-1), which is in the western portion of Area 6 and all of Area 5 (Figure 1). The configuration of the vegetation monitoring units within the U.S. Department of the Interior – Office of Surface Mining Reclamation and Enforcement (OSMRE) Permit Area, were developed in consultation with OSMRE. Undisturbed lands included within the VMU were not part of the sampling program. O-VMU-1 encompasses about 934 acres, comprised mostly of permanent program lands (PPL) and some initial program lands (IPL). Both PPL and IPL as one unit must meet the PPL success criteria as discussed in the Permit in Section 6.5.1.2. The 10-year period of extended responsibility, however, only applies to PPL.

The elevation of O-VMU-1 ranges from about 7,200 to 7,600 feet above mean sea level. Reclamation started in 1975 with the vast majority seeded by 2003. Thus, the reclamation in the majority of O-VMU-1 ranges from 21 to almost 50 years old. This section provides a general description of the reclamation activities that were implemented. Additional details of the reclamation for specific areas can be obtained through review of the McKinley Mine annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation of permanent program lands included grading of the spoils to achieve a stable configuration, positive drainage, and approximate original contour. After grading, graded spoil monitoring was conducted to determine the suitability of the materials. A minimum of 6 inches of topdressing (topsoil or topsoil substitute) were then applied over suitable spoils.

After topdressing placement, the seedbed was scarified or ripped on the contour to a depth of about 8 to 12 inches. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, certified weed-free, long-stem, hay mulch, or straw was applied at a rate of about 2 tons per acre. The mulch was anchored 3 to 4 inches into the cover with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which tends to favor the establishment of cool-season grasses and shrubs. The approved seed mixes used at McKinley have varied over time but included both warm-season grasses, and introduced and native cool-season grasses, introduced and native forbs, and shrubs. The early seed mixes tended to emphasize the use the alfalfa and cool-season grasses. The majority of seed mixes planted on IPL consisted of native and introduced cool season grasses, limited warm-season grasses, some shrubs, but no forbs. Over time the seed mixes on PPL shifted to include more warm-season grasses, more shrub species, and a variety of forbs.

Initial program lands were typically graded so they were no steeper than 3:1 and topsoiled. Seeding practices were like those done on permanent program lands.

1.3 Prevailing Climate Conditions

The amount and distribution of precipitation are important determinants for vegetation establishment and performance. Once vegetation is established, the precipitation dynamics affect the amount of vegetation cover and biomass on a year-to-year basis with grasses and forbs showing the most immediate response. Precipitation has been monitored at the McKinley Mine throughout most of its life at two primary precipitation stations (Bluff and South Tipple). The mine added a system of 8 additional seasonal precipitation gauges to better capture more representative data from the various mining areas in 2011-2012 (gauges named by area). Data from the Rain 3 and 6 gauges were used to evaluate precipitation in O-VMU-1 (Figure 2).

Table 2 contains a summary of precipitation recorded at all the rain gauges in the North Mine Area. Total annual precipitation measured at the Bluff gauge near the mine entrance was 8.59 inches, below the regional average of 11.8 inches at Window Rock. Rain 3 and 6 gauges recorded 4.96 and 4.29 inches of precipitation, respectively, from late April to mid-November (the period these stations operate), whereas the Bluff gauge recorded approximately 5.24 inches of rain for the same period with data throughout all of November. Mine wide, the precipitation recorded in 2023 between April and November at the other eight gauges indicate below average precipitation, on a scale of about 2-3 inches below average, with variation both spatially and temporally.

Growing season precipitation provides additional context to evaluate vegetation performance in O-VMU-1. The departure of growing season precipitation (April through September) between Rain 3 and 6 gauges and the Window Rock (1937-1999) long-term seasonal mean is illustrated in Figure 2. Growing season precipitation in O-VMU-1 was well below the long-term seasonal mean from 2018 to 2023, with the exception of the 2022 growing season wherein both the Rain 3 and 6 gauges were above the seasonal mean, measuring approximately 1.67 and 0.36 inches above the mean, respectively. Growing season precipitation from the Rain 3 and 6 gauges in 2023 were 1.8 and 2.36 inches below average, respectively.

1.4 Livestock

CMI has been aggressively managing trespass livestock and as a result evidence of trespass horses was less apparent in 2023 in O-VMU-1. The combination of past grazing pressure with exceptional drought, however, may in some years adversely affect the ability to demonstrate that the vegetation is meeting or can meet the revegetation success standards.

2.0 VEGETATION STANDARDS AND MONITORING METHODS

Vegetation attributes in O-VMU-1 were quantified using the methods described in Section 6.5 of the Permit as modified in Permit Modification 23-03. Vegetation monitoring in O-VMU-1 was conducted from September 24 through October 5, 2023.

2.1 Vegetation Success Standards

The vegetation success standards for the Permit Area consist of five vegetative parameters: total cover, perennial cover, forage production, woody plant density, and diversity (Table 1). The total ground cover requirement, or the combined means for live vegetation cover and litter cover on the reclamation is 52%. The perennial vegetation cover requirement is 24%. Both total ground and perennial vegetation cover use absolute cover. The annual forage production requirement is 550 air-dry pounds per acre (lbs/ac). The shrub density success standard is 400 live woody stems per acre. In accordance with 30 CFR 816.116 (a)(2), success for total cover, perennial cover, forage production, and shrub density shall be ≥ 90% of the standard.

Cover is defined in three ways for accurate evaluation of diversity according to Table 1.

1) Absolute cover utilizes first-hit line point intercept (LPI) data and is used to assess the perennial grass diversity standard.
2) Relative perennial cover, the metric used to assess some grass, forb, and shrub standards, compares the cover of perennial species relative to the sum of perennial plants calculated from all-hit LPI data (excluding noxious weeds) within the VMU.
3) Relative total cover, the metric used to assess the any-single-species diversity standard, is calculated by dividing the percent cover of each perennial/biennial species by the total live vegetative cover from all-hit LPI data (excluding noxious weeds) within a VMU.

Biennial forbs are included in the vegetation cover analyses and biennial forb diversity standards because they are important to long term ecological success of the reclamation. As monocarpic, or single flowering species, these forbs produce a high number of seeds, and as a result, persist long-term in the reclamation plant community. Future mention of "perennial" in this report thus includes biennial species.

Relative shrub density, the metric used to assess the single shrub species standard, is calculated using belt-transect data by dividing the density of each species by the total density within a sampling unit. Relative calculations are valuable to determine whether a species or functional group is excessively dominant. The number of species requirement for the various diversity standard components (e.g., ≥ 2 species cool-season grasses) is calculated by adding the total number of unique species captured in the LPI surveys.

Diversity is evaluated against numerical guidelines for different vegetation types. In summary, the diversity guideline is met if perennial grasses contribute 7% or more absolute vegetation cover; at least two cool-season perennial grasses have individual relative perennial vegetation covers of 5% and 1.5% or more; at least two warm-season perennial grasses species with the highest cover species 5% or more relative perennial vegetation cover and the remaining species combining to contribute 1.5% or more relative perennial vegetation cover, at least three non-annual non-noxious forbs combining to contribute 1% or more relative total vegetation cover; shrubs combining to 6% or more relative perennial vegetation cover and no single shrub species with greater than 70% relative shrub density, and no single species of any functional group with 40% or more relative total vegetation cover. Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas.

2.2 Sampling Design

All lands (PPL and IPL) were included in the vegetation-sampling pool for unbiased random sampling. The transect locations were reviewed with OSMRE in advance of sampling. A 100-meter (m) by 100 m square grid was superimposed over the entire VMU to delineate vegetation sample plots. Random points were created in a geographic information system and the locations including the program land (IPL or PPL) designations are shown in Figure 3. In the field, the randomly selected transect locations were assessed in numerical order with 40 primary transects accompanied by 10 alternate transects. If a transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Transects that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies were considered unsuitable.

Figure 4 shows the 100 m by 100 m vegetation plot with the cover transect orientation, and the location of the production quadrats and belt transect. The origin of the LPI transect is situated at the grid centroid and transect orientation (from 0° to 360°) is chosen randomly beginning from the transect origin, the point navigated to. LPI points are traversed to on transect left with the laser pointed towards transect right, to limit disturbance from walking on the quad and belt survey areas located on transect right. Each LPI transect is 50 m long with three half square meter (½ m^2) production quadrats placed flush with the meter tape with the bottom left corner at the 10, 25, and 40 m mark to the right of the transect. The belt transect corridor is 2 m by 50 m along the transect's right side.

2.3 Foliar, Canopy and Ground Cover

The LPI method is used to collect cover measurements required by the Permit to evaluate total cover, perennial cover, and diversity. Prior to production clipping, a 50 m measuring tape is suspended between two metal pins to extend the tape fully. A tripod mounted laser is then held along the edge of the tape, and readings are taken every meter for living plants, plant litter, rock fragments, and bare ground. When a live plant is encountered as a direct foliar hit, the species is recorded, and direct lower canopy live plant hits are also recorded that are observed down the profile. The LPI-derived data were evaluated against the permit area vegetation success standards for vegetation cover and diversity provided in Table 1, with first hits used in absolute cover calculations and all hits (upper and lower canopy hits) used in relative cover calculations.

Additional cover measurements were estimated from each production quadrat including relative cover for each species and total canopy cover, surface litter, rock fragments, and bare soil. Quadrat canopy cover data is not analyzed for success and is only briefly discussed in this report as additional support information (Table A-4). Canopy cover estimates include the foliage and foliage interspaces of all individual plant species rooted in the quadrat. Canopy cover is defined as the percentage of quadrat area included in the vertical projection of the canopy. The canopy cover estimates made on a species basis may exceed 100 percent in individual quadrats where the vegetation has multi-layered canopies. In contrast, the sum of the total canopy cover, surface litter, rock fragments, and bare soil does not exceed 100 percent. All cover estimates were made in 0.05 percent increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates.

Not all plant species are expected to occur in the sampling transects and quadrats. Plants observed growing within the vegetation plots and across the reclaimed facility were inventoried while moving between sample locations and during formal sampling (Table A-7).

2.4 Annual Forage and Total Production

Forage production required by the Permit was determined by clipping and weighing all annual (current year's growth) above-ground forage biomass within the vertical confines of the three ½ m^2 quadrats placed systematically along the same 50 m transect used for LPI measurements. Biomass from all three quads from each transect are combined by species and the combined values for the transect (not the quads) are treated as a sampling unit. Production for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air-dry lbs/ac. The Permit allows for excessively grazed production quadrats to be considered for exclusion from the sampling analysis in consultation with OSMRE, but no quadrats needed to be excluded in O-VMU-1 (the Permit, Section 6.5.2.2).

Grasses and forbs were clipped to within 5 centimeters (cm) of the soil surface, and the current year's growth was segregated from the previous year's growth (e.g., gray, weathered grass leaves, and dried culms). Production from shrubs was determined by clipping the current year's growth. Annuals and noxious weeds (e.g., Russian knapweed [*Acroptilon repens*]), when encountered, were not clipped. Photographs of the individual production quadrats are included in Appendix B.

The plant biomass samples of every species collected per transect were placed individually in labeled paper bags. The samples were air-dried (~ 90 days) until no weight changes were observed with repeated measurements on representative samples. The average tare weight of the empty paper bags was determined to correct the total sample weight to air-dry vegetation weights. The net weight of the air-dried vegetation was converted to a lbs/ac.

2.5 Shrub Density

Shrub density (as required by the Permit), or the number of stems per square meter (stems/m^2), was determined using the belt transect method (Bonham 1989). The belt transect was located parallel to the 50 m transect used to determine cover. Shrubs rooted in the 2 m belt transect were counted on a species basis. A 2 m folding ruler was horizontally oriented perpendicular to the tape to ensure that observations were taken within the 2 m corridor. The number and species of woody plant stems within the belt transect were recorded.

2.6 Statistical Analysis

The procedures for liability release and the basis for statistical analysis applied in this report may be found in the Permit, and as referenced in the Permit: the Wyoming Department of Environmental Quality (WDEQ) handbook of sampling and statistical methods (WDEQ 2012), and the New Mexico Mining and Minerals Division (MMD) Coal Mine Reclamation Program guidelines (MMD 1999). Additional resources include Evaluation and Comparison of Hypothesis Testing Techniques for Bond Release Applications (McDonald et al. 2003), which was the basis of the WDEQ handbook, and other sources referenced herein. More specifically, Figure 6.5-1 and Appendix 6.5-B of the Permit guide the statistical approach in determining vegetation success for total ground cover, perennial vegetation cover, annual forage production, and shrub density. The statistical analyses applied to the O-VMU-1 vegetation data are presented in Appendix C including equations for vegetation data analysis, vegetation attribute data with descriptive statistics, the statistical analyses comparing these attributes to the revegetation success standards, the statistical model, and descriptive statistics and normality for the vegetation attributes.

Descriptive statistics and statistical adequacy are presented for total ground cover, perennial vegetation cover, annual forage production, and shrub density in Tables 3 and C-2. Vegetation attribute data (Table C-2) was evaluated with the Shapiro-Wilk test to determine if data are normally distributed (Figures C-2 to C-6). For normally distributed data, statistical adequacy was assessed (Snedecor and Cochran 1967). Hypothesis testing for normal data that met sample adequacy was conducted using a one-sample, one-sided t-test under the classical null hypothesis. A one-sample, one-sided t-test using the reverse null hypothesis was applied for normally distributed data which failed to meet statistical adequacy. A non-parametric one-sample, one-sided sign test using the reverse null hypothesis was applied to data that was not normally distributed and did not meet sample adequacy. While transformed data were not used in hypothesis testing for satisfying standards, as a supplemental analyses, non-normal data were log-transformed. If the transformed data resulted in a normal distribution, one of the t-tests previously described was performed depending on sample adequacy. If transformed data were also non-normal, data were analyzed using the non-parametric one-sample, one-sided sign test using the reverse null hypothesis on the non-transformed data.

The following presents the statistical approach in more detail. Descriptive statistics and statistical tests were performed using both Microsoft® Excel and R-Studio (version 4.2.2).

2.6.1 Normality and Statistical Adequacy

The normality of each dataset was first assessed using the Shapiro-Wilk test to determine the appropriate hypothesis test method (i.e., parametric versus non-parametric). The Shapiro-Wilk null hypothesis is that the samples (of size n) come from a normal distribution. Data were considered normal when the test statistic had a p-value > 0.10 for alpha (α) = 0.10.

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. The number of samples necessary to meet sample adequacy (N_{min}) was calculated assuming the data were normally distributed using Snedecor and Cochran (1967) equation below.

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

Where N_{min} equals the 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 percent of the mean in this case.

In addition to N_{min}, the standard deviation and the 90% confidence interval (CI) about the sample means are reported in Table 3.

It is often impractical to achieve sample adequacy in vegetation monitoring studies based on Snedecor and Cochran's equation listed above. In such cases, the Permit allows a maximum sample number approach to compare the data regardless of the distribution (WDEQ 2012, MMD 1999). Where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples is considered adequate as stated in the Permit. The 40-sample maximum is based on an estimate of the number of samples needed for a t-test under a normal distribution (Sokal and Rohlf 1981). Schulz et al. (1961) demonstrated that 30 to 40 samples provide a robust estimate for most cover and density measures with increased numbers of samples only slightly improving the precision of the estimate.

The maximum 40 samples were collected at the outset of sampling based on the guidance discussed above. Each transect is considered a unique sampling unit. Sample adequacy was calculated to determine the number of samples that would have been required for adequacy by the Snedecor and Cochran equation. Further analysis for sample adequacy of cover, production and density attributes was also demonstrated using a graphical stabilization of the mean method (Clark 2001).

2.6.2 Hypothesis Testing

The emphasis on statistical adequacy assumes that parametric tests of normally distributed data will be conducted to demonstrate compliance with the vegetation success standards. Thus, if statistical adequacy is met for normally distributed data, the data would be analyzed with a one-sample, one-sided t-test using the classical null hypothesis. Non-parametric hypothesis tests have sufficient power to analyze data that are not normally distributed. Thus, if data is not-normal then it is permissible based on the Permit and technically appropriate to use one-sample, one-sided sign test using the reverse null approach as encouraged by OSMRE.

Hypothesis testing used to demonstrate compliance with the vegetation success standards for total ground cover, perennial vegetation cover, annual forage production, and shrub density were structured as follows (in accordance with Appendix 6.5-B of the Permit):

Classical Null Hypothesis:

H_0: Reclaim ≥ 90% of the Performance Standard

H_a: Reclaim < 90% of the Performance Standard

Where H_0 is the null hypothesis, and H_a is the alternative hypothesis.

The one-sample, one-sided t-test using the classical null hypothesis decision rules based on the test statistic are:

If $t^* \geq t_{(\alpha;\, n-1)}$, conclude that the performance standard was met.

If $t^* < t_{(\alpha;\, n-1)}$, conclude failure to meet the performance standard.

Test Statistic:

$$t^* = \frac{\bar{x} \; - 0.9\;(technical\;std)}{s/\sqrt{n}}$$

Where t* is the calculated t-statistic, $\bar{x}$ is the sample mean, s is the standard deviation, n is the sample size, and α = 0.10.

Reverse Null Hypothesis:

H_0: Reclaim ≤ 90% of the Performance Standard

H_a: Reclaim > 90% of the Performance Standard

One-sample, one-sided sign test using the reverse null hypothesis decision rules are:

If P < 0.10 or $z < z_\alpha$ (for α = 0.10, z_α = -1.282), conclude that the performance standard was met (i.e., H_o is rejected, the revegetation values tend to be statistically greater than 90% of the technical standard).

If P ≥ 0.10 or $z \geq z_\alpha$ ($\alpha = 0.10$, $z_\alpha = -1.282$), conclude failure to meet the performance standard (i.e., H_o is NOT rejected, the revegetation values tend to be statistically less than or equal to 90% of the technical standard).

The z critical values of the normal distribution can be found in WDEQ, Table 1 (2012)

Sign Test Statistic:

$$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

Where z is the sign test statistic (Daniel 1990), k is the test statistic resulting from the number of measurements that were less than 90% of the technical standard, and n is the sample size.

All hypothesis tests were performed with a 90% level of confidence. Hypothesis testing was not conducted for parameters where the mean or median did not exceed the minimum permit requirements.

3.0 RESULTS

The vegetation in O-VMU-1 is well established and dominated by perennial plants and the vegetation community achieved full compliance with the vegetation success standards in 2023. Table 3 summarizes the results for total ground cover, perennial vegetation cover, annual forage production and woody plant density (shrub density) along with their corresponding technical standard.

Field data for LPI foliar cover, quadrat canopy cover, annual forage production and shrub density by the belt transect are included in Appendix A (Tables A1-A7). Photographs of the individual production quadrats are included in Appendix B and a representative photograph of the vegetation and topography is shown in Figure 5.

Table 4 summarizes the attributes for plants recorded in the LPI transects and production quadrats and Table A-7 summarizes all species observed within belt and quadrat surveys as well as those recorded opportunistically between survey areas during monitoring. Recruitment of additional native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

Field data results and statistics are discussed by parameter in the sections that follow.

3.1 Total Ground and Perennial Vegetation Cover

Total ground cover exceeded the revegetation success standard and met the required statistical demonstration. Total ground cover based on first hit LPI data, (mean total ground cover ± 90% CI) in O-VMU-1 in 2023 was 64.4 ± 2.4% and a median of 65% (Table 3), exceeding the revegetation success standard. This was composed of live vegetation cover (47.0 ± 2.6%) and litter cover (17.4 ± 1.7%). Live vegetation foliar cover in individual transects ranged from 12 to 36 hits (24 to 72% cover) and litter cover ranged from 3 to 18 hits (6 to 36% cover) calculated from first hit LPI data (Table A-1).

Perennial vegetation cover, based on first hit LPI data, was calculated by summing the perennial and biennial species vegetation cover of the sampling unit excluding annuals and noxious weeds. The average perennial cover was 45.5 ± 2.7% and the median cover was 44% (Table 3), exceeding the revegetation success standard. Perennial vegetation cover in the individual transects varied from 12 to 34 hits (24 to 68% cover) (Table A-1). For quadrat cover data (not used in evaluating standards), the mean total vegetation canopy cover was 34.3%, ranging from 0 to 97% among individual quadrats (Table A-4).

Total ground cover and perennial vegetation cover data for O-VMU-1 were normally distributed (Figures C-1 and C-2 respectively). Sample adequacy, estimated using the Snedecor and Cochran (1967) equation, was 6 samples for total ground cover and 16 samples for perennial vegetation cover, the minimum sample sizes needed to meet sample adequacy (N_{min}) at the 90% confidence level (Table 3). Both met sample adequacy with a sample size of 40.

Because total ground cover and perennial vegetation cover data were normally distributed and met sample adequacy, data were statistically analyzed using a one-sample, one-sided t-test using the classical null hypothesis. The resulting t*-statistic for total ground cover was 12.331, with a sample mean of 64.5%, a standard deviation of 9.1%, measured against a one-tail $t_{(0.1, 39)}$ value of -1.304. Therefore, testing under the classical null hypothesis ($t^* \geq t_{(\alpha; n-1)}$), we conclude that the performance standard of 52% total ground cover was met (Table C-3). The resulting t*-statistic for perennial vegetation cover was 14.372, with a sample mean of 45.5%, a standard deviation of 10.5%, measured against a one-tail $t_{(0.1, 39)}$ value of -1.304. So, under the classical null hypothesis ($t^* \geq t_{(\alpha; n-1)}$), we conclude that the performance standard of 24% perennial vegetation cover was met (Table C-4).

3.2 Production

Forage production exceeded the revegetation success standard and met the required statistical demonstration. Forage production for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air-dry lbs/ac. Annual forage production in O-VMU-1 in 2023 was 771 ± 125 lbs/ac (median of 667 lbs/ac) (Table 3). Annual forage production in individual transects ranged from 110 to 2,364 pounds per acre (Table A-5). Perennial grasses (15 species) contributed the most forage with 557 lbs/ac, while shrubs (six species) contributed 187 lbs/ac and ten perennial forbs contributed 25 lbs/ac (Table 4).

Annual forage production data for O-VMU-1 were not normally distributed (Figure C-3), though the log-transformed values were (Figure C-5). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was 111 samples (Table 3). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean method (Clark 2001) with 90% CI (Figure 6). While the mean steadily increases with increasing sample numbers, the confidence levels show little change after eight samples. The analysis suggests that improvements in variability around the mean would likely not have improved with additional samples beyond the 40 samples collected for annual forage production.

The one-sample, one-sided sign test with the reverse null hypothesis was used to test the mean against 90% of the technical standard of 550 lbs/ac. Of the 40 transects, 28 exceeded 90% of the technical standard (Table C-5) resulting in a probability (P) of 0.0089 of observing a z-value less than -2.37. Therefore, under the reverse null hypothesis we conclude that the annual forage production performance standard is met in 2023.

3.3 Shrub Density

Shrub density exceeded the revegetation success standard and met the required statistical demonstration. In 2023 shrub density in O-VMU-1 substantially exceeded the vegetation success standard of 400 stems/ac from belt transect data with an average of 2,414 ± 381 stems/ac and a median of 2,084 stems/ac (Table 3). Twenty-one woody plant species were encountered in the belt and LPI transect sampling. Fourwing saltbush (*Atriplex canescens*) was the most common shrub encountered in both methods (Tables 5, A-1 and A-4).

The shrub density data for O-VMU-1 were not normally distributed (Figure C-4) but the log transformed data were normal (Figure C-6). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for shrub density was 105 samples (Table 3). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean method (Clark 2001) showing 90% CI (Figure 7). The mean begins to stabilize after 16 samples and the 90% CI shows very little change after 24 samples. This analysis suggests that 40 samples were more than adequate, and that the collection of additional data would not improve the precision of the estimate of shrub density.

The one-sample, one-sided sign test with the reverse null hypothesis was used to test the mean against the 90% of the technical standard of 400 stems per acre. Of the 40 transects, 39 exceeded 90% of the technical standard (Table C-6) resulting in a probability (P) of <0.001 of observing a z-value less than -5.85. Therefore, under the reverse null hypothesis we conclude that the woody plant density performance standard is met in 2023.

3.4 Composition and Diversity

In 2023, the standards were met for all of the individual diversity standards in O-VMU-1 (Table 6). The revegetation diversity standards are based on a “lifeform statement” for grasses, forbs, and shrubs (Table 1) that consists of 12 individual parameters. The results for composition and diversity are discussed below by parameter. Relative perennial values of individual species and functional groups are calculated relative to the total perennial vegetation cover of 45.5% reported in Section 3.1. This data is calculated from all-hit LPI data (Table A-2). Relative perennial vegetation cover of individual species is listed in Table 4.

Grasses dominated the perennial vegetation cover with James’ galleta (*Pleuraphis jamesii*) and blue grama (*Bouteloua gracilis*) representing the highest cover of the warm-season grasses (Table 4). Cool-season grasses also dominated the vegetation reflecting the past seed mixes, season of seeding, and the site’s continued ability to support a diverse group of cool-season grasses. Thickspike wheatgrass (*Elymus lanceolatus*) and western wheatgrass (*Pascopyrum smithii*) represented the highest cover of the cool-season grasses. Shrubs are important components of the reclamation due to their persistence and tolerance to harsh conditions. The woody plant component is dominated primarily by fourwing saltbush, with winterfat (*Krascheninnikovia lanata*) and broom snakeweed (*Gutierrezia sarothrae*) subdominant. Perennial forb species occurred on the LPI transects, though they are minor contributors to vegetation cover, accounting for 1.4% absolute vegetation cover with scarlet globemallow (*Sphaeralcea coccinea*) contributing the highest cover.

The perennial grass diversity standard requires a total absolute vegetation cover of at least 7%, which was achieved in 2023 with 34.3%. The diversity standard for cool-season perennial grasses was achieved with 12 total species, and two species that represent at least 5 and 2.5% relative perennial vegetation cover (thickspike wheatgrass [27.2%] and western wheatgrass [17.3%]). The diversity standard for warm-season grasses is achieved with five total species, one species representing at least 5% (James’ galleta [8.1%]) and all remaining species representing over 1.5% relative perennial vegetation cover at 3.6%.

The perennial forb diversity standard requires at least three perennial/biennial forbs (not including noxious weeds) combining to at least 1% relative perennial vegetation cover (calculated based on the percent foliar cover of perennial species excluding annuals and noxious weeds). This standard was achieved in 2023 with 9 species totaling 3.2% relative perennial vegetation cover with the greatest contributions from scarlet globemallow (0.7%), alfalfa (0.7%, *Medicago sativa*), and curlycup gumweed (0.6%, *Grindelia squarrosa*).

The diversity standard for shrubs requires the relative perennial vegetation cover for all shrub species to total at least 6% with no single shrub exceeding or equal to 70% relative shrub density. Both of these standards were achieved with 20.9% relative perennial vegetation cover of all shrubs and 54.4% relative shrub density of fourwing saltbush – the most dominant shrub.

Lastly, the diversity standards require that no single species of any functional group represent greater than 40% relative total vegetative cover. Relative total vegetative here is defined as the percent foliar cover of any recorded species divided by the total foliar cover for all live vegetation of the sampling unit, including annuals and noxious weeds. Thickspike wheatgrass represented the highest relative total vegetation cover at 26.0%, thus the reclamation achieved the single species diversity standard.

From 2019 through 2023, 166 plant species have been observed within reclaimed areas in O-VMU-1 including 40 grasses, 82 forbs, and 44 shrubs, trees, and cacti (Table A-7). Of the 40 grasses, 23 are cool-season perennials, three are cool-season annuals, 12 are warm-season perennials and two are warm-season annuals. Of the 83 forbs, 28 are annuals and the remaining 55 are perennials and/or biennials. Cacti (three species), succulents (two species), and trees (seven species) were rare on the reclamation but provide diverse habitat or browse for wildlife. Shrubs and subshrubs were the most common woody plants observed (31 species). The recruitment of native plants and establishment of seeded species within is indicative of ecological succession and the capacity of the site to support a diverse and self-sustaining ecosystem.

Multi-hit LPI data provide an opportunity to investigate faciliatory relationships among plants (Table A-3). This summary suggests that fourwing saltbush is a common upper canopy species in O-VMU-1, most commonly harboring thickspike wheatgrass, western wheatgrass, and needle and thread (*Hesperostima comata*) in its understory. While these grass species are common outside of shrub canopies as well, bottlebrush squirreltail (*Elymus elymoides*), a strong competitor against cheatgrass (*Bromus tectorum*), was hit five times beneath fourwing saltbush, half of its total hits. This suggests that recruitment of this species may be aided by the presence of fourwing saltbush or other shrubs. Associations such as this may be informative in future management activities.

3.5 Noxious Weeds

During the 2023 monitoring program, Class C noxious weeds (NMDA 2020) were rarely encountered in O-VMU-1. Class C noxious weeds are generally widespread in the state and managed at the local level based on feasibility of control and level of infestation. Cheatgrass was encountered infrequently in LPI surveys and production quadrats. Noxious weeds are not used in the assessment of revegetation success but are included in the single species cover standard (Table 1). Noxious trees observed on O-VMU-1 in past years include saltcedar (*Tamarix ramosissima*) and Siberian elm (*Ulmus pumila*) but their presence in the reclaimed vegetation community is insignificant with densities much lower than native rangeland beyond the permit boundary. CMI continues to monitor for noxious weeds and actively controls them through husbandry practices that include annual services for weed management. Further, competition from desirable seeded and native species is expected to inhibit any substantial increase of noxious weeds in the reclamation.

4.0 SUMMARY

McKinley Mine’s vegetation success standards for the post-mining land uses of grazing and wildlife are based on total ground cover, perennial vegetation cover, annual forage production, shrub density, and diversity. The technical standards (Table 1) were developed through negotiations with OSMRE based on the analysis of historical vegetation data, interpretation of the ecological site potential, and the anticipated post-mining land uses. The vegetation monitoring results for the past five years indicate that the vegetation community in O-VMU-1 is progressing well having met the total ground cover and shrub density standards every year (Table 3). A summary of the findings from the past five years are:

1. Vegetation Cover: The total ground cover standard has been met for the past five years. Perennial vegetation cover has met the performance standard in four of the past five years. The standard was not met only in 2021 following two years of below normal growing season precipitation.
2. Forage Production: In 2020 and 2021, O-VMU-1 only received 32% of normal growing season precipitation that led to a significant decline in forage production. In 2022, with above normal precipitation, average forage production recovered, and the average was well above the performance standard, but variability among samples was high. As such, hypothesis testing could not demonstrate the standard was met. In 2023, average annual forage production both exceeded the performance standard and passed hypothesis testing with reduced variability compared to 2022. Improved field methodology likely aided in reducing variability and enhanced the ability of the data to accurately capture the inherent variation in the landscape while achieving the performance standard.
3. Shrub Density: O-VMU-1 has exceeded the success parameters for shrub density in all five monitoring years.
4. Diversity: All plant diversity standards were met in all years except for the single shrub species standard in 2021 and 2022, with fourwing saltbush comprising more than 70% relative shrub cover both years (based on the LPI method). In 2023, relative shrub density derived from belt transect data were used to evaluate this standard instead of LPI relative shrub cover, a change which more accurately represents the shrub community and reduces bias towards larger canopied shrubs.

Overall, vegetation performance in O-VMU-1 over the past five years is encouraging considering below-average precipitation for four of the past five years including the exceptional drought in 2020 and 2021. The performance of the vegetation under these conditions suggests that the reclaimed plant communities are resilient and capable of sustaining themselves under adverse conditions that are characteristic of this region. The reclamation in O-VMU-1 has demonstrated the capability of meeting and sustaining the post-mining land use.

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Tables

Table 1: Revegetation Success Standards in the McKinley Mine OSMRE Permit

Vegetative Parameter	Components		Success Standards 2019-2022	Success Standards 2023
Cover	Total Ground Cover		≥ 52%	≥ 52%
	Perennial Vegetation Cover		≥ 24%	≥ 24%
Diversity "Lifeform Statement"	Perennial Grasses	All Grasses	≥ 7% absolute cover	≥ 7% absolute cover
		Cool-Season	≥ 2 species, each ≥ 1.5% cover	≥ 2 species, **1st species ≥ 5% relative perennial cover, 2nd species ≥ 2.5% relative perennial cover**
		Warm-Season	≥ 2% contribution, ≥ 2 species, each ≥ 0.5% cover	≥ 2 species, **1st species ≥ 5% relative perennial cover, all other species combined ≥ 1.5% relative perennial cover**
	Perennial Forbs		≥ 3 species, combining for ≥ 1% relative perennial cover	≥ 3 species, combining for ≥ 1% relative perennial cover
	Shrubs	All Shrubs	≥ 3% absolute cover	**≥ 6% relative total perennial cover**
		Any Single Species	≤ 70% relative total shrub cover	≤ 70% relative total **shrub density**
	Any Single Species		≤ 40% relative total vegetative cover	≤ 40% relative total vegetative cover
Production	Pounds/acre (air dry)		≥ 550 lbs/ac	≥ 550 lbs/ac
Woody Plant Density	Stems/acre		≥ 400/acre	≥ 400/acre

Notes:
1) Success for cover, production, and stocking shall be ≥ 90% of the standard in accordance with 30 CFR 816.116 (a)(2).
2) Total ground cover does not include noxious weeds.
3) Perennial vegetation cover is foliar cover from LPI, not including annuals and noxious weeds.
4) Relative cover is the percent cover of a species or functional group divided by the total vegetation cover including annuals and noxious weeds.
5) Relative perennial cover is the total cover of a perennial species or perennial functional group divided by the total perennial cover (see below).
6) Total perennial cover includes shrubs, cactus, trees, perennial grasses and perennial forbs not including noxious species.
7) Relative total shrub density is the density of each woody species divided by the total woody plant density not including noxious weeds.
8) Production includes above-ground biomass of forage species only.
Bolded standards are those that changed in 2023

Table 2: North Mine Seasonal and Annual Precipitation, 2015-2023

Year	Station	Area	Precipitation (inches)													
			January	February	March	April	May	June	July	August	September	October	November	December	Annual Total	Growing Season Total
2015	Rain Bluff	North Shop	1.39	1.21	0.11	0.35	1.54	1.15	2.81	1.91	0.51	1.18	1.16	0.74	14.06	*8.27*
	Rain 2	2	NA	NA	NA	0.52	1.51	1.98	3.17	1.39	0.50	1.08	0.92	NA	NA	*9.07*
	Rain 3	3	NA	NA	NA	0.57	1.80	1.77	3.61	3.06	0.44	1.36	0.86	NA	NA	*11.25*
	Rain 6	6	NA	NA	NA	0.54	0.71	2.12	2.66	2.12	0.00	0.92	0.70	NA	NA	*8.15*
	Rain 10	10	NA	NA	NA	0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78	NA	NA	*7.13*
	Rain 12	12	NA	NA	NA	0.49	1.59	1.39	2.88	2.14	0.47	1.17	1.29	NA	NA	*8.96*
	Rain 15	15	NA	NA	NA	0.46	1.90	1.62	3.17	2.88	0.32	0.94	0.69	NA	NA	*10.35*
2016	Rain Bluff	North Shop	0.39	0.25	0.03	1.28	0.70	0.19	1.15	1.85	1.79	0.69	1.18	1.98	11.48	*6.96*
	Rain 2	2	NA	NA	NA	0.17	0.58	0.14	2.22	0.71	0.87	0.21	0.02	NA	NA	*4.69*
	Rain 3	3	NA	NA	NA	0.20	0.72	0.45	1.62	0.11	0.50	0.33	0.02	NA	NA	*3.60*
	Rain 6	6	NA	NA	NA	0.20	0.75	0.29	2.00	0.40	1.19	0.19	0.02	NA	NA	*4.83*
	Rain 10	10	NA	NA	NA	0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02	NA	NA	*5.00*
	Rain 12	12	NA	NA	NA	0.30	0.78	0.36	1.34	0.49	1.16	0.18	0.05	NA	NA	*4.43*
	Rain 15	15	NA	NA	NA	0.31	0.85	0.04	1.95	0.35	1.31	0.18	0.05	NA	NA	*4.81*
2017	Rain Bluff	North Shop	0.81	0.04	0.70	0.32	0.41	0.16	3.71	0.37	0.62	0.54	0.05	0.02	7.75	*5.59*
	Rain 2	2	NA	NA	NA	1.28	0.66	0.22	0.78	2.08	1.46	0.63	0.44	NA	NA	*6.48*
	Rain 3	3	NA	NA	NA	1.04	1.16	0.06	0.99	2.71	1.63	0.56	0.44	NA	NA	*7.59*
	Rain 6	6	NA	NA	NA	0.86	1.50	0.02	0.96	2.04	1.52	0.38	0.51	NA	NA	*6.90*
	Rain 10	10	NA	NA	NA	1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81	NA	NA	*5.68*
	Rain 12	12	NA	NA	NA	1.17	0.91	0.05	0.88	1.89	1.77	0.47	0.46	NA	NA	*6.67*
	Rain 15	15	NA	NA	NA	1.15	1.36	0.02	0.68	1.91	1.56	0.40	0.41	NA	NA	*6.68*
2018	Rain Bluff	North Shop	0.23	0.48	0.44	0.08	0.22	0.28	2.17	0.00	1.00	1.51	0.14	0.43	6.98	*3.75*
	Rain 2	2	NA	NA	NA	0.06	0.26	0.30	1.10	0.90	1.40	1.48	0.00	NA	NA	*4.02*
	Rain 3	3	NA	NA	NA	0.04	0.30	0.35	0.92	0.91	1.27	1.69	0.00	NA	NA	*3.79*
	Rain 6	6	NA	NA	NA	0.03	0.21	0.46	0.97	0.56	1.02	1.45	0.00	NA	NA	*3.25*
	Rain 10	10	NA	NA	NA	0.08	0.20	0.27	3.05	1.15	0.92	1.51	0.00	NA	NA	*5.67*
	Rain 12	12	NA	NA	NA	0.06	0.37	0.26	1.08	1.36	1.09	1.54	0.00	NA	NA	*4.22*
	Rain 15	15	NA	NA	NA	0.05	0.32	0.28	1.16	0.63	1.31	1.31	0.00	NA	NA	*3.75*
2019	Rain Bluff	North Shop	0.95	0.98	1.10	0.24	0.17	0.03	0.03	1.14	0.10	0.04	1.15	0.97	6.90	*1.71*
	Rain 2	2	NA	NA	NA	0.22	1.41	0.15	0.35	0.73	1.35	0.04	0.05	NA	NA	*4.21*
	Rain 3	3	NA	NA	NA	0.39	1.50	0.32	0.70	0.11	1.72	0.06	0.06	NA	NA	*4.74*
	Rain 6	6	NA	NA	NA	0.36	1.20	0.00	0.01	0.34	1.82	0.04	0.03	NA	NA	*3.73*
	Rain 10	10	NA	NA	NA	0.20	1.49	0.37	0.19	0.27	1.34	0.03	0.05	NA	NA	*3.86*
	Rain 12	12	NA	NA	NA	0.20	1.59	0.28	0.35	0.14	1.38	0.07	0.04	NA	NA	*3.94*
	Rain 15	15	NA	NA	NA	0.22	1.17	0.14	0.78	0.15	1.60	0.05	0.05	NA	NA	*4.06*
2020	Rain Bluff	North Shop	1.00	1.35	1.15	0.26	0.02	0.14	0.89	0.26	0.21	0.33	0.28	0.32	6.21	*1.78*
	Rain 2	2	NA	NA	NA	0.26	0.09	0.05	1.65	0.20	0.17	0.31	0.16	NA	NA	*2.42*
	Rain 3	3	NA	NA	NA	0.00	0.01	0.05	1.06	0.62	0.16	0.27	0.19	NA	NA	*1.90*
	Rain 6	6	NA	NA	NA	0.05	0.02	0.02	0.82	0.55	0.14	0.08	0.16	NA	NA	*1.60*
	Rain 10	10	NA	NA	NA	0.11	0.02	0.13	0.79	0.14	0.14	0.16	0.09	NA	NA	*1.33*
	Rain 12	12	NA	NA	NA	0.25	0.08	0.06	0.97	0.47	0.35	0.29	0.28	NA	NA	*2.18*
	Rain 15	15	NA	NA	NA	0.32	0.01	0.05	0.65	0.87	0.28	0.09	0.44	NA	NA	*2.18*
2021	Rain Bluff	North Shop	1.13	0.21	0.46	0.04	0.04	0.20	2.17	1.31	1.13	0.86	0.20	0.92	8.67	*4.89*
	Rain 2	2	NA	NA	NA	0.00	0.03	0.16	0.99	1.09	1.04	0.93	0.00	NA	NA	*3.31*
	Rain 3	3	NA	NA	NA	0.03	0.09	0.05	0.69	1.04	1.64	1.16	0.00	NA	NA	*3.54*
	Rain 6	6	NA	NA	NA	0.02	0.06	0.03	0.83	0.19	0.47	1.05	0.00	NA	NA	*1.60*
	Rain 10	10	NA	NA	NA	0.01	0.06	0.24	2.48	1.80	0.96	0.80	0.00	NA	NA	*5.55*
	Rain 12	12	NA	NA	NA	0.00	0.08	0.22	1.58	2.08	1.24	1.01	0.00	NA	NA	*5.20*
	Rain 15	15	NA	NA	NA	0.00	0.07	0.05	1.04	2.58	1.47	1.00	0.00	NA	NA	*5.21*
2022	Rain Bluff	North Shop	--	--	0.59	0.03	0.00	1.24	3.13	4.66	1.27	1.40	0.48	0.58	13.38	*10.33*
	Rain 2	2	NA	NA	NA	0.00	0.00	1.03	3.00	3.77	1.22	1.14	0.39	NA	NA	*9.02*
	Rain 3	3	NA	NA	NA	0.00	0.00	1.03	2.99	3.07	1.18	1.19	0.54	NA	NA	*8.27*
	Rain 6	6	NA	NA	NA	0.01	0.00	0.66	2.55	3.05	0.69	0.28	0.47	NA	NA	*6.96*
	Rain 10	10	NA	NA	NA	0.00	0.00	0.69	3.57	4.27	1.02	1.83	0.33	NA	NA	*9.55*
	Rain 12	12	NA	NA	NA	0.00	0.00	0.91	3.76	4.07	1.08	1.57	0.52	NA	NA	*9.82*
	Rain 15	15	NA	NA	NA	0.00	0.01	0.91	4.06	3.84	1.12	1.68	0.50	NA	NA	*9.94*
2023	Rain Bluff	North Shop	1.21	0.50	1.64	0.05	0.55	0.13	0.03	3.16	0.33	0.57	0.42	NA	8.59	*4.25*
	Rain 2	2	NA	NA	NA	0.00	0.48	0.09	0.08	3.08	0.44	0.09	0.09	NA	NA	*4.17*
	Rain 3	3	NA	NA	NA	0.01	0.84	0.22	0.26	2.93	0.54	0.08	0.08	NA	NA	*4.80*
	Rain 6	6	NA	NA	NA	0.00	1.49	0.22	0.07	1.97	0.49	0.05	0.00	NA	NA	*4.24*
	Rain 10	10	NA	NA	NA	0.03	0.53	0.13	0.06	2.61	0.51	0.03	0.00	NA	NA	*3.87*
	Rain 12	12	NA	NA	NA	0.00	0.74	0.21	0.10	2.47	0.41	0.05	0.00	NA	NA	*3.93*
	Rain 15	15	NA	NA	NA	0.00	0.79	0.21	0.43	2.67	0.56	0.05	0.00	NA	NA	*4.66*
Window Rock, Long			0.72	0.68	0.88	0.61	0.49	0.47	1.75	2.05	1.23	1.14	0.83	0.95	11.80	*6.60*

Notes:
Long-term averages are from Window Rock, Arizona Station (029410), 1937 to 1999 (Western Regional Climate Center, 2020).
Growing season total precipitation is between April and September
NA=rain gauges taken offline due to freezing conditions, data unavailable.
-- Rain gauge malfunction
In 2017 Rain Bluff experienced power issues in the summer that may have resulted in inaccurate precipitation readings.
data incomplete

Table 3: Summary Statistics, O-VMU-1, 2019-2023

	2019	2020	2021	2022	2023	Technical Standard
Total Ground Cover (%)[1]						
Mean	62.6	64.1	55.4	55.2	64.4	≥ 52%
Standard Deviation	10.9	9	11.3	12.8	9.1	
90% Confidence Interval	2.8	2.3	2.9	3.3	2.4	
Median	--	65	56	56	65	
Nmin[2]	9	6	12	15	6	
Live Vegetation Cover (%)[3]						
Mean	38.9	38.4	17.9	36.7	47.0	None
Standard Deviation	7.5	9.8	8.5	13.0	10.2	
90% Confidence Interval	1.9	2.6	2.2	3.4	2.6	
Nmin[2]	10	19	64	36	14	
Litter Cover (%)						
Mean	23.8	25.8	37.5	18.5	17.4	None
Standard Deviation	9	8	10	9.2	6.4	
90% Confidence Interval	2.4	2.1	2.7	2.4	1.7	
Nmin[2]	41	27	22	71	39	
Perennial Vegetation Cover (%)[4]						
Mean	33.7	37.3	16.6	32.2	45.5	≥ 24%
Standard Deviation	10.2	10.3	8	13.3	10.5	
90% Confidence Interval	3	3	2	3.5	2.7	
Median	--	36	16	32	44	
Nmin[2]	26	21	67	49	16	
Annual Forage Production (lbs./ac)[5]						
Mean	882	337	171	685	771	≥ 550 lbs/ac
Standard Deviation	779	248	151	615	481	
90% Confidence Interval	203	64	39	160	125	
Median	--	305	136	526	667	
Nmin[2]	221	153	220	229	111	
Woody Plant Density (st/ac)[6] from Belt Transect						
Mean	2,158	1,769	2,089	3,220	2,414	≥ 400/ac
Standard Deviation	1,835	1,031	1,497	3,884	1,463	
90% Confidence Interval	477	268	389	1,010	381	
Median	--	1,538	1,740	2,226	2,084	
Nmin[2]	205	96	146	413	105	

Notes:
[1] Mean foliar cover of live vegetation and litter
[2] Minimum number of samples to obtain 90% probability that the sample mean is within 10% of the population mean
[3] Mean vegetation foliar cover not including noxious weeds
[4] Mean foliar cover not including annuals and noxious weeds
[5] Annual forage production in air dry pounds per acre (lbs/ac) not including annuals or noxious weeds
[6] st/ac=stems per acre
Hypothesis testing found the success standard was not met

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU-1, 2023

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)				Mean Annual Production (lbs/ac)
			All Hit Foliar	First Hit Foliar	Relative Perennial[1]	Relative Total[2]	
Cool-Season Grasses (14)							
Annuals (2)							
Bromus arvensis	Field brome	BRAR5	0.1	0.1	--	0.2	NA
Bromus tectorum	Cheatgrass	BRTE	0.5	0.4	--	1	NA
Perennials (12)							
Achnatherum hymenoides	Indian ricegrass	ACHY	2.9	2.85	5.8	5.5	33.6
Agropyron cristatum	Crested wheatgrass	AGCR	2.2	1.85	4.4	4.2	29.1
Bromus inermis	Smooth brome	BRIN2	0.5	0.5	1.0	1.0	5.7
Elymus elymoides	Bottlebrush squirreltai	ELEL5	0.5	0.25	1.0	1.0	11.3
Elymus lanceolatus	Thickspike wheatgrass	ELLA3	13.4	12.55	27.2	26.0	198.5
Elymus trachycaulus	Slender wheatgrass	ELTR7	0.3	0.2	0.5	0.5	1.4
Hesperostipa comata	Needle and threac	HECO26	2.0	1.55	4.1	3.9	23.1
Pascopyrum smithii	Western wheatgrass	PASM	8.5	7.75	17.3	16.5	132.6
Psathyrostachys juncea	Russian wildrye	PSJU3	1.2	1	2.3	2.2	19.8
Pseudoroegneria spicata	Bluebunch wheatgrass	PSSP6	0.1	0.1	0.2	0.2	3.6
Thinopyrum intermedium	Intermediate wheatgras	THIN6	0.2	0.2	0.4	0.4	13.9
Thinopyrum ponticum	Tall wheatgrass	THPO7	0.1	0.05	0.1	<0.1	NA
Warm-Season Grasses (5)							
Perennials (5)							
Bouteloua gracilis	Blue grama	BOGR2	1.2	1.15	2.4	2.3	20.9
Muhlenbergia wrightii	Spiked muhly	MUWR	0.1	0.05	0.1	<0.1	NA
Pleuraphis jamesii	James' galleta	PLJA	4.0	3.85	8.1	7.8	56.9
Sporobolus airoides	Alkali sacaton	SPAI	0.5	0.35	0.9	0.9	6.4
Sporobolus cryptandrus	Sand dropseec	SPCR	0.1	0.05	0.1	<0.1	<0.1
Forbs (13)							
Annuals (4)							
Alyssum desertorum	Desert madwor	ALDE	0.2	0.1	--	0.3	NA
Chamaesyce serpyllifolia	Thymeleaf sandma	CHSE6	0.1	0.05	--	<0.1	NA
Monarda pectinata	**Pony beebalm**	**MOPE**	**0.1**	**0.05**	**--**	**<0.1**	**NA**
Salsola tragus	Prickly Russian thistle	SATR12	1.1	1.1	--	2.1	NA
Perennials/Biennials (13)							
Bahia dissecta	Ragleaf bahia	BADI	NA	NA	NA	NA	0.6
Boerhavia gracillima	**Slimstalk spiderling**	**BOGR**	**0.2**	**0.15**	**0.4**	**0.4**	**NA**
Erigeron divergens	Spreading fleabane	ERDI4	NA	NA	NA	NA	<0.1
Erodium cicutarium	Redstem stork's bil	ERCI6	0.2	0.1	0.3	0.3	NA
Grindelia squarrosa	Curlycup gumweec	GRSQ	0.3	0.25	0.5	0.5	14.2
Heliomeris multiflora	Showy goldeneye	HEMU3	0.1	0.1	0.2	0.2	4.3
Lappula occidentalis	Flatspine stickseec	LAOC3	0.1	0.05	0.1	<0.1	<0.1
Linum lewisii	Lewis flax	LILE3	NA	NA	NA	NA	0.4
Machaeranthera canescens	Hoary tansyaste	MACA2	0.1	0.05	0.1	<0.1	NA
Medicago sativa	Alfalfa	MESA	0.4	0.3	0.7	0.7	1.7
Sphaeralcea ambigua	**Desert globemallow**	**SPAM2**	**0.1**	**0.05**	**0.1**	**<0.1**	**0.3**
Sphaeralcea coccinea	Scarlet globemallow	SPCO	0.4	0.35	0.7	0.7	3.0
Sphaeralcea incana	Gray globemallow	SPIN2	NA	NA	NA	NA	0.2

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU-1, 2023

Scientific Name	Common Name	Code	Mean Vegetation Cover (%) All Hit Foliar	First Hit Foliar	Relative Perennial[1]	Relative Total[2]	Mean Annual Production (lbs/ac)
Shrubs, Trees, and Cacti (11)							
Artemisia frigida	Prairie sagewor	ARFR4	0.3	0.2	0.5	0.5	27.7
Artemisia nova	Black sagebrush	ARNO4	0.1	0.05	0.1	<0.1	NA
Artemisia tridentata	Big sagebrush	ARTR2	0.1	0.1	0.2	0.2	NA
Atriplex canescens	Fourwing saltbush	ATCA2	6.6	6.4	13.3	12.7	97.6
Atriplex confertifolia	Shadscale saltbush	ATCO	0.1	0.05	0.1	<0.1	NA
Atriplex corrugata	Mat saltbush	ATCO4	NA	NA	NA	NA	0.6
Ericameria nauseosa	Rubber rabbitbrush	ERNA10	0.6	0.5	1.1	1.1	41.0
Gutierrezia sarothrae	Broom snakeweed	GUSA2	1.1	1	2.1	2.0	2.7
Krascheninnikovia lanata	Winterfat	KRLA2	1.5	1.25	3.0	2.8	17.4
Purshia tridentata	Antelope bitterbrush	PUTR2	0.2	0.15	0.3	0.3	NA
Senecio spartioides	**Broom-like ragwort**	**SESP3**	**0.1**	**0.05**	**0.1**	**<0.1**	**NA**
Non-Vascular Plants (1)							
MOSS	Unknown Moss Species	MOSS	0.1	0.05	--	0.2	NA
Unknown Plants (1)							
Unknown Plant	Unknown Plant	UNK	0.2	0.2	--	0.4	NA

Cover Components	
Total Ground Cover[3]	64.4
Live Vegetation Cover	47.0
Perennial Vegetation Cover	45.5
Rock	3.3
Litter	17.4
Bare Soil	31.9

Notes:

[1] Relative % perennial/biennial foliar cover divided by mean foliar cover NOT including annuals and noxious weeds using all hits

[2] Relative % foliar cover for a species divided by the mean foliar cover for all live vegetation including noxious weeds using all hits

[3] % live vegetation foliar cover plus litter using first hits

Growing season for grasses from Allred (2005)

Plant duration from USDA Plants Database

NA = species captured in either LPI or quadrats but not both

"--" = annuals not included in relative perennial cover calculations

Bolded species are newly observed on O-VMU-1 in 2023

Table 5: Relative Shrub, Tree, and Cacti Density, O-VMU-1, 2023

Scientific Name	Common Name	Code	Relative Density (%)
Artemisia frigida	Prairie sagewort	ARFR4	8.84
Artemisia ludoviciana	White sagebrush	ARLU	0.96
Artemisia nova	Black sagebrush	ARNO4	0.42
Artemisia tridentata	Big sagebrush	ARTR2	0.46
Atriplex canescens	Fourwing saltbush	ATCA2	48.74
Atriplex confertifolia	Shadscale saltbush	ATCO	0.34
Atriplex corrugata	Mat saltbush	ATCO4	2.18
Atriplex gardneri	Gardner's saltbush	ATGA	0.04
Chrysothamnus depressus	Longflower rabbitbrush	CHDE2	0.08
Ericameria nauseosa	Rubber rabbitbrush	ERNA10	5.49
Fallugia paradoxa	Apache plume	FAPA	0.04
Gutierrezia sarothrae	Broom snakeweed	GUSA2	13.33
Krascheninnikovia lanata	Winterfat	KRLA2	17.10
Lycium pallidum	**Pale desert-thorn**	**LYPA**	**0.21**
Opuntia macrorhiza	**Twistspine pricklypear**	**OPMA2**	**0.08**
Opuntia sp.	Pricklypear	OPUNT	0.08
Pinus edulis	Twoneedle pinyon	PIED	0.08
Purshia mexicana	Mexican cliffrose	PUME	0.34
Purshia tridentata	Antelope bitterbrush	PUTR2	1.13
Senecio spartioides	**Broom-like ragwort**	**SESP3**	**0.04**

Notes:

Relative Density = (avg density per species per VMU ÷ avg total shrub density per VMU) * 100

Bolded species are newly observed on O-VMU-1 in 2023

Table 6: Results for Diversity, O-VMU-1, 2023

Diversity Component	Metric	Standard	2023	
			Result	Species
Perennial Grasses	Absolute cover	≥ 7%	34.3	--
Cool-season Grasses	# Species	≥ 2	12	--
Grass 1	Relative perennial cove	≥ 5%	27.2	Thickspike wheatgrass
Grass 2	Relative perennial cove	≥ 2.5%	17.3	Western wheatgrass
Warm-season Grasses	# Species	≥ 2	5	--
Grass 1	Relative perennial cove	≥ 5%	8.1	James' galleta
All remaining species	Relative perennial cover	≥ 1.5%	3.6	--
Perennial Forbs	# Species	≥3	9	--
	Relative perennial cover	≥ 1%	3.2	--
Shrubs or Subshrubs	Relative perennial cover	≥ 6%	20.9	--
Single Shrub Species	Relative shrub density	≤ 70%	54.4	Fourwing saltbush
Any Single Species	Relative total cover	≤ 40%	26.0	Thickspike wheatgrass

Table 7: Results for Diversity, O-VMU-1, 2019-2022

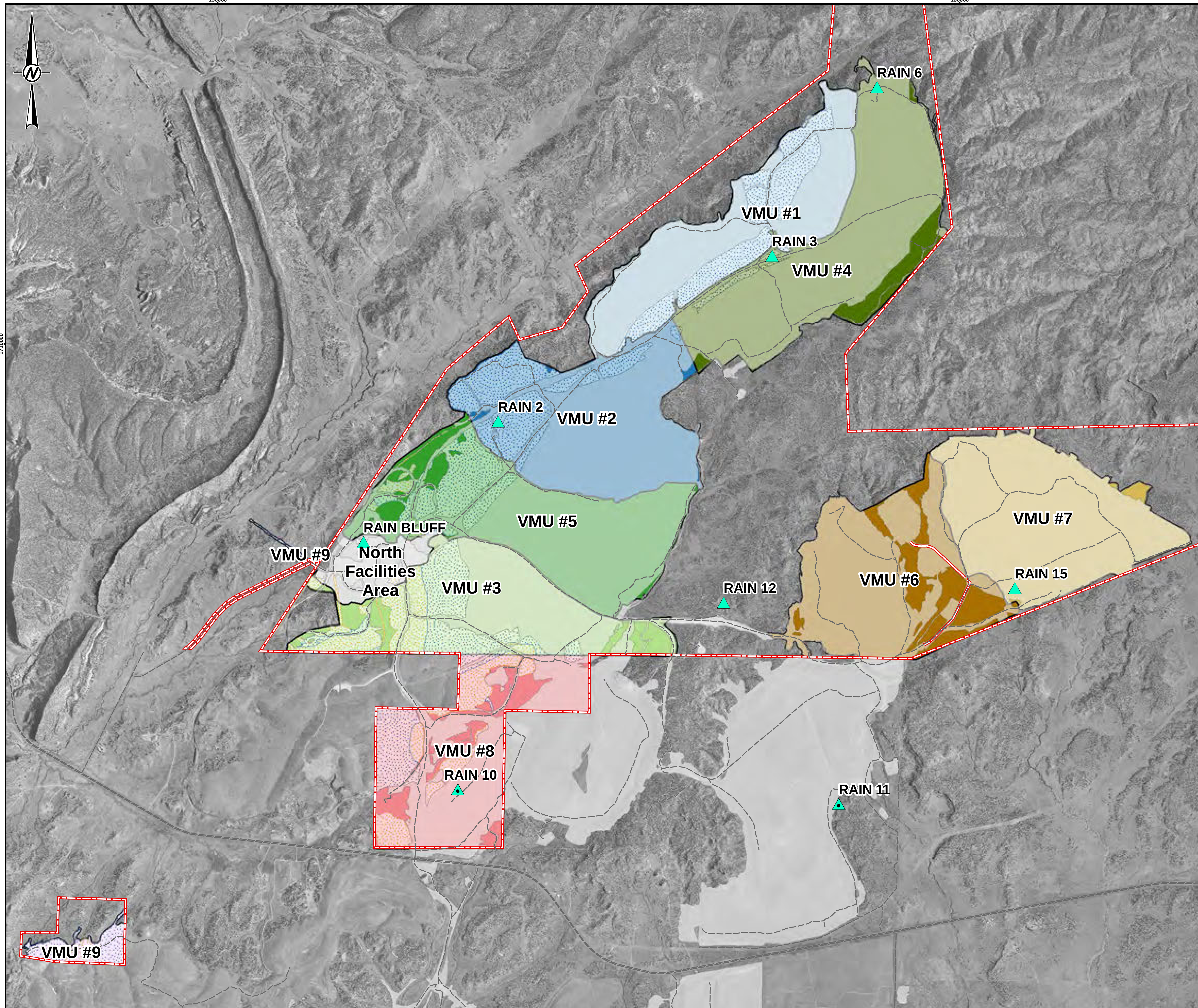
Diversity Component	Metric	Standard	2019		2020		2021		2022	
			Result	Species	Result	Species	Result	Species	Result	Species
Perennial Grasses	Total absolute cover	≥ 7%	22.8%	--	27.2%	--	7.6%	--	20.4%	--
Cool-season Grasses	# Species	≥ 2	12	--	13	--	10	--	15	--
Grass 1	Absolute cover	≥ 1.5%	6.8%	Thickspike wheatgrass	8.1%	Slender wheatgrass	3.0%	Western Wheatgrass	6.5%	Western wheatgrass
Grass 2	Absolute cover	≥ 1.5%	6.0%	Western wheatgrass	5.6%	Western Wheatgrass	1.9%	Thickspike wheatgrass	2.2%	Thickspike wheatgrass
Warm-season Grasses	# Species	≥ 2	3	--	4	--	3	--	5	--
	Total absolute cover	≥ 2.0%	2.1%	--	2.8%	--	2.7%	--	6.4%	--
Grass 1	Absolute cover	≥ 0.5%	1.1%	James' galleta	1.8%	James' galleta	1.1%	James' galleta	4.3%	James' galleta
Grass 2	Absolute cover	≥ 0.5%	0.6%	Alkali sacaton	0.7%	Blue grama	0.5%	Alkali sacaton	1.5%	Blue grama
Perennial Forbs	# Species	≥ 3	15	--	7	--	3	--	8	--
	Relative perennial cover	≥ 1%	6.8%	--	2.1%	--	2.7%	--	4.4%	--
Shrubs or Subshrubs	Total absolute cover	≥ 3%	8.6%	--	9.4%	--	6.6%	--	10.5%	--
Single Shrub Species	Relative shrub cover	≤ 70%	23.8%	Fourwing saltbush	65.2%	Fourwing saltbush	77.1%	Fourwing saltbush	80.0%	Fourwing saltbush
Any Single Species	Relative total cover	≤ 40%	17.4%	Thickspike wheatgrass	21.6%	Slender wheatgrass	28.2%	Fourwing saltbush	22.9%	Fourwing saltbush

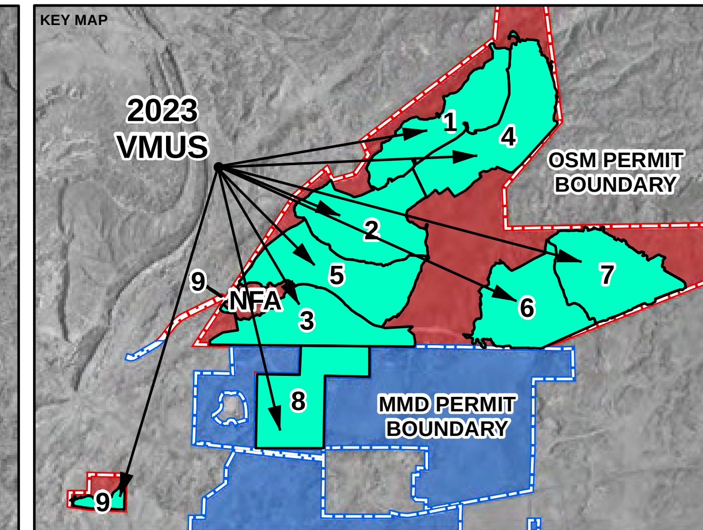
Notes:

Diversity calculated in accordance with Table 1 in either absolute or relative % cover

Success standard was not met

Figures





LEGEND

- Rain Gauges
- Mine Site Roads
- OSM Permit Boundary
- Prelaw (~ 387 acres)
- Initial Program (~ 1,248 acres)
- Permanent Program (~ 11,327 acres)
- OSM VMU 1 (~ 934 acres)
- OSM VMU 2 (~ 1,085 acres)
- OSM VMU 3 (~ 959 acres)
- OSM VMU 4 (~ 1,242 acres)
- OSM VMU 5 (~ 1,129 acres)
- OSM VMU 6 (~ 1,024 acres)
- OSM VMU 7 (~ 1,045 acres)
- OSM VMU 8 (~ 953 acres)
- OSM VMU 9 (~ 96 acres)

0 4,000 8,000

1 inch = 4,000 feet FEET

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN

REFERENCE(S)

1. ORTHOIMAGE: CHEVRON, 2013

COORDINATE SYSTEM: NAD 1927 STATEPLANE NEW MEXICO WEST FIPS 3003
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1927

CLIENT
CHEVRON ENVIRONMENTAL MANAGEMENT

PROJECT
MCKINLEY MINE - OSM PERMIT PHASE III BOND RELEASE, 2023 VEGETATION MONITORING

TITLE
GENERAL OVERVIEW OF THE MCKINLEY OSMRE PERMIT AREA VEGETATION MANAGEMENT UNITS (VMU), 2023

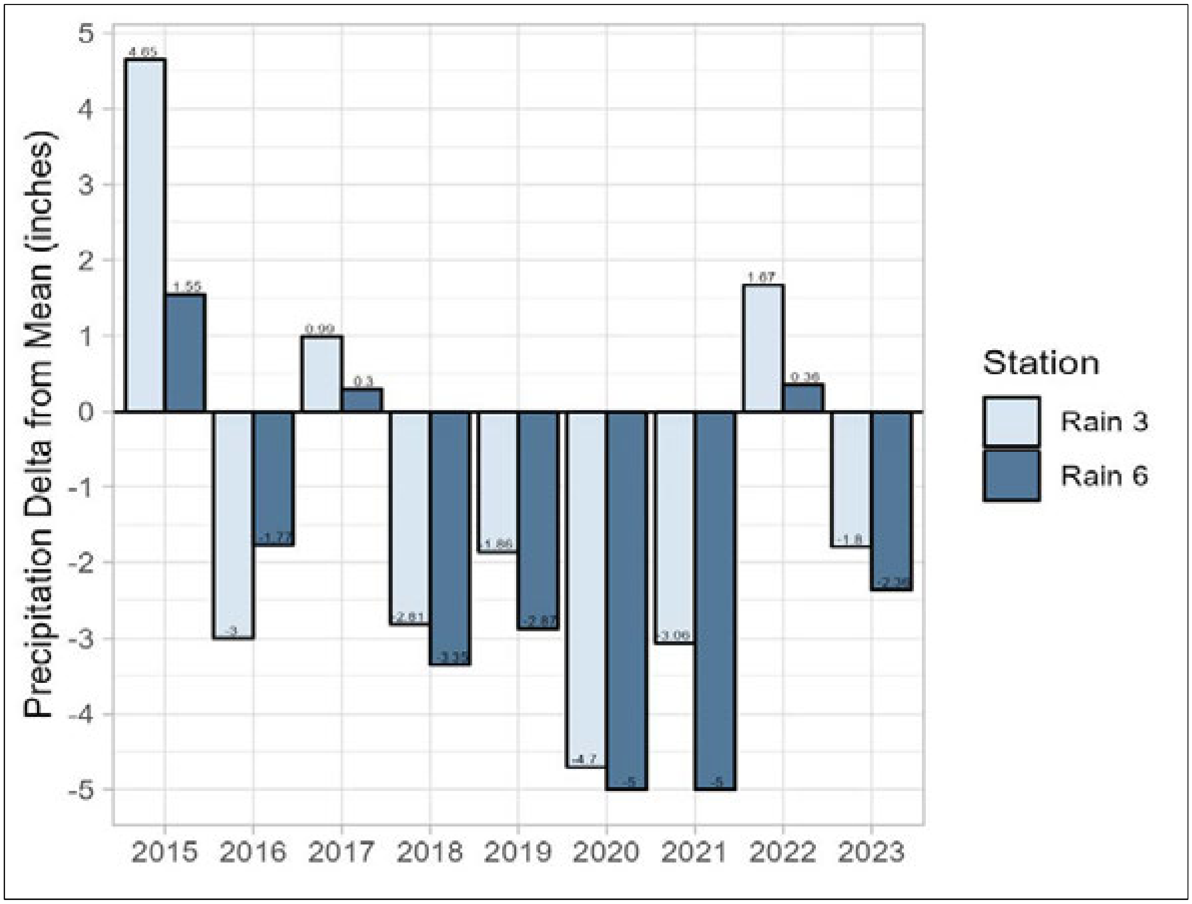
CONSULTANT

YYYY-MM-DD	2023-11-29
DESIGNED	GFD
PREPARED	GFD
REVIEWED	MR
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000	B003	0	1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Figure 2: Departure of Growing Season Precipitation from Long-Term Mean at Window Rock: Rain 3 and 6 Gauges

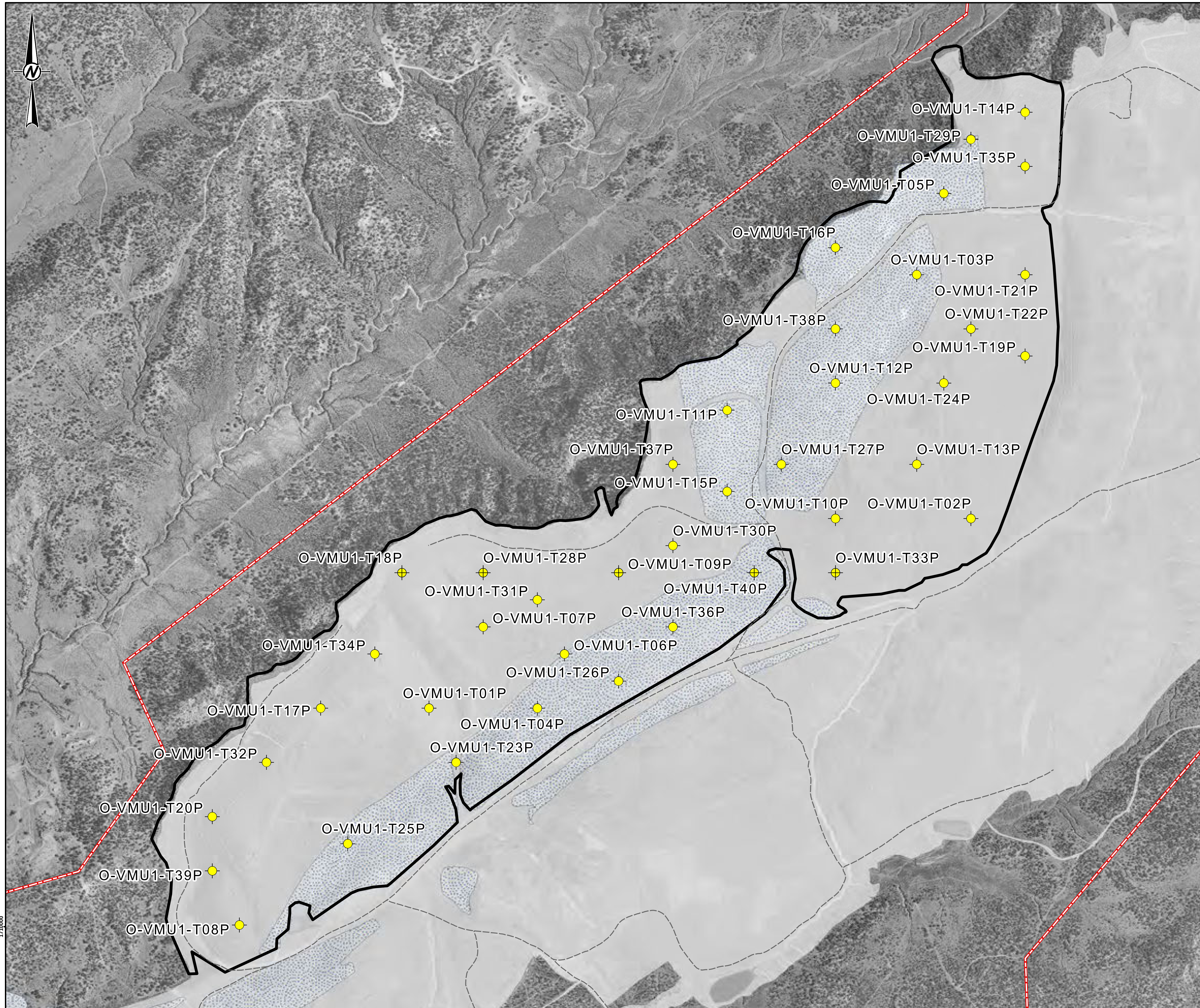


Notes:

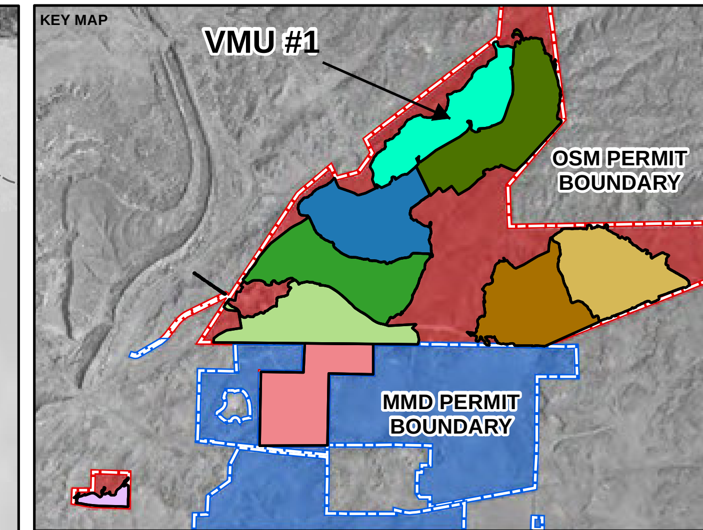
Long-term seasonal mean is from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2020).

