CHAPTER 4

GEOLOGY

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addition to ground water migration through the coal seam may result in the accumulation of sulfur, uranium, selenium, cadmium and other trace elements.

Conditions for widespread peat accumulation were optimal during the regressive phases of the Western Interior epicontinental seaway. Basin subsidence was in equilibrium with sediment loading, and sedimentation rates generally declined along the western margin of the seaway. The coastal wetlands left behind the regressing sea became the site of extensive peat accumulation. The ultimate demise of the peat forming basins was the terminal regression of the Cretaceous seaway, and the eventual advancement of the freshwater fluvial processes.

Geology of the Subareas

Introduction. Subsurface exploration of the Black Mesa leasehold by Peabody Western Coal Company began in the early 1960's and mining began in 1970. Beginning in 1977, a series of core holes were drilled and overburden samples were taken in each of the areas projected to be mined. In addition to the overburden and parting analyses, coal samples were also taken from the same core hole and analyzed. The “Drill Hole Collar Location Map”, Drawing No. 85351, is located in Volume 20 and the typical geologic cross sections are located in Volumes 13 and 14.

In 1978, a comprehensive exploration program was initiated to accurately define coal reserve parameters throughout the leasehold. At this time, a consistent correlation model has been established for all coal horizons encountered. It must be pointed out that the color designations pertain to coal horizons which may contain one or more coal benches and sub-benches. For the purpose of this report, a coal horizon is defined as a sequence of one or more coal beds which may be time-related as well as having a common environment of deposition.

J-19, J-21, J-21 West Subareas. Due to the lateral continuity of the coal horizons and the interrelated stratigraphic and structural fabric of these subareas, J-19, J-21, and J-21 West will be considered as one coal reserve "area".

Located in the southeast portion of the leasehold, this area is delineated on the south and east by Dinnebito Wash, on the north by Reed Valley, and on the west by coal exposures which have burned along the outcrop, forming bright red sequences of resistant shale and sandstone "clinker" material. Local occurrences of burnt coal and clinker material are

erosion has sufficiently elevated the horizon in relation to ground level. Underlying the orange horizon are sequences of paludal, overbank and distributary sediments that intertongue with the marginal marine sandstone and siltstones of the Toreva Formation.

N-9 Coal Area. This most northern coal area within Peabody Western's lease is bounded on all sides by Yellow Water Canyon Wash and it's tributary, Yazzie Wash. In general, the structural fabric of coal areas becomes more complex towards the northern escarpment of Black Mesa. Folds within the N-9 area are typically oriented in a northeast direction. The general strike and dip of the strata is N76E, 1.5 degrees to the east.

The minable coal horizons within the N-9 area in descending order include the red, yellow, brown and the uppermost coal seam of the orange sequence. The coals of the violet, green and blue coal horizons have been removed by erosion and/or the in-situ burning of the coal. The lower coals of the orange horizon are highly variable both in lateral extent and in thickness and are not economically recoverable. From the red horizon's outcrop to as much as 100 feet; interbedded sandstone, shale, thin coal, and scoria overlie the first recoverable coal seams in the N-9 area. The red horizon consists of up to five individual benches, ranging in thickness from less than one foot to a maximum of 7 feet. The two lowermost seams converge in the southern portion of the area and attain an average thickness of over 6 feet. A sequence of predominately mudstone, shale and sandstone of continental to marginal marine deposition separates the yellow coal horizon from the overlying red. This coal horizon is comprised of two individual seams each averaging approximately 3 feet thick. Underlying the yellow horizon is a sequence of strata, up to 50 feet thick, dominated by the presence of sandstone interbedded with shale and minor beds of coal. The most laterally consistent horizon, the brown, consists of an upper seam averaging 7.5 feet thick, with a thinner and somewhat discontinuous lower seam ranging in thickness from 1 to 6 feet. This same lateral consistency is exhibited in the non-coal interval separating the brown and orange horizons, maintaining an average thickness of 16 feet of shale and sandstone. The lowermost coal horizon, the orange, consists of one seam of recoverable thickness, ranging from 2.5 to 7 feet, with a slight thinning trend towards the northern extent of the reserve. This trend corresponds with the gradual increase of brown to orange interburden in the same direction; indicating that at time of deposition, this portion of the reserve area was subjected to an influx of clay to silt-sized sediments. The most consistent lithologic unit within the N-9 area, as well as throughout most of the Peabody lease, is a blanket sandstone believed to be deposited in a shallow

