J. E. STOVER & ASSOCIATES, INC.

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MINE ENGINEERING
MINE RECLAMATION
CIVIL ENGINEERING
CONST. MANAGEMENT

October 19, 2022

Rob Zuber
Division of Reclamation, Mining & Safety
1313 Sherman St., Room 215
Denver, CO 80203

Re: Bowie No. 1 Mine, Permit C-1981-038,
Bond Release Application SL-08
West Mine Phase III Release

Dear Mr. Zuber:

DRMS' letter dated September 13, 2022 transmitted its adequacy review for the referenced technical revision. On behalf of Bowie Resources, LLC, (BRL), following are its responses to the DRMS' comments and concerns.

1. **DRMS:** Per Division policy, contribution of annual and biennial species to the relative cover measurement should not exceed 10%. The dataset submitted for 2019 shows that annual and biennial species contributed 18.06% towards relative cover. Please address in your response.

   BRL: Please see the revised report from Cedar Creek.

2. **DRMS:** Also per Division policy, contribution of annual and biennial species to the production measurement should not exceed 10%. The dataset submitted for 2019 shows that annual and biennial species contributed 14.47% towards production. Please address in your response.

   BRL: Please see the revised report from Cedar Creek.

3. DRMS: It appears that pond names are reversed on at least one map in the submittal. Please check the naming of ponds, and update as appropriate.

   BRL: Please see revised **Figure 2.**

4. **DRMS:** Yellow starthistle was seen at the West Mine during the Division inspection of July 20, 2022. The Division requires that the area near this A List species be removed from the SL-08 application. The Division believes that a 100-foot buffer around this area is appropriate. Please re-submit maps and other relevant materials to accomplish removal of the area. Also, please address if this impacts the analysis of revegetation success performed by Cedar Creek consultants. If it does impact the analysis, please ask them to perform an updated analysis and submit the results with your adequacy responses.

   BRL: Cedar Creek has revised the report and removing the areas with the 100-foot buffer for the Star Thistle does not impact the analysis. Please see the revised report from Cedar Creek.

Sincerely,

Tamme Bishop

Tamme Bishop, P.E.
Consulting Engineer

Enclosures:
Volume I: Pages 2.05-67 & 68

Cc via email: Basil Bear, Bowie Resources, LLC
Keeling Land & Cattle Co., LLC

Bowie Resources, LLC

Bowie #1 Mine

PHASE III BOND RELEASE EVALUATION

WEST MINE – YEARS 1 & 2

2019 & 2021

March 2022

Amended September 2022

CEDAR CREEK ASSOCIATES, INC.

EXECUTIVE SUMMARY

Cedar Creek Associates, Inc. was contracted in 2019 and 2021 by Bowie Resource, LLC to evaluate the revegetated West Mine areas at the Bowie No. 1 Mine for the first and second years of a two-year Phase III Bond Release effort. Field studies conducted in 2019 and 2021 to evaluate revegetation efforts have shown that the target reclaimed plant communities have met the target success criterion for Phase III Bond Release (Table 1). Ground cover of desirable plants within the reclaimed areas compares favorably to established technical standards and plant succession is occurring and progressing in a positive direction, indicating that plants are self-sustaining.

Table 1 Bowie #1 Mine

Revegetation Success Criteria Comparisons - 2019 & 2021 (per TR-63)

		Plant Cover		**Production**		**Woody Plant Density**			
						Live Trees, Shrubs, and Sub-Shrubs (per acre)			
Area	*Year Sampled*	**Total Plant Cover*** (% average cover)		**Annual (Total) Herbaceous*** (pounds per acre)		**Average** (If n ≥ 75)		**Reverse Null Ranked "L" Test** (If n < 75)	
Success Criteria		**≥54%**		**≥405**		**≥90**		**≥90**	
West Mine	**2019**	**61.1** [4]	**Pass**	**942** [5]	**Pass**	**383**	**N/A** [1]	**91** [2]	**Pass**
	2021	**55.3**	**Pass**	**549**	**Pass**	**355**	**Pass** [3]	**N/A**	**N/A**

		Diversity (Number of Species)							
		Total Native or Introduced Perennial Herbaceous		**Total Native Perennial Cool-Season Grasses**		**Total Native or Introduced Perennial Forbs**		**Total Native Sub-Shrubs, Trees, and Shrubs**	
Area	*Year Sampled*	(Between 0.5 & 60% Relative Cover)						(<80% Rel. Cover)	
Success Criteria		**≥5**		**≥3**		**≥2**		**≥2**	
West Mine	**2019**	**10**	**Pass**	**4**	**Pass**	**5**	**Pass**	**5**	**Pass**
	2021	**9**	**Pass**	**4**	**Pass**	**4**	**Pass**	**3**	**Pass**

*Excluding noxious weeds [1] n was 60 [2] Lower 80% Confidence Limit [3] n was 78

[4] Annual and biennial relative cover exceeded the allowable limit (10%) and was not included in the success comparisons

[5] Annual and biennial production exceeded the allowable limit (10%) and was not included in the success comparisons

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BOWIE RESOURCES, LLC

Bowie No. 1 Mine

PHASE III BOND RELEASE EVALUATION REPORT - 2021

WEST MINE - YEARS 1 & 2 (2019 & 2021)

1.0 INTRODUCTION

1.1 General

Cedar Creek Associates, Inc. (Cedar Creek) was contracted in 2019 and 2021 by Bowie Resource, LLC. (Applicant) to evaluate the West Mine revegetated area within the Bowie No. 1 Mine (Bowie No. 1, Permit No. C-1981-038) for the two-year Phase III Bond Release effort. Data collection was performed in the interest of ascertaining progress toward revegetation success in accordance with Rule 3.03, Release of Performance Bonds and the approved technical revision, TR-63. The West Mine area evaluated in 2019 and 2021 consisted of approximately 11 acres of revegetation (Map 1). Results of the evaluation were compared to established technical standards in TR-63 to facilitate a comparison of success for the reclaimed areas. Field sampling for ground cover and production was systematically conducted within the reclaimed areas on June 18th through 20th in 2019 and on June 20th and 21st in 2021. Sampling was conducted by or under the direct supervision of Cedar Creek's Senior Reclamation Ecologist, Mr. Erik Mohr. In addition to the sampling effort, current conditions existing at the time of field work were photo documented to provide a visual demonstration of site-conditions. Nomenclature for plant taxa followed Weber and Whitman (2012) and lifeform classification regarding sub-shrubs followed Wyoming DEQ (1999). Raw data tables and photo plates are presented in Appendix A.

Map 1 Bowie #1 Mine - 2021

Phase III Bond Release Evaluation

Sampling Unit Locations

West Mine

N
W E
S

1 inch = 875 feet

CEDAR CREEK ASSOCIATES, INC.

0 300 600 1,200 1,800 2,400 Feet

1.2 Precipitation

Precipitation data presented on Table P and Charts P1 and P2 was recorded at weather stations in Paonia and Cimarron, CO. The Paonia weather station is approximately five miles south of the sample locations. However, data collection at this station ceased in 2016. Therefore, precipitation data was used from the Cimarron weather station (approximately 40 miles south of the sample locations) from 2017 through 2021 due to its proximity and similar elevation. These weather stations provide a rough comparison of long-term trends in precipitation in the region. However, the locations of both weather stations are considerably lower in elevation than the sample locations and so precipitation totals are not likely to be completely accurate. Based on these data and expressed vegetation in the reclaimed areas, precipitation totals appear to have been above-average in the 12 months prior to the evaluation in June of 2019 and well below-average in the 12 months prior to the evaluation in June of 2021.

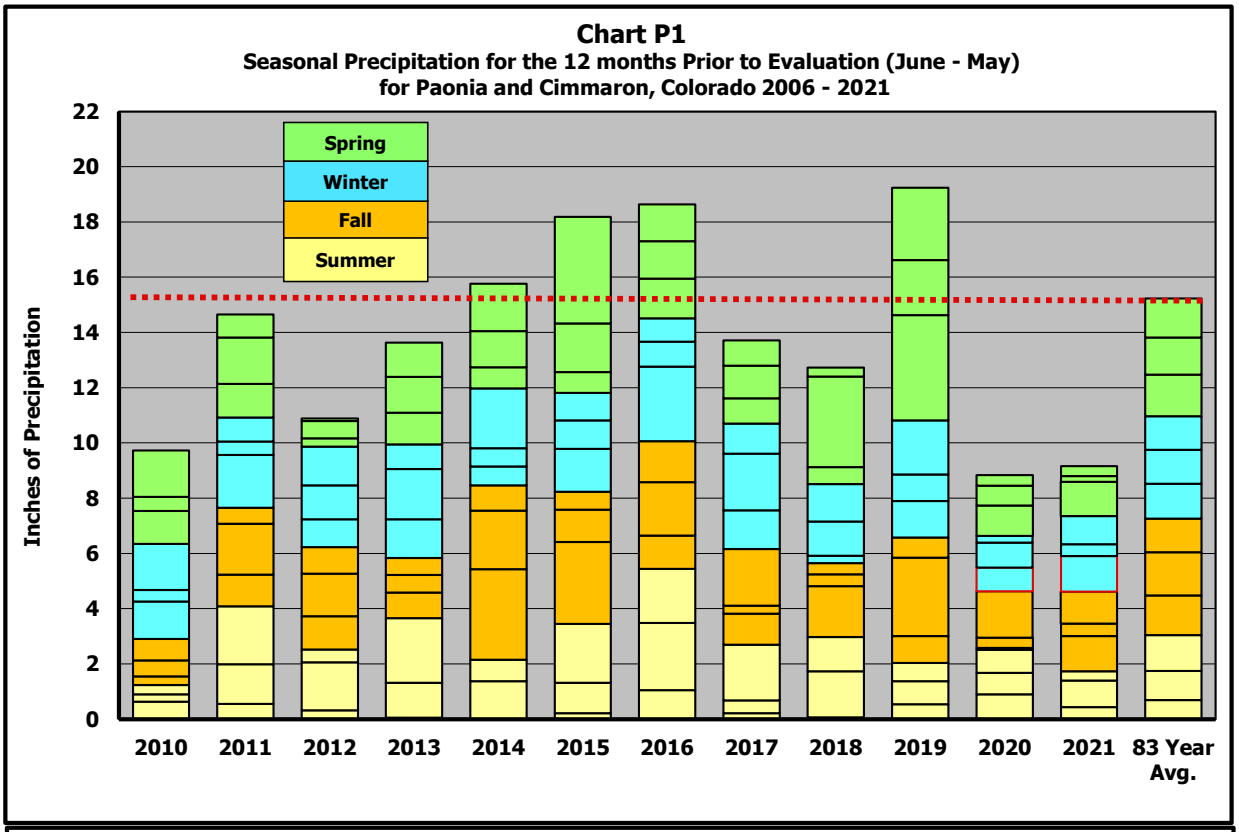
The overall average annual precipitation (Jan-Dec) for the past 84 years is 15.2 inches while monthly averages range from 0.7 in June to 1.6 inches in October (Table P). Average summer precipitation was 3.1 inches while fall, winter, and spring average 4.2, 3.7, and 4.3 inches, respectively (Charts P1 and P2). Review of the precipitation charts further reveals that growing season (spring) precipitation in the past 14 years has been variable ranging from 1.0 inches in 2012 to 8.4 inches in 2019. This variation in conditions ranging from drought to well above-average seasonal precipitation has contributed significantly to the current expression of ecological communities across the study area.

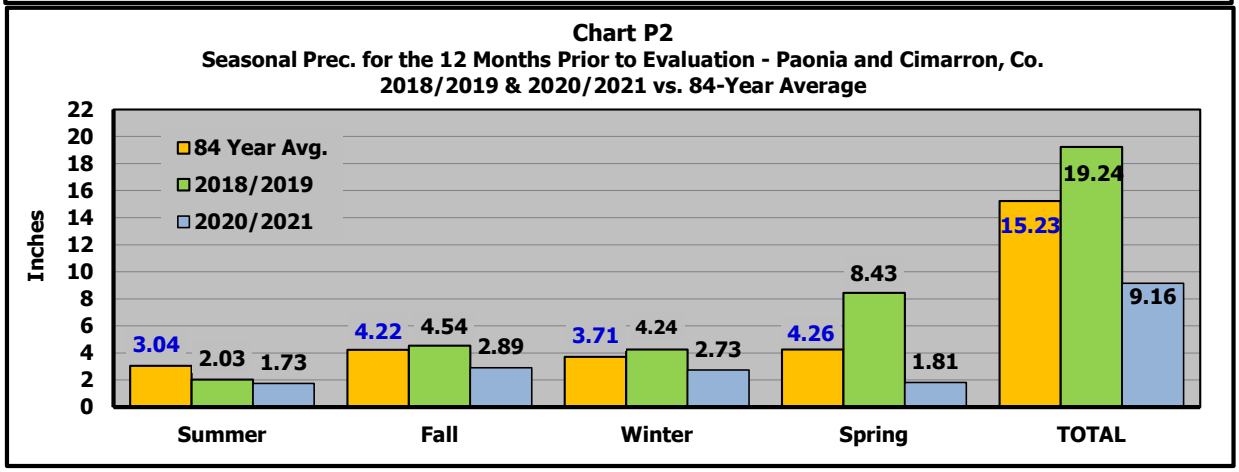
Chart P2 indicates that total precipitation in the 12 months preceding the 2019 sampling effort was above-average at 19.2 inches (126% of average). The 2018 summer and fall precipitation were 67% and 108% of average (2.1 and 4.5 inches), respectively. The 2019 winter and spring precipitation were 114% and 198% of average (4.2 and 8.4 inches), respectively. Cover and production values are likely higher than average during this sampling period.

Total precipitation in the 12 months preceding the 2021 sampling effort was below-average at 9.2 inches (60% of average). The 2020 summer and fall precipitation were 57% and 68% of average (1.7 and 2.9 inches), respectively. The 2021 winter and spring precipitation were 74% and 42% of average (2.7 and 1.8 inches), respectively. Cover and production values are considerably lower than average, especially considering the very low spring precipitation values.

