Jeff Schoenbacher
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Chevron Environmental Management and Real Estate Company

P.O. Box 469
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June 1, 2023

Mr. James Smith
Coal Program Manager
Mining and Minerals Division
1220 South St. Francis Drive
Santa Fe, NM 87505

Delivered via email to:
JamesR.Smith@emnrd.nm.gov

Re: McKinley Mine Permit No. 2016-02
Area 9 North Bond Release Application

Dear Mr. Smith:

Enclosed for MMD review and comment is an application for bond release for an area designated as Area 9 North. This application includes 139 acres of area eligible for Phase I bond release, and 1,303 acres of land eligible for Phase II and III bond release (which includes the 139 acres of land eligible for Phase I bond release). CMI requests MMD's review and comment on completeness and content of this application package to ensure that all necessary information is contained in the application document.

This application includes bonding information detailing how much bond can be released. The current bond amount for this permit is $24,645,642 and a reduction of $2,876,921 will be requested as a part of the bond-release request.

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

REPORT

Chevron Mining Inc.
McKinley Mine

Permit No. 2016-02
Area 9 North Bond Release Application

Submitted to:

Mining and Mineral Division

1220 South St. Francis Drive,

Santa Fe, NM 87505

Submitted by:

Chevron Mining Inc.

6101 Bollinger Canyon Road,

San Ramon, CA 94583-2324

Prepared by:

WSP USA Inc.

701 Emerson Road, Suite 250,

Creve Coeur, MO 63141

June 1, 2023

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APPENDICES

EXHIBITS

Chevron Mining Inc. - McKinley Mine
Permit No. 2016-02
Application for Area 9 North - Bond Release
June 1, 2023

1.0 INTRODUCTION

This document constitutes Chevron Mining Inc.'s (CMI) application for bond release of the permanent-program performance bond for Area 9 North (Area 9N) which includes 1,303 acres of land eligible for Phase II and III bond release, and 139 acres of land eligible for Phase I bond release located within the Phase II and III acreage. Phase I bond release is being requested for reclaimed road and rail corridors; reclaimed ponds; and access that will remain for the postmining land use. Phase II bond release is being sought for the overall area since vegetation has been established and the contribution of suspended solids to streamflow or runoff outside the permit is not in excess of the 19.8 NMAC requirements. Phase III bond release is being sought since the entire reclaimed area has met vegetation standards in accordance with the permit and the regulations and all remaining reclamation obligations have been completed. The application has been formatted to follow the requirements of 19.8.14.1412 New Mexico Administrative Code (NMAC).

2.0 19.8.14.1412 A (2) (A) APPLICANT AND PERMITTEE

Chevron Mining Inc.
6101 Bollinger Canyon Road
San Ramon, CA 94583-2324
Telephone: (925) 790-6958

McKinley Mine is covered by the New Mexico Mining and Minerals Division (MMD) Permit # 2016-02.

3.0 19.8.14.1412 A. (2) (B) LEGAL DESCRIPTION

The Phase I, Phase II and Phase III bond release is being requested for the permanent-program lands in an area referred to as Area 9N, which is located in the sections listed below. The list also identifies land ownership to further define in those sections what lands are affected by this bond release, which includes in whole or in part the following: leased allotments, Chevron-owned land, the Paula Westbrook lease, and a federal surface lease. The specific boundaries of the bond release application lands within this legal description are detailed in Exhibit F: Area 9N Bond Release – Land Inventory - Surface & Coal. This bond release application is intended to cover all the permanent program disturbance within these sections.

3.1 Bond Release Area Legal Description

All in T16N, R20W, New Mexico Principal Meridian, McKinley County, New Mexico:

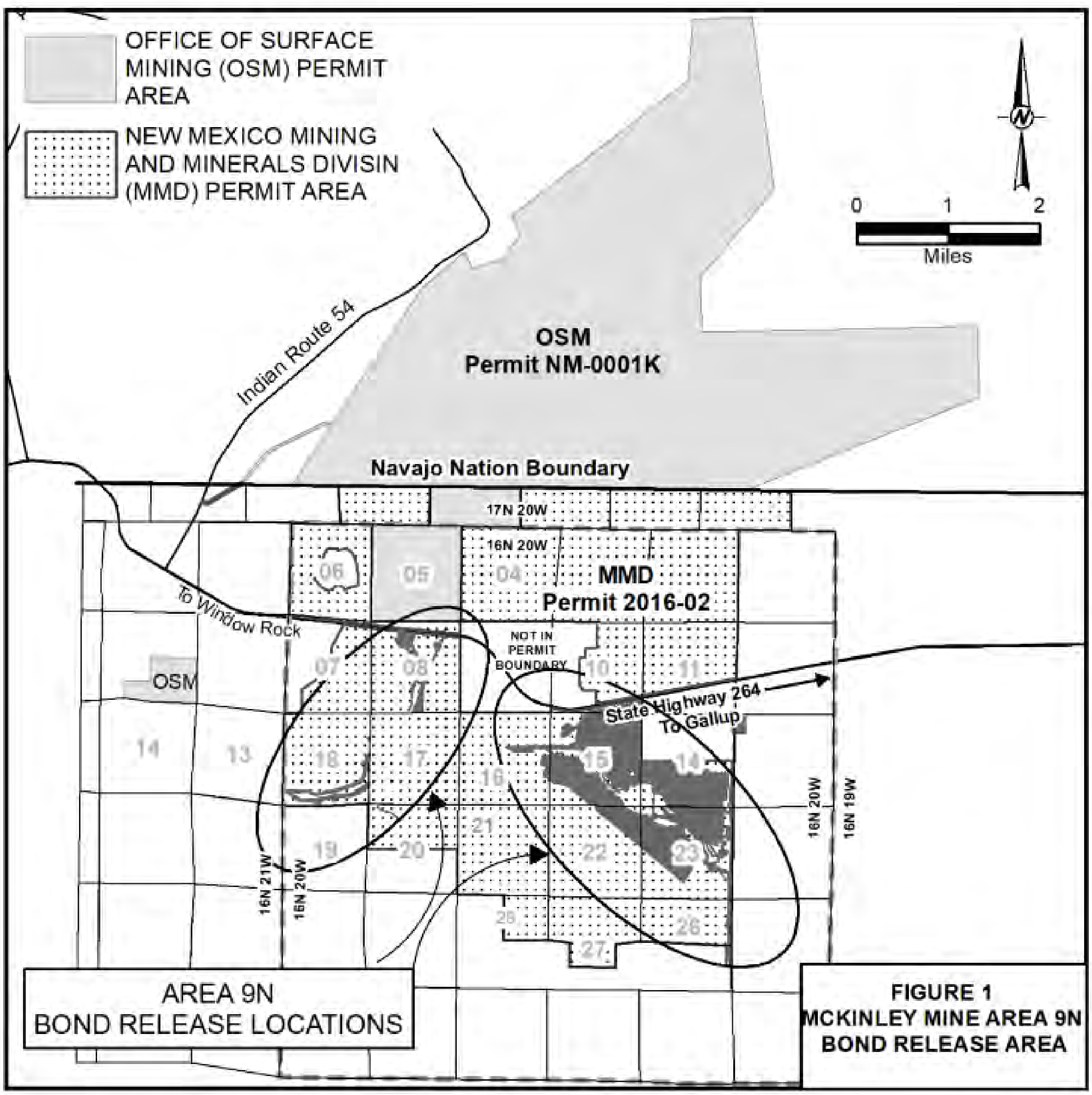
- Section Number 8 BIA Allotments 1612, 1613, 1614, & 1615
- Section Number 10 BIA Allotments 1578 & 1580
- Section Number 13 NTUA
- Section Number 14 BIA Allotments 1570 & 1571
- Section Number 15 Chevron owned Surface Deed and Westbrook Lease
- Section Number 16 BIA Allotments 1592 & 1595
- Section Number 18 BIA Allotments 1604, 1605 & 1606
- Section Number 20 BIA Allotment 1602

- Section Number 22 Federal Surface Lease (NE ¼)
- Section Number 23 Chevron owned Surface Deed
- Section Number 26 BIA Allotments 1564 & 1567

4.0 19.8.14.1412 A. (2) (C) LOCATION

The areas for which bond release is being requested are located at the CMI McKinley Mine. The McKinley Mine is located approximately 23 miles northwest of Gallup, NM, and 3 miles east of Window Rock, AZ, on NM State Highway 264. The areas in this Phase I, II and III bond release application are located within the Samson Lake, Tse Bonita School and Hunters Point USGS quadrangle maps, which are shown on the accompanying map Exhibit B: Area 9N Bond Release – USGS Quadrangle. Figure 1 shows the general location for the bond release area and the permit boundaries.

Figure 1: McKinley Mine Area 9N - Bond Release Area



5.0 19.8.14.1412 A. (2) (D) SUMMARY

5.1 Summary

Disturbance and mining in Area 9N occurred between 1986 and 2006. Phase I bond for much of the area was released in 2015, which covered backfilling and grading, graded spoil suitability, topsoil replacement and construction of hydrologic structures and drainage control. 139 acres of road and railroad corridors and pond areas that still require Phase I bond release are included with this bond release application. Phase II and Phase III bond release for 1,303 acres is being sought for the portion of bond associated with completion of reclamation requirements that results in the reduction of settleable solids and the development of vegetation to meet the requirement as established in the regulations and the applicable permit. Exhibit C: Area 9N Bond Release – Postmining Topography shows the reconstructed topography and drainage control.

Seeding of the reclaimed lands occurred between 1992 and 2014 as shown on Exhibit D: Area 9N Bond Release – Seeding Map. This map shows the year of seeding or reseeding for each disturbed area. Approximately 1,283 acres (98.5%) of the 1,303 acres in Area 9N have been seeded for 10 years or more.

In support of the post mining land use of grazing and wildlife habitat, the permit specifies that access roads and existing fences will remain for the use of the land owners. Roads are generally a two-track road with no surfacing material or roadside ditches as was typical before mining, and current land owner roads in the general area. The primary access off State Hwy 264 in Section 8 was retained along with its surfacing material for benefit of the postmining landusers. Four impoundments are proposed to remain as permanent impoundments within this bond release area as well as small depressions which were retained where former sedimentation ponds were reclaimed to retain moisture and provide water resources for the postmining land use (See Exhibit C for locations). An aerial photograph is provided in Exhibit E: Area 9N Bond Release – Aerial, which shows the access roads to remain. In addition, roads may be found on Exhibit 4.4-1 of Volume III in Permit No. 2016-02.

The original calculation of the reclamation bond for Permit 2016-02 may be found in Appendix 2.9-A in Volume I. Calculations for the requested bond release for this application are provided below under Bonding Information, with additional detail provided in Section 12.5 Phase II and Phase III Performance Bond Reduction as well as in Appendix 1 - Performance Bond Calculations.

5.2 Sediment Control

The National Pollutant Discharge Elimination System (NPDES) permit classifies all outfalls at McKinley mine as Appendix C outfalls, which fall under the criteria for Western Alkaline Coal Mining Subpart H regulations under 40 CFR 434.81. The Appendix C outfall classification means that the primary sediment control for the watersheds at each outfall are Best Management Practices (BMPs), which includes landforms, hydrologic conveyance and erosion-control structures, revegetation, etc.; no sediment ponds are necessary to control sediment in any of the watersheds. Compliance is verified through collection of water monitoring data from outfall discharges and field inspections of the BMPs.

5.3 Revegetation

Reports documenting the results of revegetation-success sampling are submitted in the Annual Reports. The majority of 9N is located in Vegetation Management Unit 3 (VMU-3), with vegetation data collected in 2019, 2020, 2021 and 2022. In addition, the corridors in Section 18 are part of VMU-4, which was monitored for vegetation success in 2109, 2020 and 2021. The results of these reports are summarized in Section 12.1 the Revegetation section of the Phase III Bond Release Request Requirements. The results demonstrate that vegetation has been successfully established.

5.4 Bond Information

The bond reduction associated with the Area 9N bond release and the amount of bond that would remain is shown below. Please see Section 12.5 Performance Bond Reduction section for more detailed bonding information as well as Appendix 1.

The following summarizes the current and remaining bond fund, proposed bond release and remaining bond:

- Current Bond Type: Surety Bond
- Current Bond Fund: $ 24,645,642
- Less Previous A11/12 PI Bond Release: $ 1,150,724
- Remaining Bond Fund: $ 23,494,918
- Area 9N direct & indirect costs to be released: $ 2,876,291
- New Bond Fund Amount: $ 20,618,627 (in 2022 dollars)

5.5 Disturbed Acreage to be Released

The acres included in this bond release application and corresponding percentage of the permitted area are presented below:

- Acreage to be released (Area 9N): 1,303.0 ac.
- Acres permitted: 12,958.2 ac.
- Percentage of acres permitted being released: 10.1 %

6.0 19.8.14.1412 A. (2) (E) SURFACE AND MINERAL RIGHTS

See the table in Appendix 2 for information on surface and mineral owners, which includes bond release acreages. Surface and mineral information is depicted on Exhibit F: Area 9N Bond Release – Land Inventory - Surface & Coal.

7.0 19.8.14.1412 A. (2) (F) NOTIFICATION LETTERS

A copy of the proposed draft notification letter is provided in Appendix 3. The notification letter will be sent once MMD advises CMI that the application is administratively complete and that CMI can proceed with the public notice process. CMI will coordinate with MMD to ensure all appropriate interests are notified by either CMI or MMD.

Notification letters regarding this bond release application will be sent to adjoining land owners and allottees (south of Highway 264), local government agencies, planning agencies, sewage and water-treatment authorities, and water companies in the vicinity of the proposed release areas.

MMD will provide notification letters and invitations for inspections to land owners and allotees within the proposed release areas, to the surface and mineral owners listed on the table in Appendix 2 (e.g., BIA, BLM, NM State Land Office, etc.) and other government agencies.

CMI requested addresses from the BIA for allottees within and adjoining the proposed bond release area who will be sent a notification letter. A copy of the information received from BIA with allottee addresses by allotment is contained in Appendix 4.

Appendix 5 contains a full list of all other interests (with addresses) that will be notified of this bond release application.

8.0 19.8.14.1412 A. (2) (G) OTHER MAPS AND INFORMATION

The following exhibits are provided as part of this bond release application:

- Exhibit A: Area 9N Bond Release – Bond Release Location
- Exhibit B: Area 9N Bond Release – USGS Quadrangle
- Exhibit C: Area 9N Bond Release – Postmining Topography
- Exhibit D: Area 9N Bond Release – Seeding Map
- Exhibit E: Area 9N Bond Release – Aerial
- Exhibit F: Area 9N Bond Release – Land Inventory - Surface & Coal

9.0 19.8.14.1412 A. (2) (H) CERTIFICATION

A notarized certification is enclosed that states that all applicable reclamation activities have been accomplished in accordance with the requirements of SMCRA, the Act, the regulatory program, and the approved reclamation plan. The certification may be found in Appendix 6.

10.0 19.8.14.1412 A. (3) PUBLIC ADVERTISEMENT

A draft public notice is contained in Appendix 7 that addresses the requirements of this section. The advertisement shall be placed in the newspapers (Navajo Times and The Gallup Independent) once MMD advises CMI that the application is administratively complete and can proceed with public notice. A copy of the full application will be placed in the McKinley County courthouse prior to sending out notification letters and publication of the advertisement.

11.0 PHASE I BOND RELEASE REQUIREMENTS

Phase I bond for much of the area was released in 2015, which covered backfilling and grading, graded spoil suitability, topsoil replacement and construction of hydrologic structures and drainage control. 139 acres of road and railroad corridors and pond areas that still require Phase I bond release are included with this bond release application Reclamation of the road and rail corridors and the sedimentation ponds were completed either before or after the initial application date for the 2015 bond release with the exception of the access road off State Highway 264 that runs through Section 8.0.

Grading of the 139 acres that were reclaimed occurred between 2010 and 2014. The location of these areas are shown with a green highlight on Exhibit A and as red hatched areas on the remaining exhibits. Topsoil replacement for these areas also occurred between 2010 and 2014.

12.0 PHASE II BOND RELEASE REQUIREMENTS

12.1 Successful Establishment of Vegetation

Vegetation establishment and success for the majority of 9N was measured in 2019, 2020, 2021, and 2022 with the results documented in the VMU-3 vegetation-monitoring report. In addition, the corridors in Section 18 are part of VMU-4, which was monitored for vegetation success in 2109, 2020, and 2021. The results of these reports are summarized in Section 12.1, which is the Revegetation section of the Phase III Bond Release Request Requirements. The results demonstrate that vegetation has been successfully established.

12.2 Sediment Control

Various demonstrations have been completed at McKinley Mine showing that surface water from reclaimed land does not contribute suspended solids to streamflow or runoff outside the permit area in excess of the requirements in 19.8.14.1412 C. (2). Key information, to that end, includes both modeling analysis and water monitoring data.

<u>Modeling Information</u>

As documented in the MMD Permit 2016-02 Section 6.3.3, on November 16, 2009, MMD approved a sediment-yield comparison study between premine and postmine lands. The study showed that reclaimed lands would have significantly less sediment yield than premining lands, that is 0.369 tons per acre for reclaimed lands verses 0.892 tons per acre for premined lands. Because of the large area included in the study, MMD considered it to be a representative study of the rest of the mine on MMD-jurisdictional lands. Subsequently, MMD advised CMI that sediment ponds in the study area and in fully reclaimed watersheds (seeded and mulched) were no longer necessary.

Monitoring Information

A comprehensive analysis of water-quality data for large, medium, and small watersheds is contained in Appendix B of the 1992 Annual Mining and Reclamation Report submitted to MMD. The findings from this report combine 1992 data with sampling data from as far back as 1982 to show that runoff from disturbed large, medium and small watersheds has better water quality than that of paired undisturbed watersheds; the results are summarized in Table 1. This data was also used as additional support for the McKinley Mine's demonstration under the 20-41 (e) Windows program (now referenced as 19.9.20.2009 (e) NMAC) for a waiver from additional sediment control, which includes a requirement that the runoff from the regraded (i.e., reclaimed) area be as good as or better quality than the waters entering the permit area (i.e., undisturbed areas) in order to qualify for the window.

Table 1: Summary of Modeling Results

Watershed	Parameter	Undisturbed Average	Disturbed Average
Large	TSS	92604	45184
Medium	TSS	25847	25738
Small	TSS	20963	15267

Conclusion

The modeling information coupled with monitoring data demonstrate that the requirement in 19.8.14.1412 C. (2) was met. This information parallels the mine's NPDES permit that makes the same findings using both modeling information and monitoring data.

12.3 Prime Farmland

There are no areas designated as Prime Farmland within the Permit # 2016-01 permitted area.

12.4 Silt Dams

Four permanent impoundments are located within the Area 9N bond release area that are discussed in Section 13.4 below. All other sedimentation ponds have been reclaimed.

12.5 Phase II Performance Bond Reduction

Please see Section 12.5 - Performance Bond Reduction for bonding and bond reduction information.

13.0 PHASE III BOND RELEASE REQUIREMENTS

13.1 Revegetation

The vegetation success for most of the Area 9N bond release area is demonstrated through the results of vegetation sampling conducted in VMU-3 in 2019, 2020, 2021, and 2022. In addition, the small corridors in Section 18 in this Area 9N application are within VMU-4, which was monitored for vegetation success in 2019, 2020, and 2021.

The VMU-3 and VMU-4 vegetation sampling reports are summarized here and demonstrate that Area 9N met vegetation success standards in the Permit No. 2016-02 (the Permit), and those recommended in the MMD Coal Mine Program Vegetation Standards (MMD 1999). The complete 2019, 2020, 2021 and 2022 Vegetation Monitoring Reports for VMU-3 are contained in Appendix 8. Because only the small corridors in Section 18 are contained in this bond release package, it is sufficient to just summarize the report findings and not include the full Vegetation Monitoring Reports for VMU-4 in this bond release package.

The Permit requires that the following parameters be met for vegetation success: ground cover, productivity, diversity, and woody stem stocking (Table 2). The ground cover requirement for live perennial/biennial cover on the reclamation is 15%. The productivity requirement is 350 air-dry lbs/ac perennial/biennial annual production (i.e., forage production). The woody stem stocking success standard is 150 live woody stems/ac.

Table 2: Revegetation Success Standards for the Mining Minerals Diversion Permit Area

Vegetative Parameter	Success Standard
Ground Cover	15% live perennial/biennial cover
Productivity	350 air-dry pounds per acre perennial/biennial annual production
Diversity	A minimum of 2 shrub or subshrub taxa contributing at least 1% relative cover each.
	A minimum of 2 perennial warm-season grass taxa contributing at least 1% relative cover each.
	A minimum of 1 perennial cool-season grass taxa contributing at least 1% relative cover.
	A minimum of 3 perennial/biennial forb taxa combining to contribute at least 1% relative cover.
Woody Stem Stocking	150 live woody stems per acre

Note: Diversity criteria assessed for individual perennial/biennial species relative cover as agreed upon by MMD and CMI in June 2019.

The MMD Coal Mine Program Vegetation Standards also state that for Phase III bond release applications, it must be demonstrated that the total annual production and total live cover of biennials and perennials equal or exceeds the approved standards for at least two of the last four years of the responsibility period. Shrub density and revegetation diversity must equal or exceed the approved standards during at least one of the two sampling years of the responsibility period (MMD 1999).

VMU-3 Summary

Based on the vegetation monitoring results over the past four years, the 9N bond release area located within VMU-3 meets the vegetation-success standards and is eligible for Phase II and III bond release. Table 3A below shows in what year the Permit vegetation success standards were met. Vegetation monitoring results for the past four years indicate that the vegetation community in VMU-3 meets the cover standards all four years, and forage production in 2019 and 2020 (Table 4A), and all the diversity standard in 2019 and 2021 (Table 5A). Total live cover of biennials and perennials has been met in all four years, while annual forage production (Table 6A) has been achieved in two of the last four years. Shrub density and diversity have exceeded the approved standards in at least one of the sampling years.

VMU-4 Summary

Based on the vegetation monitoring results over three years of the required demonstration period, the VMU-4 reclamation meets the standards and is eligible for Phase II and III bond release. Table 3B below shows in what year the Permit vegetation success standards were met. Vegetation monitoring results for the past three years indicate that the vegetation community in VMU-4 meets the cover and forage production in 2019 and 2020, and shrub density all three years (Table 4B) and the diversity standard in 2020 and 2021 (Table 5B). Annual forage production (with summary statistics in Table 6B) and total live cover of biennials and perennials has been achieved in two of the three years of sampling over the required demonstration period. Shrub density and diversity have exceeded the approved standards in at least one of the sampling years.

Table 3A: VMU-3 Revegetation Success at McKinley Mine from 2019 to 2022, Mining and Minerals Division Permit Area

Vegetative Parameter[1]	Success Standard	MMD Guidance	M-VMU-3			
			2019	2020	2021	2022
Ground Cover	15% live perennial/biennial cover	in 2 of the last 4 years	✓	✓	✓	✓
Productivity	350 air-dry pounds per acre perennial/biennial annual production	in 2 of the last 4 years	✓	✓	✗	✗
Diversity	A minimum of 2 shrub or subshrub taxa contributing at least 1% relative cover each.	in 1 of the 2 sampling years of the responsibility period	✓	✓	✓	✓
	A minimum of 2 perennial warm-season grass taxa contributing at least 1% relative cover each.		✓	✗	✓	✗
	A minimum of 1 perennial cool-season grass contributing at least 1% relative cover.		✓	✓	✓	✓
	A minimum of 3 perennial/biennial forb taxa combining to contribute at least 1% relative cover.		✓	✓	✓	✓
Woody Stem Stocking	150 live woody stems per acre	in 1 of the 2 sampling years of the responsibility period	✓	✓	✓	✓

	M-VMU-3			
	2019	2020	2021	2022
	✓	✓ (blue)	✗	✗

Notes:

[1] Parameter and corresponding standard explained in Table 2 of the Vegetation Success Monitoring Reports (Appendix H)

KEY

- ✓ All success standards met for the year
- ✗ Success standards not met for the year
- ✓ (blue) Success standards for ground cover and productivity met

Table 3B: VMU-4 Revegetation Success at McKinley Mine from 2019 to 2021, Mining and Minerals Division Permit Area

Vegetative Parameter[1]	Success Standard		M-VMU-4 2019	M-VMU-4 2020	M-VMU-4 2021
Ground Cover	15% live perennial/biennial cover	in 2 of the last 4 years	✓	✓	✗
Productivity	350 air-dry pounds per acre perennial/biennial annual production	in 2 of the last 4 years	✓	✓	✗
Diversity	A minimum of 2 shrub or subshrub taxa contributing at least 1% relative cover each.	in 1 of the 2 years when production and cover are met	✓	✓	✓
	A minimum of 2 perennial warm-season grass taxa contributing at least 1% relative cover each.		✗	✓	✓
	A minimum of 1 perennial cool-season grass contributing at least 1% relative cover.		✓	✓	✓
	A minimum of 3 perennial/biennial forb taxa combining to contribute at least 1% relative cover.		✓	✓	✓
Woody Stem Stocking	150 live woody stems per acre	in 1 of the 2 years when production and cover are met	✓	✓	✓
		All Parameters	☑	✓	✗
		Eligible for Bond Release	Yes		

Notes:

[1] Parameter and corresponding standard explained in Table 2 of the Vegetation Success Monitoring Reports (Appendix H)

KEY

✓ All success standards met for the year

☑ Second year cover and production success standards met.

✗ Success standards not met for the year

Table 4A: VMU-3 Statistical Analysis Results for Cover, Production, and Woody Plant Density, 2019 to 2022

Vegetation metric	Success Standard	Results 2019	Results 2020	Results 2021	Results 2022
Perennial/Biennial Cover	≥ 15%	49	39.9	28.5	31.4
Annual Forage Production	≥ 350 lb/ac	779	511	417	598
Woody Plant Density	≥ 150 stems/ac	2,550	2,455	2,361	4,398

Note: Highlight: Hypothesis testing found the success standard was not met.

Table 4B: VMU-4 Statistical Analysis Results for Cover, Production, and Woody Plant Density, 2019 to 2021

Vegetation Metric	Success Standard	Results		
		2019	2020	2021
Perennial/Biennial Cover	≥ 15%	40.9	41.5%	21.6%
Annual Forage Production	≥ 350 lb/ac	958	551	294
Woody Plant Density	≥ 150 stems/ac	3,723	3,116	1,996

Note: Highlight: Hypothesis testing found the success standard was not met.

Table 5A: VMU-3 Results for Diversity, 2019 to 2022

Table 5: Results for Diversity, 2019 to 2022, M-VMU-3

Diversity Component	Standard (% relative cover)	2019		2020		2021		2022	
		Result	Species	Result	Species	Result	Species	Result	Species
Subshrub or shrubs			**(6 spp.)**		**(10 spp.)**		**(5 spp.)**		**(2 spp.)**
Shrub 1	≥ 1.0%	21.44%	Four-wing saltbush	7.11%	Gardner saltbush	22.64%	Four-wing saltbush	9.62%	Four-wing saltbush
Shrub 2	≥ 1.0%	4.12%	Shadscale saltbush	5.63%	Four-wing saltbush	4.30%	Winterfat	2.68%	Winterfat
Shrub 3 (bonus)	–	0.43%	Mat saltbush	4.06%	Winterfat	1.21%	Mat saltbush	1.65%	Mormon tea
Perennial warm-season grasses			**(4 spp.)**		**(4 spp.)**		**(3 spp.)**		**(3 spp.)**
Grass 1	≥ 1.0%	22.89%	James' galleta	12.77%	James' galleta	32.09%	James' galleta	53.11%	James' galleta
Grass 2	≥ 1.0%	2.45%	Blue grama	0.93%	Alkali sacaton	3.29%	Alkalai sacaton	0.54%	Alkalai sacaton
Grass 3 (bonus)	–	0.21%	Alkali sacaton	0.53%	Purple threeawn	0.63%	Blue grama	–	–
Perennial cool-season grasses			**(8 spp.)**		**(11 spp.)**		**(5 spp.)**		**(2 spp.)**
Grass 1	≥ 1.0%	19.83%	Western wheatgrass	23.32%	Western wheatgrass	6.37%	Western wheatgrass	5.45%	Russian wildrye
Grass 2 (bonus)	–	1.28%	Tall wheatgrass	9.15%	Needle and thread	3.63%	Thickspike wheatgrass	3.33%	Western wheatgrass
Perennial/biennial forbs		**22.40%**	**(9 spp.)**	**1.17%**	**(6 spp.)**	**21.96%**	**(4 spp.)**	**26.67%**	**(10 spp.)**
Forb 1	≥ 1.0% combined	15.79%	Blazingstar species	0.52%	Bastardsage	21.16%	Rattlesnake weed	25.27%	Rattlesnake weed
Forb 2		3.62%	Flatspine stickseed	0.34%	Purple aster	0.76%	Scarlet globemallow	0.64%	Scarlet globemallow
Forb 3		2.47%	Flixweed	0.16%	Flatspine stickseed	0.04%	Flatspine stickseed	0.45%	Flatspine stickseed
Forb 4 (bonus)	–	0.52%	Palmer's penstemon	0.15%	Palmer's penstemon	--	–	0.31%	Trailing fleabane

Notes:

– = not applicable

Indicates an unmet parameter

Note:

1. Parameter and corresponding standard explained in Table 2 of the Vegetation Success Monitoring Reports (Appendix 8).

Table 5B: VMU-4 Results for Diversity, 2019 to 2021

Parameter[1]	Standard (Relative %)	2019		2020		2021	
		Result	Species	Result	Species	Result	Species
Subshrub or shrubs			(6 spp.)		(9 spp.)		(7 spp.)
Shrub 1	≥ 1.0%	26.56%	Four-wing saltbush	11.99%	Four-wing saltbush	13.42%	Four-wing saltbush
Shrub 2	≥ 1.0%	2.73%	Winterfat	3.45%	Winterfat	8.89%	Rubber rabbitbrush
Shrub 3 (bonus)	--	1.22%	Yellow rabbitbrush	0.80%	Broom snakeweed	4.27%	Winterfat
Perennial warm-season grasses			(3 spp.)		(3 spp.)		(2 spp.)
Grass 1	≥ 1.0%	21.09%	James' galleta	12.70%	James' galleta	19.06%	James' galleta
Grass 2	≥ 1.0%	0.48%	Alkali sacaton	1.10%	Alkali sacaton	11.38%	Alkali sacaton
Grass 3 (bonus)	--	0.19%	Blue grama	0.65%	Blue grama	--	--
Perennial cool-season grasses			(6 spp.)		(9 spp.)		(6 spp.)
Grass 1	≥ 1.0%	21.31%	Colorado wildrye	39.63%	Colorado wildrye	17.60%	Russian wildrye
Grass 2 (bonus)	--	13.94%	Western wheatgrass	6.34%	Thickspike wheatgrass	7.30%	Indian ricegrass
Perennial/biennial forbs		11.34%	(7 spp.)	2.21%	(5 spp.)	3.55%	(5 spp.)
Forb 1	≥ 1.0% (combined)	8.73%	Flatspine stickseed	0.96%	Gray globemallow	3.20%	Rattlesnake weed
Forb 2		1.91%	Flixweed	0.72%	Palmer's penstemon	0.24%	Unknown composite
Forb 3		0.55%	Blazingstar species	0.20%	Rose heath	0.12%	Redstem stork's bill
Forb 4 (bonus)		0.06%	pright prairie coneflow	0.17%	Scarlett globemallow	--	--

Note:

1. Parameter and corresponding standard explained in Table 2 of the Vegetation Success Monitoring Reports (Appendix 8)

Table 6A: Summary of VMU-3 Production Results

Annual Total Production (lbs/ac)[5]	2019	2020	2021	2022
Mean	1,201	525	430	670
Standard Deviation	835	386	427	661
90% Confidence Interval	217	100	111	172
Nmin[1]	137	154	297	277

Notes:

1. Minimum number of samples required to obtain 90 percent probability that the sample mean is within 10 percent of the population mean.
2. Probably the true value of the mean is within 10 percent of the mean for the sample size.

Table 6B: Summary of VMU-4 Production Results

Annual Total Production (lbs/ac)	2019	2020	2021
Mean	1,000	555	326
Standard Deviation	764	326	392
90% Confidence Interval	199	85	103
Nmin[1]	166	98	410

Notes:

1. Minimum number of samples required to obtain 90 percent probability that the sample mean is within 10 percent of the population mean.
2. Probably the true value of the mean is within 10 percent of the mean for the sample size.

Reference: MMD, 1999. Coal Mine Reclamation Program Vegetation Standards, New Mexico Energy, Minerals and Natural Resources Department Mining and Minerals Division.

Westbrook Property

In addition to the vegetation requirements discussed above, the permit also included a stipulation related to the final quantity of pinion and juniper trees to remain on the Westbrook lease in Section 15, T16N, R20W. The details of this stipulation and the final resolution of the stipulation are detailed in Section 5.5.5 of the Permit #2016-02 document.

13.2 Postmining Land Use (19.8.20.2064 NMAC)

The information in this section provides a demonstration that Area 9N meets the requirements of 19.8.20.2064 Revegetation: Grazing, which states: When the approved postmining land use is range or pasture land, the operator shall demonstrate to the director, that the reclaimed land has the capability of supporting livestock grazing at rates approximately equal to that for similar non-mined lands for at least two of the last four full years of liability required under Subsection B of 19.8.20.2065 NMAC.

To that end, a livestock carrying-capacity analysis is provided herein on the forage production data for vegetation sampling conducted from 2019 through 2022 in VMU-3 and VMU-4 based those years a given VMU was sampled. The analysis also shows what would be the carrying capacity for total production as additional support information.

Carrying capacities were calculated for the mean and available median forage production values, and for the mean total production value. 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).

The non-mined carrying capacity figure selected to compare against the reclaimed carrying capacity is the average baseline premining figure of 0.07 AUM/Acre. (Dames and Moore 1974; Settlement Agreement 1988). Use of a value of

0.07 AUM/Acre was also formally referenced in MMD's approvals of CMI bond release applications in 2010 and 2012 (MMD 2010; MMD 2012).

Table 7A and 7B summarize the carrying capacities calculated from production data collected from 2019 through 2022 for those years VMU-3 and VMU-4 were sampled. The calculations show that all production data exceeded the 0.07 AUM/Ac premining value. The calculations also show that data collected during this intensive drought episode still exceeded the 0.07 AUM/Ac premining value. Subsequently, this analysis demonstrates that the standard in 19.8.20.2064 was met in not only two of the last four years of liability but in all the sampling episodes.

Table 7A: Summary of VMU-3 Carrying Capacities from Production Data (2019, 2020, 2021 and 2022)

Categories Measured	Production Lb/Ac	AUM/Ac
Premining Baseline Condition (Avg Value)		0.07
19 VMU 3 Mean Total Production	1201	0.77
19 VMU 3 Mean Forage Production	779	0.50
20 VMU 3 Mean Total Production	525	0.34
20 VMU 3 Mean Forage Production	511	0.33
20 VMU 3 Median Forage Production	322	0.21
21 VMU 3 Mean Total Production	430	0.28
21 VMU 3 Mean Forage Production	417	0.27
21 VMU 3 Median Forage Production	282	0.18
22 VMU 3 Mean Total Production	670	0.43
22 VMU 3 Mean Forage Production	598	0.38
22 VMU 3 Median Forage Production	346	0.22

Table 7B: Summary of VMU-4 Carrying Capacities from Production Data (2019, 2020, and 2021)

Categories Measured	Production Lb/Ac	AUM/Ac
Premining Baseline Condition (Avg Value)		0.07
19 VMU 4 Mean Total Production	1000	0.64
19 VMU 4 Mean Forage Production	958	0.61
19 VMU 4 Median Forage Production	776	0.50
20 VMU 4 Mean Total Production	555	0.36
20 VMU 4 Mean Forage Production	551	0.35
20 VMU 4 Median Forage Production	571	0.37
21 VMU 4 Mean Total Production	326	0.21
21 VMU 4 Mean Forage Production	294	0.19
21 VMU 4 Median Forage Production	156	0.10

References

- Dames and Moore, 1974. Environmental Assessment-McKinley Mine, McKinley County, New Mexico,
- MMD, 1999. Coal Mine Reclamation Program Vegetation Standards, New Mexico Energy, Minerals and Natural Resources Department Mining and Minerals Division.
- MMD, 2010. Director's Order with Findings of Fact and Conclusions of Law for McKinley Mine (Permit 2006-02) Area 4 and Area 9 Reclamation Liability-Release Application. Finding of Fact No. 21.
- MMD, 2012. Director's Order with Findings of Fact and Conclusions of Law for McKinley Mine Sections 7, 8 and 18 South Mine Access Area Reclamation Liability Release Application. Finding of Fact No. 22.
- Settlement Agreement, 1988. B.8 Report. MMD Permit No. 2016-02, Volume 10, Tab 09.

13.3 Surface and Groundwater

The report, titled "Area 9 North, Bond Release Application, Groundwater and Surface Water Evaluation" included in Appendix 9 documents the status of groundwater and surface water and demonstrates that the operation has complied with the probably hydrologic consequences determination.

13.4 Ponds and Small Depressions

There are four permanent impoundments in Area 9N; as well as small depressions which were retained where prior sedimentation ponds were reclaimed in order to retain moisture and provide water sources for the post mining land use. The approximate location of permanent impoundments 9-15, 9-19A, 9-30 and 9-33 and the small depressions are shown on Exhibit C. The approved permanent impoundment designs for these impoundments are included in the Section 6.0 appendix of the McKinley Mine Permit # 2016-02 permit application package.

13.5 Performance Bond Reduction

The bond reduction associated with the Area 9N bond release and the amount of bond that would remain is shown below. The bond reduction was computed by subtracting out the revegetation costs associated with the Area 9N acreage from the existing bond. A reduction in bond for the Phase I acreage was not necessary.

Spreadsheets are provided in Appendix 1 Performance Bond Calculation showing the rationale and calculations for the bond to be released, and the bond that would be retained for the remaining lands under reclamation liability in MMD jurisdiction. It was necessary to reallocate the current bond funds to the remaining cost centers to bring the bond up to date; these calculations (in 2015 dollars i.e., the last escalation) are provided in Table 1 of Appendix 1. Table 2 in the appendix escalates the bond calculations in Table 1 to 2022 dollars. Table 3 in the appendix shows what the new bond would be in 2022 dollars after release of the Area 9N area under liability. Calculations were done to 2022 dollars for consistency with a pending bond release application.

The following summarizes the current and remaining bond fund, proposed bond release and remaining bond:

- Current Bond Type: Surety Bond
- Current Bond Fund: $ 24,645,642
- Less Previous A11/12 PI Bond Release: $ 1,150,724
- Remaining Bond Fund: $ 23,494,918
- Area 9N direct & indirect costs to be released: $ 2,876,291
- New Bond Fund Amount: $ 20,618,627 (in 2022 dollars)

Appendix 1: Performance Bond Calculations

Table 1: Remaining bond after TCP, A9&10, and A11& 12 (Escalated to 2015 dollars, and Funds Reallocated)

Item #	Cost Category		Quantity	Rate		TOTAL
1	Grading - Worst Case Pits					$0
2	Grading - Spoils					$0
3	Acid & Toxic Material Management					$0
4	Topsoil Replacement	South Facilities (Ac)	234.1	$1,135	$265,704	$265,700
5	Revegetation	Total Disturbance (Ac)	4982.3	$822	$4,095,451	$4,095,451
6	Road Removal	Sourth Facilities (Ac)	7	$4,335	$30,345	$30,345
7	Sedimentation Pond Removal	Sourth Faciliites Ponds	2	$7,000	$14,000	$14,000
8	Earthmoving Support (For South Facilities)		$418,800	100%	$418,800	$418,800
9	Facility Removal		$1,053,000	100%	$1,053,000	$1,053,000
10	Hydrologic Structures					$0
	SUBTOTAL - Direct Costs					$5,877,296
11	Contractor Mobilization/Demobilization (1% of Subtotal)					$59,000
12	Supplemental Contingencies (3% of Subtotal)					$176,000
13	Engineering Design Fees (2.5% of Subtotal)					$147,000
14	Contractor's Profit and Overhead (15% of Subtotal)					$882,000
15	Project Management Fee (2.5% of Subtotal)					$147,000
	TOTAL Without Gross Receipts Tax					$7,288,296
	Gross Receipts Tax (2022 rate: 6.75%)				6.75%	$492,000
	TOTAL With Gross Receipts Tax (In 2000 Dollars)					$7,780,296
	Inflation rate Qtr-1 2000 to Qtr-4 2015	1.62046			Total Escalated to 2015 Dollars	$12,607,692
	Inflation Factors: Qtr-1 2000 & Qtr-4 2015	500.48	811.01			
	Supplemental Fund For Permit Modifications/Revisions/Misc					$10,887,226
	Total bond (After A11/12 PI Approval and Reduction)					**$23,494,918**
					Current Bond Fund:	$24,645,642
Date: 060123						

Table 2: Bond Escalated to 2022 Dollars

Item #	Cost Category		Quantity	Rate		TOTAL
1	Grading - Worst Case Pits					$0
2	Grading - Spoils					$0
3	Acid & Toxic Material Management					$0
4	Topsoil Replacement	South Facilities (Ac)	234.1	$1,135	$265,703.50	$265,700
5	Revegetation	Total Disturbance (Ac)	4982.3	$822	$4,095,451	$4,095,451
6	Road Removal	Sourth Facilities (Ac)	7	$4,335	$30,345	$30,345
7	Sedimentation Pond Removal	Sourth Faciliites Ponds	2	$7,000	$14,000	$14,000
8	Earthmoving Support (For South Facilities)		$418,800	100%	$418,800	$418,800
9	Facility Removal		$1,053,000	100%	$1,053,000	$1,053,000
10	Hydrologic Structures					$0
	SUBTOTAL - Direct Costs					$5,877,296
11	Contractor Mobilization/Demobilization (1% of Subtotal)					$59,000
12	Supplemental Contingencies (3% of Subtotal)					$176,000
13	Engineering Design Fees (2.5% of Subtotal)					$147,000
14	Contractor's Profit and Overhead (15% of Subtotal)					$882,000
15	Project Management Fee (2.5% of Subtotal)					$147,000
	TOTAL Without Gross Receipts Tax					$7,288,296
	Gross Receipts Tax (2022 rate: 6.75%)				6.75%	$492,000
	TOTAL With Gross Receipts Tax (In 2000 Dollars)					$7,780,296
	Inflation rate Qtr 4 2000 to Qtr-2 2022	2.02689		Total Escalated to 2022 Dollars		$15,769,804
	Inflation Factors: Qtr-4 2000 & Qtr-2 2022:	500.48	1014.42			
	Supplemental Fund For Permit Modifications/Revisions/Misc					$7,725,114
	Total bond (After A11/12 PI Approval and Reduction)					**$23,494,918**
					Current Bond Fund	$24,645,642
	Note: Inflation factors from USCOE Civil Works Construction Cost System (Composite Index Weighted Average) 9/30/21					

Table 3: Bond After 9N PII and PIII in 2022 dollars

k	Cost Category		Quanity	Rate		TOTAL
		Area 9N Revegetation Reduction (ac.)	1303.0	$822.00	$1,071,066	
1	Grading - Worst Case Pits		Input			$0
2	Grading - Spoils					$0
3	Acid & Toxic Material Management					$0
4	Topsoil Replacement	South Facilities (Ac)	234.1	$1,135	$265,703.50	$265,700
5	Revegetation	Total Disturbance (Ac)	4982.3	$822	$4,095,451	$3,024,385
6	Road Removal	Sourth Facilities (Ac)	7	$4,335	$30,345	$30,345
7	Sedimentation Pond Removal	Sourth Faciliites Ponds	2	$7,000	$14,000	$14,000
8	Earthmoving Support (For South facilities)		$418,800	100%	$418,800	$418,800
9	Facility Removal		$1,053,000	100%	$1,053,000	$1,053,000
10	Hydrologic Structures		$266,600	0%	$0	$0
	SUBTOTAL - Direct Costs					$4,806,230
11	Contractor Mobilization/Demobilization (1% of Subtotal)					$48,000
12	Supplemental Contingencies (3% of Subtotal)					$144,000
13	Engineering Design Fees (2.5% of Subtotal)					$120,000
14	Contractor's Profit and Overhead (15% of Subtotal)					$721,000
15	Project Management Fee (2.5% of Subtotal)					$120,000
	TOTAL Without Gross Receipts Tax					$5,959,230
	Gross Receipts Tax (2022 rate: 6.75%)				6.75%	$402,000
	TOTAL With Gross Receipts Tax (In 2000 Dollars)					$6,361,230
	Inflation rate Qtr 4 2000 to Qtr-2 2022	2.02689			Total inflated to 2022 Dollars	$12,893,513
	Inflation Factors: Qtr-4 2000 & Qtr-2 2022	500.48	1014.42			
	Supplemental Fund For Permit Modifications/Revisions/Misc					$7,725,114
	Total bond					**$20,618,627**
					Current Bond Fund	$24,645,642

Appendix 2: Surface and Mineral Rights Owners of Lands

Chevron Mining Inc - McKinley Mine
Permit 2016-02
Area 9N Bond Release Application
Surface and Mineral Rights Owners of Lands

Area	Township and Range	Section	Phase I Acres	Phase II Acres	Phase III Acres	Surface Ownership	Allotment Numbers	Right of Entry	Mineral Rights Ownership	Right to Mine
9N	T16N, R20W	8	4.0	4.0	4.0	BIA	1612	Lease	BLM	Lease
		8	21.8	21.8	21.8	BIA	1613	Lease	BLM	Lease
		8	14.2	14.2	14.2	BIA	1614	Lease	BLM	Lease
		8	20.0	20.0	20.0	BIA	1615	Lease	BLM	Lease
		10	0.1	27.2	27.2	BIA	1578	Lease	BLM	Lease
		10	0.2	1.7	1.7	BIA	1580	Lease	BLM	Lease
		13	8.6	8.6	8.6	NTUA		License	NA	NA
		14		132.2	132.2	BIA	1570	Lease	BLM	Lease
		14		122.1	122.1	BIA	1571	Lease	BLM	Lease
		15	3.8	38.3	38.3	Westbrook		Lease	PNRC	Lease
		15	4.0	438.1	438.1	Chevron USA, Inc.		Fee Land	PNRC	Lease
		16		10.4	10.4	BIA	1592	Lease	BLM	Lease
		16	14.0	16.5	16.5	BIA	1595	Lease	BLM	Lease
		18	27.9	27.9	27.9	BIA	1604	Lease	BLM	Lease
		18	16.0	16.0	16.0	BIA	1605	Lease	BLM	Lease
		18	1.7	1.7	1.7	BIA	1606	Lease	BLM	Lease
		20	1.8	1.8	1.8	BIA	1602	Lease	BLM	Lease
		22		71.1	71.1	BLM		Lease	BLM	Lease
		23	0.9	321.4	321.4	Chevron USA, Inc.		Fee Land	PNRC	Lease
		26		1.9	1.9	BIA	1564	Lease	BLM	Lease
		26		6.1	6.1	BIA	1567	Lease	BLM	Lease
		Total	**139.0**	**1303.0**	**1303.0**					

Note: BIA is the Bureau of Indian Affairs, BLM is the Burearu of Land Management, and PNRC is the Peabody Natural Resources Company

Land Owner	**Address**
BIA	USDI, Bureau of Indian Affairs, P.O. Box 1060, Gallup, NM 87305
BLM	USDI, Bureau of Land Management, Farmington Field Office, 6251 College Blvd., Suite A, Farmington, NM 87402
Westbrook	Paula Westbrook Heirs, c/o Bruce Williams, 25 Roaad 5787, NBU 2010, Farmington, NM 87401
PNRC	Peabody Natural Resources Company, 701 Market St., Suite 718, St. Louis, MO 63101-1830
Chevron USA, Inc.	Chevron Mining Inc. 6101 Bollinger Canyon Road, San Ramon, CA 94583-2324
NTUA	NTUA, P.O. Box 170, Fort Defiance, AZ 86504

Appendix 3: Draft Notification Letter

Draft Notification Letter (Area 9N)

Date: June 1, 2023
Mr. John Doe
1000 John Doe Lane
City, NM Zip Code

**Re: McKinley Mine Area 9N Bond Release Application
Permit No. 2016-02**

Dear Mr. Doe:

Chevron Mining Inc. (formerly The Pittsburg & Midway Coal Mining Co.) has filed an application for bond release of the permanent-program performance bond for Area 9 North (Area 9N) which includes 1,303 acres of land eligible for Phase II and Phase III bond release, and 139 acres of land that qualifies for Phase I bond release (which lies within the Phase II and III area). Phase II bond release is being sought since vegetation has been established and the contribution of suspended solids to streamflow or runoff outside the permit is not in excess of the 19.8 NMAC requirements. Phase III bond release is being sought since reclaimed land has met vegetation standards in accordance with the permit and the regulations and all remaining reclamation obligations have been completed.   The Phase I bond release area includes a road, reclaimed road, and railroad corridors and reclaimed ancillary areas that qualify for Phase I release.

The application was filed with the New Mexico Mining and Minerals Division (MMD) of the Energy, Minerals & Resources Department in Santa Fe, New Mexico. This application concerns property that may be under your control or ownership or that may be of interest to you.

Chevron Mining Inc.'s headquarters is located at 6001 Bollinger Canyon Road, San Ramon, CA 94583. The current permit number for the McKinley Mine regulated by MMD is 2016-02, which expired on March 7, 2021, but has been administratively extended by MMD.

The McKinley Mine is located approximately 23 miles northwest of Gallup, NM and 3 miles east of Window Rock, AZ on NM State Highway 264. The Area 9N bond release application is located within the Hunters Point, Samson Lake and Tse Bonita School USGS quadrangle maps.

The lands for which bond release is sought are shown on the accompanying map Figure 1: McKinley Mine Area 9N - Bond Release Area, and are located within the following areas:
<u>T16N, R20W New Mexico Principal Meridian, McKinley County, New Mexico:</u>
Section Numbers: 8, 10, 13, 14, 15, 16, 18, 20, 22, 23, and 26.

Area 9N Surface Ownership

Area	Township and Range	Section	Phase I Acres	Phase II Acres	Phase III Acres	Surface Ownership	Allotment Numbers
9N	T16N, R20W	8	4.0	4.0	4.0	BIA	1612
		8	21.8	21.8	21.8	BIA	1613
		8	14.2	14.2	14.2	BIA	1614
		8	20.0	20.0	20.0	BIA	1615
		10	0.1	27.2	27.2	BIA	1578
		10	0.2	1.7	1.7	BIA	1580
		13	8.6	8.6	8.6	NTUA	
		14		132.2	132.2	BIA	1570
		14		122.1	122.1	BIA	1571
		15	3.8	38.3	38.3	Westbrook	
		15	4.0	438.1	438.1	Chevron USA, Inc.	
		16		10.4	10.4	BIA	1592
		16	14.0	16.5	16.5	BIA	1595
		18	27.9	27.9	27.9	BIA	1604
		18	16.0	16.0	16.0	BIA	1605
		18	1.7	1.7	1.7	BIA	1606
		20	1.8	1.8	1.8	BIA	1602
		22		71.1	71.1	BLM	
		23	0.9	321.4	321.4	Chevron USA, Inc.	
		26		1.9	1.9	BIA	1564
		26		6.1	6.1	BIA	1567
		Total	**139.0**	**1303.0**	**1303.0**		

Bonding Information

The following summarizes the current and remaining bond fund, proposed bond release and remaining bond:

Current Bond Type: Surety Bond

- Current Bond Fund: $ 24,645,642
- Less Previous A11/12 PI Bond Release: $ 1,150,724
- Remaining Bond Fund: $ 23,494,918
- Area 9N direct & indirect costs to be released: $ 2,876,291
- New Bond Fund Amount: $ 20,618,627 (in 2022 dollars)

Disturbed Acreage to be released:

- Total acreage to be released: 1,303.0 ac.
- Acres permitted: 12,958.2 ac.
- Percentage of acres permitted being released: 10.1%

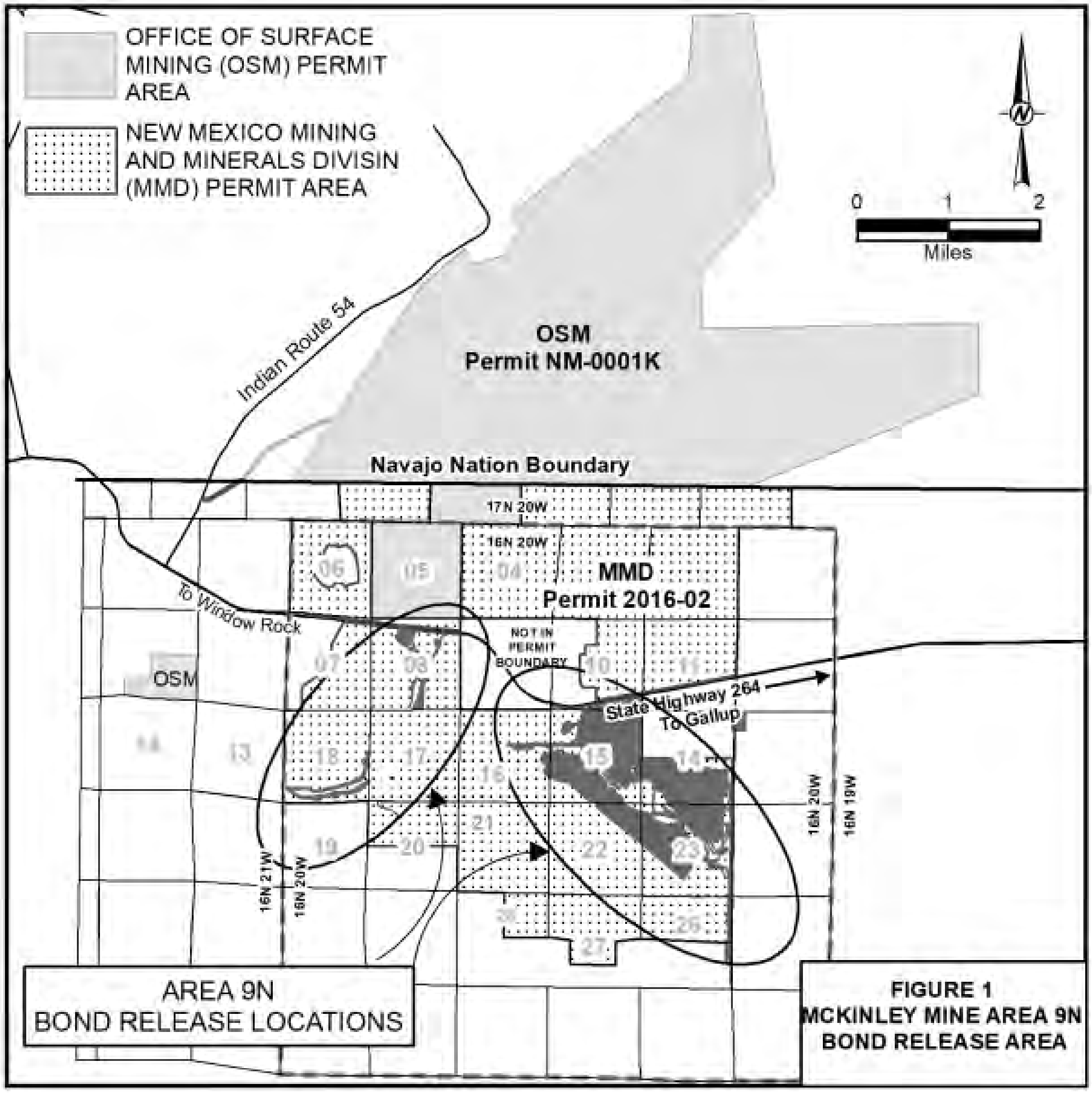
Phase I bond for much of the area was released in 2015, which covered backfilling and grading, graded spoil suitability, topsoil replacement and construction of hydrologic structures and drainage control. 139 acres of road and railroad corridors and ancillary areas that were excluded from the 2015 Phase I bond release are now eligible for Phase I bond release and included with this bond release application. Phase II and Phase III bond release is being sought for the portion of bond associated with completion of reclamation requirements that results in the reduction of settleable solids and the development of vegetation on reclaimed land to meet the requirement as established in the regulations and the applicable permit. Disturbance and mining in Area 9N occurred between 1986 and 2006. Seeding of the majority of the reclaimed lands occurred between 1992 and 2014. Assessment of Area 9N for vegetation performance was conducted in 2019, 2020, 2021 and 2022.

A copy of the detailed bond-release application is available for public inspection at the following locations:

- County Clerk, McKinley County Courthouse, 201 W Hill Ave, Gallup, New Mexico, 87301.
- New Mexico Mining and Minerals Division, 1220 South St. Francis Drive, Santa Fe, NM 87505 (Contact Name: James R. Smith by phone at 505-690-8071 or by email at JamesR.Smith@emnrd.nm.gov to make arrangements to review the bond release application).
- Within 30 days of the final publication of a notice for this bond-release application in the Gallup Independent or Navajo Times newspaper, written comments, objections, or requests for a public hearing and informal conference on this bond-release application shall be submitted to:
  - Mike Tompson, Director, Mining and Minerals Division, 1220 South St. Francis Drive, Santa Fe, NM 87505.

An inspection of the lands to be released will be conducted at the McKinley Mine at 9 AM on August 23, 2023 (Wednesday). Parties interested in participating in the inspection may contact Mr. James R. Smith of the Mining and Minerals Division at 505-690-8071.

Figure 1: McKinley Mine Area 9N Bond Release Area



Appendix 4: BIA Allottee Names and Addresses

NAVAJO NATION
ATTN: CONTROLLER-DIV OF
FINANCE
PO BOX 3150
WINDOW ROCK, AZ 86515

BESSIE ALLRED
PO BOX 254
CLEVELAND, UT 84518-0254

FRANK JAMES
PO BOX 2401
CHINLE, AZ 86503-2401

MARY LOWERY
7711 N 51ST AVE APT 1031
GLENDALE, AZ 85301-1444

ANDREW JAMES
5021 N 66TH AVE # 1
GLENDALE, AZ 85301-7208

RUTH LEE
PO BOX 4405
GALLUP, NM 87305-4405

NAVAJO NATION
PO BOX 1910
WINDOW ROCK, AZ 86515

NELLIE J BROWN
304 VISTA AVE APT 30-A
GALLUP, NM 87301-5134

JIMMIE BOYD JACKSON
PO BOX 2302
KIRTLAND, NM 87417-2302

JOHN YAZZIE
PO BOX 641
CHURCH ROCK, NM 87311-0641

LARRY H LEE
PO BOX 2792
GALLUP, NM 87305-2792

ELSIE YAZZIE
PO BOX 4802
GALLUP, NM 87305-4802

WILSON B HOSKIE
PO BOX 3812
YATAHEY, NM 87375-3812

HERBERT HOSKIE
PO BOX 2092
GALLUP, NM 87305-2092

MARILYN YAZZIE
PO BOX 3011
GALLUP, NM 87305-3011

LUCILLE DESHENE
10992 BIRCH DR
THORNTON, CO 80233-5448

HERMAN HOSKIE
PO BOX 2968
GALLUP, NM 87305-2968

LOUISE HOSKIE
PO BOX 1702
GALLUP, NM 87305-1702

IDA M NELSON
PO BOX 2404
GALLUP, NM 87305-2404

RUTH HOSKIE
10101 WASHINGTON ST APT C209
THORNTON, CO 80229-2040

HARRISON LEE
PO BOX 2404
GALLUP, NM 87305-2404

ROSE M MORGAN
PO BOX 3472
GALLUP, NM 87305-3472

LORENE J KENNEDY
12711 COLORADO BLVD D413
THORNTON, CO 80241-2829

ANDERSON H LEE
PO BOX 4918
GALLUP, NM 87305-4918

NORENE JIM
4211 E 100TH AVE LOT 286
THORNTON, CO 80229-3003

JAMES L HOSKIE
PO BOX 237
GALLUP, NM 87305-0237

GREGORY LEE
PO BOX 4405
GALLUP, NM 87305-4405

DELPHINIA SHERMAN
PO BOX 4432
GALLUP, NM 87305-4432

GARRETT MERLE LEE
1412 KIT CARSON DR
GALLUP, NM 87301-5912

THERESA JACKSON
PO BOX 1924
GALLUP, NM 87305-1924

LISALYNNE LEE
410 N ALFRED AVE
WINSLOW, AZ 86047-3126

KRYSTLE LEE
1173 SOUTHLEA DR
LAFAYETTE, IN 47909-3058

SHARON W MELTING TALLOW
ENCODERS-DO NOT MODIFY THIS
NAME &
ADDRESS RECORD FROM FIL
CANADA

SHERYL LYNN HOSTEEN
PO BOX 4369
YATAHEY, NM 87375-4369

NAVAJO NATION MINERA
PO BOX 1910
WINDOW ROCK, AZ 86515

RAYMOND LONG
PO BOX 5193
LEUPP, AZ 86035-5193

SHARON ANN THOMAS
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YATAHEY, NM 87375-4369

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ALBUQUERQUE, NM 87113-2519

WILBUR WATSON JR
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FLAGSTAFF, AZ 86003-3013

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YATAHEY, NM 87375-4482

DARRYL WATSON
P O BOX 843
CAMERSON, AZ 86020

FRITZGERALD THOMAS
PO BOX 1718
GALLUP, NM 87305-1718

SHELENE ANN BELINTE
PO BOX 4369
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Appendix 5: Other Interests

Bureau of Indian Affairs
PO Box 1060
Gallup, NM 87301

Bureau of Land Management
6251 College Blvd. Suite A
Farmington, NM 87402

Continental Divide Electric Corp.
PO Box 786
Gallup, NM 87301

El Paso Natural Gas Co.
Gallup District Office
PO Box 103
Rehoboth, NM 87322

KHAC Radio
PO Box 9090
Window Rock, AZ 86515

McKinley County Manager
207 West Hill St
Gallup, NM 87301

Navajo Communications Company Inc.
PO Drawer 6000
Window Rock, AZ 86515

Navajo Land Development
PO Box 2249
Window Rock, AZ 86515

Navajo Nation Minerals Dept.
PO Box 1910
Window Rock, AZ 86515

Navajo Partnership for Housing, Inc.
PO Box 1370
St. Michaels, AZ 86511

Navajo Tribal Utility Authority
PO Box 170
Fort Defiance, AZ 86504

New Mexico State Land Office
PO Box 1148
Santa Fe, NM 87504-1148

Peabody Natural Resource Company
701 Market St.
St. Louis, MO 63101

Public Service Co. of NM
Alvandado Square
Albuquerque, NM 87158

Santa Fe Railroad
Trainmaster Office
811 Roundhouse Rd.
Gallup, NM 87301

District Technical Support Engineer
NM State Highway Dept.
PO Box 2159
Milan, NM 87201

Tse Bonita Valley Water Users Association
HCR-5, Box 34
Gallup, NM 87301

Paula Westbrook Heirs c/o Bruce Williams
25 Road 5787
NBU 2010
Farmington, NM 87401

Appendix 6: Certification of Application

Certification of Application

I certify, to the best of my knowledge and belief, that all applicable reclamation activities have been accomplished on the lands contained in this Chevron Mining Inc – McKinley Mine, Permit 2016-02 Area 9 North Bond Release Application in accordance with the requirements of SMCRA, the Act, the regulatory program, and the approved permit and reclamation plan.

Jeff Schoenbacher — 6.1.23

Jeff Schoenbacher – CEMC
McKinley Mine – Operations Lead

Date

State of New Mexico)
) SS
County of Taos)

Subscribed and sworn to before me, in my presence, this 1st day of June, 2023.

Isaiah Vigil a Notary Public in and for the State of New Mexico.

Notary Public

My Commission expires 6/15/25

ISAIAH VIGIL
Notary Public - State of New Mexico
Commission # 1134732
My Comm. Expires Jun 15, 2025

Appendix 7: Public Notice

Public Notice

Chevron Mining Inc. (formerly The Pittsburg & Midway Coal Mining Co.) has filed an application for bond release of the permanent-program performance bond for Area 9 North (Area 9N) which includes 1,193 acres of land eligible for Phase II and Phase III bond release and 139 acres that qualify for Phase I bond release (which lies within the Phase II and III area). Phase II bond release is being sought since vegetation has been established and the contribution of suspended solids to streamflow or runoff outside the permit is not in excess of the 19.8 NMAC requirements. Phase III bond release is being sought since the reclaimed area has met vegetation standards in accordance with the permit and the regulations and all remaining reclamation obligations have been completed. The Phase I bond release area includes a road, reclaimed road and railroad corridors and reclaimed ancillary areas, that qualify for Phase I release.

The application was filed with the New Mexico Mining and Minerals Division (MMD) of the Energy, Minerals & Resources Department in Santa Fe, New Mexico.

Chevron Mining Inc.'s headquarters is located at 6001 Bollinger Canyon Road, San Ramon, CA 94583. The current permit number for the McKinley Mine regulated by MMD is 2016-02, which expired on March 7, 2021 but has been administratively extended by MMD.

The McKinley Mine is located approximately 23 miles northwest of Gallup, NM and 3 miles east of Window Rock, AZ on NM State Highway 264. The areas in the bond release application are located within the Samson Lake USGS quadrangle map.

The land for which bond release is sought is shown on the accompanying map Figure 1 McKinley Mine Area 9N Bond Release Area, and is located within the following areas:

T16N, R20W New Mexico Principal Meridian, McKinley County, New Mexico
Section Numbers: 8, 10, 13, 14, 15, 16, 18, 20, 22, 23 and 26.

Area	Township and Range	Section	Phase I Acres	Phase II Acres	Phase III Acres	Surface Ownership	Allotment Numbers
9N	T16N, R20W	8	4.0	4.0	4.0	BIA	1612
		8	21.8	21.8	21.8	BIA	1613
		8	14.2	14.2	14.2	BIA	1614
		8	20.0	20.0	20.0	BIA	1615
		10	0.1	27.2	27.2	BIA	1578
		10	0.2	1.7	1.7	BIA	1580
		13	8.6	8.6	8.6	NTUA	
		14		132.2	132.2	BIA	1570
		14		122.1	122.1	BIA	1571
		15	3.8	38.3	38.3	Westbrook	
		15	4.0	438.1	438.1	Chevron USA, Inc.	
		16		10.4	10.4	BIA	1592
		16	14.0	16.5	16.5	BIA	1595
		18	27.9	27.9	27.9	BIA	1604
		18	16.0	16.0	16.0	BIA	1605
		18	1.7	1.7	1.7	BIA	1606
		20	1.8	1.8	1.8	BIA	1602
		22		71.1	71.1	BLM	
		23	0.9	321.4	321.4	Chevron USA, Inc.	
		26		1.9	1.9	BIA	1564
		26		6.1	6.1	BIA	1567
		Total	**139.0**	**1303.0**	**1303.0**		

Bonding Information
The following summarizes the current and remaining bond fund, proposed bond release and remaining bond:

Current Bond Type:	Surety Bond

- Current Bond Fund: $ 24,645,642
- Less Previous A11/12 PI Bond Release: $ 1,150,724
- Remaining Bond Fund: $ 23,494,918
- Area 9N direct & indirect costs to be released: $ 2,876,291
- New Bond Fund Amount: $ 20,618,627 (in 2022 dollars)

Disturbed Acreage to be released:

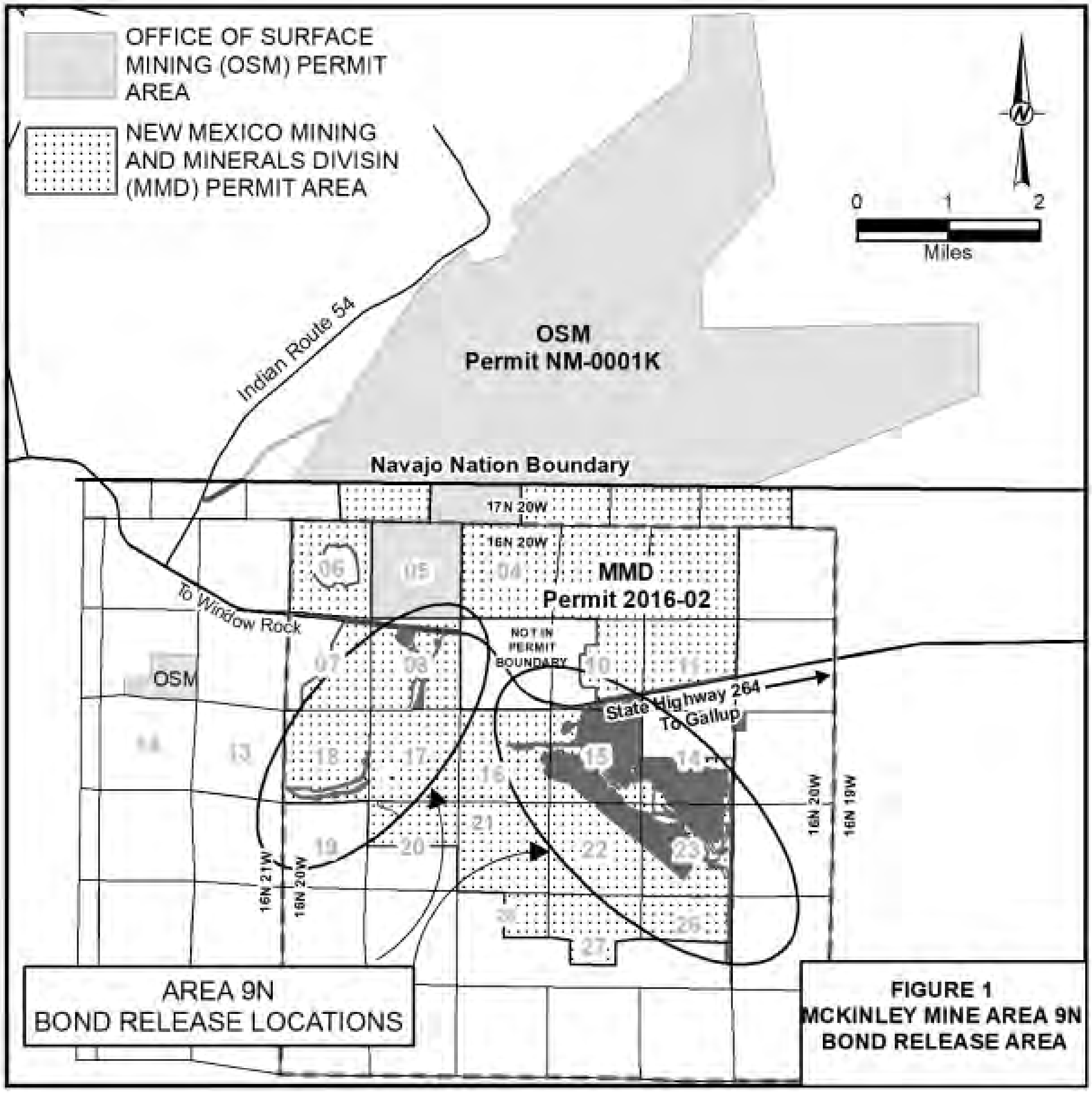
- Total acreage to be released: 1,303.0 ac.
- Acres permitted: 12,958.2 ac.
- Percentage of acres permitted being released: 10.1%

Disturbance and mining in Area 9N occurred between 1986 and 2006. Phase I bond for much of the area was released in 2015, which covered backfilling and grading, graded spoil suitability, topsoil replacement and construction of hydrologic structures and drainage control. 139 acres of road and railroad corridors and ancillary areas that were excluded from the 2015 Phase I bond release are now eligible for Phase I bond release and included with this bond release application. Seeding of the majority of the reclaimed lands occurred between 1992 and 2014. Assessment of Area 9N for vegetation performance was conducted in 2019, 2020, 2021 and 2022.

A copy of the detailed bond-release application is available for public inspection at the following locations:

- County Clerk, McKinley County Courthouse, 201 W Hill Ave, Gallup, New Mexico, 87301.
- New Mexico Mining and Minerals Division, 1220 South St. Francis Drive, Santa Fe, NM 87505 (Contact Name: James R. Smith by phone at 505-690-8071 or by email at JamesR.Smith@emnrd.nm.gov to make arrangements to review the bond release application).
- Within 30 days of the final publication of a notice for this bond-release application in the Gallup Independent or Navajo Times newspaper, written comments, objections, or requests for a public hearing and informal conference on this bond-release application shall be submitted to:
  - Mike Tompson, Director, Mining and Minerals Division, 1220 South St. Francis Drive, Santa Fe, NM 87505.

Figure 1: McKinley Mine Area 9N Bond Release Area



Appendix 8: Complete 2019, 2020, 2021, and 2022 Vegetation Monitoring Reports for VMU #3

REPORT

Vegetation Management Unit 3 Vegetation Success Monitoring, 2019

McKinley Mine, New Mexico Mining and Minerals Division Permit Area

Submitted to:

Chevron Environmental Management Company

Chevron Mining Inc. - McKinley Mine
24 Miles NW HWY 264
Mentmore, NM 87319

Submitted by:

Golder Associates Inc.

5200 Pasadena Avenue, N.E. Suite C

Albuquerque, New Mexico, USA 87113

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133-8105207

February 21, 2020

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1.0 INTRODUCTION

Mining was completed in Mining and Minerals Division (MMD) jurisdictional lands at the McKinley Mine in 2007; most of the land is reclaimed, with only the facilities remaining. The lands mined and reclaimed included prelaw, initial-program, and permanent-program lands. Liability release has been completed on all prelaw and initial-program lands, and full bond release on a limited amount of permanent-program land.

Chevron Mining Inc. (CMI) is assessing the vegetation in the remaining permanent-program reclaimed areas in anticipation of future bond and liability releases. 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 use of grazing and wildlife. The increment, or permit area as a whole, must meet vegetation establishment responsibility period criteria, which is a minimum of 10 years. Golder Associates Inc. (Golder) was retained to monitor and assess the vegetation relative to the established vegetation success standards in Permit # 2016-02.

1.1 Vegetation Management Unit 3

This report presents results from 2019 quantitative vegetation monitoring conducted in Vegetation Management Unit 3 (M-VMU-3), comprising about 1,275 acres within Area 9 north and parts of Area 9 south (Figure 1). The elevation in this area ranges from about 6,700 to 7,000 feet above mean sea level. Permanent program reclamation in Area 9 started on lands disturbed after 1986, and reclamation generally was completed by 2009. Thus, reclamation age in the majority of M-VMU-3 ranges from 8 to more than 30 years old. The configuration of the vegetation monitoring units within the MMD Permit Area, shown on Figure 1 were developed in consultation with MMD. 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 McKinley's annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation methods applied in Area 9 included grading of the spoils to achieve positive drainage and approximate original contour. Graded spoil monitoring was then conducted to verify that the upper 42 inches of spoil were suitable for plant growth or if it required mitigation to establish a suitable root zone. A minimum of 6 inches of topsoil or topsoil substitute were then applied over suitable spoils.

After topsoil or topdressing placement, the surface was scarified in preparation for planting. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, mulch consisting of either hay or straw was applied at a rate of about 2 tons/acre. The mulch was anchored 3 to 4 inches into the soil with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which coincided with logical units for seeding that had been topdressed over the spring and summer. 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 of alfalfa and cool-season grasses. Over time the seed mixes shifted to include more warm-season grasses and a broader variety of native forbs.

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 South 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 precipitation for 2019 is comparable to long-term averages for the region though monsoonal precipitation was well below average. Figure 1 shows the location of the precipitation gages used for the South Mine. Departure of growing season precipitation (April through September) from long-term seasonal mean at Window Rock (1937-1999) for McKinley is shown on Figure 2 based on the Rain 9 station. Between 2015 and 2019, growing season precipitation has been below average in all years but 2015, when growing season total precipitation was 0.85 inches above average. In 2016, 2018 and 2019, growing season precipitation was 2.4 to almost 2.8 inches below average. Growing season precipitation was 0.51 inches below average at the Rain 9 gage in 2017. From 2015 to 2019, peak growing season months have been relatively dry with a pronounced deficit in the early monsoon (July and August), with rare exceptions being July 2015 and July 2018.

1.4 Objectives

The intent of this report is to document the vegetation community attributes in M-VMU-3 and compare them to the Permit 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 ground cover, annual production, shrub density, and composition and diversity. Section 4 is a summary of the results for M-VMU-3 with emphasis on vegetation success.

2.0 VEGETATION MONITORING METHODS

Vegetation attributes on M-VMU-3 in Area 9 were quantified using the methods described in Section 6.5 of the Permit. Fieldwork was conducted at the end of the growing season, but prior to the first killing frost. Vegetation monitoring in M-VMU-3 was conducted between September 17 and 18, 2019.

2.1 Sampling Design

A systematic random sampling procedure employing a transect/quadrat system was used to select sample sites within the reclaimed area. The transect locations were reviewed with MMD in advance of sampling. A 50-square foot grid was imposed over the VMU to delineate vegetation sample plots, and random points created in a geographic information system were used to select plots for vegetation sampling. The locations of randomly selected vegetation plots are shown on Figure 3 for M-VMU-3. In the field, the randomly selected transect locations were assessed in numerical order. If the transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Unsuitable transects were those that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies.

Transects originated from the southeastern corner of the vegetation plot. Each transect was 30 meters (m) long in a dog-leg pattern (Figure 4). Four 1-m^2 quadrats were located at pre-determined intervals along the transect for quantitative vegetation measurements. Each quadrat is considered an individual sample where measurements were made of production, total canopy, species canopy and basal cover, surface litter, surface rock fragments, and bare soil as discussed below.

2.2 Vegetation and Ground Cover

Relative and total canopy cover, basal cover, surface litter, rock fragments, and bare soil were estimated for each quadrat. 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% 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%.

Basal cover is defined as the proportion of the ground occupied by the crowns of grasses and rooting stems of forbs and shrubs. Basal cover estimates were also made for surface litter, rock fragments, and bare soil. Like the total cover estimates, the basal cover estimates do not exceed 100%. All cover estimates were made in 0.05% increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates. Plant frequency was determined on a species-basis by counting the number of individual plants rooted in each quadrat.

2.3 Annual Forage and Biomass 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. 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). For this sampling event, plants that were less than 5 cm tall or considered volumetrically insignificant were not collected. Production from shrubs was determined by clipping the current year's growth.

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 pounds per acre (lbs/ac) basis.

2.4 Shrub Density

Shrub density, or the number of plants per square meter, was determined using the frequency count data from the quadrats and the belt transect method (Bonham 1989). Shrub density was calculated from the quadrat data by dividing the total number of individual plants counted by the number of quadrats measured. The density per square meter was converted to density per acre.

Shrub density was also determined using a belt transect method (Bonham 1989). Shrub density was determined from a 1-meter wide; 30-meter long belt transect situated along the perimeter of the dog-legged transect (Figure 4). Shrubs rooted in the belt transect were counted on a species basis.

2.5 Statistical Analysis and Sample Adequacy

For the vegetation success demonstrations at McKinley, statistical adequacy is determined on the basis of the canopy cover, production and shrub density data. 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).

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

Where N_{min} equals minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\overline{x}$ is the mean, and D is the desired level of accuracy, which is 10 percent of the mean.

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 and a minimum sample number approach is taken. MMD recognizes the practical limitations of achieving statistical adequacy and has provided minimum sample sizes for various quantitative methods (MMD 1999). With normally distributed data where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples are often considered adequate. The 40-sample recommendation 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 measurements 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. The 40 samples came from ten transects each having four quadrats as described in Section 2.1. Each quadrat 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 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).

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 are used to analyze data that are not normally distributed. When sample adequacy is not achieved, it is appropriate to use the reverse null approach for hypothesis testing. The reverse null 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 and Howlin 2013).

The procedures for financial assurance release as described in Coal Mine Reclamation Program Vegetation Standards (MMD 1999) guided the statistical analysis. 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 log transformation was applied to see if it normalized the data.

All hypothesis testing used to demonstrate compliance with the vegetation success standards was conducted using a reverse null approach. 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 and Howlin 2013). The one-sided hypothesis tests using the reverse null approach were designed as follows:

Perennial/Biennial Canopy Cover

H_0 : Reclaim < 90% of the Technical Standard (15%)

H_a : Reclaim ≥ 90% of the Technical Standard (15%)

Annual Forage Production

H_0 : Reclaim < 90% of the Technical Standard (350 lbs/ac)

H_a : Reclaim ≥ 90% of the Technical Standard (350 lbs/ac)

Shrub Density

H_0 : Reclaim < 90% of the Technical Standard (150 stems/ac)

H_a : Reclaim ≥ 90% of the Technical Standard (150 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 perennial/biennial cover, annual forage production and shrub density using the one-sample, one-sided t-test and the one-sample, one-sided sign test. The hypotheses testing used the reverse null hypothesis bond release testing procedure as described in Coal Mine Reclamation Program Vegetation Standards (MMD 1999).

3.0 RESULTS

The vegetation community in M-VMU-3 is well established and dominated by perennial plants. A representative photograph of the vegetation and topography in M-VMU-3 is shown in Figure 5. The vegetation cover levels in 2019 suggest that the site is progressing to achieve vegetation success standards for the Permit Area. Vegetation success standards consist of four vegetative parameters: ground cover, productivity, diversity and woody stem stocking (Table 2). The ground cover requirement for live perennial/biennial cover on the reclamation is 15%. The productivity requirement is 350 air-dry lbs/ac perennial/biennial annual production. The woody stem stocking success standard is 150 live woody stems per acre.

Diversity is evaluated against numerical guidelines for different growth forms and photosynthetic pathways of the vegetation. In summary, the diversity guideline required by MMD would be met if at least two shrub or subshrub species with individual relative cover values of 1%; at least two perennial warm-season grass species have individual relative cover levels of at least 1%; at least one perennial cool-season grass species has an individual relative cover level of at least 1%; and three perennial or biennial forb species have a combined relative cover of at least 1%. MMD (1999) allows for 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, they persist in the reclaimed plant community. Relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit.

Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas. Table 3 summarizes the attributes for plants recorded in the quadrats in addition to those encountered or observed but not recorded in the formal quantitative monitoring of M-VMU-3. Recruitment of these native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

The field data for canopy and basal cover, density, production and shrub density by the belt transect are included in Appendix A, accompanied by Figure A-1 showing the 2019 transect locations within M-VMU-3. Figure A-1 also shows the seeded areas grouped by years. Photographs of the quadrats are included in Appendix B. Appendix C provides the statistical outputs for perennial/biennial canopy cover, annual forage production and shrub density by the belt transect method.

3.1 Ground Cover

Average total ground cover in M-VMU-3 is 67.4% comprised of 49.0% total vegetation cover, 6.6% rock, and 11.8% litter on a canopy cover basis (Table 3). On a basal area basis, average ground cover is 50.5% with 3.2% vegetation, 8.7% rock and 38.6% litter. Consistent with semi-arid rangelands the vegetation canopy cover in the individual quadrats varied, ranging from 8.5 to 97.5% (Table A-1).

Perennial/biennial canopy cover was calculated by summing the perennial/biennial species cover estimates after excluding the annual forbs and grasses. The mean perennial/biennial canopy cover was 36.4%, which was less than the mean total vegetation canopy cover suggesting the limited occurrence of overlapping canopies for perennial/biennial cover. In M-VMU-3, both the mean total vegetation canopy cover (49.0% ± 6.0% [90% confidence interval, CI]) and mean perennial/biennial canopy cover (36.4% ± 7.8%) exceeded the vegetation success standard of 15% perennial/biennial cover (Table 4).

The perennial/biennial canopy cover data for M-VMU-3 were not normally distributed (Figure C-1). A log transformation of the perennial/biennial canopy cover data did not result in a normal distribution. The calculated minimum sample size needed to meet N_{min} was 63 samples for total cover and 194 samples for perennial/biennial canopy cover (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the perennial/biennial canopy cover data were evaluated using a stabilization of the mean approach (Clark 2001) and with a one-sided, one-sample sign test using the reverse null (MMD 1999). Figure 6 illustrates the stabilization of the estimated mean for perennial/biennial canopy cover based on grouping four sample increments associated with a single transect. The samples were analyzed in four sample increments to allow an estimation of variability. The corresponding variability around the mean is expressed by the 90% CIs for each successive analytical increment. These data suggest that the mean stabilized within 90% CI of the 40-sample mean after the collection of 20 to 24 samples. The variability of the estimate slightly decreased with the collection of additional data, but not to a meaningful degree. This analysis suggests that the collection of additional data beyond 40 samples would not improve the precision of the estimate of perennial/biennial cover.

Evaluation of the data using the one-sample, one-sided sign test found only 10 perennial/biennial cover quadrats did not meet 90% of the performance standard (13.5%) resulting in the probability (P) of 0.0013 of observing a z value less than -3.00. Therefore, under the reverse null hypothesis we conclude the performance standard is met for perennial/biennial canopy cover in 2019 (Table C-1).

3.2 Production

The 2019 annual forage production in M-VMU-3 was estimated to be 779 (± 197 [90% CI]) lbs/ac with an annual total production of 1,201 ± 217 lbs/ac (Table 4). Twelve perennial grasses contribute 379 lbs/ac of forage and six shrubs contribute 321 lbs/ac of browse indicating a diverse and productive rangeland. Western wheatgrass (*Pascopyrum smithii*), tall wheatgrass (*Thinopyrum ponticum*) and James' galleta (*Pleuraphis jamesii*) account for about 45% of the forage, while four-wing saltbush (*Atriplex canescens*) and shadscale saltbush (*Atriplex confertifolia*) account for an additional 40% of annual forage production (Table 3). The combined annual forage production for 12 perennial grasses and six subshrubs/shrubs in M-VMU-3 is more than double the vegetation success standard of 350 lbs/ac.

The annual forage production data for M-VMU-3 were not normally distributed (Figure C-2). A log transformation of the annual forage production data did not result in a normal distribution. The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was estimated to be 267 samples (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using a stabilization of the mean (Clark 2001) and with a one-sided, one sample sign test using the reverse null (MMD 1999). Figure 7 illustrates the stabilization of the estimated mean and 90% CI for annual forage production. These data suggest that the mean stabilized within 90% CI of the 40-sample mean after the collection of 20 to 24 samples. 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 only 14 production quadrats did not meet 90% of the performance standard (315 lbs/ac) resulting in the probability (P) of <0.0409 of observing a z value less than -1.74. Therefore, under the reverse null hypothesis we conclude the performance standard is met for annual forage production in 2019 (Table C-2).

3.3 Shrub Density

Shrub density ranged from an average of 2,550 ± 1,285 stems/ac based on the belt transect method to 7,789 ± 3,074 stems/ac for quadrat method (Table 4). In M-VMU-3, 9 shrub species, including one cacti were encountered in the belt transects (Table A-5) compared to six species in the quadrats (Table 3), reflecting the increased area of analysis associated with the belt transects. Four-wing saltbush was the most common shrub encountered under both measurement methods with the subshrub broom snakeweed (*Gutierrezia sarothrae*) subdominant to four-wing saltbush by the quadrat method only.

The shrub density data by the belt transect method were not normally distributed (Figure C-3) and the calculated minimum sample size needed to meet N_{min} at the 90% confidence level was estimated to be 316 samples (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the shrub density belt transect data were evaluated using a stabilization of the mean (Clark 2001) and one-sided, one-sample sign test using the reverse null (MMD 1999). Figure 8 illustrates the stabilization of the mean for shrub density based on individual belt transect data. The corresponding variability around the mean is expressed by the 90% CIs for each successive analytical increment. These data suggest that the mean stabilized within 90% CI of the 10-sample mean after the first belt transect and through the remainder of the sampling. This analysis suggests that the collection of additional data beyond 10 samples would not improve the precision of the estimate of shrub density.

Evaluation of the data using the one-sample, one-sided sign test found only one transect failed to meet 90% of the performance standard (135 stems/ac) resulting in the probability (P) of 0.0136 of observing a z value less than -2.21. Therefore, under the reverse null hypothesis we conclude the performance standard is met for shrub density (i.e., woody stem stocking) by the belt transect method for 2019 (Table C-3).

3.4 Composition and Diversity

Collectively, 12 perennial grasses dominate the canopy cover in M-VMU-3 with a combined relative canopy cover of almost 50% with James' galleta and western wheatgrass being most prevalent (Table 3). Four warm-season perennial grasses contribute almost 26% relative canopy cover to perennial/biennial canopy cover. Eight cool-season perennial grasses contribute 24% relative canopy cover to perennial/biennial canopy cover. Nine perennial/biennial forbs contribute nearly 24% relative canopy cover to the perennial/biennial canopy cover in M-VMU-3 with blazingstar species (*Mentzelia spp.*) being the dominant non-annual forb. The annual forb Russian thistle (*Salsola tragus*) was the most prevalent forb from an absolute cover perspective. The collective contribution of six shrubs to perennial/biennial canopy cover is 26%, with four-wing saltbush and shadscale saltbush most prevalent.

Diversity is assessed through comparing the relative cover of various life-forms, based on their duration to the perennial/biennial cover of the vegetation management unit. In this context, relative cover is the average percent cover of a perennial/biennial species divided by the mean perennial/biennial cover of the sampling unit. Relative canopy cover of individual species contributing to perennial cover are listed in Table 3.

The diversity standard for cool-season grasses is achieved by several species that exceed 1% relative cover including western wheatgrass (19.83%), tall wheatgrass (1.28%) and Indian ricegrass (1.22%, *Achnatherum hymenoides*).

The diversity standard for warm-season grasses is achieved by two species that exceed 1% relative cover including James' galleta (22.89%) and blue grama (2.45%, *Bouteloua gracilis*). Alkali sacaton (0.21%, *Sporobolus airoides*) and sand dropseed (0.08%, *S. cryptandrus*) were additional warm-season perennial grasses recorded, but they did not meet the 1% relative cover standard. Thus, the warm-season perennial grass standard was achieved in M-VMU-3.

The diversity standard for forbs requires a minimum of three non-annual forb taxa combining to contribute at least 1% relative cover. The combined relative cover of nine non-annual forbs is 23.62%, dominated by the undifferentiated blazingstar species (15.79%) and a native monocarpic forb, flatspine stickseed (3.62%, *Lappula occidentalis*). Additional forbs contributing to the diversity standard are flixweed (2.47%, *Descurainia sophia*), Palmer's penstemon (0.52%, *Penstemon palmeri*), scarlet globemallow (0.50%, *Sphaeralcea coccinea*), purple aster (0.41%, *Machaeranthera canescens*), tall tumblemustard (0.23, *Sisymbrium altissimum*), sego lily (0.07%, *Calochortus nuttallii*) and tanseyleaf tansyaster (0.02%, *Machaeranthera tanacetifolia*). Based on 2019 sampling, the combined relative cover for nine non-annual forbs is greater than 1%, meeting the diversity standard for forbs on M-VMU-3 reclamation.

The diversity standard for shrubs requires two species with a minimum relative cover of 1% for each species. The diversity standard for shrubs is achieved by four-wing saltbush (21.44%) and shadscale saltbush (4.12%).

Additional co-dominant shrubs recorded in the quadrats include mat saltbush (0.43%, *Atriplex corrugata*) and winterfat (0.27%, *Krascheninnikovia lanata*).

Based on the 2019 vegetation monitoring, 90 different plant species were present within the reclamation areas of M-VMU-3 (Table 3). We encountered 42 forbs, 22 grasses and 26 shrubs, trees and cacti. Of the 42 forbs, 15 are considered annuals whereas the remaining 27 have variable durations or are purely perennial. Of the 22 grasses, 12 are cool-season perennials, seven are warm-season perennials and three are cool-season annuals. Cacti (one species) and trees (five species) were rare on the reclamation, while shrubs and subshrubs were more commonly observed (20 species).

During the 2019 monitoring program, we infrequently encountered two Class B and four Class C noxious weeds (NMDA 2016) on M-VMU-3. Class B noxious weeds are those that are isolated in the state and managed such that they are contained and spread should be stopped. 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. The only noxious weed recorded in the quadrats was cheatgrass (*Bromus tectorum*) with a mean canopy cover of 3.44% isolated to six quadrats in transects M-VMU-3-T7P, T9P and T10P (Table A-1). Cheatgrass was not used in the assessment of revegetation success. Other noxious weeds observed on M-VMU-3 were musk thistle (*Carduus nutans*), halogeton (Halogeton glomeratus), Russian knapweed (Acroptilon repens), 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 control. 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 M-VMU-3 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 canopy cover, production, shrub density, and plant diversity. Results of the 2019 vegetation monitoring indicate that the vegetation community in M-VMU-3 is progressing well and is in full compliance with the vegetation success standards. Statistical hypothesis testing was performed on perennial/biennial cover, annual forage production and shrub density data using the one-sample, one-sided sign test. All hypotheses testing used the reverse null hypothesis as recommended in Coal Mine Reclamation Program Vegetation Standards (MMD 1999). Results of the statistical testing indicate that perennial/biennial canopy cover, annual forage production and shrub density levels in M-VMU-3 exceed their respective technical standards at the 90% level of confidence. The diversity standards for cool-season grasses, warm-season grasses, forbs and shrubs was met in M-VMU-3.

Overall, the performance of the vegetation is encouraging considering several growing seasons between 2016 and 2019 with below-average precipitation, a two-year drought in 2017 and 2018 and continued grazing pressure. The performance of the vegetation under these conditions suggests that the plant communities developing on these areas are resilient and capable of sustaining themselves under adverse conditions that are characteristic of this region.

5.0 REFERENCES

Bonham, C.D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons. New York, NY.

Clark, D.L. 2001. Stabilization of the mean as a demonstration of sample adequacy. American Society for Surface Mining and Reclamation Annual Meeting. Albuquerque, NM. June 3-7, 2001. ASSMR, Lexington, KY.

Daubenmire, R. 1968. Plant communities: A textbook of plant synecology. Harper & Row, Publishers, New York.

Mining and Minerals Division (MMD). 1999. Coal Mine Reclamation Program Vegetation Standards. Santa Fe, NM. April 30.

McDonald, L., and S. Howlin. 2013. Evaluation and comparison of hypothesis testing techniques for bond release application. University of Wyoming, Laramie, WY.

New Mexico Department of Agriculture (NMDA). 2016. New Mexico Noxious Weed List Update. New Mexico State University, Las Cruces, NM.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry (2nd edit.). W. H. Freeman and Co., San Francisco.

Schulz, A. M., R. P. Gibbens, and L. F. DeBano. 1961. Artificial populations for teaching and testing range techniques. J. Range Management. 14:236-242.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods applied to experiments in agriculture and biology. 6th ed. Ames, Iowa: Iowa State University Press.

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Tables

Table 1: South 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	Tipple	South Shop	2.05	1.59	0.11	0.52	1.64	1.11	2.37	1.62	0.30	1.36	1.31	0.76	14.74	7.56
	Rain 9	9				0.50	1.38	1.22	2.88	1.25	0.22	1.13	0.99			7.45
	Rain 10	10				0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78			7.13
	Rain 11	11				0.48	1.88	1.02	2.80	1.69	0.26	0.97	1.08			8.13
2016	Tipple	South Shop	0.62	0.22	0.05	1.31	0.80	0.07	1.37	1.74	1.75	0.40	1.57	1.84	11.74	7.04
	Rain 9	9				0.22	0.62	0.45	1.24	0.50	1.05	1.05	0.00			4.08
	Rain 10	10				0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02			5.00
	Rain 11	11				0.28	0.77	0.64	1.61	0.42	1.09	0.09	0.04			4.81
2017	Tipple	South Shop	1.25	1.64	0.48	0.35	0.77	0.42	2.48	0.90	1.34	0.15	0.09	0.02	9.89	6.26
	Rain 9	9				1.20	1.02	0.01	0.82	1.40	1.64	0.37	0.91			6.09
	Rain 10	10				1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81			5.68
	Rain 11	11				1.23	1.16	0.05	0.86	2.00	1.85	0.34	0.49			7.15
2018	Tipple	South Shop	0.35	0.79	0.54	0.09	0.29	0.51	2.61	1.34	1.10	1.65	0.19	0.29	9.75	5.94
	Rain 9	9				0.07	0.27	0.25	2.16	0.74	0.67	1.31			5.47	4.16
	Rain 10	10				0.08	0.20	0.27	3.05	1.15	0.92	1.51			7.18	5.67
	Rain 11	11				0.09	0.29	0.26	1.92	1.00	0.89	1.45			5.90	4.45
2019	Tipple	South Shop	1.30	1.81	1.23	0.44	1.77	0.33	0.22	0.05					7.15	2.81
	Rain 9	9				0.16	1.36	0.24	0.46	0.37					2.59	2.59
	Rain 10	10				0.20	1.49	0.37	0.19	0.27					2.52	2.52
	Rain 11	11				0.20	1.50	0.19	0.44	0.20					2.53	2.53
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:
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

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Table 2: Revegetation Success Standards for the Mining and Minerals Division Permit Area

Vegetative Parameter	Success Standard
Ground Cover	15% live perennial/biennial cover
Productivity	350 air-dry pounds per acre perennial/biennial annual production
Diversity	A minimum of 2 shrub or subshrub taxa contributing at least 1% relative cover each.
	A minimum of 2 perennial warm-season grass taxa contributing at least 1% relative cover each.
	A minimum of 1 perennial cool-season grass contributing at least 1% relative cover.
	A minimum of 3 perennial/biennial forb taxa combining to contribute at least 1% relative cover.
Woody Stem Stocking	150 live woody stems per acre

Notes:

Diversity criteria are assessed through evaluating individual perennial/biennial species relative cover, as agreed upon by MMD and CMI in June 2019. Further, relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit.