embayment; bringing to a close the paludal environment responsible for the deposition of the orange coal horizon.

N-10 Area. The N-10 area is located near the northern portion of the leasehold. The area is bounded on the west and south by lands reclaimed due to mining activities, on the east by a tributary of Coal Mine Wash, and on the north by Yellow Water Canyon Wash. Along the margins of these washes, the coal has burned extensively. The resultant "clinker" material, and remnants of the Yale Point Sandstone lend a distinctive break, marked by resistant cliffs, to the generally rolling topography of the area.

Because of the area's location, near the northern escarpment of Black Mesa, the structural fabric, resulting from the gentle uplift and tensional release, is considerably more complex. The western margin of the area is dominated by a set of parallel trending anticlines and synclines. These folds are oriented in a north - south direction, exhibiting limited axial length, plunging towards the south. These folds are inconspicuous in the field, with the overall strike and dip of the coal bearing strata being N16W and 2 degrees to the west. Faults, while not numerous, are present from the northern section of the area, northwards toward the Black Mesa escarpment. These faults are oriented in a northwest - southeast trend with the down-thrown blocks positioned to the northeast.

Mining in the southern and western portions of the N-10 area began in 1979 and was discontinued in 1981 with a total coal production of approximately 500,000 tons. The mineable coal horizons, in descending order are the red, yellow, brown, and orange. Although the upper coal horizons are present in this area, they have either burned in place, or are too thin and laterally variable to be of economical quantity and quality. A sequence of continental to marginal marine shale, mudstone, and sandstone up to 130 feet thick overlie the two recoverable coal seams of the red horizon. Averaging 4.5 to 3.0 feet in thickness, the coals of the red horizon are separated from the two minable coal seams of the yellow horizon by a relatively consistent interval of sediments averaging about 40 feet thick. The coals of the minable yellow horizons average 4.0 and 2.0 feet thick. The coals of the brown horizon have converged into a single minable seam ranging in thickness from 5 to 14 feet. The orange horizon is comprised of up to three coal seams of recoverable thickness, ranging from a minimum of 2 feet to a maximum of 10 feet. Each coal bench shows a great deal of variability in thickness, converging and diverging throughout the area. The innerburden material between the yellow, brown, and orange horizons consists of intercalated continental shales, siltstones, sandstones and coal,

formed in interdeltaic to alluvial environments, with minor marine sequences containing the diagnostic liguloid brachiopod fossil.

N-11 Area. The N-11 area is truncated on the north by Coal Mine Wash and on the east andwest by tributaries to Coal Mine Wash. Portions of the uppermost coal horizons have been extensively burnt, forming exaggerated topographic highs which have been dissected by tributaries of Coal Mine Wash.

The altered rock (clinker), formed by the process of in-situ coal combustion, may still reflect the texture and mineralogy of the original rock, except where alterations due to low pressure and low to extremely high temperatures have melted and fused the rock. The burning coal is eventually reduced to 5 - 10 percent of its original thickness; thus, approximately 90 - 95 percent of the original volume of the seam is gradually filled by the collapse of the overlying altered strata. Although the disturbance caused by the collapsing strata may be minimal, and the original bedding characteristics may appear intact, the original fracture system of the rock is greatly increased, and may serve as air ducts to sustain combustion and chimneys for the conveyance of heat and gases. This is an important consideration, for these same fracture systems may also serve as avenues for relatively rapid aquifer recharge due to their frequent extended depths into the Wepo Formation.