Table P - Annual Precipitation for Paonia and Cimarron, Colorado 2008 - 2021													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2008	1.67	1.10	0.54	0.77	0.64	0.67	0.24	2.07	0.62	0.74	0.91	1.55	**11.52**
2009	0.91	1.00	0.89	1.09	2.73	0.63	0.27	0.33	0.32	0.58	0.77	1.36	**10.88**
2010	0.42	1.66	1.20	0.51	1.68	0.55	1.44	2.09	1.15	1.84	0.58	1.91	**15.03**
2011	0.49	0.87	1.22	1.68	0.83	0.32	1.74	0.46	1.20	1.55	0.96	1.01	**12.33**
2012	1.22	1.41	0.30	0.62	0.09	0.05	1.26	2.35	0.92	0.64	0.61	1.41	**10.88**
2013	1.82	0.89	1.14	1.30	1.24	0.00	1.37	0.78	3.28	2.12	0.91	0.69	**15.54**
2014	0.66	2.16	0.77	1.31	1.71	0.21	1.11	2.13	2.96	1.17	0.65	1.56	**16.40**
2015	1.02	1.00	0.76	1.75	3.86	1.05	2.43	1.96	1.20	1.94	1.48	2.70	**21.15**
2016	0.90	0.85	1.44	1.35	1.33	0.51	0.80	1.81	1.07	1.94	1.48	2.70	**16.18**
2017	2.05	1.09	0.91	1.19	1.31	0.06	1.67	1.24	1.84	0.43	0.41	0.27	**12.47**
2018	1.23	1.36	0.61	3.28	0.33	0.54	0.83	0.66	0.98	2.84	0.72	1.33	**14.71**
2019	0.96	1.95	3.82	1.99	2.62	0.90	0.78	0.83	0.07	0.37	1.68	0.86	**16.83**
2020	0.90	0.25	1.09	0.72	0.39	0.44	0.96	0.33	1.28	0.45	1.16	1.28	**9.25**
2021	0.43	1.02	1.24	0.21	0.36	1.08	1.88	2.04	1.18	1.09	0.36	1.29	**12.18**
84 Year Avg.	**1.23**	**1.22**	**1.50**	**1.35**	**1.41**	**0.69**	**1.05**	**1.30**	**1.44**	**1.56**	**1.22**	**1.26**	**15.23**

Values averaged due to lack of data from weather station Values obtained from Cimmaron, CO * = No data available





1.3 Background and Standards for Success

The Bowie No. 1 Mine is located approximately three miles northwest of Paonia, Colorado in a semi-arid mountain ecosystem. Small tree and dense shrub vegetation communities surround the mine area and are dominated by Utah juniper (*Juniperus osteosperma*) and Gambel oak (*Quercus gambelii*). The post-mining land use of revegetation is livestock grazing, as well as deer and elk winter habitat. The original permit for Bowie No. 1 describes the sampling procedures and success standards for the original planned reclamation (Run of Mine, East Mine, and West Mine). Revised success criteria used in this Phase III evaluation are based on Technical Revision No. 63, Preliminary Adequacy Review (TR-63). The changes implemented in TR-63 are based on results of Phase II Bond Release Success monitoring conducted in 2013 (West Mine and Run of Mine) and 2016 (East Mine). The current success criteria and standards are as follows:

- Achieve a Total Plant Cover of ≥ 90% of the Total Plant Cover Standard of 60% (54%) – West Mine
- Achieve a Total Plant Cover of ≥ 90% of the Total Plant Cover Standard of 40% (36%) – East Mine and Run of Mine.
- Achieve annual herbaceous production levels of ≥ 90% of 450 pounds per acre (405) – West Mine.
- Achieve annual herbaceous production levels of ≥ 90% of 400 pounds per acre (360) – East Mine and Run of Mine.
- Achieve a woody plant density of ≥ 90% of 100 shrub, sub-shrub or trees per acre (90).
- Achieve a species diversity of ≥ 5 native or introduced, perennial herbaceous species with between 0.5% and 60% relative cover.
- Achieve a species diversity of ≥ 3 native, cool-season perennial grass species with between 0.5% and 60% relative cover.
- Achieve a species diversity of ≥ 2 native or introduced perennial forb species with between 0.5% and 60% relative cover.
- Achieve a species diversity of ≥ 2 native shrub, tree or sub-shrub species, not exceeding a relative cover value of ≥ 80%.

2.0 SAMPLING METHODS

2.1 Sample Site Selection / Location

A systematic procedure for sample location in the revegetated units occurred in the following stepwise manner. First, a fixed point of reference was selected for the unit to facilitate location of the systematic grid in the field. Second, a systematic grid of appropriate dimensions was selected to provide a reasonable number of coordinate intersections (e.g., 45) that could then be used for the set of sample sites. Third, a scaled representation of the grid was overlain on a computer-generated map of the target unit extending along north/south and east/west lines. Fourth, the initial placement of this grid was implemented by selection of two random numbers (an X and Y distance) used for locating the first coordinate from the fixed point of reference, thereby making the effort unbiased. Fifth, the sample points were located in the field utilizing a handheld GPS unit.

Once a selected grid point was located in the field, ground cover sampling transects were always oriented in the direction of the next site to be physically sampled to further limit any potential bias while facilitating sampling efficiency. This orientation protocol is indicated on Figure 1. Depending on logistics, timing, and access points to the target sampling area, the field crew would occasionally layout a set of points along coordinates in one direction and then sample them in reverse order. However, orientation protocol was always maintained (i.e., in the direction of the next point to be physically sampled). If the boundary of an area was encountered before reaching the full length of a transect, the orientation of the transect was turned 90° in the appropriate direction so the transect could be completed. In this manner, boundary transects were retained entirely within the target unit by "bouncing" off the boundaries. Production quadrats were always oriented 90° to the right (clockwise) of the ground cover transect and placed one meter from the starting point so as to avoid any trampled vegetation.

2.2 Determination of Ground Cover

Ground cover at each sample point was evaluated in accordance with Rule 4.15.11 (1) (a) (i) utilizing the point-intercept methodology as illustrated on Figure 1. As indicated on this figure, Cedar Creek utilizes state-of-the-art instrumentation it has pioneered to facilitate much more rapid and accurate collection of data. A transect of 10 meters length was extended in the direction of the next sampling location from the flagged center of each systematically located sample point. At each one-meter interval along the transect, a "laser point bar" was situated parallel to, and approximately 4.5 to 5.0 feet vertically above the ground surface. A set of 10 readings was taken specifically to record hits on vegetation (by species), litter, (including standing dead), rock (>2mm), or bare soil. Hits were determined at each meter interval by activating a battery of 10 low-energy specialized lasers situated along the bar at 10 centimeter intervals

and recording the variable intercepted by each of the narrowly focused (0.02") beams (Exhibit 1). In this manner, a total of 100 intercepts per transect were recorded resulting in 1 percent cover per intercept. This methodology and instrumentation facilitates the collection of the most unbiased, repeatable, and precise ground cover data possible. To facilitate diversity calculations, second hits were recorded when an overstory shrub stratum was present. However, these second hits were not included in the determination of ground cover.

2.3 Determination of Current Annual Production

At all sample sites in the reference and reclamation areas, current annual herbaceous production was collected from a 0.5 m^2 quadrat frame placed one meter and 90º to the right (clockwise) of the ground cover transect to facilitate avoidance of vegetation trampled by investigators during sample site location (Figure 1). From within each quadrat, all above ground current annual vegetation within the vertical boundaries of the frame was clipped and bagged separately by lifeform as follows:

Perennial Grasses
Sub-Shrubs
Noxious Weeds - Grass
Perennial Forbs
Annual & Biennial Forbs
Noxious Weeds – Other

All production samples were returned to the lab for drying and weighing. Drying occurred at 105º C until a stable weight was achieved (24 hours). Samples were then weighed to the nearest 0.1 gram. Total weights for each sample were compiled and converted to pounds per acre prior to success determination.

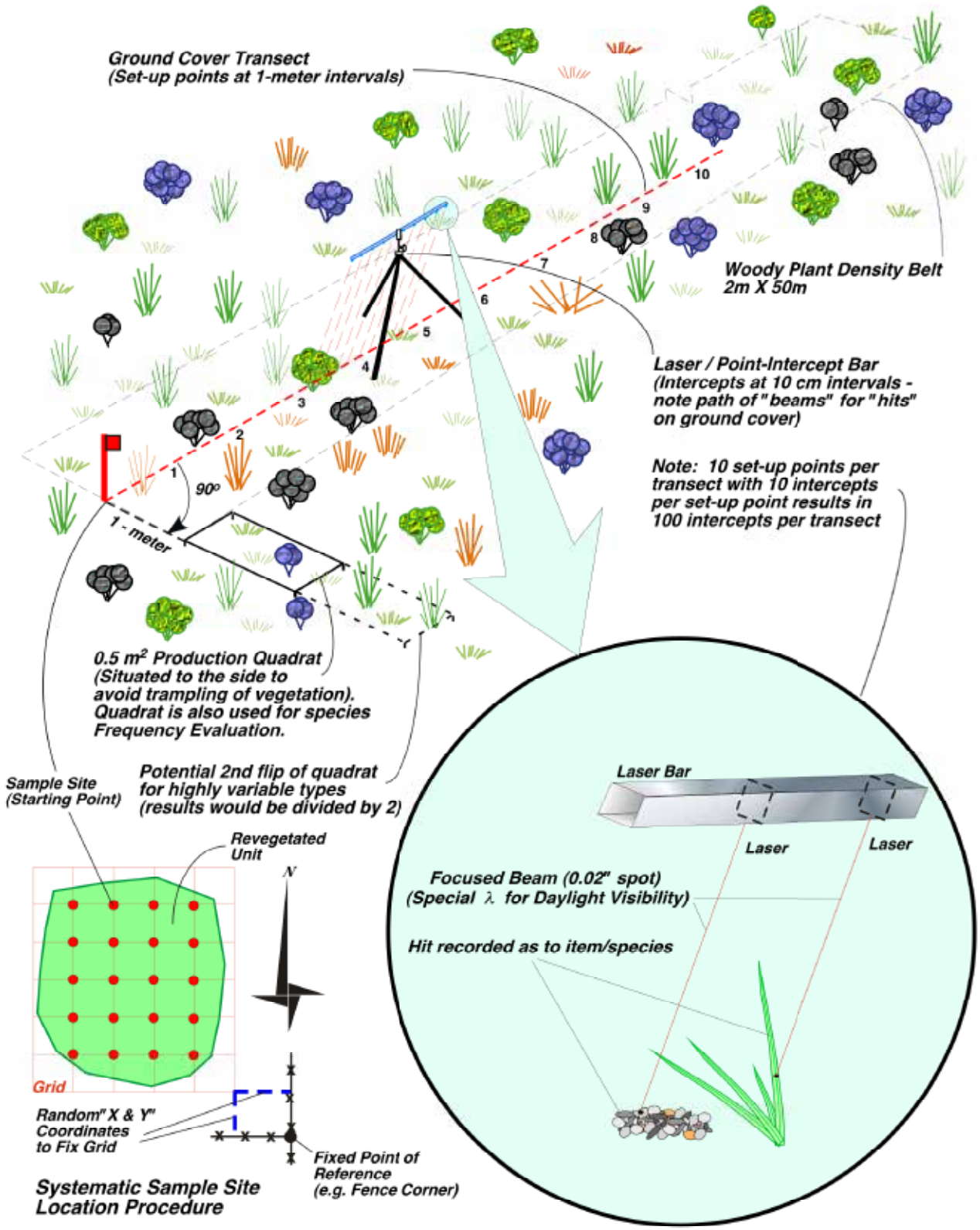


Figure 1

Sampling Procedure at a Systematic Sample Site Location

2.4 Sample Adequacy Determination

Cover, production, and woody plant density sampling within each unit was conducted using between 27 and 78 points. Cover and production sampling points were co-located, woody plant density sample points were laid out on a unique grid. From these preliminary efforts, sample means and standard deviations for total non-overlapping vegetation ground cover, total production, and wood plant density were calculated. The Cochran formula (below) for determining sample adequacy was used to calculate $\mathbf{n_{min}}$, whereby the population is estimated to within 10% (cover and production) or 15% (woody plant density) of the true mean (μ) with 90% confidence.

When the inequality ($\mathbf{n_{min}} \leq \mathbf{n}$) is true, sampling is deemed adequate; and $\mathbf{n_{min}}$ is determined as follows:

$$\mathbf{n_{min}} = (t^2 s^2) / (\mathbf{d}\,\bar{X})^2$$

Where: **n** = the number of actual samples collected (initial size = 27 to 78)

t = the value from the one-tailed t distribution for 90% confidence with n-1 degrees of freedom;

s^2 = the variance of the estimate as calculated from the initial samples;

d = precision (0.10 for cover and production; 0.15 for woody plant density);

$\bar{X}$ = the mean of the estimate as calculated from the initial samples.

2.5 Success Comparisons

Rule 4.15.11 (2)(a) of the Colorado Coal Regulations allows for direct comparison of cover and production values if sample adequacy is demonstrated and a minimum of 15 transects in each unit is collected (as in 2019 and 2021). If adequacy is not met, various forms of null and reverse null hypothesis testing based on the mean may be employed to demonstrate success which do not require adequacy.

Rule 4.15.11 (3)(b)(i) of the Colorado Coal Regulations allows for direct comparison of woody plant density values if a minimum of 75 ≥100 m^2 transects in each unit is collected (as in 2021). In lieu of a direct comparison, Rule 4.15.11 (3)(a) allows the use of a reverse null ranked "L" test to demonstrate success. In this approach, success is demonstrated when the lower 80% confidence limit of the reclaimed area median is >70% of the relevant success standard (or 90% of the technical standard according to TR-63) with a minimum sample size of 30 (as in 2019).

The reverse null ranked "L" test is defined as follow:

$$\mathbf{L = p(n+1) - Z[np\ (1-p)]^{1/2}}$$

Where: **L** = order statistic corresponding to the one sided lower 80% confidence limit;

p = 0.5 (e.g. the 0.5 quantile, or median);

n = sample size;

Z = 0.842 (the t-table value for infinite deg. of freedom for 1-sided test; α=0.2)

In the instance that the lower confidence limit is not an integer, the limit is obtained by linear interpolation between the closest order statistics.

3.0 RESULTS

Tables 1 through 4 and Charts 1 through 4 provide a summary of the 2019 and 2021 sampling efforts described above. Tabular compilations of raw data and summaries presented in Appendix A on Tables 5 through 12. Photographs of the evaluated areas are also presented in Appendix A. Evidence of moderate grazing of the reclamation vegetation approximately two to three weeks before the survey was observed at the time of the evaluations.

A total of 50 plant species were observed within the West Mine in 2019 (Table 6). Ground cover within the unit (Table 2 and Chart 1) consisted of 80.0% live vegetation, 1.3% rock, 16.3% litter, and bare ground exposure of 2.5%. Total plant cover (excluding noxious weeds) averaged 79.6%. Noxious weed cover averaged 0.4% and consisted entirely of bindweed (*Convolvulus arvensis*) which is a List C noxious weed in Colorado. The dominant taxa were alfalfa (*Medicago sativa*), desert alyssum (*Alyssum desertorum*), cicer milkvetch (*Astragalus cicer*), and western wheatgrass (*Pascopyrum smithii*) with 30.2%, 15.6%, 7.1%, and 6.9% average cover, respectively. Total herbaceous production averaged 1,120 pounds per acre while total herbaceous production excluding noxious weeds averaged 1,101 pounds per acre (Table 3 and Chart 3). Woody plant density averaged 383 live shrubs and sub-shrubs per acre, consisting primarily of gambel oak (*Quercus gambelii*), roundleaf snowberry (*Symphoricarpos rotundifolius*), and rubber rabbitbrush (*Chrysothamnus nauseousus*) (Table 4 and Chart 4).

A total of 42 plant species were observed within the West Mine in 2021. Ground cover within the unit consisted of 55.6% live vegetation, 3.4% rock, 32.9% litter, and bare ground exposure of 8.2%. Total plant cover (excluding noxious weeds) averaged 55.3%. Noxious weed cover averaged 0.2% and consisted of cheatgrass (*Anisantha tectorum*) and bindweed. The dominant taxa were alfalfa, cicer milkvetch, cutleaf viper grass *(Scorzonera lacinatum*), and western wheatgrass with 23.9%, 6.9%, 4.8% and 5.3% average cover, respectively. Total herbaceous production averaged 556 pounds per acre while total herbaceous production excluding noxious weeds averaged 549 pounds per acre. Woody plant density averaged 355 live trees, shrubs, and sub-shrubs per acre in 2021, consisting primarily of rubber rabbitbrush, gambel oak, and roundleaf snowberry.

