CHAPTER 4

GEOLOGY

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CHAPTER 4

GEOLOGY

Introduction

The following section describes the geology of: (1) the region; (2) the vicinity; and (3) the mining subareas or areas. For clarity it should be understood that, by region, we refer to all of northeastern Arizona and portions of southeastern Utah and northwestern New Mexico, by vicinity we refer to the area covered by Black Mesa and, more specifically, the area covered by the leases with the Navajo and Hopi Tribes and by the mining subareas or areas we refer to those several, separate and distinct areas which contain minable coal.

The geology of the Black Mesa region is relatively uncomplex. Rocks are predominantly sedimentary and have been gently folded and eroded. Rocks older than Jurassic age are not exposed in the vicinity of Black Mesa. However, west of the Mesa, in the Grand Canyon, the Colorado River has downcut to the Precambrian-aged Vishnu Schist, providing a view of the entire stratigraphic section of the region from Precambrian through Cenozoic rocks.

Structure

The Black Mesa is part of the Colorado Plateau Province and is characterized by an absence of severe deformation, such as commonly happens near major plateau boundaries. The province has been relatively stable since late Precambrian time and has been only moderately effected by the Laramide Orogeny of late Cretaceous and Tertiary time. As a result of the Laramide Orogeny, the rocks of the region were upwarped, folded and locally faulted. Most of the structure in the area consists of folds and faults which are oriented in a northwest - southeast direction. However, in the northeastern part of the area, in response to localized uplift, the dominant structural fabric has been warped somewhat to produce north - northeast oriented folds and faults (Figure 1). Most of the folds are inconspicuous in the field because they seldom have dips which exceed 3°. Many of these folds have extreme continuity and some have axial lengths in excess of 100 miles. The largest in the area, Preston Mesa - Mount Beautiful Anticline, can be traced for over 150 miles from the Kaiparowits Plateau to and through the Black Mesa basin. Small domes and saddles have formed irregularities along the crests of the dominant anticlines in the

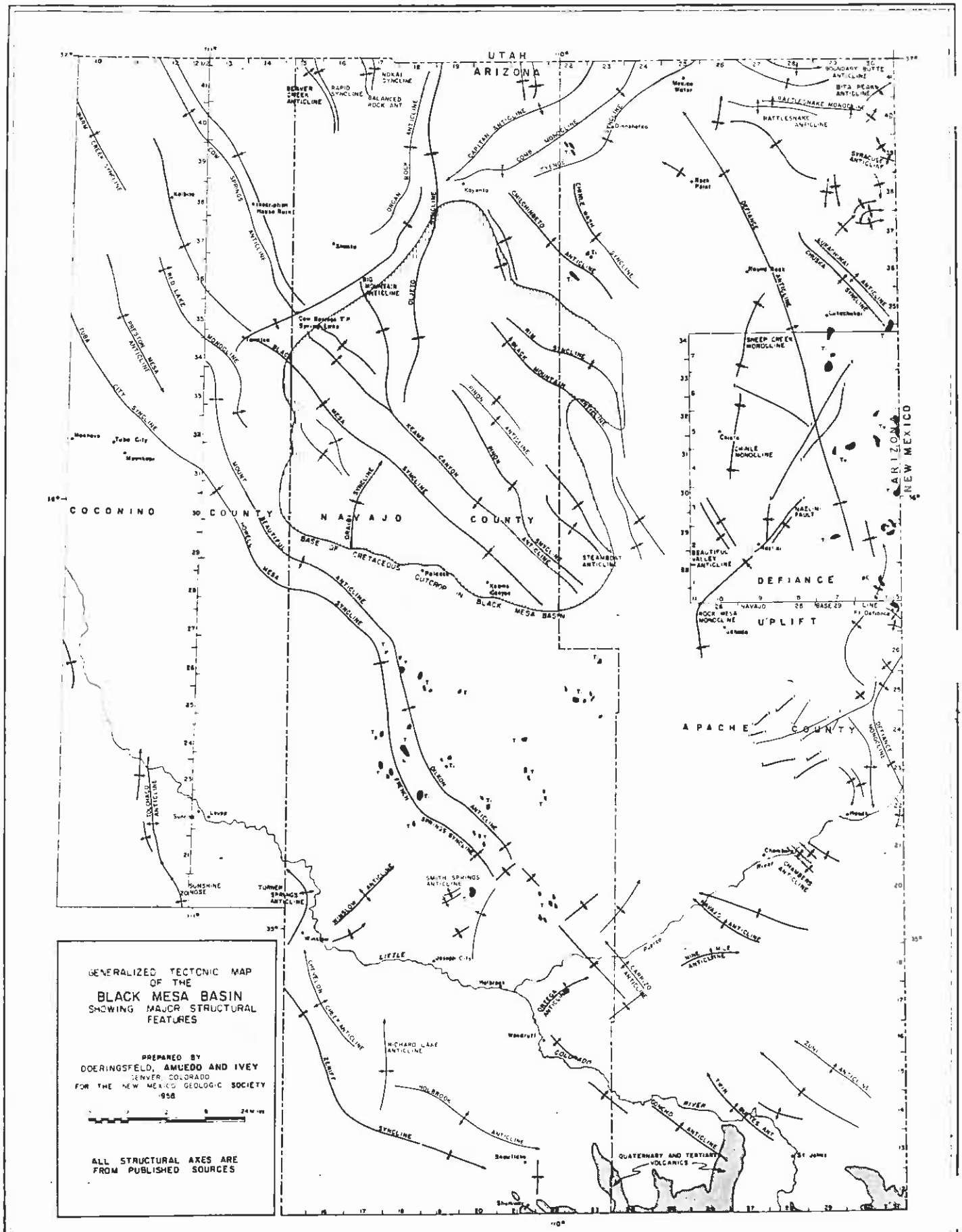

GENERALIZED TECTONIC MAP OF THE
BLACK MESA BASIN
SHOWING MAJOR STRUCTURAL FEATURES
PREPARED BY
DOERINGSFELD, AMUEDO AND IVEY
DENVER, COLORADO
FOR THE NEW MEXICO GEOLOGIC SOCIETY
1958
ALL STRUCTURAL AXES ARE FROM PUBLISHED SOURCES
UTAH
ARIZONA
NEW MEXICO
COCONINO COUNTY
NAVAJO COUNTY
APACHE COUNTY
DEFIANCE UPLIFT
BASE OF CRETACEOUS OUTCROP IN BLACK MESA BASIN
QUATERNARY AND TERTIARY VOLCANICS

FIGURE 1

beds, which lie unconformably atop the Permian-aged formations. Although not exposed in the immediate vicinity of Black Mesa, the Moenkopi Formation crops out in a belt along the western edge of the Navajo Reservation and is exposed throughout the Little Colorado River and Monument Valleys. The Moenkopi Formation has been subdivided into three members by McKee (1954). The upper or Holbrook Member consists of intercalated siltstone and claystone and contains interbedded lenses, nodules and veins of gypsum. The lower member is the Wupatki and is similar to the upper or Holbrook Member, which consists of sandstone with minor siltstone beds. The sandstone is red in color and forms prominent cliffs.

Shinarump Conglomerate. The Shinarump Conglomerate unconformably overlays the Moenkopi Formation in much of the region, except where the Moenkopi does not exist due to Pre-Shinarump erosion. Here the Shinarump unconformably lies atop Permian-aged rocks. The Shinarump Conglomerate is composed of rounded pebbles and gravels, fragments of petrified wood, sandstone, siltstone and claystone and is considered by many geologists to be the basal portion of the Chinle Formation. Although it is not exposed in the immediate vicinity of Black Mesa, extensive outcrops occur in the Little Colorado River Valley, Monument Valley and the western edge of the Defiance Uplift. The Shinarump is irregular in thickness and ranges from 30' to 150' thick.

Chinle Formation. The Shinarump Conglomerate is conformably overlain by the varied and widespread Chinle Formation of upper Triassic Age. Harshbarger (1958) has divided the Chinle into three recognizable members. The lower, or Monitor Butte Member, consists of interbedded siltstone and sandstone. A middle member, the Petrified Forest, is predominantly claystone, but contains some sandstone beds in the eastern portion of the region. The upper member, or Owl Rock, is comprised of alternating beds of silicious limestone and siltstone. The middle member of the Petrified Forest is a dominant badland former, due to the easily eroded nature of the claystone contained therein. While not exposed in the immediate vicinity of the Black Mesa leasehold, the Chinle Formation crops out over a large part of the region, including: the Painted Desert; Chinle Valley; the southern part of Monument Valley; and throughout the Defiance Plateau. The formation is fairly thick and ranges from 600' to 1400' in the vicinity of its type section.

Upper Triassic-Lower Jurassic Formation.

Glen Canyon Group. The Glen Canyon Group of rocks is transitional in age between upper Triassic and Lower Jurassic. The rocks are mainly eolian and fluvial in nature. In the

western, southwestern and southeastern parts of the region, the lower boundary of the Glen Canyon Group is marked by an erosional surface which shows minor relief. In most places this is marked by a thin veneer of conglomerate which is 1 to 3 inches in thickness. In the southern and central part of the area, there is little indication of a break in deposition between Chinle and Glen Canyon time, and the boundary is quite arbitrary. Generally, it is placed at the top of the highest limestone bed or lens in the Owl Creek Member of the Chinle.

The Glen Canyon Group is divided into the following formations, in ascending stratigraphic order, they are: the Wingate Sandstone; the Moenave Formation; the Kayenta Formation; and the Navajo Sandstone.

The Wingate Sandstone is upper Triassic in age and has been recently subdivided into two mapable units. The lower or Rock Point Member consists of reddish orange, parallel and thick-bedded siltstone and sandstone units. This member weathers into flaggy outcrops and is often referred to as "Board-Bedded Wingate". Cross stratification is at a low angle and of a small to medium scale. Although not exposed in the immediate vicinity of the leasehold, the lower member thickens southward from nearly 350' in Kayenta to 700' in the Hopi Butte country, and thins to 195' at Lupton and pinches out eastwardly.

The upper member of the Wingate Sandstone is the Lukachukai Member. It is a massive cliff former and consists of reddish orange, cross-bedded, laminated siltstone and sandstone. The Lukachukai Member pinches out and disappears rapidly south of the Hopi Reservation boundary. In the southern part of the region the Rock Point and Lukachukai members intertongue.

Moenave Formation. The second subdivision of the Glen Canyon Group is the Moenave Formation. It is composed largely of sandstone and is divided into two members. The lower member, the Dinosaur Canyon Sandstone, is composed mainly of orange-red silty sandstone which ranges from 200' to slightly over 300' in thickness. The upper member, the Springdale Sandstone, is reddish-brown and cliff forming and is cross-stratified on a medium scale. The member is 100' to 150' thick through the Echo Cliffs area, but southeastward it grades into the underlying Dinosaur Canyon Member. In the southeastern part of the region, the Moenave is not subdivided.

Kayenta Formation. The type locality for the Kayenta Formation is Kayenta, Arizona. Here

the formation consists of pale reddish-purple, to reddish-brown, fine-grained sandstone and is interbedded with grayish-red mudstone and measures 140' in thickness. This sandstone weathers into an irregular series of ledges between the massive cliffs of the overlying Navajo and underlying Wingate Sandstone. To the southwest, from its type locality, the Kayenta Sandstone grades into intercalated siltstone, mudstone and sandstone beds. Characteristically the silty material weathers into round hills and pinnacles which are capped by resistant rock.

Navajo Sandstone. The uppermost formation of the Glen Canyon Group is the Navajo Sandstone of lower Jurassic age. The sandstone is pinkish-gray and generally cross-stratified on a large scale. It is a massive cliff former and is one of the most widespread formations in the Colorado Plateau, accounting for much of the world famous scenery for which the navajo country is known. The formation exceeds 200 feet in thickness in the northwestern part of the Navajo Reservation but decreases in thickness to the east and is absent along the southeastern part of the Navajo and Hopi Reservations.

Middle and Upper Jurassic.

San Rafael Group. The San Rafael Group overlies the Glen Canyon Group throughout much of the region. The boundary between the two is an erosional unconformity. The amount of relief shown on this surface is usually less than 10 inches, and the basal beds of the San Rafael Group generally consist of reworked Navajo Sandstone or older rock. The San Rafael Group is mainly marine and marginal marine sedimentary rocks. It comprises the following formations, in ascending order: the Carmel Formation; Entrada Sandstone; Todilto Limestone; Summerville Formation; and Bluff Sandstone.

Carmel Formation. The lowest division of the San Rafael Group is the Carmel Formation, of middle to upper Jurassic age. It consists of alternating beds of multi-colored sandstone, siltstone and claystone and contains numerous large mud cracks filled with resistant sandstone. Ripple marks are widespread through the formation. The Carmel is thickest in the northwestern part of the region, where it exceeds 300 feet. It decreases in thickness to the southeast, to become a very thin series of beds along the New Mexico border, and it pinches out in the vicinity of Neutria Springs and Black Rock, New Mexico.

Entrada Sandstone. Overlying the Carmel Formation is the Entrada Sandstone of upper Jurassic age. It is composed of reddish-brown sandstone and minor siltstone. The beds

are cross-stratified and in places parallel-stratified. It is generally a cliff former. The Entrada is only 80 feet thick in southeastern Utah but thickens to an excess of 300 feet at Marsh Pass, Arizona.

Todilto Limestone. Overlying the Entrada, throughout the eastern part of the region, is a thin-bedded, platy limestone known as the Todilto Formation. It is the thinnest of the San Rafael rocks and at its type section, Todilto Park, it measures 14 feet. The beds thin westward and do not occur past the western part of the Defiance Plateau and are not exposed in the immediate vicinity of the Black Mesa leasehold.

Summerville Formation. The Summerville Formation is subdivided into two members. The lowest member consists of flat lying siltstone and claystone and occurs in the northeastern part of the area. These rocks characteristically weather to horizontally ribbed outcrops. The lower silty member grades into an upper sandy member in the south and southwest part of the northeastern portion of the area near Rock Point, Arizona. Southwestwardly the sandy member grades laterally into the Cow Springs Sandstone, which is of upper Jurassic age.

Bluff Sandstone. The uppermost division of the San Rafael Group is the Bluff Sandstone, which crops out in the Four Corners, Monument Valley area. It is in general a tan, cliff forming sandstone varying in thickness from a few feet to about 300 feet. It is easily separated from the underlying Summerville Formation by its overall general thickness. However, where thin, the Bluff is often hard to differentiate from the underlying sandy member of the Summerville Formation.

Upper Jurassic.

Cow Springs Sandstone. Near Cow Springs, Arizona is the type locality for the Cow Springs Sandstone. There the formation is 342 feet thick and is characterized by a large scale cross-stratification. The rock is in general a fine-grained, well-sorted, grayish-white sandstone and is thought to be formed by the coalescing of the sandy members of the Summerville and Bluff Formations, which underly the formation, and the overlying Recapture Shale Member of the Morrison Formation. The lower part is equivalent in age to the Summerville Formation, and the upper part is equivalent to the Bluff Sandstone and Recapture Members of the Morrison Formation.

The other Jurassic rocks in the area are represented by the widespread Morrison Formation which has been subdivided into four members by Craig et al. (1955). The rocks in the Morrison, fluvial and lacustrine in nature, overlie the older Jurassic rocks with no apparent unconformity with the exception of definite lithological differences. The basal Morrison Member is the Saltwash Sandstone, a typical fluvial deposit which was formed by a large fan of braided streams. The Saltwash Member pinches out along an arcuate boundary in the northeastern part of the region. There are two distinct facies which have been recognized: a predominant sandstone and mudstone facies and a fringe of conglomeratic sandstone, which occurs along the western edge of the main facies.

Overlying the Saltwash is the Recapture Shale which consists of intercalated beds of pink and white claystone, siltstone and weakly cemented sandstone. Over a large part of the region, this member forms the lower part of the Morrison Formation. Along the eastern margin of Black Mesa, the Recapture intertongues with the Cow Springs Sandstone. To the northeast, the Recapture Shale intertongues with the Saltwash Member of the Morrison Formation. The Recapture Shale reaches a maximum thickness of 680 feet near Rough Rock, but thins rapidly northward and pinches out completely to the south near Gallup, New Mexico.

Overlying the Recapture Shale is the Westwater Canyon Member of the Morrison. It consists of yellowish-gray, conglomeratic sandstone with variable percentages of claystone. It reaches its maximum thickness north of Fort Defiance, in excess of 300 feet, and pinches rapidly to the south along a northwestern trending arcuate boundary. This member thins gradually northward and is approximately 200 feet thick in the Four Corners area.

The uppermost member of the Morrison is the Brushy Basin Shale. It is composed largely of variegated claystone with varying amounts of silt and sand. Lenses of conglomeratic sandstone are common. This member is present only in the Four Corners area and pinches to the south and west where it has been removed by pre-Cretaceous erosion.

Cretaceous. An erosional unconformity occurs at the base of the Dakota Sandstone, between the Jurassic and Cretaceous age rocks, and truncates progressively older rocks in a southwest direction. The Dakota Sandstone overlies the Burro Canyon Sandstone in the northern part of the area. To the south, it rests upon rocks of the Morrison Formation. These relationships establish the angularity of the pre-Dakota unconformity, although it

is slight and at any given location is difficult to measure.

Burrow Canyon Sandstone. In the Four Corners area, a thin series of interstratified conglomeratic sandstone and variegated claystone overlie the Morrison Formation and underlie the Dakota Sandstone. Although not exposed in the immediate vicinity of the leasehold, these lower Cretaceous rocks have been recognized as a separate formation, the Burro Canyon Sandstone.

Dakota Sandstone. The Dakota Sandstone is exposed at the base of the cliffs along the northern edge of Black Mesa. The Dakota Sandstone is composed principally of medium to coarse-grained sand with a few conglomeratic lenses. It crops out along the margins of Black Mesa and along the eastern edge of the Defiance Plateau. In the immediate vicinity of Black Mesa, the Dakota has formed extensive box canyons along the southern and middle portions of the Mesa.

Mancos Shale. The Mancos Shale, which conformably overlies the Dakota Sandstone, consists of brown to black siltstone and claystone with occasional thin streaks of sandstone. Gypsum veins occur randomly distributed throughout the shale. The Mancos Shale totals from 500' to 1000' in thickness and crops out around the margins and within Black Mesa, as well as along the eastern edge of the Defiance Plateau.

Mesaverde Group. The Mersaverde Group lies conformably atop and interfingers with the Mancos Shale. Rocks of this group consist of sandstone, siltstone, claystone and coal. The Mesaverde is prominent at the rim rock of Black Mesa and comprises the youngest Cretaceous-aged rocks in the area. This group has been subdivided by Repenning and Page (1956) into three separate formations. In ascending stratigraphic order, they are: the Toreva and Wepo Formations; and the Yale Point Sandstone. The Wepo Formation contains the coal which is currently being mined by Peabody Coal Company. The geology of these rocks is further described in the section on the stratigraphy of the coal bearing rocks.

Tertiary Formation.

Bidahochi Formation. Although not occurring in the immediate vicinity of the leasehold, Tertiary rocks unconformably overlie the Cretaceous rocks in some parts of the region. The most widespread and important of this group is the Bidahochi Formation of Pliocene age which occurs in the southeastern part of the Navajo Reservation. This formation exceeds a

thickness of 1000' and has been subdivided into three units by Repenning and Irwin (1954). The three units are a lower clay member, a medial volcanic member and an upper sand member.

Volcanic. Tertiary volcanics of Pliocene age are widespread through the Hopi Buttes as lava flows, dikes and other volcanic deposits.

Quaternary Deposits. Two types of Quaternary-aged rocks occur in the area. The first, alluvial deposits, consisting mostly of fine-grained, unconsolidated sand with minor amounts of gravel, silt and clay, underlie most of the drainages. Although usually thin, these deposits may reach a total thickness in excess of 200' near the Little Colorado River. The second type of Quaternary deposits which occur in the area is dune sand, which results from transport of unconsolidated material by wind. In the vicinity of the Black Mesa leasehold both types of Quaternary deposits are found. The alluvial deposits are extremely thin and the eolian, or dune deposits, although widespread, are also thin and discontinuous in nature.

Stratigraphy of the Coal-Bearing Rocks

Introduction. In 1956, Repenning and Page subdivided the Mesaverde Group into three separate formations. These are, in ascending stratigraphic order: the Toreva Formation; the Wepo Formation; and the Yale Point Sandstone. The group lies conformably atop and interfingers with the Mancos Shale. The Mesaverde Group are the youngest Cretaceous-aged rocks exposed in the vicinity of Black Mesa. As noted earlier, the sandstone units in the Mesaverde are prominent cliff formers and are well exposed along the northern escarpment of Black Mesa where they, with the underlying Mancos Shale and Dakota Sandstone, form a cliff which exceeds 1200 feet in height.

Toreva Formation. The type locality for the Toreva Formation is 1.3 miles north of the Hopi village of Toreva, Arizona, situated in the southern part of Black Mesa. Repenning and Page (1956) subdivided the Toreva into three members. These members are, in descending stratigraphic order: (1) the upper sandstone member; (2) the middle carbonaceous shale member; and (3) the lower sandstone member.

Lower Sandstone Member of the Toreva Formation. At its type locality, and throughout the southern part of Black Mesa, the lower sandstone member of the Toreva is composed largely

of light brown to pale yellowish gray, fine to medium-grained quartz sandstone. In the lower part of this member, where it is transitional with the underlying Mancos Shale, it contains several units of thin-bedded siltstone and fine-grained mudstone. The upper part of the member contains no mudstone units. The lower sandstone member of the Toreva forms a vertical blocky cliff. Near Rough Rock, Arizona this cliff is approximately 144 feet high.

