Work Plan – United Nuclear Corporation

NE Church Rock and Section 27 Mines

Vegetation and Wildlife Evaluations Contributory to Development of Final Reclamation Considerations and Success Determination

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1.0 INTRODUCTION

Cedar Creek Associates, Inc. (Cedar Creek) has been retained to develop and then implement a work plan specific to vegetation, revegetation, and wildlife considerations in support of the "Closeout Plan" for United Nuclear Corporation's (UNC) Northeast Church Rock (NECR) and Section 27 (S27) Mines. This work plan identifies and defines methods and protocols to be utilized for preliminary vegetation and wildlife evaluations required for the Closeout Plan pursuant to mandates of Title 19, Chapter 10, Part 5 of the New Mexico Administrative Code (NMAC) and the Mining Act Reclamation Program (MARP). The purpose of this preliminary effort is to facilitate a determination of: 1) current floral and faunal conditions extant about the permit area, 2) quality of habitat for indigenous wildlife, and 3) revegetation potential along with revegetation plan development and recommendations to optimize the ability of revegetation to meet post-mining land use considerations. A component of the revegetation plan will document site-specific protocols for monitoring and eventual success evaluation to be used at each mine.

NECR is located approximately 16 miles Northeast of Gallup, New Mexico and occupies a permit area of about 125 acres. This area occurs primarily on lands administered by the Bureau of Indian Affairs on behalf of the Navajo Nation, but also includes a modest component of private lands. The S27 Mine is located about 35 miles North of Grants, New Mexico and it's permit area occupies approximately 35 acres. It is comprised entirely of privately held lands. Access agreements exist for both properties for the conduct of site work.

1.1 Preliminary Site Evaluation

On November 15th, 2004 a brief field reconnaissance of both sites was conducted by representatives of Cedar Creek and MWH, Inc. This reconnaissance resulted in the following five preliminary determinations. First, the NECR site exists within a Piñon – Juniper (PJ) Woodland community with occasional small pockets of mixed shrubland and ruderal shrubland (around disturbance sites) at an elevation ranging between 7,000 and 7,200 feet above mean sea level. The S27 site exists entirely within a grassland steppe community at an elevation of 7,000 feet. Second, the S27 site is entirely fenced and therefore, appears to have received little if any grazing pressure from domestic livestock. With the exception of ruderal vegetation in disturbance areas, the S27 permit area is in reasonably good range condition and native wildlife habitats likely support expected populations of grassland dependent wildlife. To the contrary, the NECR site exhibits evidence of extensive and detrimental grazing impacts resulting in notable damage to the herbaceous component of the understory. Range condition ranged from "poor" to "fair" and native wildlife habitats show evidence of substantial impact. Those wildlife dependent upon forage provided by the herbaceous component of the PJ woodland likely exhibit reduced populations. However, those wildlife dependent upon remaining habitat characteristics provided by the woody components of the woodland likely exhibit impacted, but reasonable, populations.

Third, both sites exhibit reasonable options for selection of reference locations that are representative of site-specific (pre-mining) conditions, including the current range condition. Choice of a reference area at the S27 mine that is in good range condition should not be problematic. Undisturbed areas to both the north and east would be good candidates in this regard. To the contrary, it is unlikely that any area in the vicinity of the NECR mine can be found that is in good range condition. Furthermore, it is unlikely that any significant fencing program can be instituted to substantially improve range condition in the vicinity of the NECR mine over the next decade. However, at least one area to the west / northwest of the project area was noted during the field reconnaissance that would offer a reasonable comparison target. This area exhibited substantially reduced overstory cover from tree and large shrub species thereby providing elevated values from the community's herbaceous component. This is important as eventual comparisons with revegetation would only involve this herbaceous component. If for any reason use of a reference area cannot occur, standards would be set based on best professional judgment given existing soils, NRCS productivity data, revegetation data from other mining operations in the region, and / or similar sources of information.

Fourth, a variety of plants were observed at both mine sites, the most dominant of which are listed below. Given Cedar Creek's experience with western mine reclamation at least some of these plants would likely perform well if included in a revegetation seed mix that targets both wildlife habitat and grazing post-mining land uses (assuming revegetated areas are not overgrazed too early or too often in their life cycle). Such plants are identified in boldface. In addition, a few additional plants that could perform well if seeded are identified below. These taxa may grow in the area but were not observed during the preliminary site review and can be identified by an underline.

NECR Site

Piñon Pine
One-seed Juniper
Ponderosa Pine
Gambel's Oak
Rubber Rabbitbrush
Stansbury Cliffrose
Big Sagebrush
Snakeweed
Indian Ricegrass
Bottlebrush Squirreltail
Cheatgrass
Western Wheatgrass
Thickspike Wheatgrass
Foxtail Barley
Sand Dropseed
Blue Grama

Four-wing Saltbush
Sideoats Grama
Galleta
Arizona Fescue

S27 Site

Four-wing Saltbush
Winterfat
Tamarisk
Black Sage
Rubber Rabbitbrush
Snakeweed
Russian Thistle
Tumble Mustard
Indian Ricegrass
Purple Three-awn
Red Three-awn
Blue Grama
Galleta
Western Wheatgrass
Sand Dropseed
Crested Wheatgrass
Cheatgrass

Sideoats Grama
Arizona Fescue
Alkali Sacaton

Finally, it was noted for both mining areas that wildlife utilization would be a difficult variable to assess and evaluate owing to the mobility of most taxa with respect to the small acreages involved. For example, mule deer in the area would typically utilize a home range of 2,000 to 3,000 acres more or less. In this regard, each mine area would represent only 1 to 3 percent of an animal's normal range. Therefore, it would be most prudent for future wildlife evaluations to involve qualitative techniques of direct observation, observation of sign, or evaluation of habitat perhaps coincidentally with vegetation evaluations. The only exception to this level of effort would be necessitated by need to evaluate any identified sensitive floral or faunal species that may occur in the area.

1.2 Primary Site Evaluation

With regard to the primary field evaluation for vegetation and wildlife concerns, it is anticipated that Cedar Creek's biologists would perform a one-time effort during the late summer (September) of 2005 following the normal monsoon season (when vegetative growth is at its peak). All sampling will be conducted by, or under the direct supervision of Cedar Creek's Senior Range / Wildlife Ecologist, Mr. Steven R. Viert and Plant Ecologist, Mr. Erik M. Mohr (see Appendix AA for resumes). Field methodologies will follow those discussed with MMD personnel on November 16th, 2005 and described in further detail in Sections 2.0 and 3.0 below.

2.0 PROPOSED SAMPLING METHODS FOR VEGETATION

The vegetation evaluations described below are designed to describe existing vegetation conditions adjacent to disturbed areas prior to mine closure and to facilitate an evaluation of the revegetation potential of the site. Additional goals of these evaluations are to aid development of revegetation recommendations as necessary, and to identify methodologies and standards by which revegetation success will be evaluated.