Table 3: Vegetation Cover, Density and Production by Species, M-VMU-3, 2019

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)			Mean Density (#/ac)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative Canopy[a]		
Cool-Season Grasses							
Annuals							
Bromus arvensis	Field brome	BRAR5	0.30	<0.05	--	304	3
Bromus tectorum	Cheatgrass	BRTE	3.44	0.10	--	27,013	18
Vulpia octoflora	Sixweeks fescue	VUOC	obs	obs	obs	obs	obs
Perennials							
Achnatherum hymenoides	Indian ricegrass	ACHY	0.45	0.05	1.22	4,755	7
Agropyron cristatum	Crested wheatgrass	AGCR	obs	obs	obs	obs	obs
Bromus inermis	Smooth brome	BRIN2	obs	obs	obs	obs	obs
Elymus canadensis	Canada wildrye	ELCA	obs	obs	obs	obs	obs
Elymus elymoides	Bottlebrush squirreltail	ELEL	0.18	<0.05	0.49	3,541	2
Hesperostipa comata	Needle and thread	HECO26	0.30	<0.05	0.84	5,564	4
Hordeum jubatum	Foxtail barley	HOJU	<0.05	<0.05	0.09	202	<1
Leymus ambiguus	Colorado wildrye	LEAM	0.21	<0.05	0.58	3,440	6
Pascopyrum smithii	Western wheatgrass	PASM	7.21	0.45	19.83	61,310	147
Phleum pratense	Timothy	PHPR	obs	obs	obs	obs	obs
Pseudoroegneria spicata	Bluebunch wheatgrass	PSSP6	<0.05	<0.05	<0.01	101	<1
Thinopyrum ponticum	Tall wheatgrass	THPO7	0.47	0.24	1.28	1,518	40
Warm-Season Grasses							
Perennials							
Aristida purpurea	Purple threeawn	ARPU	obs	obs	obs	obs	obs
Bouteloua curtipendula	Sideoats grama	BOCU	obs	obs	obs	obs	obs
Bouteloua gracilis	Blue grama	BOGR2	0.89	0.10	2.45	7,487	9
Bouteloua hirusta	Hairy grama	BOHI2	obs	obs	obs	obs	obs
Pleuraphis jamesii	James' galleta	PLJA	8.32	1.38	22.89	65,863	166
Sporobolus airoides	Alkali sacaton	SPAI	0.08	<0.05	0.21	1,619	<1
Sporobolus cryptandrus	Sand dropseed	SPCR	<0.05	<0.05	0.08	304	<1
Forbs							
Annuals							
Alyssum desertorum	Desert madwort	ALDE	obs	obs	obs	obs	obs
Chenopodium incanum	Mealy goosefoot	CHIN2	2.65	<0.05	--	15,783	70
Chenopodium leptophyllum	Narrowleaf goosefoot	CHLE4	0.17	<0.05	--	405	2
Chenopodium album	Lambsquarters	CHAL7	0.61	<0.05	--	809	15
Cryptantha crassisepala	Thicksepal cryptantha	CRCR3	0.85	<0.05	--	4,957	15
Eriogonum cernuum	Nodding buckwheat	ERCE2	obs	obs	obs	obs	obs
Eriogonum divaricatum	Divergent buckwheat	ERDI5	1.47	<0.05	--	14,366	19
Halogeton glomeratus	Halogeton	HAGL	obs	obs	obs	obs	obs
Helianthus annuus	Common sunflower	HEAN3	<0.05	<0.05	--	202	3
Heliomeris longifolia	Longleaf false goldeneye	HELO6	0.94	<0.05	--	4,553	12
Kochia scoparia	Kochia	KOSC	2.21	<0.05	--	11,331	47
Malacothrix fendleri	Fendler's desertdandelion	MAFE	<0.05	<0.05	--	405	<1
Polygonum erectum	Erect knotweed	POER2	0.21	<0.05	--	607	2
Salsola tragus	Russian thistle	SATR	7.13	0.14	--	43,706	213
Xanthium strumarium	Rough cocklebur	XAST	obs	obs	obs	obs	obs
Perennials/Biennials							
Achillea millefolium	Common yarrow	ACMI2	obs	obs	obs	obs	obs
Acroptilon repens	Russian knapweed	ACRE3	obs	obs	obs	obs	obs
Calochortus nuttallii	Sego lily	CANU3	<0.05	<0.05	0.07	202	<1
Carduus nutans	Musk thistle	CANU4	obs	obs	obs	obs	obs
Chaetopappa ericoides	Rose heath	CHER	obs	obs	obs	obs	obs
Conyza canadensis	Horseweed	COCA	obs	obs	obs	obs	obs
Descurainia sophia	Flixweed	DESO	0.90	<0.05	2.47	4,553	11
Grindelia nuda var. aphanactis	Curlytop gumweed	GRNUA	obs	obs	obs	obs	obs
Grindelia squarosa	Curly-cup gumweed	GRSQ	obs	obs	obs	obs	obs
Lactuca serriola	Prickly lettuce	LASE	obs	obs	obs	obs	obs
Lappula occidentalis	flatspine stickseed	LAOC3	1.32	<0.05	3.62	11,220	23
Linum lewisii	Lewis flax	LILE	obs	obs	obs	obs	obs
Machaeranthera canescens	Purple aster	MACA	0.15	<0.05	0.41	405	3
Machaeranthera tanacetifolia	Tanseyleaf tansyaster	MATA	<0.05	<0.05	0.02	101	<1
Marrubium vulgare	Horehound	MAVU	obs	obs	obs	obs	obs
Melilotus officinalis	Yellow sweetclover	MEOF	obs	obs	obs	obs	obs
Mentzelia Spp.	Blazingstar species	MENTZ	5.74	0.17	15.79	78,206	34
Penstemon palmeri	Palmer's penstemon	PEPA8	0.19	<0.05	0.52	4,047	2
Polygonum aviculare	Prostrate knotweed	POAV	obs	obs	obs	obs	obs
Ratibida columnifera	Upright prairie coneflower	RACO3	obs	obs	obs	obs	obs
Rumex crispus	Curly dock	RUCR	obs	obs	obs	obs	obs
Sisymbrium altissimum	Tall tumblemustard	SIAL2	0.08	<0.05	0.23	304	<1
Sphaeralcea coccinea	Scarlet globemallow	SPCO	0.18	<0.05	0.50	1,821	2
Sphaeralcea emoryi	Emory's globemallow	SPEM	obs	obs	obs	obs	obs
Sphaeralcea grossulariifolia	Gooseberryleaf globemallow	SPGR2	obs	obs	obs	obs	obs
Tragopogon dubius	Yellow salsify	TRDU	obs	obs	obs	obs	obs
Typha angustifolia	Narrowleaf cattail	TYAN	obs	obs	obs	obs	obs

Table 3: Vegetation Cover, Density and Production by Species, M-VMU-3, 2019

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)			Mean Density (#/ac)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative Canopy[a]		
Shrubs, Trees and Cacti							
Perennials							
Artemisia ludoviciana	White sagebrush	ARLU	obs	obs	obs	obs	obs
Artemisia tridentata	Big sagebrush	ARTR2	obs	obs	obs	obs	obs
Atriplex acanthocarpa	Tubercled saltbush	ATAC	obs	obs	obs	obs	obs
Atriplex canescens	Four-wing saltbush	ATCA	7.80	0.30	21.44	5,261	266
Atriplex confertifolia	Shadscale saltbush	ATCO	1.50	0.08	4.12	202	46
Atriplex corrugata	Mat saltbush	ATCO4	0.16	<0.05	0.43	304	4
Atriplex obovata	Mound saltbush	ATOB	obs	obs	obs	obs	obs
Atriplex sp.	Undifferentiated saltbush species	ATRIP	obs	obs	obs	obs	obs
Chrysothamnus viscidiflorus	Yellow rabbitbrush	CHVI	obs	obs	obs	obs	obs
Ephedra trifurca	Longleaf jointfir	EPTR	obs	obs	obs	obs	obs
Ephedra viridis	Mormon tea	EPVI	obs	obs	obs	obs	obs
Ericameria nauseosa	Rubber rabbitbrush	ERNA	<0.05	<0.05	<0.01	101	<1
Eriogonum leptophyllum	Slenderleaf buckwheat	ERLE10	obs	obs	obs	obs	obs
Gutierrezia sarothrae	Broom snakeweed	GUSA	0.05	<0.05	0.15	1,214	<1
Heterotheca villosa	Hairy false goldenaster	HEVI	obs	obs	obs	obs	obs
Krascheninnikovia lanata	Winterfat	KRLA	0.10	<0.05	0.27	708	4
Opuntia polyacantha	Plains pricklypear	OPPO	obs	obs	obs	obs	obs
Pinus edulis	Piñon pine	PIED	obs	obs	obs	obs	obs
Populus deltoides	Cottonwood	PODE	obs	obs	obs	obs	obs
Purshia mexicana	Mexican cliffrose	PUME	obs	obs	obs	obs	obs
Purshia tridentata	Antelope bitterbrush	PUTR2	obs	obs	obs	obs	obs
Salix exigua	Narrowleaf willow	SAEX	obs	obs	obs	obs	obs
Sarcobatus vermiculatus	Greasewood	SAVE4	obs	obs	obs	obs	obs
Tamarix ramosissima	Saltcedar	TARA	obs	obs	obs	obs	obs
Tetradymia canescens	Gray horsebrush	TECA	obs	obs	obs	obs	obs
Ulmus pumila	Siberian elm	ULPU	obs	obs	obs	obs	obs
Cover Components							
Perennial/Biennial Vegetation Cover			36.4	2.9			
Total Vegetation Cover			49.0	3.2			
Rock			6.6	8.7			
Litter			11.8	38.6			
Bare Soil			32.6	49.5			

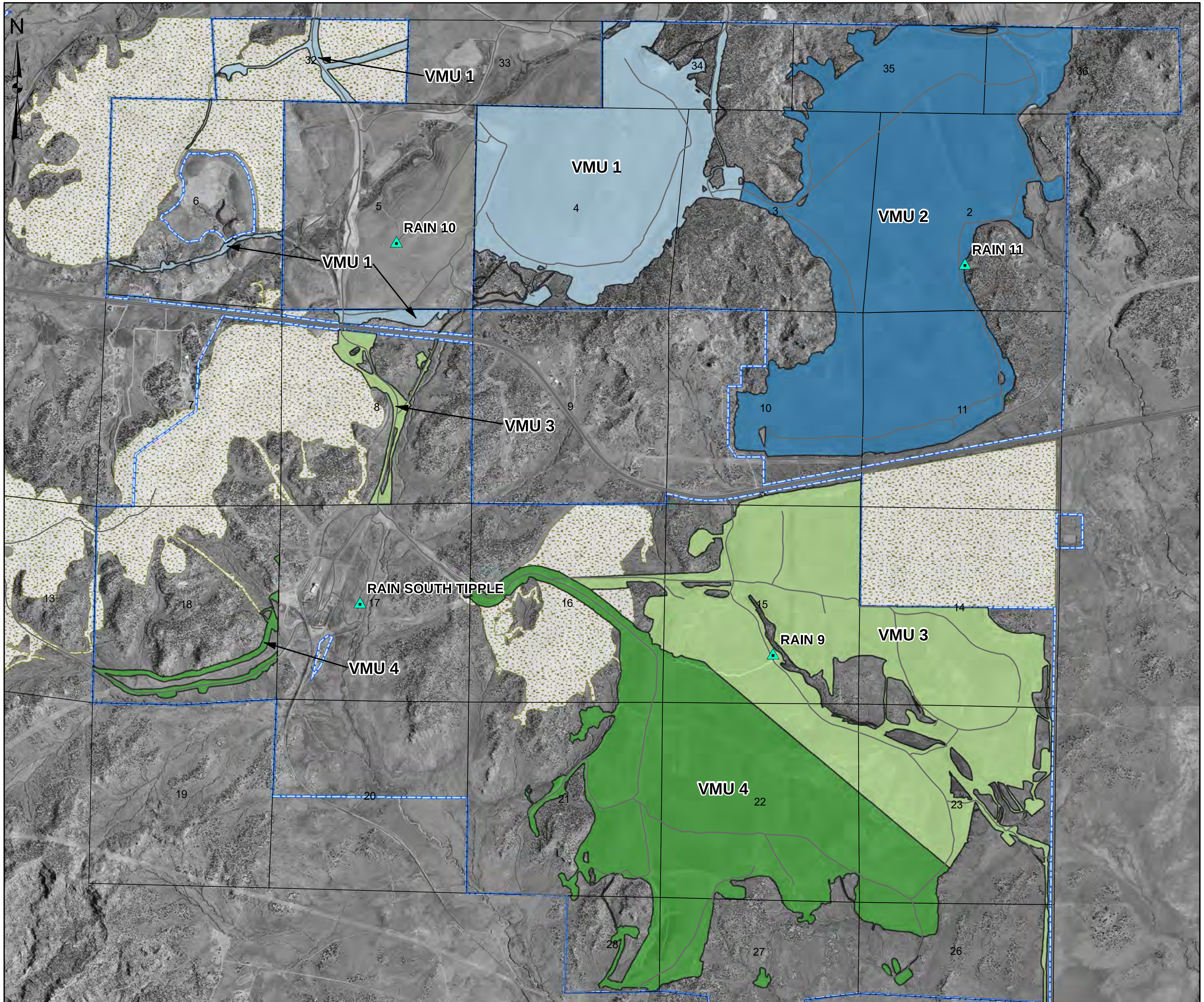
Notes:
[a] = relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit
-- = this parameter is not calculated for this attribute
#/ac = number of plants per acre
lbs/ac = air-dry forage pounds per acre
obs = observed on vegetation management unit during monitoring, but not recorded in the quadrats
Ps Pathway or growing season for the grasses is from Allred (2005)
Duration for plants is from the USDA Plants Database

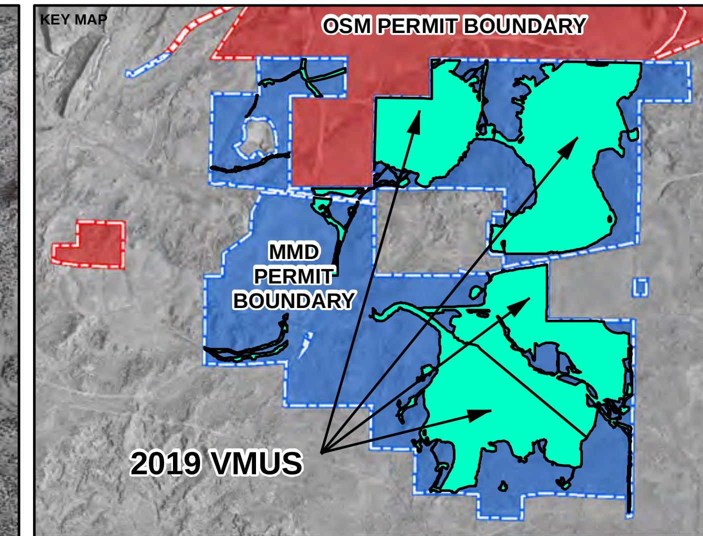
Table 4: Summary Statistics for M-VMU-3, 2019

		Technical Standard
Total Vegetation Canopy Cover (%)		
Mean	49.0	None
Standard Deviation	23.1	
90% Confidence Interval	6.0	
Nmin[1]	63	
Probability within true mean[2]	0.62	
Perennial/Biennial Canopy Cover (%)		
Mean	36.4	15.0
Standard Deviation	30.1	
90% Confidence Interval	7.8	
Nmin[1]	194	
Probability within true mean[2]	0.70	
Basal Cover (%)		
Mean	3.22	None
Standard Deviation	3.87	
90% Confidence Interval	1.01	
Nmin[1]	409	
Probability within true mean[2]	0.77	
Annual Forage Production (lbs/ac)		
Mean	779	350
Standard Deviation	756	
90% Confidence Interval	197	
Nmin[1]	267	
Probability within true mean[2]	0.73	
Annual Total Production (lbs/ac)		
Mean	1,201	None
Standard Deviation	835	
90% Confidence Interval	217	
Nmin[1]	137	
Probability within true mean[2]	0.67	
Shrub Density (stems/acre) from Quadrats		
Mean	7,789	150
Standard Deviation	11,820	
90% Confidence Interval	3,074	
Nmin[1]	654	
Probability within true mean[2]	0.83	
Shrub Density (stems/acre) from Belt Transect		
Mean	2,550	150
Standard Deviation	2,471	
90% Confidence Interval	1,285	
Nmin[1]	316	
Probability within true mean[2]	0.62	

Notes:
1 Minimum number of samples required to obtain 90 percent probability that the sample mean is within 10 percent of the population mean
2 Probability the true value of the mean is within 10 percent of the mean for the sample size

Figures





LEGEND

- Rain Gauges
- Two-tracks, Roads and Highways
- PLSS - Sections
- MMD VMU 1 (~ 838 acres)
- MMD VMU 2 (~ 1,518 acres)
- MMD VMU 3 (~ 1,275 acres)
- MMD VMU 4 (~ 1,238 acres)
- Liability Release
- MMD Permit Boundary

0 3,000 6,000
Feet
1 inch = 2,667 feet

NOTE(S)
1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN

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

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

PROJECT
MCKINLEY MINE - MMD PERMIT PHASE III BOND RELEASE
2019 VEGETATION SAMPLING PROGRAM

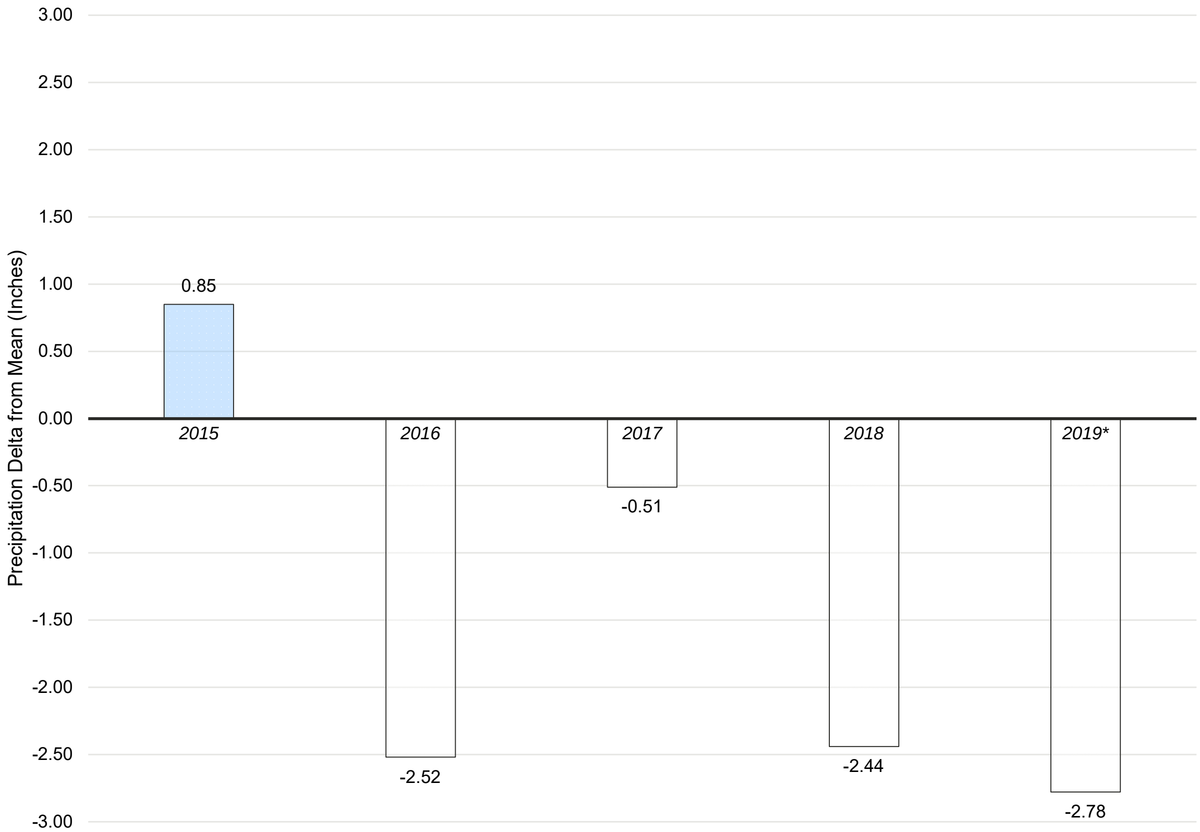
TITLE
GENERAL OVERVIEW OF MCKINLEY SOUTH MINE AREA VEGETATION MANAGEMENT UNITS (VMU), 2019

CONSULTANT
GOLDER

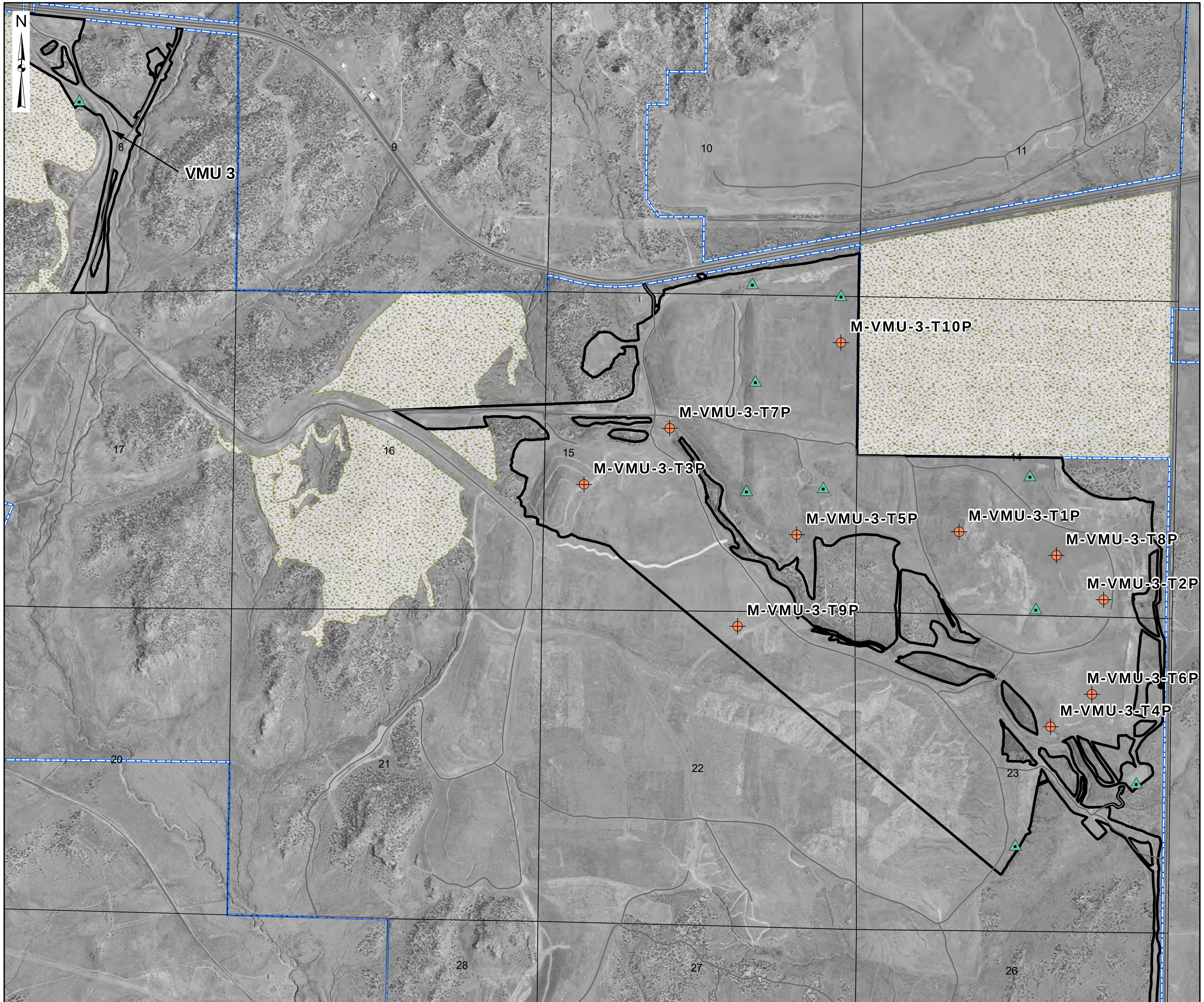
YYYY-MM-DD	2020-01-22
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR
APPROVED	FR

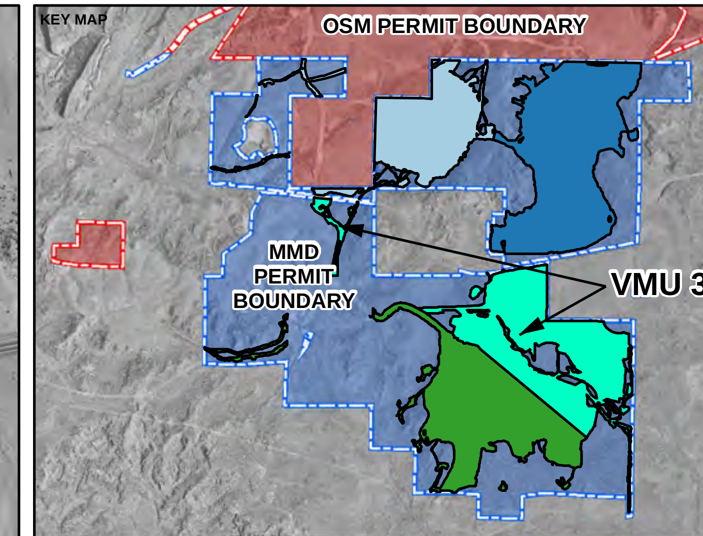
PROJECT NO.	CONTROL	REV.	FIGURE
133-8105207	000610	--	1

Figure 2: Departure of Growing Season Precipitation from Long-Term Seasonal Mean at Window Rock; Rain 9 Gage



Notes:
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
* The Seasonal mean for 2019 is from April through August





LEGEND

- Vegetation Transect - Sampled
- Vegetation Transect - Additional Alternate
- Two-tracks, Roads and Highways
- PLSS - Sections
- MMD VMU 3 (~ 1,275 acres)
- Liability Release
- MMD Permit Boundary

TRANSECT LABEL EXPLANATION:

M-VMU-1-T1P

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

0 1,600 3,200 Feet

1 inch = 1,667 feet

NOTE(S)

1. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS

REFERENCE(S)

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

CLIENT

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

PROJECT

MCKINLEY MINE - MMD PERMIT PHASE III BOND RELEASE
2019 VEGETATION SAMPLING PROGRAM

TITLE

VEGETATION MONITORING TRANSECTS, 2019
VEGETATION MANAGEMENT UNIT 3

CONSULTANT

GOLDER

YYYY-MM-DD	2020-01-22
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR
APPROVED	FR

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105207	000613	--	3

Figure 4: Vegetation Plot, Transect and Quadrat Layout

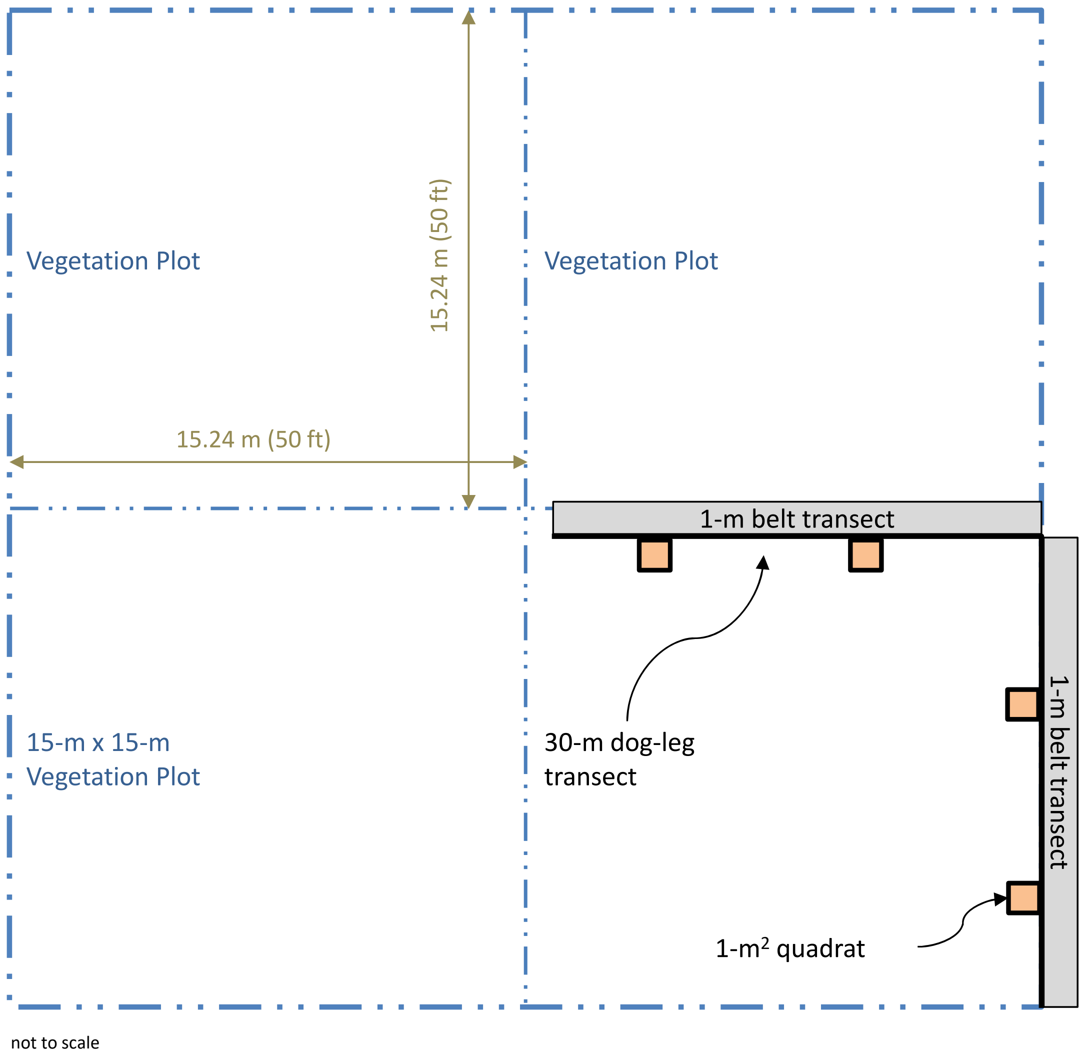


Figure 5: Typical Grass-Shrubland Vegetation in M-VMU-3, September 2019

Figure 6: Stabilization of the Mean for Perennial/Biennial Cover - M-VMU-3

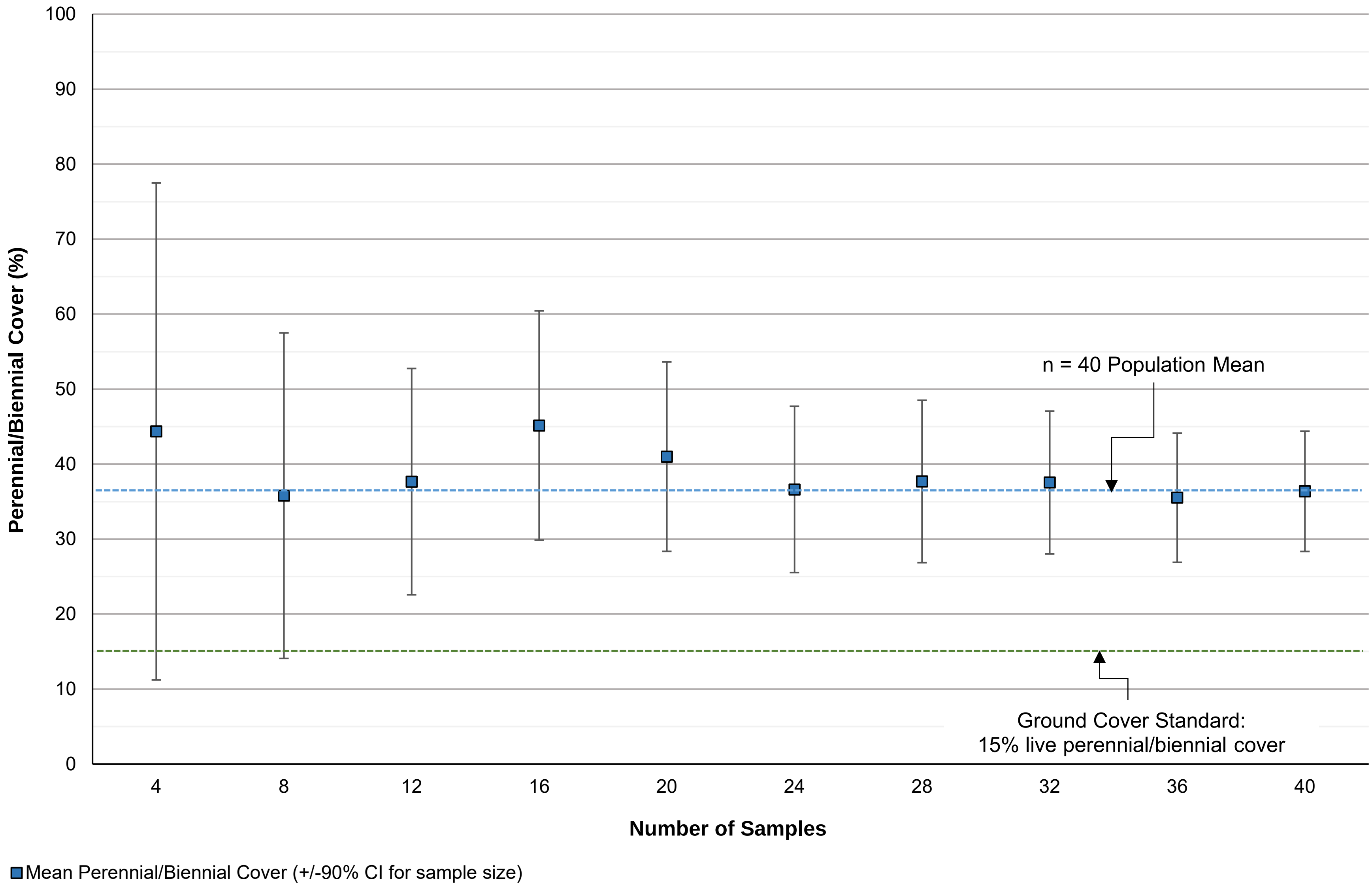


Figure 7: Stabilization of the Mean for Annual Forage Production - M-VMU-3

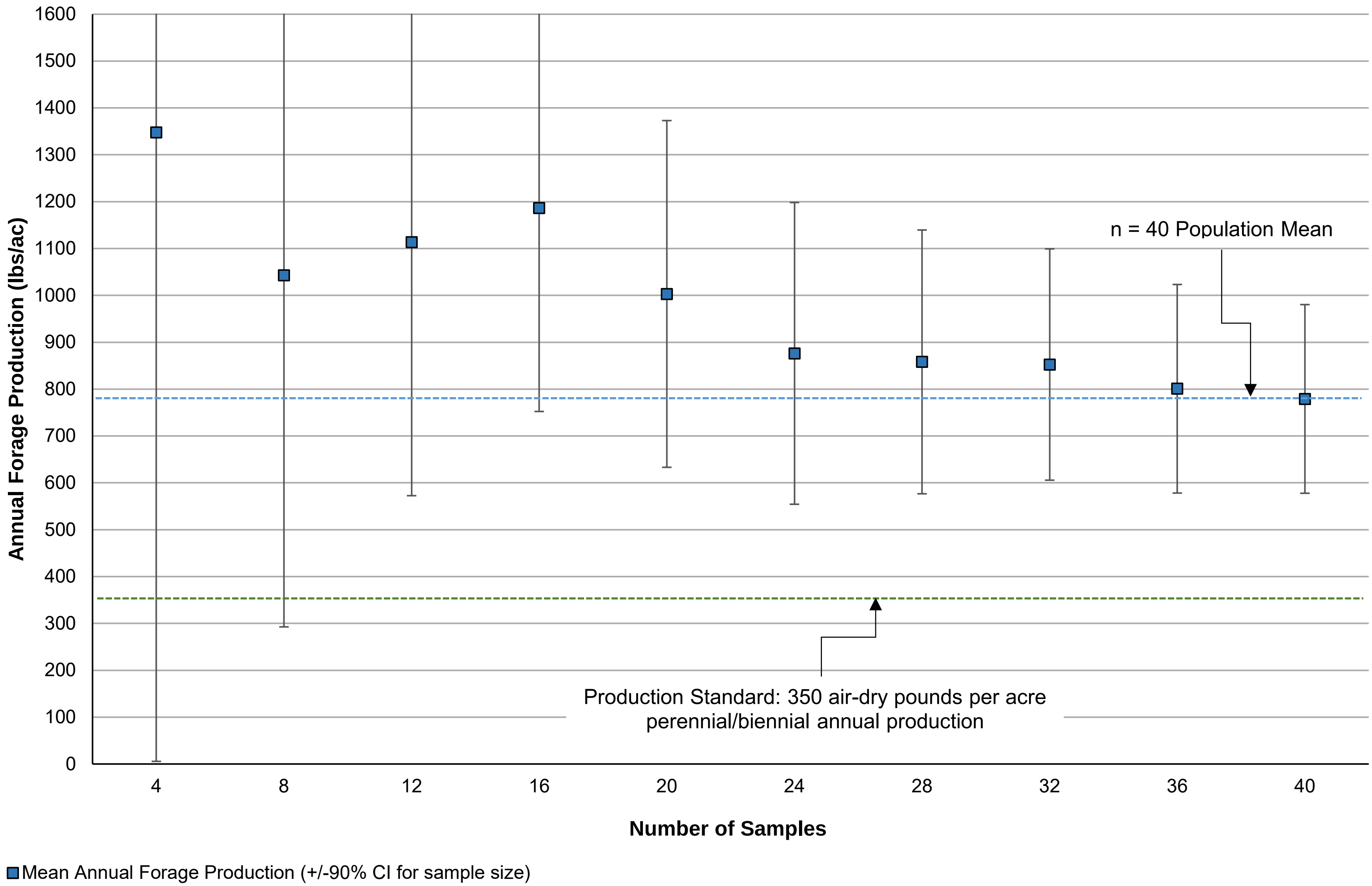
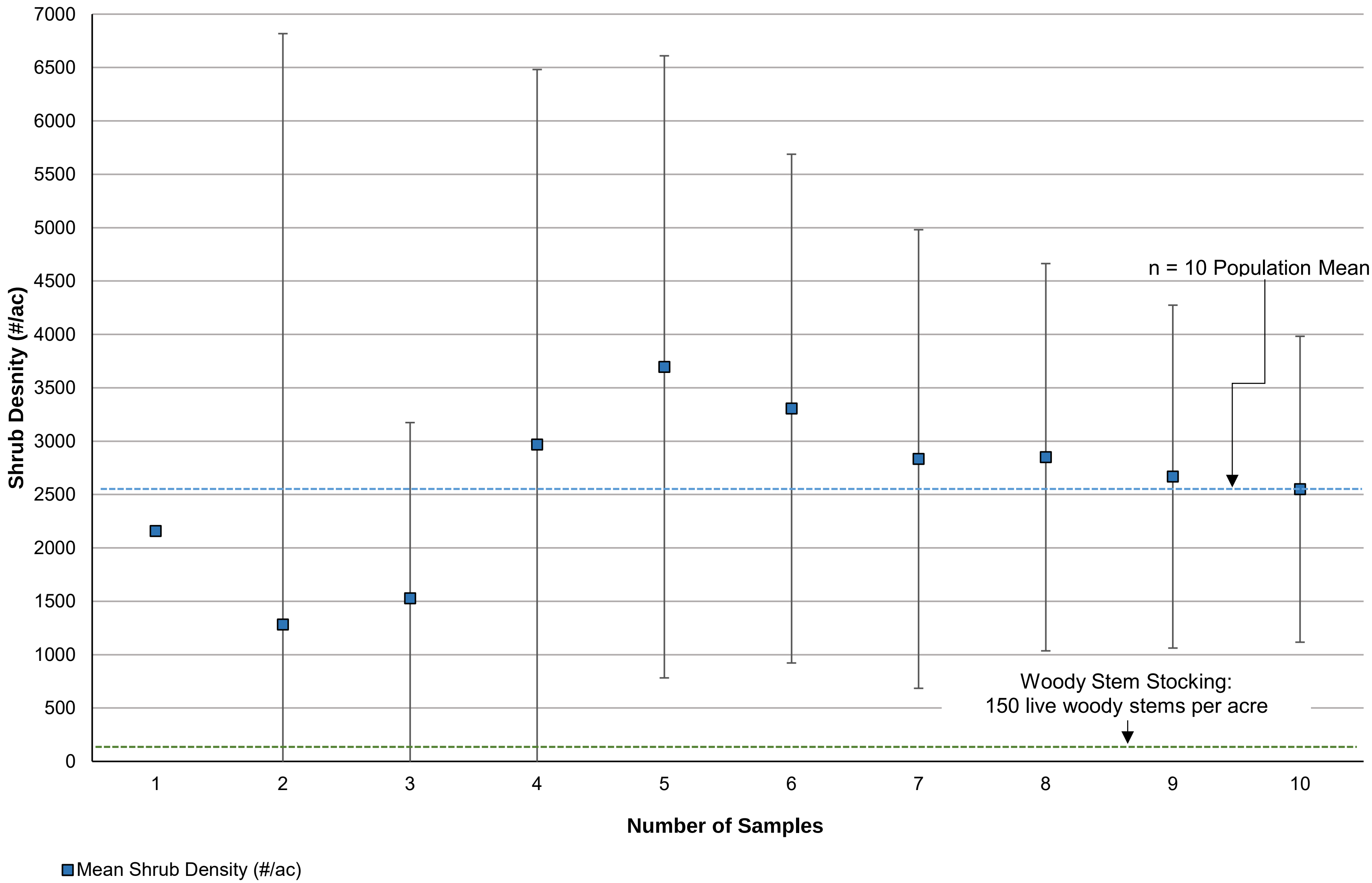
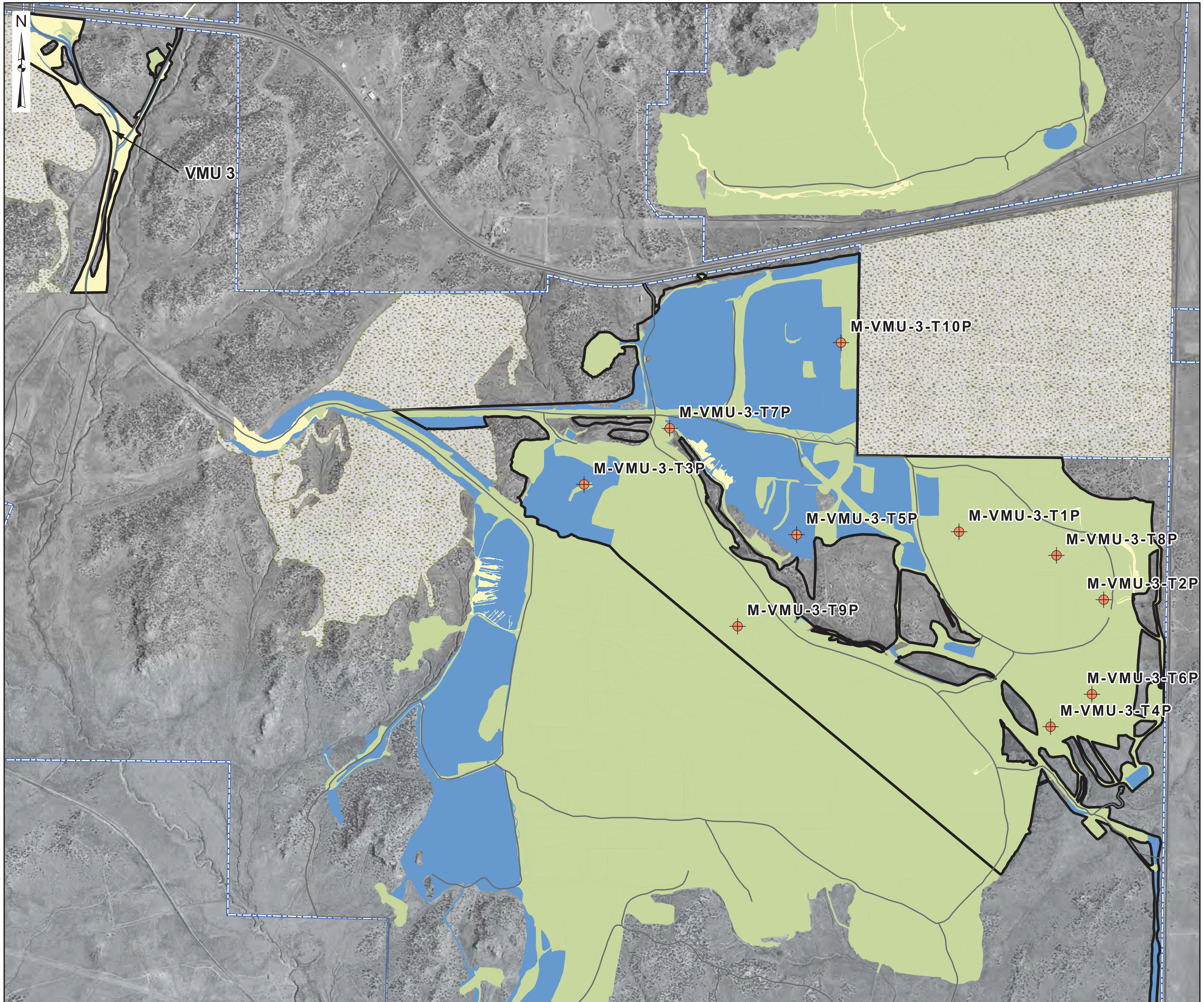


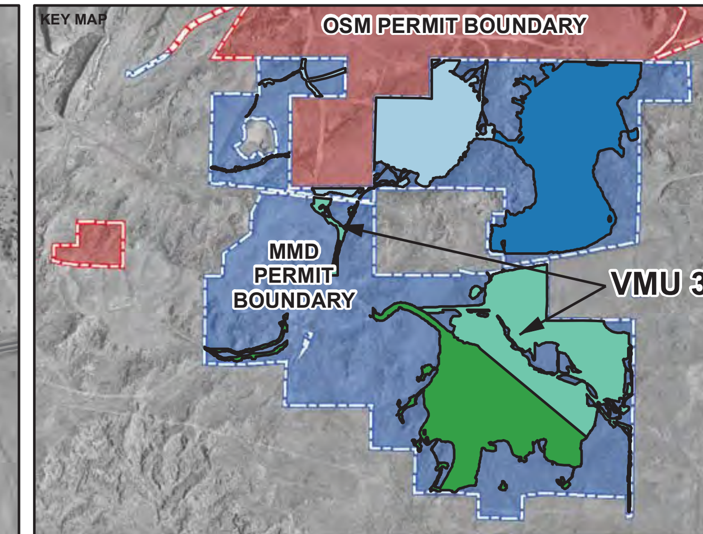
Figure 8: Stabilization of the Mean for Shrub Density - M-VMU-3



APPENDIX A

Vegetation Data Summary





LEGEND

- Transects for 2019 MMD PHIII Vegetation Sampling
- Two-tracks, Roads and Highways
- MMD VMU 3 (~ 1,275 acres)
- Liability Release
- MMD Permit Boundary

Seeded Areas by End_Year

- < 1997
- 1997 to 2013
- 2014 to 2018

TRANSECT LABEL EXPLANATION: M-VMU-1-T1P

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

0 1,600 3,200 Feet

1 inch = 1,667 feet

NOTE(S)

1. SEEDING AREA ATTRIBUTES WERE CLASSIFIED MANUALLY BASED ON SEED MIX VARIATIONS (<1997 AND 1997 TO 2013) WITH AN ADDITONAL CLASS FOR RECENT SEEDING (2014 TO 2018)

REFERENCE(S)

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

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

PROJECT
MCKINLEY MINE - MMD PERMIT PHASE III BOND RELEASE
2019 VEGETATION SAMPLING PROGRAM

TITLE
SEEDED AREA CLASSIFICATION (YEAR) AND TRANSECT LOCATIONS SAMPLED VEGETATION MANAGEMENT UNIT 3 (M-VMU-3), 2019

CONSULTANT

GOLDER

YYYY-MM-DD	2019-12-13
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR
APPROVED	FR

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105206	000623	--	A-1

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

Table A-1: M-VMU-3 Canopy Cover Data

Transect	M-VMU-3-T1P				M-VMU-3-T2P				M-VMU-3-T3P				M-VMU-3-T4P				M-VMU-3-T5P				M-VMU-3-T6P				M-VMU-3-T7P				M-VMU-3-T8P				M-VMU-3-T9P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Annuals																																								
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	1.50	2.00	--	--	--	--	--	65.50	--	--	40.00	--	28.00	0.50
BRAR5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.00	--	--	--	--	--	--
Perennials																																								
ACHY	--	--	--	--	--	0.05	0.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.20	1.10	15.00	0.25	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	35.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.60	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	2.00	--	--	--	--	--	--	--	1.00	3.00	--	--	1.00	--	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	1.60	2.80	--	--	0.05	--	--	--	--	--	--	--	0.20	--	--	--	--	--	--	--	--	--	--	--	--	7.25	--	--	--	--	--	--	--	0.25	--	--
HOJU	--	--	--	--	--	--	--	--	--	--	--	--	1.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.00	1.50	--	--	--	--
PASM	7.50	20.00	21.00	9.00	3.10	4.10	5.00	3.00	--	--	--	--	3.00	0.15	40.00	23.00	3.50	2.50	--	--	6.80	3.00	2.00	3.50	57.00	8.00	4.00	--	5.90	5.25	5.00	--	11.20	18.00	--	5.00	6.00	--	2.00	1.00
PLJA	38.00	10.00	--	--	--	--	--	9.50	31.50	11.75	13.00	--	--	--	--	--	--	--	--	--	--	14.00	--	27.00	--	--	4.50	6.00	22.50	1.75	40.00	30.00	--	--	--	--	2.20	41.25	5.00	25.00
PSSP6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.00	--	--
SPCR	1.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	18.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annuals																																								
CHAL7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	22.00	--	--	--	2.50	--	--	--	--	--	--	--	--	--
CHIN2	--	--	--	--	--	0.15	--	0.10	--	--	--	0.20	--	--	--	--	0.10	--	--	3.00	19.00	9.00	27.00	12.00	--	--	--	--	--	--	--	15.00	7.00	0.40	0.50	12.00	--	0.40	--	--
CHLE4	--	--	--	--	--	--	--	--	--	--	--	--	--	0.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.00	--	--	--	--	--	--	--	--	0.50	--	--
CRCR3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.00	8.00	20.00	2.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERDI5	--	--	--	--	--	--	--	--	3.75	1.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.80	22.00	30.00	--	--	--	--	--	--	--	--	--	--	--	--
HEAN3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.50	--	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	35.00	2.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	3.50	--	--	--	--	--	--	--	--	--	13.00	10.00	2.00	8.00	--	0.30	15.00	4.00	0.25	--	--	--	0.20	2.20	8.00	0.50	19.00	--	2.50	--	--	--	--	--	--	--	--	--
MAFE	--	--	--	--	--	--	--	--	0.15	--	--	0.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.75	--	--
POER2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.50	0.70	3.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	1.75	1.30	36.00	75.00	0.50	7.00	--	0.50	2.10	--	--	T	--	--	2.00	--	6.50	2.00	1.50	--	2.00	1.00	10.00	0.50	--	0.40	3.50	6.00	27.00	32.00	30.00	12.50	3.50	--	8.00	3.00	2.00	7.25	0.50	--
Annual/Biennial																																								
DESO	--	--	--	7.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.00	15.00	2.00	2.00
LAOC3	--	--	1.50	--	--	--	--	--	2.15	0.50	4.00	6.00	--	--	--	--	--	2.00	--	--	--	--	--	--	--	--	--	--	14.00	--	5.00	8.00	3.10	0.25	0.05	3.00	--	--	3.00	0.05
MATA	0.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SIAL2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.10	--	--	--	2.25	--	T
Annual/Biennial/Perennial																																								
MACA	5.70	--	--	--	--	--	--	--	--	--	0.05	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
CANU3	--	--	--	--	--	--	--	--	--	--	1.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	--	--	2.50	70.00	7.00	5.00	7.25	7.00	38.00	35.00	--	0.20	--	1.50	--	--	--	--	--	--	--	--	8.50	1.75	--	6.50	14.00	23.50	2.00	--
PEPA8	--	--	--	--	3.50	3.00	1.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	1.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.00	--	0.05	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	--	--	--	T	--	--	12.00	--	--	28.50	62.50	38.50	65.00	6.00	8.00	--	0.20	--	--	--	--	--	--	60.00	19.50	--	--	0.60	--	--	--	--	--	--	--	0.10	--	11.00	--
ATCO	--	--	--	--	--	--	--	60.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.75	--	1.50	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	1.10	0.20	--	--	--	--	--	--	--	--	--	0.45	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.40	--	--	--
KRLA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.00	--	--	--	--
Cover Components																																								
Perennial/Biennial Vegetation Cover	71.7	65.2	24.5	16.0	8.2	10.0	6.2	84.5	33.7	12.3	47.6	72.1	45.3	135.2	54.0	36.0	11.7	11.7	38.2	36.0	6.8	18.2	2.0	32.0	117.0	28.7	9.6	21.0	43.9	14.3	50.0	38.0	22.8	25.9	7.1	21.5	37.7	85.3	25.1	28.1
Total Vegetation Cover	72.0	63.5	85.0	78.0	8.5	16.8	30.0	87.5	35.0	13.5	43.1	67.3	49.5	97.5	37.5	44.0	17.5	14.0	45.0	41.0	35.0	35.5	57.0	60.0	77.0	32.0	59.0	55.0	86.0	41.5	70.0	65.5	32.5	54.8	15.0	34.0	75.5	50.0	50.0	27.5
Rock	1.2	6.0	1.5	0.0	3.3	15.0	40.0	8.5	20.0	23.5	0.8	0.1	0.0	0.0	0.0	0.0	0.3	2.3	1.0	0.0	3.3	0.7	0.0	0.0	0.0	16.5	1.5	20.0	0.0	4.0	2.0	0.5	4.3	2.3	40.0	41.0	2.0	3.0	0.5	0.8
Litter	7.0	11.0	6.0	0.0	3.8	1.5	6.5	2.5	3.8	0.5	16.0	28.0	50.5	2.5	60.0	47.0	27.3	1.0	4.0	3.0	2.5	3.3	1.0	10.5	23.0	17.5	9.5	1.0	10.0	4.5	6.0	10.5	3.5	1.5	9.0	5.0	16.3	6.3	38.0	12.0
Base Soil	19.8	19.5	7.5	22.0	84.5	66.8	23.5	1.5	41.2	62.5	40.2	4.6	0.0	0.0	2.5	9.0	55.0	82.8	50.0	56.0	59.3	60.5	42.0	29.5	0.0	34.0	30.0	24.0	4.0	50.0	22.0	23.5	59.8	41.5	36.0	20.0	6.3	40.8	11.5	59.8

Notes:
Species codes defined in Table 3

Table A-2: M-VMU-3 Basal Cover Data

Transcect	M-VMU-3-T1P				M-VMU-3-T2P				M-VMU-3-T3P				M-VMU-3-T4P				M-VMU-3-T5P				M-VMU-3-T6P				M-VMU-3-T7P				M-VMU-3-T8P				M-VMU-3-T9P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Annuals																																								
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	T	T	--	--	--	--	--	0.15	--	--	3.60	--	0.05	T
BRAR5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--	--	--	--	--	--
Perennials																																								
ACHY	--	--	--	--	--	T	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	T	2.00	T	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	4.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	0.10	--	--	--	--	--	--	--	T	0.05	--	--	T	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	0.25	0.15	--	--	T	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	0.40	--	--	--	--	--	--	--	T	--	--
HOJU	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.00	0.05	--	--	--	--
PASM	0.55	1.85	2.00	1.00	0.20	0.30	0.10	0.25	--	--	--	--	0.05	T	2.00	1.00	0.10	0.15	--	--	0.70	0.20	T	0.05	3.50	0.50	0.05	--	0.30	0.55	T	--	0.80	1.00	--	0.50	0.15	--	T	T
PLJA	3.50	2.25	--	--	--	--	--	1.25	4.00	1.00	3.00	--	--	--	--	--	--	--	--	--	--	2.70	--	2.00	--	--	0.20	0.75	2.60	0.25	3.50	3.00	--	--	--	--	0.30	20.00	0.05	5.00
PSSP6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.35	--	--
SPCR	0.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	9.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annuals																																								
CHAL7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	T	--	--	--	--	--	--	--	--	--
CHIN2	--	--	--	--	--	T	--	T	--	--	--	T	--	--	--	--	T	--	--	T	0.65	0.25	0.10	0.05	--	--	--	--	--	--	--	0.05	0.15	T	T	0.05	--	T	--	--
CHLE4	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	0.05	--	--
CRCR3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.45	0.20	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERDI5	--	--	--	--	--	--	--	--	0.10	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	0.10	0.05	--	--	--	--	--	--	--	--	--	--	--	--
HEAN3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	1.00	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	0.05	--	--	--	--	--	--	--	--	--	0.10	0.05	T	0.50	--	T	0.50	T	T	--	--	--	T	0.10	0.05	T	0.10	--	T	--	--	--	--	--	--	--	--	--
MAFE	--	--	--	--	--	--	--	--	T	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--
POER2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.15	T	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	0.05	0.05	2.00	2.00	T	0.05	--	T	0.05	--	--	T	--	--	T	--	0.10	0.05	T	--	0.10	T	0.07	T	--	T	T	T	0.10	0.15	0.05	T	0.20	--	T	T	0.05	0.10	T	--
Annual/Biennial																																								
DESO	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.05	T	T
LAOC3	--	--	T	--	--	--	--	--	T	T	T	0.05	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	0.15	--	T	0.05	0.05	T	T	T	--	--	T	T
MATA	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SIAL2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	T	--	T
Annual/Biennial/Perennial																																								
MACA	0.05	--	--	--	--	--	--	--	--	--	T	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
CANU3	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	--	--	0.05	0.75	T	T	0.15	0.10	1.50	2.50	--	T	--	T	--	--	--	--	--	--	--	--	0.45	T	--	0.05	0.25	1.00	T	--
PEPA8	--	--	--	--	0.10	0.05	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--	T	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	--	--	--	T	--	--	1.00	--	--	0.80	0.60	2.75	2.30	0.50	1.00	--	T	--	--	--	--	--	--	1.50	0.30	--	--	0.05	--	--	--	--	--	--	--	T	--	1.00	--
ATCO	--	--	--	--	--	--	--	3.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.15	--	T	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	T	T	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--
KRLA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.75	--	--	--	--
Cover Components																																								
Total Vegetation Cover	13.9	8.3	4.2	3.0	0.6	0.6	1.1	5.0	4.2	1.0	3.8	0.7	3.2	3.1	2.5	2.5	0.4	0.3	2.0	2.5	1.7	3.6	0.5	2.2	5.0	1.0	0.5	2.8	3.4	1.4	3.6	3.1	1.7	1.6	1.0	1.4	4.7	21.6	1.1	5.0
Rock	3.5	10.0	5.0	0.5	7.1	17.0	50.0	8.5	21.5	24.0	1.0	0.5	0.0	0.5	0.0	0.0	0.3	2.4	1.0	0.0	4.3	1.4	0.0	0.1	0.0	19.6	20.0	35.0	0.5	4.8	4.0	2.0	5.8	2.3	45.0	41.0	4.0	3.5	0.8	0.8
Litter	49.2	51.8	75.0	6.5	3.9	5.7	6.5	85.0	28.9	11.5	48.0	85.0	96.9	96.4	95.0	87.5	29.3	2.0	17.0	37.5	12.4	15.8	2.0	31.0	95.0	38.0	14.0	2.0	61.0	22.7	22.0	17.5	13.4	54.0	10.0	13.6	59.0	32.3	86.7	22.0
Base Soil	33.5	30.0	15.9	90.0	88.5	76.8	42.4	1.5	45.5	63.5	47.2	13.8	0.0	0.0	2.5	10.0	70.0	95.3	80.0	60.0	81.8	79.3	97.5	66.8	0.0	41.5	65.6	60.2	35.2	71.3	70.5	77.4	79.3	42.2	44.0	44.0	32.4	42.7	11.5	72.3

Notes:
Species codes defined in Table 3

Table A-3: M-VMU-3 Frequency Data

Transect	M-VMU-3-T1P				M-VMU-3-T2P				M-VMU-3-T3P				M-VMU-3-T4P				M-VMU-3-T5P				M-VMU-3-T6P				M-VMU-3-T7P				M-VMU-3-T8P				M-VMU-3-T9P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Annuals																																								
BRAR5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	5	10	--	--	--	--	--	80	--	--	70	--	95	6
Perennials																																								
ACHY	--	--	--	--	--	1	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	18	2	18	3	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	2	--	--	--	--	--	--	--	1	30	--	--	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	20	20	--	--	2	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	3	--	--
HOJU	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	31	3	--	--	--	--
PASM	18	52	29	10	8	27	13	13	--	--	--	--	9	3	25	16	15	5	--	--	18	8	2	7	190	11	3	--	12	12	5	--	29	28	--	6	19	--	9	4
PLJA	70	20	--	--	--	--	--	23	42	29	47	--	--	--	--	--	--	--	--	--	--	31	--	33	--	--	10	9	45	5	45	40	--	--	--	--	17	65	40	80
PSSP6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16	--	--
SPCR	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annuals																																								
CHAL7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--	1	--	--	--	--	--	--	--	--	--
CHIN2	--	--	--	--	--	1	--	3	--	--	--	3	--	--	--	--	1	--	--	2	20	34	5	40	--	--	--	--	--	--	--	15	16	2	1	11	--	2	--	--
CHLE4	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	1	--	--
CRCR3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	16	2	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERDI5	--	--	--	--	--	--	--	--	38	11	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	54	30	--	--	--	--	--	--	--	--	--	--	--	--
HEAN3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	19	26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	6	--	--	--	--	--	--	--	--	--	17	15	3	7	--	1	10	13	1	--	--	--	5	17	11	1	4	--	1	--	--	--	--	--	--	--	--	--
MAFE	--	--	--	--	--	--	--	--	1	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
POER2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	29	24	80	188	2	5	--	3	4	--	--	1	--	--	1	--	12	5	1	--	13	4	7	1	--	3	2	4	7	12	3	4	1	--	2	2	1	8	3	--
Annual/Biennial																																								
DESO	--	--	--	28	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	1	10	1
LAOC3	--	--	2	--	--	--	--	--	9	3	11	52	--	--	--	--	--	7	--	--	--	--	--	--	--	--	--	--	3	--	3	6	5	2	1	1	--	--	5	1
MATA	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SIAL2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	1	--	1
Annual/Biennial/Perennial																																								
MACA	1	--	--	--	--	--	--	--	--	--	1	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
CANU3	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	--	--	11	72	3	3	50	21	180	320	--	1	--	1	--	--	--	--	--	--	--	--	6	15	--	6	58	20	6	--
PEPA8	--	--	--	--	19	15	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	2	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	--	--	--	1	--	--	1	--	--	5	5	5	1	5	5	--	1	--	--	--	--	--	--	5	6	--	--	10	--	--	--	--	--	--	--	1	--	1	--
ATCO	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	1	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	2	2	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--
KRLA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	--	--	--	--

Notes:
Species codes defined in Table 3

GOLDER

Table A-4: M-VMU-3 Air-dry Aboveground Annual Production Data

Transect	M-VMU-3-T1P				M-VMU-3-T2P				M-VMU-3-T3P				M-VMU-3-T4P				M-VMU-3-T5P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses (g/m^2)																				
Non-Forage																				
BRAR5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRTE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.51
Forage																				
ACHY	--	--	--	--	--	0.31	1.41	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	39.31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	1.71	--	--	--	--	--	--	--	0.00	4.81	--	--	0.81	--	0.00	--	--	--
HECO26	--	--	--	--	2.21	6.71	--	--	0.31	--	--	--	--	--	--	--	0.41	--	--	--
HOJU	--	--	--	--	--	--	--	--	--	--	--	--	1.91	--	--	--	--	--	--	--
LEAM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	40.81	46.01	104.81	26.91	4.71	14.01	12.51	11.11	--	--	--	--	8.71	0.21	63.01	46.41	13.61	14.51	--	--
PLJA	107.51	35.61	--	--	--	--	--	16.31	54.11	33.01	36.61	--	--	--	--	--	--	--	--	--
PSSP6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCR	1.31	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	173.82	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.41	--	--	--
Forbs (g/m^2)																				
Non-forage																				
CHAL7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHIN2	--	--	--	--	--	0.91	--	0.41	--	--	--	0.81	--	--	--	--	0.51	--	--	10.41
CHLE4	--	--	--	--	--	--	--	--	--	--	--	--	--	0.21	--	--	--	--	--	--
CRCR3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERDI5	--	--	--	--	--	--	--	--	5.01	0.91	--	--	--	--	--	--	--	--	--	--
HEAN3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	46.71	8.91	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	9.71	--	--	--	--	--	--	--	--	--	26.91	13.21	2.01	27.61	--	2.01	33.71	17.51
MAFE	--	--	--	--	--	--	--	--	0.51	--	--	1.01	--	--	--	--	--	--	--	--
POER2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	4.51	1.41	1.21	376.53	6.41	20.81	--	0.61	0.00	--	--	0.31	--	--	1.15	--	10.71	5.21	3.01	--
Forage																				
CANU3	--	--	--	--	--	--	--	--	--	--	2.21	--	--	--	--	--	--	--	--	--
DESO	--	--	--	13.01	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LAOC3	--	--	1.01	--	--	--	--	--	1.91	0.51	8.81	4.81	--	--	--	--	--	3.21	--	--
MACA	9.71	--	--	--	--	--	--	--	--	--	0.91	0.91	--	--	--	--	--	--	--	--
MATA	0.71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	--	--	1.71	17.01	8.81	4.11	8.81	5.11	34.31	30.21
PEPA8	--	--	--	--	3.51	4.61	1.01	--	--	--	--	--	--	--	--	--	--	--	--	--
SIAL2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.51	2.51
Shrubs, Trees and Cacti (g/m^2)																				
Forage																				
ATCA	--	--	--	--	0.00	--	--	46.61	--	--	156.91	255.32	152.62	280.72	24.01	19.61	--	0.71	--	--
ATCO	--	--	--	--	--	--	--	205.81	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	0.41	--	--	--	--	--	--	--	--	--	--
GUSA	1.31	0.61	--	--	--	--	--	--	--	--	--	1.01	--	--	--	--	--	--	--	--
KRLA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Above Ground Biomass (g/m^2)																				
Non-forage	4.51	1.41	10.92	376.53	6.41	21.72	46.71	9.93	5.52	0.91	0.00	2.13	26.91	13.42	3.16	27.61	11.22	7.22	36.72	28.43
Forage	335.18	121.54	107.53	39.92	10.43	25.64	14.93	279.84	56.33	33.93	205.45	266.86	164.95	297.94	96.64	70.13	30.24	23.54	34.82	32.72
Total Production	339.69	122.95	118.45	416.45	16.84	47.36	61.64	289.77	61.85	34.84	205.45	268.99	191.86	311.36	99.80	97.74	41.46	30.76	71.54	61.15
Total Above Ground Biomass (lbs/ac)																				
Non-forage	40	13	97	3359	57	194	417	89	49	8	0	19	240	120	28	246	100	64	328	254
Forage	2990	1084	959	356	93	229	133	2497	503	303	1833	2381	1472	2658	862	626	270	210	311	292
Total Production	3031	1097	1057	3715	150	423	550	2585	552	311	1833	2400	1712	2778	890	872	370	274	638	546

Transect	M-VMU-3-T6P				M-VMU-3-T7P				M-VMU-3-T8P				M-VMU-3-T9P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses (g/m^2)																				
Non-Forage																				
BRAR5	--	--	--	--	--	--	--	--	--	--	--	--	--	14.01	--	--	--	--	--	--
BRTE	--	--	--	--	--	--	1.71	1.61	--	--	--	--	--	6.31	--	--	38.31	--	29.61	2.51
Forage																				
ACHY	--	--	--	--	--	2.11	0.51	23.81	1.31	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	--	--	--	--	--	--	--	0.41	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	--	--	--	--	--	9.91	--	--	--	--	--	--	--	0.51	--	--
HOJU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LEAM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24.11	1.21	--	--	--	--
PASM	10.31	6.81	2.21	5.41	47.31	27.61	7.51	--	16.61	22.91	7.81	--	26.51	32.31	--	17.61	12.51	--	5.71	3.01
PLJA	--	45.21	--	32.71	--	--	12.31	11.81	39.21	4.11	103.11	92.71	--	--	--	--	1.51	65.01	17.61	36.31
PSSP6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.31	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.41	--	--
SPCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs (g/m^2)																				
Non-forage																				
CHAL7	--	--	--	--	--	--	64.91	--	--	--	3.51	--	--	--	--	--	--	--	--	--
CHIN2	46.31	18.91	44.71	37.51	--	--	--	--	--	--	--	37.61	35.91	2.21	0.41	76.91	--	1.71	--	--
CHLE4	--	--	--	--	--	--	--	--	8.01	--	--	--	--	--	--	--	--	2.81	--	--
CRCR3	7.51	15.51	21.71	23.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERDI5	--	--	--	--	--	1.91	28.01	50.91	--	--	--	--	--	--	--	--	--	--	--	--
HEAN3	--	--	--	5.71	--	7.41	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	2.01	--	--	--	0.51	3.91	18.21	1.61	50.31	--	2.41	--	--	--	--	--	--	--	--	--
MAFE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.71	--	--
POER2	4.51	1.01	2.51	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	3.71	1.81	36.51	0.71	--	0.91	13.51	5.71	119.71	111.91	100.41	40.01	7.91	--	33.41	15.31	1.61	29.71	1.01	--
Forage																				
CANU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
DESO	--	4.21	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.51	13.01	7.11	2.31
LAOC3	--	--	--	--	--	--	--	--	28.51	--	12.11	23.01	2.11	0.71	0.71	10.61	--	--	4.21	0.91
MACA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MATA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	0.91	--	0.71	--	--	--	--	--	--	--	--	6.41	1.11	--	12.01	6.21	14.81	1.51	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SIAL2	--	--	--	--	--	--	--	--	--	--	--	--	--	1.71	--	--	--	1.61	--	0.61
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.11	--	1.21	--
Shrubs, Trees and Cacti (g/m^2)																				
Forage																				
ATCA	--	--	--	--	117.91	85.01	--	--	2.71	--	--	--	--	--	--	--	0.21	--	48.71	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	13.11	--	6.21	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.81	--	--	--
KRLA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.11	--	--	--	--
Total Above Ground Biomass (g/m^2)																				
Non-forage	64.05	37.24	105.44	67.74	0.51	14.14	126.35	59.84	178.03	111.91	106.33	77.62	43.82	22.53	33.82	92.22	39.92	34.94	30.62	2.51
Forage	10.31	57.14	2.21	38.83	165.22	114.73	20.33	35.62	88.76	36.93	123.03	115.72	35.03	48.95	24.82	64.76	33.87	98.36	86.38	43.15
Total Production	74.36	94.38	107.65	106.57	165.73	128.87	146.68	95.46	266.79	148.84	229.36	193.34	78.85	71.48	58.64	156.98	73.79	133.30	117.00	45.66
Total Above Ground Biomass (lbs/ac)																				
Non-forage	571	332	941	604	5	126	1127	534	1588	998	949	693	391	201	302	823	356	312	273	22
Forage	92	510	20	346	1474	1024	181	318	792	329	1098	1032	313	437	221	578	302	878	771	385
Total Production	663	842	960	951	1479	1150	1309	852	2380	1328	2046	1725	703	638	523	1401	658	1189	1044	407

Notes:
Species codes defined in Table 3
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-5: M-VMU-3 Shrub Belt Transect Data

Transect	M-VMU-3-T1P	M-VMU-3-T2P	M-VMU-3-T3P	M-VMU-3-T4P	M-VMU-3-T5P	M-VMU-3-T6P	M-VMU-3-T7P	M-VMU-3-T8P	M-VMU-3-T9P	M-VMU-3-T10P
Shrubs, Trees and Cacti										
ATAC	--	--	--	--	--	--	4	--	--	--
ATCA	3	4	50	49	9	--	14	7	3	15
ATCO	--	4	--	--	--	--	--	2	--	--
ATCO4	--	1	4	--	--	--	--	--	3	--
ATRIP	--	4	--	--	--	--	--	--	4	--
EPVI	--	2	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	1	--	--	--	--	--
KRLA	--	--	--	--	--	--	4	--	1	--
OPPO	--	--	--	--	--	--	--	--	--	1

Notes:

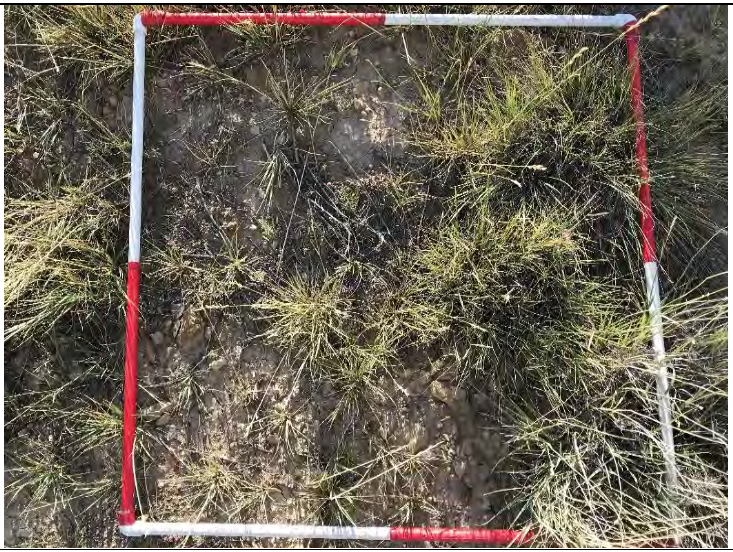
Code	Scientific Name	Common Name
ATAC	*Atriplex acanthocarpa*	Tubercled saltbush
ATCA	*Atriplex canescens*	Four-wing saltbush
ATCO	*Atriplex confertifolia*	Shadscale saltbush
ATCO4	*Atriplex corrugata*	Mat saltbush
ATRIP	*Atriplex sp.*	Undifferentiated saltbush species
EPVI	*Ephedra viridis*	Mormon tea
ERNA	*Ericameria nauseosa*	Rubber rabbitbrush
KRLA	*Krascheninnikovia lanata*	Winterfat
OPPO	*Opuntia polyacantha*	Plains pricklypear

APPENDIX B

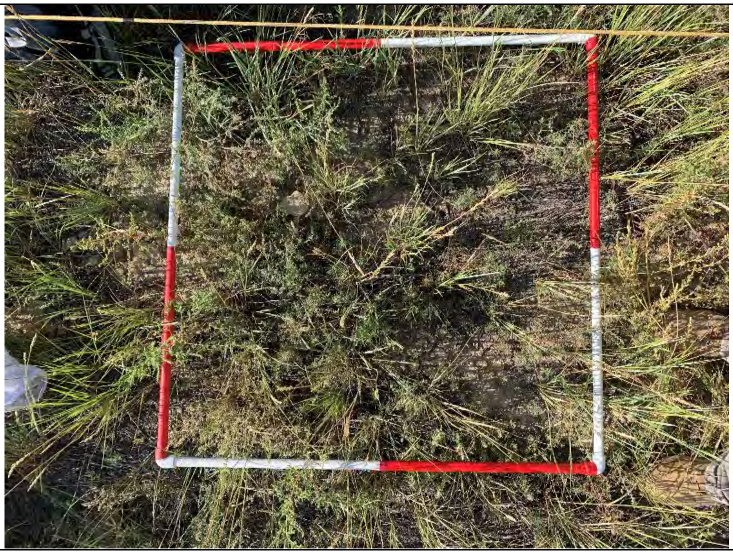
Quadrat Photographs

M-VMU-3-T1P

Q1



Q2



Q3

Q4

M-VMU-3-T2P	
	
Q1	Q2
	
Q3	Q4

<table>
<tr><th colspan="2">M-VMU-3-T3P</th></tr>
<tr><td></td><td></td></tr>
<tr><td>Q1</td><td>Q2</td></tr>
<tr><td></td><td>No Photo</td></tr>
<tr><td>Q3</td><td>Q4</td></tr>
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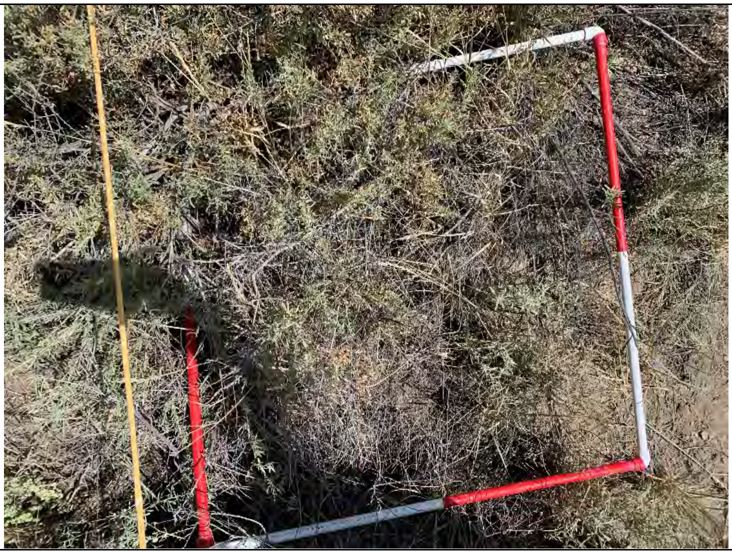
M-VMU-3-T4P

Q1

Q2



Q3

Q4

M-VMU-3-T5P	
	
Q1	Q2
	No Photo
Q3	Q4

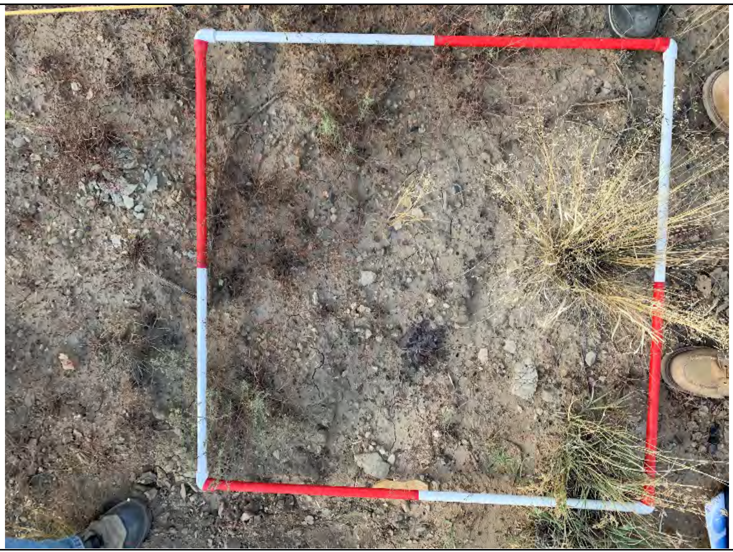
M-VMU-3-T6P

Q1

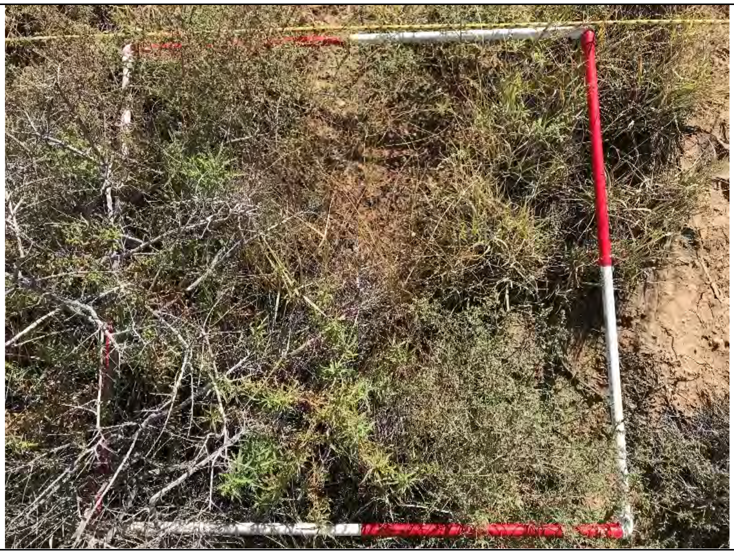
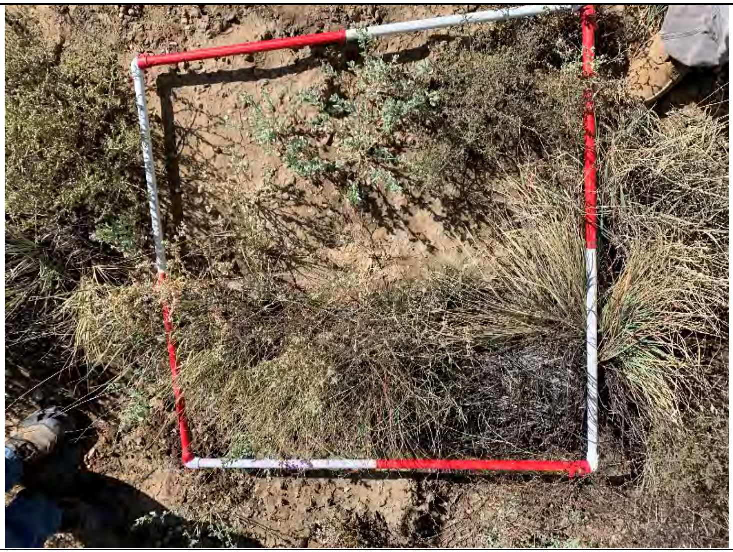
Q2

Q3

Q4

M-VMU-3-T7P	
	
Q1	Q2
No Photo	
Q3	Q4

M-VMU-3-T8P

	
Q1	Q2
	
Q3	Q4

M-VMU-3-T9P	
	
Q1	Q2
	No Photo
Q3	Q4

M-VMU-3-T10P

Q1

Q2

Q3

Q4

APPENDIX C

Vegetation Statistical Analysis

Figure C-1: Pernnial/Biennial Cover Descriptive Statistics and Normality

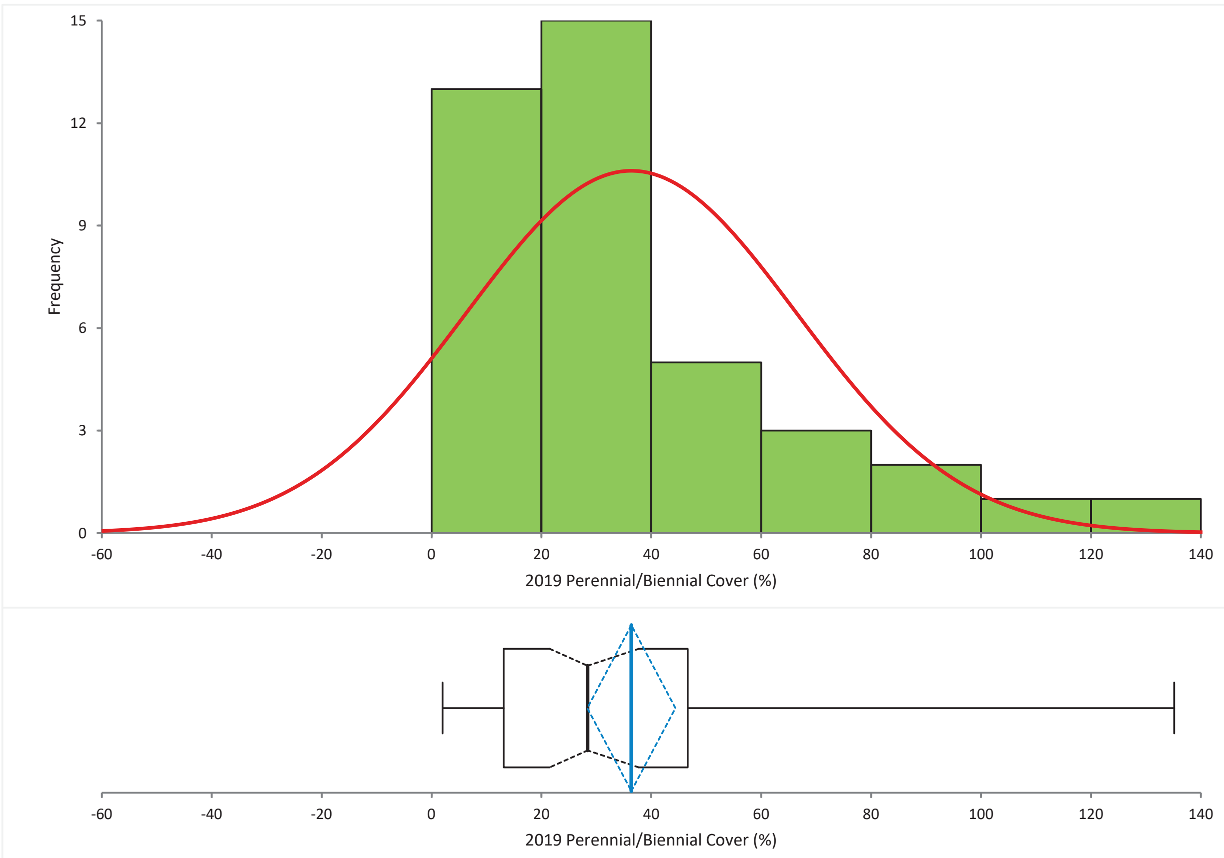
Distribution: 2019 Perennial/Biennial Cover

Analyse-it v5.40.2

M-VMU3_HypTest-RAWDATA-2019 A1:F41
Filter: No filter

Last updated 5 February 2020 at 10:49 by Ward, Dustin

Descriptives

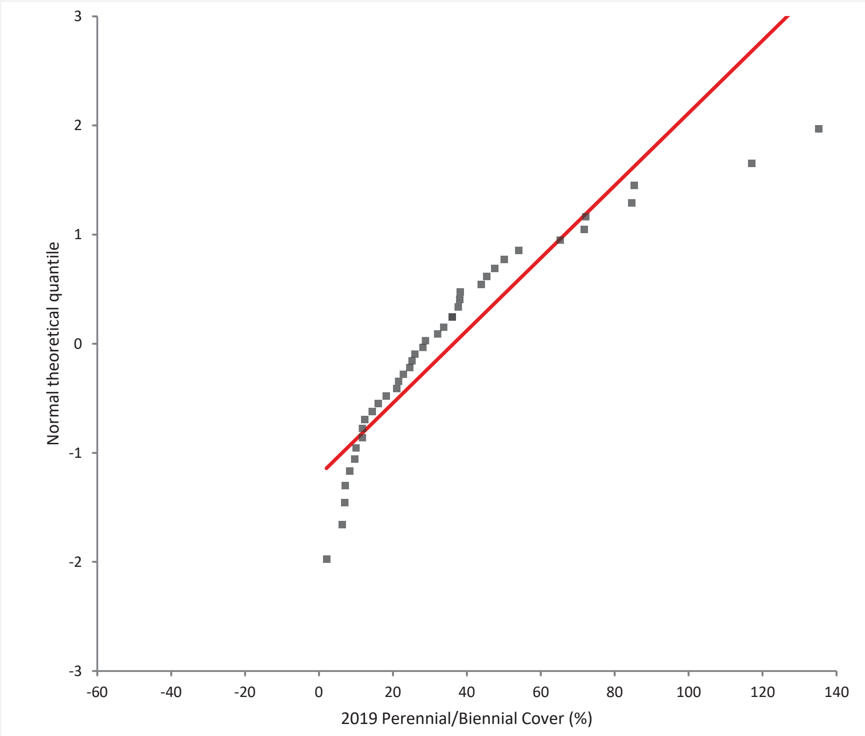


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
2019 Perennial/Biennial Cover (%)	36.36	28.35 to 44.38	4.759	30.10	1.6	2.58

Figure C-1: Pernnial/Biennial Cover Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.85
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-2: Annual Forage Production Descriptive Statistics and Normality

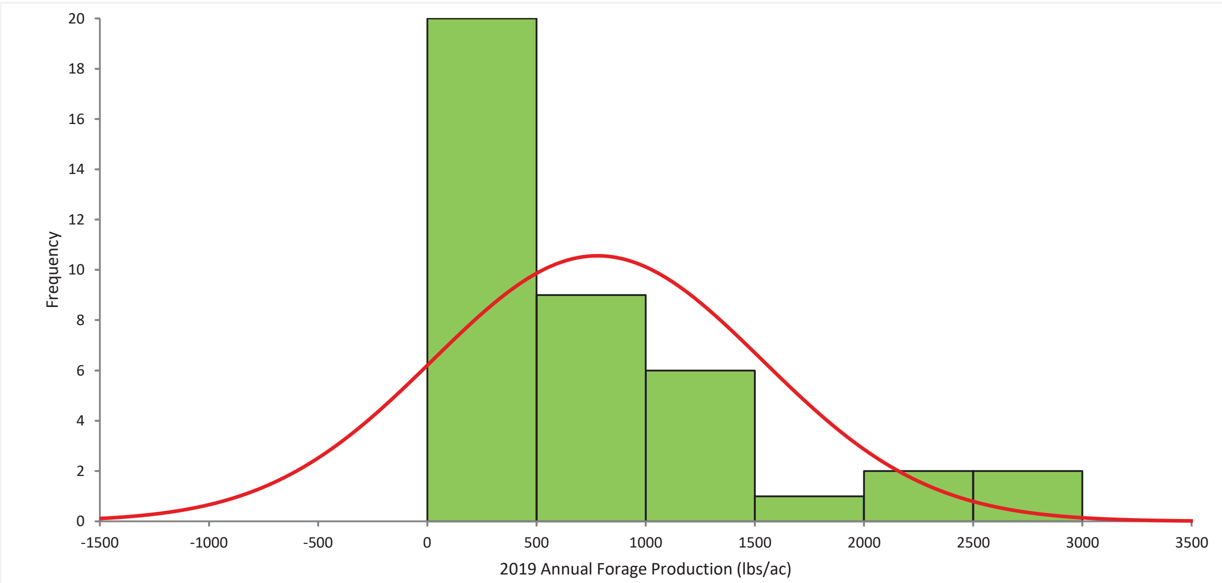
Distribution: 2019 Annual Forage Production

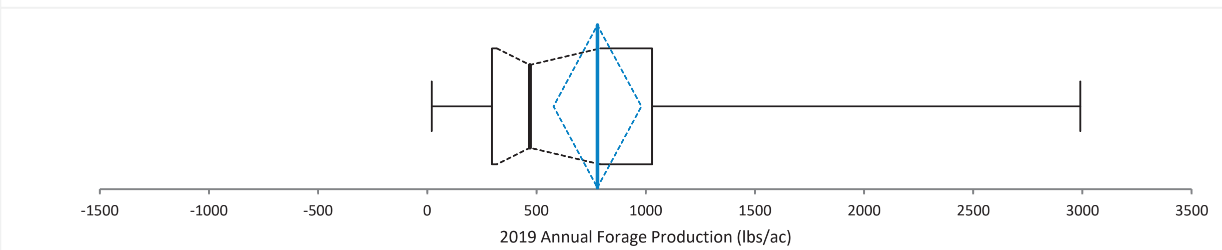
Analyse-it v5.40.2

M-VMU3_HypTest-RAWDATA-2019 A1:F41
Filter: No filter

Last updated 5 February 2020 at 13:06 by Ward, Dustin

Descriptives





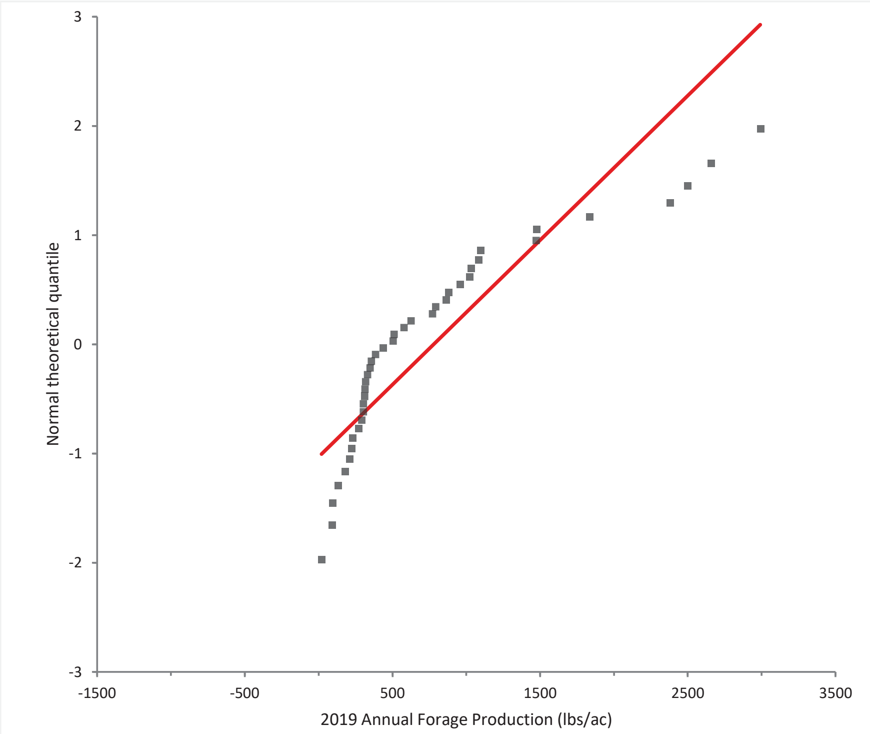
N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
2019 Annual Forage Production (lbs/ac)	779.03	577.75 to 980.32	119.466	755.57	1.6	1.83

GOLDER

Figure C-2: Annual Forage Production Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.80
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-3: Shrub Density by the Belt Transect Method Descriptive Statistics and Normality

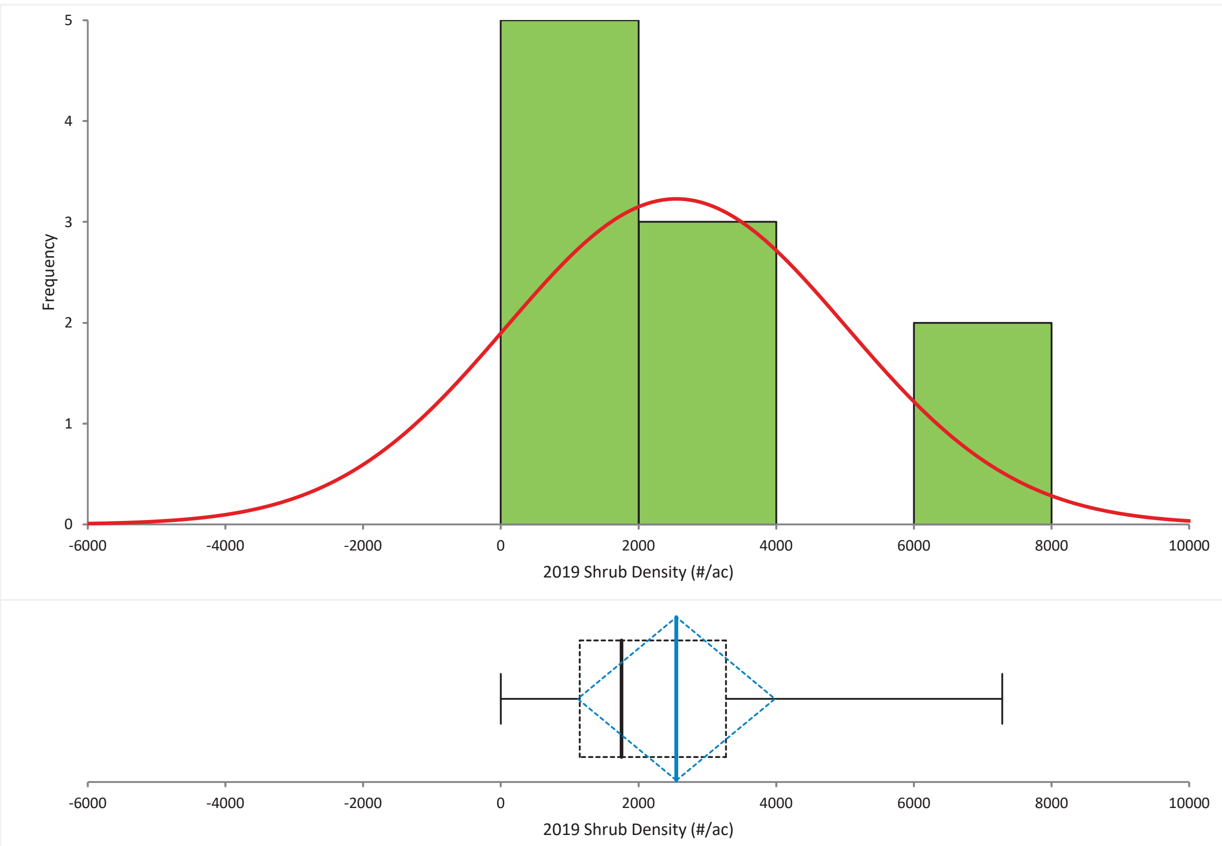
Distribution: 2019 Shrub Density

Analyse-it v5.40.2

M-VMU3_HypTest-RAWDATA-2019 A1:F41
Filter: No filter

Last updated 24 January 2020 at 14:39 by Ward, Dustin

Descriptives

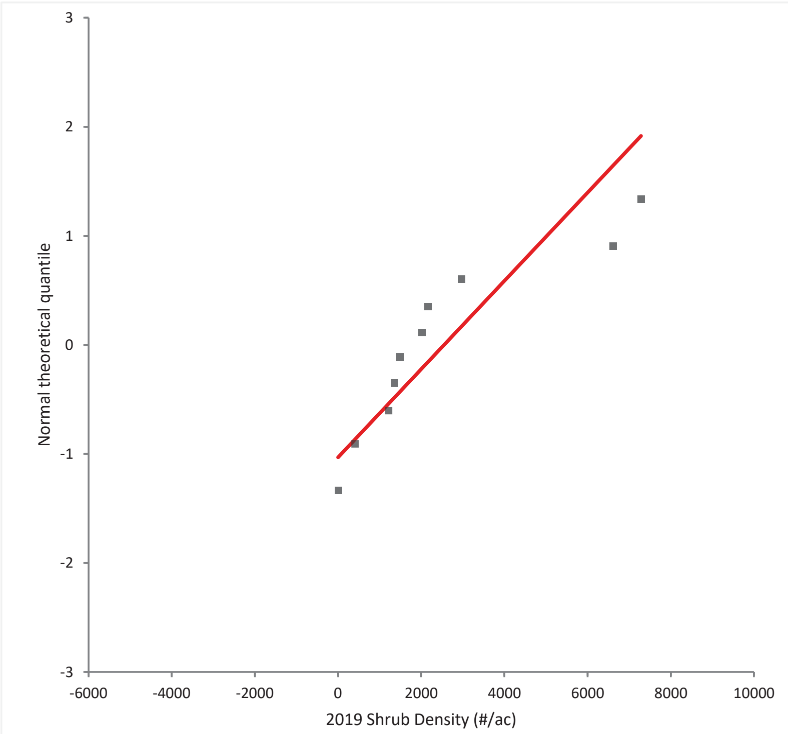


N	10

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
2019 Shrub Density (#/ac)	2.549522E+03	1.116895E+03 to 3.982149E+03	7.815267E+02	2.471405E+03	1.3	0.60

Figure C-3: Shrub Density by the Belt Transect Method Descriptive Statistics and Normality

Normality



Shapiro-Wilk test

W statistic	0.82
p-value	0.0260 [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.

Table C-1: Perennial/Biennial Canopy Cover, Method 5 - CMRP

Transect	Quad	2019 Perennial/Biennial Cover (%)	90% of Technical Standard	P/B CVR minus TS
M-VMU-3-T1P	1	71.7	13.5	58.2
	2	65.2	13.5	51.7
	3	24.5	13.5	11.0
	4	16.0	13.5	2.5
M-VMU-3-T2P	1	8.2	13.5	-5.3
	2	10.0	13.5	-3.6
	3	6.2	13.5	-7.3
	4	84.5	13.5	71.0
M-VMU-3-T3P	1	33.7	13.5	20.2
	2	12.3	13.5	-1.2
	3	47.6	13.5	34.1
	4	72.1	13.5	58.6
M-VMU-3-T4P	1	45.3	13.5	31.8
	2	135.2	13.5	121.7
	3	54.0	13.5	40.5
	4	36.0	13.5	22.5
M-VMU-3-T5P	1	11.7	13.5	-1.9
	2	11.7	13.5	-1.8
	3	38.2	13.5	24.7
	4	36.0	13.5	22.5
M-VMU-3-T6P	1	6.8	13.5	-6.7
	2	18.2	13.5	4.7
	3	2.0	13.5	-11.5
	4	32.0	13.5	18.5
M-VMU-3-T7P	1	117.0	13.5	103.5
	2	28.7	13.5	15.2
	3	9.6	13.5	-3.9
	4	21.0	13.5	7.5
M-VMU-3-T8P	1	43.9	13.5	30.4
	2	14.3	13.5	0.8
	3	50.0	13.5	36.5
	4	38.0	13.5	24.5
M-VMU-3-T9P	1	22.8	13.5	9.3
	2	25.9	13.5	12.4
	3	7.1	13.5	-6.5
	4	21.5	13.5	8.0
M-VMU-3-T10P	1	37.7	13.5	24.2
	2	85.3	13.5	71.8
	3	25.1	13.5	11.6
	4	28.1	13.5	14.6
			k	10
			n	40
			z	-3.00
			Standard one-tailed normal curve area (Table C-3; MMD, 1999)	0.4987
			P	0.0013

Notes:
P/B CVR = Perennial/Biennial Cover
TS = 90% of the Technical Standard for Perennial/Biennial Cover
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-2: Forage Production, Method 5 - CMRP

Transect	Quad	2019 Annual Forage Production (lbs/ac)	90% of Technical Standard	FP minus TS
M-VMU-3-T1P	1	2990.4	315	2675.4
	2	1084.4	315	769.4
	3	959.4	315	644.4
	4	356.2	315	41.2
M-VMU-3-T2P	1	93.1	315	-221.9
	2	228.8	315	-86.2
	3	133.2	315	-181.8
	4	2496.7	315	2181.7
M-VMU-3-T3P	1	502.6	315	187.6
	2	302.7	315	-12.3
	3	1833.0	315	1518.0
	4	2380.9	315	2065.9
M-VMU-3-T4P	1	1471.7	315	1156.7
	2	2658.2	315	2343.2
	3	862.2	315	547.2
	4	625.7	315	310.7
M-VMU-3-T5P	1	269.8	315	-45.2
	2	210.0	315	-105.0
	3	310.7	315	-4.3
	4	291.9	315	-23.1
M-VMU-3-T6P	1	92.0	315	-223.0
	2	509.8	315	194.8
	3	19.7	315	-295.3
	4	346.4	315	31.4
M-VMU-3-T7P	1	1474.1	315	1159.1
	2	1023.6	315	708.6
	3	181.4	315	-133.6
	4	317.8	315	2.8
M-VMU-3-T8P	1	791.9	315	476.9
	2	329.5	315	14.5
	3	1097.7	315	782.7
	4	1032.4	315	717.4
M-VMU-3-T9P	1	312.5	315	-2.5
	2	436.7	315	121.7
	3	221.4	315	-93.6
	4	577.8	315	262.8
M-VMU-3-T10P	1	302.2	315	-12.8
	2	877.6	315	562.6
	3	770.7	315	455.7
	4	385.0	315	70.0
			k	14
			n	40
			z	-1.74
			Standard one-tailed normal curve area (Table C-3; MMD, 1999)	0.4591
			P	0.0409

Notes:
FP = Forage Production
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-3: Shrub Density by the Belt Transect Method, Method 5 - CMRP

Transect	2019 Shrub Density (#/ac)	90% of Technical Standard	SD minus TS
M-VMU-3-T1P	2158.3	135	2023.3
M-VMU-3-T2P	404.7	135	269.7
M-VMU-3-T3P	2023.4	135	1888.4
M-VMU-3-T4P	7284.3	135	7149.3
M-VMU-3-T5P	6609.9	135	6474.9
M-VMU-3-T6P	1349.0	135	1214.0
M-VMU-3-T7P	0.0	135	-135.0
M-VMU-3-T8P	2967.7	135	2832.7
M-VMU-3-T9P	1214.1	135	1079.1
M-VMU-3-T10P	1483.8	135	1348.8
		k	1
		n	10
		z	-2.21
Standard one-tailed normal curve area (Table C-3; MMD, 1999)			0.4864
		P	0.0136

Notes:
SD = Shrub Density
TS = 90% of the Technical Standard for Woody Stem Stocking
P = 0.5-Area = prob of observing z; <=0.1 performance standard met
z value calculation:

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

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REPORT

Vegetation Management Unit 3
Vegetation Success Monitoring, 2020

McKinley Mine, New Mexico - Mining and Minerals Division Permit Area

Submitted to:

Chevron Environmental Management Company

Chevron Mining Inc. - McKinley Mine
24 Miles NW HWY 264
Mentmore, NM 87319

Submitted by:

Golder Associates Inc.

