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CROW TRIBE
OF
INDIANS

SYNFUELS FEASIBILITY STUDY

VOLUME IV

PART A: ENVIRONMENTAL

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TABLE OF CONTENTS

SECTION 1.0
INTRODUCTION

The proposed Crow synfuels plant to produce high-Btu substitute (SNG) products, like all synthetic fuel plants, utilizes appreciable land and water resources, in addition to the coal being converted, and generates gaseous, liquid, and solid wastes that will be discharged or disposed. Since the proposed facility represents a relatively large processing operation, it is necessary that controls be placed on the utilization of the limited resources of the Crow Reservation to minimize ecosystem disruption of tribal lands and on the discharge of pollutants from the plant to prevent possible future damage to health and the ecosystem. Environmental standards and guidelines for quantity and quality parameters, used to measure ecosystem disruption and damage or health hazards, are still matters of considerable controversy for synthetic fuel plants. Every effort is made within the framework of this feasibility study to examine major, project-related environmental issues; to establish the essential, existing, or baseline environmental data; to analyze and evaluate potential deleterious environmental impacts; and to propose effective mitigation measures, as deemed necessary, to demonstrate compliance with the current requirements of the National Environmental Policy Act (NEPA). This study approach will, in turn, facilitate the later acquisition of the necessary permits and licenses required for facility design, construction and operation during subsequent phases of the project. Hence, particular attention is focused on issues that are likely to have the most impact on permitting and scheduling and, ultimately, timely project authorization.

A summary of the entire environmental task effort for the Crow synfuels feasibility study is presented in Section 2.0. Section 2.0 is extracted in total and utilized to summarize the entire environmental task effort in Volume I which constitutes the executive summary for the entire Crow synfuels feasibility study.

The scope of work for the environmental task, as defined in the study proposal and as described within the statement of work in the contract agreements for the Crow synfuels feasibility study, is outlined in Section 3.0, Part A of this volume (Volume IV).

The major thrust of the feasibility study effort is included in Section 4.0, Environmental Assessment. Section 4.1 contains a compilation and evaluation of existing and available environmental baseline data in the major environmental areas of concern to the proposed Crow synfuels project: climatology, meteorology and air quality; water quantity and quality for both surface waters and groundwaters; geology; seismology; soils and vegetation; wildlife resources; and cultural resources. Primary emphasis in the environmental baseline data descriptions was placed upon the information that was particularly relevant to an overall environmental impact evaluation and assessment for several design scenarios at selected candidate siting areas within the boundaries of the Crow Reservation as discussed in considerable detail in Section 4.6 of this report.

Salient environmental jurisdictional issues that could arise in the construction and operation of a coal gasification facility on the Crow Reservation are identified and discussed in Section 4.2 to promote planning of the proposed project in a manner that avoids jurisdictional conflicts. The major environmental permitting requirements for development of the Crow synfuels project within the existing regulatory framework of pertinent federal, state, tribal, and local agencies has been compiled and evaluated in Section 4.3. Since most of these regulations were developed independently by the foregoing agencies, numerous conflicts, duplication, and overlap have resulted. Therefore, a comprehensive environmental permitting process for Indian land is developed in Section 4.3 with an appropriate timing sequence related to other development activity associated with the proposed Crow synfuels project. A regulatory decision schedule is next constructed in Section 4.4, to demonstrate the interrelationships associated with the major environmental permitting requirements for the Crow synfuels plant. The permitting requirements must be coordinated and reviewed in a timely fashion to obtain essential permits and approvals within the framework of the planned schedule for the proposed project.

Quantification of major gaseous, particulate and solid waste effluents from selected Crow synfuels plant design scenarios is presented in Section 4.5. The analysis, evaluation, and assessment of major, potentially adverse environmental impacts are developed in Section 4.6 for selected Crow synfuels plant design scenarios at the two

primary candidate siting areas, Sites 1 and 23.

Compliance with the stringent Class I Prevention of Significant Deterioration (PSD) increments for the adjacent Northern Cheyenne Reservation poses the major environmental constraint to the siting of a synfuels plant on the Crow Reservation. The preliminary screening of possible candidate sites affected by the air quality dispersion modeling analysis became the early, major concern for the entire feasibility study.

The necessary air quality emission control, as defined by the predictive modeling analysis, is derived in terms of proposed plant system design measures and of plant operational procedures to mitigate potentially adverse environmental air quality impacts for the two primary candidate site selections. Similarly, pertinent plant system design features are specifically proposed as mitigation measures to preclude potential water-related environmental impacts from process liquids and solid waste effluents based primarily upon total containment of those effluents. This drastically reduces the probability of possibly hazardous contaminant migration from the controlled plant site. Additional mitigation measures are proposed to reduce potentially adverse environmental impacts to soils, vegetation, wildlife resources, and cultural resources as a result of excavation requirements associated with water piplines, new site access roads, new rail lines, utility corridors, etc.

Finally, the major conclusions and recommendations derived as a result of environmental assessment are presented in Section 5.0.

SECTION 2.0
ENVIRONMENTAL ASSESSMENT: SUMMARY

2.1 BASELINE DESCRIPTION

A summary of existing environmental baseline information on the Crow Reservation, gathered from research of several extensive data bases, is summarized in this section. The review of this information, discussed in a considerable amount of detail in Sections 4.1.1 through 4.1.8 of Volume IV, Part A of this report, is necessary to evaluate and assess the potential environmental impacts that can be expected from the construction and operation of a 125 to 250 million standard cubic feet per day (MM SCF/D) high-Btu SNG coal gasification plant on the reservation. The baseline description addresses the climatology of the area including meteorology and air quality; geology; water resources, including both surface water and groundwater quality and quantity; physiography and land use; soils and vegetation; wildlife resources; seismology; and cultural resources. Primary emphasis within this summary has been placed upon including baseline information pertinent to the assessment of major potential environmental impacts to the two candidate plant sites selected for detailed evaluation in this feasibility study; i.e., Sites 1 and 23.

2.1.1 Climatology and Air Quality

The Crow Reservation, located in the south-central part of Montana, resides in the transition zone between the Northern Great Plains and the Rocky Mountains, and has a climate which assumes some of the characteristics of both regions. The climate of the reservation area has been classified as continental, semiarid with the associated characteristics of a large range of temperatures, clear skies, and low relative humidities. The reservation, encompassing approximately 2.3 million acres, is characterized by rolling plains and complex terrain with elevations ranging from 2,900 feet at Hardin to about 9,000 feet in the Bighorn Mountains. Since climate is dependent on terrain and elevation, the climate will correspondingly demonstrate variability depending on location and elevation. No attempt has been made to characterize the individual site areas of Sites 1 and 23 according to climate because no site-specific data are available. The importance of site-specific data is

exemplified in the characterization of the necessary climatological and meteorological data to adequately define the surface and near-surface dispersion meteorology conditions at either Site 1 or Site 23 considering the inherent terrain irregularities. Although these data are an essential requirement for subsequent, detailed air quality modeling for the final assessment of air quality impacts arising from the proposed Crow synfuels project, the EPA-approved screening techniques adapted for the predictive air dispersion modeling analysis utilized in this study do not require site-specific detailed monitoring data. For this reason, less emphasis was placed upon a discussion of the available climatology and air quality data in this summary, although a quite detailed account of the available baseline information is presented in the body of the report (see Section 4.1.1 of Volume IV, Part A). Summarily, a detailed, site-specific, preoperational air monitoring program to develop the required baseline climatological, meteorological, and air quality data becomes an absolute necessity if the Crow synfuels project proceeds beyond the stage of this feasibility study.

The Crow Reservation is currently designated as a Class II PSD area, with no violations of human health-related ambient air quality standards noted on the reservation. The Class II designation is the same classification that applies to most of the geographic areas of the country. It implies that a moderate level of industrial growth would be permitted on the reservation.

Most of the area adjacent to the reservation is also designated as Class II air quality, with two very important exceptions. The Northern Cheyenne Reservation located directly to the east of the Crow Reservation has been designated as Class I PSD area. The designation is reserved for clean, pristine areas and would permit little or no industrial development. Since industrial sources located on the Crow Reservation could affect the air quality on the Northern Cheyenne Reservation, the Class I status of the Northern Cheyenne is a significant factor in this feasibility analysis.

The other air quality designated area which may have an impact on any development on the Crow Reservation is the city of Billings. Billings is currently classified as "nonattainment" for Total Suspended Particulates (TSP), meaning that violations of

the health standard for TSP have been measured in Billings and that little or no growth will be permitted in or adjacent to Billings until the standard is reached.

2.1.1.1 Odor

No odor monitoring has been performed at any of the sites. It is anticipated that odor levels on the reservation are similar to those associated with rural dryland farming areas in the country. Certain monitoring odor occurrences related to agricultural activities may be present during harvest time.

2.1.1.2 Acid Precipitation

The acidic character of precipitation that occurs over a given areas has been an issue of increasing concern. The emission of man-made pollutants from industrial and urban activities can increase the acidity of the precipitation that falls to the ground. The effects of acid precipitation on the environment are not clearly understood; however, increased precipitation acidity can cause (1) damage to lakes and rivers, (2) demineralization of soils, (3) reduction of crop and forest productivity, and (4) deterioration of property.

No measures of acid precipitation have been made on the reservation. However, data collected near Colstrip by the University of Montana indicate that acid rains are occurring in the area. It cannot be determined whether this situation is caused by the power plant or by sources located upwind. Further studies are needed to investigate the baseline acidic precipitation on the reservation.

2.1.2 Geology

The sedimentary rocks of the Crow Reservation overlie approximately 11,000 feet, not including the Precambrian granitic basement rocks found in the eroded and

uplifted core of the Bighorn Mountains. Every geologic system except the Silurian is represented within the reservation boundaries. Precambrian to Mississippian strata generally outcrop in the southwestern part of the reservation. Pennsylvanian and younger rocks are found in the northern and eastern portions of the area.

The general stratigraphy of the reservation is presented in Table 4.1.2-1 and Figure 4.1.2-1 of Section 4.1.2 of Volume IV, Part A, for the formations which outcrop within the boundaries of the reservation. Geologic characteristics pertinent to Sites 1 and 23 that are germane to the subsequent environmental impacts assessment are summarized in Sections 2.1.2.1 and 2.1.2.2 of Volume IV, Part A.

2.1.2.1 Site 1

The proposed Site 1 area is located in parts of Township Secs. 16, 17, 20, and 21, T2S R31E. The general region encompassing Site 1 is overlain by the Niobrara and Carlile members of the Cody Shale Formation of the Upper Cretaceous Series (see Figure 4.1.2-2 of Section 4.1.2, Volume IV, Part A). The Cody Shale includes 2,600 feet of dark-gray, partly sand shale which underlies much of the plains region in south-central Montana. The Cody Shale is conformable above the Frontier Formation and under the Parkman Sandstone and includes rocks of the Colorado and Montana Groups.