Growing season precipitation is April through September

Source data is in Table 1



KEY MAP



LEGEND

- Primary Transect
- Alternate Transect
- Mine Site Roads
- OSM VMU 1 (~ 934 acres)
- Prelaw (~ 0 acres)
- Initial Program (~ 282 acres)
- Permanent Program (~ 639 acres)
- OSM Permit Boundary

TRANSECT LABEL EXPLANATION

O-VMU-1-T1P

- OSM Permit Area
- Vegetation Management Unit (VMU-#)
- Transect Number
- Primary (P) or Alternate (A)

0 1,200 2,400

1 inch = 1,200 feet FEET

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN
2. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS
3. TRANSECT LOCATIONS WERE CREATED IN ACCORDANCE WITH THE METHODS OUTLINED IN THE PERMIT

REFERENCE(S)

1. ORTHOIMAGE: CHEVRON, 2013

COORDINATE SYSTEM: NAD 1927 STATEPLANE NEW MEXICO WEST FIPS 3003
PROJECTION: TRANSVERSE MERCATOR
DATUM: NORTH AMERICAN 1927

CLIENT
CHEVRON ENVIRONMENTAL MANAGEMENT

PROJECT
MCKINLEY MINE - OSM PERMIT PHASE III BOND RELEASE, 2023 VEGETATION MONITORING

TITLE
VEGETATION MONITORING TRANSECTS 2023, VEGETATION MANAGEMENT UNIT (VMU) 1

CONSULTANT

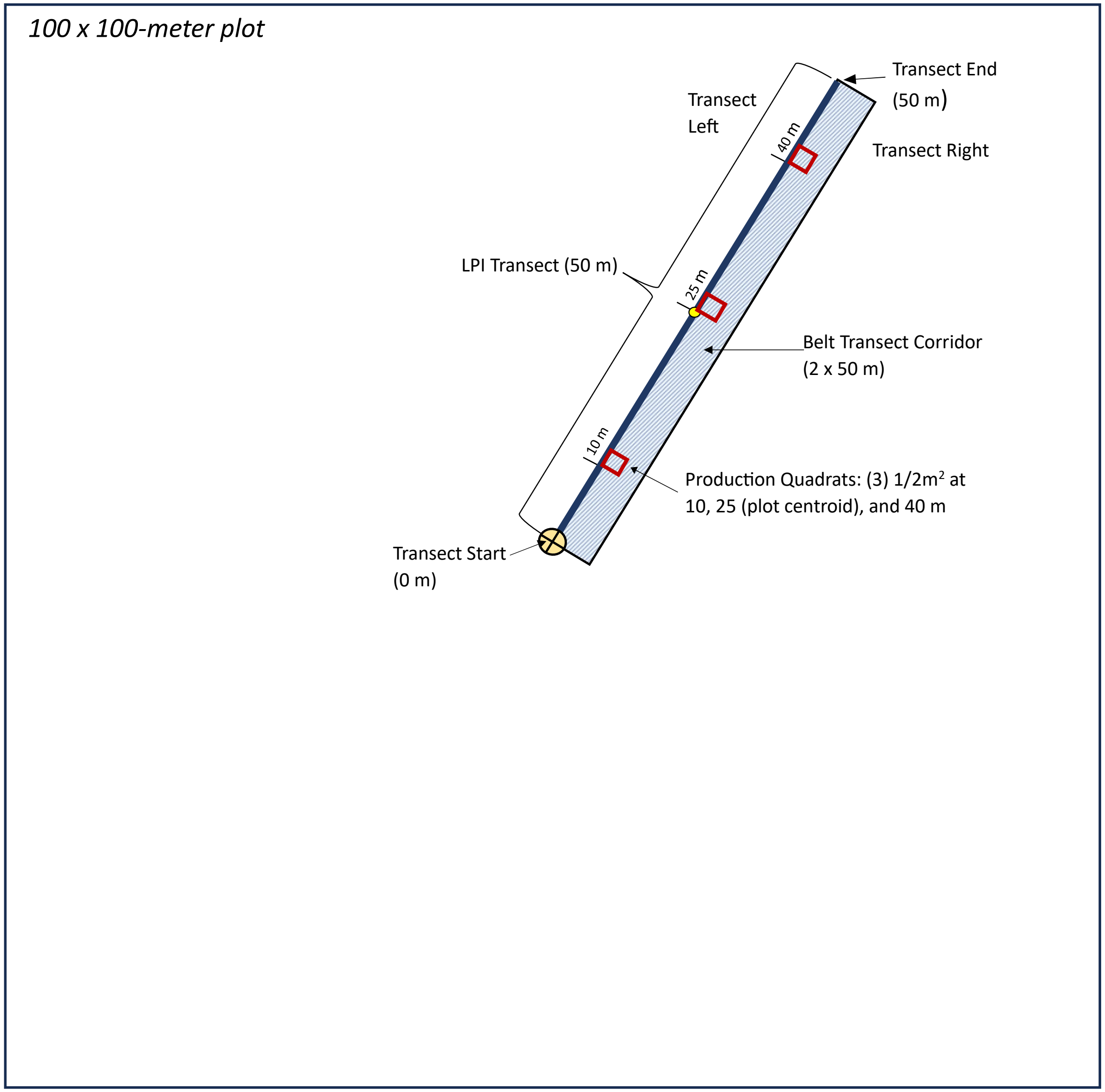
YYYY-MM-DD	2023-11-29
DESIGNED	GFD
PREPARED	GFD
REVIEWED	MR
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
31406184.000	B004	0	3

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

PATH: G:\Projects\Chevron_Environmental_Management\McKinley_Mine\99_PROJECTS\31406184000_McKinley_Onsite_Support_2023\B_2023_VegMonitoring_Surveys\02_PRODUCTION\MXD\31406184000_B004_OSM_VMU_1_2023.mxd PRINTED ON: 2023-11-29 AT: 2:16:03 PM

Figure 4: Vegetation Plot and Transect Layout



Transect start placed on plot centroid and oriented randomly (0-360 degrees)* **Not to Scale

Figure 5: Typical Grass-Shrubland Vegetation in O-VMU-1, September 2023

Figure 6: Stabilization of the Annual Forage Production, O-VMU-1, 2023

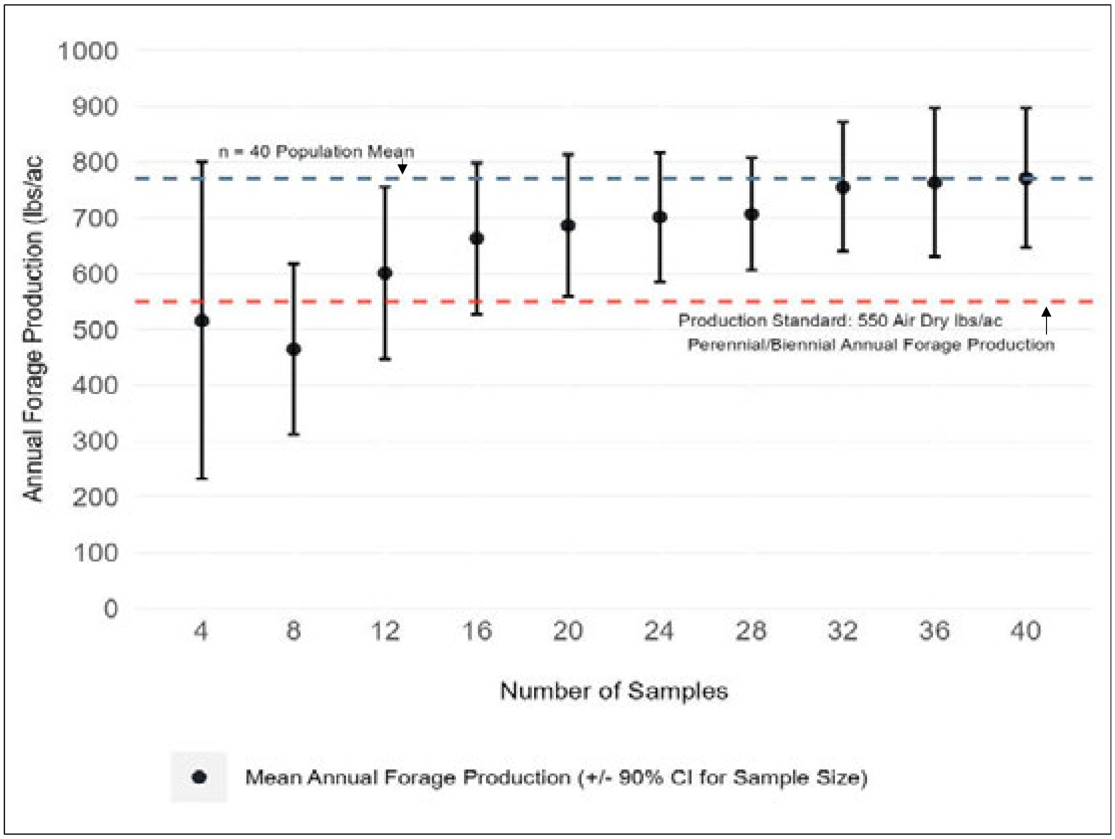
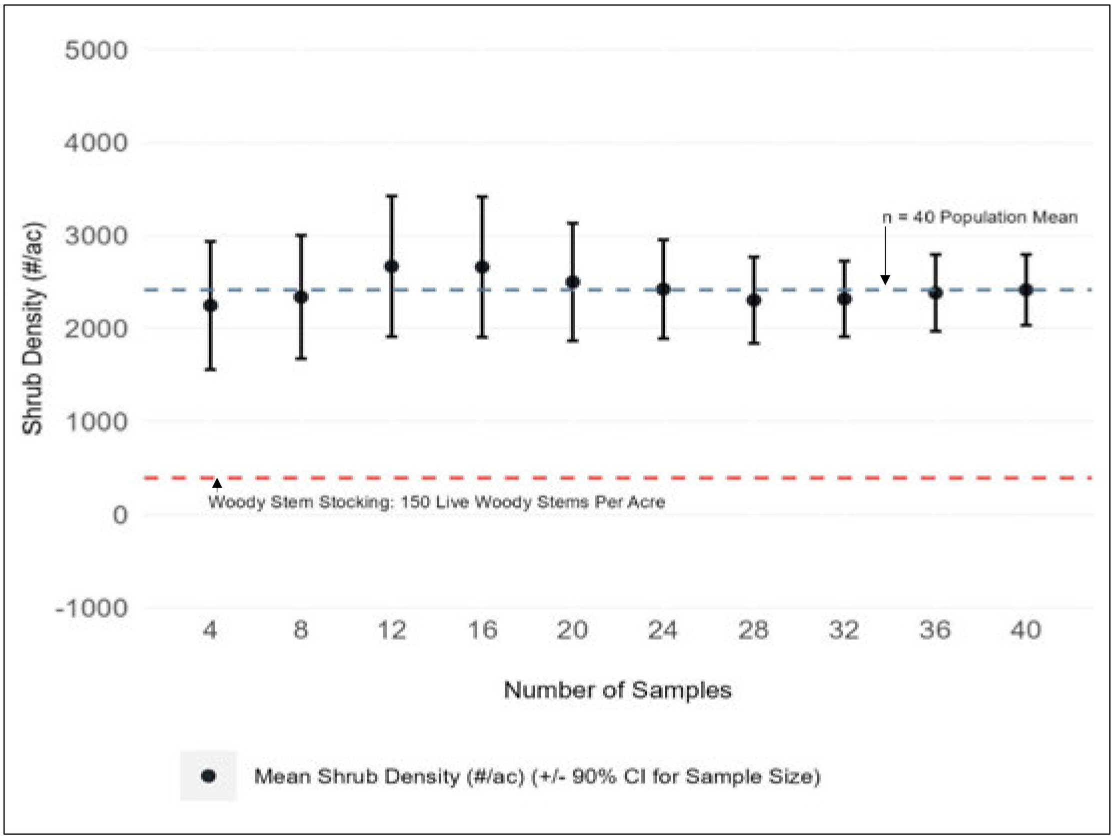


Figure 7: Stabilization of the Mean for Shrub Density, O-VMU-1, 2023



APPENDIX A

Vegetation Data Summary

Table A-1: O-VMU-1 Line Point Intercept Foliar Cover Data (first hits), 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Cool-Season Annuals																																								
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Cool-Season Perennials																																								
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AGCR	--	--	--	--	--	--	1	--	--	--	10	--	--	1	11	--	--	--	--	--	--	--	1	--	--	--	--	12	--	1	--	--	--	--	--	--	--	--	--	--
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ELEL5	--	--	1	--	1	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
ELLA3	9	16	1	17	8	2	10	1	--	3	--	4	2	17	--	1	17	14	5	2	--	1	7	15	5	3	6	3	3	26	1	6	5	15	6	2	2	--	2	14
ELTR7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--
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PASM	3	1	2	--	--	8	6	7	--	3	1	--	5	8	--	17	1	4	7	5	26	8	--	--	2	2	7	2	8	--	1	5	--	4	--	1	1	6	4	--
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SPCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
Forbs																																								
Annuals																																								
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SATR12	--	--	--	--	1	2	2	1	--	--	--	--	--	--	--	--	--	1	1	--	--	1	1	2	--	2	--	--	2	--	--	2	--	--	2	--	--	--	--	2
Perennials/Biennials																																								
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ERCI6	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
GRSQ	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	1	--	--	--	2	--	--	--	--
HEMU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--
LAOC3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
MACA2	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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ARTR2	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCA2	7	1	2	6	7	1	3	3	2	2	--	3	1	1	4	3	2	--	3	1	7	5	2	1	1	6	4	7	4	1	--	3	8	2	1	5	7	1	10	1
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA10	5	--	--	--	--	--	1	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	1
GUSA2	1	--	--	--	--	--	3	1	--	1	--	--	--	--	--	--	5	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	2	5	--	--	--	--
KRLA2	--	--	1	--	--	2	--	--	8	3	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	1	--	--	3	3	--	--	--
PUTR2	--	--	--	--	--	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--
SESP3	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Unknown Plants																																								
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Non-Vascular Plants																																								
MOSS	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																								
Total Vegetation	29	29	17	24	21	17	28	22	26	23	21	21	15	30	22	22	28	21	24	21	36	21	16	22	25	25	23	29	22	31	12	22	31	23	19	23	33	18	32	25
Live Vegetation[1]	29	29	17	24	21	17	28	22	26	23	21	21	15	30	22	22	28	21	24	21	36	21	16	22	25	25	23	29	22	31	12	22	31	23	19	21	29	17	31	25
Perennial Vegetation[2]	29	29	17	24	20	15	26	20	26	23	21	21	15	30	22	22	28	20	23	20	34	20	15	19	25	23	21	29	19	31	12	20	30	23	16	21	29	17	31	23
Rock	2	3	4	0	1	4	1	2	0	0	1	2	0	1	7	3	1	4	2	7	0	2	0	1	4	2	2	1	1	1	1	0	1	0	0	1	0	1	0	3
Litter	6	8	12	6	9	11	4	7	7	8	11	8	14	7	3	9	6	7	9	10	9	10	8	11	8	3	12	9	18	4	9	13	8	11	12	12	6	12	6	4
Bare Soil	13	10	17	20	19	18	17	19	17	19	16	19	21	12	18	16	15	18	15	12	5	17	26	16	13	20	13	11	9	14	28	15	10	16	19	14	11	19	12	18

Notes:
Species codes defined in Table A-5
[1] Live vegetation is the total vegetation foliar hits for the transect, NOT including noxious weeds
[2] Perennial vegetation is the total vegetation foliar hits for the transect, NOT including annuals and noxious weeds

Table A-2: O-VMU-1 Line Point Intercept Foliar Cover Data (all hits), 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Cool-Season Annuals																																								
BRAR5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--
BRTE	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	5	1	1	--
Cool-Season Perennials																																								
ACHY	--	--	2	1	2	1	1	--	--	4	--	4	2	1	1	--	--	1	--	6	--	4	--	--	--	--	1	2	3	1	--	2	6	--	--	1	2	4	2	3
AGCR	--	--	--	--	--	--	1	--	--	--	10	--	--	1	14	--	--	--	--	--	--	--	1	--	--	--	--	15	--	1	--	--	--	--	--	--	--	--	--	--
BRIN2	1	--	1	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--
ELEL5	--	--	3	--	1	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	2	--	1	--	1	--	--	--	--	--	--	--	--	--	--	1	--	--	--
ELLA3	10	16	2	20	9	2	12	3	--	3	--	4	2	17	--	1	19	15	5	2	--	2	7	16	5	4	6	3	3	26	2	7	5	16	6	2	2	--	2	16
ELTR7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	--	--	--	--
HECO26	--	5	4	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	1	1	--	--	13	1	--	--	1	--	11	--
PASM	3	1	2	--	--	8	6	7	1	3	1	--	5	9	--	17	1	4	7	6	30	9	--	--	2	3	8	2	9	--	1	5	1	4	--	4	3	6	4	--
PSJU3	--	--	--	--	--	--	--	--	18	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--
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Warm-Season Perennials																																								
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MUWR	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PLJA	1	3	2	--	2	--	--	7	--	3	1	8	3	--	3	--	2	--	7	--	1	--	1	--	16	8	--	--	--	--	2	2	--	--	--	--	7	--	1	2
SPAI	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	2	--	--	--	--	--	--	--	--	--	3	--	--	--	--
SPCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
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Notes:
Species codes defined in Table A-5

Table A-3: O-VMU-1 Line Point Intercept Species Associations, 2023

Lower Canopy Species	Upper Canopy Species: ACHY	ATCA2	BRIN2	BRTE	ELLA3	GUSA2	HECO26	KRLA2	LAOC3	MESA	PASM	PLJA	PSJU3	SATR12	SPAI	SPCO	UNK	Total
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Total	6	50	1	2	9	1	2	8	1	3	4	1	1	2	3	2	3	**99**

Notes:
Species codes defined in Table A-5

Table A-4: O-VMU-1 Quadrat Canopy Cover Data (%), 2023 (cont'd)

Transect	T01P			T02P			T03P			T04P			T05P			T06P			T07P			T08P			T09P			T10P			T11P			T12P			T13P			T14P			T15P			T16P			T16P			T17P			T19P			T20P		
Quadrat	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
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Cover Components																																																												
Total Vegetation Cove[1]	7.0	25.8	26.3	10.8	28.5	23.2	14.0	5.0	6.5	49.5	25.0	45.0	15.0	17.2	9.0	36.2	33.0	10.5	30.0	27.0	43.0	22.0	35.0	30.0	35.0	45.0	35.8	29.0	52.0	50.0	62.0	43.0	32.5	66.0	97.0	40.0	76.0	35.3	43.0	26.3	33.0	25.0	2.3	9.8	13.0	18.0	75.0	58.0	91.0	56.0	36.0	6.0	13.0	7.3	70.0	30.0	42.1	70.0	23.0	16.0
Rock	7.0	4.0	0.5	0.5	0.3	0.1	1.0	5.0	30.0	17.0	5.0	20.0	7.0	0.3	11.0	2.0	0.8	0.5	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	5.0	1.0	0.0	18.0	0.0	0.0	1.0	0.1	0.3	0.0	1.0	3.0	0.0	7.0	1.5	3.0	12.0	0.2	0.0	0.0	1.5	1.0	8.0	18.0	20.0	0.5	0.5	1.0	0.0	1.5	0.8
Litter	4.5	2.0	5.5	54.0	2.0	1.0	3.0	1.0	4.0	2.0	7.0	2.0	5.0	18.0	1.0	3.0	0.8	23.0	0.0	0.1	2.0	19.0	0.0	2.0	0.0	3.0	10.0	10.0	0.5	15.0	2.0	10.0	12.0	25.0	2.0	4.0	5.0	3.0	12.0	8.0	4.0	7.0	0.8	20.0	10.0	2.0	12.0	2.0	6.0	2.0	20.0	0.0	3.0	0.9	15.0	3.0	3.0	0.0	3.0	0.0
Bare Soil	81.5	68.3	67.8	34.7	69.3	75.7	82.0	89.0	59.5	31.5	63.0	33.0	73.0	64.6	79.0	58.9	65.5	66.0	70.0	72.9	45.0	59.0	65.0	68.0	65.0	52.0	54.2	61.0	47.3	30.0	35.0	47.0	37.5	9.0	1.0	55.0	19.0	61.5	45.0	64.7	60.0	68.4	90.0	68.8	74.0	68.0	12.8	40.0	3.0	40.5	43.0	86.0	66.0	71.9	14.5	66.5	53.9	30.0	72.5	83.2

Table A-4: O-VMU-1 Quadrat Canopy Cover Data (%), 2023 (cont'd)

Transect	T21P			T22P			T23P			T24P			T25P			T26P			T27P			T28P			T29P			T30P		
Quadrat	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Grasses																														
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ELLA3	--	--	--	--	15.0	37.0	20.0	6.5	8.5	25.0	26.0	--	--	--	10.0	--	35.5	--	--	--	--	--	--	--	--	0.5	21.0	55.0	27.0	13.0
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Cover Components																														
Total Vegetation Cover[1]	90.0	30.0	50.0	33.0	32.0	62.0	20.0	8.0	8.5	25.0	26.0	38.0	45.0	8.0	24.0	5.0	35.5	27.1	40.0	20.0	65.0	49.0	19.0	31.5	80.0	65.0	70.0	60.0	38.0	13.0
Rock	0.0	0.5	0.5	1.0	1.5	1.0	0.5	0.0	0.8	1.0	1.0	0.5	0.0	15.0	0.5	25.0	6.0	0.3	0.1	1.0	0.0	0.0	0.3	0.0	0.0	2.0	3.0	0.0	0.1	8.0
Litter	10.0	35.0	40.0	12.0	1.5	3.0	55.0	7.0	1.0	8.0	1.5	6.0	8.0	2.0	0.0	1.3	2.0	1.3	10.0	14.0	35.0	0.1	1.0	12.0	18.0	6.0	1.0	35.0	0.1	5.0
Bare Soil	0.0	34.5	9.5	54.0	65.0	34.0	24.5	85.0	89.8	66.0	71.5	55.5	47.0	75.0	75.5	68.8	56.5	71.4	49.9	65.0	0.0	50.9	79.8	56.5	2.0	27.0	26.0	5.0	61.9	74.0

Transect	T33P			T32P			T33P			T34P			T35P			T36P			T36P			T37P			T39P			T40P		
Quadrat	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Grasses																														
Cool-Season Annuals																														
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BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.0	--	4.0	9.0	10.0	0.1	--	--	10.0	--	--	0.0	--	--	--
Cool-Season Perennials																														
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ELLA3	--	--	0.0	11.0	31.0	--	--	--	14.0	32.0	--	20.0	9.0	25.0	--	--	--	26.0	--	--	--	--	--	--	20.0	--	--	--	37.0	12.0
ELTR7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	--	--	27.0	4.0	--	--	7.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30.0	--	--	--	--
PASM	--	3.0	--	11.5	--	--	--	--	--	--	20.0	--	2.0	--	--	1.5	--	--	10.0	--	13.0	--	5.0	--	0.9	0.1	13.0	3.0	--	2.0
PSJU3	35.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Warm-Season Annuals																														
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Warm-Season Perennials																														
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CHSE6	--	--	0.0	0.3	--	--	--	--	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	0.0	--	--	--	--	--
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SATR12	--	--	0.8	3.8	2.1	--	--	0.1	--	--	--	--	10.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.5	--	1.0
SCMU6	--	--	--	--	--	--	--	--	--	0.3	0.0	--	--	--	--	--	--	--	--	--	--	--	--	0.3	0.0	--	--	--	--	--
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Perennials/Biennials																														
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Shrubs, Trees, and Cacti																														
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ATCA2	--	--	--	--	--	--	--	--	--	--	--	6.0	--	--	--	--	--	--	--	46.0	--	--	37.0	--	0.0	--	11.0	--	--	--
ATCO4	--	--	--	--	3.5	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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AMARA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Non-Vascular Plants																														
MOSS	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--
Cover Components																														
Total Vegetation Cover[1]	36.8	17.0	0.8	26.0	34.8	36.0	27.0	32.0	15.0	32.0	48.0	24.0	21.0	47.0	90.0	8.5	0.0	30.0	63.0	96.0	42.0	12.0	50.0	20.0	25.0	30.0	24.0	15.5	37.0	16.0
Rock	0.0	0.0	0.0	0.2	2.0	5.0	0.3	0.3	5.0	0.3	0.0	0.0	2.0	0.5	0.1	0.5	0.1	0.1	0.0	0.0	0.5	5.0	0.5	0.0	0.0	0.0	0.0	0.0	0.1	25.0
Litter	0.0	35.0	0.3	43.0	0.5	23.0	0.5	0.3	0.5	3.5	2.0	35.0	4.0	10.0	2.0	8.0	2.0	25.0	20.0	4.0	2.0	4.0	5.0	3.0	0.5	0.8	6.0	0.0	0.1	1.0
Bare Soil	63.3	48.0	99.0	30.9	62.8	36.0	72.3	67.5	79.5	64.3	50.0	41.0	73.0	42.5	8.0	83.0	98.0	45.0	17.0	0.0	55.5	79.0	44.5	77.0	74.5	69.3	70.0	84.5	62.9	60.0

Notes:
Species codes defined in Table A-5
[1]Total vegetation canopy cover for the transect by the quadrat canopy cover estimate method

Table A-5: O-VMU-1 Air-dry Aboveground Annual Forage Production Data, 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Perennial Grasses																																								
Cool-Season																																								
ACHY	--	--	--	--	--	--	20	--	--	--	--	--	16	2	0	5	4	--	--	6	--	20	--	19	16	--	15	--	86	--	--	--	--	--	--	--	--	18	--	--
AGCR	--	--	--	--	--	--	--	--	--	--	62	--	--	--	50	--	--	--	--	--	--	--	--	--	--	42	--	42	--	--	--	--	1	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	36	--	--	--	--	--
ELEL5	--	--	--	--	--	--	--	1	--	6	--	13	--	--	--	--	--	--	--	--	--	26	--	--	--	--	31	--	--	--	--	--	--	--	--	--	--	--	--	--
ELLA3	17	47	--	68	37	--	46	15	--	18	--	--	59	104	--	--	59	20	48	30	--	68	74	69	13	38	--	--	26	179	1	49	8	50	89	14	--	--	14	76
ELTR7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	24	2	--	--	--	--	--	--	--	--	--	--	3	--	8	29	--	--	23	--	--	--	3	--	--	--	--	--	11	--	--	3	3	--	--	--	--	47	--
PASM	15	--	17	30	12	44	34	42	--	5	6	16	20	7	--	75	4	3	85	53	154	--	1	--	9	2	44	89	12	--	7	20	--	33	3	1	22	4	15	11
PSJU3	--	--	--	--	--	--	--	--	67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	64	--	--	--	--	--	--	--	--	--
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THIN6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19	--	4	--	--	18	--	--
Warm-Season																																								
BOGR2	--	6	--	--	--	--	--	--	--	32	40	14	--	--	9	--	10	0	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	16	--	12	--	--	--
PLJA	--	--	8	--	--	--	--	13	0	39	1	80	59	--	--	--	31	--	--	--	68	--	--	--	33	--	--	--	48	--	2	--	--	--	--	--	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	43	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Perennial/Biennial Forbs																																								
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HEMU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	10	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LAOC3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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SPIN2	--	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
Shrubs, Trees, and Cacti																																								
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ATCA2	--	--	2	38	--	--	--	--	--	19	--	85	--	1	5	44	--	0	35	52	--	2	2	--	--	--	68	--	169	--	--	--	--	7	--	--	39	86	4	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--
ERNA10	34	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	238	--	--	--	--	4
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KRLA2	--	--	--	31	--	--	--	--	44	40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--
Total Air-dry Aboveground Annual Forage Production																																								
Total (g)	66	85	29	167	50	44	114	71	110	159	110	208	154	116	92	210	137	27	197	164	222	126	80	94	123	82	160	132	341	215	108	74	31	108	397	18	265	128	83	92
Total (lbs/ac)	392	507	174	991	297	259	677	424	656	942	654	1,240	912	691	547	1,248	812	157	1,172	976	1,321	747	478	557	733	487	950	787	2,026	1,278	640	439	184	644	2,364	110	1,576	761	492	545

Notes:
Species codes defined in Table A-5
Total (g) is the total of all three .5 m^2 quads (1.5 m^2 total) per transect
Lbs/ac=total grams÷1.5*(4046.86/453.592)
Non-forage and forage determinations are based on the permit (e.g. plants of perennial and/or biennial duration are forage and plants of annual duration are non-forage; noxious weeds are non-forage)

Table A-6: O-VMU-1 Shrub Belt Transect Data (frequency), 2023

Transect	T01P	T02P	T03P	T04P	T05P	T06P	T07P	T08P	T09P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P
Shrubs, Trees, and Cacti																				
ARFR4	--	3	--	--	--	--	--	--	--	5	--	--	10	--	--	125	--	--	1	--
ARLU	1	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--
ARNO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
ARTR2	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--
ATCA2	20	18	40	43	85	19	10	11	12	40	1	49	26	16	15	39	11	6	26	70
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	1
ATCO4	--	--	1	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHDE2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA10	26	--	4	--	7	3	7	3	--	--	1	3	--	--	1	--	--	10	--	--
FAPA	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--
GUSA2	1	4	1	--	2	1	60	10	--	24	--	6	9	1	2	2	50	--	--	--
KRLA2	--	--	15	38	1	8	--	--	106	62	3	9	--	--	7	--	--	2	--	--
LYPA	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--
OPMA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OPUNT	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PIED	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PUME	--	4	--	--	--	--	--	1	--	--	--	--	--	--	--	--	2	--	--	--
PUTR2	--	2	--	--	--	1	--	1	--	--	--	--	--	2	--	--	1	--	--	--
SESP3	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	48	32	61	81	105	32	77	26	118	136	8	67	46	24	25	166	66	19	27	71

Transect	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Shrubs, Trees, and Cacti																				
ARFR4	--	15	--	34	--	--	1	--	--	4	--	--	--	--	--	--	13	--	--	--
ARLU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--
ARNO4	--	--	5	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--
ARTR2	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--
ATCA2	35	16	33	10	29	30	28	48	59	5	2	11	54	21	4	69	25	46	65	16
ATCO	--	--	--	--	--	--	--	--	--	--	--	3	1	--	1	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	40	--	1	--	--	--	--	--	--
ATGA	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
CHDE2	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	1	--	--
ERNA10	--	--	7	3	8	--	--	--	6	5	--	--	--	--	19	3	--	2	--	13
FAPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA2	--	6	21	5	--	--	--	--	--	15	5	--	7	--	19	55	10	1	1	--
KRLA2	--	4	--	1	2	9	--	1	--	--	57	--	4	--	--	29	49	--	--	1
LYPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OPMA2	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	1	--	--	--
OPUNT	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
PIED	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PUME	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
PUTR2	--	1	--	--	--	--	--	--	--	19	--	--	--	--	--	--	--	--	--	--
SESP3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	35	47	66	53	40	39	29	50	66	48	69	55	66	22	43	156	98	72	67	30

Notes:
Species codes defined in Table A-5
The shrub belt transect area is 100m^2 (2mx50m); shrubs rooted in the belt transect were counted on an individual basis

Table A-7: Species Observed 2019-2023, O-VMU-1

Common Name	Scientific Name	Code
Cool-Season Grasses (26)		
Annuals (3)		
Field brome	*Bromus arvensis*	BRAR5
Cheatgrass	*Bromus tectorum*	BRTE
Common barley	*Hordeum vulgare*	HOVU
Perennials (23)		
Indian ricegrass	*Achnatherum hymenoides*	ACHY
Columbia needlegrass	*Achnatherum nelsonii*	ACNE9
Crested wheatgrass	*Agropyron cristatum*	AGCR
Purple threeawn	*Aristida purpurea*	ARPU
Smooth brome	*Bromus inermis*	BRIN2
Canada wildrye	*Elymus canadensis*	ELCA4
Bottlebrush squirreltail	*Elymus elymoides*	ELEL5
Blue wildrye	*Elymus glaucus*	ELGL
Thickspike wheatgrass	*Elymus lanceolatus*	ELLA3
Streambank wheatgrass	*Elymus lanceolatus* ssp. *psammophilus*	ELLAP
Slender wheatgrass	*Elymus trachycaulus*	ELTR7
Rocky Mountain fescue	*Festuca saximontana*	FESA
Needle and thread	*Hesperostipa comata*	HECO26
Foxtail barley	*Hordeum jubatum*	HOJU
Colorado wildrye	*Leymus ambiguus*	LEAM
Basin wildrye	*Leymus cinereus*	LECI4
Western wheatgrass	*Pascopyrum smithii*	PASM
Timothy	*Phleum pratense*	PHPR
Sandberg bluegrass	*Poa secunda*	POSE
Russian wildrye	*Psathyrostachys juncea*	PSJU3
Bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSP6
Intermediate wheatgrass	*Thinopyrum intermedium*	THIN6
Tall wheatgrass	*Thinopyrum ponticum*	THPO7
Warm-Season Grasses (14)		
Annuals (2)		
Matted grama	*Bouteloua simplex*	BOSI2
False buffalograss	*Munroa squarrosa*	MUSQ3
Perennials (12)		
Sideoats grama	*Bouteloua curtipendula*	BOCU
Buffalograss	*Bouteloua dactyloides*	BODA2
Blue grama	*Bouteloua gracilis*	BOGR2
Hairy grama	*Bouteloua hirusta*	BOHI2
Saltgrass	*Distichlis spicata*	DISP
Tufted lovegrass	*Eragrostis pectinacea*	ERPE
Spike muhly	*Muhlenbergia wrightii*	MUWR
Switchgrass	*Panicum virgatum*	PAVI2
James' galleta	*Pleuraphis jamesii*	PLJA
Tabosa	*Pleuraphis mutica*	PLMU3
Alkali sacaton	*Sporobolus airoides*	SPAI
Sand dropseed	*Sporobolus cryptandrus*	SPCR
Forbs (82)		
Annuals (28)		
Desert madwort	*Alyssum desertorum*	ALDE
Alyssum	*Alyssum simplex*	ALSI8
Redroot amaranth	***Amaranthus retroflexus***	**AMRE**
Burningbush	***Bassia scoparia***	**BASC5**
Shepherd's purse	***Capsella bursa-pastoris***	**CABU2**
Ribseed sandmat	*Chamaesyce glyptosperma*	CHGL13
Spotted sandmat	*Chamaesyce maculata*	CHMA15
Thymeleaf spurge	*Chamaesyce serpyllifolia*	CHSE6
Narrowleaf goosefoot	*Chenopodium leptophyllum*	CHLE4
New Mexico goosefoot	*Chenopodium neomexicanum*	CHNE
Lambsquarters	*Chenopodium album*	CHAL7
Wright's bird's beak	*Cordylanthus wrightii*	COWR2
Fetid goosefoot	*Dysphania graveolens*	DYGR
Fetid marigold	*Dyssodia papposa*	DYPA
Nodding buckwheat	*Eriogonum cernuum*	ERCE2
Common sunflower	*Helianthus annuus*	HEAN3
Prairie sunflower	*Helianthus petiolaris*	HEPE
Longleaf false goldeneye	*Heliomeris longifolia*	HELO6
Burningbush	*Kochia scoparia*	KOSC
Fendler's desertdandelion	*Malacothrix fendleri*	MAFE
Pony beebalm	***Monarda pectinata***	**MOPE**
Erect knotweed	*Polygonum erectum*	POER2
Little hogweed	*Portulaca oleracea*	POOL
Russian thistle	*Salsola tragus*	SATR12
Lanceleaf sage	*Salvia reflexa*	SARE3
Manyflower false threadleaf	*Schkuhria multiflora*	SCMU6
Unknown annual forb	*Unknown Annual Forb*	UNKAF
Golden crownbeard	*Verbesina encelioides*	VEEN

Table A-7: Species Observed 2019-2023, O-VMU-1

Common Name	Scientific Name	Code
	Perennials/Biennials (54)	
Common yarrow	*Achillea millefolium*	ACMI2
Nodding onion	*Allium cernuum*	ALCE2
Sagewort	*Artemisia cana*	ARCA14
Horsetail milkweed	*Asclepias subverticillata*	ASSU2
Halfmoon milkvetch	*Astragalus allochrous*	ASAL6
Ragleaf bahia	*Bahia dissecta*	BADI
Slimstalk spiderling	***Boerhavia gracillima***	**BOGR**
Sego lily	*Calochortus nuttallii*	CANU3
Musk thistle	*Carduus nutans*	CANU4
Wyoming Indian paintbrush	*Castilleja linariifolia*	CALI4
Rose heath	*Chaetopappa ericoides*	CHER
Horseweed	*Conyza canadensis*	COCA
Western tansymustard	*Descurainia pinnata*	DEPI
Flixweed	*Descurainia sophia*	DESO
Spreading fleabane	*Erigeron divergens*	ERDI4
Trailing fleabane	*Erigeron flagellaris*	ERFL
Bastardsage	*Eriogonum wrightii*	ERWR
Redstem stork's bill	*Erodium cicutarium*	ERCI6
Sanddune wallflower	*Erysimum capitatum*	ERCA14
Blanketflower	*Gaillardia aristata*	GAAR
Indian blanket	*Gaillardia pulchella*	GAPU
Hairy gumweed	*Grindelia hirsutula*	GRHI
Curlytop gumweed	*Grindelia nuda* var. *aphanactis*	GRNUA
Curly-cup gumweed	*Grindelia squarrosa*	GRSQ
Showy goldeneye	*Heliomeris multiflora*	HEMU3
Scarlet gilia	*Ipomopsis aggregata*	IPAG
Flaxflowered ipomopsis	*Ipomopsis longiflora*	IPLO
Manyflowered ipomopsis	*Ipomopsis multiflora*	IPMU
Prickly lettuce	*Lactuca serriola*	LASE
Flatspine stickseed	*Lappula occidentalis*	LAOC3
Lewis flax	*Linum lewisii*	LILE3
Purple aster	*Machaeranthera canescens*	MACA2
Tanseyleaf tansyaster	*Machaeranthera tanacetifolia*	MATA
Horehound	*Marrubium vulgare*	MAVU
Alfalfa	*Medicago sativa*	MESA
Yellow sweetclover	*Melilotus officinalis*	MEOF
Narrowleaf four-o'clock	*Mirabilis linearis*	MILI
Colorado four o'clock	*Mirabilis multiflora*	MIMU
Beardlip penstemon	*Penstemon barbatus*	PEBA2
Palmer's penstemon	*Penstemon palmeri*	PEPA8
Prostrate knotweed	*Polygonum aviculare*	POAV
Upright prairie coneflower	*Ratibida columnifera*	RACO3
Curly dock	*Rumex crispus*	RUCR
Slimleaf plainsmustard	***Schoenocrambe linearifolia***	**SCLI12**
Tall tumblemustard	*Sisymbrium altissimum*	SIAL2
Desert globemallow	***Sphaeralcea ambigua***	**SPAM2**
Scarlet globemallow	*Sphaeralcea coccinea*	SPCO
Gooseberryleaf globemallow	*Sphaeralcea grossulariifolia*	SPGR2
Gray globemallow	*Sphaeralcea incana*	SPIN2
Small-leaf globemallow	*Sphaeralcea parvifolia*	SPPA2
Ives' fournerved daisy	*Tetraneuris ivesiana*	TEIV
Yellow salsify	*Tragopogon dubius*	TRDU
Salsify	*Tragopogon porrifolius*	TRPO
Jack-go-to-bed-at-noon	*Tragopogon pratensis*	TRPR

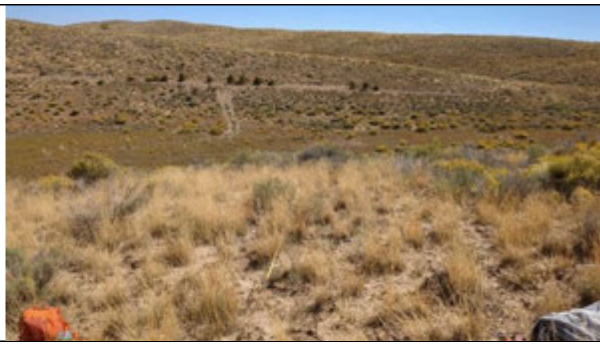
Table A-7: Species Observed 2019-2023, O-VMU-1

Common Name	Scientific Name	Code
Shrubs, Trees, and Cacti (44)		
Tarragon	*Artemisia dracunculus*	ARDR4
Prairie sagewort	*Artemisia frigida*	ARFR4
White sagebrush	*Artemisia ludoviciana*	ARLU
Black sagebrush	*Artemisia nova*	ARNO4
Big sagebrush	*Artemisia tridentata*	ARTR2
Fourwing saltbush	*Atriplex canescens*	ATCA2
Shadscale saltbush	*Atriplex confertifolia*	ATCO
Mat saltbush	*Atriplex corrugata*	ATCO4
Gardner's saltbush	*Atriplex gardneri*	ATGA
Mound saltbush	*Atriplex obovata*	ATOB
Mountain mahogany	*Cercocarpus montanus*	CEMO
Longflower rabbitbrush	*Chrysothamnus depressus*	CHDE2
Greene's rabbitbrush	*Chrysothamnus greenei*	CHGR6
Yellow rabbitbrush	*Chrysothamnus viscidiflorus*	CHVI
Pinkflower hedgehog cactus	*Echinocereus fendleri*	ECFE
Mormon tea	*Ephedra viridis*	EPVI
Rubber rabbitbrush	*Ericameria nauseosa*	ERNA10
Slender buckwheat	*Eriogonum microthecum*	ERMI4
Apache plume	*Fallugia paradoxa*	FAPA
Stretchberry	*Forestiera pubescens* var. *pubescens*	FOPUP
Broom snakeweed	*Gutierrezia sarothrae*	GUSA2
Hairy false goldenaster	*Heterotheca villosa*	HEVI
Oneseed juniper	*Juniperus monosperma*	JUMO
Winterfat	*Krascheninnikovia lanata*	KRLA2
Pale desert-thorn	***Lycium pallidum***	**LYPA**
Torrey wolfberry	*Lycium torreyi*	LYTO
Twistspine pricklypear	***Opuntia macrorhiza***	**OPMA2**
Plains pricklypear	*Opuntia polyacantha*	OPPO
Piñon pine	*Pinus edulis*	PIED
Ponderosa pine	*Pinus ponderosa*	PIPO
Cottonwood	*Populus deltoides*	PODE
Mexican cliffrose	*Purshia mexicana*	PUME
Antelope bitterbrush	*Purshia tridentata*	PUTR2
Skunkbush sumac	*Rhus trilobata*	RHTR
Wax currant	*Ribes cereum*	RICE
Woods' rose	*Rosa woodsii*	ROWO
Narrowleaf willow	*Salix exigua*	SAEX
Threadleaf groundsel	*Senecio flaccidus*	SEFL3
Broom-like ragwort	***Senecio spartioides***	**SESP3**
Saltcedar	*Tamarix ramosissima*	TARA
Gray horsebrush	*Tetradymia canescens*	TECA
Siberian elm	*Ulmus pumila*	ULPU
Banana yucca	*Yucca baccata*	YUBA
Soapweed yucca	*Yucca glauca*	YUGL

Notes:
Bold species are newly observed on O-VMU-1 in 2023

APPENDIX B

Quadrat Photographs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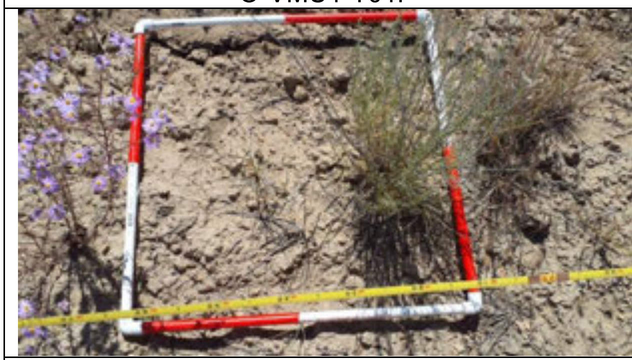	
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	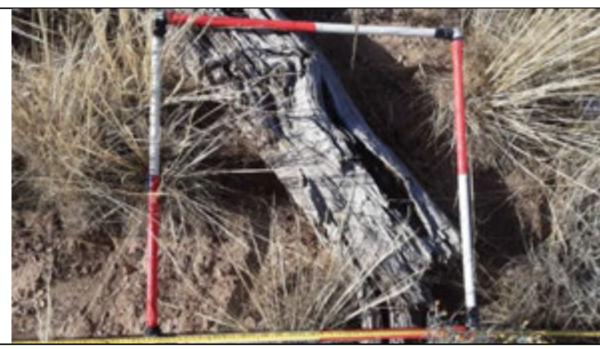
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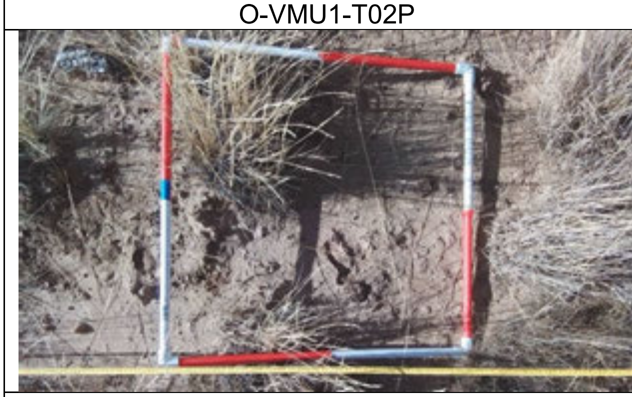	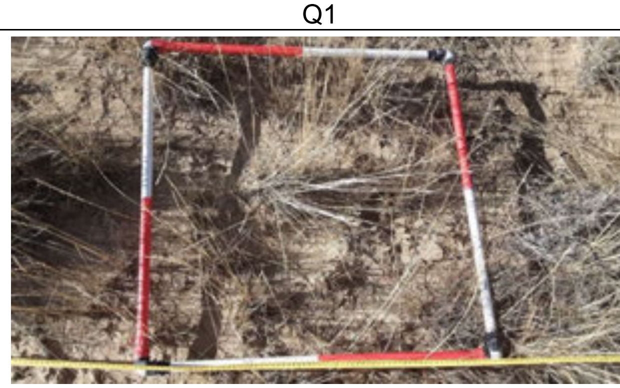
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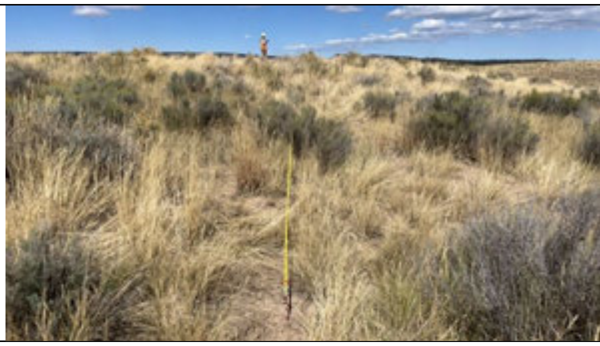	
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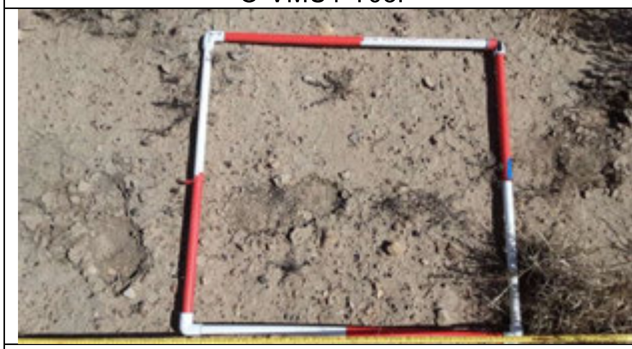	
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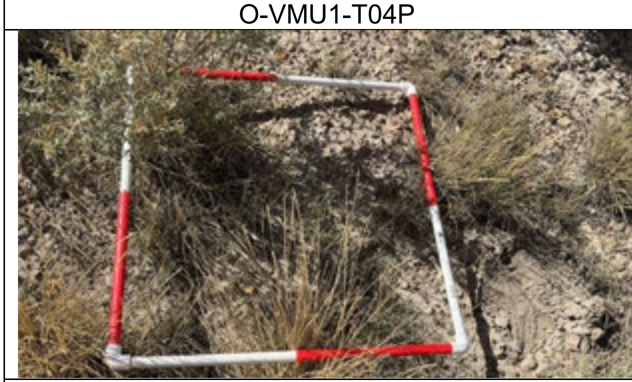	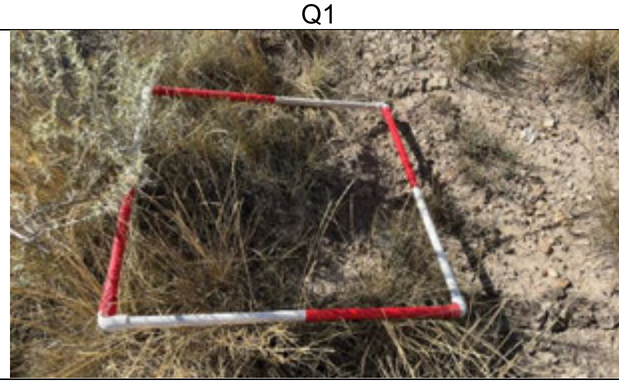
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	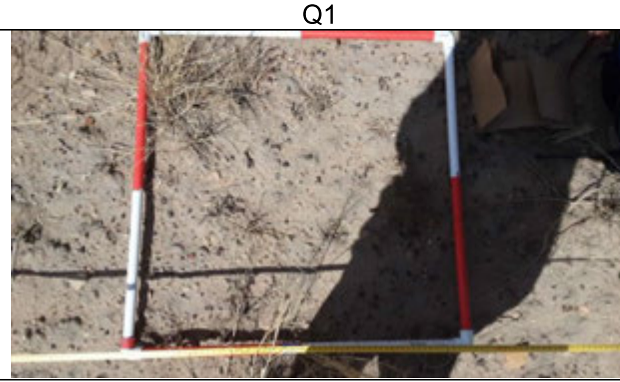
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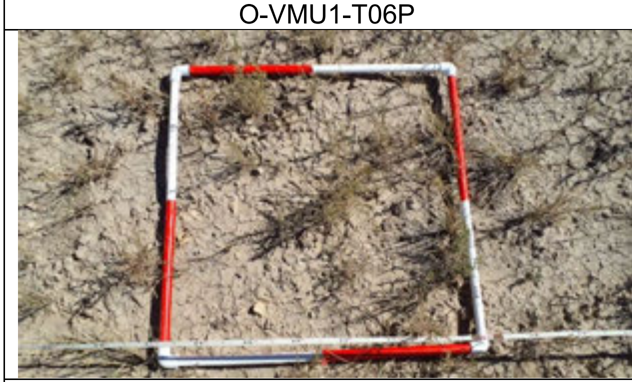	
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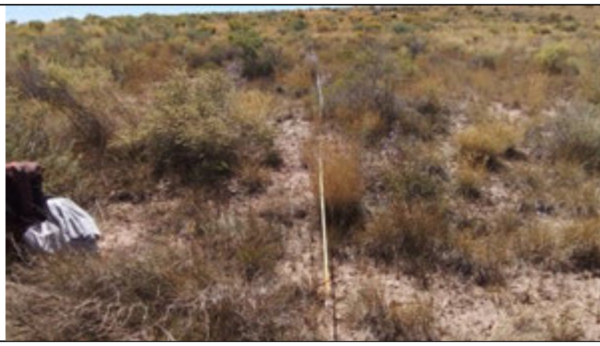

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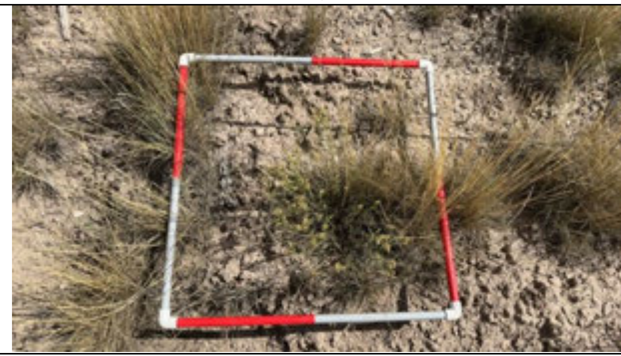

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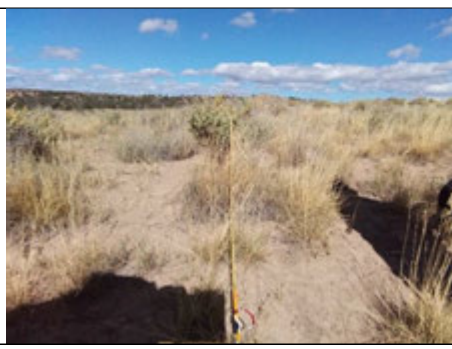

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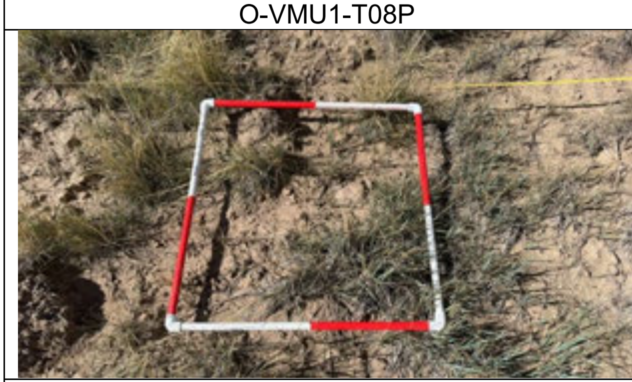

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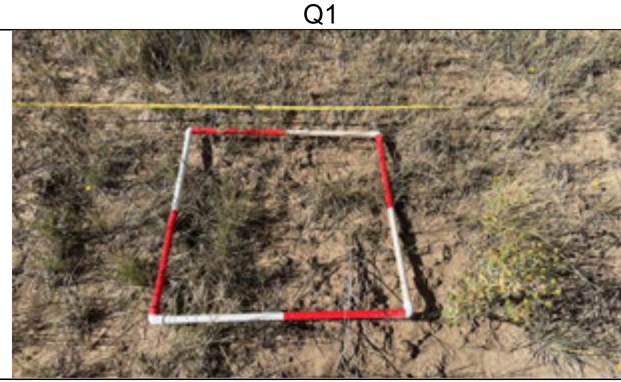

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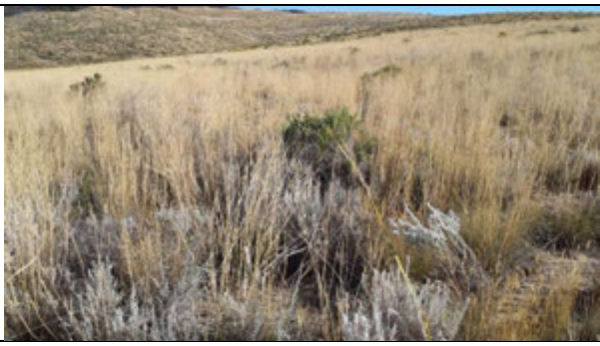
<tr><td></td><td></td></tr>
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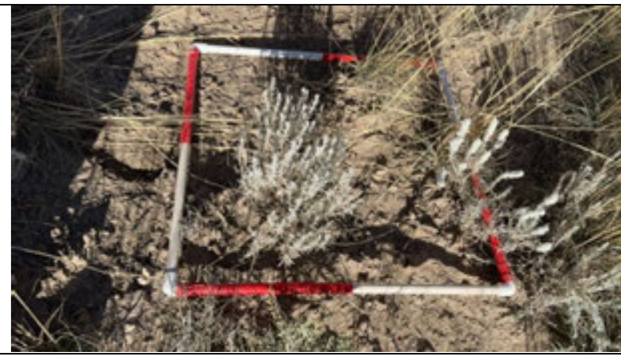
<tr><td></td><td></td></tr>
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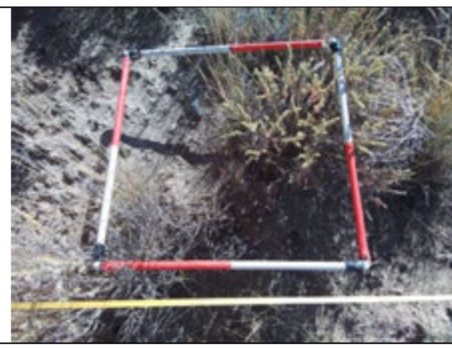
<tr><td></td><td></td></tr>
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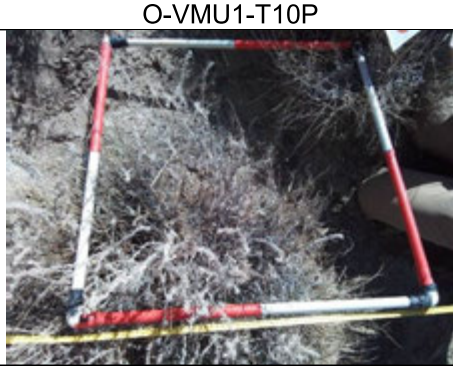
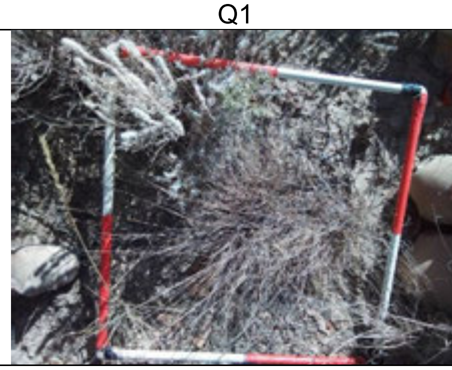
<tr><td></td><td></td></tr>
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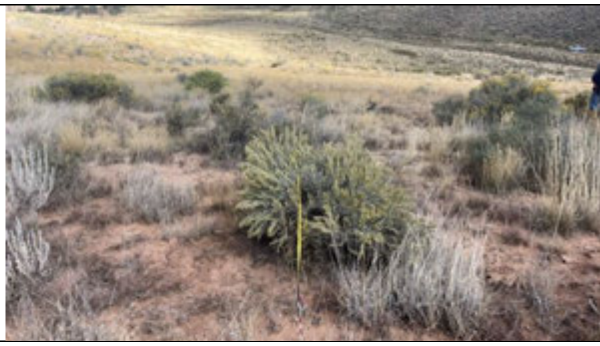	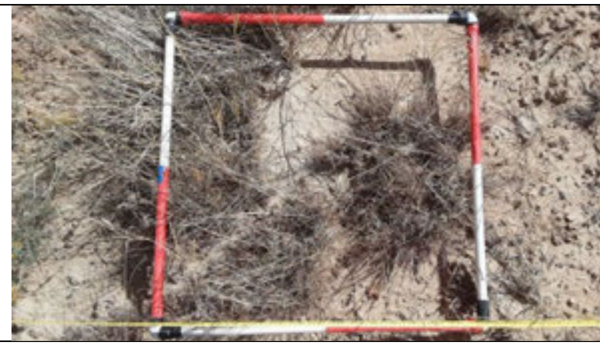
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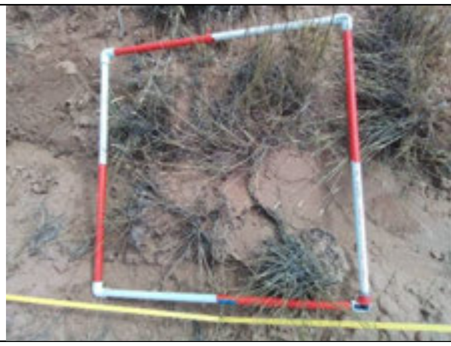	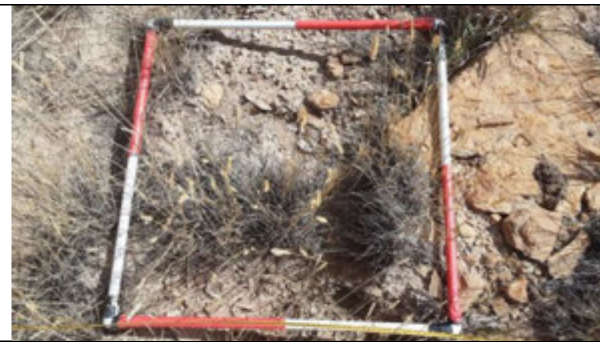
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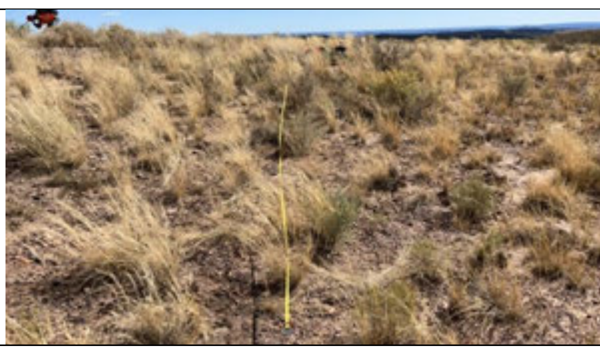	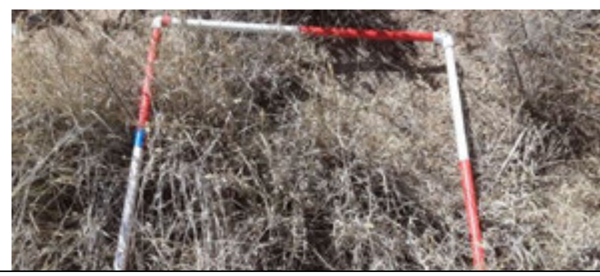
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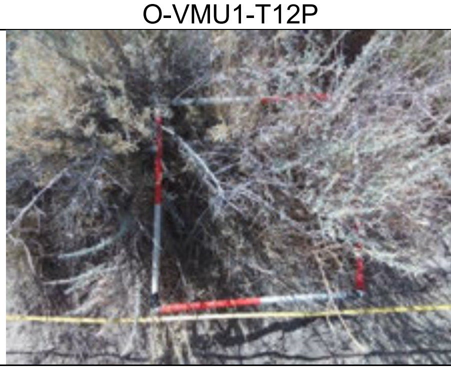	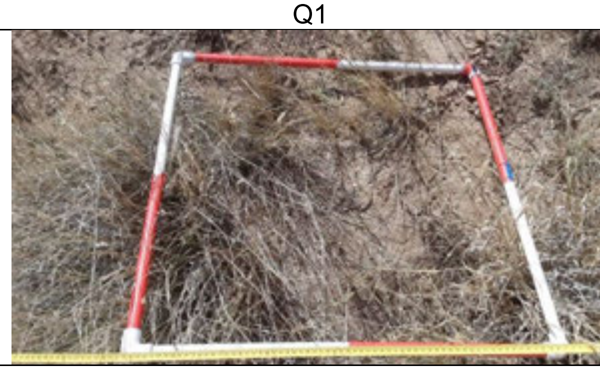
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	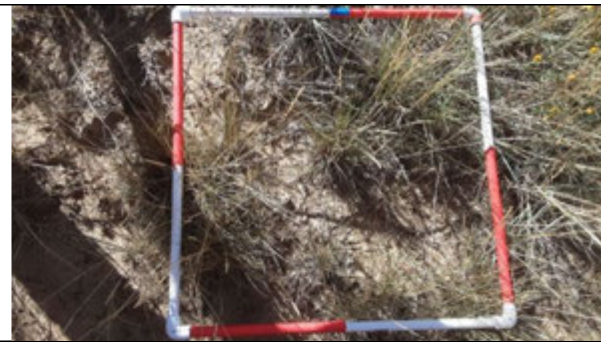
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	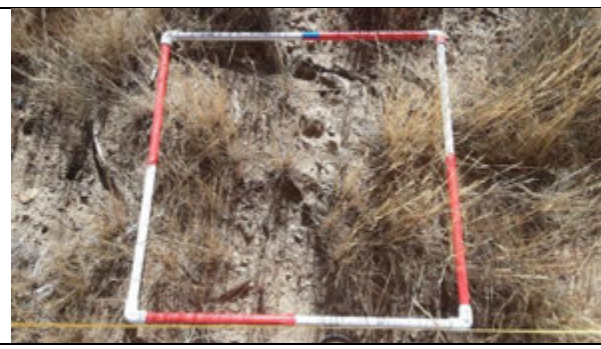
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	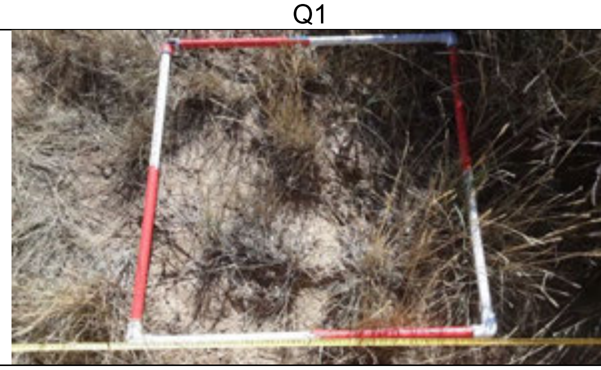
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	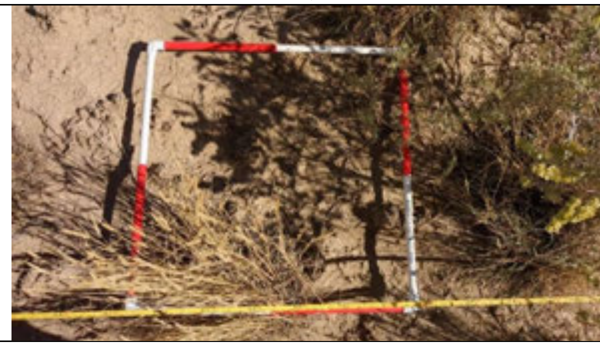
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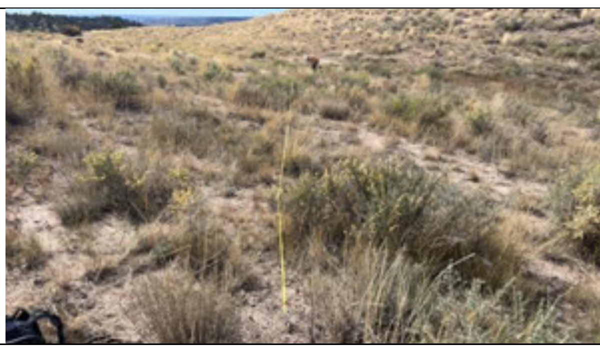	
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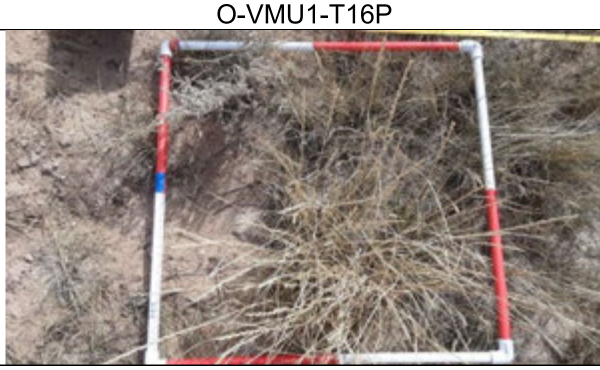	
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	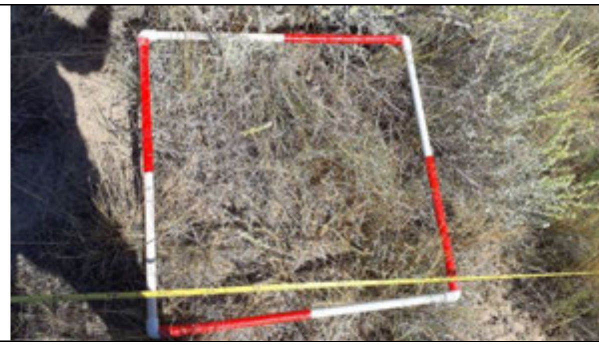
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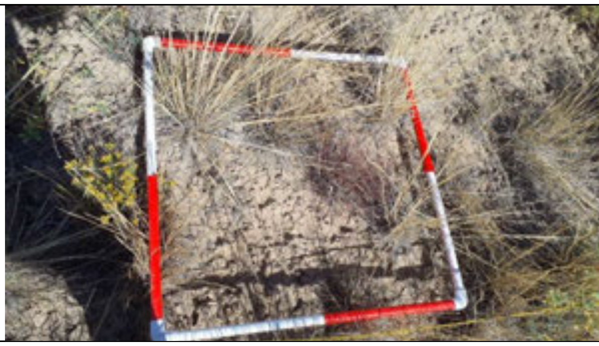	
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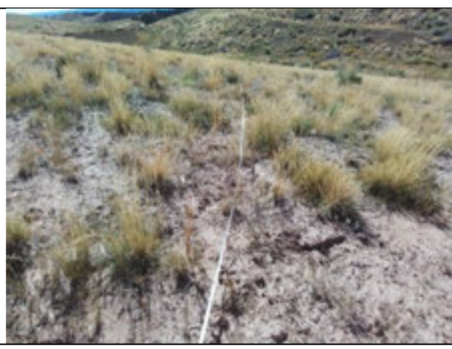	
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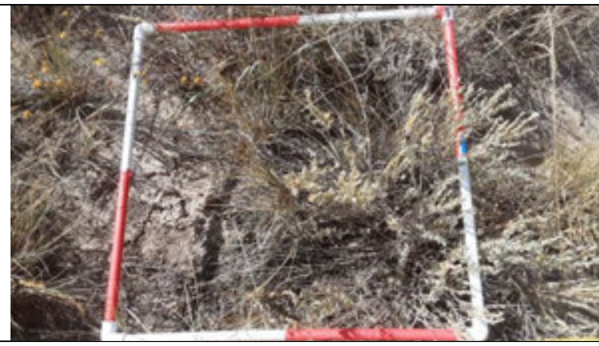
Q2	Q3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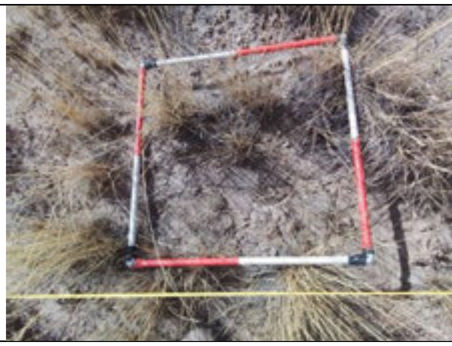	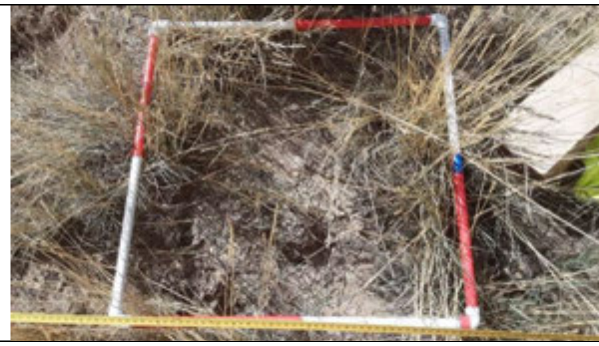
Q2	Q3

