

ECONOMIC IMPACTS OF THE NAVAJO INDIAN IRRIGATION PROJECT
AND
OTHER WATER RESOURCE DEVELOPMENTS ON THE NAVAJO INDIAN RESERVATION

Wm. D. Gorman
and
Robert R. Lansford

In this paper we propose to (1) give a status report on the Navajo Indian Irrigation Project (NIIP), (2) describe the projected economic impacts of the NIIP, and (3) briefly describe the projected economic impacts of the current and proposed coal resource developments in relation to the NIIP, I will discuss the first two issues and my colleague, Dr. Lansford will discuss the latter issue and answer all questions.

For the benefit of those of you who are not familiar with the NIIP, it was authorized by Congress in 1962 as part of a package that also authorized the San Juan-Chama diversion. The project, part of the upper Colorado River Storage Project, will furnish irrigation water to 110,630 acres of Navajo-owned land located generally south of Farmington, New Mexico.

Several years ago the Navajo Tribal Council approved the establishment of the Navajo Agricultural Products Industry (NAPI) to plan and coordinate the agricultural development. The operating plan calls for the establishment of a tribal enterprise agro-industrial type farm development owned and operated by the Tribe, but under the direction of a separate board of directors and hired professional management. All profits are to accrue to the tribal treasury.

Robert R. Lansford and William D. Gorman are professors of Agricultural Economics, New Mexico State University, Las Cruces, New Mexico,

CROP, LIVESTOCK, AND PROCESSING ACTIVITIES
FULLY DEVELOPED NIIP

<u>CROP</u>	<u>ACRES</u>
Alfalfa	25,000
Feedgrain	36,900
Vegetables	19,760
Sugar Beets	13,000
Beans	8,308
Seeds	2,000

<u>LIVESTOCK</u>	<u>NUMBER OF ANIMALS</u>
Dairy	2,200 Cows
Sheep Feedlots	19,000 Head
Beef Feedlots	216,000 Head
Egg Production	600,000 Hens

<u>PROCESSING</u>	<u>UNIT</u>
Sugar Beets	42,000 Tons
Vegetable Cannery	2,000,000 Cases
Livestock Slaughtering	250,000 Head

Present Status

The first block of land of approximately 9,000 net irrigible acres should be ready for farming next year, the 1976 crop year. All construction contracts are let and expected to be completed in time. The second block of land of slightly less than 10,000 acres will not be ready for farming until 1978,

Table 1. Projected Gross Sales, Net Operating Profit and Operating and Capital Requirements¹ Navajo Indian Irrigation Project 1976-1987.

	Gross Sales	Net Operating Profit ²	Annual Investment Capital	Investment Capital To Date	Annual Operating Capital
-----\$1,000-----					
1976	1,340	638	2,477	2,477	959
1978	4,188	953	3,152	5,629	2,968
1979	16,645	2,373	4,892	10,521	9,150
1980	34,717	4,243	6,896	17,417	18,439
1981	64,346	7,900	9,000	26,417	36,957
1982	89,000	14,427	34,643	61,060	54,478
1983	91,388	15,630	3,572	64,632	59,881
1984	108,074	17,645	8,115	72,747	68,569
1985	118,431	18,596	3,194	75,941	74,848
1986	128,889	20,079	10,050	85,991	84,686
1987	129,253	20,613	1,802	87,793	85,328

¹All profits, income and capital estimates are based on "constant dollars" with 1969-72 as the base period. Projections are based on the cropping plan and livestock and processing activities listed in SWERD Environmental Study.

²Net Operating Profit is Gross Income less all expenses except interest.

To allow for startup costs for the first block of land it was assumed that yields would be 70% of the budget expectations and costs would be 130% of budget expectations listed in Costs, Returns, and Capital Requirements of Selected Crops for the Navajo Indian Irrigation Project, Agricultural Experiment Station Reserach Report 256, Las Cruces, New Mexico, May 1973.