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February 22, 2021

Revised April 19, 2023

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1.0 INTRODUCTION

Mining was completed in Mining and Minerals Division (MMD) jurisdictional lands at the McKinley Mine in 2007; most of the land is reclaimed, with only the facilities remaining. The lands mined and reclaimed included prelaw, initial-program, and permanent-program lands. Liability release has been completed on all prelaw and initial-program lands, and full bond release on a limited amount of permanent-program land.

Chevron Mining Inc. (CMI) is assessing the vegetation in the remaining permanent-program reclaimed areas in anticipation of future bond and liability releases. 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 use of grazing and wildlife. The increment, or permit area as a whole, must meet vegetation establishment responsibility period criteria, which is a minimum of 10 years. Golder Associates Inc. (Golder) was retained to monitor and assess the vegetation relative to the established vegetation success standards in Permit # 2016-02.

1.1 Vegetation Management Unit 3

This report presents results from 2020 quantitative vegetation monitoring conducted in Vegetation Management Unit 3 (M-VMU-3), comprising about 1,275 acres within Area 9 north and parts of Area 9 south (Figure 1). The elevation in this area ranges from about 6,700 to 7,000 feet above mean sea level. Permanent program reclamation in Area 9 started on lands disturbed after 1986, and reclamation generally was completed by 2009. Thus, reclamation age in the majority of M-VMU-3 ranges from 8 to more than 30 years old. The configuration of the vegetation monitoring units within the MMD Permit Area, shown on Figure 1 were developed in consultation with MMD. 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 McKinley's annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation methods applied in Area 9 included grading of the spoils to achieve a stable configuration, positive drainage and approximate original contour. Graded spoil monitoring was then conducted to verify that the upper 42 inches of spoil were suitable for plant growth or if it required mitigation to establish a suitable root zone. A minimum of 6 inches of topsoil or topsoil substitute were then applied over suitable spoils.

After topsoil or topdressing placement, the surface was scarified in preparation for planting. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, mulch consisting of either hay or straw was applied at a rate of about 2 tons/acre. The mulch was anchored 3 to 4 inches into the soil with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which coincided with logical units for seeding that had been topdressed over the spring and summer. 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 of alfalfa and cool-season grasses. Over time the seed mixes shifted to include more warm-season grasses and a broader variety of native forbs.

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 South Mine Area has experienced several drought years recently and 2020 was characteristic of an exceptional drought year. Total annual precipitation has been below the regional average (about 11.8 inches at Window Rock) for the last five years (Table 1). Annual precipitation for 2020 was almost 55% (6.44 inches) of the long-term average for the region and monsoonal precipitation was well below average (about 27% of average). Figure 1 shows the location of the precipitation gages used for the South Mine. Departure of growing season precipitation (April through September) from long-term seasonal mean at Window Rock (1937-1999) for McKinley is shown on Figure 2 based on the South Tipple and Rain 9 gages. For the South Tipple rain gage, growing season precipitation has been 0.34 to 4.86 inches below average for the last four years. For the Rain 9 gage growing season precipitation from 2015 to 2020 has been below average in all years but 2015, when growing season total precipitation was 0.85 inches above average. Spatial variability is characteristic of monsoonal precipitation patterns during the growing season at McKinley Mine. At a little over 2 miles apart the Rain 9 gage appeared to receive much less precipitation in August and September in 2016, when compared to the South Tipple gage (Table 1). In 2016 growing season precipitation was 0.44 inches above average at the South Tipple gage, compared to 2.52 inches below average at the Rain 9 gage (Figure 2). From 2015 to 2020, precipitation during the peak growing season months has been variable with a pronounced deficit during the monsoon season. For example, comparing the Rain 9 gage to the other South Mine gages, August 2020 saw the least amount of precipitation (0.06 inches) which is less than 5% of normal for the month (2.05 inches).

1.4 Objectives

The intent of this report is to document the vegetation community attributes in M-VMU-3 and compare them to the Permit vegetation success criteria. Section 2 describes the vegetation monitoring methods that were used in 2020. Section 3 presents the results of the investigation with respect to ground cover, annual production, shrub density, and composition and diversity. Section 4 is a summary of the results for M-VMU-3 with emphasis on vegetation success.

2.0 VEGETATION MONITORING METHODS

Vegetation attributes on M-VMU-3 in Area 9 were quantified using the methods described in Section 6.5 of the Permit. Fieldwork was conducted at the end of the growing season, but prior to the first killing frost. Vegetation monitoring in M-VMU-3 was conducted between September 10 and 12, 2020.

2.1 Sampling Design

A systematic random sampling procedure employing a transect/quadrat system was used to select sample sites within the reclaimed area. The transect locations were reviewed with MMD in advance of sampling. A 50-square foot grid was imposed over the VMU to delineate vegetation sample plots, and random points created in a geographic information system were used to select plots for vegetation sampling. The locations of randomly selected vegetation plots are shown on Figure 3 for M-VMU-3. In the field, the randomly selected transect locations were assessed in numerical order. If the transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Unsuitable transects were those that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies.

Transects originated from the southeastern corner of the vegetation plot. Each transect was 30 meters (m) long in a dog-leg pattern (Figure 4). Four 1-m^2 quadrats were located at pre-determined intervals along the transect for quantitative vegetation measurements. Each quadrat is considered an individual sample where measurements were made of production, total canopy, species canopy and basal cover, surface litter, surface rock fragments, and bare soil as discussed below.

2.2 Vegetation and Ground Cover

Relative and total canopy cover, basal cover, surface litter, rock fragments, and bare soil were estimated for each quadrat. 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% 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%.

Basal cover is defined as the proportion of the ground occupied by the crowns of grasses and rooting stems of forbs and shrubs. Basal cover estimates were also made for surface litter, rock fragments, and bare soil. Like the total cover estimates, the basal cover estimates do not exceed 100%. All cover estimates were made in 0.05% increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates. Plant frequency was determined on a species-basis by counting the number of individual plants rooted in each quadrat.

2.3 Annual Forage and Biomass 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. 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). For this sampling event, plants that were less than 5 cm tall or considered volumetrically insignificant were not collected. Production from shrubs was determined by clipping the current year's growth.

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 pounds per acre (lbs/ac) basis.

2.4 Shrub Density

Shrub density, or the number of plants per square meter, was determined using the frequency count data from the quadrats and the belt transect method (Bonham 1989). Shrub density was calculated from the quadrat data by dividing the total number of individual plants counted by the number of quadrats measured. The density per square meter was converted to density per acre.

Shrub density was also determined using a belt transect method (Bonham 1989). Shrub density was determined from a 1-meter wide; 30-meter long belt transect situated along the perimeter of the dog-legged transect (Figure 4). Shrubs rooted in the belt transect were counted on a species basis.

2.5 Statistical Analysis and Sample Adequacy

The procedures for financial assurance release as described in Coal Mine Reclamation Program (CMRP) Vegetation Standards (MMD 1999) and the Permit guided this statistical analysis. Statistical tests were performed using both Microsoft® Excel and Analyse-it (version 5.65.7), 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 log transformation was applied to see if it normalized the data.

All hypothesis testing used to demonstrate compliance with the vegetation success standards was conducted using a reverse null approach. Because vegetation performance at McKinley is compared to technical standards, the one-sample, one-sided t-test (CMRP Method 3) is used for normally distributed data to evaluate the mean and the one-sample, one-sided sign test (CMRP Method 5) to analyze the median of data that are not normal (MMD 1999; McDonald and Howlin 2013). The one-sided hypothesis tests using the reverse null approach were designed as follows:

Perennial/Biennial Canopy Cover

H_0 : Reclaim < 90% of the Technical Standard (15%)

H_a : Reclaim ≥ 90% of the Technical Standard (15%)

Annual Forage Production

H_0 : Reclaim < 90% of the Technical Standard (350 lbs/ac)

H_a : Reclaim ≥ 90% of the Technical Standard (350 lbs/ac)

Shrub Density

H_0 : Reclaim < 90% of the Technical Standard (150 stems per acre [stems/ac])

H_a : Reclaim ≥ 90% of the Technical Standard (150 stems/ac)

where H_0 is the null hypothesis, that the parameter mean of the reclaimed area is less than 90% of the parameter mean of the technical standard and H_a is the alternative hypothesis, that the parameter mean of the reclaimed area is greater than or equal to 90% of the parameter mean of the technical standard. 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 – Method 3 (CMRP)

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 – Method 3 (CMRP)

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

If P ≤ 0.10, conclude that the performance standard was met

The CRMP Vegetation Standards also state, “Data transformation may effectively increase the power of a hypothesis test. If a test statistic for untransformed data fails to indicate that the performance standard has been achieved, it would be advisable to apply one or more of the transformations discussed in Appendix C to the data and re-test.” Subsequently, if a hypothesis test failed for data that was not normal, the data was transformed and tested for normality. If the transformed data was found to be normal, the hypothesis test was rerun on the transformed data.

Statistical hypothesis testing was performed on perennial/biennial cover, annual forage production and shrub density using the one-sample, one-sided t-test and the one-sample, one-sided sign test. The hypotheses testing used the reverse null hypothesis bond release testing procedure as described in CMRP Vegetation Standards (MMD 1999).

Statistical adequacy is not required for vegetation success demonstrations at McKinley under the reverse null approach, but is presented on the basis of the canopy cover, production and shrub density data. 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).

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

Where N_{min} equals minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\bar{x}$ is the mean, and D is the desired level of accuracy, which is 10 percent of the mean.

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 and a minimum sample number approach is taken. MMD recognizes the practical limitations of achieving statistical adequacy and has provided minimum sample sizes for various quantitative methods (MMD 1999). With normally distributed data where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples are often considered adequate. The 40-sample recommendation 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 measurements 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. The 40 samples came from ten transects each having four quadrats as described in Section 2.1. Each quadrat 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 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).

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 are used to analyze data that are not normally distributed. When sample adequacy is not achieved, it is appropriate to use the reverse null approach for hypothesis testing. The reverse null 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 and Howlin 2013).

3.0 RESULTS

The vegetation community in M-VMU-3 is well established and dominated by perennial plants. A representative photograph of the vegetation and topography in M-VMU-3 is shown in Figure 5. The vegetation cover levels in 2020 suggest that the site is progressing to achieve vegetation success standards for the Permit Area. Vegetation success standards consist of four vegetative parameters: ground cover, productivity, diversity and woody stem stocking (Table 2). The ground cover requirement for live perennial/biennial cover on the reclamation is 15%. The productivity requirement is 350 air-dry lbs/ac perennial/biennial annual production. The woody stem stocking success standard is 150 live woody stems/ac.

Diversity is evaluated against numerical guidelines for different growth forms and photosynthetic pathways of the vegetation. In summary, the diversity guideline required by MMD would be met if at least two shrub or subshrub species with individual relative cover values of 1%; at least two perennial warm-season grass species have individual relative cover levels of at least 1%; at least one perennial cool-season grass species has an individual relative cover level of at least 1%; and three perennial or biennial forb species have a combined relative cover of at least 1%. MMD (1999) allows for 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, they persist in the reclaimed plant community. Relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit.

Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas. Table 3 summarizes the attributes for plants recorded in the quadrats in addition to those encountered or observed but not recorded in the formal quantitative monitoring of M-VMU-3. Recruitment of these native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

The field data for canopy and basal cover, density, production and shrub density by the belt transect are included in Appendix A, accompanied by Figure A-1 and Table A-1 showing the 2020 transect locations within M-VMU-3. Figure A-1 also shows the seeded areas grouped by years and the 2019 transects. Photographs of the quadrats are included in Appendix B. Appendix C provides the statistical analysis equations (Table C-1), data (Table C-2) and outputs for perennial/biennial canopy cover (Table C-3 and Figures C-1 & C-2), annual forage production (Table C-4 and Figures C-3 & C-4) and shrub density by the belt transect method (Table C-5 and Figure C-5).

3.1 Ground Cover

Perennial/biennial canopy cover was calculated by summing the perennial/biennial species cover estimates after excluding the annual forbs and grasses. Any recorded noxious weeds are excluded from perennial/biennial cover. Average total ground cover in M-VMU-3 is 64.0% comprised of 39.9% total vegetation cover, 9.0% rock, and 15.1% litter on a canopy cover basis (Table 3). On a basal area basis, average ground cover is 50.3% with 2.7% vegetation, 10.9% rock and 36.7% litter. Consistent with semi-arid rangelands the vegetation canopy cover in the individual quadrats varied, ranging from 7.3 to 88.0% (Table A-2). The mean perennial/biennial canopy cover was 41.5%, which was greater than the mean total vegetation canopy cover suggesting the occurrence of overlapping canopies for perennial/biennial cover is common. In 2019 and 2020 M-VMU-3 significantly exceeded the vegetation success standard of 15% perennial/biennial cover for total vegetation canopy cover and perennial/biennial canopy cover (Table 4). In 2020 the mean total vegetation canopy cover 39.9% (± 4.7% [90% CI]) and the mean perennial/biennial canopy cover was 41.5% (± 6.0%).

The perennial/biennial canopy cover data for M-VMU-3 were not normally distributed (Figure C-1). A log transformation of the perennial/biennial canopy cover data resulted in a normal distribution (Figure C-2). The calculated minimum sample size needed to meet N_{min} was 58 samples for total cover and 88 samples for perennial/biennial canopy cover (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the perennial/biennial canopy cover data were evaluated using a stabilization of the mean approach (Clark 2001) and with a one-sided, one-sample sign test using the reverse null (MMD 1999). Figure 6 illustrates the stabilization of the estimated mean for perennial/biennial canopy cover based on grouping four sample increments associated with a single transect. The samples were analyzed in four sample increments to allow an estimation of variability. The corresponding variability around the mean is expressed by the 90% CIs for each successive analytical increment. These data suggest that the mean perennial/biennial canopy cover was estimated to within the 90% CI of the estimated population mean (n=40) beginning after the eighth sample, with the 90% CI tightening to no greater than 8.0% perennial/biennial canopy cover after 28 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 perennial/biennial cover.

Evaluation of the data using the one-sample, one-sided sign test found only two perennial/biennial cover quadrats did not meet 90% of the performance standard (13.5%) resulting in the probability (P) of <0.001 of observing a z value less than -5.53. Therefore, under the reverse null hypothesis we conclude the performance standard is met for perennial/biennial canopy cover in 2020 (Table C-3). This standard was also met under the same statistical analysis methods in 2019.

3.2 Production

Productivity 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 2020 annual forage production in M-VMU-3 was estimated to be 511 (± 99 [90% CI]) lbs/ac with an annual total production of 525 (± 100) lbs/ac (Table 4). The combined production for grasses, forbs and shrubs based on an analysis of comparable ecological sites reported by Parametrix (2012) was 430.5 to 794.2 lbs/ac. The annual forage production performance of M-VMU-3 in 2019 (779 lbs/ac) and 2020 demonstrate the site's ability to exceed the minimum production values for comparable ecological sites. Fifteen perennial grasses contribute 330 lbs/ac of forage and 10 shrubs contribute 171 lbs/ac of browse indicating a diverse and productive rangeland. Indian ricegrass (*Achnatherum hymenoides*), blue wildrye (*Elymus glaucus*), needle and thread (*Hesperostipa comata*), Colorado wildrye (*Leymus ambiguus*), Western wheatgrass (*Pascopyrum smithii*) and James' galleta (*Pleuraphis jamesii*) account for almost 54% of the forage, while multiple saltbush species (*Atriplex spp.*) and winterfat (*Krascheninnikovia lanata*) account for an additional 19% of annual forage production (Table 3). The combined annual forage production for 15 perennial grasses, winterfat, cliffrose (*Purshia mexicana*) and antelope bitterbrush (*P. tridentata*) in M-VMU-3 is enough to exceed the vegetation success standard of 350 lbs/ac.

The annual forage production data for M-VMU-3 were not normally distributed (Figure C-3). A log transformation of the annual forage production data, however, resulted in a normal distribution (Figure C-4). The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was estimated to be 159 samples (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the data were evaluated using a stabilization of the mean (Clark 2001) and with a one-sample, one-sided sign test using the reverse null (MMD 1999). Figure 7 illustrates the stabilization of the estimated mean and 90% CI for annual forage production. These data suggest that the mean annual forage production was estimated to within the 90% CI of the estimated population mean (n=40) beginning after the eighth sample, with the 90% CI tightening to no greater than about ± 120 lbs/ac after 28 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 forage production.

Evaluation of the data using the one-sample, one-sided sign test found 23 production quadrats exceeded 90% of the performance standard (315 lbs/ac) but fell just short of passing the hypothesis test. The calculations resulted in a probability (P) of 0.2148, which is greater than 0.10, or a z value of -0.79, which is greater than a z-critical of a -1.28 (Table C-4).

In accordance with the MMD Vegetation Guidelines, a log transformation (that is $\log_{10}$ (forage production value+1)) was applied to the data and the transformed data was re-tested using the reverse-null t-test. The hypothesis testing resulted in t-score of 1.92, which is greater than the one-tail $t_{(0.1, 39)}$ value of 1.304. Therefore, under the reverse null hypothesis ($t^* >= t_{(1-\alpha; n-1)}$), we conclude that the performance standard is met for annual forage production in 2020 (Table C-5). For M-VMU-3, this standard was also met in 2019.

3.3 Shrub Density

Shrub density ranged from an average of 2,455 (± 982 [90% CI]) stems/ac based on the belt transect method to 5,160 (± 1,815) stems/ac for the quadrat method (Table 4). In M-VMU-3, 11 shrub species were encountered in the belt transects and the quadrats (Tables 3 and A-6). Four-wing saltbush and winterfat were the most commonly encountered shrubs under both measurement methods.

The shrub density data by the belt transect method were normally distributed (Figure C-5) and the calculated minimum sample size needed to meet N_{min} at the 90% confidence level was estimated to be 199 samples (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the shrub density belt transect data were evaluated using a stabilization of the mean (Clark 2001) and one-sample, one-sided sign test using the reverse null (MMD 1999). Figure 8 illustrates the stabilization of the mean for shrub density based on individual belt transect data. The corresponding variability around the mean is expressed by the 90% CIs for each successive analytical increment. These data suggest that the mean shrub density was estimated to within the estimated population mean (n=10) after the fourth sample, with the 90% CI tightening to no greater than about ± 1,100 stems/ac after 8 samples. This analysis suggests that 10 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 t-test calculated t*-statistic for M-VMU-3 shrub density is 3.89, where the sample mean is 2,455 stems/ac with a standard deviation of 1,888, the technical standard is 150 stems/ac and the sample size is 10. The one-tail $t_{(0.1, 9)}$ value is 1.304. Therefore, under the reverse null hypothesis ($t^* >= t_{(1-\alpha; n-1)}$), we conclude that the performance standard is met for shrub density (i.e., woody stem stocking) by the belt transect method (Table C-6). This standard was met in 2019 using the reverse null approach, evaluated with the one-sample, one-sided sign test.

3.4 Composition and Diversity

Collectively, 15 perennial grasses dominate the canopy cover in M-VMU-3 with a combined relative canopy cover of almost 77% with western wheatgrass and James' galleta being most prevalent (Table 3). Eleven cool-season perennial grasses contribute almost 62% relative canopy cover to perennial/biennial canopy cover. Four warm-season perennial grasses contribute almost 15% relative canopy cover to perennial/biennial canopy cover. Six perennial/biennial forbs contribute just over 1% relative canopy cover to the perennial/biennial canopy cover in M-VMU-3 with bastardsage (*Eriogonum wrightii*) being the dominant non-annual forb. In 2020 the annual forb Russian thistle (*Salsola tragus*) was seldom recorded in the quadrats, only contributing a mean absolute canopy cover of 0.07% to the total vegetation cover. The collective contribution of ten shrubs to perennial/biennial canopy cover is 22%, with several saltbush species and winterfat most prevalent.

Diversity is assessed through comparing the relative cover of various life-forms, based on their duration to the perennial/biennial cover of the vegetation management unit. In this context, relative cover is the average percent cover of a perennial/biennial species divided by the mean perennial/biennial cover of the sampling unit. Relative canopy cover of individual species contributing to perennial cover are listed in Table 3.

The diversity standard for cool-season grasses is achieved by several species that exceed 1% relative cover including western wheatgrass (23.32%), needle and thread (9.15%), Indian ricegrass (6.59%) and blue wildrye (6.27%).

The diversity standard for warm-season grasses requires a minimum of two species with 1% relative cover each. Four warm-season perennial grasses were recorded including purple threeawn (*Aristida purpurea*), blue grama (*Bouteloua gracilis*), James' galleta, and alkali sacaton (*Sporobolus airoides*). These warm-season perennial grasses had relative covers of 12.77% for James' galleta, 0.93% for alkali sacaton, 0.83% for purple threeawn and 0.50% for blue grama. Although this diversity standard was met in 2019, in 2020 the warm-season grass standard was not achieved in M-VMU-3. Multiple factors may contribute to the reduced cover of warm-season perennial grasses in this region and reclamation plant community including reclamation seed mixes emphasizing cool-season grasses, fall planting, growing-season drought in prior years and continued grazing pressure from trespass horses. With respect to 2020, we believe that the normal winter precipitation followed by extremely dry spring and summer months probably contributed to higher cover for cool-season grasses relative to the warm-season perennial grasses (Figure 2).

The diversity standard for forbs requires a minimum of three non-annual forb taxa combining to contribute at least 1% relative cover. The combined relative cover of six non-annual forbs is 1.28% (Table 3). These forbs include: bastardsage (0.52%), purple aster (0.34%, *Machaeranthera canescens*), flatspine stickseed (0.16%, *Lappula occidentalis*), Palmer's penstemon (0.15%, *Penstemon palmeri*), scarlet globemallow (0.08%, *Sphaeralcea coccinea*) and an unknown blazingstar species (0.03%, Mentzelia species). Based on 2020 sampling, the combined relative cover for six non-annual forbs is greater than 1%, meeting the diversity standard for forbs on M-VMU-3 reclamation.

The diversity standard for shrubs requires two species with a minimum relative cover of 1% for each species. The diversity standard for shrubs is achieved by Gardner's saltbush (7.11%, *Atriplex gardneri*) and four-wing saltbush (5.63%). Additional sub-dominant shrubs recorded in the quadrats include winterfat (4.06%), rubber rabbitbrush (1.81%, *Ericameria nauseosa*) and antelope bitterbrush (1.36%).

Based on the 2020 vegetation monitoring, 98 different plant species were present within the reclamation areas of M-VMU-3 (Table 3). We encountered 43 forbs, 25 grasses and 30 shrubs, trees and cacti. Of the 43 forbs, 15 are considered annuals whereas the remaining 28 have variable durations or are purely perennial. Of the 25 grasses, 15 are cool-season perennials, seven are warm-season perennials and three are cool-season annuals. Cacti (one species) and trees (five species) were rare on the reclamation, while shrubs and subshrubs were more commonly observed (24 species).

During the 2020 monitoring program, we infrequently encountered one Class B and five Class C noxious weeds (NMDA 2020) on M-VMU-3. Class B noxious weeds are those that are isolated in the state and managed such that they are contained and spread should be stopped. Prior to 2020, Russian knapweed (*Acroptilon repens*) was categorized as a Class B noxious weed, but in June 2020 the NMDA reclassified this weed as a Class C noxious weed. 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. The only noxious weed recorded in the quadrats was cheatgrass (*Bromus tectorum*) with an absolute mean canopy cover of 2.03%. Cheatgrass was isolated to one quadrat in M-VMU-3-T01A and all quadrats in the M-VMU-3-T02P transect (Table A-2). Cheatgrass was not used in the assessment of revegetation success. Other noxious weeds observed on M-VMU-3 were musk thistle

(*Carduus nutans*), halogeton (Halogeton glomeratus), Russian knapweed, 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 control. 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 M-VMU-3 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 canopy cover, production, shrub density, and plant diversity (Table 2). The vegetation survey in 2020 was the second year of the past two years evaluating vegetation success in M-VMU-3 and we summarize our general findings here:

1. Despite the prolonged drought, the reclamation has been resilient and successful for cover and shrub density, demonstrating permanence.
2. Drought affected the expression of warm-season grasses in 2020 since only one species (a minimum of two needed) exceeded 1% relative cover. Although this diversity parameter was unmet in 2020, M-VMU-3 previously demonstrated the ability to meet all the diversity parameters in 2019.

For 2020, M-VMU-3 exceeded the success parameters for cover, shrub density, forage production, and most diversity parameters, but fell short warm-season grass diversity (Tables 5 and 6). For 2019, M-VMU- 3 was in full compliance with the suite of success standards. Results for both years indicate M-VMU-3 is eligible for Phase III bond release.

Precipitation is a key environmental factor affecting vegetation establishment and performance. Cumulative water year (WY) precipitation is shown in Figure 9 for the South Tipple gage and the Window Rock long-term averages. Precipitation patterns at the South Tipple gage were below the long-term average with clear deficits during the peak growing season favoring cool-season grasses and shrubs. Typical precipitation gains at Window Rock occur between June and September where cumulative precipitation increases at a greater rate than the rest of the WY. At the South Tipple gage the greatest precipitation gains occurred outside the typical growing season between October and May (8.68 inches, WY2019) and between November and March (5.85 inches, WY2020). In WY2019, June through August only saw 0.6 inches of precipitation when almost 4.3 inches is normal at Window Rock (Table 1). In WY2020, the total growing season precipitation (April through September) was 1.74 inches, or 26% of average, with just over one inch of that total falling in July. These temporal precipitation patterns indicate exceptionally dry conditions for M-VMU-3 and vegetation performance above all, but one or two success parameters indicates a permanent, established and resilient plant community.

Between 2019 and 2020, the estimated population means for perennial/biennial canopy cover (%) and annual forage production (lbs/ac) exceed their corresponding technical standards (Figure 9b and 9c). Shrub density based on the belt transect method ranged from an average of 2,550 stems/ac in 2019 to 2,455 stems/ac in 2020: each far exceeding the technical standard of 150 live stems/ac (Figure 9d). Based on the 2020 statistical hypothesis testing for M-VMU-3, perennial/biennial canopy cover, forage production and shrub density exceed their respective technical standards (Table 5). In 2020, the diversity standards for cool-season grasses, forbs, and shrubs were met in M- VMU-3, but the diversity standard for warm-season grasses was not met (Table 6). In 2019, two grasses exceeded the 1% relative cover requirement, but in 2020 alkali sacaton had only 0.93% relative cover. Therefore, the diversity standard for warm-season grasses was unmet in 2020.

Overall, vegetation performance in M-VMU-3 is encouraging considering below-average precipitation for the past 5 years including a two-year drought in 2017 and 2018 and the exceptional drought this past year. The continued presence of feral horses is also likely to negatively affect cover and production, especially when forage is scarce. 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.

5.0 REFERENCES

Bonham, C.D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons. New York, NY.

Clark, D.L. 2001. Stabilization of the mean as a demonstration of sample adequacy. American Society for Surface Mining and Reclamation Annual Meeting. Albuquerque, NM. June 3-7, 2001. ASSMR, Lexington, KY.

Mining and Minerals Division (MMD). 1999. Coal Mine Reclamation Program Vegetation Standards. Santa Fe, NM. April 30.

McDonald, L., and S. Howlin. 2013. Evaluation and comparison of hypothesis testing techniques for bond release application. University of Wyoming, Laramie, WY.

Parametrix. 2012. Revegetation Success Standards Report: McKinley Mine – Response to OSM. Prepared by Jim Nellessen of Parametrix, Albuquerque, New Mexico. April 2012.

New Mexico Department of Agriculture (NMDA). 2020. New Mexico Noxious Weed List Update. New Mexico State University, Las Cruces, NM. June 2020.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry (2nd edit.). W. H. Freeman and Co., San Francisco.

Schulz, A. M., R. P. Gibbens, and L. F. DeBano. 1961. Artificial populations for teaching and testing range techniques. J. Range Management. 14:236-242.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods applied to experiments in agriculture and biology. 6th ed. Ames, Iowa: Iowa State University Press.

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https://golderassociates.sharepoint.com/sites/127720/project files/6 deliverables/2020_phiii-veg/1_mmd_veg-phiii_2020/m-vmu-3/2_text/1338105207-r-rev0-m-vmu-3_2020veg-20210222.docx

Tables

Table 1: South Mine Seasonal and Annual Precipitation (2015-2020)

Year	Station	Area	Precipitation (inches)													
			January	February	March	April	May	June	July	August	September	October	November	December	Annual Total	Growing Season Total
2015	Tipple	South Shop	2.05	1.59	0.11	0.52	1.64	1.11	2.37	1.62	0.30	1.36	1.31	0.76	**14.74**	*7.56*
	Rain 9	9				0.50	1.38	1.22	2.88	1.25	0.22	1.13	0.99			*7.45*
	Rain 10	10				0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78			*7.13*
	Rain 11	11				0.48	1.88	1.02	2.80	1.69	0.26	0.97	1.08			*8.13*
2016	Tipple	South Shop	0.62	0.22	0.05	1.31	0.80	0.07	1.37	1.74	1.75	0.40	1.57	1.84	**11.74**	*7.04*
	Rain 9	9				0.22	0.62	0.45	1.24	0.50	1.05	1.05	0.00			*4.08*
	Rain 10	10				0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02			*5.00*
	Rain 11	11				0.28	0.77	0.64	1.61	0.42	1.09	0.09	0.04			*4.81*
2017	Tipple	South Shop	1.25	1.64	0.48	0.35	0.77	0.42	2.48	0.90	1.34	0.15	0.09	0.02	**9.89**	*6.26*
	Rain 9	9				1.20	1.02	0.01	0.82	1.40	1.64	0.37	0.91			*6.09*
	Rain 10	10				1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81			*5.68*
	Rain 11	11				1.23	1.16	0.05	0.86	2.00	1.85	0.34	0.49			*7.15*
2018	Tipple	South Shop	0.35	0.79	0.54	0.09	0.29	0.51	2.61	1.34	1.10	1.65	0.19	0.29	**9.75**	*5.94*
	Rain 9	9				0.07	0.27	0.25	2.16	0.74	0.67	1.31	0.00			*4.16*
	Rain 10	10				0.08	0.20	0.27	3.05	1.15	0.92	1.51	0.00			*5.67*
	Rain 11	11				0.09	0.29	0.26	1.92	1.00	0.89	1.45	0.00			*4.45*
2019	Tipple	South Shop	1.30	1.81	1.23	0.44	1.77	0.33	0.22	0.05	1.59	0.09	1.14	0.85	**10.82**	*4.40*
	Rain 9	9				0.16	1.36	0.24	0.46	0.37	1.84	0.05	0.07			*4.43*
	Rain 10	10				0.20	1.49	0.37	0.19	0.27	1.34	0.03	0.05			*3.86*
	Rain 11	11				0.20	1.50	0.19	0.44	0.20	1.72	0.06	0.08			*4.25*
2020	Tipple	South Shop	0.98	1.44	1.35	0.17	0.01	0.04	1.13	0.24	0.15	0.26	0.40	0.27	**6.44**	*1.74*
	Rain 9	9				0.16	0.02	0.11	0.60	0.06	0.14	0.08	0.45			*1.09*
	Rain 10	10				0.11	0.02	0.13	0.79	0.14	0.14	0.16	0.09			*1.33*
	Rain 11	11				0.22	0.00	0.05	0.63	0.69	0.20	0.30	0.41			*1.79*
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:
Long-term averages are from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2020).
Growing season total precipitation is the sum of monthly totals between April and September

Table 2: Revegetation Success Standards for the Mining and Minerals Division Permit Area

Vegetative Parameter	Success Standard
Ground Cover	15% live perennial/biennial cover
Productivity	350 air-dry pounds per acre perennial/biennial annual production
Diversity	A minimum of 2 shrub or subshrub taxa contributing at least 1% relative cover each.
	A minimum of 2 perennial warm-season grass taxa contributing at least 1% relative cover each.
	A minimum of 1 perennial cool-season grass contributing at least 1% relative cover.
	A minimum of 3 perennial/biennial forb taxa combining to contribute at least 1% relative cover.
Woody Stem Stocking	150 live woody stems per acre

Notes:

Diversity criteria are assessed through evaluating individual perennial/biennial species relative cover, as agreed upon by MMD and CMI in June 2019. Further, relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit.

Table 3: Vegetation Cover, Density, and Production by Species, M-VMU-3, 2020

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)			Mean Density (#/ac)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative Canopy[a]		
Cool-Season Grasses (18)							
Annuals (3)							
Bromus arvensis	Field brome	BRAR5	obs	obs	obs	obs	obs
Bromus tectorum	Cheatgrass	BRTE	2.03	0.08	--	15,884	13
Vulpia octoflora	Sixweeks fescue	VUOC	obs	obs	obs	obs	obs
Perennials (15)							
Achnatherum hymenoides	Indian ricegrass	ACHY	2.74	0.21	6.59	2,125	38
Agropyron cristatum	Crested wheatgrass	AGCR	0.29	<0.05	0.71	708	4
Bromus inermis	Smooth brome	BRIN2	1.72	0.08	4.14	9,611	7
Elymus canadensis	Canada wildrye	ELCA4	obs	obs	obs	obs	obs
Elymus elymoides	Bottlebrush squirreltail	ELEL	0.61	0.06	1.48	3,136	6
Elymus glaucus	Blue wildrye	ELGL	2.60	0.18	6.27	7,487	31
Elymus trachycaulus	Slender wheatgrass	ELTR7	2.20	0.14	5.29	5,767	19
Hesperostipa comata	Needle and thread	HECO26	3.80	0.24	9.15	7,183	32
Hordeum jubatum	Foxtail barley	HOJU	obs	obs	obs	obs	obs
Leymus ambiguus	Colorado wildrye	LEAM	1.32	0.32	3.18	2,023	27
Pascopyrum smithii	Western wheatgrass	PASM	9.68	0.53	23.32	49,169	88
Phleum pratense	Timothy	PHPR	obs	obs	obs	obs	obs
Pseudoroegneria spicata	Bluebunch wheatgrass	PSSP6	obs	obs	obs	obs	obs
Thinopyrum intermedium	Intermediate wheatgrass	THIN6	0.41	<0.05	0.99	506	5
Thinopyrum ponticum	Tall wheatgrass	THPO7	0.34	<0.05	0.83	405	12
Warm-Season Grasses (7)							
Perennials (7)							
Aristida purpurea	Purple threeawn	ARPU	0.22	<0.05	0.53	202	2
Bouteloua curtipendula	Sideoats grama	BOCU	obs	obs	obs	obs	obs
Bouteloua gracilis	Blue grama	BOGR2	0.21	<0.05	0.50	708	2
Bouteloua hirusta	Hairy grama	BOHI2	obs	obs	obs	obs	obs
Pleuraphis jamesii	James' galleta	PLJA	5.30	0.38	12.77	10,421	58
Sporobolus airoides	Alkali sacaton	SPAI	0.39	0.06	0.93	1,720	1
Sporobolus cryptandrus	Sand dropseed	SPCR	obs	obs	obs	obs	obs

Table 3: Vegetation Cover, Density, and Production by Species, M-VMU-3, 2020

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)			Mean Density (#/ac)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative Canopy[a]		
Forbs (43)							
Annuals (15)							
Alyssum desertorum	Desert madwort	ALDE	obs	obs	obs	obs	obs
Chenopodium incanum	Mealy goosefoot	CHIN2	obs	obs	obs	obs	obs
Chenopodium leptophyllum	Narrowleaf goosefoot	CHLE4	obs	obs	obs	obs	obs
Chenopodium album	Lambsquarters	CHAL7	obs	obs	obs	obs	obs
Cryptantha crassisepala	Thicksepal cryptantha	CRCR3	obs	obs	obs	obs	obs
Eriogonum cernuum	Nodding buckwheat	ERCE2	obs	obs	obs	obs	obs
Eriogonum divaricatum	Divergent buckwheat	ERDI5	obs	obs	obs	obs	obs
Halogeton glomeratus	Halogeton	HAGL	obs	obs	obs	obs	obs
Helianthus annuus	Common sunflower	HEAN3	obs	obs	obs	obs	obs
Heliomeris longifolia	Longleaf false goldeneye	HELO6	obs	obs	obs	obs	obs
Kochia scoparia	Kochia	KOSC	obs	obs	obs	obs	obs
Malacothrix fendleri	Fendler's desertdandelion	MAFE	obs	obs	obs	obs	obs
Polygonum erectum	Erect knotweed	POER2	obs	obs	obs	obs	obs
Salsola tragus	Russian thistle	SATR	0.07	<0.05	--	6,475	<1
Xanthium strumarium	Rough cocklebur	XAST	obs	obs	obs	obs	obs
Perennials/Biennials (28)							
Achillea millefolium	Common yarrow	ACMI2	obs	obs	obs	obs	obs
Acroptilon repens	Russian knapweed	ACRE3	obs	obs	obs	obs	obs
Calochortus nuttallii	Sego lily	CANU3	obs	obs	obs	obs	obs
Carduus nutans	Musk thistle	CANU4	obs	obs	obs	obs	obs
Chaetopappa ericoides	Rose heath	CHER	obs	obs	obs	obs	obs
Conyza canadensis	Horseweed	COCA	obs	obs	obs	obs	obs
Descurainia sophia	Flixweed	DESO	obs	obs	obs	obs	obs
Eriogonum wrightii	Bastardsage	ERWR	0.22	<0.05	0.52	1,214	4
Grindelia nuda var. aphanactis	Curlytop gumweed	GRNUA	obs	obs	obs	obs	obs
Grindelia squarosa	Curly-cup gumweed	GRSQ	obs	obs	obs	obs	obs
Lactuca serriola	Prickly lettuce	LASE	obs	obs	obs	obs	obs
Lappula occidentalis	Flatspine stickseed	LAOC3	0.07	<0.05	0.16	2,125	<1
Linum lewisii	Lewis flax	LILE	obs	obs	obs	obs	obs
Machaeranthera canescens	Purple aster	MACA	0.14	<0.05	0.34	809	3
Machaeranthera tanacetifolia	Tanseyleaf tansyaster	MATA	obs	obs	obs	obs	obs
Marrubium vulgare	Horehound	MAVU	obs	obs	obs	obs	obs
Melilotus officinalis	Yellow sweetclover	MEOF	obs	obs	obs	obs	obs
Mentzelia species	Unknown blazingstar species	MENTZ	<0.05	<0.05	0.03	506	<1
Penstemon palmeri	Palmer's penstemon	PEPA8	0.06	<0.05	0.15	911	2
Polygonum aviculare	Prostrate knotweed	POAV	obs	obs	obs	obs	obs
Ratibida columnifera	Upright prairie coneflower	RACO3	obs	obs	obs	obs	obs
Rumex crispus	Curly dock	RUCR	obs	obs	obs	obs	obs
Sisymbrium altissimum	Tall tumblemustard	SIAL2	obs	obs	obs	obs	obs
Sphaeralcea coccinea	Scarlet globemallow	SPCO	<0.05	<0.05	0.08	405	<1
Sphaeralcea emoryi	Emory's globemallow	SPEM	obs	obs	obs	obs	obs
Sphaeralcea grossulariifolia	Gooseberryleaf globemallow	SPGR2	obs	obs	obs	obs	obs
Tragopogon dubius	Yellow salsify	TRDU	obs	obs	obs	obs	obs
Typha angustifolia	Narrowleaf cattail	TYAN	obs	obs	obs	obs	obs

Table 3: Vegetation Cover, Density, and Production by Species, M-VMU-3, 2020

Scientific Name	Common Name	Code	Mean Vegetation Cover (%)			Mean Density (#/ac)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative Canopy[a]		
Shrubs, Trees and Cacti (30)							
Perennials (30)							
Artemisia frigida	Prairie sagewort	ARFR4	obs	obs	obs	obs	obs
Artemisia ludoviciana	White sagebrush	ARLU	obs	obs	obs	obs	obs
Artemisia tridentata	Big sagebrush	ARTR2	obs	obs	obs	obs	obs
Atriplex acanthocarpa	Tubercled saltbush	ATAC	obs	obs	obs	obs	obs
Atriplex canescens	Four-wing saltbush	ATCA	2.34	0.09	5.63	1,518	34
Atriplex confertifolia	Shadscale saltbush	ATCO	obs	obs	obs	obs	obs
Atriplex corrugata	Mat saltbush	ATCO4	obs	obs	obs	obs	obs
Atriplex gardneri	Gardner's saltbush	ATGA	2.95	0.08	7.11	405	60
Atriplex obovata	Mound saltbush	ATOB	obs	obs	obs	obs	obs
Atriplex tridentata	Basin saltbush	ATTR3	0.21	<0.05	0.51	304	5
Atriplex species	Unknown saltbush species	ATRIP	<0.05	<0.05	0.02	101	<1
Chrysothamnus viscidiflorus	Yellow rabbitbrush	CHVI	obs	obs	obs	obs	obs
Ephedra trifurca	Longleaf jointfir	EPTR	obs	obs	obs	obs	obs
Ephedra viridis	Mormon tea	EPVI	0.18	<0.05	0.42	101	4
Ericameria nauseosa	Rubber rabbitbrush	ERNA	0.75	<0.05	1.81	101	21
Eriogonum leptophyllum	Slenderleaf buckwheat	ERLE10	obs	obs	obs	obs	obs
Gutierrezia sarothrae	Broom snakeweed	GUSA	0.06	<0.05	0.14	202	2
Heterotheca villosa	Hairy false goldenaster	HEVI	obs	obs	obs	obs	obs
Krascheninnikovia lanata	Winterfat	KRLA	1.69	0.06	4.06	1,922	20
Opuntia polyacantha	Plains pricklypear	OPPO	obs	obs	obs	obs	obs
Pinus edulis	Piñon pine	PIED	obs	obs	obs	obs	obs
Populus deltoides	Cottonwood	PODE	obs	obs	obs	obs	obs
Purshia mexicana	Mexican cliffrose	PUME	0.41	<0.05	0.99	101	13
Purshia tridentata	Antelope bitterbrush	PUTR2	0.56	<0.05	1.36	405	13
Salix exigua	Narrowleaf willow	SAEX	obs	obs	obs	obs	obs
Sarcobatus vermiculatus	Greasewood	SAVE4	obs	obs	obs	obs	obs
Senecio flaccidus	Threadleaf groundsel	SEFL3	obs	obs	obs	obs	obs
Tamarix ramosissima	Saltcedar	TARA	obs	obs	obs	obs	obs
Tetradymia canescens	Gray horsebrush	TECA	obs	obs	obs	obs	obs
Ulmus pumila	Siberian elm	ULPU	obs	obs	obs	obs	obs
Cover Components							
Perennial/Biennial Vegetation Cover			41.5	2.6			
Total Vegetation Cover			39.9	2.7			
Rock			9.0	10.9			
Litter			15.1	36.7			
Bare Soil			35.9	49.6			

Notes:
[a] = relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit
-- = this parameter is not calculated for this attribute
#/ac = number of plants per acre
lbs/ac = air-dry forage pounds per acre
obs = observed on vegetation management unit during monitoring, but not recorded in the quadrats
Ps Pathway or growing season for the grasses is from Allred (2005)
Duration for plants is from the USDA Plants Database

Table 4: Summary Statistics for M-VMU-3

	2019	2020	Technical Standard
Total Vegetation Canopy Cover (%)			
Mean	49.0	39.9	None
Standard Deviation	23.1	18.1	
90% Confidence Interval	6.0	4.7	
Nmin[1]	63	58	
Probability within true mean[2]	0.62	0.61	
Perennial/Biennial Canopy Cover (%)			
Mean	36.4	41.5	15.0
Standard Deviation	30.1	23.2	
90% Confidence Interval	7.8	6.0	
Nmin[1]	194	88	
Probability within true mean[2]	0.70	0.64	
Basal Cover (%)			
Mean	3.22	2.72	None
Standard Deviation	3.87	1.42	
90% Confidence Interval	1.01	0.37	
Nmin[1]	409	78	
Probability within true mean[2]	0.77	0.63	
Annual Forage Production (lbs/ac)			
Mean	779	511	350
Standard Deviation	756	382	
90% Confidence Interval	197	99	
Nmin[1]	267	159	
Probability within true mean[2]	0.73	0.68	
Annual Total Production (lbs/ac)			
Mean	1,201	525	None
Standard Deviation	835	386	
90% Confidence Interval	217	100	
Nmin[1]	137	154	
Probability within true mean[2]	0.67	0.68	
Shrub Density (stems/acre) from Quadrats			
Mean	7,789	5,160	150
Standard Deviation	11,820	6,979	
90% Confidence Interval	3,074	1,815	
Nmin[1]	654	519	
Probability within true mean[2]	0.83	0.80	
Shrub Density (stems/acre) from Belt Transect			
Mean	2,550	2,455	150
Standard Deviation	2,471	1,888	
90% Confidence Interval	1,285	982	
Nmin[1]	316	199	
Probability within true mean[2]	0.62	0.59	

Notes:

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

2 Probability the true value of the mean is within 10 percent of the mean for the sample size

Table 5: Statistical Analysis Results for Cover, Production, and Woody Plant Density, 2019 to 2020

Parameter[1]		Standard	90% of Standard	M-VMU-3			
				2019		2020	
				Result[2]	Tested[3]	Result[2]	Tested[3]
Cover	Live perennial/biennial cover	≥ 15%	≥ 13.5%	36.4%	Pass	41.5%	Pass
Productivity	Air-dry pounds per acre perennial/biennial annual production	≥ 350 lb/ac	≥ 315 lb/ac	779	Pass	511	Pass
Woody Stem Stocking	Live woody stems per acre	≥ 150 stems/ac	≥ 135 stems/ac	2,550	Pass	2,455	Pass

Notes:

[1] Each parameter and corresponsing standards are explained in Table 2 of the Vegetation Survey Report

[2] Table 4 of each report presents results for these values

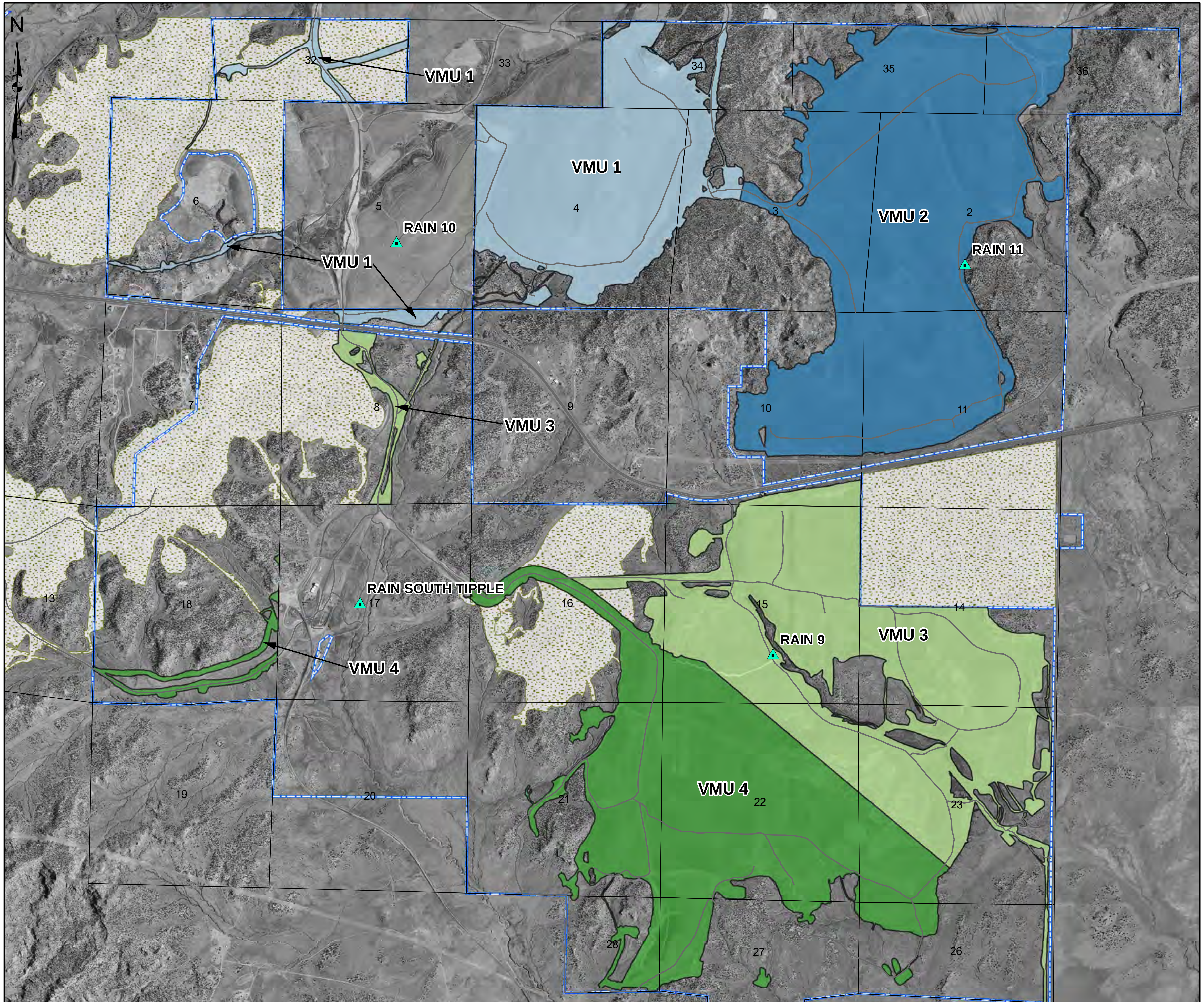
[3] Appendix C of each report presents the statistical analysis of each parameter; A "pass" or "Fail" indicates the result concerning the statistical testing required based on distribtution of data

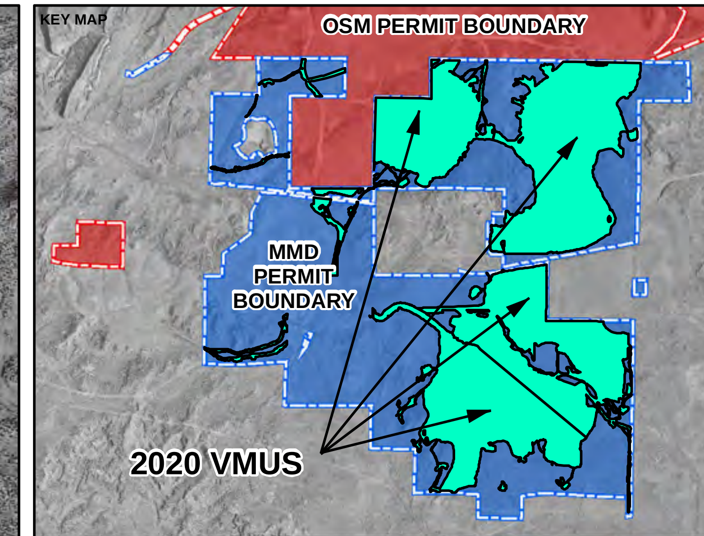
Table 6: Results for Diversity, 2019 to 2020

	Parameter[1]	Standard	M-VMU-3			
			2019		2020	
			Result[2]	Species	Result[2]	Species
Diversity	**Subshrub or shrubs**			**(6 spp.)**		**(10 spp.)**
	Shrub 1 (in % relative cover) - Required	≥ 1.0%	21.44%	Four-wing saltbush	7.11%	Gardner saltbush
	Shrub 2 (in % relative cover) - Required	≥ 1.0%	4.12%	Shadscale saltbush	5.63%	Four-wing saltbush
	Shrub 3 (in % relative cover) (Bonus)	--	0.43%	Mat saltbush	4.06%	Winterfat
	Perennial warm-season grasses			**(4 spp.)**		**(4 spp.)**
	Warm-season grass 1 (in % relative cover) - Required	≥ 1.0%	22.89%	James' galleta	12.77%	James' galleta
	Warm-season grass 2 (in % relative cover) - Required	≥ 1.0%	2.45%	Blue grama	0.93%	Alkali sacaton
	Warm-season grass 3 (in % relative cover) (bonus)	--	0.21%	Alkali sacaton	0.53%	Purple threeawn
	Perennial cool-season grasses			**(8 spp.)**		**(11 spp.)**
	Cool-season grass 1 (in % relative cover) - Required	≥ 1.0%	19.83%	Western wheatgrass	23.32%	Western wheatgrass
	Cool-season grass 2 (in % relative cover) (bonus)	--	1.28%	Tall wheatgrass	9.15%	Needle and thread
	Perennial/biennial forbs (combined relative cover)	**≥ 1.0%**	**23.62%**	**(9 spp.)**	**1.28%**	**(6 spp.)**
	Forb 1 - Required	--	15.79%	Blazingstar species	0.52%	Bastardsage
	Forb 2 - Required	--	3.62%	Flatspine stickseed	0.34%	Purple aster
	Forb 3 - Required	--	2.47%	Flixweed	0.16%	Flatspine stickseed
	Forb 3 (Bonus)	--	0.52%	Palmer's penstemon	0.15%	Palmer's penstemon

Notes:
[1] Each parameter and corresponsing standards are explained in Table 2 of the Vegetation Survey Report
[2] Text Section 3.4 and Table 3 from each report explain the diversity results that are summarized in this table
RED highlighting indicates an unmet parameter

Figures





LEGEND

- Rain Gauges
- Two-tracks, Roads and Highways
- PLSS - Sections
- MMD VMU 1 (~ 838 acres)
- MMD VMU 2 (~ 1,518 acres)
- MMD VMU 3 (~ 1,284 acres)
- MMD VMU 4 (~ 1,238 acres)
- Liability Release
- MMD Permit Boundary

0 3,000 6,000 Feet

1 inch = 2,667 feet

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1927, STATE PLANE - NEW MEXICO, WEST, FIPS 3003 (FEET)

CLIENT

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

PROJECT

MCKINLEY MINE - MMD PERMIT PHASE III BOND RELEASE
2020 VEGETATION SAMPLING PROGRAM

TITLE

GENERAL OVERVIEW OF MCKINLEY SOUTH MINE AREA VEGETATION MANAGEMENT UNITS (VMU), 2020

CONSULTANT

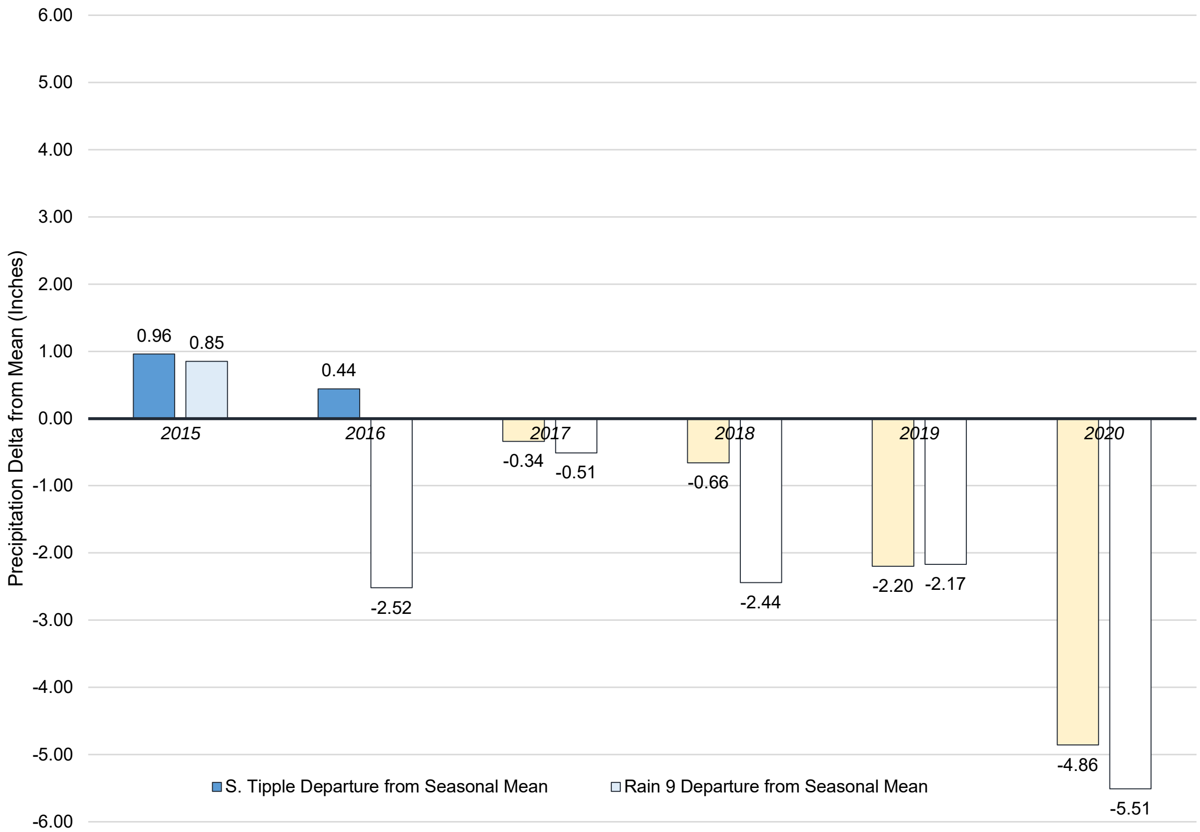
GOLDER

YYYY-MM-DD	2020-11-05
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR
APPROVED	FR

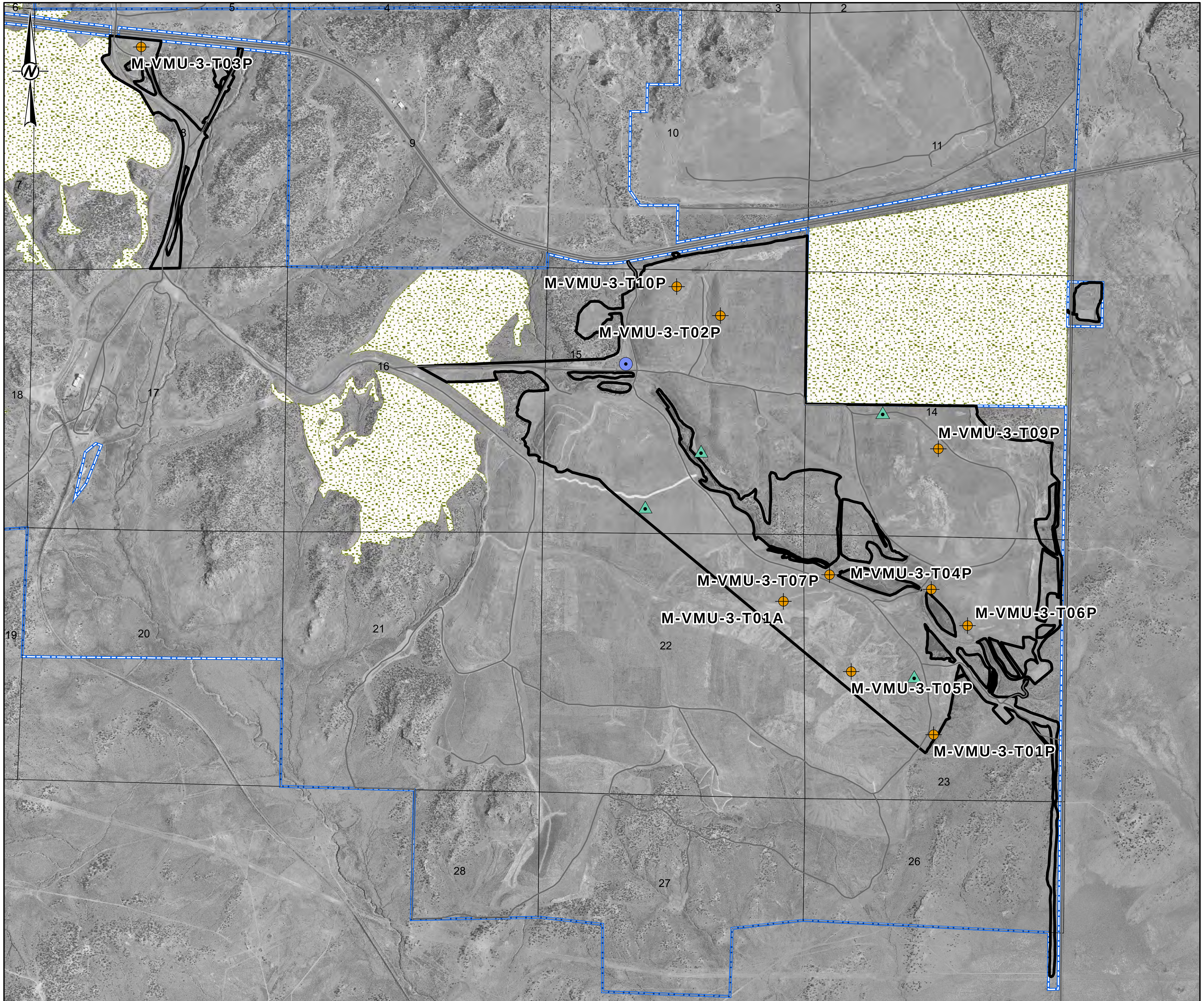
PROJECT NO.	CONTROL	REV.	FIGURE
133-8105207	000630	--	1

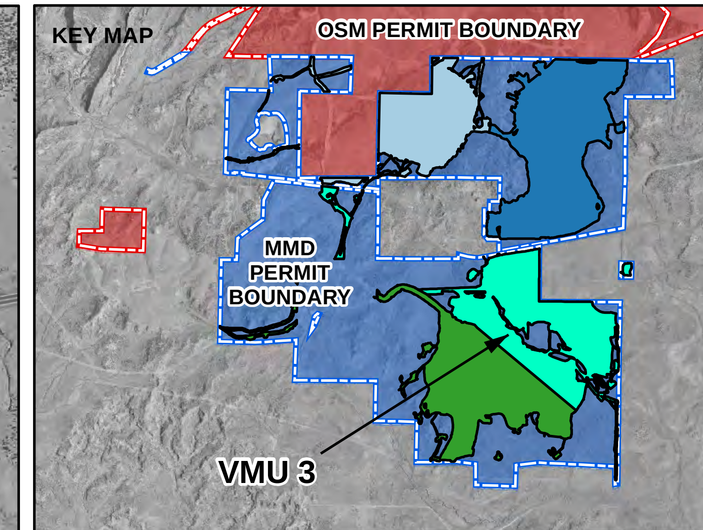
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Figure 2: Departure of Growing Season Precipitation from Long-Term Seasonal Mean at Window Rock; S. Tipple and Rain 9 Gages



Notes:
Long-term averages are from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2020).
Growing season total precipitation is the sum of monthly totals between April and September
Source data is in Table 1





LEGEND

- Vegetation Transect - Sampled
- Vegetation Transect - Deselected
- Vegetation Transect - Additional Alternate
- Two-tracks, Roads and Highways
- PLSS - Sections
- MMD VMU 3 (~ 1,284 acres)
- Liability Release
- MMD Permit Boundary

TRANSECT LABEL EXPLANATION:

M-VMU-1-T1P

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

0 1,000 2,000 4,000
1 inch = 2,000 feet FEET

NOTE(S)

1. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS.
2. M-VMU-3-T01A REPLACED M-VMU-3-T08P DUE TO LANDING IN UNRECLAIMED/NATIVE AREA.

REFERENCE(S)

1. COORDINATE SYSTEM: NAD 1927, STATE PLANE – NEW MEXICO, WEST, FIPS 3003 (FEET).
2. ORTHO SOURCE: CHEVRON, 2013.

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

PROJECT
MCKINLEY MINE – MMD PERMIT PHASE III BOND RELEASE
2020 VEGETATION SAMPLING PROGRAM

TITLE
VEGETATION MONITORING TRANSECTS, 2020
VEGETATION MANAGEMENT UNIT 3

CONSULTANT
GOLDER

YYYY-MM-DD	2020-11-20
DESIGNED	GFD
PREPARED	GFD
REVIEWED	DSW
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
1338105207	B003	0	**3**

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

1 in
0

Figure 4: Vegetation Plot, Transect, and Quadrat Layout

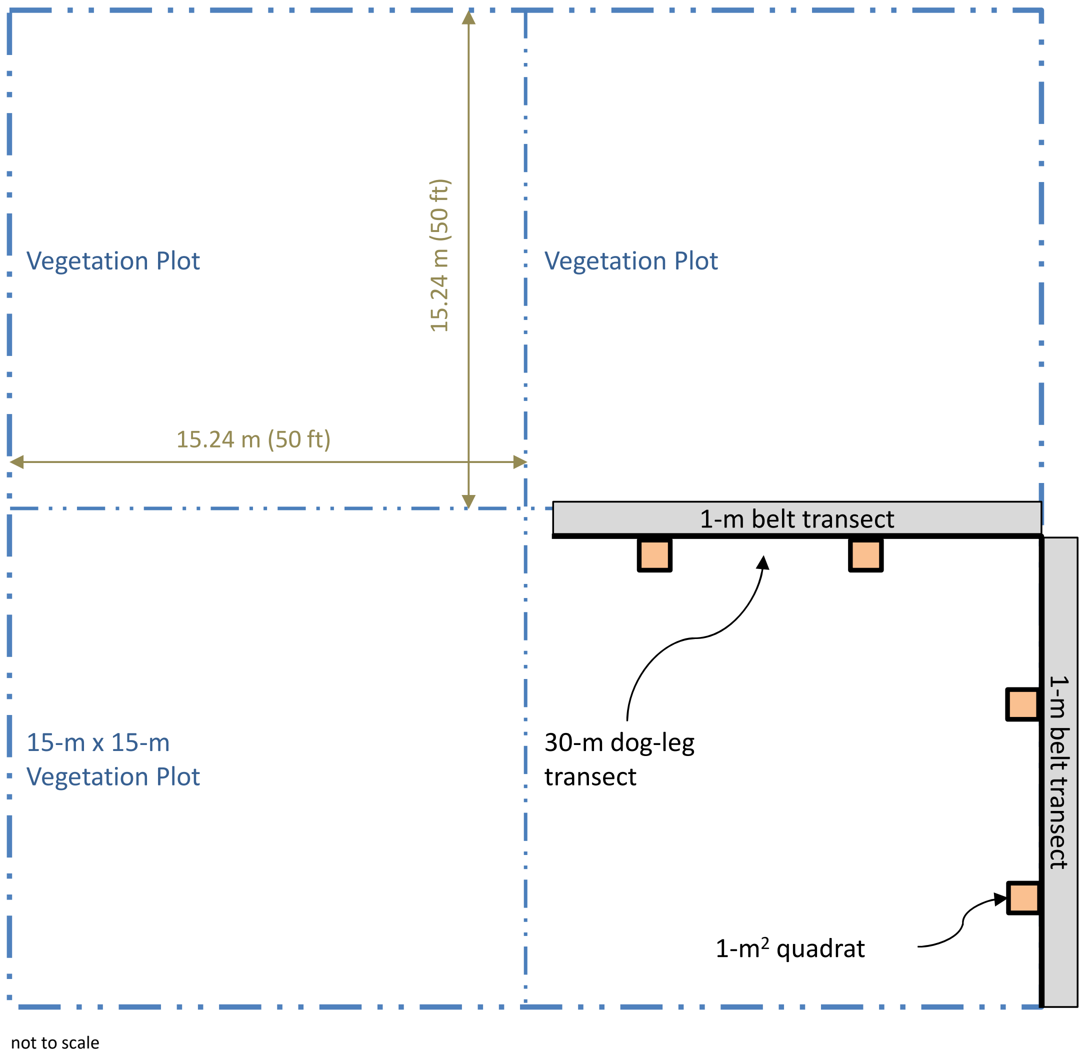


Figure 5: Typical Grass-Shrubland Vegetation in M-VMU-3, September 2020

Figure 6: Stabilization of the Mean for Perennial/Biennial Cover - M-VMU-3, 2020

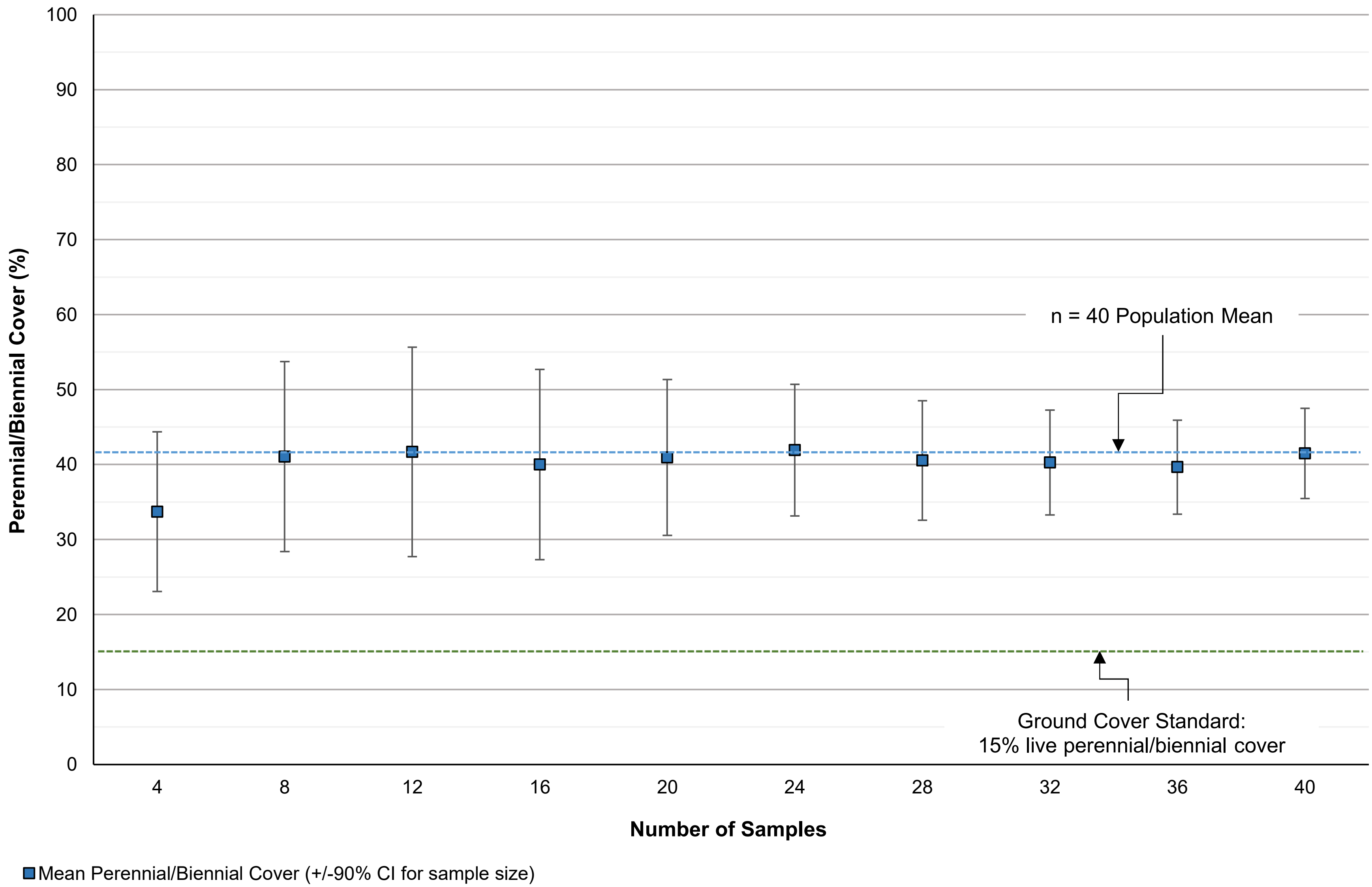
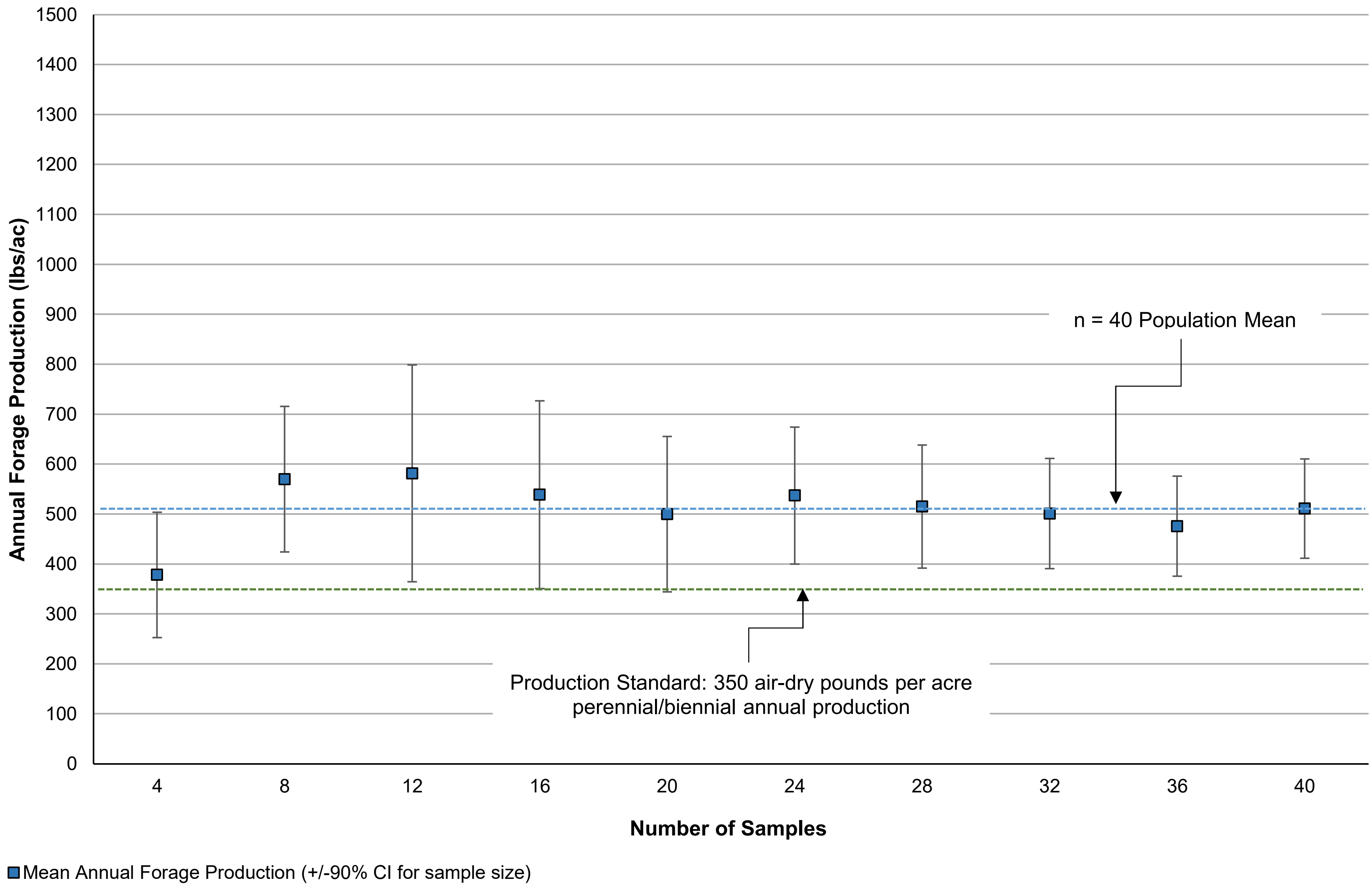


Figure 7: Stabilization of the Mean for Annual Forage Production - M-VMU-3, 2020



GOLDER

Figure 8: Stabilization of the Mean for Shrub Density - M-VMU-3, 2020

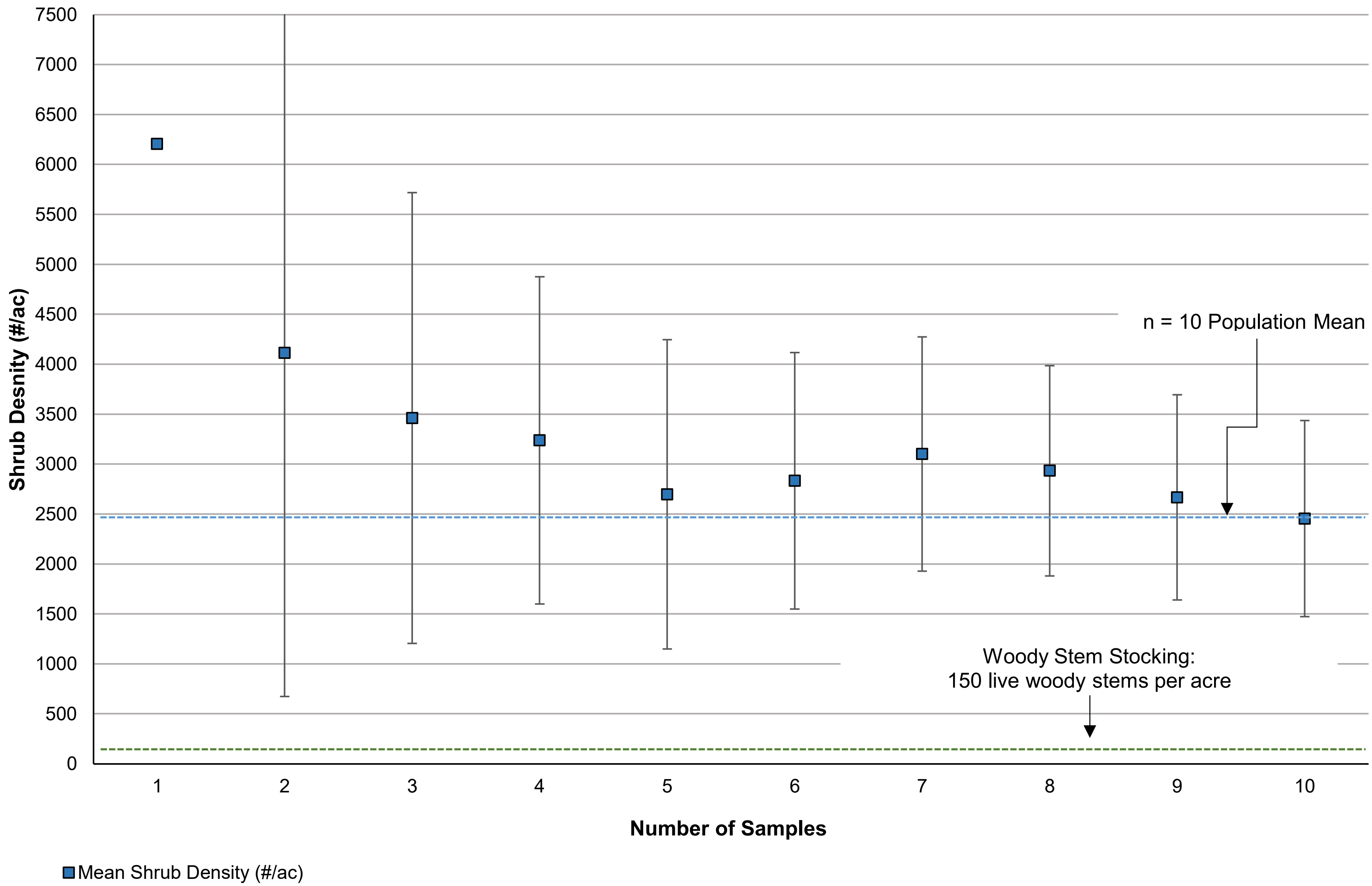


Figure 9: Graphical Summary of Water Year (WY) Precipitation Totals and Vegetation Parameters - M-VMU-3, 2019 to 2020

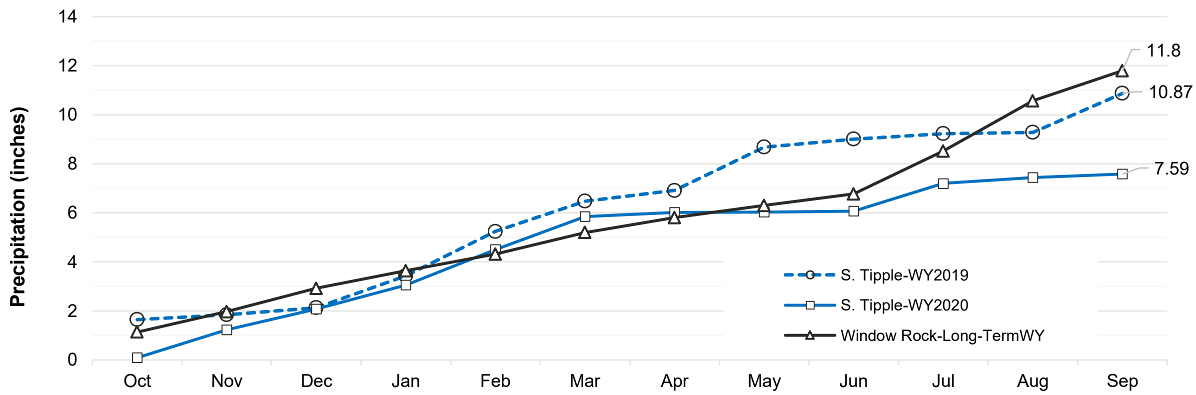


Figure 9a: Water Year (WY) Precipitation for the South Tipple location (WY2019 and WY 2020), compared to Window Rock

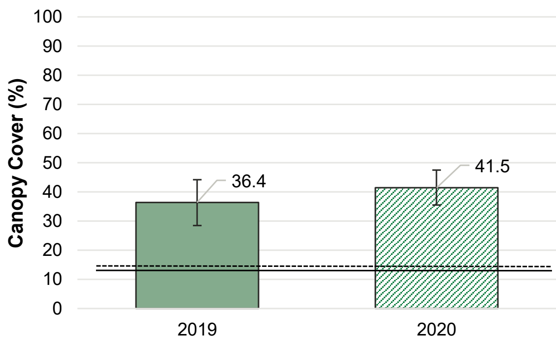


Figure 9b: M-VMU-3, Perennial/Biennial Canopy Cover (%)
with Technical Standard (15%)
and 90% of Technical Standard (13.5%)

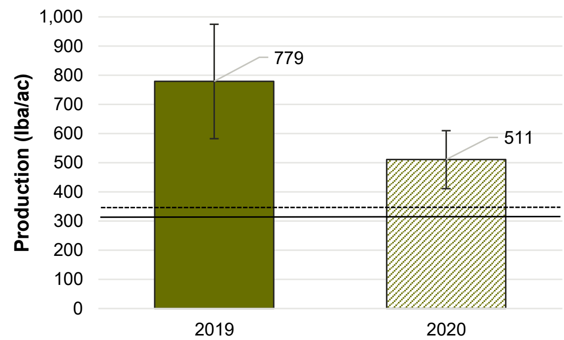


Figure 9c: M-VMU-3, Annual Forage Production (lbs/ac)
with Technical Standard (350 lbs/ac)
and 90% of Technical Standard (315 lbs/ac)

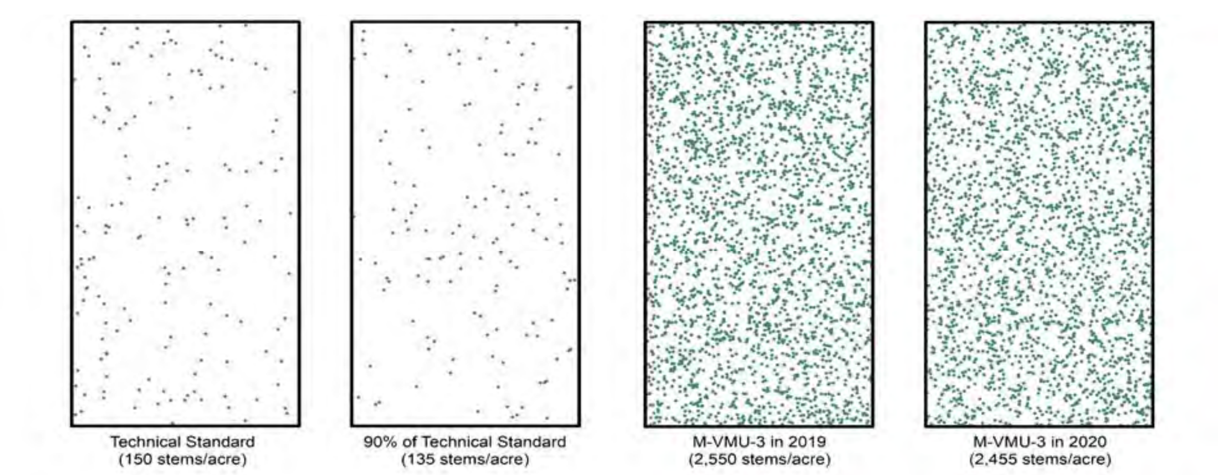
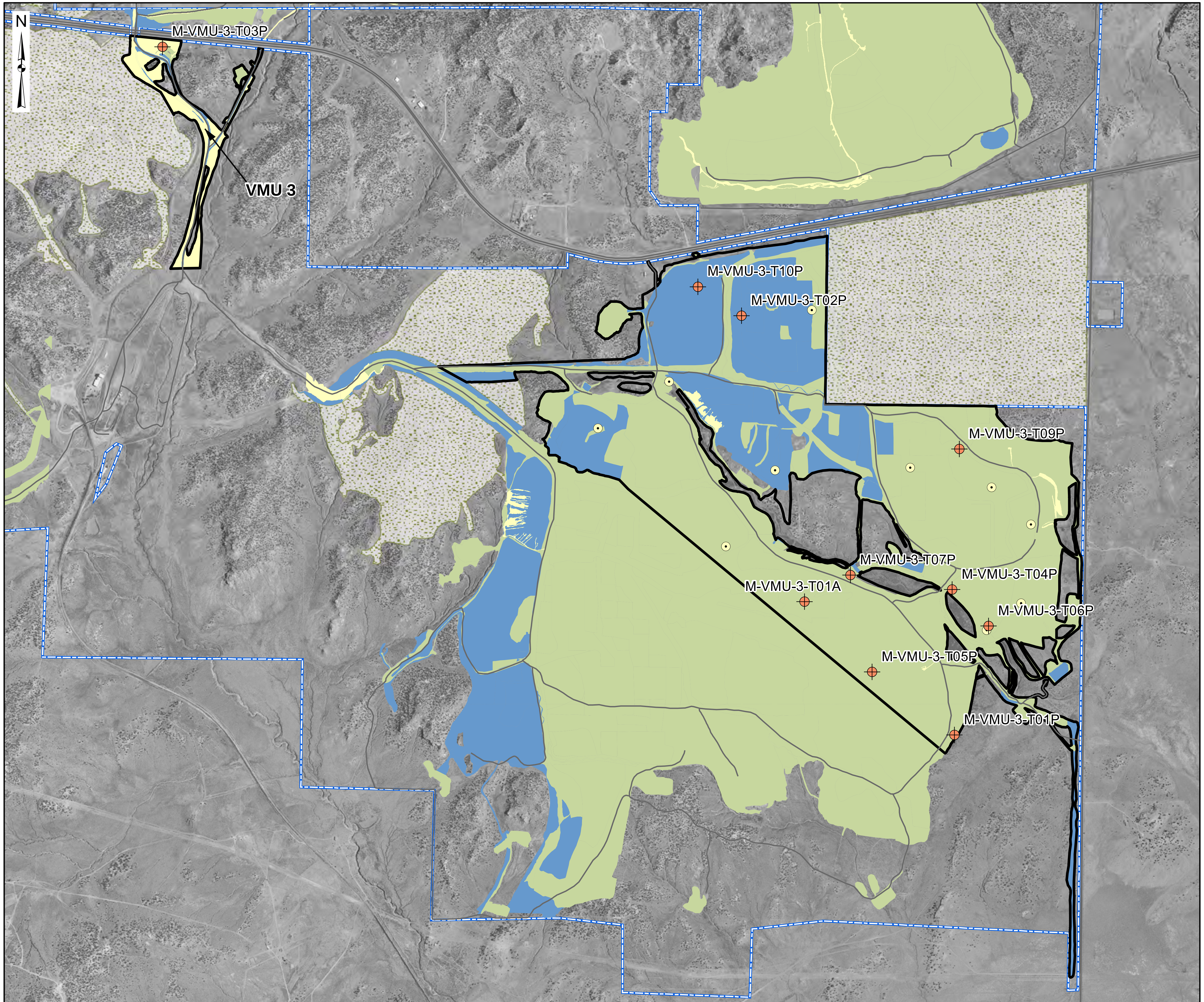


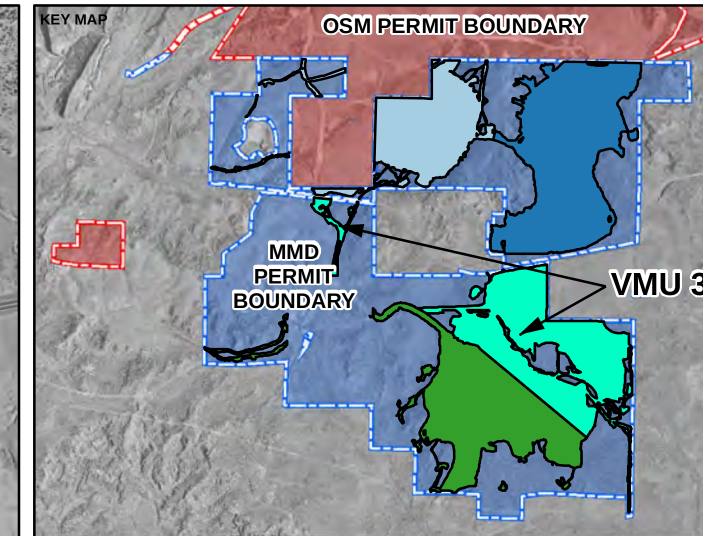
Figure 9d: M-VMU-3, Shrub Density (stems/acre) from Belt Transect with Technical Standard (150 stems/acre)
and 90% of Technical Standard (135 stems/ac)

Notes:
WY = Water Year; an example is WY 2019: this includes the monthly totals for October (2018) through September (2019)
9a: Long-term averages are from Window Rock, Arizona Station (029410) for 1937 to 1999 (WRRC, 2020) and the source data is from Table 1
9b, c and d: Source data is from Table 4
9d: Plots represent one acre (not to scale), points represent a randomized density and do not represent the actual distribution, size, form or cover of woody plants

APPENDIX A

Vegetation Data Summary





LEGEND

- Transects for 2020 MMD PHIII Vegetation Sampling
- 2019 PHIII Transects
- Two-tracks, Roads and Highways
- MMD VMU 3 (~ 1,284 acres)
- Liability Release
- MMD Permit Boundary

Seeded Areas by End_Year

- < 1997
- 1997 to 2013
- 2014 to 2018

TRANSECT LABEL EXPLANATION: M-VMU-1-T1P

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

0 2,000 4,000 Feet

1 inch = 2,000 feet

NOTE(S)

1. SEEDING AREA ATTRIBUTES WERE CLASSIFIED MANUALLY BASED ON SEED MIX VARIATIONS (<1997 AND 1997 TO 2013) WITH AN ADDITONAL CLASS FOR RECENT SEEDING (2014 TO 2018)

REFERENCE(S)

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

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

PROJECT
MCKINLEY MINE - MMD PERMIT PHASE III BOND RELEASE
2020 VEGETATION SAMPLING PROGRAM

TITLE
SEEDED AREA CLASSIFICATION (YEAR) AND TRANSECT LOCATIONS SAMPLED VEGETATION MANAGEMENT UNIT 3 (M-VMU-3), 2020

CONSULTANT
GOLDER

YYYY-MM-DD	2021-02-04
DESIGNED	DSW
PREPARED	DSW
REVIEWED	DR
APPROVED	FR

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105207	000623	--	A-1

Table A-1: M-VMU-3 Selected Transect Locations, 2020

Transect	Longitude (x)	Latitude (y)
M-VMU-3-T01A	-108.9382773	35.6058259
M-VMU-3-T01P	-108.9279101	35.5984798
M-VMU-3-T02P	-108.9428011	35.6217360
M-VMU-3-T03P	-108.9825833	35.6363702
M-VMU-3-T04P	-108.9281845	35.6065921
M-VMU-3-T05P	-108.9335890	35.6019492
M-VMU-3-T06P	-108.9256790	35.6045846
M-VMU-3-T07P	-108.9351479	35.6073398
M-VMU-3-T09P	-108.9277997	35.6144372
M-VMU-3-T10P	-108.9458036	35.6233307

Table A-2: M-VMU-3 Canopy Cover Data, 2020

Transect	M-VMU-3-T01A				M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Annuals																																								
BRTE	--	--	2.20	--	--	--	--	--	30.00	10.00	24.00	15.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
ACHY	--	--	--	--	--	--	--	--	--	--	--	--	5.90	--	--	--	--	--	--	--	--	--	22.50	--	--	--	--	--	--	--	10.25	1.00	--	--	--	--	4.25	--	54.50	11.00
AGCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.00	6.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.50	2.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	--	--	--	--	--	--	6.65	--	--	--	--	--	--	--	--	--	--	1.60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.75	57.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	--	1.80	--	--	1.75	--	1.75	3.00	4.00	8.00	--	--	--	--	--	--	--	1.00	--	--	--	--	--	--	--	--	--	3.20	--	--	--	--	--	--	--	--	--	--
ELGL	--	--	--	--	--	26.50	--	--	--	--	--	25.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30.00	--	--	5.00	17.50	--	--	--	--	--	--	--	--
ELTR7	--	--	--	--	38.00	6.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.10	--	--	16.00	--	4.00	--	--	--	--	--	--	18.00	--	--	--	--
HECO26	3.00	2.25	0.80	20.00	--	--	--	--	--	--	1.25	--	--	--	--	--	--	--	0.75	23.00	7.75	12.50	--	12.50	--	--	4.10	--	19.00	--	--	--	--	--	--	--	--	--	--	45.00
LEAM	--	--	--	--	--	--	18.00	15.75	--	--	--	--	--	19.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	9.50	--	--	9.50	--	--	--	1.20	13.75	4.00	4.00	--	--	--	--	2.50	45.00	32.50	42.00	1.10	--	--	10.00	--	24.00	--	--	--	38.50	18.00	--	--	0.75	--	14.00	42.00	33.00	23.50	18.25
PLJA	--	--	34.00	--	--	1.20	--	--	--	--	--	--	--	--	--	--	29.00	--	--	--	0.75	30.00	--	--	--	--	--	--	--	--	--	28.00	39.00	22.00	26.50	1.50	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--	--	--	6.75	8.50	--	--	--	--	--	--
THIN6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.75	8.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annual																																								
SATR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--	--	0.40	1.00	--	1.10	--	--	0.20	--	--
Annual/Biennial																																								
LAOC3	0.60	--	--	--	--	--	--	--	--	0.75	0.55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.75	--	--	--	--	--	--	--
Annual/Biennial/Perennial																																								
MACA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.50	--	--	--	--	--	--	--	--	2.30	--	--	1.80	--	--	--	--	--	--	--	--
Perennials																																								
ERWR	--	0.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.25	--	--	4.50	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	0.55	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.10	0.40	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.50	0.75	--	--	--	--	--	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	--	--	--	41.00	--	--	--	20.00	--	10.00	4.00	4.00	--	0.10	--	--	--	--	--	--	1.10	--	--	7.00	4.50	--	1.00	--	--	--	--	0.50	--	--	--	--	--	--	0.30
ATGA	--	--	--	--	--	--	20.00	--	--	--	--	70.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	28.00	--	--	--	--	--	--	--	--	--	--	--	--
ATRIP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATTR3	--	--	--	--	--	8.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	30.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--	--	--	--	--	--	--	--	2.00	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA	16.00	16.25	1.30	28.50	--	--	--	--	--	--	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.25	--	--	--	--	--	--	--	--	--	--	--	--
PUME	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	16.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PUTR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	19.50	--	--	3.00	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																								
Perennial/Biennial Vegetation Cover	19.6	28.9	36.1	50.3	88.5	43.0	39.8	22.4	23.0	17.5	20.5	111.0	9.9	19.0	17.1	93.8	31.5	45.0	34.9	67.5	31.9	58.6	45.5	51.4	7.3	31.8	25.2	64.7	30.1	41.7	33.3	48.3	47.5	32.0	26.5	33.5	46.3	33.0	78.0	74.6
Total Vegetation Cover	19.6	28.5	38.0	48.3	60.5	39.5	32.0	22.4	48.0	26.5	40.5	88.0	9.9	19.0	17.1	76.5	31.5	45.0	34.5	62.0	31.0	56.8	41.0	44.0	7.3	31.5	25.2	53.0	30.0	41.7	32.8	48.5	47.5	31.0	27.5	33.0	45.3	33.2	76.5	73.5
Rock	0.5	0.8	4.3	1.7	0.0	0.8	2.0	1.0	0.5	0.0	0.5	0.0	68.0	65.0	75.5	3.0	0.0	0.3	1.0	0.5	22.5	22.3	25.0	3.0	13.5	4.0	30.0	3.0	0.5	4.0	0.0	1.0	0.0	1.5	0.5	1.0	1.0	0.5	1.0	1.0
Litter	1.0	4.5	13.1	29.0	35.2	36.0	30.0	20.0	13.3	68.8	21.0	8.5	8.0	3.8	3.0	15.0	14.0	2.5	4.0	22.0	5.0	6.0	1.8	6.5	22.0	35.0	2.2	28.0	10.0	12.0	4.3	10.0	4.0	18.0	6.0	7.0	17.5	28.0	14.0	15.0
Base Soil	78.9	66.3	44.7	21.1	4.3	23.8	36.0	56.6	38.3	4.8	38.0	3.5	14.1	12.3	4.4	5.5	54.5	52.3	60.5	15.5	41.5	15.0	32.3	46.5	57.2	29.5	42.6	16.0	59.5	42.3	63.0	40.5	48.5	49.5	66.0	59.0	36.3	38.3	8.5	10.5