Middle Carbonaceous Member of the Toreva Formation. The middle carbonaceous shale member of the Toreva is in gradational contact with the underlying lower sandstone member. The contact is placed at the base of the first non-sandstone unit. Having an extremely varied lithology across the southern part of Black Mesa, the middle carbonaceous shale member consists of alternating thinly-bedded carbonaceous mudstone, varicolored siltstone units with thinly-bedded coal and thick lenses of poorly-sorted fine to coarse-grained quartz sandstone. Page and Repenning (1958, Page 119) state that:

> "In some places, as in Keams Canyon, the units consists almost entirely of sandstone with shale and coal in the lower part only. In other places this member contains very few sandstone units, especially in the southeastern part of the area where the unit coalesces with the Mancos Shale because of the eastward pinch out of the underlying lower sandstone member".

The relationship of all the formations of the Mesaverde Group and the Mancos Shale are complicated by intertonguing relationships which, while having no regional significance, are extremely important to understanding the nature of the coal-bearing rocks. Page and Repenning (1958) have postulated the presence of a large embayment in the vicinity of Black Mesa during upper Mancos - Mesaverde time. They stated (Pages 117-118):

> "This bay was bounded on the off shore side at the northeast by a large peninsula of sand which became the northern phase of the lower sandstone member of the Toreva Formation. As a result of the presence of this bay, and its confining peninsula, a prominent tongue of the Mancos Shale extends from the southeast into the basal part of the Toreva Formation. Because of its distinctly lagoonal and paludal nature, this tongue is not considered a part of the Mancos Shale but is referred to as the middle carbonaceous member of the Toreva Formation".

Figure 5 illustrates the complicated nature of the intertonguing observed and described by Reppenning and Page (1956). At Rough Rock, the middle carbonaceous shale member is 78 feet thick.

Upper Sandstone Member of the Toreva Formation. Consisting of poorly-sorted fine to

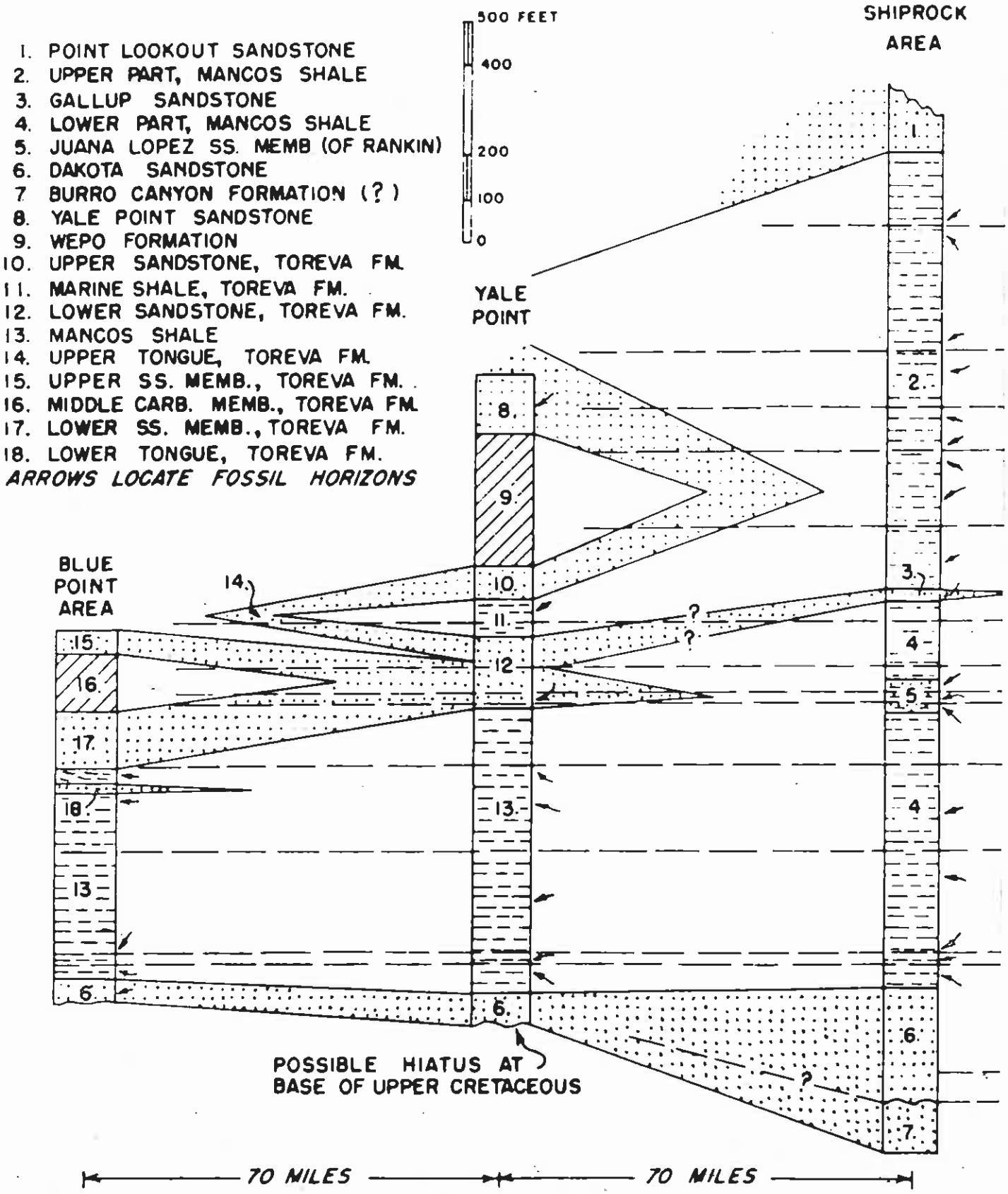


FIGURE 5

Time-lithologic correlation chart, Black Mesa to San Juan Basin. Shiprock column adapted from Reeside (1924) and Pike (1947).

coarse-grained, yellowish-gray to grayish orange-pink sandstone, the upper sandstone member of the Toreva Formation also contains a large amount of altered feldspathic sandstone, especially in upper parts of this member. The presence of the feldspar gives a whitish appearance to the sandstone and it has been used as a marker horizon by Peabody Coal Company in drilling projects at its leasehold. Characteristically, the upper sands tend to break along perpendicular joints forming blocks approximately 1 to 10 meters square called "Toreva" weathering. This characteristic is extremely useful in field mapping.

Since the middle carbonaceous shale member pinches out to the northeast, in the northeastern part of Black Mesa the Toreva has not been subdivided. However, in the upper part of the formation an additional unit of coal, carbonaceous shale and sandstone is capped by a ledge of fine to medium-grained arkosic sandstone.

The upper sandstone also exhibits intertonguing in the northeastern part of Black Mesa. Here another tongue of marine shale indicates a marine transgression of the Mancos Shale. However, because the marine shale is overlain by a sandstone which coalesces with the underlying sandstone, this shale unit is considered part of the Toreva Formation by Page and Repenning (1958). At Rough Rock the upper sandstone member of the Toreva Formation is 56 feet thick.

Wepo Formation. Named for its type section, in Wepo Wash 7 miles northeast of Pinon, the Wepo Formation consists of a complex sequence of intercalated continental sandstone, shale, siltstone and coal units intertongued with marine sandstone and shale units. At its type section, the Wepo is 656 feet thick. In general, it is a slope and ledge former and is most clearly identified in the field by the abundance of low, rounded, bright red hills of baked shale or "clinker" associated with naturally burned coal.

The Wepo Formation comprises a thick series of intercalated siltstone, mudstone, sandstone and coal beds. The siltstone and mudstone units range in color from dark olive gray, through light olive brown, to medium light gray. Frequently, these units are highly carbonaceous and may contain sandstone lenses and zones. Sandstone units are commonly yellowish gray at the outcrop and are frequently extremely argillaceous. Some of the sandstone units are very well cemented and may form cliffs in excess of 40 feet high.

Coal occurs in seven fairly consistent horizons (Figure 6). These horizons in descending

order are: (1) violet; (2) green; (3) blue; (4) red; (5) yellow; (6) brown; and (7) orange.

These horizons are frequently split into coal benches by extraneous siltstone, claystone and sandstone partings. These benches frequently maintain a consistent thickness over extended distances. Most commonly, the minable coal varies from 3 to 8 feet in thickness. However, the beds infrequently coalesce to form beds which exceed 20 feet in thickness.

The coal is somewhat variable in quality and is known to contain thin partings of volcanically-derived ash, as well as partings of fluvially derived material. Generally, the coal contains only modest amounts of vitrain or woody material, an abundance of durain and fusain and modest amounts of clarain indicating that most of the carbonaceous material was derived from sedges and grasses rather than decomposed swampy forests. Fossil resin is frequently found with the coal.

The Wepo Formation thins northeast across Black Mesa as a result of intertonguing with the underlying Toreva and the overlying Yale Point Sandstone. Near Rough Rock the Wepo is 318 feet thick, however it thickens westward. Near Cow Springs, it is measured at 743 feet thick. In the immediate vicinity of the Black Mesa leasehold, it approaches 600 feet in thickness.

Yale Point Sandstone Formation. The uppermost formation of the Mesaverde Group is the Yale Point Sandstone. While the lateral extent of this formation is limited by erosion and intertonguing, the Yale Point Sandstone is a striking cliff-former, and at its type section and along the northern escarpment of Black Mesa for a distance of 40 miles, it forms a cliff 200 feet high.

At its type section, the Yale Point is a yellowish-gray to grayish-orange, medium to coarse-grained, well-sorted quartz sandstone. The individual beds tend to be discontinuous and lense-shaped in cross section. The formation intertongues with the underlying Wepo Formation and thins to the south, becoming progressively finer-grained. The Yale Point reaches a maximum thickness of slightly more than 300 feet at Marsh Pass and thins to 50 feet at Wepo Wash.

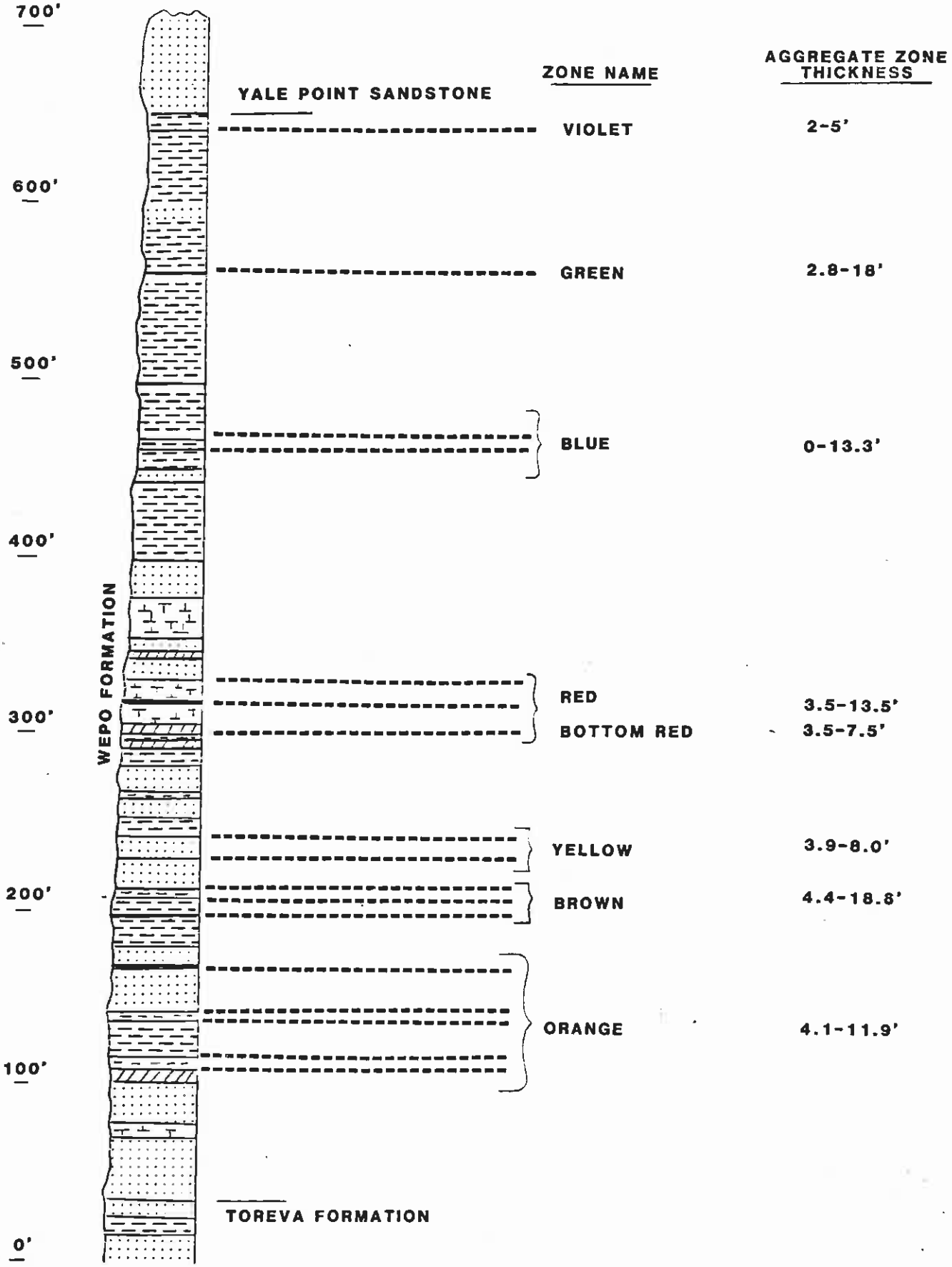


FIGURE 6
IDEALIZED STRATIGRAPHIC SECTION OF THE WEPO FORMATION
BLACK MESA, ARIZONA

Formation of Coal During the Cretaceous Period

In the Cretaceous Period, coal is a common lithology, although it represents a small percent of the overall stratigraphic sequence. Coal is a very sensitive indicator of local and regional tectonic occurrences, with its very presence, thickness, quality and geographic extent a function of many variables.

Coal develops when massess of vegetable matter accumulates in oxygen restricted conditions with the generation of humic acids which aid in reducing the matter to peat. Subsequent burial of the peat results in its diagenesis into coal. For the accumulation and preservation of western coals, of economical interest, during the Cretaceous Period, a number of geological and environmental constraints had to be satisfied. The original organic material must accumulate in a dominantly fresh, clear water environment. If the waters in the paludal system carried a high percent of suspended clays, the resulting deposit would consist of carbonaceous shale or thin coals of very poor quality.

The second major constraint is that the peat forming material must consist of primarily land-derived organics. There has been no evidence presented to substantiate any significant contribution to western coals from marine or brackish water organics (Wiemer 1976).

During the early Cretaceous Period, a sub-tropical to tropical climate developed and persisted through the close of the Eocene. This situation was favorable for the prolific accumulation of organic material in the swamps and marshes, and lead to their eventual diagenesis into coals of economical thickness. As reported by Coleman et al. (1970), an overall accumulation rate of 0.33 feet per century was observed in a present day fresh water swamp environment. It is reasonable to assume similar rates of peat accumulation occurred during the Cretaceous Period.

The relationship of the depositional interface and the ground water table is critical for the preservation of the organic material. With the lowering of the groundwater table, during dry periods, in relation to the depositional interface, the organic material may become exposed and oxidized, with little or no peat accumulation taking place. If the ground water table becomes too high in relation to the depositional interface, a bay or lake is formed, thus restricting the formation of suitable organic material (Figures 9 and 10).

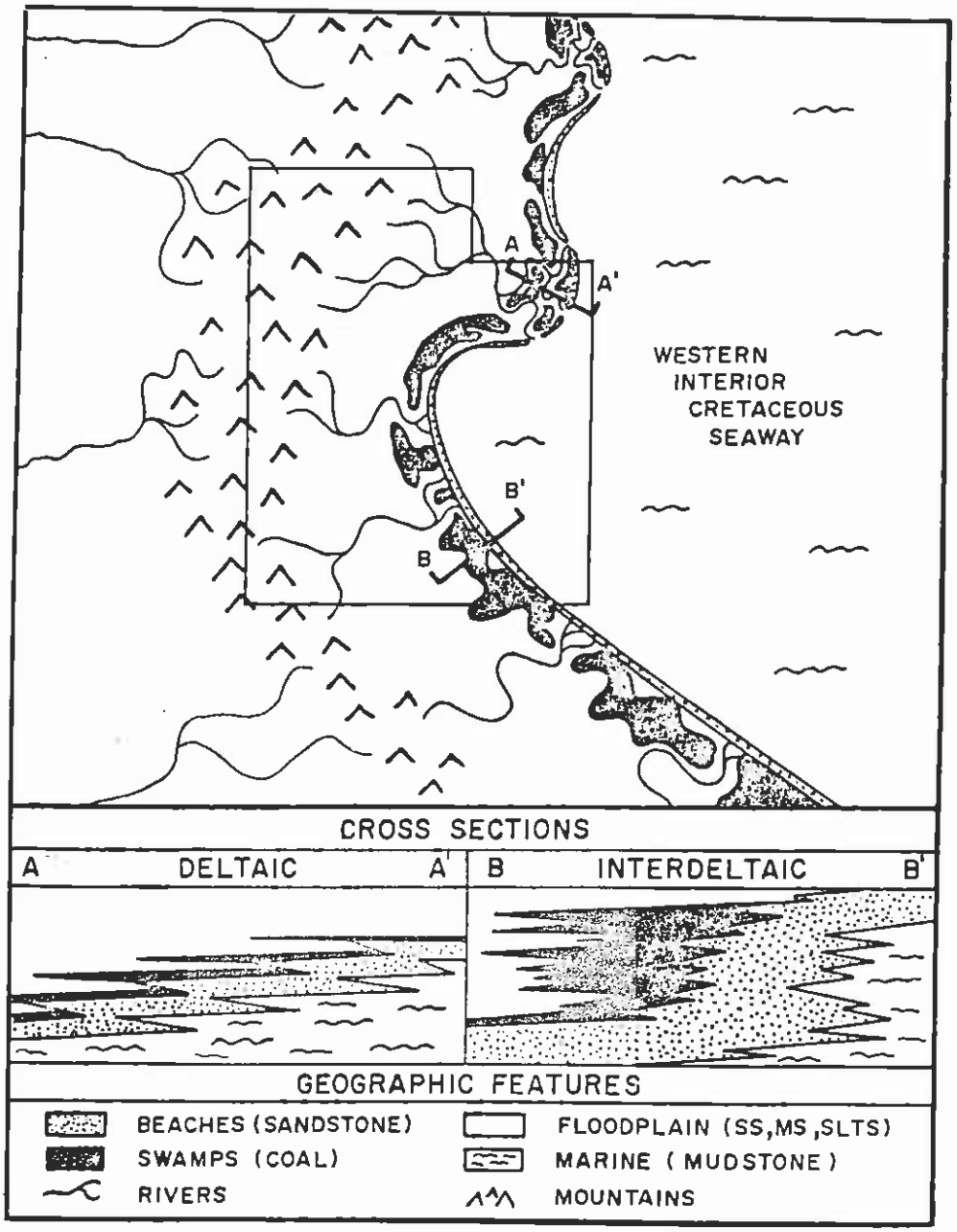


FIGURE 7

Regional diagrammatic reconstruction of the major depositional environments in which Cretaceous coalbearing sediments accumulated

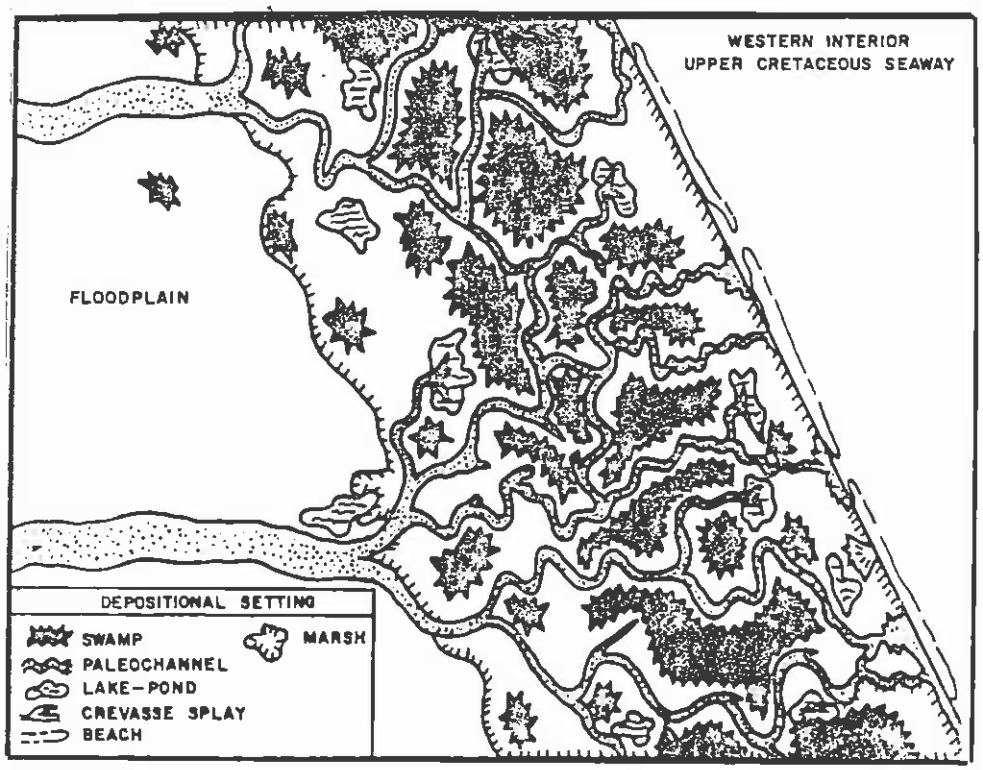


FIGURE 8

Idealized reconstruction of an interdeltaic-strandplain depositional setting

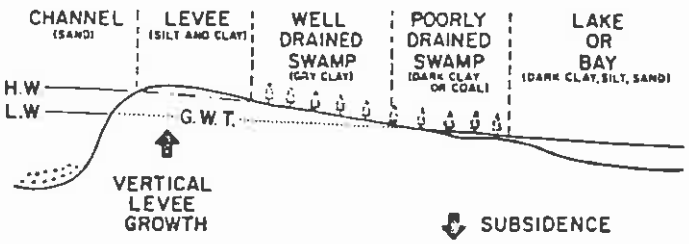


FIGURE 9

Environments of Deposition and Processes
Occurring in Channel, Channel-Margin Areas (after Weimer, 1973)

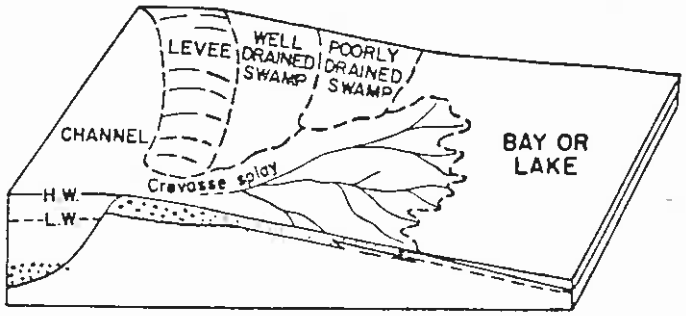


FIGURE 10

Relationship of Crevasse Splay to Other Channel
Margin Environments (after Weimer, 1973)

Possibly the most overlooked constraint is that the persistence of the above mentioned conditions, in time and space, is essential for the development of thick coal sequences. The tectonic processes occurring along the Western Interior greatly impacted the transgressive-regressive cycles of the Cretaceous seaway. The concept of transgression (the gradual advancement of a shallow sea over land) and regression (the gradual contraction of a shallow sea exposing land) is important because each depositional environment deposits a specific series of rocks which are unique to that environment. For the accumulation and preservation of thick coal sequences, a delicate balance between the rates of peat accumulation, basinal subsidence, and sedimentation is essential.