Table 2 Bowie #1 - Vegetation Cover - 2021

West Mine - Average Ground Cover Summary - 2019 & 2021

Percent Ground Cover Based on Point-Intercept Sampling

			Year -->	**2019**	**2021**
Grasses and Grass-likes					
X	A	*Anisantha tectorum*	Cheatgrass	-	0.19
I	P	*Bromus inermis*	Smooth Brome	3.50	3.04
I	A	*Bromus japonicus*	Japanese Brome	0.79	0.04
N	P	*Carex filifolia*	Threadleaf Sedge	0.04	-
N	P	*Elymus lanceolatus*	Thickspike Wheatgrass	3.61	4.93
N	P	*Elymus psammophilus*	Streambank Wheatgrass	1.36	1.26
N	P	*Leymus cinereus*	Great Basin Wildrye	0.04	-
N	P	*Nassella viridula*	Green Needlegrass	0.96	0.56
N	P	*Pascopyron smithii*	Western Wheatgrass	6.93	5.30
I	P	*Poa pratensis*	Kentucky Bluegrass	0.04	-
Forbs					
N	P	*Achillea millefolium*	Common Yarrow	0.04	-
N	A	*Alyssum desertorum*	Desert Alyssum	15.64	2.04
I	P	*Astragalus cicer*	Cicer Milkvetch	7.11	6.85
N	A	*Collomia linearis*	Slenderleaf Collomia	0.18	-
X	P	*Convolvulus arvensis*	Field Bindweed	0.36	0.04
N	P	*Crepis acuminata*	Tapertip Hawkbeard	0.07	-
N	A	*Cryptantha watsonii*	Watson's Cryptantha	0.21	-
N	A	*Descurainia pinnata*	Western Tansymustard	0.25	-
N	P	*Galium aparine*	Cleavers	0.07	-
N	A	*Gayophytum ramosissimum*	Groundsmoke	0.07	-
N	A	*Helianthus annuus*	Common Sunflower	0.07	-
N	P	*Heliomeris multiflora*	Showy Goldeneye	0.11	-
N	P	*Heterotheca villosa*	Hairy Golden Aster	0.04	-
I	B	*Lactuca serriola*	Prickly Lettuce	0.89	0.04
N	P	*Linum lewisii*	Lewis Flax	0.32	0.07
N	P	*Lupinus caudatus*	Tailcup Lupine	0.36	0.04
I	P	*Medicago sativa*	Alfalfa	30.18	23.85
N	P	*Penstemom strictus*	Rocky Mountain Penstemom	0.64	0.04
I	P	*Sanguisorba minor*	Small Burnet	0.14	-
I	P	*Scorzonera laciniatum*	Cutleaf Viper Grass	0.75	4.78
I	P	*Securigea varia*	Crownvetch	3.96	0.93
N	P	*Sphaeralcea coccinea*	Scarlet Globemallow	0.04	-
I	P	*Taraxacum officinale*	Dandelion	-	0.26
I	B	*Tragopogon dubius*	False Salsify	0.39	-
Sub-Shrubs					
		None		-	-
Shrubs & Trees					
N	P	*Amelanchier utahensis*	Utah Serviceberry	0.11	-
N	P	*Chrysothamnus nauseosus*	Rubber Rabbitbrush	0.14	-
N	P	*Purshia tridentata*	Bitterbrush	0.11	0.85
N	P	*Quercus gambelii*	Gambel Oak	0.25	-
N	P	*Symphoricarpos rotundifolia*	Snowberry	0.25	0.48
			Total Plant Cover	**80.00**	**55.56**
			Rock	1.29	3.37
			Litter	16.25	32.93
			Bare ground	2.46	8.15
			Total Plant Cover (excluding noxious weeds)	**79.64**	**55.33**
Summary by Lifeform:					
			Perennial Grasses	**16.46**	**15.07**
			Annual Grasses	0.79	0.04
			Perennial Forbs	**43.82**	**36.81**
			Annual and Biennial Forbs	17.71	2.07
			Noxious / Aggressive Weeds	0.36	0.22
			Sub-Shrubs	**-**	**-**
			Shrubs and Trees	**0.86**	**1.33**
Sample Adequacy Calculations:					
			Mean =	**80.00**	**55.56**
			Variance =	**101.04**	**22.18**
			n =	**28**	**27**
			n_{min} =	**2.72**	**1.24**

N - Native I - Introduced, X - Noxious

A - Annual, B - Biennial, P - Perennial

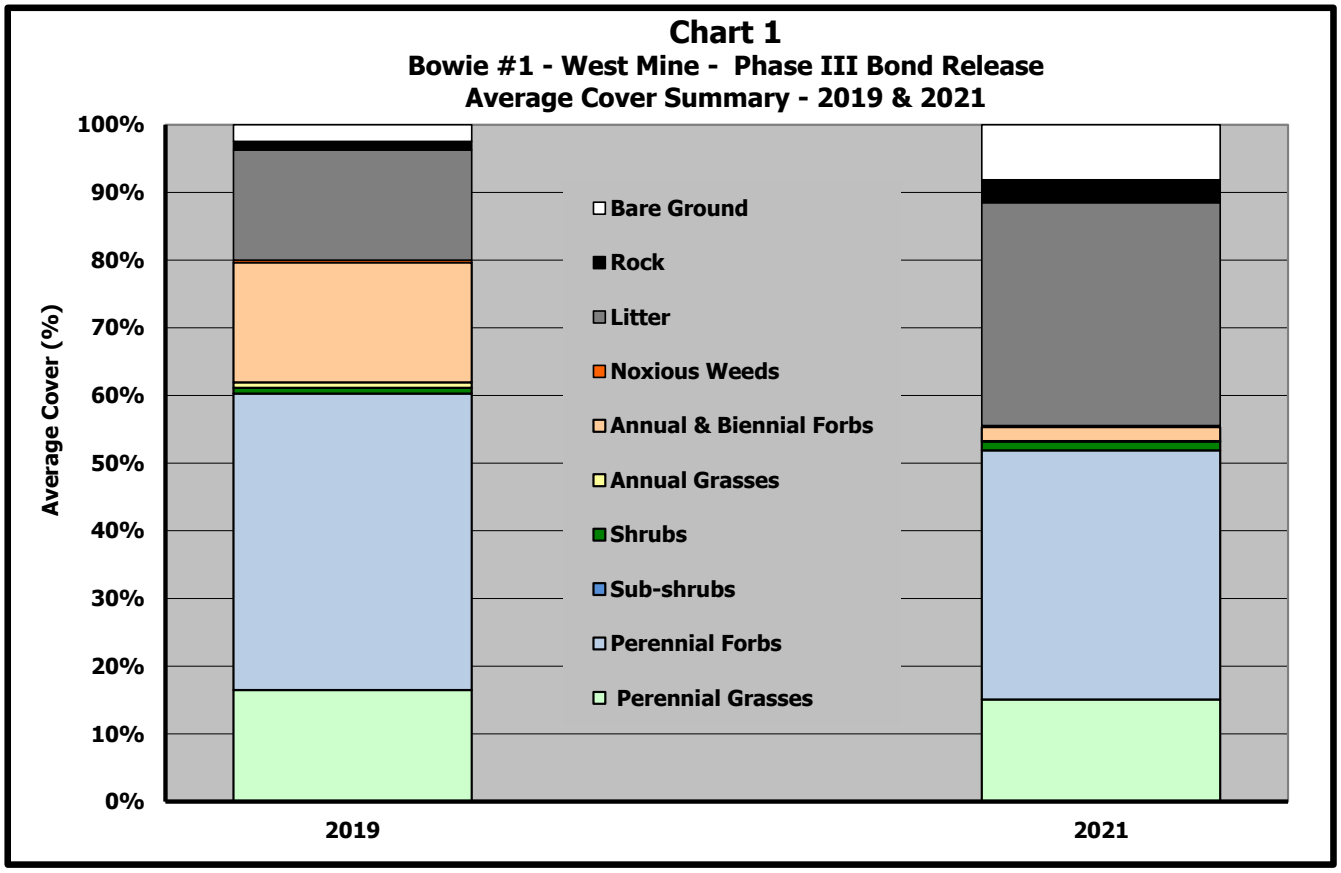


Chart 1
Bowie #1 - West Mine - Phase III Bond Release
Average Cover Summary - 2019 & 2021
Average Cover (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2019
2021
Bare Ground
Rock
Litter
Noxious Weeds
Annual & Biennial Forbs
Annual Grasses
Shrubs
Sub-shrubs
Perennial Forbs
Perennial Grasses

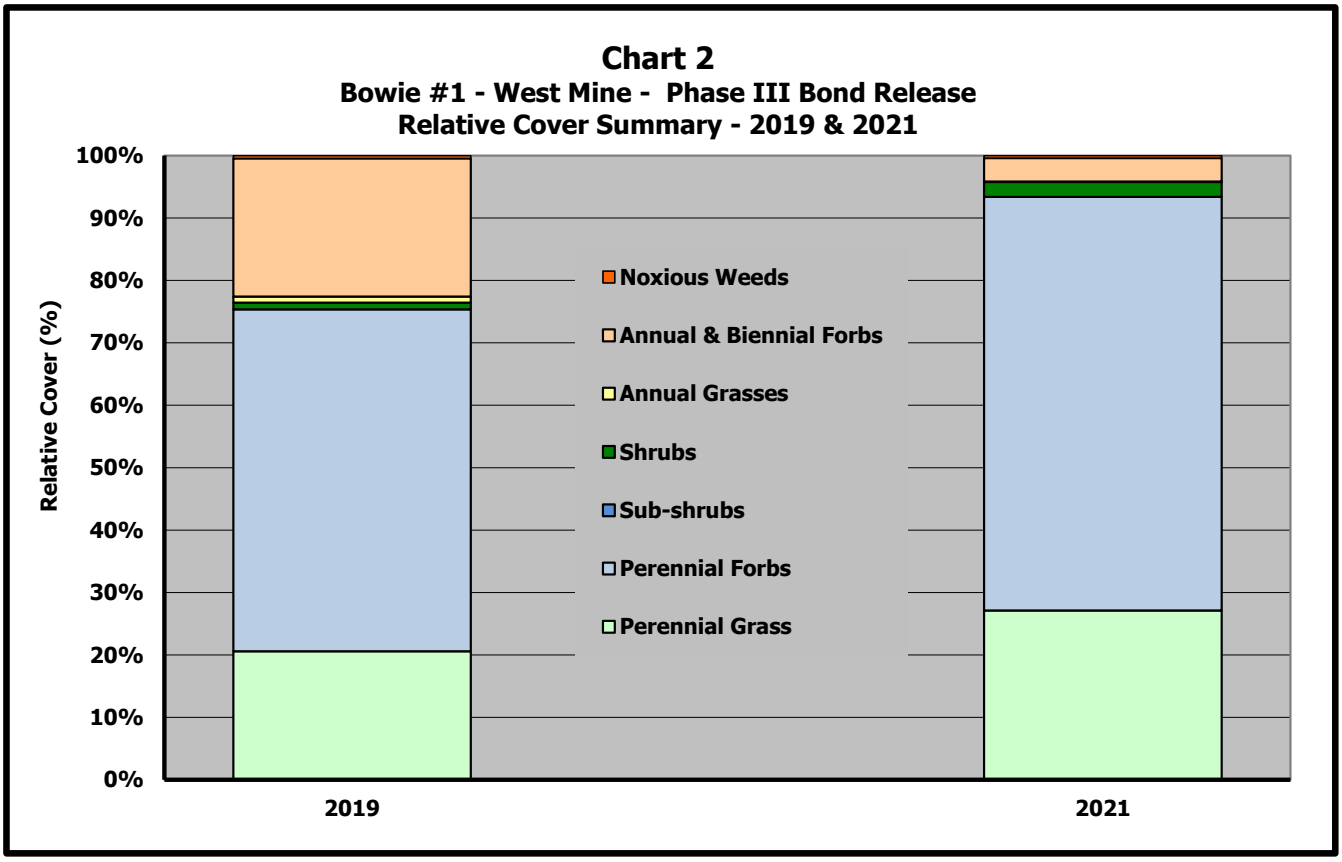


Chart 2
Bowie #1 - West Mine - Phase III Bond Release
Relative Cover Summary - 2019 & 2021
Relative Cover (%)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2019
2021
Noxious Weeds
Annual & Biennial Forbs
Annual Grasses
Shrubs
Sub-shrubs
Perennial Forbs
Perennial Grass

Table 3 Bowie #1 - Vegetation Production - 2021

West Mine - Summary of Vegetation Production

Oven Dry Pounds (lbs) per Acre

Area	Year	*Perennial Grasses*	*Perennial Forbs*	*Sub-shrubs*	*Annual / Biennial Forbs*	*Noxious Weeds*		TOTAL (Exc. Noxious Weeds)	TOTAL
						Grass	*Other*		
West Mine	**2019**	472.7	469.3	-	159.4	4.3	14.5	**1,101.4**	**1,120.3**
	2021	56.3	472.6	-	19.8	7.0	0.1	**548.6**	**555.7**

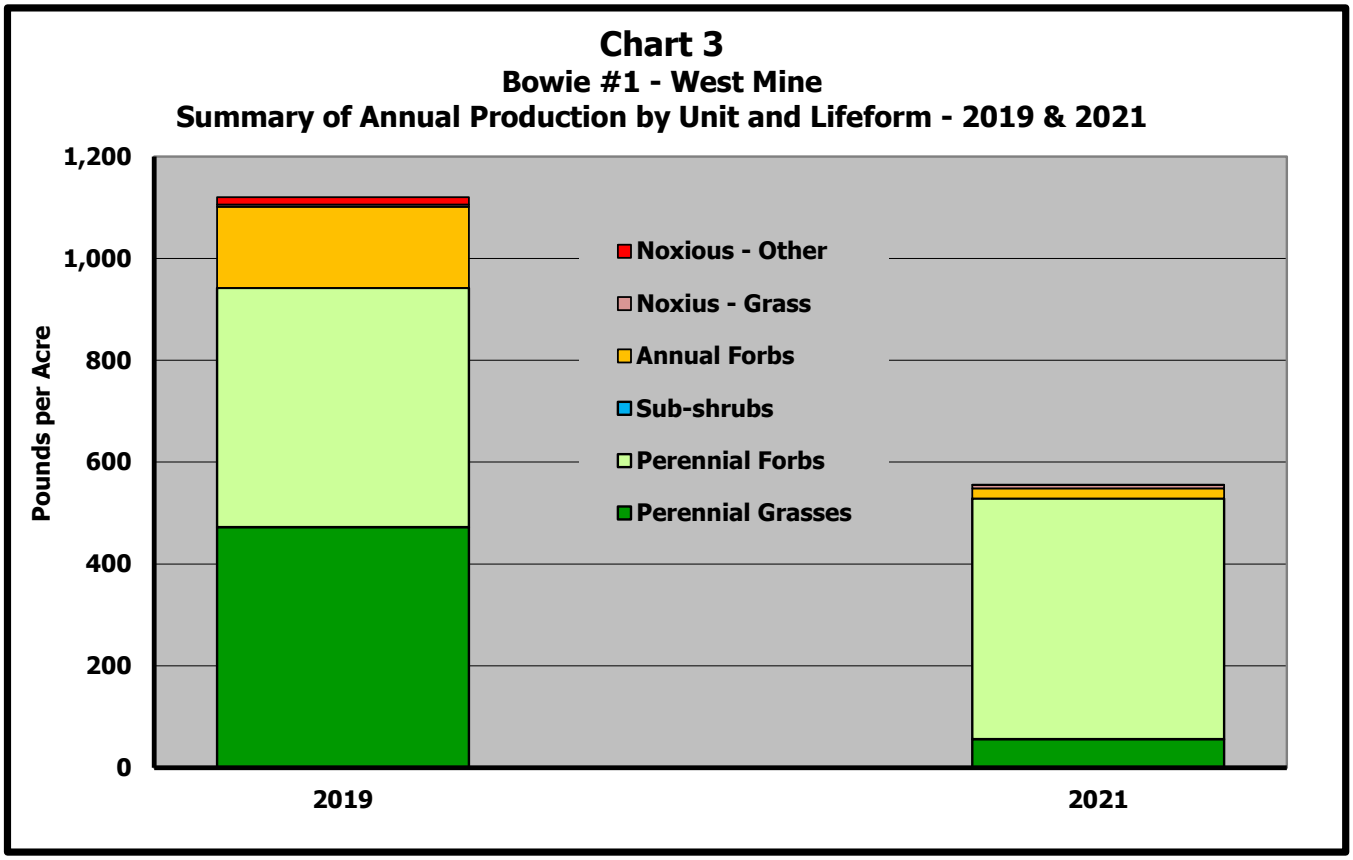
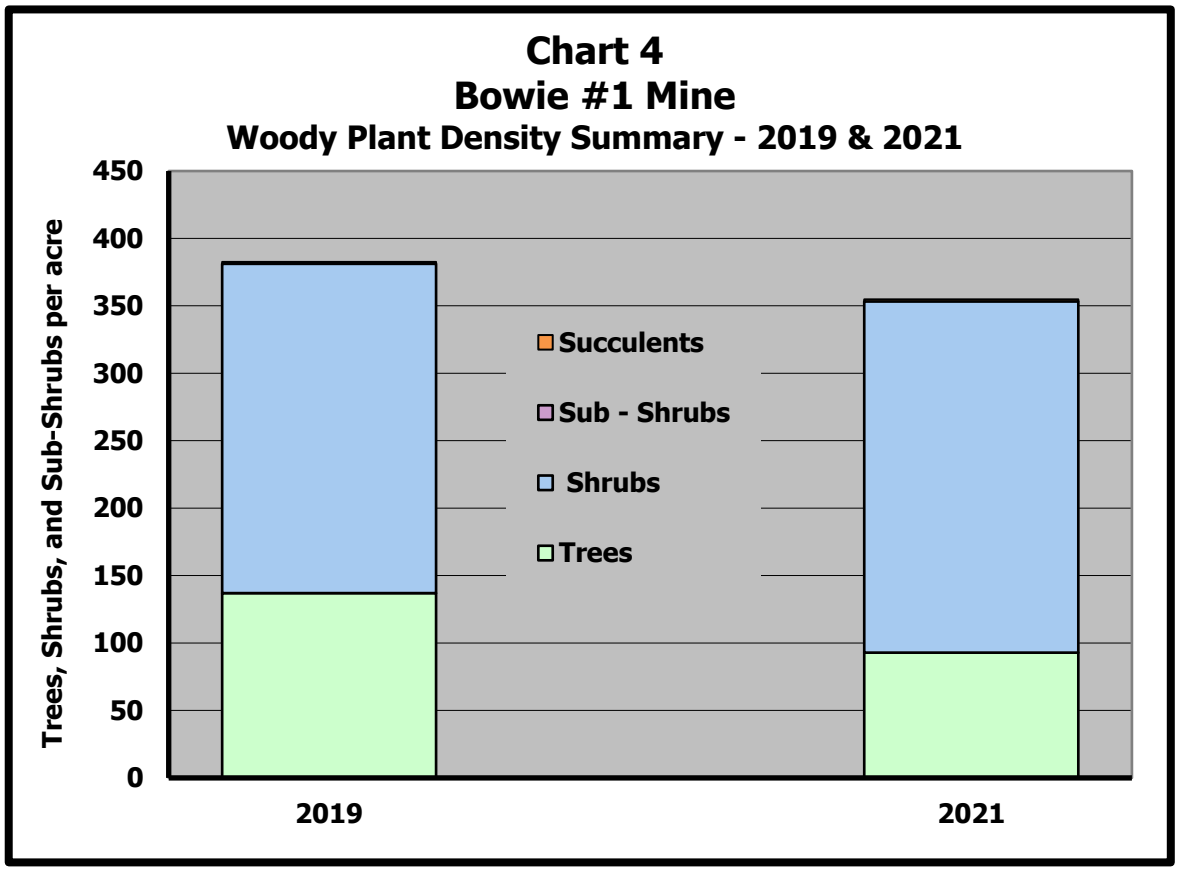