2.1 Sample Layout

The sample layout protocol for the 2005 site characterization evaluations will be a procedure designed to account for the heterogeneous expression of the multiple characteristics and physiognomic features within the various undisturbed target areas while precluding bias in the sample site selection process (Figure 1). By design, the procedure is initiated randomly, and thereafter, samples are located in a systematic manner, e.g., at grid coordinates spaced at consistent intervals for each sampled area. In this manner, "representation" from across the entire unit is "forced" rather than risking that significant pockets are entirely missed, or overemphasized as often occurs with other sample distribution techniques such as "Simple Random Sampling". Any reference area sampling will occur in an identical manner, although grid dimensions would be reduced accordingly. A representation of a possible distribution of samples around the undisturbed perimeter of each mine is presented on Maps 1 and 2. Once in the field, potential samples found to be on a disturbed area (i.e., ruderal vegetation) would be skipped.

The procedure for sample location within either target unit (vegetation community) or reference area will be as follows. First, a fixed point of reference that can be relocated from year to year (such as a fence corner or GPS coordinate) will be selected for each target sampling area. Second, depending on the size of the target sampling or reference area, a computer generated systematic grid of appropriate dimensions (e.g., 400 ft X 400 ft) will be selected to provide sufficient coordinate intersections to be used for sample sites. This typically results in a minimum of 20 and maximum of 50 sites, depending on the perceived variability of the target area. Reference areas would use smaller grid dimensions and the minimum number of coordinate intersections would be 15. If an insufficient number of potential sample sites is provided by the initial grid system, an "intergrid" would be utilized for additional samples. Third, scaled representations of the selected grids will be overlain on field maps of each area utilizing an orientation that can be easily established in the field (e.g., along cardinal compass points). Where necessary, this overlain grid will facilitate identification of "field markers" to allow occasional corrections if necessary, and to facilitate analyses of the total number of potential sample sites. Initial placement of the grid will be controlled by the fourth step, selection of random numbers for each area to allow location

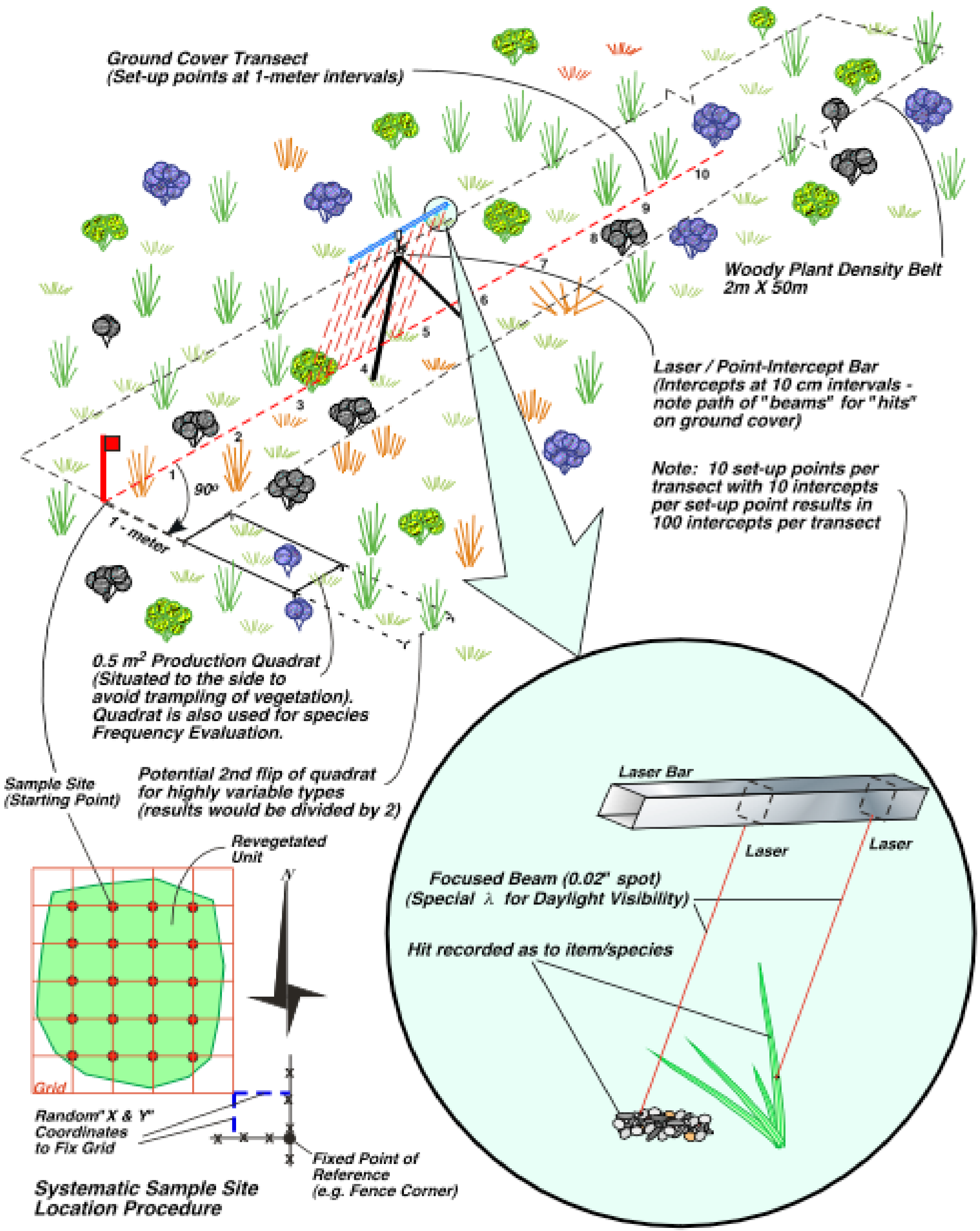


Figure 1

Sampling Procedure at a Systematic Sample Site Location

of the initial coordinate point. These random coordinates will be presented on eventual project mapping as appropriate. Fifth, where an excess number of potential sample points may be indicated by overlain maps, the excess will be randomly chosen (in the office) for elimination, unless it is later determined they are necessary for meeting sampling adequacy for a given variable. In this latter case, points will be added back in reverse order until sufficient samples points become available. Sixth, utilizing a hand held surveying compass and hip-chain all sample points will be located in the field and flagged (if necessary) at the time of sampling. The location of all sample sites to be utilized for the 2005 sampling effort will be indicated on project mapping.

Once a selected grid point is located in the field, sampling metrics will always be oriented in the direction of the next site to be physically sampled to further limit any potential bias. Orientation of the various sampling protocols will follow that which is indicated on Figure 1. Depending on logistics, timing, and access points to a sampling or reference area, the field crew will occasionally establish a set of points along coordinates in one direction and then sample them in reverse order. However, orientation protocol will always be maintained i.e. in the direction of the next point to be physically sampled. If the boundary of an area is encountered before reaching the full length of a transect, the orientation of the transect will be turned 90^{o} in the appropriate direction until the transect is completed. In this manner, transects near the edge of a unit will be retained entirely within the correct unit by "bouncing" off the boundaries.

