Chapter 5 – Cumulative Impacts, Unavoidable Adverse Effects, and Irreversible and Irretrievable Commitment of Resources

5.0 CUMULATIVE IMPACTS, UNAVOIDABLE ADVERSE EFFECTS, AND IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

5.1 CUMULATIVE IMPACTS

5.1.1 Introduction

Cumulative impacts result when the effects of an action are added to or interact with other effects in a particular place and within a particular time. It is the combination of these effects, and any resulting environmental degradation, that is the focus of the cumulative impact analysis. While impacts can be differentiated as direct, indirect, and cumulative, the concept of cumulative impacts takes into account all disturbances since cumulative impacts result in the compounding of the effects of all actions over time. Thus the cumulative impacts of an action can be viewed as the total effects on a resource, ecosystem, or human community of that action and all other activities affecting that resource no matter what entity (federal, non-federal, or private) is taking the actions (USEPA 1999).

The proposed project would be one of various major industrial complexes in the region. As such, it would contribute only a portion of the cumulative impacts. In some instances, the cumulative impact on the environment of the proposed project and mining activities would be the sum of the individual impacts from each project in the region. There are other impacts, however, that cumulatively may be greater than the sum of the individual projects.

The cumulative effects on the resources, ecosystem, and human community were considered by first compiling those projects in the region whose actions might have an effect on the environment (Table 5-1). The projects are grouped into the following categories:

1. Power Plants and Transmission Lines
2. Oil & Gas-Related Projects
3. Mining Projects
4. Roadway Projects
5. Water-Related Projects
6. Other Developments

Following the table, the cumulative effects on each resource are discussed. The area of analysis includes the San Juan Basin, unless otherwise specified for a particular resource.

Table 5-1 Past, Present, and Reasonably Future Projects

Project	Status	Description	Location
Power Plants and Transmission Lines			
Four Corners Generating Station (FCGS)	Existing	FCGS is one of the largest coal-fired generating stations in the United States. The five-unit, 2,040-megawatt power plant is operated by APS and provides power to over 1 million households in New Mexico, Arizona, California and Texas. Fueled by low-sulfur coal from the nearby Navajo mine, the plant is owned by APS and five other utilities in the Southwest. The plant was the first mine-mouth generation station to take advantage of the large deposits of sub-bituminous coal in the Four Corners region: the first unit went online in 1963. Seventy-three percent of the employees at the plant are Native American.	Fruitland, NM, about 25 miles west of Farmington on the Navajo Reservation
San Juan Generating Station (SJGS)	Existing	SJGS is operated by PNM and consists of four coal-fired, pressurized units that generate about 1,800 gross megawatts of electricity. SJGS went online in 1973. It is the seventh-largest coal-fired generating station in the West, and is PNM's primary generation source, serving 58 percent of the power needs of PNM customers. .	About 15 miles northwest of Farmington, NM
Navajo Generating Station (NGS)	Existing	NGS is a coal-fired power plant with a capacity of 2,250 megawatts from three 750-MW units. NGS serves electric customers in Arizona, Nevada and California. It began producing commercial power in 1974. The power plant is served by coal mined at Peabody's Kayenta mining operations (50 miles to the east) and hauled by the Black Mesa and Lake Powell Railroad.	About 5 miles east of Page, AZ
Escalante Generating Station	Existing	Escalante Generating Station, located in Prewitt, NM, , is a single-unit, 250-megawatt, coal-fired power plant. Escalante Station is owned and operated by Tri-State Generation & Transmission Association, a cooperative. Western Fuels Association (WFA) purchases coal from the Lee Ranch Mine and operates the Escalante-Western Railway to transport it to the Escalante Station. WFA provided 1.1 million tons of coal in 2005.	Prewitt, NM, 27 miles northwest of Grants, NM
Animas/Bloomfield Power Plant	Existing	Gas power plant. Owned and operated by the City of Farmington. Pipeline, natural gas, cogeneration. 51 MW.	Bloomfield, NM
Comanche Generating Station (CGS)	Existing/ Expansion Under Construction	CGS is cogeneration power plant whose capacity will be 1,410 MW from three units when its 750 MW unit that is under construction comes on-line in 2009. It is owned by Xcel Energy. While outside the region of influence, it is included because of proposed project scoping concerns about its expansion.	Pueblo, CO
Mustang Energy Project (MEP)	Proposed	MEP, proposed by Peabody, would be a 300 MW project. It would employ technology to achieve ultra low emissions. Upon air quality permit approval it would have a four-year construction phase.	Near Grants, New Mexico
Navajo Transmission Project (NTP)	Proposed	Dine Power Authority, an enterprise of the Navajo Nation, would be the developer of the NTP. The NTP would add 470 miles of 500kV alternating current transmission capability from the Four Corners area to the Las Vegas area, with an interconnection point north of Flagstaff to allow access to the metropolitan Phoenix market.	NM, AZ, NV

Project	Status	Description	Location
Ute Mountain Ute power generation facility	Proposed	Would include new coal-bed methane and oil and gas wells. The Ute Mountain Indian Tribe has filed a claim to water rights on the San Juan River. The tribe claimed between 7,300 and 9,300 acre-feet of water. The claim is being made at the same time that the Navajo Nation is working to settle its claim on the San Juan River.	San Juan Basin, CO
Milagro Power Plant	Proposed	Gas power plant; pipeline, natural gas, cogeneration. Owned and operated by William Field Services. Two units, 61 MW.	Bloomfield, NM
Algodones Solar Facility	Existing	A 25-kilowatt solar generating station. Operated and owned by PNM. Through its customer-owned solar photovoltaic program, PNM purchases renewable energy certificates from participating customers at a rate of 13 cents every time their interconnected solar PV systems generate a kilowatt-hour of electricity. There are currently 59 customers enrolled in the program, for a combined capacity of 113 kilowatts (AC) of solar energy. PNM estimates the program, combined with federal and state tax credits as well as payment for energy being sent onto the grid, reduces the cost of a typical residential solar PV system by more than 60 percent.	Algodones, NM
Energy utility corridor planning	Planned	A programmatic environmental impact statement (PEIS) is currently underway by an interagency project management team (DOE, BLM, USFS, and DOD) to identify energy utility corridors for the implementation of Section 368 of the Energy Policy Act of 2005 (designation of West-wide energy corridors). The interagency team is developing criteria for designation of corridors and alternatives that will be used for evaluation in the PEIS; the WUG study is being used as a starting point for this process, which also will incorporate input from current plans and conditions.	Various locations throughout the western US
Sunshine Wind Project (Hopi)	Planned	The Hopi Tribal Council and the Coconino County Planning & Zoning Department approved the project. The proposed Sunshine Wind Park in eastern Coconino County is the most fully developed and market-ready wind project in Arizona. The Sunshine Wind Park would help to ensure Arizona's power supply by harnessing the wind for abundant, reliable, inexhaustible, cost-competitive, pollution-free energy. Approximately 40 state-of-the-art wind turbines would provide 60 megawatts of generating capacity. The wind park is targeted for development in 2007 and turbines would be sited on a combination of Hopi private fee lands and private ranch lands (Bar-T-Bar Ranch and other private lands). Sunshine Arizona Wind Energy, LLC, the developer of Sunshine Wind Park, is a partnership of Northern Arizona investors and Foresight Wind Energy, LLC.	35 miles east of Flagstaff near the Meteor Crater exit along I-40
Oil & Gas-Related Projects			
Proposed oil and gas drilling	Planned	These activities would require well pads (approximately 50 by 50 feet each) and construction areas, in addition to access roads, pipelines, or distribution power lines as needed (for productive wells). Also, Western Oil and Gas has proposed approximately 600 natural gas wells in eastern Burnham Chapter extending north into Upper Fruitland and Nenahnezad/San Juan Chapters.	NAPI area

Project	Status	Description	Location
San Juan Refinery, Bloomfield	Existing	Giant owns and operates the Bloomfield oil and gas refinery, located on 285 acres near Farmington, New Mexico. The Bloomfield refinery is one of two of the only active refineries in the Four Corners area. The total approximate refining capacity of the refinery is 16,600 bpd. A locally produced, high-quality crude known as Four Corners Sweet is the primary feedstock, although the supply is supplemented, as necessary, with other feedstocks from within and outside the four corners area. Crude oil supply to the refinery comes primarily from the Four Corners area and is either collected by Giant's pipeline network or delivered by truck transports to pipeline injection points and/or refinery tankage. The Four Corners region is the primary area for refined products from the Ciniza and Bloomfield refineries. Giant's secondary markets include metropolitan Albuquerque (the largest market in New Mexico) and the Northern Arizona region.	Bloomfield, NM
San Juan River Gas Plant	Existing	Owned by Western Gas Resources [Acquired by Anadarko in August 2006] A natural gas treatment plant located near Fruitland, New Mexico. The San Juan River Plant consists of several units; a purification plant, a natural gasoline plant, a compressor station and a dehydration unit. The Gas Plant facility includes compression, amine gas treating, liquids stabilization, Claus sulfur recovery plant, dehydration, and a cryogenic liquid recovery plant. The plant produces a lean, dry residue gas stream, a mixed natural gas liquid stream (NGL) and a liquid sulfur stream. The liquid products contain ethane, propane, butanes, pentanes and heavier components. The plant handles regulated flammables such as ethane, propane, mixed butanes and mixed pentanes. The plant uses an amine process to remove carbon dioxide and hydrogen sulfide but does not contain threshold quantities of any materials classified as toxic. There are not toxic release scenarios to consider at the San Juan River plant.	Located about 10 miles west of Farmington, NM
Transwestern Pipeline Company's Phoenix Expansion Project	Planned	An EIS is currently being prepared for the Phoenix Expansion Project, which would expand the Transwestern Pipeline Company's natural gas pipeline system by approximately 260 miles from its mainline in Yavapai, County, Arizona to delivery points in the Phoenix metropolitan area market. As part of the overall project, Transwestern plans to build approximately 25 miles of pipeline looping parallel to its existing San Juan Lateral, in San Juan County (FERC 2006). The San Juan Lateral extends from San Juan County, New Mexico, to connect with Transwestern's mainline in McKinley County, New Mexico, and is located approximately 15 miles or further from the study area.	San Juan County, NM
Oil and Gas Development (BLM Durango Office)	Projected	The BLM Durango Office estimates that in La Plata and Montezuma County, there would be a drilling of 60-170 gas and oil wells annually. These would be concentrated on Southern Ute and Federal lands in La Plata County.	La Plata and Montezuma Counties, CO
Oil and Gas Development (BLM Farmington Office)	Projected	The Record of Decision for the Farmington Final EIS indicates the potential development of 9,942 new oil and gas wells on the lands managed by the BLM Farmington Office.	San Juan, McKinley, and Rio Arriba Counties, NM

Project	Status	Description	Location
Southern Ute Indian Tribe (SUIT) Development of Fruitland Coal Bed Methane		Current basin-wide Fruitland coal bed spacing allows one gas well per 320 acres. Recent infill applications **for specific areas** have been approved by the COGCC, allowing an optional second Fruitland coal bed gas well on each 320-acre spacing unit. Infill drilling within 320-acre spacing units is currently occurring and may be a future trend Basin-wide. If oil and gas operators and regulators continue to see sufficient economic merit and legal justification to perpetuate the current trend of drilling optional infill wells on existing 320 acre spacing units, 1000 additional infill Fruitland coal bed methane wells (350 north of the Ute Indian Reservation) could yet be drilled in the Colorado portion of the San Juan Basin.	San Juan Basin, CO
Mid-America Pipeline	Proposed	An Environmental Analysis (EA) has been prepared by the Bureau of Land Management (BLM) for a proposed natural gas liquids pipeline project to analyze the potential impacts of granting rights-of-way and temporary use permits for 12 pipeline loop sections to be constructed by the Mid-America Pipeline Company (MAPL). Parallel sections of pipeline would total 202 miles along an 840-mile route between Granger and Wamsutter areas in Wyoming, and Hobbs, New Mexico. The pipelines would be 8 to 16 inches in diameter, buried, steel, and carry natural gas liquids. Existing ancillary facilities, including pump stations, would be expanded to have more capacity.	Would pass through San Juan County, NM [to pass through Huerfano, NM, 30 miles east of the project site]
Ciniza Refinery	Existing	Giant [acquisition of Giant by Western Refining, Inc. was announced August 28, 2006] owns and operates the Ciniza refinery, one of two active refineries in the Four Corners area. The total approximate refining capacity of the refinery is 26,000 bpd. A locally produced, high-quality crude known as Four Corners Sweet is the primary feedstock Crude oil supply to the refinery comes primarily from the Four Corners area and is either collected by Giant's pipeline network or delivered by truck. Markets are the Four Corners region, metropolitan Albuquerque, and the Northern Arizona region.	Near Gallup, NM
San Juan National Forest Energy Development	Proposed	The Forest Service leased 6,000 additional acres in and around the HD Mountains in May 2001, and the industry submitted plans to the Forest Service to drill up to 200 new coal bed methane wells on the San Juan National Forest, including over 100 inside the HD Mountains Roadless Area. Potentially four wells could be drilled per section, with associated roads, pipelines, and power lines. This could result in 125 new gas wells and 60 miles of new roads within the roadless area,.	25 miles east of Durango, CO
Mining Projects			
BNCC Lease Areas I-III, IV North (Navajo Mine)	Existing	Coal supporting the Four Corners Generating Station.	South of Fruitland, NM, about 25 miles west of Farmington.
Navajo Mine Extension Project	Proposed	Coal reserve in Areas IV and V are proposed to supply coal to proposed project.	20 miles southwest of Farmington, NM
San Juan Coal Company San Juan Mine	Existing	An underground mine which is the exclusive supplier of coal to the SJGS. Surface mining at San Juan reached a depth in the early 2000s that represented an economic limit, but underground mining is feasible and the coal supply contract with SJGS extends through 2017.	15 miles west of Farmington, NM
San Juan Coal Company La Plata Mine	Past	From 1986 through 2002 the La Plata mine also supplied coal to the San Juan Generating Station. The mine ceased operation in 2002 and reclamation continued through 2005.	