A series of test holes were recently drilled by Woodward-Clyde Consultants (1980) in Secs. 9, 16, and 17, T2S R31E, slightly north of the candidate Site 1 area. The results of this preliminary test drilling showed stiff to very stiff clays over hard to very hard bedrock, presumably the Niobrara and Carlile Members of the Cody Shale Formation, at depths of 3 to 7 feet. The upper 5 feet of bedrock had weathered in one of the test holes. Additionally, the clays were silty, sand, calcareous, and occasionally porous. The claystone bedrock was slightly sandy to sandy and contained scattered bentonitic clay lenses.

A near-vertical fault crosses Woody Creek Dome, trending from Sec. 33, T3S R31E into Sec. 11. This fault dies out in a very short distance in Cody shale south of the dome and has a maximum vertical displacement of about 100 feet. A similar fault in Secs. 3 and 9, west of the anticlinal axis extending northward from Woody Creek dome, has prominent surface expression, and on the north side of Woody Creek Valley it displaces the white-weathering calcareous Greenhorn Shale member of the Cody Shale nearly 100 feet.

Several other smaller faults on the north side of the valley are en echelon to the Woody Creek Dome fault, and they occur in a belt parallel to the axis of the northward-plunging Two Leggin Uplift. Structural closure along the faults is less than 100 feet. One of these faults, approximately 5 miles in length, nearly bisects the proposed Site 1 area (see Figure 4.1.2-1 of Section 4.1.2, Volume IV, Part A).

2.1.2.2 Site 23

The proposed Site 23 is located in Sec. 11, T9S R38E, and is adjacent to the proposed Shell coal mining leases (see Figure 4.1.2-3 of Section 4.1.2, Volume IV, Part A). The topography of the general area is characterized by a series of relatively narrow, flat-topped surfaces or plateaus that dip gently from northwest to southeast, separated by narrow stream valleys occupied by Squirrel, Tanner, and Youngs creeks and their lesser subsidiary drainages.

Four coal seams, representative of the stratigraphy of the area and averaging 10 to 48 feet in thickness, are the object of the proposed nearby Shell mining project. The four coal seams are part of the Tongue River member, which is the youngest (uppermost) unit of the Fort Union Formation.

The Wasatch Formation constitutes the uppermost bedrock unit at higher elevations in the western and northern portions of the Site 23 Shell lease area and in the Wolf Mountains. The Tongue River Formation is the uppermost unit of bedrock in the southern part of the lease and along the valleys of Youngs, Tanner, and Squirrel creeks where erosion has removed the overlying Wasatch.

Figure 4.1.2-3 of Section 4.1.2, Volume IV, Part A, illustrates the surficial relationship among the bedrock formations across the lease and the proposed siting area. Geologic units and formations significant to the site are also tabulated (see Table 4.1.2-2 of Section 4.1.2, Volume IV, Part A).

The Shell coal lease and Site 23 are on the northern flank of the Ash Creek anticline. This anticline causes the general southeasterly dip of regional bedding to be warped to the northeast at an average dip of 2 degrees through the general area. Prominent structural features on the lease include the clearly defined northeast and northwest lineation, consisting of fault-controlled topographic features. The northwest lineations, consisting of a series of northeast-southwest trending normal faults that transect the area, are not as obvious because they are masked by overlying undisturbed sediments. The down-dropped block is on the southeastern side of the faults, and strata on that side of the faults commonly dip abruptly into the faults.

Several parallel faults in the southeastern part of the Shell lease area show apparent displacements ranging 10 to 200 feet. Movement along these faults is assumed to have occurred in a steep to near-vertical plane.

2.1.3 Water Environment

The Crow Reservation is located in the Yellowstone River Drainage. Lands within the reservation are drained by eight basins: Sarpy Creek, Tullock Creek, Rosebud Creek, Tongue River, Little Bighorn River, Bighorn River, Fly Creek, and Pryor Creek (see Figure 4.1.3-1 of Section 4.1.3, Volume IV, Part A). The Bighorn River, Little Bighorn River, and Pryor Creek drain most of the reservation and six of the eight "early" candidate siting locations seriously considered in this study would be located within the Yellowstone River Basin. The Little Bighorn River drainage, covering about 600,000 acres, drains most of the eastern part of the reservation. The lesser drainages on the eastern reservation boundary include Tullock Creek, Sarpy Creek, Rosebud Creek, and Tongue River. Tullock Creek drains to and joins

the Bighorn River north of the reservation near Bighorn, Montana. Sarpy Creek drains north directly to the Yellowstone River. Rosebud Creek drainage consists of several small tributaries draining to the Rosebud Creek east of the reservation.

2.1.3.1 Surface Water

A Lurgi coal gasification facility capable of producing a maximum of 250 MM SCF/D SNG will require a regulated water supply of 14,000 gpm (31 cfs). Therefore, an analysis and evaluation of the foregoing surface drainages and their surface flow characteristics on the Crow Reservation revealed that the Yellowstone Reservoir (Bighorn Lake) and the Bighorn River currently constitute the only regulated supply of water on the reservation that will satisfy the aforementioned design requirements for either Site 1 or Site 23 on a continuing basis.

Allowing for inflows and diversions, the average annual flow in the Bighorn River in the reach of potential water withdrawal for coal gasification facility utilization is 2,652,000 to 2,728,740 ac-ft/yr (see Figure 4.1.3-2 of Section 4.1.3, Volume IV, Part A). Flow in the Bighorn River normally peaks between May and July due to snowpack runoff. The flow variability in the Bighorn River below Yellowtail Dam at St. Xavier is influenced by Bighorn Lake but, since the storage capacity of 1.4 million ac-ft/yr is only about 57 percent of the average annual inflow to the lake, a portion of the peak inflows spill over Yellowtail Dam. During the four-water-year period of 1975 through 1978, the average monthly flow ranged from 28 percent to 267 percent (1,085 and 10,240 cfs, respectively) of the average flow of 3,838 cfs (see Figure 4.1.3-3 of Section 4.1.3, Volume IV, Part A). The four-water-year average flow of 3,838 cfs is about 6 percent higher than the long-term average flow of 3,603 cfs. Flow duration curves show the flow to be 2,200 cfs or greater during 80 percent of the time for the period 1966 to 1979 (see Figure 4.1.3-4 of Section 4.1.3, Volume IV, Part A). The lowest single day flow during that period was 112 cfs in 1968 in the Bighorn River at St. Xavier and 400 cfs in 1968 near Bighorn, Montana.

Although not contemplated as a source of water supply for the proposed Crow

synfuels project, four perennial drainages are located in the southeastern part of the reservation in the proposed Shell mining Site 23 area. Three of these perennial streams—Youngs Creek, Tanner Creek, and Little Youngs Creek—drain the proposed Shell mine sites. The fourth drainage, Squirrel Creek, flows in a southeasterly course slightly north of the Site 23 area. All four drainages are tributary to the Tongue River. These streams flow in a southeasterly direction in deeply incised parallel valleys. The drainage basins in the mine areas are only about 2 miles wide and have an average topographic relief between valley bottom and uplands of 300 feet. The alluvial deposits in the valleys are generally less than 40 feet deep and 1,000 feet wide. The approximate average width of alluvial deposits in Youngs Creek is 600 feet, and the average width in Little Youngs and Tanner Creeks is approximately 400 feet.

Thick clinker beds outcrop over much of the drainage basin of Little Youngs Creek and Youngs Creek but do not occur in the Tanner Creek drainage. The clinker beds control the flow regime of Youngs Creek and Little Youngs Creek to a large degree. The very porous and permeable clinker beds are the recharge area for many small groundwater flow systems which discharge to the creeks and maintain relatively high base flows of good-quality water in the creeks. The high infiltration rates in the clinkered area greatly affect peak stream flows in the creeks relative to to other streams in nonclinkered area. The proposed mine site area also has a number of ephemeral tributaries that drain into the perennial streams.

2.1.3.2 Groundwater

Groundwater is available and has been developed for limited use throughout the Crow Reservation. In fact, groundwater constitutes the entire water supply for the Westmoreland Resources Absaloka coal mining operation in the northeastern part of the reservation. The major sources of groundwater on the Crow Reservation are the local deposits of alluvium and colluvium of recent (Quarternary) age, and the sandstones, limestones, and coal beds of the bedrock formations underlying the reservation.

The alluvium and terrace deposits along the major streambeds on the Crow Reservation are the most readily available groundwater supplies. Both Quarternary alluvium and Pleistocene terrace deposits are found in the valley fill along the Little Bighorn River (see Figure 4.1.2-2, Section 4.1.2, Volume IV, Part A). Water yields from the alluvium are estimated to be 50 gpm to 450 gpm. The high-end of the range would require thick, saturated deposits having high permeability or the use of an infiltration/collection gallery system. Yields from the terrace deposits are probably less than 50 gpm (see Table 4.1.3-4 of Section 4.1.3, Volume IV, Part A).

One of the most promising candidate siting areas for the Crow coal gasification facility, Site 1, is overlain primarily by two of the lower members of the Cody Shale formation, the Carlile and Niobrara, in the Colorado Group, as previously discussed. Since pertinent well data are not available at the Site 1 location, the drill test data recently developed are somewhat indicative of the groundwater potential in that area. No free water was found in any of the test holes to the maximum depths drilled of 20 feet. Additionally, the Cody Shales are generally considered to be poor sources of groundwater capable of yielding 50 gpm or less and to occur at depths of 600 to 3,500 feet (see Table 4.1.3-5 and Figure 4.1.3-6 of Section 4.1.3, Volume IV, Part A).

In the Site 23 area, alluvial deposits exist in the valleys of Squirrel Creek, Little Youngs, Youngs, and Tanner creeks. The alluvial deposits are lithologically variable, containing lenticular deposits of fine sand, silt, clay, and clinker gravels varying in thickness 40 to 60 feet. The width of alluvial deposits is generally less than 1,000 feet.

The Tongue River Member of the Fort Union Formation is composed of several major coal seams, interbedded sandstone, siltstone, shale, and clinker beds. The major coal seams—Smith, Anderson, Dietz, and Canyon—and their associated clinkers are the principal water-bearing units in the Tongue River Member and, hence, in the Site 23 area. Locally thick sandstone beds between the coal beds are water-yielding, but the sandstones occur as discontinuous lenses that appear to be isolated bodies with very limited hydraulic connection.

The interburden between the coal seams generally has a hydraulic conductivity that is several orders of magnitude lower than that in the coal beds. As a result, there is only a limited hydraulic connection between adjacent coal seams. The Tongue River Member can be conveniently divided into four main hydrogeologic units: Smith-Roland, Anderson-Dietz, Canyon-Wall, and Lower Tongue River Member.