	
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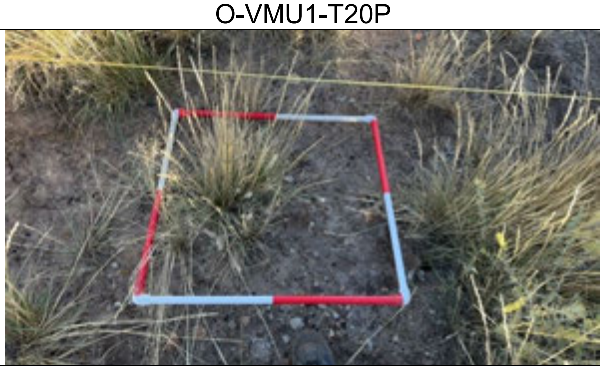	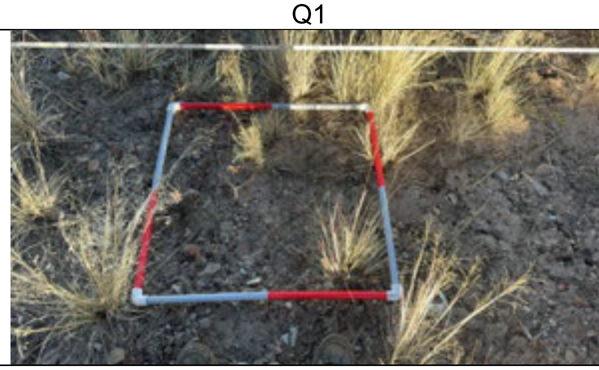
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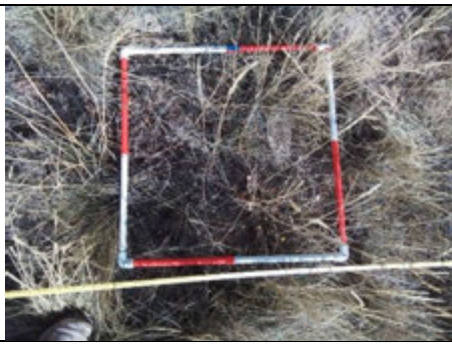	
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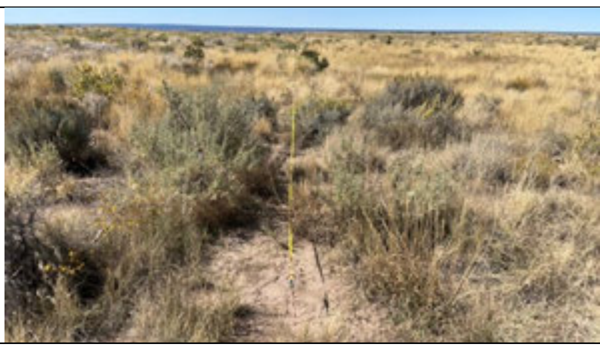	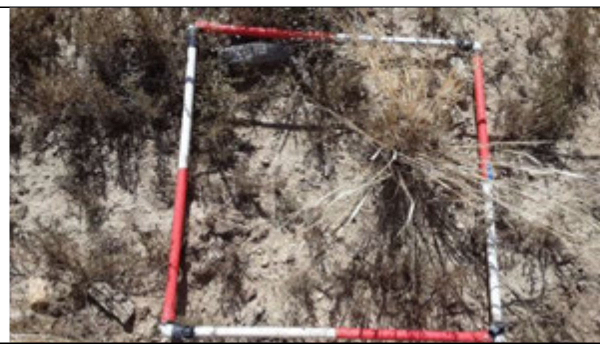
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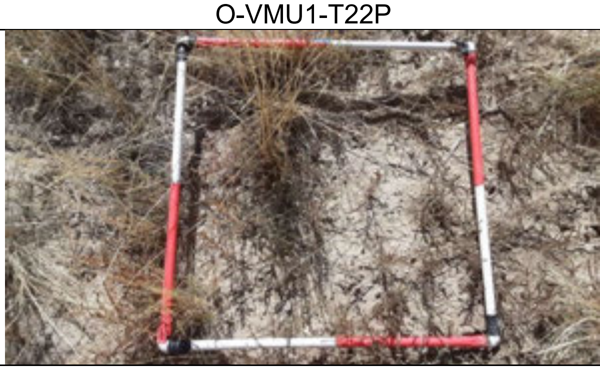
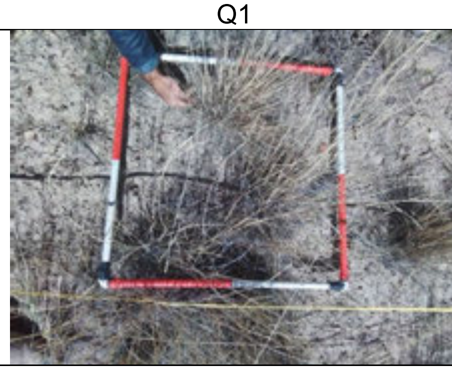
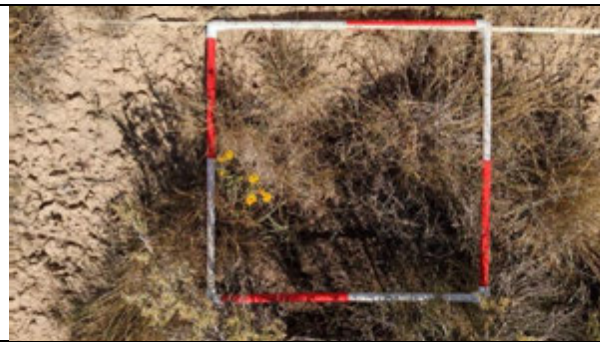
	
Q2	Q3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	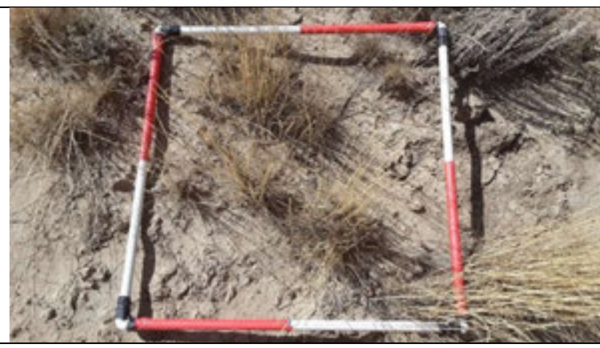
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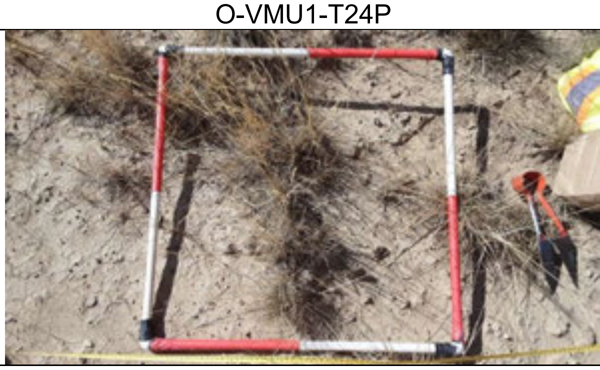	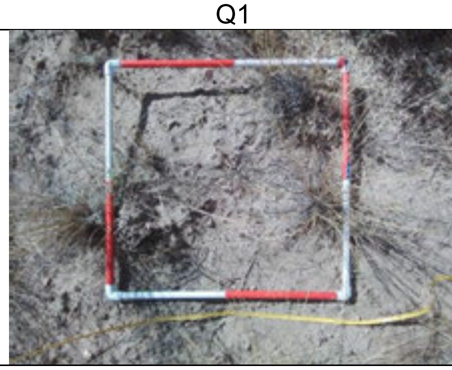
Q2	Q3

	
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Q2	Q3

	
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Q2	Q3

	
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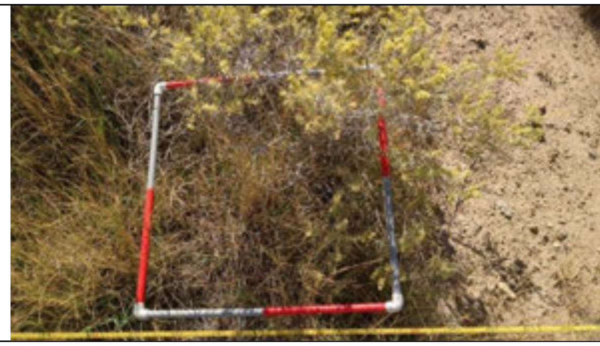
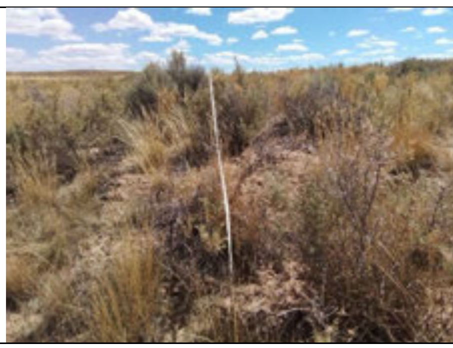
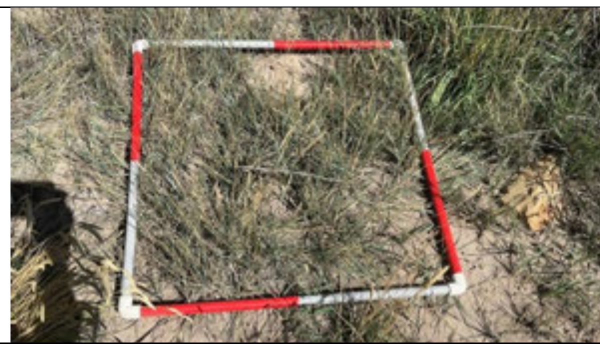
	
Q2	Q3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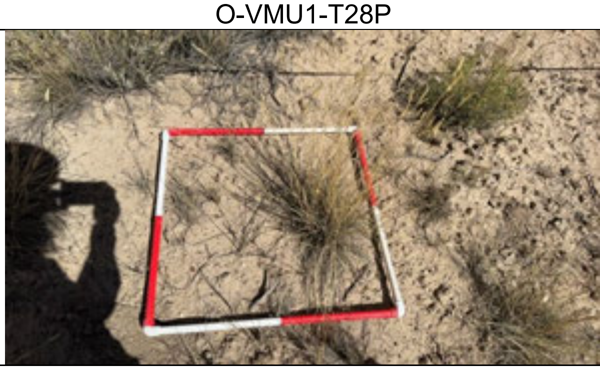
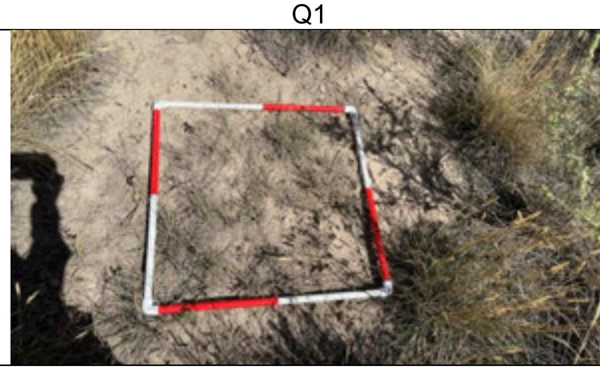
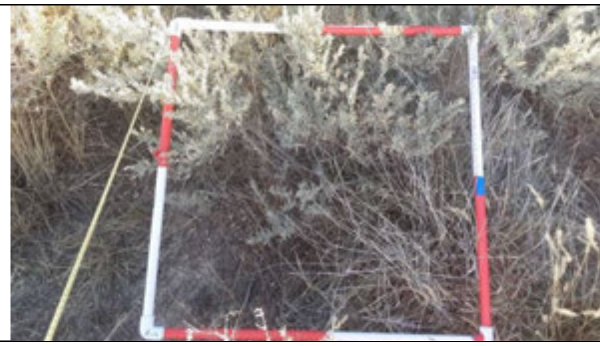
	
Q2	Q3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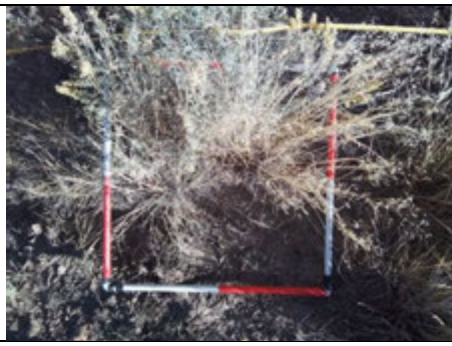	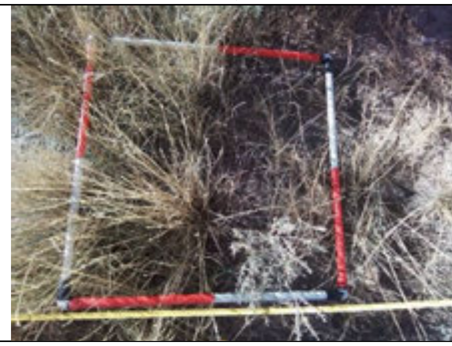
Q2	Q3

	
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	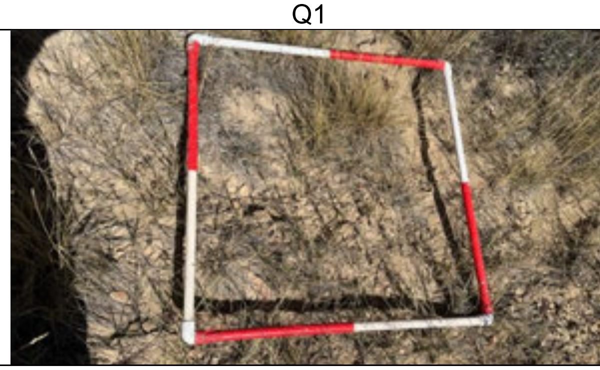
Q2	Q3


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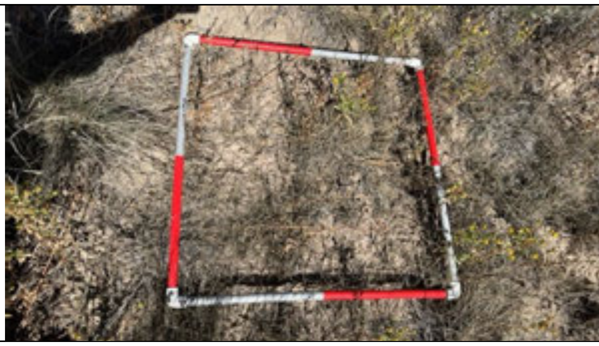
Q1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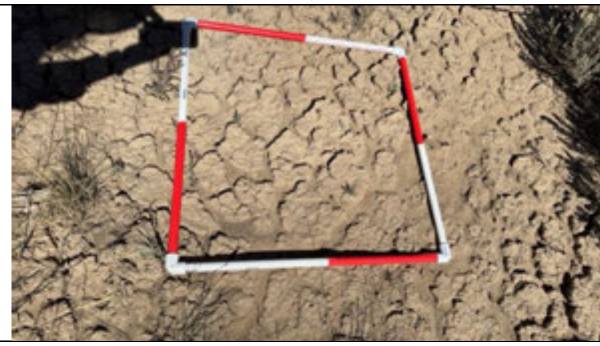
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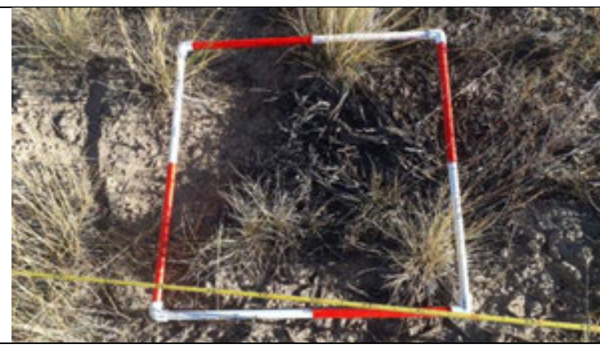
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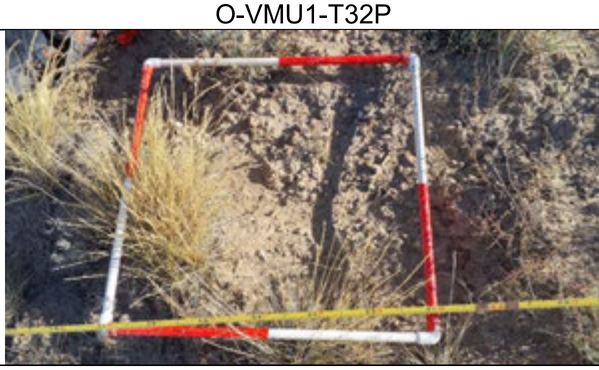
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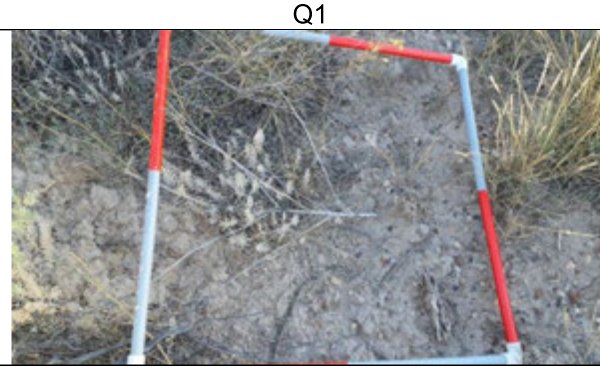
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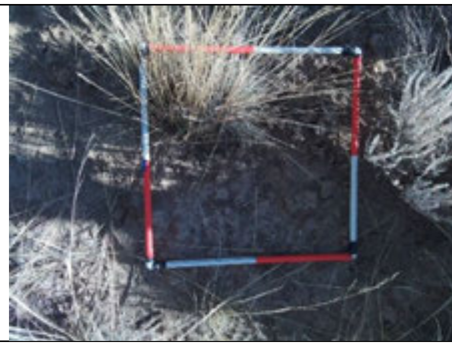
<tr><td></td><td></td></tr>
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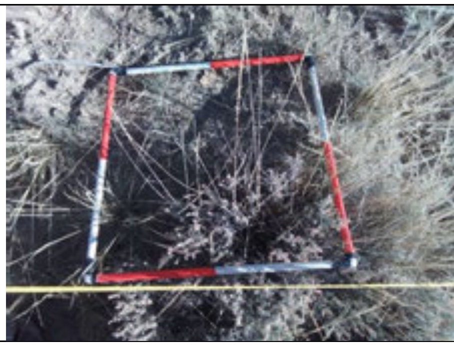
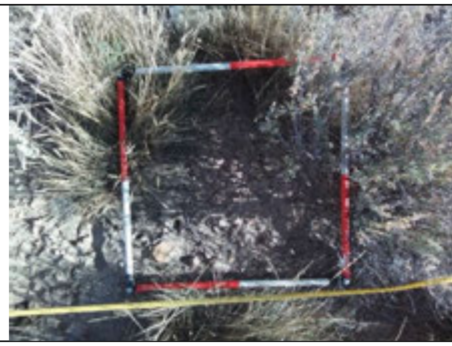
<tr><td></td><td></td></tr>
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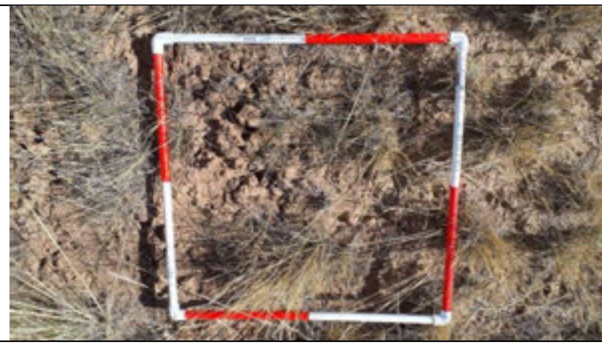
<tr><td></td><td></td></tr>
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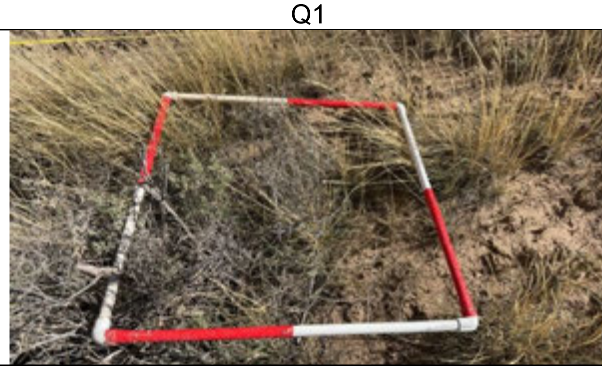
<tr><td></td><td></td></tr>
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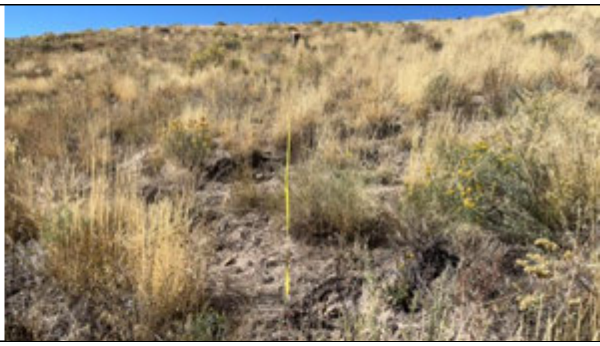	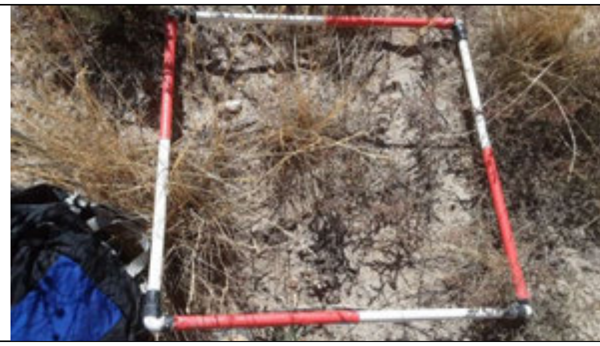
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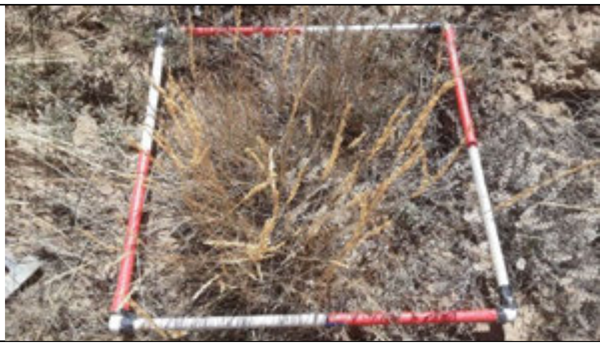	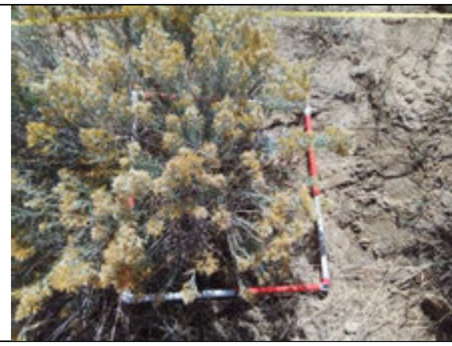
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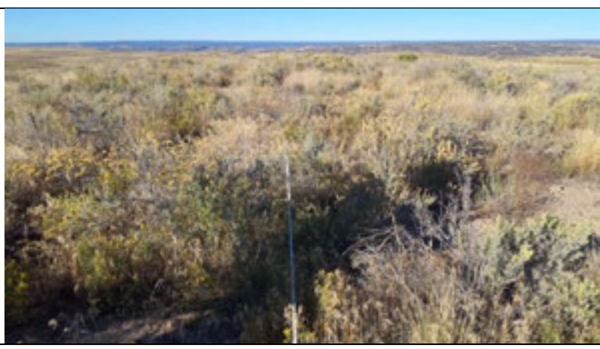	
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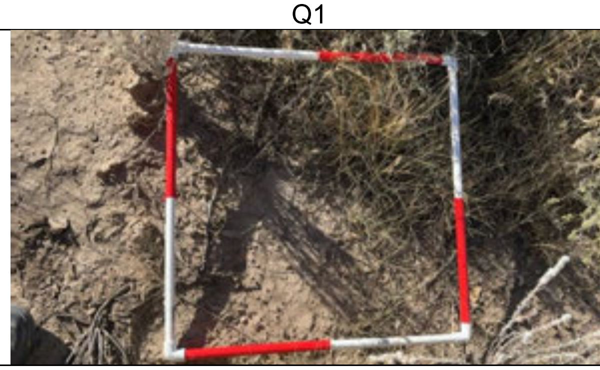
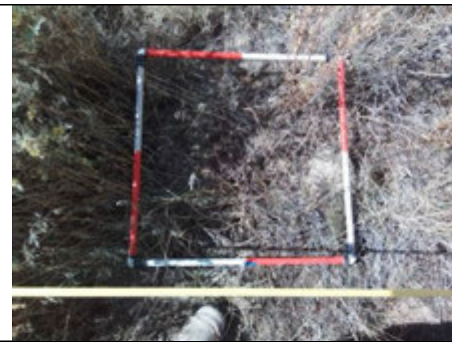
	
Q2	Q3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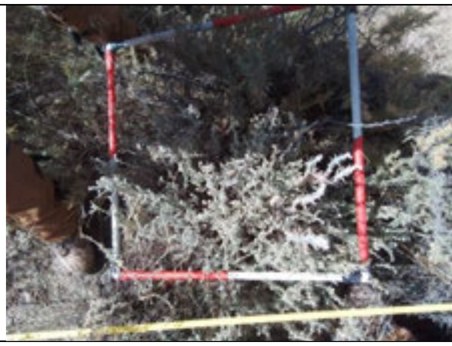	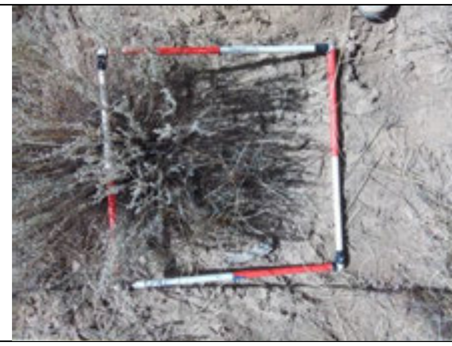
Q2	Q3

	
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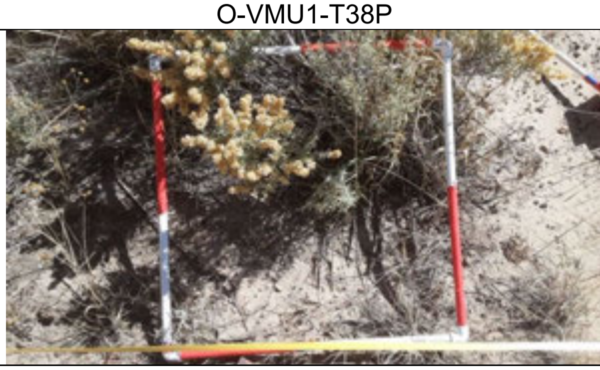
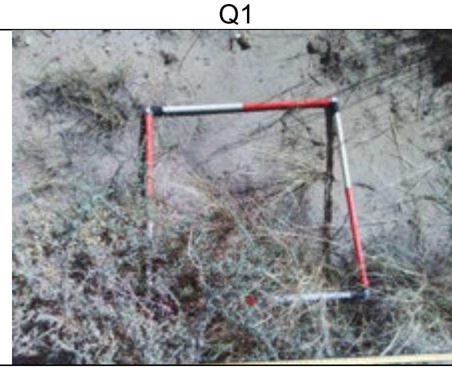
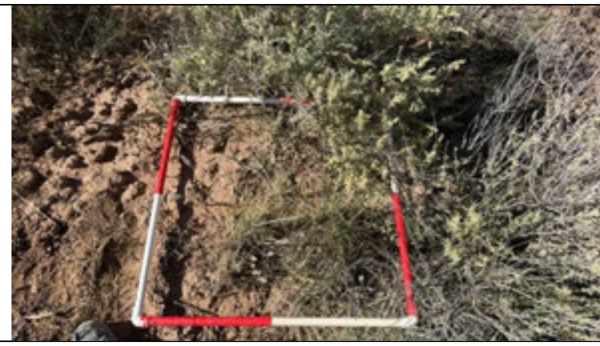
	
Q2	Q3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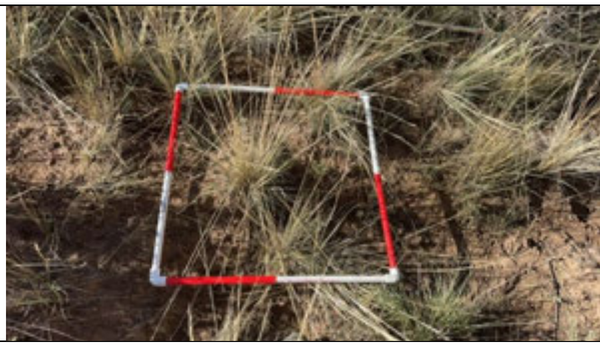
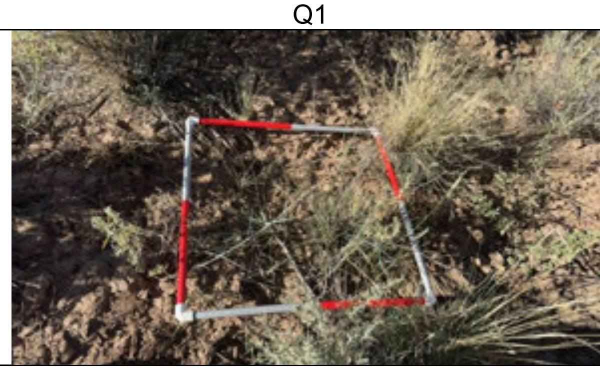
	
Q2	Q3

	
O-VMU1-T40P	Q1
	
Q2	Q3

APPENDIX C

Vegetation Statistical Analysis

Table C1: Equations for Vegetation Data Analysis

Attribute	Equation	Where
Sample Size / Count	$n = \sum samples$	n = number of samples ∑ = sum
Mean	$\bar{x} = \frac{\sum x}{n}$	$\bar{x}$ = sample mean ∑x = sum of values for variable n = number of samples
Standard Deviation	$s = \sqrt{\frac{\sum(\bar{x} - x)^2}{n - 1}}$	s = standard deviation ∑ = sum $\bar{x}$ = sample mean n = number of samples
Variance (population)	$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$	s^2 = variance ∑ = sum x_i = Value of variable for sample *i* $\bar{x}$ = sample mean n = number of samples
t-distribution	t = 1-α, v	t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom α = significance level (0.10) v = degrees of freedom (n-1)
90% Confidence Interval	$\bar{x} \pm z \frac{s}{\sqrt{n}}$	$\bar{x}$ = sample mean z = the critical value from the normal distribution with α/2 in each tail s = standard deviation n = number of samples
N_{min} (Sample Adequacy - Normal Data)	$N_{min} = \frac{t^2 s^2}{(\bar{x}D)^2}$	N_{min} = number of samples required t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom s = standard deviation (s^2 = variance) $\bar{x}$ = sample mean D = the desired level of accuracy, which is 10 percent of the mean
Logarithmic Transformation	Y' = log(Y + k)	log = logarithmic function Y = attribute value k = constant, here we use 1
one-sample, one-sided t test	$t^* = \frac{\bar{x} - 0.9\ (technical\ std)}{s/\sqrt{n}}$	t* = calculated t-statistic $\bar{x}$ = sample mean s = standard deviation n = sample size
one-sample, one-sided sign test	$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$	z = sign test statistic k = test statistic resulting from the number of values falling below 90% of the technical standard n = sample size
Relative Cover (Perennial/Biennial Species)	Rp/b-cvr = Cvrp/b-sp. / Cvrp/b-abs.	$R_{p/b\text{-}cvr}$ = Calculated Relative Cover for a Perennial/Biennial Species $Cvr_{p/b\text{-}sp.}$ = Mean Absolute Cover of a Perennial/Biennial Species $Cvr_{p/b\text{-}abs.}$ = Mean Absolute Perennial/Biennial Cover
Relative Cover (All Species)	Rcvr = Cvrsp. / CvrAbs.	R_{cvr} = Calculated Relative Cover for a species $Cvr_{sp.}$ = Mean Absolute Cover of ANY species $Cvr_{abs.}$ = Mean Absolute Cover for All Species

Notes:
All Appendix C analysis, tables, and figures computed using R software: (R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/

Table C-2: Data for Normal Distribution and Variance Analysis, O-VMU-1, 2023

Transect	Raw Data				Log-Transformed Data	
	Total Ground Cover (%)	Perennial Vegetation Cover (%)	Annual Forage Production (lbs./ac)	Woody Plant Density (#/ac)	Log - Annual Forage Production	Log - Woody Plant Density
O-VMU-1-T01P	70	58	392	1,942	2.59	3.29
O-VMU-1-T02P	74	58	506	1,295	2.70	3.11
O-VMU-1-T03P	58	34	175	2,469	2.24	3.39
O-VMU-1-T04P	60	48	991	3,278	3.00	3.52
O-VMU-1-T05P	60	40	297	4,249	2.47	3.63
O-VMU-1-T06P	56	30	259	1,295	2.41	3.11
O-VMU-1-T07P	64	52	678	3,116	2.83	3.49
O-VMU-1-T08P	58	40	424	1,052	2.63	3.02
O-VMU-1-T09P	66	52	656	4,775	2.82	3.68
O-VMU-1-T10P	62	46	943	5,504	2.97	3.74
O-VMU-1-T11P	66	42	654	324	2.82	2.51
O-VMU-1-T12P	58	42	1,239	2,711	3.09	3.43
O-VMU-1-T13P	58	30	913	1,862	2.96	3.27
O-VMU-1-T14P	74	60	690	971	2.84	2.99
O-VMU-1-T15P	50	44	545	1,012	2.74	3.01
O-VMU-1-T16P	62	44	1,248	6,718	3.10	3.83
O-VMU-1-T17P	68	56	812	2,671	2.91	3.43
O-VMU-1-T18P	56	40	157	769	2.20	2.89
O-VMU-1-T19P	66	46	1,172	1,093	3.07	3.04
O-VMU-1-T20P	62	40	976	2,873	2.99	3.46
O-VMU-1-T21P	90	68	1,321	1,416	3.12	3.15
O-VMU-1-T22P	62	40	747	1,902	2.87	3.28
O-VMU-1-T23P	48	30	479	2,671	2.68	3.43
O-VMU-1-T24P	66	38	558	2,145	2.75	3.33
O-VMU-1-T25P	66	50	734	1,619	2.87	3.21
O-VMU-1-T26P	56	46	488	1,578	2.69	3.20
O-VMU-1-T27P	70	42	950	1,174	2.98	3.07
O-VMU-1-T28P	76	58	787	2,023	2.90	3.31
O-VMU-1-T29P	80	38	2,025	2,671	3.31	3.43
O-VMU-1-T30P	70	62	1,277	1,942	3.11	3.29
O-VMU-1-T31P	42	24	640	2,792	2.81	3.45
O-VMU-1-T32P	70	40	439	2,226	2.64	3.35
O-VMU-1-T33P	78	60	184	2,671	2.27	3.43
O-VMU-1-T34P	68	46	643	890	2.81	2.95
O-VMU-1-T35P	62	32	2,364	1,740	3.37	3.24
O-VMU-1-T36P	66	42	110	6,313	2.04	3.80
O-VMU-1-T37P	70	58	1,575	3,966	3.20	3.60
O-VMU-1-T38P	58	34	760	2,914	2.88	3.46
O-VMU-1-T39P	74	62	493	2,711	2.69	3.43
O-VMU-1-T40P	58	46	544	1,214	2.74	3.08
Mean	64.45	45.5	771.1	2414.0	2.8	3.3
Standard Deviation	9.1	10.5	480.6	1463.2	0.3	0.3
Count	40	40	40	40	40	40
Variance	80	107	225,197	2,087,303	0.083	0.070
90% Confidence Interval	2	3	125	381	0.076	0.070
Technical Standard	52%	24%	550	400	2.74	2.60
90% of Standard	46.8%	21.6%	495	360	2.47	2.34

Notes:
2023 Data are found in Appendix A

Table C-3: Total Ground Cover, one-sample, one-sided t-test - classical null (left-sided), O-VMU-1, 2023

Total Ground Cover (%)	
Mean (%)	64.5
Standard Deviation (%)	9.1
Sample Size	40
Technical Standard (%)	52
t*	12.331
1-tail t (0.1, 39)	-1.304

Notes:
Data is from Table C-2
Decision Rules (the Permit - Appendix 6.5-B):
t* < t (α; n-1), failure to meet standard
t* ≥ t (α; n-1), performance standard met
t from Section 3, Table 1 (WDEQ, 2012)
Test Statistic:

$$t^* = \frac{\bar{x} - 0.9\,(technical\ std)}{s/\sqrt{n}}$$

t*(12.331) ≥ t (-1.304), **performance standard is met**

Table C-4: Perennial Vegetaion Cover, one-sample, one-sided t-test - classical null (left-sided), O-VMU-1, 2023

Total Perennial Cover (%)	
Mean (%)	45.5
Standard Deviation (%)	10.5
Sample Size	40
Technical Standard (%)	24
t*	14.372
1-tail t (0.1, 39)	-1.304

Notes:
Data is from Table C-2
Decision Rules (the Permit - Appendix 6.5-B):
t* < t (α; n-1), failure to meet standard
t* ≥ t (α; n-1), performance standard met
t from Section 3, Table 1 (WDEQ, 2012)
Test Statistic:

$$t^* = \frac{\bar{x} - 0.9\,(technical\ std)}{s/\sqrt{n}}$$

t*(14.372) ≥ t (-1.304), **performance standard is met**

Table C-5: Annual Forage Production, one-sample, one-sided sign test- reverse null, O-VMU-1, 2023

Transect	Annual Forage Production (lbs./ac)	90% of Technical Standard	Difference
O-VMU1-T01P	392	495	-103
O-VMU1-T02P	506	495	11
O-VMU1-T03P	175	495	-320
O-VMU1-T04P	991	495	496
O-VMU1-T05P	297	495	-198
O-VMU1-T06P	259	495	-236
O-VMU1-T07P	678	495	183
O-VMU1-T08P	424	495	-71
O-VMU1-T09P	656	495	161
O-VMU1-T10P	943	495	448
O-VMU1-T11P	654	495	159
O-VMU1-T12P	1,239	495	744
O-VMU1-T13P	913	495	418
O-VMU1-T14P	690	495	195
O-VMU1-T15P	545	495	50
O-VMU1-T16P	1,248	495	753
O-VMU1-T17P	812	495	317
O-VMU1-T18P	157	495	-338
O-VMU1-T19P	1,172	495	677
O-VMU1-T20P	976	495	481
O-VMU1-T21P	1,321	495	826
O-VMU1-T22P	747	495	252
O-VMU1-T23P	479	495	-16
O-VMU1-T24P	558	495	63
O-VMU1-T25P	734	495	239
O-VMU1-T26P	488	495	-7
O-VMU1-T27P	950	495	455
O-VMU1-T28P	787	495	292
O-VMU1-T29P	2,025	495	1,530
O-VMU1-T30P	1,277	495	782
O-VMU1-T31P	640	495	145
O-VMU1-T32P	439	495	-56
O-VMU1-T33P	184	495	-311
O-VMU1-T34P	643	495	148
O-VMU1-T35P	2,364	495	1,869
O-VMU1-T36P	110	495	-385
O-VMU1-T37P	1,575	495	1,080
O-VMU1-T38P	760	495	265
O-VMU1-T39P	493	495	-2
O-VMU1-T40P	544	495	49
		k	12
		n	40
		z	-2.37
		Standard one-tailed normal curve area (Table C-3; MMD, 1999)	0.49114697
		P	0.009

Notes:

Data is from Table C-2

When k exceeds 50% of n-observations, the performance standard has not been met

P = 0.5-Area = prob of observing z; ≤0.1 performance standard met

z value calculation:

$$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

k (12) ≤ 20, P (0.009) ≤ 0.1, **performance standard is met**

Table C-6: Woody Plant Density, one-sample, one-sided sign test- reverse null, O-VMU-1, 2023

Transect	Woody Plant Density (#/ac)	90% of Technical Standard	Difference
O-VMU1-T01P	1,942	360	1,582
O-VMU1-T02P	1,295	360	935
O-VMU1-T03P	2,469	360	2,109
O-VMU1-T04P	3,278	360	2,918
O-VMU1-T05P	4,249	360	3,889
O-VMU1-T06P	1,295	360	935
O-VMU1-T07P	3,116	360	2,756
O-VMU1-T08P	1,052	360	692
O-VMU1-T09P	4,775	360	4,415
O-VMU1-T10P	5,504	360	5,144
O-VMU1-T11P	324	360	-36
O-VMU1-T12P	2,711	360	2,351
O-VMU1-T13P	1,862	360	1,502
O-VMU1-T14P	971	360	611
O-VMU1-T15P	1,012	360	652
O-VMU1-T16P	6,718	360	6,358
O-VMU1-T17P	2,671	360	2,311
O-VMU1-T18P	769	360	409
O-VMU1-T19P	1,093	360	733
O-VMU1-T20P	2,873	360	2,513
O-VMU1-T21P	1,416	360	1,056
O-VMU1-T22P	1,902	360	1,542
O-VMU1-T23P	2,671	360	2,311
O-VMU1-T24P	2,145	360	1,785
O-VMU1-T25P	1,619	360	1,259
O-VMU1-T26P	1,578	360	1,218
O-VMU1-T27P	1,174	360	814
O-VMU1-T28P	2,023	360	1,663
O-VMU1-T29P	2,671	360	2,311
O-VMU1-T30P	1,942	360	1,582
O-VMU1-T31P	2,792	360	2,432
O-VMU1-T32P	2,226	360	1,866
O-VMU1-T33P	2,671	360	2,311
O-VMU1-T34P	890	360	530
O-VMU1-T35P	1,740	360	1,380
O-VMU1-T36P	6,313	360	5,953
O-VMU1-T37P	3,966	360	3,606
O-VMU1-T38P	2,914	360	2,554
O-VMU1-T39P	2,711	360	2,351
O-VMU1-T40P	1,214	360	854
		k	1
		n	40
		z	-5.85
Standard one-tailed normal curve area (Table C-3; MMD, 1999)			0.499999998
		P	0.000000002

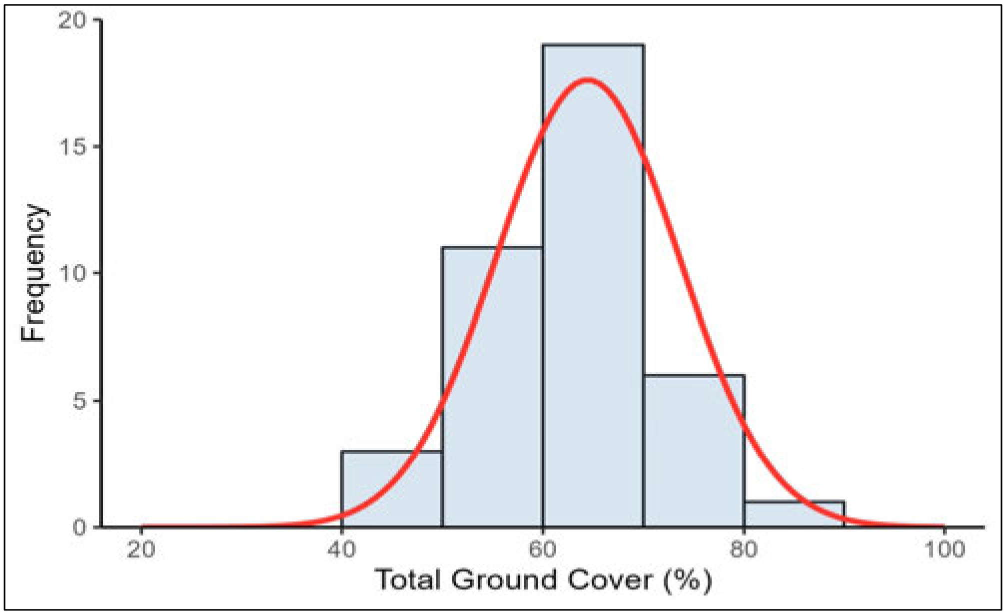
Notes:
Data is from Table C-2
When k exceeds 50% of n-observations, the performance standard has not been met
P = 0.5-Area = prob of observing z; ≤0.1 performance standard met
z value calculation:

$$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

k (1) ≤ 20, P (0.0000000025) ≤ 0.1, **performance standard is met**

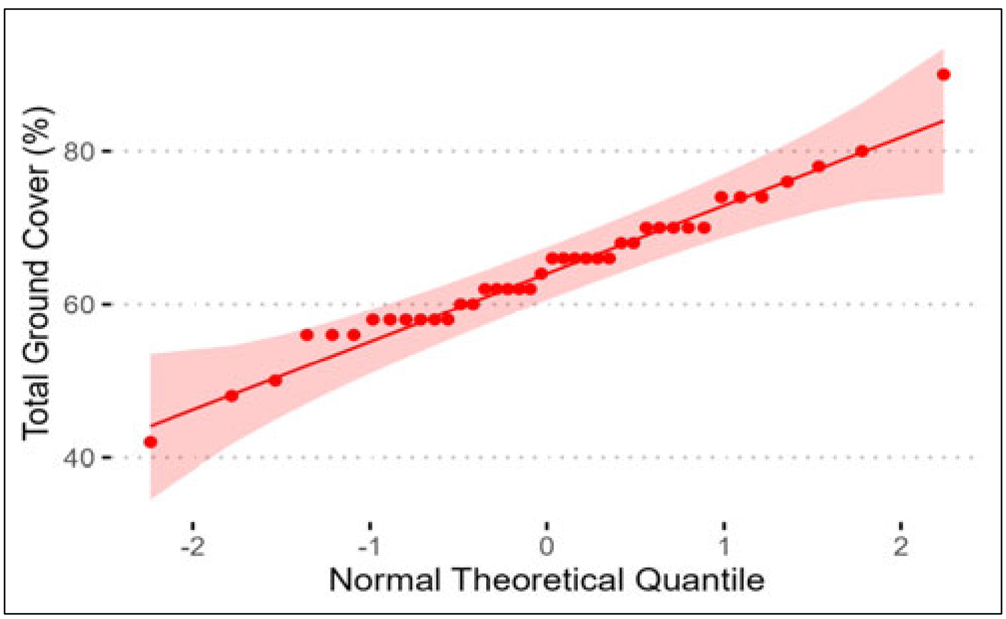
Figure C-1: Total Ground Cover (%), O-VMU-1, 2023

Descriptives



40	64.45	62.10	66.80	1	9	0.19	0.59	58.00	65.00	70.00

Normality



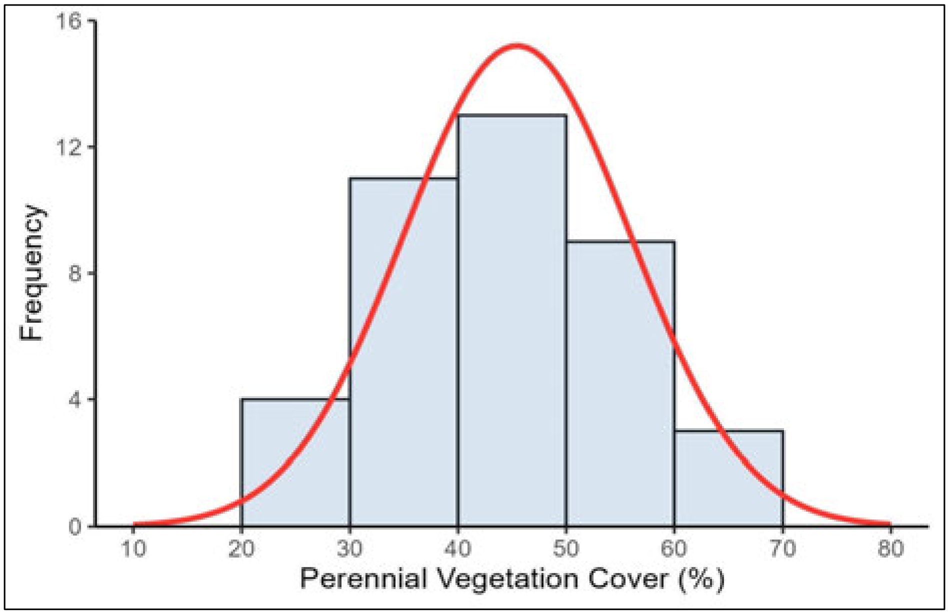
Shapiro-Wilk Test

W statistic	P-value
0.97720	0.586675

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Fail to reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P > 0.1)
(Data are normally distributed)

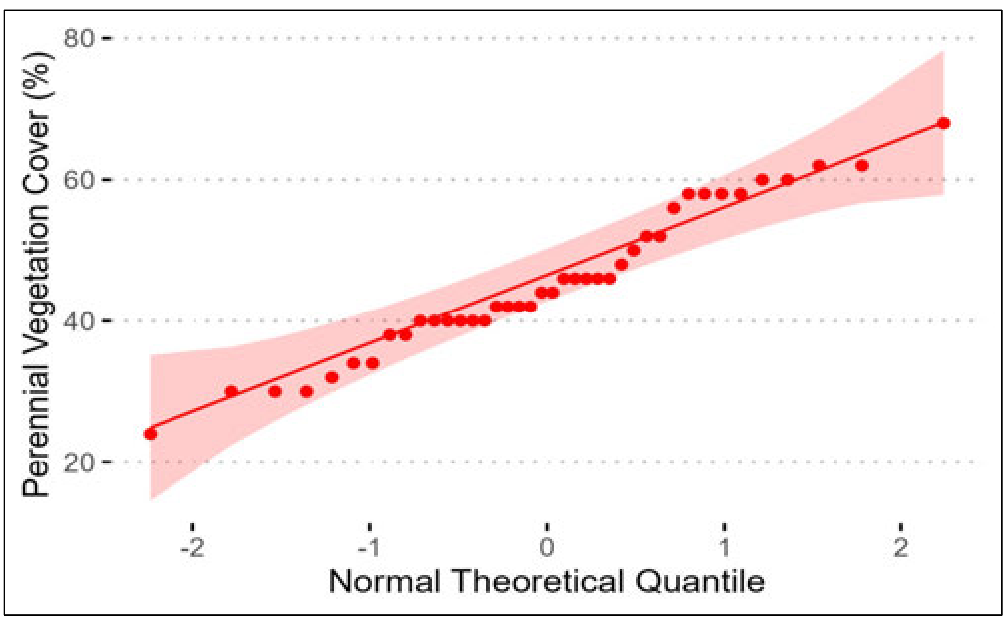
Figure C-2: Perennial Vegetation Cover (%), O-VMU-1, 2023

Descriptives



40	45.45	42.72	48.18	2	10	0.18	-0.78	40.00	44.00	53.00

Normality



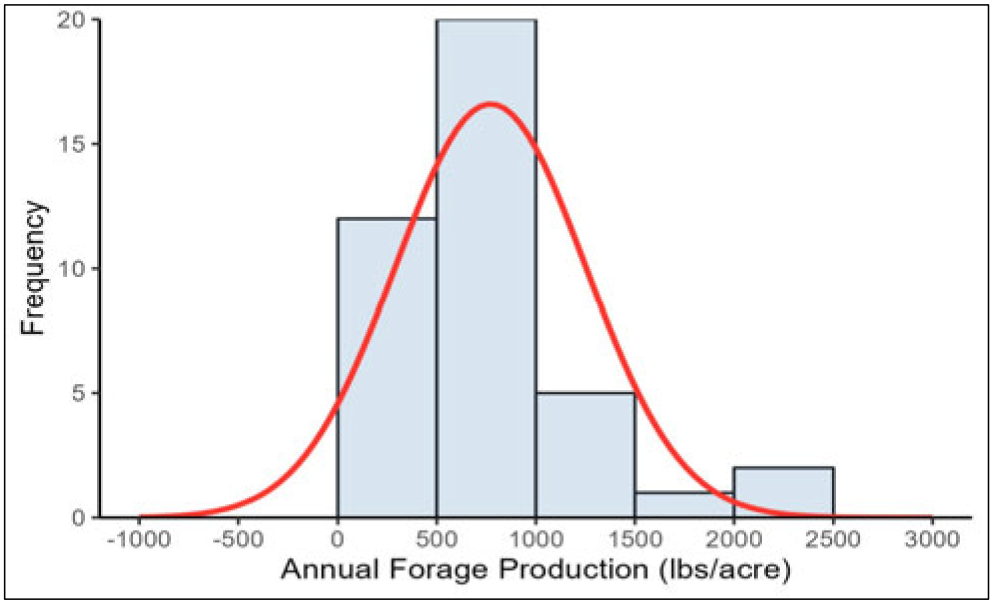
Shapiro-Wilk Test

W statistic	P-value
0.96797	0.309798

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Fail to reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P > 0.1)
(Data are normally distributed)

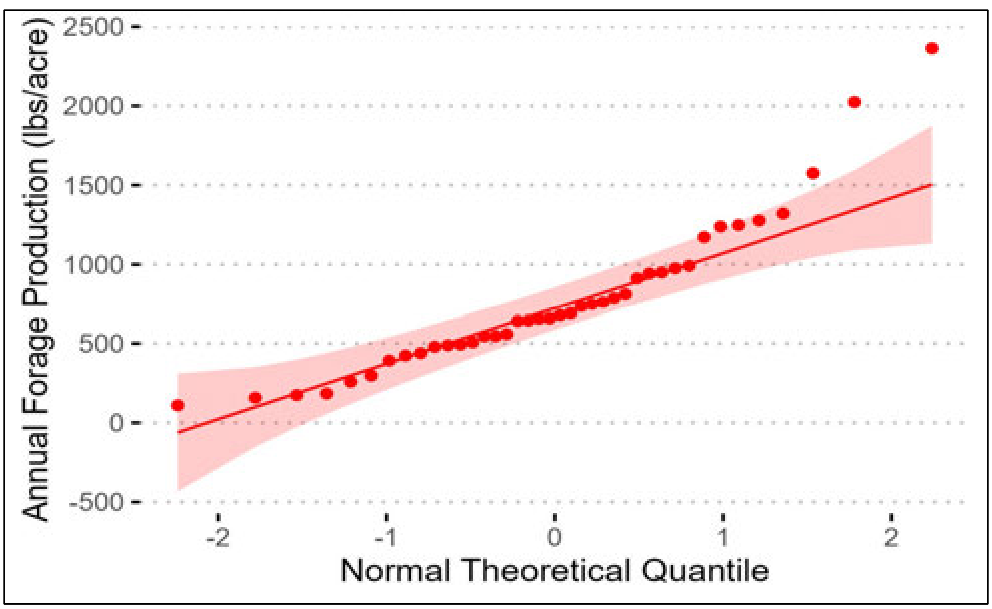
Figure C-4: Annual Forage Production (lbs./ac), O-VMU-1, 2023

Descriptives



40	771.1	646.12	896.13	75.99	480.59	1.28	1.87	485.67	667.03	956.60

Normality



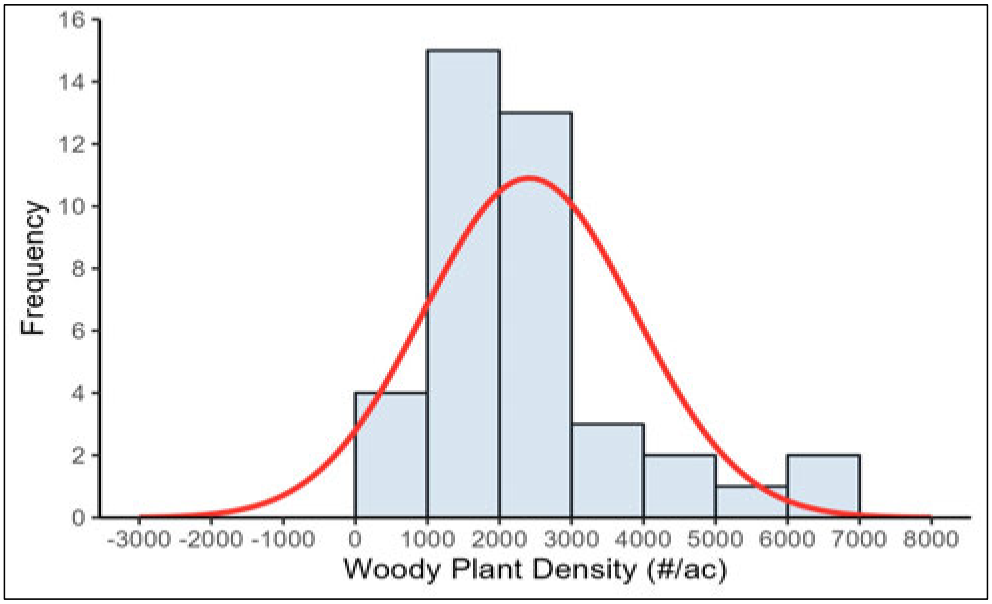
Shapiro-Wilk Test

W statistic	P-value
0.89750	0.001618

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P < 0.1)
(Data are not normally distributed)

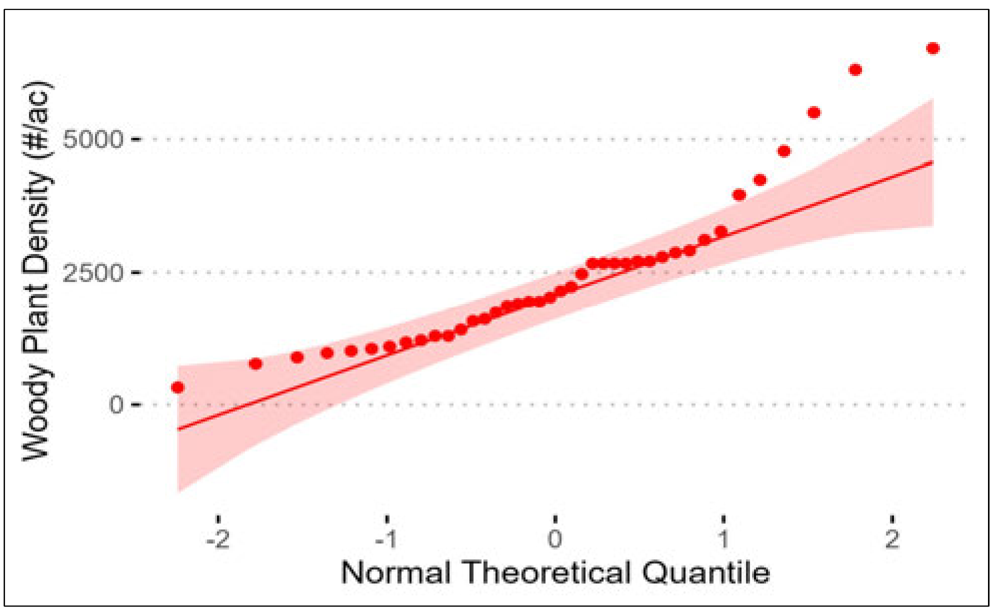
Figure C-4: Woody Plant Density (st/ac), O-VMU-1, 2023

Descriptives



40	2414	2033.39	2794.51	231.35	1463.16	1.24	1.21	1295.00	2084.13	2812.57

Normality



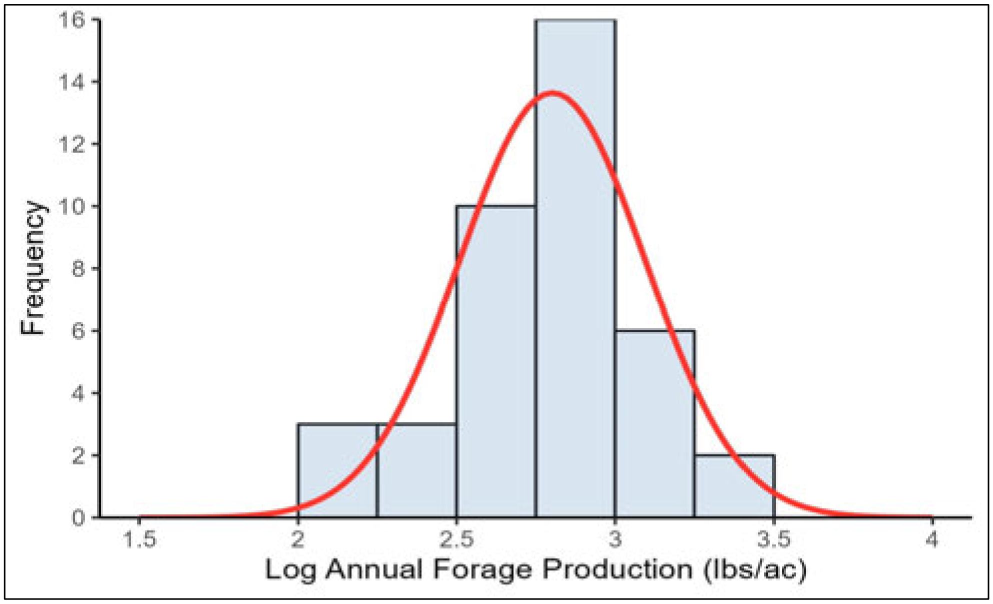
Shapiro-Wilk Test

W statistic	P-value
0.88227	0.000606

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P < 0.1)
(Data are not normally distributed)

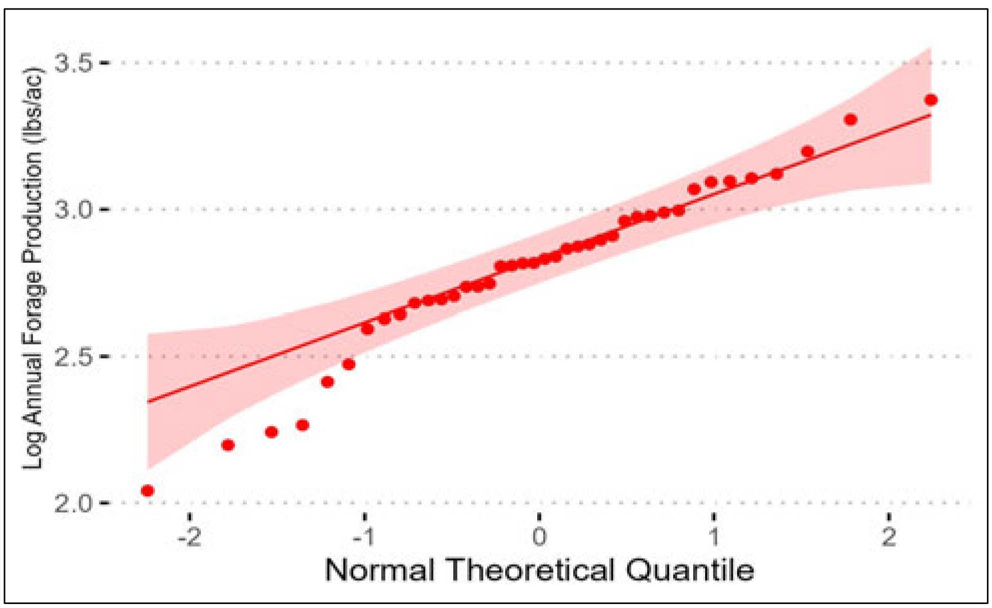
Figure C-5: Log Annual Forage Production (lbs./acre), O-VMU-1, 2023

Descriptives



40	2.802	2.73	2.88	0.05	0.29	-0.57	0.17	2.69	2.82	2.98

Normality



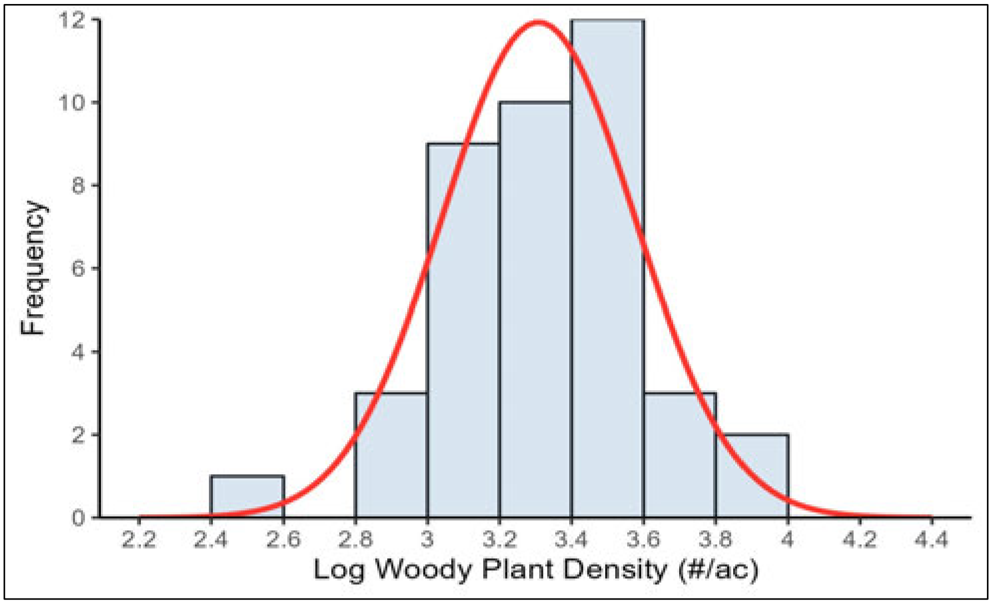
Shapiro-Wilk Test

W statistic	P-value
0.96248	0.203481

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Fail to reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P > 0.1)
(Data are normally distributed)

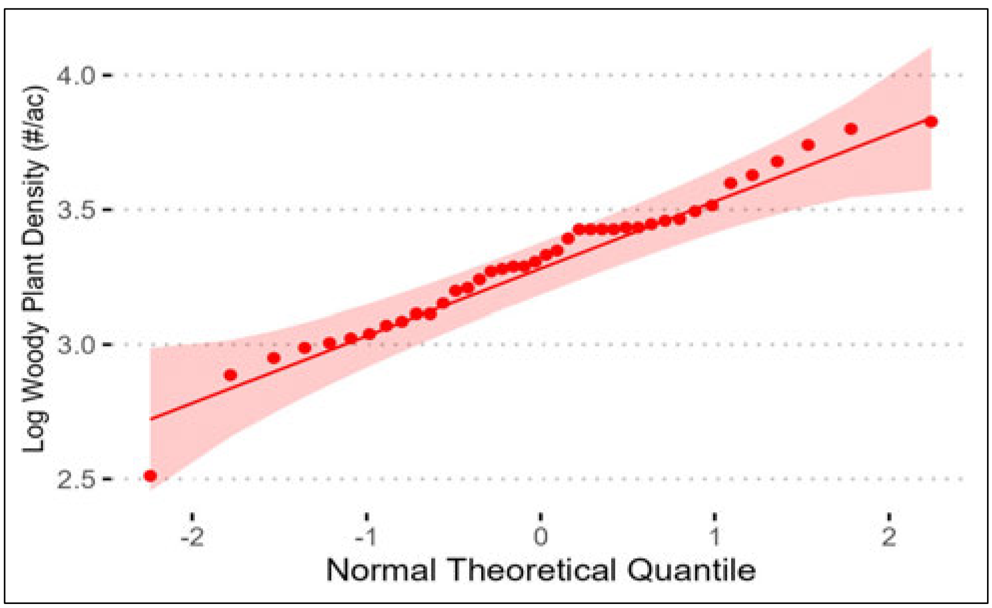
Figure C-6: Log Woody Plant Density (st/ac), O-VMU-1, 2023

Descriptives



40	3.308	3.24	3.38	0.04	0.27	-0.38	0.42	3.11	3.32	3.45

Normality



Shapiro-Wilk Test

W statistic	P-value
0.97444	0.491358

H0: F(Y) = N(μ, σ)
The population is normally distributed.
H1: F(Y) ≠ N(μ, σ)
The population is not normaly distributed
Fail to reject the null hypothesis in favor of the alternative hypothesis with 90% confidence (P > 0.1)
(Data are normally distributed)

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REPORT

Vegetation Management Unit 1 Vegetation Success Monitoring, 2019

McKinley Mine, U.S. Department of the Interior - Office of Surface Mining Reclamation and Enforcement Permit Area

Submitted to:

Chevron Environmental Management Company

Chevron Mining Inc. - McKinley Mine
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Mentmore, NM 87319

Submitted by:

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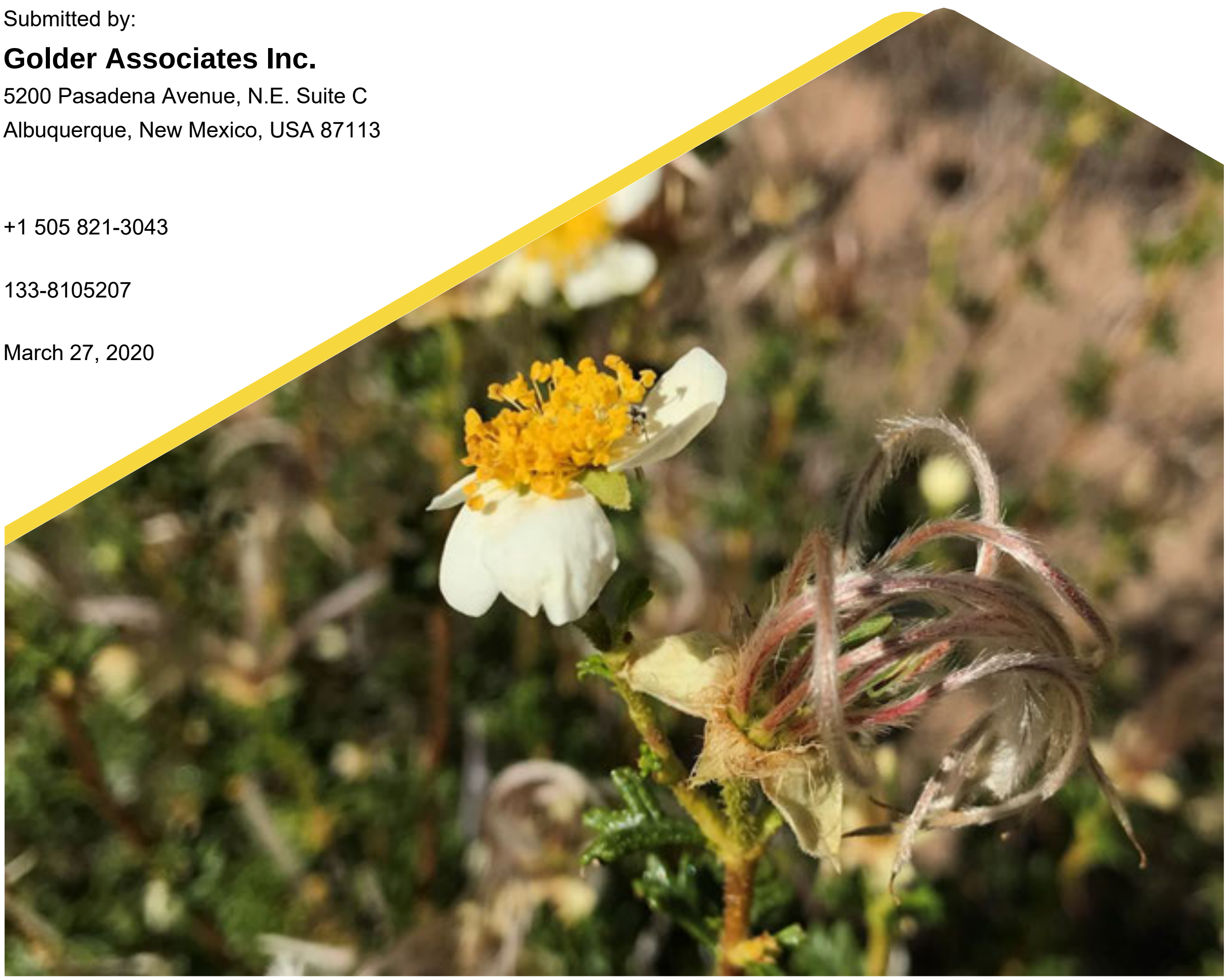
March 27, 2020



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1.0 INTRODUCTION

Mining at the McKinley Mine ceased in 2009 and reclamation of remaining support facilities (e.g., impoundments, roads, etc.) is nearing completion. Reclamation practices have been applied at the McKinley Mine under various programs since at least the early 1970s. Chevron Mining Inc. (CMI) is assessing the vegetation in reclaimed areas in anticipation of future bond and liability release. CMI understands the importance of returning the mined lands to productive traditional uses in a timely manner. In order to qualify for release, the lands must be in a condition that is as good as or better than the pre-mine conditions, stable, and capable of supporting the designated postmining land uses of grazing and wildlife. The increment, or permit area as a whole, must meet the permanent-program revegetation success criteria in McKinley Mine Permit No. NM-0001K (the Permit). Golder Associates Inc. (Golder) was retained to monitor and assess the vegetation relative to the established vegetation success standards.