Table 4 Bowie #1 Mine - Woody Plant Density - 2021

West Mine - Woody Plant Density Summary

Young and Mature Plants Per Acre

Species	Lifeform	2019	2021
Amelanchier utahensis	Shrub	17.7	6.2
Atriplex canescens	Shrub	10.6	12.4
Chrysothamnus nauseosus	Shrub	78.1	119.8
Opuntia polyachantha	Succ.	1.4	1.6
Purshia tridentata	Shrub	27.7	20.2
Quercus gambelii	Tree	137.0	92.8
Rosa woodsii	Shrub	13.5	16.6
Symphoricarpos rotundifolia	Shrub	96.5	85.1
Total Woody Plants per acre		**382.6**	**354.8**
Trees per acre		**137.0**	**92.8**
Shrubs per acre		**244.2**	**260.4**
Sub - Shrubs per acre		**-**	**-**
Succulents per acre		**1.4**	**1.6**



4.0 SUCCESS COMPARISON

The West Mine passed all success criteria in 2019 and 2021. The demonstration of adequacy and a minimum of 15 transects in each unit allow for a direct comparison for cover and production per Rule 4.15.11 (2)(a). A reverse null ranked "L" test was utilized for the woody plant density variable as per Rule 4.15.11 (3)(a) in 2019 while a minimum of 75 transects (n=78) for woody plant density allows for a direct comparison as per Rule 4.15.11 (3)(a) in 2021. A summary of success comparisons is provided on the following pages in Table 1 and Charts 5 through 10. Table 1 gives a quick indication of the overall success of the revegetation unit compared with the standards. Charts 5 through 10 provide a visual display of the same comparisons.

Table 1 Bowie #1 Mine

Revegetation Success Criteria Comparisons - 2019 & 2021 (per TR-63)

		Plant Cover		**Production**		**Woody Plant Density**			
						Live Trees, Shrubs, and Sub-Shrubs (per acre)			
Area	*Year Sampled*	**Total Plant Cover*** (% average cover)		**Annual (Total) Herbaceous*** (pounds per acre)		**Average** (If n ≥ 75)		**Reverse Null Ranked "L" Test** (If n < 75)	
Success Criteria		**≥54%**		**≥405**		**≥90**		**≥90**	
West Mine	**2019**	**61.1** [4]	**Pass**	**942** [5]	**Pass**	**383**	**N/A** [1]	**91** [2]	**Pass**
	2021	**55.3**	**Pass**	**549**	**Pass**	**355**	**Pass** [3]	**N/A**	**N/A**

		Diversity (Number of Species)							
		Total Native or Introduced Perennial Herbaceous		**Total Native Perennial Cool-Season Grasses**		**Total Native or Introduced Perennial Forbs**		**Total Native Sub-Shrubs, Trees, and Shrubs**	
Area	*Year Sampled*	(Between 0.5 & 60% Relative Cover)						(<80% Rel. Cover)	
Success Criteria		**≥5**		**≥3**		**≥2**		**≥2**	
West Mine	**2019**	**10**	**Pass**	**4**	**Pass**	**5**	**Pass**	**5**	**Pass**
	2021	**9**	**Pass**	**4**	**Pass**	**4**	**Pass**	**3**	**Pass**

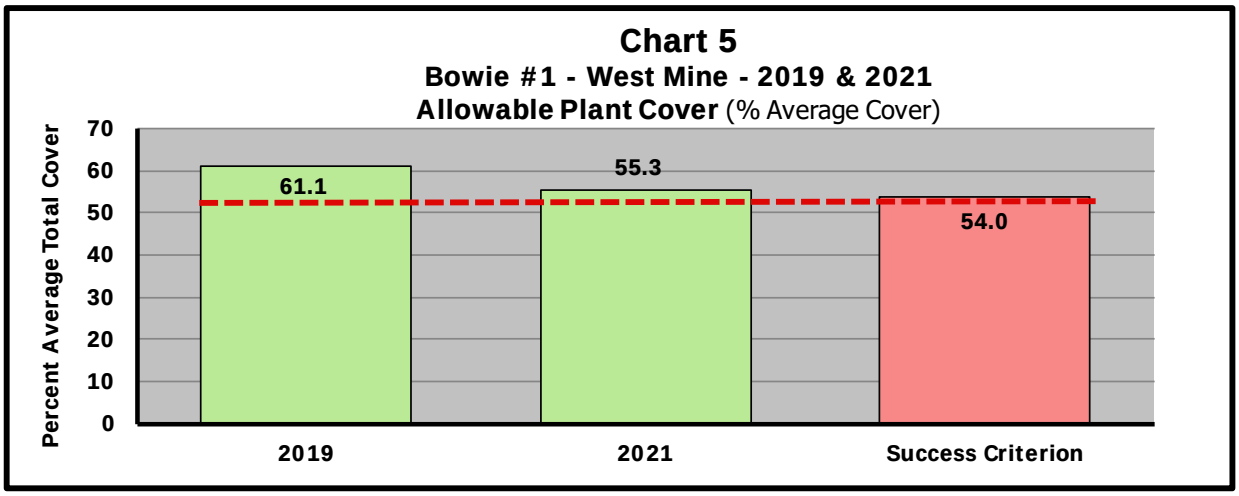
*Excluding noxious weeds [1] n was 60 [2] Lower 80% Confidence Limit [3] n was 78

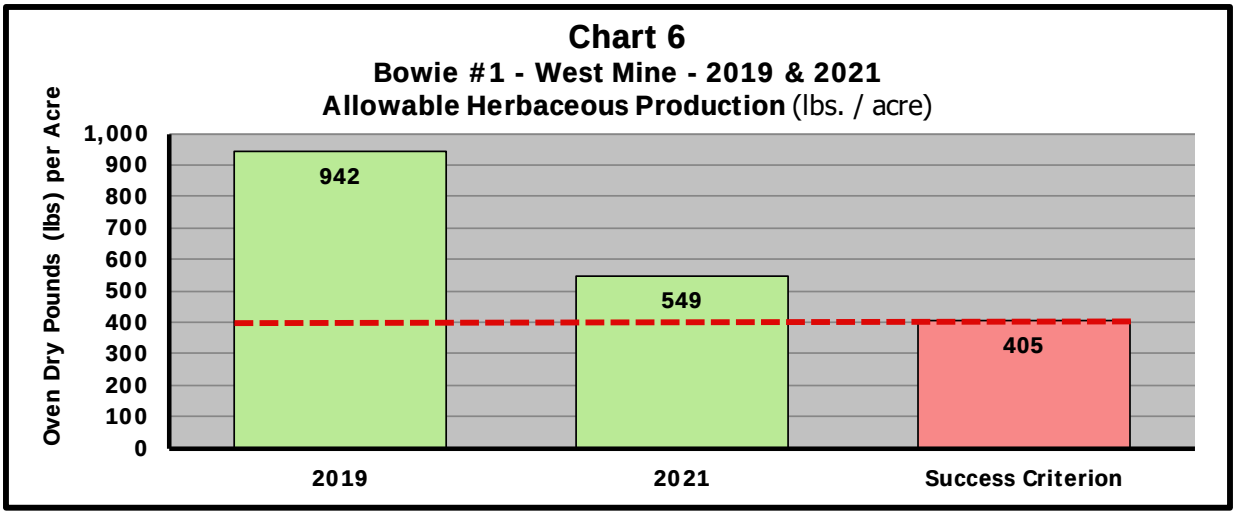
[4] Annual and biennial relative cover exceeded the allowable limit (10%) and was not included in the success comparisons

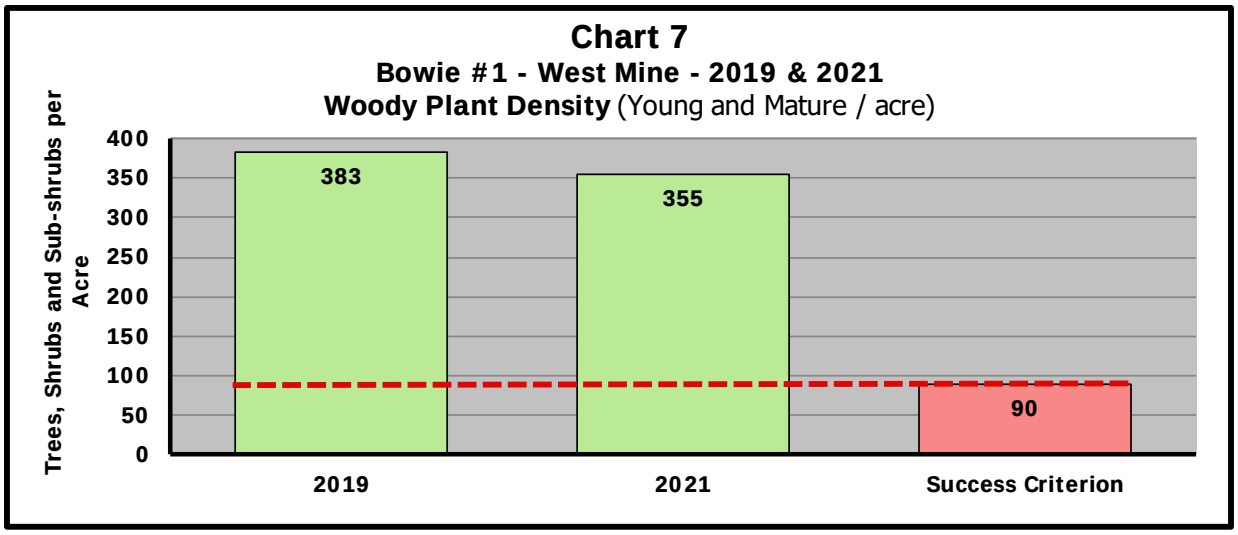
[5] Annual and biennial production exceeded the allowable limit (10%) and was not included in the success comparisons

The West Mine unit surpassed the total plant cover (excluding noxious weeds) success criterion of ≥54.0% (90% of the technical standard value of 60%) with 61.1% in 2019 and 55.3% in 2021 (Chart 5). Annual and biennial cover was not included in the success comparison in 2019 since it exceeded the allowable relative cover of 10% per CDRMS policy. The annual (total) herbaceous production success

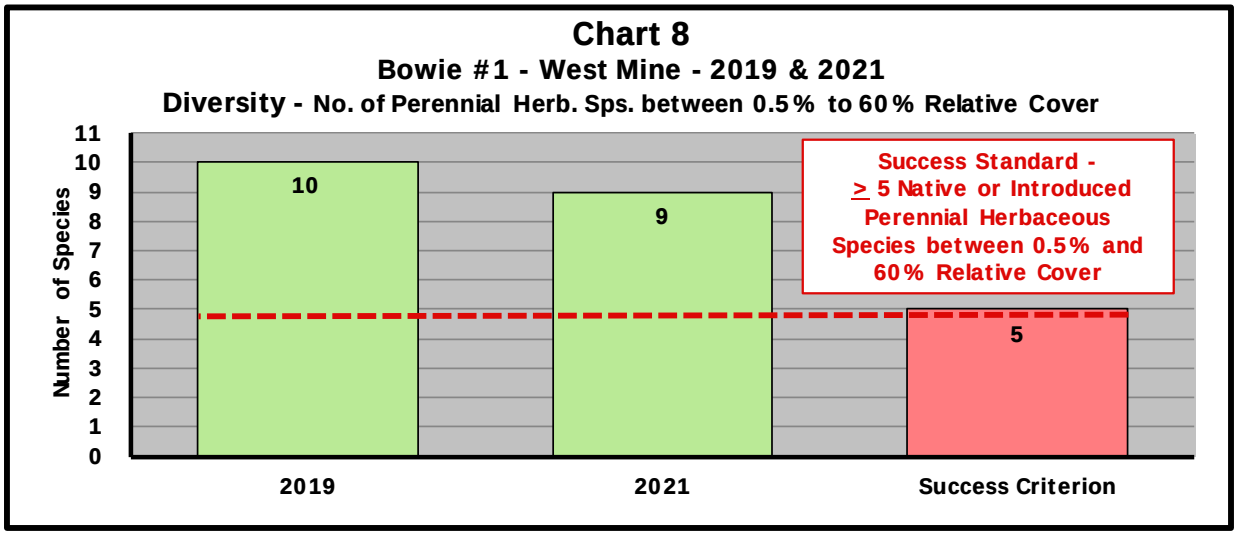
criterion of ≥405 pounds per acre (90% of the technical standard value of 450 pounds per acre) was surpassed with 942 pounds per acre in 2019 and 549 in 2021 (Chart 6). Annual and biennial production was not included in the success comparison in 2019 since it exceeded the allowable contribution of 10% per CDRMS policy. A total of 383 trees, shrubs, and sub-shrubs per acre were sampled in 2019 which equates to a lower 80% confidence limit of 91 that surpasses 90% of the technical standard when the reverse null ranked "L" test is utilized (Chart 7). A total of 355 trees, shrubs, and sub-shrubs per acre were sampled in 2021 surpassing the woody plant density success criterion of 90 per acre (90% of the technical standard value of 100 woody plants per acre).