2.2 Sample Adequacy Determination

This scope-of-work details the collection of data regarding four principal vegetation variables: ground cover, production, woody plant density, and diversity. Of these four variables, ground cover is by far the most valuable with regard to utility of information developed (see Appendix A). Furthermore, diversity information (composition) can be developed from the ground cover data set using a simple transformation. Because of the importance of ground cover data and the fact that a second variable is developed from this data, it is important that the data set be of sufficient size (statistically adequate) to support any inferences or hypotheses. To the contrary, production and woody plant density data do not necessarily need to be determined with a statistically adequate sample as post-mining revegetation testing involving these two variables will likely utilize the reverse-null hypothesis test. This test does not require a statistically adequate sample; simply sufficient samples to reduce the variance as much as is practical (typically 30 samples). It is preferred to not use this test unnecessarily (e.g., for ground cover) because it inherently "increases the success standard" by a small amount. However, given the difficulties and cost associated with obtaining an adequate sample for production, and especially for woody plant density, the reverse-null testing procedure has significant utility. Therefore, the following discussion details how sampling adequacy will be determined for the variable of ground cover only.

In this regard, sampling within each community type will be conducted to a minimum of 30 samples for ground cover (or 15 samples in reference areas). As is typical for the science, sample means and standard deviations for total non-stratified vegetation ground cover (exclusive of litter) will be the parameters utilized for calculations. These parameters will be calculated in the field to insure collection of an adequate sample and once again by computer during final data analyses for each separate community type, or reference area. Sampling will continue until an adequate sample has been collected in accordance with the Cochran formula for determining sample adequacy, n_{min}, or until a maximum of 50 samples has been collected. The Cochran formula is utilized as it is the formula proposed for use by MMD's guidelines. The Cochran formula is as follows:

$$\mathbf{n_{min} = (t^2 s^2) / (0.1\bar{x})^2}$$

Where: **n** = the number of actual samples collected with a minimum of 30 in each type;

t = the "two tailed" value from the t distribution for ∂=0.1 with n-1 degrees of freedom;

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

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

To facilitate collection of a usable data set for production and woody plant density, one sample for each of these variables will be co-located with each ground cover transects as indicated on Figure 1. This will result in a total of at least 30 samples each for production and woody plant density. This level of information should be more than sufficient to adequately characterize the target community with regard to these variables.

2.3 Statistical Testing

Following field evaluations, the selected reference areas will be compared with the remaining "baseline" area (undisturbed adjacent community) to provide an indication of their suitability for revegetation success determination. This testing will involve the commonly accepted statistical student's "t-test" of the means for ground cover sampling from each of the two areas at the level of significance of α = 0.1 with 90% confidence. However, for production and woody plant density, testing will involve a "reverse-null" hypothesis testing procedure, either against reference area data or a proposed standard. (Diversity testing will likely be a direct mathematical comparison against set standards such as 3 perennial grasses, 1 forb, and 1 shrub contributing more than 1% of the composition.) Because the "reverse-null" hypothesis test is not a commonly understood test, the following paragraphs have been provided to more fully explain this process.

For this procedure, collection of an "adequate" sample (where **$n_{min} \leq n$**) is not necessary as it is in the operator's best interest to sample until a "tight" estimate of the mean is obtained (i.e., sampling should continue until the variance is more "narrowly" defined). Typically, a sample size of 30 or greater provides such an estimate (due to the Central Limit Theorem). In the "classical" null hypothesis test, rejection of H_o means failure as the hypothesis being tested is that the target area variable is greater than or equal to 90% of the reference area or standard. However, in the reverse null test, rejection of H_o means success as the hypothesis being tested is that the target area variable is less than or equal to 90% of the reference area or standard. Therefore, once a sample has been collected from both the target area of interest and the reference area (or standard), the means and variances ($\bar{x}$ and s^2) of those samples will be utilized for testing success or failure as follows:

For two-sample testing (with a reference area) for equal variances, the following test would be performed:

$$t_c = \frac{\bar{x}_{rv} - 0.9\bar{x}_{ra}}{\sqrt{s_p^2\left(\frac{1}{n_{rv}} + \frac{1}{n_{ra}}\right)}} \quad \text{Where the pooled variance } s_p^2 =$$

$$s_p^2 = \frac{\left[(\mathrm{n_{ra}} -1)0.81 s_{ra}^2 + (\mathrm{n_{rv}} -1) s_{rv}^2\right]}{(n_{ra} + n_{rv}) - 2}$$

Then if $t_c > t$ for $t_{(\alpha=0.1,\ nra+nrv-2\ d.f.)}$ the test is successful.

For two-sample testing (with a reference area) for unequal variances, the following test would be performed

$$t_c = \frac{\bar{x}_{rv} - 0.9\bar{x}_{ra}}{\sqrt{w_{rv} - w_{ra}}} \quad \text{Where } w_{ra} = \frac{0.81 s_{ra}^2}{n_{ra}} \text{ and } w_{rv} = \frac{s_{rv}^2}{n_{rv}}$$

and the degrees of freedom are approximated by :

$$\frac{(w_{ra} + w_{rv})^2}{\frac{w_{ra}^2}{n_{ra} - 1} + \frac{w_{rv}^2}{n_{rv} - 1}}$$

Then if $t_c > t$ for $t_{(\alpha=0.1,\ \text{approx. d.f.})}$ the test is successful.

For one-sample testing (against a standard), the following test would be performed:

$$t_c = \frac{\bar{x}_{rv} - 0.9Q}{s/\sqrt{n}}$$

Where: Q = the standard (e.g. 200 woody plants per acre).

Then if $t_c > t$ for $t_{(\alpha=0.1,\ n-1\ \text{d.f.})}$ the test is successful.

2.4 Determination of Ground Cover

Ground cover at each sample point will be determined utilizing the point-intercept methodology (also referred to as "line-point") as illustrated on Figure 1. As indicated in this figure, Cedar Creek utilizes state-of-the-art laser instrumentation to facilitate much more rapid and accurate collection of data. A transect of 10 meters length will be 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" will be situated vertically above the ground surface, and a set of 10 readings recorded as to hits on vegetation (by species), litter, rock (>2mm), or bare soil. Hits will be determined at each meter interval by activating a battery of 10 specialized lasers situated along the bar at 10 centimeter intervals and recording the variable intercepted by each of the narrow (0.02"), tightly focused beams (see Figure 1). In this manner, a total of 100 intercepts per transect will be recorded resulting in 1 percent cover per intercept. Each transect serves as one data point (i.e. n = 1). This methodology and instrumentation facilitates the collection of the most unbiased, repeatable, and precise ground cover data possible.

2.5 Determination of Current Annual Production

Assuming the post-mining land use remains primarily domestic livestock grazing, the following procedure for collection of current annual production is proposed. To the contrary, if post-mining land use is changed to emphasize wildlife habitat with incidental use by domestic livestock, or to a "rangeland" designation, then the following procedure would not be implemented as there would be insufficient need for the data to justify the expenditure. In no case however, would production exclosures be utilized; visual estimations of utilization would be substituted.