Project	Status	Description	Location
McKinley Mine (Pittsburgh & Midway Company)	Existing	McKinley Mine is located between Gallup, NM and Window Rock, AZ and is owned and operated by the Pittsburgh and Midway Company. This mine is scheduled to shut down in 2008 or 2009.	Navajo Reservation, Four Corners area
Black Mesa Project (Overview and Mining Operations)	Part Existing / Part Past, Suspended, Proposed	The Office of Surface Mining (OSM) is preparing an Environmental Impact Statement (EIS) to analyze the effects of the Black Mesa Project. The Black Mesa Project includes the existing Kayenta mining operations. It also includes the Black Mesa mining operations, which were suspended at the end of 2005 when the Mohave Generating Station in Laughlin, Nevada suspended operation pending the installation of air quality control technology. The project also includes Black Mesa Pipeline's proposed operation and reclamation plan for the Coal Slurry Preparation Plant at the Black Mesa mine, the reconstruction of Black Mesa Pipeline's 273-mile long Coal Slurry Pipeline across northern Arizona to Laughlin, and the project water supply (see Black Mesa Project, project water supply).	Mining operations south of Kayenta AZ. Other components to south of Leupp AZ and to Laughlin, NV
Colorado Plateau Energy Development	Past	The 90,000-square-mile Colorado Plateau, taking in parts of Utah, Colorado, New Mexico and Arizona, the Four Corners area, is rich in coal, uranium and oil shale, all of which produce energy.	Navajo Reservation, Four Corners area
Roadway Projects			
BNCC's Burnham Road Realignment Project	Planned	Road to merge east off of Burnham Road northwest of Area II, southbound through Area IV North merging back at Burnham Road just north of Area IV South. This realignment is required to maintain safe distance between the public and the existing mining operations.	
Improvements to US 491	Planned	Highway improvements have been planned for US 491 and include widening the existing 2-lane highway to 4 lanes. The new roadway would be constructed on the eastern side of the existing roadway and would be fully contained within the existing right-of-way. (FHA et al. 2006).	US 491, 10 miles south of Shiprock, NM to Sheep Springs, NM
Water-Related Projects			
Durango Pumping Plant (tied to the Animas – La Plata Project)	Planned	Located on a parcel of land directly across from Santa Rita Park, the Durango Pumping Plant would lift water from the Animas River up through the Ridges Basin Inlet Conduit into Lake Nighthorse. The pumping plant would be placed about 200 feet from the river and would include: an intake structure, a service yard, and a surge chamber. Construction would take up to 5 years.	CO
Animas – La Plata Project	Planned	Implementation of the Colorado Ute Settlement Act Amendments of 2000. The project is being built to fulfill the water rights settlement of the Ute Mountain Ute Tribe and the Southern Ute Indian Tribe. Fulfillment of the settlement obligations, one of which is completing the Animas-La Plata Project, would provide non-Indian water users in Southwest Colorado certainty to the continued, historical use of water. Storage would largely be reserved for Indian water users, but would also provide nearly 33 percent of the storage in Lake Nighthorse for use by non-Indian entities in the Four Corners region. Seven entities would benefit. These are: 1) Southern Ute Indian Tribe, 2) Ute Mountain Ute Tribe, 3) Animas-La Plata Water Conservancy District, 4) State of Colorado, 5) Navajo Nation, 6) San Juan Water Commission and 7) La Plata Conservancy District. The Navajo Municipal Pipeline, sometimes referred to as the Farmington to Shiprock Pipeline, was authorized under the Animas-La Plata Project.	

Project	Status	Description	Location
Jicarilla Apache Nation Water Subcontract	Existing	The Proposed Action involves the Bureau of Reclamation approving a subcontract between the Jicarilla Apache Nation (Nation) and the city of Santa Fe (City). Under the subcontract, the Nation would make available for delivery to the city at the outlet works of Heron Dam up to 3,000 acre-feet per year (acre-ft/yr) of the Nation's San Juan-Chama Project water entitlement under the Federal Contract. The term of the subcontract would be limited to 50 years beginning in 2007. The Proposed Action does not involve the new construction, or additional operation, maintenance, or repair of any conveyance, diversion, treatment, or delivery works by the federal government. The city's development of its distribution system, located near Santa Fe NM, is covered by a separate EIS.	Santa Fe, NM
Navajo Indian Irrigation Project	Present	Irrigation water is released at Navajo Dam through diversion headworks. Irrigation water travels through a series of concrete lined open canals, membrane lined open canals, 7 tunnels, 15 siphons, and an in-line earth channel and reservoir behind Cutter Dam. Three pumping plants lift water to concrete lined open laterals. At full capacity, the system would carry 1,800 cubic feet per second. Two open lateral systems, totaling 40.6 miles in length, convey water to the southern and eastern parts of the development. Water is distributed to the turnouts at the individual farm units through about 340 miles of underground pipe lateral systems ranging from 6 to 84 inches in diameter.	San Juan River, NM
Navajo River Water Development Plan			
Kutz Pumping Plant	Existing	The Kutz Pumping Plant is east of New Mexico State Highway 44. It lifts water from the Main Canal to Coury Lateral, which flows southward through Block 5. Using 5 electric motor-driven pumps, this plant has a capacity of 200 cubic feet per second with a dynamic head of 365 feet. It was completed in 1982.	
Gallegos Pumping Plant	Existing	The Gallegos Pumping Plant is near where the Main Canal crosses Gallegos Canyon. It lifts water from the Main Canal to Burnham Lateral, Stage 1. It has 8 electric motor-driven pumps, and has a capacity of 880 cubic feet per second, with a total dynamic head of 337 feet. It was completed in 2000.	
Moncisco Pumping Plant	Proposed	Construction on the Moncisco Pumping Plant was scheduled to begin in 2003. It will lift water into the Burnham lateral, Stage 2, and open channel lateral, which will provide water for pumping plants to irrigate Blocks 10 and 11. Current design estimates call for this pumping plant to have a total capacity of 440 cfs and a total dynamic head of 168 feet.	
Navajo Dam Power Plant	Existing	Project plans originally included construction of a 23-megawatt power plant and switchyard at Navajo Dam to furnish a part of the energy required by the project. Construction of the plant and purchase of the related equipment started between 1974 and 1976. The United States District Judge for the United States District Court for the District of Columbia ordered that construction of the Navajo Dam power plant cease. The decision cited the inadequate Environmental Impact Statement (EIS) and lack of authority to construct the plant. After the project concluded further environmental studies on the river, the effects of a power plant, and initiated action to complete a new EIS and obtain authorization, the city of Farmington applied with the Federal Energy Regulatory Commission (FERC) to construct a power plant at Navajo Dam for their use. The	

Project	Status	Description	Location
		FERC issued a license to the city of Farmington to construct the power plant. The plant has been built to provide power to the city's customers.	
Hogback Diversion Dam Project	Existing	The Bureau of Reclamation with funding appropriated for the San Juan Recovery Implementation Program Navajo Indian Irrigation Project constructed the dam. Project water is used for agricultural irrigation. The dam is intended to divert water into the irrigation system during periods of low water flow and to provide a more reliable river habitat for the protection of native fish species. The dam is not intended to create a permanent reservoir. Temporary methods were employed by the Irrigation Project to divert water by building dikes in the river with river sediments. These temporary dikes had to be rebuilt several times each year and had unintended detrimental side effects on water and habitat quality. The permanent diversion dam has an embankment that has a structural height of 10 feet and a crest length of 1110 feet. It was completed in 2001.	San Juan River near Shiprock, NM
Black Mesa Project, Proposed Project Water Supply	Proposed	The project water supply proposed for the Black Mesa Project (see entry for overview and mining operations would include the construction and operation of water wells in the Coconino aquifer northwest of Winslow, Arizona, and the construction and operation of a water supply pipeline running about 120 miles across the Navajo and Hopi Reservations from the wells to the Coal Slurry Preparation Plant. The coal would fuel resumed operations at MGS in Laughlin, NV.	Leupp to Black Mesa, AZ
Navajo-Gallup Water Supply Project	Proposed	The USBR has developed a preferred alternative to construct 2 pipelines. One pipeline would predominantly parallel US 491 and would transport San Juan River water to the Navajo Nation and the Gallup area. Another spur would run north along Highway 591 to serve Naschitte and Sanostee, The second pipeline would serve the eastern portion of the Navajo Nation south of highway 550 (FHA et al. 2006). This pipeline from NIIP would be treated and sent along Highway 550 to Nageezi and then south to Torreon. Storage tanks and re-chlorination facilities would be included in the project.	US 491 and Highway 550
Hogback-Cudei Irrigation Project	Existing	A diversion of 48,550 acre-feet, or the quantity of water necessary to supply a depletion of 21,280 acre-feet from the San Juan River, whichever is less, of surface water from the direct flow of the San Juan River in any one year at the diversion dam for the Hogback-Cudei Irrigation Project for irrigation of 8,830 acres of land on the project generally located along the north and south sides of the San Juan River in the vicinity of the community of Shiprock, New Mexico, and between the diversion dam for the project and Four Corners, as described by the Bureau of Indian Affairs' Crop Utilization Study for the Hogback and Cudei irrigation projects dated September 1993, with a maximum diversion flow rate of 221 cubic feet per second, including any diversions from an alternate point of diversion at the historic Cudei ditch diversion heading.	
Fruitland-Cambridge Irrigation Project	Existing	A diversion of 18,180 acre-feet, or the quantity of water necessary to supply a depletion of 7,970 acre-feet from the San Juan River, whichever is less, of surface water from the direct flow of the San Juan River in any one year at the diversion dam for the Fruitland-Cambridge Irrigation Project for irrigation of 3,335 acres of land on the project generally located along the south side of the San Juan River in the vicinity of the community of Fruitland, New Mexico, and between the City of Farmington and the diversion dam for the Hogback-Cudei irrigation Project, as described by the BIA Crop Utilization Study for the Fruitland Irrigation Project dated September 1993, with a maximum diversion flow rate of 100 cubic feet per second, including	Along the San Juan River in Fruitland, NM