With regards to diversity, the West Mine unit surpasses the required number of total native or introduced perennial herbaceous species with between 0.5% and 60.0% relative cover (≥five species) with eleven in 2019 and nine in 2021 (Chart 8). The total native perennial cool-season grasses with between 0.5% and 60.0% relative cover (≥three species) was surpassed with four in both 2019 and 2021 (Chart 9). The total native or introduced forb species with between 0.5% and 60.0% relative cover (≥two species) was met with six in 2019 and four in 2021 (Chart 10). And finally, the total number of native trees, shrubs, and sub-shrubs with <80% relative cover (≥two species) was surpassed with five in 2019 and three in 2021 (Chart 11).



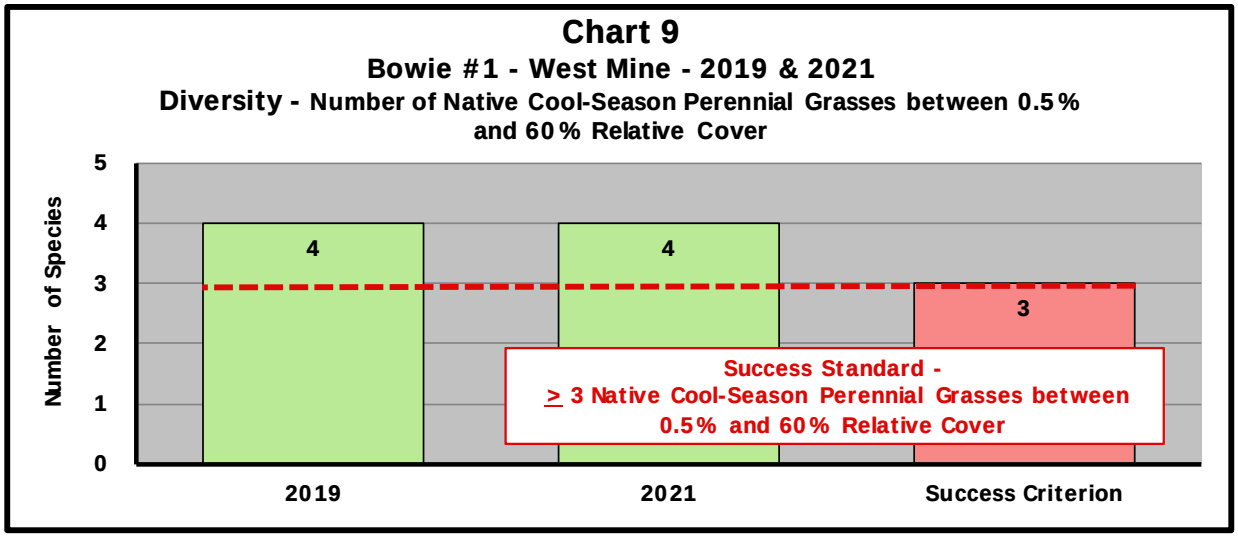


Chart 9
Bowie #1 - West Mine - 2019 & 2021
Diversity - Number of Native Cool-Season Perennial Grasses between 0.5% and 60% Relative Cover
Number of Species
0
1
2
3
4
5
4
4
3
Success Standard -
≥ 3 Native Cool-Season Perennial Grasses between 0.5% and 60% Relative Cover
2019
2021
Success Criterion

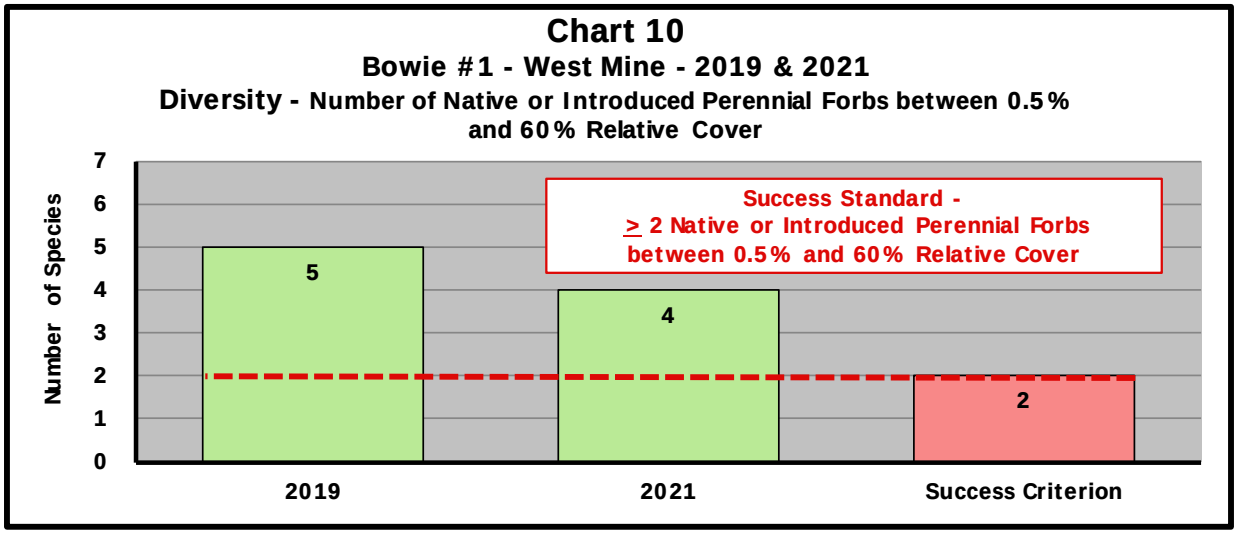


Chart 10
Bowie #1 - West Mine - 2019 & 2021
Diversity - Number of Native or Introduced Perennial Forbs between 0.5% and 60% Relative Cover
Number of Species
0
1
2
3
4
5
6
7
5
4
2
Success Standard -
≥ 2 Native or Introduced Perennial Forbs between 0.5% and 60% Relative Cover
2019
2021
Success Criterion

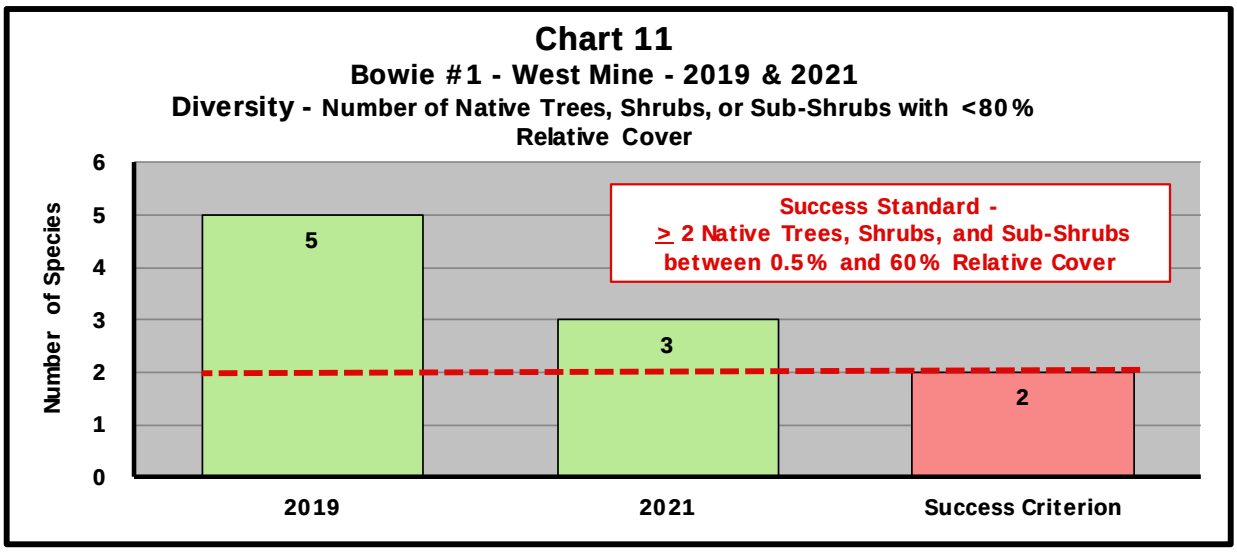


Chart 11
Bowie #1 - West Mine - 2019 & 2021
Diversity - Number of Native Trees, Shrubs, or Sub-Shrubs with <80% Relative Cover
Number of Species
0
1
2
3
4
5
6
5
3
2
Success Standard -
≥ 2 Native Trees, Shrubs, and Sub-Shrubs between 0.5% and 60% Relative Cover
2019
2021
Success Criterion

This review of collected data demonstrates the success and utility of the revegetated areas, especially given vegetative ground cover and favorable results with regard to diversity and production despite wildlife grazing. Inspection of Plates 1 through 6 provides visual evidence of this utility. Field studies have shown that the target reclaimed plant communities have progressed sufficiently to be ready for Phase III Bond Release. Ground cover of perennial plants within the reclaimed areas is comparable to adjacent undisturbed native communities and plant succession is occurring and progressing in a positive direction, indicating that plants are self-sustaining.

5.0 LITERATURE CITED

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Weber, W.A. and Wittman, R.C., 2012. Colorado Flora: Western Slope – 4th Edition. University Press of Colorado. 608 p.

Wyoming Department of Environmental Quality, 1999. Appendix A - Vegetation Sampling Methods and Reclamation Success Standards for Surface Coal Mining Operations - Appendix II - Sub-shrubs.

Appendix A

Raw Tables, Maps and Photographs

Appendix A

Raw Tables, Maps and Photographs

Table 5 Bowie #1 - Vegetation Cover - 2021

West Mine - Relative Ground Cover Summary - 2019 & 2021

Percent Ground Cover Based on Point-Intercept Sampling

			Year -->	**2019**	**2021**
Grasses and Grass-likes					
X	A	*Anisantha tectorum*	Cheatgrass	-	0.33
I	P	*Bromus inermis*	Smooth Brome	4.38	5.47
I	A	*Bromus japonicus*	Japanese Brome	0.98	0.07
N	P	*Carex filifolia*	Threadleaf Sedge	0.04	-
N	P	*Elymus lanceolatus*	Thickspike Wheatgrass	4.51	8.87
N	P	*Elymus psammophilus*	Streambank Wheatgrass	1.70	2.27
N	P	*Leymus cinereus*	Great Basin Wildrye	0.04	-
N	P	*Nassella viridula*	Green Needlegrass	1.21	1.00
N	P	*Pascopyron smithii*	Western Wheatgrass	8.66	9.53
I	P	*Poa pratensis*	Kentucky Bluegrass	0.04	-
Forbs					
N	P	*Achillea millefolium*	Common Yarrow	0.04	-
N	A	*Alyssum desertorum*	Desert Alyssum	19.55	3.67
I	P	*Astragalus cicer*	Cicer Milkvetch	8.88	12.33
N	A	*Collomia linearis*	Slenderleaf Collomia	0.22	-
X	P	*Convolvulus arvensis*	Field Bindweed	0.45	0.07
N	P	*Crepis acuminata*	Tapertip Hawkbeard	0.09	-
N	A	*Cryptantha watsonii*	Watson's Cryptantha	0.27	-
N	A	*Descurainia pinnata*	Western Tansymustard	0.31	-
N	P	*Galium aparine*	Cleavers	0.09	-
N	A	*Gayophytum ramosissimum*	Groundsmoke	0.09	-
N	A	*Helianthus annuus*	Common Sunflower	0.09	-
N	P	*Heliomeris multiflora*	Showy Goldeneye	0.13	-
N	P	*Heterotheca villosa*	Hairy Golden Aster	0.04	-
I	B	*Lactuca serriola*	Prickly Lettuce	1.12	0.07
N	P	*Linum lewisii*	Lewis Flax	0.40	0.13
N	P	*Lupinus caudatus*	Tailcup Lupine	0.45	0.07
I	P	*Medicago sativa*	Alfalfa	37.72	42.93
N	P	*Penstemom strictus*	Rocky Mountain Penstemom	0.80	0.07
I	P	*Sanguisorba minor*	Small Burnet	0.18	-
I	P	*Scorzonera laciniatum*	Cutleaf Viper Grass	0.94	8.60
I	P	*Securigea varia*	Crownvetch	4.96	1.67
I	P	*Taraxacum officinale*	Dandelion	-	0.47
N	P	*Sphaeralcea coccinea*	Scarlet Globemallow	0.04	-
I	B	*Tragopogon dubius*	False Salsify	0.46	-
Sub-Shrubs					
N	P	*None*		-	-
Shrubs & Trees					
N	P	*Amelanchier utahensis*	Utah Serviceberry	0.13	-
N	P	*Chrysothamnus nauseosus*	Rubber Rabbitbrush	0.18	-
N	P	*Purshia tridentata*	Bitterbrush	0.13	1.40
N	P	*Quercus gambelii*	Gambel Oak	0.31	0.49
N	P	*Symphoricarpos rotundifolia*	Snowberry	0.31	0.79
Summary by Lifeform:					
			Perennial Grasses	**20.58**	**27.13**
			Annual Grasses	0.98	0.07
			Perennial Forbs	**54.78**	**66.27**
			Annual and Biennial Forbs	22.14	3.73
			Noxious / Aggressive Weeds	0.45	0.40
			Sub-Shrubs	**-**	**-**
			Shrubs and Trees	**1.07**	**2.40**
Species Diversity Categories †					
			Number of Perennial Species between 0.5% & 60% Rel. Cover	**10**	**9**
			Number of Native Cool-Season Per. Grasses between 0.5% & 60% Rel. Cover	**4**	**4**
			# of Nat. or Int. Perennial Forbs between 0.5% & 60% Rel. Cover	**5**	**4**
			Number of Native Trees, Shrubs, or Sub-Shrubs <80% Rel. Cover	**5**	**3**

N - Native, Nw - Warm Season, I - Introduced, X - Noxious A - Annual, B - Biennial, P - Perennial

† Diversity standards exclude invasive and noxious weed species.