Procedure

At each ground cover sample site, current annual herbaceous production will be collected from a 0.5 m^2 quadrat frame placed one meter and 90º to the right (clockwise) of the ground cover transect to allow avoidance of vegetation trampled by investigators during sample site location. From within each quadrat, all above ground current annual herbaceous plant growth within the vertical boundaries of the frame will be clipped and bagged separately by life form or origin as follows:

Native Perennial Grass/Sedge
Introduced Perennial Grass
Introduced & Native Annual Grasses
Sub-Shrubs
Native Perennial Forbs
Introduced Perennial Forbs
Introduced & Native Annual & Biennial Forbs
Listed Noxious Weeds

Once in the field, biologists will evaluate field conditions at both NECR and S27 and may modify procedures slightly. Such modifications would involve quadrat size and would be manifested by subsequent flips of the quadrat frame as indicated on Figure 1. Such activity would only occur in an effort to collect a less variable sample. Given the preliminary site visit to NECR it is anticipated that actual quadrat shape for this site will be 0.5 m x 4 m (or 2 m^2) or the equivalent of 4 flips of the frame. Use of such a long quadrat in low production areas such as PJ woodland has better potential to reduce sample variance than other techniques. Maintenance of the proposed 0.5 m^2 single quadrat will likely be utilized at the S27 site because of the dominance and homogeneity of grassland. In either case, once a quadrat size is selected for a given area or reference area, it will be consistently maintained until an adequate sample has been collected.

All production samples will be returned to the lab for drying and weighing. Drying will occur at 105º C until a stable weight is achieved (usually after 24 hours). Samples will be then re-weighed to the nearest 0.1 gram.

2.6 Determination of Woody Plant Density

Woody plant density will be determined for sampled areas in 2005 using density belts. A 2-meter wide by 50 meter long belt transect will be established at each ground cover sample site and extended in the direction of the next sampling point (typically along a cardinal compass direction – see Figure 1). The procedure will be implemented by slowly progressing along the centerline of the belt and recording woody plants by species rooted within one-meter on either side of the centerline. Each plant counted in this manner translates to 40.5 plants per acre.

If the selected reference area is insufficiently large to readily accept 2m x 50m belts (i.e., belts may cross which would then violate statistical sampling assumptions), an alternate procedure would be utilized. In this regard a total population count of the reference area would occur. The procedure to be utilized in this circumstance would be implemented as follows. First, the external perimeter of the reference area would be delineated using hip-chain thread. Second, the entire area would be subdivided into long readily observable strips approximately 20 feet in width for each available observer, again using hip-chain thread. Finally, a line of observers would systematically sweep each strip within the reference area counting each segregated woody plant by species. Constant communication between observers precludes double counting or missing of "strip boundary" plants.

3.0 PROPOSED EVALUATION METHODS FOR WILDLIFE

As previously indicated it would be most prudent for site-specific wildlife evaluations to largely be limited to the qualitative techniques of direct observation, observation of sign, and/or evaluation of habitat owing to the small size of disturbance footprints and the complication of excessive livestock grazing at the NECR site. In this regard, it is proposed that while Cedar Creek biologists are on site for vegetation investigations, all observations of wildlife, either directly or by sign, will be recorded in a manner to facilitate an indication of abundance and/or use of project area habitats. In addition to site-specific observations during vegetation evaluations, several pedestrian observation transects will be extended radially from the central disturbance area approximately one-quarter to one-half mile to provide a better indication of: 1) wildlife use of the overall vicinity and habitats, 2) any remaining mine-related impacts, and 3) any continuing hazards to wildlife. Furthermore, project area habitats will be evaluated with regard to their capability to provide life requisites for anticipated indigenous wildlife, including sensitive or special status species.

In addition to remaining vigilant for direct or indirect observations of wildlife, Cedar Creek biologists will perform a literature review to determine if either the NECR or S27 sites offer habitat to sensitive, rare, threatened, or endangered fauna (or flora). Potential sources of such information include the Natural Diversity Data Base, New Mexico Department of Game and Fish, and the U. S. Fish & Wildlife Service, among others. Although no sensitive species are anticipated, if one or more are noted as possible for the area, special revegetation techniques may be recommended to mitigate or encourage those taxa.

4.0 PRELIMINARY CONSIDERATIONS REGARDING REVEGETATION AND BOND RELEASE

Although the primary intent of these investigation is to aid development of a better more targeted revegetation effort and bond release evaluation process, many considerations affecting these actions are already known at some level of certainty. These considerations are discussed below to various levels of detail that may be changed significantly following collection of site-specific data and information in 2005.

4.1 Fencing

Following the preliminary site-reconnaissance, it appears that a fencing program may be necessary to attempt control of domestic livestock grazing on two types of sites in the vicinity of the NECR mine. (Grazing does not appear to be an issue at the S27 mine.) The two types of sites include: 1) revegetated areas and 2) reference areas. Because both of these types of areas will likely be relatively small in size (5 to 10 acre plots), there exists a reasonable chance that fencing could remain intact for a sufficient period of time to allow plant emergence and development. With modest vigilance and periodic maintenance, all fencing may persist for a sufficient period of time to facilitate final success evaluations. To the contrary, there is a significant potential that fencing will not persist sufficiently long for ideal revegetation efforts to occur. Given this possibility, contingencies must be developed in the final bond release protocol to account for this occurrence.

4.2 Preliminary Revegetation Techniques

Again, following the preliminary site-reconnaissance, several observations suggest certain considerations for the development and implementation of a site-specific revegetation program. First among these was the observation of annual weeds extant about both the NECR and S27 sites, especially cheatgrass and Russian thistle. Given a ready seed source from these species and their known propensity for dominating newly revegetated areas, it would be a strong recommendation to avoid use of inorganic fertilizers, especially those containing nitrogen. Similarly, any fertilizers or organic composts that exhibit readily available nitrogen should be avoided as well. Introduction of such nitrogen overly encourages these taxa to the long-term and occasionally permanent detriment of planted desirable perennial species.

Second, given the small size of the individual reclamation units, it may be most cost-effective to consider use of small tractor or ATV mounted revegetation equipment using broadcast and harrow techniques as opposed to use of a rangeland drill. Although drilling is usually considered to be a superior seeding technique, certain revegetation contractors have developed broadcast and harrow skills that achieve results similar to those obtainable with drill seeding equipment, especially in sandy soils. Given the sandy loam soils existing at both sites, such "light-footprint" equipment may also be preferable to landowners at both sites to avoid leaving long-term evidence of activity.

Third, as indicated in the introduction, there are several native plant taxa that were observed on both sites that would offer excellent starting points for development of seed mixes that would have the best chance of surviving and providing for the intended post-mining land use. At the S27 site, the development of a seed mix will not be overly restricted as the impacts of grazing appear well controlled. However, at the NECR mine, selection of reclamation species must take into consideration post-mining land use, resistance to interim grazing pressure, and value as wildlife habitat in addition to the normal considerations when selecting species for a seed mix.