Project	Status	Description	Location
		any diversions from an alternate point of diversion at the historic Cambridge ditch diversion heading.	
Munipical Water Development	Existing and Planned	NTUA public water systems and other wells serve residential and livestock purposes in the area. Planned developments include PL 87-121 projects on the Indian Health Service's sanitation deficiency list. Many of these projects would rely on groundwater.	
Other Developments			
Navajo Agricultural Product Industry (NAPI)	Existing	Many large agricultural fields are located east of the study area, just beyond the BNCC Lease Area and are associated with Navajo Agricultural Product Industry (NAPI), a farming enterprise of the Navajo Nation. NAPI farms cover over 60,000 acres in production growing alfalfa, corn, wheat, barley, pumpkins, beans, potatoes and sod.	East and adjacent to the BNCC Lease Area
Farmington Airport	Existing	A regional airport, which has commercial airlines serving major destinations.	Farmington, NM
Four Corners Generating Station landing strip		A landing strip located east of the FCGS.	Less than a mile east of FCGS, Fruitland, NM
Shiprock Airport	Existing	A Navajo Nation Primary Airport used primarily for medical emergencies and secondarily for tribal government.	Shiprock, NM
Burnham Airstrip	Past	Not in service. The Burnham Chapter community would like to see it reactivated as a regional airstrip or airport for emergency services or commercial development since it is centrally located between chapters.	Near the Burnham Chapter House
Community Expansion	Planned	Communities located along US 491 plan to expand upon completion of route improvements, affecting development patterns in the general region of the project (Benally 2006).	San Juan County, NM
Planned burial area	Planned	The proposed San Juan Chapter Community-Based Land Use Plan (2002) has identified Navajo land along Transmission Line Segment C for grazing use and a planned burial area that would be located directly beneath Segment C and located approximately 2 miles southwest of the FCPP.	Estimated to be between mileposts 4 and 5 of Segment C
Nature Trail	Planned	A nature trail is planned from the San Juan River to the San Juan Chapter house to Morgan Lake, which is identified as a possible recreation center for San Juan Chapter.	San Juan River to Morgan Lake
Proposed Prison	Planned	The proposed Sanostee Land Use Plan (2004) has identified an area approximately 1 mile west of the northern end of Transmission Line Segment B as a possible location for the construction of a prison.	Between milepost 7-milepost 9 of Alternative Segment B
Proposed Housing (Sanostee Chapter)	Planned	The Sanostee Land Use Plan identifies a possible 100-acre housing site within the 1-mile corridor, adjacent to the eastern side of US 491 and directly south of the proposed utility corridor/water pipeline.	Between mileposts 10 and 11 of the Proposed Utility Corridor
Proposed Housing (Burnham Chapter)	Planned	The southernmost portion of the ½ mile study corridor overlaps with a proposed housing and a proposed commercial site located north of N5 (Architectural Research Consultants 2005).	½ mile from the southernmost portion of BNCC Lease Area V

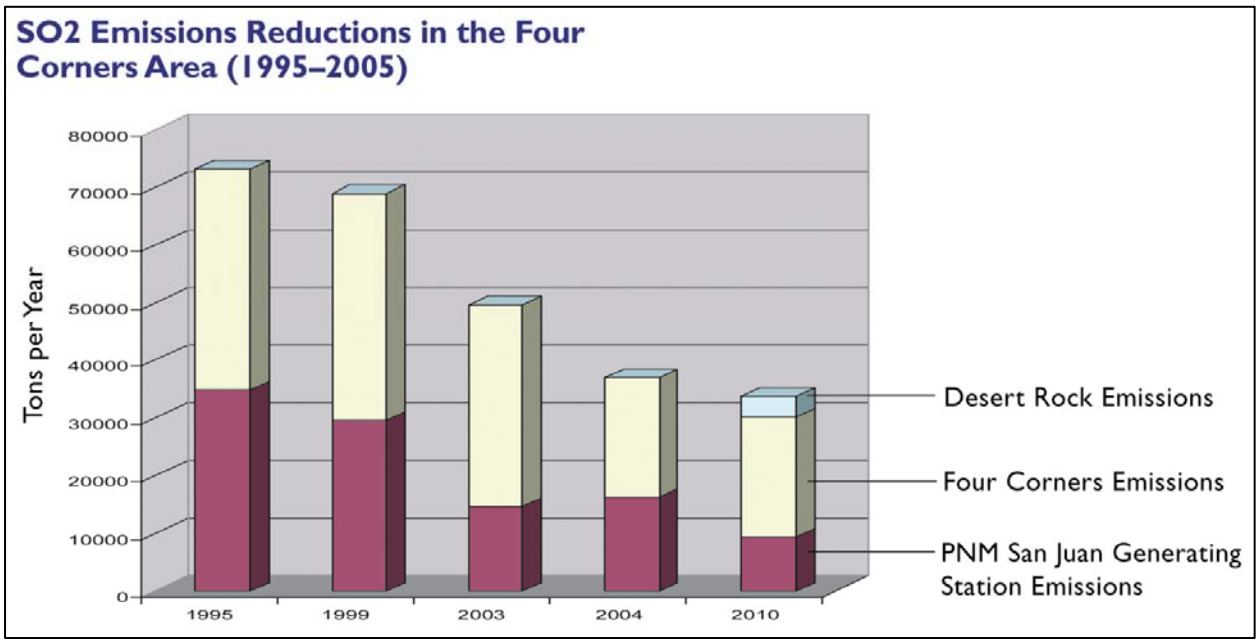
5.1.2 Air Quality

5.1.2.1 Air Quality Trends in San Juan Basin

There have been recent actions to reduce emissions at the region's power plants, and additional efforts continue. The States of New Mexico and Colorado have convened the Four Corners Air Quality Task Force to address regional air quality planning. The San Juan Generating Station recently (2005) entered into an agreement with the New Mexico Environment Department, the Grand Canyon Trust and the Sierra Club to install emission-reduction equipment to decrease its pollution in the next four years. The retrofitting project, which will take 4 1/2 years to complete, is expected to significantly reduce emissions of four different pollutants—mercury, nitrogen oxide, sulfur dioxide and fine particulates—from its four coal burning units (The Daily Times 2005).

Meanwhile, the actions already taken have resulted in reductions in SO_2 emissions at the PNM San Juan Generating Station and Four Corners Power Plant over the past ten years (see Figure 5-1).

Figure 5-1 SO_2 Emissions Reductions in the Four Corners Area (1995 – 2005)



SOURCE: Clean Air Markets Division USEPA, San Juan (ID #2451) and Four Corners (ID #2442) – 2003

Within the region, numerous proposed projects would create varying impacts on air quality as a result from construction activity, mobile sources, and stationary sources. Proposed sources listed within Table 5-1 that are located fairly close to the proposed project are the 300 MW Mustang Energy Project located near Grants, NM, the 61 MW Milagro Power Plant located near Bloomfield, NM, and several oil, gas and transmission line developments within the San Juan Basin. These and other additional projects proposed in the future would require additional environmental analysis, pursuant to Federal, state or local air permitting requirements. Therefore, the planned and proposed projects will necessarily undergo a vigorous analysis of ambient air quality impacts, as a prerequisite to receiving regulatory approvals.

In general, air permitting agencies do not require an applicant to estimate fugitive dust and vehicle tailpipe emissions associated with construction activity. Such an analysis is usually required for projects that trigger NEPA or similar state programs. Applicable air pollution control rules would likely require implementation of dust control measures during construction of all but the smallest of projects.

Construction of the proposed project may increase the potential for further, but currently unplanned, industrial development within the general vicinity of the project. This development would result in increases in air pollutant emissions over existing conditions. It is not possible to quantify the air pollutant emissions or ambient air quality impacts associated with such development at this time. However, future emissions sources would be subject to Federal, state and local air pollution control and air permitting regulations, which will tend to minimize the potential ambient air quality impacts, and would ultimately restrict or disallow further development, should ambient air quality become threatened.

5.1.2.2 Alternative B

A cumulative impacts modeling analysis is included in the ENSR Report *Desert Rock Energy Facility Application for Prevention of Significant Deterioration Permit*, and the associated modeling reports (ENSRa 2004, ENSRb 2006, ENSRc 2006). The cumulative analysis shows that the proposed project would not cause or contribute to a PSD Class I increment violation, and that no Class I increment violations are predicted in the areas modeled. In addition, the potential effects on air quality due to emissions from the proposed Desert Rock Energy Facility, in conjunction with nearby area source emissions, are expected to result in predicted concentrations in Class II areas that are in compliance with PSD and NAAQS limits. When a finer grid MM5 database was used, the predicted impacts on regional haze were below the federal threshold of 5 percent. The ENSR Class I modeling report also discusses the planned and ongoing emission reductions at the Four Corners and San Juan Generating Stations, and finds that the magnitude of the SO_2, NOx and PM_{10} emission reductions at these plants would exceed the magnitude of maximum potential emissions of these same pollutants at the proposed project site, and concludes that the cumulative impacts of the proposed project would be overall lower emissions in the Four Corners region.

As indicated in Chapters 3 and 4, the criteria pollutant emissions associated with Alternative B would be substantially lower than six other existing coal-fired power plants in northeast Arizona and northwest New Mexico. This reflects the superior boiler design and pollution control technology proposed for the proposed project, compared to the older technology comprising the other plants, which were built from the late 1950s to the early 1980s. This also serves to forecast a national trend, in that older coal-fired power plants will eventually be replaced with higher efficiency, lower polluting facilities.

5.1.2.3 Alternative C

An SO_2 cumulative impacts modeling analysis is included in the PSD permit application and the associated modeling reports (RTP 2004). The analysis concludes that compliance would be met at all Class I areas. The proposed coal-fired power plant under Alternative C would be less efficient than the Alternative B plant, resulting in higher emissions per unit of output energy. However, the Alternative C facility is approximately one-third the size of the Alternative B facility, which would result in lower overall emissions.

5.1.2.4 Global Air Quality Impacts

As described above, the proposed power plant would emit criteria pollutants, including particulates and gaseous pollutants (sulfur dioxide and nitrogen oxides) that form aerosols in the atmosphere. Although measurable concentrations of emissions from the proposed power plant would likely extend to less than 100 kilometers from the facility, due to regional wind patterns, minute quantities of these chemicals could eventually be dispersed across a wider area. In addition, combustion of biomass and all fossil fuels (coal, coke, petroleum and natural gas) and limestone-based flue gas desulfurization (FGD) processes result in emissions of carbon dioxide (CO_2). CO_2 is widely considered to be a "greenhouse gas" (GHG). Greenhouse gases, which also include methane, nitrous oxides, chlorofluorocarbons and other chemicals, play a natural role in maintaining the temperature of the earth's atmosphere, by allowing some sunlight to pass through and heat the surface of the earth and then absorbing a portion of the infrared heat reflected or transmitted from the ground. Natural sources of GHG include volcanic eruptions, plant respiration and decomposition of organic matter.

Global temperatures have increased significantly in the last 50 years. This phenomenon is referred to as "global warming." Increased emissions of GHGs from anthropogenic (i.e., human) activity over the last 100 years are suspected of playing a role in the observed global warming, although the precise mechanisms and magnitude of their effect remains subject to debate within the scientific community. However, there currently is broad consensus within those members of the scientific community who have researched this issue that GHG emissions associated with such anthropogenic activity has contributed to the observed global warming phenomenon.

Some members of the scientific community suspect that particulates and aerosols may also have an opposite effect on global temperatures, by absorbing and reflecting solar radiation back into space and by increasing the formation of clouds, which in turn reflect solar radiation, due to water vapor condensing around the small, solid nuclei. This phenomenon, which has undergone less evaluation by the scientific community than the global warming phenomenon, is referred to as "global dimming."

The electric power generating industry is participating in extensive research on further defining the extent to which emissions of anthropogenic GHG contributes to global warming. In addition, technological approaches to reducing GHG emissions from industrial facilities are the subject of numerous research projects around the world. The Edison Electric Institute (EEI) has called for increased international cooperation with regard to research and technology development (EEI 2006). One possible means to reduce atmospheric emissions of CO_2 is to compress and inject it deep underground; however, this technology, and the means to concentrate CO_2 in a gasification process, is in the experimental stage.

Within the context of this EIS, it is important to note that, due to its unique and innovative design, the proposed power plant under Alternative B would be considerably more efficient, in terms of power output versus fuel combusted, than other coal-fired power plants in the region. Furthermore, the primary reagent used in the SO_2 scrubber is quicklime (calcium oxide), which does not add further CO_2 to the plant emissions, as would FGD systems using limestone (calcium carbonate). Consequently, the proposed plant would emit less GHG per unit of energy produced, than these other existing facilities.

5.1.3 Water Resources

5.1.3.1 Surface Water

For the purposes of this cumulative effects analysis, the area of analysis for surface water resources is the San Juan River Basin. This area includes portions of five cataloging units ("watersheds") delineated by the United States Geological Survey: the Upper San Juan, Blanco Canyon, Animas, Middle San Juan, and Chaco watersheds. The San Juan River flows through the Middle and Upper San Juan watersheds. The La Plata River is contained within the Middle San Juan watershed. An undetermined number of short perennial segments flow within arroyos tributary to the San Juan River in the Middle and Upper San Juan watersheds. The analysis area does not include the watershed areas upstream of Navajo Dam and downstream of the boundary of the Navajo Nation. The total area of the San Juan River Basin included in this analysis is 9,545 square miles.