The major coal deposits of the Western Interior Cretaceous Period were formed in deltaic to interdeltaic systems associated with the major regressive phases of the Western Interior seaway (Figure 7 and 8). Most of the coals were formed in-place (autochthonous) as evidenced by the underlying root zones, while the transported coals (allochthonous) formed from compaction of organic material, and were subsequently carried by water to another depositional site. These allochthonous coals do not exhibit an underlying root zone, and are generally thin with a limited lateral distribution.

The autochthonous coals formed largely in three depositional environments. Probably the most important environment of deposition of western coals are the back-levee and/or flood basin swamps that formed marginally to a leveed channel within the deltaic to interdeltaic systems (Figure 11 and 12). The major depositional processes operating within this environment are active distributory channels, vertical levee growth, and the formation of poorly-drained and well-drained swamps marginal to the leveed channel and extending into the flood basin area. Breeches in the levee (crevasse splays) and overbank flooding events resulted in the introduction of fine-grained sediments into the swamp environment, eventually forming the inter and intra coal seam partings. The back-levee and flood basin environments are believed responsible for the geographically widespread coal occurrences within the Cretaceous and Lower Tertiary Periods.

A common, though sinuous to arcuate, depositional environment for western coals is the channel-fill swamp. The environment develops with the abandonment of distributary channels, and the formation of oxbow lakes (Figure 11 and 12). As a last stage of the channel-fill process, when the water depths become shallow, swamp vegetation may become established, with the eventual accumulation of peat. This stratigraphic sequence can often be recognized by the vertical stacking of active channel fill sand, fine-grained

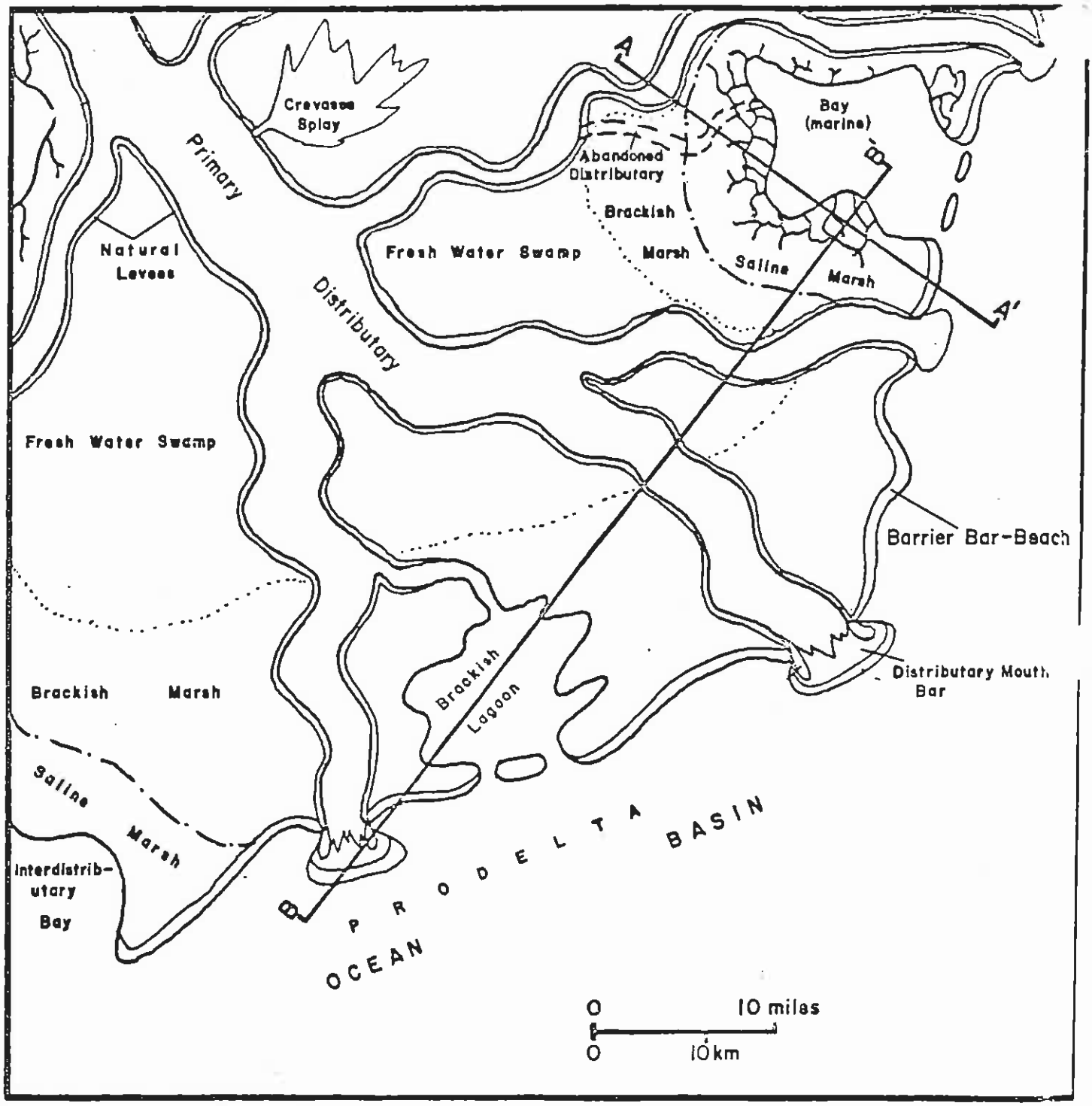
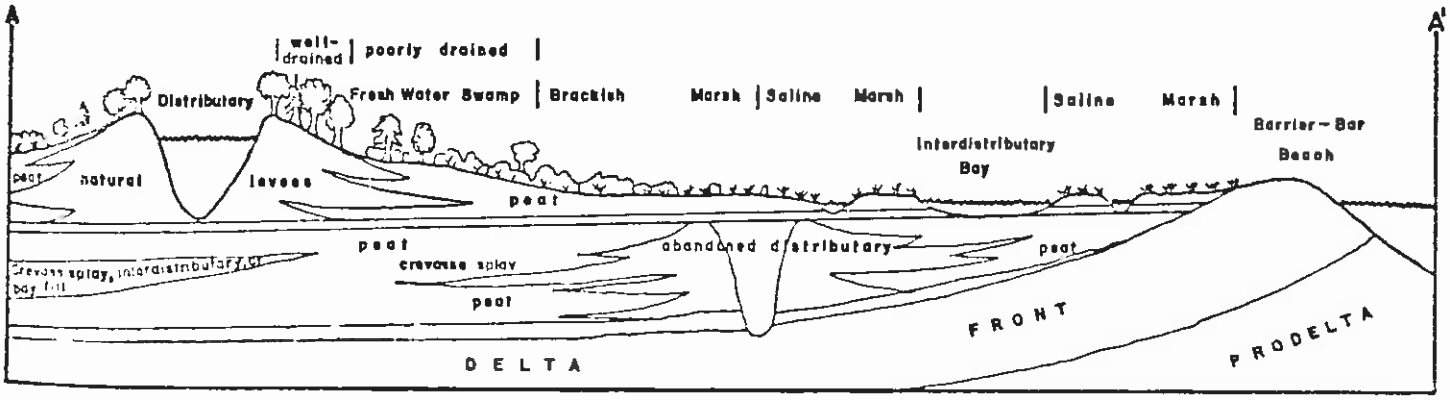


FIGURE 11
Plan View of Idealized Deltaic Depositional Framework. Width of channels, levees, etc. are exaggerated for clarity. Scale is somewhat arbitrary.
Cross Sections A-A' and B-B' are shown on Figure 12.
(Modified from Collins, 1976)



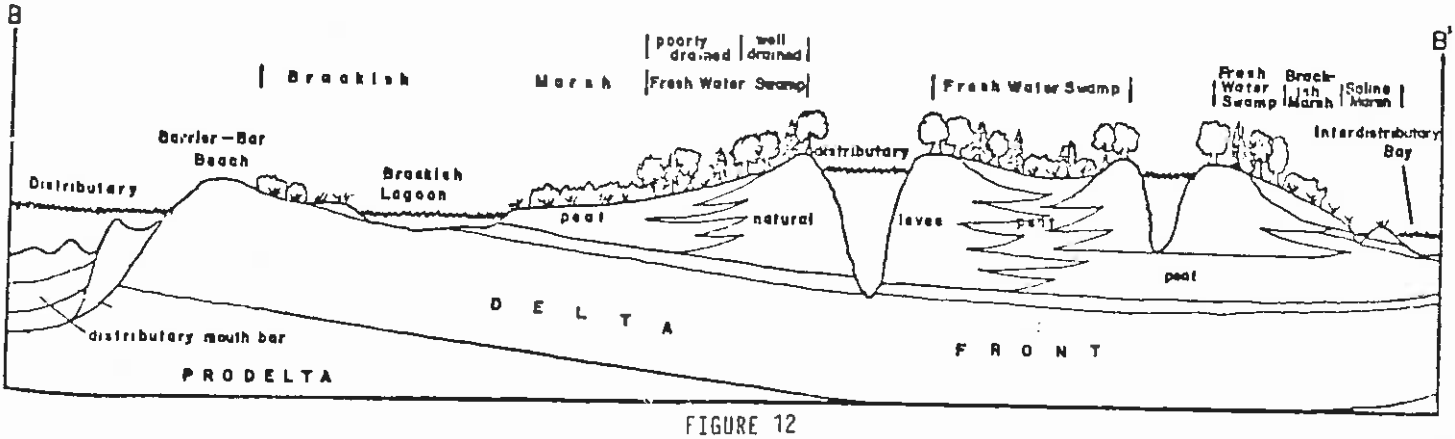


FIGURE 12

Cross Sections of Idealized Deltaic Depositional framework. Vertical and horizontal scales are arbitrary and exaggerated for clarity. See figure 11 for lines on section. (Modified from Collins, 1976)

abandonment channel fill and overlying thin coal.

The last major depositional environment of Cretaceous western coals is coastal swamps and marshes associated with lagoonal environments (Figure 11 and 12). In lagoonal environments, the peat was deposited on the delta plain portion of the lagoon, and is related to processes similar to those encountered in the back-levee, flood basin regime. Coals formed in this environment are erratic in distribution and thickness, and may frequently intertongue with continental and marine sediments. These coals also tend to possess elevated amounts of clay and sulfur minerals resulting from frequent administures of saline water during storm wash-over events.

Regardless of the type of deposition, the organic material must accumulate in an oxygen restricted environment with a pH of 4.5 or less. This restricts the presence of aerobic micro-organisms which would break down the organic material and inhibit the accumulation of peat. Subsequent burial of the organic matter elevates the pressure and temperature to which the material is subjected. As pressures and temperatures increase, water as well as other volatile constituents are driven off, thus compacting the peat to coal on an average ratio of 10:1. This ratio may vary depending on the type of original organic material involved.

The environment of deposition, original composition of organic material, depth of burial and proximity to structural deformation and/or igneous activities, ultimately determines the chemical and physical characteristics of a given coal. Coal is a very complex, organic mineral composed primarily of the macerals vitrinite (woody and cortical tissues), exinite (algal remains, resins, spores, waxy cuticles), and inertinite (decayed plant remains, charcoal), with associated primary and secondary minerals and trace elements. While the primary minerals associated with coals may have been inherent in the original organic material, or precipitated by bacterial action during the peat forming process, the minerals of secondary origin and many of the trace elements were introduced after the diagenesis of the organic material. Downward migration of water through fracture systems derived from the processes of differential compaction or structural deformation, in 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

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 that 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 that may be time-related as well as having a common environment of deposition.

J-19, J-21, J-23 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-23 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 "[illegible]rial. Local occurrences of burnt coal and clinker material are

also found within the interior of the area. These occurrences are limited in their vertical and lateral extent but do serve to hinder the minability of a given coal horizon as well as alter the natural stratigraphic sequence which, in turn, may affect the topography due to the more resistant nature of the clinker material. In general, the area is characterized by rolling topography slightly dissected along its margins by minor tributaries of the above-mentioned washes.

At the northern and western margins of the area, a series of roughly parallel trending anticlines and synclines have developed. These folds are oriented in a northwest-southeast direction, and exhibit limited axial length. The remaining portions of the area exhibit less structural deformation, with only minor folding developed. Anticlines and synclines in the central portion are oriented in an east-west direction, while the folds in the southern portion exhibit a northeast-southwest orientation. Most folds throughout the area are inconspicuous in the field and seldom have dips that exceed 3°. Though the folds exhibit relatively minor dips, they do, however, influence local surface and ground water flows. A number of apparent, high angle faults with displacements ranging from a few feet to 30 to 40 feet have been identified while small north-south linearities, interpreted as faults have been photo-mapped west of the area. Except for a small remnant of resistant Yale Point Sandstone in the northeastern corner of the area, the Wepo Formation is the only exposed sequence. Within the Peabody Western Coal Company leasehold, the Wepo Formation consists of continental and near-shore sediments that includes seven recognizable and correlatable coal horizons. Each horizon may consist of one or more coal benches or sub-benches. Within the area, these coal horizons vary in thickness, quality and lateral extent. The minability of each horizon is dependent upon the topographic relief and the thickness and quality of the coal, which in turn is largely dependent on the geologic structure, susceptibility to erosion of the overlying strata, and environment of deposition of each coal horizon.

All seven coal horizons occur in the area; however, locally they may not all be present in minable thickness, occur at minable depths, or some horizons may be totally absent due to erosion or nondeposition. In descending order, the coal horizons are designated as: (1) violet; (2) green; (3) blue; (4) red; (5) yellow; (6) brown; and (7) orange. The violet is the uppermost coal horizon and, due to its stratigraphic position, it is the first horizon to be removed by erosional forces. For this reason, the violet is present in a limited portion of the northeast corner of the area. The violet is overlain by a series of continental sediments including paludal and overbank shales and siltstone as well as by

short distances. Underlying the green horizon is a think sequence of paludal shales and siltstone, with minor occurrences of overbank sediments. The next coal horizon is the blue, which in the northern portion of the area consists of two consistent coal beds that converge in the central and southern reaches of the area. Separating the blue horizon from the underlying red is a variable thickness of paludal to overbank shales and siltstones. This strata is locally displaced by a thick sequence of distributary channel sandstone and channel fill siltstone. The distributary channels of the area are variable in width and thickness and are dependent upon relative intensities of deltaic and interdeltaic building parameters. Locally, these channels displace coal horizons by either the removal of the paludal sediments or by inhibiting their deposition. The red horizon contains the most consistent minable coal seams within the area. A think sequence of interbedded shale and siltstone of paludal deposition separates the red from the underlying bottom red coal bench. The coals of this bench are greatly variable in thickness and quality in this area. This may be due, in part, by the localized deposition of lagoonal and distributary channel sediments immediately beneath the bottom red bench. The bottom red coals obtain a minable thickness and stratigraphic position in the central and southern portions of the area. The underlying coals of the yellow horizon are similar in occurrence to the coals of the bottom red. Although relatively thicker than the bottom red coals, the yellow coal seams also diverge and converge throughout the area, and reach minable thickness and depth of overburden in the central and southern portions of the area. A variable thickness of overbank and paludal shales and siltstone separate the yellow horizon from the underlying brown. This horizon is present throughout all but the extreme northern portion of the area where all but the orange horizon have been removed by erosional forces. The brown horizon is projected to be mined in the central and southern portions of the area. A complex sequence of interbedded shale, siltstone and sandstone of overbank origin, fluvial sandstone, paludal shale and possible localized lagoonal sediments separate the brown from the lower most coal horizon, the orange. The coal seams of the orange horizon show a great deal of variability throughout the entire leasehold. Not only do the individual coal seams vary in thickness and quality, they exhibit a great diversity in converging and diverging within the horizon. Due to the orange horizon's stratigraphic position, it is projected to be mined in those portions of the area where 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.

J-7 Area. The J-7 area is located near the southern portion of the leasehold and has been

actively mined since 1975. In general, the topography of the mineable area is gently rolling with minor declivities dissecting the margins of the area created by minor tributaries of Red Peak and Yucca Flat Washes. These two washes comprise the boundaries of the area on three sides, the fourth side results from coal being exposed by folding. The coal has burned extensively at its outcrop forming characteristic bright red "clinker"- capped knobs.

The coal-bearing strata gently dips to the west. The Oljeto Syncline occurs along the western margin of the mineable area. This syncline is in turn paralleled by a small anticline which occurs on the eastern edge of Yucca Flat Wash. No faults have been mapped in the area; however, small north - south linearities, interpreted as small faults, have been photo-mapped north and east of the area. These may extend into the area, but are believed to have little, if any, significant displacement.

Four mineable coal horizons occur in the area. They are, in descending order: 1) violet; 2) green; 3) blue; and 4) red.* The green is immediately underlain by a complex series of sandstone and siltstone strata which are probably representative of stream channel deposits. Immediately underlying this sandstone complex is the blue coal horizon. These beds converge and diverge throughout the J-7 subarea. Immediately underlying the blue is a sequence of sandstone and siltstone representative of a broad-based meandering drainage system. This sequence is immediately underlain by a complex of marine siltstone and shale which contains fossils of linguloid brachiopods and cicad plants. These rocks of marine or near marine origin, immediately overlays the red coal horizon. The red seams are highly complex, diverging and converging very rapidly over short distances, and are indicative of influxes of extraneous material both waterborne and windblown. Immediately underlying the red series is a sequence of intercalated sandstone and siltstone beds. Because of the lenticular nature of the more permeable and porous sandstone strata in the subarea, it is doubtful that the interconnected aquifer within the subarea is of any significance as far as water yielding potential.

J-1/N-6 Area. The J-1/N-6 area straddles the Joint Use Boundary. It is bounded on the east, west and north by Coal Mine Wash and three of its major tributaries. The southeastern boundary of the area is delineated by a tributary of Moenkopi Wash. In general, the area is characterized by gently rolling topography slightly dissected along its margins by minor tributaries of the above-mentioned washes. Mining began in this area in 1973.

*These represent the Peabody correlations used throughout this mine plan for J-7. To relate these correlations to the geologic coreelations used in the other mining areas, refer to Table J-7, Page 2A, Appendix B, Volume 12.

At the western and northern margins of the area, modest folds have developed. The Oljeto Syncline extends north to south through the western third of the area. Immediately adjacent to this syncline there is a small anticline, whose axis is oriented in a northwest -southeast direction. In the northern part of the area, a syncline, with its axis oriented approximately perpendicular to the Oljeto Syncline, occurs. North of this syncline, another small parallel anticline is found. The strata gently dips toward the axis of the Oljeto Syncline, although locally, changes in dip caused by differential compaction of the finer grained sediments may occur.

This area is similar to the strata encountered in J-7. Several large sandstone units separate the mineable coal horizons. In descending order, these coal horizons are: (1) the green; (2) the blue; (3) the red; and (4) the yellow sequences. In addition to the above mentioned coal horizons, there exists a thin coal bed, the violet, which extends through a part of the area. The violet is separated from the green by a thick sequence of intercalated sandstone and shale. Immediately underlying the sandstone is the green horizon, which in the northeastern part of the area, lies immediately over the blue and in the southwestern part of the area is separated from the blue by very thick sequences of sandstone. Immediately underlying the blue in the northeastern and eastern part of the subarea is a thin sequence of marine shale similar to that encountered in the J-7 subarea. Immediately underlying this marine shale is the red horizon which maintains a fair proximity to the blue throughout the southern and eastern parts of the area. In the extreme northeastern part of the area is a series of thin coal beds in the yellow horizon.