Table 6 Bowie #1 - Vegetation Cover - 2021

Species Observed

			Year -->	2019	2021
Grasses and Grass-likes					
N	P	*Achnatherum hymenoides*	Indian Ricegrass	X	X
X	A	*Anisantha tectorum*	Cheatgrass	X	X
I	P	*Bromus inermis*	Smooth Brome	X	X
I	A	*Bromus japonicus*	Japanese Brome	X	X
N	P	*Carex filifolia*	Threadleaf Sedge	X	X
N	P	*Elymus lanceolatus*	Thickspike Wheatgrass	X	X
N	P	*Elymus psammophilus*	Streambank Wheatgrass	X	X
N	P	*Leymus cinereus*	Great Basin Wildrye	X	X
N	P	*Nassella viridula*	Green Needlegrass	X	X
N	P	*Pascopyron smithii*	Western Wheatgrass	X	X
X	P	*Poa bulbosa*	Bulbous Bluegrass	X	X
I	P	*Poa pratensis*	Kentucky Bluegrass	X	X
Forbs					
N	P	*Achillea millefolium*	Common Yarrow	X	
N	P	*Allium textile*	Prairie Onion	X	
N	A	*Alyssum desertorum*	Desert Alyssum	X	X
X	B	*Arctium minus*	Lesser Burdock		X
I	P	*Astragalus cicer*	Cicer Milkvetch	X	X
X	B	*Carduus nutans*	Musk Thistle		X
I	A	*Capsella bursa-pastoris*	Shepherd's Purse	X	
N	A	*Collomia grandiflora*	Grand Collomia	X	
N	A	*Collomia linearis*	Slenderleaf Collomia	X	
X	P	*Convolvulus arvensis*	Field Bindweed	X	X
N	P	*Crepis acuminata*	Tapertip Hawkbeard	X	
N	A	*Cryptantha watsonii*	Watson's Cryptantha	X	
N	A	*Cuscuta* sp.	Dodder	X	X
N	A	*Descurainia pinnata*	Western Tansymustard	X	
N	P	*Galium aparine*	Cleavers	X	
N	A	*Gayophytum ramosissimum*	Groundsmoke	X	
N	A	*Helianthus annuus*	Common Sunflower	X	X
N	P	*Heliomeris multiflora*	Showy Goldeneye	X	X
N	P	*Heterotheca villosa*	Hairy Golden Aster	X	X
I	B	*Lactuca serriola*	Prickly Lettuce	X	X
N	P	*Linum lewisii*	Lewis Flax	X	X
N	P	*Lupinus caudatus*	Tailcup Lupine	X	X
I	P	*Medicago sativa*	Alfalfa	X	X
N	P	*Penstemom strictus*	Rocky Mountain Penstemom	X	X
I	P	*Sanguisorba minor*	Small Burnet	X	
I	P	*Scorzonera laciniatum*	Cutleaf Viper Grass	X	X
I	P	*Securigea varia*	Crownvetch	X	X
N	P	*Sphaeralcea coccinea*	Scarlet Globemallow	X	X
N	P	*Stellaria jamesiana*	Tuber Starwort	X	
I	P	*Taraxacum officinale*	Common Dandelion	X	X
I	B	*Tragopogon dubius*	False Salsify	X	X
Sub-Shrubs					
N	P	*Gutierrezia sarothrae*	Snakeweed		X
N	P	*Lepidium fremonti*	Fremont peppergrass		X
Shrubs & Trees					
N	P	*Amelanchier utahensis*	Utah Serviceberry	X	X
N	P	*Atriplex canescens*	Fourwing Saltbrush	X	X
N	P	*Chrysothamnus nauseosus*	Rubber Rabbitbrush	X	X
N	P	*Purshia tridentata*	Bitterbrush	X	X
N	P	*Quercus gambelii*	Gambel Oak	X	X
N	P	*Rosa woodsii*	Woods' Rose	X	X
N	P	*Seriphidium tridentatum wyo.*	Wyoming Big Sagebrush	X	X
N	P	*Symphoricarpos rotundifolia*	Snowberry	X	X
I	P	*Ulmus pumila*	Siberian Elm	X	X

Total Counts by Lifeform	**Perennial Grasses**	**9**	**9**
	Annual Grass	1	1
	Perennial Forbs	**17**	**11**
	Annual / Biennial Forbs	13	7
	Noxious Weeds	3	5
	Sub-shrubs	**0**	**2**
	Shrubs & Trees	**9**	**9**
Total Count by Origin	**Native**	**34**	**26**
	Introduced	13	11
	Noxious Weeds	3	5
	Total Species Encountered	**50**	**42**

N - Native, I - Introduced, X - Noxious A - Annual, B - Biennial, P - Perennial

Table 7 Bowie #1 - Vegetation Cover -- 2019

West Mine

Raw Data

Percent Ground Cover Based on Point-Intercept Sampling

				Transect No.——>	1	2	7	8	10	11	13	14	16	17	19	20	22	23	25	26	28	29	31	32	34	35	37	38	40	41	43	44	Average Cover	Relative Cover	Freq.
Grasses and Grass-likes																																		
I	P	*Bromus inermis*	Smooth Brome		11	46	30										2					4				5							3.50	4.38	21
I	A	*Bromus japonicus*	Japanese Brome					4		4						1		4	1	2	1		5										0.79	0.98	29
N	P	*Carex filifolia*	Threadleaf Sedge																	1												0.04	0.04	4
N	P	*Elymus lanceolatus*	Thickspike Wheatgrass		8				1						4			4			8	5	4	1	12	6	35		3	2		8	3.61	4.51	50
N	P	*Elymus psammophilus*	Streambank Wheatgrass					6								7										8	3			14		1.36	1.70	18
N	P	*Leymus cinereus*	Great Basin Wildrye										1																			0.04	0.04	4
N	P	*Nassella viridula*	Green Needlegrass					1		2			2					6						5						2	3	6	0.96	1.21	29
N	P	*Pascopyron smithii*	Western Wheatgrass				6			5	10	11	3	46		8	14		12	6	12	15		6			12	12		16			6.93	8.66	57
I	P	*Poa pratensis*	Kentucky Bluegrass						1																							0.04	0.04	4
Forbs																																		
N	P	*Achillea millefolium*	Common Yarrow																									1				0.04	0.04	4
N	A	*Alyssum desertorum*	Desert Alyssum		5	1	12	13	5	31	25	8	13	17	25	14	21	22	31	23	24	8	17	15	14	19	3	22	19	12	8	11	15.64	19.55	100
I	P	*Astragalus cicer*	Cicer Milkvetch		21			11		7			1		55	2	9	4		7	1	19	42		13	7							7.11	8.88	50
N	A	*Collomia linearis*	Slenderleaf Collomia						4																			1					0.18	0.22	7
X	P	*Convolvulus arvensis*	Field Bindweed				1			2														1					6				0.36	0.45	14
N	P	*Crepis acuminata*	Tapertip Hawkbeard																									2					0.07	0.09	4
N	A	*Cryptantha watsonii*	Watson's Cryptantha																						5	1							0.21	0.27	7
N	A	*Descurainia pinnata*	Western Tansymustard						1								1			1			3				1						0.25	0.31	18
N	P	*Galium aparine*	Cleavers																						2								0.07	0.09	4
N	A	*Gayophytum ramosissimum*	Groundsmoke																			1						1					0.07	0.09	7
N	A	*Helianthus annuus*	Common Sunflower																2														0.07	0.09	4
N	P	*Heliomeris multiflora*	Showy Goldeneye		2				1																								0.11	0.13	7
N	P	*Heterotheca villosa*	Hairy Golden Aster																			1											0.04	0.04	4
I	B	*Lactuca serriola*	Prickly Lettuce				1	1						2		1	3		5			2	3		3		2	2					0.89	1.12	39
N	P	*Linum lewisii*	Lewis Flax						3			5								1													0.32	0.40	11
N	P	*Lupinus caudatus*	Tailcup Lupine							10																							0.36	0.45	4
I	P	*Medicago sativa*	Alfalfa		33	19	17	39	14	9	32	40	71	13		54	43	49	10	54	38	10	16	50	28	48		12	64	14	23	45	30.18	37.72	93
N	P	*Penstemom strictus*	Rocky Mtn Penstemom		1		1	1			2				2							4								7		0.64	0.80	25
I	P	*Sanguisorba minor*	Small Burnet					2				2																					0.14	0.18	7
I	P	*Scorzonera laciniatum*	Cutleaf Viper Grass		4						7		1				1	2		1	2					1			2				0.75	0.94	32
I	P	*Securigea varia*	Crownvetch						62										8											34	7		3.96	4.96	14
N	P	*Sphaeralcea coccinea*	Scarlet Globemallow															1															0.04	0.04	4
I	B	*Tragopogon dubius*	False Salsify		1		1		1		1			1		1		1			1						1		1		1		0.39	0.49	39
Sub-Shrubs																																		
		None																															0.00	0.00	0
Shrubs & Trees																																		
N	P	*Amelanchier utahensis*	Utah Serviceberry																									3					0.11	0.13	4
N	P	*Chrysothamnus nauseosus*	Rubber Rabbitbrush																													4	0.14	0.18	4
N	P	*Purshia tridentata*	Bitterbrush			3																											0.11	0.13	4
N	P	*Quercus gambelii*	Gambel Oak																								6	1					0.25	0.31	7
N	P	*Symphoricarpos rotundifolia*	Snowberry						1																			6					0.25	0.31	7
																																	Mean	
			Total Plant Cover		**86**	**69**	**69**	**78**	**94**	**70**	**77**	**66**	**92**	**79**	**86**	**88**	**94**	**89**	**72**	**94**	**89**	**70**	**85**	**83**	**77**	**87**	**68**	**66**	**95**	**80**	**63**	**74**	**80.00**		
			Rock		0	0	1	1	0	5	1	3	1	1	1	0	0	0	1	0	3	0	0	0	0	0	1	2	1	4	4	6	**1.29**		
			Litter		14	29	26	12	6	17	20	26	7	17	13	12	5	10	25	5	7	30	15	17	23	13	29	24	4	16	21	12	**16.25**		
			Bare ground		0	2	4	9	0	8	2	5	0	3	0	0	1	1	2	1	1	0	0	0	0	0	2	8	0	0	12	8	**2.46**		
			Total Plant Cover (Exc. Noxious Weeds)		**86**	**69**	**68**	**78**	**94**	**68**	**77**	**66**	**92**	**79**	**86**	**88**	**94**	**89**	**72**	**94**	**89**	**70**	**85**	**82**	**77**	**87**	**68**	**66**	**89**	**80**	**63**	**74**	**79.64**		
			Sampling Adequacy Calculations		**n = 28**					**t = 1.314**					**Variance = 101.04**					**n_{min} = 2.72**																
2nd Hits on Plants Below Shrub Layer (for Diversity)																																		
		None																																

Table 8 Bowie #1 - Vegetation Cover -- 2021

West Mine

Raw Data

Percent Ground Cover Based on Point-Intercept Sampling

				Transect No.——>	1	2	4	5	7	8	13	14	16	17	20	22	23	25	26	28	29	31	32	34	35	37	38	40	41	43	44	Average Cover	Relative Cover	Freq.
Grasses and Grass-likes																																		
X	A	*Anisantha tectorum*	Cheatgrass						1			1	1	1												1						**0.19**	**0.33**	**19**
I	P	*Bromus inermis*	Smooth Brome	2	36			6				11								10		5		12								**3.04**	**5.47**	**26**
I	A	*Bromus japonicus*	Japanese Brome																				1									**0.04**	**0.07**	**4**
N	P	*Elymus lanceolatus*	Thickspike Wheatgrass			10	10		7	3				7	10		7		3	8		8	7	6	6		8	4	7	22	**4.93**	**8.87**	**63**
N	P	*Elymus psammophilus*	Streambank Wheatgrass			6											6	6		12						2	2				**1.26**	**2.27**	**22**
N	P	*Nassella viridula*	Green Needlegrass																		8					5	2				**0.56**	**1.00**	**11**
N	P	*Pascopyron smithii*	Western Wheatgrass				1				6		5	21	2	4		5	9	6	3	3		12	7	35	12		2	10	**5.30**	**9.53**	**63**
Forbs																																		
N	A	*Alyssum desertorum*	Desert Alyssum	2	1	1		1	1		2		9	2	1		1	3			4	1	5	1			8	8	4		**2.04**	**3.67**	**67**
I	P	*Astragalus cicer*	Cicer Milkvetch	3	2	6	35	16										27			9	18		3			2	22	38	4	**6.85**	**12.33**	**48**
X	P	*Convolvulus arvensis*	Field Bindweed																1												**0.04**	**0.07**	**4**
I	B	*Lactuca serriola*	Prickly Lettuce															1													**0.04**	**0.07**	**4**
N	P	*Linum lewisii*	Lewis Flax										2																		**0.07**	**0.13**	**4**
N	P	*Lupinus caudatus*	Tailcup Lupine																										1		**0.04**	**0.07**	**4**
I	P	*Medicago sativa*	Alfalfa	25	25	18		29	17	45	30	37	34	17	38	29	34	14	32	29	32	21	19	23	30	9	25	14	2	16	**23.85**	**42.93**	**96**
N	P	*Penstemom strictus*	Rocky Mountain Penstemom																									1			**0.04**	**0.07**	**4**
I	P	*Scorzonera laciniatum*	Cutleaf Viper Grass	4	2	3	12		18		15	7	6	5	3	17	6	1	2	5	2	3	2	9	6	1					**4.78**	**8.60**	**78**
I	P	*Securigea varia*	Crownvetch	15						10																					**0.93**	**1.67**	**7**
I	P	*Taraxacum officinale*	Common Dandelion	1				3		2		1																			**0.26**	**0.47**	**15**
Sub-Shrubs																																		
		none																													**0.00**	**0.00**	**0**
Shrubs & Trees																																		
N	P	*Purshia tridentata*	Bitterbrush			7			13																			3			**0.85**	**1.53**	**11**
N	P	*Symphoricarpos rotundifolia*	Snowberry																									13			**0.48**	**0.87**	**4**
																															Mean		
			Total Plant Cover	**52**	**66**	**51**	**58**	**55**	**57**	**60**	**53**	**57**	**57**	**53**	**54**	**50**	**54**	**57**	**57**	**60**	**63**	**55**	**45**	**54**	**50**	**52**	**59**	**65**	**54**	**52**	**55.56**		
			Rock	4	7	1	1	3	0	4	1	0	5	2	3	3	3	17	0	2	0	2	5	2	2	0	6	2	10	6	**3.37**		
			Litter	41	26	43	22	34	35	31	39	39	36	43	30	38	35	25	36	31	34	35	28	23	36	29	27	30	21	42	**32.93**		
			Bare ground	3	1	5	19	8	8	5	7	4	2	2	13	9	8	1	7	7	3	8	22	21	12	19	8	3	15	0	**8.15**		
			Total Plant Cover (Exc. Noxious Weeds)	**52**	**66**	**51**	**58**	**55**	**56**	**60**	**53**	**56**	**56**	**52**	**54**	**50**	**54**	**57**	**56**	**60**	**63**	**55**	**45**	**54**	**49**	**52**	**59**	**65**	**54**	**52**	**55.33**		
Sampling Adequacy Calculations				**n = 27**					***t* = 1.315**			**Variance = 22.18**									n_{min} = **1.24**													
2nd Hits on Plants Below Shrub Layer (for Diversity)																																		
			None																															