Notes:
Species codes defined in Table 3

Table A-3: M-VMU-3 Basal Cover Data, 2020

Transect	M-VMU-3-T01A				M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Annuals																																								
BRTE	--	--	0.15	--	--	--	--	--	1.50	0.35	0.40	0.60	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
ACHY	--	--	--	--	--	--	--	--	--	--	--	--	1.25	--	--	--	--	--	--	--	--	--	1.50	--	--	--	--	--	--	--	0.65	T	--	--	--	--	0.25	--	3.25	1.30
AGCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.65	0.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.50	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	--	--	--	--	--	--	0.50	--	--	--	--	--	--	--	--	--	--	0.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.80	2.40	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	--	0.20	--	--	0.35	--	0.20	0.30	0.30	0.60	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	0.30	--	--	--	--	--	--	--	--	--	--
ELGL	--	--	--	--	--	1.60	--	--	--	--	--	1.70	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.50	--	--	0.20	1.00	--	--	--	--	--	--	--	--
ELTR7	--	--	--	--	1.35	0.65	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.40	--	--	2.00	--	0.30	--	--	--	--	--	--	1.00	--	--	--	--
HECO26	0.20	0.15	0.05	1.00	--	--	--	--	--	--	0.10	--	--	--	--	--	--	--	0.10	1.25	1.00	1.10	--	0.80	--	--	0.55	--	1.00	--	--	--	--	--	--	--	--	--	--	2.10
LEAM	--	--	--	--	--	--	3.50	6.50	--	--	--	--	--	2.75	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	0.20	--	--	0.20	--	--	--	0.15	0.75	0.20	0.15	--	--	--	--	0.20	3.25	1.10	2.75	T	--	--	0.80	--	2.00	--	--	--	2.00	0.95	--	--	0.05	--	0.80	2.00	1.75	1.00	1.00
PLJA	--	--	2.00	--	--	0.05	--	--	--	--	--	--	--	--	--	--	1.60	--	--	--	0.05	1.75	--	--	--	--	--	--	--	--	--	2.00	4.25	1.60	1.85	0.15	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	1.80	0.65	--	--	--	--	--	--
THIN6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.35	0.50	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annual																																								
SATR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	0.05	0.05	--	0.05	--	--	T	--	--
Annual/Biennial																																								
LAOC3	T	--	--	--	--	--	--	--	--	T	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--
Annual/Biennial/Perennial																																								
MACA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.25	--	--	--	--	--	--	--	--	0.20	--	--	0.20	--	--	--	--	--	--	--	--
Perennials																																								
ERWR	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	--	--	--	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	T	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.05	T	--	--	--	--	--	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	--	--	--	0.75	--	--	--	0.70	--	0.35	0.15	0.10	--	T	--	--	--	--	--	--	0.10	--	--	0.40	1.00	--	0.05	--	--	--	--	T	--	--	--	--	--	--	T
ATGA	--	--	--	--	--	--	0.55	--	--	--	--	1.90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.60	--	--	--	--	--	--	--	--	--	--	--	--
ATRIP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATTR3	--	--	--	--	--	0.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	0.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA	0.20	0.95	0.10	1.10	--	--	--	--	--	--	T	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--	--	--	--	--	--	--	--	--	--	--	--
PUME	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PUTR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.20	--	--	0.30	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																								
Perennial/Biennial Vegetation Cover	0.4	1.3	2.2	2.3	2.3	2.6	4.4	7.0	1.1	1.1	1.0	4.5	1.4	2.8	1.5	4.3	1.8	3.3	1.4	4.3	2.7	3.6	2.2	2.5	0.4	3.1	3.1	3.4	1.6	2.3	1.8	3.2	6.2	2.3	1.9	2.0	2.3	1.8	4.3	4.4
Total Vegetation Cover	0.4	1.3	2.3	2.3	2.3	2.6	4.4	7.0	2.6	1.4	1.4	5.1	1.4	2.8	1.5	4.3	1.8	3.3	1.4	4.3	2.7	3.6	2.2	2.5	0.4	3.1	3.1	3.4	1.6	2.3	1.8	3.3	6.2	2.3	1.9	2.0	2.3	1.8	4.3	4.4
Rock	0.6	0.9	6.5	2.0	0.5	1.5	2.2	1.2	0.6	0.0	1.0	0.5	70.0	66.0	81.0	4.1	0.0	0.6	1.2	0.8	24.0	38.0	30.0	3.2	14.5	10.3	35.0	15.0	0.7	6.0	1.0	1.2	0.0	2.0	0.6	1.3	1.3	1.3	5.3	4.5
Litter	5.0	19.5	43.5	55.8	78.0	62.0	54.0	32.0	62.0	87.0	48.0	83.0	12.0	18.5	12.0	85.3	28.0	35.0	8.0	44.0	23.0	32.0	13.9	32.5	25.0	42.0	9.5	54.0	18.0	21.0	11.3	35.0	20.0	38.0	18.5	20.0	50.0	58.0	39.0	36.3
Base Soil	94.0	78.3	47.7	40.0	19.2	34.0	39.4	59.8	34.9	11.6	49.6	11.4	16.7	12.8	5.5	6.4	70.2	61.2	89.4	51.0	50.3	26.5	54.0	61.9	60.1	44.7	52.5	27.6	79.7	70.7	86.0	60.5	73.8	57.7	79.1	76.8	46.5	39.0	51.5	54.8

Notes:
Species codes defined in Table 3
T = Trace amount of cover; 0.033 is the trace value used for data analysis purposes

Table A-4: M-VMU-3 Frequency Data (counts), 2020

Transect	M-VMU-3-T01A				M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Annuals																																								
BRTE	--	--	15	--	--	--	--	--	60	30	22	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Perennials																																								
ACHY	--	--	--	--	--	--	--	--	--	--	--	--	6	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	1	2	--	--	--	--	2	--	5	2
AGCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	90	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	--	1	--	--	4	--	2	2	4	15	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--
ELGL	--	--	--	--	--	15	--	--	--	--	--	15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13	--	--	7	24	--	--	--	--	--	--	--	--
ELTR7	--	--	--	--	11	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	19	--	5	--	--	--	--	--	--	14	--	--	--	--
HECO26	3	1	1	13	--	--	--	--	--	--	1	--	--	--	--	--	--	--	2	18	3	11	--	6	--	--	3	--	6	--	--	--	--	--	--	--	--	--	--	3
LEAM	--	--	--	--	--	--	1	2	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	22	--	--	7	--	--	--	3	12	6	7	--	--	--	--	18	60	85	33	2	--	--	23	--	25	--	--	--	28	33	--	--	2	--	16	40	33	21	10
PLJA	--	--	28	--	--	2	--	--	--	--	--	--	--	--	--	--	15	--	--	--	1	15	--	--	--	--	--	--	--	--	--	13	9	9	8	3	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	4	12	--	--	--	--	--	--
THIN6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annual																																								
SATR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	15	30	--	12	--	--	4	--	--
Annual/Biennial																																								
LAOC3	7	--	--	--	--	--	--	--	--	6	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--
Annual/Biennial/Perennial																																								
MACA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	3	--	--	3	--	--	--	--	--	--	--	--
Perennials																																								
ERWR	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	6	--	--	--	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	1	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2	--	--	--	--	--	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	--	--	--	2	--	--	--	1	--	1	1	1	--	1	--	--	--	--	--	--	1	--	--	3	1	--	1	--	--	--	--	1	--	--	--	--	--	--	1
ATGA	--	--	--	--	--	--	2	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
ATRIP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATTR3	--	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA	2	7	1	7	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
PUME	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PUTR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
Species codes defined in Table 3
The quadrat (plot) size is one square meter (1m^2; see Figure 4); plants rooted in the quadrat were counted on an individual basis

Table A-5: M-VMU-3 Air-dry Aboveground Annual Production Data, 2020

Transect	M-VMU-3-T01A				M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses (g/m^2)																																								
Non-forage																																								
BRTE	--	--	1.11	--	--	--	--	--	22.30	6.84	17.07	12.08	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forage																																								
ACHY	--	--	--	--	--	--	--	--	--	--	--	--	4.73	--	--	--	--	--	--	--	--	--	25.90	--	--	--	--	--	--	--	8.39	0.52	--	--	--	--	3.05	--	100.50	26.02
AGCR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.91	10.58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.10	1.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOGR2	--	--	--	--	--	--	--	6.07	--	--	--	--	--	--	--	--	--	--	0.98	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.96	23.71	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELEL	--	--	--	1.97	--	--	1.76	--	2.57	2.41	5.25	9.99	--	--	--	--	--	--	--	1.28	--	--	--	--	--	--	--	--	--	3.19	--	--	--	--	--	--	--	--	--	--
ELGL	--	--	--	--	--	48.15	--	--	--	--	--	19.84	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24.21	--	--	5.34	42.39	--	--	--	--	--	--	--	--
ELTR7	--	--	--	--	34.57	6.58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.09	--	--	24.33	--	2.02	--	--	--	--	--	--	6.39	--	--	--	--
HECO26	1.84	1.98	0.79	23.69	--	--	--	--	--	--	1.62	--	--	--	--	--	--	--	0.95	25.89	4.64	5.39	--	5.68	--	--	2.36	--	15.36	--	--	--	--	--	--	--	--	--	--	53.55
LEAM	--	--	--	--	--	--	37.57	59.15	--	--	--	--	--	24.17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	8.64	--	--	7.10	--	--	--	2.09	7.73	4.98	2.93	--	--	--	--	1.67	31.26	13.79	40.98	1.61	--	--	16.09	--	15.84	--	--	--	32.75	10.61	--	--	0.83	--	10.54	67.62	35.63	14.58	67.94
PLJA	--	--	48.35	--	--	4.34	--	--	--	--	--	--	--	--	--	--	28.51	--	--	--	1.09	37.76	--	--	--	--	--	--	--	--	--	39.09	38.02	32.51	26.73	1.44	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.55	--	--	--	1.80	2.28	--	--	--	--	--	--
THIN6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	20.44	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
THPO7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.31	45.93	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs (g/m^2)																																								
Non-forage																																								
SATR	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.88	--	--
Forage																																								
ERWR	--	1.72	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.50	--	--	12.21	--	--	--	--	--	--	--	--	--	--	--
LAOC3	0.60	--	--	--	--	--	--	--	--	1.97	0.62	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.77	--	--	--	--	--	--	--
MACA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.12	--	--	--	--	--	--	--	--	5.64	--	--	1.84	--	--	--	--	--	--	--	--
MENTZ	--	--	--	--	--	--	--	--	--	--	1.18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PEPA8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6.96	0.88	--	--	--	--	--	--	--	--	--	--	--	--
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.60	0.57	--	--	--	--	--	--
Shrubs, Trees and Cacti (g/m^2)																																								
Forage																																								
ATCA	--	--	--	--	66.56	--	--	--	23.12	--	17.67	5.77	10.99	--	0.37	--	--	--	--	--	--	5.22	--	--	8.86	8.12	--	3.09	--	--	--	--	0.61	--	--	--	--	--	--	1.60
ATGA	--	--	--	--	--	--	46.88	--	--	--	--	160.81	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	60.99	--	--	--	--	--	--	--	--	--	--	--	--
ATRIP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.83	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATTR3	--	--	--	--	--	22.67	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17.99	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	95.25	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.60	--	2.92	--	--	--	--	--	--	3.95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA	23.19	17.50	5.55	33.76	--	--	--	--	--	--	0.53	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.68	--	--	--	--	--	--	--	--	--	--	--	--
PUME	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	57.10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PUTR2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	52.94	--	--	3.35	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Air-dry Aboveground Annual Production (g/m^2)																																								
Non-forage	0.00	0.00	1.11	0.00	0.00	0.00	0.00	0.00	22.30	6.84	17.07	12.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.88	0.00	0.00
Forage	25.64	29.85	54.70	59.43	108.24	81.75	86.22	65.23	27.79	12.12	31.87	199.35	15.73	24.17	14.85	129.55	33.11	31.26	15.73	74.28	34.11	112.31	88.11	89.58	9.70	28.47	37.01	96.87	35.80	35.95	24.35	83.85	41.82	36.20	26.73	18.38	70.68	35.63	115.09	149.12
Total Production	25.64	29.85	55.81	59.43	108.24	81.75	86.22	65.23	50.09	18.96	48.94	211.43	15.73	24.17	14.85	129.55	33.11	31.26	15.73	74.28	34.11	112.31	88.11	89.58	9.70	28.47	37.01	96.87	35.80	35.95	24.35	83.85	41.82	36.20	26.73	18.38	70.68	37.52	115.09	149.12
Total Air-dry Aboveground Annual Production (lbs/ac)																																								
Non-forage	0	0	10	0	0	0	0	0	199	61	152	108	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0
Forage	229	266	488	530	966	729	769	582	248	108	284	1779	140	216	133	1156	295	279	140	663	304	1002	786	799	87	254	330	864	319	321	217	748	373	323	239	164	631	318	1027	1330
Total Production	229	266	498	530	966	729	769	582	447	169	437	1886	140	216	133	1156	295	279	140	663	304	1002	786	799	87	254	330	864	319	321	217	748	373	323	239	164	631	335	1027	1330

Notes:
g/m^2 = grams per square meter
lbs/ac = pounds per acre
1 gram per square meter (g/m^2) is equal to 8.922 pounds per acre (lbs/ac)
Species codes defined in Table 3
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: M-VMU-3 Shrub Belt Transect Data, 2020

Transect	M-VMU-3-T01A	M-VMU-3-T01P	M-VMU-3-T02P	M-VMU-3-T03P	M-VMU-3-T04P	M-VMU-3-T05P	M-VMU-3-T06P	M-VMU-3-T07P	M-VMU-3-T09P	M-VMU-3-T10P
Shrubs, Trees and Cacti										
ATCA	4	10	14	2	2	5	11	1	4	4
ATCO	--	1	--	--	--	1	3	--	--	--
ATGA	--	2	--	--	1	--	6	--	--	--
ATRIP	--	--	--	--	--	--	5	10	--	--
EPVI	--	--	--	--	--	2	2	2	--	--
ERNA	--	--	--	10	--	7	--	--	--	--
GUSA	--	--	--	7	1	3	--	--	--	--
KRLA	42	2	2	--	--	1	7	--	--	--
PUME	--	--	--	--	--	2	--	--	--	--
PUTR2	--	--	--	--	--	5	1	--	--	--

Notes:

The shnrub belt transect area (plot) is 30m2 (1mx30m; see Figure 4); shrubs rooted in the belt transect were counted on an individual basis

Code	Scientific Name	Common Name
ATCA	*Atriplex canescens*	Four-wing saltbush
ATCO	*Atriplex confertifolia*	Shadscale saltbush
ATGA	*Atriplex gardneri*	Gardner's saltbush
ATRIP	*Atriplex species*	Unknown saltbush species
EPVI	*Ephedra viridis*	Mormon tea
ERNA	*Ericameria nauseosa*	Rubber rabbitbrush
GUSA	*Gutierrezia sarothrae*	Broom snakeweed
KRLA	*Krascheninnikovia lanata*	Winterfat
PUME	*Purshia mexicana*	Mexican cliffrose
PUTR2	*Purshia tridentata*	Antelope bitterbrush

APPENDIX B

Quadrat Photographs

M-VMU-3-T01A

Q1

Q2

Q3

Q4

M-VMU-3-T01P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T02P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T03P


Q1


Q2


Q3


Q4

M-VMU-3-T04P

Q1

Q2

Q3

Q4

M-VMU-3-T05P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T06P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T07P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T09P

Q1

Q2

Q3

Q4

M-VMU-3-T10P	
	
Q1	Q2
	
Q3	Q4

APPENDIX C

Vegetation Statistical Analysis

Table C-1: 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	$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$	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	$\bar{x} \pm t\frac{s}{\sqrt{n}}$	$\bar{x}$ = sample mean t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom 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
Probaility of True Mean	$T = 1 - t\left(\frac{\sqrt{n(0.1xs)'^2}}{\bar{x}, 2, n, 1}\right)$	T = Probability the true value of the mean is within 10 percent of the mean for the sample size t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom n = number of samples s = standard deviation $\bar{x}$ = sample mean
one-sample, one-sided t test Method 3 (CMRP)	$t^* = \frac{\bar{x} - 0.9\,(technical\ std)}{s/\sqrt{n}}$	t* = calculated t-statistic $\bar{x}$ = sample mean s = standard deviation n = sample size
one-sample, one-sided sign test Method 5 (CMRP)	$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$	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	$R_{cvr} = Cvr_{sp.}/Cvr_{Abs.}$	R_{cvr} = Calculated Relative Cover for a Species $Cvr_{sp.}$ = Mean Absolute Cover of a Perennial/Biennial Species $Cvr_{abs.}$ = Mean Absolute Perennial/Biennial Cover
Logarithmic Transformation	Y' = log(Y + k)	log = logarithmic function Y = attribute value k = constant, here we use 1

Table C-2: M-VMU-3 2020 Data for Normal Distribution and Variance Analysis

Plot	Transect	Quadrat	Raw Data			Transformed Data		
			2020 Perennial / Biennial Cover (%)	2020 Annual Forage Production (lbs/ac)	2020 Woody Plant Density (#/ac)	Log P/B Cover (2020)	Log AFP (2020)	Log WPD (2020)
M-VMU-3	M-VMU-3-T01A	1	19.6	229	6,205	1.31	2.36	3.79
		2	28.9	266		1.48	2.43	
		3	36.1	488		1.57	2.69	
		4	50.3	530		1.71	2.73	
	M-VMU-3-T01P	1	88.5	966	2,023	1.95	2.99	3.31
		2	43.0	729		1.64	2.86	
		3	39.8	769		1.61	2.89	
		4	22.4	582		1.37	2.77	
	M-VMU-3-T02P	1	23.0	248	2,158	1.38	2.40	3.33
		2	17.5	108		1.27	2.04	
		3	20.5	284		1.33	2.46	
		4	111.0	1,779		2.05	3.25	
	M-VMU-3-T03P	1	9.9	140	2,563	1.04	2.15	3.41
		2	19.0	216		1.30	2.34	
		3	17.1	133		1.26	2.13	
		4	93.8	1,156		1.98	3.06	
	M-VMU-3-T04P	1	31.5	295	540	1.51	2.47	2.73
		2	45.0	279		1.66	2.45	
		3	34.9	140		1.55	2.15	
		4	67.5	663		1.84	2.82	
	M-VMU-3-T05P	1	31.9	304	3,507	1.52	2.48	3.55
		2	58.6	1,002		1.78	3.00	
		3	45.5	786		1.67	2.90	
		4	51.4	799		1.72	2.90	
	M-VMU-3-T06P	1	7.3	87	4,721	0.92	1.94	3.67
		2	31.8	254		1.52	2.41	
		3	25.2	330		1.42	2.52	
		4	64.7	864		1.82	2.94	
	M-VMU-3-T07P	1	30.1	319	1,754	1.49	2.51	3.24
		2	41.7	321		1.63	2.51	
		3	33.3	217		1.53	2.34	
		4	48.3	748		1.69	2.87	
	M-VMU-3-T09P	1	47.5	373	540	1.69	2.57	2.73
		2	32.0	323		1.52	2.51	
		3	26.5	239		1.44	2.38	
		4	33.5	164		1.54	2.22	
	M-VMU-3-T10P	1	46.3	631	540	1.67	2.80	2.73
		2	33.0	318		1.53	2.50	
		3	78.0	1,027		1.90	3.01	
		4	74.6	1,330		1.88	3.12	

Mean	41.5	511	2455	1.57	2.60	3.25
Standard Deviation	23.2	382	1888	0.24	0.32	0.39
Count	40	40	10	40	40	10
Variance	536.5	146164	3565754	0.06	0.10	0.16
90% Confidence Interval	6.0	99	982	0.06	0.08	0.21

Notes:

2020 Perennial / Biennial Cover (%) Data source is Appendix A, Table A-2; Perennial/biennial cover is the sum of individual perennial/biennial species cover estimates after excluding the annual forbs and grasses and noxious weeds

2020 Annual Forage Production (lbs/ac) Data source is Appendix A, Table A-5; 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)

2020 Woody Plant Density (#/ac) Data is derived from Appendix A, Table A-6; 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-3: 2020 Perennial/ Biennial Canopy Cover, Method 5 - CMRP

Transect	Quadrat	2020 Perennial / Biennial Cover (%)	90% of Technical Standard	P/B CVR minus TS
M-VMU-3-T01A	1	19.6	13.5	6.1
	2	28.9	13.5	15.4
	3	36.1	13.5	22.6
	4	50.3	13.5	36.8
M-VMU-3-T01P	1	88.5	13.5	75.0
	2	43.0	13.5	29.5
	3	39.8	13.5	26.3
	4	22.4	13.5	8.9
M-VMU-3-T02P	1	23.0	13.5	9.5
	2	17.5	13.5	4.0
	3	20.5	13.5	7.0
	4	111.0	13.5	97.5
M-VMU-3-T03P	1	9.9	13.5	-3.6
	2	19.0	13.5	5.5
	3	17.1	13.5	3.6
	4	93.8	13.5	80.3
M-VMU-3-T04P	1	31.5	13.5	18.0
	2	45.0	13.5	31.5
	3	34.9	13.5	21.4
	4	67.5	13.5	54.0
M-VMU-3-T05P	1	31.9	13.5	18.4
	2	58.6	13.5	45.1
	3	45.5	13.5	32.0
	4	51.4	13.5	37.9
M-VMU-3-T06P	1	7.3	13.5	-6.2
	2	31.8	13.5	18.3
	3	25.2	13.5	11.7
	4	64.7	13.5	51.2
M-VMU-3-T07P	1	30.1	13.5	16.6
	2	41.7	13.5	28.2
	3	33.3	13.5	19.8
	4	48.3	13.5	34.8
M-VMU-3-T09P	1	47.5	13.5	34.0
	2	32.0	13.5	18.5
	3	26.5	13.5	13.0
	4	33.5	13.5	20.0
M-VMU-3-T10P	1	46.3	13.5	32.8
	2	33.0	13.5	19.5
	3	78.0	13.5	64.5
	4	74.6	13.5	61.1
			k	2
			n	40
			z	-5.53
Standard one-tailed normal curve area (Table C-3; MMD, 1999)				0.4990
			P	0.0010

Notes:
P/B CVR = Perennial/Biennial Cover
TS = 90% of the Technical Standard for Perennial/Biennial Cover
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-4: 2020 Annual Forage Production, Method 5 - CMRP

Transect	Quadrat	2020 Annual Forage Production (lbs/ac)	90% of Technical Standard	FP minus TS
M-VMU-3-T01A	1	228.7	315	-86.3
	2	266.3	315	-48.7
	3	488.0	315	173.0
	4	530.2	315	215.2
M-VMU-3-T01P	1	965.7	315	650.7
	2	729.4	315	414.4
	3	769.2	315	454.2
	4	581.9	315	266.9
M-VMU-3-T02P	1	247.9	315	-67.1
	2	108.1	315	-206.9
	3	284.3	315	-30.7
	4	1778.5	315	1463.5
M-VMU-3-T03P	1	140.3	315	-174.7
	2	215.7	315	-99.3
	3	132.5	315	-182.5
	4	1155.8	315	840.8
M-VMU-3-T04P	1	295.4	315	-19.6
	2	278.9	315	-36.1
	3	140.3	315	-174.7
	4	662.7	315	347.7
M-VMU-3-T05P	1	304.3	315	-10.7
	2	1002.0	315	687.0
	3	786.1	315	471.1
	4	799.2	315	484.2
M-VMU-3-T06P	1	86.5	315	-228.5
	2	254.0	315	-61.0
	3	330.2	315	15.2
	4	864.2	315	549.2
M-VMU-3-T07P	1	319.4	315	4.4
	2	320.7	315	5.7
	3	217.2	315	-97.8
	4	748.1	315	433.1
M-VMU-3-T09P	1	373.1	315	58.1
	2	323.0	315	8.0
	3	238.5	315	-76.5
	4	164.0	315	-151.0
M-VMU-3-T10P	1	630.6	315	315.6
	2	317.9	315	2.9
	3	1026.8	315	711.8
	4	1330.4	315	1015.4
			k	17
			n	40
			z	-0.79
Standard one-tailed normal curve area (Table C-3; MMD, 1999)				0.2852
			P	0.2148

Notes:
FP = Forage Production
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:

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

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Table C-5: Forage Production

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

	2020 Log AFP
Mean (#/ac)	2.60
Standard Deviation (#/ac)	0.322
Sample Size	40
Technical Standard (#/ac)	2.50
t*	1.92
N_{min}	4
1-tail t (0.1, 9)	1.304

Notes:

AFP = Annual Forage Production

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-6: Shrub Density

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

	2020 Woody Plant Density (#/ac)
Mean (#/ac)	2,455
Standard Deviation (#/ac)	1,888
Sample Size	10
Technical Standard (#/ac)	150
t*	3.89
N_{min}	199
1-tail t (0.1, 9)	1.304

Notes:

AFP = Annual Forage Production

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)

Figure C-1: Perennial/Biennial Cover (%) Descriptive Statistics and Normality, 2020

Distribution: Raw Data: 2020 Perennial / Biennial Cover

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Table C-2: M-VMU-3 2020 Data for Normal Distribution and Variance Analysis
Filter: No filter

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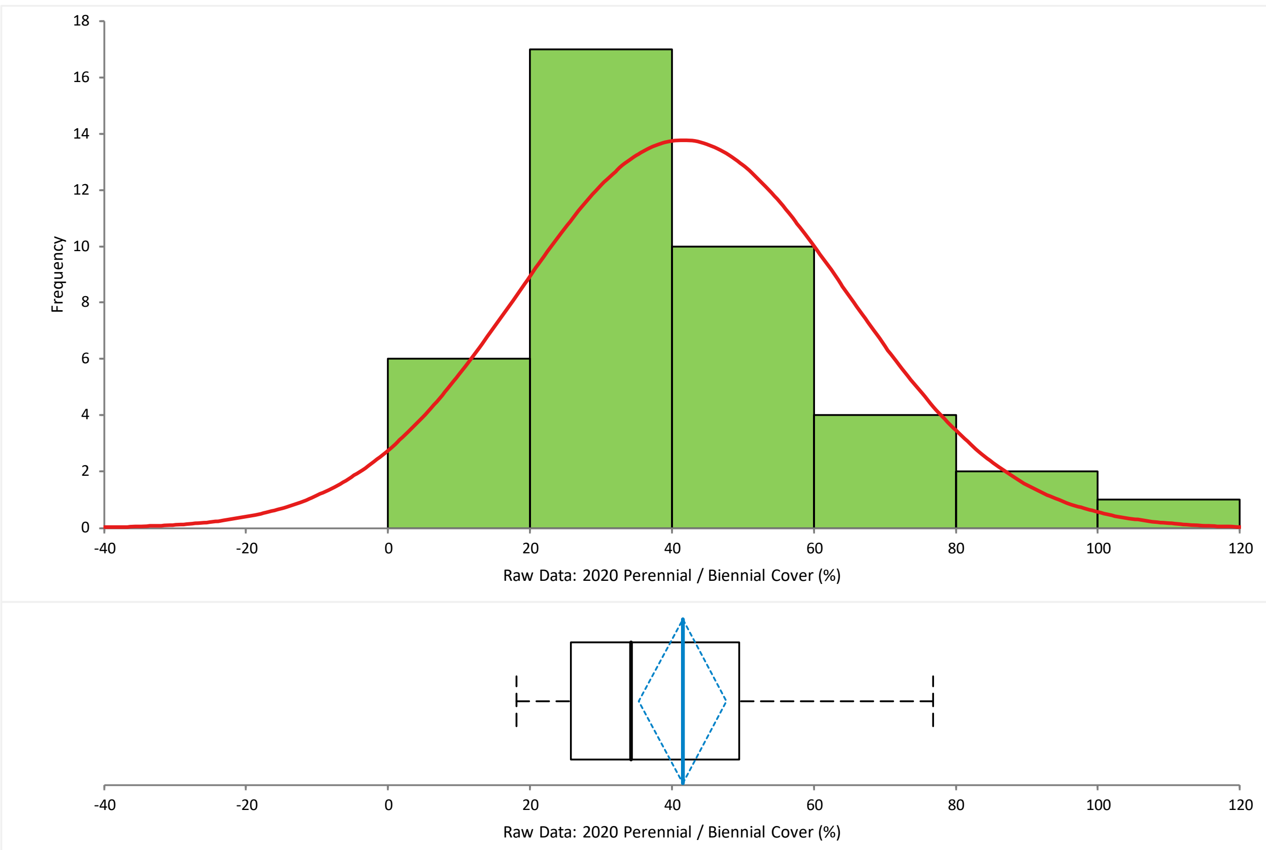
Descriptives



N	40

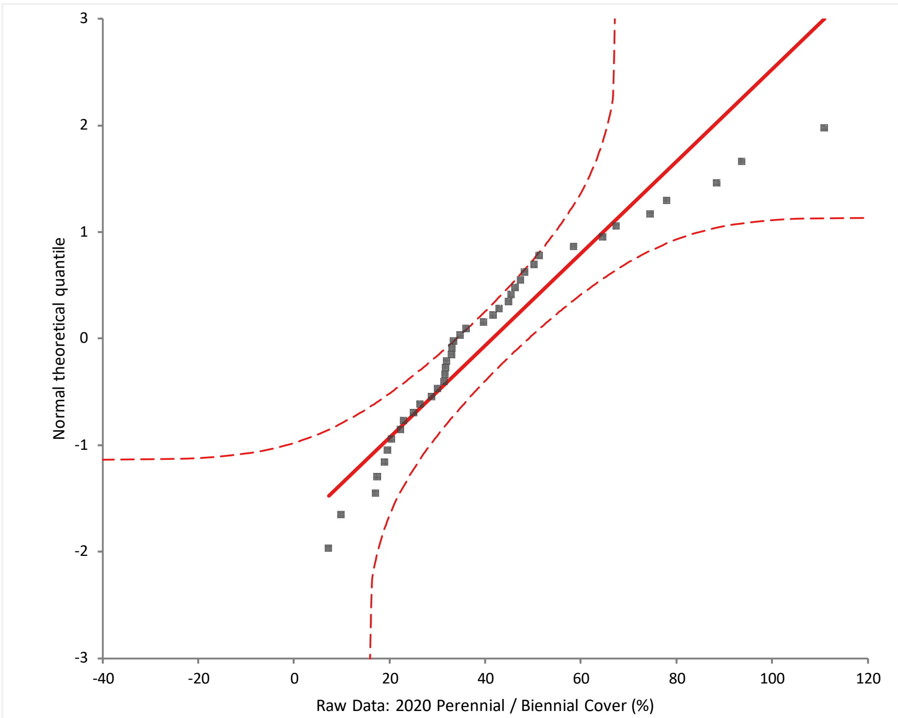
	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Raw Data: 2020 Perennial / Biennial Cover (%)	41.5	35.3 to 47.7	3.7	23.2	1.2	1.29

	1st quartile	Median	3rd quartile
Raw Data: 2020 Perennial / Biennial Cover (%)	25.7	34.2	49.5

GOLDER

Figure C-1: Perennial/Biennial Cover (%) Descriptive Statistics and Normality, 2020

Normality



Shapiro-Wilk test

W statistic	0.91
p-value	0.0037 [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-2: Perennial/Biennial Cover (Logarithmic Transformation) Descriptive Statistics and Normality, 2020

Distribution: Transformed Data: Log P/B Cover

Analyse-it v5.65.7

Table C-2: M-VMU-3 2020 Data for Normal Distribution and Variance Analysis
Filter: No filter

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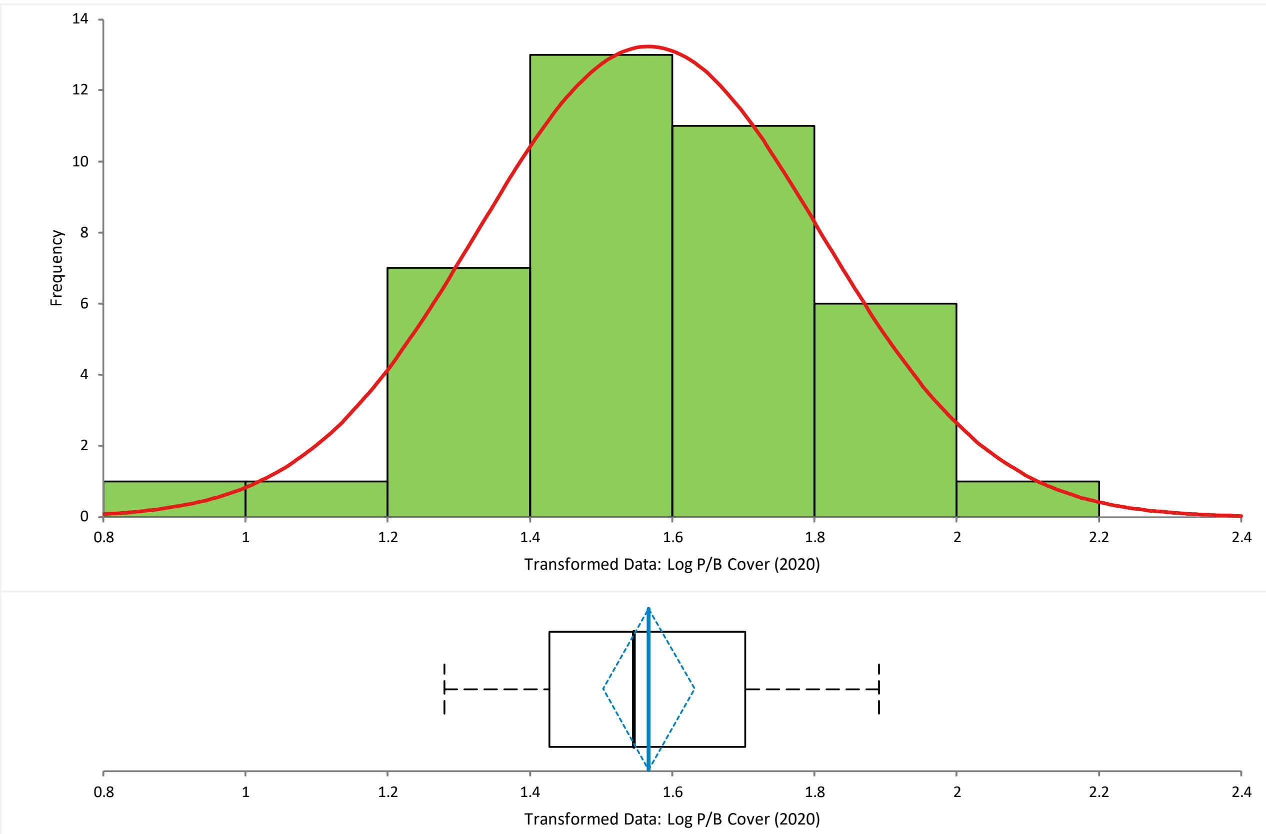
Descriptives



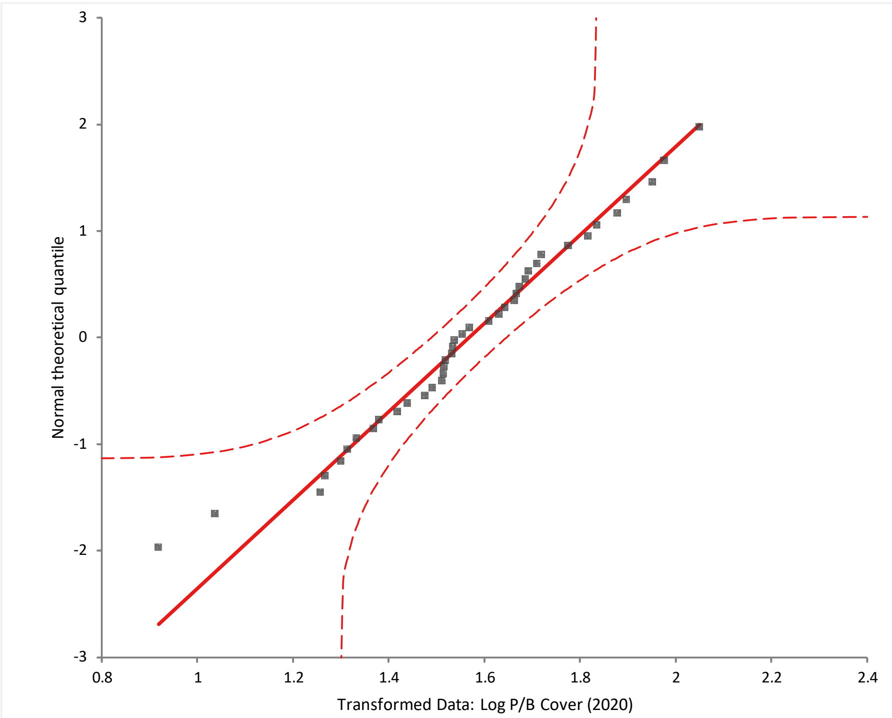
N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Transformed Data: Log P/B Cover (2020)	1.567	1.503 to 1.631	0.0381	0.241	-0.4	0.53

	1st quartile	Median	3rd quartile
Transformed Data: Log P/B Cover (2020)	1.427	1.546	1.703

Figure C-2: Perennial/Biennial Cover (Logarithmic Transformation) Descriptive Statistics and Normality, 2020

Normality



Shapiro-Wilk test

W statistic	0.98
p-value	0.7278 [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 (lbs/ac) Descriptive Statistics and Normality, 2020

Distribution: Raw Data: 2020 Annual Forage Production

Analyse-it v5.65.7

Table C-2: M-VMU-3 2020 Data for Normal Distribution and Variance Analysis
Filter: No filter

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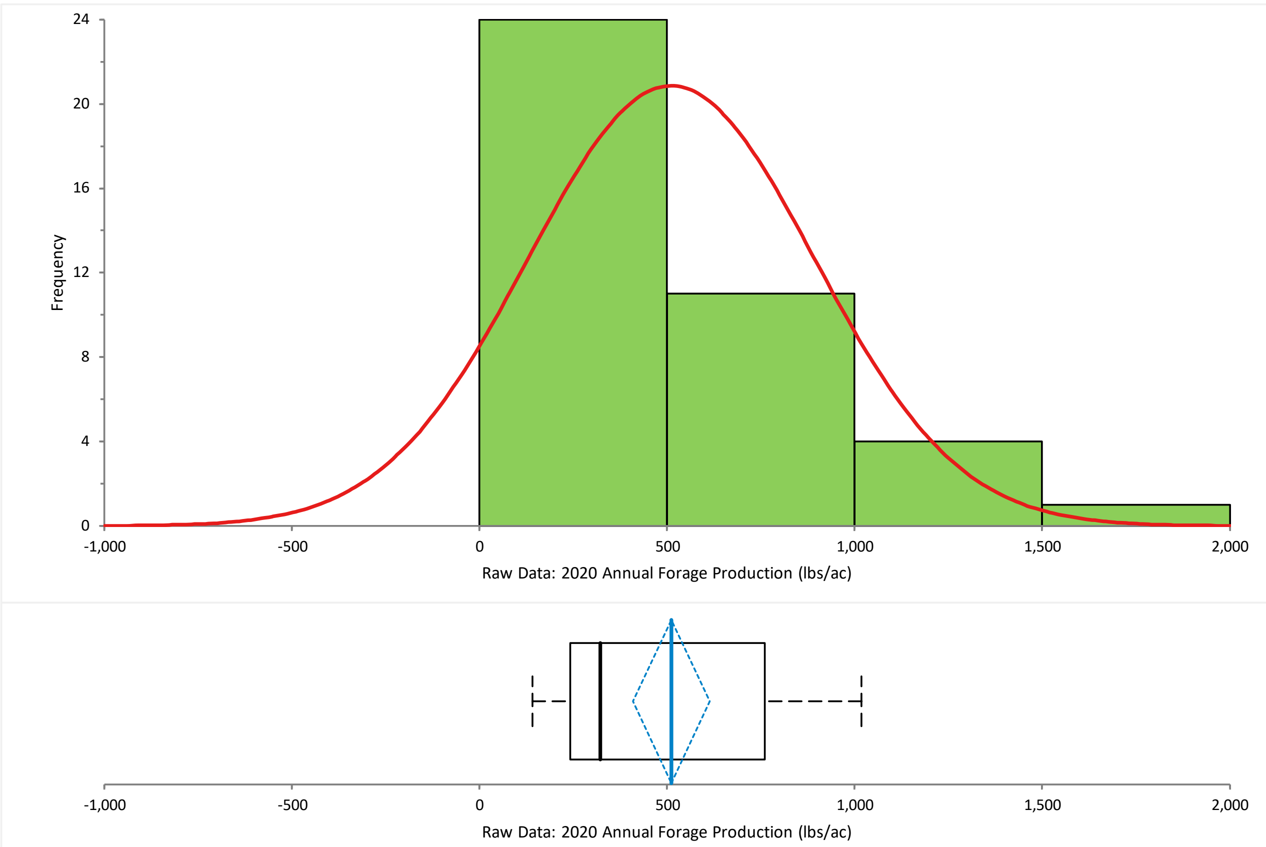
Descriptives



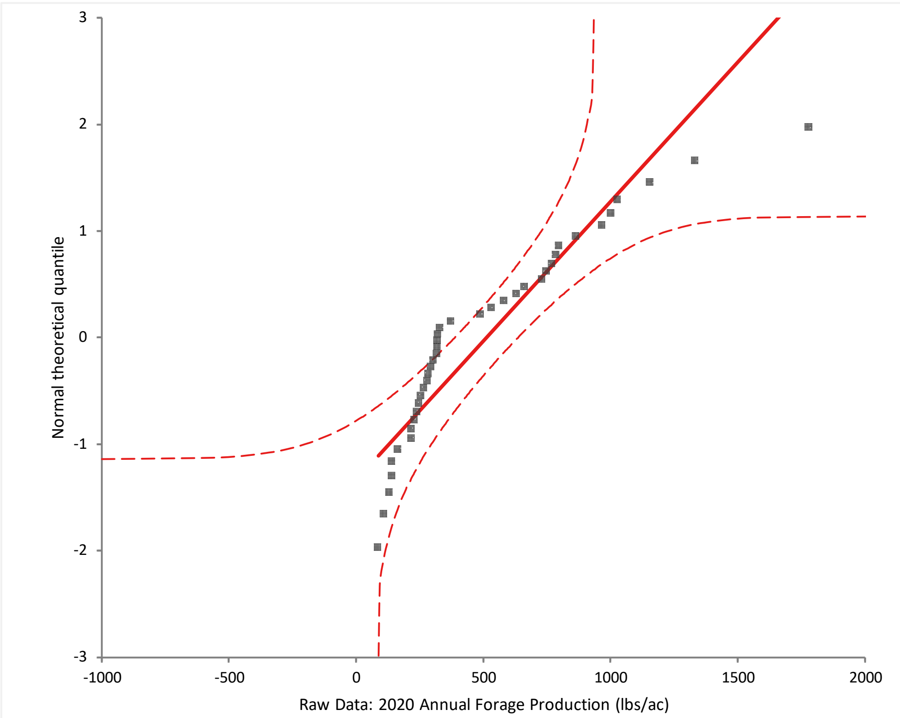
N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Raw Data: 2020 Annual Forage Production (lbs/ac)	510.9	409.1 to 612.8	60.4	382.3	1.3	1.80

	1st quartile	Median	3rd quartile
Raw Data: 2020 Annual Forage Production (lbs/ac)	242.4	321.8	760.4

Figure C-3: Annual Forage Production (lbs/ac) Descriptive Statistics and Normality, 2020

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-4: Annual Forage Production (Logarithmic Transformation) Descriptive Statistics and Normality, 2020

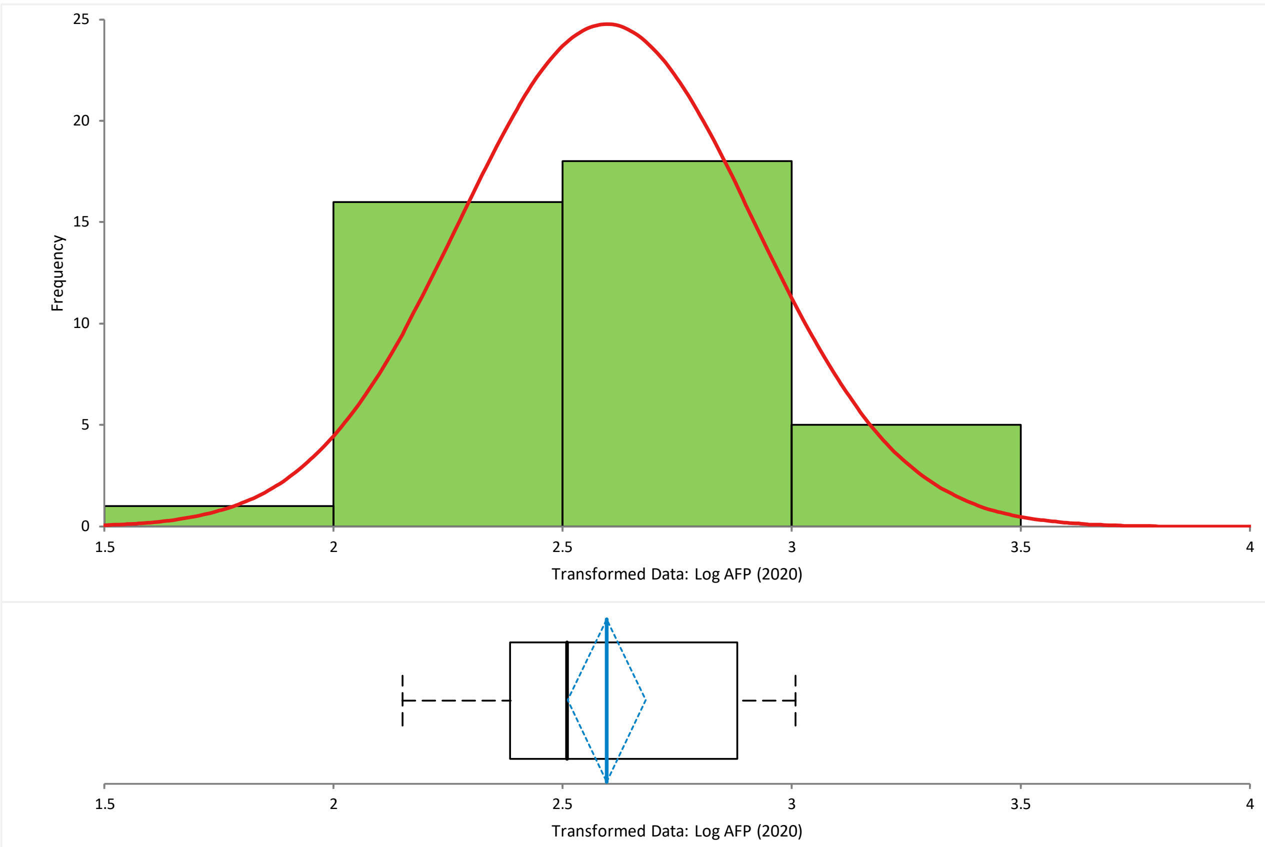
Distribution: Transformed Data: Log AFP

Analyse-it v5.65.7

Table C-2: M-VMU-3 2020 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 11 February 2021 at 13:41 by Ward, Dustin

Descriptives



N	40

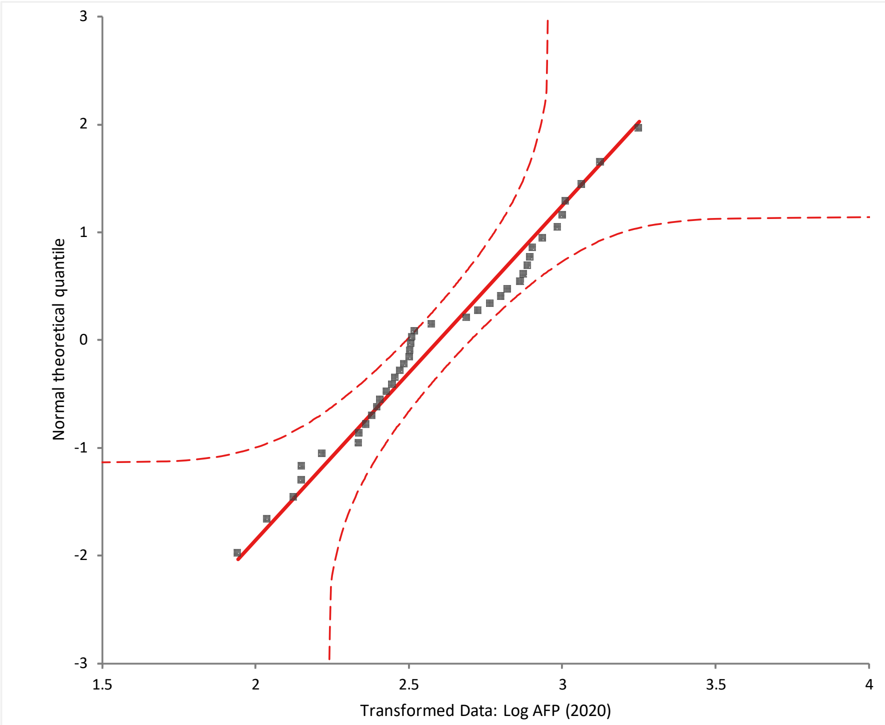
	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Transformed Data: Log AFP (2020)	2.596	2.510 to 2.682	0.0509	0.322	0.0	-0.77

	1st quartile	Median	3rd quartile
Transformed Data: Log AFP (2020)	2.386	2.509	2.882

GOLDER

Figure C-4: Annual Forage Production (Logarithmic Transformation) Descriptive Statistics and Normality, 2020

Normality



Shapiro-Wilk test

W statistic	0.97
p-value	0.4103 [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-5: Shrub Density (#/ac) by the Belt Transect Method Descriptive Statistics and Normality, 2020

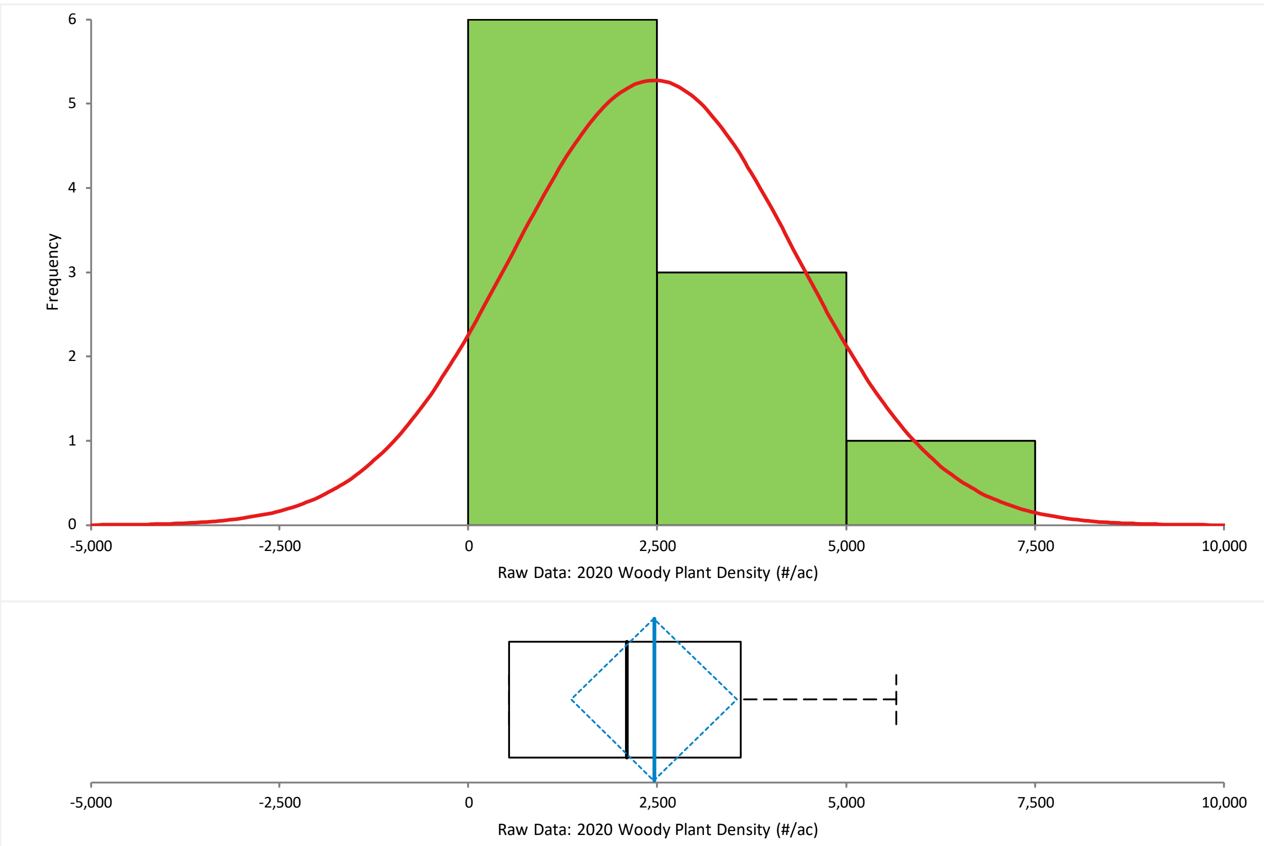
Distribution: Raw Data: 2020 Woody Plant Density

Analyse-it v5.65.7

Table C-2: M-VMU-3 2020 Data for Normal Distribution and Variance Analysis
Filter: No filter

Last updated 16 February 2021 at 10:43 by Ward, Dustin

Descriptives



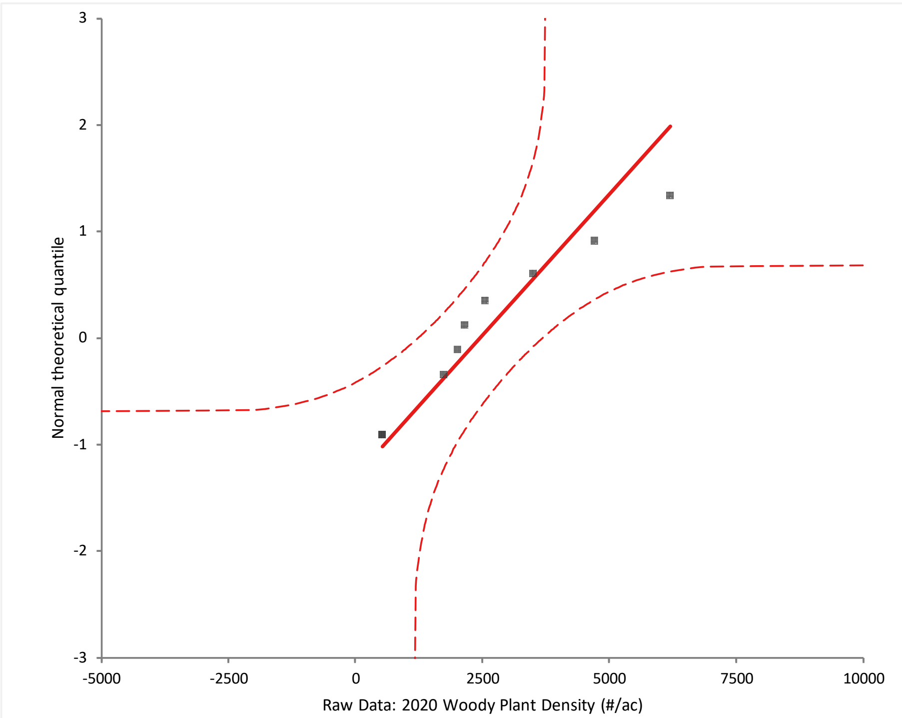
N	10

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Raw Data: 2020 Woody Plant Density (#/ac)	2455.1	1360.5 to 3549.7	597.1	1888.3	0.9	0.23

	1st quartile	Median	3rd quartile
Raw Data: 2020 Woody Plant Density (#/ac)	539.6	2090.9	3608.5

Figure C-5: Shrub Density (#/ac) by the Belt Transect Method Descriptive Statistics and Normality, 2020

Normality



Shapiro-Wilk test

W statistic	0.90
p-value	0.2061 [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.

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REPORT

Vegetation Management Unit 3 Vegetation Success Monitoring, 2021

McKinley Mine, New Mexico - Mining and Minerals Division Permit Area

Submitted to:

Chevron Environmental Management and Real Estate Company

Chevron Mining Inc. - McKinley Mine
24 Miles NW HWY 264
Mentmore, NM 87319

Submitted by:

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1.0 INTRODUCTION

Mining was completed in Mining and Minerals Division (MMD) jurisdictional lands at the McKinley Mine in 2007; most of the land is reclaimed, with only the facilities remaining. The lands mined and reclaimed included prelaw, initial-program, and permanent-program lands. Liability release has been completed on all prelaw and initial-program lands, and full bond release on a limited amount of permanent-program land.

Chevron Mining Inc. (CMI) is assessing the vegetation in the remaining permanent-program reclaimed areas in anticipation of future bond and liability releases. 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 use of grazing and wildlife. To make the demonstration for bond and liability release, the reclaimed land must meet the revegetation success standards contained in Permit No. 2016-02. The extended period of responsibility before an application for bond and liability release can be submitted for a given area in the permit is at least ten years. Golder Associates USA Inc. (Golder) was retained to monitor and assess the success of the vegetation relative to these requirements.

1.1 Vegetation Management Unit 3

This report presents results from 2021 quantitative vegetation monitoring conducted in Vegetation Management Unit 3 (M-VMU-3), comprising about 1,275 acres within Area 9 north and parts of Area 9 south (Figure 1). The elevation in this area ranges from about 6,700 to 7,000 feet above mean sea level.

Permanent program reclamation in Area 9 started on lands disturbed after 1986, and reclamation generally was completed by 2009. Thus, reclamation age in the majority of M-VMU-3 ranges from approximately 12 to 30+ years. The configuration of the VMUs within the MMD Permit Area, shown on Figure 1 were developed in consultation with MMD. 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 McKinley's annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation methods applied in Area 9 included grading of the spoils to achieve a stable configuration, positive drainage and approximate original contour. Graded spoil monitoring was then conducted to verify that the upper 42 inches of spoil were suitable for plant growth. A minimum of 6 inches of topdressing (topsoil or topsoil substitute) were then applied over suitable spoils.

After topdressing placement, the surface was scarified in preparation for planting. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, mulch consisting of either hay or straw was applied at a rate of about 2 tons/acre. The mulch was anchored 3 to 4 inches into the soil with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which coincided with logical units for seeding that had been topdressed over the spring and summer. 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 of alfalfa and cool-season grasses. Over time the seed mixes shifted to include more warm-season grasses and a broader variety of native forbs.

1.3 Prevailing Climate Conditions

The amount and distribution of precipitation are important determinants for vegetation establishment and performance at the McKinley Mine. 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 site since 2015, with the South Tipple and Rain 9 gages capturing precipitation in VMU-3 (Figure 1).

Total annual precipitation measured at the South Tipple was 15.76 inches, well above the regional average of 11.8 inches at Window Rock (Table 1); the North Bluff gauge, however, recorded 8.67 inches of annual precipitation. Higher than normal rainfall was recorded at the South Tipple in July and September, but it appears the precipitation was unique to the South Tipple area. Rain Gauge 9 located near the center of Area 9 recorded 5.29 inches of precipitation from late April to mid-November (the period this station operates), whereas the South Tipple recorded approximately 11.65 inches of rain for the same period. Mine wide, the precipitation recorded by the rest of the gauges during this time period was in the same range as what was recorded at Rain 9. Table 1 contains a summary of precipitation recorded at all the rain gauges.

Growing season precipitation provides additional context to evaluate vegetation performance in M-VMU-3. The departure of growing season precipitation (April through September) between these gauges and the Window Rock (1937-1999) long-term seasonal mean is illustrated in Figure 2. Growing season precipitation at the South Tipple, in 2021 exceeded the Window Rock long-term seasonal mean by 2.73 inches while the Rain 9 gauge only 2 miles away recorded roughly 2 inches less than Window Rock’s normals. The total difference in precipitation is 4.82 inches during the 2021 growing season, indicating that at least a portion of the reclamation in M-VMU-3 is still experiencing drought conditions. Furthermore, the excessive precipitation reported at the South Tipple came during a handful of high intensity monsoonal events. These rapid bursts of precipitation lead to higher runoff, reduced infiltration, and ultimately less moisture available to the vegetation. Substantive differences in growing season precipitation between the gages have occurred in 2016, 2018 and 2021 (Figure 2).

1.4 Objectives

The intent of this report is to document the vegetation community attributes in M-VMU-3 and compare them to the Permit vegetation success criteria. Section 2 describes the vegetation monitoring methods that were used in 2021. Section 3 presents the results of the investigation with respect to ground cover, annual production, shrub density, and composition and diversity. Section 4 is a summary of the results for M-VMU-3 with emphasis on vegetation success.

2.0 VEGETATION MONITORING METHODS

Vegetation attributes on M-VMU-3 in Area 9 were quantified using the methods described in Section 6.5 of the Permit. Fieldwork was conducted at the end of the growing season, but prior to the first killing frost, which was between September 14 and 20, 2021.

2.1 Sampling Design

A systematic random sampling procedure employing a transect/quadrat system was used to select sample sites within the reclaimed area. The proposed transect locations were reviewed with MMD in advance of sampling. A 50-square foot grid was imposed over the VMU to delineate vegetation sample plots, and random points created in a geographic information system (GIS) were used to select plots for vegetation sampling. The locations of randomly selected vegetation plots for M-VMU-3 are shown on Figure 3. In the field, the randomly selected transect locations were assessed in numerical order. If the transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Unsuitable transects were those that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies.

Transects originated from the southeastern corner of the vegetation plot. Each transect was 30 meters (m) long in a dog-leg pattern (Figure 4). Four 1-m^2 quadrats were located at pre-determined intervals along the transect for quantitative vegetation measurements. Each quadrat is considered an individual sample where measurements were made of production, total canopy, species canopy and basal cover, surface litter, surface rock fragments, and bare soil as discussed below.

2.2 Vegetation and Ground Cover

Relative and total canopy cover, basal cover, surface litter, rock fragments, and bare soil were estimated for each quadrat. 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% 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%.

Basal cover is defined as the proportion of the ground occupied by the crowns of grasses and rooting stems of forbs and shrubs. Basal cover estimates were also made for surface litter, rock fragments, and bare soil. Like the total cover estimates, the basal cover estimates do not exceed 100%. All cover estimates were made in 0.05% increments. Percent area cards were used to increase the accuracy and consistency of the cover estimates. Plant frequency was determined on a species-basis by counting the number of individual plants rooted in each quadrat.

2.3 Annual Forage and Biomass 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. 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). For this sampling event, plants that were less than 5 cm tall or considered volumetrically insignificant were not collected. Production from shrubs was determined by clipping the current year's growth.

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 pounds per acre (lbs/ac) basis.

2.4 Shrub Density

Shrub density, or the number of plants per square meter, was determined using the frequency count data from the quadrats and the belt transect method (Bonham 1989). Shrub density was calculated from the quadrat data by dividing the total number of individual plants counted by the number of quadrats measured. The density per square meter was converted to density per acre.

Shrub density was also determined using a belt transect method (Bonham 1989). Shrub density was determined from a 1-meter wide; 30-meter long belt transect situated along the perimeter of the dog-legged transect (Figure 4). Shrubs rooted in the belt transect were counted on a species basis.

2.5 Statistical Analysis and Sample Adequacy

The procedures for financial assurance release as described in Coal Mine Reclamation Program (CMRP) Vegetation Standards (MMD 1999) and the Permit guided this statistical analysis. Statistical tests were performed using both Microsoft® Excel and Analyse-it (version 5.92), 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 log transformation was applied to see if it normalized the data.

All hypothesis testing used to demonstrate that the vegetation success standards were met was conducted using a reverse null approach. Because vegetation performance at McKinley is compared to technical standards, the one-sample, one-sided t-test (CMRP Method 3) is used for normally distributed data to evaluate the mean and the one-sample, one-sided sign test (CMRP Method 5) to analyze the median of data that are not normal (MMD 1999; McDonald and Howlin 2013). The one-sided hypothesis tests using the reverse null approach were designed as follows:

Perennial/Biennial Canopy Cover

H_0 : Reclaim < 90% of the Technical Standard (15%)

H_a : Reclaim ≥ 90% of the Technical Standard (15%)

Annual Forage Production

H_0 : Reclaim < 90% of the Technical Standard (350 lbs/ac)

H_a : Reclaim ≥ 90% of the Technical Standard (350 lbs/ac)

Shrub Density

H_0 : Reclaim < 90% of the Technical Standard (150 stems per acre [stems/ac])

H_a : Reclaim ≥ 90% of the Technical Standard (150 stems/ac)

where H_0 is the null hypothesis, that the parameter mean of the reclaimed area is less than 90% of the technical standard, and H_a is the alternative hypothesis, that the parameter mean of the reclaimed area is greater than or equal to 90% of the technical standard. 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 – Method 3 (CMRP)

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 – Method 5 (CMRP)

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 perennial/biennial cover, annual forage production and shrub density using the one-sample, one-sided t-test and the one-sample, one-sided sign test. The hypotheses testing used the reverse null hypothesis bond release testing procedure as described in CMRP Vegetation Standards (MMD 1999).

Statistical adequacy is not required for vegetation success demonstrations at McKinley under the reverse null approach but is presented on the basis of the canopy cover, production and shrub density data. 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).

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

Where N_{min} equals minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\overline{x}$ is the mean, and D is the desired level of accuracy, which is 10 percent of the mean.

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 and a minimum sample number approach is taken. MMD recognizes the practical limitations of achieving statistical adequacy and has provided minimum sample sizes for various quantitative methods (MMD 1999). With normally distributed data where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples are often considered adequate. The 40 -sample recommendation 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 measurements 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. The 40 samples came from ten transects each having four quadrats as described in Section 2.1. Each quadrat 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 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).

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 are used to analyze data that are not normally distributed. When sample adequacy is not achieved, it is appropriate to use the reverse null approach for hypothesis testing. The reverse null 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 and Howlin 2013).

3.0 RESULTS

The vegetation community in M-VMU-3 is well established and dominated by perennial plants. A representative photograph of the vegetation and topography in M-VMU-3 is shown in Figure 5. The vegetation cover levels in 2021 suggest that the site is capable of meeting the vegetation success standards for the Permit Area.

Vegetation success standards consist of four vegetative parameters: ground cover, productivity, diversity and woody stem stocking (Table 2). The ground cover requirement for live perennial/biennial cover on the reclamation is 15%. The productivity requirement is 350 air-dry lbs/ac perennial/biennial annual production. The woody stem stocking success standard is 150 live woody stems/ac.

Diversity is evaluated against numerical guidelines for different growth forms and photosynthetic pathways of the vegetation. In summary, the diversity guideline required by MMD would be met if at least two shrub or subshrub species with individual relative cover values of 1%; at least two perennial warm-season grass species have individual relative cover levels of at least 1%; at least one perennial cool-season grass species has an individual relative cover level of at least 1%; and three perennial or biennial forb species have a combined relative cover of at least 1%. MMD (1999) allows for the use of biennial forbs because they are technically monocarpic (single -flowering) perennials that annually produce a significant number of seed and therefore as a species, they persist in the reclaimed plant community. Relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit.

Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas. Table 3 summarizes the attributes for plants recorded in the quadrats in addition to those encountered or observed but not recorded in the formal quantitative monitoring of M-VMU-3. Recruitment of these native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

For Phase III bond release applications, it must be demonstrated that the total annual production and total live cover of biennials and perennials equal or exceeds the approved standards for at least two of the last four years of the responsibility period. Shrub density and revegetation diversity must equal or exceed the approved standards during at least one of the two sampling years of the responsibility period (MMD 1999).

The field data for canopy and basal cover, density, production and shrub density by the belt transect are included in Appendix A. Photographs of the quadrats are included in Appendix B. Appendix C provides the statistical analysis equations, summary data and statistical outputs for perennial/biennial canopy cover, annual forage production, and shrub density by the belt transect method.

3.1 Ground Cover

According to the permit, ground cover is the canopy cover provided by perennial and biennial plant species. Perennial/biennial canopy cover was calculated by subtracting the canopy cover of annual forbs and grasses from the total cover for each quadrat. Noxious weeds are also excluded from perennial/biennial cover.

Average total ground cover in M-VMU-3 is 52.9% comprised of 28.5% total vegetation canopy cover, 2.6% rock, and 21.8% litter on a canopy cover basis (Table 3). On a basal area basis, average ground cover is 38.7% with 3.4% vegetation, 2.8% rock and 32.5% litter. Consistent with the spatial variability in semi-arid rangelands, plant canopy cover in the individual quadrats varied, ranging from 0.0 to 100.0% (Table A-1).

The mean perennial/biennial canopy cover in 2021 was 27.6% (± 6.6% [90% CI]). The calculated minimum sample size needed to meet N_{min} was 243 samples for perennial/biennial canopy cover (Table 4). In 2020 the mean total vegetation canopy cover 39.9% (± 4.7%) and the mean perennial/biennial canopy cover was 41.5% (± 6.0%) (Table 4).

Statistically, perennial/biennial canopy cover data for M-VMU-3 were not normally distributed (Figure C-1). A log transformation of the perennial/biennial canopy cover data also did not result in a normal distribution (Figure C-2). Because N_{min} was not met, the variability of perennial/biennial canopy cover data was evaluated using a stabilization of the mean approach (Clark 2001). Figure 6 illustrates the stabilization of the mean for perennial/biennial canopy cover based on incrementally calculating the mean and 90% CIs for four samples from a single transect sequentially. The analysis suggests that mean perennial/biennial canopy cover was estimated to within the 90% CI of the estimated population mean beginning about the 28^{th} sample, with the 90% CI tightening to no greater than 7.0%. This analysis suggests that 40 samples were more than adequate and collecting additional samples would not improve the precision of the canopy cover estimate.

Hypotheses testing was conducted using a one-sided, one-sample sign test using the reverse null (MMD 1999). The testing found that 14 perennial/biennial cover quadrats did not meet the performance standard (13.5%), resulting in the probability (P) of 0.0409 of observing a z-value less than -1.74 (Table C-3). Therefore, under the reverse null hypothesis we conclude the performance standard is met for perennial/biennial canopy cover in 2021. This standard was also met under the same statistical analysis methods in both 2019 and 2020.

3.2 Production

Productivity for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air-dried 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 2021 annual forage production in M-VMU-3 was estimated to be 417 (± 111) lbs/ac with an annual total production of 430 (± 111) lbs/ac (Table 4). While the production mean exceeds the standard in 2021, production did not pass hypothesis testing as discussed below. Eight perennial grasses contributed 180 lbs/ac of forage and 5 shrubs contributed 211 lbs/ac of browse, indicating a diverse and productive rangeland. Grass productivity is predominantly James' galleta (*Pleuraphis jamesii*) with small contributions of Western wheatgrass (*Pascopyrum smithii*) and alkali sacaton (*Sporobolus airoides*). Four-wing saltbush (*Atriplex canescens*) and winterfat (*Krascheninnikovia lanata*) provided the bulk of shrub production (Table 3). The combined annual forage production in M-VMU-3 exceeds the vegetation success standard of 350 lbs/ac and is on the low end for comparable ecological sites of 430.5 to 794.2 lbs/ac (Parametrix 2012). The annual forage production of M-VMU-3 in 2019 (779 lbs/ac) and 2020 (511 lbs/ac) demonstrate the site's ability to exceed the minimum production values for comparable ecological sites.

The annual forage production data for M-VMU-3 were not normally distributed (Figure C-3). A log transformation of the annual forage production data failed to produce a normally distributed dataset. The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was estimated to be 297 samples (Table 4). Because N_{min} was not met, the data were evaluated using a stabilization of the mean (Clark 2001). Figure 7 illustrates the stabilization of the estimated mean and 90% CI for annual forage production based on incrementally calculating the mean and 90% CIs for four samples from a single transect sequentially. The analysis suggests that mean perennial/biennial canopy cover was estimated to within the 90% CI of the estimated population mean beginning about the 32nd sample, with the 90% CI tightening to no greater than 125 lbs/ac. This analysis suggests that 40 samples were more than adequate and collecting additional samples would not improve the precision of the canopy cover estimate.

Hypotheses testing was conducted using a one-sided, one-sample sign test using the reverse null (MMD 1999). The testing found that 22 production quadrats did not meet 90% of the performance standard (315 lbs/ac) resulting in the probability (P) of 0.2145 of observing a z-value less than 0.79. Therefore, under the reverse null hypothesis we conclude the performance standard is not met for annual forage production in 2021 (Table C-4). For M-VMU-3, the annual forage production standard was met in 2019 and 2020 but it was not met in 2021 due to exceptional drought resulting in a lower mean and increased variance.

3.3 Shrub Density

Shrub density ranged from an average of 2,361 (± 707) stems/ac based on the belt transect method to 8,195 (± 5,562) stems/ac for the quadrat method (Table 4). In M-VMU-3, 7 shrub species were encountered in the belt transects and the quadrats (Tables 3 and A-5). Four-wing saltbush and winterfat were the most commonly encountered shrubs under both measurement methods.

The shrub density data by the belt transect method were normally distributed (Figure C-5) and the calculated minimum sample size needed to meet N_{min} at the 90% confidence level was estimated to be 1933 samples (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the shrub density belt transect data were evaluated using a stabilization of the mean (Clark 2001). Figure 8 illustrates the stabilization of the mean for shrub density based on individual belt transect data. The corresponding variability around the mean is expressed by the 90% CIs for each successive analytical increment. These data suggest that the mean shrub density was estimated to within the estimated population mean (n=10) after the fifth sample, with the 90% CI stabilizing after 8 samples. This analysis suggests that 10 samples were more than adequate, and that the collection of additional data would not improve the precision of the estimate of shrub density.

Hypotheses testing was conducted using a one-sided, one-sample sign test using the reverse null (MMD 1999). The one-sample, one-sided t-test calculated t*-statistic for M-VMU-3 shrub density is 5.18, where the sample mean is 2,361 stems/ac with a standard deviation of 1,358, the technical standard is 150 stems/ac and the sample size is 10. The one-tail $t_{(0.1,\ 9)}$ value is 1.383. Therefore, under the reverse null hypothesis ($t^* >= t_{(1-\alpha;\ n-1)}$), we conclude that the performance standard is met for shrub density (i.e., woody stem stocking) by the belt transect method (Table C-5). This shrub density standard for M-VMU-3 was met in 2019 and 2020 using the reverse null approach.

3.4 Composition and Diversity

Diversity is assessed through comparing the relative cover of various life-forms, based on their duration to the perennial/biennial cover of the vegetation management unit. In this context, relative cover is the average percent cover of a perennial/biennial species divided by the mean perennial/biennial cover of the sampling unit. Relative canopy cover of individual species contributing to perennial cover are listed in Table 3.

Collectively, eight perennial grasses dominate the canopy cover in M-VMU-3 with a combined relative canopy cover of almost 49%. Western wheatgrass and James' galleta are the most prevalent grasses (Table 3). Five cool-season perennial grasses contribute almost 13% relative canopy cover and three warm-season perennial grasses contribute almost 36% relative canopy cover. Three perennial/biennial forbs contribute just over 22% relative canopy cover in M-VMU-3. The collective contribution of five shrubs to perennial/biennial canopy cover is 29% relative cover, with several saltbush species and winterfat most prevalent.

Table 5 provides the diversity results for M-VMU-3 for 2019 through 2021 and is summarized below.

- The diversity standard for cool-season grasses is achieved by several species that exceed 1% relative cover including western wheatgrass (6.7%), thickspike wheatgrass (*Elymus lanceolatus*, 3.6%),and smooth brome (*Bromus inermus*,1.6%).
- The diversity standard for warm-season grasses requires a minimum of two species with 1% relative cover each. This was met by James' galleta (32.09%) and Alkali sacaton (3.29%). Blue grama (*Bouteloua gracilis*) provided an additional 0.63% relative cover. The warm-season grass diversity standard was met in 2019 in M-VMU-3 but not in 2020.
- The diversity standard for forbs requires a minimum of three non-annual forb taxa combining to contribute at least 1% relative cover. The combined relative cover of three non-annual forbs is 22.0% (Table 3). These forbs include rattlesnake weed (*Chamaesyce albomarginata*) (21.2%), scarlet globemallow (*Sphaeralcea coccinea*, 0.8%), and flatspine stickseed (*Lappula occidentalis,* 0.04%). Based on 2021 sampling, the combined relative cover for three non-annual forbs is greater than 1%, meeting the diversity standard for forbs on M-VMU-3 reclamation.
- The diversity standard for shrubs requires two species with a minimum relative cover of 1% for each species. The diversity standard for shrubs is achieved by four-wing saltbush (22.6%) and winterfat (4.3%). Additional sub-dominant shrubs recorded in the quadrats include mat saltbush (*Atriplex corrugate*,1.21%), and Mormon tea (*Ephedra viridis*, 1.10%).

The recruitment of native plants and establishment of seeded species within M-VMU-3 is indicative of ecological succession and the capacity of the site to support a diverse and self-sustaining ecosystem. Based on the 2021 vegetation monitoring, 91 different plant species were present within the reclamation areas of M-VMU-3 (Table 3). Species encountered included 41 forbs, 23 grasses and 27 shrubs, trees and cacti. Of the 41 forbs, 16 are considered annuals whereas the remaining 27 have variable durations or are purely perennial. Of the 23 grasses, 15 are cool-season perennials, six are warm-season perennials and two are cool-season annuals. Cacti and trees are rare on the reclamation, while shrubs and subshrubs are more common.

During the 2021 monitoring program, noxious weeds were infrequently encountered (NMDA 2020) on M-VMU-3. No noxious weeds were recorded in the quadrats, but Class B noxious weeds including cheatgrass (*Bromus tectorum*), saltcedar (*Tamarix ramosissima*), and Siberian elm (*Ulmus pumila*) was observed in the reclamation. 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 control. 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 canopy cover, production, shrub density, and plant diversity (Table 2). The vegetation monitoring results for the past three years indicate that the vegetation community in M-VMU-3 is progressing well and already meets all success standards based 2019 and 2020 data. For 2021, M-VMU-3 exceeded the success parameters for cover, shrub density, and diversity, but fell short with annual forage production (Tables 5 and 6). A summary of the findings from the past three years are:

1. Despite the drought conditions since 2017, the reclamation has been resilient and successful for cover and shrub density, demonstrating permanence.
2. Forage production was met in 2019 and 2020 but fell short in 2021.
3. While drought affected the expression of warm-season grasses in 2020 when summer precipitation was 26% of the regional average, the warm season grass standard was met in 2019 and 2021.

Overall, vegetation performance in M-VMU-3 is encouraging considering below-average precipitation for the past 6 years including a two-year drought in 2017 and 2018, the exceptional drought in 2020, and the spatial variability of moisture in 2021. The continued presence of feral horses, though less evident in 2021, may also negatively affect production, especially when forage is scarce. 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 M-VMU-3 is capable of meeting and sustaining the post-mining land use.

5.0 REFERENCES

Bonham, C.D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons. New York, NY.

Clark, D.L. 2001. Stabilization of the mean as a demonstration of sample adequacy. American Society for Surface Mining and Reclamation Annual Meeting. Albuquerque, NM. June 3-7, 2001. ASSMR, Lexington, KY.

Mining and Minerals Division (MMD). 1999. Coal Mine Reclamation Program Vegetation Standards. Santa Fe, NM. April 30.

McDonald, L., and S. Howlin. 2013. Evaluation and comparison of hypothesis testing techniques for bond release application. University of Wyoming, Laramie, WY.

Parametrix. 2012. Revegetation Success Standards Report: McKinley Mine – Response to OSM. Prepared by Jim Nellessen of Parametrix, Albuquerque, New Mexico. April 2012.

New Mexico Department of Agriculture (NMDA). 2020. New Mexico Noxious Weed List Update. New Mexico State University, Las Cruces, NM. June 2020.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry (2nd edit.). W. H. Freeman and Co., San Francisco.

Schulz, A. M., R. P. Gibbens, and L. F. DeBano. 1961. Artificial populations for teaching and testing range techniques. J. Range Management. 14:236-242.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods applied to experiments in agriculture and biology. 6th ed. Ames, Iowa: Iowa State University Press.

Tables

Table 1: South Mine Seasonal and Annual Precipitation (2015-2021)

Year	Station	Precipitation (inches)													
		January	February	March	April	May	June	July	August	September	October	November	December	Annual Total	Growing Season Total
2015	South Tipple	2.05	1.59	0.11	0.52	1.64	1.11	2.37	1.62	0.30	1.36	1.31	0.76	**14.74**	*7.56*
	Rain 9				0.50	1.38	1.22	2.88	1.25	0.22	1.13	0.99			*7.45*
	Rain 10				0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78			*7.13*
	Rain 11				0.48	1.88	1.02	2.80	1.69	0.26	0.97	1.08			*8.13*
2016	South Tipple	0.62	0.22	0.05	1.31	0.80	0.07	1.37	1.74	1.75	0.40	1.57	1.84	**11.74**	*7.04*
	Rain 9				0.22	0.62	0.45	1.24	0.50	1.05	1.05	0.00			*4.08*
	Rain 10				0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02			*5.00*
	Rain 11				0.28	0.77	0.64	1.61	0.42	1.09	0.09	0.04			*4.81*
2017	South Tipple	1.25	1.64	0.48	0.35	0.77	0.42	2.48	0.90	1.34	0.15	0.09	0.02	**9.89**	*6.26*
	Rain 9				1.20	1.02	0.01	0.82	1.40	1.64	0.37	0.91			*6.09*
	Rain 10				1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81			*5.68*
	Rain 11				1.23	1.16	0.05	0.86	2.00	1.85	0.34	0.49			*7.15*
2018	South Tipple	0.35	0.79	0.54	0.09	0.29	0.51	2.61	1.34	1.10	1.65	0.19	0.29	**9.75**	*5.94*
	Rain 9				0.07	0.27	0.25	2.16	0.74	0.67	1.31	0.00			*4.16*
	Rain 10				0.08	0.20	0.27	3.05	1.15	0.92	1.51	0.00			*5.67*
	Rain 11				0.09	0.29	0.26	1.92	1.00	0.89	1.45	0.00			*4.45*
2019	South Tipple	1.30	1.81	1.23	0.44	1.77	0.33	0.22	0.05	1.59	0.09	1.14	0.85	**10.82**	*4.40*
	Rain 9				0.16	1.36	0.24	0.46	0.37	1.84	0.05	0.07			*4.43*
	Rain 10				0.20	1.49	0.37	0.19	0.27	1.34	0.03	0.05			*3.86*
	Rain 11				0.20	1.50	0.19	0.44	0.20	1.72	0.06	0.08			*4.25*
2020	South Tipple	0.98	1.44	1.35	0.17	0.01	0.04	1.13	0.24	0.15	0.26	0.40	0.27	**6.44**	*1.74*
	Rain 9				0.16	0.02	0.11	0.60	0.06	0.14	0.08	0.45			*1.09*
	Rain 10				0.11	0.02	0.13	0.79	0.14	0.14	0.16	0.09			*1.33*
	Rain 11				0.22	0.00	0.05	0.63	0.69	0.20	0.30	0.41			*1.79*
2021	South Tipple	1.11	0.34	0.40	0.07	0.08	0.37	5.45	1.24	2.12	1.77	0.55	2.26	**15.76**	*9.33*
	Rain 9				0.00	0.10	0.27	1.81	1.22	1.11	0.78	0.00			*4.51*
	Rain 10				0.01	0.06	0.24	2.48	1.80	0.96	0.80	0.00			*5.55*
	Rain 11				0.00	0.07	0.18	2.10	1.31	1.43	0.98	0.00			*5.09*
Window Rock, Long-term normals		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

Table 2: Revegetation Success Standards for the Mining and Minerals Division Permit Area

Vegetative Parameter	Success Standard
Ground Cover	15% live perennial/biennial cover
Productivity	350 air-dry pounds per acre perennial/biennial annual production
Diversity	A minimum of 2 shrub or subshrub taxa contributing at least 1% relative cover each.
	A minimum of 2 perennial warm-season grass taxa contributing at least 1% relative cover each.
	A minimum of 1 perennial cool-season grass taxa contributing at least 1% relative cover.
	A minimum of 3 perennial/biennial forb taxa combining to contribute at least 1% relative cover.
Woody Stem Stocking	150 live woody stems per acre

Note:
Diversity criteria assessed for individual perennial/biennial species relative cover as agreed upon by MMD and CMI in June 2019.

Table 3: Vegetation Cover, Density, and Production by Species, M-VMU-3, 2021

Scientific Name	Common Name	Code	Mean Cover (%)			Mean Density (#/m²)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative [a]		
Cool-Season Grasses (17)							
Annuals (2)							
Field brome	*Bromus arvensis*	BRAR5	--	--	--	--	--
Cheatgrass	*Bromus tectorum*	BRTE	--	--	--	--	--
Perennials (15)							
Indian ricegrass	*Achnatherum hymenoides*	ACHY	0.16	<0.05	0.5	0.3	1.3
Crested wheatgrass	*Agropyron cristatum*	AGCR	--	--	--	--	--
Smooth brome	*Bromus inermis*	BRIN2	0.51	<0.05	1.6	1.5	2.6
Canada wildrye	*Elymus canadensis*	ELCA4	--	--	--	--	--
Bottlebrush squirreltail	*Elymus elymoides*	ELEL	--	--	--	--	--
Thickspike wheatgrass	*Elymus lanceolatus*	ELLA3	1.16	<0.05	3.6	0.5	<1
Slender wheatgrass	*Elymus trachycaulus*	ELTR7	--	--	--	--	--
Needle and thread	*Hesperostipa comata*	HECO26	--	--	--	--	--
Foxtail barley	*Hordeum jubatum*	HOJU	--	--	--	--	--
Colorado wildrye	*Leymus ambiguus*	LEAM	--	--	--	--	--
Western wheatgrass	*Pascopyrum smithii*	PASM	2.15	0.06	6.7	3.6	12.3
Russian wildrye	*Psathyrostachys juncea*	PSJU3	0.05	<0.05	0.2	0.1	<1
Bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSP6	--	--	--	--	--
Intermediate wheatgrass	*Thinopyrum intermedium*	THIN6	--	--	--	--	--
Tall wheatgrass	*Thinopyrum ponticum*	THPO7	--	--	--	--	--
Warm-Season Grasses (6)							
Perennials (6)							
Sideoats grama	*Bouteloua curtipendula*	BOCU	--	--	--	--	--
Blue grama	*Bouteloua gracilis*	BOGR2	0.20	<0.05	0.6	0.5	1.9
Hairy grama	*Bouteloua hirusta*	BOHI2	--	--	--	--	--
James' galleta	*Pleuraphis jamesii*	PLJA	10.25	1.5	32.1	7.4	129.1
Alkali sacaton	*Sporobolus airoides*	SPAI	1.05	0.08	3.3	0.3	18.9
Sand dropseed	*Sporobolus cryptandrus*	SPCR	--	--	--	--	--
Forbs (41)							
Annuals (16)							
Desert madwort	*Alyssum desertorum*	ALDE	--	--	--	--	--
Unknown pigweed species	*Amaranthus species*	AMARA	<0.05	<0.05	<0.01	0.1	--
Mealy goosefoot	*Chenopodium incanum*	CHIN2	<0.05	<0.05	<0.01	0.1	<1
Narrowleaf goosefoot	*Chenopodium leptophyllum*	CHLE4	--	--	--	--	--
Lambsquarters	*Chenopodium album*	CHAL7	<0.05	<0.05	<0.01	0.1	--
Nodding buckwheat	*Eriogonum cernuum*	ERCE2	--	--	--	--	--
Common sunflower	*Helianthus annuus*	HEAN3	--	--	--	--	--
Longleaf false goldeneye	*Heliomeris longifolia*	HELO6	<0.05	<0.05	<0.01	<0.05	<1
Kochia	*Kochia scoparia*	KOSC	<0.05	<0.05	<0.01	<0.05	<1
Fendler's desertdandelion	*Malacothrix fendleri*	MAFE	--	--	--	--	--
Erect knotweed	*Polygonum erectum*	POER2	--	--	--	--	--
Little hogweed	*Portulaca oleracea*	POOL	0.13	<0.05	<0.01	2.0	<1
Russian thistle	*Salsola tragus*	SATR	0.22	<0.05	<0.01	0.4	5.2
Unknown annual forb	*Unknown Annual Forb*	UNKAF	<0.05	<0.05	<0.01	0.1	2.8
Cowpen daisy	*Verbesena encelioides*	VEEN	0.45	<0.05	<0.01	0.5	4.1
Rough cocklebur	*Xanthium strumarium*	XAST	--	--	--	--	--
Perennials/Biennials (25)							
Common yarrow	*Achillea millefolium*	ACMI2	--	--	--	--	--
Rattlesnake weed	*Chamaesyce albomarginata*	CHAL11	6.76	<0.05	21.2	18.5	43.2
Rose heath	*Chaetopappa ericoides*	CHER	--	--	--	--	--
Horseweed	*Conyza canadensis*	COCA	--	--	--	--	--
Flixweed	*Descurainia sophia*	DESO	--	--	--	--	--
Bastardsage	*Eriogonum wrightii*	ERWR	--	--	--	--	--
Curlytop gumweed	*Grindelia nuda var. aphanactis*	GRNUA	--	--	--	--	--
Curly-cup gumweed	*Grindelia squarosa*	GRSQ	--	--	--	--	--
Prickly lettuce	*Lactuca serriola*	LASE	--	--	--	--	--
Flatspine stickseed	*Lappula occidentalis*	LAOC3	<0.05	<0.05	0.0	0.3	<1

Table 3: Vegetation Cover, Density, and Production by Species, M-VMU-3, 2021

Scientific Name	Common Name	Code	Mean Cover (%)			Mean Density (#/m^2)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative [a]		
Lewis flax	*Linum lewisii*	LILE	--	--	--	--	--
Purple aster	*Machaeranthera canescens*	MACA	--	--	--	--	--
Tanseyleaf tansyaster	*Machaeranthera tanacetifolia*	MATA	--	--	--	--	--
Yellow sweetclover	*Melilotus officinalis*	MEOF	--	--	--	--	--
Prairie false dandelion	*Nothocalais cuspidata*	NOCU	<0.05	<0.05	0.0	<0.05	<1
Palmer's penstemon	*Penstemon palmeri*	PEPA8	--	--	--	--	--
Prostrate knotweed	*Polygonum aviculare*	POAV	--	--	--	--	--
Upright prairie coneflower	*Ratibida columnifera*	RACO3	--	--	--	--	--
Curly dock	*Rumex crispus*	RUCR	--	--	--	--	--
Tall tumblemustard	*Sisymbrium altissimum*	SIAL2	--	--	--	--	--
Scarlet globemallow	*Sphaeralcea coccinea*	SPCO	0.25	<0.05	0.8	0.8	2.8
Emory's globemallow	*Sphaeralcea emoryi*	SPEM	--	--	--	--	--
Gooseberryleaf globemallow	*Sphaeralcea grossulariifolia*	SPGR2	--	--	--	--	--
Yellow salsify	*Tragopogon dubius*	TRDU	--	--	--	--	--
Narrowleaf cattail	*Typha angustifolia*	TYAN	--	--	--	--	--
Shrubs, Trees and Cacti (27)							
Perennials (27)							
Prairie sagewort	*Artemisia frigida*	ARFR4	--	--	--	--	--
Big sagebrush	*Artemisia tridentata*	ARTR2	--	--	--	--	--
Tubercled saltbush	*Atriplex acanthocarpa*	ATAC	--	--	--	--	--
Four-wing saltbush	*Atriplex canescens*	ATCA	7.23	0.55	22.6	1.4	163.1
Shadscale saltbush	*Atriplex confertifolia*	ATCO	<0.05	<0.05	0.1	<0.05	<1
Mat saltbush	*Atriplex corrugata*	ATCO4	0.39	<0.05	1.2	0.1	10.1
Gardner's saltbush	*Atriplex gardneri*	ATGA	--	--	--	--	--
Mound saltbush	*Atriplex obovata*	ATOB	--	--	--	--	--
Basin saltbush	*Atriplex tridentata*	ATTR3	--	--	--	--	--
Longleaf jointfir	*Ephedra trifurca*	EPTR	--	--	--	--	--
Mormon tea	*Ephedra viridis*	EPVI	0.35	<0.05	1.1	0.1	5.8
Rubber rabbitbrush	*Ericameria nauseosa*	ERNA	--	--	--	--	--
Slenderleaf buckwheat	*Eriogonum leptophyllum*	ERLE10	--	--	--	--	--
Broom snakeweed	*Gutierrezia sarothrae*	GUSA	--	--	--	--	--
Hairy false goldenaster	*Heterotheca villosa*	HEVI	--	--	--	--	--
Winterfat	*Krascheninnikovia lanata*	KRLA	1.38	0.10	4.3	0.5	31.6
Plains pricklypear	*Opuntia polyacantha*	OPPO	--	--	--	--	--
Piñon pine	*Pinus edulis*	PIED	--	--	--	--	--
Cottonwood	*Populus deltoides*	PODE	--	--	--	--	--
Mexican cliffrose	*Purshia mexicana*	PUME	--	--	--	--	--
Antelope bitterbrush	*Purshia tridentata*	PUTR2	--	--	--	--	--
Narrowleaf willow	*Salix exigua*	SAEX	--	--	--	--	--
Greasewood	*Sarcobatus vermiculatus*	SAVE4	--	--	--	--	--
Threadleaf groundsel	*Senecio flaccidus*	SEFL3	--	--	--	--	--
Saltcedar	*Tamarix ramosissima*	TARA	--	--	--	--	--
Gray horsebrush	*Tetradymia canescens*	TECA	--	--	--	--	--
Siberian elm	*Ulmus pumila*	ULPU	--	--	--	--	--
Cover Components							
Perennial/Biennial Vegetation Cover			27.6	3.3			
Total Vegetation Cover			28.5	3.4			
Rock			2.6	2.8			
Litter			21.8	32.5			
Bare Soil			47.1	61.3			

Notes:

[a] = relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover

#/m^2 = number of plants per square meter

lbs/ac = air-dry forage pounds per acre

-- = observed in VMU during monitoring, but not recorded in the quadrats

Pathway or growing season for the grasses is from Allred (2005)

Duration for plants is from the USDA Plants Database

Table 4: Summary Statistics for M-VMU-3 2021

	2019	2020	2021	Technical Standard
Total Vegetation Canopy Cover (%)				
Mean	49.0	39.9	28.5	None
Standard Deviation	23.1	18.1	26.4	
90% Confidence Interval	6.0	4.7	6.9	
Nmin[1]	63	58	243	
Probability within true mean[2]	0.62	0.61	0.28	
Perennial/Biennial Canopy Cover (%)				
Mean	36.4	41.5	27.6	15.0
Standard Deviation	30.1	23.2	25.5	
90% Confidence Interval	7.8	6.0	6.6	
Nmin[1]	194	88	243	
Probability within true mean[2]	0.70	0.64	0.28	
Basal Cover (%)				
Mean	3.2	2.7	3.4	None
Standard Deviation	3.9	1.4	6.8	
90% Confidence Interval	1.0	0.4	1.8	
Nmin[1]	409	78	1110	
Probability within true mean[2]	0.77	0.63	0.11	
Annual Forage Production (lbs/ac)				
Mean	779	511	417	350
Standard Deviation	756	382	426	
90% Confidence Interval	197	99	111	
Nmin[1]	267	159	297	
Probability within true mean[2]	0.73	0.68	0.26	
Annual Total Production (lbs/ac)				
Mean	1,201	525	430	None
Standard Deviation	835	386	427	
90% Confidence Interval	217	100	111	
Nmin[1]	137	154	297	
Probability within true mean[2]	0.67	0.68	0.26	
Shrub Density (stems/acre) from Quadrats				
Mean	7,789	5,160	8,195	150
Standard Deviation	11,820	6,979	21,384	
90% Confidence Interval	3,074	1,815	5,562	
Nmin[1]	654	519	1933	
Probability within true mean[2]	0.83	0.80	0.05	
Shrub Density (stems/acre) from Belt Transect				
Mean	2,550	2,455	2,361	150
Standard Deviation	2,471	1,888	1,358	
90% Confidence Interval	1,285	982	707	
Nmin[1]	316	199	111	
Probability within true mean[2]	0.62	0.59	0.43	

Notes:

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

2 Probability the true value of the mean is within 10 percent of the mean for the sample size

Table 5: M-VMU-3 Results for Diversity, 2019 to 2021

Diversity Component	Standard (% relative cover)	2019		2020		2021	
		Result	Species	Result	Species	Result	Species
Subshrub or shrubs			(6 spp.)		(10 spp.)		(5 spp.)
Shrub 1	≥ 1.0%	21.44%	Four-wing saltbush	7.11%	Gardner saltbush	22.64%	Four-wing saltbush
Shrub 2	≥ 1.0%	4.12%	Shadscale saltbush	5.63%	Four-wing saltbush	4.30%	Winterfat
Shrub 3 (bonus)	--	0.43%	Mat saltbush	4.06%	Winterfat	1.21%	Mat saltbush
Perennial warm-season grasses			(4 spp.)		(4 spp.)		(3 spp.)
Grass 1	≥ 1.0%	22.89%	James' galleta	12.77%	James' galleta	32.09%	James' galleta
Grass 2	≥ 1.0%	2.45%	Blue grama	0.93%	Alkali sacaton	3.29%	Alkalai sacaton
Grass 3 (bonus)	--	0.21%	Alkali sacaton	0.53%	Purple threeawn	0.63%	Blue grama
Perennial cool-season grasses			(8 spp.)		(11 spp.)		(5 spp.)
Grass 1	≥ 1.0%	19.83%	Western wheatgrass	23.32%	Western wheatgrass	6.37%	Western wheatgrass
Grass 2 (bonus)	--	1.28%	Tall wheatgrass	9.15%	Needle and thread	3.63%	Thickspike wheatgrass
Perennial/biennial forbs			(9 spp.)		(6 spp.)		(4 spp.)
Forb 1	≥ 1.0% combined	15.79%	Blazingstar species	0.52%	Bastardsage	21.16%	Rattlesnake weed
Forb 2		3.62%	Flatspine stickseed	0.34%	Purple aster	0.76%	Scarlet globemallow
Forb 3		2.47%	Flixweed	0.16%	Flatspine stickseed	0.04%	Flatspine stickseed
Forb 4 (bonus)	--	0.52%	Palmer's penstemon	0.15%	Palmer's penstemon	--	--

Notes:

-- = not applicable

Indicates an unmet parameter

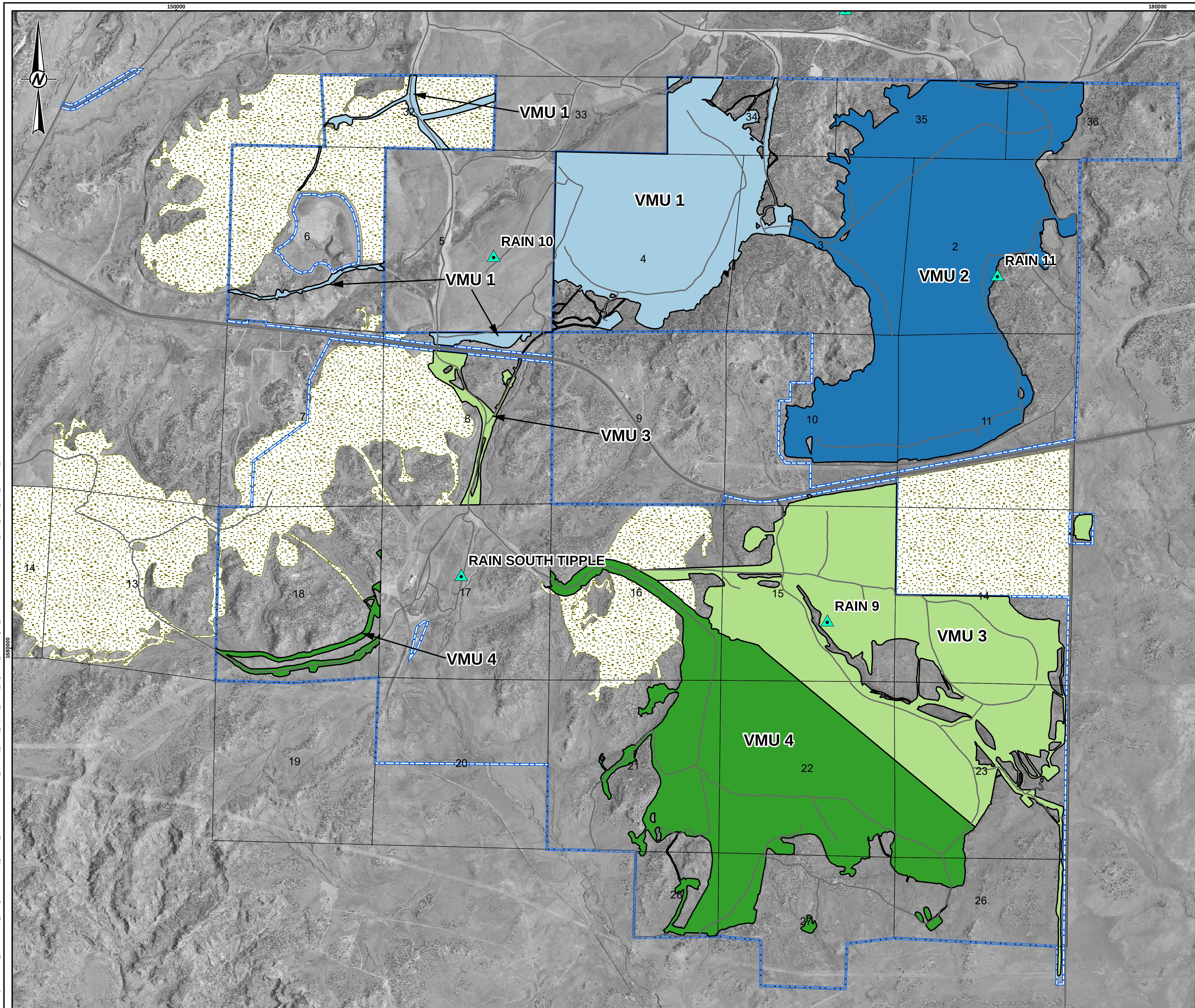
Table 6: M-VMU- 3 Statistical Analysis Results for Cover, Production, and Woody Plant Density, 2019 to 2021