J-16 Area. The J-16 area is truncated on three sides by the Moenkopi Wash and its tributaries. The eastern side is bounded by the J-28 area. Along Reed Valley, in the southern part of the area, the uppermost coal beds have burned along their crops, thus forming a sequence of baked shale and sandstone. The resulting "clinker" material, being more resistant to weathering than the surrounding rock types, formed numerous flat-topped buttes. In the northern part of the area, a small syncline runs parallel to the Moenkopi Wash. In the remaining part of J-16, no faults have been photo-mapped, and the dips are generally less than 3°. The interior of this area is predominantly gently rolling hills with minor tributaries of Moenkopi Wash dissecting the margins.

The coal horizons of this area differ from those of N-14 in that the upper horizons, the red and yellow, developed in an environment of deposition favorable to the accumulation of sufficient thickness of peat, which in turn, developed into mineable thicknesses of coal.

The lower coal horizons, the brown and orange, are also present in mineable thickness. The red zone is overlain by sequences of sandstone and shale. Separating the red and yellow horizons is a series of intercalated sandstone, shale and siltstone. Localized lenses of very dense concretions, are found in this sequence. Underlying the yellow is a sequence of predominately shale and siltstone, with minor occurrences of channel sands present. The coal beds of the brown and orange horizons converge and diverge throughout the area. In parts of the area, a thick sequence of channel sandstone laterally replaced the upper coal beds of the orange. The orange is the lowermost coal horizon in the Wepo Formation. Some thin, lenticular coal beds occur in the Toreva Formation and range from 70 - 90 feet below the orange horizon.

N-14 Area. N-14 is the most northeast mineable area in the leasehold. It consists of three contiguous but not continuous areas which are capped by Yale Point Sandstone in the north, and burned coal of the red and yellow sequences to the south. The area is steeply incised by tributaries of Moenkopi Wash which, due to erosion, have separated N-14 into three separate mineable blocks.

These three blocks are the least structurally disturbed of the northern mineable subareas. An anticline extends in a northeast - southwest direction, along the northern margin of the central block. South of the central block, roughly paralleling this anticline, is a Syncline. The western block, is folded by a series of small anticlines and synclines oriented in a northeast - southwest direction.

Mineable coal in the N-14 area occurs in the brown and orange horizons. Overlying the brown are sequences of marine shale, intercalated siltstone, mudstone and shale and a dirty sandstone unit, which is consistent throughout the area. Due to depositional influences, the upper coal horizons are either thin and discontinuous or non-existent. Immediately underlying the brown is a sequence of siltstone and shale. Directly above the first coal bed in the orange horizon is a sheet sandstone, traceable throughout the entire lease area. The orange horizon is a series of mineable coal beds separated one from another by thin beds of sandstone, shale and siltstone. In this area, the orange sequence is the lowermost coal horizon in the Wepo Formation.

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 dips seldom exceeding 3°. 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 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 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. The coals of the brown horizon have converged, exhibiting vertical and lateral continuity over most of the area. The orange horizon is comprised of three major coal benches of mineable thickness. Each coal bench shows a great deal of variability in thickness, converging and diverging throughout the area. The overburden, innerburden material 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 and west 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.

Overburden Sampling Procedures

An understanding of overburden drilling methods is essential in developing a sampling program that identifies, and thereby minimizes the possible detrimental effects that these methods may have on the chemical integrity of the individual sample.

Drilling Equipment. Peabody's overburden sampling program utilizes portable, truck-mounted rotary drill rigs equipped with air compressors, rock bits for rotary chip drilling, and diamond core equipment for rotary continuous coring.

N-9 Coal Reserve Area. This most northern coal reserve 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 individual coal reserve 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 reserve. 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 reserve 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 coal reserve 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-12 Coal Reserve Area. Stratigraphically and structurally similar, the N-12 coal reserve area is considered an extension of the N99 reserve to the southeast and the N-11 reserve to the east. The N-12, N-99, and N-11 reserve areas are all one contiguous coal reserve. The N-12 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-12 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-99 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-12 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-99 Coal Reserve Area. The N-99 coal reserve is bisected, into roughly equal areas, by the present alignment of Peabody's overland coal conveyor. If the Kayenta Mine coal supply agreement with the Navajo Generating Station extends beyond 2011, PWCC will relocate the overland coal conveyor and adjacent facilities and mine the N-99 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-99 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-99 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 N-11 and N-12 reserve areas, attaining an average thickness of approximately 10 feet. Within the northern portion of the N-99 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 [illegible] 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-99 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. When 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 timeframe, 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 that 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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ATTACHMENT 4-1

EXPLORATION APPLICATIONS

ATTACHMENT 4-1
EXPLORATION APPLICATIONS
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PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-1C

J-23 MINING AREA EXPLORATION PROGRAM – PHASE 3

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
P.O. Box 650
Kayenta, Arizona 86033
(928) 677-3201

2.0 NAME, ADDRESS AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Randy S. Lehn
Engineering & Reclamation Manager
P. O. Box 650
Kayenta, Arizona 86033
(928) 677-5078

3.0 PROPOSED EXPLORATION AREA

The J-23 Mining Area. The Phase 3 exploration area encompasses approximately 2,980 acres of the Black Mesa in central Navajo County, northern Arizona extending from PWCC coordinates 42,500 to 57,000 south and from 42,000 to 56,700 east all contained within the Hopi Partition Area. This area is shown on the enclosed Exhibit 1, J21/J23 Exploration Plan General Location Map, and Exhibit 3, J-23 Exploration Plan Drillhole Location Map.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted are in the southern portion of PWCC's Kayenta Mine Permit Area. This area ranges in elevation from approximately 6,790 feet above mean sea level (amsl) to 7,060 feet amsl and is characterized by low mesas and deeply incised ephemeral channels. The J-23 Mining Area is drained by Red Peak Valley Wash to the North, Sagebrush Wash to the West and Yucca Flat Wash to the South. The area is semi-arid with annual precipitation of approximately 12 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland vegetation types.

HABITAT ASSESSMENT

An analysis of suitable habitat for raptors within the Phase 3 area has been conducted, and is presented in the attached report entitled "Habitat Mapping Assessment for the J-23 Coal Extension Area, Kayenta Mine, Black Mesa, Arizona". The report provides delineated areas classified as suitable, marginally suitable, and unsuitable for raptor habitat, specifically northern goshawks and Cooper's hawks. PWCC plans to conduct Phase 3 exploration drilling in those areas delineated as either suitable or marginally suitable prior to April 30, 2002, which conservatively

precedes the onset of the breeding season for these raptors. Following this date, PWCC plans to continue drilling only in areas delineated as unsuitable for raptor habitat up until July 13, 2002, which conservatively coincides with the expected end of fledgling raptor occupation of nests. After July 13, 2002 PWCC plans to complete remaining drilling within either the suitable or marginally suitable areas, as completion of all exploration activities is planned by December of 2002. If drilling plans change due to inclement weather or other reasons, and plans call for drilling portions of suitable or marginally suitable habitat between April 30 and July 13, 2002, PWCC will conduct a formal survey for raptors prior to commencing drilling activities in these areas in order to develop measures for minimizing impacts to breeding raptors. Drilling in the suitable or marginally suitable habitat will be conducted between April 30th and July 13th only after specific drill sites are cleared by formal survey. The Office of Surface Mining will be consulted if any nest site conflicts are identified as a result of formal survey to formulate adequate protection plans and procedures.

THREATENED OR ENDANGERED SPECIES

The following species accounts discuss the status (presence, absence and habitat requirements) of, and potential project-related impacts (if any) to threatened, endangered, proposed, and candidate species under the Endangered Species Act (ESA) of 1973. The species discussed include those that are known to occur in Navajo County, Arizona, and could therefore potentially occur in the project area.

A complete discussion of the status of the Navajo sedge (*Carex Specuicola*) in the Black Mesa and Kayenta Mine permit areas may be found in the Permit Application Package (PAP) for the Black Mesa and Kayenta Mines (see Vegetation Resources, Chapter 9, page 65, Peabody Coal Company 1985). The original baseline study areas included the J-23 Phase 3 Exploration Drilling Project Area. The aforementioned discussion, identifying the habitat requirements and known distribution of the Navajo sedge, remains relevant. In summary, the Navajo sedge is absent from the project area because no suitable habitat (springs, seeps, or other riparian areas) is present. No impacts are possible as a result of project activities.

The Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*) has an extremely limited geographic range, associated with gravely soils of the Shinarump conglomerate of the Chinle Formation. The soil groups in the project area are derived from the Wepo Formation within the Mesa Verde Group (stratigraphically overlying the Chinle Formation by some 4,000 feet), or are eolian, alluvial, or porcellanite-derived. The elevation of the study area averages about 6800 feet above mean sea level. The known elevation range where the Peebles Navajo cactus is found is 5400-5600 feet above mean sea level. The potential for this species to occur in the project area is extremely remote due to elevation restrictions and incompatible substrate. Thus, there is no potential for project activities to impact this species.

The results of baseline Gunnison's prairie dog (*Cynomys gunnisoni*) and black-footed ferret surveys conducted by Peabody in the Black Mesa and Kayenta Mine permit areas may be found in the PAP (see Fish and Wildlife Resources, Chapter 10, page 71l, Peabody Coal Company 1985). These surveys defined the number and extent of prairie dog colonies existing on the leasehold, documented the absence of the black-footed ferret, and documented the instability of the prairie dog colonies. However, a black-footed ferret monitoring program has been conducted since that time because the potential for re-expansion of existing prairie dog colonies, and/or establishment of new colonies exists. These studies have been reported to the Office of Surface Mining on an annual basis since institution. To date, the number, extent, and distribution of prairie dog colonies within or adjacent to the permit areas has failed to meet the currently accepted minimum

requirements necessary to support the black-footed ferret, or warrant black-footed ferret searches. Therefore, the potential for the J-23 Phase 3 drilling project to affect this species remains extremely remote.

Four species of threatened fishes could potentially occur in Navajo County, Arizona, and are considered in this assessment. They include the Apache (Arizona) trout (*Oncorhynchus apache*), Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*). Habitat requirements and distribution of these species is discussed in detail in Minckley (1973). The Apache trout is presently restricted to cold water perennial streams with low gradient meadow reaches. The Little Colorado spinedace exists in moderate to small streams in pools and riffles. The loach minnow is a highly specialized, diminutive species that is essentially restricted to gravelly riffles in small to moderately large creeks and rivers. The spikedace requires moderate to large perennial streams with gravel cobble substrates and moderate to swift flow velocities. Unnamed ephemeral washes in the project area all flow north and northwest into Red Peak Valley Wash, or south and southwest into Dinnebito Wash. Red Peak Valley Wash is tributary to Moenkopi Wash. Moenkopi Wash drains to the Little Colorado River near Cameron, Arizona. Dinnebito Wash also drains to the Little Colorado River above Cameron, Arizona. Reaches of Red Peak Valley Wash and Dinnebito Wash near the project area are characterized as ephemeral, with short, warm water intermittent reaches that occur in some years. The channels are deeply incised, flowing only in response to intense, localized precipitation events. Such flows are typically of short duration, with high velocities and extremely poor water quality due to high concentrations of suspended sediment. There is no potential for impact to these species because they are not present in or near the project area due to habitat restrictions.

Bald eagles (*Haliaeetus leucocephalus*) have been sited on or near the Black Mesa and Kayenta Mine permit areas on a handful of occasions (LaRue 1994, Peabody Coal Company 1985). LaRue (1994) characterizes this species as a sparse early winter transient. The siting nearest the project area was over Dinnebito Wash on March 16, 1993. The project area contains no suitable nesting habitat. Occasional sightings of migrating bald eagles can be expected throughout the region that includes the project area, especially in early winter. Although an occasional migrant may transit the area, the project area exhibits minimum utility for this species and no impacts are expected.

With the exception of sightings associated with its reintroduction, the last report of a wild California condor (*Gymnops californianus*) in Arizona was in 1924. This species occupies high desert canyon lands and plateaus in Arizona, having been reintroduced starting in 1996. The release site is located in the Vermillion Cliffs area of northern Arizona, approximately 90 miles west northwest of the project area. Individuals have been known to range widely, therefore it is feasible a transient siting could occur in or near the project area. However, no deep canyons, cliffs, or plateaus occur in the project area so the prospect of a siting is extremely remote. Therefore the potential for impact to the California condor is extremely remote.

American peregrine falcons (*Falco peregrinus anatum*) are usually associated with cliffs or steep-walled canyon areas and nest almost exclusively on cliff faces. Nests are sometimes found on man-made structures such as building ledges and bridges. These are usually as a result of captive-bred release (hacking) programs. The density of cliffs may determine the suitability of an area for nesting. Adequate prey populations close to the nest are also important criteria in site selection. Nesting sites are usually located in close proximity to water, especially in the Southwest (Skaggs et al. 1986). Although human activities near the nest site and destruction of habitat for prey species can affect nesting peregrines by causing nest failure, no nesting habitat is present within the proposed phase exploration drilling area. Nesting habitat for the American peregrine falcon is known from the

east edge of Black Mesa. Since there are no steep-walled canyons or cliffs and no wetland habitat which may attract migratory waterfowl in the proposed phase 3 exploration drilling area, work in this area will not impact the species.

A complete discussion of the status of the Mexican spotted owl (*Strix occidentalis lucida*) in and near the Black Mesa and Kayenta Mine permit areas and northern Black Mesa may be found in the PAP at Chapter 9 page 71b (Peabody Coal Company 1985) and in LaRue (1994). The Mexican spotted owl may be considered at least a fairly common summer resident in shady mixed-conifer canyons and ravines on northern Black Mesa. Although there are no winter records, it is probably a permanent resident on northern Black Mesa. Known nest sites are in caves in cliffs adjacent to mixed conifer-filled canyon floors. The mixed conifer woodlands on Black Mesa typically occur in steep, rocky canyons and north facing slopes at elevations above 6800 feet. Fragmented stands of this habitat occur north and east of the project area, approximately 7.5 miles distant. More extensive, continuous tracts of this habitat occurs further north and east toward the rim of Black Mesa, some 8-10 miles from the project area. No sightings or other evidence of Mexican spotted owls within the Black Mesa or Kayenta Mine permit areas, including the project area, have ever occurred. The potential for impacting the Mexican spotted owl is extremely remote. No suitable habitat will be affected by the project, and the nearest nesting habitat is at least 7.5 miles distant.

The results of baseline studies indicated that the southwestern willow flycatcher (*Empidonax traillii extimus*) does not breed on or near the Black Mesa and Kayenta Mine permit areas, including the J-23 project area (Peabody Coal Company 1985). The southwestern willow flycatcher can be considered a sparse migrant, regionally. The five sightings of six individuals of *Empidonax trailli* on or near the Black Mesa and Kayenta Mine permit areas are not considered to be the southwestern subspecies (LaRue 1994). Suitable habitat consisting of cottonwood/willow and tamarisk vegetation along rivers and streams is absent in the project area. However, sparse and fragmented tamarisk stands do occur along Dinnebito wash south of the project area so the possibility exists that this species could occur transiently. The potential for impact to this species is extremely remote. No individuals have ever been documented on or near the project area, and the project will not result in disturbance of marginally suitable tamarisk vegetation along Dinnebito Wash.

The Chiricahua leopard frog (*Rana chiricahuensis*) is a candidate for listing under the ESA. According to information obtained from the U.S. Fish and Wildlife Service, suitable habitat for this species includes streams, rivers, backwaters, ponds and livestock watering tanks that are free from introduced fishes and bullfrogs (*Rana catesbeiana*). Water sources must be permanent or nearly permanent. Populations north of the Gila River (where the project area is located) are thought to be a distinct species that has not been formally described. A description of the aquatic communities within and near the Black Mesa and Kayenta Mine permit areas is included in the PAP (Peabody Coal Company 1985). No naturally occurring perennial aquatic habitats occur in or near the project area. Also, no true frogs (*Rana sp.*) were encountered during the course of conducting baseline studies. For these reasons, impacts to the Chiricahua leopard frog will not occur as a result of this project.

CULTURAL RESOURCES

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. Sites are shown on the enclosed Exhibit 3. All identified sites, with the exception of 21, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13). Anasazi Sites AZ-D:11:328, AZ-D:11:256, AZ-D:11:261, AZ-D:11:262, AZ-D:11:273, AZ-D:11:274, AZ-D:11:279, AZ-D:11:296, AZ-D:11:297, AZ-D:11:325, AZ-D:11:326, AZ-D:11:330, AZ-D:11:331, AZ-D:11:332, AZ-D:11:335, AZ-D:11:336, AZ-D:11:337,

AZ-D:11:339, AZ-D:11:349, AZ-D:11:350, and AZ-D:11:1412, having a high probability of containing human remains, have not been mitigated in the Phase 3 exploration area. These sites will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g), the Native American Graves Protection and Repatriation Act (NAGPRA). The Hopi Cultural Preservation Office (HCPO) will be reviewing the original BMAP survey and will conduct a field assessment for Traditional Cultural Properties (TCP) before drilling begins. Sites identified by HPCO will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g), the Native American Graves Protection and Repatriation Act (NAGPRA).

5.0 EXPLORATION SCHEDULE

Beginning: Fourth Quarter – Calendar Year 2001

Terminating: Approximately April 30, 2003

Reclamation: Reclamation will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 20 miles of temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 650 drill pads and 775 drillholes (estimated at up to 650 boreholes and 125 coreholes) over a 15 month period; and subsequent reclamation of all exploration disturbance. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – To the extent possible existing disturbed areas will be used for exploration staging requirements.

Exploration Access – All exploration access roads shall be constructed and reclaimed to comply with applicable provisions of 30CFR 816.150 (b) through (f). 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 typically 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. Up to approximately 105,600 feet (20 miles) of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents 1,584,000 square feet (36.4 acres) of disturbance for temporary roads. On completion of drilling activities, temporary exploration roads will be reclaimed.

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. With a total of up to 650 drill sites, this represents 110.5 acres of disturbance for drill site construction. On completion of drilling activities, all mud pits will be backfilled and drill sites 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 in order to recover an intact core sample of the coal seam or horizon of interest.

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 supervisor, 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. 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 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. Drillholes not completed as monitoring wells 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 permanent sealing is typically three to five days.

Areas disturbed by exploration activities including staging areas, temporary exploration roads, and drill sites will be stabilized or reclaimed following completion of drilling activities. 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 approximate original contour. 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 conditions (snow, rain, mud). Reclamation activities will be completed within six months following initiation, and will be consistent with seasonal reclamation planting considerations as outlined in Chapter 23, Revegetation Plan.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed one-year Phase 3 PWCC exploration program for the J-23 Mining Area:

Plugging & sealing drillholes –775 (5" x 500') @ $50/hole	$ 38,800
Backfilling mud pits – 650 @ 25cy @ $0.60yd	$ 9,750
Regrading drill pads – 650 @ 0.17 acre @ $1,000/acre (included soil replacement)	$ 110,500

Regrading roads – 105,600 feet @ $100/100 ft. (includes soil replacement)	$ 105,600
Revegetation – (146.9 acres) @ $300/acre	$ 44,070
Total Direct Costs	$308,720
Total Indirect Costs (@16.6 percent)	$ 51,250
Total Estimated Costs	$359,970

PWCC's existing bond surety will be increased by an additional $400,000 for exploration activities in the J-23, Phase 3 area.

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PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-1A

J-21 MINING AREA EXPLORATION PROGRAM – PHASE I

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
P.O. Box 650
Kayenta, Arizona 86033
(520) 677-3201

2.0 NAME, ADDRESS AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Gary W. Wendt
Environmental Program Supervisor
P. O. Box 650
Kayenta, Arizona 86033
(520) 677-5130

3.0 PROPOSED EXPLORATION AREA

J-21 Mining Area. The Phase I exploration area encompasses approximately 1,930 acres of the Black Mesa in central Navajo County, northern Arizona extending from PWCC coordinates 38,000 to 50,000 south and from 58,000 to 66,000 east. This area is shown on the enclosed Exhibit 1 J-21 Exploration Plan General Location Map and Exhibit 2 J-21 Exploration Plan Drillhole Location Map. The entire exploration area occurs within the Kayenta Mine Permit AZ-0001D boundary as described in Chapter 3, Attachment 6.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted are in the southern portion of PWCC's Kayenta Mine Permit Area. This area ranges in elevation from approximately 6,780 feet above mean sea level (amsl) to 7,150 feet amsl and is characterized by low mesas and deeply incised ephemeral and intermittent drainages. The J-21 Mining Area is drained by Dinnebito Wash. The area is semi-arid with annual precipitation of approximately 12 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland vegetation types.

Surveys and nest searches for Cooper's hawk (Accipiter cooperii) and northern goshawk (Accipiter gentilis) were conducted during May and June 1999 by SWCA Inc., Environmental Consultants. PWCC contracted SWCA to assess potential impacts of exploration on these species of high federal interest. Survey protocol was approved by OSMRE as part of the 1999 Black Mesa Complex wildlife monitoring program. Surveys were scheduled during the 1999 breeding season that extended from May 1 to June 31. In addition to the surveys, biologists searched the areas surrounding proposed bore holes for Cooper's hawk and northern goshawk breeding habitat.

Potential breeding habitat does exist on the proposed exploration area; however, no northern goshawks or Cooper's hawks were documented during either survey session. Exploration operations are not expected to impact breeding Cooper's hawks or northern goshawks in the J-21 area. SWCA's final report "Biological Report: Cooper's Hawk and Northern Goshawk Survey of the J21 South Exploration Area, Kayenta Mine, Black Mesa, Arizona" is included with this application.