1.1 Vegetation Management Unit 1

This report presents results from 2019 quantitative vegetation monitoring conducted in Vegetation Management Unit 1 (O-VMU1), which is in the western portion of Area 6 and all of Area 5 (Figure 1). The configuration of the vegetation monitoring units within the U. S. Department of the Interior – Office of Surface Mining Reclamation and Enforcement (OSM) Permit Area, shown on Figure 1, were developed in consultation with OSM. Undisturbed lands included within the VMU were not part of the sampling program. O-VMU1 encompasses about 934 acres, comprised mostly of permanent program lands (PPL) and some initial program lands (IPL) (Figure A-1). Both PPL and IPL as one unit must meet the PPL success criteria as discussed in the Permit in Section 6.5.1.2. The 10-year period of extended responsibility, however, only applies to PPL.

The elevation ranges from about 7,200 to 7,600 feet above mean sea level. Reclamation started in 1975 with the vast majority seeded by 2003. Thus, the reclamation in the majority of O-VMU1 ranges from 12 to more than 30 years old. This section provides a general description of the reclamation activities that were implemented. Additional details of the reclamation for specific areas can be obtained through review of the annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation of permanent program lands included grading of the spoils to achieve positive drainage and approximate original contour. After grading, graded spoil monitoring was conducted to determine the suitability of the materials. Topsoil or topsoil substitutes were then applied over suitable spoils.

After topsoil or topdressing placement, the seedbed was scarified or ripped on the contour to a depth of about 8 to 12 inches. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, certified weed-free, long-stem, hay mulch, or straw was applied at a rate of about 2 tons per acre. The mulch was anchored 3 to 4 inches into the cover with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which tends to favor the establishment of cool-season grasses and shrubs. Seed mixes used at McKinley have varied over time but included both warm- and cool-season grasses, introduced and native forbs, and shrubs. The early seed mixes tended to emphasize the use the alfalfa and cool-season grasses. Over time the seed mixes shifted to include more warm-season grasses and a broader variety of forbs.

Initial program lands were typically graded so they were no steeper than 3:1 and topsoiled. Seeding practices were similar to those done on permanent program lands.

1.3 Prevailing Climate Conditions

The amount and distribution of precipitation are important determinants for vegetation establishment and performance. Once vegetation is established, the precipitation dynamics affect the amount of vegetation cover and biomass on a year-to-year basis with grasses and forbs showing the most immediate response.

The North Mine Area has experienced several drought years recently. Total annual precipitation was above the regional average (about 11.8 inches at Window Rock) in 2015 and below average in 2016, 2017, and 2018 (Table 1). Annual cumulative precipitation through August for 2019 is less than the long-term averages for the region and monsoonal precipitation was well below average. Figure 1 shows the location of the rain gauges used for the North Mine; O-VMU1 seasonal precipitation was evaluated from data collected at the Rain 3 and 6 gauges. From 2015 to 2019, precipitation during peak growing season months has been variable with the most pronounced deficits in August for all years except for 2017 when Rain 3 recorded 2.71 inches compared to the long-term average of 2.05 inches. Departure of growing season precipitation (April through September) from long-term seasonal mean at Window Rock (1937-1999) for O-VMU1 is shown on Figure 2. Based on the Rain 3 and 6 stations in 2016, 2018, and 2019 growing season precipitation has been 1.8 to almost 3.5 inches below average. Thus, McKinley has experienced drought during the growing season for three of the last four years.

1.4 Objectives

The intent of this report is to document the vegetation community attributes in O-VMU1 and compare them to the Permit's vegetation success criteria. Section 2 describes the vegetation monitoring methods that were used in 2019. Section 3 presents the results of the investigation with respect to total ground cover, perennial vegetation cover, production, woody plant density (shrub density), and composition and diversity. Section 4 is a summary of the results for O-VMU1 with emphasis on vegetation success.

2.0 VEGETATION MONITORING METHODS

Vegetation attributes in O-VMU1 were quantified using the methods described in Section 6.5 of the Permit. Fieldwork was conducted midway through the growing season. Vegetation monitoring in O-VMU1 was conducted between July 29 and August 4, 2019.

2.1 Sampling Design

All lands (PPL and IPL) were included in the vegetation-sampling pool for unbiased random sampling. The transect locations were reviewed with OSM in advance of sampling. A 50-meter (m) x 50-m square grid was superimposed over the entire VMU to delineate vegetation sample plots. Random points were created in a geographic information system and the locations are shown on Figure 3 for O-VMU1. In the field, the randomly selected transect locations were assessed in numerical order with 40 primary transects accompanied by 10 alternate transects. If a transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Transects that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies were considered unsuitable. For the 2019 quantitative vegetation monitoring in O-VMU1, all primary transects were suitable with no alternates utilized for sampling.

Figure 4 shows the 50m x 50m vegetation plot with the cover transect orientation, and the location of the production quadrat and belt transect. The center of the laser point intercept (LPI) transect was situated at the grid centroid and transect orientation (from 0° to 360°) was chosen from randomly selected azimuths. Each LPI transect was 50-m long with a one square meter (1 m^2) production quadrat placed at the 25-m mark to the right of the transect in order to limit disturbance to the LPI transect measurements. The belt transect corridor measured 2m x 50m and was superimposed on transect right to limit disturbance to the adjacent measurements.

2.2 Foliar, Canopy and Ground Cover

The point-intercept method was used to collect cover measurements along each 50-m transect according to the Permit requirements. Prior to production clipping, a 50-m measuring tape was suspended between two metal pins to extend the tape fully. A tripod mounted and plumbed (self-leveling) laser was then held along the edge of the tape, and readings were taken every meter for living plants, plant litter, rock fragments, and bare ground. When a live plant was encountered as a direct foliar hit, the species was recorded. The LPI-derived data was evaluated against the permit area vegetation success standards for foliar cover and diversity provided in Table 2.

Additional measurements including relative and total canopy cover, surface litter, rock fragments, and bare soil were estimated for each production quadrat. Quadrat canopy cover data is not analyzed for success and is only briefly discussed in this report as additional support information; the data is included in Appendix A. Canopy cover estimates include the foliage and foliage interspaces of all individual plants rooted in the quadrat. Canopy cover is defined as the percentage of quadrat area included in the vertical projection of the canopy. The canopy cover estimates made on a species basis may exceed 100 percent in individual quadrats where the vegetation has multi-layered canopies. In contrast, the sum of the total canopy cover, surface litter, rock fragments, and bare soil does not exceed 100 percent. All cover estimates were made in 0.05 percent increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates.

Not all plant species are expected to occur in the sampling transects and quadrats. Plants observed growing within the vegetation plots and across the reclaimed facility were inventoried while moving between sample locations and during formal sampling.

2.3 Annual Forage and Total Production

Production was determined by clipping and weighing all annual (current year’s growth) above-ground biomass within the vertical confines of a 1-m^2 quadrat placed at the center of the 50-m transect used for LPI measurements. Production for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air dry pounds per acre (lbs/ac). Total annual production for all plant species is reported but not evaluated against the production success standard. Grasses and forbs were clipped to within 5 centimeters (cm) of the soil surface, and the current year’s growth was segregated from the previous year’s growth (e.g., gray, weathered grass leaves, and dried culms). Production from shrubs was determined by clipping the current year’s growth. Although the Piñon pine (*Pinus edulis*) and oneseed juniper (*Juniperus monosperma*) trees were encountered in the transects, these species were not recorded in the production quadrats and were therefore not included in production calculations. Annuals and a noxious weed (cheatgrass, *Bromus tectorum*) were clipped, but their contribution was excluded from the annual forage production calculations. For this sampling event, plants that were less than 5 cm tall or considered volumetrically insignificant were not harvested. Photographs of the individual production quadrats are included in Appendix B.

The plant tissue samples of every species collected were placed individually in labeled paper bags. The plant tissue samples were air-dried (> 90 days) until no weight changes were observed with repeated measurements on representative samples. The average tare weight of the empty paper bags was determined to correct the total sample weight to air-dry vegetation weights. The net weight of the air-dried vegetation was converted to a lbs/ac basis.

2.4 Shrub Density

Shrub density, or the number of plants per square meter (m^2), was determined using the belt transect method (Bonham 1989). The belt transect was located parallel to the 50-m transect used to determine cover. Shrubs rooted in the 2-m belt transect were counted on a species basis. A 2-m folding ruler was horizontally oriented along the tape to ensure that observations were taken within the two-meter corridor. The number and species of woody plant stems within the belt transect were recorded.

2.5 Statistical Analysis and Sample Adequacy

For the vegetation success demonstrations at McKinley, statistical adequacy is determined on the basis of total ground cover, perennial vegetation cover, annual forage production, and shrub density. Statistical analyses comparing these attributes to the revegetation success standards are included as figures and tables in Appendix C. The basis for these statistical analyses may be found in the permit, the New Mexico Mining and Minerals Division (MMD) coal mine reclamation program vegetation standards (MMD 1999), the Wyoming Department of Environmental Quality (WDEQ) handbook of sampling and statistical methods (WDEQ 2012), and other sources as referenced herein. Further, the hypothesis testing methods used in this report were reviewed with OSM and were employed systematically to accurately and objectively assess vegetation success.

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. The number of samples necessary to meet sample adequacy (N_{min}) was calculated assuming the data were normally distributed using Snedecor and Cochran (1967) equation below.

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

Where N_{min} equals the 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 percent of the mean in this case.

In addition to N_{min}, the 90% confidence interval (CI) of the sample mean and the level of confidence that the sample mean is within 10 percent of the true mean are reported.

It is often impractical to achieve sample adequacy in vegetation monitoring studies based on Snedecor and Cochran's equation listed above. In such cases, the permit allows a maximum sample number approach to compare the data regardless of the distribution (WDEQ 2012, MMD 1999). Where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples is considered adequate. The 40-sample maximum is based on an estimate of the number of samples needed for a t-test under a normal distribution (Sokal and Rohlf 1981). Schulz et al. (1961) demonstrated that 30 to 40 samples provide a robust estimate for most cover and density measures with increased numbers of samples only slightly improving the precision of the estimate.

CMI collected 40 samples at the outset of sampling based on the guidance discussed above. Each transect is considered a unique sampling unit. Additional analysis around sample adequacy was done to see the number of samples that would have been required for adequacy by the Snedecor and Cochran (1967) equation. Because the production and density attributes were not normally distributed additional analyses for sample adequacy were employed using the graphical stabilization of the mean method (Clark 2001).

The emphasis on statistical adequacy assumes that parametric tests of normally distributed data will be conducted to demonstrate compliance with the vegetation success standards. It is important to note that normally distributed data and sample adequacy are not required for hypothesis testing. Nonparametric hypothesis tests can be used to analyze data that are not normally distributed. When sample adequacy is not achieved, it is permissible in the permit and technically appropriate to use the reverse null approach for hypothesis testing. The reverse null approach is also generally recommended to evaluate reclamation success whether N_{min} is met or not (MMD 1999). This is because the reverse null is more defensible (compared to the classic approach) where the rejection of the null hypothesis definitively concludes that the reclamation mean is greater the technical standard (McDonald et al. 2003).

Statistical tests were performed using both Microsoft® Excel and Analyse-it (version 5.40.3), a statistical add-in for Excel. The normality of each dataset was first assessed using the Shapiro-Wilk test to determine the appropriate hypothesis test method (i.e., parametric versus nonparametric). Data were considered normal when the test statistic was significant (p-value > 0.10) for alpha (α) = 0.10. Thus, the null hypothesis that the population is normally distributed was accepted if the p value > 0.10. In cases where the data were not normally distributed, a Box-Cox square root transformation was applied to see if it normalized the data. If the transformed data became normal, then the transformed data is tested with the one-sample, one-sided t-test. If the transformed data did not become normal, then the original data is tested with the one-sample, one-sided sign test.

All hypothesis testing used to demonstrate compliance with the vegetation success standards was conducted using a reverse null approach as discussed with OSM as part of the consultation process. Because vegetation performance at McKinley is compared to technical standards, the one-sample, one-sided t-test is used for normally distributed data to evaluate the mean and the one-sample, one-sided sign test to analyze the median of data that are not normal (MMD 1999, McDonald et al. 2003). The one-sided hypothesis tests using the reverse null approach were designed as follows:

Total Ground Cover (Live Vegetation and Litter)

H_0 : Reclaim < 90% of the Technical Standard (52%)

H_a : Reclaim ≥ 90% of the Technical Standard (52%)

Perennial Vegetation Cover

H_0 : Reclaim < 90% of the Technical Standard (24%)

H_a : Reclaim ≥ 90% of the Technical Standard (24%)

Annual Forage Production

H_0 : Reclaim < 90% of the Technical Standard (550 lbs/ac)

H_a : Reclaim ≥ 90% of the Technical Standard (550 lbs/ac)

Shrub Density

H_0 : Reclaim < 90% of the Technical Standard (400 stems per acre [stems/ac])

H_a : Reclaim ≥ 90% of the Technical Standard (400 stems/ac) where H_0 is the null hypothesis and H_a is the alternative hypothesis. All hypothesis tests were performed with a 90% level of confidence.

Under the reverse null test, the revegetation success standard is met when H_0 is rejected and H_a is accepted. The decision criteria at 90% confidence under the reverse null hypothesis are as follows:

One-sample, one-sided t-test

If $t^* < t_{(1-\alpha;\ n-1)}$, conclude failure to meet the performance standard

If $t^* \geq t_{(1-\alpha;\ n-1)}$, conclude that the performance standard was met

One-sample, one-sided sign test

If $P > 0.10$, conclude failure to meet the performance standard

If $P \leq 0.10$, conclude that the performance standard was met

Statistical hypothesis testing was performed on total ground cover, perennial vegetation cover and the Box-Cox square root transformed shrub density data using the one-sample, one-sided t-test. Statistical hypothesis testing was performed on the annual forage production data using the one-sample, one-sided sign test. Hypothesis testing used the reverse null hypothesis bond release testing procedure as referenced in the permit and described in Coal Mine Reclamation Program Vegetation Standards (MMD 1999).

3.0 RESULTS

The vegetation in O-VMU1 is well established and dominated by perennial plants. The site has achieved the vegetation success standards for the Permit Area based on the vegetation attributes measured in 2019. The vegetation success standards for the Permit Area consist of four main vegetative parameters: cover, diversity, production, and woody plant density (Table 2). The ground cover requirement, or the combined means for live vegetation foliar cover and litter cover on the reclamation is 52%. Analyses of cover and perennial forb diversity include the use of biennial forbs because they are technically monocarpic (single flowering) perennials that annually produce a significant amount of seed and therefore as a species persist in the reclaimed plant community. The perennial vegetation cover requirement on the reclamation is 24%. The annual forage production requirement on the reclamation is 550 air-dry lbs/ac. The shrub density success standard is 400 live woody stems per acre. Table 3 summarizes the results for total ground cover, perennial vegetation cover, annual forage production and woody plant density (shrub density) along with their corresponding technical standard.

Diversity is evaluated against numerical guidelines for different growth forms and photosynthetic pathways of the vegetation. In summary, the diversity guideline is met if perennial grasses contribute 7% or more absolute foliar cover; at least two cool-season perennial grasses have individual absolute foliar cover levels of 1.5% or more; at least two warm-season perennial grasses combing to contribute 2% or more absolute foliar cover, each with 0.5% or more absolute foliar cover; at least three non-annual or noxious weed forbs combining for at least 1% relative foliar cover; shrubs contribute 3% or more absolute foliar cover and no single shrub species have greater than 70% relative shrub cover; and no single species have 40% or more relative total vegetative cover.

Relative cover is defined in three ways for accurate evaluation of diversity according to Table 2. For forbs, relative perennial/biennial cover is the percent foliar cover of a perennial/biennial species divided by the mean total species foliar cover of the sampling unit, excluding annuals and noxious weeds. For shrubs, relative shrub cover is the percent foliar cover of a shrub species divided by the mean total shrub foliar cover of the sampling unit, excluding shrubs or trees considered noxious. To assess whether the VMU is dominated by one species, total vegetative cover is defined as the mean total foliar cover for all live vegetation of the sampling unit, including noxious weeds.

Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas. Table 4 summarizes the attributes for plants recorded in the LPI transects and production quadrats in addition to those encountered or observed but not recorded in the formal quantitative monitoring. Recruitment of additional native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

The field data for LPI foliar cover, quadrat canopy cover, annual forage production and shrub density by the belt transect are included in Appendix A, accompanied by Figure A-1 showing the 2019 transect locations and program land designations within O-VMU1. Photographs of the individual production quadrats are included in Appendix B. Appendix C provides the ground cover, perennial/biennial foliar cover, annual forage production and shrub density by the belt transect method data used to analyze vegetation attributes in addition to the statistical outputs. A representative photograph of the vegetation and topography in O-VMU1 is shown in Figure 5.

3.1 Total Ground and Perennial Vegetation Cover

The combined means of live vegetation foliar cover and litter cover (mean total ground cover ± 90% CI) in O-VMU1 for 2019 is 62.6% ± 2.8% (Table 3). Live vegetation foliar cover is 38.9 ± 1.9% and litter cover is 23.8 ± 2.4%. Vegetation foliar cover in individual transects ranged from 10 to 28 hits (20 to 56%, Table A-1).

Perennial vegetation cover was calculated by summing the perennial/biennial species foliar cover estimates of the sampling unit after excluding annuals and noxious weeds. The average perennial cover was 33.7 ± 2.7% by the LPI transect method. Perennial vegetation foliar cover in the individual transects varied from 4 to 27 hits (8 to 54%). By the quadrat method, the mean perennial vegetation canopy cover was estimated at 36.0%, ranging from 5.3 to 87.2% (Table A-2). Both mean total ground cover and perennial vegetation cover exceeded their revegetation success standards.

Both the mean total ground cover and perennial vegetation cover data for O-VMU1 were normally distributed (Figures C-1 and C-2). Sample adequacy was estimated using the Snedecor and Cochran (1967) equation. The calculated minimum sample size needed to meet sample adequacy (N_{min}) at the 90% confidence level was estimated to be 9 samples for mean total ground cover and 26 samples for perennial vegetation cover (Table 3).

The one-sided t-test calculated t*-statistic for O-VMU1 mean total ground cover is 9.14, where the sample mean is 62.60% with a standard deviation of 10.94%, the technical standard is 52% and the sample size is 40. The one-tail $t_{(0.1,\ 39)}$ value is 1.304. Therefore, testing under the reverse null hypothesis ($t^* \geq t_{(1-\alpha;\ n-1)}$), we conclude that the performance standard for mean total ground cover was met (Table C-2).

The one-sided t-test calculated t*-statistic for O-VMU1 perennial vegetation cover is 7.48, where the sample mean is 33.70% with a standard deviation of 10.23%, the technical standard is 24% and the sample size is 40. The one-tail $t_{(0.1,\ 39)}$ value is 1.304. Therefore, testing under the reverse null hypothesis ($t^* \geq t_{(1-\alpha;\ n-1)}$), we conclude that the performance standard for mean perennial vegetation cover was met (Table C-3).

3.2 Production

Production for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air dry pounds per acre (lbs/ac). Total annual production for all plant species is reported but not used in determining productivity success for the VMU. The 2019 annual forage production in O-VMU1 was estimated to be 882 (± 203 [90% CI]) lbs/ac with an annual total production estimated at 1,070 ± 197 lbs/ac (Table 3). Perennial grasses (17 species) contributed the most forage with more than 424 lbs/ac, while shrubs (nine species) contributed a comparable 372 lbs/ac of forage and 15 perennial/biennial forbs contributed an additional 85 lbs/ac of forage (Table 4). Of the 17 perennial grasses, five cool-season perennial grasses contributed between 32 and 122 lbs/ac of forage: Western wheatgrass (*Pascopyrum smithii*), thisckspike wheatgrass (*Elymus lanceolatus ssp. Lanceolatus*), crested wheatgrass (*Agropyron cristatum*), Colorado wildrye (*Leymus ambiguus*) and needle and thread (*Hesperostipa comata*). In O-VMU1, 41 different species combine to exceed the forage production standard of 550 lbs/ac of air-dry forage by about 60%. Four-wing saltbush (*Atriplex canescens*) had the highest production in O-VMU1 with 152 lbs/ac and western wheatgrass producing slightly less at 122 lbs/ac.

The annual forage production data for O-VMU1 were not normally distributed (Figure C-3). A Box-Cox square root transformation of the production data did not result in a normal distribution (Figure C-4). Therefore, the annual forage production data were analyzed with a one-sample, one-sided sign test using the reverse null (MMD 1999). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was estimated to be 221 samples (Table 3). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean method (Clark 2001). Figure 6 illustrates the stabilization of the estimated mean and 90% CI for annual forage production. These data indicate that the mean stabilizes near 870 lbs/ac after the collection of 28 samples with little change in the mean or the 90% CI thereafter. This analysis suggests that the collection of additional data would not improve the precision of the estimate of forage production.

Evaluation of the data using the one-sample, one-sided sign test found 13 transects failed to meet 90% of the performance standard (495 lbs/ac) resulting in the probability (P) of 0.0197 of observing a z value less than -2.06. Therefore, under the reverse null hypothesis we conclude the performance standard is met for annual forage production for 2019 (Table C-4).

3.3 Shrub Density

Shrub density in O-VMU1 substantially exceeded the vegetation success standard of 400 stems/ac. Shrub density in O-VMU1 averaged 2,158 (± 477 [90% CI]) stems/ac based on the belt transect method (Table 3). Nineteen shrub species were encountered in the belt transects compared to 14 species along the LPI transects, reflecting the increased area of analysis associated with the belt transects (Tables A-1 and A-4). Four-wing saltbush and winterfat (*Krascheninnikovia lanata*) were the most common shrubs encountered (Table A-4).

The shrub density data for O-VMU1 were not normally distributed (Figure C-5). A Box-Cox square root transformation of the shrub density data resulted in a normal distribution (Figure C-6). Therefore, the Box-Cox squared root transformation of the shrub density data were analyzed with a one-sample, one-sided t test using the reverse null (MMD 1999). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for shrub density was estimated to be 205 samples (Table 3). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using the graphical stabilization of the mean method (Clark 2001). Figure 7 illustrates the stabilization of the estimated mean and 90% CI for shrub density. These data indicate that the mean stabilizes near 2,000 stems/ac after the collection of 24 samples with little change in the mean or 90% CI thereafter. This analysis suggests that the collection of additional data would not improve the precision of the estimate of shrub density.

The one-sided t-test calculated t*-statistic for O-VMU1 shrub density (Box-Cox square root transformation of stems/ac) is 11.14, where the sample mean is 83.02 with a standard deviation of 37.95, the technical standard is 18.00 and the sample size is 40. The one-tail $t_{(0.1,\ 39)}$ value is 1.304. Therefore, testing under the reverse null hypothesis ($t^* \geq t_{(1-\alpha;\ n-1)}$), we conclude that the performance standard for shrub density was met (Table C-5).

3.4 Composition and Diversity

Grasses dominated the perennial vegetation cover with thickspike and western wheatgrasses, being most prevalent (Table 4). Cool-season grasses dominate the vegetation in O-VMU1 reflecting the past seed mixes, season of seeding and sites continued ability to support a diverse group of cool-season grasses. Shrubs are important components of the reclamation and are dominated primarily by multiple saltbush species (*Atriplex spp.*) and secondarily by rubber rabbitbrush (*Ericameria nauseosa*) and winterfat. Fifteen perennial/biennial forbs species occurred on the LPI transects though they are minor contributors to foliar cover. The annual forbs including longleaf false goldeneye (*Heliomeris longifolia*), Russian thistle (*Salsola tragus*), and common sunflower (*Helianthus annuus*) were the most prevalent forbs from a cover perspective. The introduced long-lived perennial forage species, alfalfa (*Medicago sativa*), contributed a comparable amount of foliar cover and was the dominant perennial/biennial forb from a foliar cover perspective.

The revegetation standards for McKinley include a diversity standard or “lifeform statement” for grasses, forbs and shrubs (Table 2). Absolute foliar cover must exceed 7% for all perennial grass species combined. In O-VMU1, total foliar perennial grass cover is 22.8%. The diversity standard for cool-season perennial grasses is achieved by several species that exceeded 1.5% foliar cover including thickspike wheatgrass (6.75%), western wheatgrass (5.95%), and Indian ricegrass (1.90%, *Achnatherum hymenoides*). The diversity standard for warm-season grasses requires a minimum of two species combining to contribute 2% or more absolute foliar cover, each with 0.5% or more absolute foliar cover. Two warm-season grasses met the performance threshold including galleta (1.10%, *Pleuraphis jamesii*) and alkali sacaton (0.55%, *Sporobolus airoides*). With the addition of blue grama (0.40%, *Bouteloua gracilis*) absolute foliar cover for the warm-season grasses exceeds 2%. Thus, the perennial grass standards were achieved in O-VMU1.

The diversity standard for forbs requires at least three non-annual or noxious weed forbs combine for at least 1% relative foliar cover. Relative foliar cover in this context is defined as the percent foliar cover of a perennial/biennial species divided by the mean total species foliar cover of the sampling unit, excluding annuals and noxious weeds. As indicated in Section 3.1, the total perennial foliar cover for O-VMU1 is 33.7% and the relative foliar cover of individual species with respect to perennial cover is listed in Table 4. Fifteen perennial and biennial forbs combined to 6.82% relative foliar cover with greatest contributions from alfalfa (2.23%), curly-cup gumweed (0.89%, *Grindelia squarosa*), and gooseberryleaf globemallow (0.74%, *Sphaeralcea grossulariifolia*). Thus, the perennial forb diversity standard was achieved in O-VMU1.

The diversity standard for shrubs requires the combined foliar cover for all shrub species to be ≥ 3% and no single species to have > 70% relative shrub cover. Absolute total foliar cover for 14 shrubs (including two trees) was measured at 8.6% with four-wing saltbush and shadscale saltbush contributing 2.05% absolute cover each, combining to almost 50% relative total shrub cover (Figure 8). Thus, the diversity performance standards for shrubs were met.

The diversity standards also require that no single species, including weeds, have greater than 40% relative total vegetative cover. Relative total vegetative cover in this context is defined as the percent foliar cover of any recorded species divided by the mean total foliar cover for all live vegetation of the sampling unit, including noxious weeds. Thickspike wheatgrass (17.37%) and western wheatgrass (15.32%) had the highest relative foliar covers in O-VMU1 (Table 4), thus this portion of the diversity standard was achieved.

Based on the 2019 vegetation monitoring, 116 different plant species were present within the reclamation areas of O-VMU1 (Table 4). We encountered 28 grasses, 56 forbs, and 32 shrubs, trees, and cacti. Of the 28 grasses, 17 are cool-season perennials, eight are warm-season perennials and three are cool-season annuals. Of the 56 forbs, 14 are considered annuals where the remaining 42 have variable durations or are purely perennial. Cacti (one species) and trees (six species) were rare on the reclamation, while shrubs and subshrubs were more commonly observed (25 species).

During the 2019 monitoring program, we infrequently encountered four Class C noxious weeds (NMDA 2016) on O-VMU1. Class C noxious weeds are generally widespread in the state and managed at the local level based on feasibility of control and level of infestation. There were no noxious weeds recorded in O-VMU1 LPI transects but cheatgrass was recorded in the production quadrats (Table 4). Noxious weeds are not used in the assessment of revegetation success but are included when assessing if the VMU is dominated by one species. Noxious weeds observed on O-VMU1 were cheatgrass, musk thistle (*Carduus nutans*), saltcedar (*Tamarix ramosissima*) and Siberian elm (*Ulmus pumila*). The contribution of these species to the vegetation community is insignificant with densities much lower than native rangeland beyond the permit boundary. CMI continues to monitor for noxious weeds and actively controls them through husbandry practices that include annual services for weed management. Further, competition from desirable seeded and native species is expected to inhibit any substantial increase of noxious weeds in the reclamation.

The recruitment of native plants and establishment of seeded species within O-VMU1 is indicative of ecological succession and the capacity of the site to support a diverse and self-sustaining ecosystem.

4.0 SUMMARY

McKinley Mine’s vegetation success standards for the post-mining land uses of grazing and wildlife are based on total ground cover, perennial vegetation cover, annual forage production, shrub density, and diversity. The technical standards were developed through negotiations with OSM based on the analysis of historical vegetation data, interpretation of the ecological site potential, and the anticipated post-mining land uses. Results of the 2019 vegetation monitoring indicate that the vegetation community in O-VMU1 is well established and resilient considering grazing use by feral horses and below normal precipitation. The site is in full compliance with the vegetation success standards for the Permit Area based on the vegetation attributes measured in 2019.

Statistical hypothesis testing was performed on total ground cover, perennial vegetation cover and the Box-Cox square root transformed shrub density data using the one-sample, one-sided t-test. Statistical hypothesis testing was performed on the annual forage production data using the one-sample, one-sided sign test. All hypothesis testing used the reverse null hypothesis. Results of the statistical testing indicate that total ground cover, perennial vegetation cover, annual forage production and shrub density levels in O-VMU1 exceed their respective technical standards at the 90% level of confidence (Table 3). The diversity standards for perennial grasses, perennial forbs, shrubs, and single species relative dominance were achieved in O-VMU1 with 116 plant species observed or recorded on the reclamation (Table 4).

Overall, the performance of the vegetation in O-VMU1 is encouraging considering the grazing impacts and below average rainfall. The performance of the vegetation under these conditions suggests that the plant communities developing on these areas are diverse, effective, and permanent, capable of sustaining themselves under adverse conditions.

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Tables

Table 1: North Mine Seasonal and Annual Precipitation (2015-2019)

Year	Station	Area	Precipitation (inches)													
			January	February	March	April	May	June	July	August	September	October	November	December	Annual Total	Growing Season Total
2015	Rain Bluff	North Shop	1.39	1.21	0.11	0.35	1.54	1.15	2.81	1.91	0.51	1.18	1.16	0.74	14.06	8.27
	Rain 2	2				0.52	1.51	1.98	3.17	1.39	0.50	1.08	0.92		11.07	9.07
	Rain 3	3				0.57	1.80	1.77	3.61	3.06	0.44	1.36	0.86		13.47	11.25
	Rain 6	6				0.54	0.71	2.12	2.66	2.12	0.00	0.92	0.70		9.77	8.15
	Rain 10	10				0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78		9.01	7.13
	Rain 12	12				0.49	1.59	1.39	2.88	2.14	0.47	1.17	1.29		11.42	8.96
2016	Rain Bluff	North Shop	0.39	0.25	0.03	1.28	0.70	0.19	1.15	1.85	1.79	0.69	1.18	1.98	11.48	6.96
	Rain 2	2				0.17	0.58	0.14	2.22	0.71	0.87	0.21	0.02		4.92	4.69
	Rain 3	3				0.20	0.72	0.45	1.62	0.11	0.50	0.33	0.02		3.95	3.60
	Rain 6	6				0.20	0.75	0.29	2.00	0.40	1.19	0.19	0.02		5.04	4.83
	Rain 10	10				0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02		5.16	5.00
	Rain 12	12				0.30	0.78	0.36	1.34	0.49	1.16	0.18	0.05		4.66	4.43
2017	Rain Bluff[1]	North Shop	0.81	0.04	0.70	0.32	0.41	0.16	3.71	0.37	0.62	0.54	0.05	0.02	7.75	5.59
	Rain 2	2				1.28	0.66	0.22	0.78	2.08	1.46	0.63	0.44		7.55	6.48
	Rain 3	3				1.04	1.16	0.06	0.99	2.71	1.63	0.56	0.44		8.59	7.59
	Rain 6	6				0.86	1.50	0.02	0.96	2.04	1.52	0.38	0.51		7.79	6.90
	Rain 10	10				1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81		6.83	5.68
	Rain 12	12				1.17	0.91	0.05	0.88	1.89	1.77	0.47	0.46		7.60	6.67
2018	Rain Bluff	North Shop	0.23	0.48	0.44	0.08	0.22	0.28	2.17	0.00	1.00	NR	0.14	0.43	5.47	3.75
	Rain 2	2				0.06	0.26	0.30	1.10	0.90	1.40	1.48			5.50	4.02
	Rain 3	3				0.04	0.30	0.35	0.92	0.91	1.27	1.69			5.48	3.79
	Rain 6	6				0.03	0.21	0.46	0.97	0.56	1.02	1.45			4.70	3.25
	Rain 10	10				0.08	0.20	0.27	3.05	1.15	0.92	1.51			7.18	5.67
	Rain 12	12				0.06	0.37	0.26	1.08	1.36	1.09	1.54			5.76	4.22
2019	Rain Bluff	North Shop	0.95	0.98	1.10	0.24	0.17	0.03	0.03	1.14					4.64	1.61
	Rain 2	2				0.22	1.41	0.15	0.35	0.73					2.86	2.86
	Rain 3	3				0.39	1.50	0.32	0.70	0.11					3.02	3.02
	Rain 6	6				0.36	1.20	0.00	0.01	0.34					1.91	1.91
	Rain 10	10				0.20	1.49	0.37	0.19	0.27					2.52	2.52
	Rain 12	12				0.20	1.59	0.28	0.35	0.14					2.56	2.56
Window Rock, Long-term (029410)			0.72	0.68	0.88	0.61	0.49	0.47	1.75	2.05	1.23	1.14	0.83	0.95	11.80	6.60

Notes:

[1] Station experienced power issues in the summer that may have resulted in inaccurate precipitation readings.

Long-term averages are from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2019).

Growing season total precipitation is the sum of monthly totals between April and September; except for 2019 where data is only through August.

Table 2: Revegetation Success Standards from Table 5.1-1 in OSM Permit

Cover[1]	Total Ground Cover (Live Vegetation and Litter)[2]		≥ 52%
	Perennial Vegetation Cover[3]		≥ 24%
Diversity Lifeform Statement	Perennial Grasses	All Grasses	≥ 7% of cover
		Cool-season	≥ 2 species, each ≥ 1.5% cover
		Warm-season	≥ 2% contribution, ≥ 2 species, each ≥ 0.5% cover
	Perennial Forbs[4]		≥ 3 species, combining for ≥ 1% relative cover[a]
	Shrubs[4]	All Shrubs	≥ 3% cover
		Any single species	≤ 70% relative total shrub cover[b]
	Any single species (including weeds)[4,5]		≤ 40% relative total vegetative cover[c]
Production[1,6]	Pounds/acre (air dry)		550 lbs/ac
Woody Plant Density[1]			400/acre

Notes:

1) Success for cover, production, and stocking shall be ≥ 90% of the standard in accordance with 30 CFR 816.116 (a)(2).
2) Live vegetation cover is the mean total vegetation foliar cover of the sampling unit, NOT including noxious weeds.
3) Perennial vegetation cover is the mean total species foliar cover of the sampling unit, NOT including annuals and noxious weeds.
4) Relative cover (%) is calculated three ways to meet the requirements of the above diversity "lifeform statements:"
   [a] Relative Perennial/Biennial Cover (%) = the percent foliar cover of a perennial/biennial species divided by the mean total species foliar cover of the sampling unit, NOT including annuals and noxious weeds (#3).
   [b] Relative Shrub Cover (%) = the percent foliar cover of a shrub species divided by the mean total shrub foliar cover of the sampling unit; this does NOT include noxious shrubs or trees.
   [c] Relative Species Cover (%) = the percent foliar cover of a any recorded species divided by the mean total foliar cover for all live vegetation of the sampling unit, including noxious weeds.
5) Total vegetative cover is the mean total foliar cover for all live vegetation of the sampling unit, including noxious weeds.
6) Production is assessed for above-ground annual forage production in air dry pounds per acre (lbs/ac), forage does not include annuals or noxious weeds.

Table 3: Summary Statistics for O-VMU1, 2019

		Technical Standard
Total Ground Cover (%)[1]		
Mean	62.6	≥ 52%
Standard Deviation	10.9	
90% Confidence Interval	2.8	
N_{min}[2]	9	
Live Vegetation Foliar Cover (%)[3]		
Mean	38.9	None
Standard Deviation	7.5	
90% Confidence Interval	1.9	
N_{min}[2]	10	
Litter Cover (%)		
Mean	23.8	None
Standard Deviation	9.0	
90% Confidence Interval	2.4	
N_{min}[2]	41	
Perennial Vegetation Cover (%)[4]		
Mean	33.7	≥ 24%
Standard Deviation	10.2	
90% Confidence Interval	2.7	
N_{min}[2]	26	
Annual Forage Production (lbs/ac)[5]		
Mean	882	≥ 550 lbs/ac
Standard Deviation	779	
90% Confidence Interval	203	
N_{min}[2]	221	
Annual Total Production (lbs/ac)		
Mean	1,070	None
Standard Deviation	759	
90% Confidence Interval	197	
N_{min}[2]	143	
Woody Plant Density (stems/acre) from Belt Transect		
Mean	2,158	≥ 400/ac
Standard Deviation	1,835	
90% Confidence Interval	477	
N_{min}[2]	205	

Notes:

[1] Total ground cover is the combined means of live vegetation and litter cover for the sampling unit.

[2] Minimum number of samples required to obtain 90 percent probability that the sample mean is within 10 percent of the population mean

[3] Live vegetation cover is the mean total vegetation foliar cover of the sampling unit, NOT including noxious weeds.

[4] Perennial vegetation cover is the mean total species foliar cover of the sampling unit, NOT including annuals and noxious weeds.

[5] Production is assessed for above-ground annual forage production in air dry pounds per acre (lbs/ac), forage does not include annuals or noxious weeds.

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU1, 2019

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)[1]			Mean Annual Production (lbs/ac)[1,4]
			Foliar	Relative Foliar[2]	Relative Foliar[3]	
Cool-Season Grasses						
Annuals						
Bromus arvensis	Field brome	BRAR5	obs	--	obs	obs
Bromus tectorum	Cheatgrass	BRTE	obs	--	obs	5
Hordeum vulgare	Common barley	HOVU	obs	--	obs	obs
Perennials						
Achnatherum hymenoides	Indian ricegrass	ACHY	1.90	5.64	4.89	16
Agropyron cristatum	Crested wheatgrass	AGCR	1.30	3.86	3.35	48
Bromus inermis	Smooth brome	BRIN2	0.60	1.78	1.54	12
Elymus canadensis	Canada wildrye	ELCA	0.80	2.37	2.06	obs
Elymus glaucus	Blue wildrye	ELGL	obs	obs	obs	5
Elymus elymoides	Bottlebrush squirreltail	ELEL	0.10	0.30	0.26	8
Elymus lanceolatus ssp. lanceolatus	Thickspike wheatgrass	ELLAL	6.75	20.03	17.37	61
Elymus lanceolatus ssp. psammophilus	Streambank wheatgrass	ELLAP	0.20	0.59	0.51	12
Elymus trachycaulus	Slender wheatgrass	ELTR7	0.40	1.19	1.03	obs
Hesperostipa comata	Needle and thread	HECO26	1.30	3.86	3.35	32
Hordeum jubatum	Foxtail barley	HOJU	obs	obs	obs	obs
Leymus ambiguus	Colorado wildrye	LEAM	obs	obs	obs	46
Leymus cinereus	Basin wildrye	LECI	obs	obs	obs	obs
Pascopyrum smithii	Western wheatgrass	PASM	5.95	17.66	15.32	122
Phleum pratense	Timothy	PHPR	obs	obs	obs	obs
Pseudoroegneria spicata	Bluebunch wheatgrass	PSSP6	0.70	2.08	1.80	22
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	0.70	2.08	1.80	19
Warm-Season Grasses						
Perennials						
Bouteloua dactyloides	Buffalograss	BODA2	0.05	0.15	0.13	<1
Bouteloua gracilis	Blue grama	BOGR2	0.40	1.19	1.03	6
Bouteloua hirusta	Hairy grama	BOHI2	obs	obs	obs	obs
Distichlis spicata	Saltgrass	DISP	obs	obs	obs	obs
Panicum virgatum	Switchgrass	PAVI2	obs	obs	obs	obs
Pleuraphis jamesii	James' galleta	PLJA	1.10	3.26	2.83	14
Sporobolus airoides	Alkali sacaton	SPAI	0.55	1.63	1.42	<1
Sporobolus cryptandrus	Sand dropseed	SPCR	obs	obs	obs	<1

GOLDER

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU1, 2019

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)[1]			Mean Annual Production (lbs/ac)[1,4]
			Foliar	Relative Foliar[2]	Relative Foliar[3]	
Forbs						
Annuals						
Alyssum desertorum	Desert madwort	ALDE	0.40	--	1.03	18
Alyssum simplex	Alyssum	ALSI8	0.05	--	0.13	obs
Chenopodium leptophyllum	Narrowleaf goosefoot	CHLE4	0.15	--	0.39	5
Chenopodium album	Lambsquarters	CHAL7	0.20	--	0.51	2
Cordylanthus wrightii	Wright's bird's beak	COWR2	obs	--	obs	obs
Eriogonum cernuum	Nodding buckwheat	ERCE2	obs	--	obs	obs
Helianthus annuus	Common sunflower	HEAN3	0.90	--	2.32	45
Helianthus petiolaris	Prairie sunflower	HEPE	0.20	--	0.51	6
Heliomeris longifolia	Longleaf false goldeneye	HELO6	1.65	--	4.25	38
Kochia scoparia	Kochia	KOSC	0.20	--	0.51	5
Malacothrix fendleri	Fendler's desertdandelion	MAFE	obs	--	obs	<1
Polygonum erectum	Erect knotweed	POER2	obs	--	obs	obs
Salsola tragus	Russian thistle	SATR	1.35	--	3.47	64
Unknown Annual Forb 1	Unk annual forb 1	UNKAF1	0.05	--	0.13	obs
Perennials/Biennials						
Achillea millefolium	Common yarrow	ACMI2	obs	obs	obs	obs
Allium cernuum	Nodding onion	ALCE2	obs	obs	obs	obs
Asclepias subverticillata	Horsetail milkweed	ASSU2	obs	obs	obs	obs
Astragalus allochrous	Halfmoon milkvetch	ASAL6	0.10	0.30	0.26	obs
Calochortus nuttallii	Sego lily	CANU3	obs	obs	obs	obs
Carduus nutans	Musk thistle	CANU4	obs	obs	obs	obs
Castilleja linariifolia	Wyoming Indian paintbrush	CALI4	obs	obs	obs	obs
Chaetopappa ericoides	Rose heath	CHER	0.15	0.45	0.39	<1
Conyza canadensis	Horseweed	COCA	obs	obs	obs	obs
Descurainia sophia	Flixweed	DESO	0.15	0.45	0.39	3
Erigeron divergens	Spreading fleabane	ERDI4	obs	obs	obs	obs
Eriogonum wrightii	Bastardsage	ERWR	obs	obs	obs	obs
Erodium cicutarium	Redstem stork's bill	ERCI6	0.05	0.15	0.13	<1
Gaillardia pulchella	Indian blanket	GAPU	obs	obs	obs	obs
Grindelia hirsutula	Hairy gumweed	GRHI	obs	obs	obs	obs
Grindelia nuda var. aphanactis	Curlytop gumweed	GRNUA	obs	obs	obs	9
Grindelia squarosa	Curly-cup gumweed	GRSQ	0.30	0.89	0.77	34
Ipomopsis aggregata	Scarlet gilia	IPAG	obs	obs	obs	obs
Ipomopsis longiflora	Flaxflowered ipomopsis	IPLO	obs	obs	obs	obs
Ipomopsis multiflora	Manyflowered ipomopsis	IPMU	0.05	0.15	0.13	<1
Lactuca serriola	Prickly lettuce	LASE	0.05	0.15	0.13	<1
Lappula occidentalis	flatspine stickseed	LAOC3	obs	obs	obs	obs
Linum lewisii	Lewis flax	LILE	0.10	0.30	0.26	obs
Machaeranthera canescens	Purple aster	MACA	obs	obs	obs	obs
Machaeranthera tanacetifolia	Tanseyleaf tansyaster	MATA	0.10	0.30	0.26	obs
Medicago sativa	Alfalfa	MESA	0.75	2.23	1.93	30
Melilotus officinalis	Yellow sweetclover	MEOF	obs	obs	obs	obs
Mirabilis linearis	Narrowleaf four-o'clock	MILI	obs	obs	obs	obs
Mirabilis multiflora	Colorado four o'clock	MIMU	0.05	0.15	0.13	5
Penstemon barbatus	Beardlip penstemon	PEBA2	obs	obs	obs	obs
Penstemon palmeri	Palmer's penstemon	PEPA8	0.05	0.15	0.13	<1
Polygonum aviculare	Prostrate knotweed	POAV	obs	obs	obs	obs
Ratibida columnifera	Upright prairie coneflower	RACO3	obs	obs	obs	obs
Rumex crispus	Curly dock	RUCR	obs	obs	obs	obs
Sisymbrium altissimum	Tall tumblemustard	SIAL2	obs	obs	obs	obs
Sphaeralcea coccinea	Scarlet globemallow	SPCO	obs	obs	obs	1
Sphaeralcea grossulariifolia	Gooseberryleaf globemallow	SPGR2	0.25	0.74	0.64	<1
Sphaeralcea incana	Gray globemallow	SPIN2	obs	obs	obs	obs
Sphaeralcea parvifolia	Small-leaf globemallow	SPPA2	0.05	0.15	0.13	<1
Tetraneuris ivesiana	Ives' fournerved daisy	TEIV	obs	obs	obs	<1
Tragopogon dubius	Yellow salsify	TRDU	0.10	0.30	0.26	<1
Tragopogon porrifolius	Salsify	TRPO	obs	obs	obs	obs

GOLDER

Table 4: Average and Relative Foliar Cover and Production by Species, O-VMU1, 2019

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)[1]			Mean Annual Production (lbs/ac)[1,4]
			Foliar	Relative Foliar[2]	Relative Foliar[3]	
Shrubs, Trees, and Cacti						
Perennials						
Artemisia frigida	Prairie sagewort	ARFR4	0.05	0.15	0.13	obs
Artemisia tridentata	Big sagebrush	ARTR2	0.20	0.59	0.51	obs
Atriplex canescens	Four-wing saltbush	ATCA	2.05	6.08	5.28	152
Atriplex confertifolia	Shadscale saltbush	ATCO	2.05	6.08	5.28	97
Atriplex corrugata	Mat saltbush	ATCO4	0.30	0.89	0.77	obs
Atriplex gardneri	Gardner's saltbush	ATGA	1.45	4.30	3.73	6
Atriplex obovata	Mound saltbush	ATOB	obs	obs	obs	<1
Atriplex sp.	Undifferentiated saltbush species	ATRIP	obs	obs	obs	obs
Cercocarpus montanus	Mountain mahogany	CEMO	obs	obs	obs	obs
Chrysothamnus depressus	Longflower rabbitbrush	CHDE2	obs	obs	obs	obs
Ericameria nauseosa	Rubber rabbitbrush	ERNA	1.10	3.26	2.83	52
Fallugia paradoxa	Apache plume	FAPA	0.05	0.15	0.13	obs
Gutierrezia sarothrae	Broom snakeweed	GUSA	0.25	0.74	0.64	4
Heterotheca villosa	Hairy false goldenaster	HEVI	0.05	0.15	0.13	obs
Juniperus monosperma	Oneseed juniper	JUMO	0.05	0.15	0.13	obs
Krascheninnikovia lanata	Winterfat	KRLA	0.75	2.23	1.93	48
Lycium torreyi	Torrey wolfberry	LYTO	obs	obs	obs	obs
Opuntia polyacantha	Plains pricklypear	OPPO	obs	obs	obs	obs
Pinus edulis	Piñon pine	PIED	0.05	0.15	0.13	obs
Populus deltoides	Cottonwood	PODE	obs	obs	obs	obs
Purshia mexicana	Mexican cliffrose	PUME	obs	obs	obs	obs
Purshia tridentata	Antelope bitterbrush	PUTR2	0.20	0.59	0.51	12
Rhus trilobata	Skunkbush sumac	RHTR	obs	obs	obs	obs
Ribes cereum	Wax currant	RICE	obs	obs	obs	obs
Rosa woodsii	Woods' rose	ROWO	obs	obs	obs	obs
Salix exigua	Narrowleaf willow	SAEX	obs	obs	obs	obs
Senecio flaccidus	Threadleaf groundsel	SEFL	obs	obs	obs	<1
Tamarix ramosissima	Saltcedar	TARA	obs	obs	obs	obs
Tetradymia canescens	Gray horsebrush	TECA	obs	obs	obs	obs
Ulmus pumila	Siberian elm	ULPU	obs	obs	obs	obs
Yucca baccata	Banana yucca	YUBA	obs	obs	obs	obs
Yucca glauca	Soapweed yucca	YUGL	obs	obs	obs	obs
Cover Components						
Perennial Vegetation Cover[5]			33.7			
Live Vegetation Cover[6]			38.9			
Rock			5.0			
Litter			23.8			
Bare Soil			32.4			

Notes:

[1] obs = observed on vegetation management unit during monitoring, but not recorded for the method

[2] Relative foliar cover here is calculated as defined by note 4) [a] in Table 2; Relative Perennial/Biennial Cover (%) = the percent foliar cover of a perennial/biennial species divided by the mean total species foliar cover of the sampling unit, NOT including annuals and noxious weeds.

[3] Relative foliar cover here is calculated as defined by note 4) [c] in Table 2; Relative Species Cover (%) = the percent foliar cover of any recorded species divided by the mean total foliar cover for all live vegetation of the sampling unit, including noxious weeds.

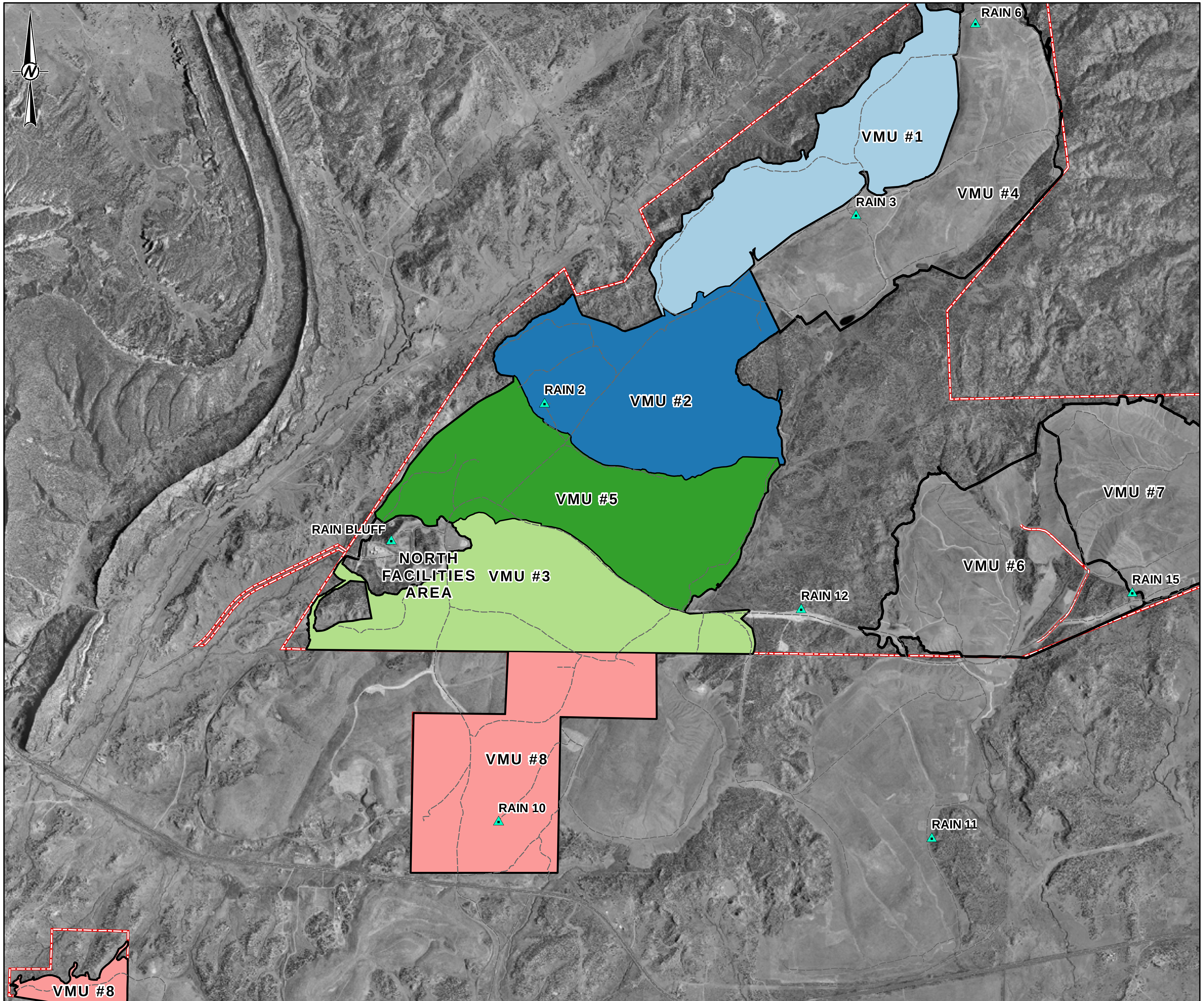
[4] Air-dry above-ground annual production in pounds per acre (lbs/ac); forage does not include annuals or noxious weeds.

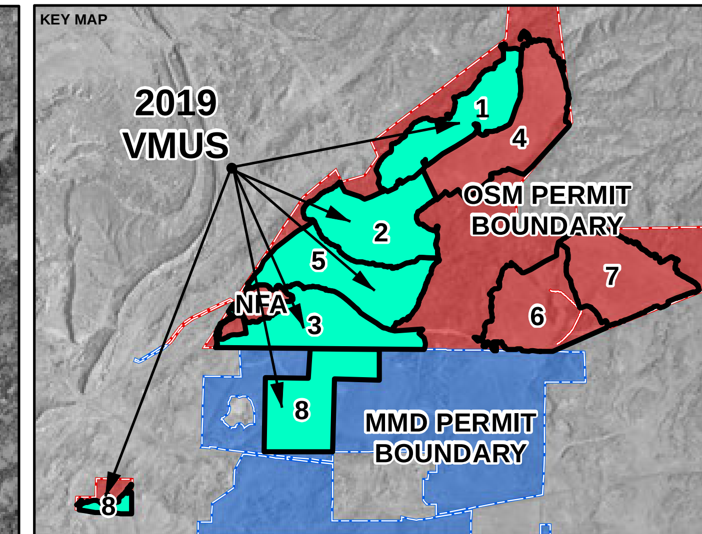
[5] Perennial vegetation cover is the mean total species foliar cover of the sampling unit, NOT including annuals and noxious weeds.

[6] Live vegetation cover is the mean total vegetation foliar cover of the sampling unit, NOT including noxious weeds; no noxious weeds recorded by the LPI method on this VMU.