The most significant of these geohydrologic units, the Anderson and Dietz coal seams and associated clinkers, form a continuous unit that extends from the Wolf Mountains on the west to the Tongue River on the east (see Figure 4.1.3-8 of Section 4.1.3, Volume IV, Part A). The combined Anderson and Dietz coal seams have a thickness of 60 to 100 feet. In the Wolf Mountains, the Anderson and Dietz coal seams are merged, but to the east the Anderson splits from the Dietz. Along Youngs Creek near the Crow Reservation border, the Anderson seam averages 20 feet in thickness, the Dietz seam averages 53 feet in thickness, and about 200 feet of interburden separates the seams. About 3 miles east of the Crow Reservation border, the seams merge to form a combined seam about 80 feet thick. Farther to the east, near the Tongue River, a thin seam called the Dietz No. 2 splits off from the combined Anderson-Dietz seam.

The western and southern extent of the Anderson-Dietz unit is defined by thick clinker beds that formed when the coal seams burned (see Figure 4.1.3-9 of Section 4.1.3, Volume IV, Part A). Some of the clinker beds are adjacent to the Anderson and Dietz coal seams, but many of the clinker beds found in the drainage basin of Little Youngs and Youngs creeks have been isolated by erosion.

Hence, it may be concluded that in the Site 23 area both the major groundwater aquifers—the alluvial deposits of the Squirrel, Youngs, Tanner, and Little Youngs Creek valleys, and Anderson and Dietz coal seams of the Tongue River Member and associated clinkers—form a more-or-less continuous groundwater unit from the Wolf Mountains on the west to the Tongue River on the east. The movement of both the surface water and groundwater is toward the Tongue River and external to the Crow Reservation. The potentiometric surface of the groundwater is also near ground surface levels.

2.1.3.3 Water Quality

Water in the Bighorn River from St. Xavier to Bighorn is a calcium sulfate type. The water quality in the Bighorn River at St. Xavier is known to be better than the primary drinking water standards. However, EPA primary standards of 0.002 mg/l and 0.01 mg/l for mercury and selenium, respectively, have been exceeded at Hardin (see Table 4.1.3-8 of Section 4.1.3, Volume IV, Part A).

Several constituents have also exceeded the secondary drinking water standards at both St. Xavier and Hardin on the Bighorn River. For example, sulfate concentrations are seldom less than 250 mg/l and concentrations in excess of 400 mg/l are common.

Total dissolved solids (TDS) concentrations average in excess of 650 ppm, which is above the recommended 500 ppm value. The concentration of dissolved manganese also has exceeded the recommended standard of 0.05 ppm. Turbidity values in excess of 5 units have also been recorded. Nevertheless, it may be concluded that water in the Bighorn River on the reservation can, with proper treatment, be made acceptable for all uses, including drinking water supply, irrigation, livestock watering, industrial use, and wildlife resources.

The Tongue River is the major stream draining the Shell mining lease area and the candidate minemouth siting area designated as Site 23, since Squirrel, Youngs, Tanner, and Little Youngs creeks are all tributaries of the Tongue River as previously discussed. Surface water quality in the Tongue River Basin above the proposed project site is primarily affected by high-quality snowmelt from the Bighorn Mountains, by irrigation in Wyoming, and by surface water and groundwater inflow. Water quality in the Tongue River above the Tongue River Reservoir is generally good (see Table 4.1.3-9 of Section 4.1.3, Volume IV, Part A).

TDS concentrations, especially the concentrations of calcium, magnesium, sodium, bicarbonate, and sulfate, tend to increase in the downstream direction. The lowest concentrations of TDS, and of all major constituents, can be expected during the

high-runoff months of May, June, and July.

A comparison of these chemical analyses and other trace element analyses for the Tongue River above and below the project area indicate that applicable Wyoming and Montana water quality standards for the Tongue River in this area would be met. EPA Primary Drinking Water Standards are also met. EPA Secondary Drinking Water Standards for iron (0.3 mg/l), sulfate (250 mg/l), and iron and manganese (0.05 mg/l) are occasionally exceeded at the monitoring station near Decker. These waters are acceptable for most uses, including domestic supply and irrigation. The high hardness and bicarbonate values might require certain industrial users to provide treatment.

Generally speaking, the groundwaters available within the reservation are poorer quality than the surface waters. The geologic profile of the reservation shows a considerable number of shale formations which are highly mineralized. Groundwaters taken from the streambed alluvium (which represent most of the groundwater development) are reflective of the water quality in the stream but usually contain somewhat hgher concentrations of dissolved minerals.

2.1.4 Physiography and Land Use

Site 1 is located in the northwestern portion of Big Horn County, Montana, in the unglaciated part of the Missouri Plateau Section of the Great Plains physiographic province. The immediate area is characterized by hilly, gravel terraces, fans, and benches. The candidate site encompasses approximately 960 acres primarily used for agricultural activities at the present time. Elevations within the siting area range from approximately 3,200 to 3,400 feet mean sea level (MSL).

Site 23 is located in an area of narrow stream valleys bordered by narrow, flat-topped plateaus on the eastern slope of the Wolf Mountains in the southeastern corner of the Crow Reservation. Elevations within the siting area range from approximately 4,100 to 4,300 feet MSL. Plant site boundaries tentatively encompass

approximately 750 acres which are currently used as a grazing range for wildlife and domestic livestock.

2.1.5 Soils and Vegetation

Although the majority of Big Horn County is rangeland, the proposed Site 1 area is used primarily for raising wheat. Therefore, native vegetation is almost nonexistent within the boundaries of candidate Site 1. However, the known soil types can be used to identify range sites. This is possible because of the observed close relationship between plants, climate, and soils. The predominate soils at Site 1 occupy the Clayey range site, receiving 10 to 14 in. of precipitation annually. The soils are moderately deep to deep, granular clay loam, silty clay loam, silty clay, sand clay, and clay. Western wheatgrass, forbs, and green needlegrass are the predominant species. Other range sites encountered at candidate plant site 1 are Shallow Clay, Dense Clay, and Pan Spots. Seven different soil series and 13 mapping units were found on candidate Site 1 (see Table 4.1.5-1 and Figure 4.1.5-2 of Section 4.1.5 and Appendix A-4 of Volume IV, Part A).

About 62 percent of candidate Site 23 is categorized as Clayey range site. Therefore, Site 23 is quite similar to Site 1 and contains 5 soil series and 7 mapping units (see Table 4.1.5-2 and Appendix A-4 of Volume IV, Part A).

Based on existing survey information, a very preliminary evaluation of possible vegetative types existing along the approximately 60-mile water pipeline traverse from the Bighorn River to Site 23 was conducted (see Section 4.1.5.2 of Volume IV, Part A). The route is situated in the transition zone between mixed prairie grassland and eastern Montana ponderosa pine forest; therefore, it consists of a complex mixture of plant communities. Riparian vegetative types indicative of drainages traverse the area frequently. The clayey areas are dominated by big sagebrush and the sandy areas by silver sage. The higher elevations with more precipitation consist of ponderosa pine and other trees (see Section 4.1.5.2 of Volume IV, Part A for a discussion of vegetation types or communities).

It is recommended that a range vegetation inventory be conducted for the eventual site and all utility corridors if the Crow synfuels project proceeds to the next phase of development. The study should be conducted as part of the overall preoperational environmental program and should include mapping of vegetation types, identification and listing of species, and measurement of density composition, cover, and production.

2.1.6 Wildlife Resources

2.1.6.1 Site 1 (Including Ancillaries and Rights-of-Way)

Information on the wildlife resources within the proposed areas of impact (see Figure 4.1.6-1 of Section 4.1.6, Volume IV, Part A) is limited to winter aerial surveys conducted by the U.S. Fish and Wildlife Service since 1979. Although various off-reservation studies of wildlife have been conducted, primarily on Westmoreland's lands (Tracts I, II, and III), no site-specific studies for the proposed area of impact have been undertaken. Therefore, information presented can, at best, be considered preliminary pending future site-specific studies within the proposed area of impact for Site 1.

Possible large mammals could consist of the pronghorn antelope and white-tailed deer. Possible carnivores within the proposed Site 1 area of impact include the bobcat, coyote, red fox, badger, and striped skunk. Species of small mammals representative of the proposed project area include the white-tailed jackrabbit, desert cottontail, prairie dog, pocket gopher, and the more common ground squirrels, chipmunks, mice, and rats.

Principal categories of birds occurring within the proposed area of impact are composed of upland game birds (sharp-tailed grouse, sage grouse, ring-necked pheasants), waterfowl and shorebirds, raptors, and passerine birds.

Possible threatened and endangered species in the Site 1 impact area could include the bald eagle, peregrine falcon, and black-footed ferret.

The major fisheries within the proposed project area are located along the Bighorn River and include brown and rainbow trout, walleye, and northern pike.

2.1.6.2 Site 23 (Including Ancillaries and Rights-of-Way)

The wildlife resources located within and immediately adjacent to the proposed area of impact (see Figure 4.1.6-1 of Section 4.1.6, Volume IV, Part A) vary significantly from those associated with Site 1 due, in part, to the diversity of habitat afforded by variations in topography and vegetation types characteristic of this area.

Although no site- and corridor-specific wildlife studies have been conducted, information collected since 1979 by VTN and others in conjunction with the proposed Crow/Shell coal lease provides baseline information for the general area encompassing the proposed plant site. Likewise, additional data collected by the U.S. Fish and Wildlife Service since 1979 provide further information that serves as a basis for a general discussion of wildlife resources within the proposed impact area. Site-specific studies of the Site 23 area of impact would also be required, if that site becomes the final site selection in the event the Crow synfuels project proceeds to the next phase, to further document the extent of wildlife occurrence and habitat use.

Major species of large mammals occurring within the general area indicate the presence of pronghorn antelope, mule deer, white-tailed deer, and an occasional elk.

Major species of carnivores occurring within the proposed project area include the coyote, lynx, bobcat, red fox, badger, longtail weasel, and the striped skunk.

Commonly occurring species within the Site 23 area are composed of the porcupine, red squirrel, white-tailed jackrabbit, desert cottontail, mountain cottontail, and numerous smaller rodents, including ground squirrels and mice.

Major categories of birds occurring within the Site 23 area include those listed for the Site 1 area; i.e., upland game birds, waterfowl and shorebirds, raptors, and passerine birds (see species list in Appendix A-2, Volume IV, Part A).

Amphibians occurring within the general area probably will be restricted to ponds, watercourses, and other water-associated areas. The following species have been documented as occurring within the general area of the proposed plant site: the painted turtle, tiger salamander, leopard frog, chorus frog, and the Plain's spadefoot toad.

Reptiles common within the general area of the proposed plant site include the bullsnake, prairie rattlesnake, yellow-bellied racer, and three species of garter snakes. Common lizards include the northern sagebrush lizard and eastern short-horned lizard.