The structural fabric of the area is relatively simple. A set of parallel, north - south trending faults, along the western margin of the area, has formed a graben-like structure of limited axial length. A laterally continuous north - south oriented fault bisects the entire area, with the down-thrown block positioned to the east. Minor, perpendicular, faulting occurs along the southern extent of the major north - south trending fault. The strata gently dips towards the southwest, although changes may occur due to localized structure or differential compaction of the finer-grained sediments.

The mineable coal horizons of the area are, in descending order, the brown and orange. The brown coal horizon consist of one major coal bed that diverges into two benches, both of mineable thickness, in the southeast portion of the area. The orange horizon consists of four major coal seams, of which only two are present in mineable thickness and at recoverable depths. The lower most mineable coal seam diverges into two mineable benches in the northwest portion of the area. The diverging of coal seams in both the brown and orange horizons was due to the influx of waterborne fine-grained sediments during

deposition. The overburden/innerburden strata consists of shallow marine and continental sediments, with a predominance of fine-grained material.

J-28 Coal Reserve Area. Located in the northeast corner of the leasehold, the J-28 coal reserve is delineated by economical recovery limits based upon the ratio of coal to non-coal waste as well as other mining constraints. The reserve is characterized by moderately to steeply rolling hills incised by tributaries of Moenkopi and Reed Valley Wash. East of the reserve and extending in to the interior, steep sided hills capped with scoria derived from the in-place burning of the blue, red and yellow horizon coal dominate the terrain. With apparently little or no influence from localized structure or differential compaction of sediments, the overall strike and dip, N29W and 2 degrees west, is consistent throughout the reserve.

Coal seams of the upper Wepo Formation, designated by Peabody as the violet and green horizons, are absent from the J-28 reserve; most likely removed by the forces of erosion. Underlying the green, the burnt coals of the blue and red horizons, and their associated red scoria lithology, occur to the south and east, but are not present within the reserve area proper. Up to three coal benches of the yellow horizon are present within the southern portion of the reserve, however these seams were developed in an environment of deposition unfavorable to the accumulation of organic material and are thin and discontinuous. In isolated areas, the lateral extent of the yellow horizon coals are further limited by the process of in-situ burning. Approximately 25 feet of predominantly clay to silt-sized sediments separate the thin coals of the yellow horizon from the first economically recoverable coal seams, ranging in thickness from 1 to 8 feet, present within the brown horizon. Limited to the southern portion of the reserve, these seams are separated from the underlying orange horizon by a highly variable thickness of continental to marginal marine sediments consisting of shale, mudstone and channel sandstone. Up to four minable seams are present within the orange coal horizon. Averaging from 3 to 6 feet in thickness, the coals of the orange and their associated non-coal intervals exhibit extensive lateral and vertical variability. The upper two coal seams, separated by as much as 50 feet of mudstone and channel sandstone in the western portion or the reserve, converge to the east and attain a maximum thickness of 16 feet. Interbedded shale, siltstone, sandstone and thin coals complete the lower sequence of the coal bearing Wepo Formation.

N-11 Extension (West) Coal Reserve Area. Stratigraphically and structurally similar, the N-11 Extension (West) coal reserve area is considered an extension of the N-11 Extension coal reserve to the southeast and the mined-out N-11 area to the east. The N-11 Extension, N-11 Extension (West), and mined-out N-11 areas are all one contiguous coal reserve. The N-11 Extension (West) coal reserve area is bounded on the west, south, and east by lands reclaimed due to mining activities, and on the north by Coal Mine Wash. As typically found throughout the Peabody leasehold, the upper coal horizons present in any given area have burned at their outcrop, forming the distinctive red scoria lithology responsible for much of the topographic highs. Within the N-11 Extension (West) reserve, the coals of the red and yellow horizons have burnt in-place, forming surface deposits of scoria material; however, the absence of large-scale erosion has limited the presence of the exaggerated highs prevalent in the N-11 Extension reserve area. The estimated strike and dip of the coal bearing strata is N12W, 2 degrees to the west.