General Notes:
Ps Pathway or growing season for the grasses is from Allred (2005)
Duration for plants is from the USDA Plants Database

Figures





LEGEND

- Rain_Gauges
- Mine Site Roads
- OSM VMU 1 (~ 934 acres)
- OSM VMU 2 (~ 1,085 acres)
- OSM VMU 3 (~ 970 acres)
- OSM VMU 5 (~ 1,129 acres)
- OSM VMU 8 (~ 1,045 acres)
- OSM Permit Boundary

0 3,500 7,000
1 " = 3,500 feet Feet

NOTE(S)
1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN
2. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS

REFERENCE(S)
1. COORDINATE SYSTEM: NAD 1927, STATE PLANE - NEW MEXICO, WEST (FIPS 3003)
2. ORTHOIMAGE: CHEVRON, 2013

CLIENT
CHEVRON MINING, INC. - MCKINLEY MINE
24 MILES, NW HWY 264
MENTMORE, NM 87319

PROJECT
MCKINLEY MINE – OSM PERMIT PHASE III BOND RELEASE
2019 VEGETATION SAMPLING PROGRAM

TITLE
GENERAL OVERVIEW OF MCKINLEY OSM PERMIT AREA VEGETATION MANAGEMENT UNITS (VMU), 2019

CONSULTANT
GOLDER

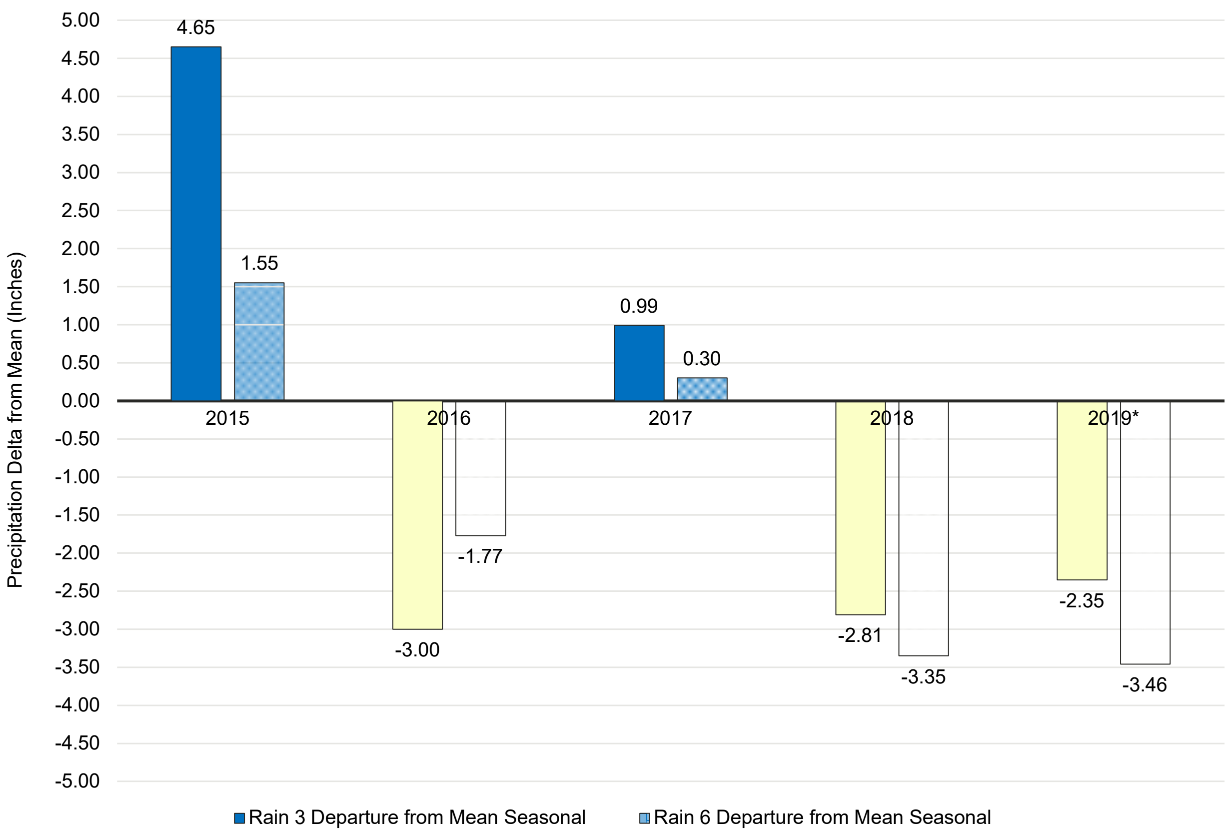
YYYY-MM-DD	2020-02-20
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR/FR
APPROVED	MS

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105207	000650	--	1

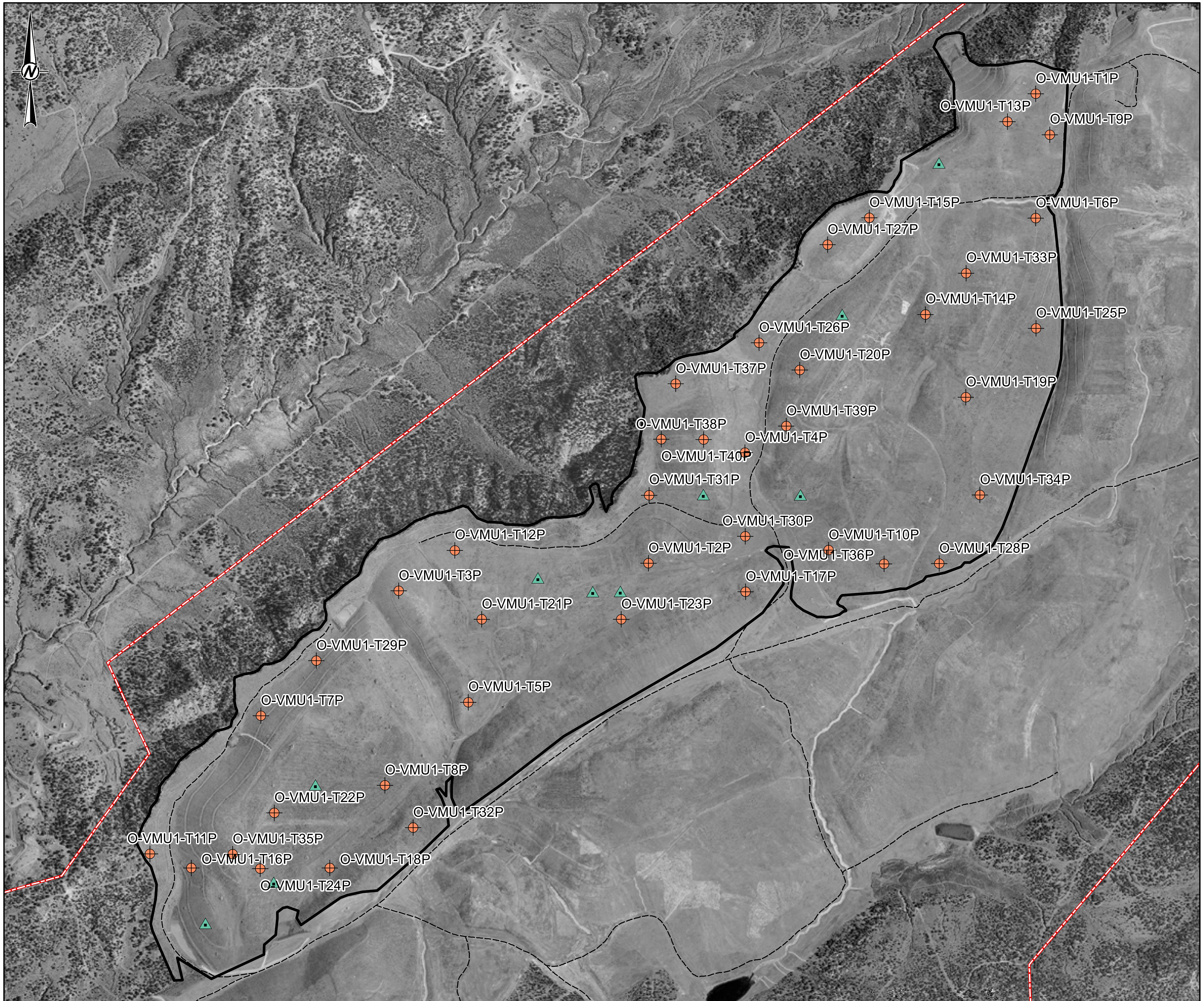
PATH: W:\McKinley\MXDs\OSM_2019\1338105207_000650_Fig1_OSM-VMU_Overview.mxd PRINTED ON: 2020-02-18 AT: 1:46:39 PM

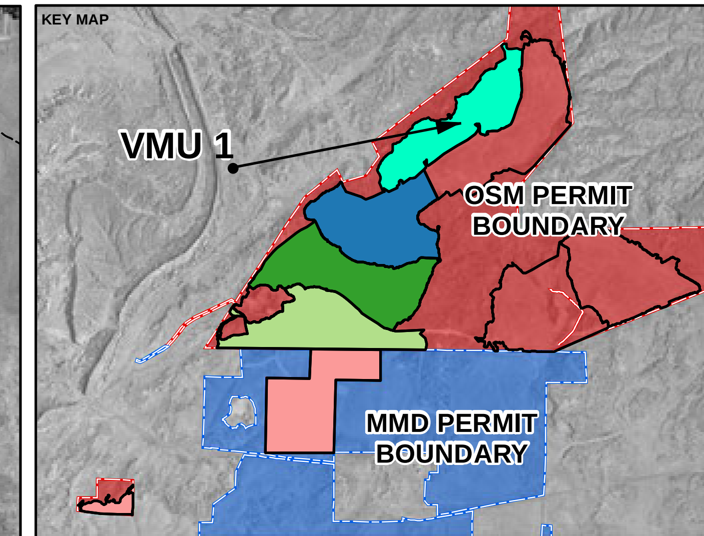
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B
1 in

Figure 2: Departure of Growing Season Precipitation from Long-Term Seasonal Mean at Window Rock; Rain 3 and 6 Gages



Notes:
Long-term seasonal mean is from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2019).
Growing season total precipitation is the sum of monthly totals between April and September
* The Seasonal mean for 2019 is assessed for April through August (Table 1)





LEGEND

- Vegetation Transect - Sampled
- Vegetation Transect - Additional Alternate
- Mine Site Roads
- OSM VMU 1 (~ 934 acres)
- OSM Permit Boundary

TRANSECT LABEL EXPLANATION

O-VMU1-T1P

OSM Permit Area | Vegetation Management Unit (VMU#) | Transect Number | Primary (P) or Alternate (A)

0 | 1,200 | 2,400

1 " = 1,167 feet | Feet

NOTE(S)

1. KEY MAP SCALE IS DIFFERENT FROM VMU TRANSECT MAP

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1927, STATE PLANE - NEW MEXICO, WEST (FIPS 3003)
2. ORTHOIMAGE: CHEVRON, 2013

CLIENT

CHEVRON MINING, INC. - MCKINLEY MINE
24 MILES, NW HWY 264
MENTMORE, NM 87319

PROJECT

MCKINLEY MINE – OSM PERMIT PHASE III BOND RELEASE
2019 VEGETATION SAMPLING PROGRAM

TITLE

VEGETATION MONITORING TRANSECTS, 2019
VEGETATION MANAGEMENT UNIT 1

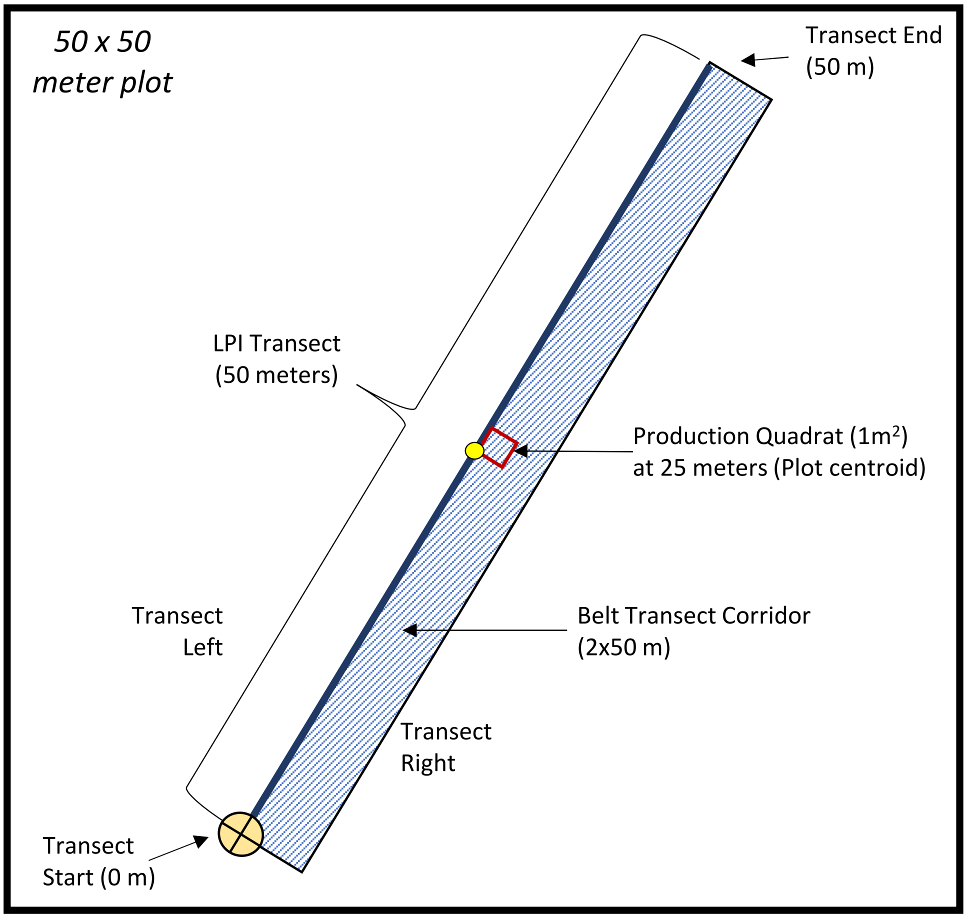
CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-20
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR/FR
APPROVED	MS

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105207	000651	--	3

Figure 4: Vegetation Plot and Transect Layout



*Transect midpoint placed on plot centroid and oriented randomly (0-360 degrees)

Not to Scale

Figure 5: Typical Grass-Shrubland Vegetation in O-VMU1, August 2019

Figure 6: Stabilization of the Mean for Annual Forage Production - O-VMU-1

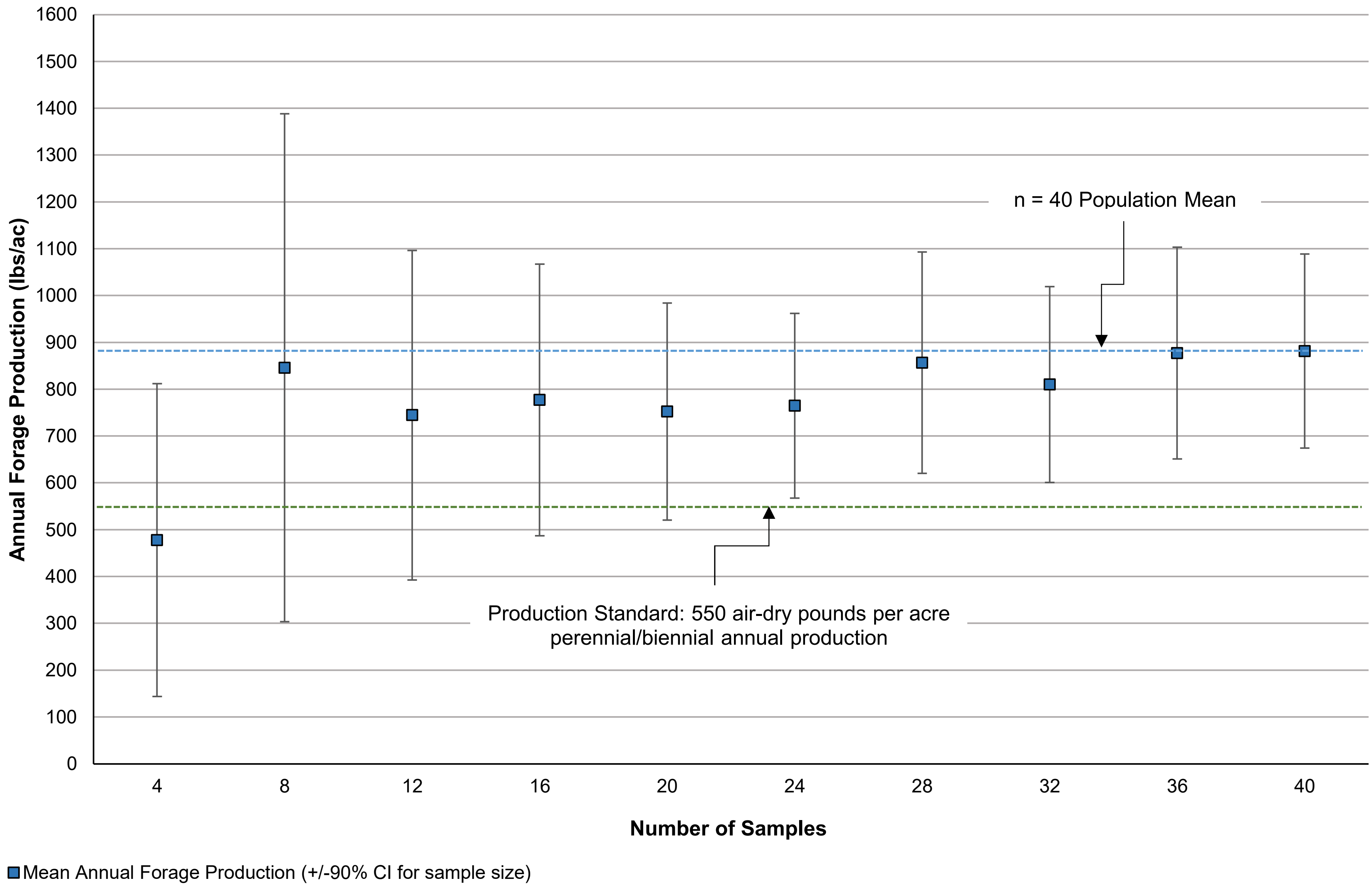


Figure 7: Stabilization of the Mean for Shrub Density - O-VMU-1

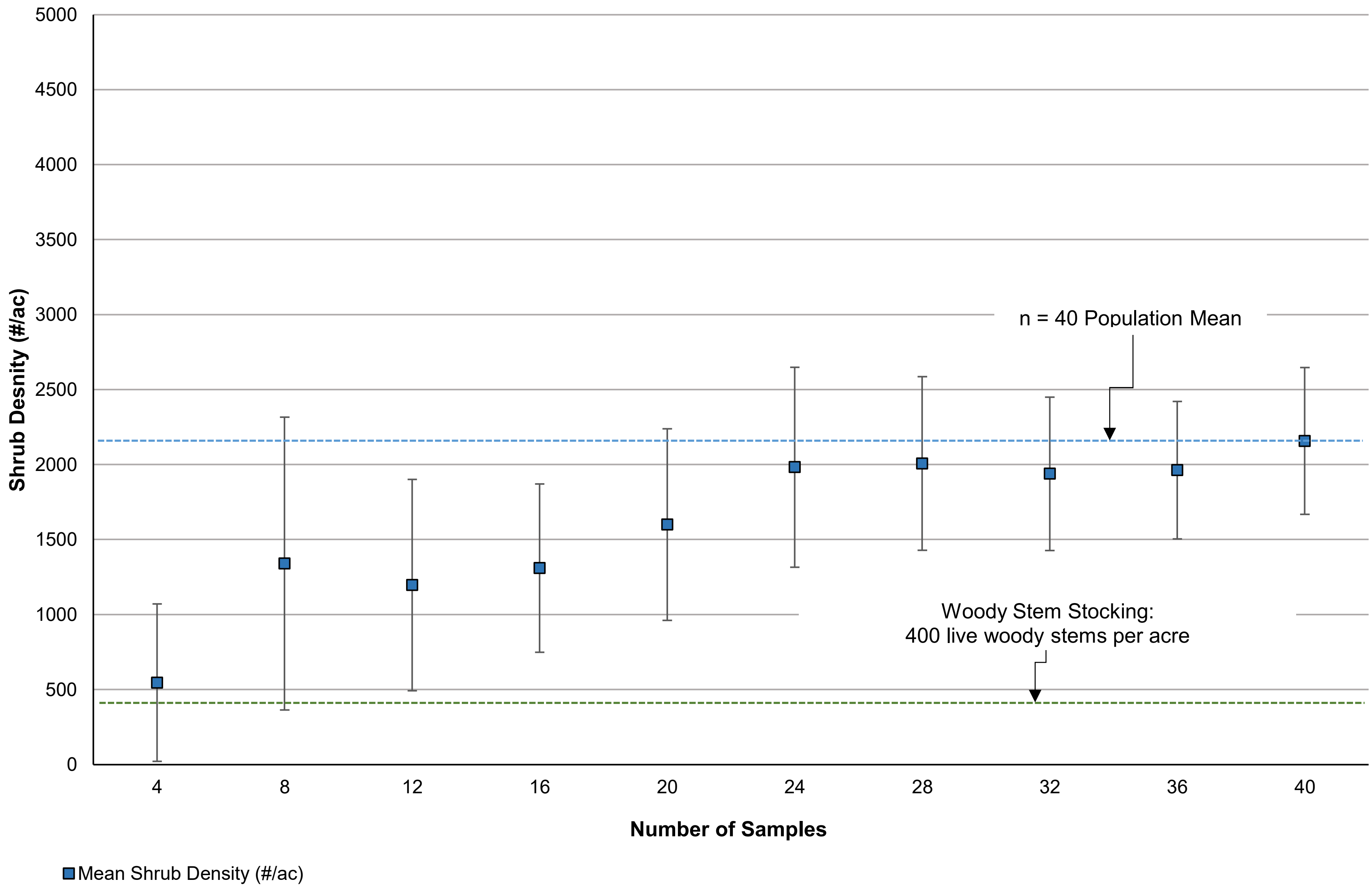
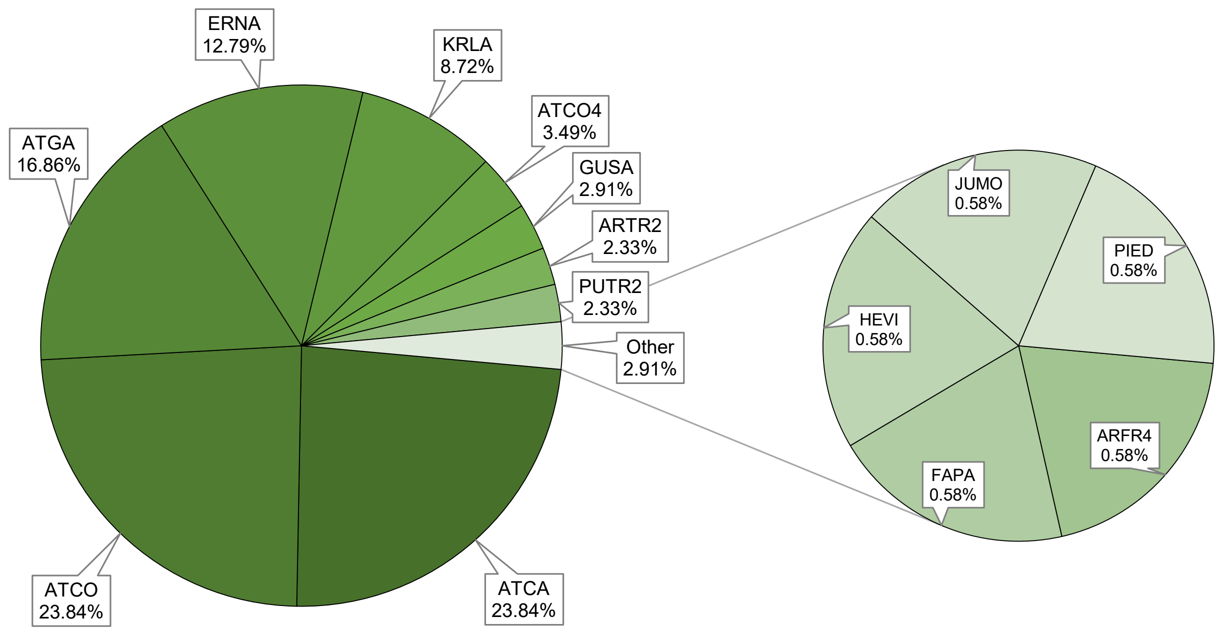


Figure 8: Relative Total Shrub, Tree, and Cacti Foliar Cover for O-VMU1

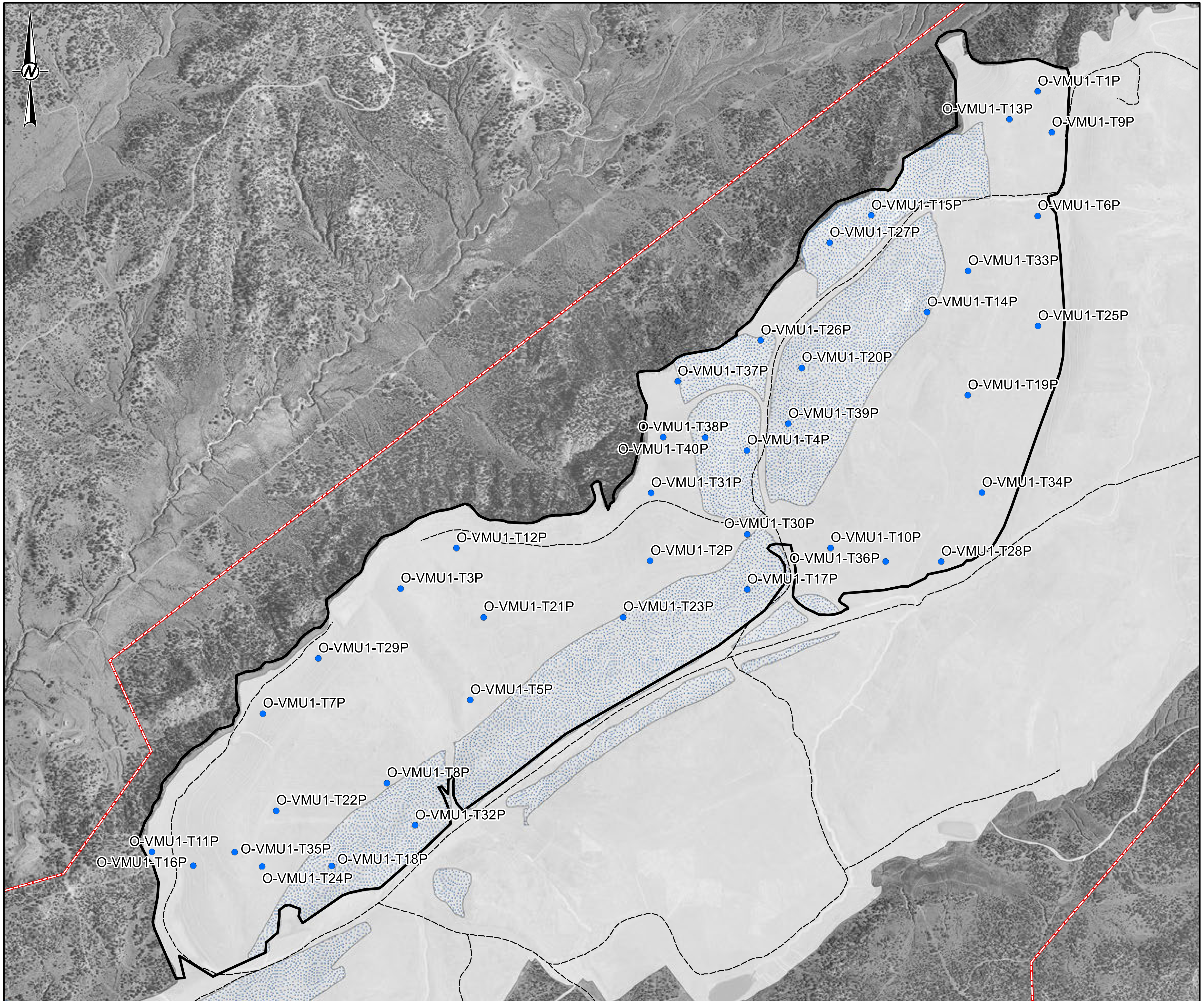


Explanation:

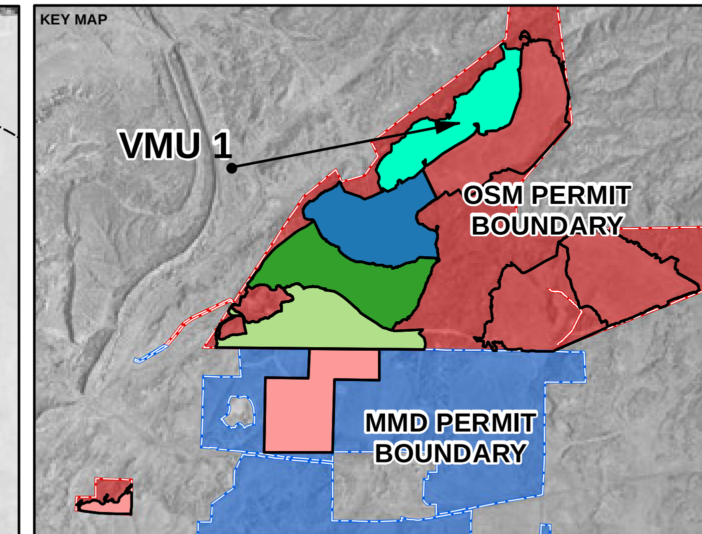
Scientific Name	Common Name	Code	Shrub, Tree, and Cacti Foliar Cover (%)
Atriplex canescens	Four-wing saltbush	ATCA	2.05
Atriplex confertifolia	Shadscale saltbush	ATCO	2.05
Atriplex gardneri	Gardner's saltbush	ATGA	1.45
Ericameria nauseosa	Rubber rabbitbrush	ERNA	1.1
Krascheninnikovia lanata	Winterfat	KRLA	0.75
Atriplex corrugata	Mat saltbush	ATCO4	0.3
Gutierrezia sarothrae	Broom snakeweed	GUSA	0.25
Artemisia tridentata	Big sagebrush	ARTR2	0.2
Purshia tridentata	Antelope bitterbrush	PUTR2	0.2
Artemisia frigida	Prairie sagewort	ARFR4	0.05
Fallugia paradoxa	Apache plume	FAPA	0.05
Heterotheca villosa	Hairy false goldenaster	HEVI	0.05
Juniperus monosperma	Oneseed juniper	JUMO	0.05
Pinus edulis	Piñon pine	PIED	0.05
	Total Absolute Foliar Cover		**8.60**

APPENDIX A

Vegetation Data Summary



KEY MAP



LEGEND

- Vegetation Transect - Sampled
- Mine Site Roads
- OSM VMU 1 (~ 934 acres)
- Prelaw
- Initial Program
- Permanent Program
- OSM Permit Boundary

TRANSECT LABEL EXPLANATION

O-VMU1-T1P

OSM Permit Area | Vegetation Management Unit (VMU#) | Transect Number | Primary (P) or Alternate (A)

0 — 1,200 — 2,400 Feet

1 " = 1,167 feet

NOTE(S)

1. KEY MAP SCALE IS DIFFERENT FROM VMU TRANSECT MAP

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1927, STATE PLANE - NEW MEXICO, WEST (FIPS 3003)
2. ORTHOIMAGE: CHEVRON, 2013

CLIENT

CHEVRON MINING, INC. - MCKINLEY MINE
24 MILES, NW HWY 264
MENTMORE, NM 87319

PROJECT

MCKINLEY MINE – OSM PERMIT PHASE III BOND RELEASE
2019 VEGETATION SAMPLING PROGRAM

TITLE

PROGRAM LANDS AND TRANSECTS LOCATIONS SAMPLED VEGETATION MANAGEMENT UNIT 1 (O-VMU1), 2019

CONSULTANT

GOLDER

YYYY-MM-DD	2020-02-21
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR/FR
APPROVED	MS

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105207	000651	--	A-1

Table A-1: O-VMU1 Laser Point Intercept Transect Foliar Cover Data (hits)

O-VMU1 Transect	T1P	T2P	T3P	T4P	T5P	T6P	T7P	T8P	T9P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Perennials																																								
ACHY	--	--	1	--	--	--	--	--	2	1	2	3	--	--	3	3	--	--	1	1	--	2	--	2	--	3	--	--	--	2	1	3	--	--	4	--	--	2	2	--
AGCR	--	2	--	6	--	--	--	--	--	--	--	1	--	2	--	--	--	--	--	--	1	--	--	--	--	5	--	--	--	--	--	5	--	--	--	--	4	--	--	--
BODA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	3	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	2
BRIN2	--	--	--	--	--	1	--	--	--	--	--	--	--	10	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELCA	--	7	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
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ELLAL	13	--	2	2	--	--	3	--	7	12	1	--	3	1	--	1	--	6	3	3	2	--	--	3	--	7	--	11	6	14	--	5	5	4	--	8	--	8	5	--
ELLAP	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--
ELTR7	--	--	--	--	--	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	--	1	--	--	--	--	6	--	--	1	--	3	--	1	--	--	--	--	--	1	--	--	--	--	--	--	1	--	--	7	2	1	--	2	--	--
PASM	1	1	1	3	--	2	7	5	2	--	4	7	4	--	--	2	2	3	5	--	7	2	10	2	10	1	4	4	5	--	5	4	--	4	5	2	1	3	--	1
PLJA	--	--	--	2	--	--	--	10	--	--	--	--	--	1	--	--	1	1	1	--	--	3	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	1
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ALSI8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL7	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	2	--	--	--
CHLE4	--	--	--	--	--	1	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
HEAN3	--	--	1	--	3	--	--	--	4	--	--	--	1	--	--	--	1	--	--	2	2	--	--	--	--	--	--	--	--	--	3	--	--	--	1	--	--	--	--	--
HELO6	--	--	--	--	--	1	--	--	1	--	--	1	10	--	--	--	--	--	2	--	4	--	--	--	1	--	--	1	--	--	--	--	6	--	--	--	--	--	--	6
HEPE	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	--	1
SATR	1	--	2	--	4	--	--	--	1	2	--	3	--	--	--	--	1	--	1	--	--	--	2	2	--	--	--	--	--	--	6	--	2	--	--	--	--	--	--	--
UNKAF1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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MATA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--
TRDU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1	--	--	--	--	--	--
Annual/Biennial/Perennial																																								
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Annual/Perennial																																								
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Perennials																																								
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LILE	--	--	1	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MIMU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPGR2	--	--	2	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Shrubs, Trees, and Cacti																																								
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ARFR4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
ARTR2	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	2	--	--
ATCA	--	--	--	--	--	2	1	--	--	--	2	--	--	--	2	3	6	--	2	1	--	1	1	--	--	--	5	--	--	--	3	3	--	1	2	2	3	--	1	--
ATCO	1	--	--	--	--	3	--	2	--	--	--	--	1	1	1	2	4	--	2	--	1	2	--	2	1	--	2	--	--	--	2	5	--	1	--	6	1	1	--	--
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ERNA	1	--	--	2	2	--	--	--	--	1	--	--	--	--	--	--	--	3	--	--	1	--	--	--	--	--	--	2	--	1	--	--	--	--	1	--	--	--	7	1
FAPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	1	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	2	--
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PIED	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--
PUTR2	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	2	--	--	--	--	--	--
Cover Components																																								
Perennial Vegetation Cover[1]	17	15	7	17	4	26	19	24	13	16	21	12	10	18	15	19	17	23	14	14	20	18	19	18	14	19	17	20	19	19	14	27	5	24	19	21	14	19	18	9
Live Vegetation Cover[2]	18	15	10	17	15	28	21	24	19	18	22	16	21	18	16	21	19	23	17	18	27	18	21	24	15	19	18	21	20	19	23	27	14	24	20	21	17	19	18	16
Rock	0	0	7	2	3	1	1	1	5	1	3	2	3	2	4	2	2	5	0	4	0	1	1	0	1	8	2	1	2	3	1	4	4	0	8	2	2	2	3	7
Litter	12	15	9	6	7	11	21	14	12	13	10	9	17	14	16	14	16	8	14	17	10	22	6	11	15	8	23	5	18	5	10	7	10	10	8	8	9	11	10	14
Bare Soil	20	20	24	25	25	10	7	11	14	18	15	23	9	16	14	13	13	14	19	11	13	9	22	15	19	15	7	23	10	23	16	12	22	16	14	19	22	18	19	13

Notes:

Species codes defined in Table 4

1 Perennial vegetation cover is the total vegetation foliar hits for the transect, NOT including annuals and noxious weeds.

2 Live vegetation cover is the total vegetation foliar hits for the transect, NOT including noxious weeds; no noxious weeds recorded by the LPI method on this VMU.

Table A-2: O-VMU1 Quadrat Canopy Cover Data (%)

O-VMU1 Transect	T1P	T2P	T3P	T4P	T5P	T6P	T7P	T8P	T9P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses																																								
Annuals																																								
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10	8.00	--	--	--	--	0.05	--	0.85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
BRIN2	--	--	--	--	--	18.50	--	--	--	--	--	--	--	1.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELLAL	10.25	--	0.55	0.50	--	7.50	0.50	--	11.50	20.50	0.50	3.75	6.50	--	--	3.25	--	3.25	10.25	--	1.75	0.50	--	--	--	--	--	35.00	0.05	16.00	--	18.25	--	13.50	--	--	--	21.50	6.50	--
ELLAP	0.75	--	--	--	--	3.25	--	--	10.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	--	5.65	1.50	--	--	31.00	0.25	0.15	--	0.50	0.50	38.00	--	--	12.50	9.50	0.75	9.00	8.30	14.75	2.75	29.40	7.75	8.50	13.00	15.50	13.50	19.00	--	7.75	--	--	0.75	15.00	2.50	--	15.00	0.25	--
PSSP6	--	--	--	--	--	--	7.50	--	1.00	4.00	0.15	2.25	--	--	--	--	--	8.00	--	--	2.75	--	--	0.75	--	--	--	--	3.25	--	--	--	--	--	--	--	--	--	--	--
ACHY	--	--	8.35	--	--	--	--	--	0.10	T	7.50	7.10	--	--	0.05	0.50	--	--	5.50	0.10	--	T	2.05	5.15	1.30	--	--	4.25	0.25	11.75	--	0.30	0.10	--	--	1.50	T	--	0.75	0.10
THIN6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AGCR	--	--	--	19.00	--	--	--	--	--	--	--	--	--	31.25	--	--	--	--	--	--	--	--	--	--	--	5.25	--	--	--	--	--	4.25	--	--	--	--	6.75	--	--	--
BOGR2	--	--	--	18.00	--	--	--	--	--	--	--	--	--	--	--	--	--	22.00	--	--	--	--	--	--	--	0.10	--	--	--	--	--	0.10	--	--	--	--	--	--	--	--
ELEL	--	--	--	--	--	--	0.15	--	--	--	--	--	--	--	--	--	--	--	0.10	--	--	--	--	--	0.50	--	--	--	--	--	--	--	0.50	--	--	--	--	--	--	0.50
HECO26	--	--	--	--	--	--	--	--	--	--	9.75	--	--	0.10	--	5.25	--	--	--	--	3.25	--	--	2.00	--	--	--	2.50	--	--	14.50	--	--	20.25	0.75	3.00	--	4.50	--	--
PLJA	--	--	--	--	--	--	--	3.25	--	--	--	--	--	--	--	--	--	6.75	--	--	--	--	--	--	19.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELGL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.25	--	--	--
LEAM	--	20.50	--	--	--	--	--	51.80	--	--	--	--	--	--	--	--	--	2.85	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.00	--	--	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--
BODA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annuals																																								
SATR	0.50	2.00	5.25	0.10	16.00	0.40	--	--	0.40	0.10	--	6.50	0.75	0.05	--	--	5.25	0.05	3.25	0.50	0.20	--	0.55	--	4.75	--	--	--	--	--	17.00	--	8.00	2.50	0.10	1.40	1.10	--	0.05	2.25
HELO6	--	--	--	--	--	0.60	--	--	0.10	--	--	1.00	4.00	--	T	6.25	--	--	2.75	0.60	0.75	--	0.05	--	--	--	0.10	2.00	--	--	--	--	6.00	--	--	5.50	--	--	--	18.50
HEAN3	--	--	0.75	--	0.50	--	--	--	0.50	--	--	5.00	17.25	--	--	--	--	0.25	--	0.40	6.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.10	0.85	--	--	--
CHLE4	--	1.60	--	--	0.15	--	--	--	--	--	--	0.25	0.50	--	--	--	1.75	--	--	0.60	--	--	--	--	--	--	T	--	--	--	6.00	--	--	--	--	--	--	--	--	--
ALDE	--	--	--	--	--	--	0.75	--	--	--	11.00	--	--	--	--	4.00	--	--	--	12.00	--	--	--	12.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.00	--	--	--	--	--	--	--	--	--	--	--	--	3.00	--	--	--	1.00	--	--	4.00
CHAL7	--	1.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10	--	--	--	--	--	--	--	1.00	--	--	0.10	--	--	--	--	0.65	--	--	--
MAFE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HEPE	--	--	--	--	4.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Annual/Biennial																																								
DESO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.00	2.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TRDU	--	--	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.50	--	--	--	--	--	--	--	--
LASE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--
ERCI6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Annual/Biennial/Perennial																																								
GRSQ	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.35	--	--	16.25	--	--	0.25	--	--	9.90	--	--	--	--	--	3.50	--	--	--	--	--	--	--
GRNUA	--	--	--	--	--	--	5.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.75	--	--	--	--	--	--	--	--	--	--	--
Annual/Perennial																																								
MESA	--	--	--	--	--	--	--	--	--	--	--	5.90	--	--	--	--	--	10.00	--	--	5.50	--	--	--	--	9.25	--	--	--	--	--	--	--	14.00	--	29.00	--	--	--	--
Perennials																																								
MIMU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPPA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.35	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--
SPGR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.70	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.50	--	--	--	--	--	--
PEPI3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TEIV	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrubs, Trees, and Cacti																																								
Perennials																																								
ATCA	--	--	T	--	--	--	--	--	--	--	--	--	--	--	28.50	10.50	19.50	0.15	7.25	4.25	--	--	--	--	--	--	--	--	--	--	--	17.50	--	--	21.00	48.50	--	--	--	--
ATCO	--	--	--	--	--	6.00	43.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	36.50	--	--	--	--	--	--	0.25	--	--	T	--	--	--
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	14.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	14.75	--	--	--	--	--	--	--	--	--	T	--	--	T	--	--	--	--	--	--	--	--	--	--	--	0.05	0.15	6.50	--	0.10	--	--	--	--	--	--	33.00	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.25	--	--	--	--	--	--	--	--	--	--	--	2.20	--	--	--	1.75	--	--	--
KRLA	--	0.05	--	--	5.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	37.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.00
PUTR2	--	--	--	--	--	--	--	--	--	--	26.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATOB	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--
SEFL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																								
Perennial Vegetation Cover[1]	11.0	20.6	29.4	39.0	5.3	35.3	87.2	55.3	23.0	24.5	44.9	19.6	44.5	33.1	51.1	34.5	29.0	56.0	32.1	13.0	46.5	41.0	31.5	35.6	31.3	27.6	61.9	55.4	24.5	34.3	22.3	42.0	6.3	56.0	36.8	84.5	14.8	41.0	40.5	16.6
Total Vegetation Cover[2]	10.5	25.3	31.5	38.5	25.5	31.5	73.0	54.8	23.5	24.0	55.3	30.6	62.5	32.5	48.5	38.6	43.5	52.0	37.0	22.0	51.5	40.2	31.8	45.5	28.0	25.5	56.5	56.5	24.0	32.5	34.0	29.5	23.0	58.5	34.0	65.0	18.0	40.0	34.0	41.0
Rock	0.5	2.0	5.5	0.5	3.1	1.0	1.0	0.2	1.0	1.5	3.0	1.1	0.8	0.3	1.5	1.3	0.5	0.8	0.5	3.3	1.0	16.0	15.0	0.1	4.5	3.3	2.5	0.3	1.8	7.0	0.3	1.5	0.3	0.3	2.5	2.5	0.8	0.5	3.5	2.5
Litter	11.0	17.5	3.0	18.0	2.4	24.5	3.5	6.5	6.5	2.8	10.0	11.0	12.5	10.3	4.0	10.5	46.5	3.5	1.5	9.0	2.5	1.8	8.3	5.0	8.5	0.3	1.5	5.3	6.3	7.0	4.0	4.3	9.0	19.0	3.0	6.6	16.0	8.8	1.5	26.0
Bare Soil	78.0	55.3	60.0	43.0	69.0	43.0	22.5	38.5	69.0	71.8	31.8	57.3	24.3	57.0	46.0	49.7	9.5	43.8	61.0	65.8	45.0	42.0	45.0	49.4	59.0	71.0	39.5	38.0	68.0	53.5	61.8	64.8	67.8	22.3	60.5	25.9	65.3	50.8	61.0	30.5

Notes:

Species codes defined in Table 4

[1] Perennial vegetation cover is the total species canopy cover for the transect, NOT including annuals and noxious weeds.

[2] Total vegetation canopy cover for the transect by the quadrat canopy cover estimate method.

Table A-3: O-VMU1 Air-dry Aboveground Annual Production Data

O-VMU1 Transect	T1P	T2P	T3P	T4P	T5P	T6P	T7P	T8P	T9P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Grasses (g/m²)																																								
Annuals																																								
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.11	20.31	--	--	--	--	0.05	--	0.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
ACHY	--	--	13.01	--	--	--	--	--	0.05	0.05	13.91	9.71	--	--	3.91	0.51	--	--	4.11	0.01	--	0.05	1.31	1.91	1.01	--	--	3.51	0.05	14.61	--	0.01	0.01	--	--	1.41	0.31	--	0.81	0.31
AGCR	--	--	--	75.91	--	--	--	--	--	--	--	--	--	75.41	--	--	--	--	--	--	--	--	--	--	--	30.51	--	--	--	--	--	4.91	--	--	--	--	27.71	--	--	--
BODA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	--	--	14.61	--	--	--	--	--	--	--	--	--	--	--	--	--	13.51	--	--	--	--	--	--	--	0.05	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	49.71	--	--	--	--	--	--	--	5.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	--	--	--	--	0.11	--	--	32.71	--	--	--	--	--	--	--	--	0.21	--	--	--	--	--	1.41	--	--	--	--	--	--	--	0.41	--	--	--	--	--	--	2.11
ELGL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23.31	--	--	--
ELLAL	21.51	--	0.61	2.21	--	15.41	2.51	--	20.51	--	4.11	8.31	4.81	--	--	3.91	--	13.21	16.71	--	5.81	1.01	--	--	--	--	--	38.81	0.01	28.31	--	19.61	--	22.21	--	--	--	38.31	6.71	--
ELLAP	1.61	--	--	--	--	3.61	--	--	49.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	--	--	--	--	--	--	23.01	--	--	0.51	--	12.61	--	--	--	--	6.21	--	--	6.81	--	--	--	4.31	--	--	27.11	--	--	53.31	2.91	3.61	--	4.51	--	--
LEAM	--	36.71	--	--	--	--	--	158.01	--	--	--	--	--	--	--	--	--	10.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	--	5.31	3.31	--	--	60.91	0.21	1.41	--	0.91	0.51	29.51	--	--	28.91	27.91	12.31	29.71	16.71	13.31	5.31	48.61	15.81	16.81	19.31	37.61	26.81	35.41	--	22.31	--	--	3.01	33.41	0.41	--	50.01	1.11	--
PLJA	--	--	--	--	--	--	--	2.61	--	--	--	--	--	--	--	--	--	9.11	--	--	--	--	--	--	50.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PSSP6	--	--	--	--	--	--	45.71	--	4.01	8.31	0.11	0.51	--	--	--	--	--	18.81	--	--	12.11	--	--	2.51	--	--	--	--	4.71	--	--	--	--	--	--	--	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--
SPCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.81	--	--	--	--	--	--
THIN6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	84.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs (g/m²)																																								
Annuals																																								
ALDE	--	--	--	--	--	--	13.61	--	--	--	20.21	--	--	--	--	1.91	--	--	--	13.11	--	--	--	29.71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL7	--	2.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	5.41	--	--	0.01	--	--	--	--	3.11	--	--	--
CHLE4	--	2.51	--	--	0.21	--	--	--	--	--	--	0.21	0.41	--	--	--	2.61	--	--	4.01	--	--	--	--	--	--	0.05	--	--	--	11.21	--	--	--	--	--	--	--	--	--
HEAN3	--	--	3.91	--	5.11	--	--	--	52.91	--	--	28.21	51.51	--	--	--	--	1.41	--	1.31	26.51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	21.11	11.41	--	--	--
HELO6	--	--	--	--	--	1.31	--	--	0.05	--	--	2.91	6.41	--	0.11	28.21	--	--	3.61	1.01	0.31	--	0.01	--	--	--	0.61	2.41	--	--	--	--	35.81	--	--	4.91	--	--	--	82.71
HEPE	--	--	--	--	26.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.61	--	--	--	--	--	--	--	--	--	--	--	--	16.31	--	--	--	3.01	--	--	0.31
MAFE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	1.31	7.91	37.51	0.05	40.31	1.81	--	--	2.01	0.21	--	32.01	3.21	0.05	--	--	12.41	0.05	14.61	3.41	0.05	--	1.91	--	1.51	--	--	--	--	--	47.51	--	48.81	3.11	4.01	15.31	0.31	--	0.05	6.91
Annual/Biennial																																								
DESO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.31	5.91	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERCI6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LASE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--
TRDU	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.91	--	--	--	--	--	--	--	--
Annual/Biennial/Perennial																																								
GRNUA	--	--	--	--	--	--	35.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.71	--	--	--	--	--	--	--	--	--	--	--
GRSQ	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.01	--	--	48.31	--	--	0.41	--	--	79.31	--	--	--	--	--	22.31	--	--	--	--	--	--	--
Annual/Perennial																																								
MESA	--	--	--	--	--	--	--	--	--	--	--	10.31	--	--	--	--	--	11.61	--	--	8.31	--	--	--	--	40.91	--	--	--	--	--	--	--	25.21	--	38.21	--	--	--	--
Perennials																																								
CHER	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MIMU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	23.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.81	--	--	--	--	--	--
SPGR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.21	--	--	--	--	--	--
SPPA2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.61	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TEIV	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
IPMU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Shrubs, Trees, and Cacti (g/m²)																																								
Perennials																																								
ATCA	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	98.51	15.61	59.41	0.51	33.81	11.91	--	--	--	--	--	--	--	--	--	--	--	49.71	--	--	63.41	349.93	--	--	--	--
ATCO	--	--	--	--	--	20.81	140.51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	274.72	--	--	--	--	--	--	0.05	--	--	0.05	--	--	--
ATGA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATOB	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	39.31	--	--	--	--	--	--	--	--	--	0.05	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	0.05	0.31	2.21	--	0.01	--	--	--	--	--	--	191.72	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.71	--	--	--	--	--	--	--	--	--	--	--	5.51	--	--	--	1.61	--	--	--
KRLA	--	0.01	--	--	9.11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	143.51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	64.21
PUTR2	--	--	--	--	--	--	--	--	--	--	54.71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SEFL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Air-dry Aboveground Annual Production (g/m²)																																								
Non-forage	1.31	13.03	41.42	0.05	71.84	3.12	13.61	0.00	54.97	0.21	20.21	63.34	61.54	0.05	0.11	30.23	39.14	1.46	18.22	23.46	26.92	0.05	1.92	30.32	1.51	0.00	0.66	2.41	5.41	0.00	58.72	0.01	100.93	3.11	4.01	41.33	17.84	0.00	0.05	89.93
Forage	23.12	36.72	58.34	96.04	9.11	89.54	284.86	160.83	75.89	41.07	96.76	29.40	34.37	81.33	211.15	65.41	87.32	91.81	84.55	29.04	103.77	149.88	49.92	67.19	75.15	90.78	391.64	73.59	47.25	45.13	49.42	75.21	28.24	112.62	99.73	393.62	52.99	92.83	200.35	66.63
Total Production	24.43	49.75	99.76	96.09	80.95	92.66	298.47	160.83	130.86	41.28	116.97	92.74	95.91	81.38	211.26	95.64	126.46	93.27	102.77	52.50	130.69	149.93	51.84	97.51	76.66	90.78	392.30	76.00	52.66	45.13	108.14	75.22	129.17	115.73	103.74	434.95	70.83	92.83	200.40	156.56
Total Air-dry Aboveground Annual Production (lbs/ac)																																								
Non-forage	12	116	370	0	641	28	121	0	490	2	180	565	549	0	1	270	349	13	163	209	240	0	17	271	13	0	6	22	48	0	524	0	900	28	36	369	159	0	0	802
Forage	206	328	520	857	81	799	2,541	1,435	677	366	863	262	307	726	1,884	584	779	819	754	259	926	1,337	445	599	670	810	3,494	657	422	403	441	671	252	1,005	890	3,512	473	828	1,787	594
Total Production	218	444	890	857	722	827	2,663	1,435	1,168	368	1,044	827	856	726	1,885	853	1,128	832	917	468	1,166	1,338	463	870	684	810	3,500	678	470	403	965	671	1,152	1,033	926	3,881	632	828	1,788	1,397

Notes:

Species codes defined in Table 4

Non-forage and forage determintations are based on the permit (e.g. plants of perennial and/or biennial duration are forage and plants of annual duration are non-forage; noxious weeds are non-forage)

Table A-4: O-VMU1 Shrub Belt Transect Data (counts)

O-VMU1 Transect	T1P	T2P	T3P	T4P	T5P	T6P	T7P	T8P	T9P	T10P	T11P	T12P	T13P	T14P	T15P	T16P	T17P	T18P	T19P	T20P
Shrubs, Trees, and Cacti																				
ARFR4	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	13	--
ARTR2	--	2	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	1	--	--
ATCA	1	--	1	--	--	12	64	3	1	--	23	2	--	7	9	14	22	1	30	42
ATCO	6	--	1	--	--	12	4	3	8	1	--	3	12	6	24	27	9	2	27	15
ATCO4	--	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--
ATGA	--	--	--	--	--	--	21	--	--	--	39	--	--	9	--	32	--	--	--	--
ERNA	6	--	1	4	46	--	7	2	--	--	--	--	--	3	3	1	--	5	--	--
FAPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--
GUSA	2	--	--	1	--	--	--	2	--	2	1	--	--	--	--	--	--	1	90	1
JUMO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
KRLA	--	25	--	--	14	--	--	5	--	--	--	--	--	--	--	--	8	1	1	--
PIED	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
PUTR2	1	--	--	--	--	--	--	--	--	2	2	--	--	--	11	--	--	--	--	--
PUME	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OPPO	--	--	1	--	--	--	--	1	--	--	1	--	--	--	--	--	2	--	--	--
YUBA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LYTO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATOB	--	--	--	--	--	--	5	--	--	--	4	--	--	--	--	--	--	--	--	--
SEFL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--
Total Shrubs, Trees, and Cacti																				
Shrubs, Trees, and Cacti	18	27	4	5	60	24	111	16	9	6	70	5	12	26	51	74	41	13	161	58

O-VMU1 Transect	T21P	T22P	T23P	T24P	T25P	T26P	T27P	T28P	T29P	T30P	T31P	T32P	T33P	T34P	T35P	T36P	T37P	T38P	T39P	T40P
Shrubs, Trees, and Cacti																				
ARFR4	4	--	--	--	--	--	--	3	--	2	--	--	11	--	--	--	--	3	--	90
ARTR2	3	--	--	--	--	2	--	--	--	--	3	--	--	--	--	--	--	4	--	1
ATCA	3	7	4	4	12	1	63	2	4	--	10	24	2	11	19	38	6	11	9	1
ATCO	1	5	8	3	13	2	28	1	--	1	9	22	2	9	2	19	9	4	10	3
ATCO4	--	--	--	--	1	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--
ATGA	--	--	--	16	9	--	--	--	21	--	1	--	1	--	33	--	19	--	--	2
ERNA	10	--	--	5	3	4	--	8	5	4	--	7	--	--	21	--	--	1	29	1
FAPA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	122	1	--	9	--	13	--	1	1	1	--	2	39	1	--	--	5	2	1	1
JUMO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA	--	125	47	--	--	35	--	--	--	--	--	--	--	--	--	--	71	--	--	92
PIED	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--
PUTR2	--	--	--	--	--	--	--	11	--	--	--	--	--	3	--	1	--	8	3	--
PUME	--	--	--	1	--	--	--	1	--	9	--	--	--	--	--	--	--	--	--	--
OPPO	--	--	--	2	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--
YUBA	--	3	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LYTO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
ATOB	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--
SEFL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Shrubs, Trees, and Cacti																				
Shrubs, Trees, and Cacti	143	141	61	40	38	57	91	27	48	18	23	55	55	24	75	59	110	33	52	192

Notes:

The shrub belt transect area is 100m[2] (2mx50m); shrubs rooted in the belt transect were counted on an individual basis

Code	Scientific Name	Common Name
ARFR4	*Artemisia frigida*	Prairie sagewort
ARTR2	*Artemisia tridentata*	Big sagebrush
ATCA	*Atriplex canescens*	Four-wing saltbush
ATCO	*Atriplex confertifolia*	Shadscale saltbush
ATCO4	*Atriplex corrugata*	Mat saltbush
ATGA	*Atriplex gardneri*	Gardner's saltbush
ERNA	*Ericameria nauseosa*	Rubber rabbitbrush
FAPA	*Fallugia paradoxa*	Apache plume
GUSA	*Gutierrezia sarothrae*	Broom snakeweed
JUMO	*Juniperus monosperma*	Oneseed juniper
KRLA	*Krascheninnikovia lanata*	Winterfat
PIED	*Pinus edulis*	Piñon pine
PUTR2	*Purshia tridentata*	Antelope bitterbrush
PUME	*Purshia mexicana*	Mexican cliffrose
OPPO	*Opuntia polyacantha*	Plains pricklypear
YUBA	*Yucca baccata*	Banana yucca
LYTO	*Lycium torreyi*	Torrey wolfberry
ATOB	*Atriplex obovata*	Mound saltbush
SEFL	*Senecio flaccidus*	Threadleaf groundsel

APPENDIX B

Quadrat Photographs

	
O-VMU1-T1P	Q1
	
O-VMU1-T2P	Q1

	
O-VMU1-T3P	Q1
	
O-VMU1-T4P	Q1

	
O-VMU1-T5P	Q1
	
O-VMU1-T6P	Q1

	
O-VMU1-T7P	Q1
	
O-VMU1-T8P	Q1

	
O-VMU1-T9P	Q1
	
O-VMU1-T10P	Q1

	
O-VMU1-T11P	Q1
	No Photo
O-VMU1-T12P	Q1

	
O-VMU1-T13P	Q1
	
O-VMU1-T14P	Q1

	
O-VMU1-T15P	Q1
	
O-VMU1-T16P	Q1

	
O-VMU1-T17P	Q1
	
O-VMU1-T18P	Q1

	
O-VMU1-T19P	Q1
	
O-VMU1-T20P	Q1

	
O-VMU1-T21P	Q1
	No Photo
O-VMU1-T22PP	Q1

	
O-VMU1-T23P	Q1
	
O-VMU1-T24P	Q1

	
O-VMU1-T25P	Q1
	
O-VMU1-T26P	Q1

	
O-VMU1-T27P	Q1
	
O-VMU1-T28PP	Q1

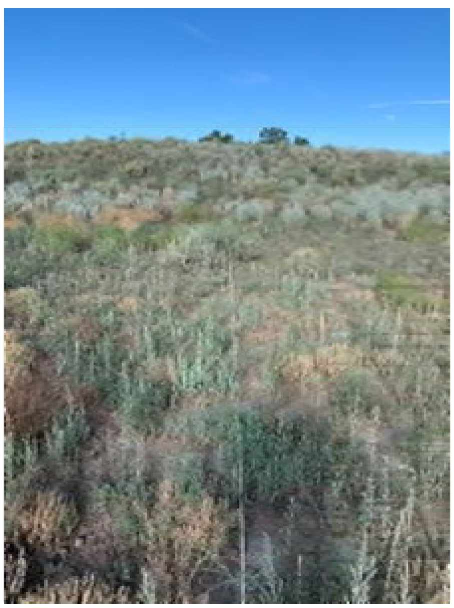
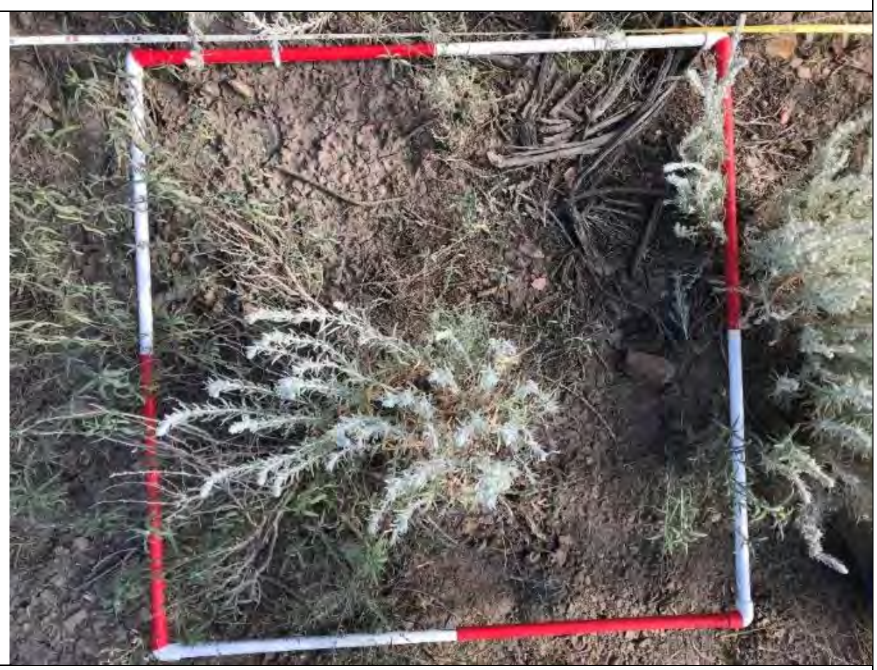
	
O-VMU1-T29P	Q1
	
O-VMU1-T30P	Q1

	
O-VMU1-T31P	Q1
	
O-VMU1-T32P	Q1

	
O-VMU1-T33P	Q1
	
O-VMU1-T34P	Q1

	
O-VMU1-T35P	Q1
	
O-VMU1-T36P	Q1

	
O-VMU1-T37P	Q1
	
O-VMU1-T38P	Q1

	
O-VMU1-39P	Q1
	
O-VMU1-T40P	Q1

APPENDIX C

Vegetation Statistical Analysis

Figure C-1: Total Ground Cover Descriptive Statistics and Normality

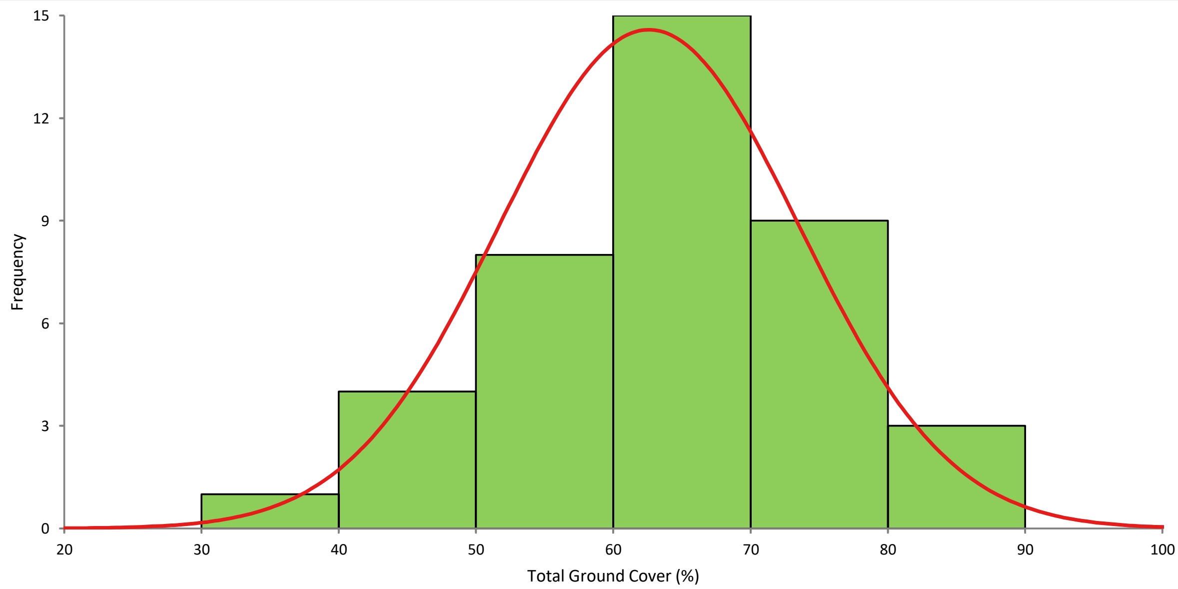
Distribution: Total Ground Cover

Analyse-it v5.40.2

Table 1: O-VMU1 2019 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 18 February 2020 at 9:41 by Ward, Dustin

Descriptives



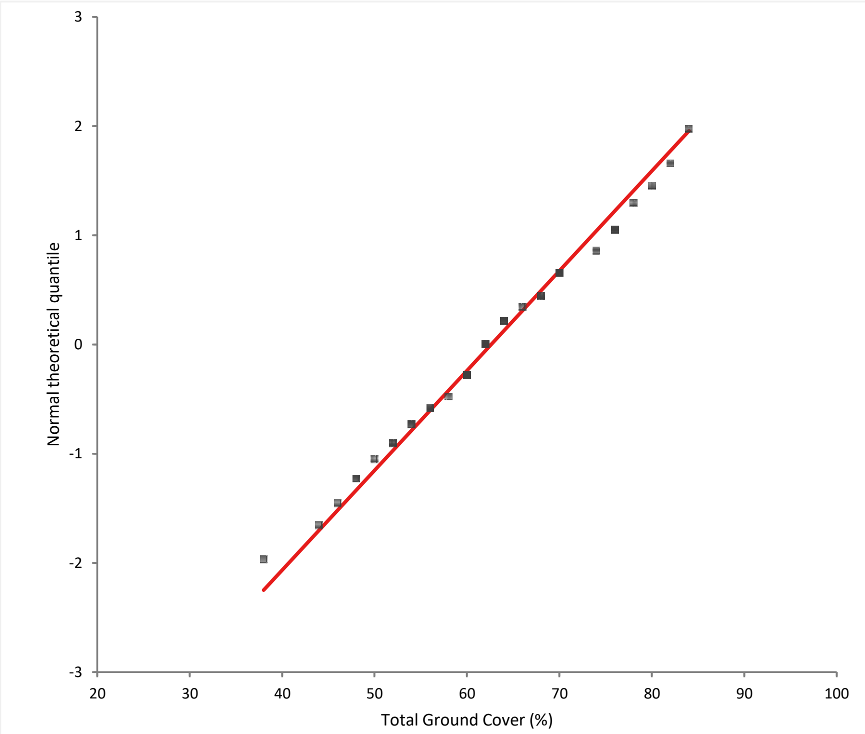
N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Total Ground Cover (%)	62.6	59.7 to 65.5	1.73	10.9	0.0	-0.43

GOLDER

Figure C-1: Total Ground Cover Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.99
p-value	0.9139 [1]

H0: F(Y) = N(μ, σ)
The distribution of the population is normal with unspecified mean and standard deviation.
H1: F(Y) ≠ N(μ, σ)
The distribution of the population is not normal.

[1] Do not reject the null hypothesis at the 10% significance level.

Figure C-2: Perennial Vegetation Cover Descriptive Statistics and Normality

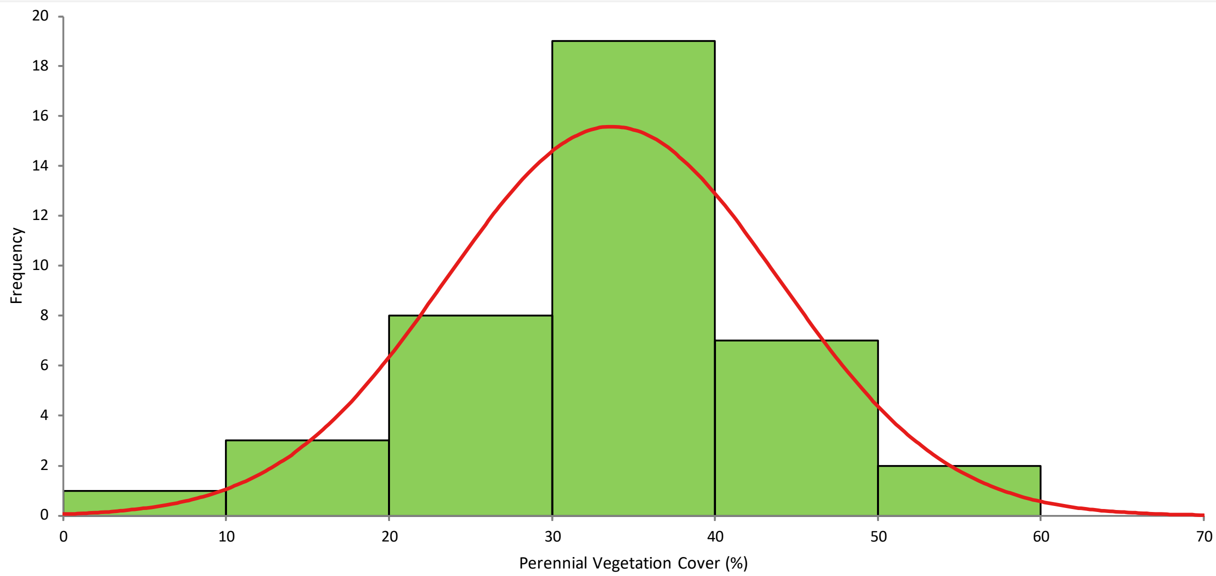
Distribution: Perennial Vegetation Cover

Analyse-it v5.40.2

Table 1: O-VMU1 2019 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 18 February 2020 at 9:43 by Ward, Dustin

Descriptives

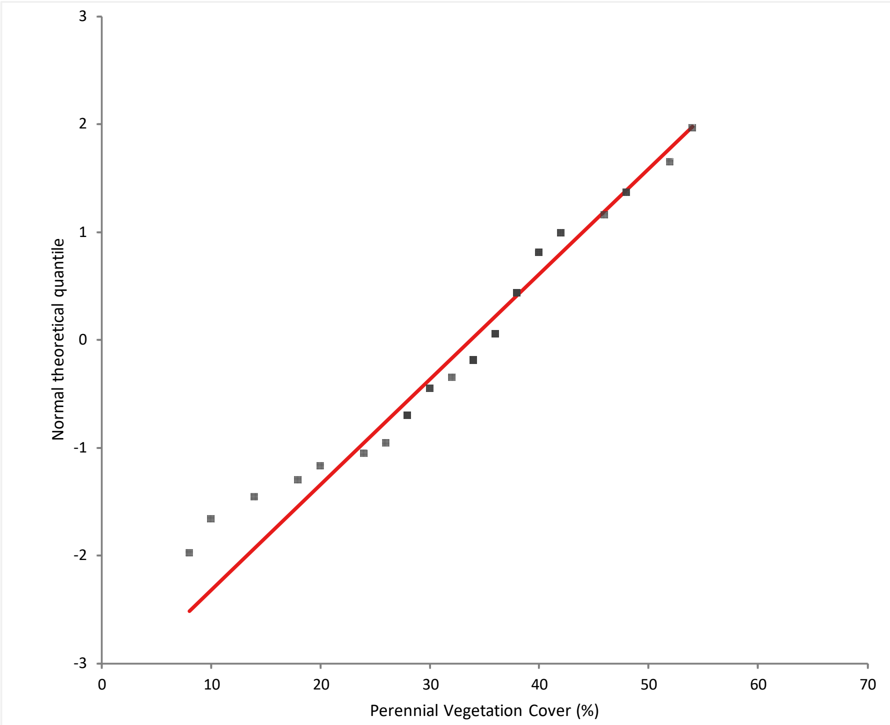


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Perennial Vegetation Cover (%)	33.7	31.0 to 36.4	1.62	10.2	-0.6	0.63

Figure C-2: Perennial Vegetation Cover Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.96
p-value	0.1160 [1]

H0: F(Y) = N(μ, σ)
The distribution of the population is normal with unspecified mean and standard deviation.
H1: F(Y) ≠ N(μ, σ)
The distribution of the population is not normal.
[1] Do not reject the null hypothesis at the 10% significance level.

Figure C-3: Annual Forage Production Descriptive Statistics and Normality

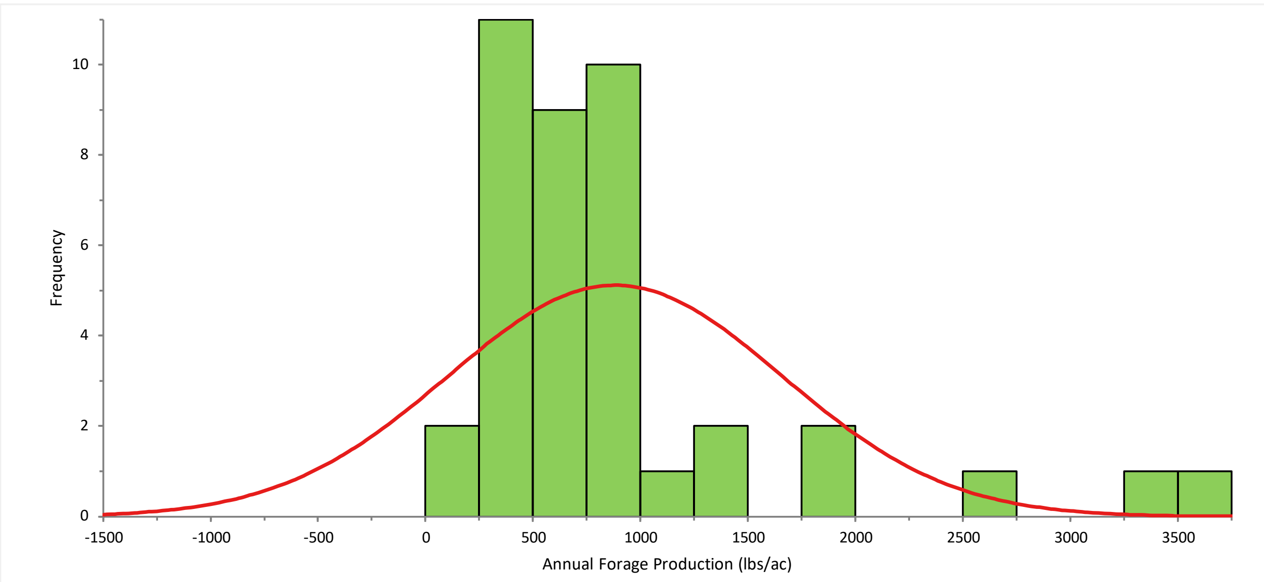
Distribution: Annual Forage Production

Analyse-it v5.40.2

Table 1: O-VMU1 2019 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 18 February 2020 at 9:45 by Ward, Dustin

Descriptives



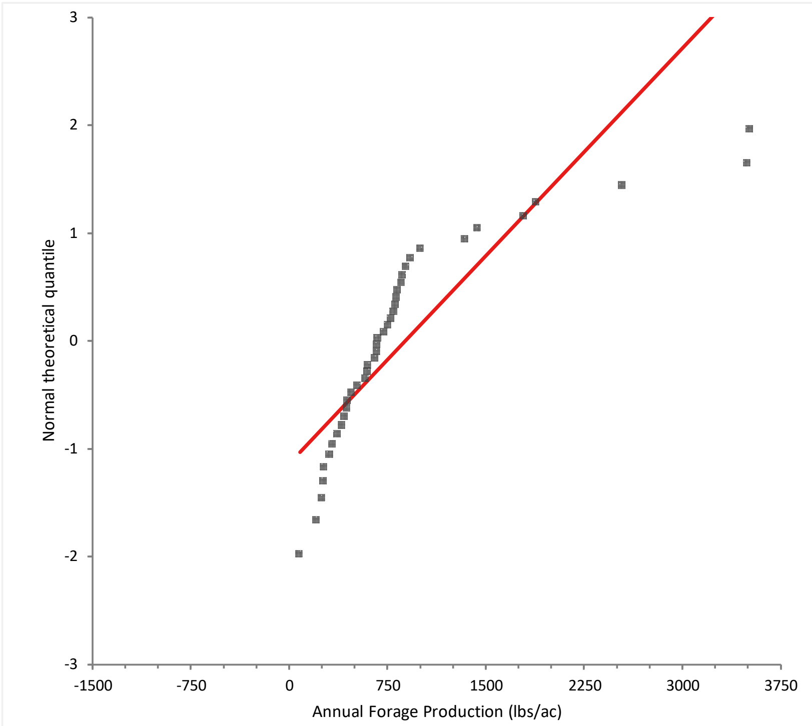
N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Annual Forage Production (lbs/ac)	8.816100E+02	6.741668E+02 to 1.089053E+03	1.231208E+02	7.786844E+02	2.3	5.33

GOLDER

Figure C-3: Annual Forage Production Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.72
p-value	<0.0001 [1]

H0: F(Y) = N(μ, σ)
The distribution of the population is normal with unspecified mean and standard deviation.
H1: F(Y) ≠ N(μ, σ)
The distribution of the population is not normal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 10% significance level.