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. Sites are shown on the enclosed Exhibit 2. All identified sites, with the exception of two, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13) and the NAGPRA and archaeology investigations completed by the Navajo Nation Archaeology Department (Spurr, 1993). Only Sites AZ-D:11:503 and AZ-D:11:505, that have a high probability of containing human remains, have not been mitigated in the Phase I exploration area. These sites will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g), the Native American Graves Protection and Repatriation Act (NAGPRA), the Navajo Nation Policy and Procedures for the Protection of Cemeteries, Grave Sites, and Human Remains, and the Navajo Nation Policy for the Protection of Jishchaa': Gravesites, Human Remains, and Funerary Items. Navajo Traditional Cultural Property (TCP) sites identified by NNAD-NAU in Reports 97-256 (dated 12/9/97) and 98-111 (dated 7/15/98) will be avoided by at least 50 feet during this drilling program.

5.0 EXPLORATION SCHEDULE

Beginning: Second Quarter – Calendar Year 2000

Terminating: Approximately April 1, 2001

Reclamation:

> Temporary sealing (drillholes, roads, and other exploration disturbance (mud pits) within 5-year affected lands area) will occur within approximately 45 days of completion of drilling for each drillhole.
> Reclamation (drillholes, roads, and other exploration disturbance outside of the 5-year affected lands area) will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 21 miles of temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 408 drill pads and 508 drillholes (estimated at up to 408 boreholes and 100 coreholes) over a one-year period; and subsequent reclamation of all exploration disturbance that is outside of the five-year affected lands area. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – The Phase I exploration activities in J-21 South will occur at the same time and in proximity to ongoing surface mining operations. Therefore, existing mining disturbance areas or facility areas will be used for exploration staging requirements.

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 typically 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. Up to approximately 110,880 feet (21 miles) of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents 1,663,200 square feet (38.2 acres) of disturbance for temporary roads. 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. With a total of up to 408 drill sites, this represents 69.4 acres of disturbance for drill site construction. 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 in order to recover an intact core sample of the coal seam or horizon of interest.

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. 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 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.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed one-year Phase I PWCC exploration program for the J-21 Mining Area:

Plugging and sealing drillholes – 508 (5" x 500') @ $50/hole	$ 25,400
Backfilling mud pits – 408 @ 25cy @ $0.60yd	$ 6,200
Regrading drill pads (outside 5-yr area) – 53 @ 0.17 acre @ $1,000/acre	$ 9,100
Regrading roads (outside 5-yr area) – 14,404 feet @ $100/100 ft.	$ 14,500
Soil replacement – [(9.0 acres – drill pads) +	
(5.0 acres – roads)] x 43,560 ft^2/acre x 0.5 ft/27 @ $0.50/yd	$ 5,700
Revegetation – (14.0 acres) @ $300/acre	$ 4,200
Total Direct Costs	$ 65,100
Total Indirect Costs (@16.6 percent)	$ 10,900
Total Estimated Costs	$ 76,000

PWCC's existing bond surety provides $331,261 for exploration activities (Volume 11A, Chapter 24, Cost Summary Section and Attachment 24-6). This exceeds the current calculated bonding requirements by $255,261.

PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-1B

J-21 MINING AREA EXPLORATION PROGRAM – PHASE 2

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
P.O. Box 650
Kayenta, Arizona 86033
(520) 677-3201

2.0 NAME, ADDRESS AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Gary W. Wendt
Environmental Program Supervisor
P. O. Box 650
Kayenta, Arizona 86033
(520) 677-5130

3.0 PROPOSED EXPLORATION AREA

J-21 Mining Area. The Phase 2 exploration area encompasses approximately 1,510 acres of the Black Mesa in central Navajo County, northern Arizona extending from PWCC coordinates 43,000 to 57,000 south and from 51,000 to 60,000 east all northwest of Dinnebito Wash and southeast of the Hopi Partition Line. This area is shown on the enclosed Exhibit 1 J-21 Exploration Plan General Location Map and Exhibit 2 J-21 Exploration Plan Drillhole Location Map. The entire exploration area occurs within the Kayenta Mine Permit AZ-0001D boundary as described in Chapter 3, Attachment 6.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted are in the southern portion of PWCC's Kayenta Mine Permit Area. This area ranges in elevation from approximately 6,720 feet above mean sea level (amsl) to 7,080 feet amsl and is characterized by low mesas and deeply incised ephemeral and intermittent drainages. The J-21 Mining Area is drained by Dinnebito Wash. The area is semi-arid with annual precipitation of approximately 12 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland vegetation types.

The wildlife and biological assessment information for the Phase 2 area was submitted on November 11, 1999 along with the Phase 1 application. The report was prepared by SWCA and was titled "Biological Report: Cooper's Hawk and Northern Goshawk Survey of the J21 South Exploration Area, Kayenta Mine, Black Mesa, Arizona".

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. Sites are shown on the enclosed Exhibit 2. All identified sites, with the exception of four, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13) and the NAGPRA and archaeology investigations completed by the Navajo Nation Archaeology Department (Spurr, 1993). Anasazi Sites AZ-D:11:230, AZ-D:11:236, and AZ-D:11:254, having a high probability of containing human remains, have not been mitigated in the Phase 2 exploration area. Two Navajo burials are located at a fourth site at PWCC coordinates 56,475'E and 48,675'S. This area is fenced and burials are marked by head stones. These sites will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g), the Native American Graves Protection and Repatriation Act (NAGPRA), the Navajo Nation Policy and Procedures for the Protection of Cemeteries, Grave Sites, and Human Remains, and the Navajo Nation Policy for the Protection of Jishchaa': Gravesites, Human Remains, and Funerary Items.

5.0 EXPLORATION SCHEDULE

Beginning: Third Quarter – Calendar Year 2000

Terminating: Approximately December 31, 2001

Reclamation:

> Temporary sealing (drillholes, roads, and other exploration disturbance (mud pits) within 5-year affected lands area) will occur within approximately 45 days of completion of drilling for each drillhole.
> Reclamation (drillholes, roads, and other exploration disturbance outside of the 5-year affected lands area) will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 40 miles of temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 660 drill pads and 775 drillholes (estimated at up to 660 boreholes and 115 coreholes) over a one-year period; and subsequent reclamation of all exploration disturbance that is outside of the five-year affected lands area. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – The Phase 2 exploration activities in J-21 South will occur at the same time and in proximity to ongoing surface mining operations. Therefore, existing mining disturbance areas or facility areas will be used for exploration staging requirements.

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 typically 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. Up to approximately 208,100 feet (40 miles) of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents 3,121,500 square feet (71.7 acres) of disturbance for temporary roads. 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. With a total of up to 660 drill sites, this represents 112.2 acres of disturbance for drill site construction. 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 in order to recover an intact core sample of the coal seam or horizon of interest.

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. 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 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.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed one-year Phase 2 PWCC exploration program for the J-21 Mining Area:

Plugging & sealing drillholes –775 (5" x 500') @ $50/hole	$ 38,800
Backfilling mud pits – 660 @ 25cy @ $0.60yd	$ 9,900
Regrading drill pads (outside 5-yr area) – 580 @ 0.17 acre @ $1,000/acre (included soil replacement)	$ 98,600
Regrading roads (outside 5-yr area) – 194,800 feet @ $100/100 ft. (includes soil replacement)	$ 194,800
Revegetation – (165.7 acres) @ $300/acre	$ 49,800
Total Direct Costs	$391,900
Total Indirect Costs (@16.6 percent)	$ 65,100
Total Estimated Costs	$457,000

PWCC's existing bond surety provides $331,261 for exploration activities (Volume 11A, Chapter 24, Cost Summary Section and Attachment 24-6). The calculated bonding requirement for Phase 1 is $76,000. The excess of $255,261 plus $259,992 of excess funds beyond the current calculated bonding requirements (Chapter 24, Bonding Summary Section) exceeds this increase in bond liability by $58,253.

PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-1C

J-23 MINING AREA EXPLORATION PROGRAM – PHASE 3

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
P.O. Box 650
Kayenta, Arizona 86033
(928) 677-3201

2.0 NAME, ADDRESS AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Randy S. Lehn
Engineering & Reclamation Manager
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3.0 PROPOSED EXPLORATION AREA

The J-23 Mining Area. The Phase 3 exploration area encompasses approximately 2,980 acres of the Black Mesa in central Navajo County, northern Arizona extending from PWCC coordinates 42,500 to 57,000 south and from 42,000 to 56,700 east all contained within the Hopi Partition Area. This area is shown on the enclosed Exhibit 1, J21/J23 Exploration Plan General Location Map, and Exhibit 3, J-23 Exploration Plan Drillhole Location Map.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted are in the southern portion of PWCC's Kayenta Mine Permit Area. This area ranges in elevation from approximately 6,790 feet above mean sea level (amsl) to 7,060 feet amsl and is characterized by low mesas and deeply incised ephemeral channels. The J-23 Mining Area is drained by Red Peak Valley Wash to the North, Sagebrush Wash to the West and Yucca Flat Wash to the South. The area is semi-arid with annual precipitation of approximately 12 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland vegetation types.

HABITAT ASSESSMENT

An analysis of suitable habitat for raptors within the Phase 3 area has been conducted, and is presented in the attached report entitled "Habitat Mapping Assessment for the J-23 Coal Extension Area, Kayenta Mine, Black Mesa, Arizona". The report provides delineated areas classified as suitable, marginally suitable, and unsuitable for raptor habitat, specifically northern goshawks and Cooper's hawks. PWCC plans to conduct Phase 3 exploration drilling in those areas delineated as either suitable or marginally suitable prior to April 30, 2002, which conservatively

precedes the onset of the breeding season for these raptors. Following this date, PWCC plans to continue drilling only in areas delineated as unsuitable for raptor habitat up until July 13, 2002, which conservatively coincides with the expected end of fledgling raptor occupation of nests. After July 13, 2002 PWCC plans to complete remaining drilling within either the suitable or marginally suitable areas, as completion of all exploration activities is planned by December of 2002. If drilling plans change due to inclement weather or other reasons, and plans call for drilling portions of suitable or marginally suitable habitat between April 30 and July 13, 2002, PWCC will conduct a formal survey for raptors prior to commencing drilling activities in these areas in order to develop measures for minimizing impacts to breeding raptors. Drilling in the suitable or marginally suitable habitat will be conducted between April 30th and July 13th only after specific drill sites are cleared by formal survey. The Office of Surface Mining will be consulted if any nest site conflicts are identified as a result of formal survey to formulate adequate protection plans and procedures.

THREATENED OR ENDANGERED SPECIES

The following species accounts discuss the status (presence, absence and habitat requirements) of, and potential project-related impacts (if any) to threatened, endangered, proposed, and candidate species under the Endangered Species Act (ESA) of 1973. The species discussed include those that are known to occur in Navajo County, Arizona, and could therefore potentially occur in the project area.

A complete discussion of the status of the Navajo sedge (*Carex Specuicola*) in the Black Mesa and Kayenta Mine permit areas may be found in the Permit Application Package (PAP) for the Black Mesa and Kayenta Mines (see Vegetation Resources, Chapter 9, page 65, Peabody Coal Company 1985). The original baseline study areas included the J-23 Phase 3 Exploration Drilling Project Area. The aforementioned discussion, identifying the habitat requirements and known distribution of the Navajo sedge, remains relevant. In summary, the Navajo sedge is absent from the project area because no suitable habitat (springs, seeps, or other riparian areas) is present. No impacts are possible as a result of project activities.

The Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*) has an extremely limited geographic range, associated with gravely soils of the Shinarump conglomerate of the Chinle Formation. The soil groups in the project area are derived from the Wepo Formation within the Mesa Verde Group (stratigraphically overlying the Chinle Formation by some 4,000 feet), or are eolian, alluvial, or porcellanite-derived. The elevation of the study area averages about 6800 feet above mean sea level. The known elevation range where the Peebles Navajo cactus is found is 5400-5600 feet above mean sea level. The potential for this species to occur in the project area is extremely remote due to elevation restrictions and incompatible substrate. Thus, there is no potential for project activities to impact this species.

The results of baseline Gunnison's prairie dog (*Cynomys gunnisoni*) and black-footed ferret surveys conducted by Peabody in the Black Mesa and Kayenta Mine permit areas may be found in the PAP (see Fish and Wildlife Resources, Chapter 10, page 71l, Peabody Coal Company 1985). These surveys defined the number and extent of prairie dog colonies existing on the leasehold, documented the absence of the black-footed ferret, and documented the instability of the prairie dog colonies. However, a black-footed ferret monitoring program has been conducted since that time because the potential for re-expansion of existing prairie dog colonies, and/or establishment of new colonies exists. These studies have been reported to the Office of Surface Mining on an annual basis since institution. To date, the number, extent, and distribution of prairie dog colonies within or adjacent to the permit areas has failed to meet the currently accepted minimum

requirements necessary to support the black-footed ferret, or warrant black-footed ferret searches. Therefore, the potential for the J-23 Phase 3 drilling project to affect this species remains extremely remote.

Four species of threatened fishes could potentially occur in Navajo County, Arizona, and are considered in this assessment. They include the Apache (Arizona) trout (*Oncorhynchus apache*), Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*). Habitat requirements and distribution of these species is discussed in detail in Minckley (1973). The Apache trout is presently restricted to cold water perennial streams with low gradient meadow reaches. The Little Colorado spinedace exists in moderate to small streams in pools and riffles. The loach minnow is a highly specialized, diminutive species that is essentially restricted to gravelly riffles in small to moderately large creeks and rivers. The spikedace requires moderate to large perennial streams with gravel cobble substrates and moderate to swift flow velocities. Unnamed ephemeral washes in the project area all flow north and northwest into Red Peak Valley Wash, or south and southwest into Dinnebito Wash. Red Peak Valley Wash is tributary to Moenkopi Wash. Moenkopi Wash drains to the Little Colorado River near Cameron, Arizona. Dinnebito Wash also drains to the Little Colorado River above Cameron, Arizona. Reaches of Red Peak Valley Wash and Dinnebito Wash near the project area are characterized as ephemeral, with short, warm water intermittent reaches that occur in some years. The channels are deeply incised, flowing only in response to intense, localized precipitation events. Such flows are typically of short duration, with high velocities and extremely poor water quality due to high concentrations of suspended sediment. There is no potential for impact to these species because they are not present in or near the project area due to habitat restrictions.

Bald eagles (*Haliaeetus leucocephalus*) have been sited on or near the Black Mesa and Kayenta Mine permit areas on a handful of occasions (LaRue 1994, Peabody Coal Company 1985). LaRue (1994) characterizes this species as a sparse early winter transient. The siting nearest the project area was over Dinnebito Wash on March 16, 1993. The project area contains no suitable nesting habitat. Occasional sightings of migrating bald eagles can be expected throughout the region that includes the project area, especially in early winter. Although an occasional migrant may transit the area, the project area exhibits minimum utility for this species and no impacts are expected.

With the exception of sightings associated with its reintroduction, the last report of a wild California condor (*Gymnops californianus*) in Arizona was in 1924. This species occupies high desert canyon lands and plateaus in Arizona, having been reintroduced starting in 1996. The release site is located in the Vermillion Cliffs area of northern Arizona, approximately 90 miles west northwest of the project area. Individuals have been known to range widely, therefore it is feasible a transient siting could occur in or near the project area. However, no deep canyons, cliffs, or plateaus occur in the project area so the prospect of a siting is extremely remote. Therefore the potential for impact to the California condor is extremely remote.

American peregrine falcons (*Falco peregrinus anatum*) are usually associated with cliffs or steep-walled canyon areas and nest almost exclusively on cliff faces. Nests are sometimes found on man-made structures such as building ledges and bridges. These are usually as a result of captive-bred release (hacking) programs. The density of cliffs may determine the suitability of an area for nesting. Adequate prey populations close to the nest are also important criteria in site selection. Nesting sites are usually located in close proximity to water, especially in the Southwest (Skaggs et al. 1986). Although human activities near the nest site and destruction of habitat for prey species can affect nesting peregrines by causing nest failure, no nesting habitat is present within the proposed phase exploration drilling area. Nesting habitat for the American peregrine falcon is known from the

east edge of Black Mesa. Since there are no steep-walled canyons or cliffs and no wetland habitat which may attract migratory waterfowl in the proposed phase 3 exploration drilling area, work in this area will not impact the species.

A complete discussion of the status of the Mexican spotted owl (*Strix occidentalis lucida*) in and near the Black Mesa and Kayenta Mine permit areas and northern Black Mesa may be found in the PAP at Chapter 9 page 71b (Peabody Coal Company 1985) and in LaRue (1994). The Mexican spotted owl may be considered at least a fairly common summer resident in shady mixed-conifer canyons and ravines on northern Black Mesa. Although there are no winter records, it is probably a permanent resident on northern Black Mesa. Known nest sites are in caves in cliffs adjacent to mixed conifer-filled canyon floors. The mixed conifer woodlands on Black Mesa typically occur in steep, rocky canyons and north facing slopes at elevations above 6800 feet. Fragmented stands of this habitat occur north and east of the project area, approximately 7.5 miles distant. More extensive, continuous tracts of this habitat occurs further north and east toward the rim of Black Mesa, some 8-10 miles from the project area. No sightings or other evidence of Mexican spotted owls within the Black Mesa or Kayenta Mine permit areas, including the project area, have ever occurred. The potential for impacting the Mexican spotted owl is extremely remote. No suitable habitat will be affected by the project, and the nearest nesting habitat is at least 7.5 miles distant.

The results of baseline studies indicated that the southwestern willow flycatcher (*Empidonax traillii extimus*) does not breed on or near the Black Mesa and Kayenta Mine permit areas, including the J-23 project area (Peabody Coal Company 1985). The southwestern willow flycatcher can be considered a sparse migrant, regionally. The five sightings of six individuals of *Empidonax trailli* on or near the Black Mesa and Kayenta Mine permit areas are not considered to be the southwestern subspecies (LaRue 1994). Suitable habitat consisting of cottonwood/willow and tamarisk vegetation along rivers and streams is absent in the project area. However, sparse and fragmented tamarisk stands do occur along Dinnebito wash south of the project area so the possibility exists that this species could occur transiently. The potential for impact to this species is extremely remote. No individuals have ever been documented on or near the project area, and the project will not result in disturbance of marginally suitable tamarisk vegetation along Dinnebito Wash.

The Chiricahua leopard frog (*Rana chiricahuensis*) is a candidate for listing under the ESA. According to information obtained from the U.S. Fish and Wildlife Service, suitable habitat for this species includes streams, rivers, backwaters, ponds and livestock watering tanks that are free from introduced fishes and bullfrogs (*Rana catesbeiana*). Water sources must be permanent or nearly permanent. Populations north of the Gila River (where the project area is located) are thought to be a distinct species that has not been formally described. A description of the aquatic communities within and near the Black Mesa and Kayenta Mine permit areas is included in the PAP (Peabody Coal Company 1985). No naturally occurring perennial aquatic habitats occur in or near the project area. Also, no true frogs (*Rana sp.*) were encountered during the course of conducting baseline studies. For these reasons, impacts to the Chiricahua leopard frog will not occur as a result of this project.

CULTURAL RESOURCES

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. Sites are shown on the enclosed Exhibit 3. All identified sites, with the exception of 21, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13). Anasazi Sites AZ-D:11:328, AZ-D:11:256, AZ-D:11:261, AZ-D:11:262, AZ-D:11:273, AZ-D:11:274, AZ-D:11:279, AZ-D:11:296, AZ-D:11:297, AZ-D:11:325, AZ-D:11:326, AZ-D:11:330, AZ-D:11:331, AZ-D:11:332, AZ-D:11:335, AZ-D:11:336, AZ-D:11:337,

AZ-D:11:339, AZ-D:11:349, AZ-D:11:350, and AZ-D:11:1412, having a high probability of containing human remains, have not been mitigated in the Phase 3 exploration area. These sites will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g), the Native American Graves Protection and Repatriation Act (NAGPRA). The Hopi Cultural Preservation Office (HCPO) will be reviewing the original BMAP survey and will conduct a field assessment for Traditional Cultural Properties (TCP) before drilling begins. Sites identified by HPCO will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g), the Native American Graves Protection and Repatriation Act (NAGPRA).

5.0 EXPLORATION SCHEDULE

Beginning: Fourth Quarter – Calendar Year 2001

Terminating: Approximately April 30, 2003

Reclamation: Reclamation will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 20 miles of temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 650 drill pads and 775 drillholes (estimated at up to 650 boreholes and 125 coreholes) over a 15 month period; and subsequent reclamation of all exploration disturbance. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – To the extent possible existing disturbed areas will be used for exploration staging requirements.

Exploration Access – All exploration access roads shall be constructed and reclaimed to comply with applicable provisions of 30CFR 816.150 (b) through (f). 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 typically 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. Up to approximately 105,600 feet (20 miles) of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents 1,584,000 square feet (36.4 acres) of disturbance for temporary roads. On completion of drilling activities, temporary exploration roads will be reclaimed.

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. With a total of up to 650 drill sites, this represents 110.5 acres of disturbance for drill site construction. On completion of drilling activities, all mud pits will be backfilled and drill sites 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 in order to recover an intact core sample of the coal seam or horizon of interest.

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 supervisor, 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. 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 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. Drillholes not completed as monitoring wells 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 permanent sealing is typically three to five days.

Areas disturbed by exploration activities including staging areas, temporary exploration roads, and drill sites will be stabilized or reclaimed following completion of drilling activities. 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 approximate original contour. 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 conditions (snow, rain, mud). Reclamation activities will be completed within six months following initiation, and will be consistent with seasonal reclamation planting considerations as outlined in Chapter 23, Revegetation Plan.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed one-year Phase 3 PWCC exploration program for the J-23 Mining Area:

Plugging & sealing drillholes -775 (5" x 500') @ $50/hole	$ 38,800
Backfilling mud pits - 650 @ 25cy @ $0.60yd	$ 9,750
Regrading drill pads - 650 @ 0.17 acre @ $1,000/acre (included soil replacement)	$ 110,500

Regrading roads – 105,600 feet @ $100/100 ft. (includes soil replacement)	$ 105,600
Revegetation – (146.9 acres) @ $300/acre	$ 44,070
Total Direct Costs	$308,720
Total Indirect Costs (@16.6 percent)	$ 51,250
Total Estimated Costs	$359,970

PWCC's existing bond surety will be increased by an additional $400,000 for exploration activities in the J-23, Phase 3 area.