The recoverable coal seams are confined to the red, brown and orange horizons. Although present throughout much of the reserve, the coals of the yellow horizon are thin and discontinuous, averaging less than 2 feet thick. Restricted to the southern portion of the reserve, under an average overburden of 50 feet of predominately mudstone, shale and scoria, a single marginally economical coal is present within the red horizon, averaging less than 2.5 feet thick. A series of interbedded shale, thin coal and sandstone lenses averaging 80 feet thick separate the red horizon from the single recoverable coal seam of the brown horizon. This interburden sequence maintains a relatively consistent thickness due to the absence of distributary channel sandstone development. This trend in lateral consistency continues with the brown coal seam maintaining an average thickness of 11 feet throughout much of the N-11 Extension (West) reserve. A highly variable thickness of shale, mudstone and sandstone, of probable continental to marginal marine deposition, separates the orange coal horizon from the overlying brown. Ranging in thickness from 19 to 63 feet, with a thickening trend to the south, this variability is most likely due to the development of a distributary channel prior to the deposition of the brown coal seam. The lower most coal horizon, the orange, consist of three minable seams averaging 3, 8, and 3.5 feet respectfully, with the two uppermost seams converging to the south, reaching a maximum thickness of approximately 12 feet.

N-11 Extension Coal Reserve Area. The N-11 Extension coal reserve is bisected, into roughly equal areas, by the present alignment of Peabody's overland coal conveyor. Assuming the Kayenta Mine coal supply agreement with the Navajo Generating Station extends beyond 2019 and potentially to 2041, PWCC will relocate the overland coal conveyor and adjacent facilities and mine the N-11 Extension coal reserve as one mining block. The northern reserve is bounded on the east and west by the geologic extensions of the N-11 and N-14 coal reserve areas and their associated reclaimed lands, and on the north by the current leasehold boundary. The southern reserve area is delineated on the east and south by the development of extensive scoria lithology, resulting in topographic highs with deeply incised drainages, and by the J-1/N-6 reclaimed lands to the west. The overall strike of the area is N26W, with dips less than 2 degrees to the west.

The uppermost coal horizons of the Wepo Formation, due to non-deposition or most likely erosion, are absent from the N-11 Extension coal reserve. Much of the distinctive "clinker" or heat-altered lithology present throughout the area owes its origin to the in-situ combustion of the uppermost coals of the red horizon. One coal seam of the red horizon, attaining a maximum thickness approaching 5 feet, is considered recoverable where depth of cover has prevented combustion or oxidation. A complex sequence of continental and marginal marine sediments ranging in thickness from 15 to 110 feet separate the red horizon coal from the underlying yellow. This interval increases from west to east and is largely a function of the percentage of sandstone present. Within the northern portion of the N-11 Extension reserve, sub-surface investigations have identified a distinct geophysical signature interpreted to be a blanket sandstone of marginal marine deposition. The occurrence of this lithology within the coal sequence has been utilized in identifying the three minable seams, each 2.5 to 3.5 feet thick, of the yellow horizon. A laterally