Specific information on each crop can be found in Costs, Returns, and Capital Requirements of Selected Crops for the Navajo Indian Irrigation Project, Agricultural Experiment Station Research Report 256, Las Cruces, New Mexico, May 1973 and Special Report on monthly cash budgets.

hence, they will have two years of operating block one before bringing in the second block. If adequate funding is received, an additional block of approximately 10,000 acres will be brought in each year after 1978 with the full 110,630 acres scheduled to be under irrigation by 1987. The project plan also calls for a 23,000-kilowatt hydroelectric plant at the Navajo Dam to provide part of the power needed on the project.

NAPI Preliminary Long Range Plan

NAPI has taken steps toward preparing a preliminary long range development and operating plan. Under current planning about 60 percent of the acres of the fully developed project are expected to be planted in alfalfa and feedgrains. Another 34 percent of the acreage will be planted in sugar beets; and fresh and processed vegetables including potatoes. The remaining six (6) percent is scheduled for beans and seed crops. Livestock activities of dairy, sheep feeding, cattle feeding and egg production are included in the long range plan. Also, fresh vegetable packing sheds, vegetable processing, sugar beet processing, and livestock slaughtering facilities will be developed if economic conditions seem favorable.

The project when fully developed is expected to realize an annual net operating profit of \$20.6 million on sales of nearly \$130 million (table 1). This figure includes profits from the crops, livestock, and processing and marketing activities contained in the long range plan. It does not include profits from machinery, fertilizer, seeds, transportation or other associated business that will develop. Net operating profit is defined as a net business income before any interest expense is paid. Since the amount and sources of debt capital or equity capital have not been determined, it is not possible to predict net income (profits after interest expense) without making some assumptions.

The project is expected to require nearly \$88 million in investment capital for sprinkler systems, machinery and equipment, buildings, and processing and marketing facilities. Annual operating capital needs are estimated at nearly \$86 million. The beef feedlot and processing plants are the largest users of operating capital.

The Navajo Tribe does not have to repay the Federal Government for the cost of bringing the water to the land. The Tribe is also not subject to Federal nor State property or income taxes on profits earned from agricultural activities on the reservation. These conditions provide them with a competitive advantage over non-Indian irrigation developments.

Although the Navajo Tribe is desperately in need of additional income and employment opportunities, they currently do not have the capital available to develop the project along the lines suggested in the long range plan. If the project is properly managed, it should be reasonably profitable and be able to attract some private equity and debt capital. However, it is likely that the Federal Government will have to provide much of the investment and operating capital at least in the early development years, but public

investments in creating long run income and employment opportunities for the Indians and other people living or migrating to the project area should be partially compensated through future reductions in public welfare payments.

Employment and Income Impact on the Local Economy

The majority of the economic impacts will accrue to residents (or future residents) of San Juan County, New Mexico with lesser impacts accruing to the Gallup area, McKinley County, New Mexico. Because of the increased economic activity, expenditures for goods and services will also be made in many of the surrounding communities such as Albuquerque, New Mexico and Durango and Cortez, Colorado. Also because of the large size of the project, communities across the United States that manufacture farming and agricultural processing equipment will also benefit.

San Juan County, New Mexico will probably receive the majority of the economic impacts for the following reasons: (1) the project is centrally located in the county, (2) San Juan County had over 52,000 residents in 1970, and with the irrigation project and coal gasification plants (with anticipated direct employment exceeding 8,000) the county should exhibit sufficient growth in population and associated business firms to reduce many of the economic leakages that now occur, and (3) the immediately adjacent communities do not have complete, well developed agricultural service industries, hence these will tend to develop adjacent to the project in San Juan County.

