CREATING DIVERSE WILDLIFE HABITAT AT LA PLATA MINE, NORTHWESTERN NEW MEXICO, A CASE STUDY: PART 1. LANDSCAPE DESIGN[1]

by

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Abstract. La Plata Mine is located in northwestern New Mexico. The pre-mine landscape is characterized by rough broken topography with moderately steep to steep scarp and dip-slopes. This area of New Mexico is primary winter range for ungulates migrating from southern Colorado. The majority of the pre-mine lease area consisted of south facing dip-slopes. In designing the post-mine landscape the mine was faced with 35% spoil swell. This results in potentially creating longer and steeper slopes than the existing pre-mine slopes. The design also has to consider the requirement that post-mine landscapes have soil-loss rates less than or equal to pre-mining conditions. The final surface configuration (FSC) was designed with the primary purpose of promoting biodiversity and maintaining low soil-loss. Special land features such as talus slopes, scalloped slopes, rock-piles, and water harvesting features were included to meet these objectives. In addition, variable soil substrates, including suitable spoil materials, and coarse textured topsoil materials were targeted for steep slopes to minimize soil loss and to promote shrub establishment. Finer textured topsoil materials were targeted for lowlands and valleys to promote establishment of grasses. Stability of the final surface design was validated using the RUSLE model. Well-designed reclamation plans can enhance post-mine biodiversity through the use of variable landscapes and soil substrata.

Additional Key Words: Surface coal mine reclamation, RUSLE, Soil loss, and Stability.

Introduction

Biological diversity (biodiversity) is attracting greater attention in reclamation programs across the country. BHP Minerals, La Plata Mine (LPM), in northwestern New Mexico, is designing their reclamation strategies with biodiversity in mind. The post-mine land-use at LPM has been designated by stakeholders as wildlife habitat. In order for the large variety of wildlife to thrive in this area, diverse habitats need to be created. Vegetative diversity begins with landscape diversity. Ledges, rock outcrops, talus slopes, water harvesting features (small depressions), and drainage systems designed using fluvial, geomorphologic principles improve wildlife habitat and give the landscape a more "natural" appearance. (Romig & Clark, 2000).

The pre-mine topography, method of mining, and post-mine land-use at LPM, all facilitate the need for a well-designed reclamation plan that promotes landform and vegetation diversity. The LPM is a non-typical surface coal-mining operation as compared to most western operations. Strongly dipping coal beds and spoil swell in excess of 35% require both a truck and shovel operation and permanent out-of-pit storage of spoil materials. The pre-mine topography at LPM was dominated by linear south-facing slopes (Figure 1.). Reconstruction to this approximate original contour (AOC) configuration is not practical at LPM because of the excessive spoil swell-factor and the linear east/west configuration of the mine disturbance area. An attempt to recreate AOC conditions would result in long (>600m), steep, south-facing slopes with very

[1]Paper presented at the 2001 National Meeting of the American Society for Surface Mining and Reclamation, Albuquerque, New Mexico, June 3-7, 2001. Pub. by ASSMR, 3134 Montavesta Rd., Lexington KY 40502

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Proceedings America Society of Mining and Reclamation, 2001 pp 26-30
DOI: 10.21000/JASMR01010026