and vertically consistent series of strata, predominately shale and mudstone with lenses of sandstone, separate the brown horizon coals from the overlying yellow. The two coal seams of the brown, averaging 5.5 and 4 feet thick respectively, merge towards the boundaries with the mined-out N-11 and N-11 Extension (West) reserve areas, attaining an average thickness of approximately 10 feet. Within the northern portion of the N-11 Extension coal reserve area, the non-coal interval between the brown and the underlying orange coal horizon is a fairly consistent sequence; 18 to 20 feet thick, composed of shale, mudstone and intercalated sandstone. Trending to the south this interval increases to as much as 65 feet, most likely due to the process of differential compaction of sediments and the presence of a distributary channel sandstone. The introduction of fine sediments into the paludal environment during deposition has caused the coals of the orange horizon to converge and diverge over relatively short distances. From two to four seams of recoverable thickness may be present in any given area of the reserve. The two uppermost coals of the orange, averaging 4 and 8 feet thick respectfully, converge near the southern margin of the reserve, attaining an average thickness in excess of 13 feet. To the north, an influx of fine sediments of probable overbank origin is responsible for the development of an in-seam parting, splitting the second orange horizon coal seam into two distinct benches, ranging in thickness from 1.5 to over 6 feet. Present throughout much of the N-11 Extension reserve area, the lowest recoverable coal seam within the orange horizon varies in thickness from less than 2 feet up to a maximum 6 feet. A series of mudstone, shale, sandstone and thin coal seams, of continental to marginal marine deposition completes the lowermost sequence of the coal bearing Wepo Formation.

Exploration Drilling and Sampling Practices

PWCC periodically conducts exploration drilling and sampling to characterize geologic and hydrologic conditions and to delineate and characterize coal, overburden, and interburden materials in both active and proposed mining areas. Exploration drilling and sampling are the primary means of determining the depth, thickness, physical and chemical characteristics, and degree of saturation of the geologic materials to be disturbed or otherwise affected by mining. Although each exploration program may involve a different area and slightly different objectives, all exploration programs will generally involve the same activities including:

- Establishment of exploration staging areas (for temporary storage of drilling equipment and supplies)

- Construction of temporary exploration roads

- Drilling, sampling, and geophysical surveying of completed drillholes

- Subsequent reclamation of all exploration disturbance outside of the five-year affected lands area

The following describe these components of exploration drilling and sampling programs as a basis for understanding the equipment and activities involved and the practices used to assure the integrity of the resulting sampling information. Exploration applications for J-21 and J-23 are presented in Attachment 4-1 and applications for N-6/N-11, N-9, and N-10 are presented in Attachment 4-2.

Exploration Staging Areas. Given that exploration activities may occur at the same time and in proximity to ongoing surface mining operations, a reasonable effort will be made to utilize existing mining disturbance areas or facilities areas. If necessary, separate staging areas will be developed for temporary storage of drilling equipment and supplies. The drilling contractor(s) may also have a temporary office trailer, fuel tank, and other temporary ancillary facilities in the staging area(s). Existing equipment parking areas or other existing disturbance areas may be used as staging areas or new staging areas may be constructed adjacent to existing roads.

If new staging areas are developed, surface disturbance will be minimized to the extent possible and they will be located adjacent to existing roads and well away from natural drainages. Staging area development will involve removal of available soil material and placement in windrows on the perimeter of the area, establishment of temporary drainage features (berms or ditches) to effectively control site drainage, and placement of surfacing material (granular spoils, scoria, or gravel) where appropriate. Contractors will be responsible for full compliance with all applicable regulatory requirements including fuel storage and containment requirements, waste collection and handling, and surface drainage and sediment control. On completion of drilling activities, staging areas will be reclaimed if outside of the five-year affected lands area.

Exploration Access. To the extent possible, exploration sites will be located adjacent to existing roads or trails. If existing access is not available and ground conditions are favorable, exploration equipment may move across undisturbed terrain to access exploration

sites. In the case of access across undisturbed terrain, equipment movements and other related traffic will be kept to an absolute minimum. In most cases where access does not exist, it will be necessary to establish temporary exploration roads. Where road construction is necessary, roads will be constructed to the minimum practical width and will be aligned to minimize total length and limit erosion to the extent possible.

Temporary exploration roads will be constructed ten to fifteen feet wide using a tracked dozer or rubber-tired loader. Road construction will involve clearing any trees or large shrubs, removing and windrowing available soil material to the side of the road, establishing appropriate temporary drainage (ditches, berms, and minor drainage control structures), and grading to provide a smooth stable operating surface. On completion of drilling activities, temporary exploration roads will be reclaimed if outside of the five-year affected lands area.