4.3 Revegetation Monitoring

Based on previous experience, especially with reclamation that may be subject to livestock grazing impacts, it would appear that a monitoring program will be necessary to maximize the potential for eventual success. In this regard, preliminary recommendations would involve qualified revegetation specialists review the revegetated areas following the 1st and 3rd growing seasons to catch developing problems early in the process. Thereafter, assuming a successful start, monitoring would occur at two additional times, following the growing season of years 7 and 11. The final effort during year 12 would be an evaluation for a bond release determination. Other than first year efforts, monitoring should be a combination of both qualitative and quantitative efforts to facilitate tracking and progress toward revegetation success standards.

4.4 Revegetation Success Considerations

Again, based on previous experience, especially in New Mexico, there are several preliminary revegetation success considerations that can be introduced at this time and verified or modified as necessary depending on data collected. In this regard, revegetation success would take into account the following three factors:

- ☐ Comparison would be to an approved reference area (or in certain cases technical standards) representative of the adjacent vegetation communities and/or desirable ecological conditions;
- ☐ Plant species present in the proposed (and planted) seed mixes; and
- ☐ The post-mining land use.

When utilizing reference areas (that are late seral by definition) for determinations of revegetation success certain allowances must be made when comparing them to early seral revegetated communities, otherwise comparisons would be scientifically invalid. The two principal allowances involve the density of woody species and the overall species composition. In this regard, standards will be the target of reclamation efforts for these variables, rather than comparison to late seral reference areas.

Potential Revegetation Success Criteria

Revegetation success in revegetated units planted primarily as grassland would be assessed against performance standards for (1) vegetative ground cover, and (2) species diversity. Revegetated units planted to include shrubland or woodland for wildlife habitat would need to meet those same performance standards as grassland, plus a performance standard for woody plant density. Revegetation efforts will be considered successful when standards have been met at the end of the 12-year responsibility period.

1. Vegetative Ground Cover Standard

Vegetative ground cover must meet at least one of the following two tests:

a) the total vegetative ground cover (exclusive of annual species) in the revegetated unit equals or exceeds 75 percent of the approved reference area's total vegetative ground cover (exclusive of annual species), with 90 percent statistical confidence; or

b) the total vegetative ground cover (exclusive of annual species) in the revegetated unit equals or exceeds 50 percent of the approved reference area's total vegetative cover (exclusive of annual species) with 90 percent statistical confidence, and predicted values of soil loss using the Revised Universal Soil Loss Equation (RUSLE) are equal to or less than the comparison "T" value, which essentially is the soil genesis rate in tons per acre per year.

2. Species Diversity Standard

Diversity, as indicated by number of important species[1] (exclusive of annual species and classified noxious weeds) in each revegetated unit or combination of units, equals or exceeds

[1] An important species is defined as one that provides at least 1 percent relative cover (composition), and therefore, contributes more significantly to the community.

the following standard: 3 perennial grasses, 1 perennial forb, and 1 woody plant with more than 1% relative cover (composition). Up to a total of 2 additional woody plants may substitute for either grasses or forbs; or to the contrary up to a total of 2 additional grasses may substitute for either forbs or shrubs.

3. Woody Plant Density Standard

The density of live shrubs and trees (in revegetated units where shrubs and trees are to be specifically planted for wildlife habitat) must be 200 per acre or more. (This standard would not apply to grassland revegetated units.)

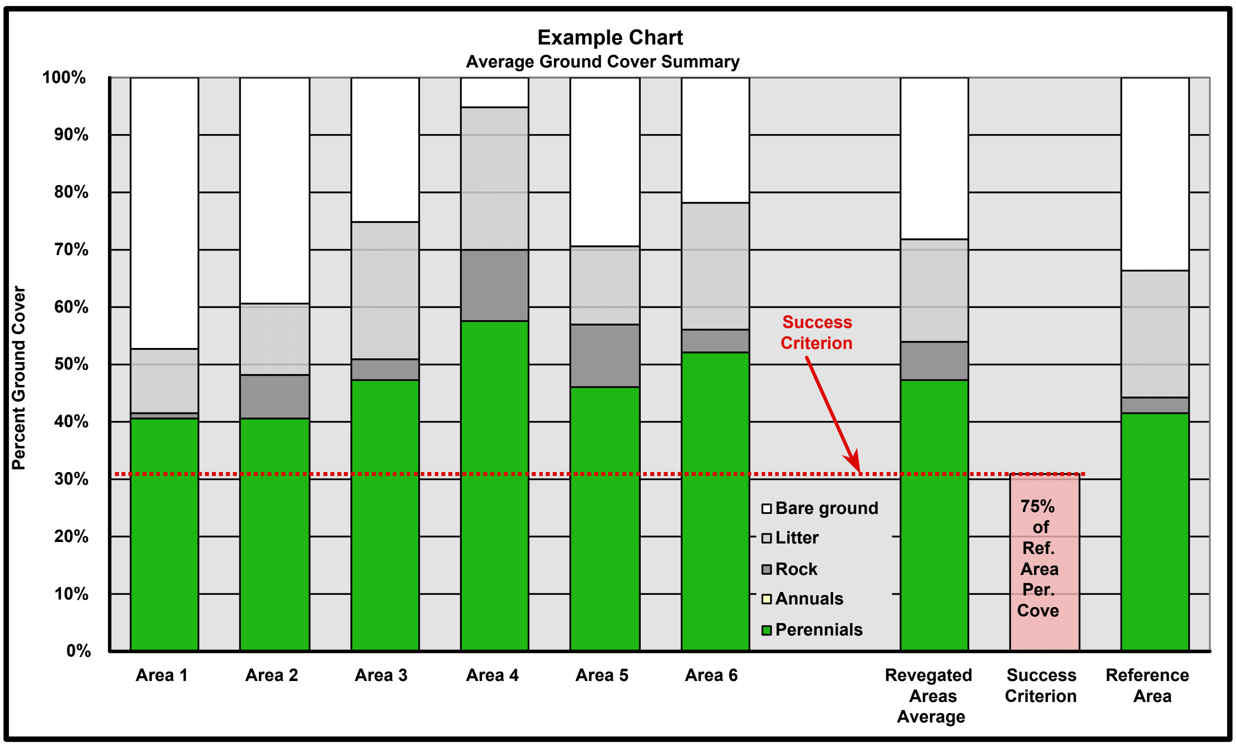
Potential Monitoring Procedures

Monitoring and eventual testing will involve sampling of ground cover and, where appropriate, woody plant density, within each revegetated unit under consideration for bond release, and in the appropriate reference area. Species diversity information will be calculated from the ground cover data. Sampling for ground cover will be accomplished utilizing the point-intercept procedure using modern instrumentation (e.g. lasers or optics) along transects of 100 intercepts each in a manner similar to the procedure described in Section 2.4 of this document. Long belt transects or total population enumeration will be used for woody plant density determination.

If the ground cover evaluation results in a "gray area" determination (between 50 and 75 percent of the reference area's ground cover value), then this aspect of success will be determined by evaluating the stability of the soil using the RUSLE protocol.