Two species, the bald eagle and the peregrine falcon, listed as endangered under the provisions of the Endangered Species Act of 1973, have been documented as occurring within the Site 23 area of impact. The black-footed ferret occurs historically in association with black-tailed prairie dogs but its present status within this area remains unknown.

Principal fisheries within the general area of the plant site consist of the Youngs Creek and Squirrel Creek drainages. Species include brook trout, white sucker, mountain sucker, and lake chub.

2.1.7 Seismology

On the basis of a literature search conducted for this study, it may be concluded that the seismology of the Crow Reservation has never been comprehensively investigated. This is primarily due to the fact that no major seismic activity has been recorded on tribal lands as evidenced by the seismic risk map of the western United States (see Figure 4.1.7-1 of Section 4.1.7, Volume IV, Part A) which indicates

the area encompassing the Crow Reservation as a Zone 1 (minimum risk, expected minor damage) earthquake risk area.

The nearest recorded earthquake (since 1904) to Site 1 occurred approximately 20 miles east of the proposed site and had a measured magnitude (Richter scale) of less than 3.99. Similarly, several minor earthquakes with a Richter magnitude of less than 3.99 have been recorded within 10 to 20 miles of Site 23 (see Figure 4.1.7-2 of Section 4.1.", Volume IV, Part A).

As previously mentioned, the Site 1 location is bisected by a northeasterly-southwesterly trending fault approximately 5 miles in length. The geologic structure in this area is composed of Niobrara and Carlile members of the Cody Shale Formation of the Late Cretaceous Period (65 to 100 million years ago) and the structural displacement is inferred to be less than 100 feet. The fault cannot be classified as capable, although it is recommended that additional test drill data be developed to substantiate this premise if Site 1 becomes the eventual selected site for the Crow coal gasification facility.

No major faults are known to occur in the Site 23 area, although a major northeast trending fault is inferred to cross the extreme southeastern corner of the siting area.

2.1.[8] Cultural Resources

The cultural resources of the Crow Reservation, although not totally documented, are reported to be quite extensive in certain areas. Hence, a more detailed site- and corridor-specific investigation and analyses will be required to more completely document the extent of the cultural resources within the proposed areas of impact. Basic information on the known archaeological and historic sites has been provided by the Montana State Historic Preservation Office and the Bureau of Indian Affairs (BIA).

The National Register lists 46 sites consisting largely of occupational and buffalo jump sites. Other sites include rock cairns, tipi rings, fortifications, lithic scatters, surface stone quarries, workshops, and transient campsites. Five of the 45 documented sites of historic, archaeological, and cultural significance are located within the immediate vicinity of Site 23. The remaining 41 sites are scattered within or adjacent to the proposed utility corridors. The potential for the occurrence of additional archaeological sites within or adjacent to Site 1 and throughout the unsurveyed portions of the proposed corridors is significant when considering past and recent discoveries within the general region.

Additionally, the Crow Tribe will continue to identify and preserve areas sacred to its tradition and culture. Two tribal land areas in the Bighorn and Pryor Mountains already have been designated in the Crow Land Use Zoning Ordinance in 1981. Therefore, consultation with Crow tribal members will be required to fully and adequately document the presence and extent of sites significant to the culture and tradition of the Crow people.

2.2 JURISDICTIONAL ISSUES

The question of jurisdiction over energy development on Indian reservations is concerned with whether, and under what circumstances, various governmental entities (tribal, federal, state, and county) have the legal authority to impose regulation. Therefore, a number of jurisdictional issues that may arise in the construction and operation of a coal gasification facility on the Crow Reservation have been identified.

This identification of issues and general principles is intended to promote planning of the facility in a manner that avoids jurisdictional conflicts, since there are ways in which the construction and operation of the facility can be structured to minimize jurisdictional overlap. Such informed structuring should ultimately simplify the environmental review process by allowing clearer identification of those permits that are in fact necessary.

There appears to be no question that, in the vast majority of situations, federal environmental statutes can and will be applied to activities on Indian reservations. Several federal environmental statutes, such as the Federal Water Pollution Control Act, the Solid Waste Disposal Act, and the Surface Mining Control and Reclamation Act, are by their terms applicable to Indians or Indian lands. Others, such as the National Environmental Policy Act, make no specific mention of Indians or Indian lands.

Perhaps the most that can be said about the current law of state jurisdiction over reservation activities is that the question of state authority is subject to a sliding-scale analysis; i.e., the more exclusively "Indian" the activities sought to be regulated are, the less likely it is that a state may assert jurisdiction. Activities conducted exclusively by Indians on reservation lands enjoy the strongest protection from the exercise of state regulatory authority.

Two relatively clear principles emerge from the study analysis of jurisdictional issues. First, the federal government has pervasive authority to enforce federal statutes on reservations. Second, inherent tribal sovereignty should permit the application of tribal environmental statutes to Indians and non-Indians engaging in development activities anywhere on a reservation.

The applicability of state and county environmental regulations to activities on Indian reservations depends on a case-by-case analysis of facts, including the involvement of non-Indians in the activity, the location of the activity, the relationship between attempted state or county regulation and federal regulatory schemes, and the effect of the attempted regulation on the tribe's right of self-government. Because such facts about the synfuels facility to be constructed on the Crow Reservation are not currently available, little basis for choosing which state or county regulations might apply and, because informed planning with active assistance of legal counsel might avoid jurisdictional conflicts, state and county regulations are not included in this feasibility study.

2.3 ENVIRONMENTAL PERMITTING

Proper planning of the environmental permitting will be required to avoid confusion, delay, duplication of effort, and inefficiencies. In recent years, however, agencies at all levels of government have taken steps to improve coordination and facilitate permitting. Coordination of permit requirements and full participation by the Crow Tribe and federal, state, and local agencies offer the greatest opportunity for improving and expediting the permit process.

The potential for environmental degradation through development of large-scale projects has resulted in the passage of a number of laws and regulations by tribal, federal, state, and local governments. Most of these regulations were developed independently, leading to conflicts, duplication, and overlap. Two or more levels of government may regulate the same aspects of the Crow synfuels project using different standards, procedures, timing, and information requirements.

Therefore, an appropriate timing sequence in relation to other development activity has been synthesized to establish an overall framework for scheduling major program elements associated with the environmental permitting process; i.e., prefeasibility study, feasibility analysis, decision to proceed with the project, environmental monitoring, NEPA process (preparation of EIS), environmental permitting process, and facility construction (see Figure 4.3-1 of Section 4.3, Volume IV, Part A).

Several major federal environmental permits and approvals will likely be required prior to construction or operation of the proposed Crow synfuels project. Based upon legal research and extensive discussion with government agency staff, six major permits will probably be required for the synfuels project: (1) PSD Permit; (2) 404 Dredge and Fill Permit; (3) NPDES Permit; (4) Hazardous Waste Management Permit; (5) Underground Injection Control Permit; and (6) Coal Mining and Reclamation Permits. A detailed discussion of each permit; its applicability, the standards and conditions that apply; requirements for application; pertinent procedures; required lead time for approval; and statutory and regulatory authority are presented in

Section 4.3.1, Volume IV, Part A.

Other potential nonpermit federal requirements that are related to environmental control are discussed in Section 4.3.1-7, Volume IV, Part A. A partial listing of other federal laws that may impact permitting of energy facilities on Indian lands which are not directly related to environmental protection but may require some environmental analysis and ultimately result in environmental conditions being made a part of any final approval or authorization are also listed in Section 4.3.1.7 of Volume IV, Part A. The National Enviromental Policy Act (NEPA), enacted in 1969, has been the most significant piece of legislation dealing with environmental matters. The most important feature of NEPA is that it requires all agencies of the federal government to prepare detailed Environmental Impact Statements (EIS) on major federal actions, programs, leases, projects, permits, etc., that significantly affect the quality of the human environment.

In most cases major energy projects on Indian lands will require an EIS. The federal agency that is designated as the lead agency responsible for the major action associated with the project is responsible for preparing the EIS consistent with its own regulations and those promulgated by the President's Council on Environmental Quality (CEQ). For Indian lands, this agency is usually the Bureau of Indian Affairs. With respect to major environmental permit programs, the NPDES Permit, the 404 Dredge and Fill Permit, and the Coal Mining and Reclamation Permits are subject to both NEPA and the EIS requirements. The PSD Permit and the Hazardous Waste Management Permits are exempt from NEPA and the EIS requirements. The NPDES Permit is subject to NEPA and the EIS requirements if the permit is to be issued by EPA.

Fulfilling the federal NEPA requirements and preparation of an EIS can be a very time-consuming effort. Consistent with guidelines prepared by the CEQ, the requirements have been designed to assure full opportunity for review and participation by all interested parties. This open process exposes a project to a full range of public and political scrutiny as well as potential judicial attack. At a minimum, the time currently required to prepare an EIS is 18 months. However,

large controversial projects could take significantly longer periods of time.

Tribal requirements are somewhat difficult to evaluate at present. The Crow Tribe has adopted an Environmental Health and Sanitation Ordinance which covers water supply, air quality, solid waste, and other health-related matters. However, this ordinance applies primarily to small-scale residential or community development. It is not yet designed to regulate environmental effects of large-scale industrial facilities. Additionally, some of the standards in the ordinance are inconsistent with current federal requirements.

The Crow Tribe has also adopted a Reclamation Code to govern surface mining of coal. Although the Crow Office of Reclamation is currently developing regulations and technical capabilities for administration, the code is not yet in force.

Large volumes of solid waste may result from the coal gasification facility. Principally, these wastes will be ash discharged from the gasifiers and bottom ash, fly ash, and flue gas emission waste from the steam generators. It is anticipated that these wastes will be nonhazardous, thus not requiring a permit under Subtitle C of the Resource Conservation and Recovery Act. Even if certain ashes are considered hazardous under EPA regulations, only those ashes from the gasifiers would require a permit. The 1980 Amendments to RCRA defer fly ash, bottom ash, slag, and flue gas emissions control waste from fossil fuel steam generators from the Subtitle C program pending completion of an EPA study. Future regulation is a possibility.

Regulation of nonhazardous solid waste under Subtitle D is left totally with the states and presumably to tribal governments. Sections I, II, and IV of the Environmental Health and Sanitation Ordinance for the Crow Reservation relate to the permitting and licensing of business establishments and waste disposal facilities and may provide some authority and regulatory framework covering solid waste disposal from the synfuel facility. Clearly, however, this ordinance was not designed to address the type of solid waste problem associated with a coal gasification process.

In the absence of clear regulatory authority over nonhazardous solid waste disposal, the mitigation of possible environmental impacts can best be addressed through a complete analysis as a part of the Environmental Impact Statement process under NEPA.

