SECTION 23

ROADS

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LIST OF REVISIONS DURING PERMIT TERM

REV. NUMBER	REVISION DESCRIPTION	DATE APPROVED

SECTION 23 ROADS

~~BHP Navajo Coal~~Navajo Transitional Energy Company (~~BNCC~~NTEC) will utilize both primary and ancillary roads in its mining operations for the Pinabete Mine Plan permit area (permit area). Roads classified as primary consist of roads used to transport coal and spoil, main access roads to the mining areas used by small and heavy equipment, and access roads to the support facilities. Roads classified as ancillary consist of roads used infrequently by small vehicles for accessing environmental monitoring stations, accessing ponds/water control structures, surveying, and power line service/inspections. The haul roads to topsoil stockpiles and temporary roads used during the construction of support facilities are also classified as ancillary roads. Ramps leading from the bottom of the pits to the intersection with the haul roads and roads in the active or immediate mining areas are not classified as either primary or ancillary roads.

23.1 Existing Roads

The use of existing roads will be limited to two-track roads that will be used to access environmental monitoring stations for collection of data. The locations of these roads are presented on Exhibit 23.2-1. They are classified as ancillary roads. Their existing conditions are suitable for the intended use, so no modification or reconstruction is anticipated. The profiles of these roads closely follow the existing topography with no significant cuts or fills. To minimize additional disturbance and adverse environmental impacts, maintenance will be limited to occasional light blading, particularly after heavy precipitation events that may cause damages.

Some of these roads will eventually be disturbed or blocked due to construction of mine support facilities and mining activities. As construction of new mine roads is completed they will be reconnected to the newly constructed roads. The mine permit will be revised accordingly.

Burnham Road (BIA 3005 and Navajo Road N-5082), an existing pubic road that provides access to the Navajo Nation's Burnham Chapter area, lies within the eastern portion of the ~~BNCC~~NTEC lease area. A 2.8- mile segment of the Burnham Road will be realigned away from the planned mining activities in Area 4 South to enhance the safety of the public using the road. As illustrated in Exhibit 23.2-1, the realigned segment will extend 2.7 miles within ~~BNCC~~NTEC's eastern lease boundary and will connect to the existing Burnham Road relocation (Office of Surface Mining Reclamation and Enforcement [OSM] Project No. NM-0003-F-I-40) in Area 4 North. Burnham Road will remain as a permanent post-mine feature and continue to function as a public road under BIA's jurisdiction. Burnham Road design plans are provided in Section 40, Environmental Protection and public road protection plans are provided in Section 40.6, Public Roads Protection Plan.

~~BNCC~~NTEC will submit a right-of-way application for temporary construction of the Burnham Road segment to BIA as planned mining activities approach the realignment area in approximately 2022. Once

construction of the road segment is complete, the construction right-of-way will no longer be required and the right-of-way will be terminated. OSM is evaluating the effects of the 2.7-mile realignment as part of the Four Corners Power Plant and Navajo Mine Environmental Impact Statement.

23.2 Primary Roads

All primary roads are designed, constructed, and maintained in a manner to facilitate safe operations and minimize adverse environmental impacts. Adequate drainage and erosion control structures are incorporated into the road designs. Information on each primary road segment is presented on Table 23.2-1 and their locations are presented on Exhibit 23.2-1.

23.2.1 Design Criteria

It is economically unfeasible due to the very heavy wheel loads imposed by the heavy mining equipment to design and construct primary roads to a recognized State or Federal public road design criteria or standard. Rather, p~~P~~rimary roads are typically designed to meet the applicable performance standards of CFR 30 Subchapter K and the Mine Safety and Health Administration (MSHA) standards and requirements for roads.

Geometric Design

The geometric design of primary roads will be done in a manner to ensure the safe operation of small vehicles and heavy equipment. The layout of the vertical and horizontal curves is for safe sight and stopping distances of the vehicles using the road. The geometric design (i.e., width, vertical/horizontal curves, crown, safety barriers, etc.) will comply with the design criteria outlined in "Design of Surface Mine Haulage Roads" (Kaufman and Ault 1977).

At elevated roadways, MSHA regulations require a safety barrier along the edge of the road that is capable of deflecting the largest vehicle back onto the road or prevent it from leaving the roadway. An acceptable barrier is an earth berm having a height equal to or greater than the axle height of the largest vehicle using the road. ~~BNCC~~NTEC uses an earth safety berm in road designs at its Pinabete Mine Plan operations. On roads used by heavy mining equipment, whenever the road is elevated 4 feet or more, a 6-feet high safety berm is incorporated into the design template. On roads used by only small vehicles, a 3-feet high safety berm is used.

A 2% crown will be incorporated into the design template to divert surface runoff from the roadway into side ditches or to the toe of safety berms.

