APPENDIX A – USACE 404(B)(1)

U.S. Army Corps of Engineers

404(b)(1) Assessment

For the Pre-2016 Mine Plan Revision

U.S. Army Corps of Engineers, Albuquerque District

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AA	Assessment Area
BLM	Bureau of Land Management
BMPs	Best Management Practices
BNCC	BHP Navajo Coal Company
cfs	cubic feet per second
CRAM	California Rapid Assessment Method
CWA	Clean Water Act
EA	Environmental Assessment
EPA	United States Environmental Protection Agency
FCPP	Four Corners Power Plant
FONSI	Finding of No Significant Impact
FSC	Final surface configuration
FY	Fiscal year
Guidelines	EPA Section 404(b)(1) Guidelines
IP	Individual Permit
LEDPA	Least Environmentally Damaging Practicable Alternative
MOA	Memorandum of Agreement
NAPI	Navajo Agricultural Products Industry
NEPA	National Environmental Policy Act
NHD	National Hydrography Dataset
NNDFW	Navajo Nation Department of Fish and Wildlife
NNEPA	Navajo Nation Environmental Protection Agency
NRCS	Natural Resources Conservation Service
NWP	Nationwide Permit
OHWM	Ordination high water mark
OSM	Office of Surface Mining
PJD	Preliminary Jurisdictional Determination
Project Area	Areas III and IV North of the Navajo Mine
RFFA	Reasonably Foreseeable Future Action
R2P2	Resource recovery and protection plan
SJGS	San Juan Generating Station
SJM	San Juan Mine
SMCRA	Surface Mining Reclamation and Control Act
SPCC	Spill Prevention, Control and Countermeasure Plan
SWPPP	Stormwater Pollution Prevention Plan
SWWF	Southwester willow flycatcher
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WUS	Waters of the United States

1. INTRODUCTION

On April 2, 2011, the U.S. Army Corps of Engineers (USACE) received an application from BHP Navajo Coal Company (BNCC) (the Applicant) for a Clean Water Act (CWA) Section 404 Standard Individual Permit (IP) for pre-2016 mining (the Project) within portions of Areas III and IV North of the Navajo Mine (Project Area). The Applicant sought authorization to fill 1.7 acres of waters of the United States (WUS) within the Project Area located in San Juan County, New Mexico. The site is located entirely within the Navajo Nation Indian Reservation.

The following analysis is provided in accordance with Section 404(b)(1) of the Clean Water Act. To avoid duplication of pertinent information, there are multiple references to sections within the Office of Surface Mining Reclamation and Enforcement's (OSM) Environmental Assessment (EA) that has been prepared concurrently with the IP, BNCC's Mine Plan Revision for a portion of Areas IV North being considered by OSM under the Surface Mining Reclamation and Control Act (SMCRA), and the existing mine plan for Area III (OSM 2009). While USACE has referenced the OSM EA, it has made its own independent Section 404(b)(1) assessment.

1.1 Regulatory Setting

In evaluating whether a particular activity should be permitted, USACE applies the Section 404(b)(1) Guidelines. 33 CFR §320.4(b)(4). This includes an analysis of alternatives and impacts to aquatic resources in order to identify the Least Environmentally Damaging Practicable Alternative (LEDPA) pursuant to the requirements of the guidelines established by the United States Environmental Protection Agency (EPA) in conjunction with USACE, known as the Section 404(b)(1) Guidelines (Guidelines) 40 CFR §230.10(a). The Guidelines prohibit discharges of dredge or fill material into WUS if there is a "… practicable alternative to the proposed discharge that would have less impact on the aquatic ecosystem, provided that the alternative does not have other significant environmental consequences." An alternative is practicable "if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes." 40 CFR §§ 230.10(a)(2) and 230.3(q). "If it is otherwise a practicable alternative, an area not presently owned by an Applicant, which could reasonably be obtained, utilized, expanded or managed in order to fulfill the basic purpose of the proposed activity may be considered." 40 CFR § 230.10(a)(2). Ultimately, a permit will only be granted if the District Engineer concludes that the benefits of the proposed alteration outweigh the damages to the wetlands resource. 33 CFR §320.4(b)(4).

If the proposed activity would involve a discharge into a special aquatic site such as a wetland, the Guidelines distinguish between those projects that are water dependent and those that are not. A water dependent project is one that requires access to or proximity to or siting within a special aquatic site to achieve its basic purpose—such as a marina. A non-water dependent project is one that does not require access to or proximity to or siting within a special aquatic site to achieve its basic purpose—such as a housing development. The proposed Project is not water dependent.

The Guidelines establish two presumptions for non-water dependent projects that propose a discharge into a special aquatic site. First, it is presumed that there are practicable alternatives to non-water dependent projects, "unless clearly demonstrated otherwise." 40 CFR § 230.10(a)(3). Second, "where a discharge is proposed for a special aquatic site, all practicable alternatives to the proposed discharge which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise." Id.

In addition, USACE must evaluate and consider impacts of a proposed project on fish and wildlife and federal, state or local requirements. 33 CFR §320.4(c),(d) and (j). The Guidelines mandate that no discharge of dredged or fill material shall be permitted if it causes or contributes to violations of any applicable State water quality standard, 40 CFR 230.10(b)(1), violates any applicable toxic effluent standard or prohibition, 40 CFR § 230.10(b)(2), jeopardizes the continued existence of any endangered or threatened species, or destroys or adversely modifies critical habitat, 40 CFR § 230.10(b)(3), or causes or contributes to significant degradation of WUS, 40 CFR § 230.10(c). The Guidelines require the USACE to make factual determinations regarding the effects of the proposal on the physical, chemical, biological, and human use characteristics of the aquatic environment, including special aquatic sites such as wetlands. 40 CFR §§ 230.11 and Subparts C, D, E, and F. BNCC's pre-2016 mining does not involve or propose fill in any special aquatic sites.

The intent the Guidelines is to focus applicant designs for proposed projects to meet the overall project purpose while avoiding or minimizing impacts to aquatic environments. This approach is emphasized in a Memorandum of Agreement between the EPA and the USACE Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines (EPA/USACE 1990) ("MOA"). The MOA articulates the Guidelines' "sequencing" protocol as first, avoiding impacts; second, minimizing impacts; and third, providing practicable compensatory mitigation for unavoidable impacts and no overall net loss of functions and values. USACE has determined, however, that these presumptions do not apply to the proposed Project as no special aquatic sites are directly impacted.

The analysis below provides the background and factual material to support the USACE's determination of the LEDPA and appropriate avoidance, minimization, and mitigation measures for BNCC's pre-2016 mining proposal.

1.2 Basic and Overall Project Purpose

The basic Project purpose includes coal mine expansion and public transportation safety. The overall project purpose is continued operation of the BNCC through July 6, 2016 to meet contractual obligations with the Four Corners Power Plant (FCPP) while maintaining safe and reliable public access to the Burnham Chapter area.

1.3 Location

The proposed pre-2016 mining areas are located near Cottonwood Arroyo, Section 2 Township 26N, Range 16W, Latitude (NAD 83) 36.511°, Longitude -108.518°, in portions of Areas III and IV North of the

Navajo Mine located completely within the Navajo Nation Indian Reservation in the Four Corners area, San Juan County, New Mexico (Figure 1).

1.4 General Description

The proposed action is to authorize under Section 404 of the CWA approximately 1.7 acres of fill in WUS associated with BNCC's pre-2016 mining in order to meet BNCC's contractual coal sales obligations to FCPP through July 6, 2016. The proposed action also involves the relocation of the Burnham Road in order to maintain safe and reliable public access to the Navajo Nation's Burnham Chapter area. To meet its pre-2016 contractual coal sales obligations, BNCC would need to continue surface coal mining and reclamation activities in Area III and revise its mine plan to include a portion of Area IV North of the Navajo Mine. Those areas are included within BNCC's mine permit under SMCRA and BNCC's coal lease with the Navajo Nation.

A mine plan detailing timing and sequence of mining and reclamation activities in Area III (Lowe and Dixon mine pits) is already in place and approved under SMCRA by OSM. On February 15, 2011, BNCC submitted to OSM a Mine Plan Revision for that portion of Area IV North proposed for pre-2016 mining. The proposed pre-2016 Mine Plan Revision for Area IV North is available at http://www.wrcc.osmre.gov/Current_Initatives/Navajo_mine/AreaIVNorth.shtm. OSM deemed the Mine Plan Revision application administratively complete on March 18, 2011. The Mine Plan specifies the proposed timing and sequencing of pre-2016 mining activities throughout an approximately 800-acre portion of Area IV North. Proposed fill in WUS in Area IV North is estimated to be about 0.5 acre.

In addition to those portions of Area IV North included within the proposed pre-2016 Mine Plan, fill in WUS to implement the remainder of the currently approved OSM mine plan for Lowe and Dixon mine pits (encompassing a total area of approximately 700 acres) in Area III and the proposed Burnham Road realignment (encompassing a total area of approximately 75 acres) are included in the IP application. Fill in WUS for mining in the Lowe and Dixon mine pit areas is currently authorized under a Nationwide Permit (NWP) #21, verification which will expire in 2013. Proposed fill in the remainder of Area III for pre-2016 mining is estimated to be about 1.3 acre. The proposed Burnham Road re-alignment has also been permitted by the USACE under a NWP #14, verification for which expired in 2009. Rather than requesting reverification of the NWP, BNCC has opted to consolidate all NWP authorizations for pre-2016 mining at Navajo Mine into a single IP.

The proposed action includes several primary components: mining activities, coal processing, transportation of coal from the mine site to the FCPP, road and infrastructure construction, and site reclamation. Other ancillary facilities related to the mining and reclamation activities include fencing, roads, and distribution powerlines. The proposed mining operation is a continuation of the existing Navajo Mine operations, a mine-mouth, open-pit operation. Coal would be extracted utilizing three draglines and various truck and loader stripping operations. Mined coal would be transported to existing coal stockpiles using haul trucks then loaded onto an existing rail transport system and transported to a coal preparation plant near FCPP.

As part of the proposed action, approximately 5.2 miles of Burnham Road (N-5082) would be realigned along the east side of the existing SMCRA mine permit area in order to move this public road a safe distance from active mining. Approximately 4.6 miles of the proposed realigned road would be within Areas III and IV North, and approximately 0.7 mile would connect with other roads adjacent to the BNCC lease and SMCRA mine permit area. Proposed fill in WUS for the Burnham Road re-alignment is estimated to be about 0.1 acre.

In total, the proposed pre-2016 mining in Areas III and IV North and the Burnham Road re-alignment would result in approximately 1.7 acres of fill in WUS.

Figure 1. Location of Navajo Mine and the proposed Project Area

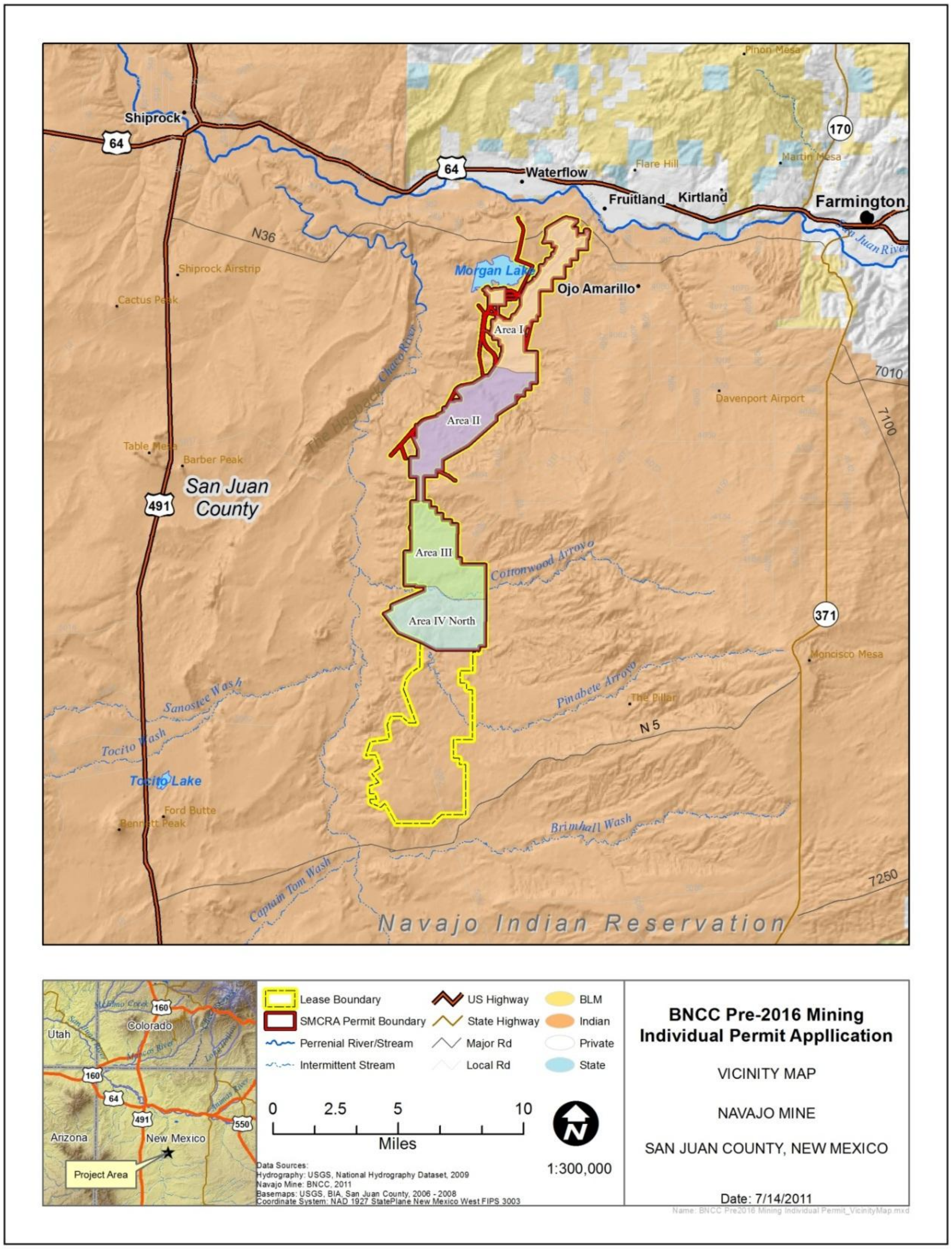
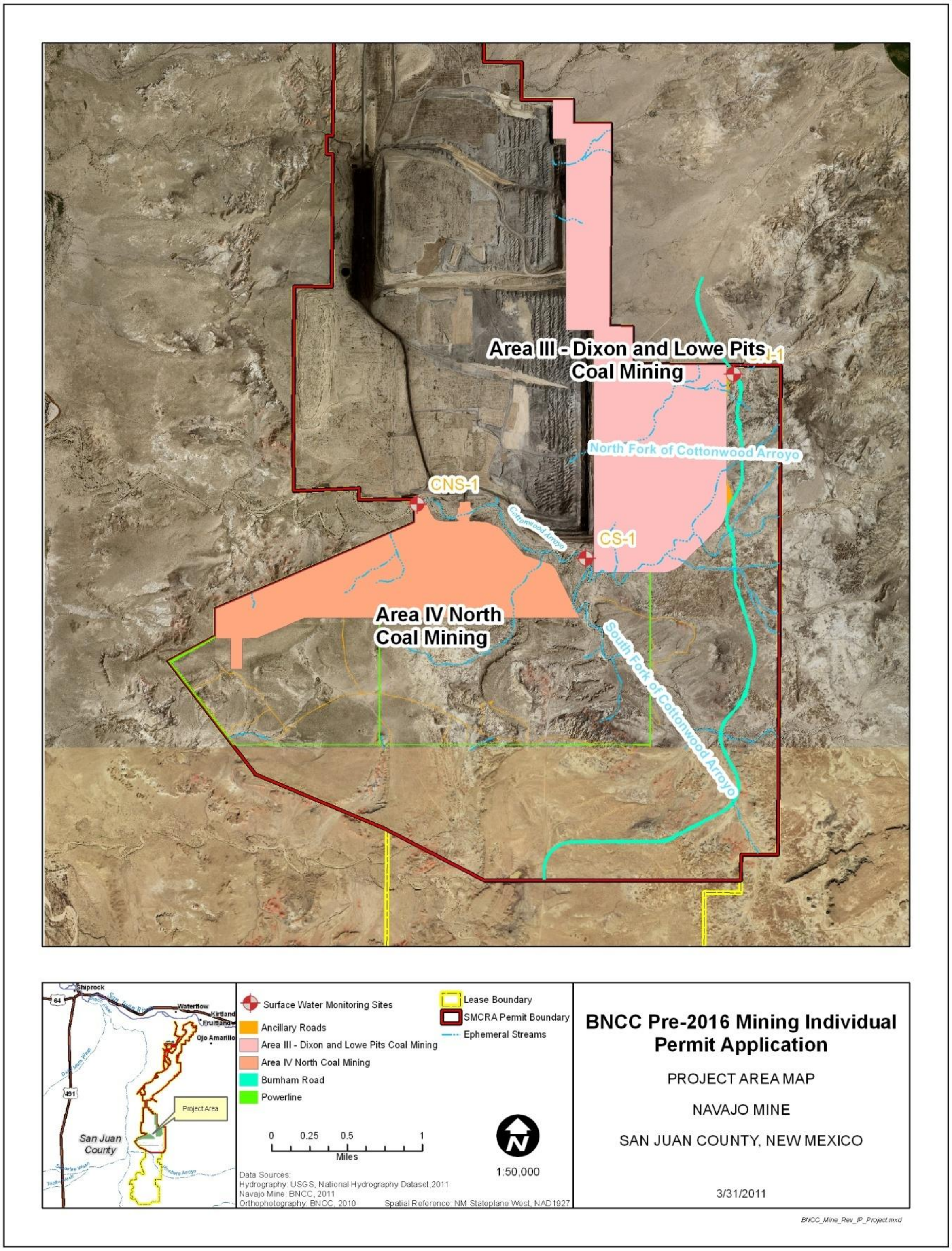


Figure 2. Proposed Project Area



2. ALTERNATIVES ANALYSIS

The analysis below considers a range of alternatives, including a variety of on-site and off-site alternatives, and evaluates practicability under the Guidelines' factors, impacts to aquatic resources, and other environmental consequences.

2.1 Alternatives

The Proposed Action includes mining a total of about 30.8 million tons of coal from Area II and III and about 12.7 million tons of coal from Area IV North to meet contractual obligations through July 6, 2016. In addition to the Proposed Action and No Action alternatives, there are three on-site and one off-site alternative, and variations identified as sub-alternatives, considered in this analysis. The primary difference between the Proposed Action and the alternatives is that each alternative proposes a possible different source for obtaining the coal that would be mined from a portion of Area IV North in the Proposed Action. The No Action alternative represents the situation under which BNCC could continue to mine under existing permits in Areas II and III of Navajo Mine, but the requested approvals for mining in Area IV North would not be granted. That would result in an emergency situation under which BNCC would potentially default upon its contractual obligations. The other alternatives also represent emergency situations in which mining would not occur in Area IV North. This would require BNCC to immediately find sufficient quantities and qualities of coal resources to fill the gap in order to meet its contractual obligations.

A summary of the alternatives analysis is listed below. Detailed descriptions of the alternatives are included in Section 2.3 Alternatives Analysis.

- Alternative 1: Proposed Action – Mine Plan Revision that includes mining a total of about 12.5 million tons of coal from Area IV North, continued mining in Area III, and realignment of Burnham Road.
- Alternative 2: No Action Alternative – Use existing approved Mine Plan to mine coal from remaining reserves located in Area II (Hosteen, Yazzie pits) and Area III (Lowe and Dixon pits), but do not mine in Area IV North and do not realign the Burnham Road.
- Alternative 3: Expedite Production in Dixon Pit – Implement a sequencing change to the Mine Plan that includes pre-stripping and expedites production in Dixon Pit. This alternative would also require realignment of the Burnham Road.
- Alternative 4: Extend Mining in Dixon and/or Lowe Pits – Navajo Coal Mine Plan revision or lease extension that extends mining in Dixon Pit and east of Lowe Pit. This alternative would also require the realignment of the Burnham Road.
- Alternative 5: Implementation of highwall or longwall mining methods -- Navajo Coal Mine Plan revision. This alternative would also require the realignment of the Burnham Road.

- Alternative 6: Obtain Coal from Off-site Source – Obtain coal from San Juan Mine located five miles north and across the San Juan River from FCPP in Fruitland, NM or Black Mesa Mine located 50 miles west of FCPP. This alternative would also require the realignment of the Burnham Road.

2.2 Determining Practicability of Alternatives

2.2.1 Considering Project Purpose

The overall project purpose is continued operation of the Navajo Mine through July 6, 2016, and to meet contractual obligations with the FCPP while maintaining safe and reliable public access to the Burnham Chapter area. The contractual obligations with FCPP require that BNCC supply between 8 and 9 million tons of coal to FCPP annually and that the coal meets quality specifications for specified parameters, including heating value, sulfur, moisture, and ash content. BNCC is required to maintain one million tons of coal inventory in pits and field stockpiles and one hundred thousand tons in blend piles. If BNCC fails to meet contractual obligations in spite of best efforts, BNCC could be ruled in default, which could result in substantial financial and reputational repercussions. Therefore, a practicable alternative to the Proposed Action must be able to meet the contractual obligations to FCPP in terms of coal volume, coal quality specifications, and delivery timing.