LITERATURE CITED

LaRue, Charles T. 1994. Birds of northern Back Mesa, Navajo County, Arizona. Great Basin Naturalist 54(1): 1-63.

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Skaggs, R.W., D.H. Ellis, W.G. Hunt, T.H. Johnson. 1986. Peregrine falcon. Pages 127-136 in Glinski, R.L. et al. Eds. Southwest Raptor Management Symposium and Workshop. Nat'l Wildl. Fed. Sci. and Tech. Ser. No. 11. 395 pp.

ATTACHMENT 4-2

EXPLORATION NOTICE OF INTENT APPLICATIONS

ATTACHMENT 4-2
EXPLORATION APPLICATIONS
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PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-2a

N-6/N-11 COAL RESOURCE AREA EXPLORATION PROGRAM – PHASE I

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
Kayenta Mine
P.O. Box 650
Kayenta, Arizona 86033
(928) 677-3201

2.0 NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Gary W. Wendt
Environmental Program Supervisor
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Kayenta, Arizona 86033
(928) 677-5130

3.0 PROPOSED EXPLORATION AREA

The Phase I exploration for the N-6/N-11 coal resource area encompasses approximately 3,820 acres of the Black Mesa in central Navajo County, northern Arizona extending from PWCC coordinates 1,500 to 15,500 south and from 30,000 to 48,000 east. This area is shown on the enclosed Exhibit 1, Exploration Plan General Location Map, and Exhibit 2, N-6/N-11 Exploration Plan Drillhole Location Map. The entire exploration area occurs within the Kayenta Mine Permit AZ-0001D and Black Mesa Mine Permit AZ-0001 boundaries as described in Chapter 3, Attachment 6.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted are in the northern portion of PWCC's Black Mesa Mine and Kayenta Mine Permit Areas. This area ranges in elevation from approximately 6,650 feet above mean sea level (amsl) to 7,150 feet amsl and is characterized by low mesas and deeply incised ephemeral and intermittent drainages. The N-6/N-11 Exploration Area is drained by Coal Mine Wash on the north and Moenkopi Wash on the south. The area is semi-arid with annual precipitation of approximately 9 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland vegetation types.

4.1 SPECIES OF INTEREST

PWCC plans to begin exploration drilling as early as the first quarter 2003. If drilling plans call for drilling between April 30 and July 13, 2003, PWCC will conduct a formal survey for raptors prior to commencing drilling activities in order to develop measures for minimizing impacts to breeding

raptors. Drilling will be conducted between April 30th and July 13th only after specific drill sites are cleared by formal survey. The Office of Surface Mining will be consulted to formulate adequate protection plans and procedures if any nest site conflicts are identified as a result of formal survey.

4.2 THREATENED OR ENDANGERED SPECIES

The following species accounts discuss the status (presence, absence, and habitat requirements) of, and potential project-related impacts (if any) to threatened, endangered, proposed, and candidate species under the Endangered Species Act (ESA) of 1973. The species discussed include those that are known to occur in Navajo County, Arizona, and could therefore potentially occur in the project area.

A complete discussion of the status of the Navajo sedge (*Carex Specuicola*) in the Black Mesa Mine and Kayenta Mine permit areas may be found in the Permit Application Package (PAP) for the Black Mesa and Kayenta Mines (see Vegetation Resources, Chapter 9, page 65, Peabody Coal Company, 1985). The original baseline study areas included the N-6/N-11 Exploration Drilling Project Area. The aforementioned discussion, identifying the habitat requirements and known distribution of the Navajo sedge, remains relevant. In summary, the Navajo sedge is absent from the project area because no suitable habitat (springs, seeps, or other riparian areas) is present. No impacts are possible as a result of project activities.

The Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*) has an extremely limited geographic range, associated with gravely soils of the Shinarump conglomerate of the Chinle Formation. The soil groups in the project area are derived from the Wepo Formation within the Mesa Verde Group (stratigraphically overlying the Chinle Formation by some 4,000 feet), or are eolian, alluvial, or porcellanite-derived. The elevation of the study area averages about 6900 feet above mean sea level. The known elevation range where the Peebles Navajo cactus is found is 5400-5600 feet above mean sea level. The potential for this species to occur in the project area is extremely remote due to elevation restrictions and incompatible substrate. Thus, there is no potential for project activities to impact this species.

The results of baseline Gunnison's prairie dog (*Cynomys gunnisoni*) and black-footed ferret surveys conducted by Peabody in the Black Mesa Mine and Kayenta Mine permit areas may be found in the PAP (see Fish and Wildlife Resources, Chapter 10, page 711, Peabody Coal Company, 1985). These surveys defined the number and extent of prairie dog colonies existing on the leasehold, documented the absence of the black-footed ferret, and documented the instability of the prairie dog colonies. However, a black-footed ferret monitoring program has been conducted since that time because the potential for re-expansion of existing prairie dog colonies, and/or establishment of new colonies exists. These studies have been reported to the Office of Surface Mining on an annual basis since institution. To date, the number, extent, and distribution of prairie dog colonies within or adjacent to the permit areas has failed to meet the currently accepted minimum requirements necessary to support the black-footed ferret, or warrant black-footed ferret searches. Therefore, potential for the N-6/N-11 drilling project to affect this species remains extremely remote.

Four species of threatened fishes could potentially occur in Navajo County, Arizona, and are considered in this assessment. They include the Apache (Arizona) trout (*Oncorhynchus apache*), Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*). Habitat requirements and distribution of these species is discussed in detail in Minckley (1973). The Apache trout is presently restricted to cold water perennial streams with low gradient meadow reaches. The Little Colorado spinedace exists in moderate to small streams in pools and riffles.

The loach minnow is a highly specialized, diminutive species that is essentially restricted to gravelly riffles in small to moderately large creeks and rivers. The spikedace requires moderate to large perennial streams with gravel cobble substrates and moderate to swift flow velocities. Coal Mine Wash and Moenkopi Wash drain the Mining Areas. Coal Mine Wash is a tributary to Moenkopi Wash. Moenkopi Wash drains to the Little Colorado River near Cameron, Arizona. Reaches of the Washes near the project area are characterized as ephemeral, with short, warm water intermittent reaches that occur in some years. The channel flows only in response to intense, localized precipitation events. Such flows are typically of short duration, with high velocities and extremely poor water quality due to high concentrations of suspended sediment. There is no potential for impact to these species because they are not present in or near the project area due to habitat restrictions.

With the exception of sightings associated with its reintroduction, the last report of a wild California condor (*Gymnops californianus*) in Arizona was in 1924. This species occupies high desert canyon lands and plateaus in Arizona, having been reintroduced starting in 1996. The release site is located in the Vermillion Cliffs area of northern Arizona, approximately 90 miles west northwest of the project area. Individuals have been known to range widely, therefore it is feasible a transient siting could occur in or near the project area. However, no deep canyons, cliffs, or plateaus occur in the project area so the prospect of a siting is extremely remote. Therefore the potential for impact to the California condor is extremely remote.

American peregrine falcons (*Falco peregrinus anatum*) are usually associated with cliffs or steep-walled canyon areas and nest almost exclusively on cliff faces. Nests are sometimes found on man-made structures such as building ledges and bridges. These are usually as a result of captive-bred release (hacking) programs. The density of cliffs may determine the suitability of an area for nesting. Adequate prey populations close to the nest are also important criteria in site selection. Nesting sites are usually located in close proximity to water, especially in the Southwest (Skaggs et al. 1986). Although human activities near the nest site and destruction of habitat for prey species can affect nesting peregrines by causing nest failure, no nesting habitat is present within the proposed exploration drilling area. Nesting habitat for the American peregrine falcon is known from the east edge of Black Mesa. Since there are no steep-walled canyons or cliffs and no wetland habitat that may attract migratory waterfowl in the proposed exploration drilling area, work in this area will not impact the species. Furthermore, the peregrine falcon was removed from the USFWS T&E list in 1999 and down listed to G4 status by the NNDFWL in 2001.

A complete discussion of the status of the Mexican spotted owl (*Strix occidentalis lucida*) in and near the Black Mesa Mine and Kayenta Mine permit areas and northern Black Mesa may be found in the PAP in Chapter 9 beginning on page 71b (PWCC 2001) and in LaRue (1994). The Mexican spotted owl may be considered at least a fairly common summer resident in shady mixed-conifer canyons and ravines on northern Black Mesa. Although there are no winter records, it is probably a permanent resident on northern Black Mesa. Known nest sites are in caves in cliffs adjacent to mixed conifer-filled canyon floors. The mixed conifer woodlands on Black Mesa typically occur in steep, rocky canyons and north facing slopes at elevations above 6800 feet. Fragmented stands of this habitat occur north and east of the project area and outside of the PWCC lease area. More extensive and continuous tracts of this habitat occur further north and east toward the rim of Black Mesa. No sightings or other evidence of Mexican spotted owls within the Black Mesa Mine or Kayenta Mine permit areas, including the project area have ever been observed. No suitable breeding or other habitat will be affected by the project. Mexican spotted owls were monitored for seven years in a more than two mile wide buffer on the north and east side of the PWCC lease area. Few occurrences of Mexican spotted owls were documented in the buffer zone and no

apparent impacts from mining were detected. Disturbance will be limited to the project area and existing access will be used as much as possible. No blasting will occur in the project area. The potential for impacting the Mexican spotted owl is extremely remote.

The results of baseline studies indicated that the southwestern willow flycatcher (*Empidonax traillii extimus*) does not breed on or near the Black Mesa Mine and Kayenta Mine permit areas, including the N-6/N-11 project area (Peabody Coal Company 1985). The southwestern willow flycatcher can be considered a sparse migrant, regionally. The five sightings of six individuals of *Empidonax trailli* on or near the Black Mesa Mine and Kayenta Mine permit areas are not considered to be the southwestern subspecies (LaRue 1994). Suitable habitat consisting of cottonwood/willow and tamarisk vegetation along rivers and streams is absent in the project area. However, sparse and fragmented tamarisk stands do occur along the washes in the project area so the possibility exists that this species could occur transiently. The potential for impact to this species is extremely remote. No individuals have ever been documented on or near the project area, and the project will not result in disturbance of marginally suitable tamarisk vegetation along Coal Mine Wash or Moenkopi Wash.

The Chiricahua leopard frog (*Rana chiricahuensis*) is a candidate for listing under the ESA. According to information obtained from the U.S. Fish and Wildlife Service, suitable habitat for this species includes streams, rivers, backwaters, ponds, and livestock watering tanks that are free from introduced fishes and bullfrogs (*Rana catesbeiana*). Water sources must be permanent or nearly permanent. Populations north of the Gila River (where the project area is located) are thought to be a distinct species that has not been formally described. A description of the aquatic communities within and near the Black Mesa Mine and Kayenta Mine permit areas is included in the PAP (Peabody Coal Company 1985). No naturally occurring perennial aquatic habitats occur in or near the project area. Also, no true frogs (*Rana sp.*) were encountered during the course of conducting baseline studies. For these reasons, impacts to the Chiricahua leopard frog will not occur as a result of this project.

4.3 CULTURAL RESOURCES AND ARCHAEOLOGY SITES

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. All identified sites, with the exception of five, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13). Anasazi Sites AZ-D:7:217, AZ-D:7:218, AZ-D:7:2024, and AZ-D:7:2025 are within the N-6/N-11 exploration project area and have a high probability of containing human remains. Navajo Site AZ-D:7:4041 is within the N-6/N-11 exploration project area and is listed as an "unknown" status regarding the presence of burials. All of these sites are shown on the enclosed Exhibit 2. These sites will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g) and the Native American Graves Protection and Repatriation Act (NAGPRA). Before drilling begins, the Navajo Nation Archaeology Department will conduct a field assessment for Traditional Cultural Property (TCP) sites throughout the project area. Any archaeology resources identified by the TCP survey will be avoided by at least 100 feet during this drilling program. PWCCs purpose with regard to Cultural Resources is to follow the Conditions of the approved AZ-0001D permit and any federal acts regarding these resources. By following the guidelines outlined in this section, this will be accomplished.

5.0 EXPLORATION SCHEDULE

Beginning: First Quarter – Calendar Year 2003

Terminating: Fourth Quarter – Calendar Year 2003

Reclamation:

Reclamation will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 3.6 miles of temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 85 drill pads and 85 drillholes (estimated at up to 50 boreholes and 35 coreholes) over a 12 month period; and subsequent reclamation of all exploration disturbance. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – To the extent possible, existing disturbed areas will be used for exploration staging requirements.

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 typically 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. Up to approximately 3.6 miles of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents approximately 6.5 acres of disturbance for temporary roads. On completion of drilling activities, temporary exploration roads will be reclaimed.

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. With a total of up to 85 drill sites, this represents 14.5 acres of disturbance for drill site construction. On completion of drilling activities, all mud pits will be backfilled and drill sites 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 in order to recover an intact core sample of the coal seam or horizon of interest.

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. 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 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. Drillholes not completed as monitoring wells 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 permanent sealing is typically three to five days.

Areas disturbed by exploration activities including staging areas, temporary exploration roads, and drill sites will be stabilized or reclaimed following completion of drilling activities. 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 Stabilization Mix described in Chapter 23, Revegetation Plan, AZ-0001D permit.

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 conditions (snow, rain, mud). Reclamation activities will be completed within six months following initiation, and will be consistent with seasonal reclamation planting considerations as outlined in Chapter 23, Revegetation Plan.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed one-year, Phase I PWCC exploration program for the N-6/N-11 coal resource area:

Plugging and sealing drillholes – 85 (5" x 500') @ $50/hole	$ 4,250
Backfilling mud pits – 85 @ 25cy @ $0.60yd	$ 1,275
Regrading drill pads – 85 @ 0.17 acre @ $1,000/acre	$ 14,450
Regrading roads – 18,900 feet @ $100/100 ft.	$ 18,900
Soil replacement – [(14.5 acres – drill pads) + (6.5 acres – roads)] x 43,560 ft^2/acre x 0.5 ft/27 @ $0.50/yd	$ 8,470
Revegetation – (21.0 acres) @ $300/acre	$ 6,300
Total Direct Costs	$ 53,645
Total Indirect Costs (@16.9 percent)	$ 9,067
Total Estimated Costs	$ 62,712

PWCC's existing bond estimate in Chapter 24 provides $110,278 for contingency activities (Volume 11A, Chapter 24, pg. 21.). This exceeds the current calculated bonding requirements by $47,566.

PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-2b

N-9 COAL RESOURCE AREA EXPLORATION PROGRAM

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
Black Mesa Mine
P.O. Box 650
Kayenta, Arizona 86033
(928) 677-3201

2.0 NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Randy S. Lehn
Engineering & Reclamation Manager
P. O. Box 650
Kayenta, Arizona 86033
(928) 677-5078

3.0 PROPOSED EXPLORATION AREA

The N-9 coal resource exploration area encompasses approximately 1200 acres of the Black Mesa in central Navajo County, northern Arizona extending from PWCC coordinates 4,000 to 16,000 north and from 18,000 to 28,000 east. This area is shown on the enclosed Exhibit 1, Exploration Plan General Location Map, and Exhibit 3, N-9 Exploration Plan Drillhole Location Map. The entire exploration area occurs within the Kayenta Mine Permit AZ-0001D boundary as described in Chapter 3, Attachment 6.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted is in the northern portion of PWCC's Kayenta Mine Permit Area. This area ranges in elevation from approximately 6,600 feet above mean sea level (amsl) to 7,150 feet amsl and is characterized by low mesas and deeply incised ephemeral channels. The N-9 Exploration Area is drained by Yazzie Wash to the north and Yellow Water Canyon Wash to the south. The area is semi-arid with annual precipitation of approximately 9 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland vegetation types.

4.1 SPECIES OF INTEREST

PWCC plans to begin exploration drilling as early as the first quarter 2003. If drilling plans call for drilling between April 30 and July 13, 2003, PWCC will conduct a formal survey for raptors prior

to commencing drilling activities in order to develop measures for minimizing impacts to breeding raptors. Drilling will be conducted between April 30th and July 13th only after specific drill sites are cleared by formal survey. The Office of Surface Mining will be consulted to formulate adequate protection plans and procedures if any nest site conflicts are identified as a result of formal survey.

4.2 THREATENED OR ENDANGERED SPECIES

The following species accounts discuss the status (presence, absence, and habitat requirements) of, and potential project-related impacts (if any) to threatened, endangered, proposed, and candidate species under the Endangered Species Act (ESA) of 1973. The species discussed include those that are known to occur in Navajo County, Arizona, and could therefore potentially occur in the project area.

A complete discussion of the status of the Navajo sedge (*Carex Specuicola*) in the Black Mesa Mine and Kayenta Mine permit areas may be found in the Permit Application Package (PAP) for the Black Mesa and Kayenta Mines (see Vegetation Resources, Chapter 9, page 65, Peabody Coal Company, 1985). The original baseline study areas included the N-9 Exploration Drilling Project Area. The aforementioned discussion, identifying the habitat requirements and known distribution of the Navajo sedge, remains relevant. In summary, the Navajo sedge is absent from the project area because no suitable habitat (springs, seeps, or other riparian areas) is present. No impacts are possible as a result of project activities.

The Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*) has an extremely limited geographic range, associated with gravely soils of the Shinarump conglomerate of the Chinle Formation. The soil groups in the project area are derived from the Wepo Formation within the Mesa Verde Group (stratigraphically overlying the Chinle Formation by some 4,000 feet), or are eolian, alluvial, or porcellanite-derived. The elevation of the study area averages about 6800 feet above mean sea level. The known elevation range where the Peebles Navajo cactus is found is 5400-5600 feet above mean sea level. The potential for this species to occur in the project area is extremely remote due to elevation restrictions and incompatible substrate. Thus, there is no potential for project activities to impact this species.

The results of baseline Gunnison's prairie dog (*Cynomys gunnisoni*) and black-footed ferret surveys conducted by Peabody in the Black Mesa Mine and Kayenta Mine permit areas may be found in the PAP (see Fish and Wildlife Resources, Chapter 10, page 711, Peabody Coal Company, 1985). These surveys defined the number and extent of prairie dog colonies existing on the leasehold, documented the absence of the black-footed ferret, and documented the instability of the prairie dog colonies. However, a black-footed ferret monitoring program has been conducted since that time because the potential for re-expansion of existing prairie dog colonies, and/or establishment of new colonies exists. These studies have been reported to the Office of Surface Mining on an annual basis since institution. To date, the number, extent, and distribution of prairie dog colonies within or adjacent to the permit areas has failed to meet the currently accepted minimum requirements necessary to support the black-footed ferret, or warrant black-footed ferret searches. Therefore, potential for the N-9 drilling project to affect this species remains extremely remote.

Four species of threatened fishes could potentially occur in Navajo County, Arizona, and are considered in this assessment. They include the Apache (Arizona) trout (*Oncorhynchus apache*), Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*). Habitat requirements and distribution of these species is discussed in detail in Minckley (1973). The Apache trout is presently restricted to cold water perennial streams with low gradient meadow reaches. The Little Colorado spinedace exists in moderate to small streams in pools and riffles. The loach minnow is a highly specialized, diminutive species that is essentially restricted to gravelly riffles in small to moderately large creeks and rivers. The spikedace requires moderate to large

perennial streams with gravel cobble substrates and moderate to swift flow velocities. Yazzie Wash and Yellow Water Canyon Wash drain the Mining Areas. Yazzie Wash and Yellow Water Canyon Wash are tributaries to Moenkopi Wash. Moenkopi Wash drains to the Little Colorado River near Cameron, Arizona. Reaches of the Washes near the project area are characterized as ephemeral, with short, warm water intermittent reaches that occur in some years. The channel flows only in response to intense, localized precipitation events. Such flows are typically of short duration, with high velocities and extremely poor water quality due to high concentrations of suspended sediment. There is no potential for impact to these species because they are not present in or near the project area due to habitat restrictions.

With the exception of sightings associated with its reintroduction, the last report of a wild California condor (*Gymnops californianus*) in Arizona was in 1924. This species occupies high desert canyon lands and plateaus in Arizona, having been reintroduced starting in 1996. The release site is located in the Vermillion Cliffs area of northern Arizona, approximately 90 miles west northwest of the project area. Individuals have been known to range widely, therefore it is feasible a transient siting could occur in or near the project area. However, no deep canyons, cliffs, or plateaus occur in the project area so the prospect of a siting is extremely remote. Therefore the potential for impact to the California condor is extremely remote.

American peregrine falcons (*Falco peregrinus anatum)* are usually associated with cliffs or steep-walled canyon areas and nest almost exclusively on cliff faces. Nests are sometimes found on man-made structures such as building ledges and bridges. These are usually as a result of captive-bred release (hacking) programs. The density of cliffs may determine the suitability of an area for nesting. Adequate prey populations close to the nest are also important criteria in site selection. Nesting sites are usually located in close proximity to water, especially in the Southwest (Skaggs et al. 1986). Although human activities near the nest site and destruction of habitat for prey species can affect nesting peregrines by causing nest failure, no nesting habitat is present within the proposed exploration drilling area. Nesting habitat for the American peregrine falcon is known from the east edge of Black Mesa. Since there are no steep-walled canyons or cliffs and no wetland habitat that may attract migratory waterfowl in the proposed exploration drilling area, work in this area will not impact the species. Furthermore, the peregrine falcon was removed from the USFWS T&E list in 1999 and down listed to G4 status by the NNDFWL in 2001.