In addition to the studies cited in Chapter 4, the cumulative effects analysis relied on two additional sources. The *San Juan Basin Watershed Management Plan* (2005) contains a comprehensive overview of surface water issues and the results of testing and monitoring efforts throughout the basin. Water quality data presented in the plan are compared to the State of New Mexico's Water Quality Standards. The New Mexico Surface Water Quality Bureau (SWQB) has identified all parts of the San Juan, Animas, and La Plata Rivers as being impaired by one or more pollutants, as reflected in the Clean Water Act Section 303(d) List. The *Cumulative Hydrologic Impact Assessment (CHIA): Effects of Coal Mining in the San Juan River Basin* was published by the OSM in 1984. The 1984 analysis evaluated potential cumulative effects of mining activities in the basin to the year 2010. It concluded that the cumulative effects of mining operations in the basin would result in short-term decreases in runoff and sediment yield from affected areas, but that the magnitude of those changes was expected to be minimal, and the stability of receiving streams was not expected to be adversely affected. The decreased quantity of flows was expected to affect the quality of the remaining streamflow, but those impacts were expected to be minimal.

Current uses of surface water in the San Juan River Basin include irrigation, stock watering, industrial, municipal, and domestic uses. Of these activities, irrigation accounts for a majority of the consumptive use. Within the impact analysis area, surface water use and discharges are predominantly for irrigation and industrial development, including power plants and associated coal mining operations. This section summarizes potential cumulative impacts that are attributable to a variety of agricultural and industrial uses, and not specifically related to electric power plants and associated mining. General impacts are based on data collection and analyses conducted by the San Juan Watershed Group for the San Juan Basin Watershed Management Plan (San Juan Watershed Group 2005).

5.1.3.1.1 Sedimentation

The operation of Navajo Dam in the upper basin effectively allows sediment to accumulate beyond what would occur under a natural flow regime (and without the dam). Although Navajo Dam virtually eliminates the sediment load from the watershed upstream of the dam, it also reduces peak flows in the spring, thus reducing the ability of the San Juan River to transport its sediment load. Recent studies identified Largo Canyon as a major source of fine sediment being deposited in the San Juan River from Largo Canyon downstream to the Animas River. The studies do not identify sources of sediment or contributing land-use activities in the watersheds, nor did they distinguish between natural and human contributors to sediment loads. The SWQB interpreted available reports and data to determine that the segment from Largo Canyon downstream to the Animas River exceeds the State's water quality standard for stream bottom deposits and included this reach in the 2004-2006 303(d) List.

Cattle and horses grazing on irrigated pasture close to the San Juan River are common, and grazing in upland areas may contribute sediment via tributaries, although its overall contribution to sediment loading is relatively small. Cumulatively throughout the basin, sediment deposited into waterways can negatively impact aquatic plants by reducing light penetration and reducing their ability to photosynthesize. This further reduces vegetation available as forage for wildlife. Sedimentary particles can also suffocate fish by clogging their gills and can also reduce respiratory efficiency of amphibians by adhering to their skin. The proposed project would be expected to have a negligible additive increase on sedimentation due to the implementation of mitigation measures.

5.1.3.1.2 Fecal Coliform Bacteria

Data collected by the USBR and the SWQB from 2000 to 2002 indicated that the fecal coliform criterion was exceeded ten times (out of 26 samples) in the San Juan River from the Hogback upstream to the Animas River, and eleven times (out of 41 samples) in the San Juan River from the Animas River upstream to Largo Canyon. The criterion was exceeded two times (out of 18 samples) in the San Juan River from Largo Canyon to Navajo Dam. These data were sufficient for the SWQB to retain the middle reach of the San Juan River on the 2004-2006 303(d) List, and to add the lower reach. The data collected in 2002 suggested that bacteria numbers increase with distance downstream, and high numbers (in excess of current or proposed criteria) can occur at any time of year. The highest numbers correspond to summer or fall precipitation events. Available data from all recent years strongly suggest that Largo Canyon is a significant contributor when it is flowing.

Among the potential sources of bacteria are poorly maintained or improperly installed (or missing) septic tanks, livestock grazing of valley pastures and riparian areas, upland livestock grazing, irrigated pasture, and wildlife (such as geese, which are numerous in some areas). Additional sources are unsewered portions of Farmington, the unsewered communities of Kirtland and Fruitland, and urban runoff. Studies concluded that on-site treatment (septic tanks and leach fields) is ineffective in most of the analysis area (particularly south of Farmers Mutual Irrigation Ditch) because the infiltration capacity of the local soils is low, and because the soils are often saturated.

5.1.3.1.3 Plant Nutrients and Dissolved Oxygen

Measurements by the SWQB of dissolved oxygen and pH demonstrated that dissolved oxygen concentrations dipped below the criterion 62 percent of the time under the bridge near La Plata, and 22 percent of the time near the USGS gauging station near Farmington. As a result, the La Plata River was added to the 2004-2006 303(d) List for dissolved oxygen. Sufficient indicators were available for SWQB to add the Animas River below Aztec to the 2004-2006 303(d) List. These indicators included high dissolved oxygen levels (produced by photosynthesizing algae), high ash free dry matter and chlorophyll a (measures of algae abundance), and concentrations of nitrogen and phosphorus sufficient to support abundant algae.

Likely sources of nutrients in the San Juan River Basin include municipal point sources (wastewater treatment plants in Aztec and Durango, Colorado), poorly maintained or improperly installed (or missing) septic tanks, livestock grazing of valley pastures and riparian areas, upland livestock grazing, wildlife, and erosion of nutrient-rich soil into the river from banks and adjacent floodplains. Levee construction (common in the Animas River valley) tends to maintain wider, shallower channels and may inhibit establishment of large trees near the water's edge. Unmanaged grazing of riparian areas prevents substantial growth of trees and shrubs, and may affect channel morphology by weakening banks. A final contributing factor is floodplain development driven by rapidly expanding populations in San Juan County and adjacent Colorado.

5.1.3.1.4 Acute Toxicity

In 2002, the SWQB collected water and sediment samples on the San Juan and Animas Rivers. Analysis of the samples suggested the presence of one or more unidentified toxins. These results were sufficient for SWQB to add the Animas River between Farmington and Aztec and the San Juan River upstream from the Animas River to Largo Canyon to the 2004-2006 303(d) List for "acute toxicity." More sampling is required to verify this toxicity and pinpoint the direct causes. However, among the likely causes on the Animas River is ammonia, which may have been liberated from the sediment upon agitation. Significant quantities of ammonia are related to nutrient enrichment. Another potential contributor to toxicity in the San Juan River is illicit dumping on public or private lands.

5.1.3.1.5 Selenium

The SWQB sampled Gallegos Canyon in 2002 for a suite of metals, ions, nutrients, and organic compounds. Other agencies collected similar data from 1994 through 2003. Of 30 measurements, 23 exceeded the total recoverable selenium criterion. Because these selenium concentrations exceeded the New Mexico Water Quality Standards, Gallegos Canyon was added to the 2004-2006 303(d) List. The selenium likely has a natural source in the Cretaceous soils of the canyon. Water samples from seeps and tributaries draining irrigated land developed on Cretaceous soils contained about 10 times more selenium than samples from sites draining irrigated land developed on non-Cretaceous soils. An additional contributing factor is agricultural runoff and seepage of irrigation water from fields in the upper watershed, which may have elevated the concentrations (San Juan Watershed Group 2005).

5.1.3.1.6 Mercury

In 2003, the USGS (Gray et al. 2004) conducted a study on Narraguinnep Reservoir, located in Cortez, Colorado to identify potential sources of mercury contamination in reservoir fish species. As there are no point sources of significant mercury contamination to this reservoir or its supply waters, the USGS evaluated potential historical mercury sources and deposition of mercury by measuring mercury concentrations in sediment cores collected from the reservoir. The cores were dated and these dates were further refined by relating water supply basin hydrological records with core sedimentology. Rates of historical mercury flux were calculated based on the mercury concentrations in the cores, sediment bulk densities, and sedimentation rates. The flux of mercury found in Narraguinnep Reservoir increased by approximately a factor of 2 after about 1970.

The three most likely sources of mercury in the Narraguinnep Reservoir are surrounding bedrocks, upstream inactive gold-silver mines, and several coal-fired electric power plants in the Four Corners region. Patterns of mercury flux did not support surrounding bedrocks or upstream mines as likely sources. The USGS study identified 14 coal-fired power plants within 320 km (200 miles) of Narraguinnep Reservoir that produce over 80 x 10^6 MWH of power, the largest of which began operation in the late-1960s and early 1970s. Approximately 3,616 pounds of mercury per year were released through stack emissions from those power plants (2001 data), contributing mercury to the surrounding environment. The patterns of mercury fluxes observed in sediment cores from the reservoir suggested that the most likely source of the mercury was atmospheric emissions from those coal-fired electric power plants (Gray et al. 2004).

Emissions from 6 of the 14 power plants analyzed in the USGS study (San Juan, Four Corners, Navajo, Cholla, Coronado, and Springerville) are summarized in Table 3-9. According to the data in the USGS study, these 6 power plants emitted approximately 3,226 pounds of mercury per year (2001 data), which comprised 89 percent of the total emissions from the 14 plants. According to Table 3-9, total mercury

emissions from the six plants in 2004 were approximately 3,161 pounds. Based on the results of air toxics modeling, a conservative estimate of mercury emissions from the proposed project could be up to 114 pounds per year. This would represent an increase of 4 percent in regional power plant mercury emissions attributable to the proposed project.

The emitted mercury would consist of both particulates and vapors, and may be deposited both near to and far from the power plant site. The actual quantity of mercury that would eventually be deposited in the San Juan River system or Morgan Lake is difficult to quantify. Under a worst case scenario in which 10 percent of the 114 pounds of mercury would be deposited or drained into the San Juan River, the average additional concentration of mercury in downstream surface water would be approximately 0.003 µg/L. This is substantially less than the Federal chronic ambient water quality criterion of 0.77 µg/L (USEPA 2006) and New Mexico's drinking water quality standard for mercury of 2 µg/L. Considering the relatively small additional contribution of additional mercury emissions and the low level of new mercury deposition in the San Juan River system, the likely cumulative effects of mercury emissions on the surface water resource would be minor and long term.

5.1.3.1.7 Surface Water Quantity

Mining operations associated with the power plants in the region are designed for "total containment" (retention on site) of surface runoff from disturbed areas. Because of the low precipitation and high evaporation rates, total runoff containment is feasible in the San Juan River Basin. Stormwater is typically ponded and used in the mining operation (e.g., for dust control) or evaporated. However, the containment and consumptive use of surface runoff on the mine sites may lead to a decrease in flow downstream. In turn, this decreased quantity may affect the quality of the remaining streamflows due to changes in total dissolved solids (TDS) and total suspended solids loading.

Following decommissioning and reclamation, runoff would be expected to return to pre-mining conditions. Assuming effective implementation and monitoring of all required measures, the cumulative effects to the quantity of stormwater runoff and downstream flows are expected to be minor and short term.

5.1.3.1.8 Channel Morphology

One of the potential cumulative effects of the region's energy-related projects may be to reduce stability of receiving streams by altering the controlling parameters such as stream discharge and total suspended solids concentrations. In extreme circumstances, this may result in major changes to the existing channel pattern and geometry. During mining operations, all runoff from disturbed areas is typically routed to sediment control systems that provide "total containment." As a result, the amount of runoff and sediment load from the affected areas would be reduced. Following mining, the sediment control systems would be removed. With successful reclamation and revegetation, runoff and sediment yield are expected to return to their pre-mining levels with little or no effect to the geomorphic stability of the receiving streams.

Power plant construction and mining operations must comply with Clean Water Act (CWA) regulations, which require that surface-water runoff from constructed surfaces be controlled to "prevent, to the extent possible using the best technology currently available, additional contributions of suspended solids to streamflow, or runoff outside the permit area." The CWA requires that discharges to streams meet all applicable water quality standards. Office of Surface Mining (OSM) approval procedures for controlling sediment transport include berms, terraces, sediment ponds, and other energy dissipative channel structures that allow water to pond and sediment to accumulate. Additionally, accidental fuel, lubrication or other hazardous material spills in the construction zone, depending upon the size, has potential to reach

the San Juan River and adversely impact localized fisheries and/or downstream habitats such as nursery backwaters.

The cumulative effects to surface water quantity, including changes in discharge of the Chaco, La Plata, and San Juan Rivers due to past, present, and foreseeable development of power plants and associated mining operations are expected to be minimal. Similarly, changes in sediment load are expected to decrease to a minimal extent. Given these minimal changes in discharge and sediment load, no observable change in the geomorphic parameters (given above) is expected for the Chaco River, La Plata River, or San Juan River. Given these minimal changes in discharge and sediment load, and assuming effective implementation and monitoring of all required mitigation and reclamation measures, the cumulative effects to channel morphology are expected to be minor and short term.