As previously discussed, the applicability of state environmental regulations to activities on Indian reservations depends on a site-specific and development-specific analysis of facts. The analysis should explore the involvement of non-Indians in the development, the location of the development, the relationship between the attempted state regulation and federal regulatory schemes, and the effect of the attempted regulation on the tribe's right of self-government. It is impossible at this stage of the project to predict with any accuracy which state regulations might apply. It must be emphasized, however, that the coal gasification project is a major project that can create significant environmental as well as social and economic impacts and will generate considerable interest and perhaps direct involvement of state and local governments. Therefore, it is strongly recommended that the appropriate state and local officials be involved in the environmental permitting process to ensure that possible off-reservation impacts are addressed.

2.4 REGULATORY DECISION SCHEDULE

A regulatory decision schedule requires the construction and combination of numerous elements. The procedures and deadlines set forth in statutes and regulations comprise the foundation. They are different for each permit, and in most cases, except for the PSD permit which has a statutory deadline of one year following the filing of a complete application, there is no limit on the timing for issuance. However, both the CEQ regulations governing the NEPA process and EPA permit regulations which include NPDES and hazardous waste permits, provide for the establishment of project decision schedules to encourage timely decision making. Additionally, agency policy and actual practice further delimit procedures and timing.

The regulatory decision schedule prepared for this study (see Figure 4.4-1 of Section 4.4, Volume IV, Part A) illustrates the close linkage of timing for the EIS and various permits. Because the EIS evaluates alternatives and may be a prerequisite to several federal decisions on the synfuels project, it should be prepared as early as possible. An early start is also recommended since the EIS process is a lengthy one. Submission of applications for all required permits occurs, in the decision schedule, eight months after the EIS process begins.

The EIS process normally should be started well before permit applications are submitted. This allows preliminary evaluation of impacts and alternatives prior to commitment to specific permit options. Furthermore, under the decision schedule, the applicant submits permits prior to agency review of the preliminary draft EIS, allowing agencies to evaluate the permit application and the EIS together. The schedule assumes that no formal public hearings on permit decision will be held untilthe final EIS has been prepared; the final EIS therefore serves as an important tool in the decision-making process.

Preparation of a single EIS for the synfuels project, as shown in the decision schedule, is a prime area for consideration and increased efficiency in the review

process. If a single EIS is used, the BIA would probably assume primary responsibility for preparation. Other federal agencies would work with BIA on a cooperative basis, rather than preparing their own EIS.

2.5 RESIDUAL QUANTIFICATION

The major environmental residuals for two selected sets of Crow synfuels plant design scenarios based upon an SNG production rate of 250 MM SCF/D and utilizing both Westmoreland and Shell coal feeds are evaluated (see Section 4.5 of Volume IV, Part A).

Since a zero discharge concept was applied to all wastewater residuals associated with the operation of the proposed synfuels facility, major emphasis was placed on the quantification of plant gaseous and particulate emissions to the ambient atmosphere and the solids and/or solid-liquid mixtures resulting principally from the FGD system within the plant boiler operation and the ash residual from both the boiler operation and the Lurgi gasification plant.

The major annual gaseous emissions were developed by Fluor based on Westmoreland and Shell coal analyses as determined by Lurgi for the process design gasification balance. The results (see Table 4.5.1-1 of Section 4.5.1, Volume IV, Part A) indicate that the Case I design scenario, reflecting a 250 MM SCF/D SNG plant producing power for internal needs only, employing a Westmoreland coal feed emits over 26 million tons/yr of gaseous effluents to the ambient atmosphere with CO_2 representing approximately 40 percent (about 10.5 million tons/yr) of the total annual emission, and with O_2, N_2, and H_2O comprising the bulk of the residuals; i.e., about 16 million tons/yr. The Case II design scenarios, which reflect a 250 MM SCF/D SNG plant that generates electrical power in excess of internal requirements for export sales by assuming 40 percent weight percent coal fines from both coal suppliers are fed to the boiler, emits over twice the quantity of total gaseous effluent to the atmosphere (about 57 to 58 million tons/yr) and approximately 60 percent more CO_2 (about 16 to 16.5 million tons/yr) emissions on an annual basis.

Preliminary annual estimates for 26 trace elements released as particulate matter to the ambient atmosphere were developed by CERT for the aforementioned Case I and Case II design scenarios utilizing both Westmoreland and Shell coal feeds and

representative trace element chemical analyses of both coals (see Table 4.5.1-2 of Section 4.5.1, Volume IV, Part A). Six of the trace elements—barium, manganese, strontium, vanadium, zinc, and zirconium—resulted in annual particulate emission rates greater than 1,000 lb/yr, with barium, strontium, and zirconium all exceeding 20,000 lb/yr for the Case II design scenario employing Westmoreland coal.

Preliminary annual estimates of the major solid residuals, consisting primarily of the ash from the Lurgi coal gasification units, bottom ash from the boilers, and sludge from the FGD unit were derived for the same Case I and Case II design scenarios. The Case II design employing Shell coal resulted in the lowest annual solid waste inventory of approximately 572,000 tons, with the Westmoreland Case II design scenario representing the largest annual inventory of slightly over one million tons, due principally to the higher sulfur and ash content of the Westmoreland coal (see Table 4.5.2-3 of Section 4.5.2, Volume IV, Part A).

2.6 ENVIRONMENTAL IMPACTS ASSESSMENT

2.6.1 Air Quality Impacts Assessment

Since compliance with the very stringent Class I air quality PSD increments on the adjacent Northern Cheyenne Reservation presents a potentially serious environmental constraint to the siting of a coal gasification facility on the Crow Reservation, the preliminary screening of possible candidate plant sites by air quality dispersion modeling analysis became the early major driver for the entire feasibility study. The air quality dispersion modeling analysis of eight possible candidate sites entailed utilization of the VALLEY model in the rural, short-term, complex terrain mode, since the program can be invoked as an early predictive screening technique without the input data requirement for currently unavailable, site-specific climatological/meteorological data in areas with irregular terrain features, i.e., siting opportunities on the Crow Reservation and potentially sensitive pollutant plant receptor locations on the nearby Northern Cheyenne Reservation. (See Section 4.6.1.1 of Volume V, Part A). The preliminary screening analysis narrowed the number of sites to be considered for more detailed tradeoff analysis in the overall siting evaluation study (Volume IV) to four candidate sites based upon current (1985 to 1990) BACT limitations for plant SO_2 emission control efficiencies of less than or equal to 90 percent vent gas incinerator SO_2 emission control efficiencies of less than or equal to 96 percent, and ESP particulate matter removal efficiencies of 99.7 percent. Two of the candidates, Sites 1 and 1A, are located in the west central area of the Crow Reservation. The other two candidate sites, 20 and 23, are located in the southeastern section of the reservation. Additional siting tradeoff studies as discussed in Volume IV further reduced the siting candidates to Site 1 and Site 23.

Since the basic process design developed by Fluor during the course of this study, as discussed in greater detail in Volume II, is predicated upon an SNG production rate of 125 MM SCF/D, the synfuels plant design scenarios were upgraded to reflect an ultimate plant production rate of 250 MM SCF/D in order to verify previous compliance of the two primary candidate sites with air quality Class I PSD

increments on the nearby Northern Cheyenne Reservation, derived from the prior, early preliminary air quality screening analysis also based upon a plant production rate of 250 MM SCF/D of SNG but utilizing preliminary plant process design estimates for both Westmoreland and Shell coal feeds.

In addition to confirming compliance with SO_2 and particulate matter Class I PSD increments for candidate Sites 1 and 23, the second phase of the air dispersion modeling analysis investigated the implications of the GEP stack height regulations recently promulgated by EPA in terms of the sensitivity of SO_2 emission control efficiencies to plant physical stack height. Emphasis was placed upon SO_2 emission control efficiencies for the boiler plant for several reasons. The plant design synthesis indicated achievable SO_2 emission control efficiencies of greater than 98 percent for the Lurgi gasification plant, while state-of-the-art BACT technology for FGD systems for coal-fired boiler plants is presently vendor-guaranteed for less than or equal to 90 percent SO_2 emission control efficiencies. Additionally, the imposition of 99.4 to 99.7 percent removal efficiency for ESP in the design scenarios to control particulate emissions within the EPA regulatory requirements for NSPS of 0.03 lb/MM Btu of heat released drastically reduces the particulate emissions. Reduced emission loadings, coupled with the higher allowable 24-hour PSD increment of 10 ug/m^3 for particulated matter as compared to its SO_2 counterpart of 5 ug/m^3, has precluded any serious air quality impacts due to plant particulate emissions at either Site 1 or Site 23 for the two design case scenarios evaluated in this study, in terms of compliance with Class I PSD requirements on the Northern Cheyenne Reservation.

As previously discussed, the Case I plant design scenario assumes a production rate of 250 MM SCF/D SNG and generation of sufficient power for internal requirements only and the Case II plant design scenario produces 250 MM SCF/D of SNG utilizing the excess fines (40 percent) in the coal feed to produce additional marketable electrical power. Therefore, more stringent SO_2 emission control is necessary to preclude violations of the Class I air quality regulations for the Case II design scenario.

The sensitivity analysis performed for both Case I and Case II design scenarios at Site 1 demonstrates that any physical stack height greater than or equal to 620 feet would meet the 24-hour SO_2 Class I PSD requirement for Case II, assuming baseline emission control efficiencies of 90 percent and 98.7 percent for boiler and vent gas incinerator emissions, respectively, and utilizing a Westmoreland coal supply. The Case I design scenario for a Westmoreland coal feed is relatively insensitive to change in physical stack height over the range of 350 to 650 feet and would achieve Class I PSD compliance for SO_2 emissions with the assumed baseline control efficiencies (90 percent) for the boiler plant over that range of values. Although it is not anticipated, the use of the Shell coal supply at Site 1 for the Case II design scenario employing baseline SO_2 emission control efficiencies of 84 percent and 98.7 percent for boiler and vent gas incinerator emissions, respectively, result in a somewhat lower physical stack height than for the Case II design for a Westmoreland coal feed. The Shell Case II design scenario requires a physical stack height greater than or equal to 485 feet in order to comply with the 24-hour SO_2 Class I PSD increment at Site 1.

A review of possible vendors for FGD systems has indicated that one potential supplier has quoted an achievable upper limit (BACT) of 93.4 percent SO_2 emission control efficiency in the assumed 1985 to 1990 time frame for the final design and construction phase of this project. Upward adjustment of 90 percent SO_2 emission control efficiency to 93.4 percent for boiler emissions would effect a reduction of 100 feet in the minimum physical stack height requirement; i.e., from 620 feet to 520 feet for plant designs utilizing Westmoreland coal supplies at candidate Site 1. The above result and all subsequent results assume that the baseline SO_2 emission control efficiency for the vent gas incinerator retains a baseline value of 98.6 percent. From previously discussed results it has been shown that the Case II design scenario utilizing the Westmoreland coal supply establishes a possibly future attainable limit for SO_2 Class I PSD compliance at Site 1 of 93.4 percent SO_2 emission control efficiency for the boiler emissions and a physical stack height of 520 feet. Therefore, assuming the slightly more conservative value of 525 feet for the plant physical stack height it logically follows that greater than or equal to 93.4 percent SO_2 emission control efficiency would be required to comply with the 24-

hour SO_2 Class I PSD increment. For the same set of initial assumptions, it is shown that greater than or equal to 84.5 percent SO_2 emission control efficiencies would be required for Class I PSD for the Case I design scenario at Site 1 utilizing Westmoreland coal. Similarly, the use of Shell coal for the Case II design scenario would, in turn, necessitate greater than or equal to 82 percent SO_2 emission control efficiency at Site 1 to achieve the Class I PSD compliance.