https://doi.org/10.21000/JASMR01010026

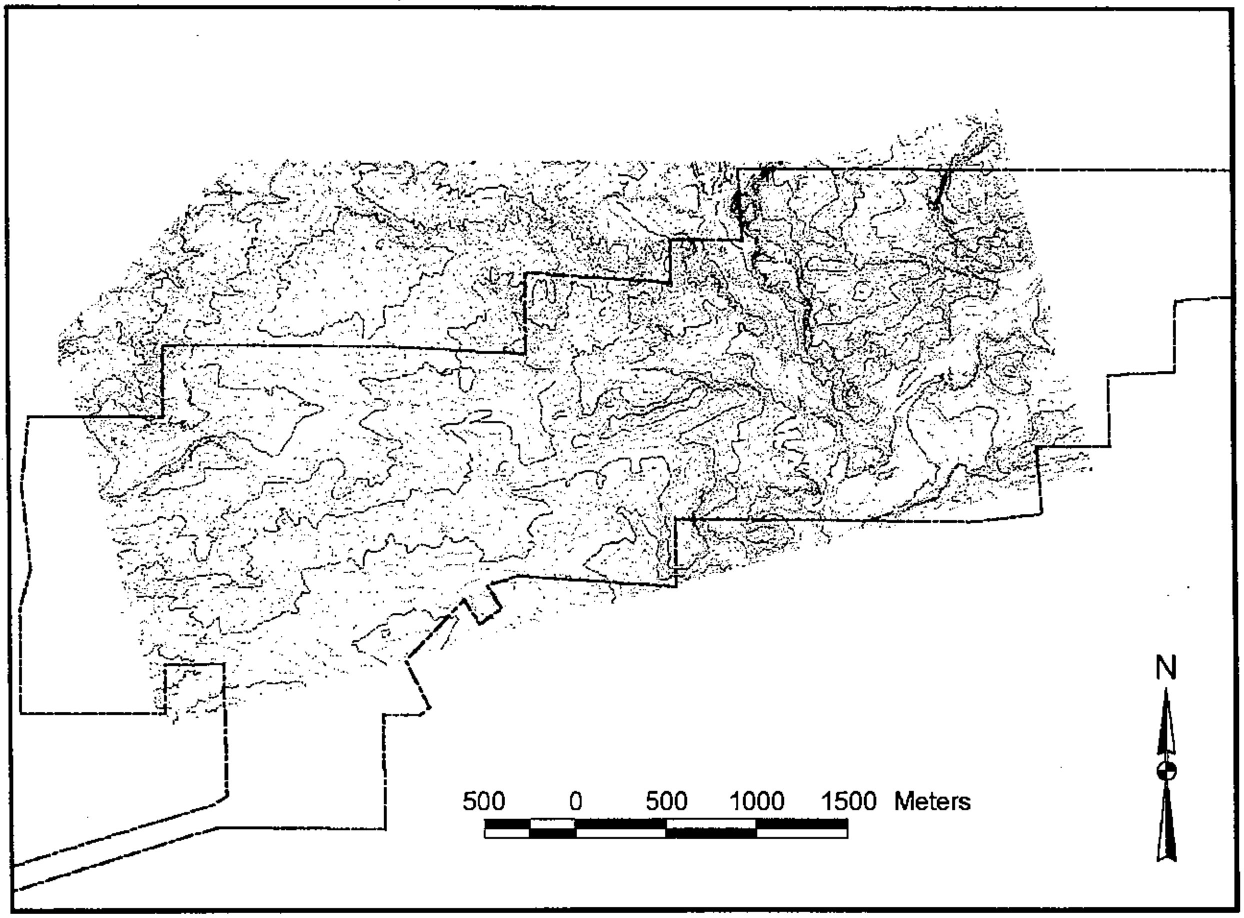

Figure 1. Pre-mine topography at La Plata Mine, 1.52 m (5 ft) contour interval.

high soil-loss potential. In addition, these long, steep slope configurations with a smooth topography do not provide the landform diversity required by the wildlife, post-mining land-use.

The New Mexico Mining and Minerals Division (MMD) who regulates LPM, understands and supports the need for more diversity in reclamation. (Romig & Clark, 2000) wrote, "We fully understand to enhance post-mine diversity we must allow flexibility in reclamation plans." This paper looks at the landscape design plan LPM has developed taking into account pre-mine soil and vegetation conditions, landform stability, and post-mine, land-use potential.

Methods and Design

The first step in designing a functional reclaimed landscape is to look closely at pre-mine conditions. Baseline soils and vegetation give a good basis for topsoil applications and seeding of reclamation areas. Specifics about the application of topsoil and revegetation strategies used to promote biodiversity are discussed in Part II of this paper found elsewhere in these proceedings. Post-mining land-use and pre-mine topography, geology, and hydrology are the principle factors that influence the landscape design aspect of a reclamation plan.

The LPM area, prior to disturbance, was primarily comprised of south-facing, broken topography. In a typical reclamation plan, steps would be taken to structure the post-mine landscape to approximate the original topography (AOC). LPM, however, has several characteristics that make an AOC landscape impractical. Coal beds dip strongly to the south making a truck and shovel operation more practical than a standard dragline method. As mining progresses in a southerly direction, the coal beds quickly become very deep, requiring the removal of a large volume of overburden. An average spoil swell-factor of 35% results in a total increase in material volume of 14%, after the removal of the coal. An attempt to recreate AOC conditions would have the effect of amplifying the topographic relief, resulting in either steeper slopes or longer slopes and greater soil-loss potential.