2.2.2 Availability

An alternative may not be available if implementation is outside the applicant's control. For example, this may occur when necessary property or resources are owned or controlled by others, or when the alternative cannot timely receive regulatory and other approvals. In this case, coal resources not owned or controlled by BNCC may not be available to timely meet BNCC's obligations. Further, if additional regulatory approvals are required, those processes may not allow for timely production of coal to meet obligations prior to July 6, 2016. Accordingly, timing associated with a specific alternative has a bearing on that alternative's feasibility and availability.

Here, mining in Area IV North is a readily available option. The area is already within BNCC's mine lease area and within BNCC's SMCRA mine permit. Following OSM's 2005 approval of BNCC's previous mine plan for all of Area IV North, BNCC installed Area IV North development infrastructure (roads, powerlines and stormwater controls) and 268 acres of the land surface was prepared for mining. The currently proposed mine plan revision focuses on mining this same disturbed area. There would be relatively little delay in accessing and mining this area. Alternatives to mining in Area IV North would in some cases require additional regulatory permitting and/or the development of infrastructure that would preclude BNCC's ability to timely produce the coal volumes and quality required by its contract with FCPP. Accordingly, while it is theoretically possible to get permit boundaries adjusted or to mine in areas other than Area IV North, such alternatives may not be practicable if they are not available in the context of their ability to be acquired or permitted rapidly enough to meet the project purpose. This issue is discussed below for each alternative.

2.2.3 Practicability Factors

To be practicable, an alternative must be available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of overall project purpose. Those practicability factors are first explained and then considered below for the Proposed Action and alternatives.

2.2.3.1 Cost

The cost factor takes into account the associated capital outlay, economic viability, and reasonableness of cost increases to determine practicability. An alternative that is unreasonably expensive is not practicable.

In this case, the applicant—BNCC—must comply with its obligations under the coal supply contract through July 6, 2016, including coal quality, volume, and timing specifications. Similarly, the lease agreement between BNCC and the Navajo Nation, as well as the Bureau of Land Management's (BLM) Resource Recovery and Protection Plan (R2P2), set requirements for the maximum economic recovery of the coal resource at Navajo Mine. Those obligations help to inform what alternatives may be economically reasonable. In addition, the geology and geography of the coal seams, overburden, and interburden, as well as mining equipment, techniques, and logistics (discussed further below) also contribute to cost considerations. Some of the constraints that these factors impose on Navajo Mine include:

- FCPP is a "base load" plant designed to operate 24 hours per day, 7 days per week. In essence, the power plant operates at near peak load continuously to supply electricity for millions of customers in Arizona, New Mexico, Texas, and southern California. These conditions require BNCC to develop operation plans that include risk management strategies that ensure a steady, continuous coal supply for FCPP.

- FCPP was designed and constructed specifically to burn low rank, low sulfur, sub-bituminous coal. Therefore, BNCC must meet coal specifications for heating value, sulfur and ash content so it can be burned in FCPP without damaging the power plant. The quality of the coal that BNCC delivers to FCPP cannot deviate from the narrow range of contractual specifications even though the quality of the coal can vary substantially. The heating value of coals within Navajo Mine typically ranges from 7,800 to 9,500 Btu per pound. The target heating value of coal delivered to FCPP under the coal supply contract is 8,700 to 8,750 Btu per pound with a contractual minimum of 8,500 Btu per pound. Therefore, to meet contractual specifications, BNCC must blend coal from multiple locations and seams to create a coal blend that meets the target heating value. To meet FCPP contractual obligations, BNCC maintains one million tons of coal as minimum working inventory available for coal blending. This represents about a 1.5-month reserve supply of coal.

- The Navajo Mine lease and applicable regulations require that BNCC maximize economic recovery criteria of the Navajo coal resource. These obligations restrict operations plans that can "sterilize" coal or eliminate opportunities to recover coal. These requirements also constrain mine operations to consider maximum economic recovery, rather than least-cost recovery.

- An additional cost factor determined by the geology of Navajo Mine is the strip ratio. The strip ratio is defined as the thickness of overburden/interburden material that must be moved per unit of coal extracted. Each pit developed generally starts at a strip ratio around 4:1. This is defined, for example, as 4 tons of overburden and interburden removed to extract 1 ton of coal. This strip ratio is found on the western edge of the outcrop, but can increase to a strip ratio of 6:1 on the eastern edge of the mine lease. The higher the strip ratio, the more overburden/interburden must be removed and the higher the cost to produce each ton of coal. As strip ratios increase, pre-stripping becomes important to meet coal supply volumes. Pre-stripping utilizes a truck/loader fleet to remove overburden prior to dragline stripping, which enables the dragline to remove coal at depths not possible without pre-stripping. Pre-stripping increases the cost of removing coal compared to dragline stripping alone by 110% to 140%.

2.2.3.2 Logistics

Mining logistics are defined by the mine plan and its subsidiary operations and reclamation plans that specify locations, timing, sequencing, and techniques for coal production as well as risk management strategies for meeting BNCC's obligations to FCPP and the Navajo Nation. Generally, risk management strategies at Navajo Mine are established to ensure steady coal production by managing for conditions that cause production delays. Risk management strategies include retention of contingency reserves, maintenance of coal stockpiles, and simultaneous operation in multiple pits to ensure the ability to produce sufficient volumes available to blend coal of different qualities. This enables the delivery of a steady supply of appropriate quality coal to meet contractual obligations. These strategies are, in BNCC's experience, necessary and standard business practices that take into account the specific circumstances at Navajo Mine. Conditions that may cause production delays include:

- Poor weather conditions – flooded pits or muddy road conditions can cause production or coal transport delays.
- Highwall or spoil bank instability or failure – Highwalls and spoil banks are continually monitored for instability. If unstable conditions are detected, operations are restricted until measures can be implemented to stabilize the area. In rare instances, highwall failure could cause significant reductions in planned coal production volumes.
- Power outages – Draglines operate on electricity, therefore power outages stop coal production.
- Train derailments – There have been derailments of the mine's coal transport train that have delayed coal delivery from particular Navajo Mine pits to the FCPP.
- Unplanned dragline or equipment outages.

Some of the operating constraints that are included in BNCC's plan to minimize the risk of coal production delays at Navajo Mine include:

- Simultaneous operations in multiple pits are needed so that, in case of pit shutdown (e.g., from a highwall failure or dragline breakdown), BNCC can continue to mine and deliver coal to contract specifications from other active pits. To meet coal quality and quantity production demands in a timely, commercially prudent, and economically feasible manner, the mine must maintain between 3 and 5 open pits. It is important to have pits in a balance of deep and shallow strip ratio positions.

- The current production capacity of BNCC's three draglines working in multiple pits is 48 million cubic yards per year. At an average strip ratio of 5.3:1, annual coal production is 8.5 million tons. Operations at higher strip ratios reduce BNCC's ability to timely and efficiently produce the necessary volume of coal. While pre-stripping can address that constraint, it does so at greatly increased costs, inefficiency, and logistical difficulties, including re-assignment of resources and equipment from other important tasks such as reclamation. Retention of contingency reserves in accessible locations is important to provide coal supply in case of an operational event or condition that may delay production.

- Ensuring sufficient pit length per dragline (at least 3,000 feet in length) is important. The space limitations at Navajo Mine make it impractical to maintain the clearance and safety conditions required for blasting and dragline operations in a single pit. Mining in a multiple seam pit requires the dragline to make 6 or 7 passes from one end of the pit to the other end per strip (a strip is about 150 foot wide cut the full length of the pit). Drilling and blasting occurs separately for each layer of rock in-between the coal seams and for each coal seam greater than 5 feet thick. Each layer of rock and coal require a drill hole about every 25 feet apart in a grid pattern over the entire strip. These conditions require drilling crews and blasting crews to constantly work in each pit outside the boom radius of the dragline. Once the coal is drilled and blasted, a truck/loader crew load the coal in trucks and haul it out the ramps to the field coal stockpiles. In addition to these activities, each dragline has a support dozer that is constantly moving material to prepare the dragline walking surface and moving material to assist the dragline. There are also graders and water trucks working on access roads within the pits. There are other pieces of equipment working to ensure the dragline power cable is moved and maintained. If the pit length is too short, these simultaneous support activities could force an unnecessary dragline shutdown. Every effort is made to have sufficient planning and adequate pit length to ensure this does not occur. Safety concerns, operational factors, and logistical constraints described above, result in an unacceptable coal-delivery risk associated with isolating two draglines in a single pit or trying to operate one dragline in a short pit (refer to production delay factors above).

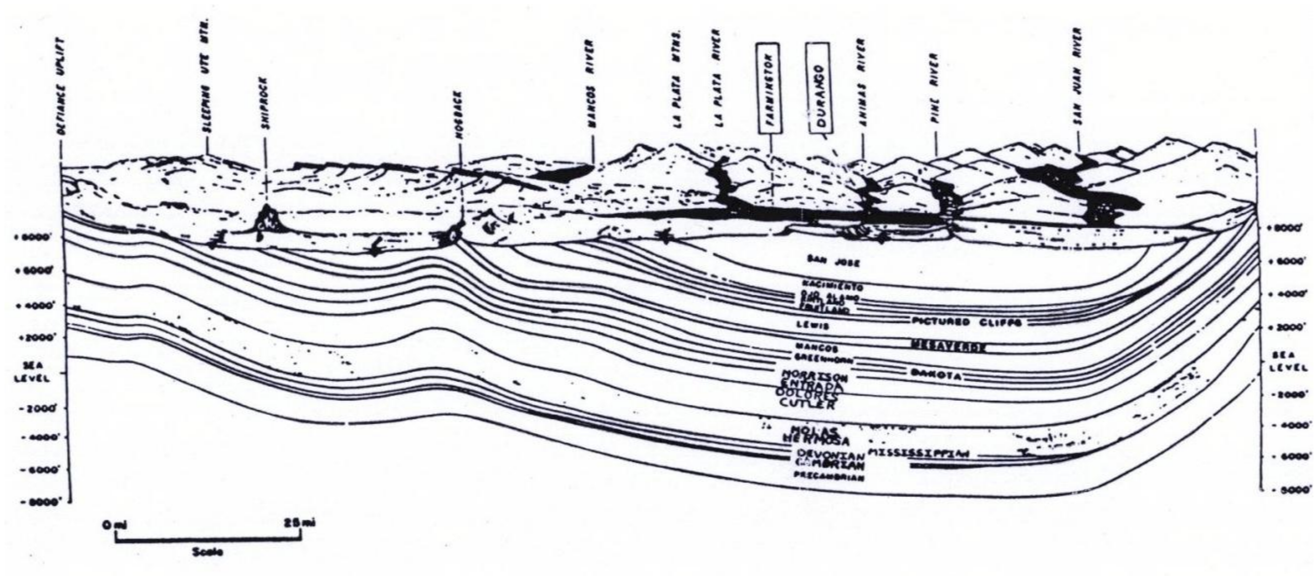
- Reserving coal in a developed pit that is close to the plant provides a contingency reserve in the event of an emergency. Coal from the pit can be trucked to the plant in the event of a train derailment or other emergency.

2.2.3.3 Existing Technology

The technology needed to accomplish surface coal mining must take into account the constraints at Navajo Mine, including geology and highly specialized mining equipment. These physical constraints set the technology and operating parameters for Navajo Mine. Some of these parameters include:

- Geology and pit development at Navajo Mine. There are 11 named coal seams at Navajo Mine with up to 7 of these seams, in certain areas, being sufficiently thick to be consistently minable. Mineable coal seam thickness at Navajo Mine ranges from 1.5 to 20 feet thick. Coal seams have an average three percent dip from west to the east. The coal dip results in the strip ratio increasing from west to east in the mine. The geology of the surrounding rock at Navajo Mine requires that all overburden and interburden must be drilled and blasted for removal. Thick coal seams also require drilling and blasting for removal. Figure 3 shows the coal seams at Navajo Mine.

Figure 3. Diagrammatic cross section of the San Juan Basin showing the coal seams dipping 3 percent from west to east.



- Dragline and other equipment constraints. The essential piece of equipment at the mine is the dragline that operates continuously (see Figure 4). It is idle only for planned or unplanned repairs or maintenance. Nearly all other mobile equipment at the mine is used to ensure that the dragline operates at optimum parameters and has high availability. To meet contractual obligations, BNCC has historically maintained between two and three operating draglines at Navajo Mine. BNCC currently owns and operates three draglines: (1) Marion 8750 – built in 1980 with 130 cubic yard (cyd) bucket, (2) Marion 8050 – built in 1978 with 64 cyd bucket, and (3) Marion 7920 – built in 1981 with 50 cyd bucket. Given the geologic conditions and the production demands, the operating parameters for the draglines at Navajo Mine are pit lengths of 3,000 feet with three ramps accessing each pit to provide sufficient access for drilling, blasting, and coal removal operations concurrent with dragline stripping in other parts of the mining pit.

Figure 4. Typical Dragline

2.2.4 Considering Environmental Consequences

For each available and practicable alternative, USACE is required to assess the impacts (adverse and beneficial) on the aquatic ecosystem and the overall environment. By comparing the environmental consequences of the practicable alternatives, USACE can identify the LEDPA.

A summary of the findings and analysis for the alternatives are included in Section 2.3.

2.3 Alternatives Analysis

In addition to the Proposed Action, BNCC considered a number of other options to produce coal instead of mining in Area IV North. In this section, each alternative and sub-alternative is screened to determine whether it is available and practicable while meeting the project purpose. Also summarized are the relative impacts to WUS and other environmental factors as they relate to the identification of the LEDPA. Table 1 provides a summary of the analysis.

Table 1. Comparison of Alternatives.

Alternative	Availability	Cost	Existing Technology	Logistics	Meets Project Purpose	Impacts to WUS and Other Environmental Consequences
Alternative 1: Proposed Action	Yes	Yes	Yes	Yes	Yes	About 1.7 acres of impacts to WUS; for other factors refer to project EA and Section 3.0 of this analysis.
Alternative 2: No Action	Yes	No Operations in high strip ratios. 2 draglines would be idle after July 2013.	Yes	No Insufficient reserves/stockpiles; High risk operating; Insufficient coal blending options or contingencies.	No Coal production would be 12.5 million tons short.	About 1.3 acres of impacts to WUS. Impacts to WUS would be reduced by about 0.4 acre. Surface impacts would be reduced by approximately 704 acres, as no mining would occur in Area IV North. Impacts from overall mine operations (emissions, dust, noise, employment) would continue at current baseline levels until 2014 when production volumes would decline. Reduced employment and significant reduction in royalties to the Navajo Nation.
Alternative 3: Expedite Production in Dixon Pit	Yes	No Operations costs increase by $69-$130 million; Uneconomical mining.	No Equipment constraints to expedite production from a single pit.	No Extensive Pre-stripping required and only 1 dragline operating; Insufficient production capacity given pit geometry; High risk operating; Insufficient coal blending options or contingencies.	Yes, but in an unreasonable manner and at excessive cost.	1.3 acres of impacts to WUS. Impacts to WUS would be reduced by 0.5 acre. Surface impacts would be reduced by approximately 704 acres as no mining would occur in Area IV North. Impacts from overall mine operations (emissions, dust, noise, employment) would be higher than under the No Action due to the doubling of the truck fleet.
Alternative 4: Extend Mining in Dixon and/or Lowe Pits	No. This alternative would require lease boundary adjustment for Lowe and significant permit revision for Dixon that would render the alternative unavailable from the standpoint of time passed without production.	No Operating costs would be significantly higher because of the 6:1 strip ratio and the increase in coal haulage distances. Also higher operations costs associated with stripping, developing boxcut extensions and infrastructure.	Yes	No Would require major diversion of Cottonwood Arroyo. High risk operating due to two draglines operating in one pit. Violation of contract stockpile requirements.	No Would not be possible to adjust the lease boundary for Lowe or to approve a mine plan revision for Dixon and to mine enough coal to meet the required delivery volumes	About 4 acres of impacts to WUS. Additional 2.1 acres of impacts to WUS compared to Proposed Action. Greater impacts to endangered Southwestern willow flycatcher due to the diversions of Cottonwood Arroyo. Clearly would not be the least environmentally damaging alternative, even if it were practicable.
Alternative 5: Implement Highwall or Longwall Mining Techniques	No. Permit timing and obstacles.	No Unreasonable additional costs associated with converting a 50 year old open pit mine to an underground operation for short-term mining.	No. Cannot timely obtain specialized equipment.	No It would be impossible to permit and convert Navajo Mine to an underground operation and meet coal supply obligations prior to July 6, 2016 in order to meet project purpose.	No	About 1.3 acres impacts to WUS. Impacts to WUS would be reduced by about 0.4 acre. Other environmental impacts cannot be reasonably calculated, as the alternative would require extensive engineering and permitting.
Alternative 6: Offsite Coal Supply	Uncertain. Third party resources are not within BNCC's control. Timely acquisition of required quantity and quality of coal is uncertain.	No Coal production and delivery costs increase by more than 300%. Would require significant capitalization at SJM to increase production by 50%. Costs of acquiring from other sources are unknown.	Yes	No It is unlikely that SJM could increase production by 50%. New storage and blending facilities would need to be permitted. Approved trucking routes would be in place soon enough to meet the project purpose and need. Navajo Nation is unlikely to approve coal delivery from a third-party mineral interest.	No	About 1.3 acres of impacts to WUS. Impacts to WUS would be reduced by about 0.4 acre. Surface impacts would be reduced by approximately 704 acres, as no mining would occur in Area IV North. Impacts from overall Navajo Mine operations (emissions, dust, noise, employment) would continue at current permitted levels until 2014 when production volumes would decline. Increased coal transportation environmental impacts to air quality, public health and safety, wildlife. Reduced employment and significant reduction in royalties to the Navajo Nation.

2.3.1 Alternative 1: Proposed Action

The Proposed Action would utilize BNCC's three draglines working within multiple permitted pits. This plan is in accordance with current and historic operations at Navajo Mine and enables reasonable operational flexibility, maintenance of sufficient stockpiles, and contingency reserve and coal blending opportunities while minimizing operational risks. This alternative meets the project purpose and need to deliver contracted coal quantities to FCPP by July 6, 2016.

2.3.1.1 Practicability Analysis for Proposed Action

The Proposed Action could be implemented at reasonable cost. The proposed mine plan continues utilization of current/historical capital equipment, contingency reserves and stockpiles. The proposed mine plan also enables mining within an acceptable strip ratio and variability in pit depth. Logistically, all conditions that could cause production delays and operational risks are managed or mitigated under this alternative by having multiple draglines operating in different pits. Therefore, the Proposed Action is a practicable alternative.

2.3.1.2 Environmental Considerations

As a practicable alternative, USACE must consider the environmental consequences of the Proposed Action. These consequences are analyzed and reported in detail in Section 3 of this report. A summary is included here. Impacts to WUS under this alternative would be about 1.7 acres with 0.5 acre of impact in Area IV North, 1.3 acres in Area III and 0.1 acre associated with realignment of Burnham Road. Impacts to other environmental factors (biological, sensitive species, water, air, etc.) are detailed in Section 3.0 of this analysis and the EA.

The realignment of Burnham Road has previously been evaluated under the National Environmental Policy Act (NEPA) (OSM 2008, BIA 2007). The 2008 EA considered the entire proposed realignment and the No Action alternative. Several off-lease alternatives were considered but not carried forward in the 2008 EA because of unacceptable impacts to sensitive species. Alternative realignments within the lease area either fail to meet the purpose and need for realignment of the road (i.e., closures would still occur and public safety would not be improved), or cross the same or greater numbers of WUS. Ultimately, the OSM issued a Finding of No Significant Impact (FONSI) for the same Burnham Road realignment that is again being analyzed in the Pre-2016 Mining EA and for which this 404(b)(1) has been prepared. The realignment of Burnham Road would impact approximately 0.1 acre of WUS due to the placement of culverts to cross several ephemeral washes. No other alternatives for this realignment are re-evaluated in this analysis.

2.3.2 Alternative 2: No Action Alternative

In the No Action Alternative, none of the requested approvals would be granted and BNCC would attempt to meet FCPP contract obligations using the remaining reserves accessible under the current mine plan and permits. These include depleting contingency reserves in Area II (Hosteen/Yazzie pit) and in Area III (Dixon and Lowe pits). Under the existing mine plan, it is estimated that BNCC would fall short of its contractual obligations to FCPP by a total of 12.7 million tons, the amount of coal that would be obtained from Area IV North. *See* Table 2. Beginning in fiscal year (FY) 2012, BNCC would fall short of its annual coal production by about one million tons for two consecutive fiscal years (FY 2012 and FY 2013). In FY 2014, BNCC would fall short of its annual production by more than four million tons because the contingency reserves in Hosteen/Yazzie pit and Lowe pit would have been depleted and only one dragline would be operating in Dixon pit. This is due to the fact that the current mine plan takes into account the geophysical characteristics of the pit and operational risks. This in turn limits the rate at which coal can be removed from Dixon pit in an operationally safe and economically feasible manner. While there are sufficient reserves in Dixon pit to meet annual coal contract obligations, the required total quantity of coal cannot be timely or efficiently produced solely from this area without significant changes in the fundamental operational model of the mine. Those adjustments would result in unreasonable operational risks, cost increases, and logistical obstacles that render this alternative impracticable.