A complete discussion of the status of the Mexican spotted owl (*Strix occidentalis lucida*) in and near the Black Mesa Mine and Kayenta Mine permit areas and northern Black Mesa may be found in the PAP in Chapter 9 beginning on page 71b (PWCC 2001) and in LaRue (1994). The Mexican spotted owl may be considered at least a fairly common summer resident in shady mixed-conifer canyons and ravines on northern Black Mesa. Although there are no winter records, it is probably a permanent resident on northern Black Mesa. Known nest sites are in caves in cliffs adjacent to mixed conifer-filled canyon floors. The mixed conifer woodlands on Black Mesa typically occur in steep, rocky canyons and north facing slopes at elevations above 6800 feet. Fragmented stands of this habitat occur north and east of the project area and outside of the PWCC lease area. More extensive and continuous tracts of this habitat occur further north and east toward the rim of Black Mesa. No sightings or other evidence of Mexican spotted owls within the Black Mesa Mine or Kayenta Mine permit areas, including the project area have ever been observed. No suitable breeding or other habitat will be affected by the project. Mexican spotted owls were monitored for seven years in a more than two mile wide buffer on the north and east side of the PWCC lease area. Few occurrences of Mexican spotted owls were documented in the buffer zone and no apparent impacts from mining were detected. Disturbance will be limited to the project area and existing access will be used as much as possible. No blasting will occur in the project area. The potential for impacting the Mexican spotted owl is extremely remote.

The results of baseline studies indicated that the southwestern willow flycatcher (*Empidonax traillii extimus*) does not breed on or near the Black Mesa Mine and Kayenta Mine permit areas, including the N-9 project area (Peabody Coal Company 1985). The southwestern willow flycatcher can be considered a sparse migrant, regionally. The five sightings of six individuals of *Empidonax trailli* on or near the Black Mesa Mine and Kayenta Mine permit areas are not considered to be the southwestern subspecies (LaRue 1994). Suitable habitat consisting of cottonwood/willow and tamarisk vegetation along rivers and streams is absent in the project area. However, sparse and fragmented tamarisk stands do occur along the washes in the project area so the possibility exists that this species could occur transiently. The potential for impact to this species is extremely remote. No individuals have ever been documented on or near the project area, and the project will not result in disturbance of marginally suitable tamarisk vegetation along Yazzie Wash or Yellow Water Canyon Wash.

The Chiricahua leopard frog (*Rana chiricahuensis*) is a candidate for listing under the ESA. According to information obtained from the U.S. Fish and Wildlife Service, suitable habitat for this species includes streams, rivers, backwaters, ponds, and livestock watering tanks that are free from introduced fishes and bullfrogs (*Rana catesbeiana*). Water sources must be permanent or nearly permanent. Populations north of the Gila River (where the project area is located) are thought to be a distinct species that has not been formally described. A description of the aquatic communities within and near the Black Mesa Mine and Kayenta Mine permit areas is included in the PAP (Peabody Coal Company 1985). No naturally occurring perennial aquatic habitats occur in or near the project area. Also, no true frogs (*Rana sp.*) were encountered during the course of conducting baseline studies. For these reasons, impacts to the Chiricahua leopard frog will not occur as a result of this project.

4.3 CULTURAL RESOURCES AND ARCHAEOLOGY SITES

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. All identified sites, with the exception of seventeen, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13). Anasazi Sites AZ-D:7:143, AZ-D:7:731, AZ-D:7:732, AZ-D:7:2017, AZ-D:7:2018, AZ-D:7:2047, AZ-D:7:2086, AZ-D:7:2089, AZ-D:7:2091, AZ-D:7:2093, AZ-D:7:2098, AZ-D:7:2102, AZ-D:7:2106, and AZ-D:7:2107 are near or within the N-9 exploration project area and have a high probability of containing human remains. Navajo sites AZ-D:7:4035, AZ-D:7:4036, and AZ-D:7:4038 are near or within the N-9 exploration project area and are listed as "unknown" status regarding the presence of burials. All of these sites are shown on the enclosed Exhibit 3. These sites will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g) and the Native American Graves Protection and Repatriation Act (NAGPRA).

Before drilling begins, the Navajo Nation Archaeology Department will conduct a field assessment for Traditional Cultural Properties (TCP) throughout the project area. Any archaeological resources identified by the TCP survey will be avoided by at least 100 feet during this drilling program.

PWCCs purpose with regard to Cultural Resources is to follow the Conditions of the approved AZ-0001D permit and any federal acts regarding these resources. By following the guidelines outlined in this section, this will be accomplished.

5.0 EXPLORATION SCHEDULE

Beginning: First Quarter – Calendar Year 2003

Terminating: Fourth Quarter – Calendar Year 2003

Reclamation: Reclamation will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 0.2 miles of additional temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 21 drill pads and 21 drillholes (estimated at up to 21 coreholes) over a 12 month period; and subsequent reclamation of all exploration disturbance. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – To the extent possible, existing disturbed areas will be used for exploration staging requirements.

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 typically 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. Up to approximately 1,000 feet (0.2 miles) of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents 15,000 square feet (0.4 acres) of disturbance for temporary roads. On completion of drilling activities, temporary exploration roads will be reclaimed.

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. With a total of up to 21 drill sites, this represents 3.6 acres of disturbance for drill site construction. On completion of drilling activities, all mud pits will be backfilled and drill sites 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 in order to recover an intact core sample of the coal seam or horizon of interest.

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 supervisor, 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. 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 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. Drillholes not completed as monitoring wells 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 permanent sealing is typically three to five days.

Areas disturbed by exploration activities including staging areas, temporary exploration roads, and drill sites will be stabilized or reclaimed following completion of drilling activities. 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 Stabilization Mix described in Chapter 23, Revegetation Plan, AZ-0001D permit.

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 conditions (snow, rain, mud). Reclamation activities will be completed within six months following initiation, and will be consistent with seasonal reclamation planting considerations as outlined in Chapter 23, Revegetation Plan.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed one-year PWCC exploration program for the N-9 coal resource area:

Plugging & sealing drillholes – 21 (5" x 500') @ $50/hole	$ 1,050
Backfilling mud pits – 21 @ 25cy @ $0.60yd	$ 315
Regrading drill pads – 21 @ 0.17 acre @ $1,000/acre	$ 3,570
Regrading roads – 1,000 feet @ $100/100 ft.	$ 1,000
Soil Replacement -[(3.6 acres - drill pads) + (.4 acres - roads)] x 43,560 ft²/acre x .5 ft/27 @ $0.50/yd	$ 1,615
Revegetation – (4.0 acres) @ $300/acre	$ 1,200
Total Direct Costs	$8,750
Total Indirect Costs (@16.9 percent)	$ 1,479

Total Estimated Costs $10,229

If necessary PWCC's existing bond surety will be increased by an additional $10,500 for exploration activities in the N-9 coal resource area.

PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-2c

N-10 COAL RESOURCE AREA EXPLORATION PROGRAM

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
Black Mesa Mine
P.O. Box 650
Kayenta, Arizona 86033
(928) 677-3201

2.0 NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Randy S. Lehn
Engineering & Reclamation Manager
P. O. Box 650
Kayenta, Arizona 86033
(928) 677-5078

3.0 PROPOSED EXPLORATION AREA

The N-10 coal resource exploration area encompasses approximately 1,100 acres of the Black Mesa in central Navajo County, northern Arizona extending from PWCC coordinates 10,500 north to 1,000 south and from 29,500 to 38,000 east. This area is shown on the enclosed Exhibit 1, Exploration Plan General Location Map, and Exhibit 4, N-10 Exploration Plan Drillhole Location Map. The entire exploration area occurs within the Kayenta Mine Permit AZ-0001D boundary as described in Chapter 3, Attachment 6.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted is in the northern portion of PWCC's Kayenta Mine Permit Area. This area ranges in elevation from approximately 6,700 feet above mean sea level (amsl) to 7,000 feet amsl and is characterized by low mesas and deeply incised ephemeral channels. The N-10 Exploration Area is drained by Yellow Water Canyon Wash to the north and Coal Mine Wash to the south. The area is semi-arid with annual precipitation of approximately 9 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland vegetation types.

4.1 SPECIES OF INTEREST

PWCC plans to begin exploration drilling as early as the first quarter 2003. If drilling plans call for drilling between April 30 and July 13, 2003, PWCC will conduct a formal survey for raptors prior to commencing drilling activities in order to develop measures for minimizing impacts to breeding raptors. Drilling will be conducted between April 30th and July 13th only after specific drill sites are cleared by formal survey. The Office of Surface Mining will be consulted to formulate adequate protection plans and procedures if any nest site conflicts are identified as a result of formal survey.

4.2 THREATENED OR ENDANGERED SPECIES

The following species accounts discuss the status (presence, absence, and habitat requirements) of and potential project-related impacts (if any) to threatened, endangered, proposed, and candidate species under the Endangered Species Act (ESA) of 1973. The species discussed include those that are known to occur in Navajo County, Arizona, and could therefore potentially occur in the project area.

A complete discussion of the status of the Navajo sedge (*Carex Specuicola*) in the Black Mesa Mine and Kayenta Mine permit areas may be found in the Permit Application Package (PAP) for the Black Mesa and Kayenta Mines (see Vegetation Resources, Chapter 9, page 65, Peabody Coal Company, 1985). The original baseline study areas included the N-10 Exploration Drilling Project Area. The aforementioned discussion, identifying the habitat requirements and known distribution of the Navajo sedge, remains relevant. In summary, the Navajo sedge is absent from the project area because no suitable habitat (springs, seeps, or other riparian areas) is present. No impacts are possible as a result of project activities.

The Peebles Navajo cactus (*Pediocactus peeblesianus* var. *peeblesianus*) has an extremely limited geographic range, associated with gravely soils of the Shinarump conglomerate of the Chinle Formation. The soil groups in the project area are derived from the Wepo Formation within the Mesa Verde Group (stratigraphically overlying the Chinle Formation by some 4,000 feet), or are eolian, alluvial, or porcellanite-derived. The elevation of the study area averages about 6800 feet above mean sea level. The known elevation range where the Peebles Navajo cactus is found is 5400-5600 feet above mean sea level. The potential for this species to occur in the project area is extremely remote due to elevation restrictions and incompatible substrate. Thus, there is no potential for project activities to impact this species.

The results of baseline Gunnison's prairie dog (*Cynomys gunnisoni*) and black-footed ferret surveys conducted by Peabody in the Black Mesa Mine and Kayenta Mine permit areas may be found in the PAP (see Fish and Wildlife Resources, Chapter 10, page 711, Peabody Coal Company, 1985). These surveys defined the number and extent of prairie dog colonies existing on the leasehold, documented the absence of the black-footed ferret, and documented the instability of the prairie dog colonies. However, a black-footed ferret monitoring program has been conducted since that time because the potential for re-expansion of existing prairie dog colonies, and/or establishment of new colonies exists. These studies have been reported to the Office of Surface Mining on an annual basis since institution. To date, the number, extent, and distribution of prairie dog colonies within or adjacent to the permit areas has failed to meet the currently accepted minimum requirements necessary to support the black-footed ferret, or warrant black-footed ferret searches. Therefore, potential for the N-10 drilling project to affect this species remains extremely remote.

Four species of threatened fishes could potentially occur in Navajo County, Arizona, and are considered in this assessment. They include the Apache (Arizona) trout (*Oncorhynchus apache*), Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*). Habitat requirements and distribution of these species is discussed in detail in Minckley (1973). The Apache trout is presently restricted to cold water perennial streams with low gradient meadow reaches. The Little Colorado spinedace exists in moderate to small streams in pools and riffles.

The loach minnow is a highly specialized, diminutive species that is essentially restricted to gravelly riffles in small to moderately large creeks and rivers. The spikedace requires moderate to large perennial streams with gravel cobble substrates and moderate to swift flow velocities. Yellow Water Canyon Wash and Coal Mine Wash drain the Mining Areas. Yellow Water Canyon Wash and Coal Mine Wash tributaries to Moenkopi Wash. Moenkopi Wash drains to the Little Colorado River near Cameron, Arizona. Reaches of the Washes near the project area are characterized as ephemeral, with short, warm water intermittent reaches that occur in some years. The channel flows only in response to intense, localized precipitation events. Such flows are typically of short duration, with high velocities and extremely poor water quality due to high concentrations of suspended sediment. There is no potential for impact to these species because they are not present in or near the project area due to habitat restrictions.

With the exception of sightings associated with its reintroduction, the last report of a wild California condor (*Gymnops californianus*) in Arizona was in 1924. This species occupies high desert canyon lands and plateaus in Arizona, having been reintroduced starting in 1996. The release site is located in the Vermillion Cliffs area of northern Arizona, approximately 90 miles west northwest of the project area. Individuals have been known to range widely, therefore it is feasible a transient siting could occur in or near the project area. However, no deep canyons, cliffs, or plateaus occur in the project area so the prospect of a siting is extremely remote. Therefore the potential for impact to the California condor is extremely remote.

American peregrine falcons (*Falco peregrinus anatum)* are usually associated with cliffs or steep-walled canyon areas and nest almost exclusively on cliff faces. Nests are sometimes found on man-made structures such as building ledges and bridges. These are usually as a result of captive-bred release (hacking) programs. The density of cliffs may determine the suitability of an area for nesting. Adequate prey populations close to the nest are also important criteria in site selection. Nesting sites are usually located in close proximity to water, especially in the Southwest (Skaggs et al. 1986). Although human activities near the nest site and destruction of habitat for prey species can affect nesting peregrines by causing nest failure, no nesting habitat is present within the proposed exploration drilling area. Nesting habitat for the American peregrine falcon is known from the east edge of Black Mesa. Since there are no steep-walled canyons or cliffs and no wetland habitat that may attract migratory waterfowl in the proposed exploration drilling area, work in this area will not impact the species. Furthermore, the peregrine falcon was removed from the USFWS T&E list in 1999 and down listed to G4 status by the NNDFWL in 2001.

A complete discussion of the status of the Mexican spotted owl (*Strix occidentalis lucida*) in and near the Black Mesa Mine and Kayenta Mine permit areas and northern Black Mesa may be found in the PAP in Chapter 9 beginning on page 71b (PWCC 2001) and in LaRue (1994). The Mexican spotted owl may be considered at least a fairly common summer resident in shady mixed-conifer canyons and ravines on northern Black Mesa. Although there are no winter records, it is probably a permanent resident on northern Black Mesa. Known nest sites are in caves in cliffs adjacent to mixed conifer-filled canyon floors. The mixed conifer woodlands on Black Mesa typically occur in steep, rocky canyons and north facing slopes at elevations above 6800 feet. Fragmented stands of this habitat occur north and east of the project area and outside of the PWCC lease area. More extensive and continuous tracts of this habitat occur further north and east toward the rim of Black Mesa. No sightings or other evidence of Mexican spotted owls within the Black Mesa Mine or Kayenta Mine permit areas, including the project area have ever been observed. No suitable breeding or other habitat will be affected by the project. Mexican spotted owls were monitored for seven years in a more than two mile wide buffer on the north and east side of the PWCC lease area. Few occurrences of Mexican spotted owls were documented in the buffer zone and no apparent impacts from mining were detected. Disturbance will be limited to the project area and

existing access will be used as much as possible. No blasting will occur in the project area. The potential for impacting the Mexican spotted owl is extremely remote.

The results of baseline studies indicated that the southwestern willow flycatcher (*Empidonax traillii extimus*) does not breed on or near the Black Mesa Mine and Kayenta Mine permit areas, including the N-10 project area (Peabody Coal Company 1985). The southwestern willow flycatcher can be considered a sparse migrant, regionally. The five sightings of six individuals of *Empidonax trailli* on or near the Black Mesa Mine and Kayenta Mine permit areas are not considered to be the southwestern subspecies (LaRue 1994). Suitable habitat consisting of cottonwood/willow and tamarisk vegetation along rivers and streams is absent in the project area. However, sparse and fragmented tamarisk stands do occur along the washes in the project area so the possibility exists that this species could occur transiently. The potential for impact to this species is extremely remote. No individuals have ever been documented on or near the project area, and the project will not result in disturbance of marginally suitable tamarisk vegetation along Yellow Water Canyon Wash or Coal Mine Wash.

The Chiricahua leopard frog (*Rana chiricahuensis*) is a candidate for listing under the ESA. According to information obtained from the U.S. Fish and Wildlife Service, suitable habitat for this species includes streams, rivers, backwaters, ponds, and livestock watering tanks that are free from introduced fishes and bullfrogs (*Rana catesbeiana*). Water sources must be permanent or nearly permanent. Populations north of the Gila River (where the project area is located) are thought to be a distinct species that has not been formally described. A description of the aquatic communities within and near the Black Mesa Mine and Kayenta Mine permit areas is included in the PAP (Peabody Coal Company 1985). No naturally occurring perennial aquatic habitats occur in or near the project area. Also, no true frogs (*Rana sp.*) were encountered during the course of conducting baseline studies. For these reasons, impacts to the Chiricahua leopard frog will not occur as a result of this project.

4.3 CULTURAL RESOURCES AND ARCHAEOLOGY SITES

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. All identified sites, with the exception of eight, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13). Anasazi Sites AZ-D:7:74, AZ-D:7:134, AZ-D:7:2002, AZ-D:7:2045, AZ-D:7:2046, and AZ-D:7:2047 are near or within the N-10 exploration project area and have a high probability of containing human remains. Navajo sites AZ-D:7:4002 and AZ-D:7:4006 are near or within the N-10 exploration project area and are listed as "unknown" status regarding the presence of burials. All of these sites are shown on the enclosed Exhibit 4. These sites will be avoided by at least 100 feet during this drilling program to comply with 30 CFR 761.11(g) and the Native American Graves Protection and Repatriation Act (NAGPRA).

Before drilling begins, the Navajo Nation Archaeology Department will conduct a field assessment for Traditional Cultural Properties (TCP) throughout the project area. Any archaeological resources identified by the TCP survey will be avoided by at least 100 feet during this drilling program.

PWCCs purpose with regard to Cultural Resources is to follow the Conditions of the approved AZ-0001D permit and any federal acts regarding these resources. By following the guidelines outlined in this section, this will be accomplished.

5.0 EXPLORATION SCHEDULE

Beginning: First Quarter – Calendar Year 2003

Terminating: Fourth Quarter – Calendar Year 2003

Reclamation: Reclamation will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 1.9 miles of additional temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 41 drill pads and 41 drillholes (estimated at up to 17 coreholes) over a 12 month period; and subsequent reclamation of all exploration disturbance. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – To the extent possible, existing disturbed areas will be used for exploration staging requirements.

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 typically 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. Up to approximately 10,000 feet (1.9 miles) of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents 150,000 square feet (3.5 acres) of disturbance for temporary roads. On completion of drilling activities, temporary exploration roads will be reclaimed.

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. With a total of up to 41 drill sites, this represents 7.0 acres of disturbance for drill site construction. On completion of drilling activities, all mud pits will be backfilled and drill sites 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 in order to recover an intact core sample of the coal seam or horizon of interest.

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 supervisor, 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. 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 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. Drillholes not completed as monitoring wells 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 permanent sealing is typically three to five days.

Areas disturbed by exploration activities including staging areas, temporary exploration roads, and drill sites will be stabilized or reclaimed following completion of drilling activities. 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 Stabilization Mix described in Chapter 23, Revegetation Plan, AZ-0001D permit.

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 conditions (snow, rain, mud). Reclamation activities will be completed within six months following initiation, and will be consistent with seasonal reclamation planting considerations as outlined in Chapter 23, Revegetation Plan.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed one-year PWCC exploration program for the N-10 coal resource area:

Plugging & sealing drillholes – 41 (5" x 500') @ $50/hole	$ 2,050
Backfilling mud pits – 41 @ 25cy @ $0.60yd	$ 615
Regrading drill pads – 41 @ 0.17 acre @ $1,000/acre	$ 6,970
Regrading roads – 10,000 feet @ $100/100 ft.	$ 10,000
Soil Replacement -[(7.0 acres - drill pads) + (3.5 acres - roads)] x 43,560 ft²/acre x .5 ft/27 @ $0.50/yd	$ 4,235
Revegetation – (10.5 acres) @ $300/acre	$ 3,150
Total Direct Costs	$27,020
Total Indirect Costs (@16.9 percent)	$ 4,567
Total Estimated Costs	$31,587

If necessary PWCC's existing bond surety will be increased by an additional $31,600 for exploration activities in the N-10.

PEABODY WESTERN COAL COMPANY
ATTACHMENT 4-2d

N-9 COAL RESOURCE AREA EXPLORATION PROGRAM – PHASE 2

1.0. NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT

Peabody Western Coal Company (PWCC)
Kayenta Mine
P.O. Box 650
Kayenta, Arizona 86033
(928) 677-3201

2.0 NAME, ADDRESS, AND TELEPHONE NUMBER OF APPLICANT'S REPRESENTATIVE

Gary W. Wendt
Environmental Program Supervisor
P. O. Box 650
Kayenta, Arizona 86033
(928) 677-5130

3.0 PROPOSED EXPLORATION AREA

The Phase 2 exploration for the N-9 coal resource area encompasses approximately 1,280 acres of the Black Mesa in central Navajo County, located in northern Arizona extending from PWCC coordinates 3,000 to 16,000 north and from 19,000 to 28,000 east. This area is shown on the enclosed Exhibit 1, Exploration Plan General Location Map, and Exhibit 5, N-9 Exploration Plan Phase 2 Drillhole Location Map. The entire exploration area occurs within the Kayenta Mine Permit AZ-0001D boundary as described in Chapter 3, Attachment 6.