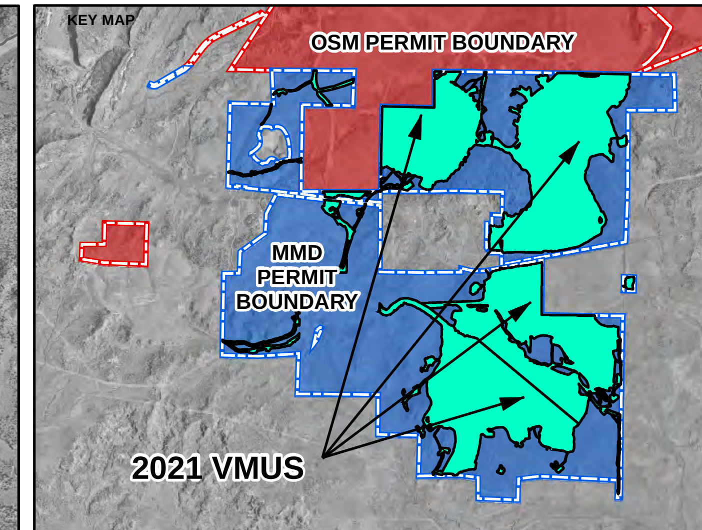
Vegetation Metric	Success Standard	Results		
		2019	2020	2021
Perennial/Biennial Cover	≥ 15%	36.4%	41.5%	27.6%
Annual Forage Production	≥ 350 lb/ac	779	511	417
Woody Plant Density	≥ 150 stems/ac	2,550	2,455	2,361

Notes:

Hypothesis testing found the success standard was not met

Figures





LEGEND

- Rain Gauges
- Two-tracks, Roads and Highways
- MMD Permit Boundary
- PLSS - Sections
- Liability Release
- MMD VMU 1 (~ 839 acres)
- MMD VMU 2 (~ 1,518 acres)
- MMD VMU 3 (~ 1,284 acres)
- MMD VMU 4 (~ 1,238 acres)

0 3,000 6,000

1 inch = 3,000 feet Feet

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN

REFERENCE(S)

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

CLIENT

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

PROJECT

MCKINLEY MINE - MMD PERMIT PHASE III BOND RELEASE, 2021 VEGETATION MONITORING

TITLE

2021 VEGETATION MANAGEMENT (2021) OVERVIEW

CONSULTANT

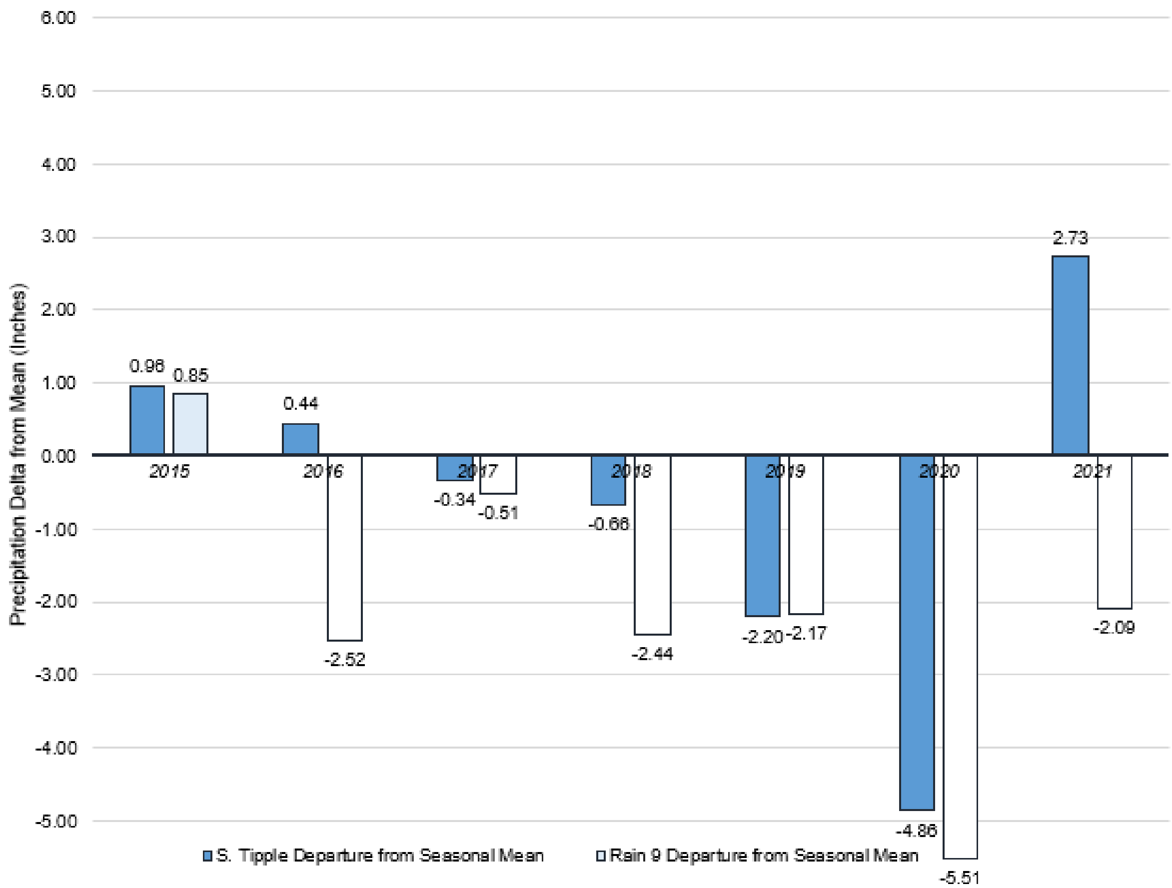
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2022-02-28
DESIGNED	GFD
PREPARED	GFD
REVIEWED	CD
APPROVED	KK

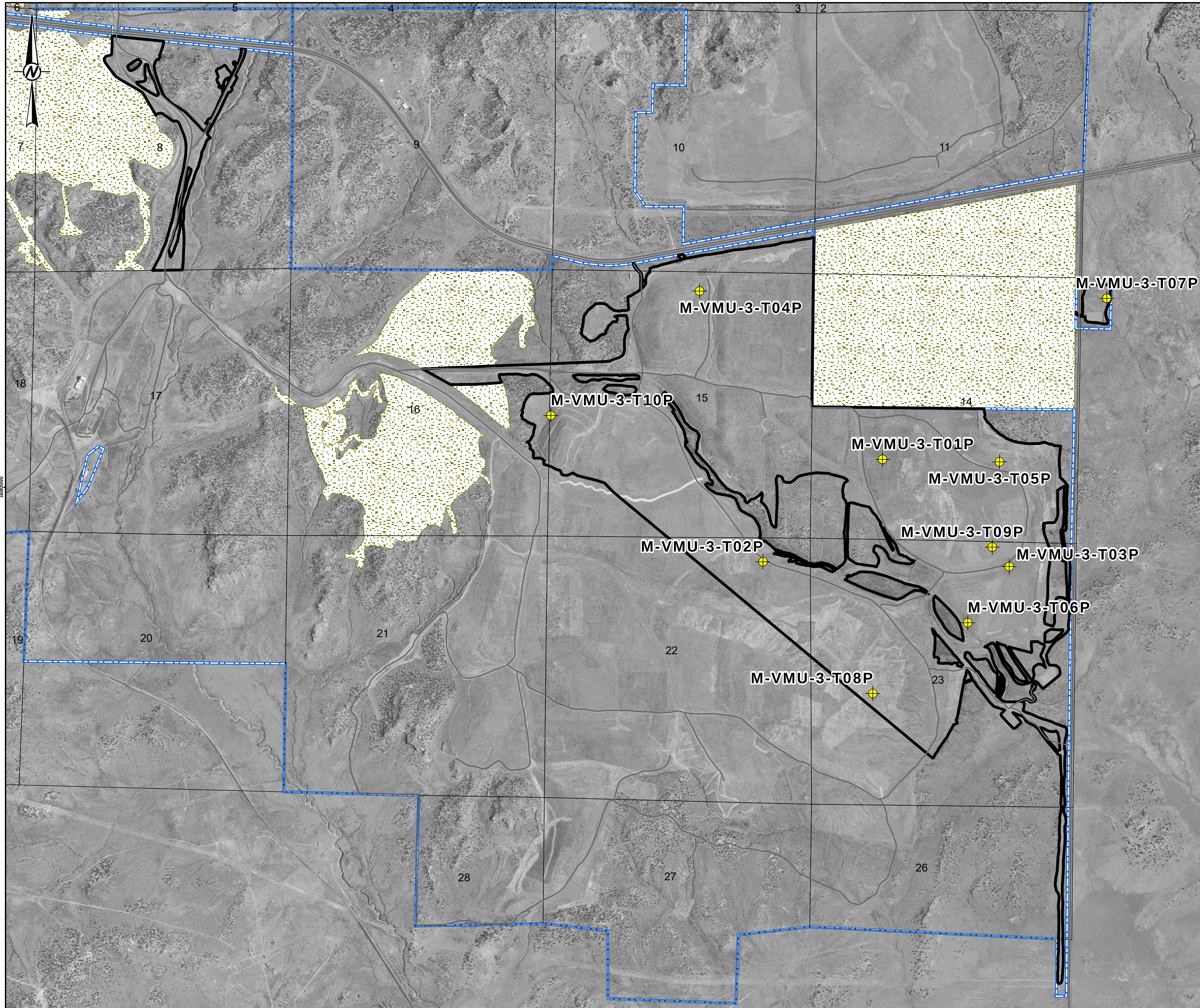
PROJECT NO.	CONTROL	REV.	FIGURE
1338105208	A001	1	1

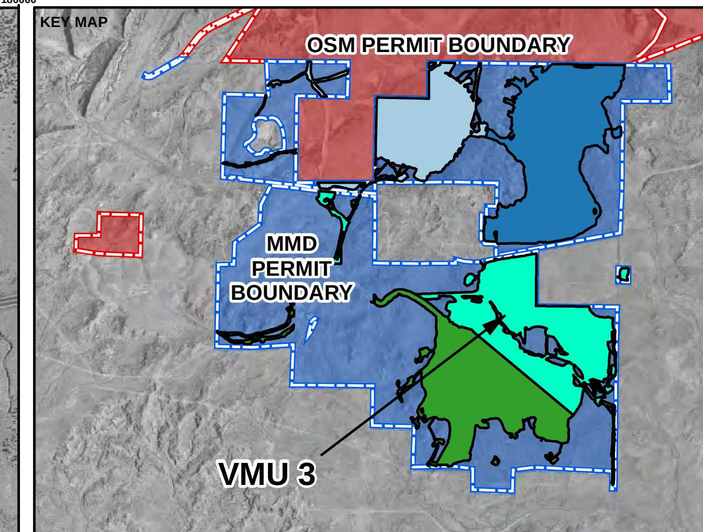
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

Figure 2: Departure of Growing Season Precipitation at South Tipple and Rain 9 Gages from Long-Term Seasonal Mean at Window Rock, NM



Notes:
Long-term averages are from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2020).
Growing season precipitation is between April and September





LEGEND

- Primary Transect
- Two-tracks, Roads and Highways
- PLSS - Sections
- MMD VMU 3 (~ 1,284 acres)
- Liability Release
- MMD Permit Boundary

TRANSECT LABEL EXPLANATION:

M-VMU-1-T1P

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

0 2,000 4,000

1 inch = 2,000 feet Feet

NOTE(S)

1. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS
2. TRANSECT LOCATIONS WERE CREATED IN ACCORDANCE WITH METHODS OUTLINED IN THE PERMIT

REFERENCE(S)

1. ORTHO SOURCE: CHEVRON, 2013

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

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

PROJECT
MCKINLEY MINE - MMD PERMIT PHASE III BOND RELEASE
2021 VEGETATION SAMPLING PLAN

TITLE
VEGETATION MONITORING TRANSECTS, 2021
VEGETATION MANAGEMENT UNIT 3

CONSULTANT

GOLDER MEMBER OF WSP

YYYY-MM-DD	2022-02-22
DESIGNED	GFD
PREPARED	GFD
REVIEWED	CD
APPROVED	KK

PROJECT NO.	CONTROL	REV.	FIGURE
1338105208	A004	1	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\1338105208_McKinley_Onsite_Support_2021\A_Vegetation_Monitoring\02_PRODUCTION\MXD\1338105208_A004_MMD_VMU_3_2021.mxd PRINTED ON: 2022-02-22 AT: 2:10:03 PM

Figure 4: Vegetation Plot, Transect, and Quadrat Layout

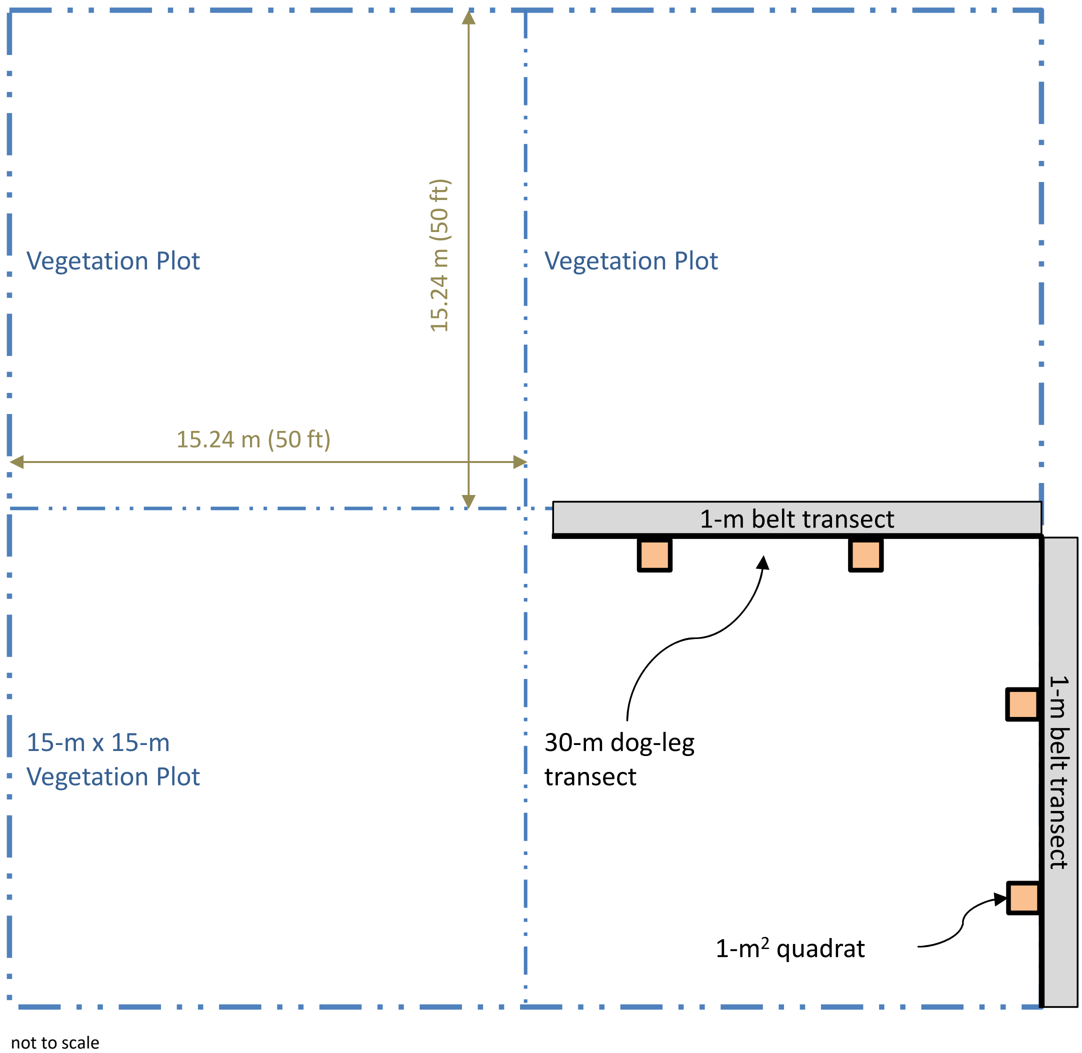


Figure 5: Typical Grass-Shrubland Vegetation in M-VMU-3, September 2021

Figure 6: Stabilization of the Mean for Perennial/Biennial Cover - M-VMU-3, 2021

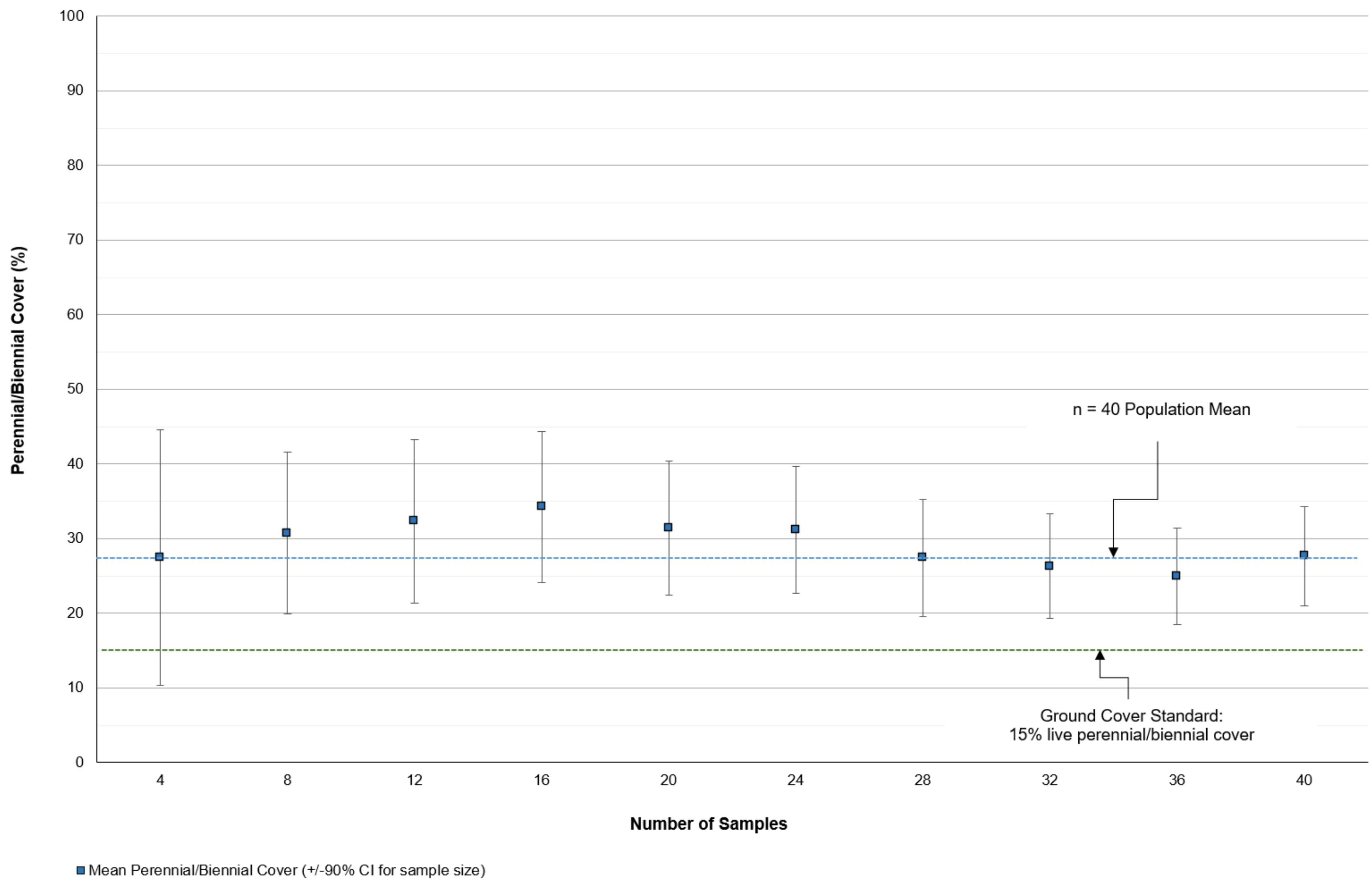


Figure 7: Stabilization of the Mean for Annual Forage Production - M-VMU-3, 2021

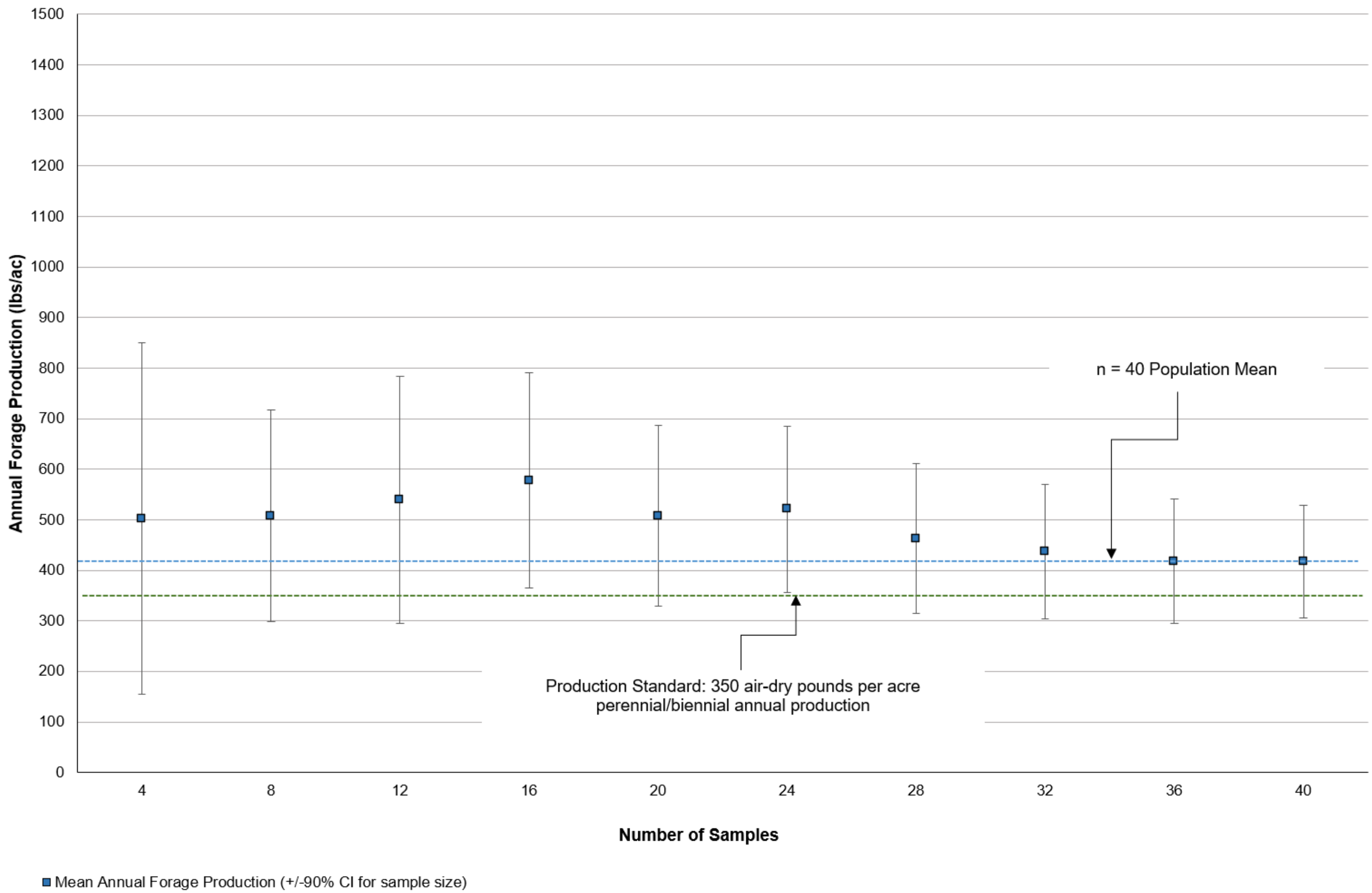
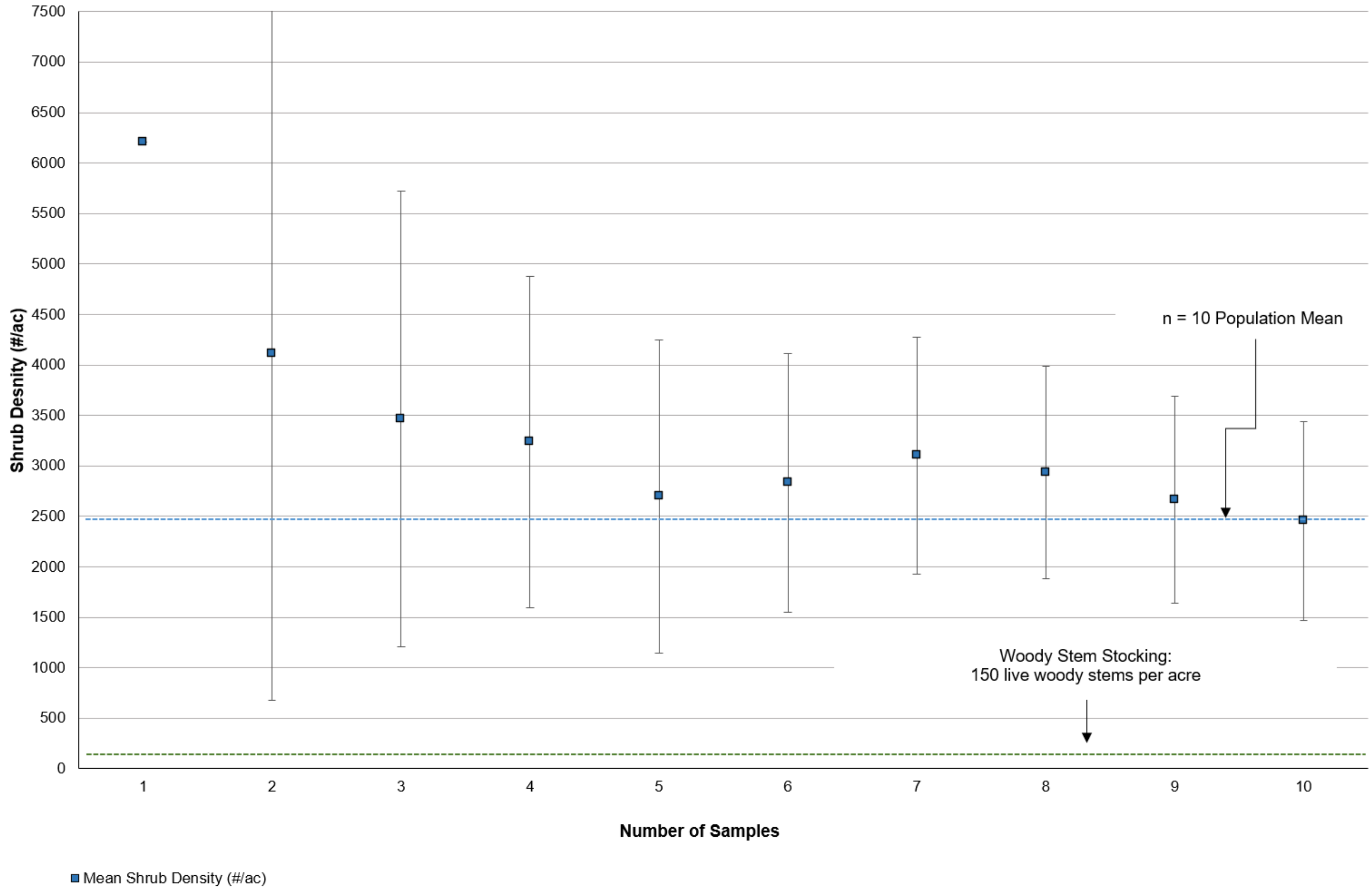


Figure 8: Stabilization of the Mean for Shrub Density - M-VMU-3, 2021



APPENDIX A

Vegetation Data Summary

Table A-1: M-VMU-3 Canopy Cover Data, 2021

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Grasses																																								
Perennials																																								
ACHY	--	--	--	--	1.1	--	--	--	--	--	--	--	--	0.2	--	0.5	0.2	1.5	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	3.0	--	--
BOGR2	--	--	--	--	--	--	--	--	--	--	2.0	6.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.5	--	--	--
ELLA3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.3	--	--	--	--	--	--	--	--	--	15.0	30.0
PASM	--	--	--	--	--	--	2.0	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33.0	--	--	--	--	--	10.0	--	12.0	--	--	--	--	5.0	4.0	6.0	--
PLJA	4.0	35.0	57.0	8.5	--	--	7.0	--	--	15.0	30.0	20.0	25.0	--	1.0	--	1.5	--	50.0	33.0	4.0	6.0	4.0	--	--	--	--	--	--	15.0	12.0	--	--	--	< 0.1	30.0	15.0	6.0	25.0	6.0
PSJU3	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPAI	--	--	--	--	2.0	30.0	--	--	--	--	7.0	--	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annual																																								
AMARA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.1	--	--	--
CHIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--
POOL	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	1.0	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.1	4.0	--	--
SATR	--	--	0.1	--	--	--	< 0.1	--	1.8	--	--	--	--	0.1	1.0	--	--	--	--	--	--	4.0	0.5	--	--	--	--	--	--	0.5	--	0.5	--	--	0.5	--	--	--	--	--
UNKAF	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VEEN	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0	0.5	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	0.1	1.0	--
Perennials																																								
CHAL11	--	--	20.0	--	7.1	0.8	7.0	33.0	--	--	0.5	--	0.1	4.0	5.0	95.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	75.0	6.0	12.0	5.0
LAOC3	--	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOCU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--
SPCO	--	--	--	--	--	--	3.0	--	--	--	--	--	--	--	--	5.0	--	--	--	--	--	1.8	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--	--	--	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	4.5	--	5.0	--	--	--	--	--	65.0	--	2.0	--	--	50.0	--	0.1	1.8	--	12.0	4.5	22.0	--	75.0	--	2.5	--	--	--	10.0	--	--	27.0	--	--	--	--	8.0	--	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	15.0	--	--	--	--	--	--	--	--	0.4	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0	--	--	12.0	--	--	--	--	--	--	--	--
KRLA	--	4.0	--	--	11.0	20.0	--	18.0	--	--	--	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																								
Perennial/Biennial Vegetation Cover	6.0	40.0	49.9	13.5	21.0	50.0	15.0	50.0	--	80.0	37.0	25.0	28.1	4.2	48.5	79.5	1.7	3.3	50.0	25.0	8.5	30.0	3.5	78.0	16.5	2.5	0.6	< 0.1	3.3	34.5	12.0	24.0	27.0	0.7	< 0.1	30.0	99.7	24.0	49.0	35.0
Total Vegetation Cover	6.0	40.0	50.0	13.5	21.0	50.0	15.0	50.0	1.8	80.0	37.0	25.0	28.1	8.3	50.0	95.0	1.7	3.3	50.0	25.0	8.5	34.0	4.0	78.0	16.5	2.5	0.6	--	3.3	35.0	12.0	24.5	27.0	0.7	0.5	30.0	100.0	28.0	50.0	35.0
Rock	0.3	0.3	--	0.5	1.0	0.8	1.0	2.0	0.2	--	0.5	2.0	23.5	1.0	< 0.1	--	0.8	20.0	5.0	5.0	< 0.1	--	< 0.1	--	< 0.1	0.5	--	--	13.0	0.3	7.0	--	4.0	8.0	3.0	3.0	--	< 0.1	1.0	1.0
Litter	11.0	35.0	17.5	30.0	45.0	5.0	5.0	3.0	25.0	20.0	5.0	5.0	15.0	4.0	25.0	1.0	50.0	15.0	3.0	25.0	51.0	8.0	25.0	10.0	24.0	45.0	55.0	95.0	12.0	23.0	2.0	33.0	9.0	26.0	25.0	10.0	--	8.0	33.0	33.0
Base Soil	82.8	24.8	32.5	56.0	33.0	44.3	79.0	45.0	73.1	--	57.5	68.0	33.5	86.7	25.0	4.0	47.6	61.7	42.0	45.0	40.5	58.0	71.0	12.0	59.5	52.0	44.4	5.0	71.8	41.8	79.0	42.5	60.0	65.4	71.5	57.0	--	64.0	16.0	31.0

Notes:
Species codes defined in Table 3

GOLDER
MEMBER OF WSP

Table A-2: M-VMU-3 Basal Cover Data, 2021

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Grasses																																								
Perennials																																								
ACHY	--	--	--	--	1.1	--	--	--	--	--	--	--	--	0.2	--	0.5	0.2	1.5	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	3.0	--	--
BOGR2	--	--	--	--	--	--	--	--	--	--	2.0	6.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.5	--	--	--
ELLA3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.3	--	--	--	--	--	--	--	--	--	15.0	30.0
PASM	--	--	--	--	--	--	2.0	14.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33.0	--	--	--	--	--	10.0	--	12.0	--	--	--	--	5.0	4.0	6.0	--
PLJA	4.0	35.0	57.0	8.5	--	--	7.0	--	--	15.0	30.0	20.0	25.0	--	1.0	--	1.5	--	50.0	33.0	4.0	6.0	4.0	--	--	--	--	--	--	15.0	12.0	--	--	--	< 0.1	30.0	15.0	6.0	25.0	6.0
PSJU3	2.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPAI	--	--	--	--	2.0	30.0	--	--	--	--	7.0	--	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annual																																								
AMARA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.1	--	--	--
CHIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	--	--	--	--
POOL	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.1	--	< 0.1	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	< 0.1	0.3	--	--
SATR	--	--	< 0.1	--	--	--	< 0.1	--	< 0.1	--	--	--	--	< 0.1	< 0.1	--	--	--	--	--	--	< 0.1	< 0.1	--	--	--	--	--	--	< 0.1	--	< 0.1	--	--	< 0.1	--	--	--	--	--
UNKAF	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VEEN	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	0.0	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	< 0.1	0.5	--
Perennials																																								
CHAL11	--	--	0.1	--	1.0	0.1	< 0.1	< 0.1	--	--	< 0.1	--	< 0.1	< 0.1	< 0.1	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	0.1	< 0.1	< 0.1
LAOC3	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOCU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--
SPCO	--	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	0.5	--	--	--	--	--	< 0.1	--	--	--	--	--	--	--	--	--	--	--	< 0.1	--	--	--	--	--	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	0.3	--	0.3	--	--	--	--	--	0.8	--	0.5	--	--	12.0	--	< 0.1	0.2	--	1.0	0.3	0.3	--	5.0	--	< 0.1	--	--	--	0.8	--	--	0.6	--	--	--	--	0.1	--	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--	--	--	--	--	--	< 0.1	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	1.0	--	--	--	--	--	--	--	--
KRLA	--	0.6	--	--	0.6	2.0	--	0.5	--	--	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cover Components																																								
Perennial/Biennial Vegetation Cover	0.4	6.8	7.2	0.8	2.9	3.1	0.2	0.6	--	5.8	3.1	3.8	3.1	< 0.1	12.5	34.1	0.3	0.3	1.0	2.0	0.6	0.3	0.4	5.5	0.3	< 0.1	0.1	< 0.1	0.6	5.5	0.5	1.1	0.6	> 0.1	> 0.1	25.0	1.3	0.7	1.5	1.0
Base Soil	89.4	73.0	72.8	63.2	71.4	92.2	64.3	64.4	81.8	29.3	86.2	80.3	46.9	96.4	24.4	15.6	47.9	64.8	69.0	75.0	54.5	74.6	69.5	18.5	41.7	54.0	44.9	5.0	74.5	39.3	89.5	48.4	84.9	66.5	71.9	37.0	89.7	87.0	46.0	48.0
Litter	10.0	20.0	20.0	35.0	25.0	4.0	33.0	33.0	18.0	65.0	10.0	13.0	25.0	2.0	63.0	50.0	51.0	15.0	25.0	18.0	45.0	25.0	30.0	75.0	58.0	45.5	55.0	95.0	12.0	55.0	3.0	50.0	10.0	25.0	25.0	35.0	9.0	12.0	50.0	50.0
Rock	0.3	0.3	--	1.0	0.8	0.8	2.5	2.0	0.2	--	0.7	3.0	25.0	1.5	< 0.1	--	0.8	20.0	5.0	5.0	--	< 0.1	< 0.1	1.0	< 0.1	0.5	--	--	13.0	0.2	7.0	0.5	4.5	8.5	3.0	3.0	--	< 0.1	2.0	1.0
Total Vegetation Cover	0.4	6.8	7.2	0.8	2.9	3.1	0.2	0.6	< 0.1	5.8	3.1	3.8	3.1	0.1	12.6	34.4	0.3	0.3	1.0	2.0	0.6	0.4	0.4	5.5	0.3	< 0.1	0.1		0.6	5.5	0.5	1.1	0.6	< 0.1	0.1	25.0	1.3	1.0	2.0	1.0

Notes:
Species codes defined in Table 3

Table A-3: M-VMU-3 Frequency Data (counts), 2021

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Perennials																																								
ACHY	--	--	--	--	1	--	--	--	--	--	--	--	--	0	--	1	0	2	--	--	--	--	--	--	--	--	--	--	--	0	--	--	--	--	--	--	--	3	--	--
BOGR2	--	--	--	--	--	--	--	--	--	--	2	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9	--	--	--
ELLA3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	15	30
PASM	--	--	--	--	--	--	2	14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	33	--	--	--	--	--	10	--	12	--	--	--	--	5	4	6	--
PLJA	4	35	57	9	--	--	7	--	--	15	30	20	25	--	1	--	2	--	50	33	4	6	4	--	--	--	--	--	--	15	12	--	--	--	0	30	15	6	25	6
PSJU3	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPAI	--	--	--	--	2	30	--	--	--	--	7	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annual																																								
AMARA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--
CHIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--
POOL	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	75	--	--
SATR	--	--	1	--	--	--	1	--	2	--	--	--	--	2	1	--	--	--	--	--	--	1	1	--	--	--	--	--	--	2	--	1	--	--	2	--	--	--	--	--
UNKAF	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VEEN	--	--	--	--	--	--	--	--	--	--	--	--	--	6	1	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	1	6	--
Perennials																																								
CHAL11	--	--	9	--	40	75	12	40	--	--	2	--	8	22	15	120	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	345	33	11	8
LAOC3	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOCU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--
SPCO	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	2	--	--	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	1	--	1	--	--	--	--	--	1	--	1	--	--	1	--	1	3	--	1	32	2	--	1	--	1	--	--	--	6	--	--	1	--	--	--	--	1	--	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	--	--	--	--	--	--	--	--
KRLA	--	2	--	--	3	11	--	2	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:

Species codes defined in Table 3

Table A-4: M-VMU-3 Air-dry Aboveground Annual Production Data, 2021

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses (g/m²)																																								
Forage																																								
ACHY	--	--	--	--	0.7	--	--	--	--	--	--	--	--	0.8	--	0.6	0.0	1.0	--	--	--	--	--	--	--	--	--	--	--	0.5	--	--	--	--	--	--	--	1.9	--	--
BOGR2	--	--	--	--	--	--	--	--	--	--	2.4	5.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BRIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7.1	--	--	--
ELLA3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--	--	--	10.7	6.8
PASM	--	--	--	--	--	--	6.4	12.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8.9	--	--	--	--	--	9.8	--	8.2	--	--	--	--	4.1	2.9	1.3	--
PLJA	104.3	45.7	10.8	13.4	--	--	5.4	--	--	86.1	22.3	17.8	28.0	--	1.0	--	3.1	--	32.8	30.0	3.3	25.8	11.3	--	--	--	--	--	--	25.4	8.5	--	--	--	--	28.6	26.0	20.1	12.2	23.9
PSJU3	3.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPAI	--	--	--	--	2.7	56.0	--	--	--	--	11.7	--	10.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Forbs (g/m²)																																								
Non-forage																																								
CHIN2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.9	--	--	--	--	--	--	--	--	--	--	--	--
HELO6	--	--	--	--	--	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KOSC	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.7	--	--	--	--	--	--	--	--	--	--	--	--
LAOC3	--	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POOL	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--	--
SATR	--	--	0.2	--	--	--	--	--	7.1	--	--	--	--	0.3	7.3	--	--	--	--	--	--	3.9	0.8	--	--	--	--	--	--	2.0	--	0.7	--	--	--	--	--	--	--	--
UNKAF	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	11.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
VEEN	--	--	--	--	--	--	--	--	--	--	--	--	--	7.3	0.5	7.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.9	0.2	1.2	--
Forage																																								
CHAL11	--	--	0.5	--	7.2	--	3.5	16.7	--	--	0.6	--	0.6	5.6	1.9	114.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	25.1	1.9	6.0	1.8
NOCU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.2	--	--	--
SPCO	--	--	--	--	--	--	5.3	--	--	--	--	--	--	--	--	2.7	--	--	--	--	--	3.3	--	--	--	--	--	--	--	--	--	--	--	0.8	--	--	--	--	--	--
Shrubs, Trees and Cacti (g/m²)																																								
Forage																																								
ATCA	--	14.9	--	7.5	--	--	--	--	--	116.4	--	5.3	--	--	140.6	--	16.8	2.8	--	16.6	27.3	36.3	--	147.4	--	6.9	--	--	--	34.9	--	--	88.3	--	--	--	--	32.8	--	--
ATCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ATCO4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	41.0	--	--	--	--	--	--	--	--	2.2	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	10.3	--	--	14.2	--	--	--	--	--	--	--	--
KRLA	--	25.2	--	--	32.6	51.0	--	24.2	--	--	--	1.7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Air-dry Aboveground Annual Production (g/m²)																																								
Non-forage	--	--	0.2	--	--	1.0	--	--	7.1	--	--	--	--	7.7	7.7	19.3	--	--	--	--	--	3.9	0.8	--	--	--	--	1.6	--	2.0	--	0.7	--	--	--	--	1.9	0.4	1.2	--
Forage	107.3	85.7	11.4	20.9	43.2	113.0	20.6	53.0	--	202.5	36.9	30.5	38.9	6.4	143.4	121.6	19.9	3.7	32.8	46.6	30.6	65.4	11.3	156.3	44.0	6.9	-12.6	--	11.9	70.5	8.5	22.4	88.3	3.0	--	28.6	62.6	59.7	30.1	32.5
Total Production	107.3	85.7	11.6	20.9	43.2	114.0	20.6	53.0	7.1	202.5	36.9	30.5	38.9	14.1	151.1	140.9	19.9	3.7	32.8	46.6	30.6	69.3	12.1	156.3	44.0	6.9	-12.6	1.6	11.9	72.5	8.5	23.1	88.3	3.0	--	28.6	64.5	60.1	31.3	32.5
Total Air-dry Aboveground Annual Production (lbs/ac)																																								
Non-forage	--	--	2	--	--	9	--	--	63	--	--	--	--	69	69	172	--	--	--	--	--	35	7	--	--	--	--	15	--	18	--	7	--	--	--	--	17	4	11	--
Forage	957	765	101	187	386	1008	184	473	--	1806	330	272	347	57	1279	1085	177	33	292	415	273	584	101	1395	393	61	-113	--	106	629	76	200	788	27	--	255	558	532	268	290
Total Production	957	765	103	187	386	1017	184	473	63	1806	330	272	347	126	1348	1257	177	33	292	415	273	619	108	1395	393	61	-113	15	106	647	76	206	788	27	--	255	575	536	279	290

Notes:
g/m^2 = grams per square meter
lbs/ac = pounds per acre
1 gram per square meter (g/m^2) is equal to 8.922 pounds per acre (lbs/ac)
Species codes defined in Table 3
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)

GOLDER
MEMBER OF WSP

Table A-5: M-VMU-3 Shrub Belt Transect Data, 2021

Transect	M-VMU-3-T01P	M-VMU-3-T02P	M-VMU-3-T03P	M-VMU-3-T04P	M-VMU-3-T05P	M-VMU-3-T06P	M-VMU-3-T07P	M-VMU-3-T08P	M-VMU-3-T09P	M-VMU-3-T10P
Shrubs, Trees and Cacti										
ATCA	13	0	12	6	27	22	3	6	3	11
ATCO	0	0	0	0	0	0	0	2	0	0
ATCO4	0	0	0	1	0	0	3	0	3	0
EPVI	0	1	0	0	0	0	0	12	0	0
KRLA	7	31	2	0	0	0	0	0	0	0
PUTR2	0	0	0	0	3	0	0	5	0	0
PUME	0	0	0	0	0	0	0	2	0	0

Code	Scientific Name	Common Name
ATCA	*Atriplex canescens*	Four-wing saltbush
ATCO	*Atriplex confertifolia*	Shadscale saltbush
ATCO4	*Atriplex corrugata*	Mat saltbush
EPVI	*Ephedra viridis*	Mormon tea
KRLA	*Krascheninnikovia lanata*	Winterfat
PUTR2	*Purshia tridentata*	Antelope bitterbrush
PUME	*Purshia mexicana*	Mexican cliffrose

APPENDIX B

Quadrat Photographs

M-VMU-3-T01P	
	
Q1	Q2
Photo Corrupted	
Q3	Q4

M-VMU-3-T02P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T03P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T04P

Q1

Q2

Q3

Q4

M-VMU-3-T05P

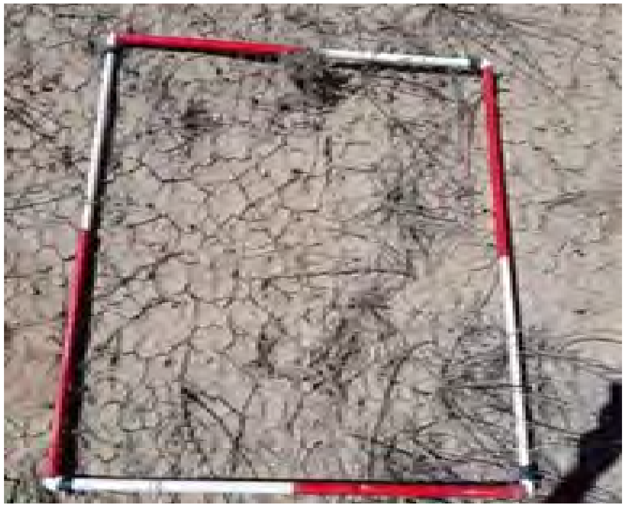
Q1

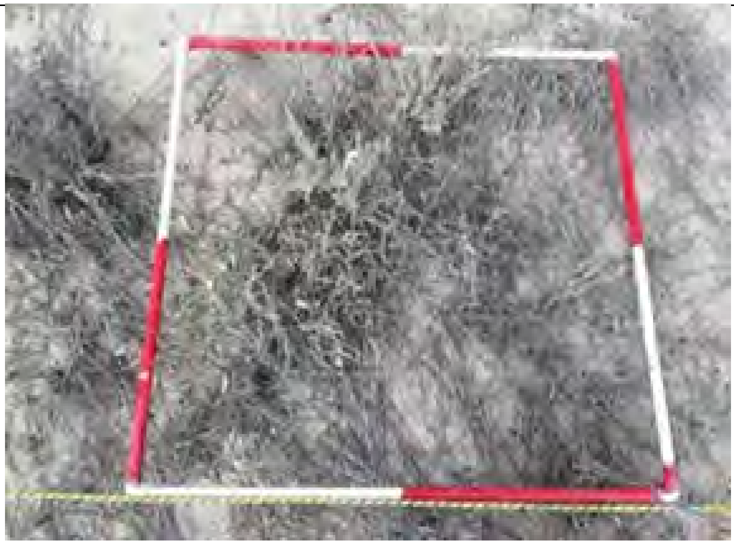
Q2

Q3

Q4

M-VMU-3-T06P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T07P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T08P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T09P	
	
Q1	Q2
	
Q3	Q4

M-VMU-3-T10P

Q1

Q2

Q3

Q4

APPENDIX C

Vegetation Statistical Analysis

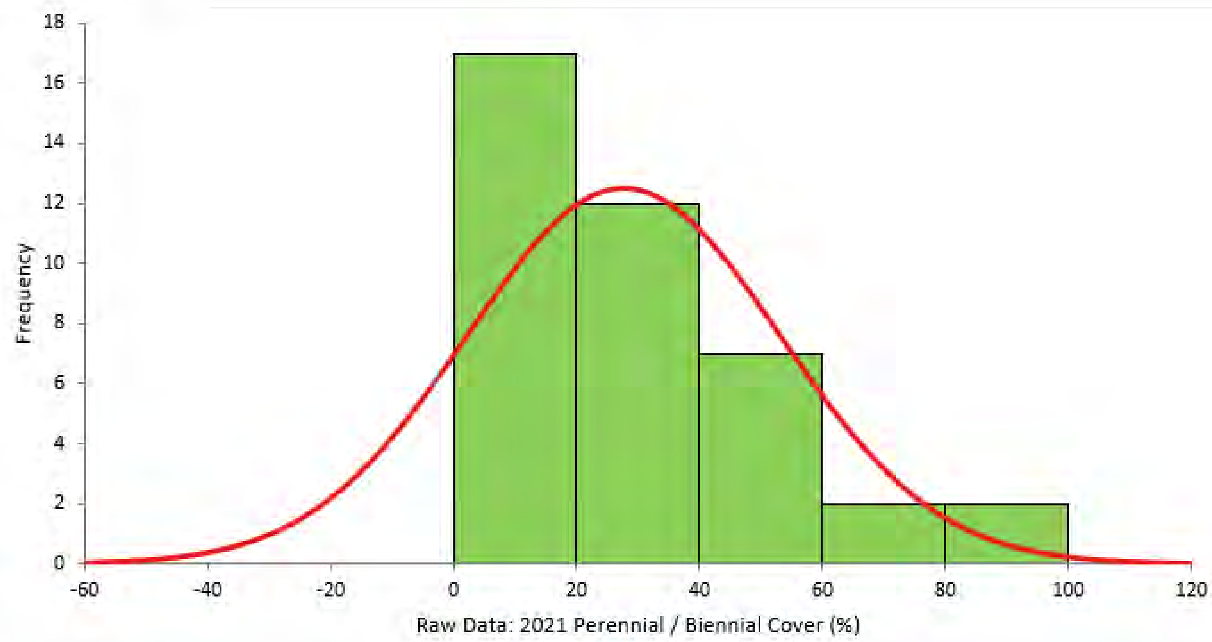
Figure C-1: Distribution: Perennial/Biennial Cover (%) Descriptive Statistics and Normality

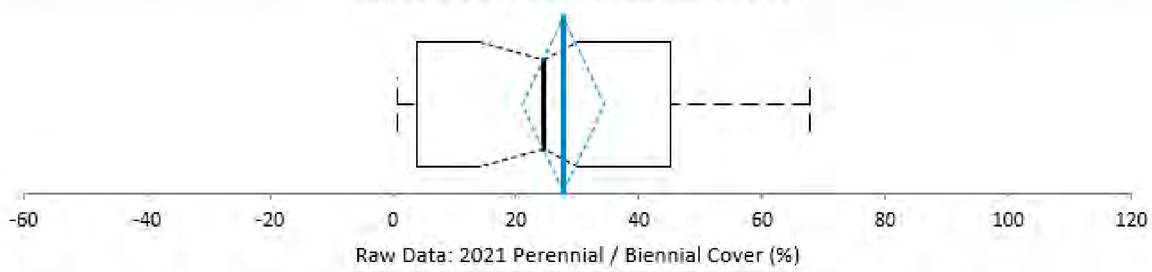
Table C-2: M-VMU-3 2021 Data for Normal Distribution and Variance Analysis

Filter: No filter

Last updated 22 February 2022 at 10:57 by Buchanan, Nicholas

Descriptives



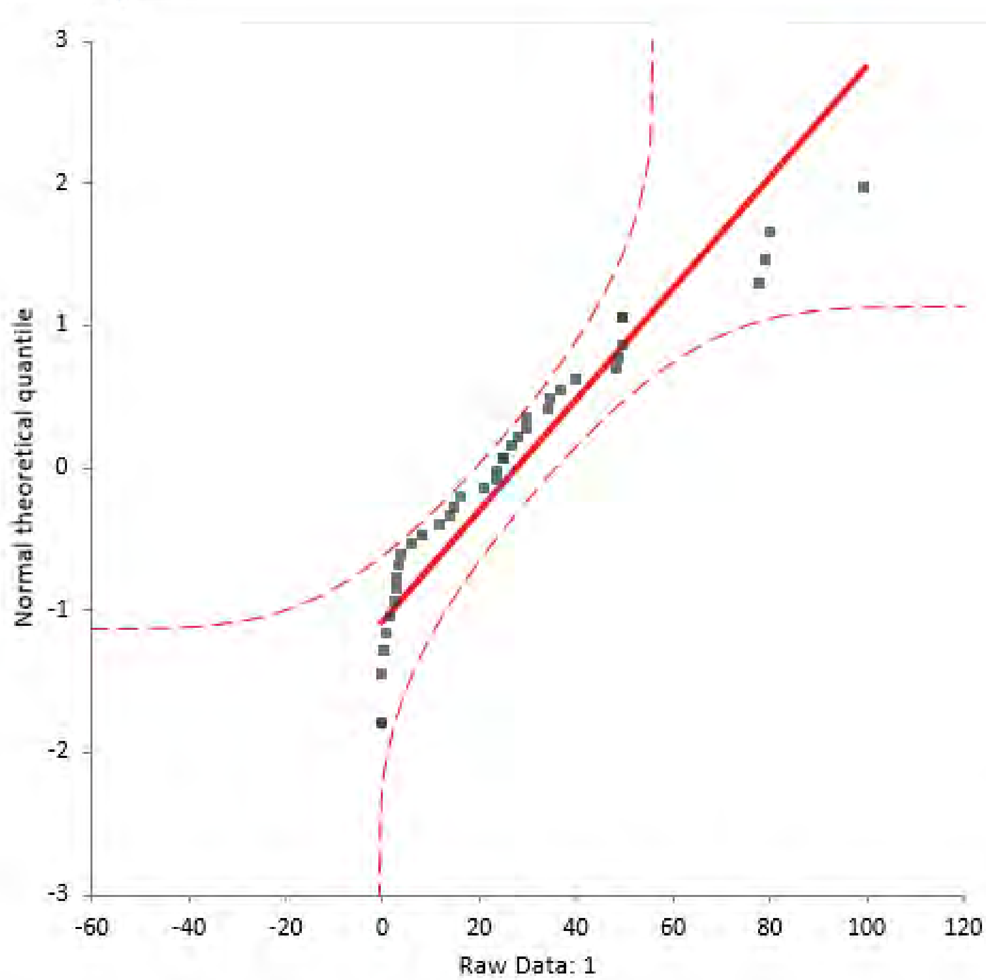


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Raw Data: 2021 Perennial / Biennial Cover (%)	27.7	20.9 to 34.5	4.0	25.5	1.0	0.63

	1st quartile	Median	3rd quartile
Raw Data: 2021 Perennial / Biennial Cover (%)	3.8	24.5	45.0

Normality



Shapiro-Wilk test

W statistic	0.89
p-value	0.0010[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-2: Perennial/Biennial Cover (Log Transformation) Descriptive Statistics and Normality, 2021

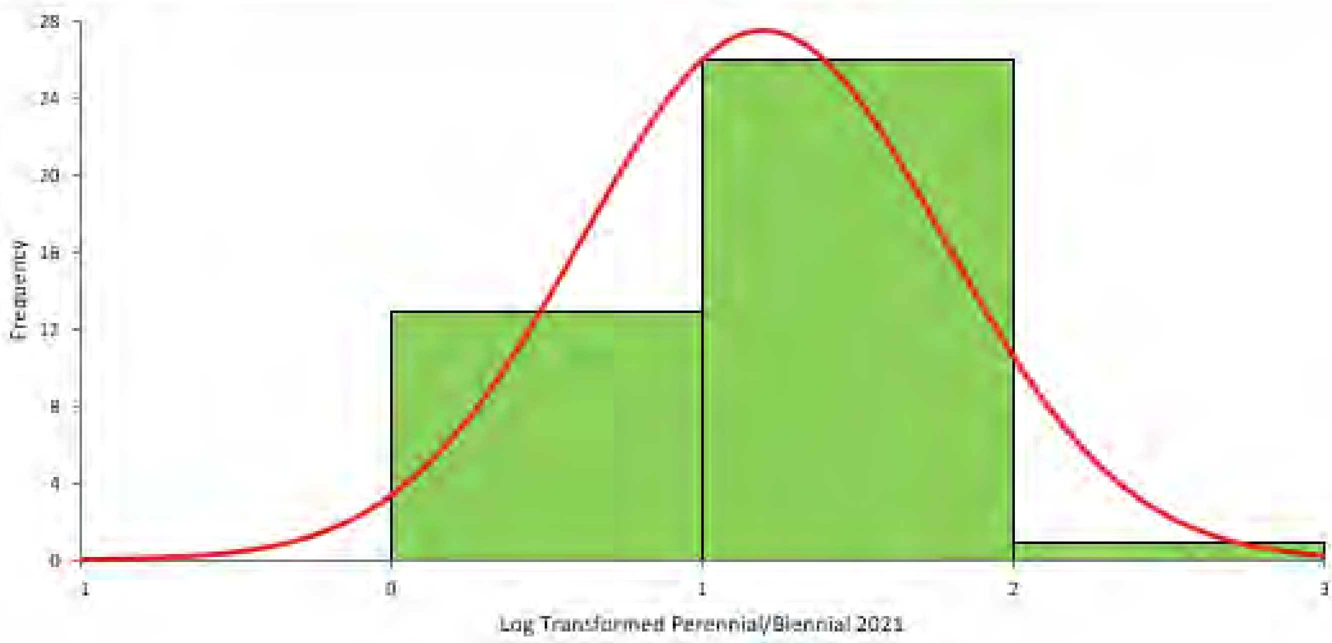
Table C-2: M-VMU-3 2021 Data for Normal Distribution and Variance Analysis

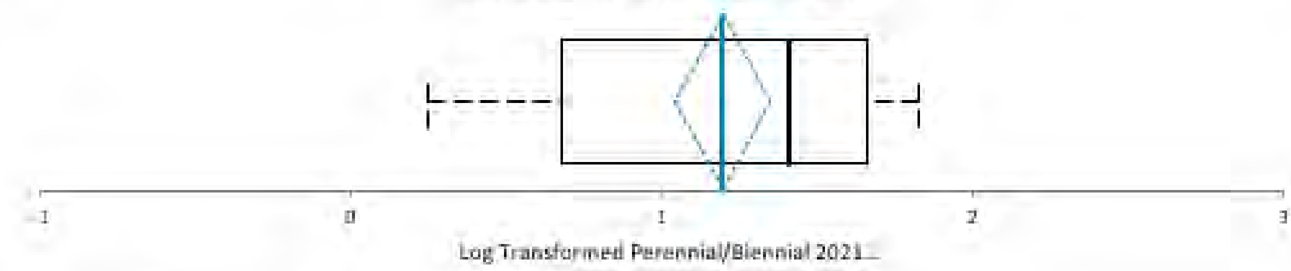
Filter: No filter

Last updated 22 February 2022 at 13:19 by Buchanan, Nicholas

Analyse-it v5.68

Descriptives



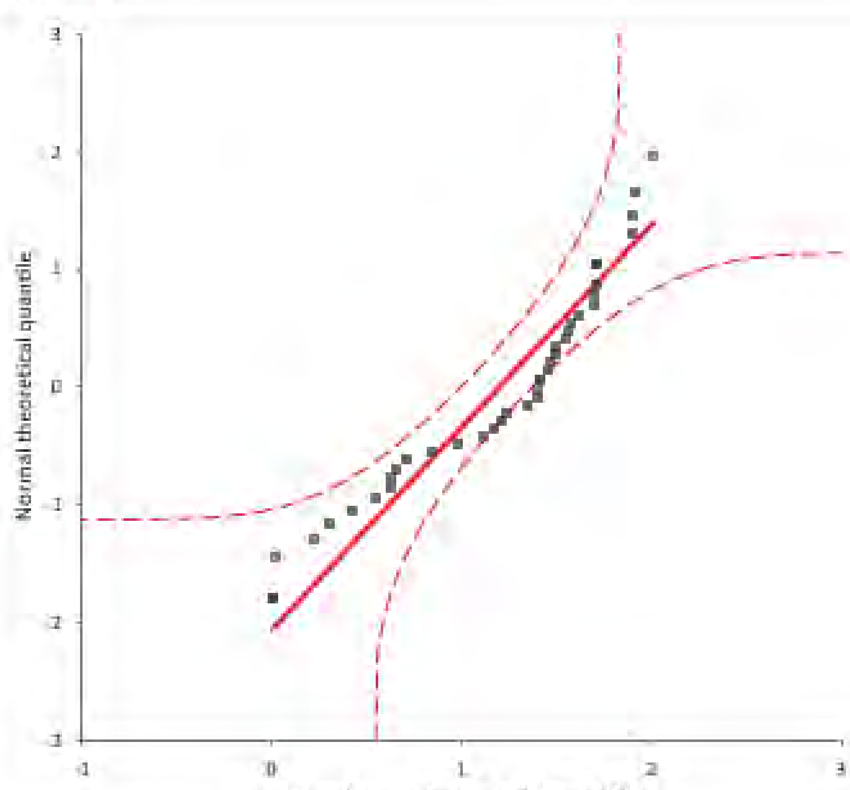


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Transformed Data: P/B Cover 2021	1.19	1.0 to 1.35	0.09	0.58	-0.74	-0.58

	1st quartile	Median	3rd quartile
Transformed Data: P/B Cover 2021	0.68	1.41	1.66

Normality



Shapiro-Wilk test

W statistic	0.91
p-value	0.0027

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-3: Annual Forage Production (lbs/ac) Descriptive Statistics amd Normality, 2021

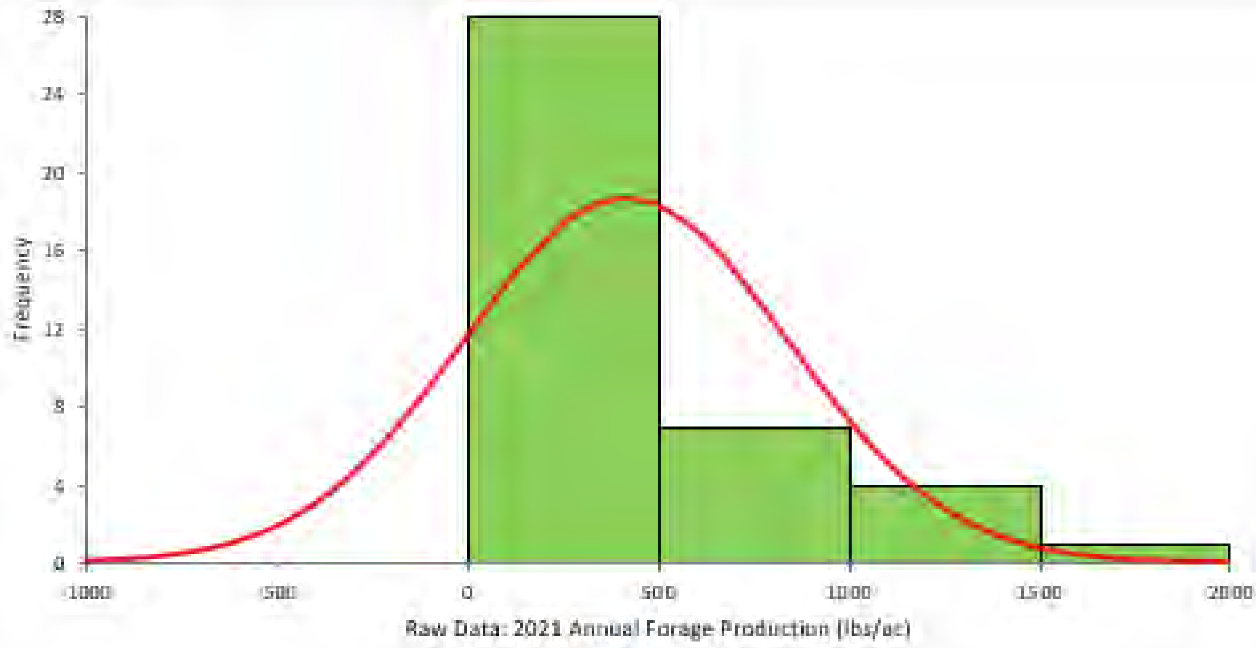
Analyse-it v5.68

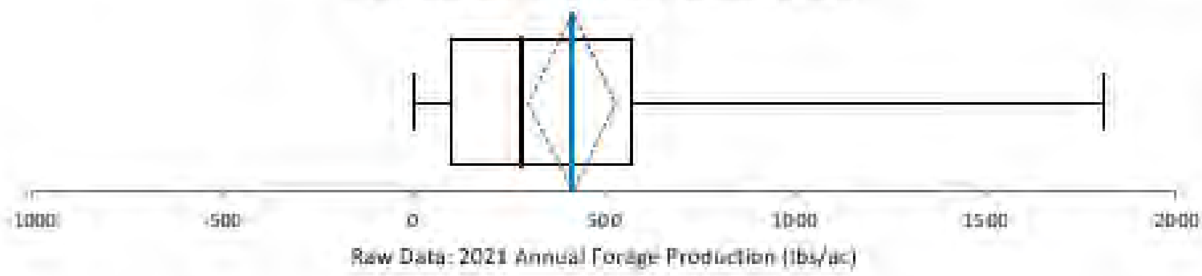
Table C-2: M-VMU-3 2021 Data for Normal Distribution and Variance Analysis

Filter: No filter

Last updated 22 February 2022 at 13:29 by Buchanan, Nicholas

Descriptives



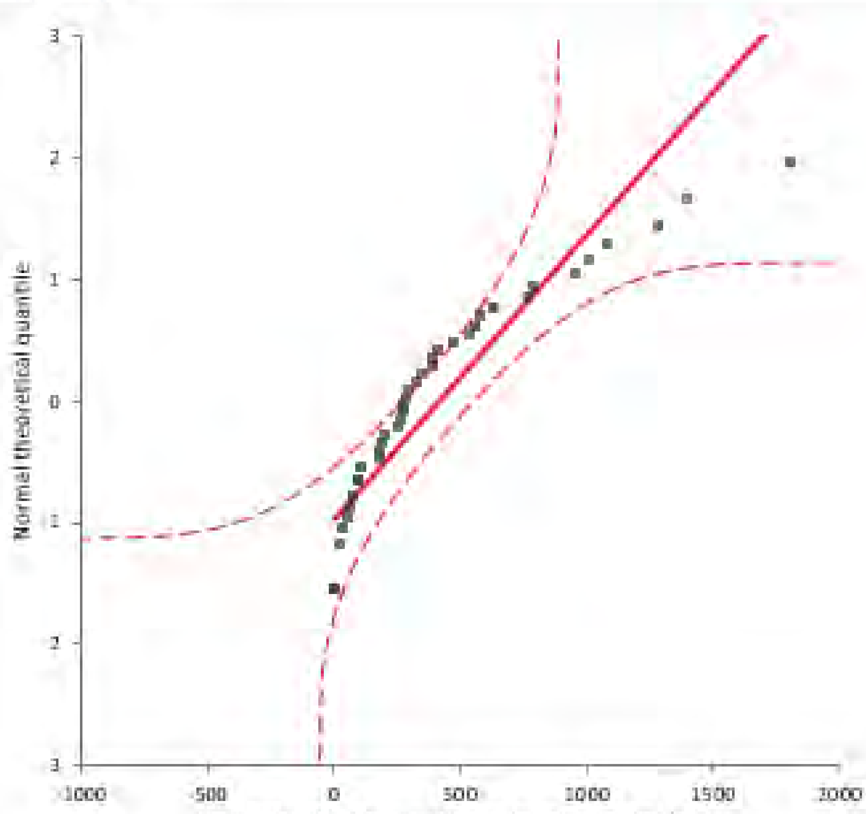


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Raw Data: 2 Annual Forage Production (lbs/ac)	417.3	303.6 to 530.9	67.44	426.5	1.5	2.07

1st quartile	Median	3rd quartile
101.0	281.5	573.2

Normality



Shapiro-Wilk test

W statistic	0.84
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 (Log Transformation) Descriptive Stats and Normality, 2021

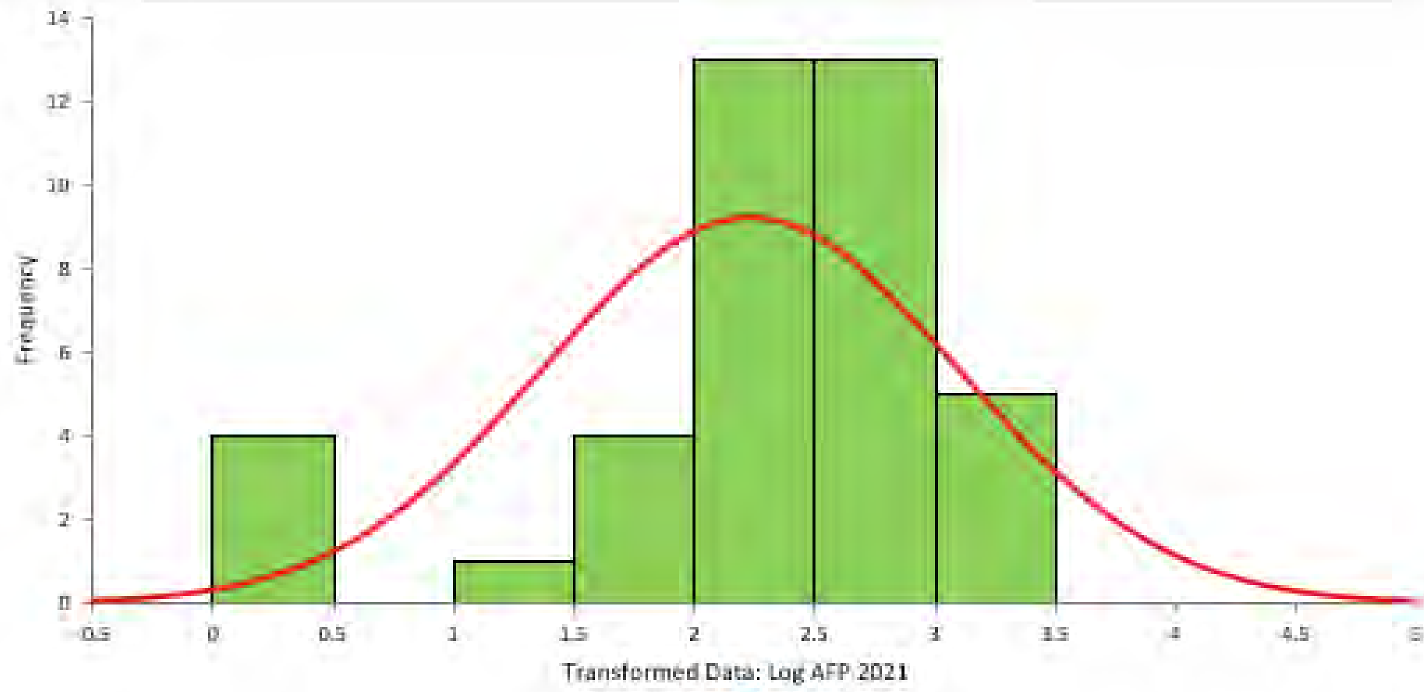
Analyse-it v5.68

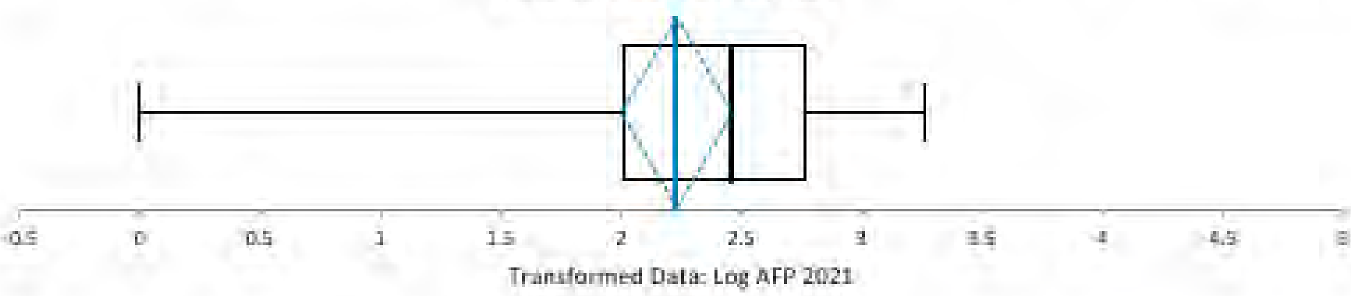
Table C-2: M-VMU-3 2021 Data for Normal Distribution and Variance Analysis

Filter: No filter

Last updated 22 February 2022 at 13:37 by Buchanan, Nicholas

Descriptives



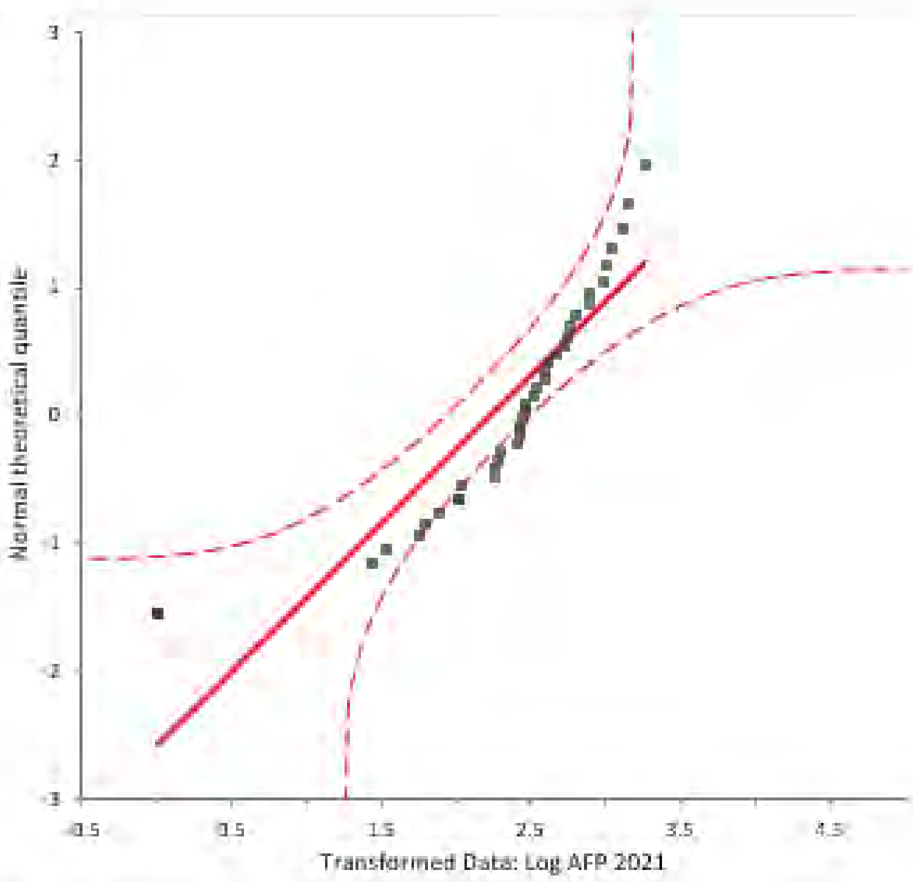


N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Transformed Data: Log AFP 2021	2.2	2.00 to 2.5	0.1	0.9	-1.7	2.28

	1st quartile	Median	3rd quartile
Transformed Data: Log AFP 2021	2.0	2.5	2.8

Normality



Shapiro-Wilk test

W statistic	0.80
p-value	<0.0001

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-5 : Distribution: Raw Data: 2021 Woody Plant Denisty

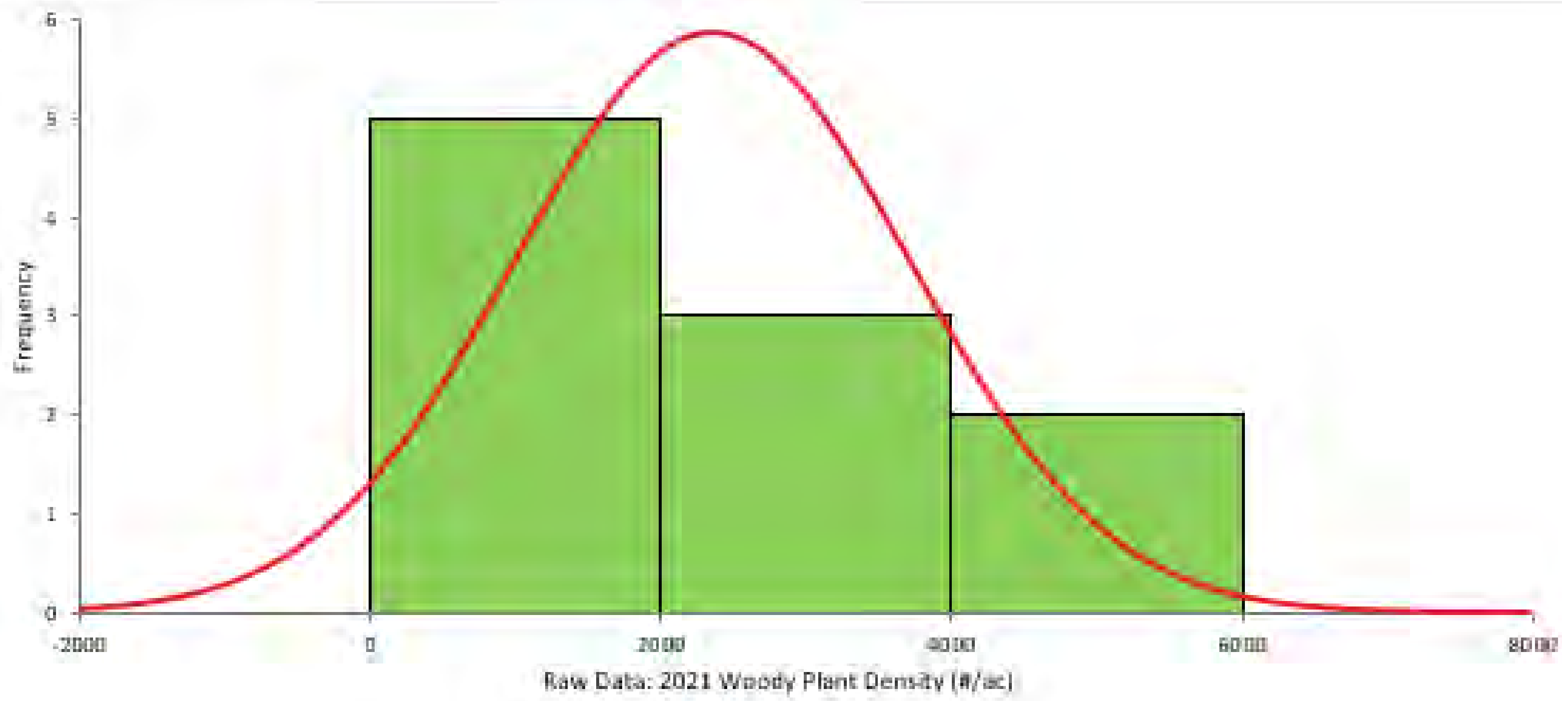
Table C-2: M-VMU-3 2021 Data for Normal Distribution and Variance Analysis

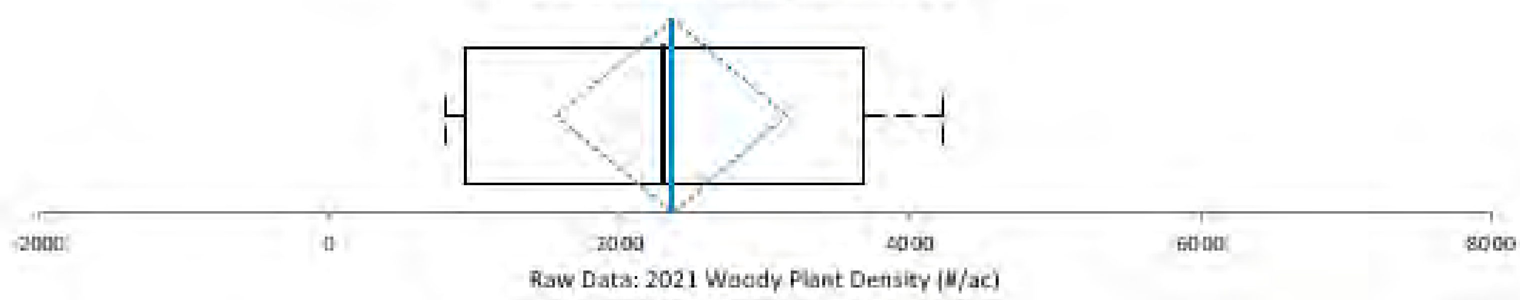
Filter: No filter

Last updated 22 February 2022 at 13:44 by Buchanan, Nicholas

Analyse-it v5.68

Descriptives



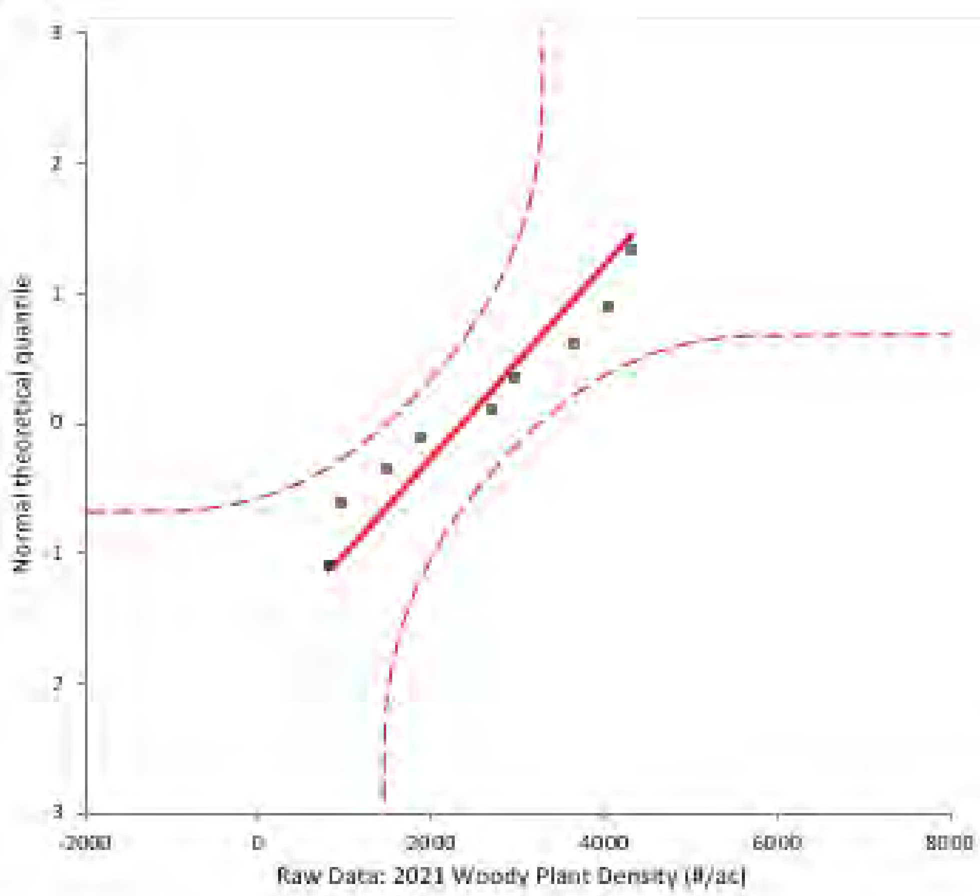


N 10

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Raw Data: 2021 Woody Plant Density (#/ac)	2361	1573 to 3148	430	1358	0.2	-1.66

	Minimum	1st quartile	Median	3rd quartile
Raw Data: 2021 Woody Plant Density (#/ac)	809	933	2294	3676

Normality



Shapiro-Wilk test

W statistic	0.90
p-value	0.2308

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: Equations for Vegetation Data Analysis

Attribute	Equation	Where
Sample Size / Count	$n = \sum samples$	n = number of samples $\sum$ = sum
Mean	$\bar{x} = \frac{\sum x}{n}$	$\bar{x}$ = sample mean $\sum x$ = sum of values for variable n = number of samples
Standard Deviation	$s = \sqrt{\frac{\sum(\bar{x} - x)^2}{n-1}}$	s = standard deviation $\sum$ = sum $\bar{x}$ = sample mean n = number of samples
Variance	$s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$	s^2 = variance $\sum$ = 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	$\bar{x} \pm t \frac{s}{\sqrt{n}}$	$\bar{x}$ = sample mean t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom 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
Probaility of True Mean	$T = 1 - t\left(\frac{\sqrt{n(0.1xs)'^2}}{\bar{x}, 2, n, 1}\right)$	T = Probability the true value of the mean is within 10 percent of the mean for the sample size t = two tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom n = number of samples s = standard deviation $\bar{x}$ = sample mean
one-sample, one-sided t test Method 3 (CMRP)	$t^* = \frac{\bar{x} - 0.9\,(technical\ std)}{s/\sqrt{n}}$	t* = calculated t-statistic $\bar{x}$ = sample mean s = standard deviation n = sample size
one-sample, one-sided sign test Method 5 (CMRP)	$z = \frac{(k+0.5)-0.5n}{0.5\sqrt{n}}$	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	$R_{cvr} = Cvr_{sp.}/Cvr_{Abs.}$	R_{cvr} = Calculated Relative Cover for a Species $Cvr_{sp.}$ = Mean Absolute Cover of a Perennial/Biennial Species $Cvr_{abs.}$ = Mean Absolute Perennial/Biennial Cover
Logarithmic Transformation	Y' = log(Y + k)	log = logarithmic function Y = attribute value k = constant, here we use 1

Notes: Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods applied to experiments in agriculture and biology. 6th ed. Ames, Iowa: Iowa State University Press.

Table C-2: M-VMU-3 2021 Data for Normal Distribution and Variance Analysis

Plot	Transect	Quadrat	Raw Data			Transformed Data		
			2021 Perennial / Biennial Cover (%)	2021 Annual Forage Production (lbs/ac)	2021 Woody Plant Density (#/ac)	Log P/B Cover (2021)	Log AFP (2021)	Log WPD (2021)
M-VMU-3	M-VMU-3-T01P	1	6.0	957	2,698	0.85	2.98	3.43
		2	40.0	765		1.61	2.88	
		3	49.9	101		1.71	2.01	
		4	14.0	187		1.18	2.27	
	M-VMU-3-T02P	1	21.0	386	4317	1.34	2.59	3.64
		2	50.0	1,008		1.71	3.00	
		3	15.0	184		1.20	2.27	
		4	50.0	473		1.71	2.68	
	M-VMU-3-T03P	1	0.0	0	1,889	0.00	0.00	3.28
		2	80.0	1,806		1.91	3.26	
		3	37.0	330		1.58	2.52	
		4	25.0	272		1.41	2.44	
	M-VMU-3-T04P	1	28.1	347	944	1.46	2.54	2.98
		2	4.2	57		0.71	1.76	
		3	48.5	1,279		1.69	3.11	
		4	79.5	1,085		1.91	3.04	
	M-VMU-3-T05P	1	1.7	177	4,047	0.43	2.25	3.61
		2	3.3	33		0.63	1.53	
		3	50.0	292		1.71	2.47	
		4	25.0	415		1.41	2.62	
	M-VMU-3-T06P	1	8.5	273	2,968	0.98	2.44	3.47
		2	30.0	584		1.49	2.77	
		3	3.5	101		0.65	2.01	
		4	78.0	1,395		1.90	3.14	
	M-VMU-3-T07P	1	16.5	393	809	1.24	2.60	2.91
		2	2.5	61		0.54	1.79	
		3	1.0	0		0.30	0.00	
		4	0.0	0		0.00	0.00	
	M-VMU-3-T08P	1	3.3	106	3,642	0.63	2.03	3.56
		2	34.5	629		1.55	2.80	
		3	12.0	76		1.11	1.89	
		4	24.0	200		1.40	2.30	
	M-VMU-3-T09P	1	27.0	788	809	1.45	2.90	2.91
		2	0.7	27		0.22	1.45	
		3	0.0	0		0.01	0.00	
		4	30.0	255		1.49	2.41	
	M-VMU-3-T10P	1	99.7	558	1,484	2.00	2.75	3.17
		2	24.0	532		1.40	2.73	
		3	49.0	268		1.70	2.43	
		4	35.0	290		1.56	2.46	

Mean	27.7	417	2361	1.19	2.23	3.29
Standard Deviation	25.5	427	1358	0.58	0.87	0.29
Count	40	40	10	40	40	10
Variance	651.0	181943	1845143	0.34	0.75	0.08
90% Confidence Interval	6.6	111	707	0.15	0.23	0.15

Notes:

2021 Perennial / Biennial Cover (%) Data from Appendix A, Table A-1

2021 Annual Forage Production (lbs/ac) Data from Appendix A, Table A-4

2021 Woody Plant Density (#/ac) Data is derived from Appendix A, Table A-5

Table C-3: 2021 Perennial/ Biennial Canopy Cover, Method 5 - CMRP

Transect	Quadrat	Total Canopy	90% of Technical Standard	P/B CVR minus TS
M-VMU-3-T01P	1	6.0	13.5	-7.5
	2	40.0	13.5	26.5
	3	49.9	13.5	36.4
	4	14.0	13.5	0.5
M-VMU-3-T02P	1	21.0	13.5	7.5
	2	50.0	13.5	36.5
	3	15.0	13.5	1.5
	4	50.0	13.5	36.5
M-VMU-3-T03P	1	0.0	13.5	-13.5
	2	80.0	13.5	66.5
	3	37.0	13.5	23.5
	4	25.0	13.5	11.5
M-VMU-3-T04P	1	28.1	13.5	14.6
	2	4.2	13.5	-9.3
	3	48.5	13.5	35.0
	4	79.5	13.5	66.0
M-VMU-3-T05P	1	1.7	13.5	-11.8
	2	3.3	13.5	-10.2
	3	50.0	13.5	36.5
	4	25.0	13.5	11.5
M-VMU-3-T06P	1	8.5	13.5	-5.0
	2	30.0	13.5	16.5
	3	3.5	13.5	-10.0
	4	78.0	13.5	64.5
M-VMU-3-T07P	1	16.5	13.5	3.0
	2	2.5	13.5	-11.0
	3	1.0	13.5	-12.5
	4	0.0	13.5	-13.5
M-VMU-3-T08P	1	3.3	13.5	-10.3
	2	34.5	13.5	21.0
	3	12.0	13.5	-1.5
	4	24.0	13.5	10.5
M-VMU-3-T09P	1	27.0	13.5	13.5
	2	0.7	13.5	-12.9
	3	0.0	13.5	-13.5
	4	30.0	13.5	16.5
M-VMU-3-T10P	1	99.7	13.5	86.2
	2	24.0	13.5	10.5
	3	49.0	13.5	35.5
	4	35.0	13.5	21.5
			k	14
			n	40
			z	-1.74
Standard one-tailed normal curve area (Table C-3; MMD, 1999)				0.4591
			P	0.0409

Notes:

P/B CVR = Perennial/Biennial Cover

TS = 90% of the Technical Standard for Perennial/Biennial Cover

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-4: 2021 Annual Forage Production, Method 5 - CMRP

Transect	Quadrat	2021 Annual Forage Production (lbs/ac)	90% of Technical Standard	FP minus TS
M-VMU-3-T01P	1	957	315	642
	2	765	315	450
	3	101	315	-214
	4	187	315	-128
M-VMU-3-T02P	1	386	315	71
	2	1008	315	693
	3	184	315	-131
	4	473	315	158
M-VMU-3-T03P	1	0	315	-315
	2	1806	315	1491
	3	330	315	15
	4	272	315	-43
M-VMU-3-T04P	1	347	315	32
	2	57	315	-258
	3	1279	315	964
	4	1085	315	770
M-VMU-3-T05P	1	177	315	-138
	2	33	315	-282
	3	292	315	-23
	4	415	315	100
M-VMU-3-T06P	1	273	315	-42
	2	584	315	269
	3	101	315	-214
	4	1395	315	1080
M-VMU-3-T07P	1	393	315	78
	2	61	315	-254
	3	0	315	-315
	4	0	315	-315
M-VMU-3-T08P	1	106	315	-209
	2	629	315	314
	3	76	315	-239
	4	200	315	-115
M-VMU-3-T09P	1	788	315	473
	2	27	315	-288
	3	0	315	-315
	4	255	315	-60
M-VMU-3-T10P	1	558	315	243
	2	532	315	217
	3	268	315	-47
	4	290	315	-25
			k	22
			n	40
			z	0.79
Standard one-tailed normal curve area (Table C-3; MMD, 1999)				0.2852
			P	0.2148

Notes:
FP = Forage Production
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: Shrub Density by the Belt Transect Method, Method 3 - CMRP

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

	2021 Woody Plant Density (#/ac)
Mean (#/ac)	2,361
Standard Deviation (#/ac)	1,358
Sample Size	10
Technical Standard (#/ac)	150
t*	5.18
N_{min}	111
1-tail t (0.1, 9)	1.383

Notes:

#/ac = Number of shrubs, trees and/or cacti per acre

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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REPORT

Vegetation Management Unit 3
Vegetation Success Monitoring, 2022

McKinley Mine, New Mexico - Mining and Minerals Division Permit Area

Submitted to:

Chevron Environmental Management and Real Estate Company

Chevron Mining Inc. - McKinley Mine
24 Miles NW HWY 264
Mentmore, NM 87319

Submitted by:

WSP USA Inc.

2440 Louisiana Boulevard NE, Suite 400
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133-8105209

February 28, 2023

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APPENDICES

1.0 INTRODUCTION

Mining was completed in Mining and Minerals Division (MMD) jurisdictional lands at the McKinley Mine in 2007; most of the land is reclaimed, with only the facilities remaining. The lands mined and reclaimed included prelaw, initial-program, and permanent-program lands. Liability release has been completed on all prelaw and initial-program lands, and full bond release on a limited amount of permanent-program land.

Chevron Mining Inc. (CMI) is assessing the vegetation in the remaining permanent-program reclaimed areas in anticipation of future bond and liability releases. 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 use of grazing and wildlife. To make that demonstration for bond and liability release, the reclaimed land must meet the revegetation success standards contained in Permit No. 2016-02. The extended period of responsibility before an application for bond and liability release can be submitted for a given area in the permit is at least ten years. Golder Associates USA Inc. (Golder), a member of WSP USA Inc (WSP), was retained to monitor and assess the success of the vegetation relative to these requirements.

1.1 Vegetation Management Unit 3

This report presents results from 2022 quantitative vegetation monitoring conducted in Vegetation Management Unit 3 (M-VMU-3), comprising about 1,275 acres within Area 9 north and parts of Area 9 south (Figure 1). The elevation in this area ranges from about 6,600 to 7,000 feet above mean sea level.

Permanent program reclamation in Area 9 started on lands disturbed after 1986, and reclamation generally was completed by 2009. Thus, reclamation age in the majority of M-VMU-3 ranges from approximately 9 to 30+ years. The configuration of the VMUs within the MMD Permit Area, shown on Figure 1 were developed in consultation with MMD. 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 McKinley's annual reports.

1.2 Reclamation and Revegetation Procedures

Reclamation methods applied in Area 9 included grading of the spoils to achieve a stable configuration, positive drainage, and approximate original contour. Graded spoil monitoring was then conducted to verify that the upper 42 inches of spoil were suitable for plant growth. A minimum of 6 inches of topdressing (topsoil or topsoil substitute) were then applied over suitable spoils.

After topdressing placement, the surface was scarified in preparation for planting. Seeding was done using various implements that drilled and/or broadcast the seed. After the seeding, mulch consisting of either hay or straw was applied at a rate of about 2 tons/acre. The mulch was anchored 3 to 4 inches into the soil with a tractor-drawn straight coulter disc. The seeding was generally performed in the fall, which coincided with logical units for seeding that had been topdressed over the spring and summer. 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 of alfalfa and cool-season grasses. Over time the seed mixes shifted to include more warm-season grasses and a broader variety of native forbs.

1.3 Prevailing Climate Conditions

The amount and distribution of precipitation are important determinants for vegetation establishment and performance at the McKinley Mine. 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 site since 2015, with the South Tipple and Rain 9 gauges capturing precipitation in VMU-3 (Figure 1).

Table 1 contains a summary of precipitation recorded at all the rain gauges for the South Mine. Total annual precipitation measured at the South Tipple was 17.82 inches, well above the regional average of 11.8 inches at Window Rock; the North Bluff Station, which was down in January and February 2022, recorded 13.38 inches of annual precipitation. Precipitation patterns at the North Bluff and South Tipple gauges are generally consistent with the three remote gauges across the South Mine though they recorded more precipitation between April to November (the period the remote stations operate). Rain Gauge 9, located near the center of Area 9 recorded 10.14 inches, whereas the South Tipple recorded 14.73 inches and the North Bluff recorded 12.21 inches for the same period. The difference was primarily related to higher monthly totals for July and August at the permanent stations. Mine wide, the precipitation recorded by the remote gauges during this time was slightly higher than what was recorded at Rain 9. In 2022, Rain 9 precipitation was about 20% above the long-term regional average measured at Window Rock whereas the South Tipple received over 70% of the regional average.

Growing season precipitation provides additional context to evaluate vegetation performance in M-VMU-3. The departure of growing season precipitation (April through September) for Area 9 (as measured at the Rain 9 and South Tipple gauges) are compared to the Window Rock (1937-1999) long-term seasonal mean in Figure 2. Growing season precipitation in M-VMU-3 was below the long-term seasonal mean from 2016 to 2021 with a severe drought in 2020 when the site only received 30% of the normal growing season precipitation for the region. Over the past two years, Area 9 has seen highly variable precipitation patterns when the South Tipple received 8.08 inches more growing season precipitation than the Rain 9 gauge or 68% above the regional average. Based on the Rain 9 gauge, M-VMU-3's growing season precipitation was 32% below normal in 2021 and 20% above normal in 2022 suggesting recovery from the drought across the VMU may be uneven.

1.4 Objectives

The intent of this report is to document the vegetation community attributes in M-VMU-3 and compare them to the Permit vegetation success criteria. Section 2 describes the vegetation monitoring methods that were used in 2022. Section 3 presents the results of the investigation with respect to ground cover, annual production, shrub density, and composition and diversity. Section 4 is a summary of the results for M-VMU-3 with emphasis on vegetation success.

2.0 VEGETATION MONITORING METHODS

Vegetation attributes on M-VMU-3 in Area 9 were quantified using the methods described in Section 6.5 of the Permit. Fieldwork was conducted at the end of the growing season, but prior to the first killing frost, which was between September 26 and 27, 2022.

2.1 Sampling Design

A systematic random sampling procedure employing a transect/quadrat system was used to select sample sites within the reclaimed area. The proposed transect locations were reviewed with MMD in advance of sampling. A 50-square foot grid was imposed over the VMU to delineate vegetation sample plots, and random points created in a geographic information system (GIS) were used to select plots for vegetation sampling. The locations of randomly selected vegetation plots for M-VMU-3 are shown on Figure 3. In the field, the randomly selected transect locations were assessed in numerical order. If the transect location was determined to be unsuitable, the next alternative location was assessed for suitability. Unsuitable transects were those that fell on or would intersect roads, drainage ways, wildlife rock piles, or prairie dog colonies.

Transects originated from the southeastern corner of the vegetation plot. Each transect was 30 meters (m) long in a dog-leg pattern (Figure 4). Four 1-m^2 quadrats were located at pre-determined intervals along the transect for quantitative vegetation measurements. Each quadrat is considered an individual sample where measurements were made of production, total canopy, species canopy and basal cover, surface litter, surface rock fragments, and bare soil as discussed below.