Table 2. Activity Summary Table – Coal Mining (tons of coal)

Fiscal Year	Area IV North	Other Mine Areas (No Action)	Total (Preferred Alternative)
FY 12 (July 11 - Jun 12)	1,220,000	7,428,000	8,648,000
FY 13 (July 12 – Jun 13)	959,000	6,973,000	7,932,000
FY 14 (July 13 – Jun 14)	4,153,000	5,229,000	9,382,000
FY 15 (July 14 – Jun 15)	4,023,000	4,901,000	8,924,000
FY 16 (July 16 – Jun 17)	2,408,000	6,323,000	8,731,000
TOTAL	12,763,000	30,854,000	43,617,000

2.3.2.1 Practicability Analysis for No Action Alternative

Under the No Action Alternative, in FY 2012 and 2013, all draglines would be operating in high strip ratio areas, substantially increasing operational costs. Two of the three BNCC draglines would be inactive or idle after July 2013 as reserves in Hosteen/Yazzie and Lowe pits are depleted, and only one dragline would operate in the remaining Dixon pit. With only one dragline operating, the coal production capacity at Navajo Mine drops to about 5 million tons per year. Assuming an average strip ratio of 5:1, the coal production capacity of the largest dragline is approximately 5 million tons. Steadily depleting stockpile and contingency reserves and operating in fewer active pits reduces the ability of BNCC to blend coal from multiple sources. This adversely impacts BNCC's ability to timely deliver sufficient volumes of coal of specified quality to FCPP. This alternative is not practicable because it would create unreasonable cost increases and logistical obstacles. The No Action Alternative does not meet the purpose and need of the Project because it does not produce in a timely manner the required quantity and quality of coal to meet the obligations of the contract.

2.3.2.2 Environmental Considerations

Impacts to WUS under the No Action Alternative would be about 1.3 acres and would be limited to Area III. Compared to the Proposed Action, the reduction in impacts to ephemeral channels would be less than one acre. Impacts to other environmental factors (biological, sensitive species, water, air, etc.) are detailed in Section 3.0 of this analysis and in the project EA. Those impacts are similar to the Proposed Action but would not occur in Area IV North, nor would the Burnham Road be realigned.

2.3.3 Alternative 3: Expedite Production in Dixon Pit

This alternative includes mining as proposed in Alternative 2, and in addition, expedite production in the Dixon Pit to attempt to make up for the shortfall to fulfill contractual obligations. As noted, current coal reserves in Dixon, Lowe, and Hosteen/Yazzie pits are technically sufficient from a strict quantity standpoint but present unreasonable operational, logistical, and cost obstacles to meet contractual obligations through July 2016. It is estimated that after July 2013, final coal reserves would remain solely in Dixon pit.

2.3.3.1 Practicability Analysis for Expedited Production in Dixon Pit

To recover the coal reserves in Dixon Pit at a rate sufficient to meet FCPP contract requirements would require BNCC to enhance or supplement dragline capacity through means of additional “pre-stripping,” which is removing overburden with a truck and loader fleet. The current strip ratio in Dixon pit requires much of the length of the pit to be pre-stripped by truck loader fleet. Because of this high strip ratio and relatively short pit length, coal production rates would not be increased by operating two draglines in Dixon pit. The spoil material that must be removed to expedite coal removal from Dixon must be removed by pre-stripping; operating two draglines in Dixon pit alone would not increase production. To make up the production shortfall would require doubling the current truck/loader fleet. BNCC’s existing truck and loader fleet of seven trucks and two loaders operating at maximum capacity can move approximately 10 million cubic yards per year. The current truck loader fleet does reclamation regrading (hauling spoil form cut areas to fill areas), pre-stripping (hauling spoil from the highwall to final regrade), and occasional topsoil removal and coal haulage as needed. In order to accelerate coal production from Dixon pit, pre-stripping capacity would need to ramp up to move 20 million cubic yards per year by fiscal year 2014. This would require purchasing an additional seven trucks, two loaders, one motor grader, and one water truck for support equipment. Another option would be to hire a contractor to conduct pre-strip operations at Dixon Pit. Either of these two alternatives would also necessitate a revision to BNCC’s current permit to change the mine plan for Dixon Pit.

The estimated capital cost for a new truck fleet with the required capacity is $27 million (Table 3). In addition, there would be approximately $18 million per year in operating and labor costs to operate the fleet. These costs are partially offset by lower operating cost due to two draglines being idle. The dragline operating cost decreases the total cost by $30 million for the four-year period. The total cost to purchase and operate a new truck and loader fleet is $69 million (capital plus operating cost for four years). The lead time for purchase of this equipment is estimated to be 19 to 23 months. The estimated cost for a contractor to conduct the pre-strip operations is $130 million for the same four-year period offset by the dragline operating cost. In either case, the additional costs would not be reasonable at Navajo Mine, and is not commercially viable. In sum, Alternative 3 is not a practicable alternative because of significant capital expenditures and logistical obstacles.

Table 3. Total new truck fleet cost for expedited production in Dixon Pit.

Equipment	Cost Per Unit	Projected Quantity Required	Total Cost (millions)
Cat 785F End-Dump Haul Truck (150 ton)	$2,022,000	7	$14.2
Cat 994F Wheel Loader (25 Cyd bucket)	$3,636,000	2	$7.3
CAT Dozers (D-11)	$1,604,000	3	$3.2
CAT 16M Motorgrader	$836,000	1	$0.8
Water truck	$2,071,000	1	$2.1
		Total	$27.6

2.3.3.2 Environmental Considerations

Impacts to WUS under this alternative would be about 1.3 acres and limited to Area III. Compared to the Proposed Action, the reduction in impacts to ephemeral channels would be less than one acre. Under this alternative, impacts to surface resources would be similar to those described under the No Action Alternative. There would be an incremental increase in fugitive dust and vehicle emissions, relative to the No Action Alternative, generated as a result in the increased intensity of mining and truck operations. The socioeconomic impact is difficult to predict; while BNCC would have significantly higher operational costs, only a select few local contractors would benefit. Additionally, if operational costs were to increase by $69-$130 million for the four-year period, it is likely that BNCC would cut costs elsewhere. Potential impacts to federally listed species would be the same as under Alternative 1.

2.3.4 Alternative 4: Extend Mining in Dixon and/or Lowe Pits

Within Area III, there are two scenarios or sub-alternatives where additional coal could be accessed contiguous to existing mining in Lowe and Dixon pit. First, in Dixon pit, the existing lease area includes additional land area south and east of the permitted mine area. Mining in these areas, shown in Figure 5, would require OSM approval of a significant Mine Plan Revision; similar in scope and timeline to the current proposed mine plan revision involving Area IV North. Sufficient volumes of coal, generally equal to that available in Area IV North, would be available under this sub-alternative. Second, under the Lowe Pit extension sub-alternative (Figure 6) an approximately 500-foot wide “surface use only” area east of Lowe Pit that presently exists, allows BNCC to recover coal to the edge of the coal lease boundary would be mined to provide an additional three strips in Lowe Pit. This would provide approximately 3 million tons of coal. The practicability and environmental effects of each of these sub-alternatives are described in this section.

Figure 5. Dixon Pit Extension Sub-Alternative

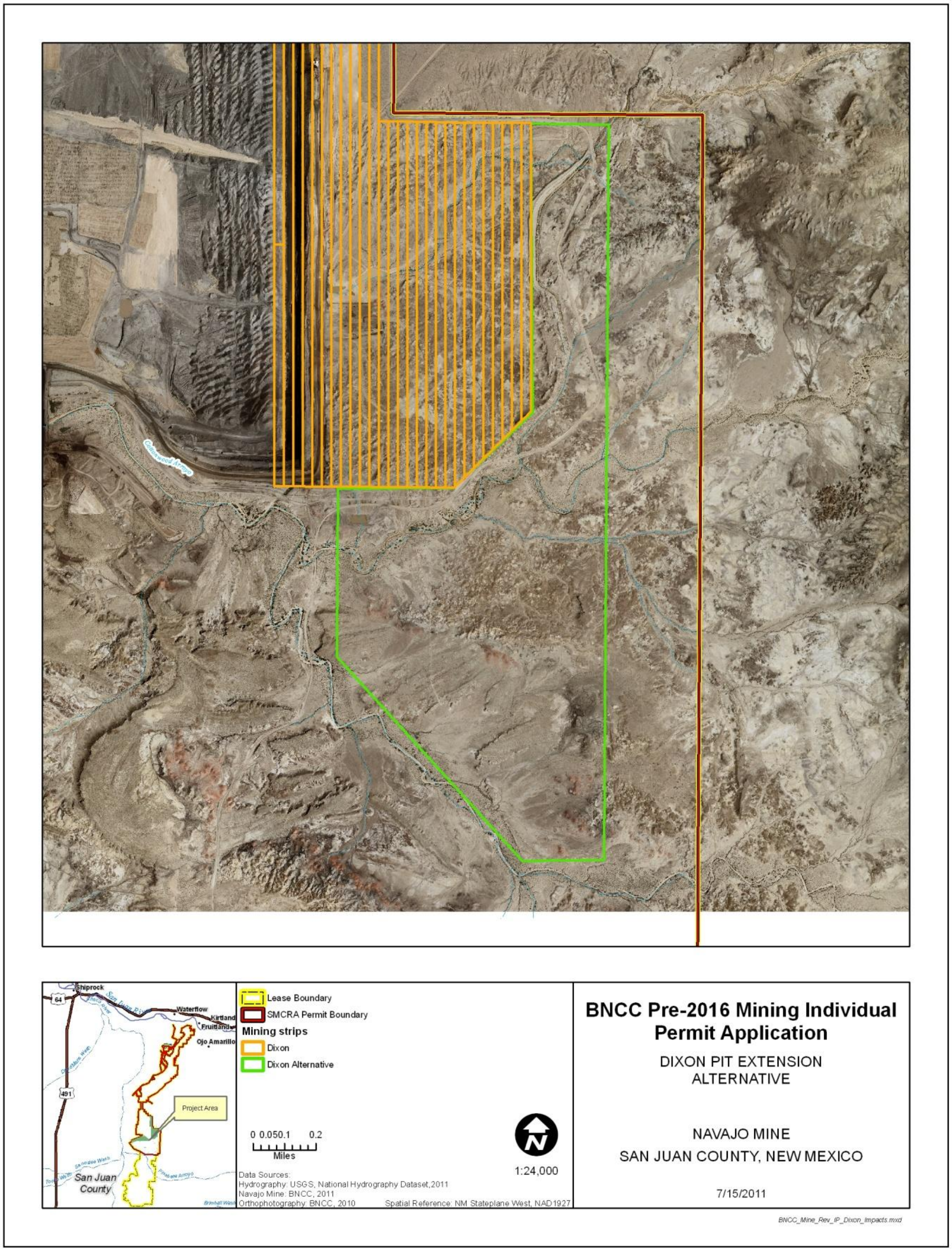
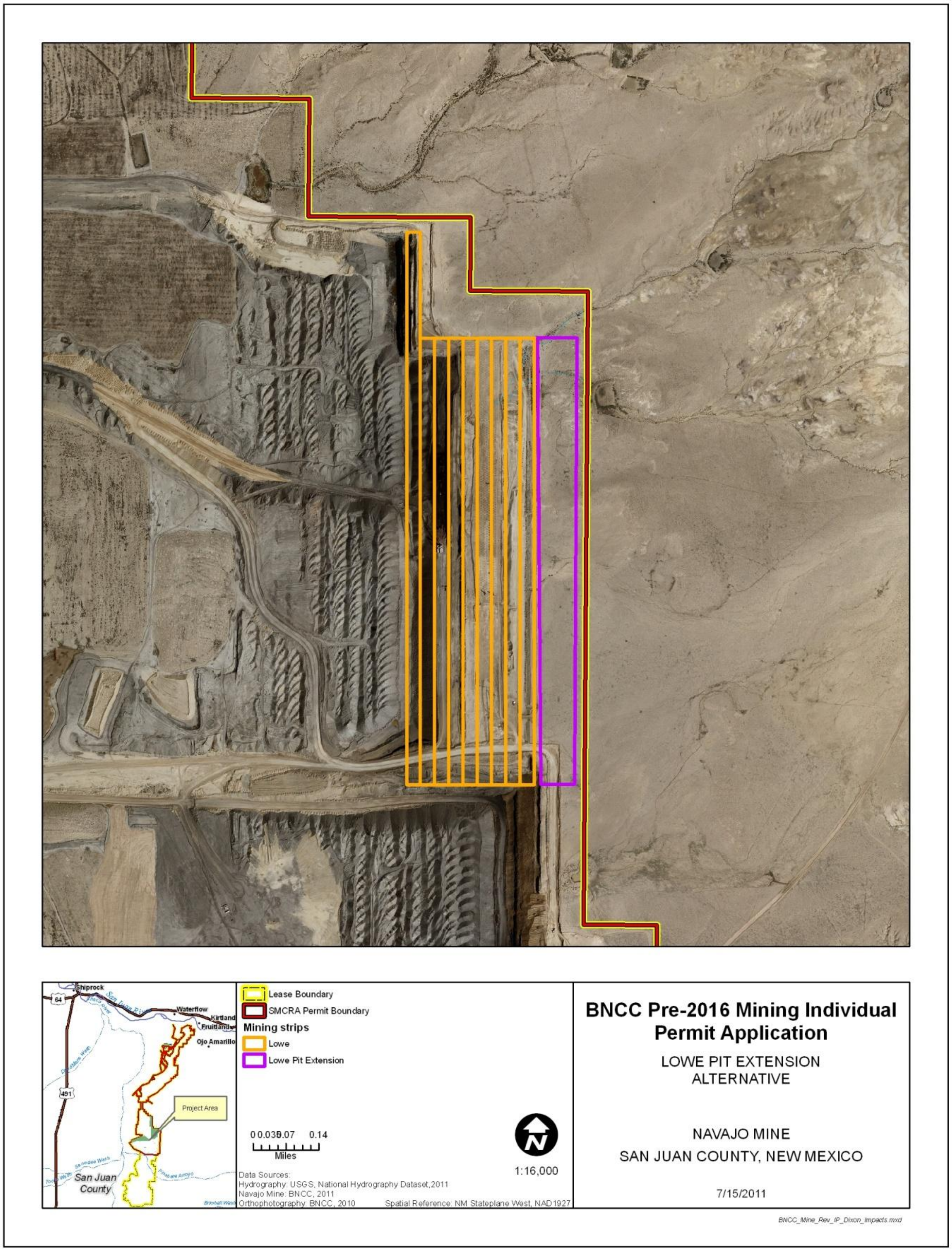


Figure 6. Lowe Pit Extension Sub-Alternative



2.3.4.1 Practicability Analysis for Dixon Pit Extension

Before BNCC could begin mining in the Dixon Pit Extension area, approval of an alternate mine plan revision is required from OSM. Given the length of time required to obtain permit approvals for recent similar actions, it is unlikely that BNCC could gain approval in time to meet coal volume required by FCPP before 2016. Operating costs would be higher in this area because the strip ratio is estimated to be 6:1 or higher (see Figure 5) and the coal haulage distances to the Lowe Coal Stockpile would be substantially longer. There would be substantial capital costs to prepare this part of the mine for coal stripping including capital investment for boxcut and other infrastructure. There would also need to be a 2.7-mile diversion constructed to channel water from the North and Middle forks of the Cottonwood Arroyo into the South fork of the Cottonwood Arroyo. The estimated cost of the diversion alone is $6 million based on approximately 1.5 million cubic yards of material to be excavated at $4 per cubic yard. This cost is based on mine experience constructing other diversions (North Fork and Lowe/Dixon). This plan also presents unreasonable logistical obstacles because it would require two draglines to operate within the same pit. Therefore the Dixon Pit Extension is not a practicable alternative.

Impacts to WUS would be substantially larger than for the Proposed Action because of large diversion structures. Approximately 5 acres of intermittent stream channel would be impacted by this alternative, about 3 acres of impact more than Alternative 1. Under the 404(b)(1) guidelines, USACE would not permit this alternative, as it clearly would not represent the LEDPA.

2.3.4.2 Practicability Analysis for Lowe Pit Lease Extension

For this option to be implemented, the Navajo Nation would have to grant BNCC an additional coal lease area and OSM would have to approve an alternate mine plan. It is highly unlikely that this mine lease extension could be granted in time to meet BNCC production/stockpile volumes since acquiring or modifying a lease on the Navajo Nation is typically a process of years rather than months. Additionally, this sub-alternative would not generate sufficient coal volumes and would need the Dixon Pit extension to meet the production required by the project purpose. This sub-alternative would allow for the extraction of approximately 3 million tons of coal.

The Lowe Pit extension would require substantial capital investment in boxcut extension, diversion construction and mine infrastructure. There would be higher operating costs because of higher than average strip ratios and long coal haulage distances.

2.3.4.3 Environmental Considerations

Extending mining in the Lowe and Dixon pits would result in approximately 4.0 acres of impacts to WUS. Compared to the Proposed Action, these alternatives would result in additional 2.1 acres of impacts to WUS. All of the impacts would be to the North and Middle forks of Cottonwood Arroyo. Included in these impacted acreages are scattered patches of riparian tree and shrub communities that provide potential migratory stopover habitat for willow flycatchers. These are the same patch areas that provide suitable habitat for the endangered southwestern willow flycatcher in proximity to the Proposed Action, but that would not be removed under the Proposed Action. Because of the intermittent flows along Cottonwood Arroyo, there would likely be greater impacts to surface and groundwater resource if mining were to result in diversions of this magnitude. Surface area impacts and most operational impacts would be similar to those under the Proposed Action. Increased coal hauling distances and the associated emissions and dust would result in greater impacts to localized air quality.

2.3.5 Alternative 5: Implement Highwall or Longwall Mining Techniques

Alternative 5 considers recovering the coal at Navajo Mine using mining techniques other than surface mining with draglines. Highwall mining techniques use highwall continuous miners or augers to extract the coal by penetrating into the horizontal coal seams exposed by the highwalls or vertical walls in an existing pit (Figure 7). Longwall mining is a type of underground mining. It is done by mining along a coal seam and using hydraulic roof supports above the longwall operation to avoid immediate collapse. Coal recovery with these alternate methods is substantially lower than the 90 percent recovery achieved with the current dragline operation at Navajo Mine. It is unlikely that highwall or longwall mining would meet the "maximum economic recovery" requirements of the Navajo Mine lease and BLM's R2P2 mandates. Furthermore, the lower coal recovery rate for these alternate mining methods would also reduce the likelihood that remaining coal reserves at Navajo Mine would be sufficient to meet FCPP contractual obligations.

Figure 7. Example Highwall Miner

Implementation of either alternative mining technique at BNCC would require many plan revisions and regulatory approvals including:

1. Addendum to the current Ground Control Plan.

2. Revision to the current Mine Plan.

3. Revision to BLM's R2P2 for Navajo Mine.

4. BIA approval to utilize these mining methods at BNCC and potential changes to mine lease and trust agreements to adjust maximum economic recovery terms for Navajo Mine.

5. Revision to the air emissions permit for Navajo Mine.

Auger mining and longwall mining would shift Navajo Mine from a surface to underground mine and would involve a shift in strategies. Detailed geotechnical evaluations and altered mine planning would be required to deal with the change in mining strategies and the surface subsidence that occurs with auger or longwall mining. Since Navajo Mine was designed and operated as a surface strip mine for the past 50 years, conversion to these alternate mining methods would require significant investment in re-design, equipment, and employee training. The capital cost for equipment alone (longwall, continuous miners, vent shaft, conveyors) is estimated to be about $300 million. This estimate is based on company experience with development of the San Juan Mine and current continued operation and development costs.

2.3.5.1 Practicability Analysis for Alternative 5

Highwall mining at Navajo Mine would be completed in conjunction with continued strip mining operations because strip mining creates the vertical faces required for auger access. Highwall mining would recover approximately 40 to 50 percent of the coal reserve as compared the approximate 80 to 90 percent recovery of the same coal reserve by a surface dragline operation. BNCC would be required to subcontract this mining operation to a third-party because it does not own the equipment or employ workers trained for this mining method. This would substantially increase operating costs. In 2001, a contractor was employed at San Juan Mine to conduct highwall operations prior to start up of the underground operations. The estimated cost was about $5.00 per ton of coal produced at the pit, which is substantially more expensive than current operations.