Figure C-4: Annual Forage Production (Box-Cox square root Transformation) Descriptive Statistics and Normality

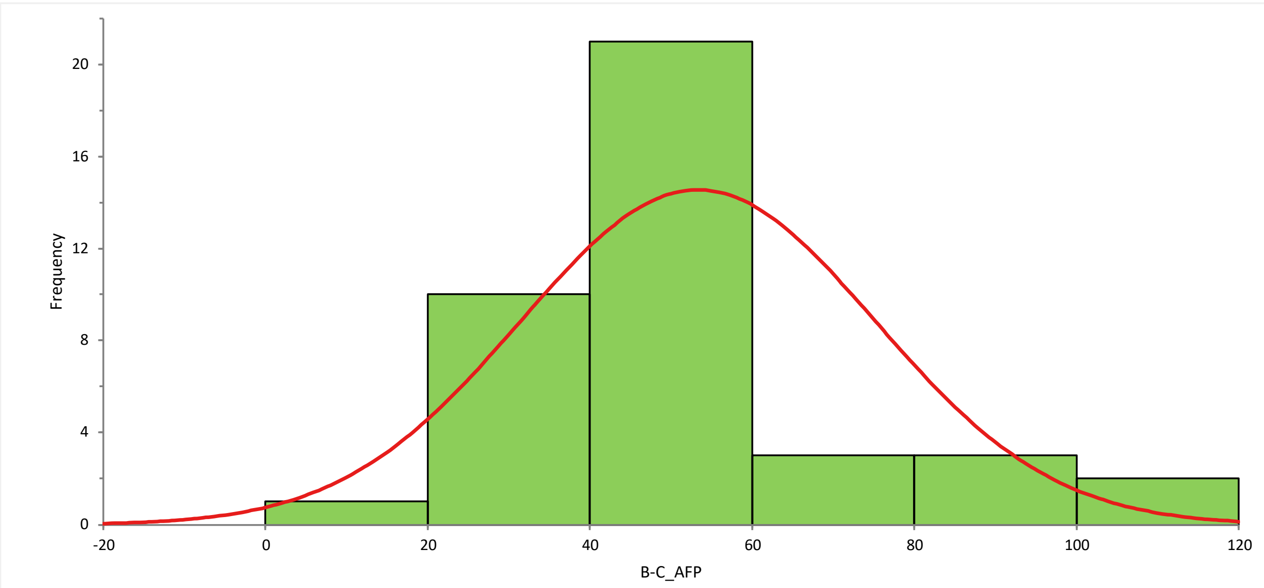
Distribution: B-C_AFP

Analyse-it v5.50

Table C-1: O-VMU1 2019 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 23 March 2020 at 12:12 by Ward, Dustin

Descriptives

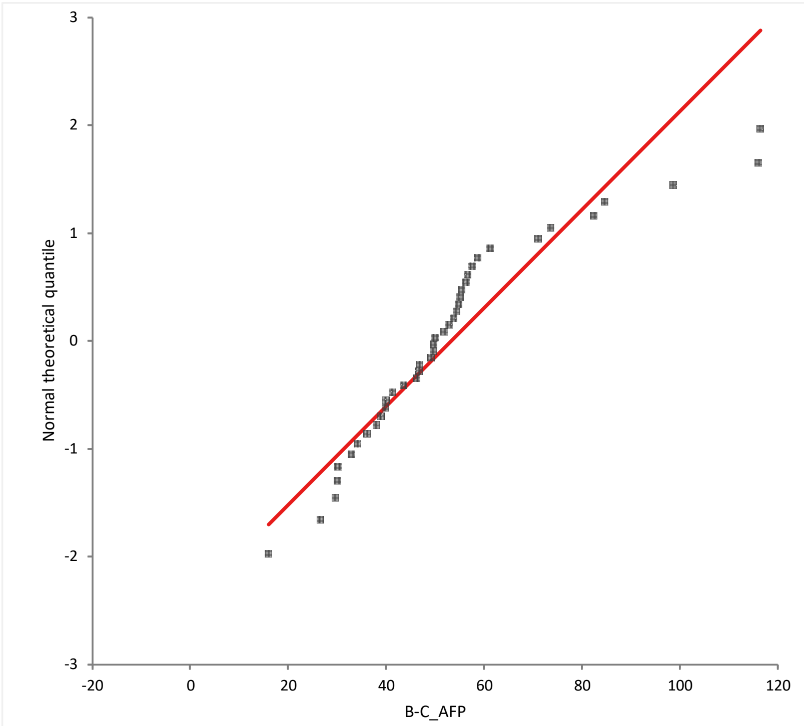


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
B-C_AFP	53.298813383	47.459233678 to 59.138393088	3.465882800	21.920167504	1.3	2.17

Figure C-4: Annual Forage Production (Box-Cox square root Transformation) Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.88
p-value	0.0006 [1]

H0: F(Y) = N(μ, σ)
The distribution of the population is normal with unspecified mean and standard deviation.
H1: F(Y) ≠ N(μ, σ)
The distribution of the population is not normal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 10% significance level.

GOLDER

Figure C-5: Shrub Density by the Belt Transect Method Descriptive Statistics and Normality

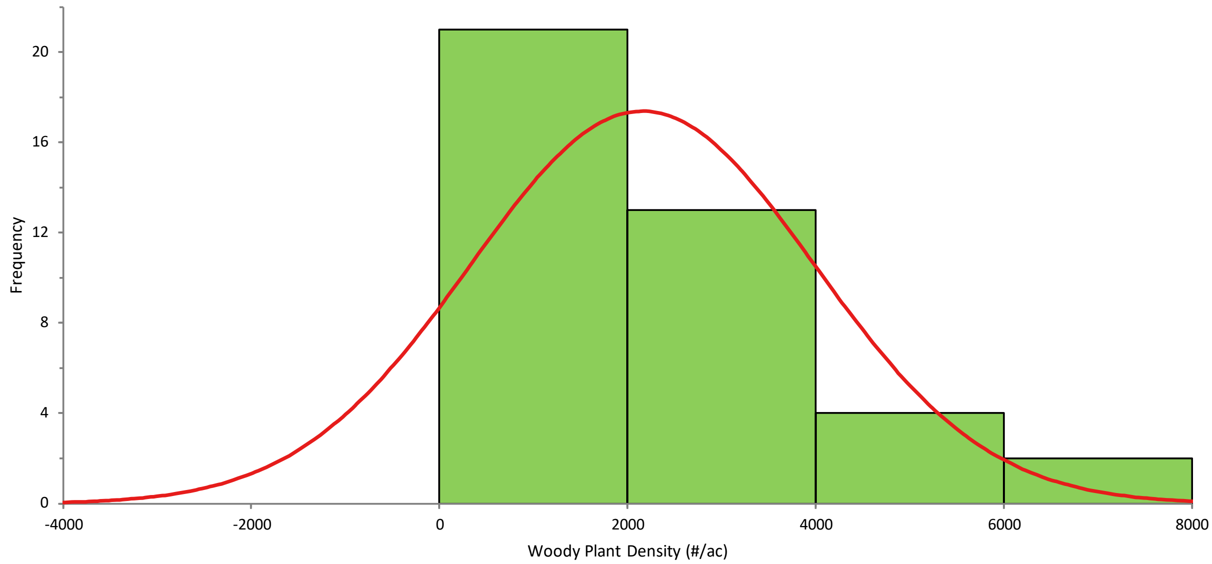
Distribution: Woody Plant Density

Analyse-it v5.40.2

Table 1: O-VMU1 2019 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 18 February 2020 at 9:46 by Ward, Dustin

Descriptives

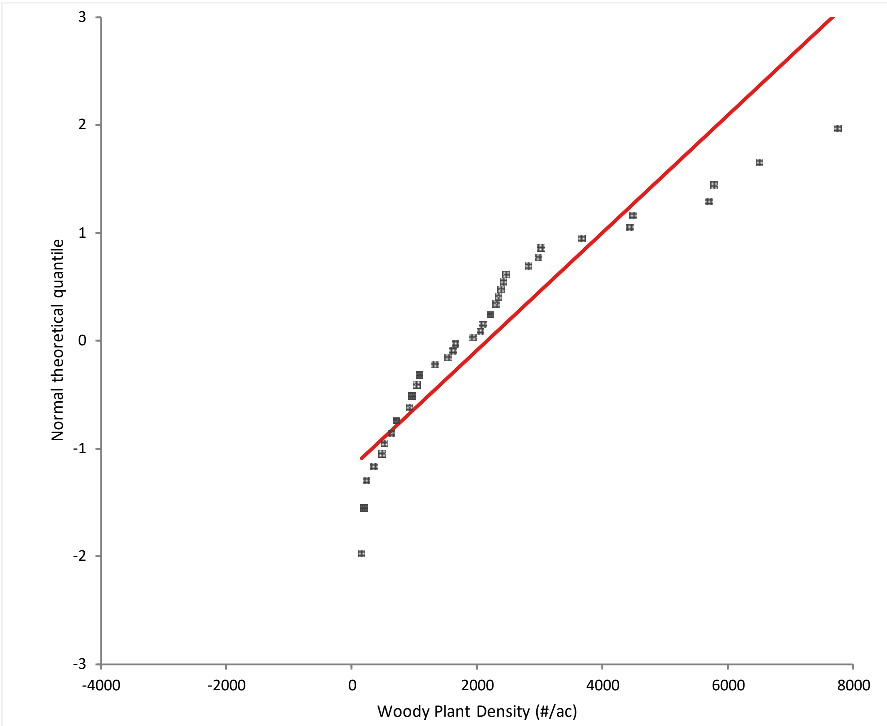


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Woody Plant Density (#/ac)	2157.98810	1669.16321 to 2646.81298	290.125291	1834.91345	1.4	1.65

Figure C-5: Shrub Density by the Belt Transect Method Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.86
p-value	0.0002 [1]

H0: F(Y) = N(μ, σ)
The distribution of the population is normal with unspecified mean and standard deviation.
H1: F(Y) ≠ N(μ, σ)
The distribution of the population is not normal.
[1] Reject the null hypothesis in favour of the alternative hypothesis at the 10% significance level.

Figure C-6: Shrub Density by the Belt Transect Method (Box-Cox square root Transformation) Descriptive Statistics and Normality

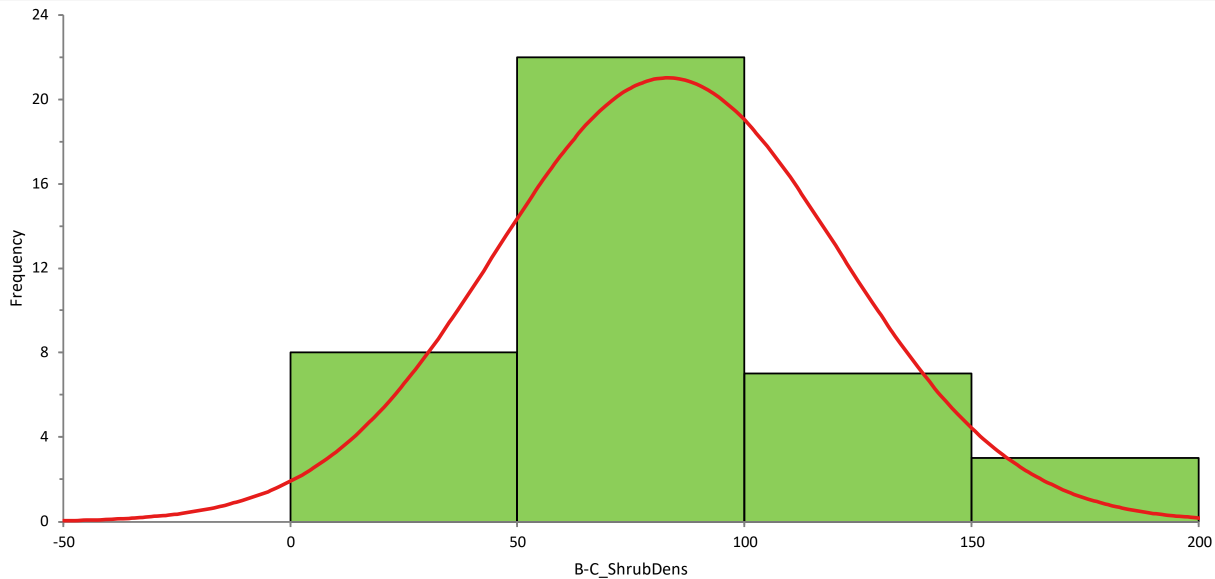
Distribution: B-C_ShrubDens

Analyse-it v5.50

Table C-1: O-VMU1 2019 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 23 March 2020 at 12:15 by Ward, Dustin

Descriptives

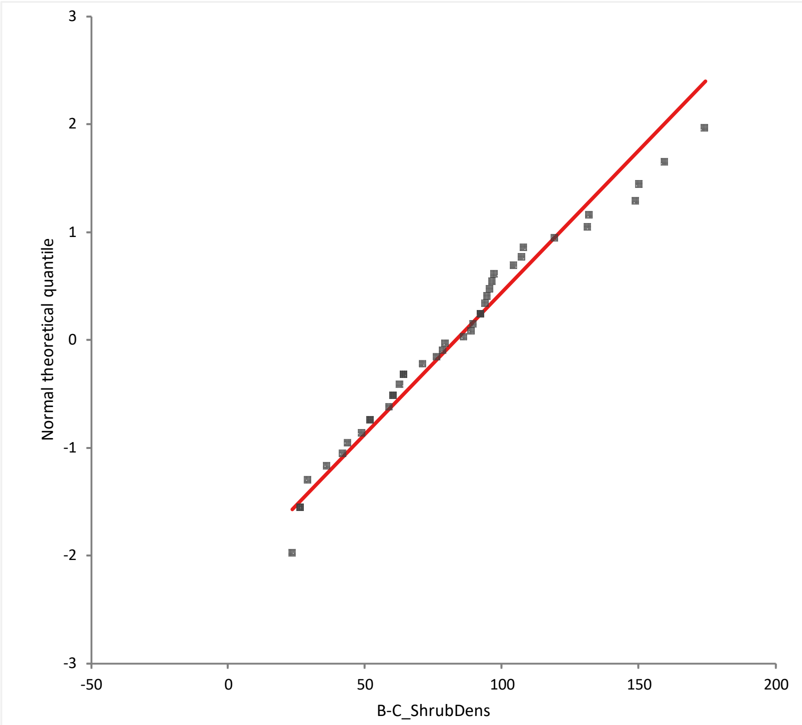


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
B-C_ShrubDens	83.016377669	72.906522461 to 93.126232877	6.000358767	37.949600964	0.5	-0.17

Figure C-6: Shrub Density by the Belt Transect Method (Box-Cox square root Transformation) Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.96
p-value	0.2239 [1]

H0: F(Y) = N(μ, σ)
The distribution of the population is normal with unspecified mean and standard deviation.
H1: F(Y) ≠ N(μ, σ)
The distribution of the population is not normal.

[1] Do not reject the null hypothesis at the 10% significance level.

Table C-1: O-VMU1 2019 Data for Normal Distribution and Variance Analysis

Plot	Transect	Total Ground Cover (%)	Perennial Vegetation Cover (%)	Annual Forage Production (lbs/ac)	Woody Plant Density (#/ac)	B-C_AFP	B-C_ShrubDens
O-VMU1	T1P	60.0	34.0	206	728	26.72	51.98
	T2P	60.0	30.0	328	1,093	34.20	64.11
	T3P	38.0	14.0	520	162	43.63	23.45
	T4P	46.0	34.0	857	202	56.54	26.45
	T5P	44.0	8.0	81	2,428	16.03	96.55
	T6P	78.0	52.0	799	971	54.53	60.33
	T7P	84.0	38.0	2,541	4,492	98.83	132.04
	T8P	76.0	48.0	1,435	647	73.76	48.89
	T9P	62.0	26.0	677	364	50.04	36.17
	T10P	62.0	32.0	366	243	36.28	29.16
	T11P	64.0	42.0	863	2,833	56.76	104.45
	T12P	50.0	24.0	262	202	30.39	26.45
	T13P	76.0	20.0	307	486	33.02	42.07
	T14P	64.0	36.0	726	1,052	51.87	62.87
	T15P	64.0	30.0	1,884	2,064	84.81	88.86
	T16P	70.0	38.0	584	2,995	46.31	107.45
	T17P	70.0	34.0	779	1,659	53.82	79.47
	T18P	62.0	46.0	819	526	55.24	43.87
	T19P	62.0	28.0	754	6,515	52.93	159.44
	T20P	70.0	28.0	259	2,347	30.19	94.90
	T21P	74.0	40.0	926	5,787	58.85	150.14
	T22P	80.0	36.0	1,337	5,706	71.14	149.08
	T23P	54.0	38.0	445	2,469	40.21	97.37
	T24P	70.0	36.0	599	1,619	46.97	78.47
	T25P	60.0	28.0	670	1,538	49.79	76.43
	T26P	54.0	38.0	810	2,307	54.92	94.06
	T27P	82.0	34.0	3,494	3,683	116.22	119.37
	T28P	52.0	40.0	657	1,093	49.25	64.11
	T29P	76.0	38.0	422	1,942	39.06	86.15
	T30P	48.0	38.0	403	728	38.13	51.98
	T31P	66.0	28.0	441	931	40.00	59.02
	T32P	68.0	54.0	671	2,226	49.81	92.36
	T33P	48.0	10.0	252	2,226	29.75	92.36
	T34P	68.0	48.0	1,005	971	61.40	60.33
	T35P	56.0	38.0	890	3,035	57.66	108.18
	T36P	58.0	42.0	3,512	2,388	116.52	95.73
	T37P	52.0	28.0	473	4,452	41.49	131.44
	T38P	60.0	38.0	828	1,335	55.56	71.09
	T39P	56.0	36.0	1,787	2,104	82.56	89.75
	T40P	60.0	18.0	594	7,770	46.76	174.29

Notes:

Total Ground Cover is all live vegetative cover and litter, not including noxious weeds (NMDA 2016)

Perennial Vegetation Cover is the sum of the perennial/biennial species foliar cover after excluding annual forbs and grasses and noxious weeds; units are percent foliar cover (%)

Annual Forage Production is the sum of perennial/biennial species production after excluding annual forbs and grasses and noxious weeds; units are pounds of air dry forage per acre (lbs/ac)

Woody Plant Density is the density of subshrubs, shrubs, cacti, or trees rooted within the belt transect, converted to stems per acre (#/ac)

Table C-2: 2019 O-VMU1 Total Ground Cover, Method 3 - CMRP

$$t^* = \frac{\bar{x} - 0.9\,(technical\ std)}{s/\sqrt{n}}$$

	2019 Total Ground Cover
Mean (%)	62.60
Standard Deviation (%)	10.94
Sample Size	40
Technical Standard (%)	52
t*	9.14
N_{min}	9
1-tail t (0.1, 39)	1.304

Notes:

Decision Rules (reverse null)

t < t (1-a; n-1), failure to meet std*

t >= t (1-a; n-1), performance std met*

t from Appendix Table C-1 (MMD, 1999)

Table C-3: 2019 O-VMU1 Perennial Vegetation Cover (%), Method 3 - CMRP

$$t^* = \frac{\bar{x} - 0.9\,(technical\ std)}{s/\sqrt{n}}$$

	2019 Perennial Vegetation Cover (%)
Mean (%)	33.70
Standard Deviation (%)	10.23
Sample Size	40
Technical Standard (%)	24
t*	7.48
N_{min}	26
1-tail t (0.1, 39)	1.304

Notes:

Decision Rules (reverse null)

t < t (1-a; n-1), failure to meet std*

t >= t (1-a; n-1), performance std met*

t from Appendix Table C-1 (MMD, 1999)

Table C-4: 2019 O-VMU1 Annual Forage Production (lbs/ac), Method 5 - CMRP

Transect	Annual Forage Production (lbs/ac)	90% of Technical Standard	AFP minus TS
T1P	206.27	495.0	-288.7
T2P	327.61	495.0	-167.4
T3P	520.50	495.0	25.5
T4P	856.85	495.0	361.9
T5P	81.28	495.0	-413.7
T6P	798.86	495.0	303.9
T7P	2541.47	495.0	2046.5
T8P	1434.90	495.0	939.9
T9P	677.08	495.0	182.1
T10P	366.42	495.0	-128.6
T11P	863.28	495.0	368.3
T12P	262.30	495.0	-232.7
T13P	306.64	495.0	-188.4
T14P	725.61	495.0	230.6
T15P	1883.84	495.0	1388.8
T16P	583.58	495.0	88.6
T17P	779.05	495.0	284.1
T18P	819.11	495.0	324.1
T19P	754.34	495.0	259.3
T20P	259.09	495.0	-235.9
T21P	925.82	495.0	430.8
T22P	1337.20	495.0	842.2
T23P	445.38	495.0	-49.6
T24P	599.46	495.0	104.5
T25P	670.48	495.0	175.5
T26P	809.92	495.0	314.9
T27P	3494.14	495.0	2999.1
T28P	656.56	495.0	161.6
T29P	421.56	495.0	-73.4
T30P	402.64	495.0	-92.4
T31P	440.92	495.0	-54.1
T32P	671.01	495.0	176.0
T33P	251.95	495.0	-243.0
T34P	1004.78	495.0	509.8
T35P	889.77	495.0	394.8
T36P	3511.81	495.0	3016.8
T37P	472.77	495.0	-22.2
T38P	828.21	495.0	333.2
T39P	1787.49	495.0	1292.5
T40P	594.46	495.0	99.5
		k	13
		n	40
		z	-2.06
Standard one-tailed normal curve area (Table C-3; MMD, 1999)			0.4803
		P	0.0197

Notes:
AFP = Annual Forage Production (lbs/ac)
TS = 90% of the Technical Standard for Annual Forage Production
P = 0.5-Area = prob of observing z; <=0.1 performance standard met
z value calculation:

$$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$$

Table C-5: 2019 O-VMU1 Woody Plant Density (Box-Cox squre root Transformation of #/ac), Method 3 - CMRP

$$t^* = \frac{\bar{x} - 0.9\ (technical\ std)}{s/\sqrt{n}}$$

	B-C_ShrubDens
Mean	83.02
Standard Deviation	37.95
Sample Size	40
Technical Standard	18.00
t*	11.14
N_{min}	59
1-tail t (0.1, 39)	1.304

Notes:

Decision Rules (reverse null)

t < t (1-a; n-1), failure to meet std*

t >= t (1-a; n-1), performance std met*

t from Appendix Table C-1 (MMD, 1999)

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Appendix A6: Wildlife Enhancements

McKinley Mine Permit No. NM-0001K

Survey Date: 8/28/24

	Cottonwood Live Poles	Coyote Willow Live Whips	Woods Rose Seedlings	Licorice Seedlings	Bulrush (From Seed)	Sedge (From Seed)	Pond AdMix (Seed)	Mule Deer Mix (Seed)	Mule Deer Mix Species Observed	Wildlife Fence	Cattle Ramp
Structure											
PI 5-1	y	y	y		y	y	y	y	Rubber rabbitbrush	y	y
PI 5-2		y			y	y	y	y	Rubber rabbitbrush	y	y
RCP 5-1		y	y					y	Cliffrose, Antelope Bitterbrush, Rubber Rabbitbrush	y	
RCP 5-2		y	y	y				y	Rubber rabbitbrush	y	
RCP 5-3		y						y	Rubber rabbitbrush	y	
5 SD 1		Too dry to plant	y	y	y	y	y	y	Cliffrose, Antelope Bitterbrush, Rubber Rabbitbrush		
5 SD 2	Not identified for wildlife enhancement planting										
5 SD 3	Not identified for wildlife enhancement planting										
Notes:											
Pond admix and Riparian Seed Mix: Permit Table 5.5-5											
Mule Deer Shrub Enhancement Mix: Permit Table 5.5-10											
Bulrush and Sedge in the Pond Admix											
Riparian miz was not applicable to these structures											
	y	Note: Letter y indicates that the activity occurred in a pond as proposed in the permit									
	(green)	Plant species observed alive in pond including mature species from prior plantings or permanent seed mix									
	(orange)	Plant materials do not appear like they survived.									
	(yellow)	Plant species not observed.									

PI 5-1

PI 5-2

RCP 5-1a

RCP 5-1b

RCP 5-2

RCP 5-3

5SD-1a

5SD-1b

Appendix A7: Performance Bond

OSMRE Bond Cost Summary (2024 dollars as noted)			
Performance Bond After VMU 1 Phase IIII Deduction			
Red font indicates direct changes made to this spreadsheet			
Mining Areas			
2N (included below)			
2			$1,099,386
3, 3A Plug (A&T, TS, Reveg) and 5 (Reveg)			$933,444
3A Plug (A&T, TS, Reveg) (Included above)			
5 (reveg) (Included above)			
6			$1,231,952
10			$449,861
12			$1,997,973
12 Box-Cut			$643,577
14			$981,006
14 and 15 Box-Cut			$401,751
15			$1,278,805
A16 Ponds and Hydro			$92,750
16 + Box-cut (Not Mined)			$0
EW Mitigation pile			$0
	Orig. Total Ac.	Orig Total	
P. Roads (470 ac total) (Gr, A&T, TS & Reveg)	470	$7,714,481	$1,495,290
A. Roads (40.7 ac total) (TS & Reveg)	40.7	$96,378	$70,747
Facilities			$4,658,117
		Quantity	
Ponds (Cost/Pond included in Mining Areas):	$14,750	-2	-$29,500
Earthmoving Support Equip.			$2,046,664
Diversions (No Name and Tse Bonita [Area 2])			$0
		PP Acres	
Revegetation Cost/Ac VMU 1 Deduction	$822	-641	-$526,902
Renewal Total Direct Costs (1999 Dollars)			$16,824,921
Inflation Factor (to Sept 06)	17.632%		
Renewal Total Direct Costs (2006 Dollars)			$19,791,553
Additional Current Dollar Direct Costs			
10B Truck Pod (in 06 Dollars)			$0
14A Truck Pod (in 06 Dollars)			
14A Truck Pod Expansion (in 06 Dollars)			$1,138,920
15E Additional 1000' Corridor (in 06 Dollars)			$487,185
2B Truck Pod (in 06 Dollars)			$0
Total Direct Costs (2006 Dollars)	$102,985,116		$21,417,658
	Orig Tot Above		
10 yr Inflation Factor (Based on 10 yrs.06-16)	36.660%		$29,269,371
Sep 16 to Mar 19 Inf Factor RSMeans (2.5 yrs)	4.649%		$30,630,104
Mar 19 to Sep 21 inf Factor RSMeans (2.5 yrs)	5.390%		$32,281,067
Sept 21 to Mar 24 inf Factor RSMeans (2.5 yrs)	16.65%		$37,655,865
Total Direct costs (2024 dollars)			$37,655,865
Indirect Costs			
Mob/Demobilization	1.0%		$376,559
Contingency Fund	3.0%		$1,129,676
Eng. Redesign Fee	2.5%		$941,397
Profit and Overhead	15.0%		$5,648,380
Project Management	2.5%		$941,397
Total Indirect Costs			**$9,037,408**
Total W/O Gross Receipts tax			**$46,693,272**
Gross Receipts Tax 6.4375%	6.43750%		$3,005,879
Navajo Nation Sales Tax 3.0 %	3.00%		$1,400,798
Navajo Fuel Excise Tax @ $0.18/gal	$1,747,486		$375,547
Fuel Tax Pro-rated on orig Tot direct costs & tax total	Orig Tot above		
Total Bond Amount			**$51,475,497**
Recommended Bond Amount (Rounded)			**$51,476,000**
Supplemental Contingency Bond Amount			$883,545
Updated Grand Total with Contingency			**$52,359,545**
Current Bond Amount			$53,921,545
Bond Reduction			$1,562,000
Note: Although mining in Area 16 is not bonded, the area has ponds, hydrologic structures and roads that are bonded.			

8/30/2024

Appendix A8: Landowner Notification

NOTIFICATION ADDRESS LIST

NAME	ADDRESS	CITY	ST	ZIP	OTHER
Navajo Nation Minerals Dept.	P.O. Box 1910	Window Rock	AZ	86515	Rowena Cheromiah, Department Manager
Navajo Nation Land Dept.	P.O. Box 9000	Window Rock	AZ	86515	Mike Halona, Dept. Manager
Public Service Co. Of NM	PNM Main Offices	Albuquerque	NM	87158	
Navajo Nation EPA Public Water Systems Supevision Program	P.O. Box 339	Window Rock	AZ	86515	Yolanda Barney
Navajo Nation EPA Water Quality / NPDES Program	P.O. Box 339	Window Rock	AZ	86515	Patrick Antonio
Navajo Tribal Utility Authority	P.O. Box 170	Ft. Defiance	AZ	86504	Walter Haase, General Manager
Continental Divide Electric Corp.	P.O. Box 786	Gallup	NM	87305	
Kinder Morgan	P.O. Box 103	Rehoboth	NM	87322	Gallup District Office
Bureau of Land Management	6251 College Blvd.	Farmington	NM	87402	
BIA-Navajo Regional Office	P.O. Box 1060	Gallup	NM	87305	Bertha Spencer
New Mexico State Land Office	P.O. Box 1148	Santa Fe	NM	87504-1148	
Ft Defiance Chapter	P.O. Box 366	Ft. Defiance	AZ	86504	Wilson Stewart, Jr., Chapter President
Tsayatoh Chapter	P.O. Box 86	Mentmore	NM	87319	Walter Hudson, Chapter President
McKinley County Manager	P.O. Box 70	Gallup	NM	87305	Anthony Dimas, Jr., County Manager

Armando Martinez
Remediation Ops
Specialist

Chevron Environmental Management Company

P.O. Box 469
Questa, NM 87564
Tel (575) 585-7639
Cell (505) 690-5408
amarti@chevron.com

RE: McKinley Mine Permit No. NM-0001K
Vegetation Management Units 1 & 4
Application for Permanent Program Bond Release and
Initial Program Reclamation Liability Release and Termination of Jurisdiction

This notice is being provided to you since you or your organization may have an interest in the action described in this letter.

Chevron Mining Inc. (CMI) has filed an application for bond release of Permanent Program Lands and a reclamation liability release and termination of jurisdiction (TOJ) of Initial Program lands for reclaimed lands in Vegetation Management Units 1 and 4 (VMU 1 and VMU 4) contained in the McKinley Mine's mining and reclamation Permit No. NM-0001K (Permit NM-0001K) approved 09-07-2016, located in McKinley County, New Mexico.

VMU 1: The application includes a request for a Phase I, II and III bond release on two permanent impoundments in VMU 1 and Phase III bond release for the remaining area. The application contains information to demonstrates that 928 acres meet applicable requirements contained in the McKinley Mine's Permit NM-0001K, and the regulatory performance standards in 30 CFR 715, 800 and 816. The current performance bond is $53,921,545 and with this reclamation complete, the application includes calculations to reduce the associated reclamation performance bond by $1,562,000.

VMU 4: The application includes a request for a Phase I, II and III bond release on three permanent impoundments in VMU 4 and Phase III bond release for the remaining area. The application contains information to demonstrates that 1,141 acres meet applicable requirements contained in the McKinley Mine's Permit NM-0001K, and the regulatory performance standards in 30 CFR 715, 800 and 816. The current performance bond is $53,921,545 and with this reclamation complete, the application includes calculations to reduce the associated reclamation performance bond by $2,705,000.

The McKinley Mine is located approximately 22 miles northwest of Gallup, NM, and 2 miles east of Window Rock, AZ, on NM State Highway 264. Figure 1 shows the location and configuration of VMU 4. The McKinley Mine is currently permitted by CMI (formerly the Pittsburg & Midway Coal Mining Co.), but now managed by Chevron Environmental Management Company (CEMC). CEMC is located at 6001 Bollinger Canyon Road, Building C-2144, San Ramon, CA, 94583. The application was filed with the Office of Surface Mining Reclamation and Enforcement (OSMRE) Western Region Office in Denver, Colorado, which has jurisdiction for the McKinley Mine on Navajo Nation lands.

VMU 1 and VMU 4 are situated on land leased from the Navajo Nation to conduct mining and reclamation on lands in the Navajo Reservation. These lands are generally located in former Mining Areas 6, 5 and 3 in the northern part of the McKinley Mine. Mining has been completed as have required reclamation activities that include backfilling and grading, installation of hydrologic controls, topdressing, and revegetation. The Office of Surface Mining has previously approved Phase I and II applications for these lands that included all categories of reclamation with the exception of a demonstration that the mine has successfully revegetated the land to meet the revegetation success standards in Permit No. NM-000K. This application contains information that the revegetation success standards have been met and that the land can be released from further reclamation liability.

A copy of the reclamation liability release and termination of jurisdiction application is available for public inspection at the following locations:

Mr. Jacob Mulinix and Ms. Christy Luciani
Western Region Office
Office of Surface Mining Reclamation and Enforcement
https://www.osmre.gov/programs/regulating-active-coal-mines/indian-lands

County Clerk's Office
McKinley County Courthouse
207 W. Hill Ave.
Gallup, NM 87301

The Navajo Nation Minerals Department – Office
of Surface Mining Program
Window Rock Blvd
Window Rock, AZ 86515

Within 30 days of the fourth and final publication of this bond release application notice in the Gallup Independent or Navajo Times newspaper, written comments, objections, or requests for a public hearing and informal conference on this reclamation liability release application shall be submitted to:

Mr. Jacob Mulinix
Office of Surface Mining Reclamation & Enforcement
Western Region Office
PO Box 25065
One Federal Center, Building 41 Lakewood, CO 80225-0065
303-236-4700
Email: jmulinix@osmre.gov

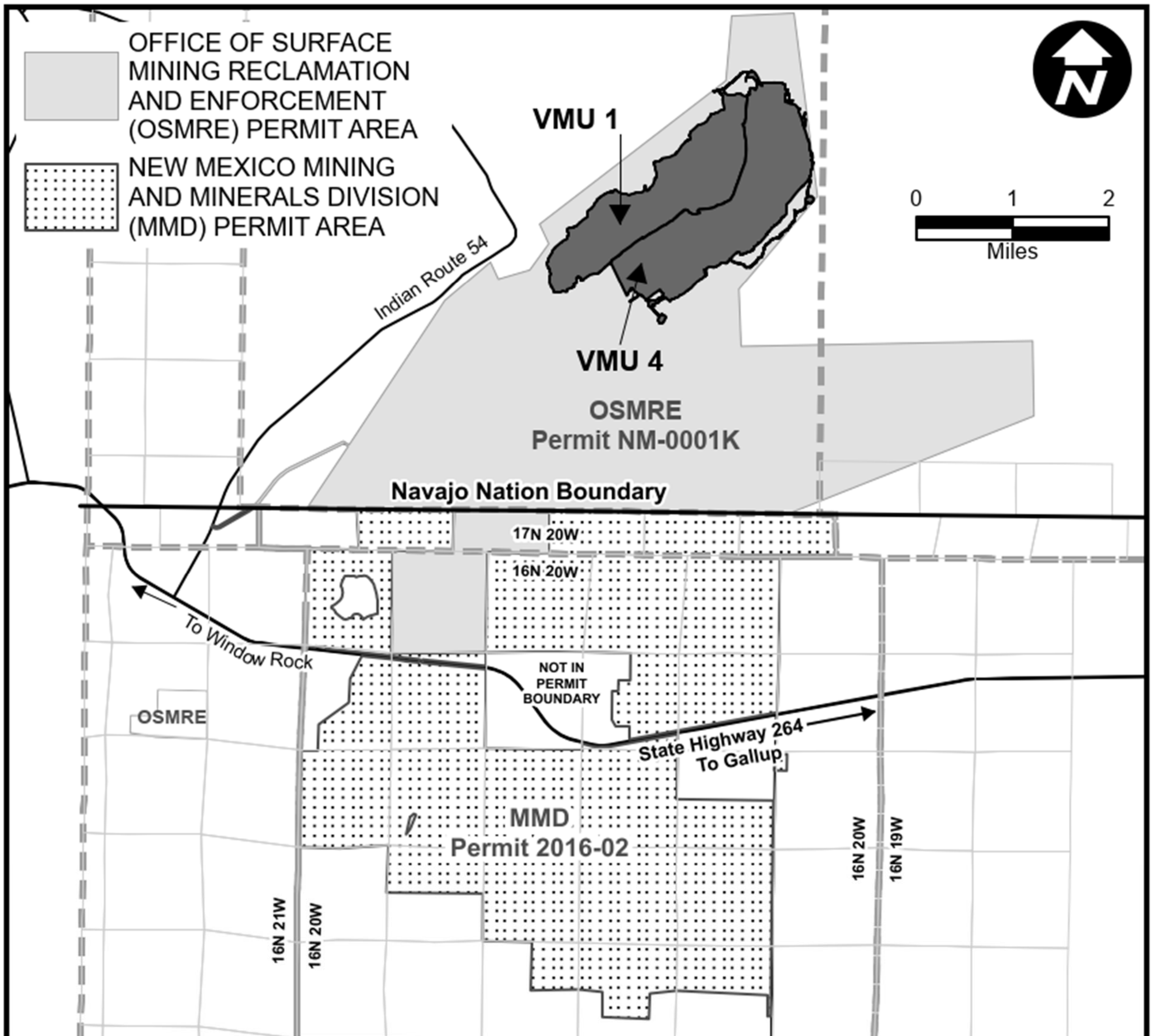

FIGURE 1
MCKINLEY MINE VMU 1 & VMU 4
BOND RELEASE & TOJ

Appendix A9: Newspaper Advertisement

McKinley Mine Permit No. NM-0001K
Vegetation Management Units 1 & 4
Application for Permanent Program Bond Release and
Initial Program Reclamation Liability Release and Termination of Jurisdiction

Chevron Mining Inc. (CMI) has filed an application for bond release of Permanent Program Lands and a reclamation liability release and termination of jurisdiction (TOJ) of Initial Program lands for reclaimed lands in Vegetation Management Units 1 and 4 (VMU 1 and VMU 4) contained in the McKinley Mine's mining and reclamation Permit No. NM-0001K (Permit NM-0001K) approved 09-07-2016, located in McKinley County, New Mexico.

VMU 1: The application includes a request for a Phase I, II and III bond release on two permanent impoundments in VMU 1 and Phase III bond release for the remaining area. The application contains information to demonstrates that 928 acres meet applicable requirements contained in the McKinley Mine's Permit NM-0001K, and the regulatory performance standards in 30 CFR 715, 800 and 816. The current performance bond is $53,921,545 and with this reclamation complete, the application includes calculations to reduce the associated reclamation performance bond by $1,562,000.

VMU 4: The application includes a request for a Phase I, II and III bond release on three permanent impoundments in VMU 4 and Phase III bond release for the remaining area. The application contains information to demonstrates that 1,141 acres meet applicable requirements contained in the McKinley Mine's Permit NM-0001K, and the regulatory performance standards in 30 CFR 715, 800 and 816. The current performance bond is $53,921,545 and with this reclamation complete, the application includes calculations to reduce the associated reclamation performance bond by $2,705,000.

The McKinley Mine is located approximately 22 miles northwest of Gallup, NM, and 2 miles east of Window Rock, AZ, on NM State Highway 264. Figure 1 shows the location and configurations of VMU 1 and VMU 4. The McKinley Mine is currently permitted by CMI (formerly the Pittsburg & Midway Coal Mining Co.), but now managed by Chevron Environmental Management Company (CEMC). CEMC is located at 6001 Bollinger Canyon Road, Building C-2144, San Ramon, CA, 94583. The application was filed with the Office of Surface Mining Reclamation and Enforcement (OSMRE) Western Region Office in Denver, Colorado, which has jurisdiction for the McKinley Mine on Navajo Nation lands.

VMU 1 and VMU 4 are situated on land leased from the Navajo Nation to conduct mining and reclamation on lands in the Navajo Reservation. These lands are generally located in former Mining Areas 6, 5 and 3 in the northern part of the McKinley Mine. Mining has been completed as have required reclamation activities that include backfilling and grading, installation of hydrologic controls, topdressing, and revegetation. The Office of Surface Mining has previously approved Phase I and II applications for these lands that included all categories of reclamation with the exception of a demonstration that the mine has successfully revegetated the land to meet the revegetation success standards in Permit No. NM-000K. This application contains information that the revegetation success standards have been met and that the land can be released from further reclamation liability.

A copy of the reclamation liability release and termination of jurisdiction application is available for public inspection at the following locations:

Mr. Jacob Mulinix and Ms. Christy Luciani
Western Region Office
Office of Surface Mining Reclamation and Enforcement
https://www.osmre.gov/programs/regulating-active-coal-mines/indian-lands

County Clerk's Office
McKinley County Courthouse
207 W. Hill Ave.
Gallup, NM 87301

The Navajo Nation Minerals Department – Office
of Surface Mining Program
Window Rock Blvd
Window Rock, AZ 86515

Within 30 days of the fourth and final publication of this bond release application notice in the Gallup Independent or Navajo Times newspaper, written comments, objections, or requests for a public hearing and informal conference on this reclamation liability release application shall be submitted to:

Mr. Jacob Mulinix
Office of Surface Mining Reclamation & Enforcement
Western Region Office
PO Box 25065
One Federal Center, Building 41 Lakewood, CO 80225-0065
303-236-4700
Email: jmulinix@osmre.gov

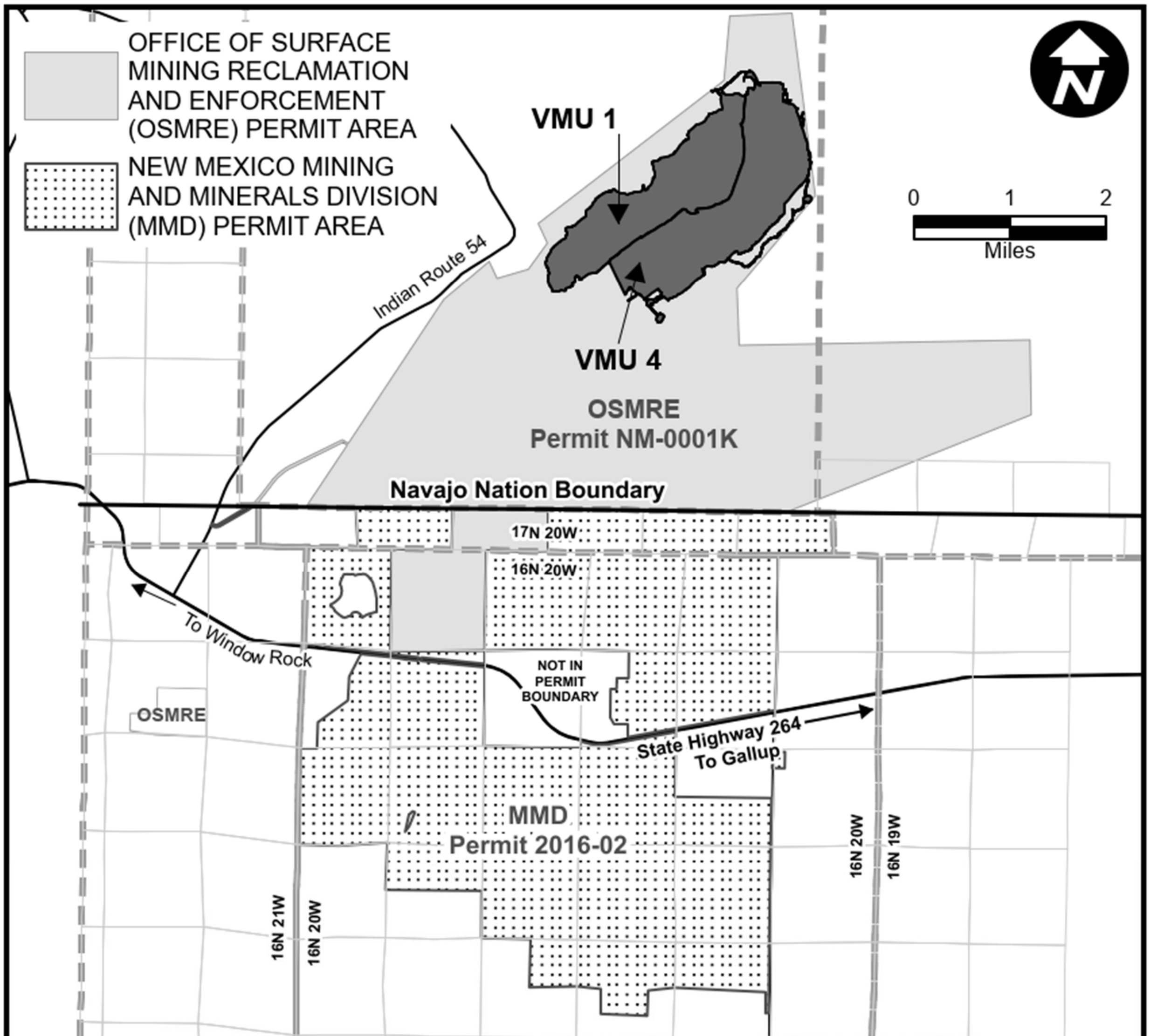

FIGURE 1
MCKINLEY MINE VMU 1 & VMU 4
BOND RELEASE & TOJ

Appendix A10: IPL Spoil Testing and Treatment Plans

P&M MCKINLEY MINE
AREA 6 TREATMENT PLAN

Submitted to:

Mr. Frank Rivera
The Pittsburg & Midway Coal Mining Company
McKinley Mine
24 Miles NW Hwy 264
Mentmore, NM 87319

Submitted by:

Golder Associates Inc.
5200 Pasadena Ave. NE, Suite C
Albuquerque, New Mexico 87113

Distribution:

6 Copies – Pittsburg & Midway Coal Mining Co.
3 Copy – Golder Associates Inc.

June 6, 2006 063-2118

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1.0 INTRODUCTION

The Pittsburg & Midway Coal Mining Co. (P&M) retained Golder Associates, Inc. (Golder) to evaluate reclamation issues in Area 6 at the McKinley Mine (Figure 1). Concerns from the Office of Surface Mining (OSM) and the Navajo Nation about vegetation performance and localized salt accumulations on the soil surface prompted sampling of the spoils in 2003 and 2004. The laboratory data indicated that low pH conditions and/or negative acid-base account (ABA) materials occurred in subsoils in some areas (Appendix A). The 2003 and 2004 sampling included the sampling of grids in accordance with the permit and selective sampling of areas with exposed spoils.

Golder evaluated the data from the 2003 and 2004 spoil sampling, conducted a field assessment of the site in the fall of 2004, and prepared an assessment report (Golder, 2005a). Golder recommended corrective actions to control runoff from an undeveloped road and selective covering of areas with exposed spoils and where the subsoils were consistently affected by low pH materials. The OSM technical evaluation of the ***Area 6 Reclamation Assessment*** was transmitted to P&M with a July 28, 2005 letter. Subsequently, a treatment plan, prepared by Golder and P&M, was submitted to the OSM in September 2005 (Golder, 2005b).

In September 2005, P&M proposed to treat about 10 acres in Area 6 by covering with 1 to 2 feet of topdressing, seeding, and mulching. The intent of this action was to provide 2 feet of cover materials over low pH materials as requested by the OSM. In addition, the short section of undeveloped road that traverses the uppermost major ridge on the reclamation would be removed and reclaimed to avoid future channelization of water.

In a December 19, 2005 submittal, the OSM requested revision of the original treatment plan report to remove sections that the OSM considered irrelevant dealing with the interpretation of the soil chemical considerations and plant interactions. In addition, the OSM requested that P&M increase the amount of area to be treated based on the results of the 2003 and 2004 spoil data. In response, P&M requested to sample the potentially affected grids on a quarter-grid basis in accordance with the permanent program lands protocols (January 15, 2006 letter). The OSM approved this request in a February 14, 2006 conference call and sampling was initiated in March 2006.

This report details the methods and results of the spring 2006 sampling episode and presents a revised treatment plan for Area 6.

1.1 Background and Setting

The project site is located on a relatively narrow northwest-trending ridge with slope gradients of about 4:1 (25 percent). Vegetation on the site is dominated by native and adapted grasses and shrubs typical of the reclaimed lands at McKinley. The area was originally seeded in the mid-1980s. In 1999, a plan to treat several locations in the southern part of Area 6 (grids 6-27-51, 6-27-52, 6-28-51, and 6-28-52) was submitted to the OSM. The treatments included combinations of liming, topsoiling, reseeding, and planting seedlings. The vegetation in these treatment areas has not become fully established.

Overall, the vegetation conditions in Area 6 are generally considered good, except for areas where spoils have been exposed by concentrated flow on the slopes and in the reseeded areas. The sparsely vegetated areas associated with incipient zero-order drainage channels forming on the slopes occupy less than 1 percent of the area. Repeated disturbance in the incipient channels associated with runoff events may have hindered vegetation development. Golder believes that dissection of this landscape is inevitable given the climate, soils, vegetation, and topography of the site. The sparsely vegetated areas associated with the exposed spoils may or may not have low pHs based on field measurements. In general, there is no apparent correlation among plant performance and the occurrence of low pH materials in the areas outside the erosion scars.

The spoil character varies vertically and horizontally with drastic changes in chemistry over relatively short distances. Only a few areas that were tested had low pH materials in upper (0- to 6-inch) spoil layer. In many cases, the adjacent subgrids did not contain low pH materials or the low pH conditions occurred deeper in the profile.

The generally good condition of the vegetation in Area 6 suggests that the materials are not toxic to vegetation. This may occur because the materials are inherently non-toxic with respect to the vegetation, or because the low pH materials occur inconsistently and below the predominant root zone. Studies in southwestern New Mexico on native and reclaimed lands indicate that the primary root zone is represented by the upper 12 to 24 inches of soil (Romig et al., 2006). Our understanding of the chemistry of soils supports the conclusion that these materials are not toxic based on accessory chemical characteristic of spoils that are not normally encountered in traditional acid soils (Golder, 2005a and b).

Golder raises the issue of toxicity in this instance not for the sake of argument, but rather to better understand the factors controlling revegetation and define the inherent capacity of the environment.

The issue of material toxicity is relevant because it is only one of several factors that may cause changes in reclaimed landscape over time. The complex response of vegetation and the subsequent development and integration of drainage systems to drought are other possible causes for the current conditions in Area 6. Similar manifestations of vegetation performance and landscape development (erosion and slope dissection) are occurring in the CDK Area, which has an entirely different complement of soil conditions. The similarities in landscape response in these two areas under divergent soil conditions suggest to us that soils are not the primary controlling factor. In contrast, the response in the two areas suggests that climatic and geomorphic factors are overriding material characteristics as these landscapes mature.

The issues of the trajectory of landscape evolution and plant toxicity notwithstanding, P&M proposes to treat portions of Area 6 in recognition of the current permit guidelines and in the spirit of cooperation. The new data and treatment plan for Area 6 are discussed below.

2.0 METHODS

Quarter grid sample locations were surveyed in the field for the grids that were identified by the OSM as requiring additional cover. P&M excavated backhoe pits at the quarter grid locations in March 2006. A total of 195 topsoil and spoil samples were collected by P&M and submitted to Green Analytical Laboratory in Durango, CO. The samples were ground to pass a 2-millimeter (mm) sieve and analyzed for saturated paste pH, neutralization potential, and total sulfur. Pyritic sulfur was determined on samples that had negative ABA based on the total sulfur analysis.

Golder made qualitative assessments of vegetation cover and vigor in Area 6 in September 2004. In March 2006, Golder evaluated vegetation cover, root distributions, and topsoil thickness at the quarter grid sampling sites. Estimates of canopy cover were made in a 10-foot radius at each subgrid sample location in early March 2006. The quantity and size of roots was evaluated at each subgrid sample location using standard methods (Soil Survey Division Staff, 1993). Golder identified the topsoil thickness at each site and provided sampling instructions to P&M (Table 1). Photographs of the quarter grid sampling sites are included in Appendix B.

3.0 RESULTS

3.1 Soil Characteristics

This section is intended to summarize the sampling data primarily with respect to soil pH and ABA data. The locations of sampling sites in Area 6 are shown on Figure 2. The pH and ABA data from the spring 2006 quarter grid sampling are listed in Table 2. Data from the 2003-2004 spoil sampling are included in Appendix A. In general, the soils and spoils are non-sodic, non-saline to strongly saline, and moderately fine- to fine-textured. The spoils are typically skeletal with approximately 40 to 50 percent gravel. Overall, the pHs ranged from 2.2 to 8.1 with the acidic materials generally occurring in the subsoil. The topsoil thickness ranged from 3 to 22 inches at the quarter grid sampling sites. The topsoil layers were neutral to slightly alkaline (pH 6.7 to 7.8), although one sample was very strongly acid (pH 4.6).

Most, but not all, samples had measurable neutralization potential. The ABAs were generally positive or near neutral (0 to -1 tons per kiloton), although three of the quarter grid samples had strongly negative ABAs (<-5). The lack of strongly negative ABAs suggests a reduced potential for further acidification of the spoils. Based on the 2003-2004 data, the spoils are mostly non- to slightly saline with a few sites that are moderately saline (maximum of 10 deciSiemens per meter). With few exceptions, the soluble calcium levels (20 to 30 milliequivalents per liter) suggest saturation with respect to gypsum.

The general lack of spatial continuity in material characteristics within and among grids suggests that the materials are variable in nature and discontinuously distributed. The subgrid sampling demonstrates that the material characteristics change over short distances (<100 horizontal feet; Figure 2). Thus, we conclude that low pH soils are not laterally or vertically extensive, occur inconsistently across the sites, and tend to be concentrated at depth below the predominant rooting zone of native species. The apparent distribution of the materials may explain the lack of evidence for discernable vegetation impacts.

3.2 Vegetation Performance

On September 23, 2004, Dr. Lewis Munk and Mr. Douglas Romig evaluated the vegetation and soil conditions in Area 6. Overall, the vegetation performance was considered to be consistent with other areas at McKinley. The vegetation was performing at adequate levels, and the reclamation was considered good, especially in light of the severe drought conditions that have prevailed in New

Mexico over the past 5 years. The vegetation cover is composed primarily of perennial grasses, shrubs, and forbs, and is consistent with the reclamation on many of the surrounding Program lands.

Droughts and periods of above average precipitation occur frequently but with varying degrees of intensity in New Mexico. On average, severe and prolonged droughts occur approximately once a century (S.S. Papadopulos & Associates, Inc. [SSP&A], 2001). Prolonged wet periods occur approximately twice each century on average; however, they are generally of shorter duration and lower magnitude than the most severe droughts. The period from 1978 to 1992 is considered to represent the wettest conditions in the last 500 years (SSP&A, 2001). This general timeframe coincides with the reclamation performance period in Area 6. Golder evaluated the vegetation in the lime treatment area, which was reseeded in 2001. This area has not become fully established. We believe that the establishment of the vegetation has been compromised by the prevailing drought conditions. Thus, insufficient time has passed to evaluate the efficacy of liming in this area. However, we do not believe that liming will affect plant performance based on our understanding of Al chemistry and the character of these materials.

Area 6 as a whole met bond release standards for both perennial and total cover as well as production. Pre-settlement lands in Area 6 (those reclaimed prior to the 1985 OSM Settlement) had the highest average perennial and total cover (44.8 and 71.1 percent, respectively) of the pre-1985 areas (Taschek Environmental Consulting [Taschek], 2006). Total production for the pre-1985 lands in Area 6 averaged 808.9 pounds per acre (lbs/ac) compared to the 550 lbs/ac production standard that is applicable to post-1985 lands (Taschek, 2006).

Minor and localized areas with sparse vegetation cover were observed where the spoils had been exposed by channel-forming processes on the slopes. These areas were typically associated with run-on from the surrounding uplands that concentrated water on the slopes exposing the spoils. Field pH measurements in these newly formed channels indicated that some, but not all, the spoils were acidic in reaction. Except for those areas with exposed spoils, we could not discern any difference in plant performance among the grids that contain low pH soils and those with neutral and alkaline subsoils.

The location of grids with low pH materials is shown on Figure 2. The vegetation conditions in Grid 6-28-51, which contains low pH soils at or near the surface, are shown on Figure 3. The conditions in Grid 2-29-51 are shown on Figure 4. Based on our evaluation of the area in 2004, we concluded that the occurrence of low pH conditions in the soils was not practically affecting plant performance.

Thus, we believe that under the circumstances present at the McKinley Mine, whereby the low pH soils occupy a relatively minor amount of the area (both spatially and volumetrically), occur inconsistently across the sites, tend to be concentrated at depth, and do not represent a toxic condition for native and adapted plants.

Like other areas in New Mexico, McKinley Mine has experienced severe drought conditions over the past 5 years. Below normal precipitation conditions have prevailed over the last 5 years (i.e., since 2000). We believe that the preceding drought conditions may have caused the perception of decreased plant performance in this area.

Canopy cover estimates made in spring 2006 ranged from 5 to 70 percent at the samples sites. These estimates correspond well with total cover measurements made during the 2005 growing season (Taschek, 2006). In addition, Figure 5 illustrates the relationship between the thickness of suitable substrate and estimated canopy cover. In general, there is considerable variability in plant cover that appears to be unrelated to suitability thicknesses, particularly at sites with greater than 6 inches of suitable material. The apparent lack of correlation suggests that other factors besides acidity may be affecting vegetative cover. Observations at the majority of sites with less than 30 percent cover suggest that these areas had been recently reworked, disturbed by vehicular traffic, or adjacent to drainages (Table 3). A general trend of reduced vegetation performance was observed at sites with thinner suitable materials over spoils with a pH less than 4.0. However, this trend was not evident at sites with spoil pH levels between 4.0 and 5.5 where canopy cover ranged from 20 to 70 percent, and corresponded less to the thickness of suitable materials.

3.3 Root Distribution

Root quantity and size classes were described for the entire depth of the sample pit. Total rooting depth was also measured for each soil profile, corresponding to the depth where root quantities were greater than a trace (very few or greater). Total rooting depths ranged from 3 to 39 inches for the areas sampled. The principal root sizes were very fine and fine, and most of the roots were observed in the upper 12 to 16 inches of the profile. The root size class and distribution is typical of a semi-arid grassland community and corresponds with other root studies in the region (Romig et al., 2006). Nearly 70 percent of roots in semi-arid grasslands occur in the upper 10 inches, and 90 percent of roots are found within the upper 2 feet of soil (Romig et al., 2006).

In the majority of subgrids, no direct relationship is evident between rooting depth and suitability thickness, suggesting that other factors besides acidity may be affecting root distribution (Figure 6).

In many instances, roots were growing in acidic materials. For example, roots at Grid 6-22-55A extended to 28 inches below the surface, yet the soil surface was pH 4.6 and the subsoil was pH 3.1 at 18 inches.

4.0 TREATMENT PLAN

Golder worked with P&M to develop a treatment plan for Area 6 based on our best understanding of the problem, existing permit guidelines, and to address the concerns of the OSM, Bureau of Indian Affairs, and the Navajo Nation. The proposed treatment areas and cover requirements are designated on Figure 7. These areas were identified on the basis of the soil chemical data from the grid sampling and field surveys to identify zones where spoils have been exposed through the drainage integration process. The overall objective of the plan is to add enough cover to obtain a 2 foot layer over the proposed treatment areas with low pH.

The thickness of the cover materials that are needed to achieve a 2-foot cover are indicated on Figure 7. No mitigation is proposed for 6 subgrids that have pH levels between 5.0 and 5.5 (Figure 7). The 6 subgrids have positive pyritic ABAs within 2 feet of the soil surface, thus pH is not expected to decrease further. The thickness of suitable cover for these subgrids averages about 15 inches. The vegetation is performing quite well and canopy cover was estimated to range from 50 to 70 percent in these areas.

Approximately 50,000 tons of material will be required to cover the proposed treatment areas. P&M plans to use topsoil resources in Topsoil Stockpile (No. 63) or augment with other topsoil substitutes. Minor areas identified outside the delineated treatment areas shown on Figure 7 may be treated during the implementation of the reclamation. Disturbed areas associated with the equipment access corridors will be reclaimed (seeded and mulched) following the importation of the cover materials. In addition, we recommend inter-seeding the lime treatment area.

Finally, the undeveloped road that traverses the ridgetop will be rehabilitated to avoid channelization of water onto the adjacent slopes.

4.1 Reclamation Recommendations

The reclamation approach presented here will be conducted using methods that have been traditionally applied at the McKinley Mine. We recommend the institution of surface water control measures in areas with improper drainage that are leading to localized erosion of the slopes and exposure of the spoils. In particular, the non-engineered road that runs down the main ridge in Area 6 should be moved and/or rehabilitated to prevent runoff onto the slope. Specific reclamation recommendations for the designated lands are listed below:

- Apply additional suitable cover materials per the plan (Figure 7). The cover will be obtained from the adjacent Topsoil Stockpile (No. 63) or from topsoil substitutes.

- Scarify 6 to 8 inches deep parallel to the contour.

- Broadcast or drill seed using the mix proposed in Table 4.

- Apply mulch at a rate of 2 to 2.5 tons per acre. Crimp 3 to 4 inches deep with vertical coulters to fix the mulch.

- Livestock access should be restricted for a minimum of 5 years and carefully controlled thereafter.

- Long-stem, certified weed-free, mulch should be used if possible.

- P&M will make an effort to have topsoil placed and seeding completed to take advantage of the summer rains.

5.0 REFERENCES

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TABLES

TABLE 1

TOPSOIL THICKNESS AND SAMPLING INTERVALS FOR AREA 6 SUBGRIDS

Grid	Quarter	Topsoil Thickness	Sample 1	Sample 2	Sample 3	Sample 4
6-21-55	A	4	4-9"	9-15"	15-21"	21-24"
	B	9	9-15"	15-21"	21-24"	
	C	13	13-19"	19-24"		
	D	12	12-18"	18-24"		
6-21-56	A	18	18-24"			
	B	15	15-21"	21-24"		
	C	3	3-9"	9-15"	15-21"	21-24"
	D	5	5-11"	11-17"	17-24"	
6- 22-55	A	6	6-12"	12-18"	18-24"	
	B	10	10-16"	16-24"		
	C	11	11-17"	17-24'		
	D	9	9-15"	15-21"	21-24"	
6- 22-56	A	12	12-18"	18-24"		
	B	20	20-24"			
	C	22	22-24"			
	D	16	16-24"			
6- 23-53	A	11	11-17"	17-24"		
	B	13	13-19"	19-24"		
	C	10	10-16"	16-24"		
	D	7	7-13"	13-19"	19-24"	
6- 23-54	A	12	12-18"	18-24"		
	B	14	14-20"	20-24"		
	C	13	13-19"	19-24"		
	D	3	3-9"	9-15"	15-21"	21-24"
6- 25-54	A	7	7-11"	11-17"	17-24"	
	B	8	8-12"	12-18"	18-24"	
	C	3	3-9"	9-15"	15-21"	21-24"
	D	6	6-12"	12-18"	18-24"	
6- 26-51	A	7	7-13"	13-19"	19-24"	
	B	5	5-11"	11-17"	17-24"	
	C	7	7-13"	13-19"	19-24"	
	D	5	5-11"	11-17"	17-24"	
6- 26-52	A	10	10-16"	16-24"		
	B	13	13-19"	19-24"		
	C	11	11-17"	17-24"		
	D	3	3-9"	9-15"	15-21"	21-24"
6- 27-51	A	11	11-17"	17-24"		
	B	14	14-20"	21-24"		
	C	7	7-13"	13-19"	19-24"	
	D	5	5-11"	11-17"	17-24"	
6- 27-52	A	7	7-13"	13-19"	19-24"	
	B	9	9-15"	15-21"	21-24"	
	C	7	7-13"	13-19"	19-24"	
	D	10	10-16"	16-24"		
6- 28-51	A	16	16-24"			
	B	5	5-11"	11-17"	17-24"	
	C	8	8-14"	14-20"	20-24"	
	D	10	10-16"	16-24"		
6- 29-51	A	0	0-6"	6-12"	12-18"	18-24"
	B	10	10-16"	16-22"	22-24"	
	C	7	7-13"	13-19"	19-24"	
	D	6	6-12"	12-18"	18-24"	
6- 29-52	A	7	7-13"	13-19"	19-24"	
	B	13	13-19"	19-24"		
	C	13	13-19"	19-24"		
	D	7	7-13"	13-19"	19-24"	

TABLE 2
QUARTER GRID SAMPLING DATA- AREA 6 McKINLEY MINE

Location	Sample Depth	pH Units	Neutralization Potential (t/kt)	Total S ABA (t/kt)	Pyritic ABA (t/kt)	Total S AGP (t/kt)	Pyritic ABA (t/kt)	Total S (%)	Pyritic S (%)
6-21-55A	0-4	7.1	--	--	--	--	--	--	--
6-21-55A	4-9	7.5	13.8	12.2	--	1.59	--	0.051	--
6-21-55A	9-15	7.4	12.3	10.3	--	2.00	--	0.064	--
6-21-55A	15-21	6.4	8.27	-28.6	0.28	36.8	7.99	1.179	0.009
6-21-55A	21-24	5.1	3.76	-1.79	0.22	5.55	3.54	0.178	0.007
6-21-55B	0-9	7.6	--	--	--	--	--	--	--
6-21-55B	9-15	7.6	12.3	10.6	--	1.65	--	0.053	--
6-21-55B	15-21	7.8	89.7	88.5	--	1.22	--	0.039	--
6-21-55B	21-24	7.6	18.3	16.4	--	1.91	--	0.061	--
6-21-55C	0-13	7.7	--	--	--	--	--	--	--
6-21-55C	13-19	7.1	12.8	10.8	--	1.94		0.062	--
6-21-55C	19-24	5.6	6.26	-6.03	0.22	12.3	6.04	0.394	0.007
6-21-55D	0-12	7.6	--	--	--	--	--	--	--
6-21-55D	12-18	6.8	13.3	9.35	--	3.93	--	0.126	--
6-21-55D	18-24	7.2	10.3	2.97	--	7.30	--	0.234	--
6-21-56A	0-18	7.8	--	--	--	--	--	--	--
6-21-56A	18-24	6.6	6.76	-2.75	0.25	9.52	6.51	0.305	0.008
6-21-56B	0-15	7.7	--	--	--	--	--	--	--
6-21-56B	15-21	7.9	34.6	33.4	--	1.18	--	0.038	--
6-21-56B	21-24	7.4	14.3	12.8	--	1.45	--	0.046	--
6-21-56C	0-3	7.7	--	--	--	--	--	--	--
6-21-56C	3-9	7.6	20.3	18.5	--	1.82	--	0.058	--
6-21-56C	9-15	8.0	74.7	73.3	--	1.37	--	0.044	--
6-21-56C	15-21	8.0	26.1	24.6	--	1.50	--	0.048	--
6-21-56C	21-24	8.1	30.1	28.4	--	1.66	--	0.053	--
6-21-56D	0-5	6.7	--	--	--	--	--	--	--
6-21-56D	5-11	4.3	0.25	-14.0	0.47	14.2	-0.22	0.455	0.015
6-21-56D	11-17	3.8	0.00	-15.7	0.66	15.0	-0.66	0.479	0.021
6-21-56D	17-24	3.2	0.00	-47.0	26.3	45.2	-26.27	1.448	0.841
6-22-55A	0-6	4.6	--	--	--	--	--	--	--
6-22-55A	6-12	3.9	0.00	-29.8	1.28	29.1	-1.28	0.931	0.041
6-22-55A	12-18	3.7	0.00	-32.3	1.94	27.6	-1.94	0.883	0.062
6-22-55A	18-24	3.1	0.0	-94.2	3.28	80.4	-3.3	2.575	0.105
6-22-55B	0-10	7.6	--	--	--	--	--	--	--
6-22-55B	10-16	4.9	2.77	-17.1	0.47	19.8	2.30	0.635	0.015
6-22-55B	16-24	3.6	1.76	-14.2	0.25	16.0	1.51	0.512	0.008
6-22-55C	0-11	6.9	--	--	--	--	--	--	--
6-22-55C	11-17	4.0	14.8	0.58	--	14.2	--	0.455	--
6-22-55C	17-24	4.0	3.76	-13.8	0.22	17.5	3.54	0.561	0.007
6-22-55D	0-9	7.7	--	--	--	--	--	--	--
6-22-55D	9-15	7.8	24.1	23.3	--	0.77	--	0.025	--
6-22-55D	15-21	6.9	23.1	20.0	--	3.01	--	0.096	--
6-22-55D	21-24	5.1	4.26	-10.7	0.50	15.0	3.76	0.479	0.016
6-22-56A	0-12	7.5	--	--	--	--	--	--	--
6-22-56A	12-18	6.9	54.6	49.7	--	4.97	--	0.159	--
6-22-56A	18-24	4.6	0.75	-8.7	0.19	9.44	0.56	0.302	0.006
6-22-56B	0-20	8.0	21.8	20.7	--	1.08	--	0.035	--
6-22-56C	0-22	7.4	--	--	--	--	--	--	--
6-22-56C	22-24	7.7	17.8	15.0	--	2.74	--	0.088	--
6-22-56D	0-16	7.8	--	--	--	--	--	--	--
6-22-56D	16-24	8.3	42.1	41.1	--	1.02	--	0.033	--

QUARTER GRID SAMPLING DATA- AREA 6 McKINLEY MINE

Location	Sample Depth	pH Units	Neutralization Potential (t/kt)	Total S ABA (t/kt)	Pyritic ABA (t/kt)	Total S AGP (t/kt)	Pyritic ABA (t/kt)	Total S (%)	Pyritic S (%)
6-23-53A	11-17	8.1	26.6	24.0	--	2.52	--	0.081	--
6-23-53A	17-24	6.5	5.26	-2.49	0.41	7.75	4.85	0.248	0.013
6-23-53B	0-13	7.4	--	--	--	--	--	--	--
6-23-53B	13-19	6.8	8.77	4.08	--	4.69	--	0.150	--
6-23-53B	19-24	6.6	5.76	1.31	--	4.45	--	0.143	--
6-23-53C	0-10	6.7	--	--	--	--	--	--	--
6-23-53C	10-16	5.4	4.76	-4.41	0.22	9.17	4.54	0.293	0.007
6-23-53C	16-24	6.5	6.26	-2.93	0.19	9.20	6.08	0.294	0.006
6-23-53D	0-7	7.7	--	--	--	--	--	--	--
6-23-53D	7-13	7.8	15.0	12.0	--	3.00	--	0.096	--
6-23-53D	13-19	7.3	9.27	3.41	--	5.86	--	0.188	--
6-23-53D	19-24	8.0	17.5	16.1	--	1.48	--	0.047	--
6-23-54A	0-12	8.0	--	--	--	--	--	--	--
6-23-54A	12-18	7.8	14.3	11.8	--	2.53	--	0.081	--
6-23-54A	18-24	8.0	11.3	6.90	--	4.37	--	0.140	--
6-23-54B	0-14	7.4	--	--	--	--	--	--	--
6-23-54B	14-20	6.7	20.8	12.0	--	8.83	--	0.283	--
6-23-54B	20-24	4.1	0.00	-41.8	0.12	41.5	-0.12	1.329	0.004
6-23-54C	0-13	7.7	--	--	--	--	--	--	--
6-23-54C	13-19	6.3	5.76	2.94	--	2.82	--	0.090	--
6-23-54C	19-24	6.4	9.77	4.09	--	5.68	--	0.182	--
6-23-54D	0-3	7.8	--	--	--	--	--	--	--
6-23-54D	3-9	7.8	7.97	6.23	--	1.73	--	0.056	--
6-23-54D	9-15	7.2	6.76	3.12	--	3.64	--	0.117	--
6-23-54D	15-21	7.2	7.26	1.79	--	5.47	--	0.175	--
6-23-54D	21-24	6.4	6.26	-5.28	0.75	11.5	5.51	0.370	0.024
6-25-54A	0-7	7.6	--	--	--	--	--	--	--
6-25-54A	7-11	5.5	0.00	-15.2	0.53	14.5	-0.53	0.463	0.017
6-25-54A	11-17	5.3	7.78	-2.97	0.37	10.7	7.40	0.344	0.012
6-25-54A	17-24	6.0	7.78	-7.90	2.12	15.7	5.65	0.502	0.068
6-25-54B	0-8	7.7	--	--	--	--	--	--	--
6-25-54B	8-12	7.5	9.52	8.47	--	1.04	--	0.033	--
6-25-54B	12-18	6.5	10.3	1.33	--	8.94	--	0.286	--
6-25-54B	18-24	3.8	0.75	-19.3	0.78	20.1	-0.03	0.643	0.025
6-25-54C	0-3	7.6	--	--	--	--	--	--	--
6-25-54C	3-9	5.5	6.26	-0.01	0.41	6.27	5.86	0.201	0.013
6-25-54C	9-15	4.4	4.26	-7.95	0.19	12.2	4.07	0.391	0.006
6-25-54C	15-21	3.3	0.00	-23.2	0.41	22.4	-0.41	0.717	0.013
6-25-54C	21-24	4.2	2.25	-8.08	1.72	10.3	0.53	0.331	0.055
6-25-54D	0-6	7.5	--	--	--	--	--	--	--
6-25-54D	6-12	6.0	8.27	1.97	--	6.30	--	0.202	--
6-25-54D	12-18	3.4	0.00	-25.2	2.78	23.9	-2.78	0.766	0.089
6-25-54D	18-24	3.3	0.00	-29.6	2.28	28.4	-2.28	0.908	0.073
6-26-51A	0-7	7.4	--	--	--	--	--	--	--
6-26-51A	7-13	7.4	14.8	12.6	--	2.24	--	0.072	--
6-26-51A	13-19	7.3	12.8	10.5	--	2.31	--	0.074	--
6-26-51A	19-24	6.9	12.3	7.02	--	5.27	--	0.169	--
6-26-51B	0-5	7.7	--	--	--	--	--	--	--
6-26-51B	5-11	7.4	15.6	14.5	--	1.05	--	0.034	--
6-26-51B	11-17	7.2	11.8	7.63	--	4.15	--	0.133	--
6-26-51B	17-24	7.3	14.3	9.67	--	4.63	--	0.148	--