2.2 Vegetation and Ground Cover

Relative and total canopy cover, basal cover, surface litter, rock fragments, and bare soil were estimated for each quadrat. 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% 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%.

Basal cover is defined as the proportion of the ground occupied by the crowns of grasses and rooting stems of forbs and shrubs. Basal cover estimates were also made for surface litter, rock fragments, and bare soil. Like the total cover estimates, the basal cover estimates do not exceed 100%. Percent area cards were used to increase the accuracy and consistency of the cover estimates. Plant frequency was determined on a species-basis by counting the number of individual plants rooted in each quadrat.

2.3 Annual Forage and Biomass 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. 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). For this sampling event, plants that were less than 5 cm tall or considered volumetrically insignificant were not collected. Production from shrubs was determined by clipping the current year's growth.

The plant biomass 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 pounds per acre (lbs/ac) basis.

2.4 Shrub Density

Shrub density, or the number of plants per square meter, was determined using the frequency count data from the quadrats and the belt transect method (Bonham 1989). Shrub density was calculated from the quadrat data by dividing the total number of individual plants counted by the number of quadrats sampled. The density per square meter was converted to density per acre.

Shrub density was also determined using a belt transect method (Bonham 1989). Shrub density was determined from a 1-meter wide; 30-meter long belt transect situated along the perimeter of the dog-legged transect (Figure 4). Shrubs rooted in the belt transect were counted on a species basis.

2.5 Statistical Analysis and Sample Adequacy

The procedures for financial assurance release as described in Coal Mine Reclamation Program (CMRP) Vegetation Standards (MMD 1999) and the Permit guided this statistical analysis. Statistical tests were performed using both Microsoft® Excel and Analyse-it (version 5.92), 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 log transformation was applied to see if it normalized the data.

All hypothesis testing used to demonstrate that the vegetation success standards were met was conducted using a reverse null approach. Because vegetation performance at McKinley is compared to technical standards, the one-sample, one-sided t-test (CMRP Method 3) is used for normally distributed data to evaluate the mean and the one-sample, one-sided sign test (CMRP Method 5) to analyze the median of data that are not normal (MMD 1999; McDonald and Howlin 2013). The one-sided hypothesis tests using the reverse null approach were designed as follows:

Perennial/Biennial Canopy Cover

H_0 : Reclaim < 90% of the Technical Standard (15%)

H_a : Reclaim ≥ 90% of the Technical Standard (15%)

Annual Forage Production

H_0 : Reclaim < 90% of the Technical Standard (350 lbs/ac)

H_a : Reclaim ≥ 90% of the Technical Standard (350 lbs/ac)

Shrub Density

H_0 : Reclaim < 90% of the Technical Standard (150 stems per acre [stems/ac])

H_a : Reclaim ≥ 90% of the Technical Standard (150 stems/ac)

where H_0 is the null hypothesis, that the parameter mean of the reclaimed area is less than 90% of the technical standard, and H_a is the alternative hypothesis, that the parameter mean of the reclaimed area is greater than or equal to 90% of the technical standard. 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 – Method 3 (CMRP)

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 – Method 5 (CMRP)

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 perennial/biennial cover, annual forage production and shrub density using the one-sample, one-sided t-test and the one-sample, one-sided sign test. The hypotheses testing used the reverse null hypothesis bond release testing procedure as described in CMRP Vegetation Standards (MMD 1999).

Statistical adequacy is not required for vegetation success demonstrations at McKinley under the reverse null approach but is presented on the basis of the canopy cover, production and shrub density data. 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).

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

Where N_{min} equals minimum number of samples required, t is the two-tailed t-distribution value based on a 90% level of confidence with n-1 degrees of freedom, s is the standard deviation of the sample data, $\overline{x}$ is the mean, and D is the desired level of accuracy, which is 10 percent of the mean.

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 and a minimum sample number approach is taken. MMD recognizes the practical limitations of achieving statistical adequacy and has provided minimum sample sizes for various quantitative methods (MMD 1999). With normally distributed data where sample adequacy cannot be met because of operational constraints or for other reasons, 40 samples are often considered adequate. The 40 -sample recommendation 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 measurements with increased numbers of samples only slightly improving the precision of the estimate.

CMI collected 40 samples based on the guidance discussed above. The 40 samples came from ten transects each having four quadrats as described in Section 2.1. Each quadrat 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 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).

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 are used to analyze data that are not normally distributed. When sample adequacy is not achieved, it is appropriate to use the reverse null approach for hypothesis testing. The reverse null 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 than the technical standard (McDonald and Howlin 2013).

3.0 RESULTS

The vegetation community in M-VMU-3 is well established and dominated by perennial plants. A representative photograph of the vegetation and topography in M-VMU-3 is shown in Figure 5. The vegetation cover levels in 2022 suggest that the site can meet the vegetation success standards for the Permit Area.

Vegetation success standards consist of four vegetative parameters: ground cover, productivity, diversity, and woody stem stocking (Table 2). The ground cover requirement for live perennial/biennial cover on the reclamation is 15%. The productivity requirement is 350 air-dry lbs/ac perennial/biennial annual production. The woody stem stocking success standard is 150 live woody stems/ac.

Diversity is evaluated against numerical guidelines for different growth forms and photosynthetic pathways of the vegetation. In summary, the diversity guideline required by MMD would be met if at least two shrub or subshrub species with individual relative cover values of 1%; at least two perennial warm-season grass species have individual relative cover levels of at least 1%; at least one perennial cool-season grass species has an individual relative cover level of at least 1%; and three perennial or biennial forb species have a combined relative cover of at least 1%. MMD (1999) allows for the use of biennial forbs because they are technically monocarpic (single-flowering) perennials that annually produce a significant number of seed and therefore as a species, they persist in the reclaimed plant community. Relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit.

Diversity is also demonstrated by evidence of colonization or recruitment of native (not-seeded) plants from adjacent undisturbed native areas. Table 3 summarizes the attributes for plants recorded in the quadrats. Recruitment of these native plant species is indicative of ecological succession and the capacity of the site to support a self-sustaining ecosystem.

For Phase III bond release applications, it must be demonstrated that the total annual production and total live cover of biennials and perennials equal or exceeds the approved standards for at least two of the last four years of the responsibility period. Shrub density and revegetation diversity must equal or exceed the approved standards during at least one of the two sampling years of the responsibility period (MMD 1999).

The field data for canopy and basal cover, density, production and shrub density by the belt transect are included in Appendix A. Photographs of the quadrats are included in Appendix B. Appendix C provides the summary data and statistical outputs for perennial/biennial canopy cover, annual forage production, and shrub density by the belt transect method.

3.1 Ground Cover

Perennial/biennial canopy cover was calculated by summing the perennial/biennial species cover estimates after excluding the annual forbs and grasses. Any recorded noxious weeds are excluded from perennial/biennial cover. Average total ground cover in M-VMU-3 is 47.0% comprised of 31.4% total vegetation canopy cover, 10.6% rock, and 5% litter on a canopy cover basis (Table 4). Consistent with the spatial variability in semi-arid rangelands, plant canopy cover in the individual quadrats varied, ranging from 0.0 to 100.0% (Table A-1). On a basal area basis, average ground cover is 23.6% with 2.0% vegetation, 12.4% rock and 9.2% litter.

The mean total canopy cover in 2022 was 31.4% (± 7.8% 90% confidence interval [90% CI]) and the mean perennial/biennial canopy cover was 30.9% (± 8.1%). The calculated minimum sample size needed to meet N_{min} was 291 samples for perennial/biennial canopy cover (Table 4). In 2021 the mean total vegetation canopy cover was 28.5% (± 6.9%) and the mean perennial/biennial canopy cover was 27.6% (± 6.6%) (Table 4).

Perennial/biennial canopy cover data for M-VMU-3 were not normally distributed (Figure C-1). A log transformation of the perennial/biennial canopy cover data also did not result in a normal distribution (Figure C-4). Hypotheses testing was conducted using a one-sided, one-sample sign test using the reverse null hypothesis (MMD 1999). The testing found that 14 quadrats did not meet 90% of the perennial biennial standard (13.5%), resulting in the probability (P) of 0.4591 of observing a z-value less than -1.74 (Table C-2). Therefore, under the reverse null hypothesis we conclude the performance standard is met for perennial/biennial canopy cover in 2022. This standard was also met under the same statistical analysis methods in 2019, 2020, and 2021.

Because N_{min} was not met, the variability of perennial/biennial canopy cover data was evaluated using a stabilization of the mean approach (Clark 2001). Figure 6 illustrates the stabilization of the mean for perennial/biennial canopy cover based on incrementally calculating the mean and 90% CIs for four samples from a single transect sequentially. The analysis suggests that mean perennial/biennial canopy cover was estimated to be within the 90% CI of the estimated population mean beginning about the 8th sample, with the 90% CI tightening around the mean to ± 6% cover after 32 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 perennial/biennial cover.

3.2 Production

Productivity for vegetation success is assessed for above-ground annual forage production, excluding annuals and noxious weeds in air-dried 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 2022 annual forage production in M-VMU-3 was estimated to be 598 (± 172) lbs/ac with an annual total production of 670 (± 172) lbs/ac (Table 4). While the production mean exceeds the standard, production did not pass hypothesis testing as discussed at the end of this section. Ten perennial grasses contributed an average of 410 lbs/ac of forage and 6 shrubs contributed 128 lbs/ac of browse, indicating a diverse and productive rangeland. Grass productivity is predominantly James' galleta (*Pleuraphis jamesii*) with much smaller contributions of Western wheatgrass (*Pascopyrum smithii*) and Russian wildrye (*Psathrostachys juncea*). Four-wing saltbush (*Atriplex canescens*) and winterfat (*Krascheninnikovia lanata*) provided the bulk of shrub production (Table 3). The combined annual forage production in M-VMU-3 exceeds the vegetation success standard of 350 lbs/ac and is comparable to regional ecological sites of 430.5 to 794.2 lbs/ac (Parametrix 2012). The annual forage production of M-VMU-3 in 2019 (779 lbs/ac), 2020 (511 lbs/ac), and 2021 (417 lbs/ac) demonstrate the site's ability to exceed the minimum production values for comparable ecological sites.

The annual forage production data for M-VMU-3 were not normally distributed (Figure C-2). A log transformation of the annual forage production data failed to produce a normally distributed dataset (Figure C-5). As a result, hypotheses testing was conducted using a one-sided, one-sample sign test using the reverse null hypothesis (MMD 1999). The testing found that 19 of the 40 quadrats did not meet 90% of the annual forage production standard (315 lbs/acre), resulting in the probability (P) of 0.4364 of observing a z-value less than -0.16 (Table

C-3). Therefore, under the reverse null hypothesis we conclude the annual forage production success standard is not met in M-VMU-3 in 2022. This standard, however, was met in M-VMU-3 in 2019 and 2020.

The calculated minimum sample size needed to meet N_{min} at the 90% confidence level for annual forage production was estimated to be 323 samples (Table 4). Because N_{min} was not met, the data were evaluated using a stabilization of the mean (Clark 2001). Figure 7 illustrates the stabilization of the estimated mean and 90% CI for annual forage production. The analysis suggests that mean perennial/biennial canopy cover was estimated to within the 90% CI of the estimated population mean beginning about the 4^{th} sample, with the 90% CI tightening around the mean to ± 200 lbs/ac after 28 samples. This analysis suggests that 40 samples were more than adequate and collecting additional samples would not improve the precision of the canopy cover estimate.

3.3 Shrub Density

Shrub density ranged from an average of 4,398 (± 3,749) stems/ac based on the belt transect method to 4,553 (± 3,585) stems/ac for the quadrat method (Table 4). In M-VMU-3, ten shrub species were encountered in the belt transects and the quadrats (Tables 3 and A-5). Four-wing saltbush and winterfat were the most encountered shrubs under the quadrat method, whereas shadscale saltbush (*Atriplex confertifolia*) and winterfat were the most common under the belt transect method.

The shrub density data by the belt transect method were not normally distributed based on the Shapiro-Wilks test at a 10% significance level (Figure C-3). A log transformation of the annual forage production data failed to produce a normally distributed dataset (Figure C-6). Hypotheses testing was conducted using the one-sample, one-sided t-test (MMD 1999) on the log transformed belt transect data. The calculated t*-statistic for M-VMU-2 shrub density is 5.22, where the sample mean is 4,398 stems/ac with a standard deviation of 7,207 and the technical standard is 150 stems/ac. The one-tail $t_{(0.1,\ 9)}$ value is 1.383. Therefore, under the reverse null hypothesis ($t^* >= t_{(1-\alpha;\ n-1)}$), we conclude that the performance standard is met for shrub density (i.e., woody stem stocking) by the belt transect method (Table C-4).

The calculated minimum sample size needed to meet N_{min} at the 90% confidence level was estimated to be 903 samples (Table 4). Because N_{min} was not met and called for an unreasonable number of samples, the shrub density belt transect data were evaluated using a stabilization of the mean (Clark 2001). Figure 8 illustrates the stabilization of the mean for shrub density based on individual belt transect data. The corresponding variability around the mean is expressed by the 90% CIs for each successive analytical increment. These data suggest that the mean stabilized within the 90% CI of the 10-sample mean after the collection of 8 samples. The variability of the estimate remains relatively high but the lower CI is above the standard after 6 samples and the collection of additional data would not likely change the mean to a meaningful degree. This analysis suggests that 10 samples were adequate, and that the collection of additional data would not improve the precision of the estimate of shrub density.

3.4 Composition and Diversity

Diversity is assessed through comparing the relative cover of various life-forms, based on their duration to the perennial/biennial cover of the vegetation management unit. In this context, relative cover is the average percent cover of a perennial/biennial species divided by the mean perennial/biennial cover of the sampling unit. Relative canopy cover of individual species contributing to perennial cover are listed in Table 3.

Collectively, eleven perennial grasses dominate the canopy cover in M-VMU-3 with a combined average relative canopy cover of almost 67%. Russian wildrye and James' galleta are the most prevalent grasses (Table 3). Nine cool-season perennial grasses contribute almost 13% average relative canopy cover and two warm-season perennial grasses contribute almost 54% average relative canopy cover. Thirteen perennial/biennial forbs contribute just under 29% average relative canopy cover in M-VMU-3. The collective contribution of six shrubs to perennial/biennial canopy cover is about 16% average relative cover, with four-wing saltbush and winterfat the most prevalent.

Table 5 provides the diversity results for M-VMU-3 for 2019 through 2022 and is summarized below.

- The diversity standard for shrubs requires two species with a minimum relative cover of 1% for each species. The diversity standard for shrubs is achieved by four-wing saltbush (9.6%) and winterfat (2.7%). A third sub-dominant shrubs recorded in the quadrats includes Mormon tea (*Ephedra viridis*, 1.7%).
- The diversity standard for warm-season grasses requires a minimum of two species with 1% relative cover each. The warm grasses were dominated by James' galleta (53.1%) and alkali sacaton (*Sporobolus airoides*, 0.54%). The warm-season grass diversity standard, however, was met in 2019 and 2021 in M-VMU-3.
- The diversity standard for cool-season grasses is achieved by several species that exceed 1% relative cover including Russian wildrye (5.5%) and western wheatgrass (3.3%).
- The diversity standard for forbs requires a minimum of three non-annual forb taxa combining to contribute at least 1% relative cover. The combined relative cover of three non-annual forbs is 26.7% (Table 3). These forbs include rattlesnake weed (*Chamaesyce albomarginata*) (25.3%), scarlet globemallow (*Sphaeralcea coccinea*, 0.6%), and flatspine stickseed (*Lappula occidentalis,* 0.5%). Based on 2022 sampling, the combined relative cover for three non-annual forbs is greater than 1%, meeting the diversity standard for forbs on M-VMU-3 reclamation.

The recruitment of native plants and establishment of seeded species within M-VMU-3 is indicative of ecological succession and the capacity of the site to support a diverse and self-sustaining ecosystem. Based on the 2022 vegetation monitoring, 94 different plant species were present within the reclamation areas of M-VMU-3 (Table A-6). Encountered species include 26 grasses, 41 forbs, and 27 shrubs, trees, and cacti. Of the 41 forbs, 18 are annuals whereas the remaining 23 have variable durations or are purely perennial. Of the 26 grasses, 18 are cool-season perennials, six are warm-season perennials and two are cool-season annuals. Cacti and trees are rare on the reclamation, while shrubs and subshrubs are more common.

During the 2022 monitoring program, noxious weeds were infrequently encountered (NMDA 2020) on M-VMU-3. Russian knapweed (*Acroptilon repens*) and musk thistle (*Carduus nutans*) were encountered at a frequency of less than one plant per quadrat. Cheatgrass (*Bromus tectorum*), saltcedar (*Tamarix ramosissima*) and Siberian elm (*Ulmus pumila*) have also been observed in the reclamation. 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 control. 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 canopy cover, production, shrub density, and plant diversity (Table 2). The vegetation monitoring results for the past four years indicate that the vegetation community in M-VMU-3 met the full suite of success standards in 2019 and has met the cover and shrub density standard in every year since then (Table 4). This year, mean annual forage production was above the standard, but hypothesis testing found the standard was not met. A summary of the findings from the past four years are:

1) The reclamation has demonstrated resilience and permanence by meeting the revegetation performance standards in two of the last four years of the responsibility period according to MMD’s guidance.

2) In all years, perennial/biennial cover and shrub density were well above the numeric performance standards and were shown through statistical hypothesis testing that the standards were met.

3) In all years, average annual forage production was above the numeric performance standards. While statistical hypothesis testing in the past two years did not demonstrate that the standards were met, it was met in 2019 and 2020.

4) The diversity standard for M-VMU-3 has been met in two of the past four years with only the second warm-season grass not attaining the required relative cover value in 2020 and 2022.

5) Based on the vegetation monitoring results over the past four years, the M-VMU-3 reclamation is eligible for Phase III bond release.

Overall, vegetation performance in M-VMU-3 is encouraging considering below-average precipitation for the past six out of seven years including two dry years in 2018 and 2019, the exceptional drought in 2020, and the spatial variability of moisture in 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 M-VMU-3 has demonstrated that it meets standards and capable sustaining the post-mining land use.

5.0 REFERENCES

Bonham, C.D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons. New York, NY.

Clark, D.L. 2001. Stabilization of the mean as a demonstration of sample adequacy. American Society for Surface Mining and Reclamation Annual Meeting. Albuquerque, NM. June 3-7, 2001. ASSMR, Lexington, KY.

Mining and Minerals Division (MMD). 1999. Coal Mine Reclamation Program Vegetation Standards. Santa Fe, NM. April 30.

McDonald, L., and S. Howlin. 2013. Evaluation and comparison of hypothesis testing techniques for bond release application. University of Wyoming, Laramie, WY.

Parametrix. 2012. Revegetation Success Standards Report: McKinley Mine – Response to OSM. Prepared by Jim Nellessen of Parametrix, Albuquerque, New Mexico. April 2012.

New Mexico Department of Agriculture (NMDA). 2020. New Mexico Noxious Weed List Update. New Mexico State University, Las Cruces, NM. June 2020.

Sokal, R.R. and F.J. Rohlf. 1981. Biometry (2nd edit.). W. H. Freeman and Co., San Francisco.

Schulz, A. M., R. P. Gibbens, and L. F. DeBano. 1961. Artificial populations for teaching and testing range techniques. J. Range Management. 14:236-242.

Snedecor, G.W. and W.G. Cochran. 1967. Statistical methods applied to experiments in agriculture and biology. 6th ed. Ames, Iowa: Iowa State University Press.

Tables

Table 1: South Mine Seasonal and Annual Precipitation (2015-2022)

Year	Station	Precipitation (inches)													
		January	February	March	April	May	June	July	August	September	October	November	December	Annual Total	Growing Season Total
2015	South Tipple	2.05	1.59	0.11	0.52	1.64	1.11	2.37	1.62	0.30	1.36	1.31	0.76	**14.74**	*7.56*
	Rain 9				0.50	1.38	1.22	2.88	1.25	0.22	1.13	0.99		9.57	*7.45*
	Rain 10				0.42	1.32	1.11	2.59	1.39	0.30	1.10	0.78		9.01	*7.13*
	Rain 11				0.48	1.88	1.02	2.80	1.69	0.26	0.97	1.08		10.18	*8.13*
2016	South Tipple	0.62	0.22	0.05	1.31	0.80	0.07	1.37	1.74	1.75	0.40	1.57	1.84	**11.74**	*7.04*
	Rain 9				0.22	0.62	0.45	1.24	0.50	1.05	1.05	0.00		5.13	*4.08*
	Rain 10				0.13	0.55	0.20	2.75	0.38	0.99	0.14	0.02		5.16	*5.00*
	Rain 11				0.28	0.77	0.64	1.61	0.42	1.09	0.09	0.04		4.94	*4.81*
2017	South Tipple	1.25	1.64	0.48	0.35	0.77	0.42	2.48	0.90	1.34	0.15	0.09	0.02	**9.89**	*6.26*
	Rain 9				1.20	1.02	0.01	0.82	1.40	1.64	0.37	0.91		7.37	*6.09*
	Rain 10				1.00	0.67	0.08	0.94	1.63	1.36	0.34	0.81		6.83	*5.68*
	Rain 11				1.23	1.16	0.05	0.86	2.00	1.85	0.34	0.49		7.98	*7.15*
2018	South Tipple	0.35	0.79	0.54	0.09	0.29	0.51	2.61	1.34	1.10	1.65	0.19	0.29	**9.75**	*5.94*
	Rain 9				0.07	0.27	0.25	2.16	0.74	0.67	1.31	0.00		5.47	*4.16*
	Rain 10				0.08	0.20	0.27	3.05	1.15	0.92	1.51	0.00		7.18	*5.67*
	Rain 11				0.09	0.29	0.26	1.92	1.00	0.89	1.45	0.00		5.90	*4.45*
2019	South Tipple	1.30	1.81	1.23	0.44	1.77	0.33	0.22	0.05	1.59	0.09	1.14	0.85	**10.82**	*4.40*
	Rain 9				0.16	1.36	0.24	0.46	0.37	1.84	0.05	0.07		4.55	*4.43*
	Rain 10				0.20	1.49	0.37	0.19	0.27	1.34	0.03	0.05		3.94	*3.86*
	Rain 11				0.20	1.50	0.19	0.44	0.20	1.72	0.06	0.08		4.39	*4.25*
2020	South Tipple	0.98	1.44	1.35	0.17	0.01	0.04	1.13	0.24	0.15	0.26	0.40	0.27	**6.44**	*1.74*
	Rain 9				0.16	0.02	0.11	0.60	0.06	0.14	0.08	0.45		1.62	*1.09*
	Rain 10				0.11	0.02	0.13	0.79	0.14	0.14	0.16	0.09		1.58	*1.33*
	Rain 11				0.22	0.00	0.05	0.63	0.69	0.20	0.30	0.41		2.50	*1.79*
2021	South Tipple	1.11	0.34	0.40	0.07	0.08	0.37	5.45	1.24	2.12	1.77	0.55	2.26	**15.76**	*9.33*
	No. Bluff	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 9				0.00	0.10	0.27	1.81	1.22	1.11	0.78	0.00		5.29	*4.51*
	Rain 10				0.01	0.06	0.24	2.48	1.80	0.96	0.80	0.00		6.35	*5.55*
	Rain 11				0.00	0.07	0.18	2.10	1.31	1.43	0.98	0.00		6.07	*5.09*
2022	South Tipple	0.36	0.74	1.25	0.00	0.01	0.66	3.68	5.36	1.51	2.92	0.59	0.74	**17.82**	*11.22*
	No. Bluff	--	--	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 9				0.00	0.00	0.51	2.38	4.05	1.02	1.77	0.41		10.14	*7.96*
	Rain 10				0.00	0.00	0.69	3.57	4.27	1.02	1.83	0.33		11.71	*9.55*
	Rain 11				0.00	0.00	0.56	3.30	4.62	1.09	1.97	0.51		12.05	*9.57*
Window Rock, Long Term		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

Table 2: Revegetation Success Standards for the Mining and Minerals Division Permit Area

Vegetative Parameter	Success Standard
Ground Cover	15% live perennial/biennial canopy cover
Productivity	350 air-dry pounds per acre perennial/biennial annual production
Diversity	A minimum of 2 shrub or subshrub taxa contributing at least 1% relative cover each.
	A minimum of 2 perennial warm-season grass taxa contributing at least 1% relative cover each.
	A minimum of 1 perennial cool-season grass taxa contributing at least 1% relative cover.
	A minimum of 3 perennial/biennial forb taxa combining to contribute at least 1% relative cover.
Woody Stem Stocking	150 live woody stems per acre

Table 3: Vegetation Cover, Density, and Production by Species, M-VMU-3, 2022

Common Name	Scientific Name	Code	Mean Vegetation Cover (%)			Mean Density ($\#/m^2$)	Mean Annual Production (lbs/ac)
			Canopy	Basal	Relative Canopy[a]		
Cool-Season Grasses (8)							
Perennials (8)							
Indian ricegrass	*Achnatherum hymenoides*	ACHY	0.12	<0.05	0.42	<0.1	2
Purple threeawn	***Aristida purpurea***	**ARPU**	**<0.05**	**<0.05**	**0.09**	**<0.1**	**1**
Thickspike wheatgrass	*Elymus lanceolatus*	ELLA3	0.63	<0.05	2.23	0.65	10
Slender wheatgrass	*Elymus trachycaulus*	ELTR7	<0.05	<0.05	0.09	<0.1	<1
Tufted lovegrass	***Eragrostis pectinacea***	**ERPE**	**<0.05**	**<0.05**	**0.09**	**<0.1**	**<1**
Needle and thread	*Hesperostipa comata*	HECO26	0.25	<0.05	0.89	0.35	2
Western wheatgrass	*Pascopyrum smithii*	PASM	0.93	0.06	3.33	2.13	17
Russian wildrye	*Psathyrostachys juncea*	PSJU3	1.53	0.15	5.45	3.25	19
Warm-Season Grasses (2)							
Perennials (2)							
James' galleta	*Pleuraphis jamesii*	PLJA	14.86	1.45	53.11	24	358
Alkali sacaton	*Sporobolus airoides*	SPAI	0.15	<0.05	0.54	0	2
Forbs (18)							
Annuals (5)							
Redroot amaranth	***Amaranthus retroflexus***	**AMRE**	**<0.05**	**<0.05**	**--**	**<0.1**	**1**
Narrowleaf goosefoot	*Chenopodium leptophyllum*	CHLE4	<0.05	<0.05	--	<0.1	<1
Little hogweed	*Portulaca oleracea*	POOL	0.23	<0.05	--	<0.1	2
Russian thistle	*Salsola tragus*	SATR	0.78	<0.05	--	2.7	26
Cowpen daisy	*Verbesena encelioides*	VEEN	2.28	<0.05	--	2.1	31
Perennials/Biennials (13)							
Russian knapweed	***Acroptilon repens***	**ACRE3**	**0.33**	**<0.05**	**1.18**	**0.4**	**8**
Borage Species	**Boraginaceae species**	**BORAG**	**<0.05**	**<0.05**	**0.01**	**<0.1**	**<1**
Musk thistle	***Carduus nutans***	**CANU4**	**0.06**	**<0.05**	**0.21**	**<0.1**	**1**
Rattlesnake weed	*Chamaesyce albomarginata*	CHAL11	7.07	0.06	25.27	29.63	48
Chenopod Species	**Chenopodaceae species**	**CHENOP**	**<0.05**	**<0.05**	**0.04**	**<0.1**	**<1**
Redstem stork's bill	***Erodium cicutarium***	**ERCI6**	**0.06**	**<0.05**	**0.2**	**0.13**	**1**
Trailing fleabane	***Erigeron flagellaris***	**ERFL**	**0.09**	**<0.05**	**0.31**	**<0.1**	**1**
Flatspine stickseed	*Lappula occidentalis*	LAOC3	0.13	<0.05	0.45	7.23	3
Nightshade species	**Solanaceae species**	**SOLAN**	**<0.05**	**<0.05**	**0.09**	**<0.1**	**1**
Scarlet globemallow	*Sphaeralcea coccinea*	SPCO	0.18	<0.05	0.64	0.43	4
Gooseberryleaf globemallow	*Sphaeralcea grossulariifolia*	SPGR2	<0.05	<0.05	0.06	0.28	1
Yellow salsify	*Tragopogon dubius*	TRDU	<0.05	<0.05	0.04	<0.1	<1
Unknown forb species	Various	UNKFORB	<0.05	<0.05	<0.01	<0.1	<1
Shrubs, Trees and Cacti (6)							
Perennials (6)							
Four-wing saltbush	*Atriplex canescens*	ATCA	2.69	<0.05	9.62	0.78	66
Mormon tea	*Ephedra viridis*	EPVI	0.46	<0.05	1.65	<0.1	19
Rubber rabbitbrush	*Ericameria nauseosa*	ERNA	0.45	<0.05	1.61	<0.1	17
Broom snakeweed	*Gutierrezia sarothrae*	GUSA	<0.05	<0.05	<0.01	<0.1	<1
Winterfat	*Krascheninnikovia lanata*	KRLA	0.75	<0.05	2.68	<0.1	27
Plains pricklypear	*Opuntia polyacantha*	OPPO	<0.05	<0.05	0.13	<0.1	<1
Cover Components							
Perennial/Biennial Vegetation Cover			28.0	2.0			
Total Vegetation Cover			31.4	2.0			
Rock			10.6	12.4			
Litter			5.0	9.2			
Bare Soil			47.1	76.4			

Notes:
[a] = relative cover is the average percent cover of a perennial/biennial species divided by the total perennial/biennial cover of the sampling unit
-- = this parameter is not calculated for this attribute
#/ac = number of plants per acre
lbs/ac = air-dry forage pounds per acre
Bold species are newly observed this year

Table 4: Summary Statistics, M-VMU-3

Vegetation Metric	Year 2019	2020	2021	2022	Technical Standard
Total Vegetation Canopy Cover (%)[2]					
Mean	49.0	39.9	28.5	31.4	None
Standard Deviation	23.1	18.1	26.4	30.0	
90% Confidence Interval	6.0	4.7	6.9	7.8	
Nmin[1]	63	58	243	258	
Perennial/Biennial Canopy Cover (%)[3]					
Mean	36.4	41.5	27.6	30.9	15.0
Standard Deviation	30.1	23.2	25.5	31.3	
90% Confidence Interval	7.8	6.0	6.6	8.1	
Nmin[1]	194	88	243	291	
Basal Cover (%)					
Mean	3.2	2.7	3.4	2.0	None
Standard Deviation	3.9	1.4	6.8	3.0	
90% Confidence Interval	1.0	0.4	1.8	0.8	
Nmin[1]	409	78	1110	646	
Annual Forage Production (lbs/ac)[4]					
Mean	779	511	417	598	350
Standard Deviation	756	382	426	661	
90% Confidence Interval	197	99	111	172	
Nmin[1]	267	159	297	323	
Annual Total Production (lbs/ac)[5]					
Mean	1,201	525	430	670	None
Standard Deviation	835	386	427	661	
90% Confidence Interval	217	100	111	172	
Nmin[1]	137	154	297	277	
Shrub Density (stems/acre) from Quadrats					
Mean	7,789	5,160	8,195	4,553	None
Standard Deviation	11,820	6,979	21,384	13,783	
90% Confidence Interval	3,074	1,815	5,562	3,585	
Nmin[1]	654	519	1933	2602	
Shrub Density (stems/acre) from Belt Transect					
Mean	2,550	2,455	2,361	4,398	150
Standard Deviation	2,471	1,888	1,358	7,207	
90% Confidence Interval	1,285	982	707	3,749	
Nmin[1]	316	199	111	903	

Notes:

1 Minimum sample number to obtain 90% probability that the samples mean is within 10% of the population mean
2 Total canopy cover for all species
3 Mean canopy cover not including annuals or noxious weeds.
4 Annual forage production in air dry (lbs/ac) not including annuals or noxious weeds.
5 Total production in air dry (lbs/ac) including annuals or noxious weeds.
Hypothesis testing found the success standard was not met

Table 5: Results for Diversity, 2019 to 2022, M-VMU-3

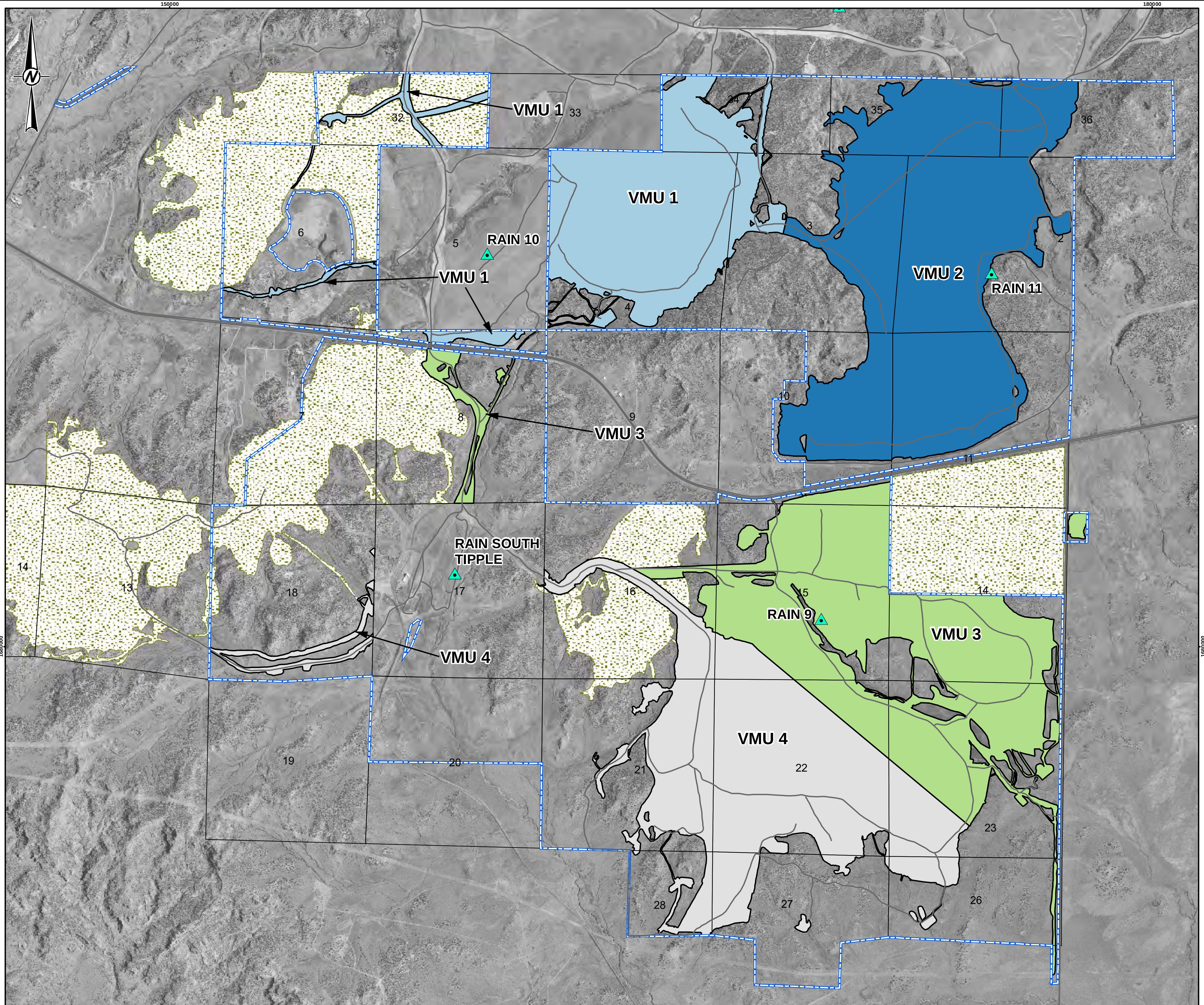
Diversity Component	Standard (% relative cover)	2019		2020		2021		2022	
		Result	Species	Result	Species	Result	Species	Result	Species
Subshrub or shrubs			**(6 spp.)**		**(10 spp.)**		**(5 spp.)**		**(2 spp.)**
Shrub 1	≥ 1.0%	21.44%	Four-wing saltbush	7.11%	Gardner saltbush	22.64%	Four-wing saltbush	9.62%	Four-wing saltbush
Shrub 2	≥ 1.0%	4.12%	Shadscale saltbush	5.63%	Four-wing saltbush	4.30%	Winterfat	2.68%	Winterfat
Shrub 3 (bonus)	--	0.43%	Mat saltbush	4.06%	Winterfat	1.21%	Mat saltbush	1.65%	Mormon tea
Perennial warm-season grasses			**(4 spp.)**		**(4 spp.)**		**(3 spp.)**		**(3 spp.)**
Grass 1	≥ 1.0%	22.89%	James' galleta	12.77%	James' galleta	32.09%	James' galleta	53.11%	James' galleta
Grass 2	≥ 1.0%	2.45%	Blue grama	0.93%	Alkali sacaton	3.29%	Alkalai sacaton	0.54%	Alkalai sacaton
Grass 3 (bonus)	--	0.21%	Alkali sacaton	0.53%	Purple threeawn	0.63%	Blue grama	--	--
Perennial cool-season grasses			**(8 spp.)**		**(11 spp.)**		**(5 spp.)**		**(2 spp.)**
Grass 1	≥ 1.0%	19.83%	Western wheatgrass	23.32%	Western wheatgrass	6.37%	Western wheatgrass	5.45%	Russian wildrye
Grass 2 (bonus)	--	1.28%	Tall wheatgrass	9.15%	Needle and thread	3.63%	Thickspike wheatgrass	3.33%	Western wheatgrass
Perennial/biennial forbs		**22.40%**	**(9 spp.)**	**1.17%**	**(6 spp.)**	**21.96%**	**(4 spp.)**	**26.67%**	**(10 spp.)**
Forb 1	≥ 1.0% combined	15.79%	Blazingstar species	0.52%	Bastardsage	21.16%	Rattlesnake weed	25.27%	Rattlesnake weed
Forb 2		3.62%	Flatspine stickseed	0.34%	Purple aster	0.76%	Scarlet globemallow	0.64%	Scarlet globemallow
Forb 3		2.47%	Flixweed	0.16%	Flatspine stickseed	0.04%	Flatspine stickseed	0.45%	Flatspine stickseed
Forb 4 (bonus)	--	0.52%	Palmer's penstemon	0.15%	Palmer's penstemon	--	--	0.31%	Trailing fleabane

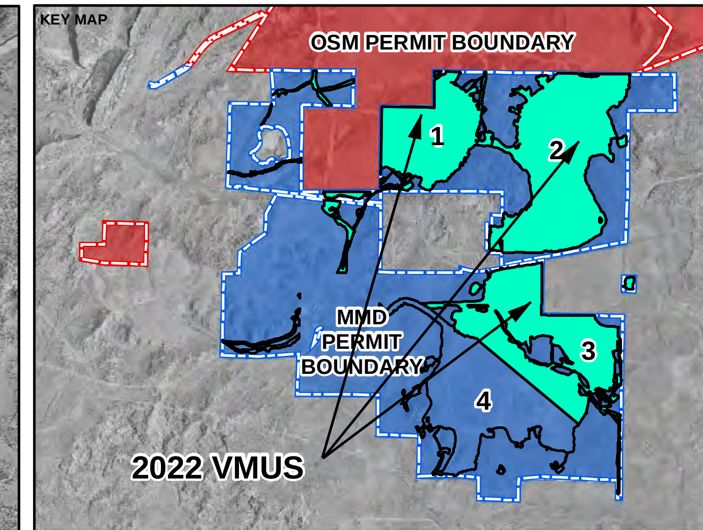
Notes:

-- = not applicable

Indicates an unmet parameter

Figures





LEGEND

- Rain Gauges
- Two-tracks, Roads and Highways
- MMD Permit Boundary
- PLSS - Sections
- Liability Release
- MMD VMU 1 (~ 839 acres)
- MMD VMU 2 (~ 1,518 acres)
- MMD VMU 3 (~ 1,284 acres)

0 3,000 6,000

1 inch = 3,000 feet FEET

NOTE(S)

1. VMU = VEGETATION MANAGEMENT UNIT FOR VEGETATION SAMPLING PLAN
2. VMU4 IS PENDING BOND RELEASE

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 - MMD PERMIT PHASE III BOND RELEASE,
2022 VEGETATION MONITORING SAMPLING PLAN

TITLE

GENERAL OVERVIEW OF THE MCKINLEY MMD PERMIT AREA VEGETATION MANAGEMENT UNITS (VMU), 2022

CONSULTANT

wsp

YYYY-MM-DD	2023-02-02
DESIGNED	GFD
PREPARED	AFS
REVIEWED	CD
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105209	B001	0	1

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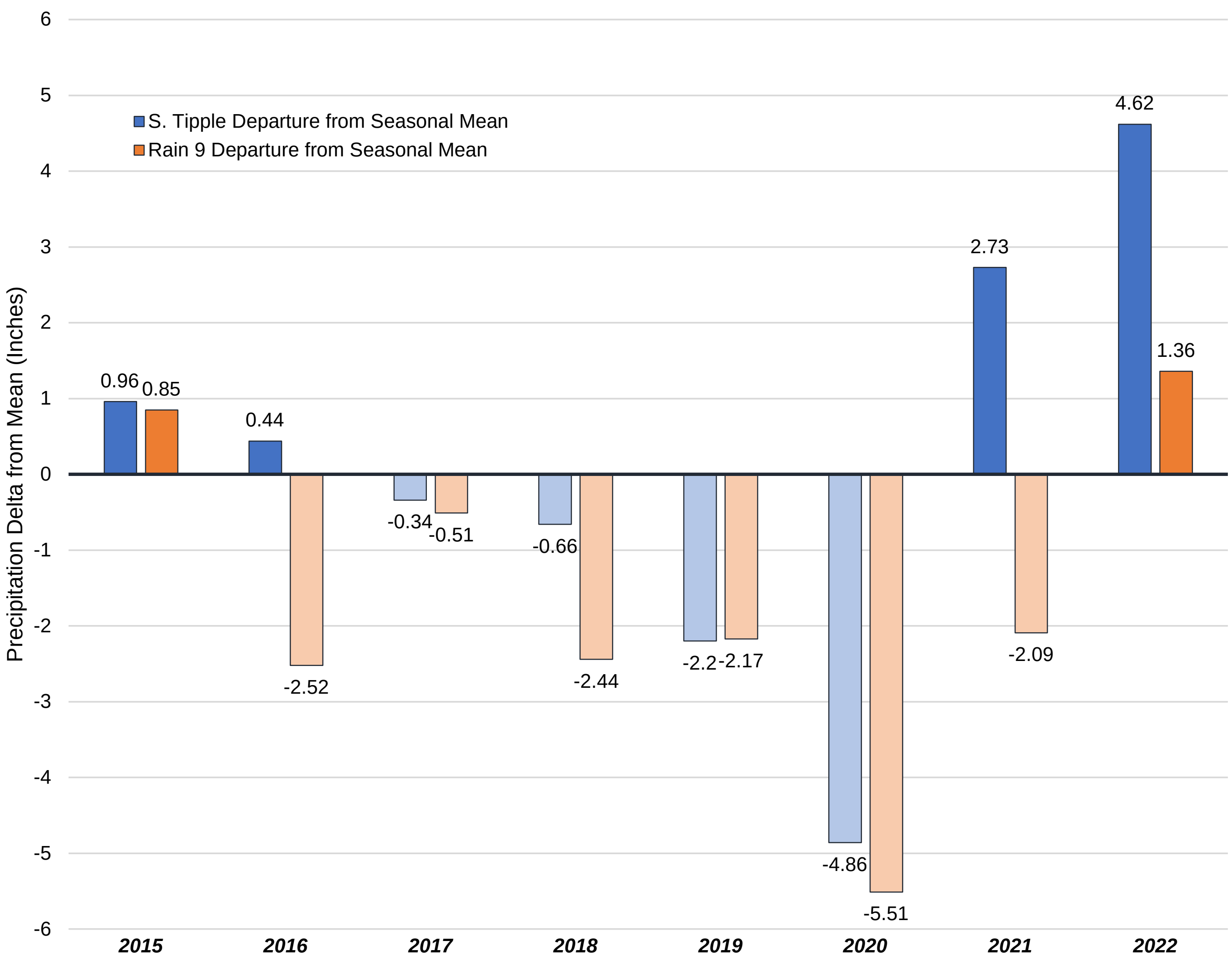
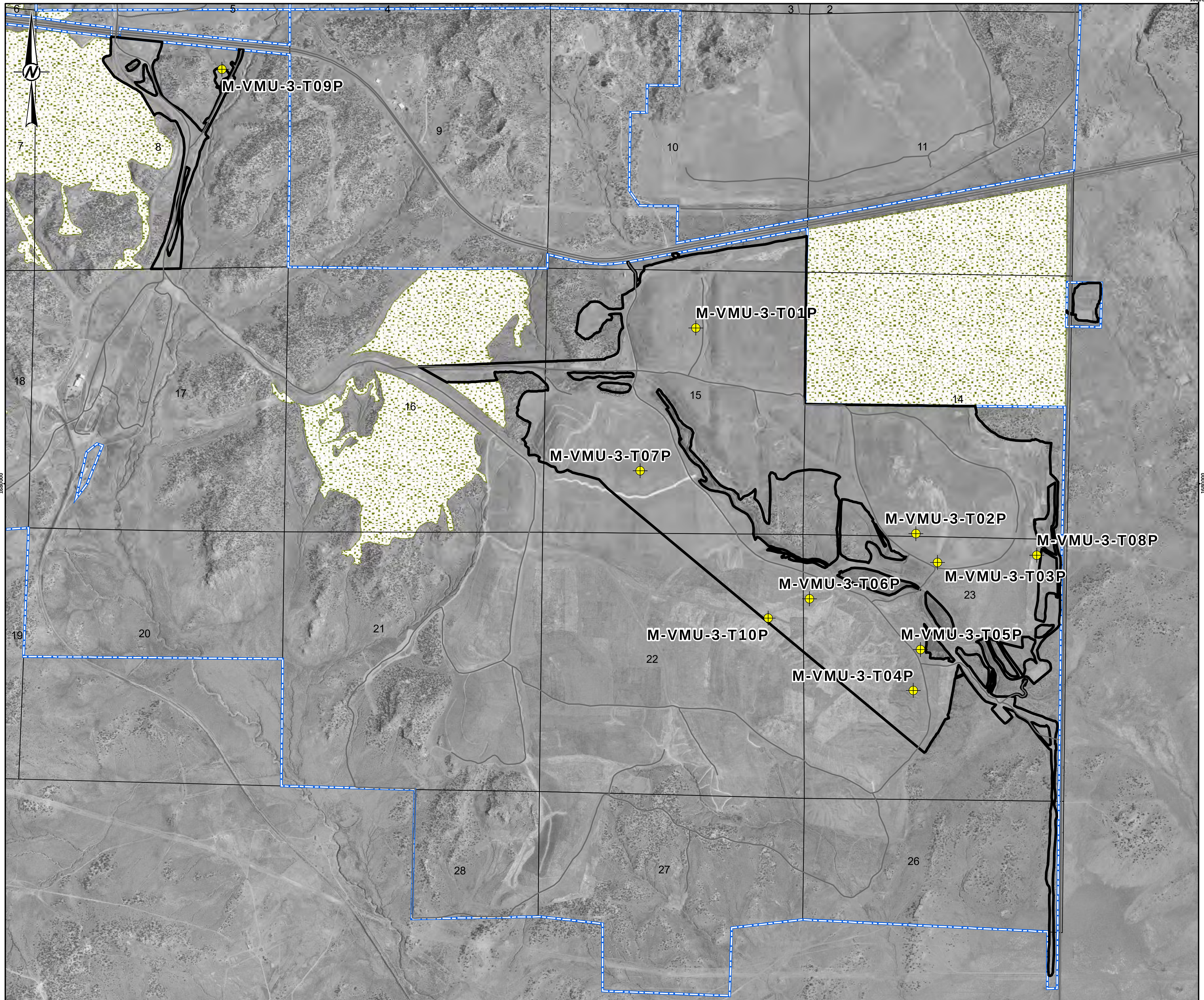
IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI B

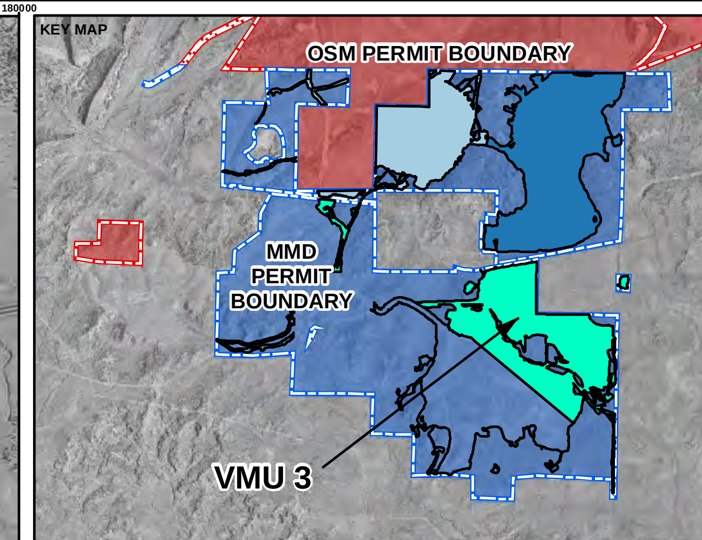
1 in

Figure 2: Departure of Growing Season Precipitation from Long-Term Seasonal Mean at South Tipple and Window Rock; Rain 9 Gauges



Notes:
Long-term averages are from Window Rock, Arizona Station (029410) for 1937 to 1999 (Western Regional Climate Center, 2020).
Growing season precipitation is between April and September





LEGEND

- Primary Transect
- Two-tracks, Roads and Highways
- PLSS - Sections
- MMD VMU 3 (~ 1,284 acres)
- Liability Release
- MMD Permit Boundary

TRANSECT LABEL EXPLANATION:

M-VMU-1-T1P

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

0 2,000 4,000

1 inch = 2,000 feet FEET

NOTE(S)

1. KEY MAP SCALE IS DIFFERENT FROM OVERVIEW OF VMUS
2. TRANSECT LOCATIONS WERE CREATED IN ACCORDANCE WITH 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 - MMD PERMIT PHASE III BOND RELEASE,
2022 VEGETATION MONITORING SAMPLING PLAN

TITLE
VEGETATION MONITORING TRANSECTS 2022,
VEGETATION MANAGEMENT UNIT 3

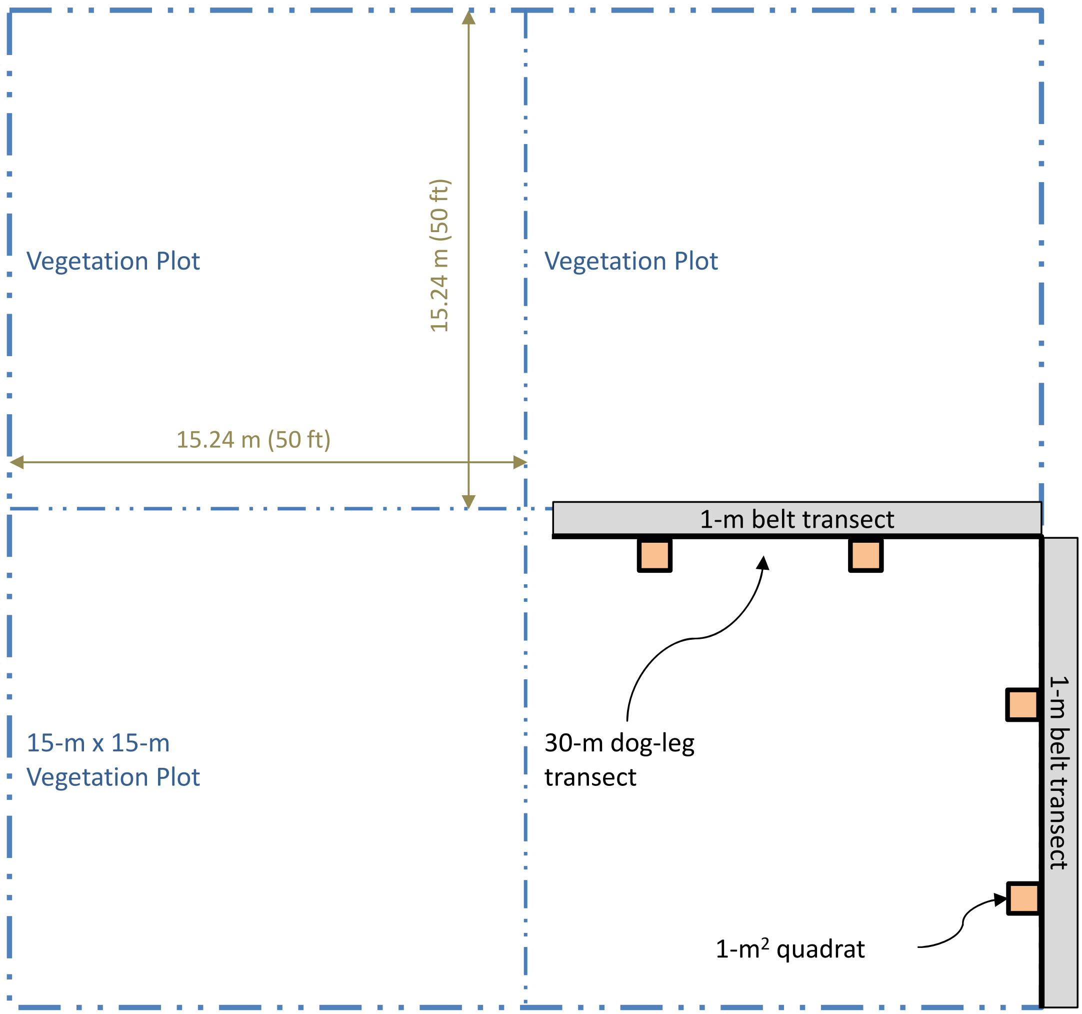
CONSULTANT

YYYY-MM-DD	2023-02-03
DESIGNED	GFD
PREPARED	AFS
REVIEWED	CD
APPROVED	DR

PROJECT NO.	CONTROL	REV.	FIGURE
133-8105209	B004	0	4

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

Figure 4: Vegetation Plot, Transect, and Quadrat Layout



not to scale

Figure 5: Typical Grass-Shrubland Vegetation in M-VMU-3, September 2022

Figure 6: Stabilization of the Mean for Perennial/Biennial Cover - M-VMU-3, 2022

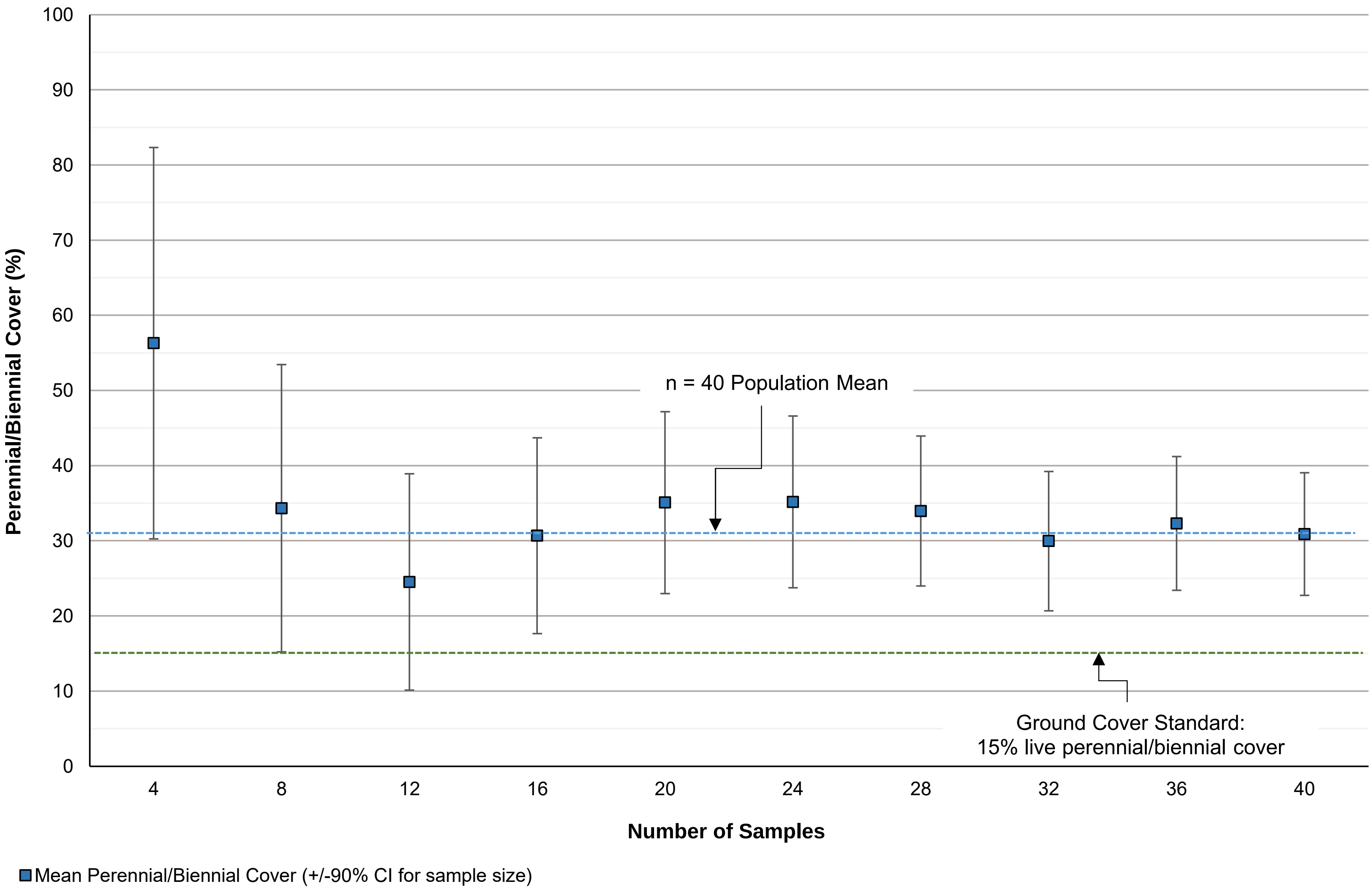


Figure 7: Stabilization of the Mean for Annual Forage Production - M-VMU-3, 2022

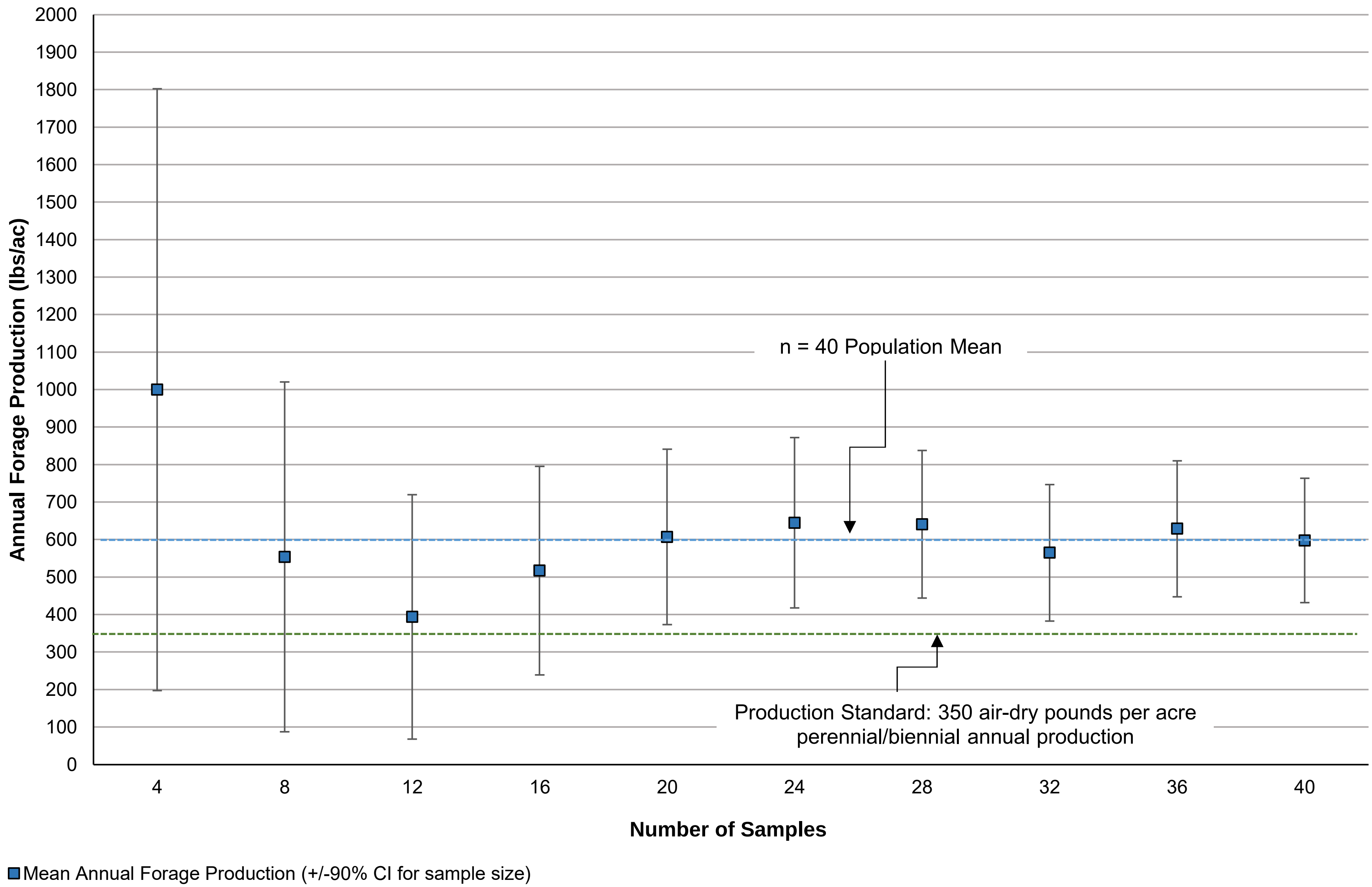
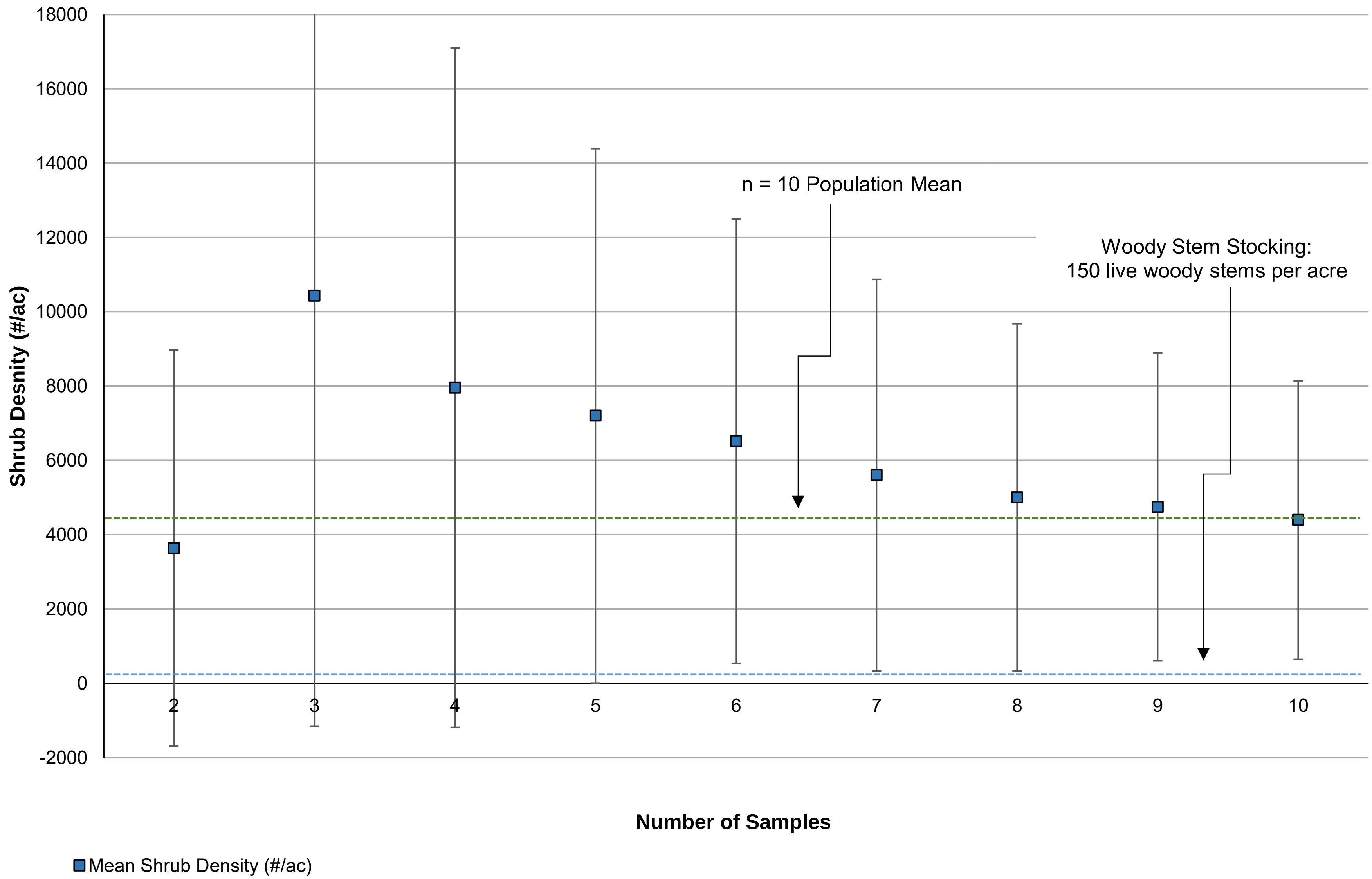


Figure 8: Stabilization of the Mean for Shrub Density - M-VMU-3, 2022



APPENDIX A

Vegetation Data Summary

Table A-1: M-VMU-3 Canopy Cover Data, 2022

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Grasses																																								
Perennials																																								
ACHY	--	--	--	4.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELLA3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.5	--	--	--	3.0	--	--	--	--	5.5	--	--	--	--	--	--	--	--	15.0	--	--	--	--	--	--	--
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PLJA	70.0	85.0	--	--	32.0	0.0	8.0	--	0.8	--	--	11.5	20.0	38.0	3.5	--	--	10.0	--	3.5	--	--	98.0	32.0	39.5	22.0	4.0	17.0	--	--	--	7.0	42.0	20.0	--	17.0	--	0.0	7.0	6.5
PSJU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0	--	--	--	--	--	--	--	--	24.0	--	--	--	--	--	23.0	10.0	--	--	--	--	--
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SATR	--	--	2.5	3.0	--	--	--	--	9.0	0.7	9.0	--	--	0.1	0.8	0.1	--	0.1	0.1	0.3	0.1	--	0.1	--	--	3.5	--	--	0.0	--	--	0.1	--	0.1	--	0.5	--	1.3	--	--
VEEN	1.5	--	0.1	1.3	--	--	--	--	--	--	--	--	23.0	3.0	20.0	8.0	6.5	0.5	25.0	1.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	--	1.3
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CHAL11	3.0	0.3	48.0	7.0	--	--	--	--	--	--	--	--	55.0	6.5	25.0	14.0	9.5	3.5	90.0	2.5	--	--	0.3	0.3	--	--	--	--	--	--	--	--	4.0	--	--	--	--	3.4	7.0	3.8
CHENOP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--	--	--	--	--	--	--	--
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Shrubs, Trees and Cacti																																								
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EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.5	17.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Cover Components																																								
Perennial/Biennial Vegetation Cover	75.3	85.3	50.6	14.2	34.0	3.5	12.0	0.0	0.8	0.0	0.8	18.0	96.1	44.5	31.0	25.0	48.5	33.0	105.0	24.5	6.0	0.0	98.8	37.8	39.5	22.3	4.0	41.0	0.1	0.0	0.0	7.2	61.0	85.0	26.0	17.1	0.0	23.4	14.0	34.3
Total Vegetation Cover	85.0	85.0	50.0	18.0	34.0	3.5	12.0	--	9.0	0.7	9.5	16.0	95.0	40.0	45.0	31.0	45.0	31.0	96.0	25.0	6.0	7.0	98.0	35.0	39.5	25.8	4.0	38.0	0.0	--	--	7.8	64.0	87.0	25.0	17.5	--	23.5	15.0	34.0
Rock	--	0.0	0.1	28.0	--	15.0	3.0	60.0	0.5	30.0	63.0	30.0	0.5	0.8	0.1	3.5	2.0	4.5	0.3	1.0	40.0	35.0	0.1	1.5	1.0	0.3	0.4	0.3	3.5	0.1	--	1.8	0.5	1.0	0.5	20.0	45.0	5.0	25.0	0.3
Litter	0.5	5.0	0.5	8.0	46.0	1.5	35.0	0.3	35.0	0.1	--	3.5	0.5	3.5	--	3.5	2.0	5.0	3.8	0.5	1.1	0.1	1.9	1.0	0.1	1.0	1.0	10.0	2.5	0.8	0.2	1.5	0.1	3.5	13.0	2.5	--	0.1	0.5	5.0
Base Soil	14.5	10.0	49.5	46.0	20.0	80.0	50.0	39.8	55.5	69.2	27.5	50.5	4.0	55.8	54.9	62.0	51.0	59.5	--	73.5	52.9	57.9	--	62.5	59.4	73.0	94.7	51.8	94.0	99.2	99.8	89.0	35.4	8.5	61.5	60.0	55.0	71.4	59.5	60.8

Notes:
Species codes defined in Table A-6

Table A-2: M-VMU-3 Basal Cover Data, 2022

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Perennials																																								
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PASM	--	--	0.0	--	--	--	--	--	--	--	--	--	--	--	--	0.5	1.0	--	--	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.8
PLJA	4.0	15.0	--	--	0.3	0.0	0.8	--	0.0	--	--	0.5	--	4.5	0.3	--	--	0.5	--	0.3	--	--	10.0	4.0	3.5	3.0	0.5	2.5	--	--	--	0.5	4.0	2.0	--	1.3	--	0.0	0.3	0.3
PSJU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--	--	--	--	--	--	3.0	--	--	--	--	--	2.5	0.1	--	--	--	--	--
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SATR	--	--	0.1	0.3	--	--	--	--	0.9	0.0	0.2	--	--	0.0	0.1	0.0	--	0.0	0.0	0.1	0.0	--	0.0	--	--	0.1	--	--	0.0	--	--	0.0	--	0.0	--	0.1	--	0.0	--	--
VEEN	0.2	--	0.0	0.1	--	--	--	--	--	--	--	--	0.2	0.3	0.1	0.5	0.1	0.1	0.2	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.0	--	0.1
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CHAL11	0.0	0.0	0.2	0.1	--	--	--	--	--	--	--	--	0.4	0.2	0.1	0.3	0.4	0.1	0.3	0.1	--	--	0.0	0.1	--	--	--	--	--	--	--	--	0.1	--	--	--	--	0.1	0.0	0.1
SPCO	0.0	--	0.1	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	0.1	0.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Cover Components																																								
Perennial/Biennial Vegetation Cover	4.4	15.0	0.3	0.8	0.4	0.3	0.9	--	0.9	0.0	0.2	1.3	0.7	4.9	0.7	1.5	2.9	1.4	1.3	0.7	0.1	0.2	10.1	4.8	3.5	3.1	0.5	5.5	0.0	--	--	0.6	4.5	5.2	0.1	1.3	--	0.6	0.3	1.4
Total Vegetation Cover	4.4	15.0	0.3	0.8	0.4	0.3	0.9	--	0.9	0.0	0.2	1.3	0.7	4.9	0.7	1.5	2.9	1.4	1.3	0.7	0.1	0.2	10.1	4.8	3.5	3.1	0.5	5.5	0.0	--	--	0.6	4.5	5.2	0.1	1.3	--	0.6	0.3	1.4
Rock	--	0.3	0.5	32.0	5.0	15.3	11.0	60.0	0.5	31.0	70.0	34.0	0.5	1.0	0.8	4.5	3.0	5.5	1.0	1.0	45.0	45.0	0.1	1.8	2.0	1.0	0.4	0.5	3.5	5.0	2.0	2.0	1.1	2.0	4.0	23.5	45.0	5.5	27.5	0.5
Litter	48.0	44.0	3.0	3.0	55.0	0.8	8.0	0.3	45.0	0.1	1.0	2.5	6.0	3.0	7.0	2.5	14.0	3.5	8.0	2.0	1.7	1.1	25.0	1.5	8.5	2.0	4.0	5.0	2.5	0.2	0.0	1.0	15.1	9.0	21.0	1.5	--	5.1	5.0	2.5
Base Soil	47.6	40.7	96.2	64.2	39.6	83.7	80.1	39.8	53.6	68.9	28.9	62.3	92.8	91.1	91.6	91.5	80.1	89.6	89.7	96.3	53.2	53.7	64.8	92.0	86.0	93.9	95.2	89.0	94.0	94.9	98.0	96.4	79.3	83.8	74.9	73.7	55.0	88.8	67.2	95.6

Notes:
Species codes defined in Table A-6

Table A-3: M-VMU-3 Frequency Data (counts), 2022

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P				M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																																								
Perennials																																								
ERPE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
ACHY	--	--	--	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELLA3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	3	--	--	--	--	16	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--
ELTR7	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--	9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	--	1	--	--	--	--	--	--	--	9	--	--	--	--	11	10	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	50
PLJA	40	157	--	--	20	1	18	--	5	--	--	14	10	68	9	--	--	16	--	8	--	--	174	42	28	88	33	40	--	--	--	19	40	65	--	26	--	3	14	15
PSJU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--	--	21	--	--	--	--	--	89	17	--	--	--	--	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	8	--	--	--	--	--	1	--	--	--	--	--	2	--	--	--	--	--	--	--	--	--	--	--
Forbs																																								
Annual																																								
AMRE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--
CHLE4	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHSE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POOL	30	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5	--	--	--	--	--	--	--
SATR	--	--	5	5	--	--	--	--	22	2	44	--	--	2	6	1	--	2	3	3	3	--	1	--	--	1	--	--	1	--	--	1	--	1	--	1	--	2	--	--
VEEN	3	--	1	1	--	--	--	--	--	--	--	--	17	6	10	17	11	1	9	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	3
Perennials																																								
ERCI6	2	--	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LAOC3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	284	--	--	--	5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TRDU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BORAG	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4	--	3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
CHENOP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
UNKFORB	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
SOLAN	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	24	--
ERFL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
CANU4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3	--	--	--	--	--	--	--
ACRE3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	7	9	--	--	--	--	--	--
CHAL11	8	6	214	60	--	--	--	--	--	--	--	--	38	70	175	95	48	31	290	10	--	--	6	4	--	--	--	--	--	--	--	--	6	--	--	--	--	11	82	31
SPCO	1	--	9	2	--	--	--	--	--	--	--	--	--	--	--	--	--	4	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPGR2	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	3	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1	--	--	5	--	--
Shrubs, Trees and Cacti																																								
Perennials																																								
ATCA	--	--	--	--	1	1	--	--	--	--	--	--	1	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	2	--	21	1	1	--	2	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
KRLA	--	--	--	--	3	--	1	--	--	--	--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OPPO	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
Species codes defined in Table A-6

Table A-4: M-VMU-2 Air-dry Aboveground Annual Production Data (g/m^2), 2022

Transect	M-VMU-3-T01P				M-VMU-3-T02P				M-VMU-3-T03P				M-VMU-3-T04P				M-VMU-3-T05P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																				
Perennials																				
ERPE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ACHY	--	--	--	8.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.1	--	--	--	--	--
ELLA3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.0	--	--	--	6.3	--
ELTR7	--	--	--	1.6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	--	--	--	--	--	--	--	5.5	--	--	--	5.2	--	--	--	--
PASM	--	--	0.4	--	--	--	--	--	--	--	0.5	--	--	--	--	21.9	12.0	--	--	1.3
PLJA	229.1	178.4	--	--	0.0	0.4	20.4	--	1.0	--	--	25.6	71.3	142.5	4.8	--	--	16.3	--	10.8
PSJU3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	5.0	--
SPAI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	9.9	--	--	--
Forbs																				
Annual																				
AMRE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHLE4	--	--	--	--	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHSE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POOL	8.1	--	--	0.5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SATR	--	--	7.2	7.3	--	--	--	--	12.8	1.0	46.0	--	--	0.7	1.4	0.3	--	0.9	2.7	0.0
VEEN	5.5	--	0.9	2.0	--	--	--	--	--	--	--	--	0.0	8.6	38.7	25.8	24.7	1.0	25.0	3.0
Perennials																				
ERCI6	1.0	--	--	2.4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LAOC3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	13.9	--
TRDU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BORAG	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHENOP	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SOLAN	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERFL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CANU4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ACRE3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHAL11	1.8	0.2	15.2	6.5	--	--	--	--	--	--	--	--	25.9	17.2	30.7	21.6	13.0	9.7	52.7	1.6
SPCO	0.4	--	5.9	0.4	--	--	--	--	--	--	--	--	--	--	--	--	--	6.5	5.7	--
SPGR2	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--	--	1.5	--	--
Shrubs, Trees and Cacti																				
Perennials																				
ATCA	--	--	--	--	2	8	--	--	--	--	--	--	50	--	--	--	--	--	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	6	81	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	77
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA	--	--	--	--	3	--	16	--	--	--	--	--	--	--	--	--	103	--	--	--
OPPO	0	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Air-dry Aboveground Annual Production (g/m2)																				
Non-forage	15	--	8	12	--	--	--	--	13	--	46	--	--	9	40	26	25	2	28	3
Forage	231	179	22	17	5	8	36	--	1	--	--	31	148	160	42	49	144	115	84	91
Total Production	246	179	30	29	5	8	36	--	14	1	46	31	148	169	82	75	169	117	112	94
Total Air-dry Aboveground Annual Production (lbs/ac)																				
Non-forage	131	--	72	108	--	--	--	--	114	--	410	--	--	84	358	233	220	18	247	31
Forage	2063	1593	192	152	41	71	321	--	9	--	4	278	1320	1425	372	435	1286	1025	750	811
Total Production	2194	1593	264	260	41	71	321	--	123	9	415	278	1320	1508	729	668	1506	1043	997	842

Transect	M-VMU-3-T06P				M-VMU-3-T07P				M-VMU-3-T08P				M-VMU-3-T09P				M-VMU-3-T10P			
Quadrat	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Grasses																				
Perennials																				
ERPE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.7	--	--	--	--	--
ACHY	--	--	--	--	--	0.0	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ARPU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ELLA3	--	--	--	17.3	--	--	--	--	--	--	--	--	17.1	--	--	--	--	--	--	--
ELTR7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
HECO26	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
PASM	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	40.0
PLJA	--	--	230.1	100.7	107.4	70.9	19.1	52.9	--	--	--	13.5	155.9	51.6	--	70.5	--	1.3	13.7	14.8
PSJU3	--	5.2	--	--	--	--	--	25.1	--	--	--	--	--	39.2	8.8	--	--	--	--	--
SPAI	--	--	0.5	--	--	--	--	--	0.7	--	--	--	--	--	--	--	--	--	--	--
Forbs																				
Annual																				
AMRE	--	--	--	--	--	--	--	--	--	--	--	--	--	3.1	--	--	--	--	--	--
CHLE4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHSE	--	5.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
POOL	--	--	--	--	--	--	--	--	--	--	--	--	1.1	--	--	--	--	--	--	--
SATR	1.0	--	0.1	--	--	33.3	--	--	0.0	--	--	0.6	--	0.0	--	1.4	--	3.2	--	--
VEEN	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.4	--	2.5
Perennials																				
ERCI6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
LAOC3	--	--	0.8	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
TRDU	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BORAG	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
CHENOP	--	--	--	--	--	--	--	--	--	--	--	1.0	--	--	--	--	--	--	--	--
SOLAN	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.4	--
ERFL	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.5	--	4.1
CANU4	--	--	--	--	--	--	--	--	--	--	--	--	4.3	--	--	--	--	--	--	--
ACRE3	--	--	--	--	--	--	--	--	--	--	--	--	21.3	13.5	--	--	--	--	--	--
CHAL11	--	--	0.5	0.4	--	--	--	--	--	--	--	--	2.4	--	--	--	--	2.4	8.5	2.7
SPCO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
SPGR2	--	--	--	--	0.3	--	--	--	--	--	--	--	--	--	--	--	--	1.7	--	--
Shrubs, Trees and Cacti																				
Perennials																				
ATCA	18	--	--	--	--	--	--	--	--	--	--	--	--	140	25	--	--	52	--	--
EPVI	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ERNA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
GUSA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
KRLA	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
OPPO	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Air-dry Aboveground Annual Production (g/m2)																				
Non-forage	1	5	--	--	--	33	--	--	--	--	--	1	27	17	--	1	--	4	2	3
Forage	18	5	232	118	108	71	19	78	1	--	--	15	175	231	35	70	--	58	22	62
Total Production	19	10	232	118	108	104	19	78	1	--	--	15	202	247	35	72	--	61	25	65
Total Air-dry Aboveground Annual Production (lbs/ac)																				
Non-forage	9	46	1	--	--	297	--	--	--	--	--	6	238	148	--	12	--	32	22	26
Forage	164	46	2069	1057	961	633	170	696	6	--	--	131	1565	2060	312	629	--	514	198	552
Total Production	173	92	2070	1057	961	930	170	696	6	--	--	137	1803	2208	312	641	--	546	220	578

Notes:

g/m^2 = grams per square meter

lbs/ac = pounds per acre

1 gram per square meter (g/m^2) is equal to 8.922 pounds per acre (lbs/ac)

Species codes defined in Table A-6

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-5: M-VMU-3 Shrub Belt Transect Data, 2022

Transect	M-VMU-3-T01P	M-VMU-3-T02P	M-VMU-3-T03P	M-VMU-3-T04P	M-VMU-3-T05P	M-VMU-3-T06P	M-VMU-3-T07P	M-VMU-3-T08P	M-VMU-3-T09P	M-VMU-3-T10P
Shrubs, Trees and Cacti										
ARTR2	--	--	--	--	--	--	--	--	--	1
ATCA2	2	5	5	4	--	10	1	--	20	3
ATCO	--	--	162	--	4	--	--	--	--	1
ATCO4	--	--	3	--	--	--	--	1	--	--
EPVI	--	--	--	--	1	--	--	--	--	1
ERNA	--	--	--	--	2	--	--	5	--	3
GUSA2	--	1	--	--	--	2	--	--	--	41
KRLA2	--	3	8	--	24	11	--	--	--	--
PUME	--	--	--	--	--	--	--	--	--	1
PUTR2	1	--	--	--	--	--	--	--	--	--

Code	Scientific Name	Common Name
ARTR2	*Artemisia tridentata*	Big sagebrush
ATCA2	*Atriplex canescens*	Fourwing saltbush
ATCO	*Atriplex confertifolia*	Shadscale saltbush
ATCO4	*Atriplex corrugata*	Mat saltbush
EPVI	*Ephedra viridis*	Mormon tea
ERNA	*Ericameria nauseosa*	Rubber rabbitbrush
GUSA2	*Gutierrezia sarothrae*	Broom snakeweed
KRLA2	*Krascheninnikovia lanata*	Winterfat
PUME	*Purshia mexicana*	Mexican cliffrose
PUTR2	*Purshia tridentata*	Antelope bitterbrush

Table A-6 : Species Observed 2019-2022, M-VMU-3

Common Name	Scientific Name	Code
Cool-Season Grasses (20)		
Annuals (2)		
Field brome	*Bromus arvensis*	BRAR5
Cheatgrass	*Bromus tectorum*	BRTE
Perennials (18)		
Indian ricegrass	*Achnatherum hymenoides*	ACHY
Crested wheatgrass	*Agropyron cristatum*	AGCR
Purple threeawn	*Aristida purpurea*	ARPU
Smooth brome	*Bromus inermis*	BRIN2
Canada wildrye	*Elymus canadensis*	ELCA4
Bottlebrush squirreltail	*Elymus elymoides*	ELEL
Thickspike wheatgrass	*Elymus lanceolatus*	ELLA3
Slender wheatgrass	*Elymus trachycaulus*	ELTR7
Tufted lovegrass	*Eragrostis pectinacea*	ERPE
Needle and thread	*Hesperostipa comata*	HECO26
Foxtail barley	*Hordeum jubatum*	HOJU
Colorado wildrye	*Leymus ambiguus*	LEAM
Western wheatgrass	*Pascopyrum smithii*	PASM
Russian wildrye	*Psathyrostachys juncea*	PSJU3
Bluebunch wheatgrass	*Pseudoroegneria spicata*	PSSP6
Alkali sacaton	*Sporobolus airoides*	SPAI
Intermediate wheatgrass	*Thinopyrum intermedium*	THIN6
Tall wheatgrass	*Thinopyrum ponticum*	THPO7
Warm-Season Grasses (6)		
Perennials (6)		
Sideoats grama	*Bouteloua curtipendula*	BOCU
Blue grama	*Bouteloua gracilis*	BOGR2
Hairy grama	*Bouteloua hirusta*	BOHI2
James' galleta	*Pleuraphis jamesii*	PLJA
Alkali sacaton	*Sporobolus airoides*	SPAI
Sand dropseed	*Sporobolus cryptandrus*	SPCR
Forbs (41)		
Annuals (18)		
Desert madwort	*Alyssum desertorum*	ALDE
Unknown pigweed species	*Amaranthus* species	AMARA
Redroot amaranth	*Amaranthus retroflexus*	AMRE
Mealy goosefoot	*Chenopodium incanum*	CHIN2
Narrowleaf goosefoot	*Chenopodium leptophyllum*	CHLE4
Lambsquarters	*Chenopodium album*	CHAL7
Thymeleaf spurge	*Chamaesyce serpyllifolia*	CHSE
Nodding buckwheat	*Eriogonum cernuum*	ERCE2

Common sunflower	*Helianthus annuus*	HEAN3
Longleaf false goldeneye	*Heliomeris longifolia*	HELO6
Kochia	*Kochia scoparia*	KOSC
Fendler's desertdandelion	*Malacothrix fendleri*	MAFE
Erect knotweed	*Polygonum erectum*	POER2
Little hogweed	*Portulaca oleracea*	POOL
Russian thistle	*Salsola tragus*	SATR
Unknown annual forb	Unknown Annual Forb	UNKAF
Cowpen daisy	*Verbesena encelioides*	VEEN
Rough cocklebur	*Xanthium strumarium*	XAST
Perennials/Biennials (33)		
Common yarrow	*Achillea millefolium*	ACMI2
Russian knapweed	*Acroptilon repens*	ACRE3
Borage Species	*Boraginaceae species*	BORAG
Musk thistle	*Carduus nutans*	CANU4
Rattlesnake weed	*Chamaesyce albomarginata*	CHAL11
Rose heath	*Chaetopappa ericoides*	CHER
Chenopod Species	*Chenopodaceae species*	CHENOP
Horseweed	*Conyza canadensis*	COCA
Flixweed	*Descurainia sophia*	DESO
Redstem stork's bill	*Erodium cicutarium*	ERCI6
Trailing fleabane	*Erigeron flagellaris*	ERFL
Bastardsage	*Eriogonum wrightii*	ERWR
Curlytop gumweed	*Grindelia nuda var. aphanactis*	GRNUA
Curly-cup gumweed	*Grindelia squarosa*	GRSQ
Prickly lettuce	*Lactuca serriola*	LASE
Flatspine stickseed	*Lappula occidentalis*	LAOC3
Lewis flax	*Linum lewisii*	LILE
Purple aster	*Machaeranthera canescens*	MACA
Tanseyleaf tansyaster	*Machaeranthera tanacetifolia*	MATA
Yellow sweetclover	*Melilotus officinalis*	MEOF
Prarie false dandelion	*Nothocalais cuspidata*	NOCU
Palmer's penstemon	*Penstemon palmeri*	PEPA8
Prostrate knotweed	*Polygonum aviculare*	POAV
Upright prairie coneflower	*Ratibida columnifera*	RACO3
Curly dock	*Rumex crispus*	RUCR
Tall tumblemustard	*Sisymbrium altissimum*	SIAL2
Nightshade species	*Solanaceae species*	SOLAN
Scarlet globemallow	*Sphaeralcea coccinea*	SPCO
Emory's globemallow	*Sphaeralcea emoryi*	SPEM
Gooseberryleaf globemallow	*Sphaeralcea grossulariifolia*	SPGR2
Yellow salsify	*Tragopogon dubius*	TRDU
Unknown forb species	Various	UNKFORB
Narrowleaf cattail	*Typha angustifolia*	TYAN

Shrubs, Trees and Cacti (27)		
Perennials (27)		
Prairie sagewort	*Artemisia frigida*	ARFR4
Big sagebrush	*Artemisia tridentata*	ARTR2
Tubercled saltbush	*Atriplex acanthocarpa*	ATAC
Four-wing saltbush	*Atriplex canescens*	ATCA
Shadscale saltbush	*Atriplex confertifolia*	ATCO
Mat saltbush	*Atriplex corrugata*	ATCO4
Gardner's saltbush	*Atriplex gardneri*	ATGA
Mound saltbush	*Atriplex obovata*	ATOB
Basin saltbush	*Atriplex tridentata*	ATTR3
Longleaf jointfir	*Ephedra trifurca*	EPTR
Mormon tea	*Ephedra viridis*	EPVI
Rubber rabbitbrush	*Ericameria nauseosa*	ERNA
Slenderleaf buckwheat	*Eriogonum leptophyllum*	ERLE10
Broom snakeweed	*Gutierrezia sarothrae*	GUSA
Hairy false goldenaster	*Heterotheca villosa*	HEVI
Winterfat	*Krascheninnikovia lanata*	KRLA
Plains pricklypear	*Opuntia polyacantha*	OPPO
Piñon pine	*Pinus edulis*	PIED
Cottonwood	*Populus deltoides*	PODE
Mexican cliffrose	*Purshia mexicana*	PUME
Antelope bitterbrush	*Purshia tridentata*	PUTR2
Narrowleaf willow	*Salix exigua*	SAEX
Greasewood	*Sarcobatus vermiculatus*	SAVE4
Threadleaf groundsel	*Senecio flaccidus*	SEFL3
Saltcedar	*Tamarix ramosissima*	TARA
Gray horsebrush	*Tetradymia canescens*	TECA
Siberian elm	*Ulmus pumila*	ULPU

APPENDIX B

Quadrat Photographs


M-VMU-3-T01P Q-1	M-VMU-3-T01P Q-2


M-VMU-3-T01P Q-3	M-VMU-3-T01P Q-4


M-VMU-3-T02P Q-1	M-VMU-3-T02P Q-2


M-VMU-3-T02P Q-3	M-VMU-3-T02P Q-4

M-VMU-3-T03P Q-1

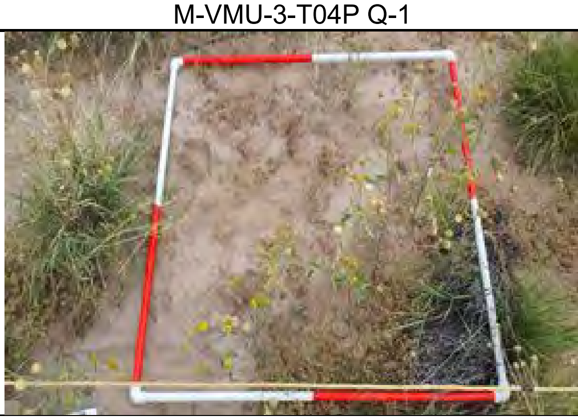
M-VMU-3-T03P Q-2

M-VMU-3-T03P Q-3

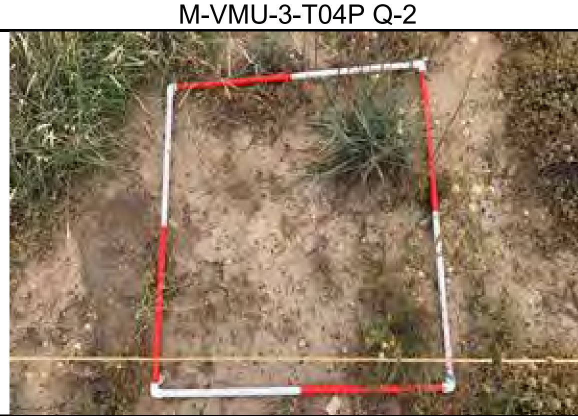
M-VMU-3-T03P Q-4

M-VMU-3-T04P Q-1

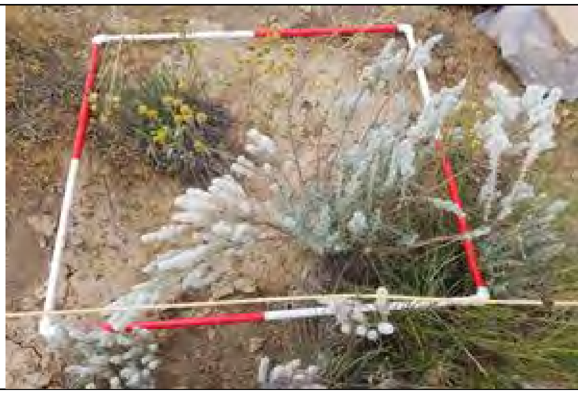
M-VMU-3-T04P Q-2



M-VMU-3-T04P Q-3



M-VMU-3-T04P Q-4



M-VMU-3-T05P Q-1

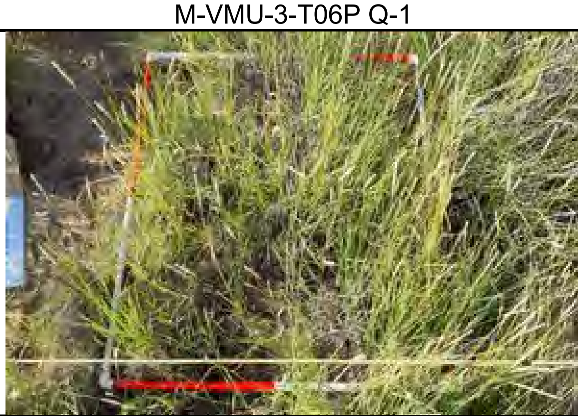
M-VMU-3-T05P Q-2

M-VMU-3-T05P Q-3

M-VMU-3-T05P Q-4

M-VMU-3-T06P Q-1

M-VMU-3-T06P Q-2



M-VMU-3-T06P Q-3

M-VMU-3-T06P Q-4

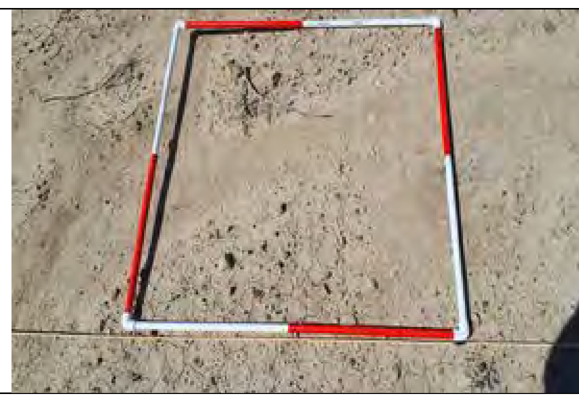

M-VMU-3-T07P Q-1


M-VMU-3-T07P Q-2


M-VMU-3-T07P Q-3


M-VMU-3-T07P Q-4


M-VMU-3-T08P Q-1


M-VMU-3-T08P Q-2


M-VMU-3-T08P Q-3


M-VMU-3-T08P Q-4

M-VMU-3-T09P Q-1

M-VMU-3-T09P Q-2

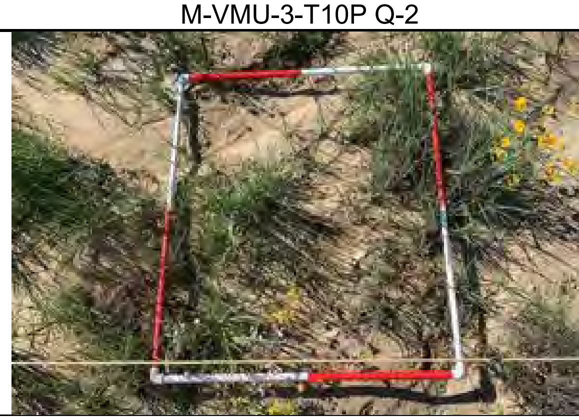
M-VMU-3-T09P Q-3

M-VMU-3-T09P Q-4

M-VMU-3-T10P Q-1

M-VMU-3-T10P Q-2

M-VMU-3-T10P Q-3



M-VMU-3-T10P Q-4

APPENDIX C

Vegetation Statistical Analysis

Table C-1: M-VMU-3 2022 Data for Normal Distribution and Variance Analysis

Transect	Quadrat	Perennial/ Biennial Cover (%)	Annual Forage Production (lbs/ac)	Woody Plant Density (#/ac)	Log P/B Cover	Log AFP	Log WPD
M-VMU-3-T01	1	75	2063	405	1.88	3.31	2.61
	2	85	1593		1.94	3.20	
	3	51	192		1.71	2.29	
	4	14	152		1.18	2.18	
M-VMU-3-T02P	1	34	41	1214	1.54	1.62	3.08
	2	4	71		0.66	1.86	
	3	12	321		1.11	2.51	
	4	0	0		0.00	0.00	
M-VMU-3-T03P	1	1	9	24011	0.26	1.01	4.38
	2	0	0		0.00	0.00	
	3	1	4		0.24	0.74	
	4	18	278		1.28	2.45	
M-VMU-3-T04P	1	96	1320	540	1.99	3.12	2.73
	2	45	1425		1.66	3.15	
	3	31	372		1.51	2.57	
	4	25	435		1.41	2.64	
M-VMU-3-T05P	1	49	1286	4182	1.69	3.11	3.62
	2	33	1025		1.53	3.01	
	3	105	750		2.03	2.88	
	4	25	811		1.41	2.91	
M-VMU-3-T06P	1	6	164	3103	0.85	2.22	3.49
	2	0	46		0.00	1.68	
	3	99	2069		2.00	3.32	
	4	38	1057		1.59	3.02	
M-VMU-3-T07P	1	40	961	135	1.61	2.98	2.13
	2	22	633		1.37	2.80	
	3	4	170		0.70	2.23	
	4	41	696		1.62	2.84	
M-VMU-3-T08P	1	0	6	809	0.02	0.84	2.91
	2	0	0		0.00	0.00	
	3	0	0		0.00	0.00	
	4	8	131		0.94	2.12	
M-VMU-3-T09P	1	70	1565	2698	1.85	3.19	3.43
	2	92	2060		1.97	3.31	
	3	26	312		1.43	2.50	
	4	17	629		1.26	2.80	
M-VMU-3-T10P	1	0	0	6880	0.00	0.00	3.84
	2	23	514		1.39	2.71	
	3	15	198		1.20	2.30	
	4	34	552		1.55	2.74	
Mean		30.9	597.7	4398	1.16	2.20	3.22
Standard Deviation		31.3	637.5	7207	0.69	1.06	0.66
Count		40	40	10	40	40	10
Variance		980	406361	51942423.4	0.47	1.12	0.44
90% Confidence Interval		8.1	165.8	3748.8	0.18	0.28	0.34

Notes:
2022 Data are found in Appendix A

Table C-2: 2022 Perennial/ Biennial Canopy Cover, Method 5 - CMRP

Transect	Quadrat	2022 Perennial / Biennial Cover (%)	90% of Technical Standard	P/B CVR minus TS
M-VMU-3-T01	1	75.3	13.5	61.8
	2	85.3	13.5	71.8
	3	50.6	13.5	37.1
	4	14.2	13.5	0.7
M-VMU-3-T02P	1	34.0	13.5	20.5
	2	3.5	13.5	-10.0
	3	12.0	13.5	-1.5
	4	0.0	13.5	-13.5
M-VMU-3-T03P	1	0.8	13.5	-12.7
	2	0.0	13.5	-13.5
	3	0.8	13.5	-12.8
	4	18.0	13.5	4.5
M-VMU-3-T04P	1	96.1	13.5	82.6
	2	44.5	13.5	31.0
	3	31.0	13.5	17.5
	4	25.0	13.5	11.5
M-VMU-3-T05P	1	48.5	13.5	35.0
	2	33.1	13.5	19.6
	3	105.0	13.5	91.5
	4	24.6	13.5	11.1
M-VMU-3-T06P	1	6.0	13.5	-7.5
	2	0.0	13.5	-13.5
	3	98.8	13.5	85.3
	4	37.8	13.5	24.3
M-VMU-3-T07P	1	39.5	13.5	26.0
	2	22.3	13.5	8.8
	3	4.0	13.5	-9.5
	4	41.0	13.5	27.5
M-VMU-3-T08P	1	0.1	13.5	-13.5
	2	0.0	13.5	-13.5
	3	0.0	13.5	-13.5
	4	7.7	13.5	-5.9
M-VMU-3-T09P	1	69.5	13.5	56.0
	2	92.0	13.5	78.5
	3	26.0	13.5	12.5
	4	17.1	13.5	3.6
M-VMU-3-T10P	1	0.0	13.5	-13.5
	2	23.4	13.5	9.9
	3	15.0	13.5	1.5
	4	34.3	13.5	20.8
			k	14
			n	40
			z	-1.74
Standard one-tailed normal curve area (Table C-3; MMD, 1999)				0.4591
			P	0.0409

Notes:
P/B CVR = Perennial/Biennial Cover
TS = 90% of the Technical Standard for Perennial/Biennial Cover
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-3: 2022 Annual Forage Production, Method 5 - CMRP

Transect	Quadrat	2022 Annual Forage Production (lbs/ac)	90% of Technical Standard	FP minus TS
M-VMU-3-T01	1	2063	315	1748.2
	2	1593	315	1278.3
	3	192	315	-123.2
	4	152	315	-163.2
M-VMU-3-T02P	1	41	315	-274.4
	2	71	315	-243.8
	3	321	315	6.0
	4	0	315	-315.0
M-VMU-3-T03P	1	9	315	-305.8
	2	0	315	-315.0
	3	4	315	-310.5
	4	278	315	-37.1
M-VMU-3-T04P	1	1320	315	1004.7
	2	1425	315	1109.7
	3	372	315	56.5
	4	435	315	119.8
M-VMU-3-T05P	1	1286	315	971.0
	2	1025	315	709.8
	3	750	315	435.1
	4	811	315	496.4
M-VMU-3-T06P	1	164	315	-151.1
	2	46	315	-268.6
	3	2069	315	1754.1
	4	1057	315	741.6
M-VMU-3-T07P	1	961	315	645.9
	2	633	315	317.8
	3	170	315	-145.0
	4	696	315	381.2
M-VMU-3-T08P	1	6	315	-309.1
	2	0	315	-315.0
	3	0	315	-315.0
	4	131	315	-184.0
M-VMU-3-T09P	1	1565	315	1249.7
	2	2060	315	1745.0
	3	312	315	-3.3
	4	629	315	313.9
M-VMU-3-T10P	1	0	315	-315.0
	2	514	315	199.0
	3	198	315	-117.0
	4	552	315	237.2
			k	19
			n	40
			z	-0.16
			Standard one-tailed normal curve area (Table C-3; MMD, 1999)	0.0636
			P	0.4364

Notes:
FP = Forage Production
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-4: Shrub Density by the Belt Transect, Method 3 - CMRP

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

	2022 Log Woody Plant Density (#/ac)
Mean (#/ac)	3.22
Standard Deviation	0.66
Sample Size	10
Technical Standard	2.13
t*	5.22
1-tail t (0.1, 9)	1.383
2-tail t (0.1, 9)	1.833

Notes:

#/ac = Number of shrubs, trees and/or cacti per acre

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)

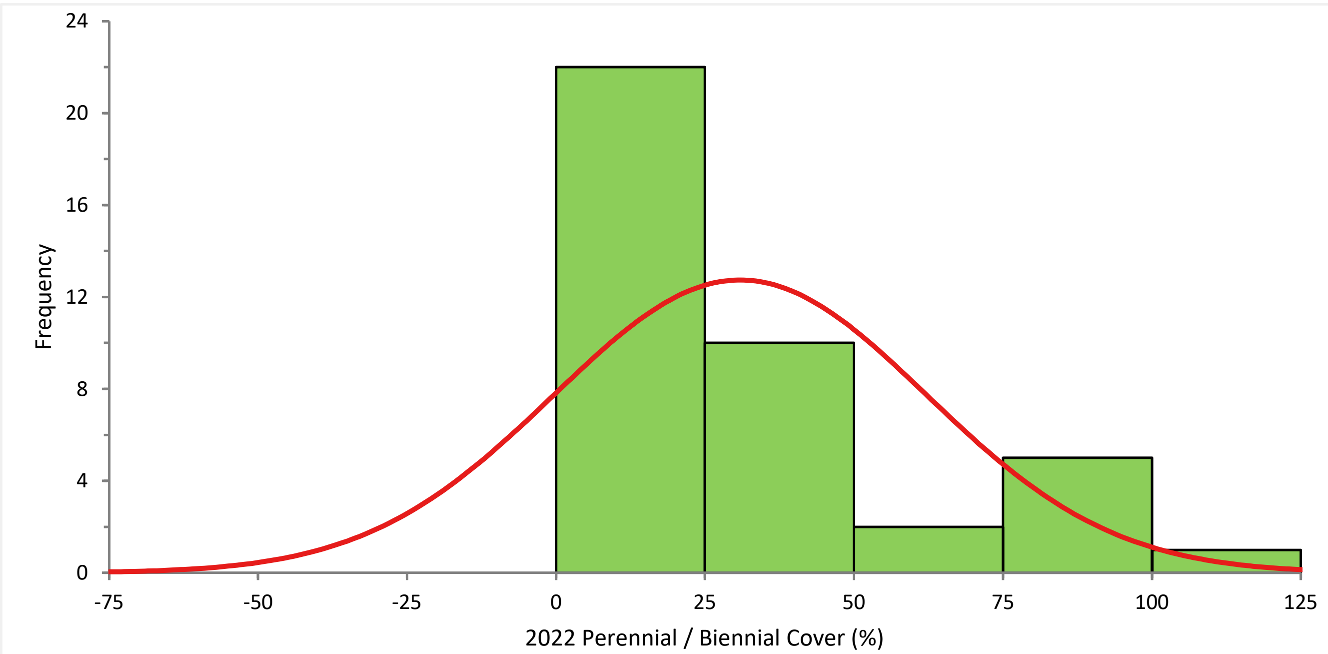
Fig C-1: M-VMU-3 2022 Perennial / Biennial Cover

Analyse-it v5.68

Filter: No filter

Last updated 12 January 2023 at 15:36 by Buchanan, Nicholas

Descriptives



N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
2022 Perennial / Biennial Cover (%)	30.9	22.6 to 39.2	4.95	31.3	1.1	0.13

	1st quartile	Median	3rd quartile
2022 Perennial / Biennial Cover (%)	3.7	24.0	43.0

Fig C-1: M-VMU-3 2022 Perennial / Biennial Cover

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Filter: No filter

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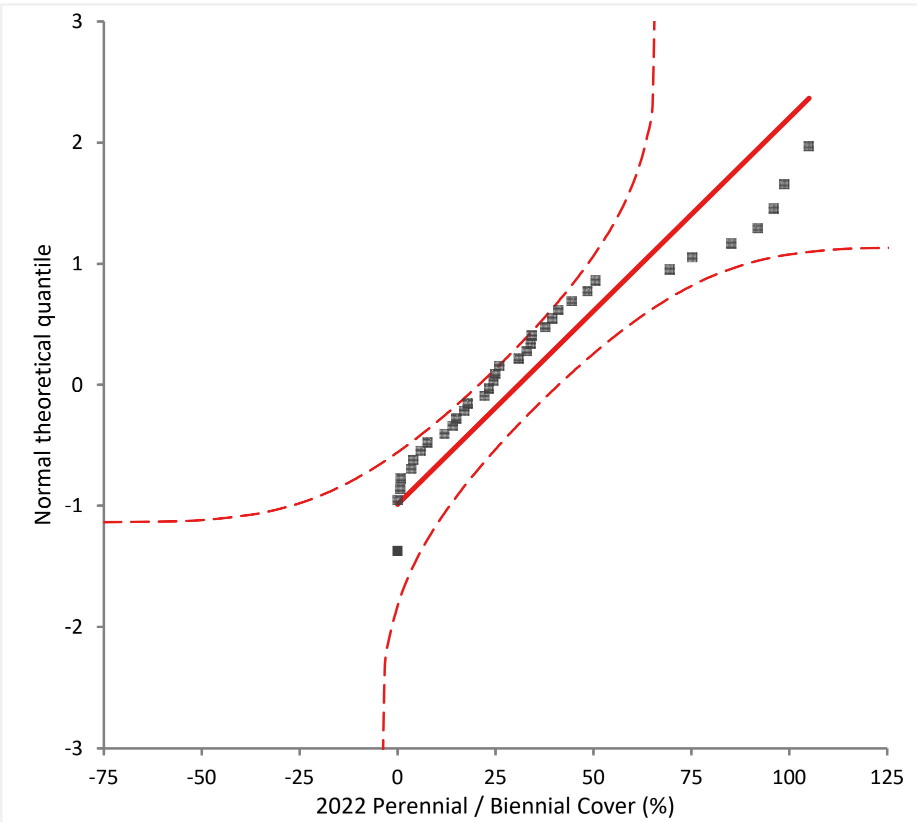
Normality



Shapiro-Wilk test

W statistic	0.86
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.