5.1.3.1.9 Surface Water Quality

Coal combustion byproducts (CCBs) that cannot be marketed must be disposed in landfills, surface impoundments, or mines. For the proposed project, CCBs would be relocated to dry areas of mined out pits and ramps. In accordance with regulations, no surface water from disturbed areas in which CCBs have been disposed of would be permitted to commingle with stormwater and discharge. Discharges from areas above the mined out pits and ramps would only occur after they have been adequately reclaimed (i.e., area is regarded to approved topography, topsoil replaced, and revegetated) and operator has demonstrated using established models (e.g., SEDCAD) that post-mine sediment yields would be equal to or less than pre-mine levels per 40 CFR 434 Subpart H.

OSM regulates and monitors disposal of CCBs. As part of the proposed project, disposal of CCBs would comply with all requirements established by the OSM, as described in Chapter 2.

5.1.3.2 Groundwater

Use of groundwater under existing or future water rights and any other impacts to the subsurface hydrologic balance, must be examined within the context of all other foreseeable possible groundwater impacts in the immediate area of the proposed project. This includes parts of the region that are outside of the immediate surface "footprint" of the facility, but are hydrologically connected the facility.

There are two potential impacts on groundwater that must be considered within a regional context: (1) impacts to groundwater supply and (2) impacts to groundwater depth. These are environmental effects from groundwater use under the action alternatives that could be exacerbated by an accumulation of regional groundwater activities. Mitigation for the proposed project would include groundwater monitoring, as described in Section 4.2. Groundwater quality could also suffer cumulative effects if the regional land use or other practices had created problems that the proposed project or the Navajo Mine extension worsened.

5.1.3.2.1 Estimates of Current Groundwater Use

None of the projects listed in Table 5-1 is expected to deplete or impair the quality of groundwater in the region. Most use San Juan River water. Since the Morrison Formation aquifer is recharged well to the west of the site, in the remote Chuska and Lukachukai Mountains, there is no indication that depletion of San Juan River or other surface water would cause a conjunctive impact on deep groundwater.

Cumulative impacts from municipal and industrial usage are also not large. As part of the state water resources planning process, the contract to prepare the plan for the San Juan Hydrologic Unit was awarded by the ISC to the San Juan Water Commission. The plan, including estimates of water usage projected to 2044, was completed in September of 2003 (San Juan Water Commission 2003). There are 3,920 existent New Mexico state groundwater rights in the San Juan River Basin representing 23,709 acre-feet/year (acre-ft/yr). Domestic and irrigation uses account for over half of that. This is less than 1.5 percent of the total water rights (surface and groundwater) in the Basin.

All totaled, 1,629 acre-ft/yr of current groundwater use is estimated by the regional water plan (San Juan Water Commission 2003). In the Chaco subbasin, accurate current use estimates were not available to the San Juan Regional Water Plan. Using 2000 Census data, it was estimated that 930 acre-ft/yr is used for municipal water supplies (including villages and communities along US 491, BIA 5082, NM 37, and NM 57). 699 acre-ft/yr of this is diverted for agriculture, entirely stock watering. This leaves 231 acre-ft/yr of municipal water.

On April 19, 2005, the State of New Mexico and the Navajo Nation signed the proposed San Juan River Basin in New Mexico Navajo Nation Water Rights Settlement Agreement. The Settlement Agreement provides water rights and associated water development projects, including the Navajo-Gallup Water Supply Project, for the benefit of the Navajo Nation in exchange for a release of claims to water that potentially might otherwise displace existing non-Navajo water uses in the Basin in New Mexico.

In order to cost the proposed project, municipal and industrial use projections have been developed through the years 2040 (Navajo Nation et al. 2001). For the entire U.S. 491 (666) region, municipal water use is estimated to be 518 acre-ft/yr, supplied in part from the Morrison Formation. From the current groundwater use projections, the four chapter houses closest to the project are estimated to be using the following (in acre-ft/yr):

Santosee	89
Newcomb	12
Burnham	0
Nenahnezad	0
TOTAL	101

The water is distributed by the existing Navajo Tribal Utility Authority (NTUA). In 2040 the estimated demand would increase to 168 acre-ft/yr.

In addition to these sources of data, OSM has also looked at regional groundwater conditions as part of the Navajo Mine coal field Comprehensive Hydrologic Impact Assessment (CHIA), a SMCRA-defined study intended to integrate the cumulative impact of multiple coal mining permits. The Navajo Mine CHIA provides historic data on water quality.

The CHIA projected increased coal mining activities at Navajo Mine, in addition to other proposed and existing mines (Burnham, Gateway, and De-Na-Zin in the Chaco Wash watershed) and increased water usage at the Navajo Indian Irrigation Project. The CHIA concluded that while there would be some cumulative impacts to surface water quality and quantity, under OSM criteria, no material damage to these systems was predicted. No impacts or damage to groundwater was predicted.

A number of pivot-center irrigation plots are located in the vicinity of the Navajo Mine permit. These systems receive water, by pipeline, from the Navajo Indian Irrigation Project (NIIP). The undepleted portion of this water seeps into the subsurface and adds to the local groundwater but the amount is not known.

5.1.3.2.2 Regional Groundwater Quality

Groundwater quality in the area, as described in Chapter 4, is variable. In summary, coal seam aquifers are very high in TDS, selenium, and sulfate because of their equilibration with material naturally high in these parameters. Alluvial aquifers are variable, ranging from 1,000 to 4,820 ppm TDS, suitable for stock watering (Link and Kelley 1980). Post-Morrison Formation aquifers are also variable in quality and are of similar composition to the alluvial waters. Studies of chapter house wells (Burnham, Santosee) screened in these formations (Miller Brooks 2007a, b) result in average fluoride concentrations of 2.07 and 0.4 mg/L, respectively, below the Navajo Nation maximum contaminant level (NN MCL) of 4.0 mg/L. Nitrate concentrations were 0.78 mg/L for Burnham and 0.02 mg/L for Santosee (NN MCL = 10 mg/L). TDS concentrations were 3,558 mg/L for Burnham and 614 mg/L for Santosee. These data suggest that the post-Morrison Formation aquifer water quality is variable, but good in everything but TDS.

The Morrison Formation aquifers are also variable (Dam, et al 1990) but generally of poor quality. Radium-226, selenium, fluoride, chloride, nitrate, and sulfide are all below standards (in some cases, secondary drinking water standards). Arsenic (NN MCL = 0.01 mg/L), TDS, iron, and manganese are all above standards. Under Navajo Nation regulations, the only permissible use of this water without treatment would be stock watering.

5.1.3.3 Cumulative Impacts on Groundwater

The use of 4,450 to 4,950 acre-ft/yr of groundwater as part of one of the action alternatives would be a large, new depletion of groundwater in the region, compared to the 100 to 230 acre-ft/yr currently used. The effects of this, as discussed in Chapter 4, would be most prominent in the immediate vicinity of the project wellfield. The impacts would drop off as distance from the well field increases and, under the criteria described in Section 4.2, no measurable adverse impact to wells in the project area is expected from either Alternative B or C. Alternative A would have no effect on cumulative groundwater use.

Based upon the current and forecast groundwater use in the project area, there is no suggestion that any foreseeable actions in the region would add to a cumulative adverse impact on groundwater use from the proposed project. Since there are no expected impacts from project facilities or BNCC Lease Areas IV South and V on water quality and numerous layers of protective monitoring, regulatory oversight and enforcement to assure this expectation, there is no cumulative impact expected on groundwater quality from Alternative A, B, or C.

5.1.4 Biological Resources

Cumulative impacts to biological resources would be considered significant if any of the following were to occur:

- Substantial loss of habitat function or disruption of life history requirements of a species or population segment that would make them eligible for listing under the Navajo Endangered Species List (NESL) or the federal Endangered Species Act (ESA).

- Decreased viability or increased mortality of ESA threatened and endangered, proposed, and/or candidate species or adverse alteration of their critical habitats.
- Substantial loss of habitat function or disruption of life history requirements of Special Status Species that would preclude improvement of their status.

Impact analyses and conclusions are based on best available scientific literature, a thorough analysis of the potential effects of the project, and the professional judgment of the wildlife and fisheries biologists and ecologists who completed the evaluation. In the absence of quantitative data, best professional judgment was used. Impacts are sometimes described using ranges of potential impacts or in qualitative terms if appropriate. For the purpose of this assessment, the San Juan River Hydrologic Unit or Basin constitutes the analysis area.

5.1.4.1 Habitat, Community and Population Trends

An exhaustive literature review was conducted to determine trends in flora and fauna populations, habitat types, and vegetative communities within San Juan County, New Mexico. With the exception of native and non-native fish surveys conducted along the San Juan River systematically since the early 1990s, and limited raptor survey data collected at Navajo Mine since, there is little to no usable population trend data for flora and fauna resources common to the proposed project area.

Fisheries data reviewed (USFWS 2002) indicate that for native fishes (i.e., flannelmouth sucker, bluehead sucker) that populations trends are generally stable with periodic short-term increases in capture rates (indicating more fish). Much data exist on the numbers of Colorado pikeminnow and razorback suckers captured from year to year; however these species are stocked to assist with recovery efforts so they are not necessarily good indicators of system fisheries health or population trends. It is important to note however, that the USFWS has documented the impairment to reproductive success of razorback sucker attributable to selenium and mercury concentrations in the San Juan River water column. Existing levels of dissolved mercury in the San Juan River and the additive effect from the proposed project are discussed in Sections 4.2 and 4.3. In addition, mercury that is sorbed to sediment is still available to methylating bacteria when carried into the anoxic zones of river beds and reservoirs where methylation occurs. Additionally, while more than a million pikeminnows have been stocked since 1996, populations have declined significantly since 1998 for reasons that are unknown.

Annual raptor surveys conducted at Navajo Mine since 1995 document a stable population trend for ferruginous hawk. There are several Breeding Bird Survey routes in the region that are typically completed annually. However, due to the limited number of survey routes for the spatial area being considered in this analysis, it is unlikely that sufficient data exist to make any conclusive determinations regarding bird population trends in the county.

The NNDFW NNHP has been monitoring populations of the federally threatened Mesa Verde cactus within and near the project area since the early 1990s. As of 2006, a dramatic decline in the known and monitored populations had occurred. This decline has largely been attributed to regional drought combined with predation from insects and continued regional development (Personal communication with Daniela Roth, NNHP).

The closest geographical systematic analysis of wildlife population trends has been conducted in the Jicarilla Ranger District of the Carson National Forest nearly 80 miles from the project area. Habitat and population trend data on the forest for Management Indicator Species are not relevant data sets as the species and habitat types largely do not occur in the proposed project analysis area. Without a sound basis

to establish trends in populations, projecting cumulative impact thresholds to area biological resources is somewhat subjective.

5.1.4.2 Cumulative Biological Impacts

Development of the projects listed in Table 5-1 have resulted and probably would continue to result in the loss and alteration of wildlife habitat, including fragmentation; intentional and unintentional harassment of wildlife; invasion of non-native vegetation; intentional and unintentional mortalities of wildlife from exposure to contaminants, depletion of water resources, collisions with vehicles, increases in legal or illegal harvest of game and non-game species, electrocution/collision with overhead electrical transmission lines; increases in air and water pollution that directly and indirectly effect plants and animals. Further, increases in human activity in previously undisturbed habitats inevitably results in adverse impacts on vegetative communities and wildlife. The cumulative effects of these incursions are difficult to accurately quantify as the ultimate effects are dependant upon the species potentially present in the area, the timing of the human activity, the nature of the activity, the duration of the activity, and what is happening in adjacent habitats at the time of proposed disturbance. Further, some species of wildlife are more suited to adapt to rapid environmental change, while other species may be seasonally or permanently displaced from otherwise favorable habitat. Residential and industrial development in the San Juan Basin may have already influenced the occurrence, distribution, and abundance of wildlife within and near the proposed project area.

The degree and magnitude of wildlife impacts that could be additive as a result of developing the proposed action is generally considered a minor cumulative effect. The cumulative loss of habitat from the proposed project is not a significant loss of habitat because of the abundance of similar habitat in the region and across the Navajo Nation. However, increases in traffic along existing regional and planned local road networks cumulatively would have a noticeable, adverse cumulative impact on wildlife as a result of road-killed animals in the San Juan Basin. According to the cumulative Class I increment air modeling analysis included in §4.5 of the ENSR Report Desert Rock Energy Facility Application for Prevention of Significant Deterioration Permit – Class I Area Modeling Update, January 2006, cumulative air quality impacts of the proposed project would be negligible (i.e., overall lower emissions in the Four Corners region) due to increased emission controls occurring at the Four Corners Power Plant and at the San Juan Generating Station. Based on that conclusion, biological resources would not be subject to cumulatively significant adverse impacts related to air quality.