Road Structure

Primary roads will be constructed using stable materials capable of supporting the weight of mine vehicles and which will not hamper vehicle mobility or controllability. Depending upon site specific conditions, such as geomorphological factors, material availability, and economics, primary roads are commonly surfaced with non-toxic and non-acid forming materials including but not limited to:

1. Compacted shale, silty clay, and sandy silt,
2. Compacted gravel or crushed stone, or
3. Aggregate scoria (red dog).~~To design and construct the road structure to a recognized design criteria or standard would be economically unfeasible due to the very heavy wheel loads imposed by the heavy mining equipment.~~

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Cut and Fill Side Slopes

The steepness of cut and embankment slopes shall be as follows:

1. Cut slopes will not be steeper than 2 horizontal: 1 vertical (2h:1v) in unconsolidated material and not steeper than 1h:1v in consolidated material.
2. Embankment slopes will be 4h:1v when the embankment height is less than 4 feet and 2h:1v with a safety berm when the embankment height is equal to or greater than 4 feet.

Embankment Slope Stability

The minimum static safety factor for road embankments shall be 1.3. To demonstrate this, slope stability analysis was performed on two worst-case scenarios (i.e., maximum embankment height and cut slope). Since all the embankments are to be constructed with similar soils, a worst-case analysis should be sufficient. Slope stability analyses are presented in Appendix 23.A.

Design Storm

All required drainage and sediment control structures (i.e., culverts, side ditches, relief ditches, downdrains, etc.) are designed to pass the peak flow from the 10yr-6hr storm event or larger event.

Design Loads

Culverts and other buried structures within the roadway will be designed to withstand the dead load plus the maximum live surcharge load imposed upon it.

23.2.2 Construction

Road construction will not commence until the regulatory authority approves the designs. Prior to commencing construction, 1 foot of topdressing will be salvaged along the roadways. The salvaged topdressing will be removed and placed either in a stockpile or hauled directly onto a regraded area. If mining activities encroach onto a road and the road needs to be removed, the remaining topdressing beneath the road will be salvaged. Fugitive dust emitted from construction areas will be controlled by watering or by other proven means. The fugitive dust control plan is discussed in Section 40 (Environmental Protection).

Excavation

Excavation or cuts for roads shall conform to the following:

1. To keep surface disturbance to a minimum, the excavation will be limited to the lines and grades indicated on the design drawings.
2. Rock excavation may require blasting; appropriate permits will be obtained prior to commencing blasting activities.

Embankments

The construction of the embankments shall conform to the following:

1. Prior to beginning placement of fill material, the fill area will be cleared of trees, stumps, roots, boulders, vegetation, and rubbish.
2. Only approved suitable fill material free of debris, organic material, frozen matter, and excessive moisture or dryness will be used.
3. Fill material shall be placed in lifts and compacted before placing the next lift. A registered professional engineer will specify the degree of compaction required and the thickness of the lifts. No additional lifts will be placed until the specified degree of compaction is achieved.

Installation of Culverts

To insure that the design strength of the culvert is developed, selected fill material shall be placed in lifts around the culvert and compacted. No additional lifts will be placed until the specified degree of compaction is achieved.

23.2.3 Drainage and Sediment Control

Primary roads are designed, constructed and maintained in a manner to minimize the contribution of additional suspended solids to surface runoff leaving the permit area. The primary roads will be located with minimal impact upon existing drainage channels.

Culverts are used unless site conditions or other factors dictate otherwise. At topographical lows or areas where roads intersect drainage channels, surface flows are routed through road embankments with culverts. The placement and orientation of culverts will be in a manner to minimize the alteration of the stream channel. If the stream channel is to be significantly altered, appropriate mitigation measures will be incorporated into the design to minimize the impacts. The inlet and outlet of culverts will be riprapped when required to prevent erosion.

All primary road culverts are designed to safely pass the peak discharge from a 10yr-6hr event or larger event. The watersheds for all the culverts are delineated from contour mapping. Soil curve numbers were determined using data from the Natural Resources Conservation Service soil surveys (Keetch 1980). The curve numbers assigned to the hydrologic groups are: A 65, B 78, C 87, and D 93. Using this data, a weighted curve number was calculated for the watersheds. The precipitation values for the design storm were obtained from the National Oceanic and Atmospheric Administration (NOAA) Atlas IV-New Mexico (NOAA 2006). The watersheds and culverts were modeled in SEDCAD to determine the peak flows and the culvert sizes required. If the results from the hydraulic analysis indicate the potential for erosion to occur at the inlet or outlet, riprap rock or other forms of protective lining will be installed.

At transitions from cut to fill a relief ditch is constructed to direct flows along the toe of the road embankment. Additional relief ditches may be needed at the safety berm termination points on the downstream end. The gradient of the relief ditches varies depending on the adjacent topography. The road crown, side ditches, and safety berms direct the surface flows into the relief ditches. The safety berms minimize uncontrolled flows down the slopes of road embankment. The relief ditch watersheds and geometric configuration of the ditches were modeled in SEDCAD to determine the peak flow and if any protective lining will be required in the ditch to control erosion. Only the relief ditches with steep grades and sufficient watershed area are analyzed.

The availability of rock size greater than D_{50} equal to 9 inches is very limited in the local area. Therefore, if results from the hydraulic analysis specify riprap size of D_{50} equal to 12 inches or greater, wire-enclosed riprap will be used in lieu of the size specified. D_{50} equal to 6-inches rock will be placed and enclosed with wire.