Given these restraints, LPM designed a Final Surface Configuration (FSC) (Figure 2.) that accommodates the surplus of spoil material while maintaining stability. MMD has approved several temporary and permanent out-of-pit spoil dumps for storage of this material. Spoils in temporary dumps will be used to backfill the pit areas after mining has ceased. The permanent dump areas will be reclaimed insitu, creating hills in the landscape that did not exist prior to mining. Some excess spoils will be used to blend the recreated topography with the undisturbed landscape. The FSC was created with the help of computer modeling software taking the aforementioned factors into consideration.

Stability and landform diversity were foremost in the landscape design for LPM's reclamation. Four major revegetation classes were defined as the foundation for the reclamation plan. The classes are 1) North and east facing Shrubland, 2) South and west facing Shrubland, 3) Grassland, and 4) Drainages. The Shrubland communities were situated on steeper slope areas and sub-divided by aspect. Grassland areas were defined by the nearly level and gently sloping areas. The drainage community forms a narrow (8.5 m) zone along the newly formed drainage corridors. The specifics on soil substrate, soil replacement depths and seeding of each community are covered in Part II of this paper.

To further enhance biodiversity and stability, other landscape features are proposed to be utilized during the reclamation of mined areas. Small depressions will be used to provide water to wildlife and reduce runoff potential within small watersheds. Talus slopes will also help in controlling runoff and erosion and will provide cover for small mammals. Rock-piles or "rabbit condos" will provide additional habitat for the small animals and perches for raptors. These features in combination also help to "break-up" the landscape