4.0 AFFECTED LANDS

The area where the proposed exploration activities would be conducted is in the northwestern portion of PWCC's Kayenta Mine Permit Area. This area ranges in elevation from approximately 6,650 feet above mean sea level (amsl) to 7,150 feet amsl and is characterized by low mesas and deeply incised ephemeral drainages. The N-9 Exploration Area is drained by Yazzie Wash to the northwest and Yellow Water Canyon Wash to the southeast. The area is semi-arid with annual precipitation of approximately 9 inches, soils are generally poorly developed and relatively shallow, and vegetation is dominated by sagebrush shrubland and pinyon-juniper woodland types.

4.1 SPECIES OF INTEREST

PWCC plans to begin exploration drilling as early as the second quarter 2005. If drilling plans call for drilling between April 30 and July 13, 2005, PWCC will conduct a formal survey for raptors prior to commencing drilling activities in order to develop measures for minimizing impacts to breeding raptors. Drilling will be conducted between April 30th and July 13th only after specific drill sites are cleared by formal survey. The Office of Surface Mining will be consulted to formulate

adequate protection plans and procedures if any nest site conflicts are identified as a result of formal survey.

4.2 THREATENED OR ENDANGERED SPECIES

The following species accounts discuss the status (presence, absence, and habitat requirements) of, and potential project-related impacts (if any) to current threatened and endangered species under the Endangered Species Act (ESA) of 1973 and Group 2 and 3 species in the March 2001 Navajo Endangered Species List (NESL) issued by the Navajo Nation Department of Fish and Wildlife. The species discussed include those that are known to occur in Navajo County, Arizona, and have the required habitat present and could therefore potentially occur in the project area.

In 2003, supplemental vegetation and wildlife baseline studies and threatened and endangered species searches were conducted in life of mine coal resource areas of the Black Mesa leasehold. The N-9 coal resource area was included in the surveys. These results are presented in the pending N-9 revision package submitted to OSMRE. In addition, the N-9 coal resource area was included in the original vegetation and wildlife baseline studies previously conducted on the leasehold. This information is presented in Chapters 9 and 10 respectively, of the Black Mesa and Kayenta Mines Permit Application Package (PAP). The N-9 area continues to be included in ongoing annual wildlife monitoring studies.

Plants

The following listed plants are those that have even the slightest potential for occurrence in the project area. Plants not listed have no potential for occurrence due to elevation, required habitat, or occurrence potential restricted to known locations outside of the Black Mesa area.

Astragalus cremnophylax var. *cremnophylax* – Sentry milkvetch
This milkvetch is known from Grand Canyon National Park on Kaibab limestone, a Permian-age formation. Black Mesa study areas do not include limestones and are far younger (Cretaceous-age). Thus no suitable habitat was found and no sentry milkvetch was encountered.

Astragalus cutleri (*A. preusii* var. *cutleri*) – Copper Canyon milkvetch
This plant is an endemic in southern San Juan County, Utah occurring on seleniferous soils derived from the Triassic-age Shinarump Conglomerate member of the Chinle formation at 3,800 feet. The lowest Black Mesa study area elevations of about 6,200 feet are substantially higher and no substrates approximating those of the known occurrences are present. No individuals of Copper Canyon milkvetch were encountered during intensive surveys.

Astragalus humillimus – Mancos milkvetch
This plant is known from San Juan County, New Mexico and adjacent Montezuma County, Colorado at elevations from about 5,000 to 6,500 feet in cracks on "slickrock" exposures of the Cretaceous-age Point Lookout sandstone, which is also found in McKinley and Sandoval Counties, New Mexico in close association with the Satan Tongue member of Mancos Shale. In the Black Mesa study areas, Yale Point sandstone, a facies of the Mesa Verde formation of the Black Mesa Basin, forms limited exposures of bare rock. These sandstones are older than those of the San Juan Basin, the Cretaceous sea having receded from the Black Mesa Basin before it receded from the San Juan Basin. In addition to the differences in substrates, the Black Mesa study areas are mostly higher in elevation than the known occurrences of Mancos milkvetch. No individuals of Mancos milkvetch were found during intensive searches in 2003.

Carex specuicola – Navajo sedge
This plant is known to occur in extreme northern Arizona and barely into Utah in seeps and hanging gardens below vertical cliffs of Navajo sandstone at elevations between 4,400 and 7,000 feet. No exposures of the lower Jurassic-age Navajo sandstone are present in the Black Mesa study areas. The upper Cretaceous Yale Point sandstone that forms cliffs along washes in the Black Mesa area is generally without development of seepage zones. The very few seepage zones observed during the intensive surveys had extensive crusts of evaporated salt. No individuals of Navajo sedge were observed during the intensive surveys.

Echinocereus triglochidiatus var. *arizonicus* – Arizona hedgehog cactus
This rare cactus is known from central Arizona at elevations from 3,400 to 6,360 feet on very rocky sites comprised mostly of boulders and cobbles of orthoclase-rich granite of late Cretaceous age. Other substrates on which it has been found include volcanic tuff and mid-Tertiary age dacite. Substrates of the Black Mesa study areas are distinctly unlike these. In addition, the range of elevations within the Black Mesa sites is 6,200 to 7,150 feet, which is, for the most part, substantially higher than the highest known occurrences of the cactus. These facts made the occurrence of this cactus unlikely in the Black Mesa study areas, and, in fact, no individuals of Arizona hedgehog cactus were encountered during the 2003 surveys.

Pediocactus bradyi – Brady pincushion cactus
This narrow endemic is found in Coconino County, Arizona along the rim of Marble Canyon between elevations of 3,400 and 5,200 feet. Substrates are narrowly defined where intermixed Moenkopi and Kaibab formation debris form the soil parent material. Black Mesa study area elevations begin at about 6,200 feet and range upward to about 7,150 feet. Furthermore none of the Upper Cretaceous-age substrates of the Black Mesa areas approximate the Moenkopi or Kaibab formation materials (Upper Triassic to lower Jurassic age). There was almost no chance of finding this cactus, and none were found during 2003 intensive surveys of the Black Mesa study areas.

Pediocactus peeblesianus var. *fickeiseniae* – Fickeisen plains cactus
The known occurrences of this cactus are in Coconino and Mohave Counties, Arizona on soils derived from Kaibab limestone at elevations between 4,000 and 5,600 feet. Black Mesa study area sites are all well above the known elevational limit and limestone-derived soils are not present. Nonetheless, it was sought during the intensive surveys but not found.

Pediocactus peeblesianus var. *peeblesianus* – Navajo plains cactus
This cactus is known from southern Navajo County at elevations from 5,100 to 5,650 feet in the upper reaches of the Little Colorado River watershed on thin veneers of gravel that are not replicated in the Black Mesa study areas. The elevations of the Black Mesa study areas are well above the highest known occurrence of this cactus. No individuals of Navajo plains cactus were encountered in the intensive field surveys.

Phlox cluteana – Navajo Mountain Phlox
This plant is known from the northern Chuska Mountains, Navajo Mountain, and Black Rock Mountain on the Navajo Nation, and in adjacent New Mexico and Utah at elevations from 6,000 to 10,400 feet on sandy soils with leaf litter under ponderosa pine, Gambel oak, and pinyon – juniper woodland. Although it seems likely that the pinyon-juniper woodland habitat in which it is found represents the opposite end of the moisture spectrum from that found in the Black Mesa pinyon-juniper sites, it was sought in the intensive searches of spring 2003, but not found.

Platanthera zothecina – Alcove bog orchid
This plant requires the constant flow of moisture usually in hanging garden / alcove environments and is known from small populations at widely scattered locations in central and northeastern Arizona, east-central Utah, and northwestern Colorado. The northeastern Arizona locations include nearby Tsegi and Betatakin Canyons. Although nearby, these locations are in very deep canyons with overhanging cliffs of Navajo sandstone. The much younger Cretaceous-age sandstones (Yale Point member of the Mesa Verde formation) of the Black Mesa study area form small cliffs along some of the washes of the area, but nowhere are there deep shady well-wetted sites that would support this plant. The very few appearances of moisture on the Black Mesa cliff sites have only enough flow to periodically bring dissolved salts to the surface where rapid evaporation produces extensive salt crusting.

Sclerocactus mesae-verdae – Mesa Verde Cactus
This cactus is known from San Juan County, New Mexico as well as adjacent Montezuma County, Colorado at elevations from 4,900 to 5,500 feet. on very heavy soils derived from Mancos formation shales or from shaley facies of the overlying Mesa Verde formation. Exposures of Mesa Verde formation facies in the northern Black Mesa Basin and the Black Mesa study areas in general are dominated by the Yale Point sandstone and extensive areas of heavy clay soils are absent. These rocks are age-equivalent to the upper Mancos and lower Mesa Verde rocks of the San Juan Basin but are not marine deposits (the Cretaceous sea having withdrawn from the Black Mesa Basin earlier). No individuals of Mesa Verde cactus were encountered during the 2003 intensive searches in the Black Mesa study areas.

Fish, Wildlife, and Amphibians

The following listed species are those that have a potential for occurrence in the project area. Species not listed have no potential for occurrence due required habitat or occurrence potential restricted to known locations outside of the Black Mesa area.

The results of baseline Gunnison's prairie dog (*Cynomys gunnisoni*) and black-footed ferret surveys conducted by Peabody in the Black Mesa Mine and Kayenta Mine permit areas may be found in the PAP (see Fish and Wildlife Resources, Chapter 10, page 711, Peabody Coal Company, 1985). These surveys defined the number and extent of prairie dog colonies existing on the leasehold, documented the absence of the black-footed ferret, and documented the instability of the prairie dog colonies. However, a prairie dog/black-footed ferret monitoring program has been conducted since that time because the potential for re-expansion of existing prairie dog colonies, and/or establishment of new colonies exists. These studies have been reported to the OSMRE on an annual basis since institution. To date, the number, extent, and distribution of prairie dog colonies within or adjacent to the permit areas has failed to meet the currently accepted minimum requirements necessary to support the black-footed ferret, or warrant black-footed ferret searches. No prairie dog colonies are present in the project area. Therefore, potential for the N-9 drilling project to affect this species remains extremely remote.

Four species of threatened fishes could potentially occur in Navajo County, Arizona, and are considered in this assessment. They include the Apache (Arizona) trout (*Oncorhynchus apache*), Little Colorado spinedace (*Lepidomeda vittata*), loach minnow (*Tiaroga cobitis*), and spikedace (*Meda fulgida*). Habitat requirements and distribution of these species is discussed in detail in Minckley (1973). The Apache trout is presently restricted to cold-water perennial streams with low gradient meadow reaches. The Little Colorado spinedace exists in moderate to small streams in pools and riffles.

The loach minnow is a highly specialized, diminutive species that is essentially restricted to gravelly riffles in small to moderately large creeks and rivers. The spikedace requires moderate to large perennial streams with gravel cobble substrates and moderate to swift flow velocities. Yazzie Wash and Yellow Water Canyon Wash drain the N-9 exploration area. Yazzie Wash and Yellow Water Canyon Wash are tributaries to Moenkopi Wash. Moenkopi Wash drains to the Little Colorado River near Cameron, Arizona. Reaches of the Washes near the project area are characterized as ephemeral, with short, warm water intermittent reaches that occur in some years. Channels flow only in response to intense, localized precipitation events. Such flows are typically of short duration, with high velocities and extremely poor water quality due to high concentrations of suspended sediment. There is no potential for impact to these species because they are not present in or near the project area due to habitat restrictions.

With the exception of sightings associated with its reintroduction, the last report of a wild California condor (*Gymnops californianus*) in Arizona was in 1924. This species occupies high desert canyon lands and plateaus in Arizona, having been reintroduced starting in 1996. The release site is located in the Vermillion Cliffs area of northern Arizona, approximately 90 miles west northwest of the project area. Individuals have been known to range widely, therefore it is feasible a transient siting could occur in or near the project area. However, no deep canyons, cliffs, or plateaus occur in the project area so the prospect of a siting is extremely remote. Therefore the potential for impact to the California condor is extremely remote.

American peregrine falcons (*Falco peregrinus anatum)* are usually associated with cliffs or steep-walled canyon areas and nest almost exclusively on cliff faces. The density of cliffs may determine the suitability of an area for nesting. Adequate prey populations close to the nest are also important criteria in site selection. Nesting sites are usually located in close proximity to water, especially in the Southwest (Skaggs et al. 1986). Although human activities near the nest site and destruction of habitat for prey species can affect nesting peregrines by causing nest failure, no nesting habitat is present within the proposed exploration drilling area. Nesting habitat for the American peregrine falcon is known from the east edge of Black Mesa. Since there are no steep-walled canyons or cliffs and no wetland habitat that may attract migratory waterfowl in the proposed exploration drilling area, work in this area will not impact the species. Furthermore, the peregrine falcon was removed from the USFWS T&E list in 1999 and down listed to G4 status by the NNDFWL in 2001.

A complete discussion of the status of the Mexican spotted owl (*Strix occidentalis lucida*) in and near the Black Mesa Mine and Kayenta Mine permit areas and northern Black Mesa may be found in the PAP in Chapter 10 beginning on page 71b (PWCC 2001), LaRue (1994), and annual wildlife monitoring reports through 2000. The Mexican spotted owl may be considered at least a fairly common summer resident in shady mixed-conifer canyons and ravines on northern Black Mesa. Although there are no winter records, it is probably a permanent resident on northern Black Mesa. Known nest sites are in caves in cliffs adjacent to mixed conifer-filled canyon floors. The mixed conifer woodlands on Black Mesa typically occur in steep, rocky canyons and north facing slopes at elevations above 6800 feet. Fragmented stands of this habitat occur north and east of the project area and outside of the PWCC lease area. More extensive and continuous tracts of this habitat occur further north and east toward the rim of Black Mesa. No sightings or other evidence of Mexican spotted owls within the Black Mesa Mine or Kayenta Mine permit areas, including the project area have ever been observed. No suitable breeding or other habitat will be affected by the project. Mexican spotted owls were monitored for seven years in a more than two mile wide buffer on the north and east side of the PWCC lease area. Few occurrences of Mexican spotted owls were documented in the buffer zone and no apparent impacts from mining were detected.

The closest nesting sites were found more than 13,000 feet northeast of the northern most portion of the N-9 project area. Disturbance will be limited to the project area and existing access will be used as much as possible. No blasting will occur in the project area. The potential for impacting the Mexican spotted owl is extremely remote.

The results of baseline studies present in Chapter 10 of the PAP and ongoing monitoring studies indicate the southwestern willow flycatcher (*Empidonax traillii extimus*) does not breed on or near the Black Mesa Mine and Kayenta Mine permit areas, including the N-9 project area. The southwestern willow flycatcher can be considered a sparse migrant, regionally. The five sightings of six individuals of *Empidonax trailli* on or near the Black Mesa Mine and Kayenta Mine permit areas are not considered to be the southwestern subspecies (LaRue 1994). Suitable habitat consisting of cottonwood/willow and tamarisk vegetation along rivers and streams is absent in the project area. However, sparse and fragmented tamarisk stands do occur along the washes in the project area so the possibility exists that this species could occur transiently. The potential for impact to this species is extremely remote. No individuals have ever been documented on or near the project area, and the project will not result in disturbance of marginally suitable tamarisk vegetation along Yazzie Wash or Yellow Water Canyon Wash.

The golden eagle (*Aquila chrysaetos*) is a sparse, irregular occurring transient over Black Mesa with some permanent residents in the broader region. Birds may occasionally be present in the Black Mesa area hunting locally or temporally abundant small mammal prey. Suitable habitat for nesting does not occur in the project area. There will be no impacts to this species as a result of project area activities.

The ferruginous hawk (*Buteo regalis*) is an uncommon migrant and sometimes winter resident that frequents open rangeland habitat. On Black Mesa they have been most frequently seen using reclaimed lands as they hunt for preferred small mammal prey. The open habitat used by this species is not present in the project area and the time frames for activity are outside of the historical occurrence for this species on Black Mesa. Therefore, any impacts to this species are highly unlikely.

The northern leopard frog (*Rana pipiens*) is listed as Group 2 species under the NESL. Suitable habitat for this species includes streams, rivers, backwaters, ponds, and livestock watering tanks that are free from introduced fishes and bullfrogs (*Rana catesbeiana*). Water sources must be permanent or nearly permanent. A description of the aquatic communities within and near the Black Mesa Mine and Kayenta Mine permit areas is included in the PAP (Peabody Coal Company 1985). No naturally occurring perennial aquatic habitats occur in or near the project area. Also, no true frogs (*Rana sp.*) were encountered during the course of conducting baseline studies. For these reasons, impacts to the northern leopard frog will not occur as a result of this project.

4.3 CULTURAL RESOURCES AND ARCHAEOLOGY SITES

Cultural resources and archaeology sites were identified by surveys conducted by the Black Mesa Archaeological Project (BMAP) from 1967 to 1983. All identified sites within 500 feet of the Phase 2 exploration area and within 100 feet of existing access roads, with the exception of thirteen, have been mitigated during the BMAP survey (Permit AZ-0001D, Chapter 13). Anasazi Sites AZ-D:7:0731, AZ-D:7:0732, AZ-D:7:2018, AZ-D:7:2047, AZ-D:7:2089, AZ-D:7:2091, AZ-D:7:2093, AZ-D:7:2103, AZ-D:7:2106, and AZ-D:7:2107 are near or within the N-9 Phase 2 exploration project area and have a high probability of containing human remains. Navajo Sites AZ-D:7:4035, AZ-D:7:4036, and AZ-D:7:4038 are near or within the N-9 exploration project area and are listed as "unknown" status regarding the presence of burials. All of these sites are shown

on Exhibit 5. These sites will be avoided by at least 100 feet during new construction activities for this drilling program to comply with 30 CFR 761.11(g) and the Native American Graves Protection and Repatriation Act (NAGPRA). Sites AZ-D:7:2089, AZ-D:7:2106, and AZ-D:7:4035 occur within 150 feet of proposed drill holes; therefore, the perimeter of these sites will be verified in the field to ensure they are avoided by at least 100 feet by new construction activity. A field assessment for Traditional Cultural Property (TCP) sites was conducted throughout the project area prior to beginning the Phase 1 drilling program in 2003. PWCC's purpose with regard to Cultural Resources is to follow the Conditions of the approved AZ-0001D permit and any federal acts regarding these resources. By following the guidelines outlined in this section, this will be accomplished.

5.0 EXPLORATION SCHEDULE

Beginning: Second Quarter – Calendar Year 2005

Terminating: Fourth Quarter – Calendar Year 2005

Reclamation:

> Reclamation will be completed within approximately 6 months of completion of drilling for each drillhole.

6.0 PROPOSED EXPLORATION PROGRAM

This proposed exploration program involves construction of up to 3.09 miles of new temporary exploration roads; drilling, sampling, geophysical surveying, and completion of up to 139 drill pads and 169 drillholes (estimated at up to 139 boreholes and 30 coreholes) over a 7 month period; and subsequent reclamation of all exploration disturbance. Proposed exploration equipment, practices, environmental protection/control measures, and reclamation plans and costs are presented or described in the following sections.

Exploration Staging Areas – To the extent possible, existing disturbed areas will be used for exploration staging requirements.

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 would 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 typically be constructed ten to fifteen feet wide using a tracked dozer or rubber-tired loader. Road construction will involve clearing 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. Up to approximately 3.09 miles of road may be constructed over the course of the proposed exploration activities. At a width of 15 feet, this represents

approximately 5.6 acres of disturbance for temporary roads. On completion of drilling activities, temporary exploration roads will be reclaimed.

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. With a total of up to 139 drill sites, this represents 23.6 acres of disturbance for drill site construction. On completion of drilling activities, all mud pits will be backfilled and drill sites 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 offset 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 in order to recover an intact core sample of the coal seam or horizon of interest.

Drilling activities will utilize one or more truck-mounted rotary drills capable of achieving depths up to 400 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. A water truck (minimum capacity of 1,000 gallons) and at least one pickup truck will support each drill. 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. 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 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. Drillholes not completed as monitoring wells 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 placed next to the concrete surface plug. The time interval between completion of drilling operations and completion of permanent sealing is typically three to five days. A metal cap is placed at the surface over the hole during this time interval.

Areas disturbed by exploration activities including staging areas, temporary exploration roads, and drill sites will be stabilized or reclaimed following completion of drilling activities. 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 Stabilization Mix described in Chapter 23, Revegetation Plan, AZ-0001D permit.

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 conditions (snow, rain, mud). Reclamation activities will be completed within six months following initiation, and will be consistent with seasonal reclamation planting considerations as outlined in Chapter 23, Revegetation Plan.

7.0 RECLAMATION COST ESTIMATE

The following summarizes estimated reclamation costs associated with the proposed seven-month, Phase 2 PWCC exploration program for the N-9 coal resource area:

Plugging and sealing drillholes – 169 (5" x 300') @ $30/hole	$ 5,070
Backfilling mud pits – 139 @ 25cy @ $0.60yd	$ 2,085
Regrading drill pads – 139 @ 0.17 acre @ $1,000/acre	$23,630
Regrading roads – 16,315 feet @ $100/100 ft.	$16,315

Soil replacement – [(23.6 acres – drill pads) +	
(5.6 acres – roads)] x 43,560 ft^2/acre x 0.5 ft/27 @ $0.50/yd	$11,777
Revegetation – (29.2 acres) @ $300/acre	$ 8,760
Total Direct Costs	$67,637
Total Indirect Costs (@34.47 percent)	$23,314
Total Estimated Costs	$90,951

OSMRE currently holds $127,192,000 in total bond money for Kayenta Mine. Per OSMRE'S September 3, 2003 letter to PWCC, the bond for Permit AZ-0001D is set at $126,200,000, an excess of $992,000. After accounting for the costs associated with the N-9 Phase 2 drilling and the J-19 dragline repair site, $691,750 remains for miscellaneous revisions for the remainder of the permit term.