Since the project is for the benefit of the Navajo people and it is not unreasonable to expect that over 90 percent of the jobs created in direct farming, processing, and marketing activities will be filled by Navajos (2). The economy of the Navajo Reservation is not well developed so many of the indirect (services and supplies) jobs created will probably go to non-Navajos. This probable effect could be mitigated somewhat if the Navajo people increase their involvement in service business firms. Because of the undeveloped reservation economy there will be few economic linkages that would enhance the general economy of the entire reservation.

Because of the substantial distance of the Irrigation Project from most areas of the reservation, most employees will probably reside in San Juan County, New Mexico. It is probable that some commuting will develop particularly for individuals closely tied to the Navajo extended family system, but the majority of the Navajo employees will probably reside in the existing communities in San Juan County, or in possible new ones under consideration.

The enterprise farming complex (NAPI) is owned by the Tribe. Presumably this will be a profitable venture and all profits will be available for Tribal investments or support of the many existing tribal programs. To the extent profits are distributed across the reservation, all Navajo people will benefit from the irrigation project.

Estimation of the Economic Multiplier

The economic impact of the irrigation project will not be limited to wage and other payments made to the local community; the income resulting from

these payments will be, in part, re-spent within the community and will create additional income and jobs. An economic multiplier is typically used in estimating the total change in the economic variables resulting from the initial change.

The method of estimating the income and employment multiplier is based upon the relation between basic (export) industrial sectors and non-basic (local use) sectors. Basic sectors depend on demand from outside the community. The income resulting from a region's exports provides the demand for outputs of the local sector. Most of the agricultural products produced and processed on the project will be exported to other regions, hence it is a basic industry. Retail trade is a good example of a local service sector.

A comparison of basic and non-basic jobs, using San Juan County 1971 employment figures as a base period, indicated that for every basic job there were 1.4 people employed in non-basic sectors (table 2). If one assumes these relationships hold true in the future then every new job created in the basic sector will result in a total increase in employment of 2.4 people -- the new basic sector job and 1.4 additional jobs created in the remaining sectors of the local economy.

Application of economic base analysis techniques to estimate the economic impact of new employment in an area is not an exact science. They must be interpreted as "rough estimates" subject to substantial error. The economic multiplier that might result in San Juan County in 1987 at the time the irrigation project is expected to be fully developed could easily range from less than two (2) to greater than three (3). The multiplier size will depend upon the change in the amount of leakages in the local economy as the area develops (purchases outside of San Juan County).

An employment multiplier of 2.4 is much larger than one would expect as a result of incremental increases in basic employment in a region the size and population of San Juan County. However, this may be a realistic estimate of the employment impact by 1987 considering the immense size of the irrigation project and the substantial growth that will occur in the energy industries in the county. The combination of these two basic developments should induce considerable expansion in the local economy.

Direct Employment Effects

The project has had and will have direct employment effects resulting from planning and construction activities, and jobs in farming and related activities (table 3). It is estimated that by 1987 and thereafter when the project is scheduled to be fully developed, 2,137 jobs will be created from the irrigation development in the basic industries of agriculture, government, project related construction and processing activities.

Indirect Employment Effects

Employment is forecasted to increase by more than 5,000 in San Juan County by 1986 and thereafter as a result of the irrigation project. This

Table 2. Allocations of San Juan County Employment into Basic and Non-Basic Categories 1971.¹

Employment Category	Sector		Total
	Basic	Non-Basic	
-----number of jobs-----			
Manufacturing	1,319	0	1,319
Mining	1,410	0	1,410'
Contract Construction ²	950	719	1,669
Government			
Federal	1,218		1,218
State		244	244
Local		1,724	1,724
Agriculture	532	0	532
Transportation & Public Utilities ²	938	937	1,875
Wholesale & Retail Trade ²		2,889	2,889
Finance, Insurance & Real Estate ²		366	366
Service & Miscellaneous ²		2,183	2,183
Total ³	6,367	9,062	15,429

Sources: New Mexico: County Work Force Estimates 1967-73, Prepared by the Research and Analysis Section of the Employment Security Commission of New Mexico.