In addition to the plan revisions and regulatory approvals listed above, longwall mining would require a new mine plan for underground operation. Converting to an underground mining operation would also affect the existing workforce. Workers that did not want to transfer to the underground operation would need to be terminated or transferred and a new underground workforce would have to be recruited and trained. As with highwall mining, longwall mining would recover about 60 to 70 percent less coal than surface dragline operations. A longwall operation would only recover a portion of the largest seam and would not be able to recover the other 7 or 8 seams. A long wall mine can only mine one seam—not all 8 or 9 seams. In addition, longwall mining would sterilize substantial surface recoverable coal reserves due to subsidence and the inability to economically or physically recover the thinner coal seams. This reduced resource recovery could be in violation of "maximum economic recovery" requirements of the mine lease agreement and BLM's R2P2 mandates. Further, it is unlikely that either the highwall or the longwall options would produce sufficient quantities of coal to timely meet contractual obligations. Finally, converting from a surface strip mine to a modern underground longwall mine would require significant recapitalization and business plan revision by BNCC. BNCC would need to agree to undertake new business and safety risks associated with these mining methods. Therefore, neither highwall nor longwall mining methods are considered practicable to meet coal delivery obligations prior to July 6, 2016 due to timing, cost, quantity, and logistical obstacles.

2.3.5.2 Environmental Considerations

Under this alternative, there would be 1.3 acres of impacts to WUS that would occur in Area III. Compared to the Proposed Action, the reduction in impacts to ephemeral channels would be less than one acre. Other environmental impacts would be similar to those described under Alternative 3 due to the need to double the operational truck fleet and commensurate increase in dust and vehicle emissions. In addition, socioeconomic impacts would occur as noted above.

2.3.6 Alternative 6: Off-site Coal Supply

Alternative 6 considers supplying coal to meet the contract obligations with FCPP from an off-site source such as San Juan Mine located five miles north and across the San Juan River from FCPP. Coal from the San Juan Mine is similar to that at Navajo Mine and therefore could likely be burned at the FCPP; whereas other regional mines are unlikely to have similar coal quality for use at FCPP. Implementation of Alternative 6 would require that sufficient quantities of coal be provided from the San Juan Mine. Presently, San Juan mine has an annual production capacity of 8 to 9 million tons. At this rate, the coal reserves at the mine are estimated to be sufficient until 2022. Up to 4 million tons of coal would need to be supplied to FCPP by San Juan mine to meet the production shortfalls estimated for the No Action Alternative (see Table 2). To supply this quantity of coal, San Juan Mine would have to increase its production capacity by 50 percent. Furthermore, new coal loading facilities would have to be installed at San Juan Mine and FCPP as well as new stockpile, mixing, and storage facilities so that the off-site coal could be blended and stored with other coal from Navajo Mine to meet the quality specifications for FCPP and delivery obligations through July 6, 2016. Because of cost and permitting restrictions, the most likely delivery method would be to truck the coal from San Juan Mine to FCPP, which is approximately 15 miles by available public roads. This would require that BNCC obtain State and local approvals and permits to operate coal trucks along a proposed public road delivery route. The number of truck-trips needed to provide FCPP with 2.5 million tons of coal from San Juan Mine annually is estimated to be almost 700 trips daily. A conveyor option has previously been considered by BNCC to deliver coal from Navajo Mine to the San Juan Generating Station (SJGS) adjacent to San Juan Mine. This alternative however was rejected due to high costs and potential impacts to endangered fish and critical habitat in and along the San Juan River.

Other potential sources of off-site coal include the Kayenta Mine (10 miles southwest of Kayenta, AZ and approximately 160 miles from FCPP using available public roads) and El Segundo Mine (30 miles north of Milan, NM and approximately 180 miles from FCPP using available public roads). As with transporting coal from San Juan Mine (SJM) to FCPP, the most likely delivery method would be to truck the coal requiring BNCC to obtain State and local approvals to operate coal trucks along a public road and would require the same 700 trips daily.

2.3.6.1 Practicability Analysis for Off-site Coal Supply

Alternative 6 would require that FCPP negotiate a lease modification with the Navajo Nation to allow delivery of coal from a source other than Navajo Mine. Furthermore, San Juan Mine would have to negotiate a modification with its contract with SJGS to allow for sale of coal to a third-party. Coal production costs at San Juan Mine are approximately one-third higher than those at Navajo Mine. In addition, transport costs would increase the cost of coal supplied to FCPP. The logistics of transporting coal by truck to FCPP from an off-site source would greatly increase likelihood of coal supply disruptions at FCPP, and require additional stockpiles and coal quality monitoring. Similar obstacles would occur for transporting coal from either Kayenta or El Segundo Mine with additional difficulties of obtaining contracts with other coal companies and approximately 12 times the travel distance. Alternative 6 is not practicable because of substantial additional costs and logistical obstacles.

2.3.6.2 Environmental Considerations

Under this alternative, there would continue to be 1.3 acres of impacts to WUS that would occur in Area III. Compared to the Proposed Action, the reduction in impacts to ephemeral channels would be less than one acre. Other impacts would be similar to those described under Alternative 3 for the on-site mining that would continue. Increased environmental impacts associated with off-site coal delivery to FCPP would occur under this alternative. The 700 daily truck trips between FCPP and SJM, Kayenta Mine, or El Segundo Mine would have increased adverse impacts on air quality, vehicle traffic, transportation infrastructure wear, public health and safety, and wildlife.

2.3.7 Conclusion

In light of the Project purpose, no alternatives to the Proposed Action are practicable, primarily due to the logistical obstacles, operational risks, additional costs, and permitting time required to implement the various alternatives. Additionally, alternatives other than the Proposed Action have either greater impacts to WUS and/or to other elements of the environment or only reduce impacts to WUS (in this case ephemeral washes, not wetlands or special aquatic sites) by about 0.6 acre. The difference in effect on ephemeral channels (e.g., less than one acre) is of substantially less significance in comparison to the adverse effects these alternatives would have on other resources, the company, its employees, and its ability to meet its contractual obligations. All of the alternatives to the Proposed Action represent extreme emergency scenarios that are not commercially reasonable under normal operating circumstances at the Navajo Mine. Further, given the extreme circumstances under which BNCC would be operating to meet immediate obligations through July 6, 2016, implementation of any of those alternatives could threaten the viability of the company.

3. Existing Conditions

3.1 Location and General Description

The WUS in the proposed Project area are headwater (first and second order) intermittent and ephemeral channels. No wetlands or other special aquatic sites would be impacted by pre-2016 mining. Channel processes here are largely governed by the magnitude and frequency of precipitation events. In this arid environment, where annual precipitation averages 5.25 inches, dry channels support flowing water typically in response to occasional high intensity or long duration (defined as 1 hour or longer) rainfall events. Water flow has a wide range of magnitudes, but its duration is typically short because of short duration rainfall events and very high channel infiltration.

The ephemeral streambeds located within Areas III and IV North range from small channels (1-3 feet wide and 6-18 inches deep) at the head of drainages to Cottonwood Arroyo, a larger channel (36 to 39 feet wide and 15 to 32 inches deep) upstream of the Chaco River. The small channels typically drain badland areas and only contain flow immediately after large rain events. Channels such as Cottonwood Arroyo receive discharges from much larger watersheds and have larger, more sustained flows.

The majority of the channels within the Project Area are C5 type channels (Rosgen 1996). C5 channels are characterized as having a sand bed with point bars as a result of high lateral bank adjustment, high to very high sediment supply, and little difference between channel bed pavement and sub-pavement materials. Without stabilizing vegetation, these channels can experience considerable lateral adjustment during a single runoff event. Sediment transport rates can be very high as a result of an unconsolidated bed but the transport distance would be relatively short due to short-duration runoff events, measured in hours. Since these channels have no real means of stabilization due to lack of bank vegetation, rock, or other natural materials, they are subject to lateral and vertical instability as a result of changes in sediment or flow regimes (Rosgen 1996).

3.1.1 Jurisdictional Determination

3.1.1.1 Waters of the U.S. Delineation Methodology

Field data collected in 2008, 2009, and 2011 were used to delineate WUS in Areas III and IV North. This section describes the data collection efforts in 2008 and 2009 and the USACE's field verification in 2011. A Preliminary Jurisdictional Determination (PJD) was submitted to the USACE in 2009 in conjunction with a NWP 21 reverification that included mining activities in the Lowe and Dixon mine pits (Area III) and Area IV North.

Field mapping was performed on January 13, 2009 by Matthew Smith of Ecosphere and Mark Oliver of Basin Hydrology, Inc. using methodologies outlined in A Field Guide to the Identification of the Ordinary High Water Mark (OHWM) in the Arid West Region of the Western United States (USACE 2008). Field determinations within portions of Area III and IV North where proposed mining activities would potentially impact "bluelines" [as obtained from the U.S. Geological Survey (USGS) High-resolution National Hydrography Dataset (NHD)] were conducted to determine whether the drainage feature actually supports a defined bed and bank feature, based on scour and deposition processes. If these features were not present, that section of blueline was removed from the project maps.

If scour and deposition features were present, an assessment was made to determine which geomorphic features present were representative of an OHWM. Primary OHWM features used were the top elevation of lateral and point bars, changes in particle size, and the presence/absence of vegetation. Along with OHWM width, average OHWM depth was measured. Average depth was based on the difference between the OHWM elevation and the average elevation of the channel bed surface. A GPS point and photograph were taken where each OHWM measurement was made (Table 4). Measurements were made at locations that would allow a reasonable approximation of the surface area and volume of WUS potentially impacted by BNCC mining activities.

Table 4. OHWM Measurements for sites along the ephemeral streams in Areas III and IV North.

Site ID	Date	Cowardin Classification[1]	Average Width (Feet)	Average Depth (feet)
1	2009	R4SBJ	4.17	0.67
2	2009	R4SBJ	3.50	0.42
3	2009	R4SBJ	2.83	0.33
4	2009	R4SBJ	2.75	0.25
5	2009	R4SBJ	3.33	0.33
5.1	2009	R4SBJ	2.83	0.42
4.1	2009	R4SBJ	2.50	0.42
6	2009	R4SBJ	6.08	0.58
7	2009	R4SBJ	5.50	0.92
7.1	2009	R4SBJ	6.17	0.67
8	2009	R4SBJ	3.17	0.42
9	2009	R4SBJ	4.00	0.75
10	2009	R4SBJ	31.00	1.67
11	2009	R4SBJ	26.00	1.58
12	2009	R4SBJ	31.00	2.17
13	2009	R4SBJ	3.83	1.17
14	2009	R4SBJ	2.75	0.75
15	2009	R4SBJ	34.00	1.58
16	2009	R4SBJ	32.00	2.00
17	2009	R4SBJ	7.67	0.83

Site ID	Date	Cowardin Classification[1]	Average Width (Feet)	Average Depth (feet)
18	2009	R4SBJ	8.42	0.92

[1] Cowardin classification codes are determined using the Cowardin 1987 manual. R4SBJ denotes an ephemeral riverine channel that is unvegetated (Cowardin et al. 1979)

An OHWM measurement was taken along each section of blueline within the Area IV North where impacts were proposed. Any pronounced difference in the nature of the streambed was taken into account. For instance, several of the bluelines start on relatively flat areas with little bed-and-bank development, and then drop off cliffs into areas with steeper gradients. OHWM measurements were taken above and below the drop-offs to obtain better estimates of the area and volume of the streambeds.

Several additional measurements were taken to more fully characterize the hydrologic environment in Areas III and IV North where mining is proposed. On the eastern side of Area III and Area IV North, OHWM measurements taken in March, 2008 for a previous project using the same methodology were used to characterize the area and volume of WUS (Table 5).

Table 5. OHWM Measurements taken in March 2008.

Site ID	Date	Cowardin Classification[1]	Width (Feet)	Depth (feet)
NCC2	2008	R4SBJ	2.5	0.33
NCC3	2008	R4SBJ	1.25	0.17
NCC4	2008	R4SBJ	10	1.58
NCC8	2008	R4SBJ	11.67	1.25
NCC9	2008	R4SBJ	3.92	0.58
NCC10	2008	R4SBJ	8	1.33
NCC11	2008	R4SBJ	4.5	0.67
NCC12	2008	R4SBJ	3.5	2
NCC13	2008	R4SBJ	20	1.58

[1] Cowardin classification codes are determined using the Cowardin 1987 manual. R4SBJ denotes an ephemeral riverine channel that is unvegetated (Cowardin et al. 1979).

The 2009 PJD calculated that there are a combined approximately 18 linear miles and 24 acres of ephemeral WUS within the Lowe and Dixon pits in Area III, the portion of Area IV North now proposed for pre-2016 mining, and the area that would be affected by the Burnham Road relocation.

3.1.1.2 Field Verification

On February 22, 2011, representatives of Ecosphere and BNCC met onsite with Deanna Cummings of the USACE to verify the 2009 OHWM measurements and the 2009 PJD, and update the data and PJD as needed. Measurements taken at three separate locations within the SMCRA mine permit boundary were identical with 2009 measurements of channel width and slightly lower for channel depth (Table 6).

Table 6. Comparison of OHWM measurements from the original 2009 PJD and the 2011 field verification.

	2009 OHWM Measurement (inches)[1]		2011 OHWM Measurement (inches)	
Site Number	**Width**	**Depth**	**Width**	**Depth**
4	33	3	33	2
7	66	11	66	8
Burnham Crossing (b1)	140	15	140	6

[1] 2009 measurements were estimated using similar OHWM measurements from downstream.

3.1.2 Ecological Functions of Ephemeral Channels

3.1.2.1 Assessment Methodology

Ecosphere and USACE evaluated the background condition of the desert streams and channels within Areas III and IV North utilizing the California Rapid Assessment Method (CRAM; Collins et al. 2008). USACE encourages the use of rapid assessment methods as a core tool to evaluate aquatic resource condition. CRAM was originally intended to provide a rapid and repeatable assessment method that can be used routinely for wetland monitoring and assessment throughout the State of California; however, the constructs of CRAM can be applied to a wide range of arid, ephemeral streams similar to those found throughout the arid southwestern United States (SCCWRP 2010). For example, CRAM was used for several large solar and transmission projects located in southern California under the direction of the Los Angeles District of USACE. The use of CRAM for ephemeral streams received scrutiny through this public review process.

CRAM is intended to provide consistent and comparable assessments of wetland and riverine conditions, while accommodating special characteristics of different regions and types of hydrologic or aquatic resources. The CRAM typology currently recognizes six major hydrological types, four of which have subtypes (Collins et al. 2008). Arid, ephemeral and intermittent streams fall into the Riverine type. For the purposes of CRAM, condition is defined as the state of an assessment area's physical and biological structure, the hydrology, and its buffer and landscape context relative to the best achievable states for the same type of hydrologic resource. Condition is evaluated based on observations made at the time of the assessment. Assessment results can then be used to infer the ability to provide various functions, services, values, and beneficial uses to which a hydrologic resource is most suited (Collins et al. 2008), although these are not measured directly by CRAM. CRAM also identifies key anthropogenic stressors that may be affecting the hydrologic resource's condition.

CRAM is used to understand the condition of the desert streams on the project site described in this section, to estimate the effects of post-project direct and indirect impacts described in Section 4.1, and to evaluate the adequacy of the proposed mitigation in Section 5.0. In April 2008, USACE and EPA issued joint regulations known as the “Mitigation Rule.” These regulations define compensatory mitigation for losses of aquatic resources (33 CFR Parts 325 and 332, and 40 CFR Part 230). The Albuquerque District is updating its Mitigation and Monitoring Guidelines to provide consistency with the Mitigation Rule. The Mitigation Rule emphasizes the watershed approach and functional assessment methodology in evaluating project impacts and mitigation strategies.

CRAM assesses four overarching attributes of stream condition: (1) landscape context, (2) hydrology, (3) physical structure, and (4) biotic structure. Within each of these attributes are a number of metrics (10) that assess more specific aspects of stream condition (Table 7). In addition to producing a condition score, CRAM also includes a stressor checklist to help explain the scores and to identify possible management actions to improve condition. A description of these attributes and their corresponding metrics is provided below. Collins et al. 2008 provides a detailed description of the method. To conduct a CRAM assessment, each of the metrics is evaluated for an Assessment Area (AA) in the field to yield a numeric score for an assessed wetland based either on narrative or on schematic descriptions of condition or on thresholds across continuous values. Choosing the best-fit description for each metric generates a letter grade for each attribute. Metric and attribute scoring in CRAM was developed such that the incremental increase in condition associated with moving from one category to the next higher category is the same across metrics and attributes; that is, an increase from category D to category C is proportionally the same as an increase from category B to category A. These letter grades are converted to numeric scores by assigning the following values: A=12, B=9, C=6, D=3. Metric scores under each attribute are aggregated in CRAM to yield scores at the level of attributes, and attribute scores are aggregated to yield a single overall index score, via simple arithmetic formulas. Attribute and index scores are expressed as percent possible, ranging from 25 (lowest possible) to a maximum of 100.

Table 7. Relationship between CRAM attributes and metrics/submetrics. The four attributes are averaged to produce an overall CRAM index score.

Attribute	Metric
Buffer and Landscape Context	Landscape Connectivity
	Buffer:
	Percent of AA with Buffer
	Average Buffer Width
	Buffer Condition
Hydrology	Water Source
	Hydroperiod
	Hydrologic Connectivity
Physical Structure	Structural Patch Richness
	Topographic Complexity

Attribute	Metric
Biological Structure	Plant Community:
	Number of Plant Layers Presents
	Number of Co-dominants
	Percent Invasion
	Horizontal Interspersion and Zonation
	Vertical Biotic Structure

3.1.2.2 CRAM Results

Seventeen AAs within the study site were assessed with CRAM (Figure 9). These sites were each within the stream lengths that would be impacted by the various components of the Project (mining disturbance, Burnham Road crossings, and powerline crossings). At the time of the CRAM assessment, only one of the sites (site 5) contained flowing surface water. This flow was due to irrigation return flow from the upstream Navajo Agricultural Products Industry (NAPI) agricultural fields. All sites were classified as unconfined riverine systems (i.e., the width of the valley across which the system can migrate without encountering a hillside, terrace, or other feature that is likely to prevent further migration is at least twice the average bankfull width of the channel).

CRAM index scores for the 17 sites ranged from 54 to 73 with the highest score at site 5 along the North fork of Cottonwood Wash and the lowest score at site 2 adjacent to the previous disturbance within the Area IV North mining area (Table 8 and Figure 9). Attachment B contains the full CRAM scores for all 17 sites.

Table 8. Overall CRAM index and attribute scores separated by stream size and the overall scores.

CRAM Index and Attribute Scores	Headwater Systems	Cottonwood Wash and Tributaries	Overall
Overall Index Score	59	65	62
Landscape Context	84	95	91
Hydrology	75	75	75
Physical Structure	41	43	42
Biotic Structure	39	48	44

The drainages within the Project Area fall into two distinct categories. The smaller, headwater stream systems had distinctly different channel widths, morphologies, and biological communities than the larger stream channels of Cottonwood Wash and its larger tributaries. Overall, 7 of the 17 sites captured the headwater stream systems (sites 1, 2, 4, 6, 7, 20, and 22 [Figure 9]). These sites were primarily south of the main Cottonwood Wash channel within the Area IV North mining disturbance (Figure 9). Two of the sites—6 and 7—were located along the proposed Burnham Road realignment east of the current Burnham Road along small channels that drained badland formations (Figure 9).

These sites generally scored lower than the sites along Cottonwood Wash and its tributaries; however, the overall score was only 6 points lower than for the Cottonwood Wash sites (Table 8). The primary differences were in the buffer and biotic structure attribute scores. The buffer scores were lower because site 2 was located adjacent to the existing disturbance in Area IV North and site 4 was just downstream of a detainment pond designed to capture all flow before it entered the Area IV North mining area. These two sites had significantly lower buffer scores (53) than the remainder of sites within the headwater systems. In general, the headwater stream systems had simpler vegetation communities with less species diversity and lower overall plant cover as the lower biotic structure attribute scores depict (Table 8).

The sites along Cottonwood Wash and its more significant tributaries (5, 8, 9, 10, 11, 12, 15, 17, and 18) had wider channels with more complexity within the channel and true riparian habitats along their floodplain terraces including small patches of coyote willow (*Salix exigua*), tamarisk (*Tamarisk* sp.), saltgrass (*Distichlis spicata*), and rubber rabbitbrush (*Ericameria nauseosa*). In addition, the vegetation communities had greater overall cover than the headwater stream systems.

In general, CRAM can be used as an initial diagnostic tool of general aquatic resource health and produces condition scores that are comparable and repeatable. An overall CRAM index score provides a way to summarize the conditional health of a wetland or riparian area, relative to its maximum achievable condition. Scores can range from a minimum of 30 to a maximum of 100, with higher scores being better; however, using the current CRAM Riverine Module, maximum overall CRAM index scores may not be achievable for arid ephemeral systems because the CRAM Riverine module was originally designed for coastal Riverine systems that typically have greater plant diversity and cover and greater ecological complexity. The results of the CRAM analysis from this project and previous projects in southern California indicate that the CRAM Riverine module can be applied to arid, ephemeral streams but some of the metrics may need to be recalibrated for this environment. The Landscape and Buffer Attribute appeared adequate as currently constructed while the Hydrology Attribute performed reasonably well, but some of the current metrics may need to be revised. Metrics within the Biological and Physical Attributes were problematic when applied to the ephemeral streams on site due to the lack of physical and biological complexity in ephemeral channels. When compared to CRAM scores for perennial, coastal streams, scores for the Project Area were consistently lower for the Physical and Biological Attributes since these attributes of the CRAM Riverine module were designed to detect complexity within a system (Collins et al. 2008). Nevertheless, the current CRAM Riverine Module still provides a useful method for relative comparison of condition and health of these arid ephemeral systems, and can be used to establish a pre-Project baseline for evaluation of Project impacts and effects, to determine mitigation suitability, and in future mitigation monitoring.