5.0 REPORTING

Following collection of field data, a report would be prepared detailing the analyses of final results for the 2005 field efforts with the exception of bond release related information. This report would provide a description and exhibition of the methodology sufficiently detailed to facilitate implementation of an identical protocol in subsequent years by independent researchers. Results will be presented and described, by segregate unit in text, tabular, and as possible graphic form to aid interpretation by reviewers (see example chart below). Following development of this data report, subsequent sections will detail specifics regarding proposed revegetation monitoring and bond release protocols for future efforts.



However, prior to this reporting effort and based on site-specific data collected, revegetation specifications (e.g., seed mixes) will be finalized for implementation in the field later during the fall of 2005.

APPENDIX A

VALUE OF GROUND COVER FOR EVALUATING REVEGETATION AND COMPARISON OF COVER MEASUREMENT METHODOLOGIES

Ground cover is at least one of the primary vegetation comparison variables designated for use by nearly all Western regulatory agencies, especially those charged with oversight of revegetation efforts following mining. For example Nevada's "Standards for Successful Revegetation" rely entirely on the variable of ground cover for surety release comparisons. In the coal mining industry, surety release determinations use ground cover as one of the main indices for revegetation establishment and growth. Ground cover represents one of the most accurate, precise and cost-effective floral variables that can be measured on young reclaimed plant communities. Therefore, ground cover is considered one of the best variables, if not the best, to be used to ascertain revegetation success on mined lands. The advantages of using ground cover as a primary success evaluation variable include:

- **Simplicity**-. Concentration on a single variable of plant ecology facilitates improved comprehension and comparability over time or between reclaimed areas, thereby allowing direct and impartial evaluation of revegetation success. Ground cover is a readily measured plant variable that is easily understood and compared. It has the advantage in that both cover and plant diversity (composition) can be evaluated from a single collected data set. Also, surety release evaluations based on multiple variables overly complicate the process. Such evaluations may be inappropriate and / or problematic for early seral comparisons as mutually exclusive tendencies between variables increase the potential for an artificial failure.

- **Temporal and Spatial Comparability**-. Trends in cover can be established and evaluated for a specific reclaimed area over time. Differences and similarities between multiple reclaimed areas of differing ages or treatments can be readily established spatially at a single point in time. Ground cover data facilitate the determination of species composition or diversity (using a simple conversion), relative health (condition), and can be used to track the seral successional status of a sampled area (i.e. whether or not the area is advancing or regressing along the successional continuum). Furthermore, the same data can be utilized to develop a "sister" variable, frequency, if desired.

- **Precision and Accuracy**-. When using bias-free techniques, such as the point-intercept method, it is one of the most repeatable variables among independent observers. No other plant measurement can be recorded as accurately or precisely as ground cover, and given the advent of modern instrumentation, such precision can be obtained in a very cost-effective manner.

- **<u>Correlation with Production</u>-.** Strong inferences or correlations can be developed between ground cover and annual biomass, since they are both directly influenced by species composition as well as the timing and amount of precipitation received during the growing season.

- **<u>Sample Population Requirements / Statistical Adequacy</u>-.** Ground cover is a preferred variable for revegetation success determination because a significant amount of cover data can be readily obtained in a statistically adequate, acceptable, and cost-effective manner (assuming use of unbiased procedures). This relates to the inherently lower variability of ground cover.

- **<u>Sediment and Erosion Control Modeling / Design</u>-.** Ground cover data has direct application and is readily used for a number of purposes in erosion and sediment modeling and design. For example, it is one of the primary input variables for use in the Revised Universal Soil Loss Equation (RUSLE).

- **<u>Species Dominance and Diversity</u>-.** Ground cover data (determined using the point-intercept procedure) provides some of the most important information regarding community variability that can be obtained and evaluated. Ground cover data closely reflects species dominance within the evaluated area.

While ground cover is often the preferred variable for evaluating the success of reclaimed mined lands, it is important to note that ground cover estimation methods are not equally precise or reliable. To further complicate the overall process, various ground cover measurement methods and practices may be more appropriate to specific vegetation community structure or conditions. In this regard, it is generally accepted that there are four principal groups of techniques available to field biologists for the determination of ground cover including: 1) plotless or variable plot (a form of 2 – dimensional), 2) quadrat (2-dimensional), 3) line-intercept (1-dimensional), and 4) point-intercept (0-dimensional).

Plotless (or variable plot) techniques are used most frequently in forestry applications for the inventory of timber stands and are, therefore, of little value for revegetation monitoring of mining disturbances in the arid and semi-arid West. A good example of such a technique is the use of a wedge prism for determination of tree basal area.

Quadrat techniques are based on 2 – dimensional frames of a specific size and shape and are highly dependent upon the judgment of an observer who may or may not be experienced in their use. Most commonly, the observer must mentally integrate all vegetation by species into a single portion of a quadrat and compare this mental picture to demarcations on the quadrat frame. Although an experienced biologist can "read" a quadrat frame relatively quickly, the procedure automatically incorporates three additional, and often substantial, sources of variation beyond that which is natural. These include: 1) observer bias because of the "judgment" involved; 2) variation due to the size of the quadrat; and 3) variation due to the shape of the quadrat. These additional sources of "artificial" variation are often significant and can result in highly variable data of low value (i.e. comparisons made with such data are of limited utility). Up to 30% or more sampling error can occur with this technique.

Line-intercept (1 – dimensional) techniques are generally considered to be the second best method for measuring ground cover (Bonham, 1989) although these exhibit at least four negative attributes. First, to be implemented properly, the procedure is <u>very</u> time-intensive. Second, data regarding other ground cover features such as litter, rock, and bare soil exposure are usually not collected due to the inordinate time it takes to collect such data. Third, a moderate amount of bias is possible as the observer must make judgments regarding which portions of the plant canopy actually intercept the line (tape). Fourth, the technique tends to somewhat overstate vegetation cover as observations typically involve the perimeter of a plant's canopy despite the fact that such canopies are not solid cover (i.e., underlying material can often be seen through the gaps in the canopy). Between 5 and 15% sampling error can typically occur with this technique.

This leads to the final and best method for measuring ground cover, the "dimensionless" point-intercept procedure. According to the most knowledgeable professionals active in the reclamation industry as well as academicians, it is the most objective and repeatable technique for estimating ground cover because decisions (judgment) by an observer are virtually eliminated. If historic instrumentation (pin frame) is utilized, the technique can be time consuming, limited to short herbaceous species, and if not properly implemented can lead to an overstatement of cover similar to that which occurs with line-intercept. However, use of modern instrumentation such as optics with fine cross-hairs or finely-focused specialized lasers practically eliminates these difficulties leaving only the positive attributes of the technique -- precision, objectivity, repeatability, and cost-effectiveness. In comparison to the other techniques, statistically adequate data can be collected as much as 10 times more quickly, and such data exhibit maximum utility, especially for success evaluations. Sampling error can typically be held to under 2% with this technique.