TABLE 2
QUARTER GRID SAMPLING DATA- AREA 6 McKINLEY MINE

Location	Sample Depth	pH Units	Neutralization Potential (t/kt)	Total S ABA (t/kt)	Pyritic ABA (t/kt)	Total S AGP (t/kt)	Pyritic ABA (t/kt)	Total S (%)	Pyritic S (%)
6-26-51C	0-7	7.5	--	--	--	--	--	--	--
6-26-51C	7-13	5.6	13.8	8.86	--	4.92	--	0.157	--
6-26-51C	13-19	4.3	1.25	-11.9	1.47	13.1	-0.22	0.420	0.047
6-26-51C	19-24	3.6	0.00	-29.8	0.91	23.0	-0.91	0.738	0.029
6-26-51D	0-5	7.4	--	--	--	--	--	--	--
6-26-51D	5-11	7.1	10.8	8.37	--	2.40	--	0.077	--
6-26-51D	11-17	6.5	11.3	8.08	--	3.19	--	0.102	--
6-26-51D	17-24	6.0	8.77	0.60	--	8.17	--	0.261	--
6-26-52A	0-10	7.5	--	--	--	--	--	--	--
6-26-52A	10-16	6.6	9.27	2.36	--	6.91	--	0.221	--
6-26-52A	16-24	3.7	4.76	-11.0	0.69	15.7	4.07	0.503	0.022
6-26-52B	0-13	7.6	--	--	--	--	--	--	--
6-26-52B	13-19	5.8	5.77	-4.99	1.12	10.8	4.65	0.345	0.036
6-26-52B	19-24	5.4	5.77	-12.6	0.25	18.4	5.52	0.590	0.008
6-26-52C	0-11	7.5	--	--	--	--	--	--	--
6-26-52C	11-17	5.3	5.77	-4.46	0.41	10.2	5.37	0.328	0.013
6-26-52C	17-24	6.3	6.78	-5.09	0.44	11.9	6.34	0.380	0.014
6-26-52D	0-3	6.0	--	--	--	--	--	--	--
6-26-52D	3-9	2.9	0.00	-32.0	0.06	26.7	-0.06	0.856	0.002
6-26-52D	9-15	2.9	0.00	-31.7	1.31	27.4	-1.31	0.877	0.042
6-26-52D	15-21	2.8	0.00	-37.6	3.03	33.4	-3.03	1.069	0.097
6-26-52D	21-24	2.7	0.00	-36.3	2.37	31.0	-2.37	0.994	0.076
6-27-51A	0-11	7.4	--	--	--	--	--	--	--
6-27-51A	11-17	6.0	5.76	-2.03	0.78	7.79	4.98	0.249	0.025
6-27-51A	17-24	4.6	2.75	-10.2	0.03	13.0	2.72	0.416	0.001
6-27-51B	0-14	7.4	--	--	--	--	--	--	--
6-27-51B	14-20	4.9	3.25	-8.83	-0.37	12.1	3.63	0.387	-0.012
6-27-51B	21-24	4.5	1.25	-20.5	0.03	21.8	1.22	0.697	0.001
6-27-51C	0-7	7.0	--	--	--	--	--	--	--
6-27-51C	7-13	6.1	10.8	4.05	--	6.74	--	0.216	--
6-27-51C	13-19	3.3	0.00	-23.7	0.09	21.0	-0.09	0.672	0.003
6-27-51C	19-24	4.2	4.27	-13.6	0.06	17.8	4.21	0.571	0.002
6-27-51D	0-5	7.9	--	--	--	--	--	--	--
6-27-51D	5-11	6.3	9.78	3.00	--	6.78	--	0.217	--
6-27-51D	11-17	6.3	8.78	-0.06	0.06	8.84	8.72	0.283	0.002
6-27-51D	17-24	7.1	9.78	5.40	--	4.38	--	0.140	--
6-27-52A	0-7	7.7	--	--	--	--	--	--	--
6-27-52A	7-13	7.1	17.8	15.6	--	2.23	--	0.071	--
6-27-52A	13-19	3.7	0.26	-21.7	0.31	22.0	-0.05	0.704	0.010
6-27-52A	19-24	3.1	0.00	-24.5	-0.06	18.7	0.06	0.600	-0.002
6-27-52B	0-9	6.9	--	--	--	--	--	--	--
6-27-52B	9-15	4.2	0.76	-13.6	-0.03	14.3	0.79	0.459	-0.001
6-27-52B	15-21	5.4	13.8	-2.18	0.87	16.0	12.9	0.511	0.028
6-27-52B	21-24	3.7	0.76	-20.4	1.72	21.2	-0.96	0.678	0.055
6-27-52C	0-7	7.9	--	--	--	--	--	--	--
6-27-52C	7-13	7.4	19.6	17.3	--	2.25	--	0.072	--
6-27-52C	13-19	7.3	19.1	16.7	--	2.33	--	0.075	--
6-27-52C	19-24	7.4	26.1	24.6	--	1.45	--	0.046	--
6-27-52D	0-10	7.7	--	--	--	--	--	--	--
6-27-52D	10-16	4.3	2.25	-14.1	0.09	16.4	2.16	0.525	0.003
6-27-52D	16-24	3.8	0.00	-20.6	0.28	19.8	-0.28	0.634	0.009

TABLE 2
QUARTER GRID SAMPLING DATA- AREA 6 McKINLEY MINE

Location	Sample Depth	pH Units	Neutralization Potential (t/kt)	Total S ABA (t/kt)	Pyritic ABA (t/kt)	Total S AGP (t/kt)	Pyritic ABA (t/kt)	Total S (%)	Pyritic S (%)
6-28-51A	0-16	7.5	--	--	--	--	--	--	--
6-28-51A	16-24	3.6	0.00	-24.6	0.06	23.3	-0.06	0.747	0.002
6-28-51B	0-5	7.6	--	--	--	--	--	--	--
6-28-51B	5-11	4.2	1.76	-22.8	0.44	24.6	1.33	0.787	0.014
6-28-51B	11-17	4.5	2.77	-18.3	1.12	21.1	1.64	0.675	0.036
6-28-51B	17-24	4.3	1.76	-24.4	1.50	26.2	0.26	0.839	0.048
6-28-51C	0-8	6.7	--	--	--	--	--	--	--
6-28-51C	8-14	3.8	0.00	-26.5	13.12	24.2	-13.1	0.776	0.420
6-28-51C	14-20	4.6	0.26	-25.3	2.34	25.5	-2.08	0.817	0.075
6-28-51C	20-24	5.4	6.27	-18.7	2.59	25.0	3.68	0.801	0.083
6-28-51D	0-10	7.5	--	--	--	--	--	--	--
6-28-51D	10-16	4.8	1.76	-14.1	0.44	15.9	1.33	0.508	0.014
6-28-51D	16-24	3.4	0.00	-20.7	0.06	19.5	-0.06	0.623	0.002
6-29-51A	0-6	6.7	--	--	--	--	--	--	--
6-29-51A	6-12	3.6	0.00	-26.3	-0.72	25.0	0.72	0.801	-0.023
6-29-51A	12-18	3.2	0.00	-27.4	-0.03	26.1	0.03	0.836	-0.001
6-29-51A	18-24	3.4	0.00	-29.9	0.00	27.7	0.00	0.885	0.000
6-29-51B	0-10	7.2	--	--	--	--	--	--	--
6-29-51B	10-16	3.1	0.00	-23.0	-0.03	21.7	0.03	0.695	-0.001
6-29-51B	16-22	2.4	0.00	-30.5	1.16	25.3	-1.16	0.808	0.037
6-29-51B	22-24	2.2	0.00	-45.6	10.6	38.3	-10.59	1.227	0.339
6-29-51C	7-13	5.4	6.27	-2.55	0.12	8.82	6.15	0.282	0.004
6-29-51C	13-19	4.4	2.77	-13.0	0.00	15.8	2.77	0.505	0.000
6-29-51C	19-24	3.7	1.26	-19.7	0.53	20.9	0.73	0.670	0.017
6-29-51D	0-6	7.2	--	--	--	--	--	--	--
6-29-51D	6-12	6.9	9.78	5.85	--	3.94	--	0.126	--
6-29-51D	12-18	6.7	9.78	5.84	--	3.95	--	0.126	--
6-29-51D	18-24	7.2	10.8	8.56	--	2.22	--	0.071	--
6-29-52A	0-7	7.6	--	--	--	--	--	--	--
6-29-52A	7-13	7.3	13.8	11.7	--	2.14	--	0.068	--
6-29-52A	13-19	6.5	10.8	-2.6	0.69	13.3	10.1	0.427	0.022
6-29-52A	19-24	4.3	1.76	-17.3	0.44	19.1	1.33	0.611	0.014
6-29-52B	0-13	7.2	--	--	--	--	--	--	--
6-29-52B	13-19	7.1	10.8	7.25	--	3.54	--	0.113	--
6-29-52B	19-24	4.7	1.76	-13.7	0.25	15.5	1.51	0.496	0.008
6-29-52C	0-13	7.4	--	--	--	--	--	--	--
6-29-52C	13-19	6.9	11.8	9.50	--	2.28	--	0.073	--
6-29-52C	19-24	7.0	18.8	15.4	--	3.43	--	0.110	--
6-29-52D	0-7	7.6	--	--	--	--	--	--	--
6-29-52D	7-13	7.1	16.8	14.8	--	2.02	--	0.065	--
6-29-52D	13-19	6.8	6.78	-1.67	0.50	8.44	6.28	0.270	0.016
6-29-52D	19-24	5.9	5.77	-9.23	1.28	15.0	4.49	0.480	0.041

Notes:

t/kt = tons per kiloton

ABA = acid-base accounting

AGP = acid generation potential

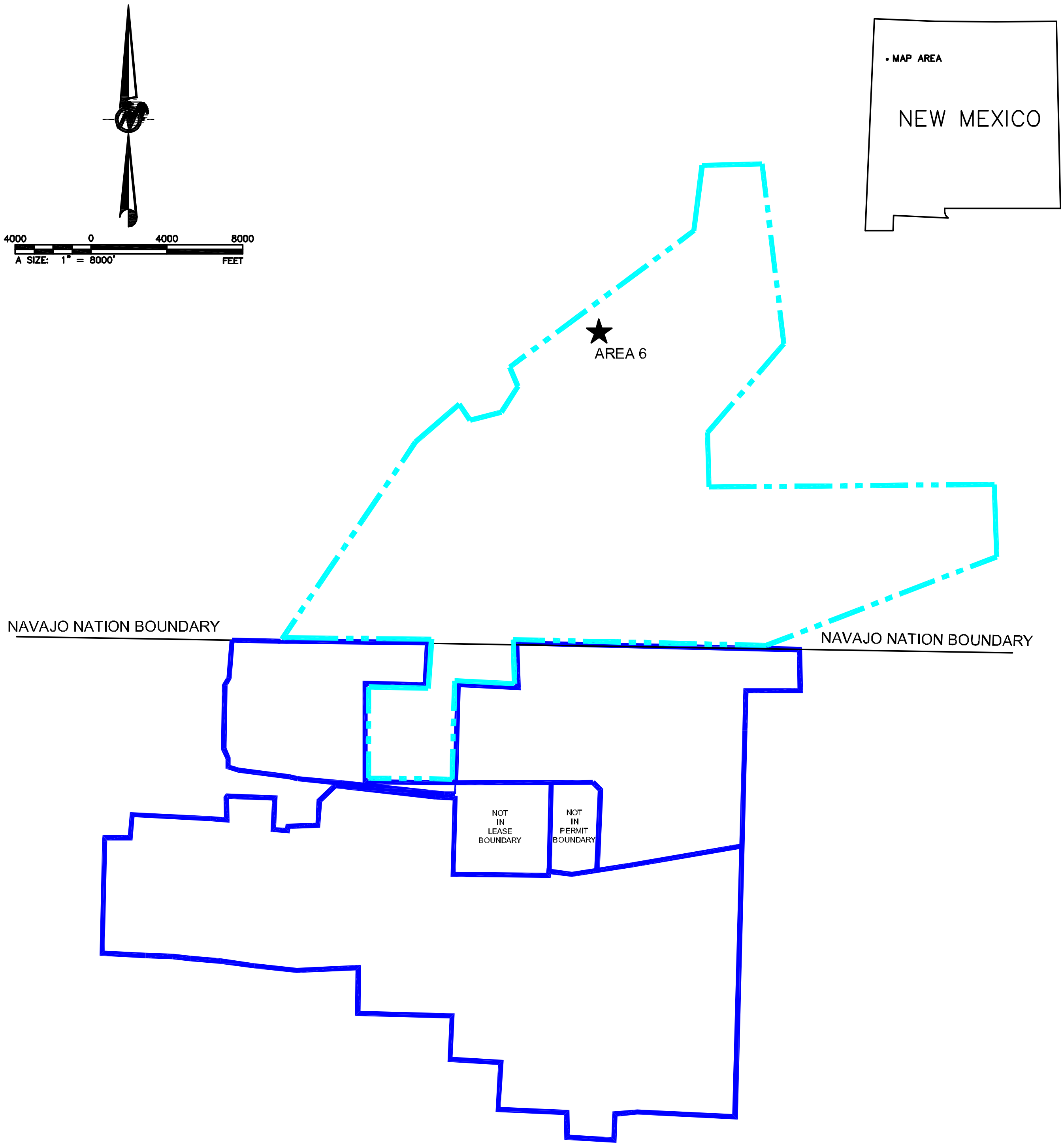
CANOPY COVER AND ROOT DISTRIBUTION AT SUBGRID SAMPLE SITES

SUBGRID	SUITABLE THICKNESS (inches)	pH	CANOPY COVER (%)	ROOT DISTRIBUTION			SITE NOTES
				SURFACE	INTERVAL 2	INTERVAL 3	
6-21-55A	21	5.1	70	3VF (11")	2VF (38")		
6-21-55B	24	7.6	40	4VF-F, 1M (8")	2VF (22")	1VF (34")	
6-21-55C	24	5.6	60	3VF-F (12")	1VF (28")		
6-21-55D	24	6.8	45	3VF-F (19")	2VF (31")		
6-21-56A	24	6.6	30	2VF-F (8")	2VF (26")	1VF (26")	
6-21-56B	24	7.4	ND	2VF-F, 1M (9")	1VF-F (36")		not staked
6-21-56C	24	7.6	ND	2VF-F (13")	1VF (34")		not staked
6-21-56D	5	4.3	35	2VF-F (5")	Trace in spoils		
6-22-55A	0	4.6	25	2VF (13")	Trace (30")		immediately below access road
6-22-55B	10	4.9	40	3VF (12")	1VF (39")		
6-22-55C	11	4.0	45	4VF-F (16")	1VF (31")		
6-22-55D	21	5.1	65	3VF-F (12")	1VF (24")		
6-22-56A	18	4.6	20	3VF-F (3")	2VF (14")	1VF (23")	area has been reworked
6-22-56B	24	8.0	ND	2VF-F-M (8")	1VF-F (37")		not staked
6-22-56C	24	7.4	ND	2VF-F (8")	1VF (36")		not staked
6-22-56D	24	7.8	ND	2VF-F (4")	2VF (32")		not staked
6-23-53A	24	6.5	55	2VF-F (6")	1VF (26")		
6-23-53B	24	6.6	65	2VF-F (8")	1VF (20")	Trace (38")	
6-23-53C	10	5.4	60	2VF-F (6")	1VF-F (18")	1VF (36")	
6-23-53D	24	7.3	60	1VF-F (6")	1VF (36")		
6-23-54A	24	7.8	55	3VF (0-12")	1VF (12-30")		
6-23-54B	20	4.1	30	3VF (8")	2VF (24")	1VF (36")	area has been reworked
6-23-54C	24	6.3	65	4VF-F (16")			
6-23-54D	24	6.4	25	2VF (10")	1VF (22")		immediately below access road
6-25-54A	7	5.5	60	3VF (22")	1VF (29")		
6-25-54B	18	3.8	30	3VF (10")	2VF (19")	1 VF (34")	area has been reworked
6-25-54C	3	5.5	20	2VF (6")	1VF (16")		
6-25-54D	12	3.4	40	3VF-F (16")	1VF (32")		
6-26-51A	24	6.9	65	3VF-F, 1M (12")	2VF (22")	1 VF (32)	
6-26-51B	24	7.2	60	3VF-F (0-12")	2VF (35")		
6-26-51C	13	4.3	30	3VF, 1M (8")	3VF (26")		area has been reworked
6-26-51D	24	6.0	60	4VF-F, 1M (12")	2VF (129")		
6-26-52A	16	3.7	60	2VF-F (8")	1VF (16")		
6-26-52B	19	5.4	50	2VF-F (8")	1VF-F (22")	Trace (36")	
6-26-52C	11	5.3	20	3VF-F (18")	2VF (22")		adjacent to gradient ditch
6-26-52D	3	2.9	10	1VF (4")			area has been reworked
6-27-51A	17	4.6	45	4VF-F (14")	1VF (29")		
6-27-51B	14	4.9	50	2VF-F-M (8")	2VF-F (12")	1VF (37)	
6-27-51C	13	3.3	8	3VF (12")	1VF (32")		on berm of gradient ditch
6-27-51D	24	6.3	50	4VF-F (18")	2VF (24")		
6-27-52A	13	3.7	5	1VF-F (10")	1VF (20")	Trace (30")	area has been reworked
6-27-52B	9	4.2	20	1VF (14")	Trace (26")		area has been reworked
6-27-52C	24	7.3	25	1VF (12")	Trace (22")		adjacent to downdrain
6-27-52D	10	4.3	25	1VF (17")			area has been reworked
6-28-51A	16	3.6	60	2VF-F (8")	1VF (20")	1VF (36")	
6-28-51B	5	4.2	20	1VF-F (8")	1VF (20")	Trace (34")	
6-28-51C	8	3.8	35	2VF-F (10")	1VF-F (18")	1VF (37")	
6-28-51D	10	4.8	30	2VF-F (13")	1VF (27")		
6-29-51A	6	3.6	20	2VF (8")	1VF (33")		area has been reworked
6-29-51B	10	3.1	20	1VF (8")	1VF (13")		
6-29-51C	7	5.4	40	2VF-F (18")	1VF (31")		
6-29-51D	24	6.7	40	2VF-F (12")	1VF (37")		
6-29-52A	19	4.3	45	2VF-M (14")	2VF (23")		
6-29-52B	19	4.7	55	2VF (26")			
6-29-52C	24	6.9	45	2VF (26")			
6-29-52D	24	5.9	50	2VF (17")	1VF-F (23")		

TABLE 4
PROPOSED SEED MIX FOR AREA 6

Common Name	Scientific Name	PLS/ft^2	Comments
Western wheatgrass	*Pascopyrum smithii*	3	Native-Cool season
Indian ricegrass	*Oryzopsis hymenoides*	2	Native-Cool season
Blue grama	*Bouteloua gracilis*	5	Native-Warm season
Sideoats grama	*Bouteloua curtipendula*	2	Native- Warm season
Alkali sacaton	*Sporobolus airiodes*	3	Native- Warm season
Galleta	*Hilaria jamesii*	2	Native- Warm season
Mountain brome	*Bromus marginatus*	2	Native-Cool season
Hard fescue	*Festuca trachyphyll*	2	Introduced-Cool season
Needle and thread	*Stipa comata*	2	Native-Cool season
Fourwing saltbush	*Atriplex canescens*	1	Native
Rocky Mountain penstemon	*Penstemon strictus*	1	Native
Scarlet globemallow	*Sphaeralcea coccinea*	1	Native
Antelope bitterbrush	*Purshia tridentata*	2	Native
Apache plume	*Fallugia paradoxa*	2	Native
Mountain mahogany	*Cercocarpus montanus*	1	Native
Total		**31**	

FIGURES



OSM NM-OOOIH PERMIT BOUNDARY

MMD-PERMIT BOUNDARY

PROJECT

MCKINLEY MINE
MCKINLEY COUNTY, NEW MEXICO

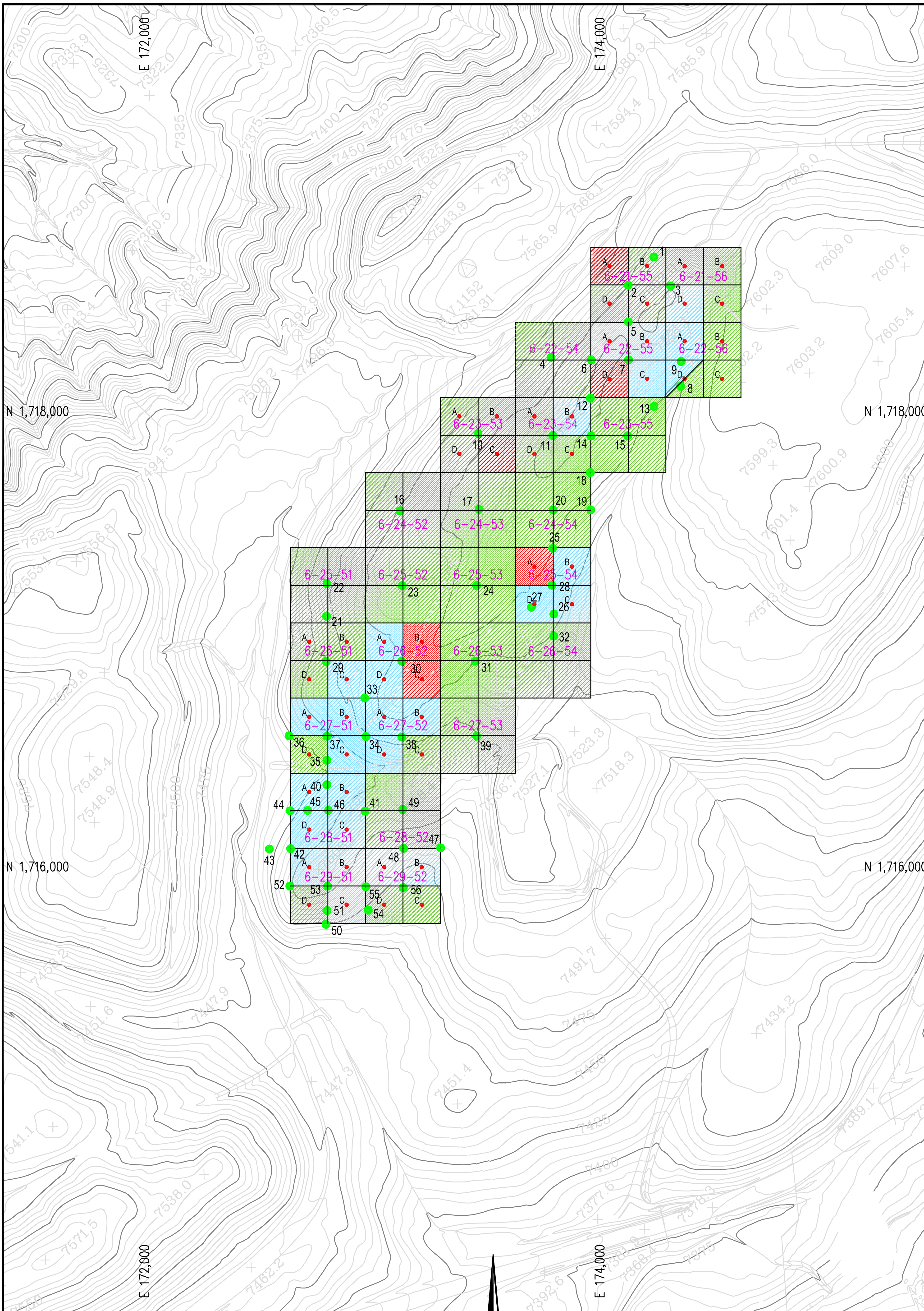
TITLE

GENERAL LOCATION MAP

Golder Associates
Albuquerque, New Mexico

PROJECT No.		063-2118	FILE No.	Aera6 SiteMap
DESIGN	LM	06/05/06	SCALE AS SHOWN	REV. A
CADD	CM	06/05/06	FIGURE 1	
CHECK	LM	06/05/06		
REVIEW	--	DATE		

K:\2006 Projects\063-2118\Aera6 SiteMap.dwg



LEGEND

(green)	PASSED	(blue)	TREATMENT GRIDS
(red)	PH 5.0 TO 5.5		
A	QUARTER GRID SAMPLE LOCATION		
7	SAMPLE LOCATION		
6-29-51	GRID NUMBER		

NOTE: SAMPLE LOCATIONS PROVIDED BY P&M. DATA PROVIDED IN ATTACHED TABLE.

200' 0 200' 400'
SCALE: 1" = 400' FEET

PROJECT
THE PITTSBURG & MIDWAY COAL MINING CO.
A CHEVRON TEXACO COMPANY
McKINLEY MINE

TITLE
AREA 6 SAMPLE LOCATIONS

Golder Associates
Albuquerque, New Mexico

PROJECT No.		063-2118
DESIGN	LM	05/08/06
CADD	CM	05/23/06
CHECK	LM	05/23/06
REVIEW	--	00-00-00

FILE No. Area 6 All Samp-Locs Mary6
SCALE AS SHOWN REV. A

FIGURE 2

Figure 3. View to northeast from Grid 6-28-51. Note: Rock down chute in Grid 6-27- 52 in background (top of rise). The rock water way in foreground separates 6-28-51 from 6-27-51.

Figure 4. View of vegetation on Grid 6-28-51. View to the west from center of grid.

Figure 5
Suitable Cover Thickness Vs Canopy Cover

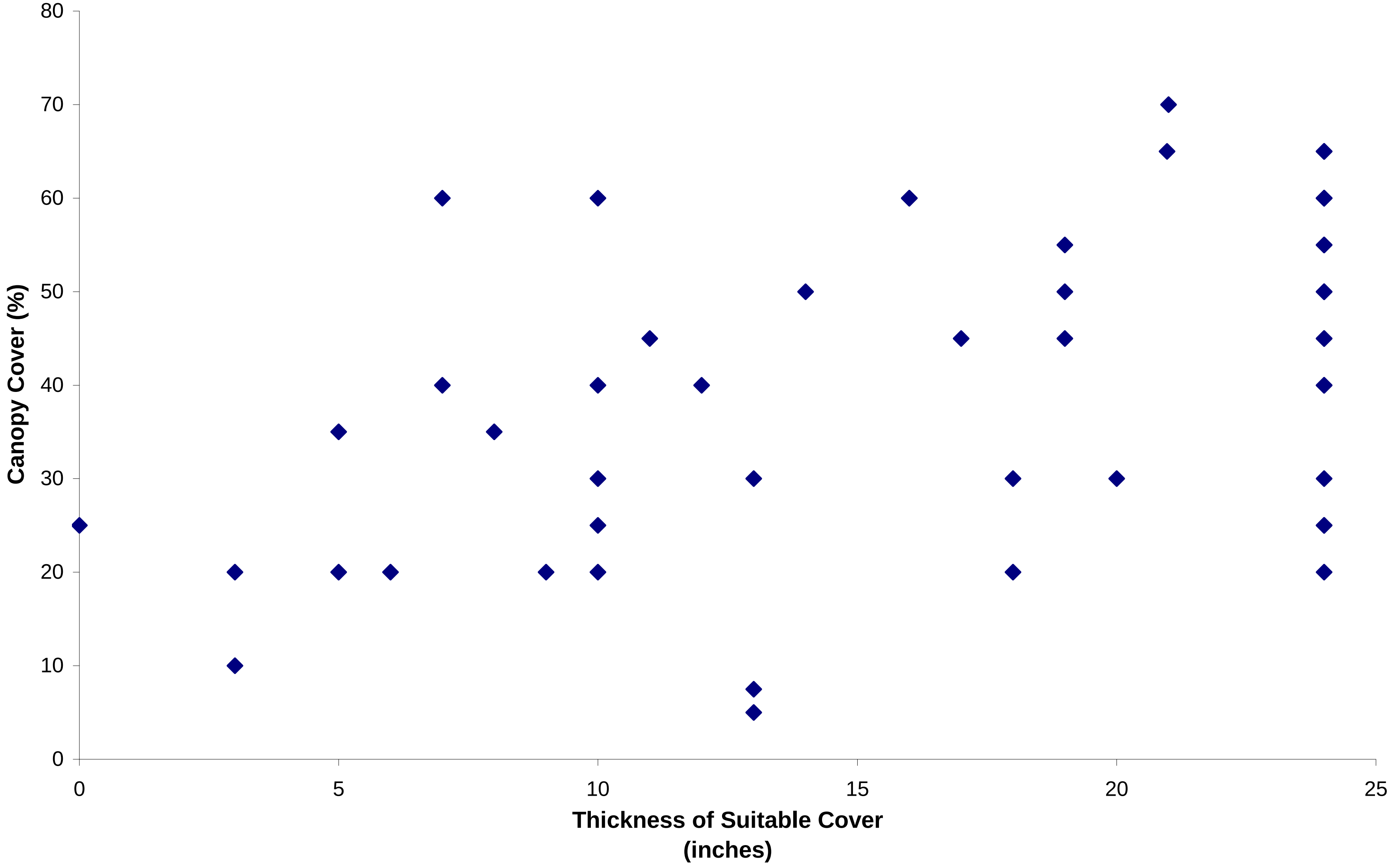
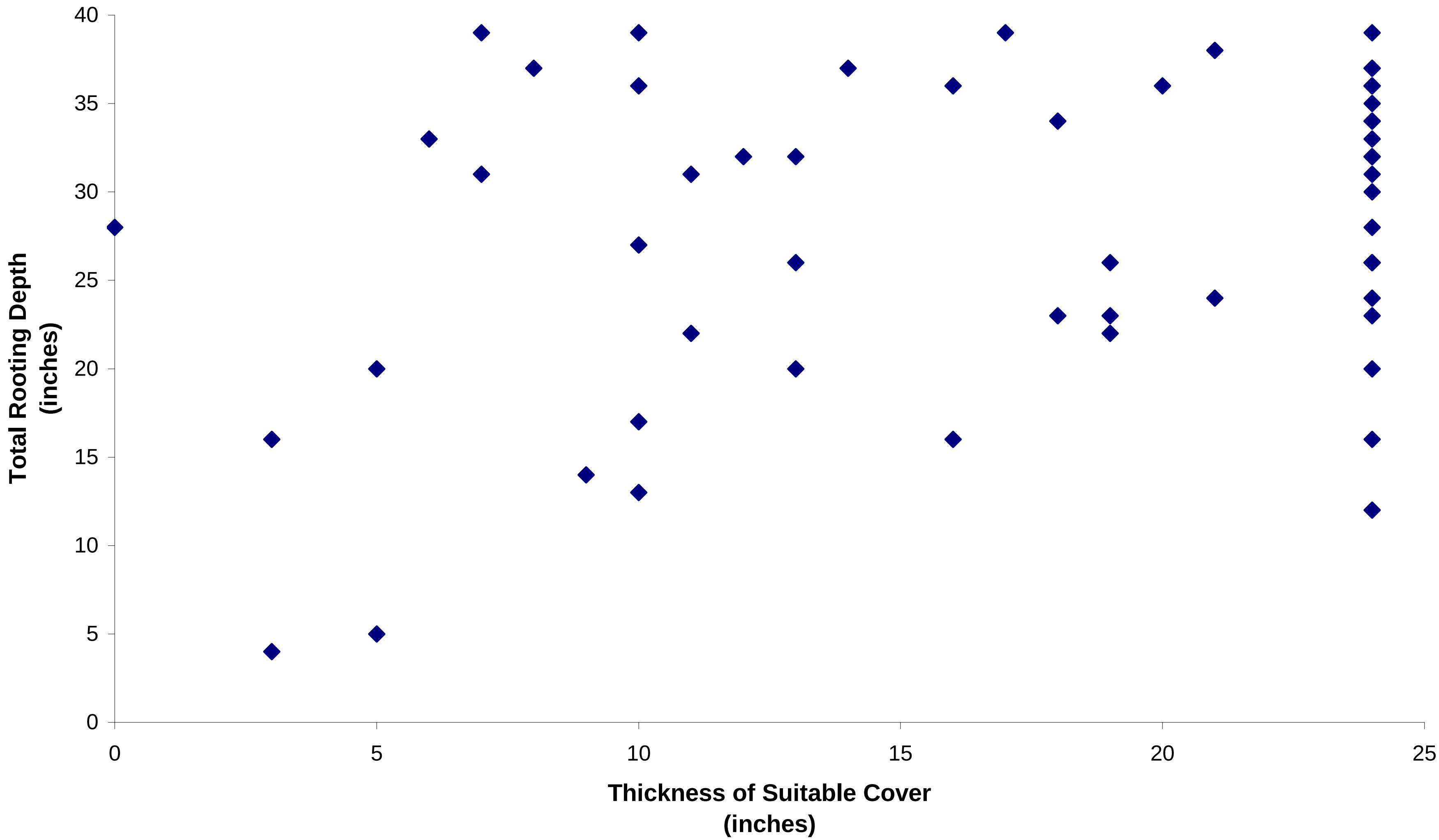
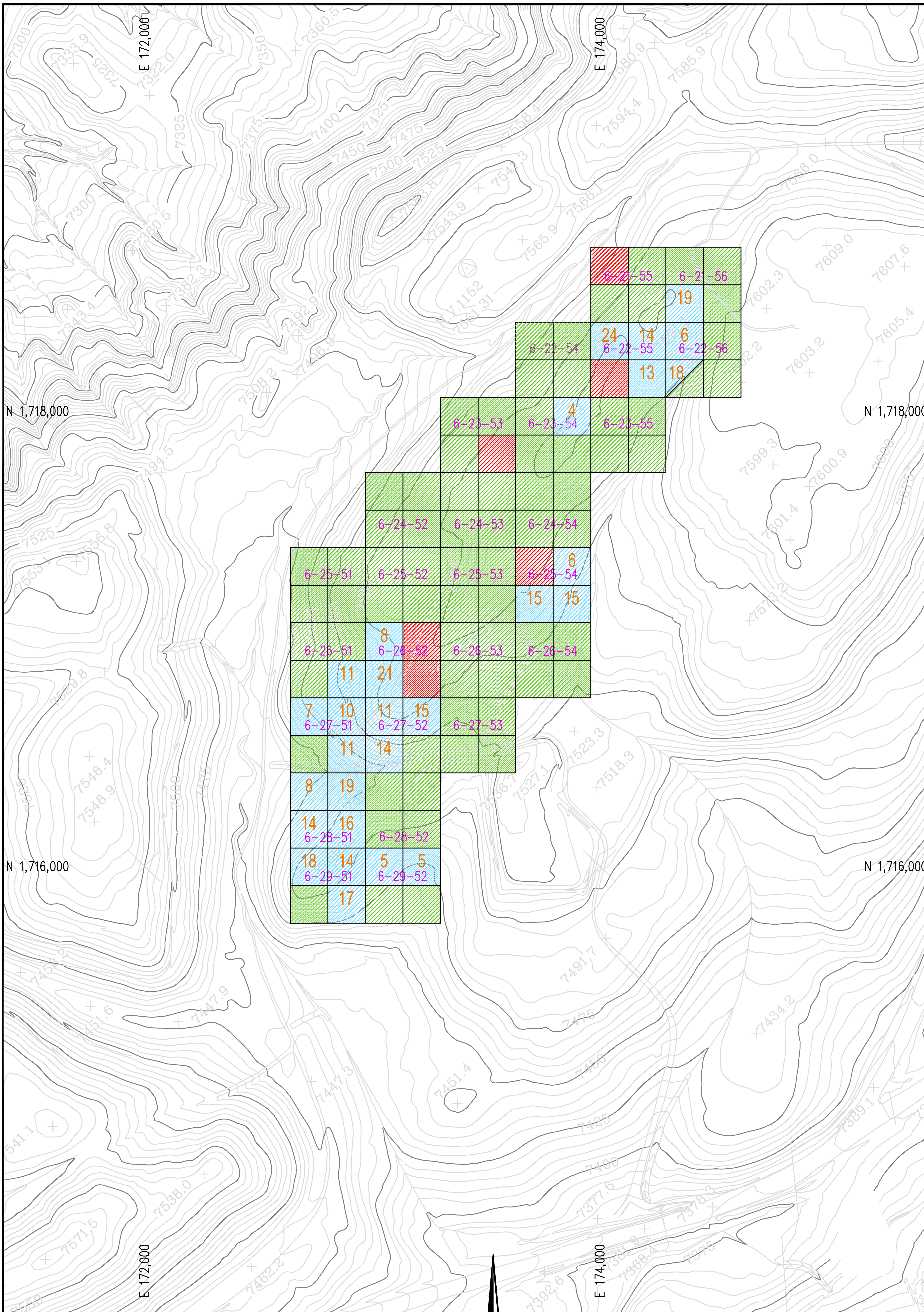


Figure 6
Suitable Cover Thickness Vs Total Rooting Depth





LEGEND

PASSED

TREATMENT GRIDS

PH 5.0 TO 5.5

19 REQUIRED COVER THICKNESS (INCHES)

6-29-51 GRID NUMBER

NOTE: SAMPLE LOCATIONS PROVIDED BY P&M. DATA PROVIDED IN ATTACHED TABLE.

SCALE: 1" = 400' FEET

PROJECT

THE PITTSBURG & MIDWAY COAL MINING CO.
A CHEVRON TEXACO COMPANY
McKINLEY MINE

TITLE

AREA 6 COVER THICKNESS REQUIRMENTS

Golder Associates
Albuquerque, New Mexico

PROJECT No.		063-2118
DESIGN	LM	05/08/06
CADD	CM	05/23/06
CHECK	LM	05/23/06
REVIEW	--	00-00-00

FILE No. Area 6 All Samp-Locs Mary6

SCALE AS SHOWN REV. A

FIGURE 7

APPENDIX A

MCKINLEY MINE AREA 6 ANALYTICAL DATA (2003-2004)

TABLE A1
MCKINLEY MINE AREA 6 ANALYTICAL DATA
(2003 AND 2004)

Map ID	Mine Grid	Subgrid	Depth (inches)	pH	EC (dS/m)	% SAT	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	Sand (%)	Silt (%)	Clay (%)	Class	Total S (%)	TS-AP (t/kt)	NP (t/kt)	TS-ABP (t/kt)	PAP (t/kt)	PABP (t/kt)	$CaCO_3$ (%)
1	6-21-55	C	0-6	7.5	0.5	37.1	3.70	0.93	0.93	57.5	20.0	22.5	SCL	0.018	0.6	11.1	10.6	---	---	1.111
1	6-21-55	C	6-18	7.0	1.27	41.2	7.04	4.68	3.35	47.5	28.8	23.8	L	0.024	0.8	4.6	3.8	---	---	0.457
1	6-21-55	C	18-30	6.9	2.53	44.7	12.9	11.2	7.26	28.8	41.3	30.0	CL	0.032	1.0	5.6	4.6	---	---	0.556
1	6-21-55	C	30-42	6.0	3.19	48.1	19.2	14.9	8.18	37.5	32.5	30.0	CL	0.058	1.8	6.5	4.7	---	---	0.655
2	6-21-55	M	0-6	7.5	0.72	56.6	5.99	1.65	1.13	23.8	32.5	43.8	C	0.045	1.4	15.5	14.1	---	---	1.545
2	6-21-55	M	6-18	5.2	3.21	46.7	25.8	17.9	3.27	46.3	26.3	27.5	SCL	0.271	8.5	0.0	-8.5	0.1	-0.1	ND
2	6-21-55	M	18-30	6.7	3.48	48.3	25.9	22.5	3.81	31.3	33.8	35.0	CL	0.182	5.7	8.2	2.5	---	---	0.823
2	6-21-55	M	30-42	6.4	3.55	55.4	27.9	21.9	3.17	30.0	28.8	41.3	C	0.280	8.8	12.2	3.5	---	---	1.222
3	6-21-56	H	0-6	6.3	5.06	50.1	33.1	52.5	3.31	37.5	31.3	31.3	CL	0.284	8.9	19.4	10.5	---	---	1.942
3	6-21-56	H	6-18	4.6	4.44	45.2	24.6	50.0	1.60	47.5	30.0	22.5	L	0.627	19.6	1.8	-17.8	0.1	1.7	0.179
3	6-21-56	H	18-30	3.9	5.39	47.2	26.4	62.4	1.42	50.0	28.8	21.3	L	0.629	19.6	0.0	-19.6	0.0	0.0	ND
3	6-21-56	H	30-42	4.0	6.67	41.2	25.4	87.2	1.47	51.3	31.3	17.5	L	0.622	19.4	0.0	-19.4	1.8	-1.8	ND
4	6-22-54	M	0-6	7.1	0.59	50.0	3.99	1.47	0.79	33.8	31.3	35.0	CL	0.069	2.2	4.5	2.3	---	---	0.448
4	6-22-54	M	6-18	7.2	0.52	52.6	3.02	1.87	0.94	32.5	30.0	37.5	CL	0.067	2.1	9.6	7.6	---	---	0.964
4	6-22-54	M	18-30	6.6	3.08	53.4	30.1	16.0	1.33	40.0	25.0	35.0	CL	0.185	5.8	5.1	-0.7	3.4	1.6	0.508
4	6-22-54	M	30-42	6.5	3.62	48.9	32.4	25.7	2.00	38.8	28.8	32.5	CL	0.261	8.1	5.3	-2.9	3.5	1.8	0.527
5	6-22-55	B	0-6	6.5	0.67	49.2	4.92	1.65	0.72	33.8	32.5	33.8	CL	0.136	4.2	6.5	2.3	---	---	0.655
5	6-22-55	B	6-18	5.9	0.61	50.0	2.34	1.65	1.64	10.0	51.3	38.8	SiCL	0.109	3.4	7.0	3.6	---	---	0.704
5	6-22-55	B	18-30	6.5	0.56	49.1	1.38	1.03	2.84	10.0	51.3	38.8	SiCL	0.068	2.1	5.6	3.4	---	---	0.556
5	6-22-55	B	30-42	6.6	1.01	52.5	2.14	1.59	5.96	17.5	43.8	38.8	SiCL	0.125	3.9	5.6	1.7	---	---	0.556
6	6-22-55	H	0-6	6.2	6.34	44.8	27.9	21.3	40.7	52.5	18.8	28.8	SCL	0.310	9.7	5.6	-4.1	3.0	2.6	0.556
6	6-22-55	H	6-18	4.4	10.8	54.8	23.0	51.9	92.6	37.5	27.5	35.0	CL	0.651	20.3	2.1	-18.3	0.3	1.8	0.209
6	6-22-55	H	18-30	4.8	10.3	55.7	21.3	42.8	84.4	40.0	23.8	36.3	CL	0.674	21.0	1.2	-19.8	1.4	-0.2	0.121
6	6-22-55	H	30-42	5.0	10.5	51.6	20.7	36.0	85.3	32.5	36.3	31.3	CL	0.588	18.4	2.6	-15.8	2.7	-0.1	0.259
7	6-22-55	M	0-6	7.1	0.71	36.0	7.49	1.00	0.51	67.5	16.3	16.3	SL	0.019	0.6	17.4	16.9	---	---	1.744
7	6-22-55	M	6-18	3.9	3.43	45.1	26.2	16.5	6.00	40.0	30.0	30.0	CL	0.460	14.4	0.0	-14.4	1.4	-1.4	ND
7	6-22-55	M	18-30	6.5	3.37	39.7	29.3	16.8	4.44	37.5	43.8	18.8	L	0.280	8.8	8.7	0.0	3.8	4.9	0.872
7	6-22-55	M	30-42	6.8	2.42	38.5	22.9	8.14	1.85	32.5	53.8	13.8	SiL	0.133	4.2	5.3	1.1	---	---	0.526
8	6-22-56	G	0-6	6.0	3.16	38.4	40.9	7.21	0.76	48.8	28.8	22.5	L	0.251	7.8	10.0	2.2	---	---	1.002
8	6-22-56	G	6-18	3.5	3.37	42.5	28.6	18.2	1.68	50.0	31.3	18.8	L	0.474	14.8	0.0	-14.8	0.3	-0.3	ND
8	6-22-56	G	18-30	3.9	4.05	41.1	27.6	32.5	2.84	58.8	23.8	17.5	SL	0.418	13.1	0.0	-13.1	0.9	-0.9	ND
8	6-22-56	G	30-42	3.6	5.43	44.5	25.6	54.5	5.65	56.3	25.0	18.8	SL	0.710	22.2	0.0	-22.2	2.7	-2.7	ND
9	6-22-56	H	0-6	5.9	3.26	34.4	36.1	15.2	0.70	67.5	15.0	17.5	SL	0.191	6.0	8.5	2.6	---	---	0.853
9	6-22-56	H	6-18	3.1	7.27	44.3	26.3	55.9	0.48	47.5	30.0	22.5	L	0.910	28.4	0.0	-28.4	0.2	-0.2	ND
9	6-22-56	H	18-30	4.3	2.73	39.3	29.0	9.38	0.97	43.8	41.3	15.0	L	0.456	14.2	0.3	-13.9	3.3	-3.0	0.031
9	6-22-56	H	30-42	5.8	3.11	43.1	31.5	14.2	1.38	46.3	30.0	23.8	L	0.409	12.8	5.3	-7.5	5.2	0.0	0.526
10	6-23-53	M	0-6	7.8	0.86	34.5	2.47	1.73	5.65	60.0	20.0	20.0	SCL/SL	0.029	0.9	23.4	22.5	---	---	2.343
10	6-23-53	M	6-18	5.7	4.25	51.5	24.8	21.3	12.5	32.5	32.5	35.0	CL	0.277	8.6	0.2	-8.4	3.4	-3.2	0.025
10	6-23-53	M	18-30	6.7	4.92	44.8	21.1	29.3	18.9	30.0	36.3	33.8	CL	0.227	7.1	2.2	-4.8	3.5	-1.2	0.224
10	6-23-53	M	30-42	7.1	4.26	52.2	23.8	22.8	14.7	23.8	38.8	37.5	CL	0.154	4.8	3.2	-1.6	2.2	1.0	0.324

TABLE A1
MCKINLEY MINE AREA 6 ANALYTICAL DATA
(2003 AND 2004)

Map ID	Mine Grid	Subgrid	Depth (inches)	pH	EC (dS/m)	% SAT	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	Sand (%)	Silt (%)	Clay (%)	Class	Total S (%)	TS-AP (t/kt)	NP (t/kt)	TS-ABP (t/kt)	PAP (t/kt)	PABP (t/kt)	$CaCO_3$ (%)
11	6-23-54	M	0-6	7.7	1.90	39.1	11.5	3.87	7.96	57.5	18.8	23.8	SCL	0.036	1.1	12.9	11.8	---	---	1.293
11	6-23-54	M	6-18	4.5	6.30	42.2	24.8	37.2	37.5	57.5	17.5	25.0	SCL	0.441	13.8	0.0	-13.8	0.1	-0.1	ND
11	6-23-54	M	18-30	6.4	4.26	36.9	26.5	19.3	17.1	65.0	15.0	20.0	SCL/SL	0.243	7.6	3.6	-4.0	1.7	1.9	0.359
11	6-23-54	M	30-42	7.2	4.16	38.3	24.9	17.6	18.3	57.5	21.3	21.3	SCL	0.097	3.0	8.6	5.5	---	---	0.855
12	6-23-55	A	0-6	6.7	1.37	48.7	8.88	3.46	3.64	30.0	32.5	37.5	CL	0.127	4.0	10.5	6.5	---	---	1.051
12	6-23-55	A	6-18	5.6	3.57	51.9	21.3	10.3	16.3	36.3	32.5	31.3	CL	0.238	7.4	4.1	-3.4	0.5	3.6	0.407
12	6-23-55	A	18-30	5.7	5.59	50.3	23.7	20.1	37.3	27.5	37.5	35.0	CL	0.339	10.6	3.6	-7.0	1.2	2.4	0.358
12	6-23-55	A	30-42	3.8	5.49	46.9	23.1	28.6	28.1	45.0	32.5	22.5	L	0.901	28.1	2.6	-25.6	12.9	-10.3	0.259
13	6-23-55	C	0-6	6.1	4.14	50.2	32.6	15.0	13.3	25.0	35.0	40.0	CL/C	0.272	8.5	20.4	11.9	---	---	2.041
13	6-23-55	C	6-18	5.8	5.43	51.8	28.0	21.3	27.3	28.8	33.8	37.5	CL	0.396	12.4	5.8	-6.6	4.9	0.8	0.575
13	6-23-55	C	18-30	5.5	6.27	50.7	26.3	24.7	37.4	48.8	26.3	25.0	SCL	0.404	12.6	6.7	-5.9	4.9	1.8	0.674
13	6-23-55	C	30-42	6.2	5.53	40.8	27.2	24.0	28.2	43.8	37.5	18.8	L	0.325	10.1	11.0	0.9	---	---	1.101
14	6-23-55	H	0-6	7.3	0.55	42.1	3.42	0.77	2.17	52.5	21.3	26.3	SCL	0.047	1.5	27.1	25.6	---	---	2.706
14	6-23-55	H	6-18	6.0	3.01	58.4	9.33	5.35	20.6	32.5	31.3	36.3	CL	0.218	6.8	3.6	-3.2	0.7	2.9	0.358
14	6-23-55	H	18-30	6.4	7.25	68.4	18.4	11.9	63.1	23.8	37.5	38.8	CL	0.309	9.7	3.6	-6.1	2.3	1.3	0.358
14	6-23-55	H	30-42	6.5	7.44	59.6	12.5	8.64	73.1	35.0	31.3	33.8	CL	0.309	9.7	4.6	-5.1	1.1	3.5	0.457
15	6-23-55	M	0-6	7.2	0.71	43.1	5.99	1.84	0.95	42.5	28.8	28.8	CL	0.030	0.9	24.9	23.9	---	---	2.487
15	6-23-55	M	6-18	6.2	3.16	49.8	28.9	11.5	5.39	33.8	32.5	33.8	CL	0.196	6.1	65.5	59.3	---	---	6.546
15	6-23-55	M	18-30	4.9	6.08	45.3	22.9	33.1	31.4	47.5	28.8	23.8	L	0.265	8.3	6.2	-2.0	2.6	3.7	0.624
15	6-23-55	M	30-42	4.4	8.39	45.5	22.9	62.6	44.4	53.8	23.8	22.5	SCL	0.395	12.3	0.8	-11.5	0.7	0.1	0.080
16	6-24-52	M	0-6	7.5	0.59	43.9	4.16	1.78	1.13	42.5	27.5	30.0	CL	0.058	1.8	9.2	7.4	---	---	0.922
16	6-24-52	M	6-18	7.0	0.63	44.3	3.82	2.80	0.99	45.0	27.5	27.5	SCL/CL	0.083	2.6	7.2	4.6	---	---	0.723
16	6-24-52	M	18-30	6.4	3.39	47.6	25.1	24.0	2.86	32.5	33.8	33.8	CL	0.151	4.7	5.2	0.5	2.7	2.5	0.523
16	6-24-52	M	30-42	6.3	4.33	48.9	25.4	34.3	6.83	30.0	33.8	36.3	CL	0.212	6.6	5.2	-1.4	3.3	2.0	0.523
17	6-24-53	M	0-6	7.8	0.53	42.0	3.67	0.86	1.61	45.0	25.0	30.0	SCL/CL	0.018	0.6	12.7	12.2	---	---	1.275
17	6-24-53	M	6-18	7.5	1.83	46.4	15.3	4.85	3.25	43.8	25.0	31.3	CL	0.045	1.4	16.8	15.4	---	---	1.683
17	6-24-53	M	18-30	7.0	3.61	49.9	27.6	22.0	5.48	42.5	25.0	32.5	CL	0.154	4.8	5.6	0.8	---	---	0.557
17	6-24-53	M	30-42	7.2	3.68	46.4	28.0	26.2	5.05	47.5	25.0	27.5	SCL	0.139	4.3	9.5	5.2	---	---	0.954
18	6-24-54	C	0-6	7.5	0.41	36.5	3.42	0.59	0.90	63.8	15.0	21.3	SCL	0.014	0.4	32.1	31.7	---	---	3.212
18	6-24-54	C	6-18	6.7	3.04	41.5	26.6	9.05	7.96	55.0	18.8	26.3	SCL	0.113	3.5	25.6	22.1	---	---	2.558
18	6-24-54	C	18-30	5.2	5.55	51.8	23.0	19.6	33.5	30.0	33.8	36.3	CL	0.383	12.0	2.1	-9.9	5.3	-3.2	0.209
18	6-24-54	C	30-42	5.1	8.71	53.7	20.8	26.0	77.4	30.0	37.5	32.5	CL	0.653	20.4	1.6	-18.8	10.4	-8.8	0.160
19	6-24-54	D	0-6	6.2	2.80	44.1	31.4	7.54	2.03	42.5	28.8	28.8	CL	0.144	4.5	28.8	24.3	---	---	2.883
19	6-24-54	D	6-18	5.8	3.73	48.8	35.1	13.4	7.35	32.5	31.3	36.3	CL	0.352	11.0	7.2	-3.8	5.3	1.9	0.724
19	6-24-54	D	18-30	4.6	4.21	50.6	25.0	18.4	15.1	30.0	31.3	38.8	CL	0.277	8.6	1.3	-7.3	0.3	1.0	0.129
19	6-24-54	D	30-42	3.6	6.40	55.1	23.1	26.0	35.7	47.5	26.3	26.3	SCL	0.805	25.1	0.0	-25.1	1.0	-1.0	ND
20	6-24-54	M	0-6	7.5	0.57	41.7	4.67	1.12	1.02	47.5	27.5	25.0	SCL	0.065	2.0	47.7	45.7	---	---	4.771
20	6-24-54	M	6-18	6.4	2.92	51.2	19.9	10.4	9.05	13.8	46.3	40.0	SiC/SiCL	0.184	5.7	4.6	-1.2	3.1	1.5	0.458
20	6-24-54	M	18-30	5.7	5.11	48.2	27.7	20.6	26.8	35.0	35.0	30.0	CL	0.350	10.9	1.6	-9.3	0.6	1.0	0.160
20	6-24-54	M	30-42	6.2	8.13	51.6	23.6	20.9	70.9	22.5	38.8	38.8	CL	0.367	11.5	13.5	2.0	---	---	1.351

TABLE A1
MCKINLEY MINE AREA 6 ANALYTICAL DATA
(2003 AND 2004)

Map ID	Mine Grid	Subgrid	Depth (inches)	pH	EC (dS/m)	% SAT	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	Sand (%)	Silt (%)	Clay (%)	Class	Total S (%)	TS-AP (t/kt)	NP (t/kt)	TS-ABP (t/kt)	PAP (t/kt)	PABP (t/kt)	$CaCO_3$ (%)
21	6-25-51	F	0-6	7.3	0.63	46.4	5.14	2.11	0.54	32.5	40.0	27.5	CL	0.022	0.7	15.5	14.8	---	---	1.546
21	6-25-51	F	6-18	7.2	0.93	45.1	6.04	4.18	0.93	38.8	31.3	30.0	CL	0.098	3.1	24.4	21.3	---	---	2.437
21	6-25-51	F	18-30	6.4	3.55	47.2	32.1	22.9	1.61	42.5	27.5	30.0	CL	0.211	6.6	5.8	-0.9	3.7	2.1	0.575
21	6-25-51	F	30-42	6.8	3.80	40.5	27.8	29.0	3.34	53.8	23.8	22.5	SCL	0.168	5.2	8.7	3.5	---	---	0.872
22	6-25-51	M	0-6	7.5	0.56	50.0	3.55	1.79	1.27	32.5	33.8	33.8	CL	0.039	1.2	10.2	9.0	---	---	1.022
22	6-25-51	M	6-18	7.3	0.62	50.6	3.22	2.58	1.32	28.8	36.3	35.0	CL	0.038	1.2	3.2	2.1	---	---	0.324
22	6-25-51	M	18-30	7.3	4.37	46.4	22.9	38.2	6.26	36.3	31.3	32.5	CL	0.080	2.5	15.5	12.9	---	---	1.545
22	6-25-51	M	18-30	7.3	4.39	46.3	23.1	38.7	6.35	36.3	31.3	32.5	CL	0.081	2.5	15.5	12.9	---	---	1.545
22	6-25-51	M	30-42	7.4	6.91	46.2	23.1	58.0	23.1	37.5	30.0	32.5	CL	0.115	3.6	10.2	6.6	---	---	1.022
23	6-25-52	M	0-6	7.3	0.58	39.7	5.19	1.25	0.75	51.3	23.8	25.0	SCL	0.052	1.6	13.5	11.8	---	---	1.346
23	6-25-52	M	6-18	7.3	0.52	39.7	3.41	1.49	0.94	51.3	23.8	25.0	SCL	0.067	2.1	9.2	7.1	---	---	0.922
23	6-25-52	M	18-30	7.3	0.76	34.7	4.82	2.64	1.11	61.3	20.0	18.8	SL	0.069	2.2	17.4	15.3	---	---	1.745
23	6-25-52	M	30-42	6.9	3.12	37.7	26.9	17.5	1.67	57.5	21.3	21.3	SCL	0.107	3.4	6.2	2.9	---	---	0.623
24	6-25-53	M	0-6	7.4	0.92	39.4	4.20	1.46	4.48	42.5	27.5	30.0	CL	0.068	2.1	13.5	11.4			1.351
24	6-25-53	M	6-18	6.1	6.05	47.4	26.8	14.4	49.6	43.8	27.5	28.8	CL	0.213	6.7	3.6	-3.1	0.4	3.2	0.359
24	6-25-53	M	18-30	7.4	4.70	61.5	2.90	2.15	58.7	30.0	37.5	32.5	CL	0.115	3.6	1.8	-1.8	0.3	1.5	0.180
24	6-25-53	M	30-42	6.0	9.84	56.3	15.5	10.6	95.3	31.3	36.3	32.5	CL	0.257	8.0	1.1	-6.9	1.0	0.1	0.111
25	6-25-54	B	0-6	7.1	0.52	48.1	4.25	1.13	0.91	35.0	27.5	37.5	CL	0.048	1.5	13.6	12.1	---	---	1.359
25	6-25-54	B	6-18	6.9	0.68	46.4	3.74	1.88	1.94	32.5	33.8	33.8	CL	0.154	4.8	8.5	3.7	---	---	0.853
25	6-25-54	B	18-30	6.0	2.18	55.0	5.64	3.63	14.0	37.5	32.5	30.0	CL	0.257	8.0	3.6	-4.4	1.8	1.8	0.358
25	6-25-54	B	30-42	7.0	3.95	45.1	5.59	4.80	33.3	35.0	33.8	31.3	CL	0.246	7.7	6.5	-1.1	5.1	1.4	0.655
26	6-25-54	F	0-6	7.1	0.81	42.8	7.44	1.56	1.32	50.0	25.0	25.0	SCL	0.058	1.8	45.2	43.3	---	---	4.516
26	6-25-54	F	6-18	5.8	3.11	43.2	37.8	6.94	1.90	52.5	26.3	21.3	SCL	0.571	17.8	17.9	0.1	---	---	1.794
26	6-25-54	F	18-30	3.8	4.84	38.0	25.1	37.8	8.05	40.0	43.8	16.3	L	0.617	19.3	0.0	-19.3	4.6	-4.6	ND
26	6-25-54	F	30-42	5.7	5.11	38.5	25.3	33.2	18.1	50.0	33.8	16.3	L	0.416	13.0	4.3	-8.7	1.9	2.3	0.427
27	6-25-54	G	0-6	7.5	0.66	44.7	4.82	1.09	1.26	46.3	23.8	30.0	SCL	0.049	1.5	50.3	48.8	---	---	5.033
27	6-25-54	G	6-18	4.7	2.28	45.4	22.0	6.38	1.86	38.8	32.5	28.8	CL	0.223	7.0	2.6	-4.4	0.3	2.2	0.259
27	6-25-54	G	18-30	5.0	2.91	43.0	25.7	10.9	4.35	40.0	36.3	23.8	L	0.400	12.5	3.6	-8.9	2.5	1.1	0.358
27	6-25-54	G	30-42	4.7	4.05	50.6	20.9	21.3	13.7	45.0	27.5	27.5	SCL/CL	0.396	12.4	1.6	-10.8	1.2	0.4	0.160
28	6-25-54	M	0-6	7.4	0.69	52.6	4.11	1.51	2.54	21.3	42.5	36.3	CL	0.032	1.0	17.9	16.9	---	---	1.794
28	6-25-54	M	6-18	5.4	4.19	50.3	23.0	10.3	21.6	41.3	30.0	28.8	CL	0.356	11.1	3.8	-7.3	0.1	3.6	0.377
28	6-25-54	M	18-30	7.4	3.70	72.8	3.23	2.19	32.7	7.5	52.5	40.0	SiC/SiCL	0.094	2.9	6.7	3.8	---	---	0.674
28	6-25-54	M	30-42	3.9	5.39	42.8	23.8	20.8	28.1	57.5	27.5	15.0	SL	0.412	12.9	0.0	-12.9	1.7	-1.7	ND
29	6-26-51	M	0-6	7.4	0.75	41.0	5.69	1.97	1.27	45.0	26.3	28.8	SCL/CL	0.041	1.3	11.2	9.9	----	---	1.122
29	6-26-51	M	6-18	5.4	3.35	43.5	28.3	18.7	2.77	45.0	25.0	30.0	SCL/CL	0.229	7.2	3.2	-3.9	0.5	2.7	0.324
29	6-26-51	M	18-30	5.3	5.36	48.6	24.9	46.6	11.9	41.3	27.5	31.3	CL	0.273	8.5	0.2	-8.3	0.1	0.2	0.025
29	6-26-51	M	30-42	3.4	8.29	44.7	23.3	82.0	10.0	56.3	25.0	18.8	SL	0.566	17.7	0.0	-17.7	0.1	-0.1	ND
30	6-26-52	M	0-6	7.6	1.83	46.3	10.7	5.12	6.39	37.5	27.5	35.0	CL	0.042	1.3	3.6	2.3	---	---	0.359
30	6-26-52	M	6-18	3.7	7.50	43.6	23.4	66.2	33.1	46.3	28.8	25.0	L	0.565	17.7	0.0	-17.7	0.4	-0.4	ND
30	6-26-52	M	18-30	3.4	9.45	47.9	24.4	78.1	54.4	43.8	30.0	26.3	L	0.660	20.6	0.0	-20.6	1.3	-1.3	ND
30	6-26-52	M	30-42	3.5	9.80	45.5	25.5	78.2	58.3	45.0	31.3	23.8	L	0.538	16.8	0.0	-16.8	1.8	-1.8	ND

TABLE A1
MCKINLEY MINE AREA 6 ANALYTICAL DATA
(2003 AND 2004)

Map ID	Mine Grid	Subgrid	Depth (inches)	pH	EC (dS/m)	% SAT	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	Sand (%)	Silt (%)	Clay (%)	Class	Total S (%)	TS-AP (t/kt)	NP (t/kt)	TS-ABP (t/kt)	PAP (t/kt)	PABP (t/kt)	$CaCO_3$ (%)
31	6-26-53	M	0-6	6.3	1.30	47.9	10.4	3.79	1.52	37.5	33.8	28.8	CL	0.134	4.2	6.2	2.0	---	---	0.623
31	6-26-53	M	6-18	6.1	2.86	47.3	27.1	11.1	3.16	41.3	32.5	26.3	L	0.237	7.4	9.2	1.8	---	---	0.922
31	6-26-53	M	18-30	6.5	3.34	48.8	21.9	14.3	10.2	35.0	36.3	28.8	CL	0.246	7.7	10.2	2.5	---	---	1.022
31	6-26-53	M	30-42	6.3	5.68	53.0	20.2	14.9	38.0	38.8	33.8	27.5	CL	0.387	12.1	3.2	-8.9	1.4	1.8	0.324
32	6-26-54	B	0-6	7.7	1.32	43.6	1.55	0.63	12.1	30.0	30.0	40.0	CL/C	0.063	2.0	7.2	5.2	---	---	0.715
32	6-26-54	B	6-18	7.0	8.56	65.3	14.9	9.54	77.0	20.0	38.8	41.3	CL	0.225	7.0	6.5	-0.5	3.0	3.5	0.655
32	6-26-54	B	18-30	7.8	7.19	80.7	5.19	4.26	69.2	15.0	41.3	43.8	SiC	0.153	4.8	9.5	4.7	---	---	0.952
32	6-26-54	B	30-42	4.2	8.13	49.7	23.2	28.1	63.5	63.8	20.0	16.3	SL	0.628	19.6	0.0	-19.6	2.0	-2.0	ND
33	6-27-51	C	0-6	7.4	0.71	43.6	4.79	1.97	1.63	40.0	27.5	32.5	CL	0.040	1.3	17.2	15.9			1.716
33	6-27-51	C	6-18	6.1	3.62	45.2	26.1	22.7	3.21	45.0	28.8	26.3	L	0.399	12.5	4.6	-7.9	0.4	4.2	0.457
33	6-27-51	C	18-30	4.4	3.36	44.8	23.9	23.7	3.81	55.0	22.5	22.5	SCL	0.508	15.9	1.6	-14.3	0.7	0.9	0.160
33	6-27-51	C	30-42	3.7	5.03	45.5	22.9	47.2	5.83	47.5	30.0	22.5	L	0.888	27.7	0.0	-27.7	0.5	-0.5	ND
34	6-27-51	D	0-6	6.3	3.29	44.5	37.7	12.3	1.62	45.0	26.3	28.8	SCL/CL	0.162	5.0	21.9	16.8	---	---	2.190
34	6-27-51	D	6-18	4.3	3.93	44.0	26.4	29.0	4.87	45.0	28.8	26.3	L	0.547	17.1	0.8	-16.3	1.6	-0.8	0.080
34	6-27-51	D	18-30	5.8	3.88	44.9	31.5	22.5	5.26	43.8	30.0	26.3	L	0.372	11.6	6.7	-4.9	3.6	3.1	0.674
34	6-27-51	D	30-42	6.3	4.88	44.8	30.0	49.4	7.44	32.5	37.5	30.0	CL	0.323	10.1	9.2	-0.9	3.6	5.6	0.922
35	6-27-51	F	0-6	6.6	1.94	42.5	20.0	5.33	0.77	47.5	27.5	25.0	SCL	0.081	2.5	24.4	21.8			2.437
35	6-27-51	F	6-18	5.7	4.22	41.4	27.3	34.0	5.92	47.5	27.5	25.0	SCL	0.384	12.0	3.8	-8.2	3.6	0.2	0.377
35	6-27-51	F	18-30	5.2	3.92	44.0	27.0	26.5	6.22	50.0	31.3	18.8	L	0.422	13.2	4.3	-8.9	0.9	3.4	0.427
35	6-27-51	F	30-42	4.7	4.68	43.0	25.1	37.4	9.74	51.3	31.3	17.5	L	0.453	14.1	1.3	-12.8	2.9	-1.6	0.129
36	6-27-51	H	0-6	7.2	0.56	46.4	4.64	0.91	0.80	45.0	25.0	30.0	SCL/CL	0.027	0.8	25.6	24.7	---	---	2.558
36	6-27-51	H	6-18	6.7	2.58	40.0	24.7	8.89	2.47	51.3	23.8	25.0	SCL	0.110	3.4	19.6	16.2	---	---	1.964
36	6-27-51	H	18-30	7.1	3.58	44.4	25.6	22.6	5.09	41.3	26.3	32.5	CL	0.223	7.0	17.7	10.7	---	---	1.766
36	6-27-51	H	30-42	7.0	4.33	45.4	25.3	24.7	14.2	43.8	28.8	27.5	CL	0.258	8.1	11.1	3.1	---	---	1.111
37	6-27-51	M	0-6	7.2	1.16	42.9	10.4	2.92	1.14	47.5	25.0	27.5	SCL	0.043	1.3	30.3	29.0	---	---	3.031
37	6-27-51	M	6-18	4.4	4.18	42.7	26.5	32.3	5.83	52.5	25.0	22.5	SCL	0.485	15.1	0.0	-15.1	0.3	-0.3	ND
37	6-27-51	M	18-30	5.7	3.83	47.3	31.3	20.8	5.44	45.0	28.8	26.3	L	0.456	14.3	10.7	-3.6	4.2	6.5	1.070
37	6-27-51	M	30-42	7.1	2.60	44.8	18.2	8.64	6.44	46.3	26.3	27.5	SCL	0.060	1.9	4.6	2.7	---	---	0.457
38	6-27-52	M	0-6	7.0	2.50	38.0	26.6	7.54	1.18	66.3	13.8	20.0	SCL/SL	0.050	1.6	15.1	13.5	---	---	1.507
38	6-27-52	M	6-18	4.9	3.35	38.4	23.8	18.1	6.18	53.8	23.8	22.5	SCL	0.584	18.2	6.5	-11.7	4.6	1.9	0.655
38	6-27-52	M	18-30	4.4	6.02	40.6	20.5	48.3	21.5	58.8	22.5	18.8	SL	0.462	14.4	0.0	-14.4	0.7	-0.7	ND
38	6-27-52	M	30-42	5.9	5.47	42.3	22.7	60.3	9.31	53.8	28.8	17.5	SL	0.812	25.4	6.5	-18.8	5.1	1.5	0.655
39	6-27-53	M	0-6	7.5	0.58	37.8	4.35	1.37	0.95	58.8	18.8	22.5	SCL	0.023	0.7	14.1	13.4	---	---	1.412
39	6-27-53	M	6-18	6.6	1.90	46.2	15.0	4.43	4.92	41.3	28.8	30.0	CL	0.158	4.9	17.4	12.4	---	---	1.738
39	6-27-53	M	18-30	6.8	3.56	60.1	4.07	2.42	32.3	46.3	26.3	27.5	SCL	0.222	6.9	3.1	-3.9	0.7	2.4	0.309
39	6-27-53	M	30-42	6.9	7.07	64.0	9.53	5.38	71.8	30.0	36.3	33.8	CL	0.341	10.6	9.5	-1.1	7.4	2.1	0.954
40	6-28-51	B	0-6	7.1	0.64	46.6	4.72	1.81	0.99	38.8	31.3	30.0	CL	0.044	1.4	14.7	13.3	---	---	1.466
40	6-28-51	B	6-18	5.0	2.73	44.8	29.4	10.4	1.13	42.5	32.5	25.0	L	0.324	10.1	3.8	-6.3	0.6	3.2	0.377
40	6-28-51	B	18-30	3.9	3.78	46.1	27.2	29.0	1.73	47.5	30.0	22.5	L	0.701	21.9	0.0	-21.9	8.7	-8.7	ND
40	6-28-51	B	30-42	5.8	4.80	45.0	30.3	51.2	5.18	46.3	27.5	26.3	SCL	0.381	11.9	7.7	-4.2	5.5	2.3	0.773