3.1.2.3 Buffer and Landscape Context

Because this attribute of CRAM addresses general landscape aspects of the riparian vegetation and buffer of a site, the metrics as scored with the Riverine Module are generally applicable to sites within the Project Area. Although the existing riparian vegetation on the study site may differ in complexity, structure, and species composition from more mesic riparian systems, the connectivity of the riparian corridor and buffer of arid, ephemeral streams still provide important structural habitat for a variety of wildlife species, play an important role in the dispersal of both animals and plants, and can also shade and stabilize fluvial environments, providing habitat for wildlife (Naiman, Decamps, and Pollock 1993, Patten 1998).

For riverine CRAM, this attribute is scored with two metrics: (1) the continuity of the riparian corridor over a prescribed distance upstream and downstream of the assessment area, and (2) the amount, size, and condition of the buffer on both sides of the assessment area. Final condition scores for the Landscape and Buffer Context attribute ranged from 52-100 (average score = 91, Table 8). Overall, this was the highest scoring CRAM attribute, with 35% of sites assessed receiving a score of 100 (the highest obtainable for this attribute). These sites were located primarily along the eastern side of the Project Area where there is little existing mining disturbance and in the center of the Project Area where there is little development.

3.1.2.4 Hydrology

For riverine CRAM, this attribute is scored with three metrics: (1) Water Source (direct fresh water sources to the channel during the dry season), (2) Channel Stability (the degree of channel aggradation or degradation), and (3) Hydrologic Connectivity (assessed based on the degree of channel entrenchment, calculated as the flood-prone width divided by the bank full width; Leopold, Emmet, and Myrick 1966, Rosgen 1996, Montgomery and MacDonald 2002). Final scores for the Hydrology attribute ranged from 58-100 (average score = 75, Table 8). Metrics of the Hydrology attribute in CRAM assess the sources, quantities, and movements of water, plus the quantities, transport, and fates of water-borne materials, particularly sediment as bed load and suspended load (Collins et al. 2008).

Overall, channel stability within the Project Area can be characterized as generally being in equilibrium with minor signs of aggradation and degradation, which is expected for normally functioning arid, ephemeral streams. Signs of excessive degradation were observed at several sites where incised channels were encountered. Several of the sites were within badland formations (Sites 6, 20, and 22) where the unstable soils are prone to erosion. Site 1 was downstream of a stock pond that had been breached after excessive sedimentation. The change in flow caused headcutting and incision downstream of the breached dam.

Hydrologic Connectivity is assessed based on the degree of channel entrenchment, or the inability of flows in a channel to exceed the channel banks (Rosgen 1996). The majority of sites within the Project Area scored a “C” or “D” for this metric. Sites within badland formations such as sites 6, 20, and 22 had highly incised channels due to the unstable soils and heavy runoff during storm events. Several sites along Cottonwood Wash and its larger tributaries also exhibited incised channels with sites 9, 10, 15, 17, and 18 scoring a "D" for this metric.

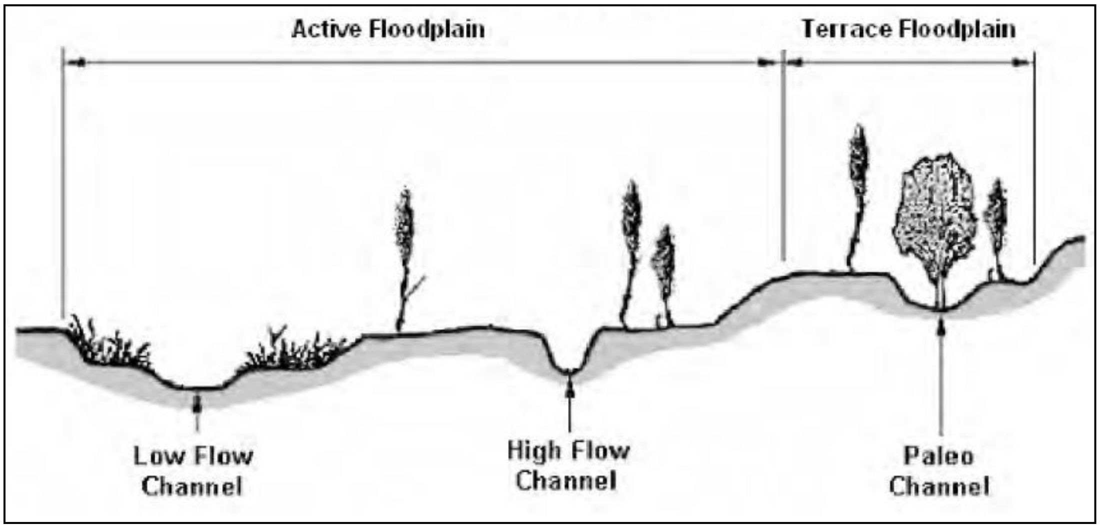
3.1.2.5 Physical Structure

The metrics used to score the Physical Structure Attribute of CRAM (physical patch types and topographic complexity) generally scored very low for the ephemeral streams assessed on the study site. Overall, this attribute did not apply well as constructed to the arid, ephemeral streams found on the project site. For CRAM, this attribute is scored with two metrics: (1) Patch Richness (the number of different obvious types of physical surfaces or features that may provide habitat for aquatic, wetland, or riparian species) and (2) Topographic Complexity (the spatial arrangement and interspersion of patch types). Final scores for the Physical Structure attribute ranged from 38 to 100 (average score = 42; Table 8). Overall, this was the lowest scoring CRAM attribute, with all but two of the sites receiving a final score of 38.

For the physical patch type richness metric, most sites scored low due to the few patch types observed in the field. This is somewhat misleading because some of the patch types listed in the current Riverine module, such as algal mats and submerged vegetation would not occur within an arid system. There was no difference between the headwater systems and Cottonwood Wash for this metric, both scores were identical at 3.9 (see tables in Attachment B).

To receive a high score for the Topographic Complexity CRAM metric, the presence of two elevational changes (i.e., "benches" or breaks in channel slope) is required. In perennial streams, benching is facilitated by variations in flow and sediment regimes. Because ephemeral streams in arid environments experience extreme and rapid variations in flood regime, the formation of benches is not a process that is expected to occur. Revised cross-section diagrams for arid stream systems would assist in interpretation of the topographic complexity metric, and potentially generate more variable scores for this metric. For example, in Figure 8, these cross-section diagrams could depict representations of in-channel features (e.g., low flow channel, active floodplain, and adjacent terraces) rather than elevation changes associated exclusively with the edge of the assessment area as was seen within the Project Area.

Figure 8. Typical arid, ephemeral/intermittent stream cross section and its associated hydrogeomorphic floodplain units (Lichvar et al. 2009).



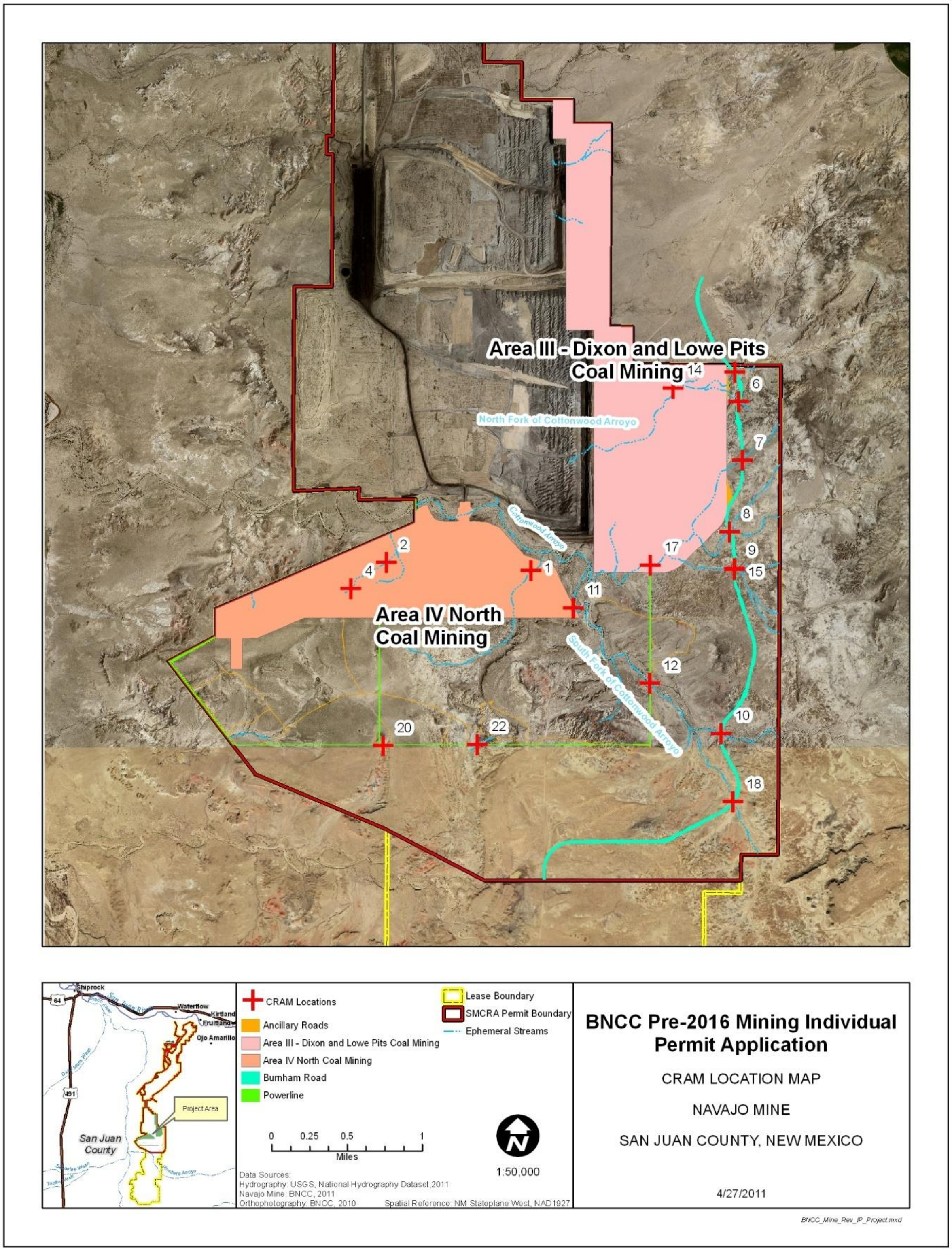
3.1.2.6 Biological Structure

The metrics used to score the Biological Structure Attribute of CRAM (physical patch types and topographic complexity) generally scored very low for the ephemeral streams in the Project Area site. The streams here are typical of arid, ephemeral streams in that they are relatively simple systems with few plant species, low plant cover, and low complexity across the landscape.

Metrics comprising this attribute focus on aspects of the vascular vegetation that contribute to a wetland's material structure and architecture. It is scored with three metrics: (1) Plant Community (number of vegetation layers, dominant plant species richness, and the number of invasive co-dominant species), (2) Horizontal Interspersion and Zonation (the number of distinct plant zones and the amount of edge between them), and (3) Vertical Biotic Structure (the degree of overlap among plant layers). Final condition scores for the Biotic Structure attribute ranged from 28-61 (average score = 44, Table 8). Overall, this was the second lowest scoring CRAM attribute.

Using to CRAM's scoring criteria, there was an ecological condition difference between the biotic structure attribute scores for the headwater systems (biotic structure score of 39) and Cottonwood Wash and its major tributaries (biotic structure score of 48). This was evident in the field with the majority of headwater sites having simpler vegetation communities with an average of only two plant layers and little variety within the landscape. The headwater systems also lacked riparian vegetation (tamarisk, willows and saltgrass) that were observed along Cottonwood Wash and its major tributaries. Several sites along Cottonwood Wash or its major tributaries contained three plant layers and better diversity of plant communities within the landscape.

Figure 9. Location of CRAM Assessment Areas within the overall Project Area.



3.2 Physical and Chemical Characteristics

3.2.1 Physical Substrate Characteristics

Soils within the Project Area have been surveyed by the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) as part of the Soil Survey of San Juan County, New Mexico – Eastern Part (NRCS 1980) and Soil Survey of Shiprock Area, Parts of San Juan County, New Mexico and Apache County, Arizona (NRCS 2004). As part of the Survey, soils were classified utilizing the USDA Soil Taxonomy System (NRCS 1999).

Mining specific soil surveys have also been completed within the Navajo Mine. Soil surveys were completed in 1985 and 1988. The surveys generally follow the taxonomic system utilized by the NRCS. The mining-specific soil surveys were focused on identification of the soils map units and salvageable topdressing material within the survey area. Topdressing refers to all unconsolidated material capable of supporting plant growth in the upper 60 inches of the native in-situ soil profile. The survey procedures and survey results are documented in the SMCRA mine permit (OSM 2009).

The mining-specific survey results classify the Project Area into three general soil types—Badlands, Natragrids, and potential topdressing sources. The three types of material each cover approximately 1/3 of the Project Area (33 percent each). Substrates within the smaller headwater stream channels within the Project Area would be characterized by one of the above soil types. Cottonwood Arroyo and its larger tributaries have substrates dominated by alluvium deposited during large storm events.

3.2.2 Water Circulation, Fluctuation, and Salinity Characteristics

The small, ephemeral channels that occur within the Project Area carry flows for short durations in response to precipitation events and snowmelt. These channels are tributaries to Cottonwood Arroyo. No perennial or intermittent streams are present within the Project Area, with the closest perennial drainage being the lower reaches of Chaco River and San Juan River—approximately 15 miles downstream of the Project Area. The Cottonwood Arroyo drains a watershed of about 80 square miles, traverses the Navajo Mine between Areas III and IV North, and joins the Chaco River about 3 miles downstream of the Mine.

About 48 percent of the Cottonwood Arroyo's watershed is occupied by badlands, which accounts for the high discharge and flow intensities observed in this stream. Peak flows in the Cottonwood Arroyo from a 10-year, 6-hour event at the upstream lease boundary are predicted to be about 2,879 cubic feet per second (cfs) (BNCC 2011). The Cottonwood stream channel near its mouth with the Chaco River has a uniform, shallow gradient. Suspended sediment concentrations are high during storm runoff events and the sandy channel bed and bank materials are reworked by the larger flood events.

Downstream and to the west of the Navajo Mine, Lowe Arroyo and Cottonwood Arroyo drain into Chaco River, another ephemeral stream, which then flows into the San Juan River approximately 30 river miles downstream of the confluence with Cottonwood Arroyo. The USGS monitored streamflow in the Chaco

River close to the San Juan River (4,350 mi^2 watershed) from November 1975 through September 1994. The USGS (2007a) found that base flows sampled from 1959 to 1994 ranged from 0 to 30 cfs and annual peak flows ranged from 1,170 to 6,410 cfs, and that the two year discharge was approximately 3,750 cfs.

A second, upstream USGS gauging station located on the Chaco River near Burnham, New Mexico (3,649 mi^2) indicates measurable flows only in response to rainfall or snowmelt events. Annual peak storm flows for the 1978 to 1982 monitoring period ranged from 950 to 6,740 cfs (USGS 2007a). The Chaco River gauging station near the San Juan River had a peak discharge of only 3,400 cfs when the upstream Chaco River gauging station experienced a 6,740 cfs discharge (USGS 2007b).

3.2.3 Suspended Particulate/Turbidity Characteristics

Since area channels have flowing water only in response to rainfall or snowmelt events, and channel bed and bank features are generally comprised of unconsolidated sand or finer textured particles, the runoff generally contains very high suspended sediment, total dissolved solids, and other dissolved constituents acquired from these soils.

Sediment concentrations were monitored downstream of the proposed Project Area at the Chaco River near the San Juan River from October 1969 through September 1989. Suspended sediment concentrations vary with discharge, but are typically in the range from 300 to 5,000 mg/l, except during storm runoff events when concentrations usually range from 50,000 to 171,000 mg/l (USGS 2007b). Observed suspended sediment loads were as high as 629,000 tons/day. The Chaco River near Burnham gauging station has recorded peak suspended sediment concentrations as high as 174,000 mg/l and suspended sediment loads as high as 3,500,000 tons/day (USGS 2007a).

3.2.4 Contaminants

Surface water sampling was conducted by BNCC from 1997-1999 for Cottonwood Arroyo and is considered representative of current conditions (BNCC 2011). The moderately saline sodium sulfate waters are alkaline with a moderate hardness. The average conductivity on Cottonwood Arroyo has ranged from 861 to 1,728 µmhos/cm on Cottonwood Arroyo (Table 9). The average selenium concentration ranges from 0.003 to 0.006 mg/L, and exceeds the Navajo Nation Environmental Protection Agency (NNEPA) standard for aquatic wildlife habitat of 0.002 mg/L. Selenium levels in samples acquired upstream of the mine (CN-1) are often elevated above the samples downstream of the mine (CNS-1).

Table 9. Summary of Surface Water Monitoring Data for Cottonwood Arroyo and NNEPA Livestock and Wildlife Watering Criteria

Site Names and NNEPA Watering Criteria				
Site Name	NNEPA Livestock and Wildlife Watering Criteria[1]	CN-1	CS-1	CNS-1
Stream		N Fork Cotton-wood	S Fork Cotton-wood	Cottonwood
Location		**Upstream**	**Upstream**	**Downstream**
Start Date	**N/A**	**1997**	**1997**	**1997**
End Date	**N/A**	**1999**	**1999**	**1999**
pH (S.U.)	**N/A**	7.99	8.14	8.17
# of Observations	**N/A**	28	12	19
Total Dissolved Solids (mg/L)	**2,212**	976	652	639
Total Suspended Solids (mg/L)	**N/A**	114919	74009	97282
Total Settleable Solids (mg/L)	**N/A**	311.6	85.5	133.2
Total Sediment (mg/L)	**N/A**	123097	79420	85247
Conductivity (µ mhos/cm)	**N/A**	1298	1728	861
Boron (mg/L)	**5**	0.07	0.14	0.08
Calcium (mg/L)	**N/A**	58	43	39
Chloride (mg/L)	**600**	29	21	17

Site Names and NNEPA Watering Criteria				
Site Name	NNEPA Livestock and Wildlife Watering Criteria[1]	CN-1	CS-1	CNS-1
Stream		N Fork Cotton-wood	S Fork Cotton-wood	Cottonwood
Fluoride (mg/L)	**2**	0.83	0.68	0.74
Iron (mg/L)	**N/A**	3.59	7.54	6.65
Total Iron (mg/L)	**N/A**	669.6	540.17	181.55
Magnesium (mg/L)	**N/A**	7.61	5.46	4.22
Manganese (mg/L)	**N/A**	0.17	0.44	0.38
Total Manganese (mg/L)	**N/A**	14.48	11.01	5.84
Potassium (mg/L)	**N/A**	5.5	6.9	5.3
Selenium (mg/L)	**0.05**	0.006	0.003	0.003
Sulfate (mg/L)	**1,000**	515	280	277
Sodium (mg/L)	**N/A**	240	166	169
Bicarbonate (mg/L)	**N/A**	168	189	192
Carbonate (mg/L)	**N/A**	1	1	7

[1] Navajo Nation Environmental Protection Agency Water Quality Program, 2004, Navajo Nation Surface Water Quality Standards.

Water quality is further discussed in Sections 3.2 and 4.2 of the EA.

3.3 Biological Characteristics

The ephemeral channels that traverse the Project Area do not hold water long enough for permanent wetland vegetation to establish in most locations. The smaller channels (1-3 feet wide and 6-18 inches deep) do not support any wetland vegetation and usually have scoured sand beds that transition immediately to upland vegetation such as greasewood (*Sarcobatus vermiculatus*), saltbush (*Atriplex* spp.), James' galleta (*Pleuraphis jamesii*), and sand dropseed (*Sporobolus cryptandrus*).

Cottonwood Arroyo contains flow for longer periods of time and likely has a higher groundwater table. Patches of tamarisk (*Tamarix* spp.) have been observed along its banks with an occasional patch of coyote willow (*Salix exigua*). No wetland vegetation indicative of saturated soils for prolonged periods during the growing season such as sedges (*Carex* spp.) and rushes (*Juncus* spp.) were observed during field visits. The majority of the banks are lined with rubber rabbitbrush (*Ericameria nauseosa*), greasewood, saltbush, and big sagebrush (*Artemisia tridentata*).

The Co-Dominant Species submetric of CRAM is assessed as living vegetation that comprises at least 10 percent relative cover within each plant layer identified in the AA. To be classified as a plant layer, the cover in that height layer must be at least 5 percent total cover. Most stream sites assessed had short (< 0.5 meter tall) and medium (0.5-1.5 meters tall) layers with five of 17 sites (29 percent) having a tall layer (1.5-3.0 m tall). The most common co-dominant species include sand dropseed, James' galleta, rubber rabbitbrush, Russian thistle (*Salsola tragus*), and greasewood. Along the banks of Cottonwood Arroyo and its larger tributaries, tamarisk and saltgrass (*Distichlis spicata*) were also co-dominant species not observed in the headwater stream systems.