U. S. Department of Labor, Bureau of Labor Statistics, Employment and Earnings United States, 1909-72, Bulletin 1312-9, 1973.

¹The category "All other non-agricultural" employment as used by the Research and Analysis Section of the Employment Security Commission of New Mexico, could not be used in this approach because comparable national data was not available. This category includes all self-employed regardless of occupation, unpaid family workers, and private household workers.

²Location Quotient technique was used to assign employment as basic or non-basic for these sectors. The assumption method was used for the other sectors.

³Determination of Economic base Multiplier: $15,429 + 6,367 = 2.4$ i.e., for each additional job added to the basic category, 1.4 jobs are added in the non-basic sectors, for a total of 2.4 jobs created.

Table 3. Estimated Changes in Basic and Non-Basic Employment Resulting from Development of the Navajo Indian Irrigation Project 1967-1987.

Year	Basic Employment			Total Basic	Non-Basic ³	Total Employment
	Manufacturing ¹	Agriculture	Construction ²			
1967			375	375	525	900
1968			320	320	448	768
1969			143	143	200	343
1970			89	89	125	214
1971			229	229	321	550
1972		33	267	300	420	720
1973		39	370	409	573	982
1974	8	40	355	403	564	967
1975	8	45	402	455	637	1,092
1976	8	55	505	568	797	1,365
1977	8	55	505	568	797	1,365
1978	8	137	515	660	924	1,584
1979	8	291	515	814	1,140	1,954
1980	8	485	490	983	1,376	2,359
1981	118	726	350	1,194	1,672	2,866
1982	307	815	390	1,512	2,117	3,629
1983	307	891	400	1,598	2,237	3,835
1984	307	1,061	370	1,738	2,433	4,171
1985	307	1,133	340	1,780	2,492	4,272
1986	585	1,213	320	2,118	2,965	5,083
1987	585	1,241	310	2,137	2,992	5,129

1. Includes employment created in food processing.

2. Construction employment on the project including Bureau of Reclamation Personnel.

3. An employment multiplier of 2.4 was used (1.4 non-basic jobs created for each basic job added, See Table 8).

"best guess" forecast is based on a total employment multiplier of 2.4 (one basic job increase and 1.4 additional jobs created in the non-basic industries). If the local economy does not develop as this employment multiplier would suggest and considerable economic leakage occur, the total employment effect would be somewhat less. If the 2.4 employment multiplier underestimates the effects on the local economy, significantly more than 5,000 jobs may be created. For example a total employment multiplier of 2.0 would predict creation of slightly more than 4,250 jobs, whereas an employment multiplier of 3.0 would indicate creation of more than 6,400 jobs.

Direct Income Effects

There are two sources of direct income effects on the local economy resulting from development of the irrigation project: wages and salaries by NAPI and business profits earned by NAPI spent in the local economy. Wages and salaries for all employees are expected to increase from \$600,000 in 1976 to \$14,000,000 as the project becomes completely developed in 1987 (table 4).

NAPI is forecasted to earn \$10,300,000 in net income in 1987 and years thereafter (assuming they will have to pay an interest expense of 8% on all investment capital and on about 1/2 of their operating capital). Assuming profits are distributed by the Navajo Tribe on a per capita basis relative to total Navajo population, about 20 percent or \$2,100,000 would be spent annually in the local area. The other \$8,000,000 would be spent in other portions of the reservation. Total direct income (labor plus NAPI profits) spent in the San Juan County area as a result of the irrigation project is forecasted to be about \$16,100,000 by 1987.

Indirect and Total Income Effects

Indirect income in the local community created by the irrigation project when fully developed is forecasted at \$22,500,000 annually. The employment multiplier discussed earlier was used as an estimate of the indirect income effects.

Total income effects for San Juan County are estimated at \$38.6 million annually after 1986 (sum of estimated direct and indirect income).