Table 9 Bowie #1 Mine - Vegetation Production - 2019

West Mine

Raw Data — **Oven Dry Weight (grams per 1/2 square meter)**

Sample No.	*Perennial Grasses*	*Perennial Forbs*	*Sub-shrubs*	*Annual / Biennial Forbs*	*Noxious Weeds*		TOTAL	
					Grass	*Other*	g/0.5m^2	lbs / ac
1	17.4	65.9		7.3			**90.6**	**1,613.9**
2	44.5	11.8		3.8			**60.1**	**1,070.6**
3	61.6	4.7		1.2			**67.5**	**1,202.4**
6	10.0	88.0		11.6			**109.6**	**1,952.4**
7	65.4	0.4		7.1		0.3	**73.2**	**1,304.0**
8	10.3	55.4		8.8		0.2	**74.7**	**1,330.7**
9	3.3	45.1		7.4		3.7	**59.5**	**1,059.9**
10	10.2	57.0		6.4		1.6	**75.2**	**1,339.6**
11	0.4	51.9		6.6		1.2	**60.1**	**1,070.6**
12	9.5	33.4		13.2		0.3	**56.4**	**1,004.7**
13	17.0	7.8		7.5		0.4	**32.7**	**582.5**
14	3.8	27.1		7.6			**38.5**	**685.8**
15	3.5	28.8		8.8		1.0	**42.1**	**750.0**
16	68.6			15.8	0.7		**85.1**	**1,516.0**
17	18.7	1.3		6.3			**26.3**	**468.5**
18	26.0	2.5		3.3			**31.8**	**566.5**
19	15.3			10.0		3.1	**28.4**	**505.9**
20	14.5	15.8		9.8			**40.1**	**714.3**
21	16.7	60.3		8.3			**85.3**	**1,519.5**
22	23.8	20.9		6.6		1.7	**53.0**	**944.1**
23	22.0	26.6		12.6		0.7	**61.9**	**1,102.7**
24	13.3	74.3		10.7			**98.3**	**1,751.1**
25		19.6		16.8		4.7	**41.1**	**732.2**
26	11.1	12.5		16.8		0.5	**40.9**	**728.6**
27	51.6			13.4	1.1	0.8	**66.9**	**1,191.8**
28	43.6	0.4		9.7		0.3	**54.0**	**962.0**
29	27.7			21.2		4.1	**53.0**	**944.1**
30	14.7	22.8		4.5		0.8	**42.8**	**762.4**
31	52.3	13.8		7.1			**73.2**	**1,304.0**
32	43.1	45.7		7.4	8.7	2.1	**107.0**	**1,906.1**
33	9.4	69.4		26.8			**105.6**	**1,881.2**
34	40.1	6.0		8.8		0.5	**55.4**	**986.9**
35	19.3	41.3		8.2			**68.8**	**1,225.6**
36	68.2			7.1			**75.3**	**1,341.4**
37	110.1			3.7			**113.8**	**2,027.2**
38	2.5	19.9		9.6		6.3	**38.3**	**682.3**
39	22.5	67.2		5.2		0.4	**95.3**	**1,697.7**
40	11.7	13.4		10.1			**35.2**	**627.1**
41	29.8	17.1		12.3			**59.2**	**1,054.6**
42	39.0	19.1		1.6			**59.7**	**1,063.5**
43	30.3	15.3		2.1		0.4	**48.1**	**856.9**
44	19.5	45.0		7.8			**72.3**	**1,288.0**
45	18.7	25.2		3.9			**47.8**	**851.5**
Average	**26.5**	**26.3**	**0.0**	**8.9**	**0.2**	**0.8**	**62.9**	**1120.3**

Sampling Adequacy: **t = 1.302** **var. = 547.308**
n= 43 **Mean = 62.89** **n_{min} = 23.462**

Table 10 Bowie #1 Mine - Vegetation Production - 2021

West Mine

Raw Data

Oven Dry Weight (grams per 1/2 square meter)

Sample No.	*Perennial Grasses*	*Perennial Forbs*	*Sub-shrubs*	*Annual / Biennial Forbs*	*Noxious Weeds*		TOTAL	
					Grass	*Other*	g/0.5m^2	lbs / ac
1	2.0	15.3		0.1			**17.4**	**310.0**
2	4.1	11.4					**15.5**	**276.1**
3	0.9	32.7					**33.6**	**598.6**
4	0.8	34.0					**34.8**	**619.9**
5		53.2					**53.2**	**947.7**
6		27.1					**27.1**	**482.8**
7	0.7	16.8		0.2	0.4		**18.1**	**322.4**
8	3.0	38.5			0.2		**41.7**	**742.8**
9	0.5	34.1		0.1			**34.7**	**618.1**
12	10.4	53.8					**64.2**	**1,143.7**
13	3.1	21.4					**24.5**	**436.4**
14		10.5					**10.5**	**187.0**
15		33.1					**33.1**	**589.6**
16	0.4	26.7					**27.1**	**482.8**
17		17.2		4.3	3.0		**24.5**	**436.4**
18	1.8	32.3		0.4	0.2		**34.7**	**618.1**
20	4.1	17.2		3.2	3.1		**27.6**	**491.7**
21	2.3	30.5					**32.8**	**584.3**
22		15.8					**15.8**	**281.5**
23		16.1					**16.1**	**286.8**
24	0.5	50.2			0.1		**50.8**	**905.0**
25	5.8	20.6			4.7		**31.1**	**554.0**
26	12.9	9.0					**21.9**	**390.1**
27	2.1	22.5		3.2	1.9		**29.7**	**529.1**
28	6.1	15.1					**21.2**	**377.7**
29	5.6	21.1		0.2			**26.9**	**479.2**
30	3.1	39.5		2.7		0.2	**45.5**	**810.5**
31	3.6	15.4		5.8			**24.8**	**441.8**
32	4.2	24.9					**29.1**	**518.4**
33	1.2	22.5		0.2			**23.9**	**425.8**
34	3.0	3.1		0.2	0.2		**6.5**	**115.8**
35	5.3	18.0		5.3	0.3		**28.9**	**514.8**
36	0.9	15.3		0.1	0.1		**16.4**	**292.1**
37		38.9			0.5		**39.4**	**701.9**
38	6.3	10.5		0.2			**17.0**	**302.8**
39	3.1	16.3		5.3			**24.7**	**440.0**
40	8.6	31.1		4.7			**44.4**	**790.9**
41	2.8	32.0		2.0	0.4		**37.2**	**662.7**
42	2.3	77.2		1.7	1.4		**82.6**	**1,471.4**
43		18.3					**18.3**	**326.0**
44	3.1	25.5		5.2			**33.8**	**602.1**
45	18.1	49.5		1.5			**69.1**	**1,230.9**
Average	**3.2**	**26.5**	**0.0**	**1.1**	**0.4**	**0.0**	**31.2**	**555.7**

Sampling Adequacy: **t = 1.303** **var. = 240.807**

n= 42 **Mean = 31.20** **n_{min} = 41.983**

Table 11 Bowie #1 Mine - Woody Plant Density - 2019

West Mine - 2019

Raw Data — **Young and Mature Plants per 2m x 50m Belt Transect**

	Amelanchier utahensis	Atriplex canescens	Chrysothamnus nauseosus	Opuntia polyachantha	Purshia tridentata	Quercus gambelii	Rosa woodsii	Symphoricarpos rotundifolia	**Total** (per transect)	**Total** (per acre)
	Shrub	Shrub	Shrub	Succ.	Shrub	Tree	Shrub	Shrub		
1					1				1	40
2			2						2	81
3			1						1	40
4					2				2	81
6			1		1				2	81
7									0	0
8					3				3	121
9					1			4	5	202
10			8			18			26	1,052
11						22			22	890
12			13		2				15	607
13			1		2		3		6	243
14					7				7	283
15					4				4	162
16					1	2			3	121
19			8					1	9	364
20			1						1	40
21					3				3	121
22					2	18	1	5	26	1,052
23									0	0
24				2					2	81
25							1		1	40
26					2				2	81
27									0	0
28									0	0
29									0	0
30									0	0
31					2		5		7	283
32					2				2	81
33		2							2	81
34									0	0
35			2		1				3	121
36									0	0
37		2	3				3		8	324
38					3				3	121
39									0	0
40									0	0
41									0	0
42						9			9	364
43									0	0
44									0	0
45	2					3			5	202
46			1						1	40
47		1							1	40
48		8							8	324
49	7					73		24	104	4,208
50						26		37	63	2,549
51	2							7	9	364
52		2					2	7	11	445
53									0	0
54			5						5	202
55			9						9	364
56			21					9	30	1,214
57			9						9	364
58			20				4		24	971
59	14		2			22		42	80	3,237
60			3						3	121
Total Count	25	15	110	2	39	193	19	136	539	
Per Acre	**17.7**	**10.6**	**78.1**	**1.4**	**27.7**	**137.0**	**13.5**	**96.5**	**382.6**	

Sample Adequancy Calculations	**mean = 382.60**	**t = 1.673**	**var. = 601956.7**
	n= 57	**n_{min} = 511.27**	

Table 12 Bowie #1 Mine - Woody Plant Density - 2021

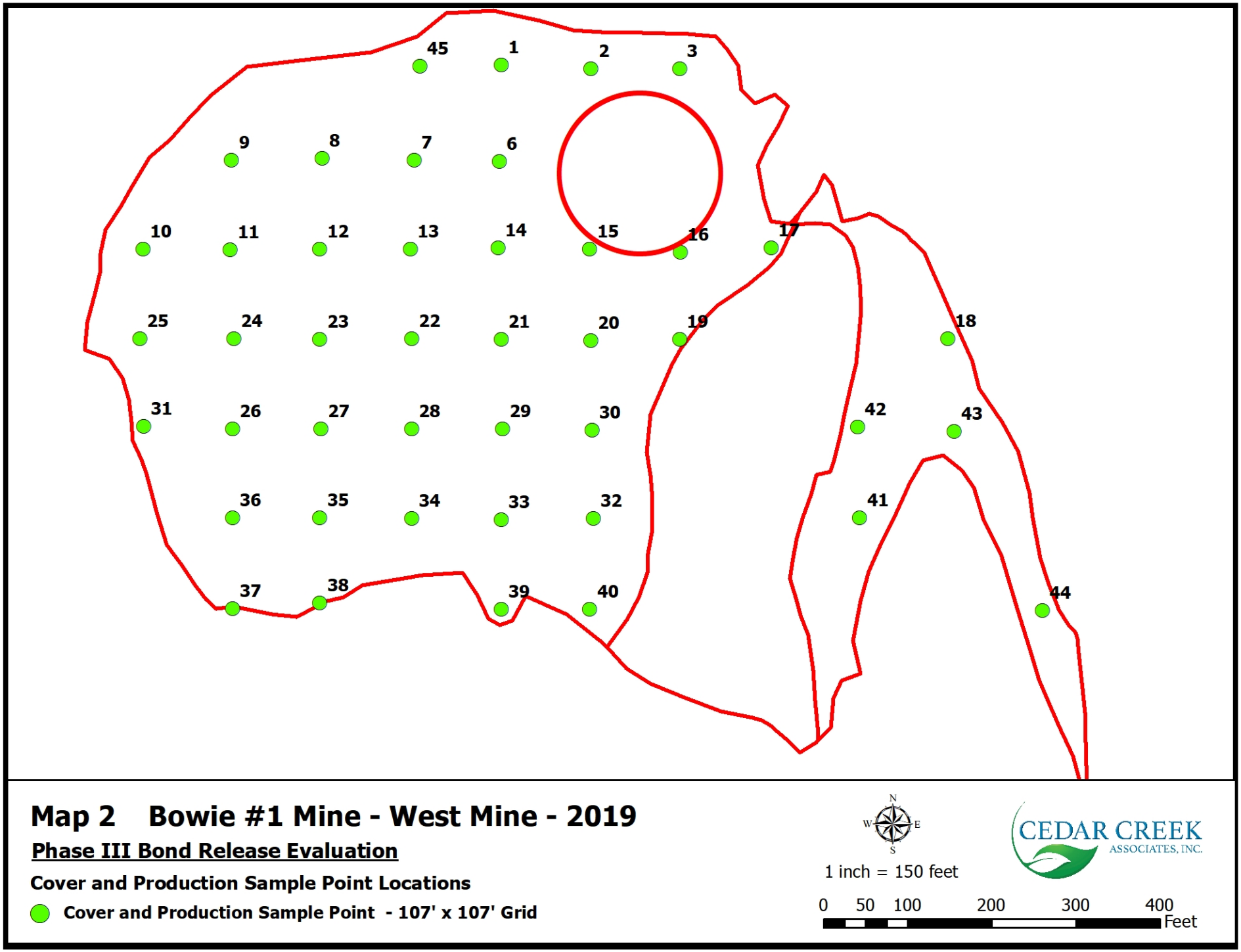
West Mine - 2021

Raw Data

Young and Mature Plants per 2m x 50m Belt Transect

	Amelanchier utahensis	Atriplex canescens	Chrysothamnus nauseosus	Opuntia polyachantha	Purshia tridentata	Quercus gambelii	Rosa woodsii	Symphoricarpos rotundifolia	**Total** (per transect)	**Total** (per acre)
	Shrub	Shrub	Shrub	Succ.	Shrub	Tree	Shrub	Shrub		
1					2			1	3	121
2		2					3		5	202
3					1				1	40
4		1			2				3	121
5									0	0
6			19		1	18		3	41	1,659
7					4				4	162
8			2		7				9	364
9									0	0
10					3				3	121
11					1		5		6	243
13			1						1	40
14			6					3	9	364
15		6	2			5		2	15	607
16			8	1	1				10	405
17		1							1	40
18									0	0
19			1		1		3		5	202
20						6			6	243
21			1		1	5			7	283
24						42		3	45	1,821
25									0	0
26									0	0
27									0	0
28									0	0
29			1		1				2	81
30					3				3	121
32			1				1		2	81
33						12			12	486
34									0	0
35					1				1	40
36									0	0
37									0	0
38									0	0
39		3							3	121
40					1				1	40
41							1		1	40
42									0	0
43							10		10	405
44					1				1	40
45					1				1	40
46									0	0
47					1				1	40
48									0	0
49									0	0
50									0	0
51					1			1	2	81
52									0	0
53									0	0
54									0	0
55					1				1	40
56			1				1		2	81
57									0	0
58									0	0
59						5			5	202
60				1					1	40
61									0	0
62									0	0
63		2						2	4	162
64					1				1	40
65						32			32	1,295
66						42			42	1,699
67	2		6			12			20	809
68			9					26	35	1,416
69		3							3	121
70		4							4	162
71		2						2	4	162
72					1		8		9	364
73					1			1	2	81
74			7	1				1	9	364
75			11						11	445
76			30					3	33	1,335
77			43					38	81	3,277
78			13						13	526
79			42					37	79	3,196
80	10		2					41	53	2,144
81			6		1				7	283
82			19						19	769
Total Count	12	24	231	3	39	179	32	164	684	
Per Acre	**6.2**	**12.4**	**119.8**	**1.6**	**20.2**	**92.8**	**16.6**	**85.1**	**354.8**	

Sample Adequancy Calculations	**mean = 161.12**	**var. = 114084.3**	
	t = 1.665	**n= 78**	**n_{min} = 1218.17**



Map 2 Bowie #1 Mine - West Mine - 2019

Phase III Bond Release Evaluation

Cover and Production Sample Point Locations

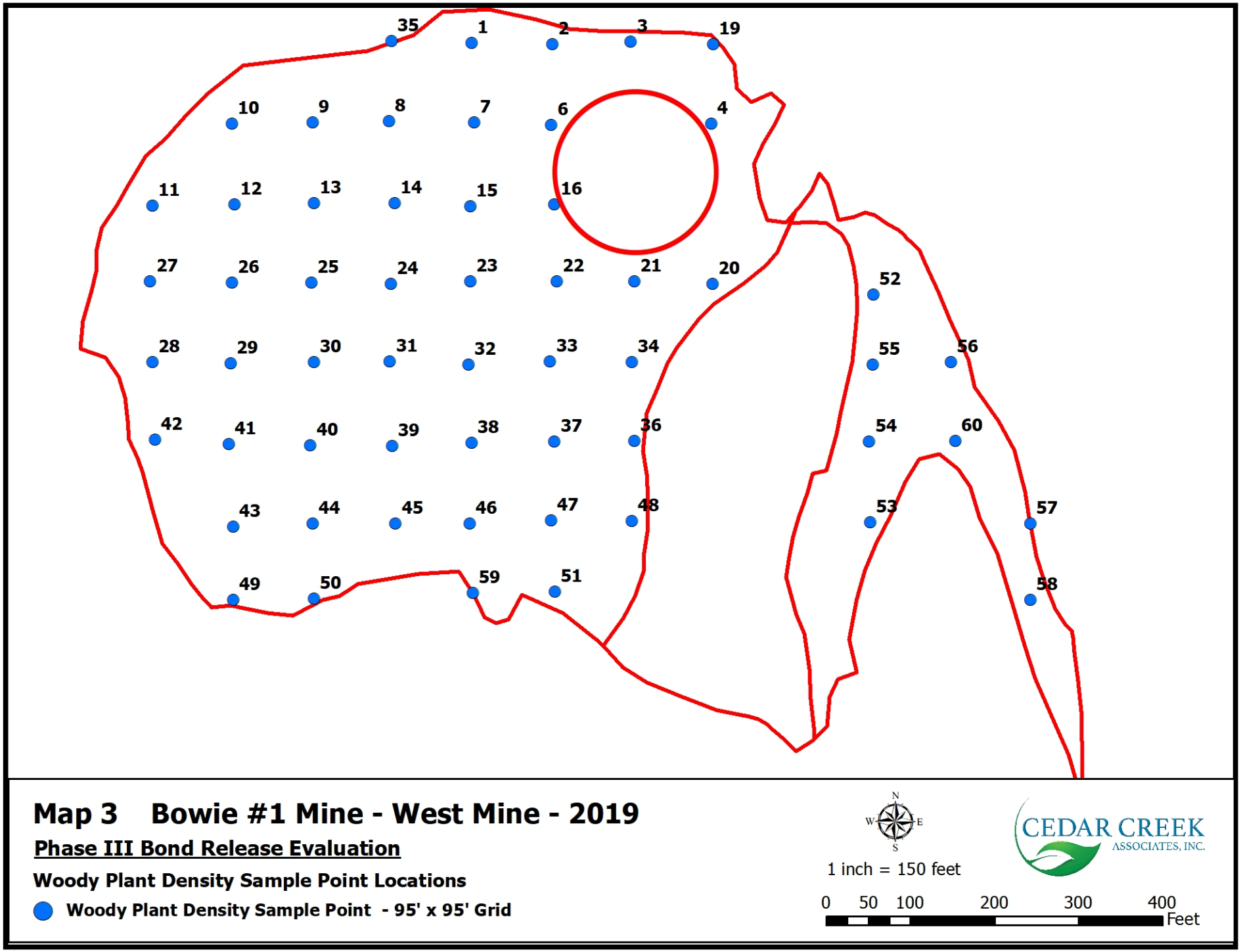
Cover and Production Sample Point - 107' x 107' Grid

N W E S

1 inch = 150 feet

0 50 100 200 300 400 Feet

CEDAR CREEK ASSOCIATES, INC.