A more complete analysis of biological resources that use these ephemeral streambeds is included in the Biological Evaluation (BE) that has been submitted to the Navajo Nation Department of Fish and Wildlife (NNDFW) and USFWS.

3.3.1 Threatened and Endangered Species

According to the USFWS, there are 11 federally listed threatened, endangered, proposed threatened, or candidate plant and animal species with potential to occur in San Juan County, New Mexico. USFWS listed species were obtained from the USFWS Southwest Region Endangered Species List (USFWS 2011). Federally listed species for San Juan County, New Mexico, their habitat associations, and a description of the potential for each to occur in the action area is provided in the Biological Evaluation (BE) in Appendix C of the EA.

There is no suitable habitat for any federally listed species to reside or breed within the Navajo Mine lease or permit areas, including within the areas proposed for mining in Areas IV North and III. It is possible that the endangered southwestern willow flycatcher travel through the area, however the potential is low due to the lack of suitable landing and resting habitat.

For purposes of analysis of impacts to threatened and endangered species, where the Action Area as defined in the BE, and includes both direct and indirect impacts, extends to include a short reach of the San Juan River, known and potential habitat for several federally listed species occur associated with habitats along and within the river system. In addition to breeding and migratory stopover habitat for the southwestern willow flycatcher (SWWF), there is habitat and known occurrences of yellow-billed cuckoo, roundtail chub, and known occurrence and critical habitat for the Colorado pikeminnow and razorback sucker. The San Juan River is approximately 16 miles away from proposed mining in Area IV North and active mining in Area III and approximately 3.3 miles from infrastructure and transportation related disturbances in Areas I and II. As such, the BE prepared for the project (Appendix C of the EA) evaluates the potential impacts to these species.

3.3.2 Fish, Crustaceans, Mollusks, and Other Aquatic Organisms in the Food Web

The Project Area does not contain streams, ponds, or other water features that could sustain any species of fish, crustaceans, mollusks, or other aquatic organisms.

3.3.3 Other Wildlife

Wildlife common in the Project Area includes a variety of mammals, birds, invertebratesassociated with Great Basin desertscrub, the dominant vegetation community in the Project Area (Dick-Peddie 1993, Brown 1994). Great Basin desertscrub habitat is a cold desert ecosystem dominated by a variety of shrubs with a sparse understory of forbs and grasses, with bare ground dominating in poor, alkaline soils (Fitzgerald, Meaney, and Armstrong 1994; Dick-Peddie 1993). For detailed information on vegetation of the Project Area, see Section 3.6 of the EA. For a detailed list of wildlife species that may occur here, see the Section 3.7 of the EA.

Landscape features and topography such as rock outcrops, washes, and rolling hills contribute to the diversity of wildlife species that inhabit the Project Area. Annual precipitation is a limiting factor for wildlife and most species in the Project Area are well adapted to arid conditions and sparse vegetation. The mean annual precipitation in the Project Area recorded at a meteorological station in Area IV North from 2006 through 2010 is 6.7 inches. Most precipitation comes during the monsoon season in July and August with only about one inch of rain falling each month on average (D. Vaughn, BNCC, personal communication, 2011).

Ephemeral drainages in the Project Area support sparse and relatively poor-quality riparian vegetation, typically dominated by salt cedar (*Tamarix sp*.) and greasewood or upland species. The majority of the channels, especially those that would be impacted, are smaller channels (1-3 feet wide) that do not support any wetland vegetation and usually have scoured sand beds that transition immediately to upland vegetation. Thinly scattered willow (*Salix exigua*), less than five feet in height, are established in an approximate 100-foot stretch of Cottonwood Arroyo between the existing Burnham Road and the proposed mining disturbance. Drainages, even those with little or no vegetation, are often used disproportionately by wildlife, especially in such arid environments. These areas provide important cover as protection from predation, as breeding habitat, and refuge from adverse weather—especially heat in summer.

3.3.4 Special Aquatic Sites

The BNCC Project Area does not contain any special aquatic sites. The jurisdictional WUS found within the Project Area are largely unvegetated ephemeral stream channels. Vegetation that does occur sparsely in channels is largely dominated by upland plant species with isolated patches of riparian habitat, including tamarisk.

3.4 Potential Effects on Human Use Characteristics

3.4.1 Municipal and Private Water Supplies

Runoff from the ephemeral streams within the project site does not recharge municipal or private water supplies.

3.4.2 Recreational and Commercial Fisheries

There are no recreational or commercial fisheries located in the Project Area, on the San Juan River, or Chaco River downstream of the Project Area.

3.4.3 Water-Related Recreation

No water-related recreational activities occur in the Project Area or downstream. Recreation was not addressed in the EA since it was not considered an affected resource.

3.4.4 Aesthetics

The Visual Resources section of the EA (Section 3.4) provides a comprehensive analysis of the proposed Project in relation to the surrounding viewshed.

3.4.5 Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

The Project site is not located in or near any National Parks, Monuments, Seashores, Wilderness Areas, or research sites. The nearest feature in this category is Mesa Verde National Park which is 38 miles north of Navajo Mine. More areas are the Weminuche Wilderness Area (Southwestern Colorado) and San Pedro Parks Wilderness Area (Northwest New Mexico), approximately 85 miles and 99 miles distant, respectively.

4. Impacts Analysis

4.1 Impacts to Waters of the U.S.

BNCC's proposed action includes four components that have the potential to impact WUS within the Project Area. The components include mining within portions of Area III and IV North, the Burnham Road realignment, construction of a powerline in Area IV North, and the improvement of ancillary roads within Area IV North (Table 10). The powerline and ancillary roads were constructed under previous authorizations.

Table 10. Projected impacts to WUS from the Proposed Project components.

Type of Activity	Total Area Affected (acres)	Proposed Fill in WUS (acres)	Type of Disturbance
Area III[1]: **Dixon and Lowe Pits Coal Mining**	701	1.1	**Permanent**
Area IV North[2]: **Coal Mining** **Transmission Line** **Ancillary Roads**	 704 32 23	 0.5 0.0[3] 0.002	 **Permanent** **Temporary**
Subtotal	759	0.602	
Burnham Road Realignment[4]	75	0.1	**Permanent**
Total	**1,888**	**1.7**	

1 – Area III is included within the Mine Permit area under SMCRA. Timing and sequence of mining in Area III is already approved under SMCRA

2 – Area IV North is included within the Mine Permit Area under SMCRA. Proposed timing and sequence of mining in Area IV North is currently being reviewed by OSM

3 – The powerline crosses 5 WUS channels, but no poles were placed within the OHWM and no access roads cross the channels.

4 – Burnham Road Realignment was previously approved, but is included in the Environmental Assessment being prepared for pre-2016 mining.

Mining in Areas III and IV North would impact 1.1 and 0.5 acres of WUS (Table 10), respectively. Mining would effectively remove these channels until reclamation occurs (see Section 5). In Area IV North, the 0.5 acre of WUS that would be affected are all headwater stream systems with narrow channels and no riparian vegetation (see CRAM scores in Attachment B). Mining activities will not affect the main stem of Cottonwood Arroyo or its riparian corridor due to avoid and minimize measures taken as required under Section 404 of the CWA(Figures 10 and 11). Coal in those areas would not be mined.

In order to protect surface water quality and to comply with requirements under Section 402 of the Clean Water Act, BNCC has already constructed one retention pond upstream of mining activities in Area IV North to intercept and detain flow on the western side of Area IV North and would construct another retention pond on the eastern side of Area IV North (Figure 11). These retention ponds are constructed to prevent channel flows and run-off from entering the active mining areas of Area IV North to protect water quality by preventing surface water from commingling with potential contaminants and to protect mining operations and employees.

Continued mining in Area III would mine through 1.1 acres of WUS in addition to the one acre already impacted and permitted with a current Nationwide Permit 21 (SPA-2011-00122-ABQ). The North fork of Cottonwood Arroyo has already been diverted around Area III through a diversion channel that was constructed in 2002. Mining activities would continue through the North fork of Cottonwood Arroyo up to the diversion channel and would also impact a tributary drainage that flows south into the main stem of Cottonwood Arroyo (Figure 10).

BNCC has established a 100 foot wide stream buffer zone along the South fork and main stem of Cottonwood Arroyo in accordance with its SMCRA mine permit requirements. Land disturbance associated with surface mining activities is not permitted within this stream buffer zone. The stream buffer protects approximately 3.1 acres of the main stem of Cottonwood Arroyo from mining activities in Area III (Figure 10) and 0.14 acre of the South fork of Cottonwood Arroyo from mining activities in Area IV North (Figure 11).

The proposed Burnham Road realignment would include eight crossings of WUS, including three crossings of Cottonwood Arroyo and five crossings of small headwaters channels (Figures 10 and 12). Each of the crossings would be constructed with culverts to avoid and minimize fill in WUS and ensure safe travel during precipitation events. Table 11 includes the width and depth of the channels at each crossing, the acres of impacts, and the amount of fill within the OHWM of the channel. OHWM measurements for the eight crossings were taken in 2011 during the PJD verification and CRAM field assessment. The eight crossings would impact up to 0.1 acre of WUS and the culvert crossings would require approximately 3,200 cubic feet of fill.

The Burnham Road crossings were designed and constructed to minimize their effect on channel flow hydraulics and sediment transport ability. Attachment A includes engineered drawings of each WUS crossing. Water would continue to flow past each culvert road crossing with only minimal and localized hydraulic effect. Culvert crossings would be constructed to ensure that there is no downstream headcutting and that flow is not affected.

Table 11. Burnham Road crossings of WUS including acres of impacts and amount of fill.

Crossing Number	Cottonwood Arroyo	Width (feet)	Depth (feet)	Area (acres)	Fill (cubic yards)
1	Yes	16.4	0.49	0.064	1,371.9
2	No	2.3	0.16	0.007	51.8
3	No	3.6	0.43	0.009	173.7

Crossing Number	Cottonwood Arroyo	Width (feet)	Depth (feet)	Area (acres)	Fill (cubic yards)
4	Yes	8.5	0.43	0.032	598.1
5	No	4.3	0.33	0.012	177.9
6	No	4.3	0.33	0.013	186.1
7	No	6.5	0.25	0.025	270.4
8	Yes	9.0	0.25	0.034	370.2
			Total	**0.1**	**3,200**

The powerline was permitted and constructed under a previous NWP 21 (SPA-2008-520-DUR) and the five crossings of WUS did not require any fill in or impacts to WUS. The powerline spans every drainage and no access roads were required to cross WUS for construction, nor would any be required for maintenance. The ancillary roads south of the Area IV North mining area are all existing roads in varying degrees of condition. BNCC does not plan to improve any of these roads and currently only one WUS crossing has been identified. This crossing would remain a low-water crossing with no improvements and therefore no additional impacts to WUS are expected.

4.2 Reclamation

BNCC is required to reclaim all areas disturbed during strip mining operations as contemporaneously as practicable with mining operations (30 CFR §816.100). SMCRA requires diverse, effective, and permanent vegetative plant communities native to the BNCC permit area to be established on all regraded and other disturbed lands (30 CFR 816.111). A reclamation plan has been developed for the mine in compliance with the requirements of the SMCRA permit (BNCC 2011). Reclamation consists of the following activities:

- Backfilling and grading.
- Replacement of topdressing.
- Revegetation.
- Reclamation monitoring.
- Post-mining land use with the same as or higher and better use than pre-mining uses. In this case, the drainage density would be restored to the pre-mine density.

4.2.1 Backfilling and Grading

Spoil materials are regraded with dozers, front-end loaders, haul trucks, or draglines to an approved final surface configuration (FSC) topography. Backfilling and grading activities are conducted as contemporaneously as practicable.

Regrading generally consists of both primary and secondary regrading activities. Primary regrading utilizes track dozers to level off the spoil ridges. Some areas and ramps might not have sufficient backfill material readily available for track dozers to adequately regrade the area. In these instances, supplemental equipment may be used to facilitate primary regrading activities. This equipment includes, but is not limited to, scrapers, draglines, and end-dump trucks and large front-end loaders. Secondary regrading may, if needed, follow primary grading for additional contouring of the land surface to accommodate topdressing replacement.

Once the area has been regraded to the FSC topography, the regraded spoil is systematically sampled for root-zone suitability. Areas not meeting the OSM approved root-zone criteria are mitigated as required with up to four feet of suitable root-zone material.

4.2.2 Replacement of Topdressing

Areas disturbed by mining or mining related activities (e.g., ramps, primary haulroads, and support facilities) would have topdressing material replaced for the purpose of reclamation. Areas of minimal surface disturbance (e.g., ancillary roads, powerline disturbances, drill sites) would not receive additional topdressing material. Heavily compacted regraded surfaces are ripped to alleviate compaction. Topdressing may be replaced year-round with equipment (i.e., scrapers or haul trucks) best suited for the conditions of the reclamation area. Topdressing material would be hauled from either topdressing stockpiles or hauled directly from a topdressing salvage site and replaced on the reclamation plot at an average prescribed depth.

4.2.3 Revegetation

Revegetation activities are initiated on those areas that have been regraded and topdressed during the first normal growing season after regrading and topdressing. Revegetation activities run from March through October and include seedbed preparation, seeding, mulching, and irrigation. The seedbed is mechanically prepared using traditional agricultural practices to reduce soil compaction, promote water infiltration, control wind and water erosion, and improve seed to soil contact for early seed development. The prepared seed bed is seeded with approved native cool and warm season seed mixes consisting of native forbs, grasses, and shrubs appropriate for the region. Mulch is applied and crimped into all reseeded areas to control erosion, slow evaporation at the surface, promote infiltration, decrease wind velocity at the soil surface, and provide an organic base to promote nutrient cycling.

BNCC utilizes irrigation to help promote the establishment of a sustainable revegetation cover. Irrigation is applied over two growing seasons, as needed, from May to mid-October. The first growing season is intended to help promote the successful germination and establishment of the seed mixes. The second growing season irrigation is generally a one-time application scheduled for April or May intended to support root development. During years of high winter or spring precipitation, the second year irrigation is reduced or is unnecessary.

4.2.4 Monitoring

Once the area has been regraded, topdressed, and revegetated, BNCC is required to monitor its progress for a minimum of 10 years to ensure that a diverse, effective, and sustaining vegetative cover capable of supporting the prescribed post-mining land-use is established.

4.2.5 Schedule

According to BNCC's mine plan revision (2011), reclamation in the Lowe and Dixon pits of Area III would begin in 2015 and continue through 2023 with final revegetation occurring then in 2023. This timetable does not include monitoring duties detailed in Section 4.2.4. The reestablishment of drainages would occur throughout this period as mining activities clear entire drainages. Area IV North would begin reclamation in 2016 and continue through 2024.

Figure 10. Projected impacts to WUS in Area III and the northern portion of the Burnham Road realignment.

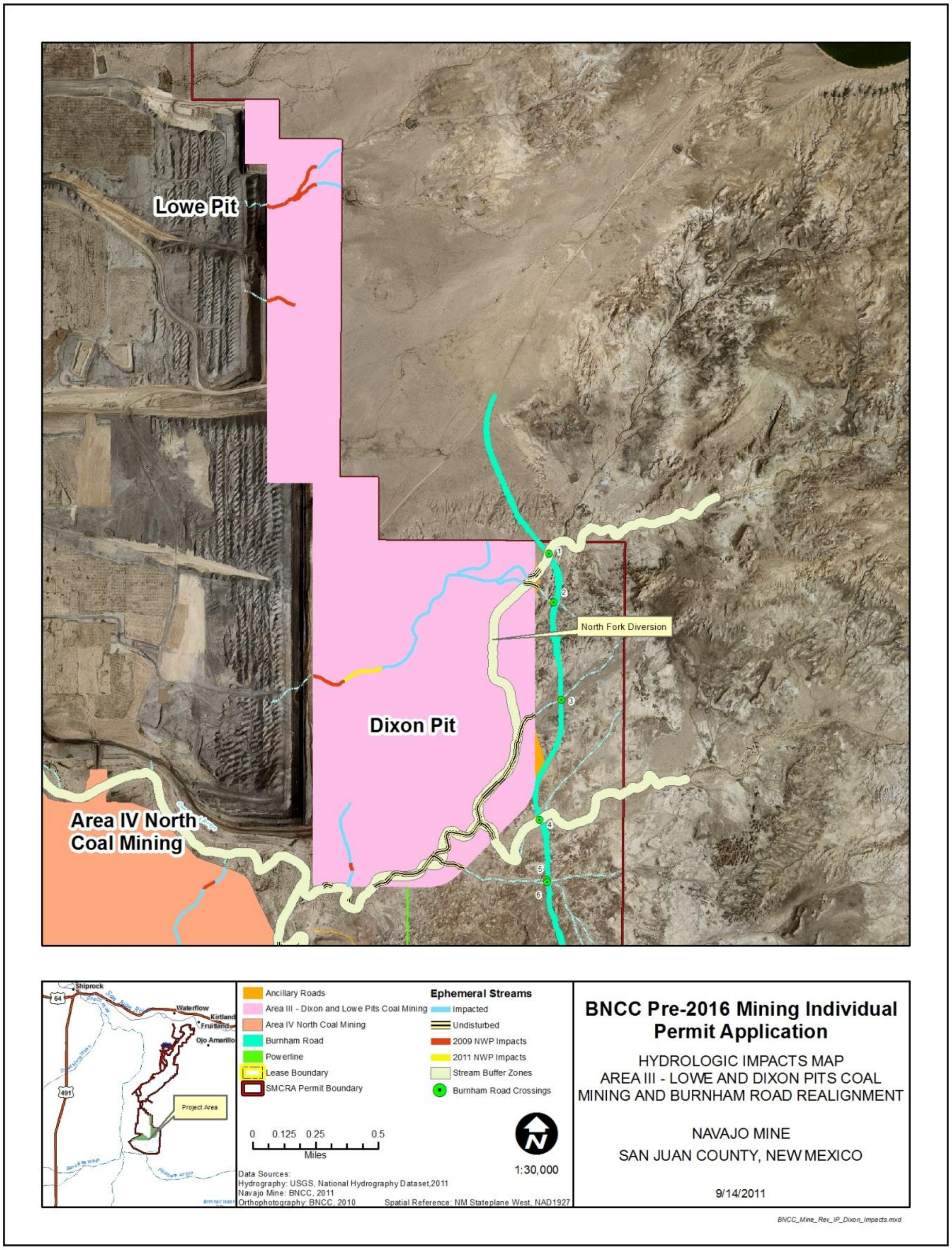


Figure 11. Project impacts to WUS in Area IV North.