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MCKINLEY MINE AREA 6 ANALYTICAL DATA
(2003 AND 2004)

Map ID	Mine Grid	Subgrid	Depth (inches)	pH	EC (dS/m)	% SAT	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	Sand (%)	Silt (%)	Clay (%)	Class	Total S (%)	TS-AP (t/kt)	NP (t/kt)	TS-ABP (t/kt)	PAP (t/kt)	PABP (t/kt)	$CaCO_3$ (%)
41	6-28-51	D	0-6	7.4	0.53	40.4	3.79	1.58	0.64	45.0	27.5	27.5	SCL/CL	0.029	0.9	11.0	10.1	---	---	1.100
41	6-28-51	D	6-18	5.6	3.59	47.7	23.5	26.6	4.12	33.8	33.8	32.5	CL	0.215	6.7	3.6	-3.1	1.8	1.8	0.358
41	6-28-51	D	18-30	5.8	4.16	43.4	24.7	32.1	7.53	46.3	26.3	27.5	SCL	0.254	7.9	8.5	0.6	---	---	0.853
41	6-28-51	D	30-42	6.9	4.19	41.4	22.0	32.3	8.44	48.8	27.5	23.8	SCL	0.135	4.2	10.0	5.8	---	---	1.001
42	6-28-51	G	0-6	7.3	0.70	42.1	5.74	1.65	0.97	47.5	27.5	25.0	SCL	0.029	0.9	17.9	17.0	---	---	1.794
42	6-28-51	G	6-18	5.7	3.50	40.2	34.8	17.6	2.45	45.0	31.3	23.8	L	0.335	10.5	5.3	-5.2	2.8	2.4	0.526
42	6-28-51	G	18-30	4.4	5.39	43.5	26.0	61.4	5.39	43.8	30.0	26.3	L	0.525	16.4	11.7	-4.7	3.7	7.9	1.169
42	6-28-51	G	30-42	4.2	6.71	44.6	28.3	94.6	7.44	51.3	25.0	23.8	SCL	0.671	20.9	0.0	-20.9	4.7	-4.7	ND
43	6-28-51	G1	0-6	7.4	0.33	37.7	2.68	0.63	0.40	65.0	15.0	20.0	SCL/SL	0.009	0.3	31.5	31.2	---	---	3.152
43	6-28-51	G1	6-18	6.1	3.10	43.5	37.5	8.02	0.87	58.8	21.3	20.0	SCL/SL	0.210	6.6	22.6	16.0	---	---	2.261
43	6-28-51	G1	18-30	5.1	2.63	42.3	28.7	5.71	0.94	50.0	32.5	17.5	L	0.664	20.7	2.6	-18.1	1.7	0.9	0.259
43	6-28-51	G1	30-42	4.1	2.68	46.1	26.4	7.69	0.81	42.5	32.5	25.0	L	0.516	16.1	0.0	-16.1	1.5	-1.5	ND
44	6-28-51	H	0-6	4.5	2.59	42.1	28.9	7.61	0.76	46.3	28.8	25.0	L	0.205	6.4	1.8	-4.6	0.0	1.8	0.179
44	6-28-51	H	6-18	3.5	2.97	43.7	30.0	8.80	1.02	48.8	30.0	21.3	L	0.451	14.1	0.0	-14.1	2.7	-2.7	ND
44	6-28-51	H	18-30	5.2	4.09	44.6	28.1	36.0	2.30	56.3	22.5	21.3	SCL	0.485	15.2	4.3	-10.9	2.5	1.7	0.427
44	6-28-51	H	30-42	6.6	4.48	46.0	29.6	44.9	3.81	42.5	28.8	28.8	CL	0.246	7.7	16.9	9.3	---	---	1.695
45	6-28-51	H1	0-6	7.1	0.43	46.4	3.24	0.75	0.83	46.3	26.3	27.5	SCL	0.041	1.3	7.4	6.1	---	---	0.742
45	6-28-51	H1	6-18	4.0	2.90	44.9	25.4	15.2	1.16	52.5	26.3	21.3	SCL	0.366	11.4	0.0	-11.4	0.4	-0.4	ND
45	6-28-51	H1	18-30	6.1	2.96	46.9	29.1	15.5	0.87	61.3	23.8	15.0	SL	0.487	15.2	14.4	-0.8	4.5	9.9	1.437
45	6-28-51	H1	30-42	4.0	4.07	48.1	23.3	37.8	1.41	42.5	31.3	26.3	L	0.496	15.5	0.0	-15.5	1.4	-1.4	ND
46	6-28-51	M	0-6	3.9	3.07	41.3	28.5	15.5	1.14	47.5	30.0	22.5	L	0.529	16.5	0.0	-16.5	0.1	-0.1	ND
46	6-28-51	M	6-18	4.2	3.41	42.8	26.8	24.9	1.28	53.8	25.0	21.3	SCL	0.578	18.0	0.0	-18.0	0.6	-0.6	ND
46	6-28-51	M	18-30	3.6	4.92	47.4	25.8	50.2	1.45	45.0	28.8	26.3	L	0.683	21.3	2.8	-18.6	0.7	2.1	ND
46	6-28-51	M	30-42	3.6	4.72	45.4	25.3	48.0	1.79	45.0	28.8	26.3	L	0.868	27.1	0.0	-27.1	4.6	-4.6	ND
47	6-28-52	E	0-6	6.8	1.69	39.8	12.0	6.48	3.14	58.8	20.0	21.3	SCL	0.180	5.6	11.2	5.6	---	---	1.120
47	6-28-52	E	6-18	7.1	2.55	38.5	14.8	12.8	6.70	57.5	23.8	18.8	SL	0.108	3.4	14.0	10.6	---	---	1.398
47	6-28-52	E	18-30	7.3	2.85	36.2	12.5	12.1	12.0	62.5	20.0	17.5	SL	0.067	2.1	23.4	21.3	---	---	2.338
47	6-28-52	E	30-42	7.3	3.12	37.3	15.5	14.4	12.4	61.3	22.5	16.3	SL	0.071	2.2	16.5	14.2	---	---	1.645
48	6-28-52	F	0-6	7.3	0.76	46.4	5.84	2.52	0.84	40.0	28.8	31.3	CL	0.033	1.0	16.0	14.9	---	---	1.596
48	6-28-52	F	6-18	6.4	3.32	47.4	35.5	14.6	1.64	40.0	30.0	30.0	CL	0.191	6.0	24.9	18.9	---	---	2.487
48	6-28-52	F	18-30	6.1	4.74	38.6	28.7	40.6	9.13	46.3	28.8	25.0	L	0.592	18.5	33.8	15.3	---	---	3.378
48	6-28-52	F	30-42	5.8	5.98	45.1	25.8	66.8	12.4	51.3	27.5	21.3	SCL	0.577	18.0	3.3	-14.8	3.0	0.3	0.327
49	6-28-52	M	0-6	7.2	0.39	36.1	2.73	0.98	0.77	55.0	18.8	26.3	SCL	0.021	0.7	5.8	5.1	---	---	0.575
49	6-28-52	M	6-18	7.1	0.90	34.6	5.69	3.16	1.59	63.8	20.0	16.3	SL	0.104	3.3	51.1	47.8	---	---	5.110
49	6-28-52	M	18-30	6.7	3.87	40.0	27.4	24.9	7.00	52.5	26.3	21.3	SCL	0.154	4.8	11.7	6.9	---	---	1.169
49	6-28-52	M	30-42	6.4	4.82	41.3	27.7	36.9	12.6	43.8	32.5	23.8	L	0.250	7.8	10.7	2.9	---	---	1.070
50	6-29-51	F	0-6	6.6	2.29	45.2	23.6	6.15	1.58	46.3	26.3	27.5	SCL	0.142	4.4	15.1	10.6	---	---	1.507
50	6-29-51	F	6-18	4.3	3.21	41.3	24.4	20.4	2.91	52.5	26.3	21.3	SL	0.529	16.5	0.1	-16.4	0.3	-0.2	0.011
50	6-29-51	F	18-30	3.7	4.26	44.5	22.5	34.4	5.92	47.5	30.0	22.5	L	0.718	22.4	0.0	-22.4	0.3	-0.3	ND
50	6-29-51	F	30-42	4.1	4.47	41.8	22.5	40.7	6.96	38.8	35.0	26.3	L	0.774	24.2	0.0	-24.2	1.8	-1.8	ND

TABLE A1
MCKINLEY MINE AREA 6 ANALYTICAL DATA
(2003 AND 2004)

Map ID	Mine Grid	Subgrid	Depth (inches)	pH	EC (dS/m)	% SAT	Ca (meq/L)	Mg (meq/L)	Na (meq/L)	Sand (%)	Silt (%)	Clay (%)	Class	Total S (%)	TS-AP (t/kt)	NP (t/kt)	TS-ABP (t/kt)	PAP (t/kt)	PABP (t/kt)	$CaCO_3$ (%)
51	6-29-51	F	0-6	5.4	3.81	47.6	28.8	29.5	1.78	27.5	40.0	32.5	CL	0.140	4.4	13.0	8.6	---	---	1.299
51	6-29-51	F	6-18	6.5	3.44	47.6	32.2	19.2	1.87	37.5	33.8	28.8	CL	0.359	11.2	3.3	-7.9	0.1	3.2	0.327
51	6-29-51	F	18-30	6.1	3.85	38.6	33.1	26.2	1.83	33.8	40.0	26.3	L	0.278	8.7	17.4	8.7			1.744
51	6-29-51	F	30-42	3.8	4.68	46.3	26.1	43.7	1.80	33.8	40.0	26.3	L	0.384	12.0	0.0	-12.0	0.2	-0.2	ND
52	6-29-51	H	0-6	6.4	3.38	45.2	35.0	11.3	2.41	41.3	31.3	27.5	CL	0.100	3.1	46.6	43.5	---	---	4.665
52	6-29-51	H	6-18	5.8	4.22	44.9	34.3	22.9	4.65	37.5	37.5	25.0	L	0.552	17.3	11.0	-6.2	3.3	7.7	1.101
52	6-29-51	H	18-30	5.8	5.06	48.2	38.6	26.7	8.00	35.0	33.8	31.3	CL	0.343	10.7	23.4	12.7	---	---	2.338
52	6-29-51	H	30-42	5.8	6.02	46.7	37.8	47.0	8.61	37.5	33.8	28.8	CL	0.433	13.5	19.4	5.9	---	---	1.942
53	6-29-51	M	0-6	6.1	4.37	44.8	35.9	31.6	5.18	40.0	30.0	30.0	CL	0.247	7.7	8.2	0.5	---	---	0.823
53	6-29-51	M	6-18	3.5	7.32	45.0	25.1	75.8	19.6	56.3	25.0	18.8	SL	0.703	22.0	0.0	-22.0	1.6	-1.6	ND
53	6-29-51	M	18-30	4.2	8.32	45.6	27.8	64.1	50.5	55.0	25.0	20.0	SCL/SL	0.630	19.7	0.3	-19.4	2.3	-2.0	0.031
53	6-29-51	M	30-42	3.2	11.2	46.5	27.7	115	31.8	52.5	28.8	18.8	SL	0.760	23.7	0.0	-23.7	0.2	-0.2	ND
54	6-29-52	G	0-6	5.5	3.81	38.9	29.9	27.5	2.77	53.8	23.8	22.5	SCL	0.238	7.4	3.8	-3.7	2.8	0.9	0.377
54	6-29-52	G	6-18	3.6	4.06	45.7	26.2	34.4	3.82	48.8	30.0	21.3	L	0.704	22.0	0.0	-22.0	5.8	-5.8	ND
54	6-29-52	G	18-30	4.6	3.53	38.6	26.8	25.2	4.17	43.8	35.0	21.3	L	0.378	11.8	1.3	-10.5	4.7	-3.4	0.129
54	6-29-52	G	30-42	5.4	3.47	34.6	25.7	42.0	6.92	41.3	43.8	15.0	L	0.272	8.5	1.3	-7.2	5.6	-4.3	0.129
55	6-29-52	H	0-6	7.0	3.12	41.4	29.1	12.3	4.65	48.8	26.3	25.0	SCL	0.072	2.3	13.5	11.2	---	---	1.348
55	6-29-52	H	6-18	7.5	3.51	42.3	15.0	25.9	8.83	48.8	31.3	20.0	L	0.081	2.5	11.2	8.7	---	---	1.120
55	6-29-52	H	18-30	7.5	2.59	40.0	12.8	17.6	5.09	45.0	31.3	23.8	L	0.073	2.3	16.1	13.9	---	---	1.615
55	6-29-52	H	30-42	7.5	2.92	43.3	15.1	21.2	4.96	45.0	32.5	22.5	L	0.091	2.8	12.7	9.8	---	---	1.268
56	6-29-52	M	0-6	7.2	0.59	38.8	6.44	1.71	0.77	56.3	20.0	23.8	SCL	0.019	0.6	21.4	20.8	---	---	2.140
56	6-29-52	M	6-18	6.4	2.99	40.9	31.5	13.0	2.01	57.5	20.0	22.5	SCL	0.177	5.5	8.7	3.2	---	---	0.872
56	6-29-52	M	18-30	6.7	4.03	41.4	25.9	30.9	5.83	45.0	27.5	27.5	SCL/CL	0.282	8.8	24.9	16.1	---	---	2.487
56	6-29-52	M	30-42	7.3	3.98	45.3	25.8	29.8	7.00	32.5	36.3	31.3	CL	0.145	4.5	42.2	37.7	---	---	4.219

Notes:
ND = non detect
dS/m = deciSiemens per meter
meq/L = milliequivalents per liter
t/kt = tons per kiloton
TS-AP = acid potential on total sulfur basis
NP = neutralization potential
TS-ABP = acid-base potential on a total sulfur basis
PAP = acid potential on a pyritic sulfur basis
PABP = acid-base potential on a pyritic sulfur basis

APPENDIX B

PHOTOGRAPHS OF AREA 6 SUBGRIDS

6-21-55A

Canopy Cover: 65-70%; Topsoil: 4"
Suitable thickness: 21" (pH: 5.1 below)

6-21-55B

Canopy Cover: 40%; Topsoil 9"
Suitable thickness: 24"

6-21-55C

Canopy Cover: 60%; Topsoil: 13"
Suitable thickness: 24"

6-21-55D

Canopy Cover: 45%; Topsoil: 12"
Suitable thickness: 24"

6-21-56A

Canopy Cover: 60%; Topsoil: 18”
Suitable thickness: 24”

6-21-56B

No Picture

6-21-56C

No Picture

6-21-56D

Canopy Cover: 35%; Topsoil: 5”
Suitable thickness: 5” (pH: 4.3 below)

6-22-55A

Canopy Cover: 25%; Topsoil: 6"
Suitable thickness: 0" (pH: 4.6 below)

6-22-55B

Canopy Cover: 40%; Topsoil: 10"
Suitable thickness: 10" (pH: 4.9 below)

6-22-55C

Canopy Cover: 45%; Topsoil: 11"
Suitable thickness: 11" (pH: 4.0 below)

6-22-55D

Canopy Cover: 65%; Topsoil: 9"
Suitable thickness: 21" (pH: 5.1 below)

6-22-56A

Canopy Cover: 20%; Topsoil: 12”
Suitable thickness: 18” (pH: 4.6 below)

6-22-56B

No Picture

6-22-56C

No Picture

6-22-56D

No Picture

6-23-53A

Canopy Cover: 55%; Topsoil: 11”
Suitable thickness: 24”

6-23-53B

Canopy Cover: 65%; Topsoil: 13”
Suitable thickness: 24”

6-23-53C

Canopy Cover: 60%; Topsoil: 10”
Suitable thickness: 10” (pH: 5.4 below)

6-23-53D

Canopy Cover: 60%; Topsoil: 7”
Suitable thickness: 24”

6-23-54A

Canopy Cover: 45-60%; Topsoil: 12”
Suitable thickness: 24”

6-23-54B

Canopy Cover: 30%; Topsoil: 14”
Suitable thickness: 20” (pH: 4.1 below)

6-23-54C

Canopy Cover: 65%; Topsoil: 13”
Suitable thickness: 24”

6-23-54D

Canopy Cover: 25%; Topsoil: 3”
Suitable thickness: 24”

6-25-54A

Canopy Cover: 60%; Topsoil: 7"
Suitable thickness: 11" (pH: 5.3 below)

6-25-54B

Canopy Cover: 30%; Topsoil: 8"
Suitable thickness: 18" (pH: 3.8 below)

6-25-54C

Canopy Cover: 20%; Topsoil: 3"
Suitable thickness: 3" (pH: 5.5 below)

6-25-54D

Canopy Cover: 40%; Topsoil: 6"
Suitable thickness: 12" (pH: 3.4 below)

6-26-51A

Canopy Cover: 65%; Topsoil: 7”
Suitable thickness: 24”

6-26-51B

Canopy Cover: 60%; Topsoil: 5”
Suitable thickness: 24”

6-26-51C

Canopy Cover: 30%; Topsoil: 7”
Suitable thickness: 13” (pH: 4.3 below)

6-26-51D

Canopy Cover: 60%; Topsoil: 5”
Suitable thickness: 24”

6-26-52A

Canopy Cover: 60%; Topsoil: 10”
Suitable thickness: 16” (pH: 3.7 below)

6-26-52B

Canopy Cover: 50%; Topsoil: 13”
Suitable thickness: 19” (pH: 5.4 below)

6-26-52C

Canopy Cover: 20%; Topsoil: 11”
Suitable thickness: 11” (pH: 5.3 below)

6-26-52D

Canopy Cover: 10%; Topsoil: 3”
Suitable thickness: 3” (pH: 2.9 below)

6-27-51A

Canopy Cover: 45%; Topsoil: 11”
Suitable thickness: 17” (pH: 4.6 below)

6-27-51B

Canopy Cover: 50%; Topsoil: 14”
Suitable thickness: 14” (pH: 4.9 below)

6-27-51C

Canopy Cover: 5-10%; Topsoil: 7”
Suitable thickness: 13” (pH: 3.3 below)

6-27-51D

Canopy Cover: 50%; Topsoil: 5”
Suitable thickness: 24”

6-27-52A

Canopy Cover: 5%; Topsoil: 7”
Suitable thickness: 13” (pH: 3.7 below)

6-27-52B

Canopy Cover: 20%; Topsoil: 9”
Suitable thickness: 9” (pH: 4.2 below)

6-27-52C

Canopy Cover: 25%; Topsoil: 7”
Suitable thickness: 24”

6-27-52D

Canopy Cover: 25%; Topsoil: 10”
Suitable thickness: 10” (pH: 4.3 below)

6-28-51A

Canopy Cover: 60%; Topsoil: 16”
Suitable thickness: 16” (pH: 3.6 below)

6-28-51B

Canopy Cover: 20%; Topsoil: 5”
Suitable thickness: 5” (pH: 4.2 below)

6-28-51C

Canopy Cover: 35%; Topsoil: 8”
Suitable thickness: 8” (pH: 3.8 below)

6-28-51D

Canopy Cover: 30%; Topsoil: 10”
Suitable thickness: 10” (pH: 4.8 below)

6-29-51A

Canopy Cover: 20%; Topsoil: 6”
Suitable thickness: 6” (pH: 3.6 below)

6-29-51B

Canopy Cover: 20%; Topsoil: 10”
Suitable thickness: 10” (pH: 3.1 below)

6-29-51C

Canopy Cover: 40%; Topsoil: 7”
Suitable thickness: 7” (pH: 5.4 below)

6-29-51D

Canopy Cover: 40%; Topsoil: 6”
Suitable thickness: 24”

6-29-52A

Canopy Cover: 45%; Topsoil: 7”
Suitable thickness: 19” (pH: 4.3 below)

6-29-52B

Canopy Cover: 55%; Topsoil: 13”
Suitable thickness: 19” (pH: 4.7 below)

6-29-52C

Canopy Cover: 45%; Topsoil: 13”
Suitable thickness: 24”

6-29-52D

Canopy Cover: 50%; Topsoil: 7”
Suitable thickness: 24”

TECHNICAL MEMORANDUM

Date:	November 16, 2011	**Project No.:**	103-80026
To:	Mr. Frank Rivera	**Company:**	Chevron Mining Inc. McKinley Mine 24 Miles NW Hwy 264 Mentmore, NM 87319
From:	Lewis Munk		
cc:		**Email:**	LMunk@golder.com

RE: **CHEVRON MINING INC., MCKINLEY MINE, AREA 6 RECLAMATION PLAN**

1.0 INTRODUCTION

The Office of Surface Mining (OSM) prepared a Technical Evaluation of a CMI Interim Lands Reclamation Assessment Report for Area 6 of the McKinley North Mine. The OSM Technical Evaluation was prepared following submittal a report from Golder Associates Inc. (Golder) and field inspection in October 2010. This issue originally stemmed from concerns about vegetation performance on some Initial Program Lands discovered during inspections conducted in the fall of 2008 and spring of 2009. The primary concerns were centered in the recently mitigated areas in Area 6. Chevron Mining Inc. McKinley Mine (CMI) retained Golder to finalize a mitigation plan for Area 6 on the McKinley Mine.

Because Area 6 contains some low pH soils, it has been the subject of previous investigations and mitigation efforts (Golder, 2005a, 2006, and 2010). In association with the May 2009 inspection, the OSM identified bare and sparsely vegetated areas in Area 6. The inspection report included an aerial photograph intended to illustrate the distribution of bare areas, which were represented by lighter photographic tones. The date of the aerial photograph is unknown, but the lighter toned features correspond to the area that was topdressed and seeded in 2006. The bare areas that were observed are now known to be related to poor establishment of the areas reseeded in 2006. These areas are now dominated by dense stands of kochia (*Bassia prostrata*) with scattered perennial grasses and shrubs.

2.0 BACKGROUND

Area 6 was originally seeded in the mid-1980s and represents what might be considered adolescent, but not quite, mature reclamation from a landscape evolution perspective. Various mitigation measures have been locally applied over time in an attempt to mitigate perceived acid soil limitations, (e.g., lime treatments and the addition of cover). In general, none of these treatments appear to have substantively improved the vegetation relative to the existing conditions on the original reclamation. Evidence of localized sheet and rill erosion was observed in areas with lower vegetation cover. Golder maintains that the response of the vegetation and consequent development of erosion features is related to natural processes operating under the prevailing climatic regime for this region (Golder, 2004, 2005c, and 2010).

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The response of the initial program lands is consistent with the expected trajectory and diversification of a landscape with similar topography, soils, vegetation, and climatic conditions.

Over the long-term, this area is expected to tend toward a condition represented by the pre-mining landscape, which contained patches of vegetation with divergent characteristics, bare areas with exposed sedimentary rocks, and erosion features on the more steeply sloping lands. We anticipate that the natural erosion process will ultimately result in the development of an integrated drainage system with higher drainage density than currently exists. Thus, we believe that some erosion features can be considered normal and natural and represent the progression of the landscape. We believe that the landscape evolution process is analogous to the expectations for vegetation diversification, whereby plant diversity is expected to increase from the initial seeded condition to a more diverse condition at release.

We do not believe that mitigation of these areas is warranted from a vegetation performance perspective considering that they will not affect the post-mining land use and are not inconsistent with the pre-mining environment and surrounding undisturbed ecosystem (Golder 2010). The issues of the trajectory of landscape evolution, acid soils and plant toxicity, and the regulatory determination of acid-forming materials notwithstanding, CMI proposes in the spirit of cooperation to treat portions of Area 6 in recognition of the regulatory agencies concerns. In addition, CMI is volunteering to reconfigure a steep slope area (that had not been identified by OSM) to increase the vegetation production potential. The treatment plan for Area 6 is discussed below.

From a mitigation perspective, we propose that corrective actions be applied to areas that have been affected by the improper design or maintenance of water control features or roads. However, erosion features on areas that were constructed in accordance with approximate original contour guidance and/or permit requirements should be considered a part of the reclaimed landscape and would not require mitigation. The erosion process is episodic and relatively slow and we do not expect, if natural erosion processes are allowed to proceed, that erosion will affect the post-mining land use or prove to be inconsistent with the pre-mining environment.

2.1 Area 6 Treatment Plan

The Area 6 project site is characterized by northwest-trending ridges with slope gradients of about 4:1 (25 percent). Localized areas of short, steep slope segments occur mostly in association with the western-most ridge. Minor and localized areas with sparse vegetation cover were observed where the subsoils were exposed by drainage integration processes operating on the slopes. These areas typically contained a higher proportion of shrubs, lower grass cover, and more bare soil than lower gradient areas or slopes not affected by runoff. Runoff from the surrounding uplands that concentrated water on the slopes has caused exposure of the subsoils. Areas with lower vegetation density typically occur in the mid- to lower-slope position where erosion is typically most prevalent in natural hillslope situations. Field pH measurements and supplemental grid sampling data in these areas revealed that some, but not all the subsoils were acid in reaction (Golder, 2006). Except for those areas with steep slopes, it is critical to note that we could not discern any difference in plant performance among the grids that contain acidic subsoils and those with neutral and alkaline subsoils. Vegetation on the site is dominated by native and adapted grasses and shrubs typical of the reclaimed lands at McKinley Mine.

2.1.1 Treatment Plan for East Ridge Portion of Area 6

The OSM identified Grids 6-23-555, 6-24-54, 6-24-55, 6-25-54, 6-26-53, 6-26-52, 6-27-52, 6-27-53, and 6-28-52 as areas that require treatment. The vegetation and slopes were assessed by Golder in October 2011. This area had been treated in 2006; additional cover materials were applied over much of this area and it was reseeded. Several partial grids in the southern portion of the East Ridge adjacent to the treatment areas identified in 2006 were identified to receive additional cover. Consistent with the previous agreements they will be covered with 12 to 18 inches of cover to achieve the required 18 inch thickness layer with pH > 5.5. These areas occupy about 1.3 acres and about 3,150 cubic yards (CY) of suitable materials will be required to cover the proposed treatment areas. CMI plans to use neutral materials and/or topsoil resources. These areas are now dominated by dense stands of kochia (*Bassia prostrata*) with only scattered perennial grasses and shrubs. We recommend that the entire area that was seeded in 2006, be reseeded.

OSM identified an additional area in Grid 6-20-56 that requires treatment (Figure 1). This area is believed to have been a haul road prior to reclamation. Portions of the haul road berms have somewhat lower vegetation cover than the surrounding areas. We think that all that is needed here is additional cover (≈ 1 foot thick) and reseeding. The proposed cover areas occupy about 0.3 acres and will require about 500 CY of topdressing.

A rill has formed adjacent to and south of the former haul road. The rill is incised with steep-walls approximately 1 foot deep. It extends for about 200 feet downslope and terminates in a fan on the slope. The rill formation was probably accentuated by the collection and diversion of water from an unmaintained road upslope. We propose to stabilize the rill by flattening the banks and armoring the invert with riprap. The road should be closed if not needed and/or soil conservation measures (e.g., water bars) implemented to reduce the channelization of water to the rill. Another unmaintained road occurs to the north of the rill that is starting to erode in the same way. We recommend that this road be closed and/or the same soil conservation applied to reduce the channelization of water. The approximate location of these roads are shown on Figure 1.

2.1.2 Treatment Plan for the West Ridge Portion of Area 6

OSM identified the need for treatment in portions of grids 6-19-55, 6-20-54, and 6-23-55C. The areas in the vicinity of 6-19-55 and 6-20-54, are actually affected by slope configuration problems and channeling of water on an unmaintained road. Two short sections of slope with relatively high gradients (2:1 to 2.5:1) occur on the West side of Area 6 (Figure 1). These slopes receive episodic runoff from the adjacent lower gradient areas to the west. The vegetation and cover on these slopes are lower than the surrounding areas with lower gradient slopes. The OSM identified the northern area (Figure 2) as a location requiring corrective action. CMI and Golder have identified a larger area south of the OSM site with similar characteristics that we believe warrants treatment to increase vegetation production. Thus, CMI proposes to reconfigure the slope to the south (Figure 3). Slope profiles are shown on Figure 2 for the northern area and Figure 3 for the CMI proposed southern area. The reduced plant growth in these areas is limited by the high gradient slopes and combined effects of limited infiltration of antecedent rainfall and direct flow of water. McKinley proposes to stabilize these areas by reconfiguring the slopes to eliminate the slope inflections and to reduce the overall gradient. These sites will be reseeded following the surface treatment.

A segment of slope in Grid 6-23-55C is affected by erosion associated with a slope inflection. The upper portion of this feature is stable and we recommend reduction of the slope gradient below the slope inflection point. The steep slope section below the inflection point will be treated by adding sufficient material to eliminate the over steepened slope segment (Figure 4). Vegetation near the treatment area is characterized by native shrubs (Apache plume) and trees (Ponderosa pine). CMI will attempt to minimize destruction of the existing vegetation in the areas surrounding the treatment, as discussed with the agencies in October 2010. The reconstructed slope will be seeded after placement and grading of the slope.

The plan drawings in Figures 2, 3, and 4 are approximate and the corrective actions will need to be field fit during implementation.

2.1.3 General Reclamation Techniques

Minor areas identified outside the delineated treatment areas shown on Figure 1 may be treated during the implementation of the reclamation. Disturbed areas associated with the equipment access corridors will be seeded and mulched following the importation of the cover materials.

The reclamation approach presented here will be conducted using methods that have been traditionally applied at the McKinley Mine. We recommend the institution of surface water control measures in areas with improper drainage that are leading to localized erosion of the slopes and exposure of the spoils. In particular, the non-engineered road that runs down the main ridge in Area 6 should be moved and/or rehabilitated to prevent runoff onto the slope. Specific reclamation recommendations for the designated lands are listed below:

- Apply additional suitable cover materials per the plan (Figure 1).
- Scarify 6 to 8 inches deep parallel to the contour.

- Broadcast or drill seed using the permanent seed mix.
- Apply mulch at a rate of 2 to 2.5 tons per acre. Crimp 3 to 4 inches deep with vertical coulters to fix the mulch.
- Livestock access should be restricted for a minimum of 5 years and carefully controlled thereafter.
- Long-stem, certified weed-free, mulch should be used if possible.
- Golder recommends seeding by June 30th to take advantage of the summer rains.

3.0 REFERENCES

Golder Associates Inc. (Golder), 2004. *CDK Area Reclamation Assessment*. Prepared for McKinley Mine. December 22, 2004.

Golder. 2005a. *Area 6 Reclamation Assessment*. Prepared for McKinley Mine. January 31, 2005.

Golder. 2005b. *Area 6 Treatment Plan*. Technical Memorandum prepared for McKinley Mine. September 21, 2005.

Golder. 2005c. *CDK Area Reclamation Assessment and Treatment Plan*. Prepared for McKinley Mine. December 21, 2005.

Golder. 2006. P&M McKinley Mine Area 6 Treatment Plan. Prepared for McKinley Mine. June 6, 2006.

Golder. 2010. Interim Lands Reclamation Assessment. Prepared for McKinley Mine. September 16, 2010.

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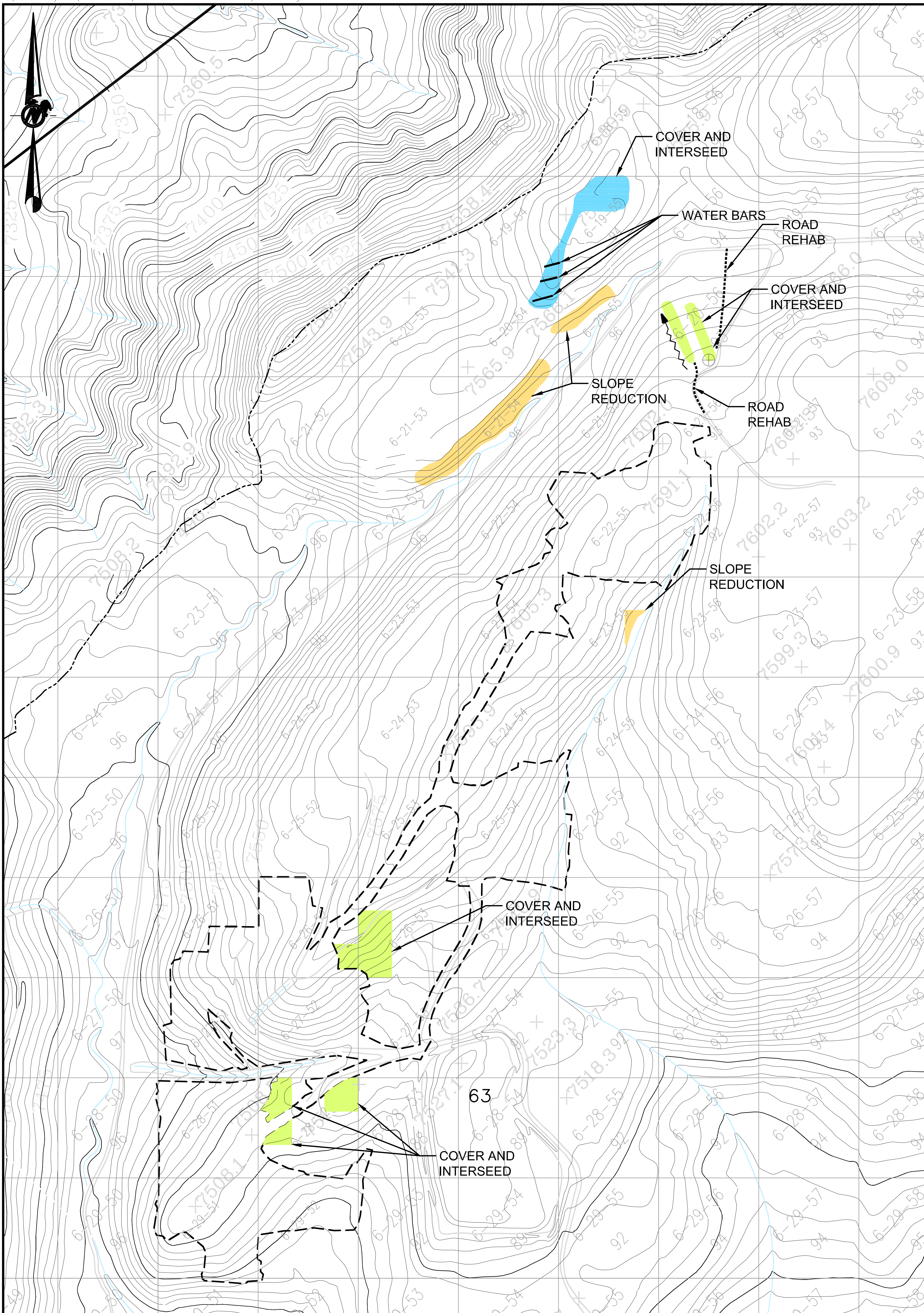


LEGEND

DISTURBANCE	— · · — · · —
OSM PERMIT BOUNDARY	———
GRID NUMBER	2-64-20
2006 TREATMENT BOUNDARY	— — — —

PROJECT

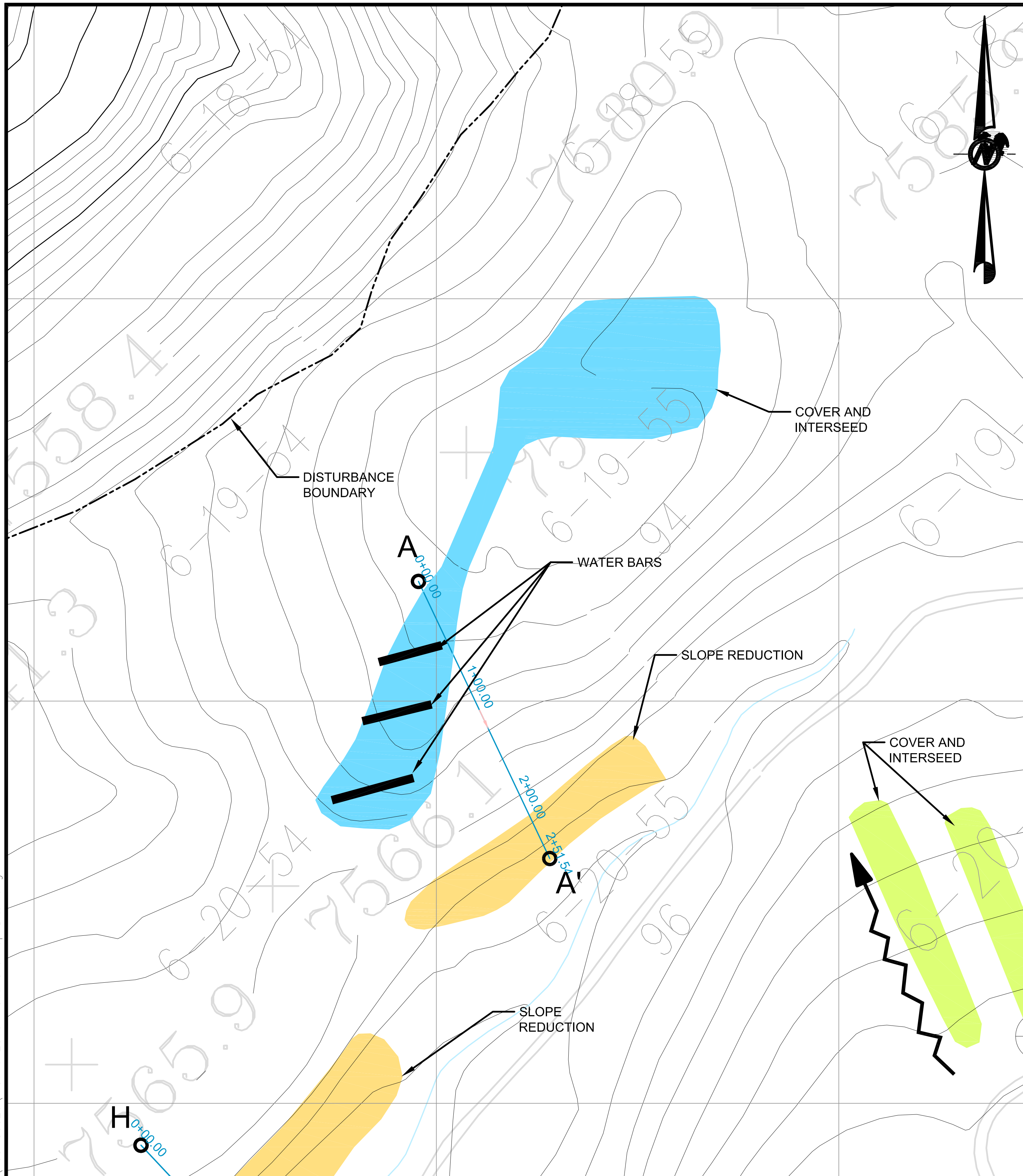
CHEVRON MINING INC.
McKINLEY MINE

TITLE

AREA 6
2011 TREATMENT

Golder Associates
Albuquerque, New Mexico

PROJECT No.		103-80026	FILE No.	Area 6 2010 Treat
DESIGN	LM	09/10/00	SCALE AS SHOWN	REV. 0
CADD	CM	11/10/11	**FIGURE 1**	
CHECK	LM	11/10/11		
REVIEW	DR	11/10/11		



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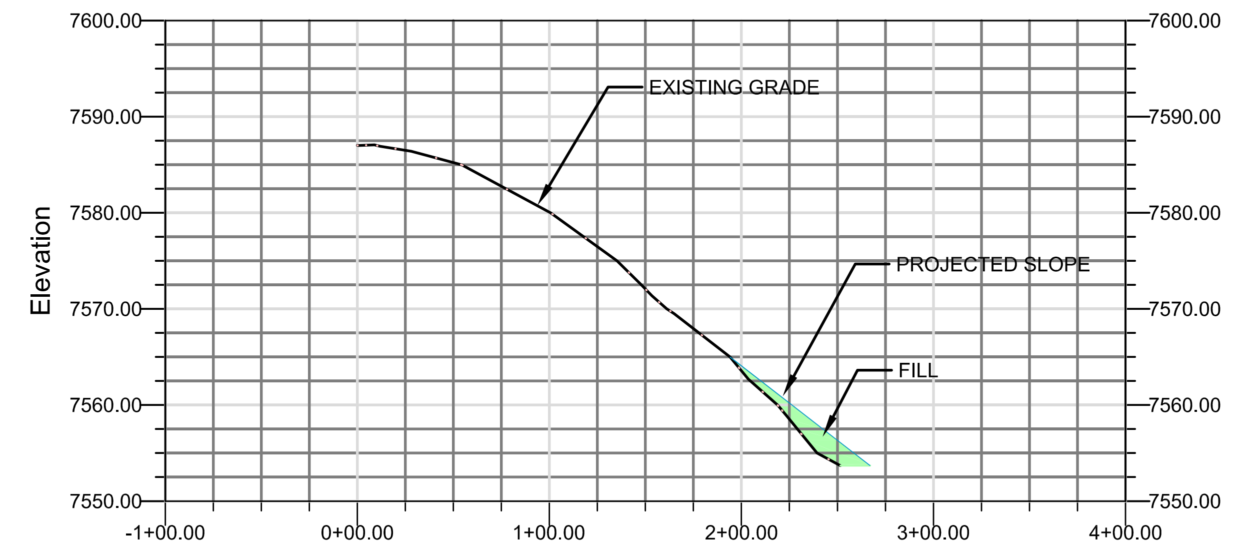

CROSS SECTION A-A'

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SCALE VERTICAL: 1"=20'

PROJECT
CHEVRON MININGIN INC.
McKINLEY MINE

TITLE
AREA 6
CROSS SECTION A-A'

Golder Associates
Albuquerque, New Mexico

PROJECT No.	103-80026		FILE No. Area 2010 Treatment	
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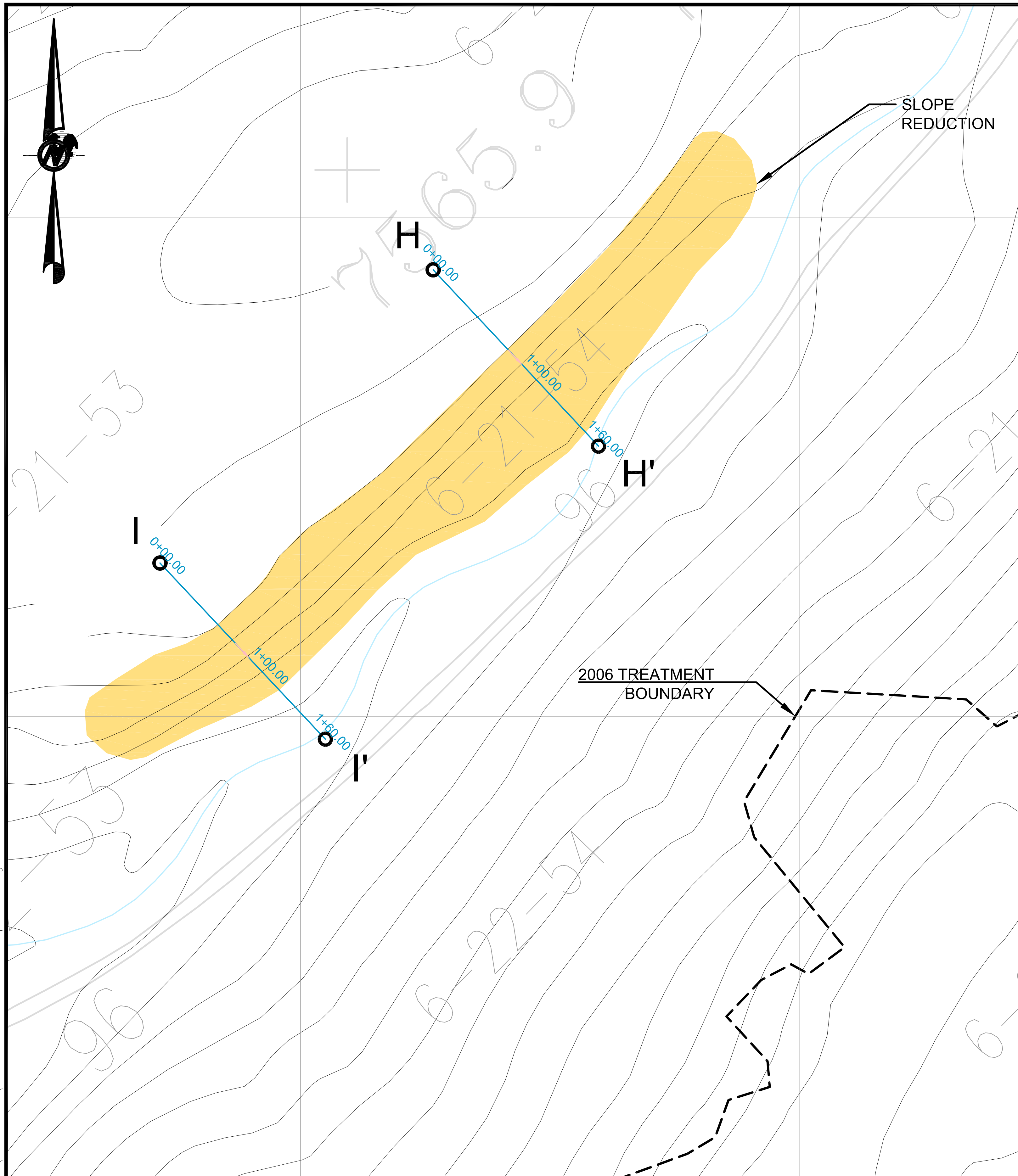

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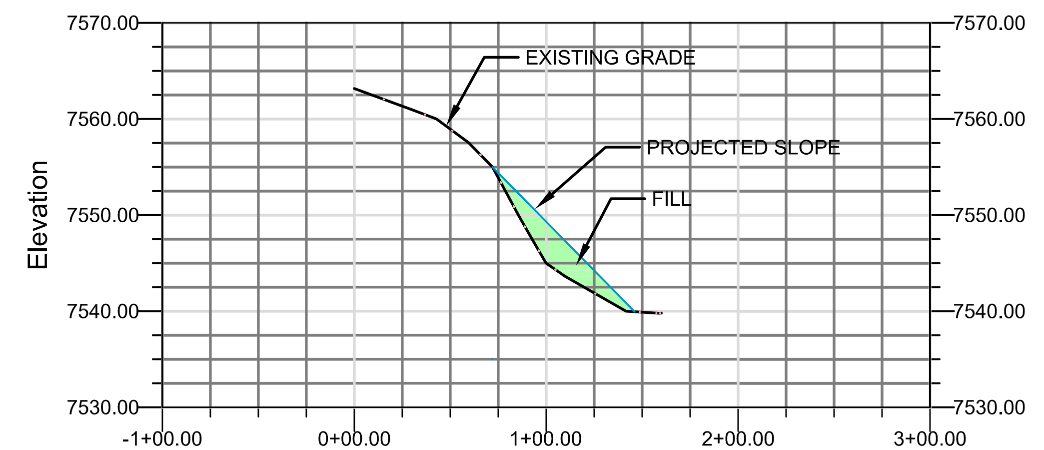

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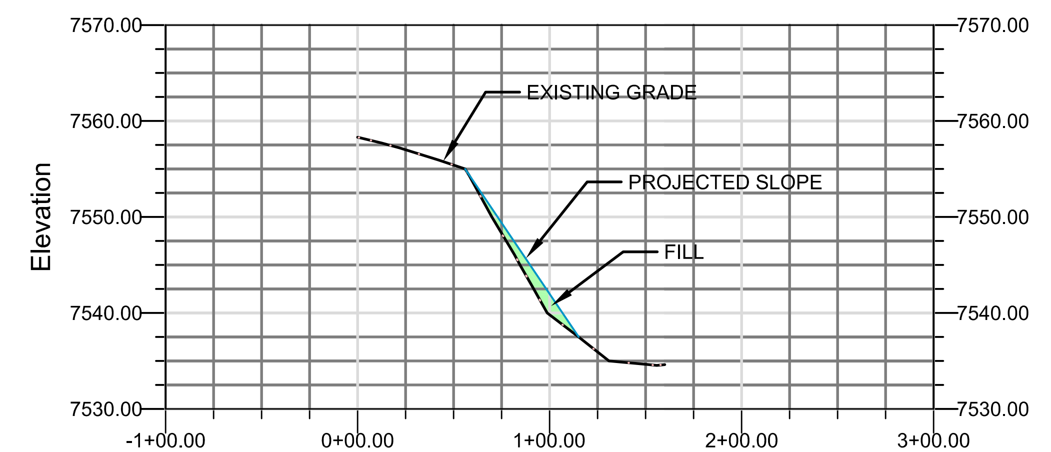

CROSS SECTION I-I'

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SCALE VERTICAL: 1"=20'

PROJECT
CHEVRON MININGIN INC.
McKINLEY MINE

TITLE
AREA 6
CROSS SECTIONS H-H' AND I-I'

Golder Associates
Albuquerque, New Mexico

PROJECT No.		103-80026	FILE No. Area 2010 Treatment		
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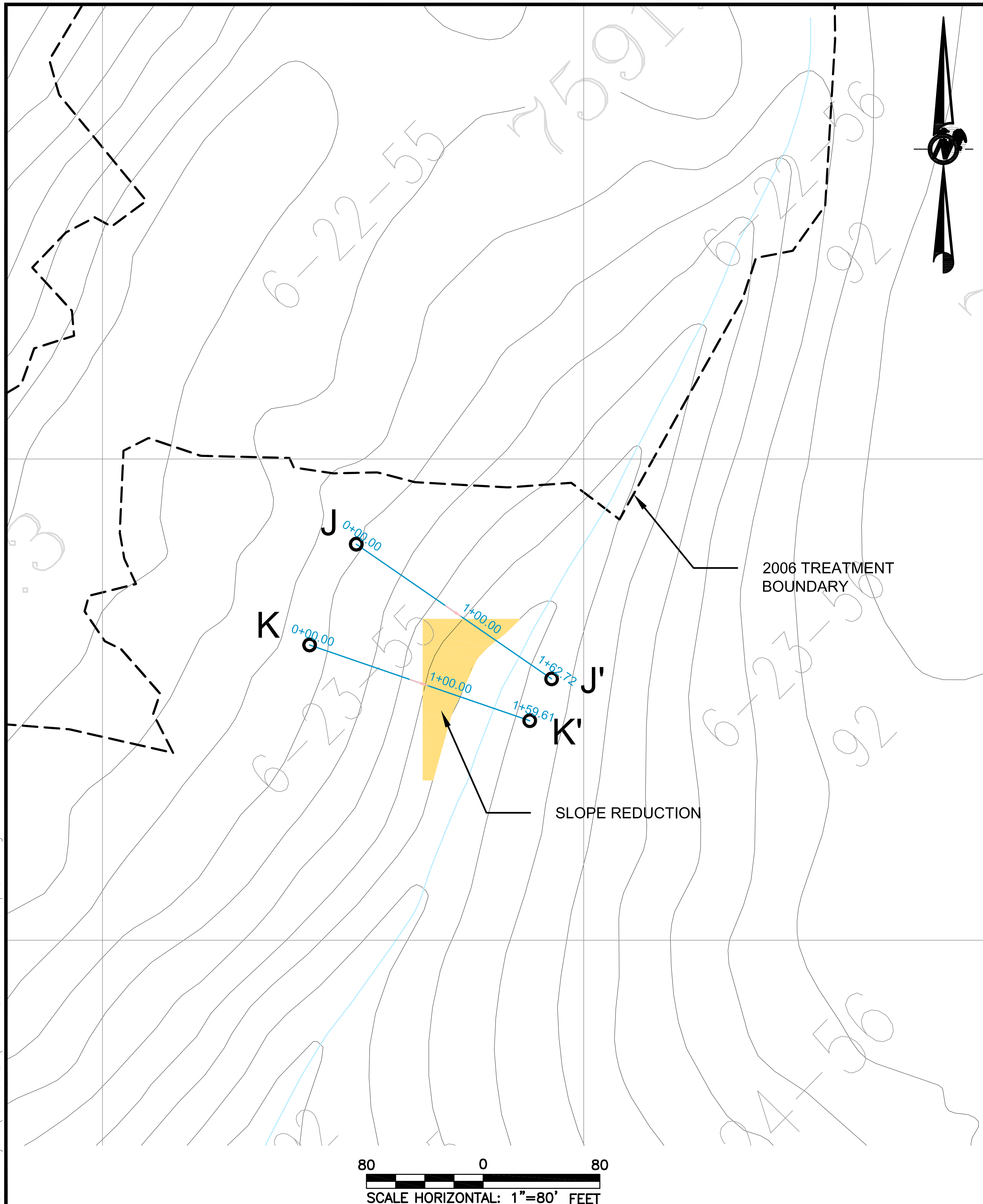

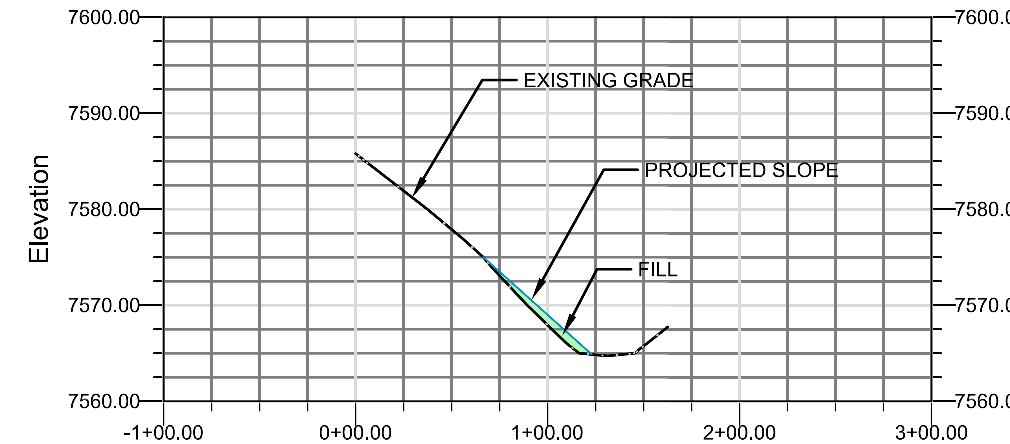

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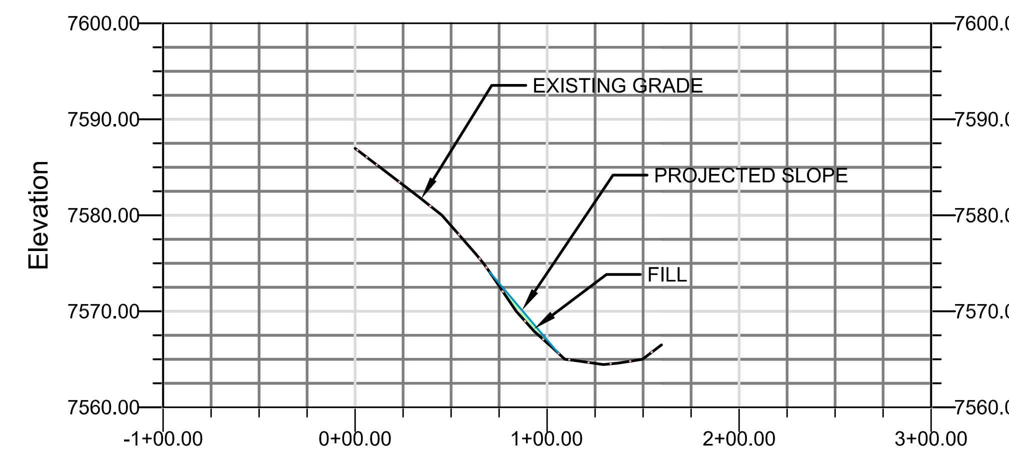

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PROJECT
CHEVRON MININGIN INC.
McKINLEY MINE

TITLE
AREA 6
CROSS SECTIONS J-J' AND K-K'

PROJECT No.		103-80026	FILE No. Area 2010 Treatment	
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CHECK	LM	11/09/11		
REVIEW	XX	XX/XX/11		

Golder Associates
Albuquerque, New Mexico

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REPORT

RECLAMATION PLAN FOR BARREN AND THINLY VEGETATED SITES IDENTIFIED WITHIN AREA 6 – MCKINLEY MINE

Submitted To: Chevron Mining Inc.
McKinley Mine
24 Miles NW Hwy 264
Mentmore, NM 87319

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Albuquerque, NM 87113 USA

Distribution:
3 Copies – Chevron Mining Inc., McKinley Mine
6 Copies – Office of Surface Mines
3 Copies – Golder Associates Inc.

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December 7, 2012

123-81543

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1.0 INTRODUCTION

The Office of Surface Mining (OSM) prepared a Technical Evaluation of a CMI Interim Lands Reclamation Assessment Report for Area 6 of the McKinley North Mine (June 28, 2011). The OSM Technical Evaluation was prepared following submittal of a report from Golder Associates Inc. (Golder) and a field inspection in October 2010 (Golder, 2010). The issues in Area 6 stemmed from concerns about vegetation performance on some initial program lands during inspections conducted in the fall of 2008 and spring of 2009. The primary concerns were centered in the areas that were covered and seeded in 2006. The bare areas that were observed in 2009 are now known to be related to poor vegetation establishment of the areas that had received additional cover and were inter-seeded in 2006. In 2010, these areas were dominated by dense stands of kochia (*Bassia prostrata*) with scattered perennial grasses and shrubs. The severe drought conditions in 2009, 2011 and 2012 resulted in diminished prevalence of kochia. As of 2012, the density of perennial species had increased in some areas, but establishment was inconsistent across the 2006 cover and inter-seeding treatment.

Chevron Mining Inc. McKinley Mine (CMI) retained Golder to finalize a mitigation plan for Area 6 on the McKinley Mine, which was submitted in November 2011. Field review of the plan by the OSM in June 2012 resulted in need for modification of that plan. A working meeting to develop a final plan was conducted on September 25, 2012. The treatment plan that is presented herein incorporates the determinations of the field review team made during the September 2012 site inspection.

2.0 BACKGROUND

Because Area 6 contains some low pH soils, it has been the subject of previous investigations, plans, and mitigation efforts (Golder, 2005a, 2006, 2010, and 2011). The electronic versions of the past reports prepared by Golder are included on the enclosed CD for ease in reference and review. The reports were compiled at the request of some of the field review team members in September 2012. The major finding from the past technical assessment is summarized below.

Area 6 was originally seeded in the mid-1980s and represents what might be considered adolescent, but not quite, mature reclamation from a landscape evolution perspective. Various measures have been locally applied over time in an attempt to mitigate perceived acid soil limitations, (e.g., lime treatments and the addition of cover). In general, none of these treatments appear to have substantively improved the vegetation relative to the existing conditions on the original reclamation. Evidence of localized sheet and rill erosion was observed in areas with lower vegetation cover. Golder maintains that the response of the vegetation and consequent development of erosion features is related to natural processes operating under the prevailing climatic regime for this region (Golder, 2004, 2005c, and 2010). The response of these lands is consistent with the expected trajectory and diversification of a landscape with similar topography, soils, vegetation, and climatic conditions.

Over the long-term, this area is expected to tend toward a condition represented by the pre-mining landscape, which contained patches of vegetation with divergent characteristics, bare areas with exposed sedimentary rocks, and erosion features on the more steeply sloping lands. We anticipate that the natural erosion process will ultimately result in the development of an integrated drainage system with a higher drainage density than currently exists. Thus, we believe that some erosion features can be considered normal and natural and represent the progression of the landscape. The landscape evolution process is analogous to the expectations for vegetation diversification, whereby plant diversity is expected to increase from the initial seeded condition to a more diverse condition.

Erosion features on areas that were constructed in accordance with applicable approximate original contour guidance and/or permit requirements are considered a part of the reclaimed landscape and are not believed to require mitigation. The erosion process is episodic and relatively slow and we do not expect, if natural erosion processes are allowed to proceed, that erosion will affect the post-mining land use or prove to be inconsistent with the pre-mining environment. Therefore, CMI proposed to perform corrective actions in areas that were affected by the improper design or maintenance of water control features or roads.

The issues of the trajectory of landscape evolution, acid soils and plant toxicity, and the regulatory determination of acid-forming materials notwithstanding, CMI proposes to treat portions of Area 6 in recognition of the regulatory agencies concerns. The treatment plan for Area 6 is discussed below.

2.1 Area 6 Treatment Plan

The Area 6 project site is characterized by northwest-trending ridges with slope gradients of about 4:1 (25 percent). Localized areas of short, steep slope segments occur mostly in association with the western-most ridge. Minor and localized areas with sparse vegetation cover were observed where the subsoils were exposed by drainage integration processes operating on the slopes. These areas typically contained a higher proportion of shrubs, lower grass cover, and more bare soil than lower gradient areas or slopes not affected by runoff. Runoff from the surrounding uplands that concentrated water on the slopes has caused exposure of the subsoils. Areas with lower vegetation density typically occur in the mid- to lower-slope position where erosion is typically most prevalent in natural hillslope situations. Field pH measurements and supplemental grid sampling data in these areas revealed that some, but not all the subsoils were acid in reaction (Golder, 2006 and 2010). Except for those areas with steep slopes, it is critical to note that we could not discern any differences in plant performance among the grids that contain acidic subsoils and those with neutral and alkaline subsoils (Golder, 2005, 2006, and 2010). Vegetation on the site is dominated by native and adapted grasses and shrubs typical of the reclaimed lands at McKinley Mine.

2.1.1 Treatment Plan for East Ridge Portion of Area 6

The OSM identified Grids 6-23-55, 6-24-54, 6-24-55, 6-25-54, 6-26-53, 6-26-52, 6-27-52, 6-27-53, and 6-28-52 as areas that require treatment (OSM Letter June 28, 2011). The vegetation and slopes in these areas were assessed by Golder in October 2011 (Golder, 2011) and by the field review team in September 2012. Additional conservation practices were applied in several areas on the East Ridge in 2012 by CMI as part of routine maintenance operations. These actions were evaluated in the field by the review team. In accordance with the 2006 treatment plan, much of this area was treated in 2006; additional cover materials were applied and it was inter-seeded. We recommend inter-seeding nearly the entire area that was treated in 2006 as discussed in Section 2.1.3.

A segment of slope in Grid 6-23-55 is affected by erosion associated with a slope inflection (Figure 1). The upper portion of this feature is stable. The field team identified the need to construct a short reclaimed channel or down drain in Grid 6-23-55 and apply limestone armor over a portion of the area. The concave bowl-shaped feature on the slope will be minimally graded to direct flow to the reclaimed channel. Vegetation near the treatment area is characterized by native shrubs (Apache plume) and planted trees (Ponderosa pine). CMI will attempt to minimize destruction of the existing vegetation in the areas surrounding the treatment, as discussed with the agencies in October 2010 and September 2012. The reconstructed slope will be seeded after the limestone armor placement and grading of the slope.

No further action was required in Grids 6-28-52, 6-27-53 after review by the field team in September 2012. However, a small area in Grid 6-26-53 was identified as requiring a limestone armor treatment. This area was delineated in the field by GPS during the field visit and is shown n Figure 1.

In 2011, the OSM identified an additional area in Grid 6-20-56 that required treatment (Figure 1). This area is believed to have been a haul road prior to reclamation. Portions of the haul road berms have somewhat lower vegetation cover than the surrounding areas. A rill formed adjacent to and south of the former haul road. The rill was incised with steep-walls approximately 1 foot deep. It extended for about 200 feet downslope and terminates in a fan on the slope. The rill formation was probably accentuated by the collection and diversion of water from an unmaintained road upslope. In 2012, CMI stabilized this rill by flattening the banks, placing wattles, armoring, and inter-seeding. In September 2012, the field review team determined that no further actions were required in this area, except for the road closure described below.

An unmaintained road occurs in Grid 6-20-56. We recommend that this road be closed (rip and interseed) and soil conservation practices be applied to reduce the potential for channelization of water. The road rehabilitation area is shown on Figure 1.

2.1.2 Treatment Plan for the West Ridge Portion of Area 6

OSM identified the need for treatment in portions of grids 6-19-55 and 6-20-54. The areas in the vicinity of 6-19-55 and 6-20-54, are affected by slope configuration problems and channeling of water on an unmaintained road. Two short sections of slope with relatively high gradients (2:1 to 2.5:1) occur on the west side of Area 6 (Figure 1). These slopes receive episodic runoff from the adjacent lower gradient areas to the west. The vegetation cover is somewhat lower on these higher gradient slopes than the surrounding areas with lower gradient slopes. Limestone armor will be added to the road and the lower slope position (Grid 6-20-56) that received past runoff. Water bars will be constructed on the road to divert flow from the steep slope to the east. Based the field review team determination, approximately 12 inches of additional cover will be added to a subgrid of 6-19-55 to be consistent with previous commitments to OSM (Figure 1).

In 2011, CMI and Golder identified a steep slope segment centered in Grid 6-21-54 for a slope reduction treatment (Golder, 2011). However, the consensus of the field team was that the plant growth in these areas is limited by the high gradient slopes and combined effects of limited infiltration of antecedent rainfall and direct flow of water. The field review team determined that no further actions were required on the higher gradient slopes in this area.

2.1.3 Interseeding Area

The response of seeded perennials has been inconsistent on the areas where new cover was placed in 2006. In some areas the vegetation response is following a reasonable trajectory given the recent drought conditions in other areas vegetation is poorly represented. Thus, inter-seeding is recommended for most of the areas that were covered and seeded in 2006. In addition, some herbicide-treated areas have not been fully reoccupied by native species. The areas proposed for inter-seeding are shown on Figure 2. The recommended seeding practices are discussed in the following section. The proposed seed mix deviates from the standard permit mix because it is designed to complement strengths and weaknesses in the existing vegetation in Area 6.

2.1.4 General Reclamation Techniques

Minor areas identified outside the delineated treatment areas shown on Figures 1 and 2 may be treated during the implementation of the reclamation plan. Disturbed areas associated with the equipment access corridors will be seeded and mulched following the importation of the cover materials and limestone armor.

The reclamation approach presented here will be conducted using methods that have been traditionally applied at the McKinley Mine. We recommend the institution of surface water control measures in areas with improper drainage that are leading to localized erosion of the slopes and exposure of the spoils. In particular, the non-engineered road that runs down the main ridge in Area 6 should be moved and/or rehabilitated to prevent runoff onto the slope. Specific reclamation recommendations for the designated lands are listed below:

- Apply additional limestone armor per the plan (Figure 1). The limestone armor should be applied at a rate equivalent to a thickness of about 3 to 4 inches over the treatment area.
- The reclaimed channel (down-drain) construction will follow general details applied in other areas of the McKinley Mine.

Seeding should follow the practices specified below:

- Scarify 6 to 8 inches deep parallel to the contour prior to seeding.
- Broadcast and/or drill seed using the recommended seed mix.
- Apply mulch at a rate of 2 to 2.5 tons per acre. Crimp 3 to 4 inches deep with vertical coulters to anchor certified weed-free mulch.
- Long-stem mulch should be used if possible.
- Livestock access should be restricted for a minimum of 5 years and carefully controlled thereafter.
- Golder recommends seeding by June 30th to take advantage of the summer rains.

Table 1: Proposed Seed Mix for Area 6 Interseeding

Species	Common Name	Lbs/ac
Warm Season Grass		
Bouteloua gracilis	Blue Grama	0.35
Bouteloua curtipendula	Sideoats grama	2.0
Hilaria jamesii	Galleta	0.75
Cool Season Grass		
Sporobolus cryptandrus	Sand Dropseed	0.05
Orhyzopsis hymenoides	Indian Ricegrass	1.75
Shrubs		
Eurotia lanata	Winterfat	2.0
Chrysothamnus nauseosus	Rubber Rabbitbush	0.5
Forbs		
Dalea candidum	Prairie Clover	0.75
Ratibida columnaris	Prairie coneflower	0.30
Linum lewisii	Blue flax	0.25
	PLS (lbs/acre)	**8.7**

PLS= Pure Live Seed

3.0 REFERENCES

Golder Associates Inc. (Golder), 2004 CDK Area Reclamation Assessment. Prepared for McKinley Mine. December 22, 2004.

Golder. 2005a. Area 6 Reclamation Assessment. Prepared for McKinley Mine. January 31, 2005.

Golder. 2005b. Area 6 Treatment Plan. Technical Memorandum prepared for McKinley Mine. September 21, 2005.

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Golder. 2010. Interim Lands Reclamation Assessment. Prepared for McKinley Mine. September 16, 2010.

Golder, 2011. Area 6 Reclamation Plan. Technical Memorandum prepared for Chevron Mining Inc., McKinley Mine. November 16, 2011.

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