Exploration Drill Sites. Most drilling can be conducted with minimal site preparation, since the drill can be set-up and leveled using self-contained hydraulic jacks. Where site preparation is necessary due to the topography or the need to utilize drilling fluids, a pad having maximum dimensions of approximately 75 feet in width and 100 feet in length will be established. Pad preparation will involve the use of a tracked dozer, backhoe, or rubber-tired loader to recover and windrow available soil material on the pad perimeter and establish a level drill site. If feasible, based on hole depth and drilling conditions, portable tubs will be utilized to mix and contain necessary drilling fluids.

If greater pit capacity is required than would be feasible using portable tubs, mud pits for the containment of drilling fluids and cuttings will be excavated within the pad area. Maximum disturbance area for each drill site is expected to be approximately 0.17 acres. On completion of drilling activities, all mud pits will be backfilled and drill sites outside of the five-year affected lands area will be reclaimed.

Drilling and Related Activities. In general, PWCC’s exploration drilling activities fall into three categories; boreholes, cropholes, and coreholes. At borehole and crophole locations the drill rig is set up on the drill site, leveled with hydraulic jacks mounted on the truck, and a single boring (typically 4.5 to 5 inch diameter) is drilled to intercept the lowest potentially mineable coal seam or an individual seam at the crop locations. At corehole locations, the drill rig is set up on the drill site, leveled with hydraulic jacks, and a “pilot” or borehole is drilled to intercept the lowest potentially mineable coal seam (or pre-determined horizon) to determine its depth at that location.

Once the target depth is determined, a second drillhole is off-set five to ten feet from the pilot hole and is drilled to just above the coal seam or horizon of interest. The coal seam or horizon of interest is then core-drilled using a diamond core bit and split-tube core barrel assembly.

Drilling activities will utilize one or more truck-mounted rotary drills capable of achieving depths up to 500 feet. In order to minimize the potential for sample contamination, drillholes will be drilled using air, air/foam, or water as the circulation medium. If the use of drilling muds is necessary to maintain circulation and drillhole integrity, polymer muds free of metallic compounds will be used. Each drill will be supported by a water truck (minimum capacity of 1,000 gallons) and at least one pickup truck. All drilling and related operations will be conducted by an experienced driller in such a way as to minimize potential environmental impacts and will be supervised by a qualified geologist, hydrologist, soil scientist, environmental coordinator, or engineer.

During drilling operations, water levels and flows in the drillholes will be closely monitored in order to characterize hydrologic conditions. Samples of surficial materials and sub-surface rock and coal materials may be collected and logged during drilling for subsequent analysis. Samples may be either chip or cutting samples or core samples. Chip or cutting samples are obtained during normal rotary drilling operations using specially designed buckets with extended handles. The buckets are often placed at the collar of the drillhole where the air or air/foam circulation medium carries cuttings to the surface from the drill bit. When sampling using this method, samples are obtained at regular intervals corresponding to progressive drilling advance, bagged, and labeled for physical and/or chemical analysis.

Core sampling is used to recover relatively intact samples of coal, overburden, or interburden materials. Core samples are obtained using a diamond core bit and split-tube core barrel assembly. Generally, core sampling proceeds in ten-foot intervals and the core samples are separated every two-feet, bagged in plastic core sleeves, labeled, and boxed. An exploration geologist, hydrologist, soil scientist, or environmental coordinator examines the core, logs and characterizes the cored materials by litho-type based on appearance (color, grain size, bedding, mineralogy, hardness) and field tests, and then selects and ships representative core samples to the analytical laboratory for physical and/or chemical analysis. Selection of core samples for analysis is generally based on PWCC’s requirements for characterization of coal and overburden/interburden

materials, with core samples being segregated by litho-type as previously determined.