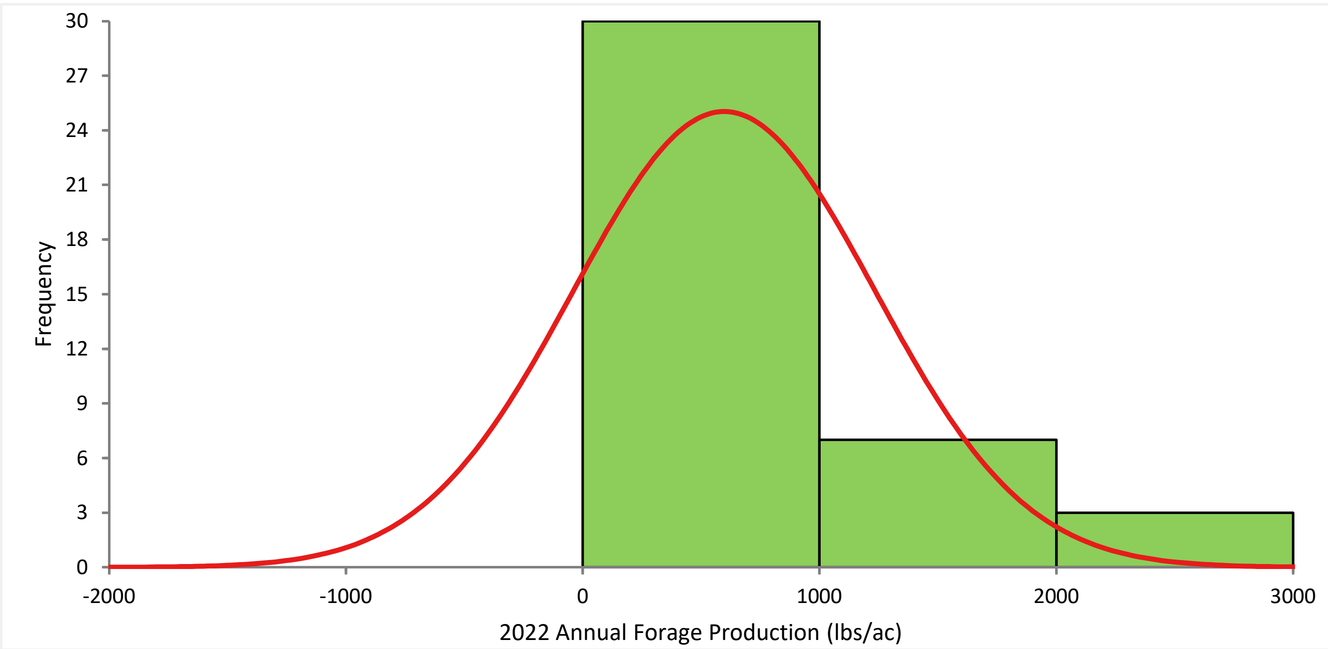
Fig C-2 2022 M-VMU-3 Annual Forage Production

Analyse-it v5.68

Filter: No filter

Last updated 12 January 2023 at 15:35 by Buchanan, Nicholas

Descriptives



N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
2022 Annual Forage Production (lbs/ac)	597.7	427.9 to 767.6	100.79	637.5	1.1	0.07

	1st quartile	Median	3rd quartile
2022 Annual Forage Production (lbs/ac)	56.7	346.3	998.2

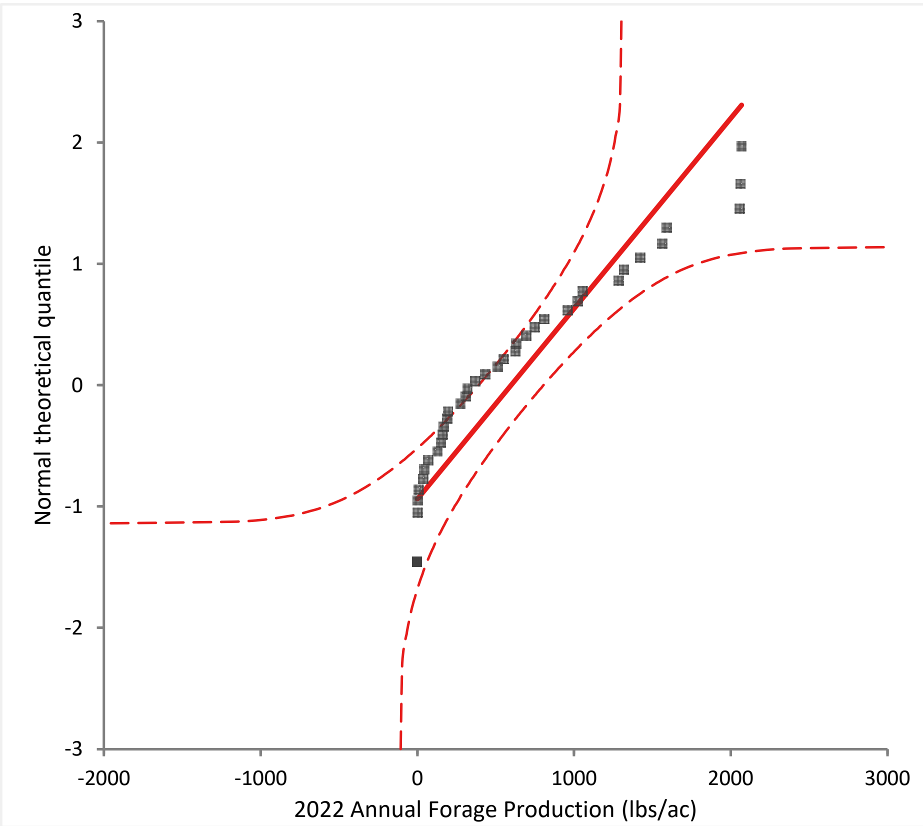
Fig C-2 2022 M-VMU-3 Annual Forage Production

Analyse-it v5.68

Filter: No filter

Last updated 12 January 2023 at 15:35 by Buchanan, Nicholas

Normality



Shapiro-Wilk test

W statistic	0.85
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.

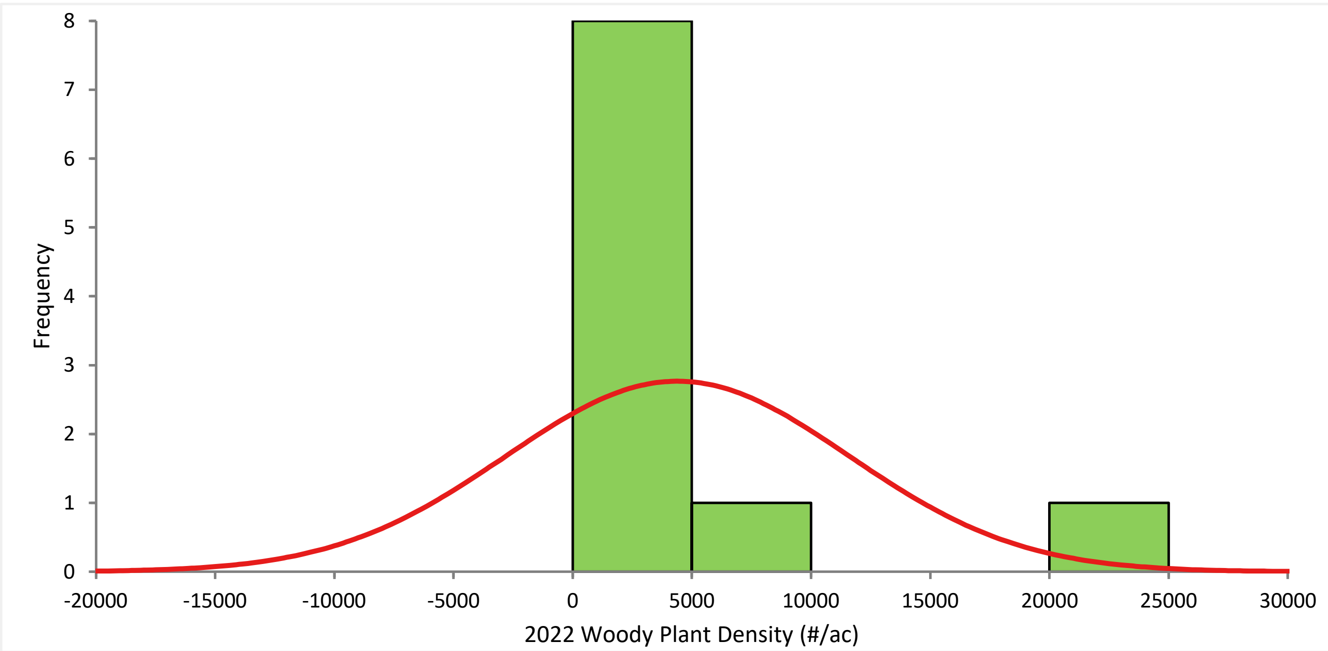
Fig C-3: M-VMU-3 2022 Woody Plant Density

Analyse-it v5.68

Filter: No filter

Last updated 2 February 2023 at 17:43 by Buchanan, Nicholas

Descriptives



N	10

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
2022 Woody Plant Density (#/ac)	4397.6	219.8 to 8575.4	2279.09	7207.1	2.7	7.72

	1st quartile	Median	3rd quartile
2022 Woody Plant Density (#/ac)	528.3	1956.0	4406.6

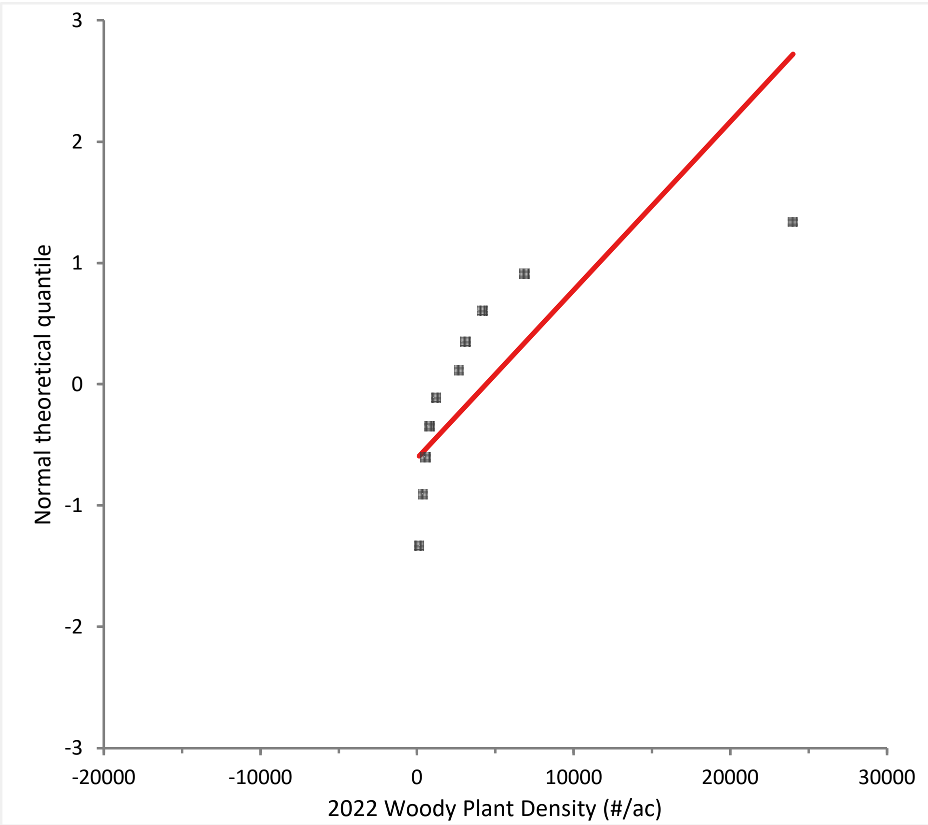
Fig C-3: M-VMU-3 2022 Woody Plant Density

Analyse-it v5.68

Filter: No filter

Last updated 2 February 2023 at 17:43 by Buchanan, Nicholas

Normality



Shapiro-Wilk test

W statistic	0.61
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.

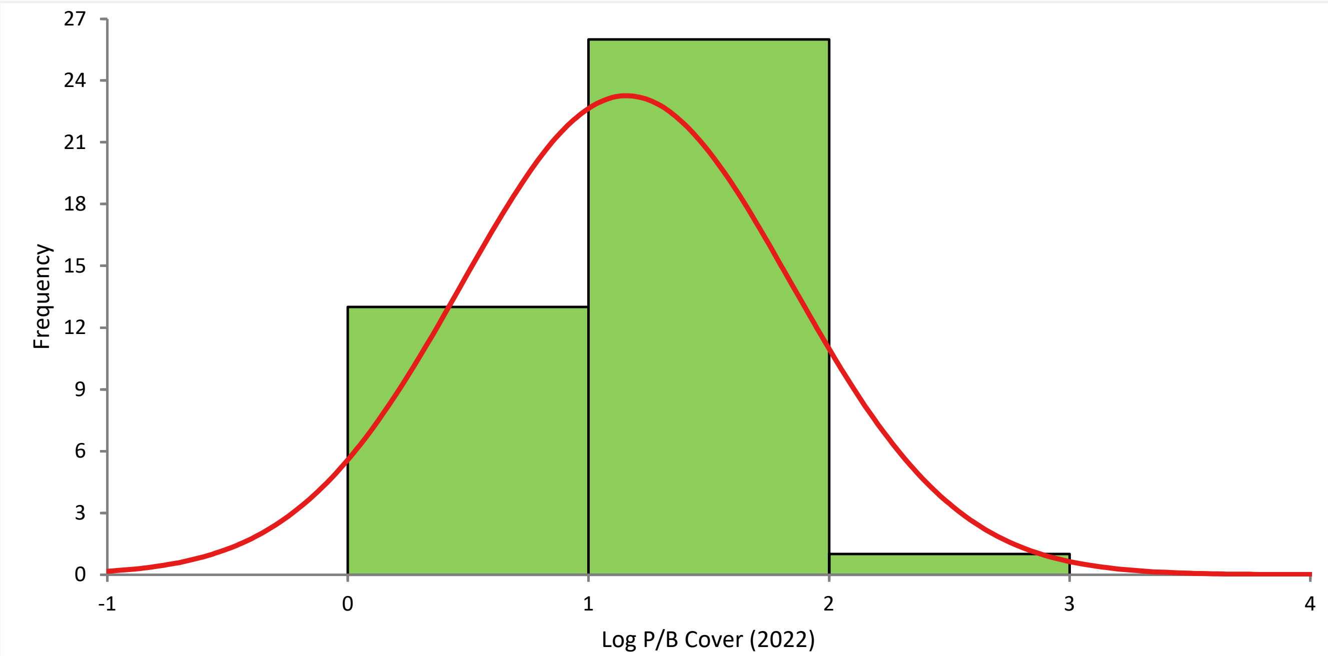
Figure C-4 2022 M-VMU-3 Log Perennial/Biennial Cover

Analyse-it v5.68

Filter: No filter

Last updated 12 January 2023 at 15:38 by Buchanan, Nicholas

Descriptives



N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Log P/B Cover (2022)	1.159	0.976 to 1.342	0.1085	0.686	-0.7	-0.91

	1st quartile	Median	3rd quartile
Log P/B Cover (2022)	0.674	1.397	1.644

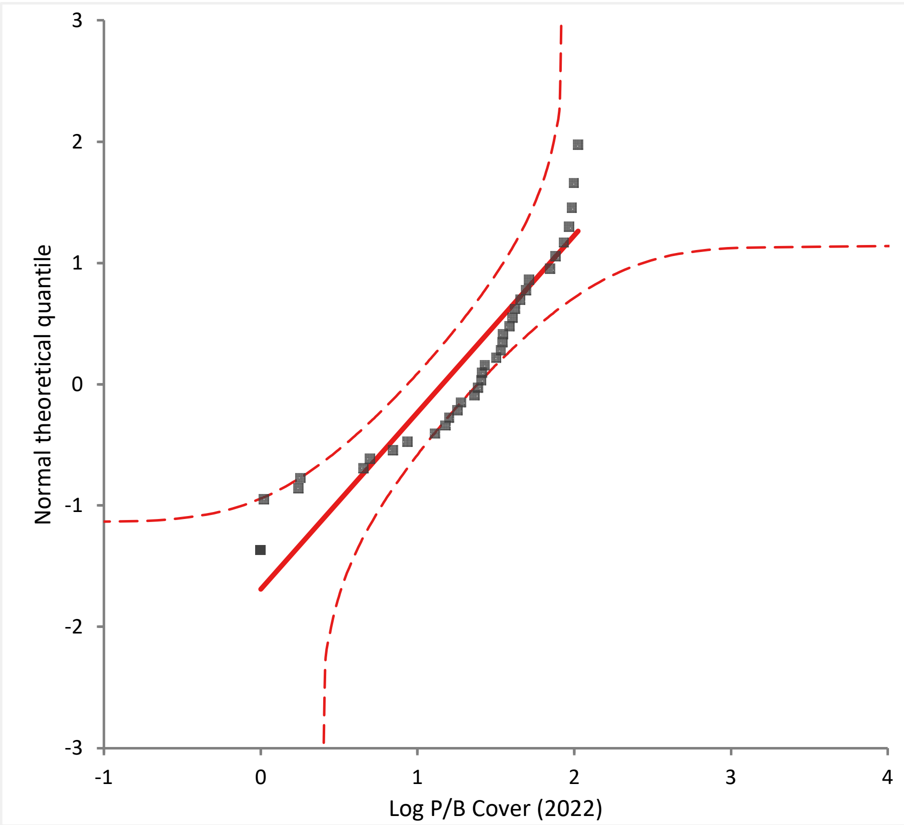
Figure C-4 2022 M-VMU-3 Log Perennial/Biennial Cover

Analyse-it v5.68

Filter: No filter

Last updated 12 January 2023 at 15:38 by Buchanan, Nicholas

Normality



Shapiro-Wilk test

W statistic	0.87
p-value	0.0003[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.

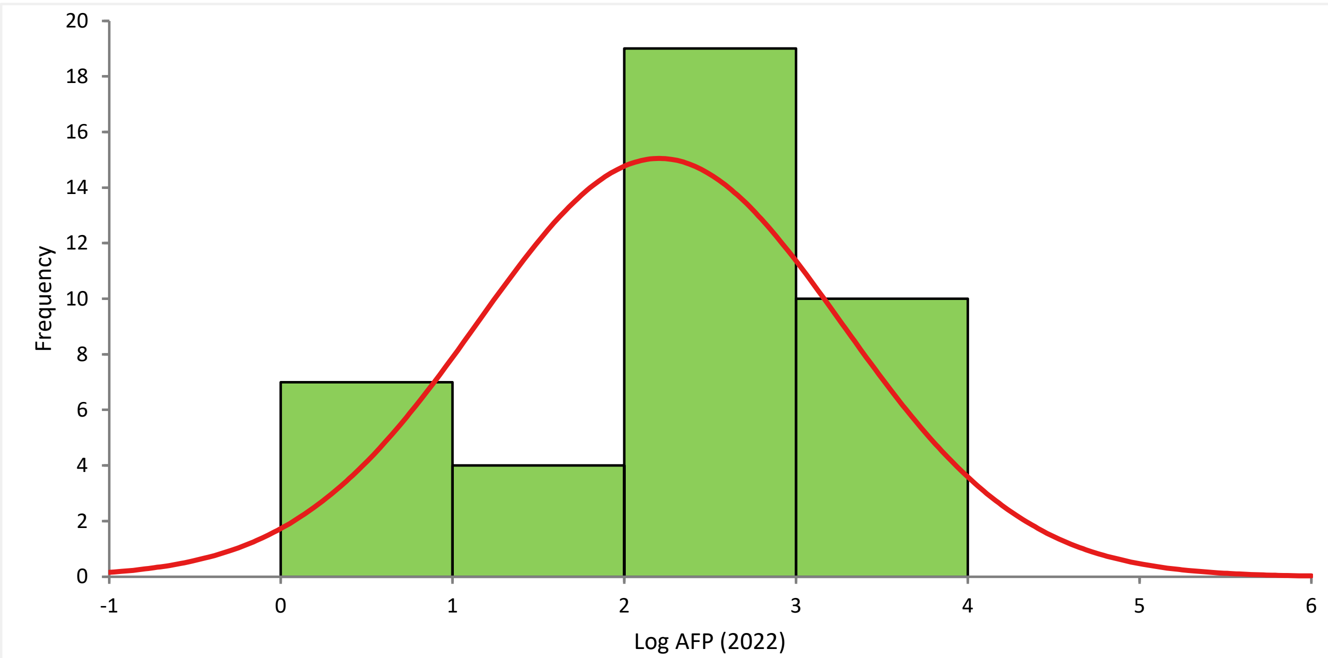
Figure C-5 2022 M-VMU-3 Log Annual Forage Production

Analyse-it v5.68

Filter: No filter

Last updated 12 January 2023 at 15:39 by Buchanan, Nicholas

Descriptives



N	40

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Log AFP (2022)	2.204	1.922 to 2.487	0.1677	1.060	-1.1	0.05

	1st quartile	Median	3rd quartile
Log AFP (2022)	1.752	2.539	2.999

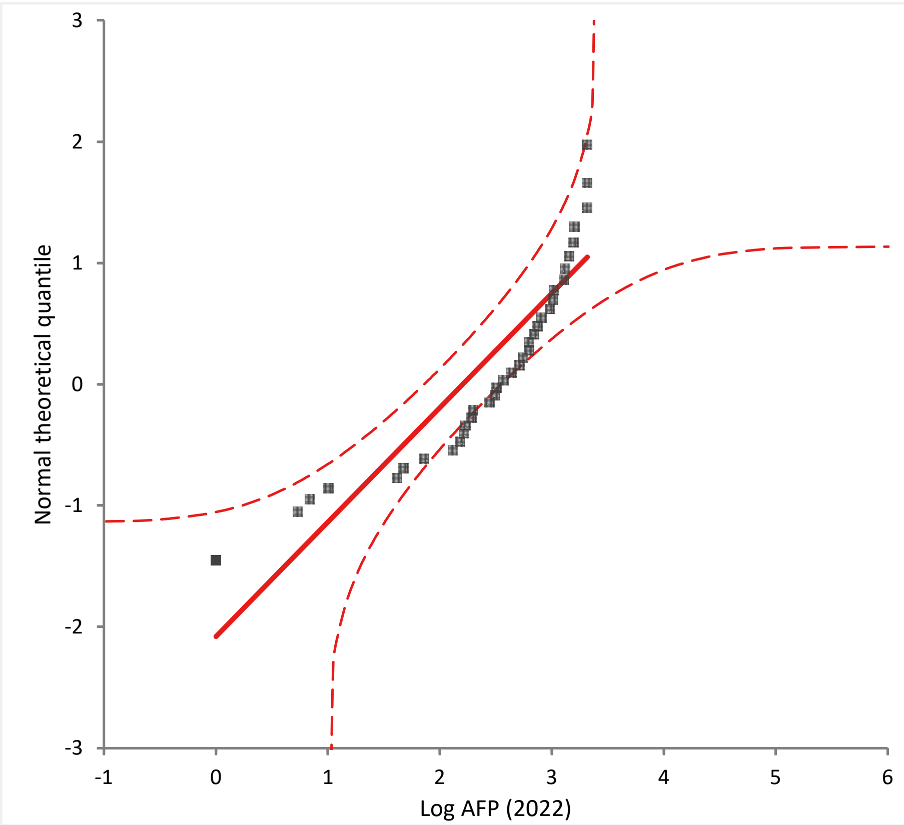
Figure C-5 2022 M-VMU-3 Log Annual Forage Production

Analyse-it v5.68

Filter: No filter

Last updated 12 January 2023 at 15:39 by Buchanan, Nicholas

Normality



Shapiro-Wilk test

W statistic	0.83
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.

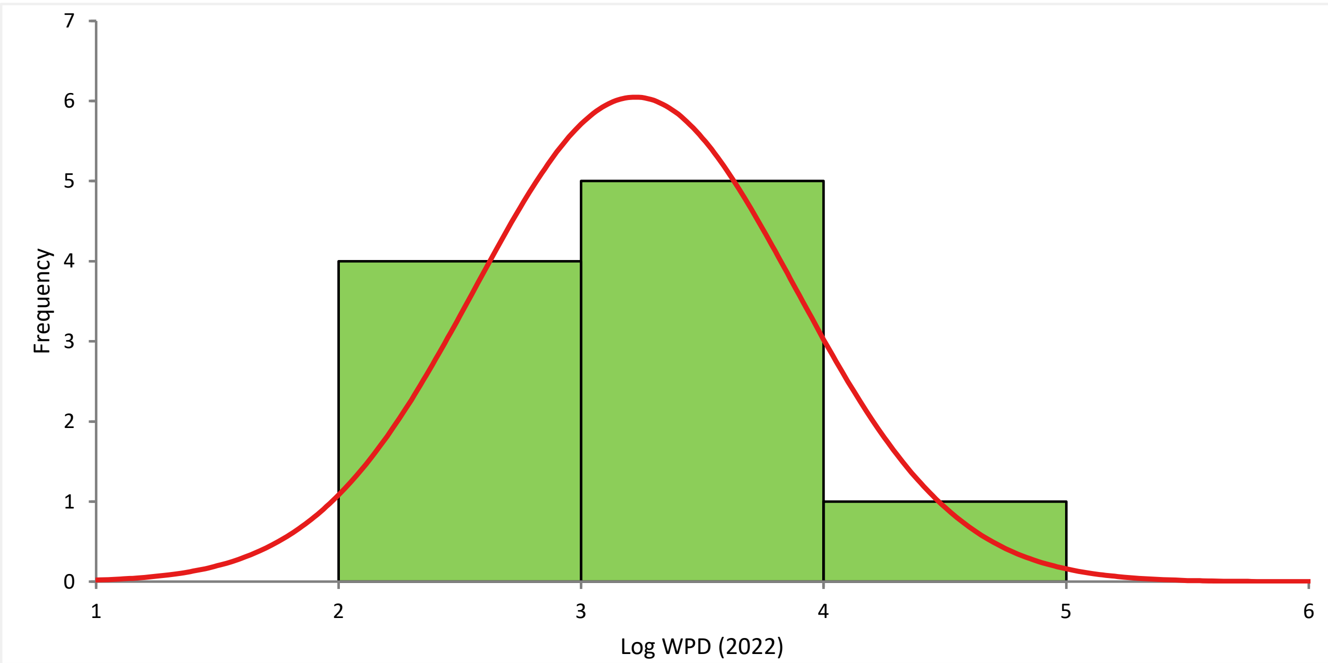
Figure C-6 2022 M-VMU-3 Log Woody Plant Density

Analyse-it v5.68

Filter: No filter

Last updated 2 February 2023 at 17:45 by Buchanan, Nicholas

Descriptives



N	10

	Mean	90% CI	Mean SE	SD	Skewness	Kurtosis
Log WPD (2022)	3.223	2.841 to 3.605	0.2086	0.660	0.1	-0.20

	1st quartile	Median	3rd quartile
Log WPD (2022)	2.722	3.258	3.639

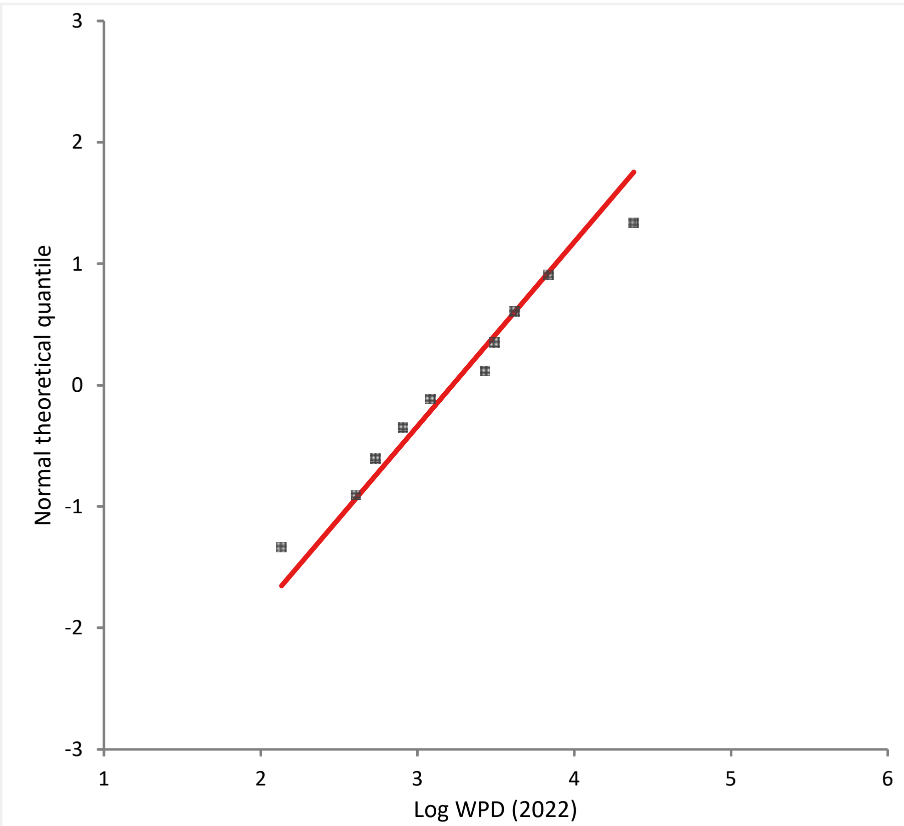
Figure C-6 2022 M-VMU-3 Log Woody Plant Density

Analyse-it v5.68

Filter: No filter

Last updated 2 February 2023 at 17:45 by Buchanan, Nicholas

Normality



Shapiro-Wilk test

W statistic	0.99
p-value	0.9977 [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.

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Appendix 9: Area 9 North, Bond Release Application, Groundwater, and Surface Water Evaluation

AREA 9 NORTH

BOND RELEASE APPLICATION

GROUNDWATER AND SURFACE WATER EVALUATION

CHEVRON MINING INC. – MCKINLEY MINE

NEAR GALLUP, NEW MEXICO

June 1, 2023

Project #: 476-014-012

SUBMITTED BY: Trihydro Corporation

1252 Commerce Drive, Laramie, WY 82070

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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 Mining and Minerals Division (MMD) Permit No. 2016-02 and this report was prepared in accordance with MMD Permit 2016-02, Section 3.0, Baseline and Background Information 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 MMD Permit 2016-02, Section 3.0.

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 Area 9 North, 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 2022 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.
- 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 as Section 2.0. A summary of available impoundment water quality is presented in Section 3.0. Sections 4.0 and 5.0 review the long-term chemical and physical characteristics of Defiance Draw and its tributary that runs through the mine and the groundwater wells, respectively.

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%.

As presented in Mine Permit No. 2016-02, 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. 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 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 Area 9 North are reported from the meteorological monitoring station at the mine, South Tipple, located west of the main Area 9 North (Figure 2-1). Precipitation station Rain 9 (Figure 2-1) is located near the northern boundary of Area 9 North and operates between late April and mid-November. Precipitation from the Rain 9 station was not necessary for this evaluation. It should be noted that the average precipitation during the Rain 9 operating period (April to November) was approximately 35% higher at the South Tipple station than the Rain 9 station during the reporting period. This difference was particularly evident in data from 2021 where approximately 120% more precipitation was recorded at the South Tipple station than the Rain 9 station. Some of the difference is likely due to partial operating months (April and November) at the Rain 9 station and the localized nature of summer thunderstorms.

Table 2-1 provides the monthly and annual precipitation data from South Tipple and Rain 9 for the reporting period. Average monthly precipitation at the South Tipple station ranged from 0.35 in. in April to 2.20 in. in July during the 10-year evaluation period. On average, most of the precipitation is received between July and October. The month with the highest 1-month precipitation total was July 2021 with 5.45 in. 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, neither of which are in the vicinity of Area 9 North.

The original 1980 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. Well No. 1 is the closest to the bond release area.

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 Office of Surface Mining Reclamation and Enforcement [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 wells 9A and 9S are near Area 9 North; to date, however, only Well 11, north of Highway 264, has contained sufficient groundwater for sampling.

Groundwater monitoring is required by MMD Permit Number 2016-02 and OSMRE Permit Number NM-0001K to be reported quarterly. 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 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. Per the Mine Permit, surface water in Area 9 North is monitored at the DD and DDT6 monitoring stations. 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 within Area 9 North. Outfalls 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 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, 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. 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
Nitrite as N	1 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	1000 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 SURFACE WATER PROTECTION STANDARDS

The NMAC provides surface water standards to protect surface water resources of the State of New Mexico for present and potential future use as livestock watering or supporting wildlife habitats (NMAC 20.6.4.900).

Surface water standards are numbers that represent the maximum concentrations of water contaminants in the surface water which still allow for the present and future use of surface water resources. Quantitative criteria for these surface water sources that correspond with available data from impoundments in the Mine are listed below (NMAC 20.6.4.900).

Analyte	Upper Limit (unless otherwise indicated)
Arsenic, dissolved	200 µg/L
Boron, dissolved	5,000 µg/L
Cadmium, dissolved	50 µg/L
Chlorine residual	11 µg/L
Chromium, dissolved	1,000 µg/L
Cobalt, dissolved	1,000 µg/L
Copper. Dissolved	500 µg/L
Cyanide, total	5.2 µg/L
Lead, dissolved	100 µg/L
Mercury, dissolved	10 µg/L
Nitrite + Nitrate	132 mg/L
Selenium, dissolved	50 µg/L
Selenium, total recoverable	5 µg/L
Vanadium, dissolved	100 µg/L
Zinc, dissolved	25,000 µg/L
Radium 226 + Radium 228	30 pCi/L
Tritium	20,000 pCi/L
4,4'-DDT and derivatives	0.001 µg/L
E. coli	2,507 MPN/100 mL

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. Related permit sections are summarized below. A copy of the active and approved Permit Section 3.4.4 is provided as Appendix A.

2.4.1 PHC DETERMINATION

The current and approved PHC determination is provided in Permit No. 2016-02, Section 3.4.4 of Appendix C-1. 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. There are three impoundments in Area 9 North: 9-19A, 9-30, and 9-33. 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 5.5.3.

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, which is discussed further in Section 3.0. These impoundments will be used to provide water for livestock and wildlife and to create small riparian habitats for small mammals, birds and reptiles. Small depressions and three permanent impoundments occur in the Area 9 North bond release area. 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 6.3. 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, and adopted by the director of MMD, there may be a small amount of draw down due to usage associated with coal mining activities, but this draw down 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

Gallup Sandstone Aquifer

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.

Alluvial Aquifers

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, chloride, fluoride, iron, magnesium, manganese, field pH, nitrate, phosphate, phosphorous, potassium, selenium, sodium, sulfate, total dissolved solids, total suspended solids, and zinc. The exact analyte list is water-source dependent.

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 IMPOUNDMENT WATER MONITORING SUMMARY

There are six permanent impoundments located in the vicinity of Area 9 North as shown on Figure 2-1. Three permanent impoundments are located within Area 9 North, specifically 9-19A, 9-30, and 9-33. Discussion follows regarding these impoundments to expand upon the overall hydrologic balance in the greater Area 9. Permanent impoundments within the vicinity of Area 9 North include 6S, 7S, and 9-15. All of the permanent impoundments were built as sediment ponds to store stormwater runoff from disturbed areas within the Defiance Draw watershed. As discussed in Section 2.3.2 above, discharge data have already been reviewed and assessed and are not included in the following discussion.

Additionally, small depressions were built in accordance with 19.8.20.2055 C. These structures provide opportunistic water for livestock and wildlife and add diversity to the vegetation. Because of their small size, no water monitoring was required. 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.

3.1 IMPOUNDMENT DATA

Of the six permanent impoundments listed above, only 6S and 9-33 have consistently held water. Impounded water in 6S generally originates from groundwater pumped from Well No. 1 into the impoundment. This water is used for reclamation and construction purposes (e.g., dust suppression, soil moisture conditioning). Impoundment 9-33 is recharged by surface runoff. Impoundments 9-19A, 9-30, and 9-33 had sufficient water for sampling once during the reporting period. Results of the single sampling event for the three monitoring locations are presented in Table 3-1. The following section includes water-quality data from the impoundments and a comparison to regulatory standards. There is no comparison to baseline water quality given the limited temporal data set. A discussion regarding the PHC is provided in Section 3.2.3.

3.2 ASSESSMENT OF IMPOUNDMENT DATA

Since the impoundments were only sampled once during the reporting period, there is no water quality data comparison to the baseline water quality. Section 3.2.2 provides a comparison to the regulatory standards.

3.2.1 COMPARISON TO BASELINE WATER QUALITY

A comparison to baseline water quality data is not included in this discussion since there is no baseline data.

3.2.2 COMPARISON TO REGULATORY STANDARDS

There was one water-quality sampling event for the impoundments in which samples were analyzed and the results compared against the standards for livestock watering and supporting wildlife habitats (NMAC 20.6.4.900). These results may be found in Table 3-1.

3.2.3 COMPARISON TO PROBABLE HYDROLOGIC CONSEQUENCES

The PHC indicates that runoff to the affected segment of the Puerco River may be minimally diminished due to the harvesting of water in the impoundments and other riparian areas. Given that most of the impoundments in Area 9 North vicinity rarely hold water, the impact to the amount of runoff to the Puerco River is likely negligible as most of the water would not have reached the river, even in the absence of the impoundments. The PHC also acknowledges discharge as having a possible short-term consequence on downstream physical water quality. However, there is no water quality data for this comparison.

4.0 LONG-TERM MONITORING, DEFIANCE DRAW

Area 9 North is located in the Puerco River Drainage Basin, with possible influence on drainages DD and DDT6. DD and DDT6 are ephemeral streams and only carry water following storm events. Two stream discharge locations, one on DD and one on DDT6, are shown on Figure 2-1. In addition to discharge, stream samples are analyzed for alkalinity, bicarbonate, carbonate, conductance, total and dissolved iron, manganese, field pH, selenium, settleable solids, TDS, TSS. Station CMW is used to monitor flow and water quality from a relatively undisturbed drainage; the data are used as background information and to contrast against other station data from disturbed watersheds.

Automated sampling and recording (gauging) stations are located at the three Mine-area watersheds identified above. The data logger records stream stage, ISCO status, and battery data at 15-minute intervals. When the conductivity sensor becomes submerged by stream flow in the channel, the data logger records the discharge event and triggers the ISCO automated water sampler. Automated sample collection begins 1 minute after the onset of a significant flow event. Stormwater samples from each event are composited and submitted for analyses.

The ISCO samplers are nonoperational below 32 degrees Fahrenheit (°F). Therefore, the samplers are shut down and removed from service between approximately November 15th and April 30th. This annual shutdown minimizes equipment damage during a period that does not typically yield significant runoff.

A summary of data for the DD, DDT6, and CMW is provided below followed by a comparison of results to the disturbed and undisturbed watersheds and the PHC. Stream flow data for the three monitoring locations are presented in Table 4-1. Statistical analyses of water quality data for the three monitoring locations are presented in Table 4-2 with an assortment of temporal plots in Appendix B, including a plot with precipitation data over time.

4.1 SURFACE WATER DATA

4.1.1 DISCHARGE DATA

Table 4-1 presents cumulative annual discharge for the three monitoring locations along DD, DDT6, and CMW. The average annual discharge at DD, DDT6, and CMW during the reporting period was 191 acre-feet (ac-ft), 42 ac-ft, 148 ac-ft, respectively. The maximum annual discharge was 1,110 ac-ft from DD in 2022. The 2022 cumulative volumes are approximately 400% of the 5-year average and more than 30 times higher than the 2021 totals.

4.1.2 STREAM WATER QUALITY DATA

Analytical data for the two stream monitoring locations along DD and DDT6 (Appendix B) are summarized below. Further discussion is then provided to highlight some of the observed geochemical trends.

4.1.2.1 DEFIANCE DRAW

A review of the analytical data and temporal plots for the reporting period associated with surface water monitoring location DD indicate the following.

- Alkalinity is a useful parameter when discussing bicarbonate and carbonate, which are the two most important compounds that determine alkalinity. Alkalinity and bicarbonate have been generally stable since 2013 except for the apparent outlier value in 2020.
- Total calcium concentrations have fluctuated at DD during the reporting period.
- Carbonate concentrations have historically been reported at or near the laboratory detection limit or the limit of quantification and is an insignificant component of total alkalinity at the historical pH levels.
- The calculated cation/anion balance has varied during the reporting period. The increased cation/anion balance during these quarters is due to a general increase in many metals, and a decrease in some anions during this same timeframe.
- Chloride concentrations have been variable during the reporting period.
- Dissolved iron concentrations at DD spiked in the second quarter 2018 but have generally been stable since 2013.
- Total iron concentrations shown on the temporal plot in Appendix B exhibit a highly variable but generally neutral trend since 2013.
- Total magnesium concentrations as shown on the temporal plot in Appendix B have been highly variable but generally neutral during the reporting period.
- Consistent with other dissolved cations, the dissolved manganese concentration spiked in 2018 but then decreased in subsequent years.
- Total manganese values shown on the temporal plot in Appendix B fluctuate with a mostly neutral trend during the reporting period. Analytical results indicate that a greater amount of suspended manganese was present than dissolved manganese over most of the sample events except in 2019 when most of the manganese existed in the dissolved state.

- Total mercury concentrations were below or near the limit of quantification in 2017 and 2021 (sometimes raised due to sample matrix interference). Mercury concentrations increased to in second quarter 2018 but decreased in late 2018 and have been similar since then.
- Nitrate, expressed as nitrogen, concentrations are variable with a neutral trend over the reporting period.
- The pH levels as shown on the temporal plot in Appendix B have fluctuated between approximately 8 and 9 standard units during the reporting period with the highest levels occurring since 2018.
- Phosphate levels have fluctuated during the reporting period with a slightly decreasing trend.
- Total phosphorus concentrations show a slightly increasing trend with a peak in July 2022.
- Total potassium concentrations in DD are variable with a neutral trend over the reporting period.
- The sodium adsorption ratio at DD has been relatively stable over the reporting period with a slightly decreasing trend since 2017.
- Total selenium concentrations were reported at or below the laboratory limit of quantification.
- Total sodium concentrations at DD have varied widely with an overall decreasing trend during the reporting period.
- Sulfate concentrations have been relatively stable and slightly decreasing trend since 2017.
- Settleable solids concentrations at DD have been relatively stable with a slight decrease in 2022.
- Total dissolved solids concentrations have been relatively stable during the reporting period except for spikes in 2013, 2018, 2021, and 2022 as shown on the temporal plot in Appendix B.
- Total suspended solids concentrations fluctuate significantly from year-to-year but do not indicate a discernable trend. The majority of the cations found in surface water exist in the suspended phase relative to the dissolved phase.
- Note - precipitation gauged at the Mine is also displayed at the bottom of Appendix B.

Examination of the collective analytical trends discussed above indicates that water quality concentrations have varied and sometimes significantly. Year-to-year concentrations of many analytes tend to rise and fall in a similar fashion, likely due to storm intensities during a particular quarter. Many analytes showed decreases in 2022, which may be a result of more frequent storm events compared to other years. However, most analytes do not exhibit any strong trends, supporting the presumption that adverse impacts from mining and reclamation operations on surface water quality at DD have not occurred.

4.1.2.2 DEFIANCE DRAW TRIBUTARY 6

Defiance Draw Tributary 6 was only sampled in 2013, 2014, 2015, 2018,2021, and 2022 during the reporting period. A review of the analytical data and temporal plots for the reporting period associated with surface water monitoring location DDT6 indicate the following.

- Alkalinity and bicarbonate have been relatively stable during the reporting period.
- Total calcium concentrations at DDT6 have fluctuated during the reporting period.
- Carbonate concentrations have been below detection limits each year except for 2018.
- The calculated cation/anion balance have been slightly higher in 2018 and 2021 than in previous years.
- Chloride concentrations have been relatively stable since 2013.
- Dissolved iron concentrations at DDT6 have fluctuated since 2013.
- Total iron concentrations have been relatively stable since 2013 as shown on the temporal plot in Appendix B.
- Total magnesium concentrations have been relatively stable since 2013 as shown on the temporal plot in Appendix B.
- Dissolved manganese concentrations have fluctuated since 2013.
- Total manganese has been relatively stable since 2013 as shown on the temporal plot in Appendix B. Analytical results indicate that a greater amount of suspended manganese was present than dissolved manganese over most of the sample events.
- Total mercury concentrations were below or only slightly above the limit of quantification since 2013.
- Nitrate, expressed as nitrogen, concentrations have been relatively stable since 2013.
- The pH levels, as shown on the temporal plot in Appendix B, have fluctuated since 2013 between 7.5 and 8.5 with slightly higher levels in 2021.
- Phosphate concentrations have fluctuated since 2013 and have been below the limit of quantification since 2021.
- Total phosphorus concentrations have fluctuated since 2013 but have been decreasing since 2015.
- Total potassium concentrations have been relatively stable since 2013.
- The sodium adsorption ratio at DDT6 has been relatively stable since 2013 with spikes in 2013 and 2015.
- Total selenium concentrations were reported below or only slightly above the laboratory limit of quantification since 2013.

- Total sodium concentrations have been relatively stable since 2013.
- Sulfate concentrations have been relatively stable since 2013.
- Total dissolved solids concentrations have been relatively stable since a peak in 2013 with a slight decrease in 2022, as shown on the temporal plot in Appendix B.
- Total suspended solids concentrations have fluctuated since 2013 with a general decreasing trend since 2015. The majority of the cations found in surface water exist in the suspended phase relative to the dissolved phase.

Examination of the collective analytical trends discussed above indicates that water quality concentrations have generally been stable since 2013 with many analytes showing decreases in 2021, which may be a result of a slight decrease in flow at DDT6 compared to other years. The relatively stable trends in concentrations at this watershed indicate that there have been no adverse impacts.

4.2 ASSESSMENT OF SURFACE WATER DATA

4.2.1 COMPARISON TO BACKGROUND WATER QUALITY

The following discussion provides a comparison of surface-water quality, by analyte, between the relatively undisturbed CMW watershed and the other disturbed watersheds, DD and DDT6. A review of the analytical data and temporal graphs indicate the following.

- Alkalinity and bicarbonate concentrations at CMW were similar to the other watersheds during the reporting period with 2018 values showing the most variability between the watersheds. Alkalinity/bicarbonate concentrations in DD in 2020 were the highest concentrations of any of the watersheds during the reporting period as shown on the temporal plot in Appendix B.
- Carbonate results are near or below laboratory limits during the reporting period.
- Chloride concentrations at CMW are relatively similar to those at the two disturbed watersheds throughout the reporting period. The chloride concentration of 26.6 mg/L at DD in 2013 was the highest of the reporting period.
- Dissolved iron concentrations for CMW are similar to or higher relative to the disturbed watersheds, particularly in 2022 with similar values at all watersheds. The dissolved iron concentration in CMW in 2019 was highest value during the reporting period.
- Total iron concentrations shown on the temporal plot (Appendix B) have generally increased at all watersheds during the reporting period. Total iron concentrations in CMW during 2021 were highest during the reporting period.

- Total magnesium concentrations at CMW have increased and are consistently higher than the other watersheds since 2016 as shown on temporal plot in Appendix B.
- Dissolved manganese concentrations indicate no obvious trend at the three watersheds during the reporting period.
- Total manganese values were similar to or slightly elevated at CMW relative to the disturbed watersheds.
- Mercury concentrations are generally below or slightly above the limits of quantification since 2013.
- Nitrate concentrations at CMW are slightly higher than the values at the two disturbed watersheds during the reporting period.
- The pH values from disturbed watersheds have generally behaved in a similar manner relative to the undisturbed values at CMW throughout the reporting period as shown on the temporal plot in Appendix B.
- Phosphate concentrations from disturbed watersheds were similar to or lower than the relatively undisturbed value at CMW since 2013.
- Total phosphorus concentrations were higher at CMW relative to the disturbed watersheds during the reporting period.
- Total potassium from disturbed watersheds were lower than the relatively undisturbed concentration at CMW throughout the reporting period.
- The sodium adsorption ratio at CMW was similar to the disturbed watersheds during the reporting period.
- Total selenium concentrations from both CMW and the disturbed watersheds were generally below the laboratory limit of quantification.
- Total sodium concentrations at CMW are slightly higher than those reported at the disturbed watersheds.
- Sulfate concentrations from CMW have been higher than the disturbed watersheds during the reporting period.
- Total settleable solids concentrations in CMW have generally been elevated compared to the other watersheds during the reporting period.
- Total dissolved solids values shown on the temporal plot in Appendix B are similar at all watersheds during the reporting period except for a spike in concentrations at CMW in 2019 and a spike at DD in 2018 and 2022.
- Total suspended solids concentrations at the CMW station have generally been higher relative to the other disturbed watersheds, as shown on the temporal plot in Appendix B.

A statistical comparison of the analytical data from the disturbed watersheds (DD and DDT6) and the undisturbed watershed (CMW) is presented in Table 4-2. The statistical analyses in Table 4-2 show the minimum, maximum, mean, median, and standard deviation of analyte concentrations for samples from the three watersheds between 2013 and 2022. In cases where data were estimated below the reporting limit (j-flag) or nondetect, the method detection limit was used. Comparisons of analyte concentrations from the two groups of watersheds indicate that the mean concentrations of each analyte are higher in the undisturbed watershed than the disturbed watersheds except for chloride. The mean chloride concentrations in DD and DDT6 are approximately 0.9 and 1.7 mg/L higher than in CMW. However, the median concentrations in DD and DDT6 are only 0.5 and 0.8 mg/L higher than in CMW, and the standard deviations of the disturbed watershed samples are 44 percent to 102 percent higher than the undisturbed watershed samples. These factors indicate the mean value is biased high due to a few higher values, and the overall chloride concentrations are similar in the three watersheds. Based on the comparison of water quality in the disturbed watersheds versus the undisturbed watershed, the data indicate that mining and reclamation did not adversely impact water quality in the disturbed watersheds. Raw surface water analytical data were provided in the annual reports and available by request.

4.2.2 COMPARISON TO PROBABLE HYDROLOGIC CONSEQUENCES

The PHC determination (Permit Section 3.4.4) acknowledges the possible consequence of stormwater on downstream water chemistry. Based on data from TBW and DDT6 and comparison to the relatively undisturbed watershed CMW, the results indicate that permanent changes to the surface water quality and quantity in the mine area are not anticipated.

5.0 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. Water level data for the groundwater sources are presented in Table 5-1. Tabulated water quality data for the groundwater sources are presented in Table 5-2 with an assortment of temporal plots in Appendix C.

5.1 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. Well D3B2 is near Area 9 North. However, because the well has historically been dry, groundwater quality data are not available for this evaluation. The alluvial wells being dry is consistent with the PHC.

5.2 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. Of the five Gallup Sandstone wells only Well 1 is located in the vicinity of Area 9 North.

5.2.1 WATER LEVELS

Water level and saturated thickness are presented in Table 5-1 for Well 1. Depth to groundwater in Well 1 has been increasing (i.e. water level dropping) since 2018. Saturated thickness plotted with precipitation and well production since 2013 is presented on Figure 5-1. Yearly water usage was generally consistent between 2002 and 2009 when mining operations ceased. Between 2011 and 2021, yearly water use was significantly less during reclamation activities although Well 1 has been the primary source for water for dust control through 2022. The figure shows that reductions in saturated thickness in Well 1 are likely a result of a combination of reduced precipitation and increased production, which given the level of change is likely from outside users of the aquifer.

5.2.2 WATER QUALITY

Sampling of Gallup Sandstone Aquifer Well 1 has been conducted quarterly for multiple parameters. Significant chemical parameters are included in the Groundwater Database Summary 2013-2022 (Table 5-2). Appendix C presents select temporal plots for Well 1 based on available 2013 to 2022 data.

Examination of the analytical data and temporal plots for the reporting period associated with Well 1 indicate the following.

- Alkalinity is a useful parameter when discussing bicarbonate and carbonate trends below. Alkalinity and bicarbonate concentrations have generally shown a slight increase since 2017 at Well 1. 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 7.2 and 7.6 SU at Well 1 and has shown a generally inverse relationship to alkalinity over the reporting period as shown on the temporal plot in Appendix C-1a. Carbonate concentrations were not above the detection limit in Well 1 during the reporting period. These results indicate that carbonate concentrations are an insignificant component of total alkalinity.
- Fluoride concentrations were mostly below detection limit (0.5 mg/L) between 2013 and 2016. Detection limits decreased (0.25 and 0.28 mg/L) after 2016 but concentrations remained near the previous detection limit.
- Dissolved calcium, magnesium, sodium and hardness are plotted together on the temporal plot in Appendix C-1b. Dissolved calcium, magnesium, and sodium concentrations have been stable in Well 1 since 2013 except a spike in dissolved sodium in August 2021 and August 2022. Hardness as a function of calcium carbonate has fluctuated between approximately 200 and 300 mg/L since 2014.
- The calculated ion balance percentages have been consistently less than 10%, other than two anomalous values in November 2011 and March 2017.
- Chloride, sulfate, TDS, and turbidity are plotted together on the temporal plot in Appendix C-1c. Chloride concentrations at Well 1 have been relatively stable since 2013. Sulfate concentrations at Well 1 have been relatively stable except for spike in June 2020. Total dissolved solids concentrations at Well 1 have varied between approximately 325 mg/L and 450 mg/L since 2013. Turbidity in Well 1 has been below 25 Nephelometric Turbidity Units (NTU) since 2013.

- Total iron and manganese are plotted together on the temporal plot in Appendix C-1d. Total iron concentrations at Well 1 have varied between 1 and 2 mg/L since May 2013 except for a spike in August 2022. Total manganese concentrations presented on the temporal plot have varied between 0.105 and 0.13 mg/L since 2013.
- Phosphate concentrations have been below the detection limit in Well 1 since 2013.

Examination of the previously discussed analytical trends suggests that water-quality concentrations have remained relatively consistent since 2013 at Well 1. Overall, these trends support the presumption that impacts from mining and reclamation operations on Gallup Sandstone Aquifer groundwater have not occurred or are limited. Reductions in water levels in Well 1 are likely due to the prolonged drought conditions in the region and off-site use and to a lesser extent from the small amount of production at the mine for dust control.

5.3 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), 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. To date, only Well 11 has contained sufficient groundwater for sampling.

Only wells 9A and 9S are near or within Area 9 North. However, neither well has had sufficient water for sampling since 2013. Therefore, spoil groundwater is not included in the groundwater quality discussion. Upon the ultimate stages of bond release, the two spoil wells will be plugged and abandoned in accordance with NMAC 19.27.4.30.C.1.

5.4 ASSESSMENT OF GROUNDWATER DATA

5.4.1 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.

5.4.2 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). Table 5-2 include these standards at the bottom, allowing for easy comparison to water quality data from Well 1, with bolded values indicating exceedances. Only the following monitored constituents are regulated by the referenced standards: fluoride, nitrate and nitrite as N, and selenium for human health standards and chloride, iron, manganese, sulfate, TDS, zinc, and pH for domestic water supply. There were no exceedances of water quality from Well 1 for standards associated with chloride, fluoride, manganese, nitrate, nitrite, pH, sulfate, and TDS.

5.4.3 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 plugged and abandoned in accordance with NMAC 19.27.4.30.C.1.

6.0 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 three 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.

6.1 LONG-TERM ASSESSMENT OF IMPOUNDMENTS

Three permanent impoundments are located within Area 9 North. Additionally, impoundments in the vicinity of Area 9 North were only sampled once during the reporting period and therefore, have not been included in this discussion.

6.2 LONG-TERM ASSESSMENT OF SURFACE WATER

Comparison of surface water quality from DD and DDT6 to background water quality data (CMW) indicate that water quality in the DD and DDT6 watersheds is consistent with background levels for the monitored analytes. Data agree with the PHC determination that no permanent changes to the surface water quality and quantity would result from mining activities, qualifying the McKinley Mine for bond release of long-term surface-water monitoring.

6.3 LONG-TERM ASSESSMENT OF GROUNDWATER

Comparison of groundwater quality from Well 1 to water quality standards indicate that water quality in the Gallup Sandstone Aquifer is below water quality standards for the regulated analytes fluoride, nitrate and nitrite as N, selenium chloride, iron, manganese, sulfate, TDS, zinc, and pH. As discussed in the PHC, because of the impermeability of the shale units overlying the Gallup Sandstone Aquifer and the geologic structure in the area, there is no hydraulic connection between the underlying Gallup Sandstone and the mined strata. Data agree with the PHC determination that no permanent changes to the groundwater quality and quantity would result from mining activities, qualifying the McKinley Mine for bond release of long-term groundwater monitoring. Upon the final stages of bond release, the bedrock wells will be plugged and abandoned. Groundwater from Well 1 may continue to be used for domestic and agricultural purposes.

7.0 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.

TABLES

TABLE 2-1. PRECIPITATION DATA, SOUTH TIPPLE AND RAIN 9
MCKINLEY MINE, CHEVRON MINING INC.
NEAR GALLUP, NEW MEXICO

Month	2013		2014		2015		2016		2017		2018		2019		2020		2021		2022		Average (2013-2022)	Maximum (2013-2022)
	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	Rain 9 (in)	S. Tipple (in)	S. Tipple (in)	S. Tipple (in)
January	--	1.38	--	0.04	--	2.05	--	0.62	--	1.25	--	0.35	--	1.30	--	0.98	--	1.11		0.36	0.94	2.05
February	--	0.15	--	0.06	--	1.59	--	0.22	--	1.64	--	0.79	--	1.81	--	1.44	--	0.34		0.74	0.88	1.81
March	0.00	0.39	--	0.73	--	0.11	--	0.05	--	0.48	--	0.54	--	1.23	--	1.35	--	0.4		1.25	0.65	1.35
April	0.27	0.23	0.08	0.36	0.50	0.52	1.20	1.31	0.22	0.35	0.07	0.09	0.16	0.44	0.16	0.17	0.00	0.07	0.00	0.00	0.35	1.31
May	0.02	0	0.19	0.14	1.38	1.64	1.02	0.80	0.62	0.77	0.27	0.29	1.36	1.77	0.02	0.01	0.10	0.08	0.00	0.01	0.55	1.77
June	0.02	0.05	0.00	0	1.22	1.11	0.01	0.07	0.45	0.42	0.25	0.51	0.24	0.33	0.11	0.04	0.27	0.37	0.51	0.66	0.36	1.22
July	2.02	1.8	0.88	0.85	2.88	2.37	0.82	1.37	1.24	2.48	2.16	2.61	0.46	0.22	0.60	1.13	1.81	5.45	2.38	3.68	2.20	5.45
August	2.61	2.53	1.04	1.44	1.25	1.62	1.40	1.74	0.50	0.90	0.74	1.34	0.37	0.05	0.06	0.24	1.22	1.24	4.05	5.36	1.65	5.36
September	2.87	3.03	2.20	2.12	0.22	0.3	1.64	1.75	1.05	1.34	0.67	1.1	1.84	1.59	0.14	0.15	1.11	2.12	1.02	1.51	1.50	3.03
October	0.62	0.58	0.24	0.36	1.13	1.36	0.37	0.40	0.05	0.15	1.31	1.65	0.05	0.09	0.08	0.26	0.78	1.77	1.77	2.92	0.95	2.92
November	0.54	1.67	0.03	0.09	0.99	1.31	0.91	1.57	0.00	0.09	0.00	0.19	0.07	1.14	0.45	0.40	0.00	0.55	0.41	0.59	0.76	1.67
December	--	0.2	--	1.53	--	0.76	--	1.84	--	0.02	--	0.67	--	0.85	--	0.27	--	2.26		0.74	0.91	2.26

Total Annual Precipitation

Year	**2013**		**2014**		**2015**		**2016**		**2017**		**2018**		**2019**		**2020**		**2021**		**2022**		**Rain 9 Average**	**S. Tipple Average**
Total (inches)	--	12.01	--	7.72	--	14.74	--	11.74	--	9.89	--	10.13	--	10.82	--	6.44	--	15.76	--	17.82	--	11.71
Apr-Nov (inches)	8.97	10.28	4.66	5.36	9.57	10.23	7.37	9.01	4.13	6.50	5.47	7.78	4.55	5.63	1.62	2.40	5.29	11.65	10.14	14.73	6.18	8.36

Notes:

-- - precipitation station not operating due to freezing temperatures

[green shading] Partial operating month

in - inches

Apr - April

Nov - November

TABLE 3-1. PERMANENT IMPOUNDMENT WATER QUALITY DATA
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Impoundment ID	Date Sampled	Arsenic, dissolved µg/L	Boron, dissolved µg/L	Cadmium, dissolved µg/L	Chlorine Residual µg/L	Chromium, dissolved µg/L	Cobalt, dissolved µg/L	Copper, dissolved µg/L	Cyanide, total µg/L	Lead, dissolved µg/L	Mercury, dissolved µg/L	Nitrate + Nitrite mg/L	Selenium, dissolved µg/L	Selenium, total recoverable µg/L	Vanadium, dissolved µg/L	Zinc, dissolved µg/L	Adjusted gross alpha pCi/L	Radium 226 + Radium 228 pCi/L	Tritium pCi/L	4,4'-DDT and derivatives µg/L	E. coli MPN/100 mL
9-19A	12/7/2022	ND (1.0)	ND (40)	ND (0.5)	ND (50)	ND (1.0)	ND (6.0)	3.9	ND (5.0)	0.67	ND (0.2)	ND (1.0)	1.2	3.2	ND (50)	10	**20.8**	0.71	147	**0.15**	< 10
9-30	12/7/2022	1.2	ND (40)	ND (0.5)	ND (50)	ND (1.0)	ND (6.0)	2.9	ND (5.0)	0.74	ND (0.2)	ND (1.0)	ND (1.0)	**6.7**	ND (50)	25	0	0.36	-28	**0.15**	< 10
9-33	12/7/2022	2.0	41	ND (0.5)	ND (50)	ND (1.0)	ND (6.0)	3.9	ND (5.0)	0.87	ND (0.2)	ND (1.0)	ND (1.0)	2.1	ND (50)	ND (10)	14.5	0.46	-62.9	**0.15**	< 10
Water Quality Standards		200	5,000	50	11	1,000	1,000	500	5.2	100	10	132	50	5	100	25,000	15	30	20,000	0.001	2,507

TABLE 4-1. SURFACE WATER DISCHARGE DATA
CHEVRON MINING INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Watershed	2013 (ft^3)	2013 (ac-ft)	2014 (ft^3)	2014 (ac-ft)	2015 (ft^3)	2015 (ac-ft)	2016 (ft^3)	2016 (ac-ft)	2017 (ft^3)	2017 (ac-ft)	2018 (ft^3)	2018 (ac-ft)
DD	8,780,798	202	7,985,148	183	4,112,178	94	4,047,021	93	1,108,868	25	6,557,234	151
DDT6	1,905,221	44	1,347,142	31	2,690,529	62	-	-	-	-	530,125	12
CMW	6,943,946	159	1,776,160	41	22,428,950	515	3,032,811	70	1,809,229	42	7,219,414	166

Watershed	2019 (ft^3)	2019 (ac-ft)	2020 (ft^3)	2020 (ac-ft)	2021 (ft^3)	2021 (ac-ft)	2022 (ft^3)	2022 (ac-ft)	Average (ft^3)	Average (ac-ft)	Maximum (ft^3)	Maximum (ac-ft)
DD	477,324	11	175,241	4	1,471,258	34	48,330,681	1,110	8,304,575	191	48,330,681	1,110
DDT6	-	-	-	-	475,508	11	11,193,602	257	1,814,213	42	11,193,602	257
CMW	5,258,259	121	382,050	9	1,707,449	39	14,049,485	323	6,460,775	148	22,428,950	515

TABLE 4-2. STATISTICAL ANALYSES FOR SURFACE WATER ANALYTE CONCENTRATIONS (2013 - 2022)
CHEVRON MINING INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Analyte	Sample Location	Category	Nb. Samples	Nb. Detects	% Detects	Nb. Distinct Values	Sample Mean	Sample Median	Sample Std. Dev.	Minimum (Detects)	Maximum (Detects)	Minimum (ND = MDL)	Maximum (ND = MDL)
Alkalinity	CMW	GENERAL	27	27	100%	25	176.907	117	120.00	65.9	526	--	--
Alkalinity	DD	GENERAL	43	43	100%	43	188.380	106	353.01	27.8	2400	--	--
Alkalinity	DDT6	GENERAL	13	13	100%	13	157.151	102.4	142.71	80.32	601	--	--
Bicarbonate	CMW	GENERAL	27	27	100%	25	176.907	117	120.00	65.9	526	--	--
Bicarbonate	DD	GENERAL	43	43	100%	43	185.566	106	352.48	27.8	2400	--	--
Bicarbonate	DDT6	GENERAL	13	13	100%	13	155.074	102.4	141.42	80.32	601	--	--
Carbonate	CMW	GENERAL	27	0	0%	9	24.944	3.4	30.69	--	--	0.7	70
Carbonate	DD	GENERAL	43	4	9%	14	9.330	2	16.26	17.8	35.4	0.7	70
Carbonate	DDT6	GENERAL	13	1	8%	4	8.708	2	19.81	27.7	27.7	0.7	70
Chloride	CMW	GENERAL	27	25	93%	21	4.585	4.2	1.94	2.6	10.7	1.2	2.5
Chloride	DD	GENERAL	43	39	91%	33	5.495	4.7	3.91	2.5	26.6	1.2	2.5
Chloride	DDT6	GENERAL	13	13	100%	11	6.108	5	2.80	3.3	12.5	--	--
Hardness, Total	CMW	GENERAL	25	25	100%	25	1663.520	1540	970.13	230	3400	--	--
Hardness, Total	DD	GENERAL	39	38	97%	39	926.367	720	747.14	97.3	3600	600	600
Hardness, Total	DDT6	GENERAL	11	11	100%	10	491.364	320	504.08	131	1680	--	--
Ion Balance	CMW	GENERAL	24	24	100%	24	52.519	49.82727	27.91	1.946650355	89.42511	--	--
Ion Balance	DD	GENERAL	38	38	100%	38	52.265	58.73911	29.03	0.127562158	89.67657	--	--
Ion Balance	DDT6	GENERAL	11	11	100%	11	42.207	48.78799	22.33	8.478393608	65.22493	--	--
Nitrogen, Nitrate	CMW	GENERAL	27	26	96%	20	1.427	1.5	0.62	0.66	2.8	0.22	0.22
Nitrogen, Nitrate	DD	GENERAL	43	41	95%	31	1.111	1	0.75	0.3	4.8	0.04	0.11
Nitrogen, Nitrate	DDT6	GENERAL	13	11	85%	8	1.048	1.4	0.70	0.34	2.5	0.11	0.11
pH, field	CMW	GENERAL	30	30	100%	13	8.360	8.35	0.49	7.3	9.6	--	--
pH, field	DD	GENERAL	45	45	100%	15	8.462	8.5	0.38	7.8	9.6	--	--
pH, field	DDT6	GENERAL	13	13	100%	9	8.337	8.2	0.52	7.9	9.8	--	--
Phosphate	CMW	GENERAL	25	20	80%	21	19.108	11.7	19.09	3.5	68.4	1.2	2.5
Phosphate	DD	GENERAL	38	27	71%	30	12.233	6.35	13.79	1.1	52.2	0.25	2.5
Phosphate	DDT6	GENERAL	11	5	45%	7	5.929	1.2	9.25	0.52	25	1.2	2.5

TABLE 4-2. STATISTICAL ANALYSES FOR SURFACE WATER ANALYTE CONCENTRATIONS (2013 - 2022)
CHEVRON MINING INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Analyte	Sample Location	Category	Nb. Samples	Nb. Detects	% Detects	Nb. Distinct Values	Sample Mean	Sample Median	Sample Std. Dev.	Minimum (Detects)	Maximum (Detects)	Minimum (ND = MDL)	Maximum (ND = MDL)
Sodium Adsorption Ratio	CMW	GENERAL	24	24	100%	24	1.080	0.944207	0.60	0.27	2.356122	--	--
Sodium Adsorption Ratio	DD	GENERAL	38	38	100%	38	1.043	0.752888	0.72	0.34	3.815798	--	--
Sodium Adsorption Ratio	DDT6	GENERAL	11	11	100%	11	0.979	0.727012	0.77	0.25	2.94358	--	--
Solids, Total Dissolved	CMW	GENERAL	26	26	100%	25	2108.385	603	4666.61	240	24000	--	--
Solids, Total Dissolved	DD	GENERAL	43	43	100%	42	1595.140	760	1927.72	120	7740	--	--
Solids, Total Dissolved	DDT6	GENERAL	12	12	100%	12	1033.917	820	1021.96	235	3970	--	--
Solids, Total Suspended	CMW	GENERAL	27	27	100%	27	46039.259	42500	33979.85	1370	135000	--	--
Solids, Total Suspended	DD	GENERAL	43	43	100%	41	14628.186	8740	13764.93	432	46400	--	--
Solids, Total Suspended	DDT6	GENERAL	13	13	100%	13	10519.923	3600	13687.87	499	42500	--	--
Sulfate	CMW	GENERAL	27	27	100%	27	78.811	70	42.90	28.3	182	--	--
Sulfate	DD	GENERAL	43	43	100%	37	24.644	23	11.38	5.1	55.7	--	--
Sulfate	DDT6	GENERAL	13	13	100%	11	21.931	22	7.26	6.4	36.6	--	--
Calcium, Total	CMW	METALS	27	27	100%	27	370.107	371	228.19	51	917	--	--
Calcium, Total	DD	METALS	43	43	100%	43	232.242	172	215.30	33.000000	1200	--	--
Calcium, Total	DDT6	METALS	13	13	100%	13	144.931	78	148.06	36.900000	471	--	--
Iron, Dissolved	CMW	METALS	27	27	100%	27	61.960	1	110.90	0.0933	402	--	--
Iron, Dissolved	DD	METALS	43	41	95%	43	51.638	16	84.47	0.0594	387	0.04	0.0805
Iron, Dissolved	DDT6	METALS	13	13	100%	12	11.046	3.2	15.77	0.082	57.1	--	--
Iron, Total	CMW	METALS	27	27	100%	26	304.478	217	263.07	22.8	1000	--	--
Iron, Total	DD	METALS	43	43	100%	39	199.574	150	171.25	15.6	810	--	--
Iron, Total	DDT6	METALS	13	13	100%	13	96.891	77	85.82	4.78	340	--	--
Magnesium, Dissolved	CMW	METALS	22	22	100%	22	31.098	6.665	46.34	2.73	185	--	--
Magnesium, Dissolved	DD	METALS	34	34	100%	34	26.872	13.4	32.38	1.57	113	--	--
Magnesium, Dissolved	DDT6	METALS	7	7	100%	7	7.289	3.7	7.10	2.08	22.1	--	--
Magnesium, Total	CMW	METALS	27	27	100%	27	116.470	101	71.68	22	270	--	--
Magnesium, Total	DD	METALS	43	43	100%	42	69.491	47.9	57.35	11.7	270	--	--
Magnesium, Total	DDT6	METALS	13	13	100%	13	30.442	26	18.61	9.6	65.2	--	--

TABLE 4-2. STATISTICAL ANALYSES FOR SURFACE WATER ANALYTE CONCENTRATIONS (2013 - 2022)
CHEVRON MINING INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Analyte	Sample Location	Category	Nb. Samples	Nb. Detects	% Detects	Nb. Distinct Values	Sample Mean	Sample Median	Sample Std. Dev.	Minimum (Detects)	Maximum (Detects)	Minimum (ND = MDL)	Maximum (ND = MDL)
Manganese, Dissolved	CMW	METALS	27	27	100%	27	2.124	0.448	3.17	0.0033	14.2	--	--
Manganese, Dissolved	DD	METALS	43	43	100%	42	1.698	0.53	2.15	0.0015	7.8	--	--
Manganese, Dissolved	DDT6	METALS	13	13	100%	13	0.416	0.32	0.44	0.0025	1.4	--	--
Manganese, Total	CMW	METALS	27	27	100%	27	9.792	9.6	6.55	1.14	24.5	--	--
Manganese, Total	DD	METALS	43	43	100%	41	5.170	3.76	4.47	0.444	23	--	--
Manganese, Total	DDT6	METALS	13	13	100%	13	2.652	1.6	2.58	0.323	7.43	--	--
Mercury, Total	CMW	METALS	25	20	80%	21	0.002	0.002	0.00	0.00029	0.0057	0.00005	0.00048
Mercury, Total	DD	METALS	38	27	71%	28	0.001	0.00048	0.00	0.000095	0.0066	0.00005	0.0005
Mercury, Total	DDT6	METALS	11	6	55%	11	0.000	0.00024	0.00	0.000098	0.00094	0.00005	0.00048
Phosphorus, Total	CMW	METALS	27	27	100%	27	8.683	5.21	10.01	1.07	37	--	--
Phosphorus, Total	DD	METALS	43	43	100%	42	4.490	3.54	4.76	0.59	28	--	--
Phosphorus, Total	DDT6	METALS	13	13	100%	13	2.467	2.66	1.74	0.445	5.48	--	--
Potassium, Total	CMW	METALS	27	27	100%	27	53.137	38.3	33.56	16.5	140	--	--
Potassium, Total	DD	METALS	43	43	100%	43	33.709	27.8	19.76	8.37	100	--	--
Potassium, Total	DDT6	METALS	13	13	100%	12	25.738	22	13.76	11	55	--	--
Selenium, Total	CMW	METALS	27	13	48%	22	0.043	0.0135	0.06	0.0079	0.28	0.0082	0.105
Selenium, Total	DD	METALS	43	13	30%	23	0.022	0.0141	0.02	0.0085	0.1	0.0048	0.105
Selenium, Total	DDT6	METALS	13	9	69%	13	0.014	0.0094	0.01	0.0065	0.0356	0.0048	0.021
Sodium, Dissolved	CMW	METALS	22	22	100%	21	32.114	30	9.00	19.9	54.3	--	--
Sodium, Dissolved	DD	METALS	34	34	100%	31	30.756	28.55	9.24	12	53.4	--	--
Sodium, Dissolved	DDT6	METALS	7	7	100%	7	28.129	25.1	10.33	16.1	47.6	--	--
Sodium, Total	CMW	METALS	27	27	100%	27	36.119	34	11.39	16.1	64	--	--
Sodium, Total	DD	METALS	43	43	100%	41	32.644	31.1	11.68	12	66.9	--	--
Sodium, Total	DDT6	METALS	13	13	100%	12	25.031	25.2	6.43	10	35.2	--	--

TABLE 4-2. STATISTICAL ANALYSES FOR SURFACE WATER ANALYTE CONCENTRATIONS (2013 - 2022)
CHEVRON MINING INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Analyte	Sample Location	Category	Nb. Samples	Nb. Detects	% Detects	Nb. Distinct Values	Sample Mean	Sample Median	Sample Std. Dev.	Minimum (Detects)	Maximum (Detects)	Minimum (ND = MDL)	Maximum (ND = MDL)
Zinc, Dissolved	CMW	METALS	9	9	100%	9	0.885	0.34	1.00	0.11	2.74	--	--
Zinc, Dissolved	DD	METALS	21	19	90%	21	0.390	0.26	0.45	0.024	1.59	0.003	0.032
Zinc, Dissolved	DDT6	METALS	7	7	100%	7	0.075	0.061	0.05	0.025	0.17	--	--

Abbreviations:
MDL: Method Detection Limit
Nb.: Number of
ND: Non-Detect
Std. Dev.: Standard Deviation

Notes:
NDs are replaced by their respective MDLs.
Trace values are reported as detected values and reported with their respective MDLs.
Highlighted rows indicated disturbed watersheds (locations DD and DDT6).

TABLE 5-1. DEPTH TO WATER AND SATURATED THICKNESS
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Location	Year	DTW	Well Depth	Saturated Thickness
		ft bmp	ft bmp	ft
WELL 1	2013	482.00	930.00	448.00
	2014	466.33	930.00	463.67
	2015	466.00	930.00	464.00
	2016	489.00	930.00	441.00
	2017	483.00	930.00	447.00
	2018	462.20	930.00	467.80
	2019	481.85	930.00	448.15
	2020	526.90	930.00	403.10
	2021	530.35	930.00	399.65
	2022	529.20	930.00	400.80

Notes:
DTW - depth to water
ft - feet
bmp - below measuring point

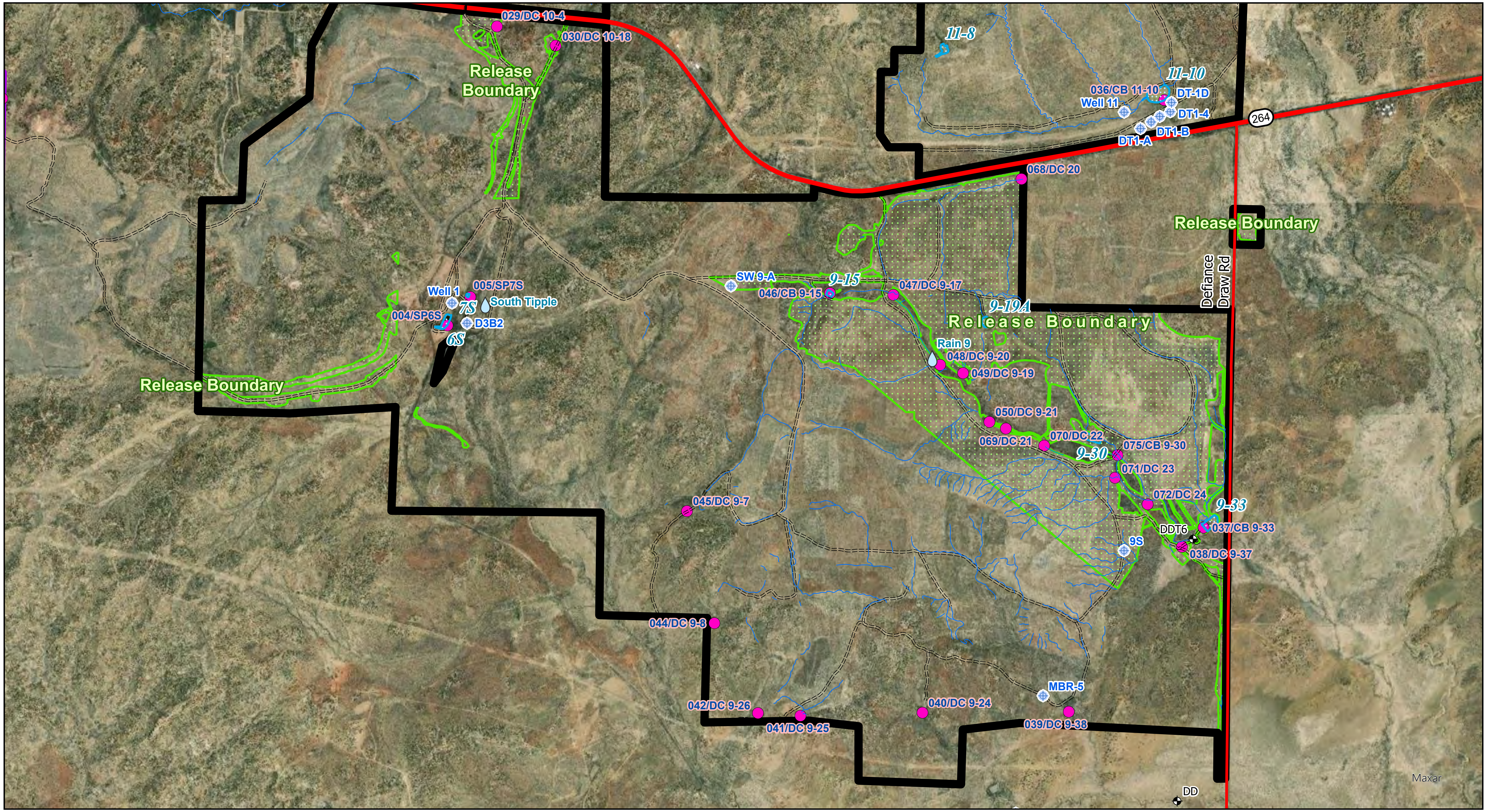
TABLE 5-2. GROUNDWATER QUALITY SUMMARY WELL 1 (2013-2022)
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Station ID	Date Sampled	Alkalinity mg/L $CaCO_3$	Bicarbonate mg/L $CaCO_3$	Boron, Total mg/L	Calcium, Dissolved mg/L	Calcium, Total mg/L	Carbonate mg/L $CaCO_3$	CAT_AN_BAL %	Chloride mg/L	Fluoride mg/L	Hardness, Total mg/L $CaCO_3$	Iron, Dissolved mg/L	Iron, Total mg/L	Magnesium, Dissolved mg/L	Magnesium, Total mg/L	Manganese, Dissolved mg/L	Manganese, Total mg/L	Station ID	Date Sampled
Well 1	3/20/2013	145	145		63.5		ND (2)	4.67	3.7	ND (0.5)			2.57	13.9			0.118	Well 1	3/20/2013
Well 1	5/23/2013	152	152		62.1		ND (2)		4.2	0.48 (J)			1.12	13.5			0.11	Well 1	5/23/2013
Well 1	8/22/2013	154	154		62		ND (2)	3.30	4	ND (0.5)			1.41	13.6			0.107	Well 1	8/22/2013
Well 1	11/7/2013	150	150		64		ND (2)	35.15	3.7	ND (0.5)			1.67	14.2			0.121	Well 1	11/7/2013
Well 1	3/19/2014	152	152		63.9		ND (2)	5.06	4.1	ND (0.5)	212		1.63	14.2			0.115	Well 1	3/19/2014
Well 1	4/15/2014	155	155		69.3		ND (2)	9.48	3.8	ND (0.5)	235		1.69	15.1			0.114	Well 1	4/15/2014
Well 1	9/9/2014	154	154		64.3		ND (2)	4.53	4.1	0.36 (J)	232		1.60	13.9			0.115	Well 1	9/9/2014
Well 1	10/22/2014	155	155		65.8		ND (2)	6.05	3.9	ND (0.5)	221		1.83	14.8			0.124	Well 1	10/22/2014
Well 1	2/10/2015	152	152		69		ND (2)	6.57	3.4	ND (0.5)	238		1.92	15.4			0.121	Well 1	2/10/2015
Well 1	4/29/2015	153	153		66.2		ND (2)	5.29	4.4	ND (0.5)	237		1.48	14.9			0.117	Well 1	4/29/2015
Well 1	9/2/2015	145	145		68.5		ND (2)	5.84	4.4	ND (0.5)	252		1.61	15.4			0.122	Well 1	9/2/2015
Well 1	11/3/2015	144	144		72.2		ND (2)	8.49	3.6	ND (0.5)	227		1.65	16.2			0.125	Well 1	11/3/2015
Well 1	3/9/2016	149	149		67.9		ND (2.0)		4	0.27	257		1.95	15.2			0.128	Well 1	3/9/2016
Well 1	6/24/2016	148	148		70.2		ND (5.0)		4.3	0.33	251		1.82	15.9			0.129	Well 1	6/24/2016
Well 1	7/28/2016	149	149		68.3		ND (5.0)		4.3	ND (0.50)	252		1.6	15.4			0.12	Well 1	7/28/2016
Well 1	11/9/2016	151	151		65.2		ND (5.0)		4.3	0.46	250		1.51	14.5			0.118	Well 1	11/9/2016
Well 1	3/3/2017	154	154		72		ND (1.7)	56.77	4.4	0.47	301		1.93	16.1			0.13	Well 1	3/3/2017
Well 1	6/7/2017	148	148		70.9		ND (1.7)	8.76	3.6	0.45	265		1.62	15.8			0.123	Well 1	6/7/2017
Well 1	9/13/2017	144	144		64.7		ND (1.7)	2.64	4.2	ND (0.25)	228		1.75	15.2			0.125	Well 1	9/13/2017
Well 1	11/16/2017	148	148		62.8		ND (1.7)	0.81	4.2	0.38	217		1.33	14.2			0.115	Well 1	11/16/2017
Well 1	2/21/2018	145	145		69.2		ND (1.7)	4.15	4.1	0.32	241		1.91	15.4			0.13	Well 1	2/21/2018
Well 1	5/17/2018	142	142		69.5		ND (1.7)	7.56	4.3	0.53	229		1.46	15.5			0.119	Well 1	5/17/2018
Well 1	9/13/2018	149	149		68.3		ND (1.7)	5.08	3.9	0.49	229		1.82	15.4			0.129	Well 1	9/13/2018
Well 1	11/14/2018	152	152		66.8		ND (1.7)	3.11	4.2	0.39	226		1.41	15.1			0.122	Well 1	11/14/2018
Well 1	2/28/2019	151	151		69.2		ND (1.7)	0.128	3.9	0.69	225		1.78	15.4			0.128	Well 1	2/28/2019
Well 1	5/14/2019	146	146		71.6		ND (1.7)	0.124	4.2	0.97	269		1.8	15.6			0.124	Well 1	5/14/2019
Well 1	8/20/2019	150	150		71.7		ND (2.6)	0.124	4.8	0.64	244		1.12	16.2			0.124	Well 1	8/20/2019
Well 1	11/13/2019	151	151		67.5		ND (2.6)	0.113	4.2	0.51	264		1.02	15.5			0.113	Well 1	11/13/2019
Well 1	2/19/2020	149	149		68.5		ND (2.6)	4.16	3.8	0.56	254		1.15	15.2			0.121	Well 1	2/19/2020
Well 1	6/3/2020	150	150		65		ND (8)	9.53	4.3	0.68	280		1.3	14			0.12	Well 1	6/3/2020
Well 1	7/30/2020	150	150		69		ND (8)	3.94	4.6	ND (0.25)	250		1.3	16			0.12	Well 1	7/30/2020
Well 1	11/4/2020	150	150		71		ND (8)	5.43	4.1	0.42	270		1.2	15			0.12	Well 1	11/4/2020
Well 1	2/24/2021	160	160		71		ND (8)	5.53	4.9	0.46	260		1.7	16			0.13	Well 1	2/24/2021
Well 1	5/11/2021	158	158		71		ND (2)	5.35	3.6	ND (0.28)	240		1.1	16			0.11	Well 1	5/11/2021
Well 1	8/10/2021	166	166		69		ND (2)	5.85	5.3	ND (0.28)	240		1.6	16			0.12	Well 1	8/10/2021
Well 1	11/4/2021	151	151		69		ND (2)	5.71	3.7	0.36	240		1.4	16			0.12	Well 1	11/4/2021
Well 1	2/10/2022	150	150		68		ND (2)	4.70	4.0	ND (0.5)	220		1.8	16			0.12	Well 1	2/10/2022
Well 1	4/26/2022	149	149		72		ND (2)	7.18	3.3	0.27	240		1.2	16			0.12	Well 1	4/26/2022
Well 1	8/31/2022	176	176		62		ND (2)	4.74	7.0	0.71	210		3.1	15			0.12	Well 1	8/31/2022
Well 1	12/7/2022	150	150		66		ND (2)	4.75	3.7	ND (0.5)	250		2.0	15			0.13	Well 1	12/7/2022
Water Quality Standards		None	None	None	None	None	None	None	250	1.6	None	1	None	None	None	0.2	None	Water Quality Standards	

TABLE 5-2. GROUNDWATER QUALITY SUMMARY WELL 1 (2013-2022)
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

Station ID	Date Sampled	Nitrogen, Nitrate mg/L	Nitrogen, Nitrite mg/L	pH, Field SU	Phosphate mg/L	Phosphorus, Total mg/L	Potassium, Total mg/L	Selenium, Dissolved mg/L	Selenium, Total mg/L	Sodium, Dissolved mg/L	Sodium, Total mg/L	Sodium Adsorption Ratio	Sulfate mg/L	Zinc, Dissolved mg/L	Zinc, Total mg/L	Total Dissolved Solids mg/L	Turbidity SU
Well 1	3/20/2013			7.5		ND (0.1)				32.2		0.95	136			370	10
Well 1	5/23/2013			7.5		ND (0.1)				33.1			134			348	11.2
Well 1	8/22/2013			7.3		ND (0.1)				31.6		0.95	130			349	6.1
Well 1	11/7/2013			7.3	ND (0.31)					32.7		0.96	131			357	7.1
Well 1	3/19/2014			7.6	ND (0.31)					33.9		1.00	133			382	5.9
Well 1	4/15/2014			7.4	ND (0.31)					36.8		1.04	128			361	9
Well 1	9/9/2014			7.6	ND (0.31)					33.9		1.00	133			356	8.3
Well 1	10/22/2014			7.2	ND (0.31)					34.4		1.00	133			378	11
Well 1	2/10/2015			7.8	ND (0.31)					34.8		0.99	143			408	13.5
Well 1	4/29/2015			7.5	ND (0.31)					33.8		0.98	138			351	12.8
Well 1	9/2/2015			7.7	ND (0.31)					34.2		0.97	149			415	17.8
Well 1	11/3/2015			7.3	ND (0.31)					35.2		0.97	149			444	6.3
Well 1	3/9/2016			7.7	ND (0.31)					33.6			150			385	20.8
Well 1	6/24/2016			7.4	ND (0.31)					33.4			153			379	3.1
Well 1	7/28/2016			7.5	ND (0.31)					32.7			159			428	11.7
Well 1	11/9/2016			7.3	ND (0.31)					31.7			174			399	9.8
Well 1	3/3/2017			7.5	ND (0.25)			5.15		34.9		10.29	152			371	13.9
Well 1	6/7/2017			7.6	ND (0.25)			5.14		34.5		0.96	138			396	4.8
Well 1	9/13/2017			7.6	ND (0.25)			4.96		32		0.93	154			384	0.2
Well 1	11/16/2017			7.4	ND (0.25)			4.54		31.4		0.93	150			373	7.3
Well 1	2/21/2018			7.6	ND (0.25)			5.08		34.5		0.98	160			432	16
Well 1	5/17/2018			7.6	ND (0.25)			5.11		34.5		0.97	144			368	13
Well 1	9/13/2018			8.1	ND (0.25)			5.09		34.2		0.97	149			328	6.3
Well 1	11/14/2018			7.5	ND (0.25)			4.86		32.8		0.94	150			397	16
Well 1	2/28/2019			7.0	ND (0.25)			5.19		34		0.96	155			389	6.2
Well 1	5/14/2019			7.0	ND (0.25)			5.12		34.2		0.95	152			395	11
Well 1	8/20/2019			6.8	ND (0.25)			5.11		34.4		0.95	145			412	12
Well 1	11/13/2019			7.1	ND (0.25)			4.92		32.8		0.94	151			385	8.8
Well 1	2/19/2020			6.8	ND (0.25)			5.07		33.3		0.95	152			402	12
Well 1	6/3/2020			7.0	ND (0.25)			4.6		33		0.97	220			370	19
Well 1	7/30/2020			7.1	ND (0.25)			5.0		35		0.99	160			400	7.6
Well 1	11/4/2020			7.0	ND (0.25)			4.9		34		0.96	150			380	11
Well 1	2/24/2021			7.3	ND (0.25)			5.3		37		1.03	150			360	12
Well 1	5/11/2021			7.3	ND (2)			5.1		34		0.95	150			395	12
Well 1	8/10/2021			7.5	ND (2)			4.8		48		1.35	160			372	14
Well 1	11/4/2021			7.4	ND (2)			5.0		35		0.99	150			387	6.2
Well 1	2/10/2022			7.5	ND (2.5)					33		0.94	150			398	7.0
Well 1	4/26/2022			7.0	ND (0.5)					35		0.97	150			396	7.2
Well 1	8/31/2022			7.0	ND (2.5)					61		1.80	160			438	25
Well 1	12/7/2022			7.4	ND (2.5)					37		1.07	150			387	18
Water Quality Standards		10	1	6.0 - 9.0	None	None	None	None	0.05	None	None	None	600	None	10	1,000	None

FIGURES



EXPLANATION

NPDES OUTFALL (JAN. 2019)	DRAINAGE
WATER WELL	HIGHWAY
STREAM MONITORING STATION	ANCILLARY ROAD
WEATHER MONITORING STATION	TWO TRACK TRAIL
POND	
MMD BOUNDARY	
AREA 9 NORTH RELEASE AREA	

N

0 2,500'

Trihydro CORPORATION

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

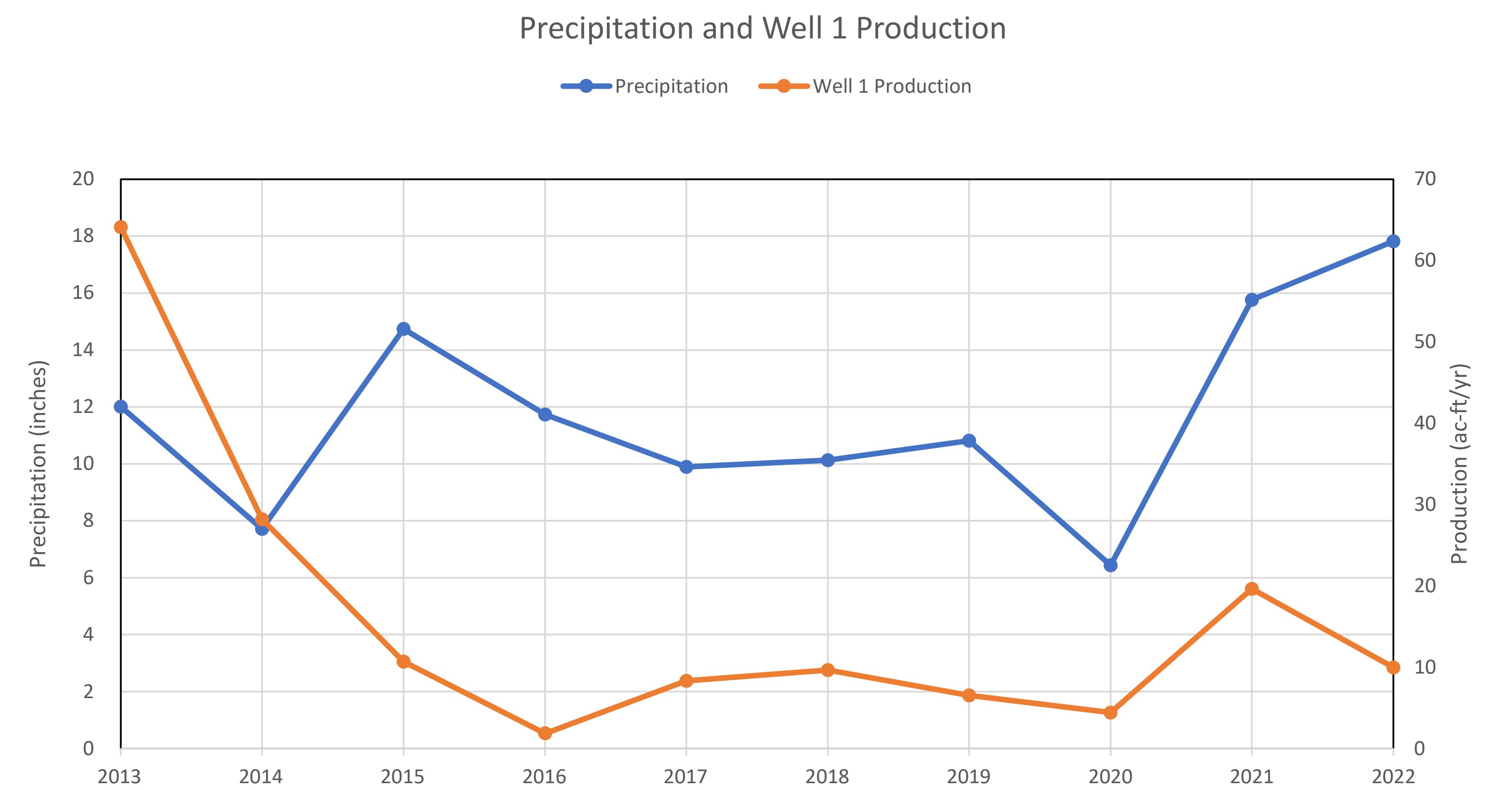
FIGURE 2-1

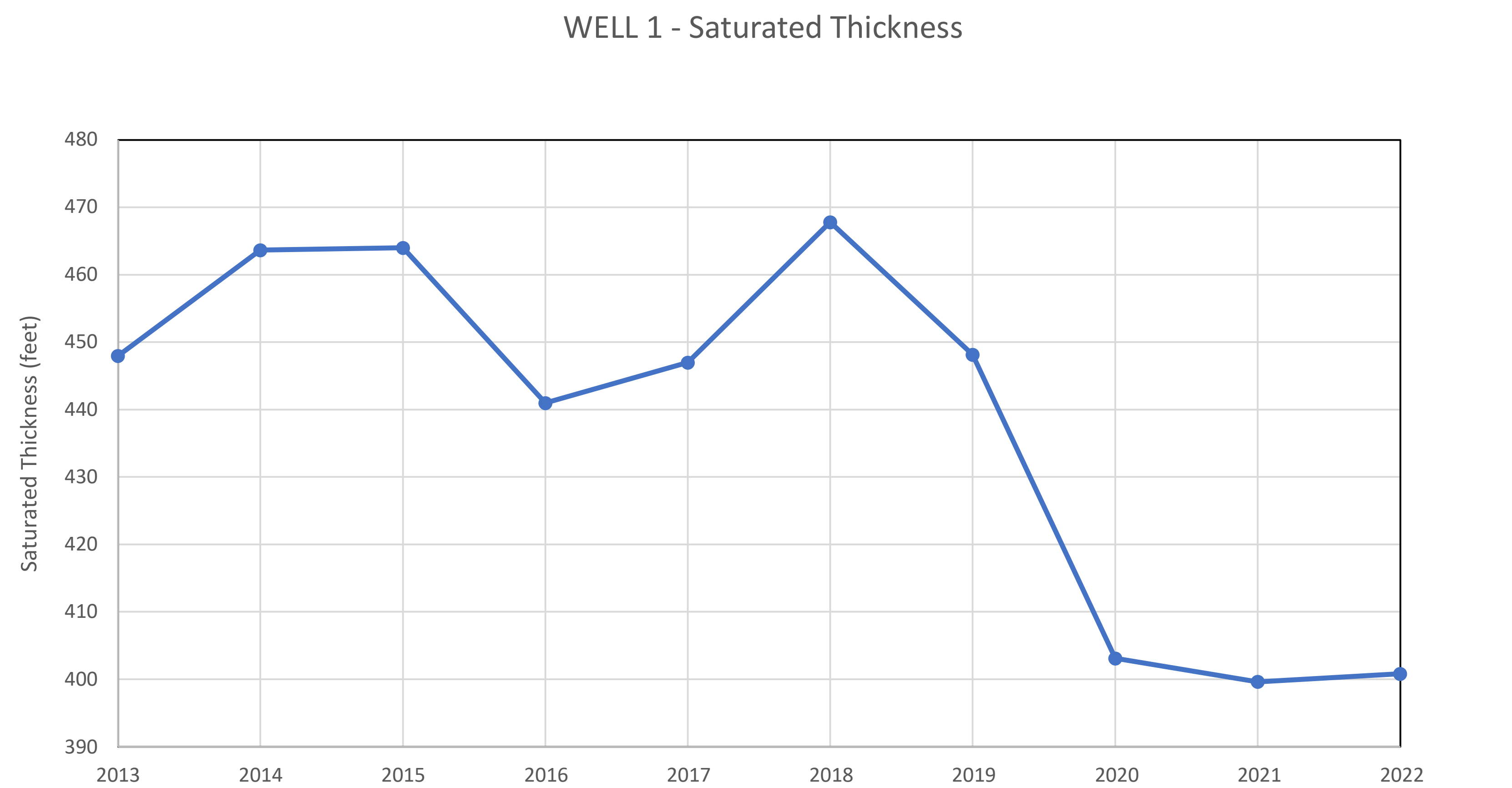
AREA 9 NORTH PROPOSED BOND RELEASE AREAS

CHEVRON MINING INC.
MCKINLEY MINE
MCKINLEY COUNTY, NEW MEXICO

Drawn By: BR	Checked By: TH	Scale: 1" = 2,500'	Date: 5/30/23	File: 2_Area9North

FIGURE 5-1. SATURATED THICKNESS, PRECIPITATION, AND PRODUCTION DATA
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO





APPENDIX A

MCKINLEY MINE PERMIT SECTION 3.4, HYDROLOGY INFORMATION

3.4 HYDROLOGY INFORMATION

3.4.1 BACKGROUND

GENERAL INFORMATION

The McKinley Mine area is semiarid with annual precipitation averaging 11 inches. Normally, more than half of the annual precipitation falls during the months of July through October. Generally, this precipitation is received as rainfall from intense, localized thunderstorms that occur sporadically in the area.