Navajo Income Effects

The total direct effects from development of the irrigation project on incomes to Navajos is estimated at \$23 million annually after the project is fully developed. This estimate is based on the assumption that 90 percent of the basic jobs and labor income will go to Navajos, and the \$10,300,000 in NAPI net income will be spent for Tribal programs on the reservation. Since adequate information was not available, no attempt was made to estimate the indirect income effects accruing to the Navajo people. However, unless the economy on the reservation develops rapidly in the next decade, the indirect effects would be very limited.

Table 4. Estimated Annual Income From Wages and Salaries Paid by Navajo Agricultural Products Industry, 1976-86.¹

Year	Wages and Salaries \$1,000 dollars
1976	600
1977	1,300
1978	2,600
1979	4,100
1980	6,700
1981	8,800
1982	9,400
1983	10,800
1984	11,300
1985	13,700
1986	14,000

¹Based on the NAPI Long Range Plan rounded to the nearest \$100,000.

Navajo Indian Irrigation Project Water Use

As originally planned the Navajo Indian Irrigation Project would utilize flood irrigation with a gravity distribution system. It was estimated that to irrigate the 110,630 acres there would be required an average annual diversion of 508,000 acre-feet from the river and that about 256,000 acre-feet would return to the San Juan River as return flows thus an average annual depletion of 252,000 acre-feet. By the conversion of the Navajo Indian Project to a sprinkler irrigation system, it is estimated that only 330,000 acre-feet of water would be required to be diverted annually to irrigate 105,000 productive acres, with 226,000 acre-feet depleted annually and loss and return flows averaging 104,000 acre-feet (table 5).

The per acre consumptive irrigation requirement has been estimated by the Bureau of Reclamation to be 1.886 acre-feet based on annual per acre consumptive use of 2,496 acre-feet and an effective precipitation of 0.61 acre-feet.

The average farm irrigation efficiency is estimated to be 75 percent resulting in per acre farm deliveries of 2.516 acre-feet. The project efficiency is estimated to be 60 percent resulting in an additional 0.627 acre-feet losses in canal, lateral, etc., thus resulting in an average annual diversion from Navajo Reservoir to be 3.143 acre-feet per acre.

New Mexico Water Rights from the San Juan River as Part of the Colorado River Compact

In the Reservation area, water in the quantities required for large thermal power units, gasification plants, and major industrial developments must be obtained from surface sources since underground sources are not sufficient. Potential surface sources are limited to Colorado River Basin water currently allotted to New Mexico. Operating under the limitations of the Colorado River Basin Compact, the following annual allotments from storage in the Navajo Reservoir have been: (1) 330,000 acre-feet diversion and 226,000 acre-feet depletion for the Navajo Indian Irrigation Project, (2) Navajo Power Plant 178,000 acre-feet diversion and 28,000 acre-feet depletion, (3) 100,000 acre-feet of depletable municipal and industrial water (M & I), (4) 55,000 acre-feet of diversion and 39,000 acre-feet of depletion to the Utah Construction and Mining Company (now Utah International), and (5) 20,000 acre-feet diversion and 10,000 acre-feet depletion for the Hammond Irrigation Project. The current water allocations and contracted uses including the 100,000 acre-feet of M & I water are summarized in table 6.

The water use projections for the Navajo Indian Irrigation Project, Navajo Power Plant, electrical generation would appear to be reasonable. There are sufficient data available on irrigation water requirements under sprinkler irrigation. The Four Corners Power Plant has been in operation for several years, therefore, the water requirements have been recorded. The Navajo Power Plant located at Navajo Dam has a depletion right of 28,000 acre-feet but only a small portion will be depleted at the Power Plant, thus leaving the remaining amount available for other uses by the Navajo nation.

Table 5. Estimated consumptive use, consumptive irrigation requirements and diversions for the Navajo Indian Irrigation Project in Northwestern, New Mexico.