Wildlife exposed to mercury via their diet may be subject to reproductive failure, immune system impairment, behavioral aberrations, motor dysfunctions, or even direct toxicity. Most at risk are those animals at upper trophic levels that feed on fish, or on other animals that feed on fish. While little reliable information is available, there are no known instances of mercury intoxication of wildlife in New Mexico. Assessment of the impact of mercury on wildlife is difficult however, since some of the symptoms associated with chronic mercury poisoning may not be immediately apparent, resulting in reduced functionality, inappropriate breeding behavior, or early mortality by some other mechanism, e.g. impaired predator evasion.

Habituation of animals to their environment is an important factor in assessing impacts of noise. The definition of habituation is “the elimination of the organism’s response to often recurring, biologically irrelevant stimuli without impairment of its reaction to others.” Habituation is ubiquitous in the animal kingdom (Peeke and Petrinovich 1984). No study takes place without subjects habituating to their natural or experimental environments to some degree. More predictable sources of disturbance can lead to greater apparent habituation in field situations than less predictable ones. Situations in which similar noise-

producing activities occurring in the same habitat at frequent intervals may therefore affect locally-breeding wildlife less than less-frequent or less-predictable activities.

Fauna in the vicinity of the proposed project are likely accustomed to operations noise from the existing coal mine. Although conventional and special construction noise associated with construction of either Alternative B or C and associated facilities would contain unfamiliar sounds, their aggregate levels at positions coincident with residential locations 1.5 to 3 miles from the proposed project site are expected to be less than a commonly-observed threshold of 65 dBA hourly L_{eq} for "chronic" effects. Likewise, power plant operational noise levels for both Alternatives B and C are predicted to be below 60 dBA hourly L_{eq} at the site property line, so adverse impacts due to these noise contributors would be unlikely.

However, unattenuated steam blows and other high-magnitude and unfamiliar impulse sounds associated with any kind of project construction or operation may startle certain species and therefore cause "acute" adverse impacts on wildlife reproductive physiology or energetic consumption as individuals incur energetic costs or lose mating or foraging opportunities by repeatedly reacting to or avoiding noise. A species' capacity for and pace of habituation would temper these impacts to some degree.

There would be a minor loss of available habitat for bald eagle with the addition of a transmission corridor across the San Juan River that would periodically inhibit eagle foraging and travel flight patterns along the river corridor. This impact is considered small as the proposed transmission would parallel an existing transmission line, thereby widening an existing obstruction to eagle flight along the river. It is not known whether the addition of a second transmission line would serve to assist eagles, raptors or other birds avoid collusions with the lines due to increased visibility. An unknown number of Mesa Verde cactus may also be damaged or killed with the construction and maintenance of Segment D of the proposed transmission line and the Navajo Transmission Project (NTP). A mitigation plan has been prepared for the NTP to minimize impacts on the Mesa Verde cactus. Construction and maintenance of transmission access roads and the construction footprint of tower locations would result in some permanent loss of potentially viable habitat and/or seed bank for Mesa Verde cactus. Minor increases in mercury and selenium, and other potentially toxic elements, reaching the San Juan River from air pollution deposition may contribute to adversely impacting razorback sucker and Colorado pikeminnow reproductive success.

Overall, the degree and magnitude of the proposed project impacts on wildlife that could be cumulative are speculative but generally would be considered minor to moderate as defined in Chapter 4. The proposed project would not add a significant adverse effect to cumulative impacts on vegetation and wildlife in the area.

5.1.5 Land Use and Recreation

The additive interactive impacts on land use would result from numerous existing and proposed industrial energy developments within the region, including power plants, refineries, transportation networks, transmission lines and coal mining activities. Most large energy developments within the region of cumulative impacts are located within the Four Corners area, with transmission lines and pipeline developments connecting them to each other and to larger urban areas that are located outside of Indian lands. Increased energy development would drive the demand for the use of new and existing right-of-way corridors for transmission lines, pipelines, distribution lines and roads to support the construction of planned facilities within the region.

Overall, an increase in energy developments would contribute to the modification of the character of the Four Corners area. As development occurs, the very rural environment would become increasingly more industrial. Large industrial developments that require many employees would spur other commercial and residential growth within the region, causing the need for improved transportation corridors and other infrastructure. If populations increase as a result of large industrial developments the use of designated recreation areas and dispersed recreation within the Four Corners area also could increase. In addition, the quality of the recreational setting could be degraded by the loss of a wilderness aesthetic, visual intrusions upon the landscape, and potentially increased regional haze due to the cumulative increase in development.

Conversion of land (farm land and undeveloped land used for livestock grazing) to rights-of-way or to industrial land uses as part of Alternative B or C would have a small, but incremental cumulative impact regionally. As more lands are converted to industrial use, the character of the area is shaped or modified in ways that could decrease the amount of agricultural uses.

5.1.6 Geology/Soils/Topography

The cumulative impacts of earth-moving activities within the Four Corners area would be considered negligible to minor. There are Federal, State, and Tribal mandates on protection of waterways in relation to soil erosion and sedimentation that would be followed at all project sites in the area. Coal would be irretrievably removed from the strata in mining sites; however, CCBs that are not reutilized in a post-use market would be relocated into excavations (typically) at the site of the coal mine. There would be negligible cumulative impacts on topography as Federal, State, and Tribal mandates require reclamation following cessation of operations or activities. Mineral resources may see a minor cumulative impact due to regional oil and gas development.

5.1.7 Visual Resources

Implementation of the proposed project would add a new industrial facility to the overall landscape setting and would contribute to cumulative adverse visual influences that currently occur in the project area. Considering the relative remoteness and natural state of the project area, the proposed project facilities would represent a substantial impact in terms of landscape character/scenic integrity when addressed cumulatively with the other industrial projects in the region. In terms of sensitive viewers, the project facilities under Alternatives B and C would represent a lower impact due to the constrained opportunities for the project to be viewed, the distances from which viewers would have to see the project, visual interference of the project by topography, and the presence of existing transmission facilities.

5.1.8 Socioeconomic Conditions

Socioeconomic conditions in the region of influence are vulnerable to incremental effects on employment, income, governmental revenue, and other social and economic characteristics. The local area of influence and the entire Navajo reservation is an area of low-income and high unemployment (Tables 3.34 and 3.35). In such an area, the addition of well-paying jobs lifts households out of poverty and the termination of well-paying jobs returns households to poverty. The same area also is dependent on relatively few government revenue sources. A project that provides substantial industrial taxes and fees would broaden the revenue base. DPA's goal for the proposed project is to contribute to Navajo Nation economic development by generating revenue, increasing self-sufficiency, and improving the quality of life.

The remainder of the region of influence comprises two counties in Colorado and two counties in New Mexico. Each county has a minority and low-income population proportionately larger than its respective state. Colorado's Ute Mountain and Southern Ute Indian Reservations are also within the region. The vulnerability to incremental effects is similar to that in the local area.

Alternative B or C would be one of several similar actions in the same geographic area. Two large power plants, the Four Corners Generating Station (FCGS) and the San Juan Generating Station (SJGS), would be within the local area of the proposed power plant. FCGS began operations in 1963 and has fuel agreements to supply it through July 2016, and SJGS began operations in 1973 and has fuel agreements to supply it through 2017. Those power plants have provided both permanent and temporary employment to Navajo residents of the area, most of whom live on the reservation. Another power plant, the Navajo Generating Station (NGS), is near Page, Arizona, 100 miles from the proposed power plant. While NGS is not on the Navajo reservation, its exclusive fuel supply comes from Peabody's Kayenta mining operation on the Navajo Nation. Peabody's Kayenta operation, as the coal supplier to NGS, is an important revenue source for the Navajo Nation.

Mining is important to the economy of the region and makes the largest private-industry contribution to the revenue of the Navajo Nation. The largest mining operations on the Navajo Nation are coal mines, including the Navajo Mine, the McKinley Mine (Pittsburgh and Midway companies), and the Kayenta mining operations. Operations at the Black Mesa mining operation are currently suspended, and in 2008 McKinley Mine leases will expire (Navajo Nation Economic Development, 2002; Black Mesa Project Preliminary Draft EIS, 2006). The mining operation at the BNCC lease areas IV South and V would require a workforce of 200, most of whom would be miners. Mining would take place over the same 50-year interval as the operations phase of the proposed power plant and would provide all of the coal required by the proposed project. At shutdown, reclamation of mining areas would occur concurrently with the power plant abandonment, dismantling, and land reclamation.

It is assumed that 60 percent of the mining operation workforce for the proposed project would come from the local area and 40 percent would come from the remainder of the region of influence. Few or none would come from outside the region. Based upon the current and historical workforce at coal mines on the Navajo, Hopi, and Ute Indian Reservations, it is assumed that 65 to 80 percent of the workforce, or 130 to 160 workers, would be American Indian. Most of them would be Navajo. The Navajo preference in hiring would apply to the operation. The workforce available in the region includes both experienced miners and others. Given the reservation's high unemployment rate, the mining tradition, and high mining wages, many would enter the coal mining occupation.

The local area of influence had over 2,000 mining workers in the year 2000 and the region of influence also had a relatively large proportion of its workforce in mining. Mining jobs with some employers have decreased, indicating that experienced miners would likely be available. Surface coal mining ceased at the San Juan mine in New Mexico (underground mining continued) and the Black Mesa mining operation near Kayenta, Arizona suspended mining in 2005.

The mining wages would be similar to those at the existing Navajo Mine (BNCC lease areas I, II, and III). Agreements reached in 2004 indicated that the average earnings would be over $48,000 by 2006 (Gallup Independent 2004; Militant 2004).

Several of the other projects in the area have had similar effects upon socioeconomic conditions. Currently in the local area, of the establishments ranked in the top ten by number of employees in 2004, BHP (New Mexico Coal) coal mining operations, FCGS, and SJGS accounted for almost 2,100 jobs. In the local area, two oil and gas mining companies also ranked as top ten employers: Conoco Phillips and

Williams Energy. The two companies accounted for over 500 jobs and are similar to the coal mining operations and power plants in terms of the mix and number of employees required. Utilities and mining are leading employers in the local area of influence, through employment at the establishments named above or at other establishments.

The operations phase employment related to the proposed project would add an increment of about 200 power plant jobs to about 1,150 existing power plant jobs in the region. Similarly, the 200 mining operations jobs with BNCC to supply coal to the proposed project would be an expansion of a current operation. While those jobs would benefit the area, they would not change the overall makeup of employment by industry in the region.

Future energy resource development is certain in the region. In addition to the proposed project the coal-fired Mustang Energy Project is also proposed within the region of influence. There are large coal reserves and large oil and natural gas reserves in the San Juan basin. Coal production is steady and would increase as a result of the proposed project. The prospective coal sales agreement between Sithe and BNCC would include an estimated $26 million per year in taxes and royalties that would be received by the Navajo Nation. BNCC would also be responsible for an array of taxes paid to other government entities, such as the State of New Mexico in BNCC lease areas I, II, and III. Those taxes would also apply to areas IV and V. There have been intergovernmental tax credits against coal severance taxes to benefit all parties that have resulted from collaborative efforts by the State of New Mexico, the Navajo Nation, and coal and utility companies (New Mexico Legislature 2004).

Oil and natural gas production is less predictable due to market factors. Production of oil and natural gas fell off some in the 1980s and had a resurgence with the onset of coal bed methane production. Currently, the permitting of oil and gas wells is occurring at an unprecedented rate within the region in an attempt to increase resource extraction yields. According to the Farmington Proposed RMP/Final EIS (BLM 2003), oil and gas facilities would provide additional economic benefits in the form of jobs, expenditures, and public revenues from additional oil and gas development of federal and non-federal land in the New Mexico portion of the San Juan Basin. In the local Aztec, Bloomfield, and Farmington area, additional new non-federal development is estimated to generate about 560 additional jobs as a part of the 2020 area workforce. Regionally, job and earnings increases would range from 1 to 2 percent of current levels.

The ongoing coal mining and electricity generation at the proposed project site over its 50-year lifespan would occur in an area where the mining, construction, and utilities industries have been important to the regional economy for many years. The large and growing demand for electricity in the southwestern United States ensures that a variety of new and existing power generation technologies would be pursued to meet that demand. The coal, oil, and natural gas resources of the Four Corners Area would continue to be in demand.

The proposed project might fulfill a substantial portion of the Dine Power Authority (DPA's) goals concerning Navajo Nation economic development by generating revenue and increasing self-sufficiency. NTUA may purchase electricity from the proposed project starting in 2011, which would be distributed for local use. A purchase of 50 MW would supply the equivalent of 50,000 homes with electricity (Government Auditing Office [GAO] 2001). This is more than the estimated 47,603 households on the entire Navajo Nation as indicated in the 2000 Census.