Hydrologic and channel information pertinent to the primary road culverts, downdrains, and relief ditches are presented on Table 23.2-2. The appendices containing the supporting design data are referenced on the table. The location of the culverts, relief ditches, downdrains, and their corresponding watersheds are presented on Exhibit 23.2-1.

23.2.4 Operation and Maintenance

Routine road maintenance consists of surface repairs; blading of side ditches and roadway surfaces; application of water and chemical road stabilizers; maintaining drainage control structures to design standards; and maintaining safety berms. Periodic inspections will be conducted to insure proper maintenance and safe operating conditions.

For description of fugitive dust control and the removal and reclamation of primary roads, refer to Section 40 (Environmental Protection) and Section 32 (Temporary Structures and Facilities Removal and Reclamation), respectively.

23.2.5 Removal and Reclamation

Refer to Section 32 (Temporary Structures and Facilities Removal and Reclamation) for removal and reclamation of primary roads.

23.3 Ancillary Roads

Ancillary roads are roads that are used infrequently by small vehicles for accessing environmental monitoring stations, accessing ponds/water control structures, surveying, and servicing/inspecting power lines. The haul roads to topdressing stockpiles and temporary roads used during the construction of the mine support facilities are also classified as ancillary roads; these are utilized infrequently during periods of topsoil removal and construction. They are designed, constructed, and maintained in a manner to minimize adverse environmental impacts. Information on each ancillary road segments is presented on Table 23.3-1 and their locations are presented on Exhibit 23.2-1.

23.3.1 Design, Construction, and Maintenance

New ancillary roads will be constructed to the typical cross section presented on Exhibit 23.3-1. They will primarily be constructed with a motor grader. The road width is typically one blade wide for small vehicles and approximately 80 feet wide for topsoil haulage roads. Their profile will closely traverse the existing topography to minimize cuts and fills or surface disturbance. At topographic lows or where drainages are intersected, the road profile will be constructed flush with the flow line to prevent ponding and restriction of flows in existing drainage channels. In badland areas, it is not unusual to encounter minor drainages (small watersheds) with deeply incised channels. When the road alignment crosses this type of drainage, a culvert is installed to minimize the excavation and surface disturbance. If the results from the hydraulic

analysis indicate the potential for erosion to occur at the inlet or outlet, riprap rock or other forms of protective lining will be installed. Culverts and other drainage or required erosion control structures will be designed to pass the peak flow from the 2yr-6hr storm event. Typical road profiles at drainage crossings are presented on Exhibit 23.3-1.

Hydrologic and channel information pertinent to the ancillary road culverts, and any other required drainage or erosion control structures are presented on Table 23.3-2. The appendices containing the supporting design data are referenced on the table. All culvert locations and corresponding watersheds are presented on Exhibit 23.2-1.

Ancillary roads constructed as described above and to the typical section do not require approval prior to construction. After construction, the actual alignment will be surveyed and added to Exhibit 23.2-1.

Ancillary roads will be maintained in a manner to minimize adverse environmental impacts. To minimize additional surface disturbance, the maintenance is limited to occasional light blading particularly after heavy precipitation that may cause damage. The drainage control structures (i.e., culverts, riprap channels, etc.) will be properly maintained. Periodic inspections will be conducted to insure proper maintenance and safe operating conditions.

Fugitive dust emitted from ancillary roads is expected to be minimal since these roads will be infrequently used. Therefore, they will not be treated or watered to control dust.

For information on the removal and reclamation of ancillary roads, refer to Section 32 (Temporary Structures and Facilities Removal and Reclamation).

If deviations from the typical design, such as significant cuts and fills and the crossing of perennial or intermittent stream channels are required, a site-specific design will be developed for the road in order to demonstrate compliance with performance standards. The road design will be submitted to the regulatory authority for approval. Construction will not commence until the design is approved.

23.4 Information Collection and Analysis

Certified exhibits for primary roads will be submitted to Office of Surface Mining Reclamation and Enforcement, Western Region technical office in Denver, Colorado. ~~Section 23 are available for review upon request at either the BNCC offices or the Office of Surface Mining Reclamation and Enforcement, Western Region technical office in Denver, Colorado.~~ Certified as-built drawings will also be kept on file at the mine site and made available upon request.

Personnel

Persons or organizations responsible for data collection, analysis, and preparation of this permit application package section:

~~Ron Van Valkenburg~~	BHP Billiton Mine Management
~~Kent Applegate~~	Company (disclosed agent)
~~BHP Navajo Coal~~Navajo Transitional Energy Company	Farmington, NM
	GEOMAT, Inc.
	Farmington, NM

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Kaufman, Walter W., and James C. Ault. 1977. Design of Surface Mine Haulage Roads – A Manual. Information Circular 8758. U.S. Department of the Interior, Bureau of Mines, Washington D.C.

Keetch, C. Wesley. 1980. Soil Survey of San Juan County, New Mexico, Eastern Part. United States Department of Agriculture, Soil Conservation Service, Washington, D.C. Survey Available at http://soildatamart.nrcs.usda.gov/manuscripts/NM618/0/sanjuan.pdf (Verified March 29, 2012)

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