Appendix AA

Resumes of Steven R. Viert & Erik M. Mohr
Proposed Investigators for Vegetation & Wildlife Evaluations

STEVEN R. VIERT

EXPERIENCE ABSTRACT

Employed as an environmental consultant since 1977. Responsibilities include service as corporate officer, project manager, permitting specialist, range ecologist, and wildlife biologist. Project management activities include interdisciplinary coordination, subcontractor supervision, client/agency liaison, cost control, critical path scheduling, overall planning, and quality assurance.

Career accomplishments include authorship of, or technical contribution to:

54 NEPA Documents ● **22** Permit Evaluations/Audits/Revisions ● Strategy Development, Agency Liaison, Permit Preparation for Numerous Projects ● **102** Vegetation Baseline / Community Mapping Studies ● **95** Vegetation Impact Assessments ● **64** Wetland Evaluations ● **72** Revegetation Success / Bond Release Determinations ● **58** Wildlife Baseline / Habitat Studies ● **49** Wildlife Impact Assessments / Mitigation Plans ● Threatened and Endangered Species Evaluations (**63** flora, **48** fauna) ● **16** Land Use Evaluations / Reviews ● **4** Alluvial Valley Floor Assessments ● State-of-the-Art Riparian Investigations & Expert Witness Testimony ● Management of **2** Complete Coal Mine Permit Applications ● Design and Development of the "Laser Bar" an instrument for rapid and precise measurement of vegetation ground cover utilizing the point-intercept procedure (patent process initiated).

Types of projects have included:

Hard Rock Mines ● Coal Mines ● Litigation Support ● Wetland Evaluations / Enhancement ● Riparian Assessments ● Corridor Analyses ● Oil & Gas ● Water Developments ● Synfuels Projects ● Abandoned Mines ● Power and Other Industrial Plants ● Superfund Remedial Investigations

Involved with over **300** projects including work in:

Desert Southwest ● Northern and Central Great Plains ● Rocky Mountains ● Pacific Northwest ● Intermountain Region ● West Coast ● Midwest ● Alaska

EDUCATION AND CERTIFICATIONS

B. S., Wildlife Management, University of Michigan, 1974
M. S., Range Ecology, Colorado State University, 1975
M. B. A., Finance / Land Use Management, Colorado State University, 1982

Certified Wildlife Biologist - The Wildlife Society
Certified in Habitat Evaluation Procedures (HEP) - U. S. Fish and Wildlife Service
Black-footed Ferret Survey Techniques - U. S. Fish and Wildlife Service
Desert Tortoise Survey and Examination Techniques - U. S. Fish and Wildlife Service

EMPLOYMENT HISTORY

Cedar Creek Associates, Inc. - 1982 to Present
Environmental Research & Technology, Inc. - 1977 to 1982 (presently ENSR Corporation)
Colorado Division of Wildlife - 1974 to 1975

EXPERIENCE SPECIFICS

Mr. Viert's education and several years of environmental and regulatory compliance experience have facilitated development of specialized multi-disciplinary skills for projects in mining, industrial and urban land development or rehabilitation, corridor assessment, wetland evaluation / restoration, and water development. Areas of expertise include permitting and project management, vegetation and range ecology, wildlife / habitat ecology, bond release evaluations, and land use classification / evaluation.

PERMITTING AND PROJECT MANAGEMENT. Mr. Viert has been actively involved in all phases of permit application development from feasibility analyses to final assessment of reclamation success for the release of bonds. Permitting and management responsibilities have included overall permit preparation, strategy formulation, client / agency liaison, regulatory compliance evaluation, subcontractor supervision, critical path scheduling, cost control, quality assurance, and technical document editing for a variety of projects. Permitting projects have ranged from small 404 applications to large NEPA compliance efforts. Of particular note are two large management efforts leading to the successful acquisition of SMCRA permits for a 12.5 million TPY coal mine in the Powder River Basin of Wyoming and a 5 million TPY underground coal mine in the Book Cliffs of Utah. Mr. Viert's permitting experience and related interactions with regulatory agencies for development projects and associated permit application submittals have provided him with a working knowledge of the policies and regulations of several state and federal agencies such as OSMRE, COE, NRC, BLM, USFS, USFWS, CMLRD, WDEQ, MDEQ, UDOGM, NDPSC, NM-MMD, NDEP, among others. Mr. Viert's project management experience has been gained on projects ranging from single discipline evaluations (e.g., wetlands) to large multi-disciplinary efforts (including engineering, legal, environmental, and reclamation) for mining and other development projects.

VEGETATION / RANGE ECOLOGY. Mr. Viert has completed well over 100 vegetation studies and assessments for a wide range of projects including litigation (riparian issues between the state of Colorado and the USFS), surface and underground coal mines, hard rock mines, synfuel developments, corridor assessments for power and communication lines, pipelines and transportation arterials, oil and gas fields, water developments, abandoned mines, and municipal developments. Study components of these projects have included: floral measurements (cover, density, production, etc.), statistical design and analyses, community mapping, impact assessment and mitigation planning, determination of general range condition and community dynamics, evaluation of livestock carrying capacity and management, forest measurement, and development of revegetation success standards and bond release criteria. In addition, he has often evaluated sensitive issues such as wetlands and threatened and endangered species. One such project in Arizona led to a "non-jeopardy" opinion by the USFWS for an identified impact to a listed endangered species, the Arizona hedgehog cactus. He has assisted in the development and modification of several revegetation planning efforts and, as discussed below, designed and implemented a number of studies for post-revegetation monitoring to determine revegetation success for bond release. In 1977, Mr. Viert pioneered the development and use of the Optical Point Bar, a new instrument for economically and precisely measuring ground cover that is used in analyses of vegetation. In 1995, Mr. Viert improved the Optical Point Bar substituting high-intensity lasers for the optics. The patent process has been initiated.

RECLAMATION SUCCESS AND BOND RELEASE DETERMINATIONS. In this specialized field, Mr. Viert has been very actively involved in state-of-the-art design and implementation of site-specific technical studies for a large number of mining companies, especially coal. These studies are designed to be the most potentially successful, defensible, practical, and economical methods of analyses to facilitate the release of bond sureties. Mr. Viert has successfully negotiated with State and Federal Agencies for both the implementation of such designs as well eventual release of bonds and liability. Mr. Viert's efforts have led to the final release of bond on over 20 reclamation projects.

EXPERIENCE SPECIFICS (Continued)

WILDLIFE BIOLOGY. In this field, Mr. Viert has been actively involved in over 60 wildlife studies and impact assessments for various mines and land developments. Technical capabilities in this field include habitat evaluation and mapping, large mammal population studies, upland game animal surveys, general baseline measurement, sensitive and threatened or endangered species evaluations [especially for black-footed ferret and desert tortoise (over 1600 hours of survey / monitoring)], impact assessment, state-of-the-art mitigation planning, and aquatic sampling.

PUBLICATIONS

Viert, S. R. 2003. Heap Leach Pad Reclamation at the Goldstrike Mine, Nevada – A Unique Case Study. Proceedings of the 9th Billings Land Reclamation Symposium and 20th annual meeting of the American Society of Mining & Reclamation (Joint Conference). June 3 – 6, 2003 in Billings, Montana. Power Point Presentation.