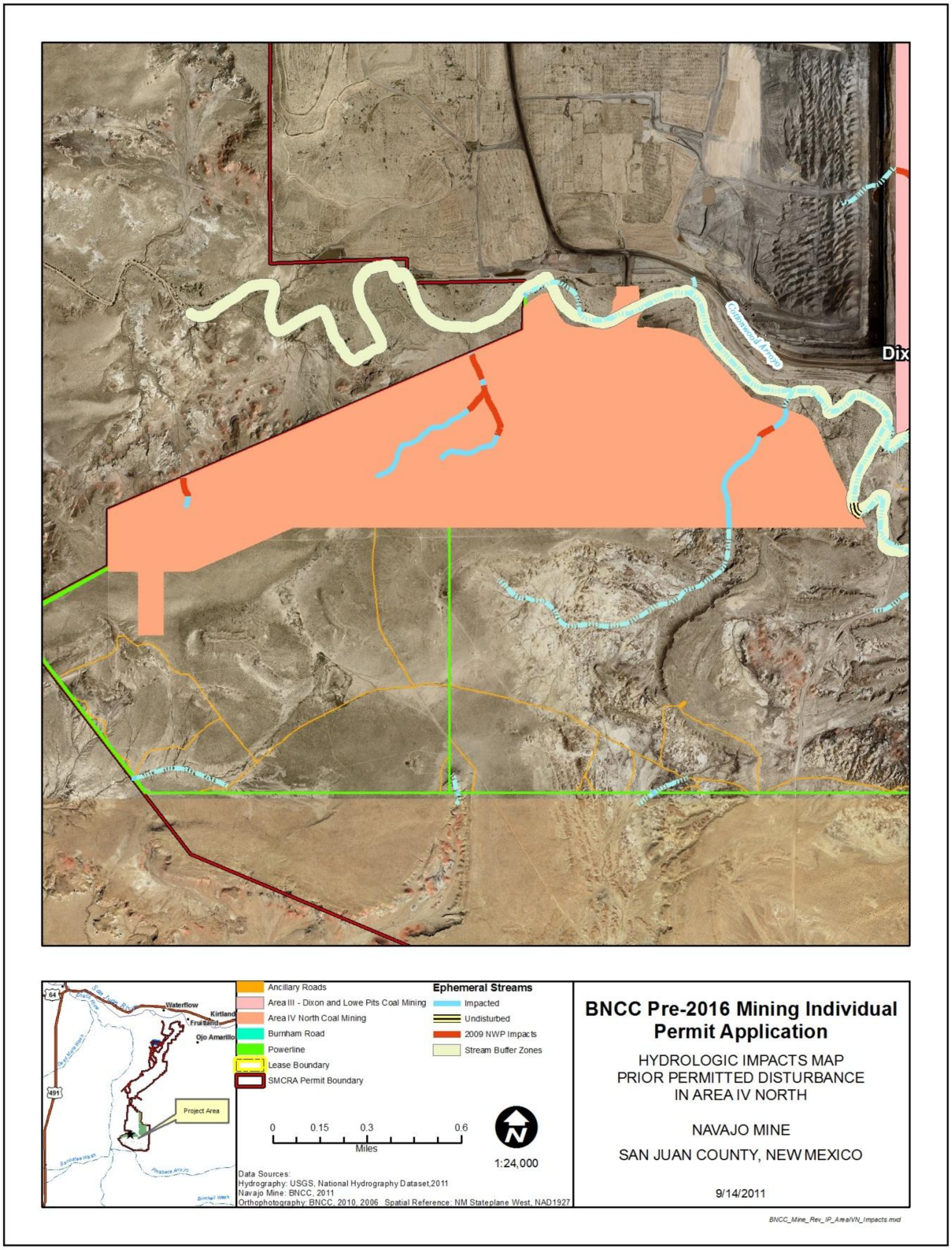
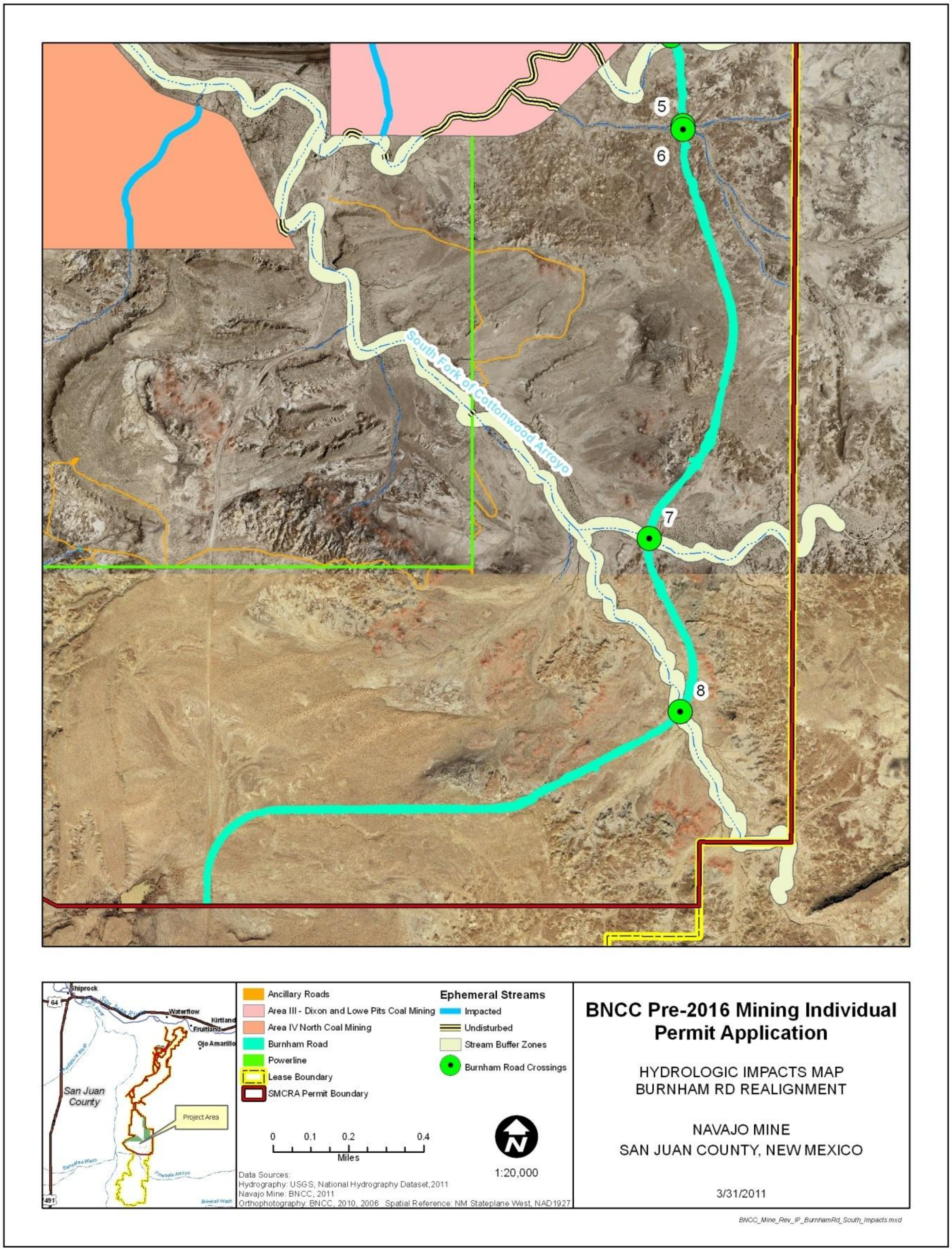


Figure 12. Project impacts to WUS by the southern portion of the Burnham Road realignment.



4.3 CRAM Analysis of Impacts

The direct and indirect effects during construction and operation of the Area III and IV North mining areas, as previously discussed, have the potential to adversely affect the ephemeral channels found within the Project Area. CRAM was used to assess the existing functionality of these channels and assign numerical scores based on the analysis of various functional attributes. The results regarding existing conditions are discussed in Section 3.1.2. By dividing the four attributes of the CRAM methodology into their respective metrics, it is possible to describe, according to CRAM's numerical scoring system, the estimated direct and indirect effects of the proposed mining on those same functional attributes of the ephemeral channels, including buffer condition, structural patch richness, and number of plant layers. Some of the projections are quantitative, but because USACE determined that certain attributes of the established CRAM Riverine module (Physical and Biological) do not adapt well to the arid region ephemeral channels, some of the projections are qualitative.

The purpose of this analysis is to supplement the assessment of impacts to aquatic resources and assist the USACE in determining adequate mitigation to replace the functionality of those resources lost due to the Project. In particular, the CRAM analysis will help the USACE determine the ability of proposed mitigation plans to compensate for the areal extent of and functions provided by the channels that would be affected by mining in Areas III and IV North. More detailed impacts analysis for the physical, chemical, and biological properties of the ephemeral channels are included in Sections 4.2 and 4.3.

The ephemeral channels within the active mining areas of Areas III and IV North would be completely mined through during the extraction of coal resources. The CRAM scores for these channel lengths would revert to "0" for all attributes until the channels are reclaimed (Attachment B). This applies to channel lengths associated with CRAM sites 1, 2, 4, and 14 (Figure 9).

The remainder of the channel lengths included in the CRAM analysis would not be impacted by the mining activities. Rather, those channel lengths would be impacted by the Burnham Road relocation. Relocation will require culverts in Areas III and IV North. In the CRAM Riverine module (Collins et al 2008), dirt road crossings such as those planned for Burnham Road (see Attachment A for engineered drawings) would not lower scores for any of the attributes associated with those sites. Therefore, the attribute scores would not be affected by construction of the eight Burnham Road ephemeral channel crossings, nor would the scores be affected by the existing powerline.

The Buffer and Landscape Connectivity Attribute scores would be impacted for channel lengths affected by mining and those channels not mined through but in proximity to mining. For riverine systems, landscape connectivity is assessed as the continuity of the riparian corridor over a distance of 500 meters upstream and 500 meters downstream of the assessment areas. Of special concern is the ability of wildlife to enter the riparian area from the adjacent upland buffer area. This requires adequate cover along the riparian corridor through the assessment area from upstream and downstream for ease of wildlife movement. Non-buffer land cover measuring more than 10 meters in length on either side of the stream riparian corridor upstream or downstream are considered breaks in the landscape connectivity. CRAM locations 5, 6, 7, and 8 are located within 500 meters of the proposed mining areas. The proximity of the mining areas would be considered breaks in landscape connectivity. Based on the current Riverine Module CRAM scoring method, this would effectively reduce the post-project scoring of the Landscape Connectivity metric for these sites to a “D” for sites 5, 6, and 7 from a “C” since the mining area is within 200 meters. Site 8 is between 200 and 500 meters from Area III so the score was reduced to a “C” (Attachment B).

The CRAM definition of Buffer is “the area adjoining the assessment area that is in a natural or semi-natural state and currently not dedicated to anthropogenic uses that would severely detract from its ability to entrap contaminants, discourage forays into the assessment area by people and non-native predators, or otherwise protect the assessment area from stress and disturbance.” The buffer metric is composed of three submetrics: (1) percentage of the AA perimeter that has a buffer; (2) the average buffer width; and (3) the condition or quality of the buffer. Sites 11 and 17 are located adjacent to Areas IV North and III, respectively (Figure 9). Each site still has a buffer around the entire site; however, the buffer width does not extend the full 250 meters where it encounters the mining area. The Buffer Width sub-metric was reduced to a “B” from an “A” for these two sites (Attachment B).

Overall, CRAM scores are reduced for 10 of the 17 sites (Attachment B). Scores did not change for the other seven sites due to the type of impacts and location of the channel lengths. For four of the sites within the mining areas, the overall scores were reduced to a “0” (Attachment B). Three of these sites (1, 2, and 4) are headwater streams within Area IV North (Figure 9). The remaining site 14 is located on the North fork of Cottonwood Arroyo located within Area III (Figure 9). The North fork diversion has already cut off this section of channel from its natural flow, and two retention ponds have already been constructed within its length to prevent channel flow and run-off from entering the Dixon Pit.

The remaining six sites have reduced scores due to their proximity to proposed mining activities in Areas III and IV North. These sites had their Buffer and Landscape Connectivity Attribute scores reduced. Scores for the other three attributes did not change. The effects on overall CRAM scores were minimal with the average reduction only 6 points and the range from 0 to 9 points (Attachment B).

In summary, it is estimated that there would be an approximately 45 percent reduction (functional loss) in CRAM scores for headwater channel systems (Table 12) due to mining (sites 1, 2, and 4) and the reduction of the Landscape Connectivity metric for sites 6 and 7. In addition, there would be an approximately 12 percent reduction in CRAM scores (functional loss) for Cottonwood Arroyo and its larger tributaries (Table 12) due to site 14 being mined through and the reductions to the Buffer Width sub-metric (sites 11 and 17) or the Landscape Connectivity metric (sites 5 and 8) due to proximity to Areas III and IV North. See Table 12 for CRAM Summary Scores and Attachment B for CRAM data spreadsheets with existing and projected scores for all headwater streams and Cottonwood Arroyo and its larger tributaries. BNCC proposes to compensate for the loss of functionality due to the Project’s impacts by improving the functions and services along the lower Chinde Wash within BNCC’s Lease Boundary. See Section 5.0 for details regarding the mitigation sites and plans.

Table 12. CRAM Summary: Existing Scores and Post-Project Projections

	Headwater Systems				Cottonwood Wash			
CRAM Projection	Original Avg Scores	Projected Average Scores	Impact delta	Percent Reduction	Original Avg Scores	Projected Average Scores	Impact delta	Percent Reduction
Buffer and Landscape Connectivity	20.2	10.9	9.3	46.0%	22.9	19.0	3.9	17.0%
Landscape Connectivity	9.4	4.3	5.1	54.5%	12.0	9.3	2.7	22.5%
Buffer Metrics	10.8	6.6	4.1	38.5%	10.9	9.7	1.2	11.0%
% of AA with Buffer	12.0	6.9	5.1	42.9%	12.0	10.8	1.2	10.0%
Average Buffer Width	10.7	6.9	3.9	36.0%	12.0	10.2	1.8	15.0%
Buffer Condition	10.3	6.4	3.9	37.5%	9.9	9.0	0.9	9.1%
Raw Score	20.2	10.9	9.3	46.0%	22.9	19.0	3.9	17.0%
Final Score	84.2	45.5	38.7	46.0%	95.4	79.1	16.2	17.0%
Hydrology	27.0	15.0	12.0	44.4%	27.0	24.0	3.0	11.1%
Water Source	12.0	6.9	5.1	42.9%	10.8	10.2	0.6	5.6%
Hydroperiod/Channel Stability	7.7	4.3	3.4	44.4%	10.5	9.3	1.2	11.4%
Hydrologic Connectivity	7.3	3.9	3.4	47.1%	5.7	4.5	1.2	21.1%
Raw Score	27.0	15.0	12.0	44.4%	27.0	24.0	3.0	11.1%
Final Score	75.0	41.7	33.3	44.4%	75.0	66.7	8.3	11.1%
Physical Structure	9.9	5.6	4.3	43.5%	10.2	9.3	0.9	8.8%
Structural Patch Richness	3.9	2.1	1.7	44.4%	3.9	3.6	0.3	7.7%
Topographic Complexity	6.0	3.4	2.6	42.9%	6.3	5.7	0.6	9.5%
Raw Score	9.9	5.6	4.3	43.5%	10.2	9.3	0.9	8.8%
Final Score	41.1	23.2	17.9	43.5%	42.5	38.8	3.8	8.8%
Biotic Structure	14.0	7.4	6.6	46.9%	17.3	15.6	1.7	9.8%
PC: No. of plant layers	6.0	3.4	2.6	42.9%	7.2	6.3	0.9	12.5%
PC: No. of codominants	3.4	1.7	1.7	50.0%	3.3	3.0	0.3	9.1%
PC: Percent Invasion	9.4	5.6	3.9	40.9%	9.0	8.7	0.3	3.3%
Plant Community Metrics	6.3	3.6	2.7	43.2%	6.5	6.0	0.5	7.7%
Interspersion	4.7	2.1	2.6	54.5%	6.6	6.0	0.6	9.1%
Vertical Biotic Structure	3.0	1.7	1.3	42.9%	4.2	3.6	0.6	14.3%
Raw Score	14.0	7.4	6.6	46.9%	17.3	15.6	1.7	9.8%
Final Score	38.9	20.7	18.3	46.9%	48.1	43.4	4.7	9.8%
Overall AA Score	59.2	32.4	26.8	45.2%	64.5	56.6	7.9	12.3%

4.4 Physical and Chemical Impacts

4.4.1 Physical Substrate Impacts

The proposed mining activities would include removal of soil material, overburden, and interburden geologic material within the proposed mining area. This would include the headwater systems of Area IV North as depicted in Figure 11. The main stem and South fork of Cottonwood Arroyo would not be impacted by the proposed project; however, the alluvium within the North fork of Cottonwood Arroyo (Figure 10) would be mined through and combined with the other overburden. These activities would mix and homogenize surface soils and top dressing (soil materials) within the areas that would be mined. The mixing would occur as a result of soil stripping, soil stockpiling and subsequent soil material/top dressing placement within reclaimed areas. Soil impacts would occur over a medium-term period (5 to 10 years). The proposed mining activities would occur through 2016. Reclamation would be contemporaneous with mining activities but it is expected that final reclamation of the Project Area would continue for approximately 5 years after mining has been completed. Impacts to soils would be of low severity because the soils are not suitable for agricultural use and potential for erosion would be mitigated by reclamation.

All soil material handling activities would be completed per OSM requirements and in compliance with the approved mine plans, which prescribe mitigation measures to preserve the integrity of soils. The mitigation includes removal of soils that would be utilized for top dressing ahead of mining activities to prevent contamination, stockpiling soils not used immediately for reclamation, and the use of berms surrounding soil stockpiles to reduce erosion. Additionally, BMPs would be implemented as described in the mine Storm Water Pollution Prevention Plan (SWPPP) for active mining. Any surface spills of petroleum hydrocarbons or other regulated substances would be handled per the BHP Navajo Mine SPCC Plan. When necessary, petroleum contaminated soils resulting from accidental spill and leaks would be managed using the existing land farming facilities within the Navajo Mine as described in the current Mine Plan Revision (BNCC 2011).

4.4.2 Water Circulation, Fluctuation, and Salinity Impacts

Construction and Operation Impacts

With the proposed mining in Areas III and IV North, there would be direct impacts of slightly reduced flows from storm events on tributaries to the Chaco River, including tributaries to Cottonwood Arroyo, from the mining area in Area IV North. In addition, there would be decreases in storm-related flows to Cottonwood Arroyo due to the construction of highwall impoundments and sediment ponds.

BNCC utilizes highwall impoundments to intercept upgradient flow above the active pits. These sumps, coupled with mining of the ephemeral drainages, decrease storm-related flows in Chaco River to the west. The mine pits and the sediment ponds located downgradient of disturbed areas also decrease flows to the Chaco River. The sediment ponds have the capability to discharge following large storm events, and there have been five discharge events between 1977 and 2005, with most events occurring during the last five years from sediment ponds downgradient of large reclaimed areas. BNCC has periodically used water from the sediment impoundments for dust suppression in order to maintain sufficient storage in the ponds for storm runoff.

Mitigation Measures

All areas impacted under the proposed action would ultimately be reclaimed to approximate original contours and pre-mine drainage density (BNCC 2011). The culverts installed on Burnham Road would be permanent features, but have been engineered to not alter downstream water flow or circulation. Attachment A includes the engineered culvert diagrams.

4.4.3 Suspended Particulate/Turbidity Impacts

Construction and Operation Impacts.

While some sediment runoff is expected from surface disturbance, BNCC would implement erosion controls and sediment control measures required under SMCRA and NPDES to prevent, to the extent possible, additional contributions of sediment to streamflow or to runoff outside the mine permit area, meet the more stringent of applicable state or Federal effluent limitations, and minimize erosion to the extent possible. Measures would include siltation structures, discharge structures, impoundments, BMPs, and NPDES compliance as described below.

With the Burnham Road realignment, there may be low to moderate short-term impacts to surface water from precipitation runoff during construction and operation. Soil disturbance and vegetative removal would result in an increased potential for wind and water erosion. Impacts would be greatest during construction until interim reclamation of the disturbed areas outside of the driving surface. The Burnham Road realignment crosses several tributaries to the Cottonwood Wash. Culverts would be installed where drainages cross the road.

Post-mining sediment yields would not vary substantially from pre-mining conditions. BNCC conducted modeling of 10-year, six hour storm events for Cottonwood Arroyo with pre and post mine contours. The results indicated that there was little change in sediment yields (less than one percent) and in the magnitude of storm runoff (less than three percent) down gradient of mining after reclamation in comparison with pre-mine conditions (Table 11-22, BNCC 2011).

Mitigation Measures

BNCC proposes to implement BMPs to avoid and minimize water quality impacts during mining by controlling runoff and sedimentation into nearby channels, including minimization of disturbance footprints, establishment of stream buffer zones, employment of upstream diversions or highwall impoundments, the use of sediment ponds, perimeter berms or containment features, and re-seeding of areas prepared for reclamation as soon as practical. BNCC would comply with SMCRA requirements and

EPA's NPDES permits under Section 402 of the Clean Water Act to control the discharge of sediment within the active mining sectors of Areas III and IV North.

BNCC would also prepare and implement BMPs and a SWPPP, and would comply with EPA's Construction Stormwater General Permit under Section 402 of the Clean Water Act to control water and sediment discharge during the Burnham Road realignment construction. BNCC also plans to reseed 17 of the 50 acres of disturbance associated with the Burnham Road realignment following completion of the project. Culverts would be designed for peak flows from the 25, 50, or 100-year 24-hour storm events, depending upon the drainage area above the culvert location (see engineered drawings in Attachment A).

Within the mine areas, reclamation would incrementally re-establish topography with positive drainage towards the Chaco River. Sediment yields in runoff from the reclaimed areas are expected to quickly decline below the pre-mine conditions due to improved post-mine vegetation cover due to irrigated reseeding efforts, the use of mulch, and periodic irrigation.

Under the SMCRA mine permit requirements, BNCC is required to prove that reclaimed areas would yield sediment at rates equal to or less than pre-mine conditions as a performance standard for reclamation bond release. These demonstrations would provide verification that there have been no long-term detrimental impacts to water quality from mining.

4.4.4 Contaminant Impacts

Construction and Operation Impacts

Within Area IV North, impacts may include an improvement in the water quality of surface runoff from reclaimed areas in comparison with the areas prior to mine disturbance, as most of the area proposed for mining in Area IV North is comprised of sodic badland soils and areas disturbed by accelerated weathering from uncontrolled natural combustion of shallow coals (BNCC 2011). However, the water quality improvement in runoff from reclaimed areas is unlikely to result in measurable changes in surface water quality in Cottonwood Arroyo due to the small acreage of mine reclamation (about 1,800 acres) relative to the total drainage area of Cottonwood Arroyo (about 51,000 acres) and the high variability in the background surface water quality.

Anticipated impacts during mining include increases of TDS and sulfate concentrations in runoff from disturbed areas, regraded mine spoils, and reclaimed areas. The TDS and sulfate concentrations may result from dissolution of weathered geologic materials on the surface (spoils). The water quality of runoff from newly exposed strata and mine spoils show TDS and sulfate concentrations of 1,200 mg/l and 670 mg/l, respectively. The sulfate concentration is above the average concentrations observed in surface water background samples from Cottonwood Arroyo as summarized in Table 9 while the TDS concentration is higher than the average TDS observed on Cottonwood Arroyo. Surface runoff from disturbed areas would be controlled by implementation of BMPs and is unlikely to reach Chaco River.