The assumption of de minimus GEP stack height regulation crediting a 213-foot (65 m) allowance for modeling purposed does not affect any serious design constraints at Site 23 for the Case II design scenario employing the Shell coal supply. Thus, an actual physical stack height of 213 feet could be utilized for this scenario at Site 23 provided greater than or equal to 76.3 percent boiler SO_2 emission control efficiency and a 98.6 percent vent gas incinerator SO_2 emission control efficiency are maintained. Since the BACT for boiler SO_2 emission control efficiency for the Case II design utilizing the Shell coal supply is 84 percent, it can be concluded that SO_2 Class I PSD compliance at Site 23 does not present a major potential environmental air quality impact or regulatory constraint for currently envisioned plant design scenarios (see Section 4.6.1.1.2 of Volume IV, Part A).

Since Billings, Montana, is currently a nonattainment area for particulates and a Class II designated air quality area for SO_2, these potential air quality impacts were evaluated for both Case I and Case II design scenarios at Site 1 for both Westmoreland and Shell coal supplies. The results of air quality dispersion analysis indicate compliance with the 24-hour SO_2 Class II air quality PSD increment at Billings for all the presently contemplated design scenarios and coal supplies.

Assuming the aforementioned design scenarios and coal supplies, the modeling analysis also indicates that the nonattainment status for particulate emissions at Billings would not be violated by operation of the proposed Crow synfuels facility at Site 1.

As previously discussed, a similar dispersion modeling analysis of the potential impact of particulate matter emissions from the worst-case Case II design scenario

utilizing the Shell coal feed at Site 23 indicates compliance with the Class I PSD increment on the Northern Cheyenne Reservation, principally due to the stringent BACT invoked by the ESP with a 99.4 percent particulate matter removal efficiency. It is concluded that the major potential air quality impacts and, hence, possible Class I PSD noncompliance for particulates with respect to the Northern Cheyenne Reservation, could arise from fugitive dust emissions from the proposed Shell mining operation since Site 23 represents a potential minemouth siting opportunity. Therefore, strict procedural control by properly implemented water spraying of the affected mining areas and adjacent access roads to reduce potential dusting from vehicular traffic and heavy mining equipment would be the primary mitigation measure. However, it must be recognized that Class I regulatory compliance in this instance would be the responsibility of Shell as the mine operator.

Thus, it can be concluded that the exceptional SO_2 emission control efficiencies (greater than or equal to 98.6 percent) believed to be attainable from the Claus, SCOT, and Stretford gas purification units within the Lurgi gasification process design (see Section 4.6.1.2 of Volume IV, Part A) are a major reason that the design scenarios, particularly Case II with a Westmoreland feed at Site 1, are able to comply with Class I PSD requirements on the Northern Cheyenne Reservation.

Additionally, the inclusion of special burners within the vent gas incinerators to limit NO_x and hydrocarbon gaseous emissions from the gasification plant reduce the potential air quality adverse impacts from those potential pollutants. NO_x reduction is particularly significant, since NO_x and particulate mattter are known to be the major contributors to visibility degradation from coal combustion processes (see Tables 4.6.1-8 and 4.6.1-9, Section 4.6.1, Volume IV, Part A).

2.6.2 Water Resources Impact Assessment

2.6.2.1 Water Quantity Impacts Assessment

As previously discussed, the presently contemplated withdrawal of 14,000 gpm (20,500 ac-ft/yr) from the Bighorn River to accommodate the water requirements for

the upgraded 250 MM SCF/D SNG coal gasification facility constitutes the only potential water quantity impact to the Crow Reservation resulting from the proposed project. Since a water withdrawal rate of 20,500 ac-ft/yr constitutes only about 1 percent of the average flow rate in the reach of potential water withdrawal for the Crow synfuels project utilization, the potential environmental water quantity impact is considered minimal (see Figure 4.1.3-2 of Section 4.1.3, Volume IV, Part A).

2.6.2.2 Water Quality Impacts Assessment

Potential adverse water quality impacts to the Crow Reservation and the surrounding environs from the operation of the proposed Crow synfuels plant are closely interrelated to the properly implemented mitigation of the liquids and solids process waste residue, since the engineering design of the facility is predicated upon zero liquid discharge; i.e., having no direct discharge of liquid waste effluents to surface waters or groundwaters within the areas of the two selected candidate sites, Site 1 and Site 23. Hence, the major mitigation measures to preclude potential water quality impacts evolve quite naturally around the basic design of the synfuels plant process water management system irrespective of the siting area (see Figure 4.6.2-1 of Section 4.6.2.2, Volume IV, Part A).

The capability of water soluble ions or compounds to migrate or to be transported externally from the immediate area of either plant site is dependent on (1) their increased mobility in liquid (aqueous) state, and (2) a continuous transport linkage, the liquid pathway in this instance, to an area of potential environmental impact.

Therefore, the ancillary containment features incorporated into the design of the external liquid-solid, and solid process waste effluents systems constitute the primary mitigation measure necessary to prevent liquid contaminant migration into either surface waters or groundwaters. Thus, the design philosophy of mitigation by containment either eliminates or minimizes the second of the two conditions necessary to produce the contaminant transfer mechanism.

All potentially hazardous process liquid waste effluents for the Crow synfuels plant are stored in a series of ponds located within the completely fenced plant siting area thereby precluding entry by ambulatory wildlife (Section 4.6.2.2 of Volume IV, Part A). The largest of the ponds and recipient of the majority of potentially hazardous process liquid wastes, the solar evaporation pond, effectively incorporates a multilayer containment barrier comprised of two relatively impervious lining materials, HDPE and clay.

The other smaller repositories of possibly hazardous liquid waste effluents, e.g., the wastewater equalization pond, the treated effluent pond, the diversion box and pond, and the oily stormwater pond, also incorporate the foregoing lining system design (see Figures 4.6.2-2 through 4.6.2-8 of Section 4.6.2.2, Volume IV, Part A).

Additional mitigation measures incorporated in the pond design included design provisions for adequate freeboard and pond embankment side slope to preclude potential surface runoff of the stored, liquid waste effluents as a consequence of inadvertent natural occurrences such as tornadoes, heavy storms, or floods. Provisions for leakage detection are also included in pond design for all the aforementioned possibly hazardous liquid waste storage repositories should the integrity of the lining system be circumvented for any reason. The leakage detection system for the ponds is designed to allow plant operators a means of detecting any failures in the foregoing pond lining system and adequate time to employ corrective measures prior to the development of a potentially adverse environmental water quality impact.

Although it was not considered within the scope of work for this feasibility study, the volume of liquid wastes may be reduced and, consequently, the liquid surface areas of the waste ponds. It is recommended that this factor be more thoroughly evaluated prior to the completion of the final engineering design for the facility. In addition to reducing plant water requirements, minimal pond areas are less likely to attract migratory birds and waterfowl thereby reducing the possibility of this impact.

Thus, it may be concluded that under normal plant operating conditions and barring the occurrence of any catastrophic natural events (earthquakes, floods, tornadoes, etc.), the foregoing engineered containment design of liquid waste repositories for the Crow synfuels plant should prevent any major potentially adverse environmental impacts to the water quality of the Crow Reservation and the area adjacent to the reservation.

However, it must be recognized that an ion material balance was not conducted for the major and trace liquid constituents comprising the liquid waste streams as part of this feasibility study. Hence, detailed identification and characterization of the process liquid waste stream constituents is not possible at this time. It is, therefore, recommended that if the Crow synfuels plant proceeds to the next phase, process liquid waste stream characterizations should be thoroughly evaluated in order to substantiate the long-term capability of the proposed multilayer liner system to contain the identifiable constituents comprising the process liquid wastes.

2.6.3 Solid Waste Disposal Impact Assessment

A similar containment design approach to the foregoing liquid waste disposal system has been developed for solids waste disposal for the proposed Crow synfuels plant. Since the quantities of solid wastes for a coal gasification plant are considerably more extensive than liquid wastes and the repositories are located external to the plant site boundaries, potentially more serious environmental water quality impacts than for liquid process waste residues could arise.

The Crow synfuels plant will produce a variety of solid wastes for disposal, as previously discussed. The majority of the wastes consist of ash from the Lurgi coal gasification units, ash from the boilers, and sludge from the Flue Gas Desulfurization (FGD) unit. Other solid wastes from the plant include water treatment sludges, spent catalysts, and general plant refuse. It is recommended that general plant refuse will be at least qualitatively inspected prior to disposal at a local public waste disposal site to make certain that potentially hazardous process wastes are not

inadvertently comingled. The quantification and environmental impact evaluation of the spent catalysts could not be adequately assessed in this feasibility study due to a lack of essential proprietary information concerning their physical and chemical properties.

The proposed solid waste disposal plan developed by Fluor as the Base Case for this study and, therefore, is specific for Site 1 assuming the Westmoreland coal feed. The ash and other solid wastes will be stored adjacent to the synfuels plant battery limits since ash disposal at the existing Westmoreland Absaloka mine is not an economical option as discussed in greater detail in Volume V of this report (see Figure 4.6.3-1, Section 4.6.3, Volume IV, Part A). For the alternate Shell coal case at Site 23, the ash will be returned to the proposed Shell mine for disposal.

The worst-case scenario, Case II, employs the Westmoreland coal at the proposed ultimate production rate of 250 MM SCF/D and producing additional electrical power above that required for internal plant consumption. It produces 0.977 million cubic yards of major solid waste effluents on an annual basis, or 24.4 million cubic yards of solid waste over a 25-year plant operating life. Similarly, the 125 MM SCF/D Case IIA design scenario counterpart of Case II produces approximately one-half of the volume of solid wastes, i.e., 0.489 million cubic yards per year or 12.2 million cubic yards in the 25-year plant operating lifetime. About 55.48 percent of the solid waste volume for the design Case II and IIA scenario utilizing Westmoreland coal is the result of gasifier ash from the Lurgi process with ash and FGD sludges from the boiler operation representing about 28.25 percent and 16.27 percent, respectively, of the total solid waste volume both annually and cumulatively over 25 years. The design Case IA (125 MM SCF/D SNG) represents the lowest solid waste volume requirement for the designs using a Westmoreland coal feed. Solid waste volumes of 0.710 million cubic yards over 25 years are evidenced for design Case IA, with gasifier ash representing about 76.5 percent of the total solid waste volume. This result arises from the reduced requirement for the boilers, since the plant is designed to produce only enough power for internal facility needs.