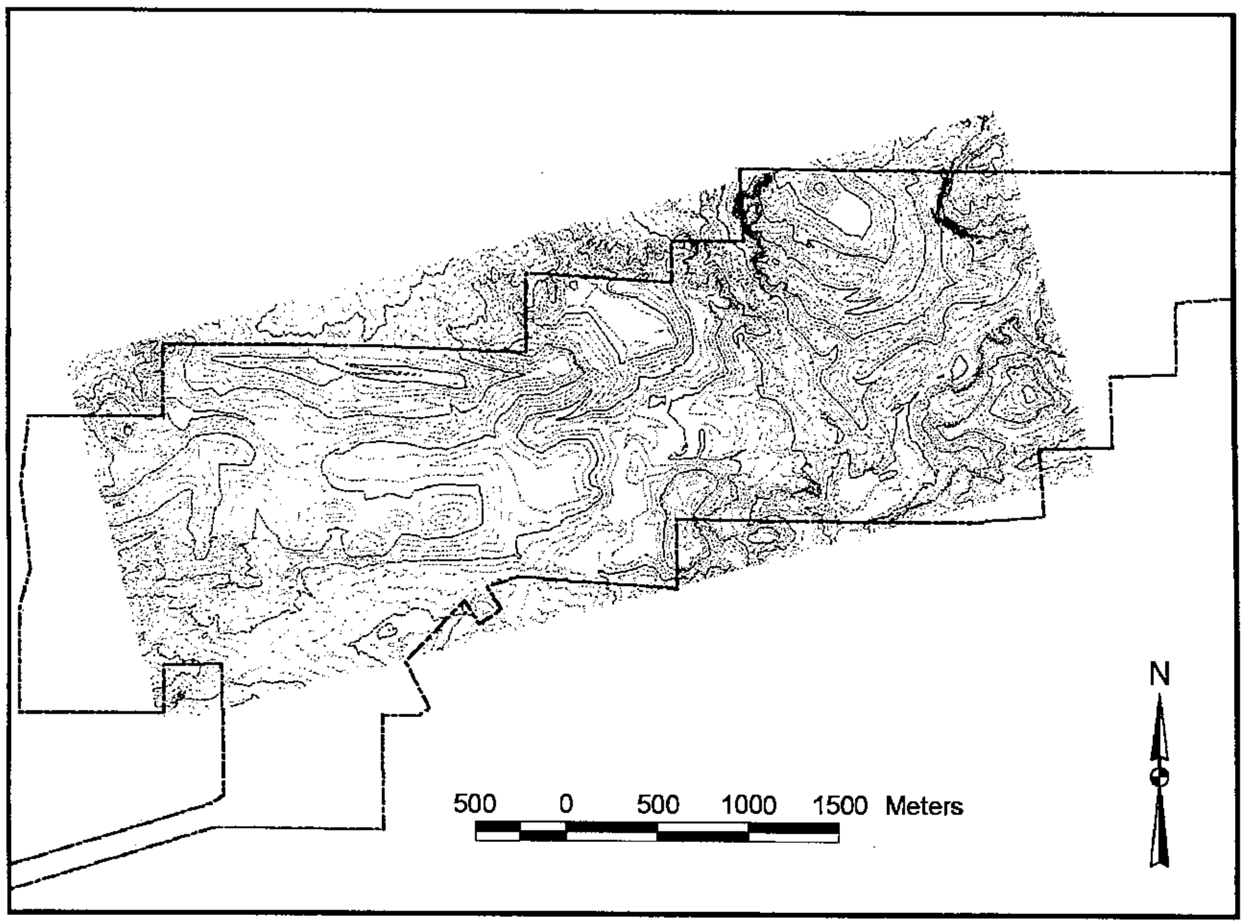

Figure 2. Post-Mine topography (Final Surface Configuration (FSC)) at La Plata Mine, 1.52 m (5 ft) contour interval.

forming microhabitats and niches for diverse flora and fauna.

Large mammal habitat is also important for LPM's post-mine land-use. Mule deer, and elk to a lesser extent, utilize this region for winter range. The three principle components for mule deer winter habitat are: thermal cover, hiding cover, and forage (Wallmo 1981; Leckenby et al. 1982). Rock ledges, rock-piles, and the broken topographic nature of the FSC are important factors in providing thermal and hiding cover. Seed mixes, specific to each of the four revegetation communities, (discussed in more detail in Part II) were selected to provide suitable shrub and grass forage for large and small mammals, upland birds, raptors, and songbirds.

Minimizing soil-loss potential was imperative to the design of LPM's reclamation plan. Stockpiled topsoil and topsoil substitutes (suitable spoils) were sampled and analyzed for their soil-erodibility factor (K factor) based on parameters found in the Revised Universal Soil Loss Equation (RUSLE) (Weesies, 1998). Results of the analyses showed K-factors ranged from 0.17 to 0.36. Topsoils and suitable spoils with a low K-factor value and high rock content, which correspond to high C-values (cover), were targeted for steep slopes given their low susceptibility to erosion. High K-factor soils, having increased erodibility, were selected for the lowland areas and gently sloping topography.

Stability of the post-mining landscape was verified using the RUSLE model. Factors entering into the calculations and sources for the information are shown in Table 1. In order for the reclamation effort to meet the stability criteria established by MMD, predicted soil-loss must be equal to or less than that of the pre-mining landscape. Soil-loss prior to mining was calculated to be 0.87 Mg ha^{-1} yr^{-1}. The reconstructed post-mine landscape is predicted to have a soil-loss of 0.76 Mg ha^{-1} yr^{-1}. The accuracy of the RUSLE model is roughly +/- 50% (Toy, et al., 1999), therefore, post-mine soil-loss falls within the same range as pre-mine conditions.

Discussion

To achieve biodiversity in reclaimed lands, there must be diversity in the landscape. Uniform slopes, and a lack of "natural" landscape variations inhibit the development of microhabitats and niches needed for biodiversity. LPM has designed a diverse landscape to help stimulate diversity in vegetative cover and ultimately to produce a diverse ecosystem.

Designing the landscape to be stable, minimizing soil loss potential, requires modeling and testing to ensure success. LPM utilized the RUSLE model to predict soil loss on the recreated landscape. RUSLE simulations have shown soil-loss to be equal to or slightly below pre-mine conditions, complying with state and federal regulations.

Table 1. Factors used in RUSLE model for calculating pre- and post-mine soil loss.

RUSLE Factors	Description
R Factor	Represents precipitation and climate for the study area. A value of 12 was used for both pre-mine and post-mine.
K Factor	Represents soil erosion potential. Pre-mine values were based on a soil survey conducted prior to mining. Post-mine values were based on samples collected from stockpiled topsoil.
LS Factor	Represents slope length and gradient. Pre-mine values were obtained from the pre-mine topographic map (figure 1). Post-mine values were obtained from the FSC contour map (figure 2).
C Factor	Represents ground cover, including rock fragments, vegetative residue, canopy cover, root mass, and production potential. Pre-mine values were obtained from baseline soil and vegetation surveys. Post-mine values were based on topsoil application practices and predicted plant communities on the reclaimed lands.
P Factor	Represents support practices. A value of 1 was used in both pre-mine and post-mine calculations, indicating that no support practices were utilized.

Careful planning is essential to creating successful reclamation. Support from regulatory agencies has given surface mining operations the go-ahead to explore new and hopefully better reclamation strategies.

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