With regard to social impacts of the project upon the Navajo people and revenues generated from tribal assets, there is no single "Navajo culture" which controls the lives of Navajos living on the Navajo Reservation. Rather through the revenue generated in the sale of tribal assets communities within the Navajo Nation become dispersed along a cultural continuum ranging from very "traditional" to very

"acculturated." "Traditional" means those Navajos still living and holding values much the same as their ancestors did and "acculturated" means those Navajos who have changed their life style, live lives and hold values more nearly like the majority of Americans made possible through the additional revenues recognized through the sale of coal and water. Impacts of the proposed project would be very different upon individual Navajos, and Navajo families depending where they may occur on this cultural continuum.

5.1.9 Cultural Resources

Cultural resources vulnerable to incremental effects of the proposed project are identified as archaeological sites, places of traditional cultural importance to the Navajo people and other Native American tribes that indicated a traditional interest in the project area, and traditional Navajo culture, as well as other Native American traditional cultures.

Cumulative impacts to archaeological resources may occur in part as a product of mitigating the effect of the project on historic properties. In many instances if an archeological site can not be avoided by a project, a method of mitigating the direct and indirect impacts of the project is through archaeological excavation; referred to as data recovery. Data recovery is viewed as a method to preserve the scientific information about the past contained within archaeological sites when the site itself cannot be preserved. However, the very nature of data recovery (excavation) is destructive to the site. Once excavated, the archaeological site is no longer present unless efforts are made to preserve portions of the site or stabilize remaining portions of the site for preservation goals. Large projects, like the proposed project, tend not to mitigate each and every identified archaeological site within the project area, but rather select a representative sample of the various site types that are present within the project area for data recovery. This results in the destruction of sites that were part of the original inventory but were not treated. It also has a resultant effect of losing scientific and historic information about the past that was contained within the sites not treated. This approach for treating archaeological resources may not have a large impact on archaeological resources as a result of a single project, but the cumulative effect of many large projects within the region amounts to the loss of large amounts of scientific and historic information about the past that could inform on our understanding of historic regional events and cultural evolutionary processes.

Ethnographic studies performed in association with this project identified many places on the landscape that are considered to embody cultural and religious significance for local Navajo families. These places (offering areas, shrines, ceremonial areas, etc) on the landscape are considered sacred symbols that serve as cultural and individual identity markers for the Navajo. These places serve to reinforce the Navajo relationship to the landscape through reminding them of their historic ties to the landscape and their rightful sense of belonging. The continued modification of the landscape through numerous regional projects that remove these important places or modify the Navajo's visual relationship to the landscape can have a cumulative impact on an individual Navajos sense of well-being and their relationship to the landscape. What cumulative effect this has over time on the Navajo individual and family is unknown and up to this point unquantifiable.

There are also cumulative impacts of large scale projects that can affect Native American communities that do not live within the project area but claim the area as part of their traditional use area. These Native American communities can experience negative reactions to knowledge about the destruction and/or damage of traditional cultural places and archaeological sites that they ascribe living, emotional, and historical values to these places. Acute feelings of sadness, depression, anxiety, shame, powerlessness, and sleeplessness can be experienced by Native American individuals when they learn of the destruction (or planned destruction) of offering places, traditional cultural properties, and ancestral sites. These strong

negative emotions have been associated with a form of historic trauma, a psychological syndrome related to health problems and substance abuse among indigenous populations.

Historical trauma is a cumulative wounding of the spirit in a person's lifespan and across generations, caused by stress of historical events that have resulted in massive cataclysmic changes in indigenous cultures. Historical trauma is not an abstract, nebulous, theoretical concept; it has serious and measurable consequences in the psychological, social, economic, intellectual, political, physical, and spiritual domains of Native American life. While non-Indians may think that the loss of any one traditional cultural property, archaeological site, or offering places is not significant, the gradual and incremental loss of hundreds of these places is taking a toll on Native American health and well-being that as yet has been unquantifiable.

5.1.10 Paleontological Resources

Paleontological resources constitute a fragile and nonrenewable scientific record of the history of life on earth. Once damaged, destroyed, or improperly collected, the scientific and educational values may be reduced greatly or lost forever. In addition to their scientific, educational, and recreational values, paleontological resources can be used to understand interrelationships between the biological and geological components of ecosystems over long periods of time. Paleontological resources are subject to an active discovery process. The San Juan Basin/Colorado Plateau area has yielded significant paleontological resources that have resulted in a better understanding of the Earth's history and development of life. Additional paleontological resources may be found on Navajo Nation lands and in the northwest New Mexico/southwest Colorado region but quantity and quality are not known until discovered and properly evaluated. Paleontological resources are subject to cumulative impact via discovery and/or loss through natural processes such as soil erosion and rock weathering, and as a result of surface disturbance such as blading and grading for development, power lines, roads, agricultural lands, dams, or facilities, trenching for pipelines, mining, and oil and gas activity. Paleontological resources may be lost when fossil-bearing units are inundated by lakes or reservoirs developed from dams. Development of roadways and utility corridors may allow greater public access to areas with known or potential paleontological resources and thus, may allow "discovery" of fossil resources. Fossils may be lost or damaged from theft and vandalism. Paleontological resources would be properly evaluated for the potential of resource occurrence and afforded protection from loss by adherence to the mitigation measures identified in Chapter 4 or similar actions for each of the projects proposed for the region. Cumulative impacts to paleontological resources are anticipated to be minimal with adherence to project mitigation guidelines and recommendations.

5.1.11 Traffic and Transportation

There would be moderate cumulative impacts to the transportation network in the area as it develops to meet the demands of industrial development and increased population. There would be a need to expand and/or improve existing infrastructure to accommodate cumulative regional transportation needs.

5.1.12 Noise

According to Table 5-1, there is currently about 6,300 MW of power being produced by coal-burning plants in the Four Corners region under consideration, which by virtue of their similar power-generation technology should generally have operational noise sources comparable to those predicted for the proposed project. Although the expected additional power production capacity of 1,500 MW for DREP Alternative B would increase this aggregate by approximately 19 percent, and even if one assumes that this figure also reasonably reflects the durable increase in other noise-producing activities related to the

project (i.e., commuter transportation, new residents in the proposed project area, etc.), the rise in ambient sound energy over the entire region would be less than a decibel. Alternative C, with its smaller generation capacity of 500 MW and following the same logic, would contribute less than half of what Alternative B would contribute. Hence, expected cumulative impact on the region from either operating alternative would be insignificant.

The appearance of over two dozen proposed or planned major projects detailed in Table 5-1 foreshadows the occurrence of new construction noise into the region's audible environment. However, such construction noise is only temporary—long duration in many individual cases, but terminated nonetheless upon project completion. The cumulative noise impact from such construction activity is therefore difficult to predict or quantify and depends on a number of factors, including:

- **Duration of each project and its intensity** (i.e., how much equipment and how many personnel are active and thereby generating noise at a given moment or averaged over a defined period).
- **Project concurrency**. Assuming two simultaneous construction projects are virtually identical with regard to intensity and each generates the same overall noise, the aggregate sound energy is three decibels higher than that of a single project. The relationship is ten times the logarithm of the quantity of concurrent identical projects.
- **Timeframe.** At what point in time does one quantify the cumulative impact, which projects are under construction, and at what phase or how complete is each project?
- **Location.** A receptor's proximity to one or more construction projects within the region will influence the degree of impact magnitude. For example, a construction project might be sufficiently near a residence to become its dominant noise source. Alternately, the project may be so distant from the residence as to have negligible impact.
- **Type of construction activity.** As mentioned in Chapter 4, construction noise is usually categorized by equipment type, process or function. For instance, pile driving and rock blasting would, in general, be considered louder activities than building steel erection or concrete pours.

5.1.13 Public Health

The public health evaluation for criteria pollutants and air toxics concluded that there would be no significant cumulative effects on public health. Minor issues for sensitive sub-populations exposed to particulates and some of the uncertainties in the air toxics' chemical risk assessment are noted below.

5.1.13.1 Criteria Pollutants

Cumulative effects were evaluated by combining existing air concentrations of the criteria pollutants with facility-specific modeled air concentrations and then evaluating whether these combined concentrations could affect nearby residential communities in the vicinity of the proposed plant. Proposed plant operations would not increase existing concentrations of the criteria pollutants above the NAAQS, even at maximum concentrations which occur within 1 km (0.6 m) of the proposed facility fence-line, and consequently there would be no increase in adverse health effects for the majority of the population. The NAAQS are rigorous health standards established without regards to cost. However, asthmatic individuals are a sensitive sub-population that could be affected by exposures to airborne particulates even at concentrations below the NAAQS criteria. In addition, concerns have been raised that low funding for the Indian Health Service has resulted in a medically underserved population in the Navajo Nation. Co-risk factors associated with medically underserved populations such as nutritional status, access to health care, multiple historical exposures, and stress factors can combine to further affect a population's susceptibility

to adverse health effects. While the presence of airborne particulates is not associated with causing asthma, and the available data indicate that nearby population does not appear to have higher asthma rates than the rest of the country, the scientific literature indicates that even low concentrations could exacerbate an existing condition and a lower threshold for effects has not been established. Therefore, while significant effects for asthmatics are unlikely because (1) emissions from the proposed facility only slightly increase particulate concentrations (an annual increase at the location of the maximum concentration of only 1.4 ug/m^3 compared to an existing annual concentration of 5 ug/m^3; note, the annual PM2.5 NAAQS is 15 ug/m^3), and (2) because no one lives close to the proposed facility where concentrations would be highest, some slight effects on asthmatics cannot be entirely ruled out.

5.1.13.2 Air Toxics

The risk analysis calculated non-cancer health effects (hazards) and cancer health risks for air toxics. Results of the analysis found non-cancer hazards met USEPA health goals and cumulative cancer risks slightly exceeded the upper end of USEPA's target cancer risk range; however, exceedances above cancer goals were largely due to the existing concentrations of arsenic in soil and native vegetation and not due to the incremental increase in soil arsenic from future facility emissions (arsenic concentrations in soil are currently 3.2 mg/kg and, after 50 years, will increase to 4.2 mg/kg). Existing concentrations of arsenic in soil and vegetation are naturally present. Concentrations of 3 -10 mg/kg or more of arsenic in soil are common throughout the United States (arsenic is the 20^{th} most abundant metal in the earth's crust). However, risks due only to the increase in soil concentrations from facility emissions over 50 years (approximately 1 part per million increase) still result in cancer risks above the de minimis lower end of USEPA's target risk range of 1 x 10^{-6} (acceptable risk range is 10^{-6} to 10^{-4}), with risks of 1 x 10^{-5} for Alternative B and risks of 5 x 10^{-6} for Alternative C. For Alternative B that represents an increase in cancer risks over existing conditions of only 8 percent, and only 3 percent for Alternative C.

Because the proposed facility has not been built, there is uncertainty regarding what actual environmental concentrations would be, particularly after 50 years. In addition to uncertainties in chemical concentrations in the environment, many assumptions were made to quantify the amount of exposure an individual is expected to have to air toxic chemicals in air, soil, plants, and livestock. While nearly all assumptions were health-protective (over-estimating, rather than underestimating exposure), there is uncertainty regarding what an individual's actual exposures might be and there would be variability within the population. Increases in the exposure assumptions used in the risk assessment, for examples increases in the assumption of how much native vegetation a person might eat, would increase the estimated risks and hazards. Cumulative cancer risks are due almost entirely to the ingestion of arsenic in soil and native plants. Cumulative non-cancer hazards were due to arsenic and mercury with hazard estimates of 1 and 0.6 for children aged 0 to 6 years for arsenic and mercury exposures, respectively. Non-cancer hazards for lifetime child/adult exposures were 0.3 and 0.2 for arsenic and mercury respectively. These hazards meet USEPA's target health goal of non-cancer hazards of ≤ 1. Cumulative cancer risks due primarily to arsenic are 2 x 10^{-4}, at USEPA's upper target risk goal of 10^{-4}. Arsenic cancer risks at the existing soil concentrations are 1 x 10^{-4}. If there are individuals regularly consuming large amounts of native vegetation in the area of the maximum arsenic and mercury deposition (i.e., within 1 km (0.6 m) of the proposed plant fenceline), hazards above the health goal of > 1 might be possible and cancer risks from arsenic would potentially increase (mercury is not a carcinogen). In addition, while the results of this analysis indicate that there are not likely to be any concerns for public health from exposure to air toxics resulting from the operations of the proposed facility, even over 50 years of operation, people who live within the 10 km (6.0 m) maximum impact area, could potentially ingest fish caught from the San Juan River and Morgan Lake. As discussed in previous sections, these water bodies have fish consumption advisories due to elevated mercury and selenium concentrations in fish tissues, respectively.