A more realistic overall plan for long-term Crow synfuels plant operation is represented by the Case III scenarios which assume cumulative 25-year solid waste volumes based upon a 5-year operation at the Case IIA design level (125 MM SCF/D SNG) followed by a 20-year operation of the upgraded Case II plant design, since utilization of the excess coal fines to produce additional electrical power for sale to an electrical utility represents a more economically viable mode of plant operation than other options evaluated in this feasibility study as discussed in Volume II in considerably more detail.

The Case III scenarios result in a 25-year solid waste volume commitment of approximately 22 million cubic yards for the foregoing Case II scenario utilizing a Westmoreland coal supply with about 55.4 percent of the total solid waste resulting from Lurgi gasifier ash. Case design scenarios IIA and II, employing the Shell coal feed require considerably less solid waste disposal volume requirements principally due to lower ash content and also lower sulfur content of the Shell coal resulting in lower SO_2 emission control requirements (84 percent vs 90 percent) and, hence, less FGD sludge production for disposal.

Shell coal feed Cases IIA and II require solid waste disposal volumes of 0.282 million cubic yards and 0.565 million cubic yards, respectively, on an annual basis; and 7.562 million cubic yards and 14.125 million cubic yards, respectively, over an assumed 25-year plant operating period for the previously cited Shell coal design Cases IIA and II (see Table 4.6.3-1 of Section 4.6.3.1, Volume IV, Part A).

The solids waste disposal facility at Site 1 is designed for complete containment or isolation of the solid wastes by encapsulation with 5 feet of clay. Thus, any potential water quality impacts must be predicated upon either (1) transport of aqueous anions or cations derived from solubilized solid wastes through the clay liner; (2) fairly extensive fracturing of that liner due to some inadvertent catastrophic natural event such as an earthquake, flood, etc.; or (3) improper liner preparation and construction procedures, thereby creating the necessary transport pathway for possible solid waste contaminants to nearby surface waters or possibly groundwater aquifers.

The clay liners will be specifically designed to have a permeablity of 10^{-7} cm/sec or less considering natural penetration through a 5-foot liner thickness as set forth in RCRA regulations. Therefore, it would require more than 48 years under normal gravitational hydrostatic pressures for a possible aqueous contaminant to penetrate the liner.

However, since significant attenuation of most possible contaminants would most certainly be affected during this time interval, it may be concluded that potentially adverse water quality impacts to the area encompassing Site 1 are quite remote if the clay liner remains intact and provided that ancillary hydrostatic head forces are not present to increase the liner permeability.

The introduction of hydrostatic head forces can be precluded by assuring that neither the natural drainages or flooding conditions will result in drainage into the solid waste disposal facility area—a factor that has been accounted for in the previously discussed Site 1 solid waste facility design.

Unquenched ash samples from the Lurgi gasification tests of representative samples of both Westmoreland and Shell coals were subjected to two separate types of leachate tests. Analysis of leachate indicates that potential contaminant concentrations do not exceed the limits for hazardous wastes as currently defined by EPA. It is recommended that a more thorough evaluation of the characteristics of these solid wastes be made prior to the construction phase of the proposed Crow synfuels project (see Section 4.6.3.3 of Volume IV, Part A).

Additionally, the natural geohydrologic environment of the Site 1 area lends itself to mitigation of any potentially adverse water quality impacts from either solid or liquid process waste residues.

As previously discussed, the geology of the Site 1 area indicates that stiff clays predominate over hard claystone bedrock at depths of 3 to 7 feet. The clays are silty, sandy, calcareous, and occasionally porous. The claystone bedrock is slightly sandy and contains scattered bentonitic clay lenses. The bedrock consists primarily

of the Niobrara and Carlile shale members of the Colorado Group of the Cody Shale Formation of the Upper Cretaceous series. Preliminary test borings indicate that these clays and claystone bedrock expand when wetted indicating both relatively high natural impermeability and low, unsaturated interstitial pore volumes—natural conditions highly suited to the mitigation of potential aqueous contaminants (see Section 4.1.2 of Volume IV, Part A).

Preliminary test borings in the Site 1 area have indicated no free water in any of the test holes to the maximum depth drilled of 20 feet. Hence, potential water quality impacts to groundwater aquifers by seepage should have little effect on any near-surface construction such as a solid waste disposal facility. Additionally, surface water drainage and evaporation should be limited to the overburden section above the clay cap of the disposal area (see Section 4.1.3 of Volume IV, Part A).

Although the process solid wastes would most likely be returned to the proposed Shell mining area for disposal from Site 23, it is proposed that a similar isolation or containment design approach to solid waste disposal as has been developed for Site 1 be applied as well at Site 23. In fact, perusal of the possible natural geohydrologic environmental setting at Site 23 dictates a possibly greater need for assurance of complete containment of the solid wastes at Site 23 to minimize potentially adverse water quality impacts.

As previously inferred, the major groundwater aquifers—the alluvial deposits of the Squirrel, Youngs, Tanner, and Little Youngs Creek valleys, and Anderson and Dietz coal seams of the Tongue River member and associated clinkers—form a more or less continuous groundwater unit from the Wolf Mountains on the west to the Tongue River on the east. The movement of both the surface water and the groundwater is toward the Tongue River and external to the Crow Reservation. The potentiometric surface of the groundwater is also near ground surface levels (see Section 4.1.3 of Volume IV, Part A).

Hence, the possibility could exist for a nearly continuous transport path for potential aqueous contaminants from synfuels plant process liquids and solid residues if the

proposed isolation or containment liners are circumvented for any reason in the Shell Mine Site 23 area. Therefore, additional precautions must be taken in the site selection, design, and construction of the aforementioned disposal areas—especially the solids waste facility—in the Shell mining area to make certain that (1) the waste disposal containment liners are capable of high, long-term integrity, and (2) continuous aqueous contaminant surface water or groundwater pathways are not possible in the waste disposal area in order to preclude any potentially adverse water quality impacts to the Tongue River drainage system.

Regardless of siting area, it is recommended that thorough preoperational and operational groundwater monitoring programs be established at both the plant site in the vicinity of the proposed liquid waste storage area and at any solid waste disposal area.

2.6.4 Preliminary Wildlife Resource Impact Assessment

Approximately 960 acres will be utilized for the proposed Crow synfuels facility at Site 1; another 290 acres will be required for access roads, railroads, and water pipeline; and an additional 300 to 600 acres will be allocated to a solids waste disposal site. Thus, approximately 1,250 acres will be required for the project at Site 1 (see Figure 4.6.4-1 of Section 4.6.4, Volume IV, Part A).

Wildlife habitat within these proposed sites could be considered lost for the duration of the project. Terrestrial wildlife with limited mobility and small home range sizes will be most affected. Sharp-tailed grouse are known to be quite abundant within the general area and loss of habitat will directly impact those populations.

Disturbances associated with the site preparation and construction processes could impact pronghorn antelope and sharp-tailed grouse depending on the timing of construction activities. Uncontrolled access and activities could result in further disturbance, harassment, and poaching, thereby directly impacting wildlife populations particularly during winter months when populations such as pronghorn antelope and sharp-tailed grouse are concentrated.

Preliminary plant layout indicates that approximately 1,440 acres will be required for Site 23. Plant site boundaries tentatively encompass approximately 750 acres. Approximately sixty miles of pipeline will be required to transport necessary water to the plant site. Access roads as proposed will cover approximately 27 miles. Therefore, total surface acres required for both the access roads and pipeline is about 690 acres. Therefore, a total of 1,440 acres of wildlife habitat could be considered lost for the duration of the project. Since the solid waste would be disposed in the Shell mining area, land disturbance would have occurred prior to any activities associated with the Crow synfuels project.

The proposed plant Site 23 lies within a major pronghorn antelope winter range with plant boundaries overlapping or lying directly adjacent to critical-use areas. Construction activities could seriously impact these animals depending on the time of activities (see Figure 4.6.4-2, Section 4.6.4.2, Volume IV, Part A). Movements of antelope from the lower portions of the winter range to the upper northwest sections could be disrupted. Birthing activities of pronghorn antelope and mule deer could also be disrupted resulting in lowered reproductive success. Golden eagles and prairie falcons are also known to nest within close proximity to the plant site; therefore, any disturbance during nesting season could result in abandonment of the area.

Although activities associated with access road and pipeline construction will be temporary, impacts could be significant if these activities transpire during critical life-cycle periods for indigenous wildlife. Since access roads and pipelines will cross known mule deer, white-tailed deer, and elk ranges, uncontrolled access during construction activities could result in poaching and further harassments, particularly in more remote areas.

It is further recommended that proper design of water intake structures on the Bighorn River be affected to reduce potential fish losses due to impingement.

In the Site 1 area water quality degradation of Fly Creek and Two Leggins Creek could increase if measures are not taken to contain runoff and resultant sediment

loads. Depending on the quantity of additional sediment resulting from construction activities, impacts to the Bighorn River fisheries could result. Similarly, in the vicinity of the Site 23 area, increased siltation of Youngs and Dry creeks and, consequently, the Tongue River could occur if measures are not taken to minimize or contain runoff from disturbed sites. The already low populations of brook trout in the upper reaches of Youngs and Dry creeks could be essentially eliminated if excessive siltation occurs. Likewise, the Owl Creek and Little Bighorn River fisheries could be impacted if excessive siltation occurs. Hence, strict procedural control during site preparation and construction activities is recommended to mitigate this potential impact.

2.6.5 Utility Corridors: Environmental Considerations

Some of the major concerns with ecological impacts of utility line corridors center on the management of the corridor. Herbicides have been used extensively in the past to maintain a clear right-of-way. This practice resulted in the loss of vegetation and, hence, carrying capacity. Thus, it is recommended that use of herbicides should be either avoided or strictly controlled. On the other hand, the areas relatively clear of overstory vegetation frequently have a good diversity of shrub vegetation and other understory vegetation. This, in turn, maintains a more diverse food web than the forest alone. Thus, the cleared right-of-way maintains an ecotone and introduces increased species diversity along the corridor if properly managed. Therefore, it is recommended that the ecology of the utility corridors be examined in greater detail after final site selection to reduce the potential impacts on the regional ecosystem. Since the length of the water pipeline corridor is considerably more extensive for Site 23, the potential for possible environmental impacts to both vegetation and wildlife are concomitantly greater. It must be emphasized, however, that over the long term, the most important mitigation measure with respect to utility corridors is to maintain the vegetation and, thus, the carrying capacity for wildlife.

2.6.6 Preliminary Cultural Resources Impact Assessment

Since the extent of cultural resources for much of the Crow Reservation, including the proposed candidate plant sites and areas of impacts, is largely unknown, it becomes difficult to adequately assess the cultural or archaeological impacts for the proposed project. However, cultural resources are vulnerable to impacts from surface and subsurface disturbance and from intrusion into previously inaccessible and remote areas.