Trace constituents in spoil leachate are below detection limits except for fluoride and boron (BNCC 2011). These parameters are well below their corresponding Navajo Nation livestock and wildlife use criteria. Manganese was also detected, but has no livestock and wildlife use criterion.

Mitigation Measures

BNCC would control release of contaminants by implementing BMPs, controlling runoff and flow into and through the mine area, and complying with its SMCRA, NPDES permits, and Clean Water Act requirements. BNCC has developed a series of retention ponds engineered to ensure that no contaminated water leaves the active mine pits. BNCC would not refuel any vehicles within 100 feet of ephemeral channels nor would equipment be stored within the ephemeral channels. This would reduce the potential of spills that would impact the ephemeral channel system within the Project Area. BNCC maintains and implements a SPCC plan that identifies areas of risk, specifies appropriate controls for bulk storage areas, identifies control strategies for managing a spill, should it occur, and lists procedures for safely disposing of any contaminated materials.

4.5 Biological Impacts

4.5.1 Threatened and Endangered Species Impacts

The BE includes the effects determinations to the SWWF, yellow-billed cuckoo, Colorado pikeminnow, roundtail chub, and razorback sucker (Appendix C of the EA). The mitigation outlined in Section 5 would have a potential beneficial effect on SWWF by creating habitat that could be used by the species. Because there would not be a measurable change in water quality or quantity reaching the San Juan River, the Proposed Action would have no effect on the three listed fish species.

4.5.2 Fish, Crustaceans, Mollusks, and Other Aquatic Organisms in the Food Web

The Project Area does not support any fish, crustaceans, mollusks, or other aquatic species. The aquatic organisms within the San Juan River would not be impacted since there would not be a measurable change in water quality or quantity reaching the San Juan River from the Proposed Action.

4.5.3 Other Wildlife

Impacts to wildlife as a result of mining are explained in detail in Section 4.7 of the EA. In general, loss and fragmentation of wildlife habitats are inevitable consequences of surface disturbance when vegetation is removed as proposed for the Project Area. Therefore, direct impacts to wildlife primarily include the loss and fragmentation of wildlife habitats including for small mammals and generalists such as coyote, black-tailed jackrabbit, desert cottontail, and lizards (Ecosphere 2004, 2008).

Direct impacts from habitat loss and alteration would be confined to the active mine site and are expected to be low to moderate in the short term because comparable habitat types surround the Project Area. Impacts would be low in the long term after successful reclamation of the mined area.

Further, impacts would likely be limited to specialist species that are less able to adapt to changes in their environment, examples include sensitive species such as those described in Section 4.8 of the EA.

4.5.4 Special Aquatic Sites

The Project Area does not include any special aquatic sites. While no fill in wetlands is proposed, the proposed mitigation plan is expected to result in improved wetland health and habitat (see Section 5).

4.6 Impacts on Human Use Characteristics

4.6.1 Municipal and Private Water Supplies

No municipal or private water supplies exist in the Project Area, and no impacts to water supplies are expected.

4.6.2 Recreational and Commercial Fisheries

No recreational or commercial fisheries exist in the Project area, therefore no impacts to fisheries are expected.

4.6.3 Water-Related Recreation

No water-related recreation activities occur in the Project Area, and no impacts to recreation are expected.

4.6.4 Aesthetics

See the Visual Resources—Section 4.4 of the EA—for a detailed discussion of the proposed Project's impacts to the viewshed.

4.6.5 Parks, National and Historical Monuments, National Seashores, Wilderness Areas, Research Sites, and Similar Preserves

There are no parks, national or historic monuments, national seashores, wilderness areas, research sites or similar preserves in or near the Project Area, and no impacts to such sites are expected. The nearest site is Mesa Verde National Park which is 38 miles north of Navajo Mine.

4.7 Determination of Cumulative Effects on Waters of the U.S.

Although a particular alteration of a wetland may constitute a minor change, the cumulative effect of numerous piecemeal changes can result in a major impairment of wetland resources. Thus, the particular wetland site for which an application is made must be evaluated with the recognition that it may be part of a complete and interrelated wetland area. 33 CFR §320.4(b)(3). Accordingly, a cumulative impact/effects analysis is required. Under 40 CFR §1508.7, a cumulative impact is defined as "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Under 40 CFR §230.11(g), cumulative effects on the aquatic ecosystem are defined as:

> …the changes in an aquatic ecosystem that are attributable to the collective effect of a number of individual discharges of dredged or fill material. Although the impact of a particular discharge may constitute a minor change in itself, the cumulative effect of numerous such piecemeal changes can result in a major impairment of the water resources and interfere with the productivity and water quality of existing aquatic ecosystems. Cumulative effects attributable to the discharge of dredged or fill material in waters of the United States should be predicted to the extent reasonable and practical. The permitting authority shall collect information and solicit information from other sources about the cumulative impacts on the aquatic ecosystem. This information shall be documented and considered during the decision-making process concerning the evaluation of individual permit applications, the issuance of a General permit, and monitoring and enforcement of existing permits."

For the purposes of this cumulative effects analysis, effects to the aquatic ecosystem from past, currently-proposed and actions determined to occur within the reasonably foreseeable future are considered.

Resources in the overall project and cumulative effects analysis area include primarily ephemeral stream systems. These are characterized by either no vegetation or upland vegetation, and convey flowing water only in response to rain events. They have limited function including water and sediment conveyance, pollutant attenuation and minor wildlife corridor activity. Some, including Cottonwood Wash, verge on intermittent, due both to its larger size and inflows from NAPI, and have been observed to contain persistent invasive aquatic species such as tamarisk and native riparian species including willow and saltgrass as observed during the 2009 delineation and 2011 CRAM field effort.

Previous area activities include mining and reclamation through Areas I, II and III, and include pre-Clean Water Act mining impacts. Mining was initiated in 1957. The total current mine lease area is 33,600 acres. To date, approximately 13,000 acres have been mined, of which approximately 8,000 acres have been reclaimed. Areas not yet reclaimed include infrastructure currently in use that would be reclaimed when all mining activities cease and recently mined areas. SMCRA permit requirements for previously-mined areas include surface hydrology creation to ensure post-mine surface water discharge equivalent to the pre-mine discharge and provide for post-mine grazing land use.

The currently proposed action would result in 1.7 acres of impact to WUS. The relevant SMCRA permit requires post-mining reclamation of unavoidable long-term temporal fills to the surface water resources. This will be accomplished by recreating surface hydrology to pre-mining conditions. Additionally, the applicant proposes short-term mitigation that would increase riparian function within Chinde Wash to offset the long-term temporal loss preceding reclamation. There are 1.7 acres of impacts, BNCC has submitted a mitigation plan to restore 3 acres, for a mitigation ratio of over 2:1

Actions determined to occur in the reasonable foreseeable future (RFFAs) with potential discharges of dredged and/or fill material to aquatic resources include mining in Areas IV North, IV South, and V. Post-2016 mining within the BNCC lease along with operation of the FCPP would likely undergo scoping within the next year. Under that proposal, mining would likely be proposed in the unmined portion of Area IV North and Area IV South. Additionally, the mine lease includes Area V, and due to lease agreements and BLM regulations/requirements to maximize economic recovery, Area V is included as a RFFA within the area. Estimated aquatic resources in the remaining Area IV North and Area V South include approximately 29 stream miles of predominately ephemeral streams. Area V contains approximately 20 stream miles of predominately ephemeral streams. Potential impacts due to dredged and/or fill activities may not occur in all resources as a result of RFFAs. Any potential impacts via long-term temporal loss due to RFFAs would likely be offset by mitigation under CWA Section 404 requirements in addition to post-mining reclamation to recreate surface water features commensurate with those mined as required under SMCRA.

Other potential activities in the reasonably foreseeable future include transmission line construction and/or alteration of existing lines and the return to pre-mine grazing land use. These activities would not likely result in permanent discharge of dredged and/or fill into aquatic resources and so are not included in the cumulative effects analysis.

Through a combination of mitigation for unavoidable long-term temporal loss and restoration of surface water hydrology during post-mining reclamation, no cumulative effects to aquatic resources within the overall project area are expected.

5. Mitigation Proposed by the Applicant

Under SMCRA and CWA requirements, BNCC is committed to avoiding and minimizing impacts to water resources. In particular, BMPs and NPDES controls would be implemented to avoid and minimize erosion, sedimentation, and pollution of waters. Additional details are provided in water resources sections of the EA, and USACE concurs with the plans provided. Further, as discussed below, BNCC would avoid impacts to Cottonwood Arroyo, would reclaim the mine area to restore prominent drainage features and the hydrologic balance, and develop compensatory mitigation to offset temporal loss of functionality of impacted WUS.

BNCC has developed the mine plan for Areas III and IV North with the purpose of preserving the natural flow of Cottonwood Arroyo to the extent possible. Cottonwood Arroyo would not be further diverted for mining purposes under the Proposed Action. In addition, flow would not be retarded by any structure greater than a culvert. It is anticipated that there would be eight crossings of Cottonwood Arroyo or its tributaries that would necessitate the installation of culverts including the haulroad crossing just north of the mining disturbance area (Table 11). A small segment of the South fork of the Cottonwood Arroyo (approximately 150 linear feet) intersects the proposed Area IV North mining disturbance area. BNCC has established a stream buffer zone along the South fork of Cottonwood Arroyo, in accordance with its SMCRA Mine Permit requirements. Land disturbance associated with surface mining activities are not permitted within this stream buffer zone, unless approved by OSM. The stream buffer zone reduces potential impacts to Cottonwood Arroyo by 0.14 acre (Figure 11). In addition, BNCC has established a stream buffer zone along the North fork of Cottonwood Arroyo that avoids surface disturbance within that section of stream for Area III and reduces impacts to Cottonwood Arroyo by about 3.0 acres (Figure 10).

BNCC has committed through its SMCRA Mine Permit to restore Areas III and IV North to their approximate original contours. The reclamation of mine disturbance to the approximate original contours serves to minimize the disturbance to hydrologic balance and restore prominent drainage features within the Mine Permit area to their approximate pre-mining conditions. The reclamation of the Mine Permit area is guaranteed by a $154,000,000 bond to be released in phases after OSM determines reclamation activities have reached set performance standards. Reclamation in the Lowe and Dixon pits of Area III would begin in 2015 and continue through 2023 with final revegetation occurring then. The re-establishment of drainages would occur throughout this period as mining activities clear entire drainages. Area IV North would begin reclamation in 2016 and continue through 2024.

To offset the temporal loss of functionality impacts of WUS during active mining, BNCC has committed to the enhancement or creation of riparian habitat, functions, and values. Because BNCC’s impacts to WUS occur incrementally per year of operation, the USACE is working with the applicant to prepare a tiered approach to addressing mitigation requirements. BNCC has committed to exotics removal (tamarisk and Russian olive) and riparian planting to reestablish and improve the functions and values of the lower Chinde Wash located in Area II of Navajo Mine.

Consistent with USACE Guidance, including the Final Compensatory Mitigation Rule (April 10, 2008), Regulatory Guidance Letter No. 02-2 (Dec. 24, 2002), and the Memorandum of Agreement Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Final Compensatory Mitigation Rule, the mitigation requirements in this plan are designed to compensate for the loss of jurisdictional areas in the Project Area so as to ensure no net loss of functions and services of WUS as a result of the permitted activity. The primary mechanism for mitigating the loss of jurisdictional areas is re-establishment.

To achieve the goal of no net loss, the USACE requires a re-establishment mitigation ratio of 3.9:1 for a total of approximately 7.4 acres of mitigation. The re-establishment ratio was determined by analyzing the functional loss to ephemeral streams in the Project Area to the functional gain proposed by mitigation efforts at Lower Chinde by CRAM weighted units, as described in Section 5.0. The mitigation ratio also takes into account the impacts and mitigation occurring in the same watershed (Chaco River), any delays in the establishment of planted trees and shrubs, and any other pertinent factors.

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Attachment A - Construction diagrams of the Burnham Road Crossings

Attachment B - Complete CRAM scores for ephemeral streams within the Project Area

Table 1. Comprehensive CRAM scores for the Headwater Stream systems.

CRAM ID	1		2		4		6		7		20		22		Original Avg Scores	Projected Average Scores	Impact delta
Drainage Type	Headwater		Headwater		Headwater		Headwater		Headwater		Headwater		Headwater				
Impact Type	Mining Buffer		Mining Strip		Mining Strip		Burnham Road		Burnham Road		Powerline		Powerline				
CRAM Projection	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected			
Buffer and Landscape Connectivity	22	0	13	0	13	0	24	15	24	15	22	22	24	24	20	11	9
Landscape Connectivity	12	0	3	0	3	0	12	3	12	3	12	12	12	12	9	4	5
Buffer Metrics	9.67	0.00	9.67	0.00	9.67	0.00	12.00	12.00	12.00	12.00	10.39	10.39	12.00	12.00	11	7	4
% of AA with Buffer	12	0	12	0	12	0	12	12	12	12	12	12	12	12	12	7	5
Average Buffer Width	9	0	9	0	9	0	12	12	12	12	12	12	12	12	11	7	4
Buffer Condition	9	0	9	0	9	0	12	12	12	12	9	9	12	12	10	6	4
Raw Score	21.7	0.0	12.7	0.0	12.7	0.0	24.0	15.0	24.0	15.0	22.4	22.4	24.0	24.0	20	11	9
Final Score	90.3	0.0	52.8	0.0	52.8	0.0	100.0	62.5	100.0	62.5	93.4	93.4	100.0	100.0	84	45	39
Hydrology	24	0	27	0	33	0	24	24	33	33	24	24	24	24	27	15	12
Water Source	12	0	12	0	12	0	12	12	12	12	12	12	12	12	12	7	5
Hydroperiod	6	0	9	0	9	0	6	6	9	9	6	6	9	9	8	4	3
Hydrologic Connectivity	6	0	6	0	12	0	6	6	12	12	6	6	3	3	7	4	3
Raw Score	24.0	0.0	27.0	0.0	33.0	0.0	24.0	24.0	33.0	33.0	24.0	24.0	24.0	24.0	27	15	12
Final Score	66.7	0.0	75.0	0.0	91.7	0.0	66.7	66.7	91.7	91.7	66.7	66.7	66.7	66.7	75	42	33
Physical Structure	9	0	9	0	12	0	9	9	9	9	12	12	9	9	10	6	4
Structural Patch Richness	3	0	3	0	6	0	3	3	3	3	6	6	3	3	4	2	2
Topographic Complexity	6	0	6	0	6	0	6	6	6	6	6	6	6	6	6	3	3
Raw Score	9.0	0.0	9.0	0.0	12.0	0.0	9.0	9.0	9.0	9.0	12.0	12.0	9.0	9.0	10	6	4
Final Score	37.5	0.0	37.5	0.0	50.0	0.0	37.5	37.5	37.5	37.5	50.0	50.0	37.5	37.5	41	23	18
Biotic Structure	14	0	16	0	16	0	10	10	13	13	16	16	13	13	14	7	7
PC: No. of plant layers	6	0	6	0	6	0	6	6	6	6	6	6	6	6	6	3	3
PC: No. of codominants	3	0	6	0	3	0	3	3	3	3	3	3	3	3	3	2	2
PC: Percent Invasion	6	0	9	0	12	0	3	3	12	12	12	12	12	12	9	6	4
Plant Community Metrics	5	0	7	0	7	0	4	4	7	7	7	7	7	7	6	4	3
Interspersion	6	0	6	0	6	0	3	3	3	3	6	6	3	3	5	2	3
Vertical Biotic Structure	3	0	3	0	3	0	3	3	3	3	3	3	3	3	3	2	1
Raw Score	14.0	0.0	16.0	0.0	16.0	0.0	10.0	10.0	13.0	13.0	16.0	16.0	13.0	13.0	14	7	7
Final Score	38.9	0.0	44.5	0.0	44.5	0.0	27.8	27.8	36.2	36.2	44.5	44.5	36.2	36.2	39	21	18
Overall AA Score	57	0	54	0	61	0	56	48	66	58	62	62	58	58	59	32	27

Table 2. Overall CRAM Scores for Cottonwood Arroyo and its large tributaries.

CRAM ID	5		8		9		10		11		12		14		15		17		18		Original Avg Scores	Projected Average Scores	Impact delta
Drainage Type	Cottonwood		Cottonwood		Cottonwood		Cottonwood		Cottonwood		Cottonwood		Cottonwood		Cottonwood		Cottonwood		Cottonwood				
Impact Type	Burnham Road		Burnham Road		Burnham Road		Burnham Road		Mining Disturbance - Area IV N		Powerline		Mining Strip - Area III		Burnham Road		Powerline		Burnham Road				
CRAM Projection	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected	Original	Projected			
Buffer and Landscape Connectivity	22	13	22	16	22	22	24	24	24	23	24	24	22	0	22	22	22	22	22	22	23	19	4
Landscape Connectivity	12	3	12	6	12	12	12	12	12	12	12	12	12	0	12	12	12	12	12	12	12	9	3
Buffer Metrics	10.39	10.39	10.39	10.39	10.39	10.39	12.00	12.00	12.00	11.17	12.00	12.00	10.39	0.00	10.39	10.39	10.39	9.67	10.39	10.39	11	10	1
% of AA with Buffer	12	12	12	12	12	12	12	12	12	12	12	12	12	0	12	12	12	12	12	12	12	11	1
Average Buffer Width	12	12	12	12	12	12	12	12	12	9	12	12	12	0	12	12	12	9	12	12	12	10	2
Buffer Condition	9	9	9	9	9	9	12	12	12	12	12	12	9	0	9	9	9	9	9	9	10	9	1
Raw Score	22.4	13.4	22.4	16.4	22.4	22.4	24.0	24.0	24.0	23.2	24.0	24.0	22.4	0.0	22.4	22.4	22.4	21.7	22.4	22.4	23	19	4
Final Score	93.4	55.9	93.4	68.4	93.4	93.4	100.0	100.0	100.0	96.6	100.0	100.0	93.4	0.0	93.4	93.4	93.4	90.3	93.4	93.4	95	79	16
Hydrology	27	27	24	24	27	27	27	27	36	36	24	24	30	0	27	27	27	27	21	21	27	24	3
Water Source	9	9	9	9	12	12	12	12	12	12	12	12	6	0	12	12	12	12	12	12	11	10	1
Hydroperiod//Channel Stability	9	9	9	9	12	12	12	12	12	12	9	9	12	0	12	12	12	12	6	6	11	9	1
Hydrologic Connectivity	9	9	6	6	3	3	3	3	12	12	3	3	12	0	3	3	3	3	3	3	6	5	1
Raw Score	27.0	27.0	24.0	24.0	27.0	27.0	27.0	27.0	36.0	36.0	24.0	24.0	30.0	0.0	27.0	27.0	27.0	27.0	21.0	21.0	27	24	3
Final Score	75.0	75.0	66.7	66.7	75.0	75.0	75.0	75.0	100.0	100.0	66.7	66.7	83.4	0.0	75.0	75.0	75.0	75.0	58.4	58.4	75	67	8
Physical Structure	18	18	9	9	9	9	9	9	9	9	12	12	9	0	9	9	9	9	9	9	10	9	1
Structural Patch Richness	9	9	3	3	3	3	3	3	3	3	6	6	3	0	3	3	3	3	3	3	4	4	0
Topographic Complexity	9	9	6	6	6	6	6	6	6	6	6	6	6	0	6	6	6	6	6	6	6	6	1
Raw Score	18.0	18.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	12.0	12.0	9.0	0.0	9.0	9.0	9.0	9.0	9.0	9.0	10	9	1
Final Score	75.0	75.0	37.5	37.5	37.5	37.5	37.5	37.5	37.5	37.5	50.0	50.0	37.5	0.0	37.5	37.5	37.5	37.5	37.5	37.5	43	39	4
Biotic Structure	20	20	16	16	16	16	19	19	13	13	18	18	17	0	16	16	22	22	16	16	17	16	2
PC: No. of plant layers	6	6	6	6	6	6	9	9	6	6	9	9	9	0	6	6	9	9	6	6	7	6	1
PC: No. of codominants	6	6	3	3	3	3	3	3	3	3	3	3	3	0	3	3	3	3	3	3	3	3	0
PC: Percent Invasion	12	12	12	12	12	12	9	9	3	3	6	6	3	0	12	12	9	9	12	12	9	9	0
Plant Community Metrics	8	8	7	7	7	7	7	7	4	4	6	6	5	0	7	7	7	7	7	7	7	6	1
Interspersion	9	9	6	6	6	6	6	6	6	6	6	6	6	0	6	6	9	9	6	6	7	6	1
Vertical Biotic Structure	3	3	3	3	3	3	6	6	3	3	6	6	6	0	3	3	6	6	3	3	4	4	1
Raw Score	20.0	20.0	16.0	16.0	16.0	16.0	19.0	19.0	13.0	13.0	18.0	18.0	17.0	0.0	16.0	16.0	22.0	22.0	16.0	16.0	17	16	2
Final Score	55.6	55.6	44.5	44.5	44.5	44.5	52.8	52.8	36.2	36.2	50.0	50.0	47.3	0.0	44.5	44.5	61.2	61.2	44.5	44.5	48	43	5
Overall AA Score	73	65	59	54	62	62	66	66	68	68	65	65	65	0	62	62	67	66	57	57	64	57	8