Downhole geophysical surveys may be conducted on all or selected drillholes following drillhole completion using a truck-mounted logging system. Geophysical surveys will result in a suite of logs including, but not limited to natural gamma, high-resolution density, and resistance that can be used in conjunction with driller's logs, lithologic descriptions, and sampling information to accurately characterize geologic, hydrologic, coal, and overburden occurrence and characteristics.

During drilling, PWCC will control dust from drilling and related activities, divert and control both natural runoff from disturbed areas and fluid loss from drilling, and will clean-up any trash or debris. If air is utilized as the circulation medium, dust from drilling will be controlled by a flexible shroud at the drill collar. Drill cuttings and drilling fluids will be effectively controlled and contained by portable tubs, mud pits, or berms within the drill pad area.

Drillhole Sealing, Abandonment, and Reclamation of Drilling Disturbance. On completion of drilling, sampling, and logging for each exploration drillhole, PWCC will proceed with either temporary plugging or permanent sealing unless it is advantageous to complete the drillhole as a monitoring well. Completion of any drillhole as a monitoring well will involve the well completion procedures outlined in Chapter 16, Hydrologic Monitoring Program and well completion information will be provided to OSM following completion of the drilling program. Because they will be mined through within a relatively short time-frame, drillholes within the five-year mining area will be temporarily plugged rather than permanently sealed. Temporary plugging will involve placement of drill cuttings to within one foot of ground level and filling the remainder of the drillhole with cement to the ground surface to prevent surface or other materials and surface water runoff from entering the drillhole. Drillholes outside of the five-year mining area will be permanently sealed. Permanent sealing will involve backfilling the drillhole with drill cuttings to within five feet of ground level and filling the remainder of the drillhole with cement to the ground surface. Drillhole locations are marked by a metal tag with the PWCC drillhole number which is attached to a wooden surveyors stake set in the concrete surface plug. The time interval between completion of drilling operations and completion of temporary plugging or permanent sealing is normally approximately three to five days.

Areas disturbed by exploration activities including temporary staging areas, temporary exploration roads, and drill sites will be stabilized or reclaimed following completion of drilling activities. Exploration disturbance areas within the five-year affected lands area will be stabilized to minimize erosion during the interim period before these areas are mined through. Stabilization measures will include removal of all trash and debris from the drill site for disposal, spreading any excess cuttings over the site, and backfilling of any excavations, including mud pits. Where mud pits are necessary, they will be fenced as needed, allowed to dry, and later backfilled with drill cuttings and/or previously excavated material.

Exploration disturbance areas outside the five-year affected lands area will be reclaimed. All trash and debris will be removed from drill sites for disposal; excess cuttings will be spread over the site; excavations, including mud pits, will be backfilled; disturbance areas will be regraded; drainage will be reestablished; soil material will be replaced; and vegetation will be reestablished. Where the creation of a drill pad results in a bench which exceeds four feet in height, the bench will be reduced to a maximum slope of 3h:1v. Where construction of temporary exploration roads results in minor cuts and fills, a track-hoe or similar equipment will be used to pull fill material back onto the road bench and grade the road surface to blend with the surrounding terrain. Available soil material will be replaced on disturbed areas if soils existed prior to the disturbance and were recovered during construction. The surface will be scarified to a depth of approximately four inches or more. Water bars or berms will be constructed to control drainage on and from the reclaimed areas and to aid in surface water retention. The disturbed areas will be seeded using broadcast seeding techniques using the Special Stabilization Mix described in Chapter 23, Revegetation Plan.

Generally, reclamation will be coordinated for all areas disturbed by exploration activities within a calendar year. Reclamation and revegetation will be contemporaneous with drilling as much as possible with exceptions due to extreme weather (snow, rain, mud) conditions and activities will be completed within six months following initiation consistent with seasonal reclamation planting considerations as outlined in Chapter 23, Revegetation Plan.

Exploration applications for J-21 and J-23 are presented in Attachment 4-1 and applications for N-6/N-11, N-9, and N-10 are presented in Attachment 4-2.

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