Construction activities could totally destroy buried deposits if adequate and required archaeological clearances are not obtained. Increased human access to previously remote areas could enhance the potential for vandalism and theft at cultural sites. Valuable information important to the understanding of prehistoric and historic events could be lost or destroyed. Religious and sacred sites important to the Crow tradition could also be impacted. Compliance with all tribal, state, and federal rules, regulations, codes, orders, and proclamations will be required to adequately mitigate any potentially adverse impacts.

2.6.7 Potential Impacts From Radioactive Trace Elements in Coal

Trace concentrations of uranium and thorium obtained from representative samples of both the Westmoreland and Shell coals (see Section 4.5 of Volume IV, Part A) have been previously quantified in terms of their content within particulate matter emitted to the atmosphere.

Utilizing these emission rates as source terms for the air dispersion modeling analysis indicates that considerably less than 0.1 ug/m^3 of either uranium-238 or thorium-232 would be the maximum concentrations at selected receptor locations on the Northern Cheyenne Reservation from Case II design scenarios located at either Site 1 or Site 23.

Several selected references have estimated (see Section 4.6.7 of Volume IV, Part A) that approximately 90 percent of the uranium content in the coal feed for a power plant combustion process terminates in the solid ash residues. Based upon 90 percent uranium retention in the solid wastes for the proposed Crow synfuels facility, approximately 4.6 curies/yr of U-238 would accumulate in the solid waste facility for worst-case Case II design scenarios. It is recommended that potential radionuclide inventories, particularly in the solid wastes, be more thoroughly investigated if the Crow synfuels project proceeds beyond the stage of this feasibility study.

2.7 ENVIRONMENTAL MONITORING REQUIREMENTS

Requirements for detailed, site-specific baseline environmental monitoring data constitute an essential facet of the Crow synfuels feasibility study and are outlined in a preliminary manner for both air and water quality, since these preoperational monitoring programs must be started at least one year prior to the initiation of the environmental permitting process and, consequently, impact both the regulatory decision-making schedule and the overall Crow synfuels project schedule.

SECTION 3.0
SCOPE OF WORK

3.1 BASELINE DEFINITIONS

Baseline definitions are prepared for the existing environmental setting at selected gasification plant candidate site(s). The baseline descriptions address the following topics.

All information available on climatology, air pollution diffusion potential, and existing air quality has been collected and reviewed. Particular attention was given to the potential pollutant transport to the Northern Cheyenne Reservation Class I which is a PSD-designated Class I area. Where appropriate, site-specific information will be collected for baseline purposes.

Physical characteristics of the site, including land use, topography, soils, vegetation, minerals, geology, and geological or seismic hazards as applicable to a particular site location were reviewed and evaluated.

All existing, available information on wildlife resources in the vicinity of the selected candidate siting areas and transportation corridors was reviewed and evaluated.

All existing, available information on pertinent water resources including both surface water and groundwater quantity and quality for selected candidate site location(s) was reviewed and evaluated.

All existing information on archaeological resources on the plant and transportation corridors was reviewed.

3.2 STANDARDS AND CONSTRAINTS

An essential part of the environmental task effort for the feasibility study entails the assembly of major applicable environmental standards and constraints. Consequently, the following items were prepared:

A list of federal, tribal, and state environmental legislation along with a brief statement of the applicability of these laws to coal gasification.

A tabulation of current National Ambient Air Quality Standards (NAAQS), as well as tribal and Montana Air Quality Standards, to identify any differences.

A table of allowable increments available to the various classifications of land areas under the Prevention of Significant Deterioration (PSD) program.

A list of New Source Performance Standards (NSPS) for typical equipment which is part of the preliminary plant design.

A presentation of effluent guidelines and standards for allied industrial processes under the National Pollution Discharge Elimination System (NPDES) regulations.

A list of predicted federal, tribal, state, and local permits and approvals which may be required to allow construction of the proposed facility to proceed.

3.3 MANDATED CONTROL MEASURES

Current federal, tribal, state and local laws, regulations and directives were reviewed to establish the mandated environmental control measures which must be incorporated in the plant design. An evaluation was made of the various available processes, systems and components which are commercially available to satisfy the environmental control requirements. A selection was made of the preferred process or system for each area of environmental concern, and a cost estimate was made of the installation.

Although the tribe will work closely with state and local officials during the course of the project, one potential advantage of a synfuels project located on the Crow Reservation is the tribe's possible exemption from state and local regulations and taxes. The environmental jurisdiction issues associated with this premise were reviewed and evaluated.

3.4 PLANT CONSIDERATIONS

The following equipment and process units were reviewed as part of the overall environmental assessment of the coal gasification plant:

Enclosed conveyors, baghouses, and other ancillary devices for controlling coal dusts.

Systems and equipment for reducing or minimizing SO_2 and particulate matter emissions generated within the coal gasification process, since these source emissions must comply with the stringent regulations for Class I PSD air quality increments on the nearby Northern Cheyenne Reservation.

Equipment and/or materials required to control or reduce NO_x emissions from power plant boilers, fired heaters, and other fuel-burning sources.

Plant stack height to comply with the recently invoked EPA Good Engineering Practice (GEP) stack height regulations.

Process units for removing sulfur content of internal plant streams. Typical operations in this category are the Rectisol Unit, Claus Plant, ADIP and SCOT units, and tail gas incineration.

Control measures and/or devices required to comply with the National Ambient Air Quality Standards.

Types of equipment required to meet New Source Performance Standards.

Equipment that will reduce plant water usage; e.g., substitution of air-cooled exchangers in place of water-cooled items.

Equipment needed to process internal plant wastewater streams to permit continuous reuse and to achieve "zero discharge" from the plant. Typical key units in such a water processing scheme are the Phenosolvan Plant, Sour Water Stripping Unit, and Biotreating Unit for process and sanitary wastewaters.

Liquid storage reservoir construction, including an impervious lining and test wells to control and monitor possible groundwater contamination.

Design and construction of solid waste disposal areas suitable for deposit of boiler and gasified ash, chemical and biological sludges, and spent catalysts. Control of fugitive particulates and water seepage related to these solid wastes is essential.

Special equipment, noise-attenuating materials, and structures to control and to monitor noise levels. OSHA limitations for worker exposure as well as noise-level limits for the periphery of the plant must be observed.

Preoperational and operational monitoring equipment and services required to establish baseline and operational data related to air and water quality as required by federal and state environmental authorities.

3.5 MINE CONSIDERATIONS

Control measures for ash disposal from the gasification plant at the mine, if deemed technically appropriate for any selected plant candidate site scenarios, were defined, based to a large extent on the ultimate requirements imposed by the Resource Conservation and Recovery Act (RCRA).

Mitigating measures were identified for archaeological resources expected to be found on transportation routes. Because detailed archaeological surveys were not planned for the feasibility study, mitigating measures concentrated on a protocol for preserving archaeological resources identified through future surveys.

3.6 RESIDUALS ASSESSMENT

An assessment was made of the gross quantities of air, water, solids, and any identified nuclear radiation emitting residuals from normal plant operation. An inventory of these discharges (residuals) was compiled and an evaluation made of their potential impact on the environment. The following major areas were assessed on a basis consistent with the availability of necessary supporting data for the Crow synfuels project within the framework of the time schedule for the current feasibility study.

3.6.1 Air Quality

The gaseous emissions from the coal gasification plant are principally combustion products, process discharges, and fugitive emissions. These emissions typically contain sulfur dioxide, nitrogen oxides (NO_x), carbon monoxide, hydrocarbons, particulate matter, hydrogen sulfide, and ammonia as well as traces of organic matter and heavy metals. A block-type process flow diagram is included to illustrate the source and subsequent gaseous discharges.

The gaseous and particulate emissions data were utilized in an early preliminary air quality screening analysis and evaluation to assess potential candidate plant sites for compliance with the Class I air quality designation assigned to the nearby Northern Cheyenne Reservation. A computer-based mathematical dispersion model for the topography of the candidate plant site and the appropriately designated receptor locations was used to predict resulting ground-level concentrations of the specific pollutant(s) that are of concern with respect to compliance with NAAQS or PSD increments.

Following the selection of the one or two most promising plant candidate sites, a more detailed plant process design plan was developed on the basis of the coal test data from Lurgi to determine the preliminary plant requirements for pollutant emission controls.

3.6.2 Water Quality

Although no water discharges are anticipated from the plant, coal gasification processes yield waste liquid effluents which contain a variety of pollutants, including suspended solids, ammonia, hydrogen sulfide, phenols, aromatic hydrocarbons, and other organic compounds. Fluor prepared a block-flow diagram for the plant water management scheme. This diagram combined essential features of a process block-flow diagram and a water balance; it shows proposed treatment(s) of the incoming raw water supply and distribution to the various users. The document indicates the sources of waste effluents, subsequent treating methods, and ultimate end-use of the treated streams. In past Lurgi gasification plant designs, "zero discharge" of liquid effluents has been possible through evaporation within the plant and judicious reuse of treated wastewater. The proposed design for the Crow SNG plant is expected to retain this desirable feature. The study includes a tabulation which indicates the degree of treatment accomplished for the water treatment and waste-treating operations. The water-treating scheme is based on a raw water analysis from the Bighorn River.

The impacts on groundwater uses and quality from mining-related changes in aquifers were identified. Potential impacts caused by increased sedimentation on surface water systems also were evaluated. Possible pathways, attenuation rates, and the ultimate fate of coal ash leachate were estimated, based on available information.

3.6.3 Solid Wastes

Solid wastes generated by the Lurgi coal gasification process consist primarily of refuse removed from raw mine coal, fly ash and bottom ash at the boilers, slag and ash from gasifier vessels, and sludges originating in water-treating, waste-treating, and flue gas desulfurization units. Minor amounts of spent catalyst must be periodically discarded. A list was prepared of the solid wastes, outlining the source, estimated quantities, and general composition of each type of solid waste. Environmentally acceptable methods were established and incorporated with the

general design of the proposed plant. Conventional disposal of solid wastes requires sizable handling and transport equipment.

Transporting these wastes may generate fugitive dust emissions. Fluor examined and assessed the severity of this secondary emission. Leaching from waste fill into the groundwater is another concern that the Crow Tribe explored and evaluated during this work; however, these problems have been addressed at the now operating Westmoreland Mine Site.

RCRA became law in October 1976. To date, regulations to implement this legislation have not been instituted. The Crow synfuels project monitored this area of regulation closely and included any emerging limitations for waste disposal in the plant design considerations.

3.6.4 Radioactivity

The impact of radioactivity from the coal gasification process appears to be minor. The study includes only a review of studies and reports on radioactivity emitted from similar processes and a brief summary of conclusions reported in the reviewed sources.