Although the cumulative mercury concentrations evaluated in this assessment do not result in exposures to mercury at unsafe levels, the toxic effects of methyl mercury (present primarily in living things like vegetation and cattle, but primarily a concern in fish) can impact very basic cellular functions, causing a wide range of symptoms. Researchers are still working to understand the complex nature of mercury toxicity. Much of the damage done to a victim of mercury over-exposure is permanent, persisting even after the body burden has returned to background levels. Moreover, if a pregnant or breastfeeding woman is over-exposed, a disproportionate amount of that mercury is passed to the baby, where it can adversely affect the developing nervous system. A child exposed to mercury in this way may be irreparably harmed. The evaluation of mercury toxicity in this assessment included consideration of mercury's toxic effects during pregnancy.

5.1.14 Environmental Justice

The proposed project would occur in a region with several other existing coal-fired generation facilities, where energy projects are anticipated to be a continuing trend. This section assesses whether the cumulative impact of past, present, and future projects results in disproportionate, adverse impacts on minority or low-income populations. As described in Chapter 3 (Section 3.8.4), the proposed project would be located in an area that is disproportionately minority (American Indian) and low-income.

The San Juan Basin is rich with natural resources that support energy development projects, including coal, oil, gas, and coalbed methane. These employers are heavily represented among the largest private employers on the Navajo Reservation (see Table 3-46). The proposed Desert Rock Energy Project would provide economic benefits in the form of jobs, taxes, and royalties, and the energy sector is an important contributor to the budget of the Navajo government. The adverse economic impacts of Alternative A (no action) would result from the rejection of direct and indirect income and induced income that the project would have provided in an area of high unemployment. This effect would be compounded by the employment losses in the mining sector associated with the Black Mesa Mine and those anticipated with the closure or reduced output from McKinley Mine, and older power plants in the region that may be retired.

The clustering of these industries to take advantage of the natural resources in the San Juan Basin also means that cumulative environmental and land use impacts would affect the same population. Although the energy generated by the proposed project and other existing and planned projects could benefit power consumers on the Navajo Reservation, substantial benefits would accrue to communities outside of the area that would receive the power (i.e., the Phoenix and Las Vegas metropolitan areas) that generally would not experience the environmental or visual effects of the power plants. Although this differential between impacts on the residents close to a power plant and the recipients of most of the power is common (as power plants are often located in rural or undeveloped areas), it is noted that the proposed project area is characterized by two existing, coal-fired plants in fairly close proximity. However, as described in the sections on air quality and human health, the cumulative pollutant levels would be below federal, health-protective standards and thus, significant adverse impacts are not anticipated to occur. There may be individuals that are especially sensitive to the air emissions in the area; although there is no data regarding the health conditions in this particular local area, the region is identified as medically underserved. Cumulative impacts on land use would result from the clustering of industrial facilities and infrastructure to support them, and the associated cumulative impacts on visual resources, would disproportionately impact the local population, constituting an environmental justice impact associated with those resources.

5.2 UNAVOIDABLE ADVERSE IMPACTS AND IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This section summarizes the unavoidable adverse impacts and irreversible and irretrievable commitments of resources that would be associated with each of the alternatives. An *unavoidable adverse impact* is a residual impact that would persist after implementation of mitigation measures. A resource is considered *irreversible* when primary or secondary impacts from its use limit future use options. Irreversible applies primarily to nonrenewable resources, such as minerals or cultural resources, and to those resources that are renewable only over long time spans, such as soil productivity. A resource commitment is considered *irretrievable* when the use or consumption of the resource is neither renewable nor recoverable for use by future generations. Irretrievable commitment applies to the loss of production, harvest, or natural resources. For example, in the surface mining of coal, the removal of coal would be an irreversible and irretrievable commitment of resources. While the coal would be irreversibly committed from the geologic formations, it is also irretrievably committed when burned for electrical generation.

Table 5-2 characterizes these types of impacts that would be anticipated for each alternative. This analysis is derived from the discussions of direct, indirect and cumulative impacts in Chapters 4 and 5.

Table 5-2 Unavoidable Adverse Impacts and Irreversible and Irretrievable Commitment of Resources

Resource or Resource Use	Unavoidable Adverse Impacts	Irreversible Commitments of Resources	Irretrievable Commitments of Resources
Air Quality			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	Criteria pollutants would be emitted, although levels would be below federal standards.	None	None
Alternative C	Criteria pollutants would be emitted, although levels would be below federal standards.	None	None
Water Resources			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	After 40 years of pumping, a large cone of depression in the potentiometric surface of the Morrison Formation would be experienced at the project site. This cone would decrease radially from the center of the wellfield and go to zero at about 10 miles. The process of mining would destroy the overburden, interburden, and coal aquifers. The resaturation of any encountered aquifers may not happen, dependent upon unknown factors in local geology. Most of the coal seams mined would be dry.	Because of the time required for recharge of aquifer, commitment would be considered irreversible.	Because of the time required for recharge of aquifer, commitment would be considered irretrievable.
Alternative C	Same as Alternative B, except the effects under Alternative C related to the cone of depression would be only slightly less than Alternative B.	Because of the time required for recharge of aquifer, commitment would be considered irreversible.	Because of the time required for recharge of aquifer, commitment would be considered irretrievable.
Biological Resources			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	There would be negligible to minor unavoidable adverse impacts to bald eagle from loss of habitat, fish from increase in trace amounts of selenium, mercury and other toxics, loss of wildlife habitat and disruption of food chains and fauna lifecycles, and disruption of wildlife due to construction and operations.	None	An irretrievable commitment of wildlife habitat could occur where vegetation is displaced and human activity is ongoing for the life of the project.
Alternative C	There would be negligible to minor unavoidable adverse impacts to bald eagle from loss of habitat, fish from increase in trace amounts of selenium,	None	An irretrievable commitment of wildlife habitat could occur where vegetation is displaced and human

Resource or Resource Use	Unavoidable Adverse Impacts	Irreversible Commitments of Resources	Irretrievable Commitments of Resources
	mercury and other toxics, loss of wildlife habitat and disruption of food chains and fauna lifecycles, and disruption of wildlife due to construction and operations.		activity is ongoing for the life of the project.
Land Use/Recreation			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	Leased homesites on the mining lease areas would be displaced as the result of mining operations.	None	None
Alternative C	Leased homesites on the mining lease areas would be displaced as the result of mining operations.	None	None
Geology/Soils/Topography			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	Negligible unavoidable adverse impacts due to surface-disturbance. Coal would be adversely impacted.	Irreversible impacts to topography, soils, soil erosion, and soil productivity. Coal would be irreversibly committed from geologic formation.	Coal would be irretrievably committed when burned for fuel.
Alternative C	Negligible unavoidable adverse impacts due to earth-moving activities. Coal would be adversely impacted.	Irreversible impacts to topography, soils, soil erosion, and soil productivity. Coal would be irreversibly committed from geologic formation.	Coal would be irretrievably committed when burned for fuel.
Agriculture			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	None	None	None
Alternative C	None	None	None
Visual Resources			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	The addition of a 917-foot-high main stack plus additional industrial facilities and infrastructure would have an unavoidable adverse impact on the viewshed.	None	None
Alternative C	The addition of an approximately 500-foot-high main stack plus additional industrial facilities and infrastructure would have an unavoidable adverse impact on the viewshed.	None	None

Resource or Resource Use	Unavoidable Adverse Impacts	Irreversible Commitments of Resources	Irretrievable Commitments of Resources
Socioeconomic Resources			
Alternative A – No Action	Employment and tax and royalty revenue would not be generated for the Navajo Nation.	None	None
Alternative B – Proposed Action	None	None	None
Alternative C	None	None	None
Cultural Resources			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	Archaeological resources and traditional cultural properties that are listed or considered for listing on the National Register could be adversely impacted by construction; however impacts would be addressed through consultation with the NNHPO.	Some cultural resources could be irreversibly affected by the proposed project including archaeological resources, traditional cultural properties and human remains, if previously undiscovered were inadvertently damaged during construction.	None
Alternative C	Archaeological resources and traditional cultural properties that are listed or considered for listing on the National Register could be adversely impacted by construction; however impacts would be addressed through consultation with the NNHPO.	Some cultural resources could be irreversibly affected by the proposed project including archaeological resources, traditional cultural properties and human remains, if previously undiscovered were inadvertently damaged during construction.	None
Paleontology			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	Previously undiscovered paleontological sites could be adversely impacted by construction activities.	Previously undiscovered paleontological sites could be irreversibly committed during construction.	None
Alternative C	Paleontological sites that are unknown could be adversely impacted by construction activities.	Previously undiscovered paleontological sites could be irreversibly committed during construction.	None

Resource or Resource Use	Unavoidable Adverse Impacts	Irreversible Commitments of Resources	Irretrievable Commitments of Resources
Transportation			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	None	None	None
Alternative C	None	None	None
Noise			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	Noise levels would increase in localized areas, particularly during construction, but would be below established standards.	None	None
Alternative C	Noise levels would increase in localized areas, particularly during construction, but would be below established standards.	None	None
Public/Human Health			
Alternative A – No Action	None	None	None
Alternative B – Proposed Action	Criteria pollutants and air toxins would be emitted, but cumulative concentrations would be below health-protective criteria with the exception of arsenic. Arsenic cancer risk levels increase slightly above de minimis target health goals and background levels, but background levels already exceed target health goals; arsenic is naturally present in soil at levels above target health goals.	None	None
Alternative C	Criteria pollutants and air toxins would be emitted, but cumulative concentrations would be below health-protective criteria with the exception of arsenic. Arsenic cancer risk levels increase slightly above de minimis target cancer goals and background levels, but background levels already exceed target health goals; arsenic is naturally present in soil at levels above target health goals.	None	None

Resource or Resource Use	Unavoidable Adverse Impacts	Irreversible Commitments of Resources	Irretrievable Commitments of Resources
Environmental Justice			
Alternative A – No Action	Economic benefits would be foregone in an area of high poverty and unemployment.	None	None
Alternative B – Proposed Action	Cumulative land use and visual impacts associated with coal-fired power plants in the region would disproportionately affect an environmental justice population.	None	None
Alternative C	Cumulative land use and visual impacts associated with coal-fired power plants in the region would disproportionately affect an environmental justice population.	None	None

5.3 RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF THE LONG-TERM PRODUCTIVITY

The purpose of this section is to highlight how short-term uses of the environment would affect the long-term productivity of resources. In this analysis, "short term" is defined as the period from the onset of construction activities through the initiation of project operation. "Long term" includes the period after decommissioning the power plant, which for both action alternatives is expected to occur about 50 years after the project becomes operational.

5.3.1 Short-Term Gains

The primary short-term gain involves the mining of coal to generate and distribute electricity to markets in the southwest for up to 50 years. Other short-term gains include the economic advantage to the Navajo Tribe and the local surrounding workforce and economies which would benefit from the construction and operation of the power plant and the extension of the Navajo Mine and production of large quantities of commercially useful byproducts.

5.3.2 Short-Term Losses

Short-term losses associated with the proposed project include:

- The loss of water used by the project to other simultaneous alternative uses in the San Juan River Basin and more specifically in the Morrison Aquifer.
- Loss of aesthetic and scenic quality in a very natural setting.
- Creation of fugitive dust in the mining and hauling of coal, although recommended mitigation measures would reduce this impact.
- Impacts on biota in the footprint of the power plant, facilities, infrastructure and mining areas.

5.3.3 Long-Term Losses

Long-term losses associated with these gains for the proposed project include:

- Consumption of an estimated 6 million tons of coal per year.
- Disturbance of up to an estimated 13,000 acres of land surface to extract the coal.
- Utilization of approximately 2200 acres of land for construction of the power plant and all other facilities required for the generation and transmission of electricity.
- Deposition of limited trace quantities of substances emitted by the power plant into the atmosphere or on surrounding land areas including oxides of sulfur and nitrogen particulates, trace metals and radioactive materials.
- Displacement of several Navajo leased homesites on the BNCC Lease Area prior to mining-related activities.

5.3.4 Long-term Gains

Long-term gains associated with the proposed project are the following:

- Generation of revenues for the Navajo Nation benefiting Navajo housing, health care, and education, or other Navajo initiatives
- Development of a base industry from which existing services industries can serve and provide opportunities for the development of new service industries
- Capital improvements to locally impacted Chapter facilities
- New electric generation to meet load growth needs and more stable electric prices in the southwest markets
- Increased grazing capacity on the BNCC Lease Area following mandated reclamation efforts
- Long-term employment opportunities that increase total wages paid and spent within the community (Tribal and county).