The average annual pan evaporation rate is 70 to 75 inches which, when adjusted for pond conditions is 47 to 50 inches. Water quickly evaporates from surface reservoirs and to a very limited extent infiltrated upper soil zones. A study completed by P&M and provided in the Baseline/Background - Soil Information volume contains detailed information documenting the nature of the soil-water deficit.

In 1979/1980 a hydrology study of the McKinley Mine was conducted by Geohydrology Associates, Inc. In 1983, Geohydrology Associates, Inc. provided P&M with the computations for the unit hydrographs provided in the 1981 report. In 1980, a report entitled "A Literature Review Mined-Land Sediment Control and the Dryland Fluvial System" was prepared for P&M by the Research Institute of Colorado. Copies of these reports are located in the hydrology background volume.

SURFACE WATER RESOURCES

All surface water flows in the mine area are ephemeral. There are no known streams containing biological communities per CSMC Rule 80-1 Part 20-57(c) downstream of the mine within reasonable distances. Undisturbed area surface water quality is moderately poor relative to chemical quality, and extremely poor relative to physical quality. Surface runoff from the McKinley Mine indicates suspended solids contents for flow events ranging from 6,000 milligrams per liter to just under 250,000 milligrams per liter.

The rainfall patterns (intense localized thunderstorms) that occur in this geographic area, in combination with the inherent geomorphological characteristics, result in extremely high soil erosion rates. This in turn equates to tremendous suspended solids levels in the runoff. The soil chemistry and geomorphology contribute to the high levels of dissolved solids, salinity and alkalinity. Additional discussions concerning surface water resources are provided in Section 4.7.

GROUNDWATER RESOURCES

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 in the area is the Gallup Sandstone Aquifer. This 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 McKinley Mine. Additional discussions concerning ground water resources are provided in Section 4.7.

3.4.2 WATER RIGHTS

SURFACE

A search of the records of surface water rights maintained by the State Engineer's Office shows that within the McKinley Mine Lease boundary, the only known existing surface water rights are owned by P&M. These rights, File 3294, approved December 14, 1972, have a diversion point on the Tse Bonita Wash at the northeast corner of the NE¼, NE¼, Sec 5, T16N, R20W, and are for 20 acre-feet per year. There are no other owners of surface water rights recorded within five miles of the lease boundary.

GROUNDWATER

Groundwater rights in the Gallup basin were not required prior to declaration of that basin on March 5, 1980. Since then, P&M has made the following declarations:

- (SE¼, SW¼, NW¼, Sec 17, T16N, R20W) 1,005.2 ac-ft/annum (File No. G-87)
- (NE¼, SW¼, SW¼ Sec 29, T17N, R20W) 634 ac-ft/annum (File No. G-88)
- (SE¼, NW¼, SW¼ Sec 5, T16N, R20W) 795.8 ac-ft/annum (FileG89)
- (NE¼, SW¼, NW¼ Sect 17, T16N, R20W) 6.5 ac-ft/annum (File No. G-90)
- (NW¼, SW¼, NW¼ Sec 26, T16N, R20W) 29 ac-ft/annum (File No. G-91)
- (NE¼, NE¼, SW¼ Sec 4 T16N, R20W) 16.1 ac-ft/annum (File No.G-92)
- (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)

3.4.3 HYDROLOGIC MODELING

The Baseline/Background - Hydrologic Information volume (BBHIV) contains modeling information which characterizes and contrasts surface water quality and quantity for medium sized watersheds in undisturbed, disturbed, and reclaimed conditions.

3.4.4 PROBABLE HYDROLOGIC CONSEQUENCES (PHC)

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 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 BBHIV 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 the stabilization of the reclamation areas and the creation of small post-mining 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 this application. The models show that the per acre sediment yields from the mining and postmining areas will be less than the premining areas.

Chemical Quality

Surface water chemical quality will be unaffected or could possible 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 are of poor quality, and naturally occurring exposed coal seams. The PATFM Management program, which is discussed in Sections 5.2 and 6.6, will identify graded spoil areas that have acid or toxic materials present in or near the top 48 inches (rooting zone) of spoil. 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 soilds, salinity, and alkalinity.

GROUNDWATER QUANTITY

Gallup Sandstone Aquifer

As discussed above, the Gallup Sandstone Aquifer that 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. As noted in the Technical Analyses and Environmental Assessment performed by the OSMRE on Permit No. NM- 0001B/3-10P, and adopted by the director of MMD, there may be a small amount of draw down due to usage associated with coal mining activities, but this draw down is insignificant in comparison to the City of Gallup and Navajo Nation consumption impacts.

To further substantiate this information and to show current information pertaining to the Gallup Sandstone formation, P&M has 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 the BBHIV 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 new map showing the current potentiometric surface of the Gallup Aquifer. This map has been included in this application as Exhibit 3.4-2. Elevations of the potentiometric surface of the Gallup Sandstone Aquifer have been modified to reflect the 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. P&M has been unable to gather information on any of the other wells in the area due to a lack of ownership. Therefore, the information provided is the most complete and accurate available.

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. 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

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.

GROUNDWATER QUALITY

Gallup Sandstone Aquifer

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.

Alluvial Aquifers

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.

3.4.5 CUMULATIVE HYDROLOGIC IMPACT ASSESSMENT

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, and adopted by the Director of MMD, 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 soilds (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.

- Ground water is an important source of water in the Gallup area. The major ground water pumping centers are at the Santa Fe and Yah-ta-hey well fields, both completed in the Gallup Sandstone and operated by the city of Gallup. Other users of the Gallup Aquifer include the McKinley and Mentmore mines north west of Gallup. Shallow ground water is not widely used owing to the relatively poor chemical quality and small well yields.

- Cumulative impacts related to ground-water quality are not expected: ground-water 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.

  Ground-water quantity in the Gallup aquifer may be affected by the cumulative impacts of mining, particularly if declared water rights are fully used by P&M. 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 hydraulic head, is predicted as a result of surface coal mining.

Thus, based upon the report, P&M feels that any impacts which have or will occur on the hydrologic systems at the McKinley Mine are insignificant.

3.4.6 DEVELOPED WATER RESOURCES

All identified developed water resources in the proposed permit area and within 1000 feet of the proposed permit boundary are shown on Exhibit 3.4-3 and are listed in Tables 3.4-1 and 3.4-2. A total of 55 developed water resources were identified:

- 18 wells;
- 20 impoundments;
- 10 storage tanks;
- 2 cisterns;

- 2 windmills;
- 1 spring;
- 1 watering trough; and
- 1 pipeline.

Thirty one of the developed water resources are within the permit boundary and 23 are within 1000 feet of the permit boundary. One developed water resource, the NTUA pipeline, is located both outside and inside the proposed permit area.

SURFACE WATER RESOURCES

Developed surface water resources in the proposed permit area and within 1000 feet of the proposed permit boundary consist of 18 impoundments and 2 cisterns. The 18 impoundments are used for harvesting water from precipitation events. The two cisterns are associated with Impoundment 31. Table 3.4-1 provides a listing of these structures along with their associated coordinates.

Thirteen of the impoundments (Nos. 12, 13, 14, 15, 16, 17, 19, 22, 23, 24, 31, 32, and 33) and the two cisterns are located within the proposed permit area. Of these developed water resources, only ten impoundments (Nos. 12, 13, 14, 15, 16, 17, 19, 22, 23, and 24) will be disturbed during the life of operations in this application. These impoundments will be replaced with stock ponds as shown on Exhibit 5.6-2 during final reclamation.

TABLE 3.4-1
DEVELOPED SURFACE WATER RESOURCES

ID#	DESCRIPTION	NORTHING	EASTING
11	Impoundment	1,697,985	177,374
12	Impoundment	1,694,686	174,879
13	Impoundment	1,693,735	175,646
14	Impoundment	1,692,544	176,124
15	Impoundment	1,692,011	174,862
16	Impoundment	1,691,236	174,871
17	Impoundment	1,691,052	175,149
19	Impoundment	1,686,502	172,716
22	Impoundment	1,684,310	172,871
23	Impoundment	1,684,253	175,964
24	Impoundment	1,682,725	175,078
31	Impoundment	1,680,006	176,880
31A	Cistern	1,679,694	177,031
31B	Cistem	1,679,779	177,337
32	Impoundment	1,675,475	176,282
33	Impoundment	1,672,150	173,462
34	Impoundment	1,673,635	162,954
35	Impoundment	1,671,459	165,024
37	Impoundment	1,670,010	168,053
38	Impoundment	1,669,920	171,666

Four impoundments (Nos. 34, 35, 37, and 38) located outside the permit area are located downslope of Area 9 mining activities and could be impacted temporarily as mining progresses to the east. However, the decrease in recharge capacity to the impoundments will be short term and minimal since post mining contours are designed to recreate original drainage patterns and only a portion of the drainage area to the impoundments will be disturbed. Impoundment 11 will not be affected by mining because it is located on the Navajo Indian Reservation and is upslope of Area 11 mining activities.

GROUND WATER RESOURCES

Developed ground water resources in the proposed permit area and within 1000 feet of the proposed permit boundary consist of 18 wells, 2 impoundments, 10 storage tanks, 1 spring, 2 windmills, 1 watering trough, and the NTUA water pipeline. These water resources are listed in Table 3.4-2 along with their associated coordinates.

Six water storage tanks (Nos. 1A, 5A, 6A, 10A, 20A, 20B), 1 impoundment (No. 10B), 1 watering trough (No. 36), and 2 windmills (Nos. 4A and 10C) are located off the proposed permit area and will not be disturbed.

Location of the NTUA pipeline (No. 39) is shown on Exhibit 3.4-3. The pipeline crosses within the proposed permit area on the eastern boundary parallel to County Road 1. This area will not be disturbed by mining operations.

Storage Tanks 8A, 18A, 21A and 26A and Impoundment 8B are located within the proposed permit area. These storage facilities will not be disturbed by mining operations and will be left in place for post mining use.

A hand dug, concrete-lined gallery known as Claw Springs (No. 9) is the only known bedrock ground water resource identified in the permit area. This site was developed by the Navajo Tribe for use by area residents and their livestock. Claw Springs consists of a concrete-lined water trough, a hand pump, and an overhead loading facility. The facility is in dire need of repair and is not usable in its present condition. Information (e.g. well depth, quantity, and rate of discharge) was not available from the Navajo Tribe. Water samples were collected on February 6, 1990 by P&M. Analytical results from the February 6, 1990 sample and initial sampling conducted in 1980 are provided in the BBHIV.

Table 3.4-3 contains information that has been gathered concerning the intended use, static water level, date measured, date sampled, source of water, and depth drilled for all developed water wells in and within 1000 feet of the proposed permit boundary. Five of the water wells (Nos. 25, 27, 28, 29 and 30) have been plugged with drilling fluids in accordance with New Mexico State Engineer Office guidelines. The remaining 13 wells (Nos. 1, 2, 3, 4, 5, 6, 7, 8, 10, 18, 20, 21, and 26) will not be disturbed by mining activities.

TABLE 3.4-2
DEVELOPED GROUND WATER RESOURCES

WELL ID#	DESCRIPTION	NORTHING	EASTING
1	NTUA Well 18T516	1,698,339	148,768
1A	Water Tank	1,698,359	147,870
2	NTUA Well 18T517	1,698,732	149,891
3	NTUA Well 18T551	1,698,889	154,286
4	Well (Bald)	1,695,175	148,601
4A	Windmill	1,695,407	148,429
5	Well (Mag 7A)	1,688,099	152,022
5A	Water Tank	1,687,746	151,867
6	Well (Mag 7B)	1,689,405	154,430
6A	Water Tank	1,689,321	154,364
7	Well (CDK)	1,691,754	157,629
8	NTUA Well 16T550	1,691,632	167,573
8A	Water Tank	1,691,706	167,649
8B	Impoundment	1,691,748	167,525
9	Claw Spring	1,696,185	168,751
10	NTUA Well 14T509	1,697,936	176,244
10A	Water Tank	1,698,031	176,265
10B	Impoundment	1,697,989	176,015
10C	Windmill	1,697,923	176,109
18	Well (Wilhelm)	1,687,316	177,471
18A	Water Tank	1,687,162	177,429
20	Well (Blackhat)	1,685,759	166,462
20A	Water Tank	1,685,965	166,005
20B	Water Tank	1,685,853	166,178
21	Well (McAvoy)	1,684,677	169,126
21A	Water tank	1,684,724	168,982
25	Well (plugged)	1,683,897	171,649
26	Well (South Tipple)	1,683,897	157,875
26A	Water Tank	1,682,480	157,803
27	Well (plugged)	1,681,514	168,621
28	Well (plugged)	1,681,435	169,841
29	Well (plugged)	1,681,158	168,729
30	Well A-61 (plugged)	1,680,417	168,646
36	Watering Trough	1,670,895	164,471
39	NTUA Water Pipeline	See Exhibit 3.4-3	

Water samples from Wells 7 and 26 were collected on June 20, 1990 by P&M. Analytical results for the two June 20 samples plus NTUA Wells 14T-509 and 16T-550 are provided in the BBHIV.

Wells 7 and 21 are deep wells drilled into the Gallup aquifer by P&M for mine use. Well 26 is a Gallup aquifer well that was developed by a private business prior to P&M purchasing the property around the well. These wells and two storage tanks (Nos. 21A and 26A) will be left in place for post mining use to replace plugged wells. Well construction details for Wells 7 and 26, (a.k.a Well #1 and Well #3) and Gallup aquifer Wells #2 and #3A, which are Gallup aquifer wells drilled by P&M on the North Mine area, have been included as Figures 1 through 4 following this section.

TABLE 3.4-2
SUMMARY OF WATER WELL RESOURCE INFORMATION

WELL ID#	WELL NAME	INTENDED USE OF WATER	STATIC WATER LEVEL	DATE MEASURED	DATE SAMPLED	SOURCE OF WATER	DEPTH DRILLED
1	18T516	HC	488.0	11-23-87	*	GD	1600
2	18T517	HC	448.0	11-23-87	*	GD	1680
3	18T551	HC	493.6	06-09-88	*	GDM	1750
4	Bald	HC	*	*	*	G	700
5	Mag 7A	HC	530	*	*	G	777
6	Mag 7B	HC	*	*	*	G	900**
7	CDK	WHR	503	Sep-77	06-20-90	G	1055
8	16T550	HC	684	08-14-69	04-23-70	GD	1363
10	14T509	HC	36	04-04-59	05-16-66	G	477
18	Wilhelm	HC	*	*	*	G	400
20	Blackhat	HC	Dry	Oct-88	*	G	455
21	McAvoy	HC	*	*	*	G	*
25	Section 15 (plugged)	HC	185	05-15-90	*	G	460
26***	South Tipple 1	HC/WHR	332	Sep-75	06-20-90	G	930
27	Section 15 (plugged)	HC	240	05-14-90	*	G	460
28	Section 15 (plugged)	HC	165	05-15-90	*	G	360
29	Section 15 (plugged)	HC	200	05-15-90	*	G	450
30	Section 15 (plugged)	HC	200	05-14-90	*	G	340

NOTES: HC = Human Consumption, WHR = Watering Haulroads, G = Gallup , D = Dakota, M = Morrison
* = Data not Available, ** = Estimated by John Engles, P&M Land Agent, *** = Measured capacity of South Tipple was 1.75 to 2.00 gallons per minute per linear foot.

ALTERNATE WATER SOURCES

If the Gallup Sandstone aquifer were to be determentally affected by mining, P&M has identified alternate water sources that could be developed to replace existing sources. Information was obtained from Mr. John W. Shomaker, geohydrologist, with John W. Shomaker, Inc. of Santa Fe and Albuquerque.

Alternate water sources available from aquifers that underlie the Gallup Sandstone include the aquifer comprised of the Dakota Sandstone and the Westwater Canyon

Member of the Morrison Formation, and the sequence of sandstone beds of the San Rafael Group, including the Cow Springs Sandstone and the Entrada Sandstone. At still greater depth, the San Andres Limestone-Glorieta Sandstone aquifer is likely to be usable for water supply.

A Dakota-Westwater well is likely to be similar to the City of Gallup's Allan No. 1 or Lewis No. 1 North Well, near Yah-Ta-Hey. These wells reached the base of the Westwater at about 3,450 and 3,200 feet, and had one-day specific capacities of 0.38 and 0.18 gpm per foot of drawdown, respectively. Water quality is indicated by specific conductance, which was 1,260 μmhos for the Allan well, and 1,030 μmhos for the Lewis well.

Drilling depths would depend on location within the P&M lands, but would be on the order of 2,000 feet. Locations as far north and east as possible are likely to provide the best well-yield.

The San Rafael Group aquifer consists of several hundred feet of fine-grained sandstone; drilling depth would be about 3,400 feet to fully penetrate the Entrada. Specific capacity is likely to be similar to that of the Westwater Canyon, but water quality may be somewhat poorer. Analysis of the logs of the Kerr-McGee No. 1 Santa Fe well, about 12 miles southeast of the McKinley Mine, indicated salinity equivalent to about 2,100 mg/l sodium chloride, but a well at the mine would be very close to the Entrada outcrop and water quality can be expected to be better.

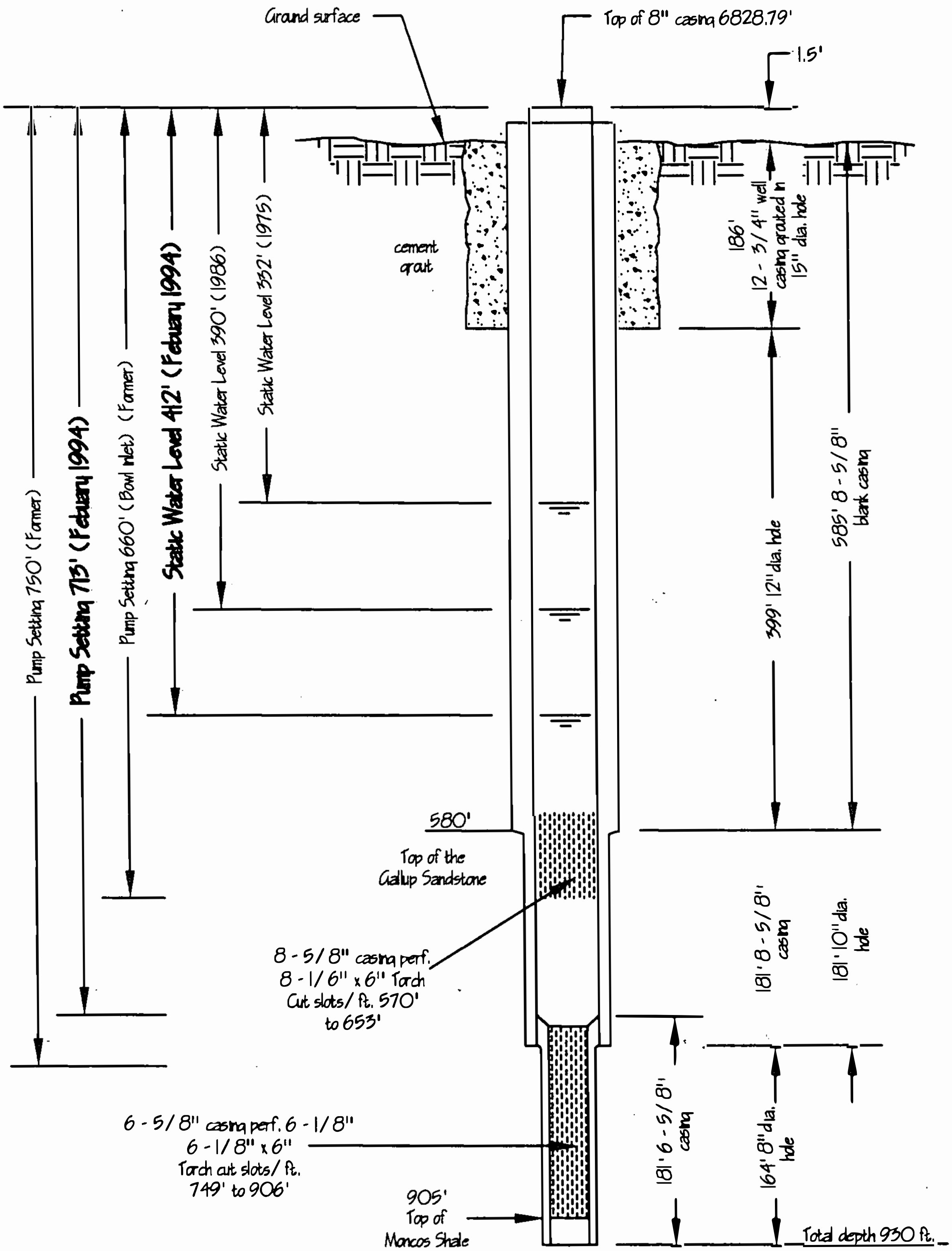
The San Andres-Glorieta aquifer could be completed in a well about 4,000 feet deep. Yield is difficult to estimate, but a specific capacity of 0.1 gpm/ft is a reasonable expectation. Water quality is not known, although in the Kerr-McGee well, the upper part of the aquifer had an apparent salinity equivalent to 4,000 mg/l sodium chloride.

TRANSFER OF WELLS

During this permit term, no water wells are anticipated to be transferred from P&M's control for usage by any other parties. However, should a transfer be contemplated, P&M will apply for approval by both the director of MMD and the State Engineer for the transfer of the well in question.

3.4.7 STREAM BUFFER ZONES

At the McKinley Mine - South there are no channels that are considered to be intermittent; thus, no stream buffer zones are required.



REVISION	DATE	APP'D

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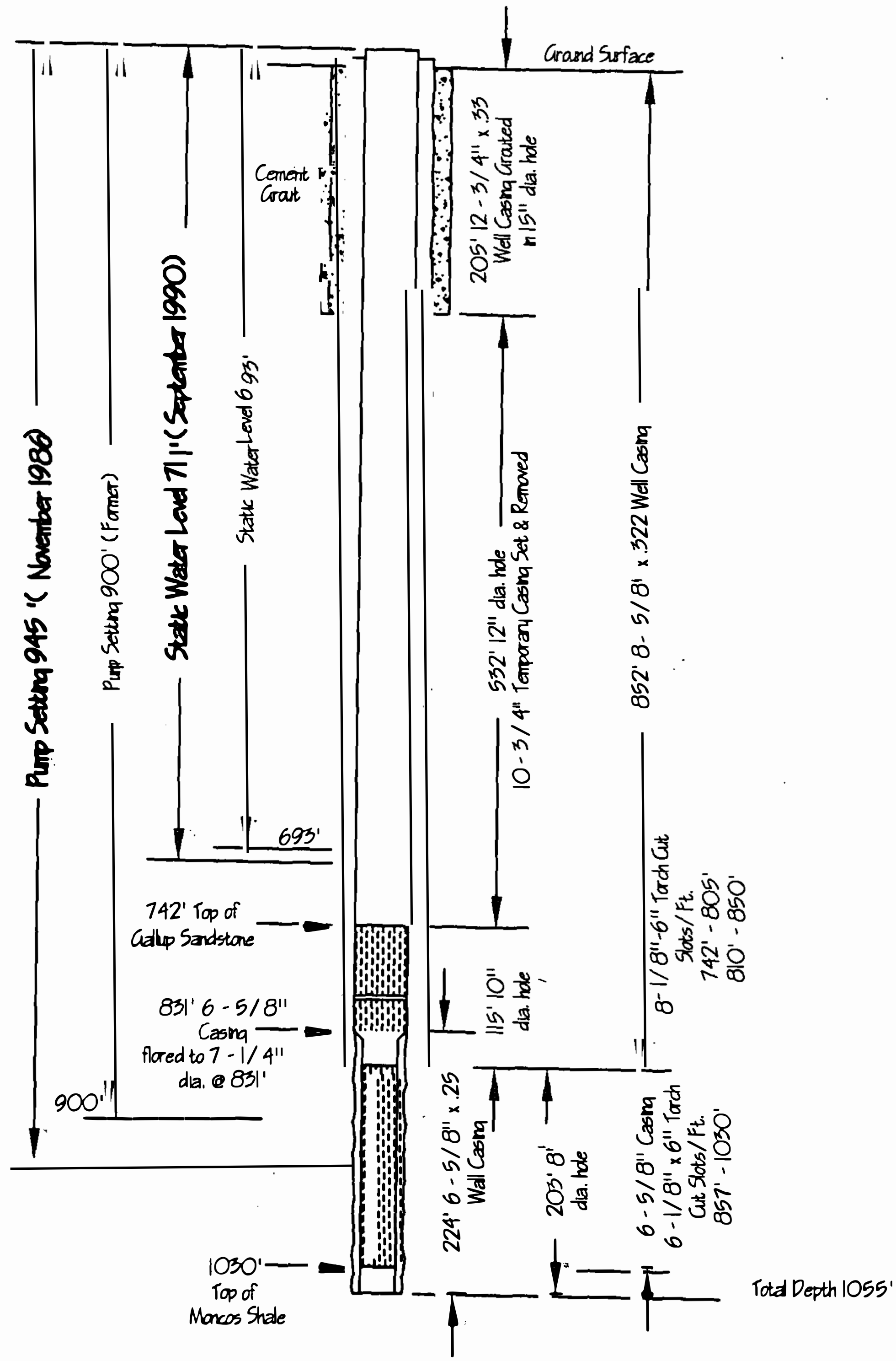
P&M

The Pittsburg & Midway Coal Mining Co.
A Chevron Company
McKINLEY MINE

FIGURE [illegible]H
WELL NO. 1
SCHEMATIC DIAGRAM

Drawn By: A.GRASS
Date Drawn: 2/8/96
Checked By:
Approved By:
Scale: NONE
Drawing No: 0490-1



REVISION	DATE	APP'D

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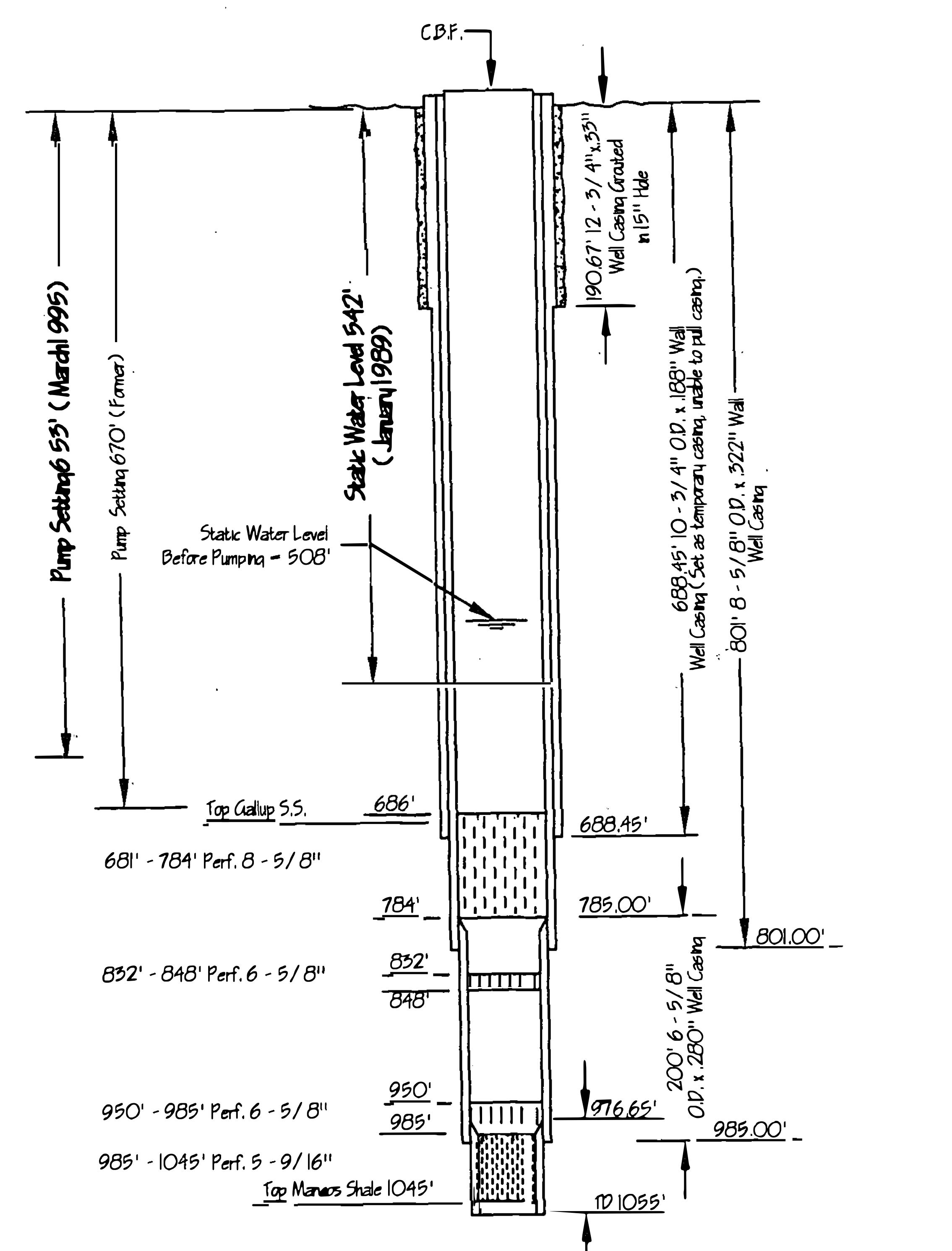
A Chevron Company
McKINLEY MINE

FIGURE [redacted]-2
WELL No. 2
SCHEMATIC DIAGRAM

Drawn By: A.GRASS
Date Drawn: 2/8/96
Checked By:
Approved By:
Scale: NONE
Drawing No: 0490-2



NOTE: All Perforations Are
1/8" x 6" ± Torch Cut
Slots. Slots.

REVISION	DATE	APP'D

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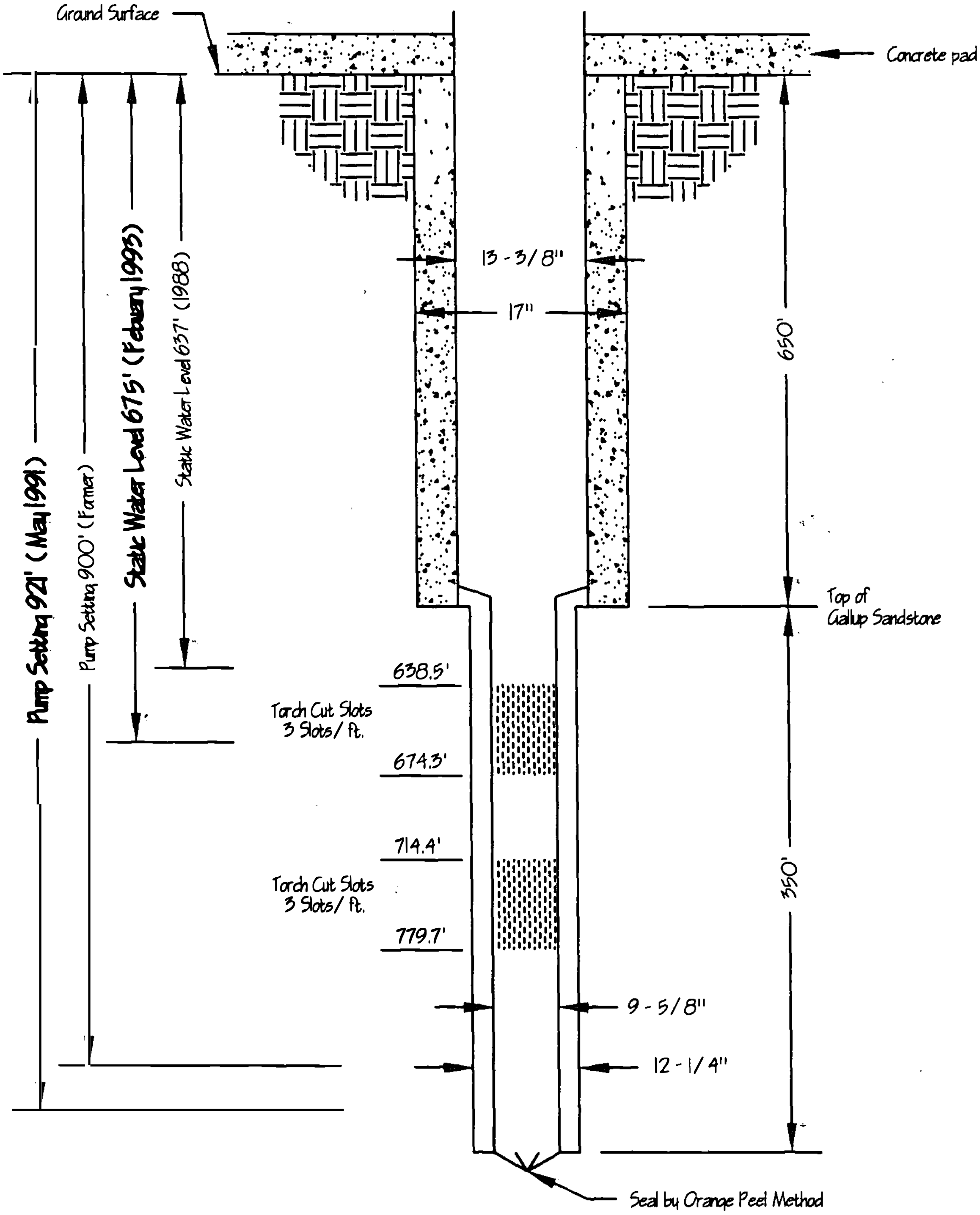
A Chevron Company
McKINLEY MINE

FIGURE [illegible]-3
WELL No. 3
SCHEMATIC DIAGRAM

Drawn By: A.GRASS
Date Drawn: 2/8/96

Checked By:
Approved By:

Scale: NONE
Drawing No: 0490-3



REVISION	DATE	APP'D

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A Chevron Company
McKINLEY MINE

FIGURE [redacted]-4
WELL NO. 3A
SCHEMATIC DIAGRAM

Drawn By: A.GRASS
Date Drawn: 2/8/96

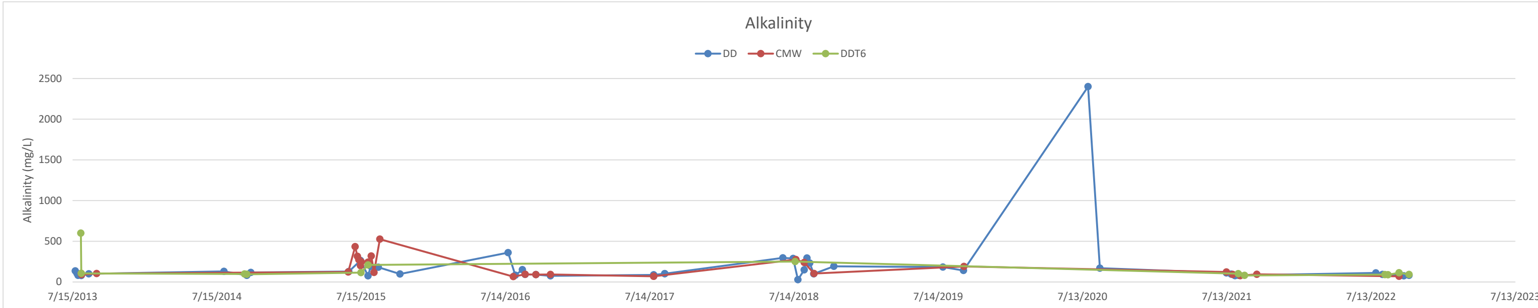
Checked By:
Approved By:

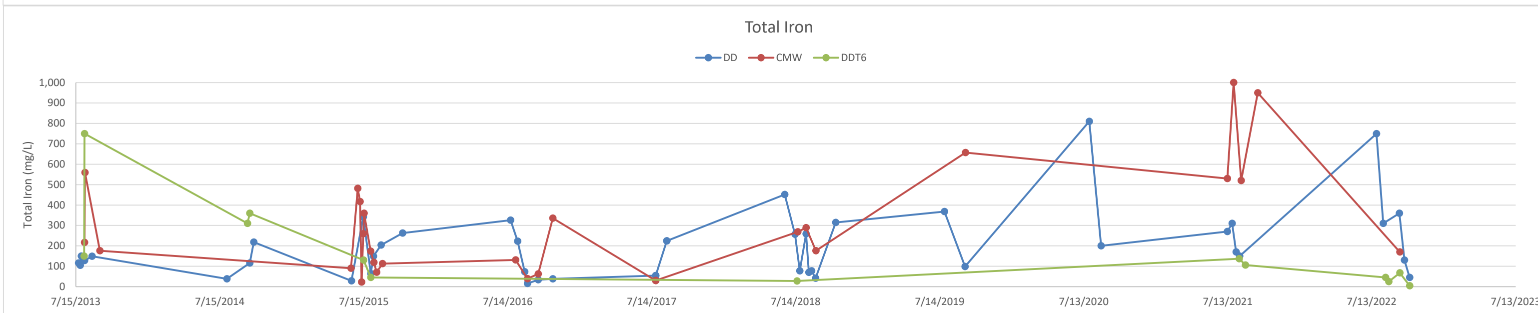
Scale: NONE
Drawing No: 0490-4

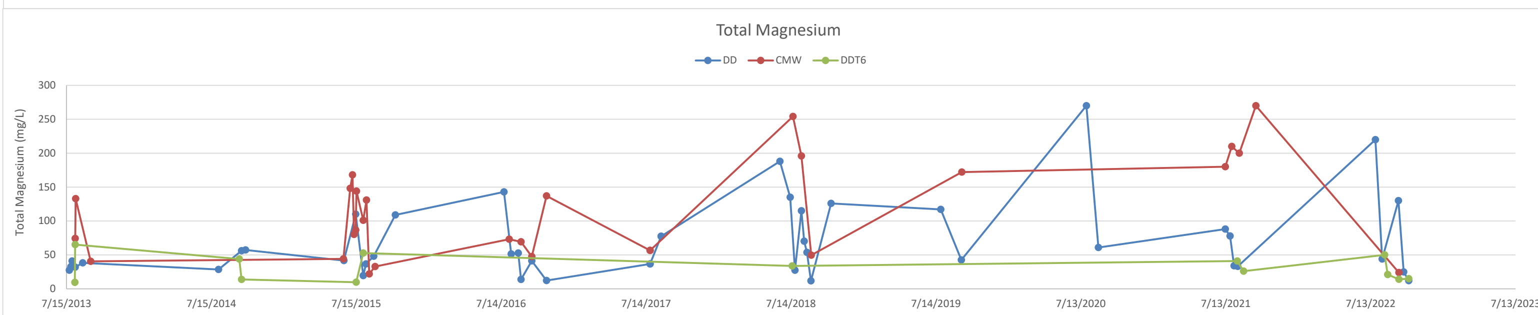
APPENDIX B

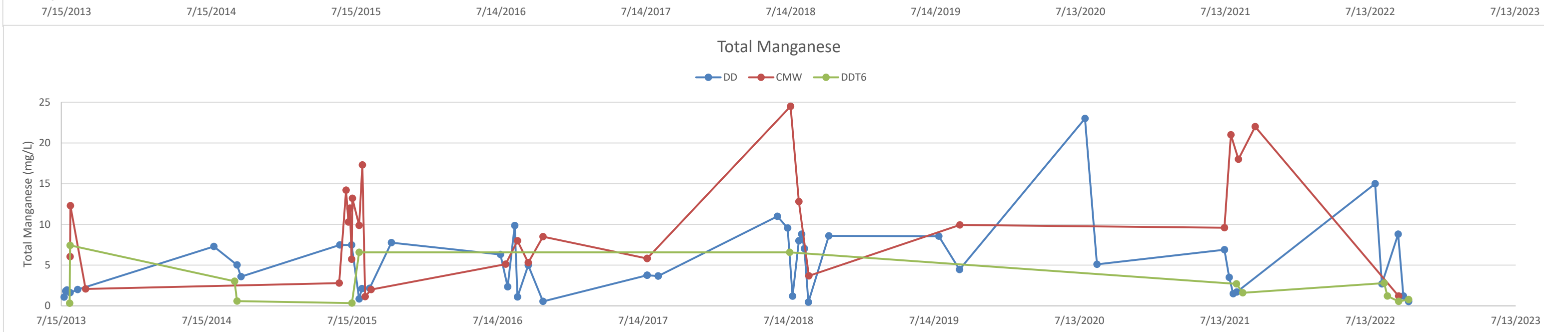
SURFACE WATER QUALITY: TEMPORAL PLOTS

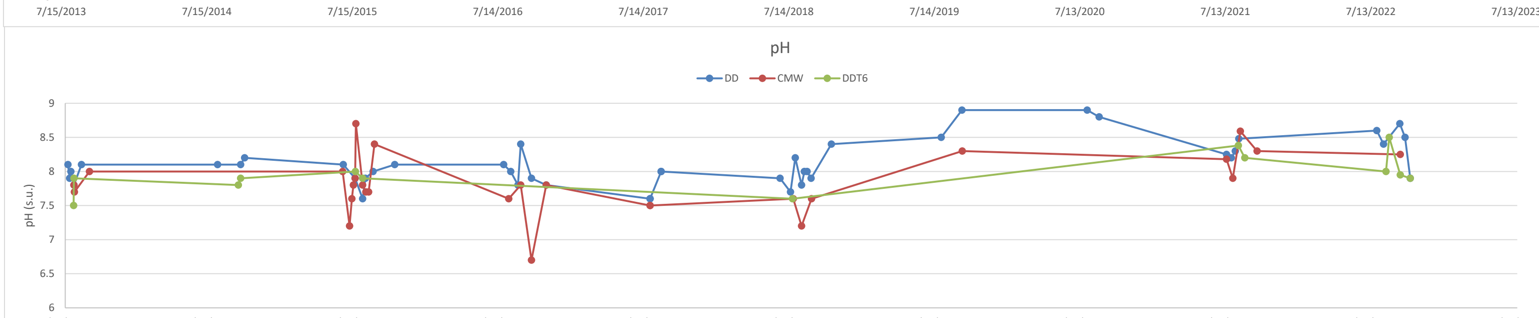
APPENDIX B. SURFACE WATER QUALITY DATA
CHEVRON MINING INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO

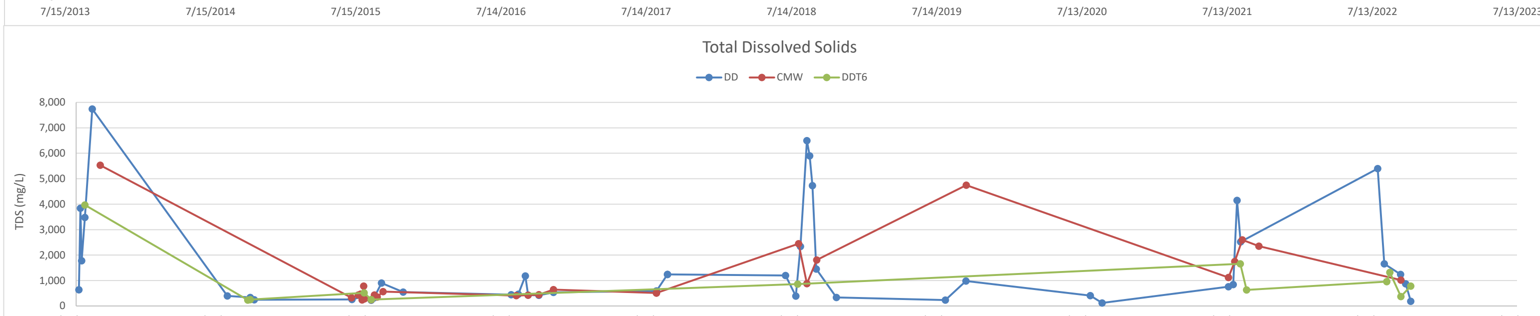


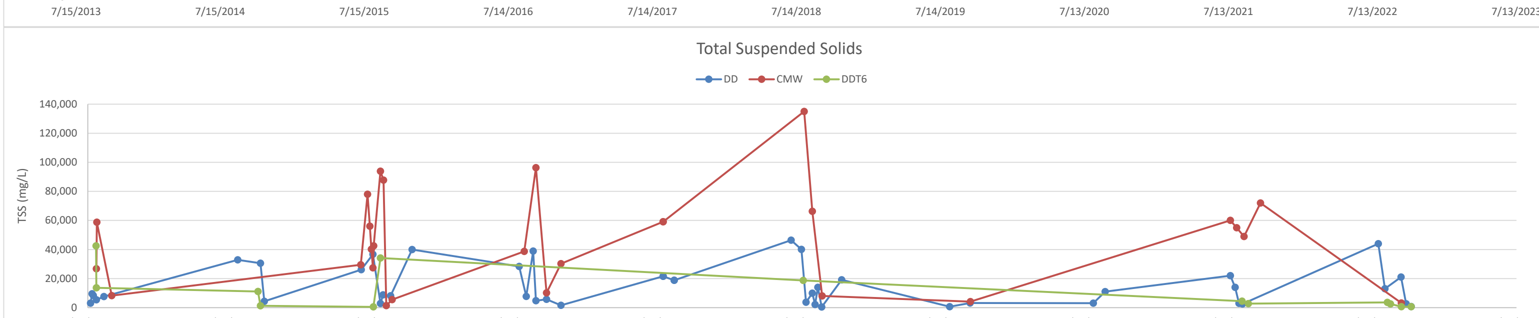


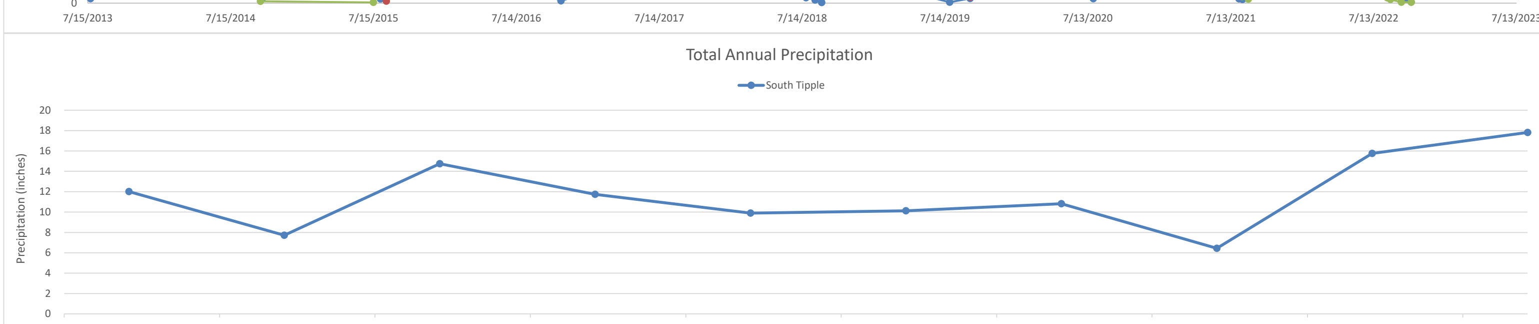


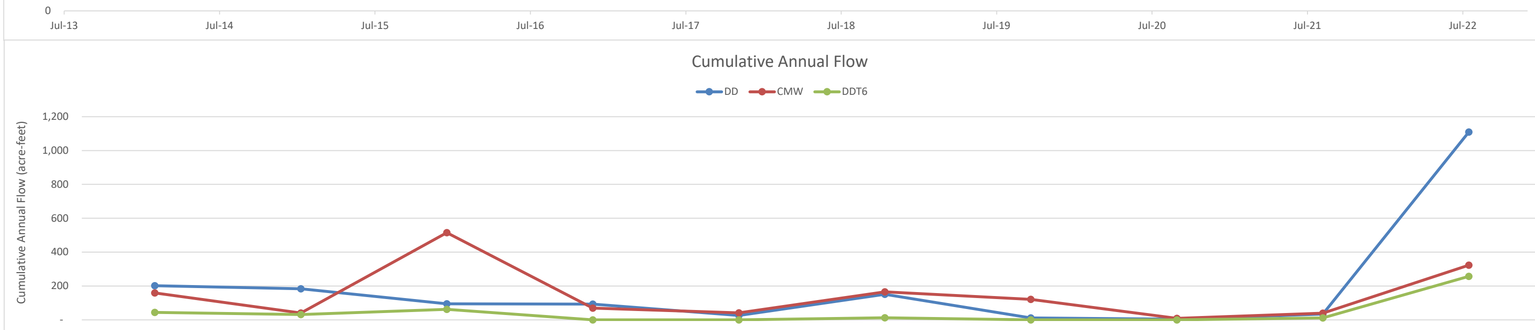








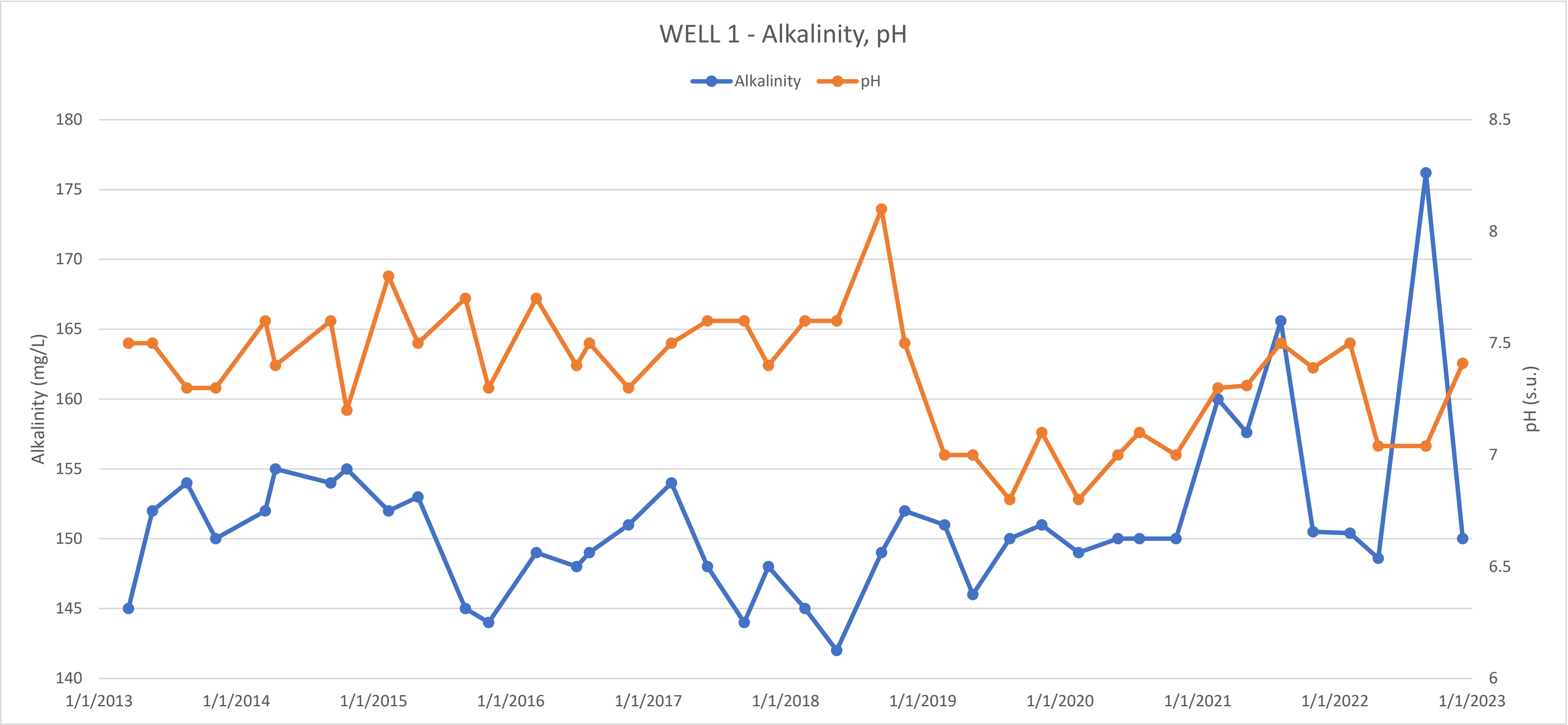




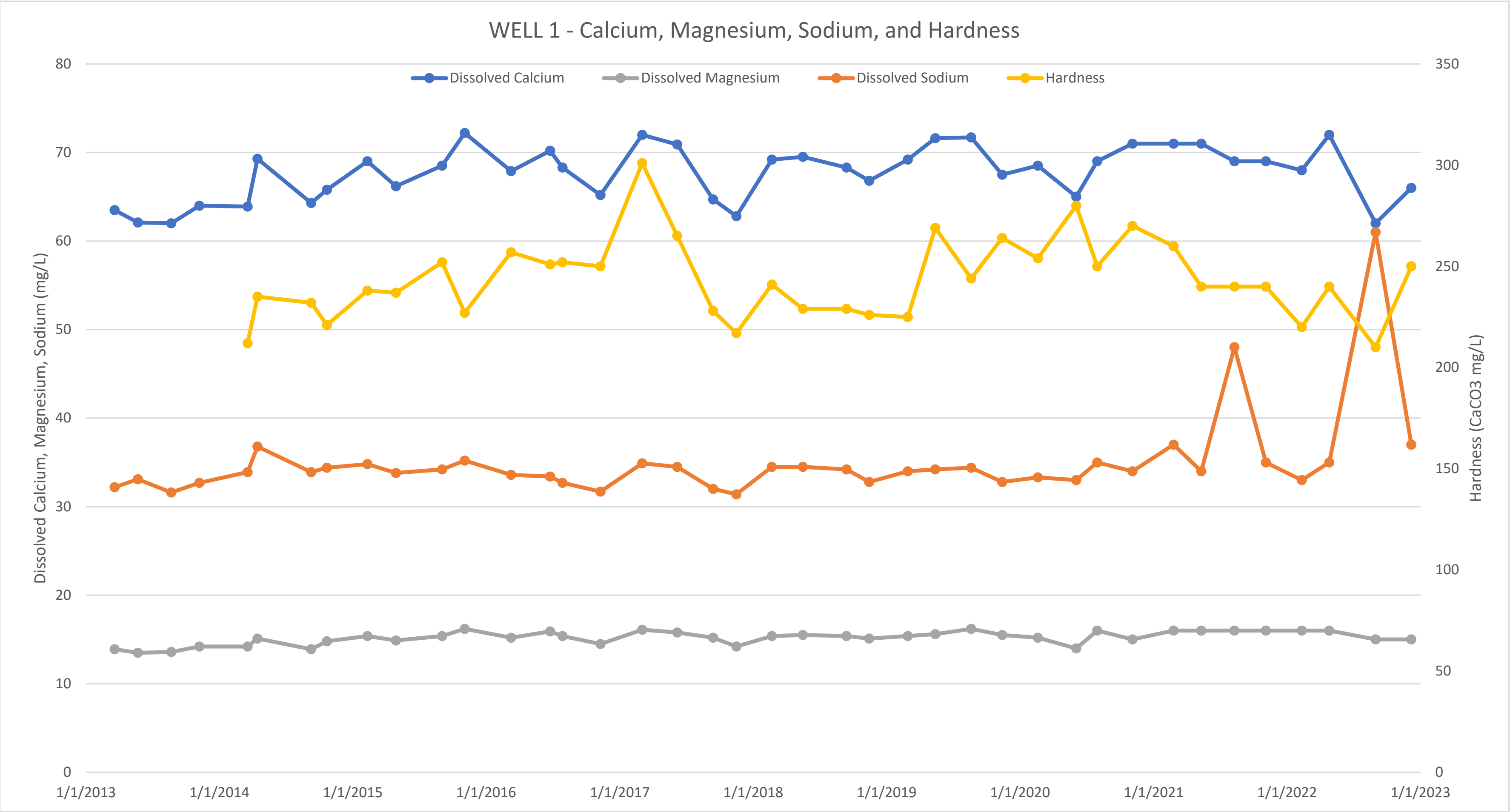
APPENDIX C

GROUNDWATER QUALITY DATA: WELL 1TEMPORAL PLOTS

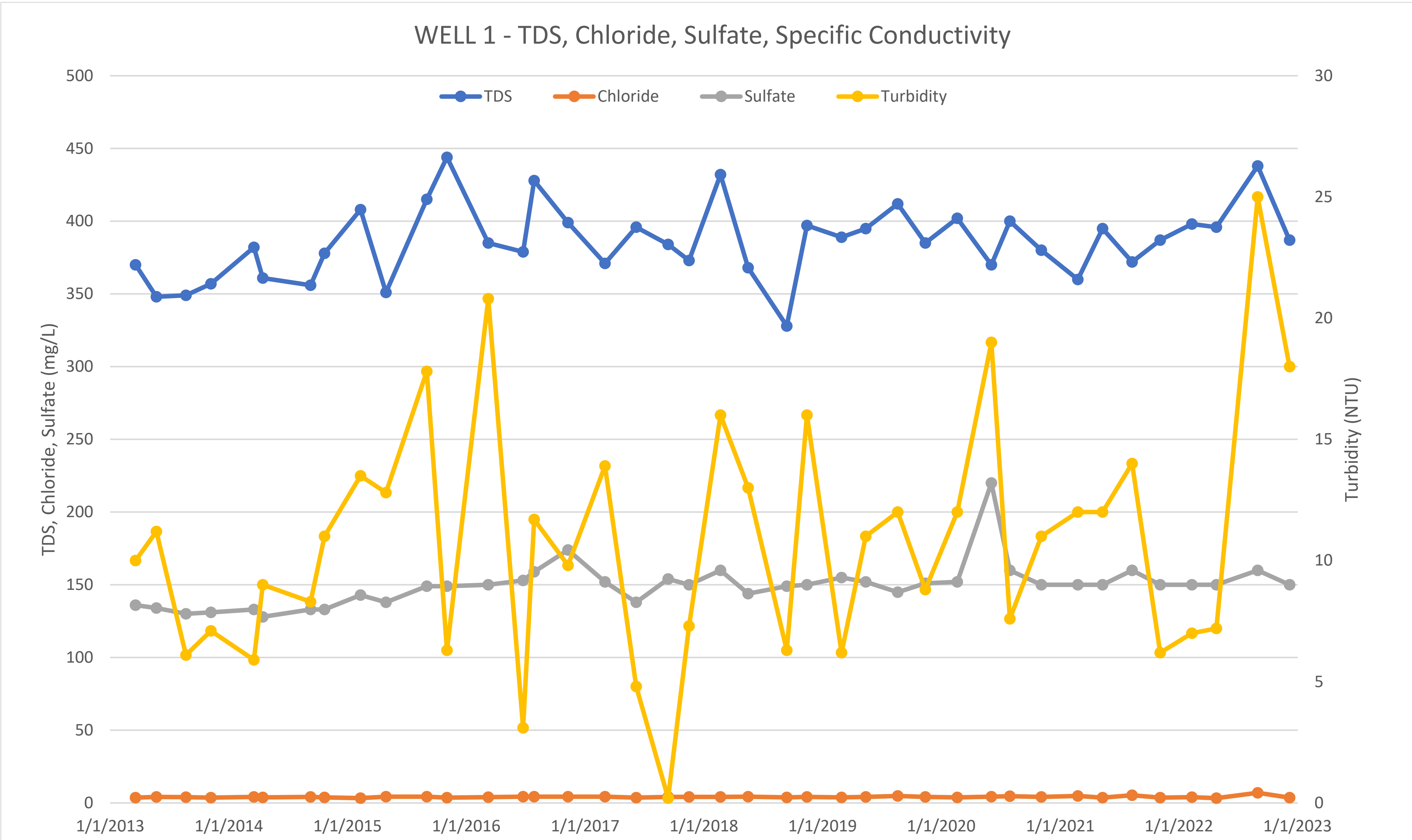
APPENDIX C-1a. WATER QUALITY - WELL 1
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO



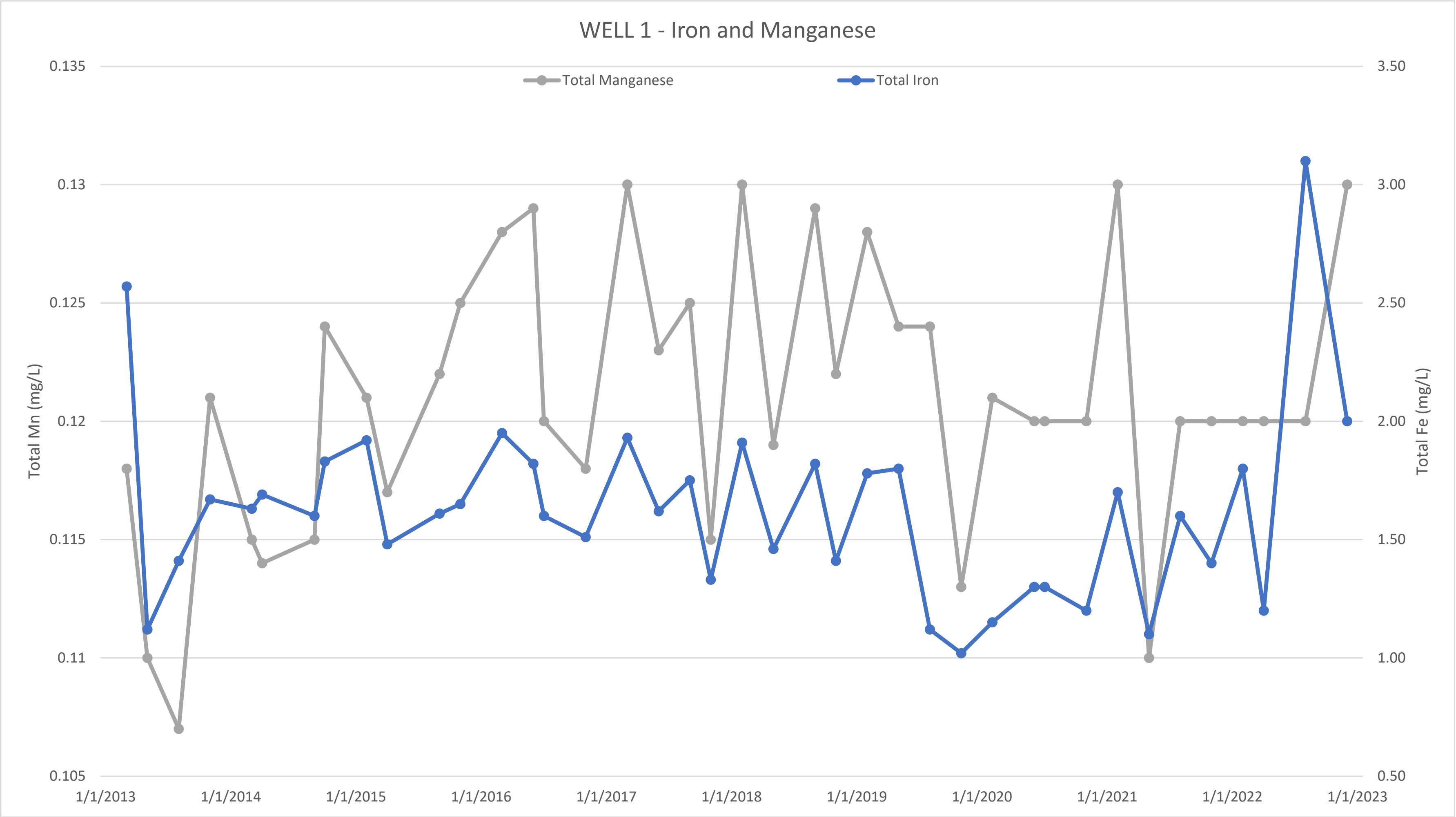
APPENDIX C-1b. WATER QUALITY - WELL 1
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-1c. WATER QUALITY - WELL 1
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO



APPENDIX C-1d. WATER QUALITY - WELL 1
CHEVRON MINING, INC., MCKINLEY MINE
NEAR GALLUP, NEW MEXICO



Exhibits

Exhibit A: Area 9N Bond Release – Bond Release Location

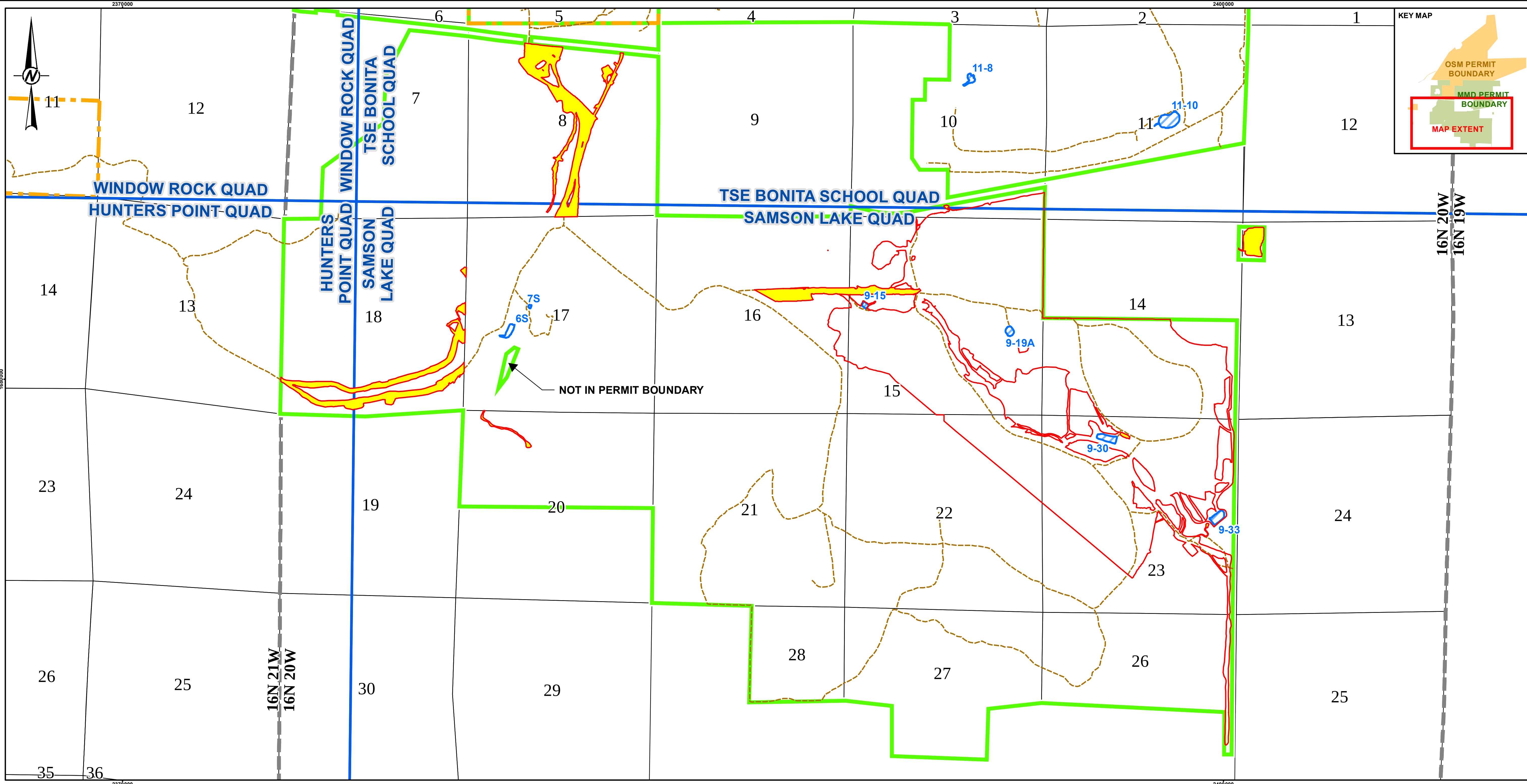
Exhibit B: Area 9N Bond Release – USGS Quadrangle

Exhibit C: Area 9N Bond Release – Postmining Topography

Exhibit D: Area 9N Bond Release – Seeding Map

Exhibit E: Area 9N Bond Release – Aerial

Exhibit F: Area 9N Bond Release – Land Inventory - Surface & Coal



LEGEND

- Phase I, II, and III Area 9N Bond Release Boundary (139 acs)
- Phase II and III Area 9N Bond Release Boundary (1,164 acs)
- MMD Permit Boundary
- OSM Permit Boundary
- Post-Mining Two-Track Trails
- Permanent Pond
- Pond
- Township and Range
- Section
- USGS 24k Topo Map Boundaries

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

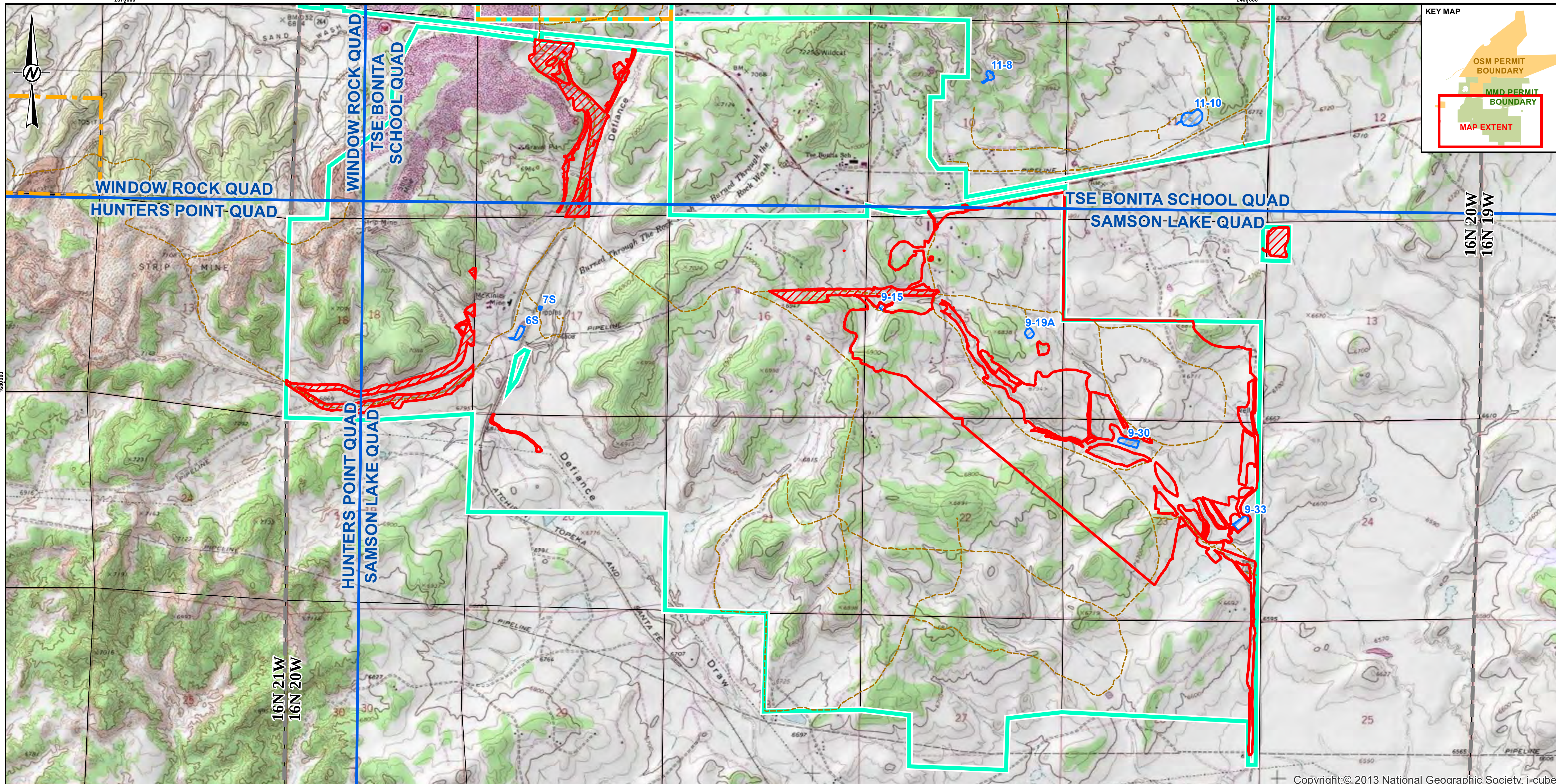
CONSULTANT
wsp

YYYY-MM-DD	2023-06-01
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

PROJECT
CHEVRON MCKINLEY MINE

TITLE
AREA 9N BOND RELEASE – BOND RELEASE LOCATION

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**EXHIBIT A**



LEGEND

- Phase I, II, and III Area 9N Bond Release Boundary (139 acs)
- Phase II and III Area 9N Bond Release Boundary (1,164 acs)
- MMD Permit Boundary
- OSM Permit Boundary
- Post-Mining Two-Track Trails
- Permanent Pond
- Pond
- Township and Range
- Section
- USGS 24k Topo Map Boundaries

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

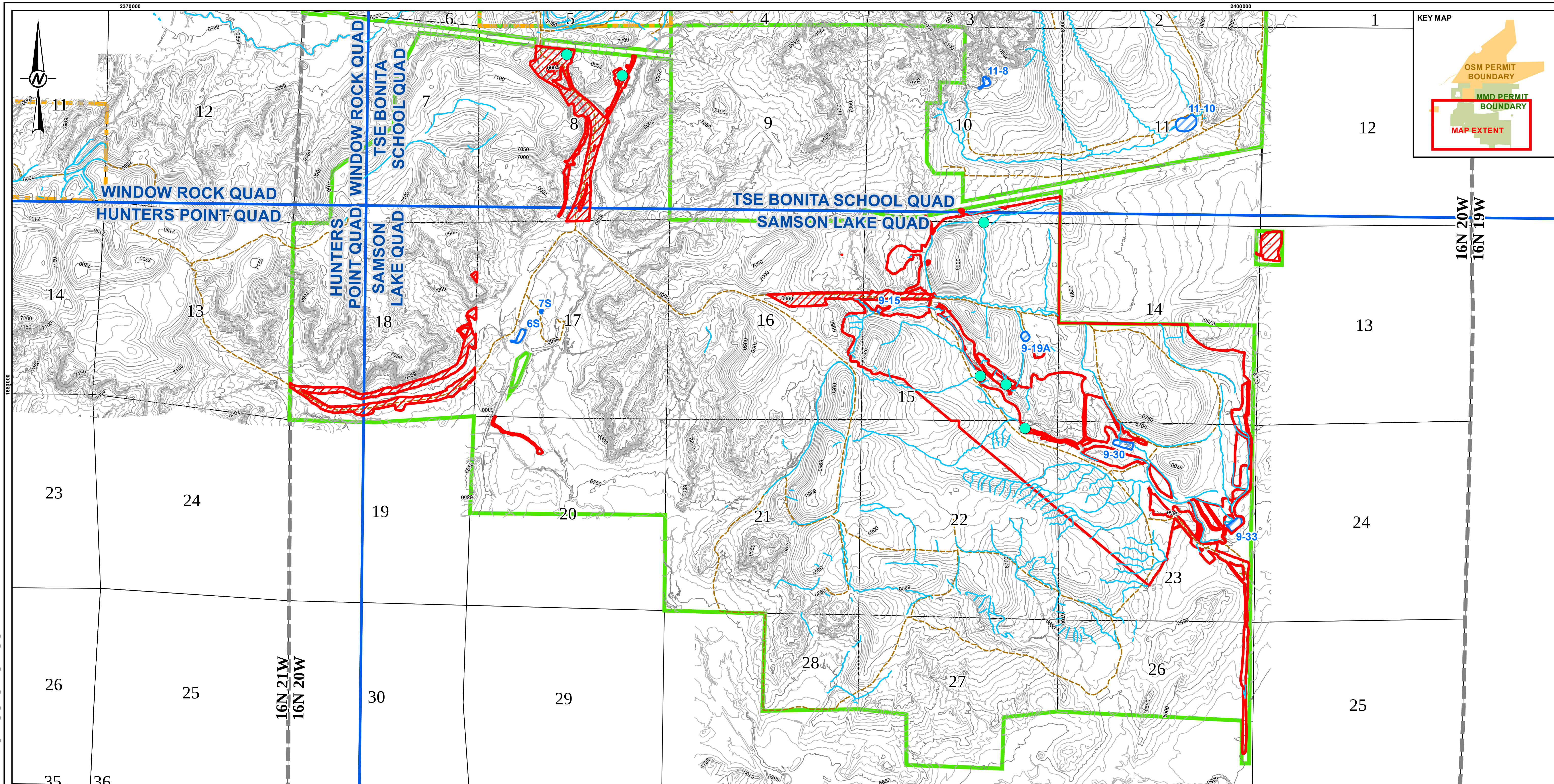
YYYY-MM-DD	2023-06-01
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

PROJECT
CHEVRON MCKINLEY MINE

TITLE
AREA 9N BOND RELEASE – USGS TOPOGRAPHIC MAP

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	**EXHIBIT B**

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



LEGEND

- Phase I, II, and III Area 9N Bond Release Boundary (139 acs)
- Phase II and III Area 9N Bond Release Boundary (1,164 acs)
- Small Depression Location
- Major Surface Contour (25 ft. Interval)
- Minor Surface Contour (5 ft. Interval)
- Surface Drainage
- MMD Permit Boundary
- OSM Permit Boundary
- Post-Mining Two-Track Trails
- Permanent Pond
- Pond
- Township and Range
- Section
- USGS 24k Topo Map Boundaries

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
CHEVRON MCKINLEY MINE

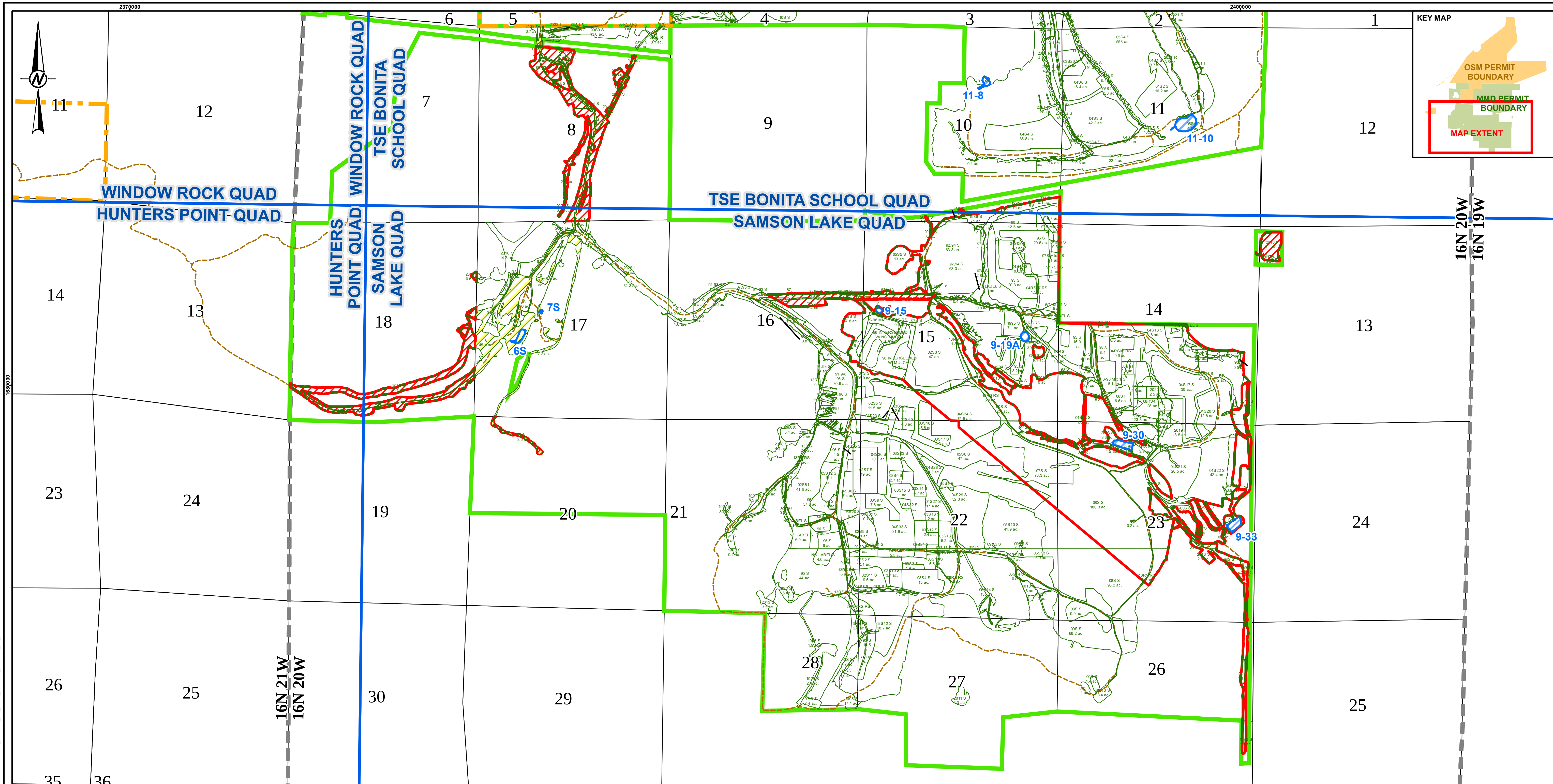
CONSULTANT
wsp

YYYY-MM-DD	2023-06-01
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

TITLE
AREA 9N BOND RELEASE – POST-MINING TOPOGRAPHY

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	EXHIBIT C

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



LEGEND

- Phase I, II, and III Area 9N Bond Release Boundary (139 acs)
- Phase II and III Area 9N Bond Release Boundary (1,164 acs)
- MMD Permit Boundary
- OSM Permit Boundary
- Post-Mining Two-Track Trails
- Permanent Pond
- Pond
- Township and Range
- Section

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

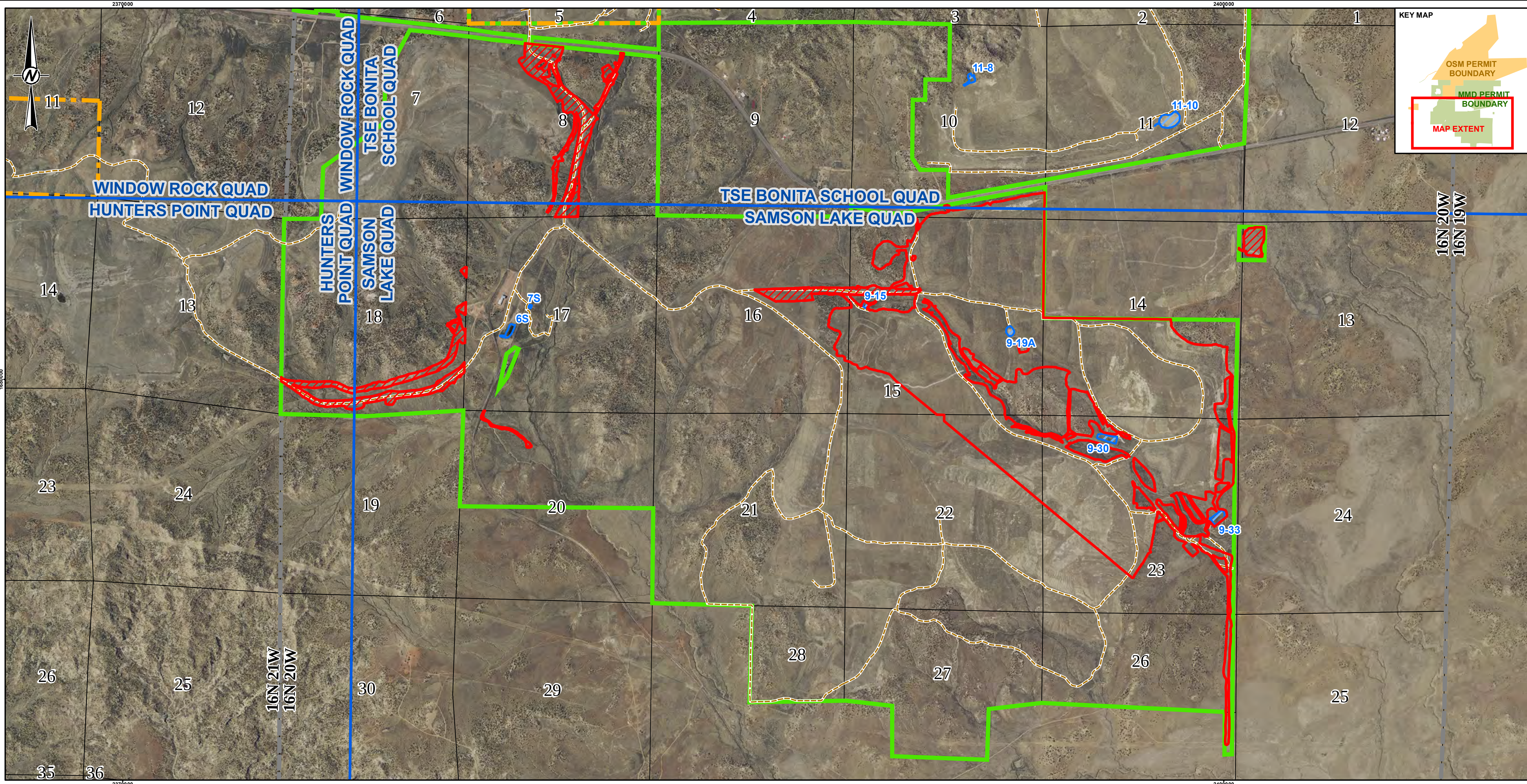
PROJECT
CHEVRON MCKINLEY MINE

CONSULTANT
wsp

YYYY-MM-DD	2023-06-01
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

TITLE
AREA 9N BOND RELEASE – SEEDING MAP

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	EXHIBIT D



LEGEND

- Phase I, II, and III Area 9N Bond Release Boundary (139 acs)
- Phase II and III Area 9N Bond Release Boundary (1,164 acs)
- MMD Permit Boundary
- OSM Permit Boundary
- Post-Mining Two-Track Trails
- Permanent Pond
- Pond
- Township and Range
- Section
- USGS 24k Topo Map Boundaries

0 2,000 4,000
Feet

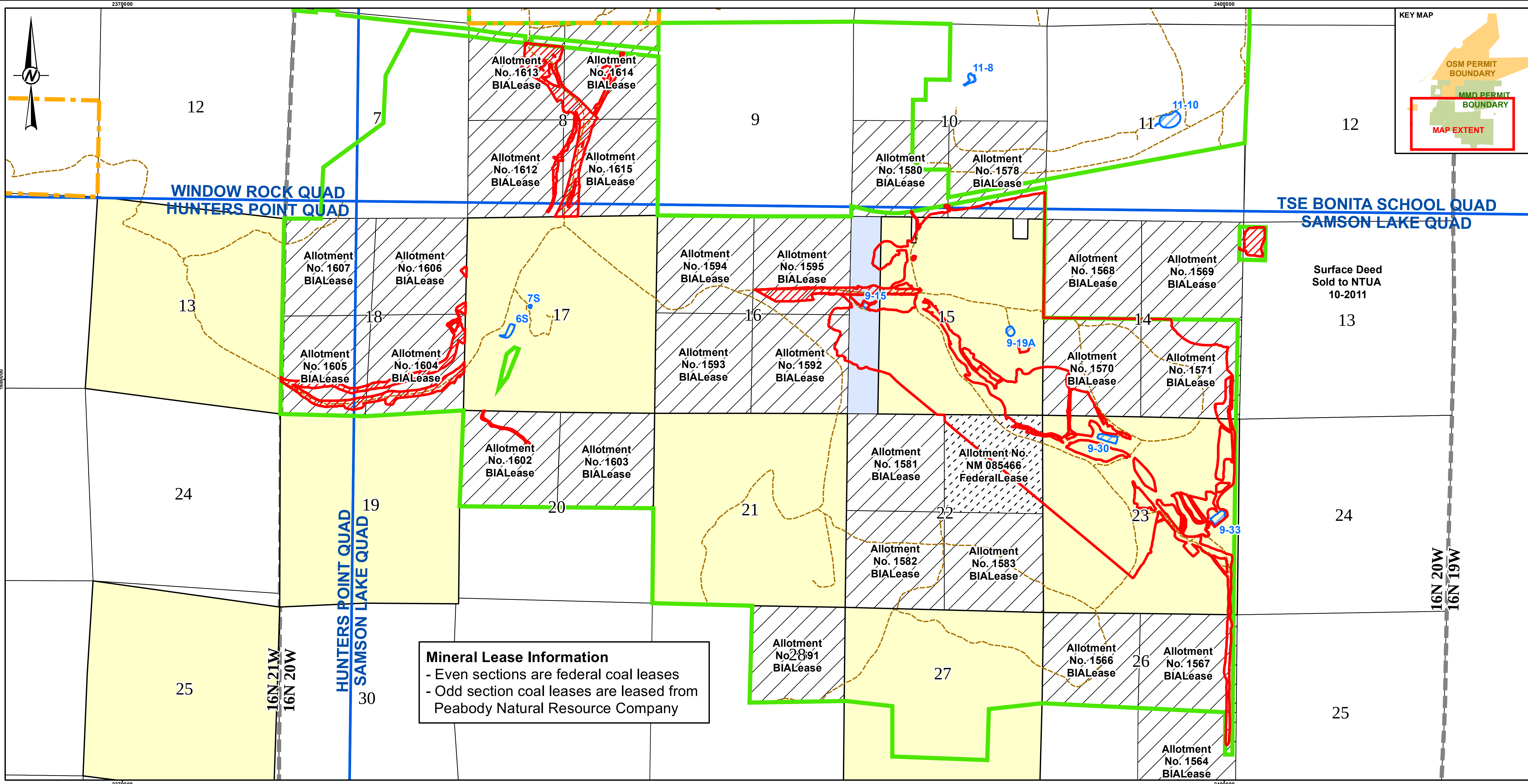
NOTE(S)
1.

REFERENCE(S)
1. AERIAL IMAGERY: NAIP 2020.
2. COORDINATE SYSTEM: NAD 1983 STATEPLANE NEW MEXICO WEST FIPS 3003 FEET

CLIENT	Chevron Mining Inc. McKINLEY MINE	PROJECT	CHEVRON MCKINLEY MINE
CONSULTANT	wsp	TITLE	AREA 9N BOND RELEASE – AERIAL
YYYY-MM-DD	2023-06-01		
DESIGNED	-		
PREPARED	HJ		
REVIEWED	KK		
APPROVED	MS		

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	EXHIBIT E

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



Mineral Lease Information

- Even sections are federal coal leases
- Odd section coal leases are leased from Peabody Natural Resource Company

LEGEND

- Phase I, II, and III Area 9N Bond Release Boundary (139 acs)
- Phase II and III Area 9N Bond Release Boundary (1,164 acs)
- MMD Permit Boundary
- OSM Permit Boundary
- Post-Mining Two-Track Trails
- Permanent Pond
- Pond
- Township and Range
- Section
- USGS 24k Topo Map Boundaries

SURFACE INFORMATION

- BIA Allotment Surface Lease
- Chevron Fee Surface
- Federal Surface Lease
- Private Lease to Chevron

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	2023-06-01
DESIGNED	-
PREPARED	HJ
REVIEWED	KK
APPROVED	MS

PROJECT
CHEVRON MCKINLEY MINE

TITLE
AREA 9N BOND RELEASE – LAND INVENTORY - SURFACE & COAL

PROJECT NO.	PHASE	REV.	FIGURE
1338105302	0003	A	EXHIBIT F