35
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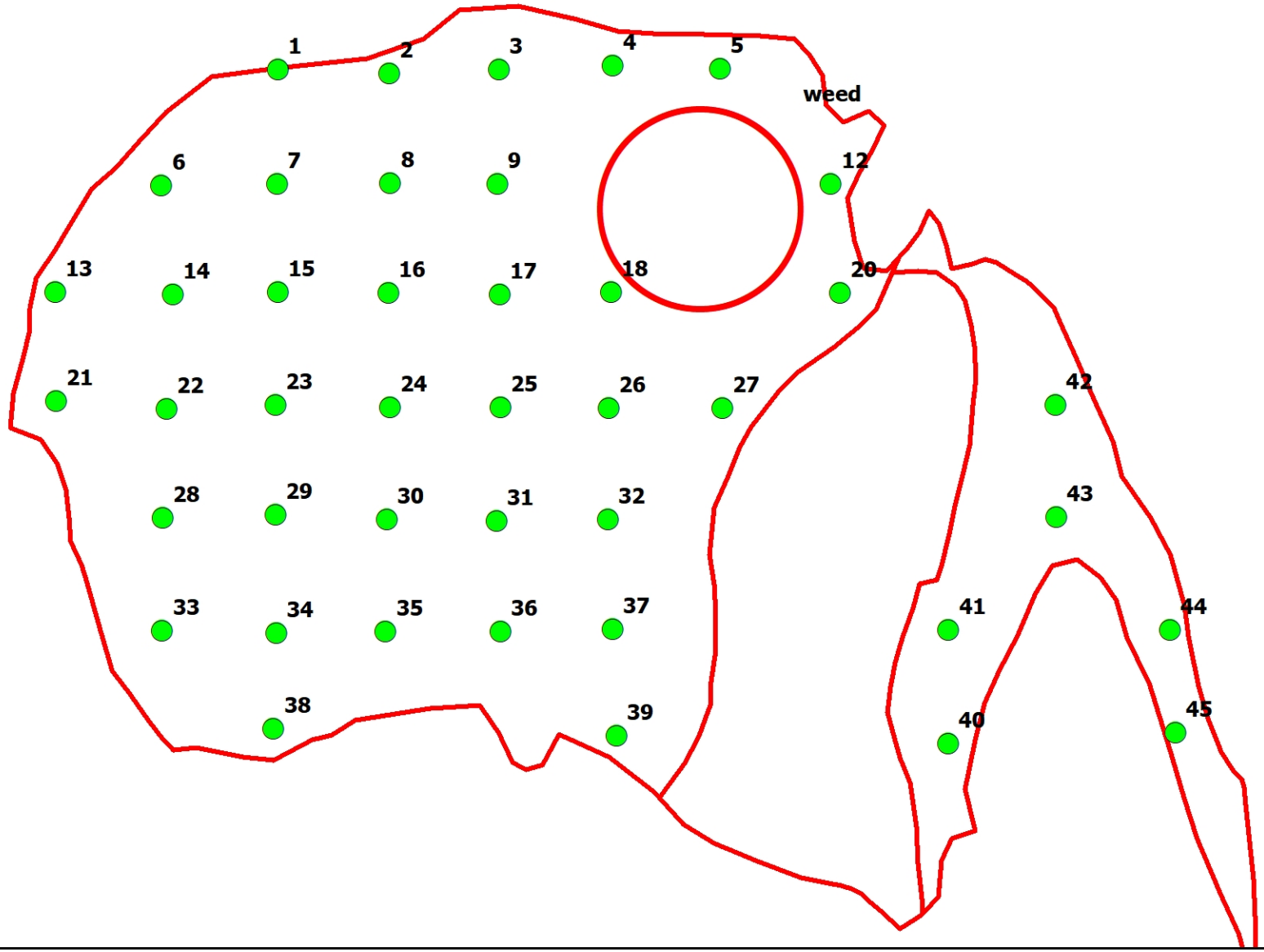
Map 3 Bowie #1 Mine - West Mine - 2019
Phase III Bond Release Evaluation
Woody Plant Density Sample Point Locations
Woody Plant Density Sample Point - 95' x 95' Grid
N
W
E
S
1 inch = 150 feet
CEDAR CREEK
ASSOCIATES, INC.
0 50 100 200 300 400
Feet



Map 4 Bowie #1 Mine - West Mine - 2021

Phase III Bond Release Evaluation

Cover and Production Sample Point Locations

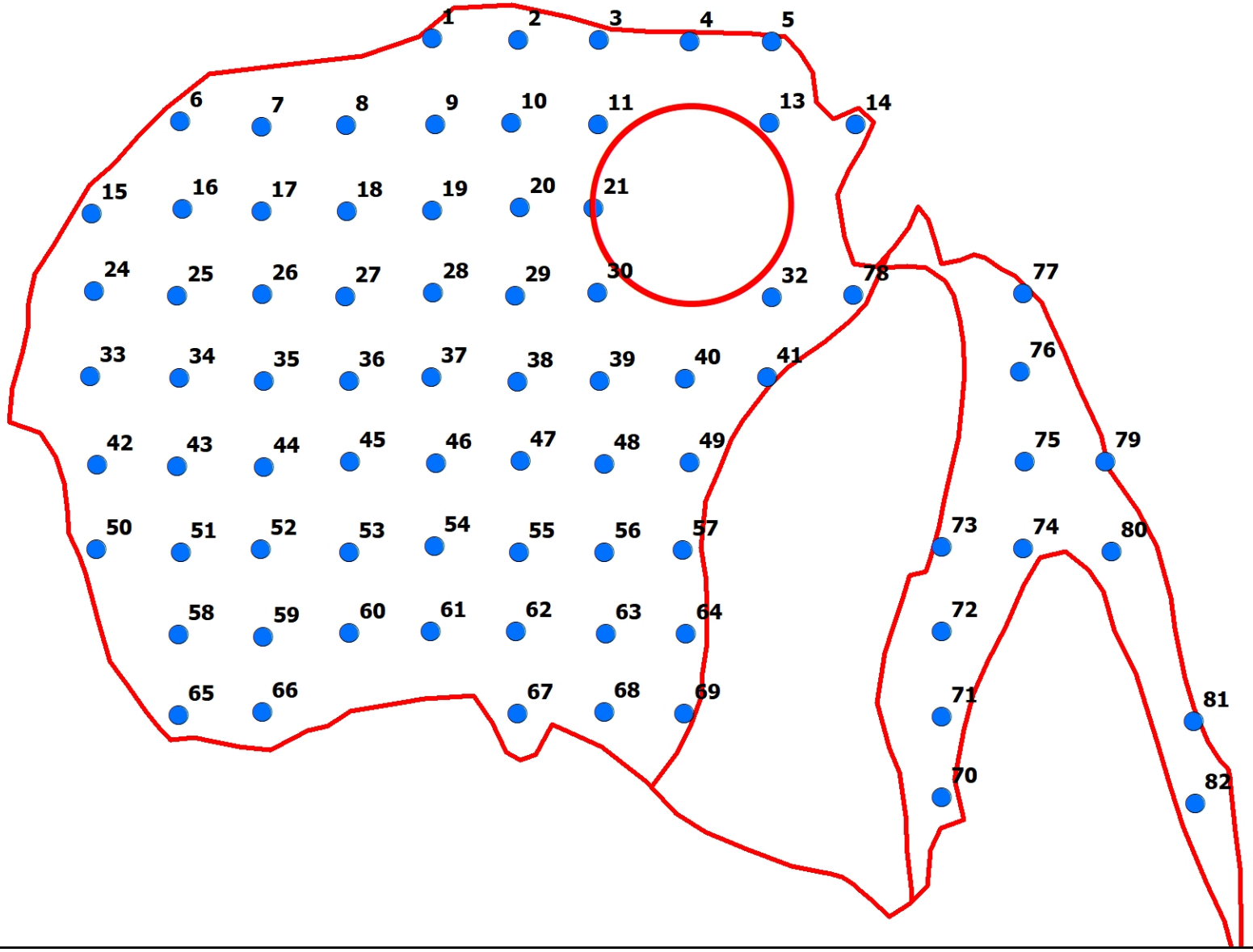
Cover and Production Sample Point - 107' x 107' Grid

N
W E
S

1 inch = 150 feet

0 50 100 200 300 400 Feet

CEDAR CREEK ASSOCIATES, INC.



Map 5 Bowie #1 Mine - West Mine - 2021

Phase III Bond Release Evaluation

Woody Plant Density Sample Point Locations

Woody Plant Density Sample Point - 82'' x 82' Grid

N
W E
S

1 inch = 150 feet

0 50 100 200 300 400
Feet

CEDAR CREEK ASSOCIATES, INC.

Photo 1: Bowie #1 – West Mine - 2019

Photo 2: Bowie #1 – West Mine - 2019

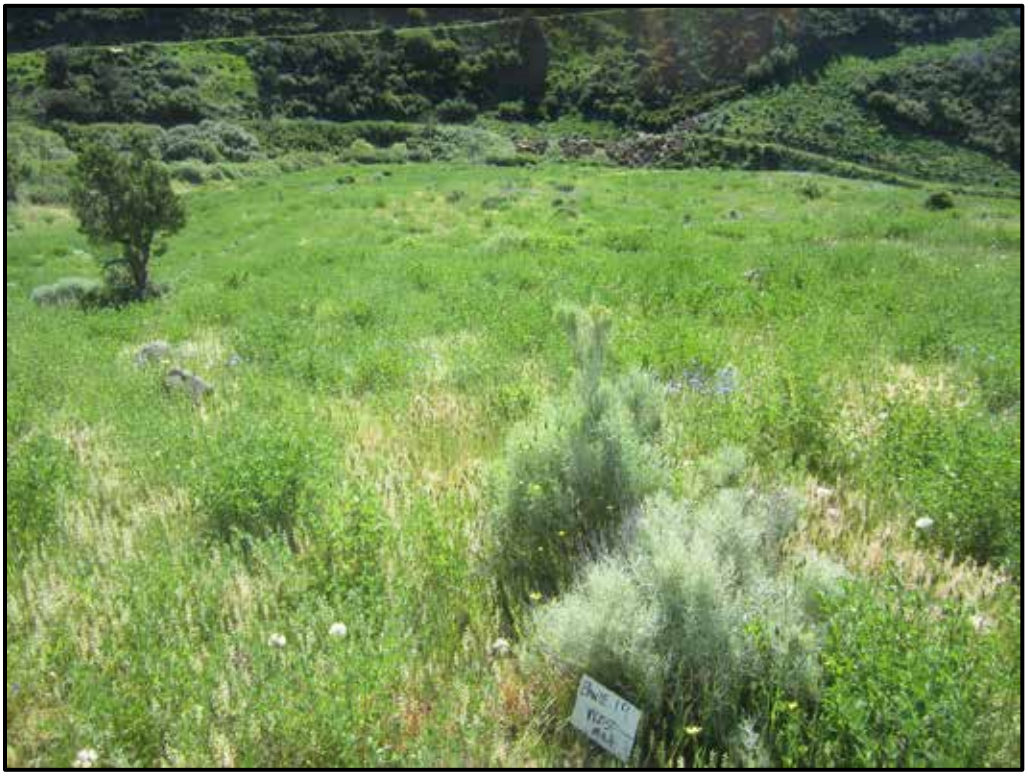


Photo 3: Bowie #1 – West Mine – 2019

Photo 4: Bowie #1 – West Mine - 2021

Photo 5: Bowie #1 – West Mine – 2021

Photo 6: Bowie #1 – West Mine - 2021

WEST MINE FAN
1.0 ACRES ELIGIBLE
FOR PHASE I
RELEASE

WEST MINE PORTAL BENCH
13.1 ACRES ELIGIBLE FOR
PHASE III RELASE

Regraded, Topsoiled (12.3 AC)
(Proposed for Final Phase III Release wtih SL08)

Projected Re-disturbance (3.5 AC)

Regraded, Topsoiled, excluded from SL-08 (0.79 AC)
(Location of Star Thistle with 100' buffer)

7448.5
7450
7424.0
7406.9
7406.9
140
7300
7250
ATV TRAIL
East Roatcap Creek
142
WEST MINE FAN LEVEL ACCESS ROAD
7350
DISTURBED AREA BOUNDARY
SEDIMENTATION POND
W - 2
W - 1
CROSS DRAINAGE CHANNEL
RESHAPED DRY ROUGH CREEK ROAD
WEST MINE PORTAL ACCESS AND HAUL ROAD (RECLAIMED)
7600
132
7400
139
46 KV POWERLINE (RECLAIMED)
NO POLES IN THIS CORRIDOR, OVERHEAD ONLY
7254.4
7252.7
249.9
7253.2
146
7254.1
143
14
23
PERMIT BOUNDARY
East Roatcap Cre

PROJECT: BOWIE NO. 1 MINE

TITLE:
AS-BUILT CONTOUR MAP
WEST MINE
(PHASE III BOND RELEASE APPLICATION 02/22)

DWG. NAME: FIGURE 2

DMG I.D. No. C – 81 – 038

SCALE: 1" = 100'

PREPARED FOR:
BRL BOWIE RESOURCES, LTD.
BOWIE RESOURCES, LTD.
BOWIE NO. 1 MINE
P.O. BOX 483
PAONIA, COLORADO 81428

PREPARED BY: J. E. STOVER & ASSOCIATES
2768 Compass Dr., Suite 101
Grand Jct., CO 81506

N E W S
ONE INCH

DESIGNED:	D.A.J.	06/12/01
DRAWN:		
CHECKED:		

ENGINEER'S CERTIFICATION

I hereby certify that this drawing was done by me or under my direct supervision and that all of the information presented on this drawing is true and correct to the best of my knowledge and belief.

Tammerin K Stover-Bishop Date
Colorado P.E. 43402

REVISIONS

No.	DESCRIPTION:	BY	DATE
1.	SL-08 Adequacy response #1	TKB	10.19.22

REFERENCES

1		