Gionet, L., W.R. Erickson, and S.R. Viert. 2000. AngloGold H-Pit Mitigation Wetlands: Establishment & Successional Development on a Xeric Borrow Area. Proceedings of the 17th Annual Meeting of the American Society for Surface Mining and Reclamation, Tampa Florida, June 11-15, 2000. 23 pp.

Viert, S. R. 1996. A Conservation Assessment and Plan for the Arizona Hedgehog Cactus (*Echinocereus triglochidiatus* var. *arizonicus*). Unpublished document prepared for the U.S. Forest Service, Tonto National Forest, Phoenix Arizona. February 6, 1996. 51 pp. + tables & graphics.

Viert, S. R. 1989. Design of restoration methods to encourage fauna. In: J. D. Majer, PhD (Ed.). Animals in primary succession - the role of fauna in reclaimed land. Cambridge University Press, London, England.

Viert, S. R. 1985. A new instrument for measuring ground cover based on the point-intercept technique - the optical point bar. Proceedings of the 1985 Annual Meeting of the American Society for Surface Mining and Reclamation, Denver, Colorado, October 8-10. 4 pp.

Phelan, T. M. and S. R. Viert. 1986. Prairie dog and black-footed ferret surveys in northeast and east-central Utah. Cedar Creek Associates, Inc. 31 pp. + appendices.

Phelan, T. M. , S. R. Viert, and S. G. Long. 1986. Wildlife technologies for western surface coal mining. Office of Technology Assessment, U. S. Congress, Washington, D. C. 183 pp. + appendices.

Numerous technical discipline reports concerning vegetation, range ecology, wetlands, wildlife, and other environmental topics

Current as of 1/02

ERIK M. MOHR

EXPERIENCE ABSTRACT

Biologist - Employed as an environmental consultant since 1991. Responsibilities include service as botanist, riparian ecologist, habitat restoration / revegetation specialist, and range ecologist.

Career accomplishments include authorship of, or technical contribution to:

18 Threatened & Endangered Species Biological Assessments (**11** flora, **7** fauna) ● **32** Revegetation Success / Bond Release Evaluations ● **6** Habitat Restoration Plans ● **10** Vegetation Baseline / Community Mapping Studies ● **3** Successful Grant Proposals ● **55** Rangeland Monitoring Evaluations

Types of projects have included:

● Hard Rock Mines ● Coal Mines ● Salt Mines ● Wetland Evaluations / Enhancement ● Riparian Assessments ● Rangeland Monitoring ● Revegetation Monitoring ● Threatened, Endangered and Sensitive Plant Surveys ● Habitat Restoration ● Weed Monitoring

Involved with over **100** projects including work in:

Desert Southwest ● Northern and Central Great Plains ● Rocky Mountains ● Pacific Northwest ● Intermountain Region ● South Pacific

EDUCATION

M.S., Rangeland Ecosystem Science, Colorado State University, 2000
B.A., Botany, University of Washington, 1994
B.L.A., Landscape Architecture, University of Washington, 1993

EMPLOYMENT HISTORY

Cedar Creek Associates, Inc. - 2000 to Present
Boulder County Parks and Open Space Program - 1999
U.S.F.S. Rocky Mountain Forest and Range Experimental Station – 1997 & 1999
U.S.F.S. Rio Grande / San Juan National Forest – 1998
Foster-Wheeler Environmental Corporation – 1997
Biozone, Inc. – 1997
Riparia, Inc. – 1994 to 1996
Prescott Creeks Preservation Association – 1994 to 1996
U.S.F.S. Wenatchee National Forest – 1994
U.S.F.S. Okanogan National Forest – 1991 to 1993

REPRESENTATIVE CLIENTS

AngloGold Mining Corp. (NV.), Barrick Mining Corp. (NV, UT, SD, NM.), Bowie Resources Limited (CO.) Canyon Resources (CA.), City of Prescott (AZ.), Cyprus-Bagdad Mining Co. (AZ.), Kennecott Energy (CO.), Las Fuentes Development (AZ.), Mt. Baker – Snoqualmie National Forest (WA.), Newmont Gold Corp. (NV.), Intrepid Potash - Moab. (UT.), Plum Creek Timber Co. (WA.), Prescott College (AZ.), Prescott National Forest (AZ.), Queenstake Mining Corp. (NV.), Quinn Coal Company (CO.) Tanglewood Homeowners Association (AZ.), United Nuclear Corp. (NM.), & Western Energy Co. (MT.).

EXPERIENCE SPECIFICS

Mr. Mohr's extensive education and years of field work in ecology and related disciplines have fostered an understanding of the complicated aspects of field biology and regulatory compliance. Areas of expertise include plant taxonomy, reclamation / restoration, and range / riparian ecology.

PLANT TAXONOMY. Mr. Mohr has been involved in over 40 different plant identification surveys throughout the Western U.S. Study components of these projects have included: threatened, endangered or sensitive species identification; floral measurements (cover, density, production, etc.); community mapping; and permanent plot establishment and monitoring. These surveys have been conducted in all of the major ecosystems of the West ranging from the Sonoran Desert of Arizona to the alpine tundra of Washington. Mr. Mohr is expert with all the major plant taxonomic keys of the Western U.S. and is familiar with most of the introduced weeds and ornamental plants found in the region.

RECLAMATION / RESTORATION. Mr. Mohr has assisted in the completion of over 30 restoration projects in wetland, riparian, and upland habitats. Techniques used in these projects include: pole planting, containerized plantings, bare root planting, direct seeding, hydroseeding, supplemental watering procedures, and landform contouring. Mr. Mohr has also been involved with over 50 reclamation monitoring and bond release determinations. Components of these projects included: evaluation and analysis of vegetation cover, production, and density; comparisons to, and recommendations regarding, regulatory standards; and statistical analyses of pertinent variables.

RANGE / RIPARIAN ECOLOGY. In these fields, Mr. Mohr has a unique combination of education, fieldwork, research and teaching experience. Mr. Mohr has spent seven summers on various Western rangelands monitoring forage production, estimating carrying capacity, assisting in the creation of grazing plans and identifying noxious weed infestations. Mr. Mohr has also spent two years as a riparian ecologist in Arizona. Projects included a riparian inventory for the Prescott National Forest, establishment of a 125 acre riparian preserve within Prescott city limits, co-teaching a Riparian Ecology and Restoration Class for Prescott College, several riparian restoration undertakings, and a mesquite bosque restoration / mitigation plan.

GEOGRAPHIC INFORMATION SYSTEMS. Since 2001, Mr. Mohr has developed and utilized a working knowledge of the GIS program ArcView for a variety of projects. Techniques utilized include: collection of remote spatial data using a sub-meter Trimble GPS receiver, correction of collected data, assemblage of remotely collected data and existing data sets to provide meaningful visual aids in presentation documents, and creation of linked databases that provide both historical and recent information on specific areas within a project. Much of the effort using the ArcView GIS program has been to develop a practical program to streamline the process of reclamation management that can then be applied to various reclamation / restoration projects.