	Per Acre	Total Irrigation Project (105,000 Productive Acres)
	-----Acre-Feet-----	
Consumptive Use	2.496	262,050
Effective Rainfall	(-) <u>0.61</u>	<u>-64,050</u>
Consumptive Irrigation Requirement	1.886	198,000
Farm Loss ¹	(+) <u>.63</u>	<u>66,150</u>
Farm Delivery	2.516	264,150
Canal, Lateral Loss ²	(+) <u>.627</u>	<u>66,150</u>
Project Delivery	3.143	330,000
Average Project Diversion		330,000
Average Irrigation Requirement		198,000
Average Non-beneficial Uses		<u>28,000</u>
Total Depletions		226,000
Losses and Returns		104,000

¹Based on 75 percent farm irrigation efficiency.

²Based on 60 percent project efficiency.

Table 6. New Mexico Water Use From Storage* in the Navajo Reservoir on the San Juan River.

Water Right	Annual Diversion acre-feet	Net Annual Depletion acre-feet	Use Contracted For	Present Level of Depletion acre-feet	Projected Date For Complete Use
Navajo Indian Irrigation Project	330,000	226,000	irrigation	none	1987
Navajo Power Plant	178,000	28,000	hydro-power	none	1979
Utah International, Inc. ¹	55,000	40,000	thermal power	40,000	completed 1970
Utah International, Inc. ^{2**}	44,000	44,000	coal gasification	none	1983
El Paso Natural Gas Company ³	28,250	28,250	coal gasification	none	1983
Public Service Company of New Mexico ^{4**}	20,200	20,200	thermal power	5,000	1979
Hammond Irrigation Project	20,000	10,000	irrigation	8,000	completed 1962
City of Gallup ^{5**}	7,500	7,500	municipal	none	unknown
Southern Union Production Company**	50	50	compressor station	50	1970

Sources: New Mexico State Engineer's Office and Appendixes to Re-Evaluation Report Navajo Indian Irrigation Project, New Mexico, August 1966.

¹This water right permit from SEO is being used by Arizona Public Service Company for cooling for the Four Corners Power Plant at Fruitland, New Mexico.

²This water right contract will be used by WESCO in the operation of four gasification plants.

³The 28,250 acre-feet depletion right to El Paso Natural Gas Company has been recommended by the Inter-State Streams Commission, and Governor, not approved by U.S. Congress; contract had not been signed as of April 1, 1975.

⁴Contract water-right approved.

⁵No contract has been signed to date.

*Some use may be supplied from return flow.

**Temporary water supply to year 2005, as per Section 11 of Authorizing Act.

Since there has been no experience in the Four Corners area with large-scale coal gasification projects, the water use requirements may or may not be accurate.

Coal Resources in the Area

Coal reserves suitable for strip mining in the San Juan Basin of New Mexico are estimated at nearly 5.8 billion tons (Table 7). The general location of the coal fields is shown in figure 1. Of this total strippable approximately 50 percent is in the San Juan Basin in New Mexico but not on the Reservation (7).

Table 7 presents a summary of reserves considered strippable under criteria designed to include coal within stripping range using current techniques, and a deeper category representing what is expected to be feasible stripping coal in the near future.

The strippable total coal reserves are nearly equally divided between those under less than 150 feet of overburden and those being deeper. Approximately 1.4 billion tons of strippable coal with less than 150 feet of overburden are located on the Reservation. The most important reserve is the Navajo Fruitland coal field being the largest and best known coal field in the San Juan Basin. Utah International, Inc. has two leases on the Navajo Fruitland field. One lease signed in 1957, covers 24,000 acres with royalty arrangements of 15 cents per ton. A second lease immediately south of the first lease covers 6,500 acres with royalty arrangements of 20 cents per ton. The combined leases have estimated reserves of more than one billion tons. One-third of this is committed to use in the Four Corners electrical generating station. Of the remaining two-thirds, about 234 million tons will be allocated initially to the WESCO Coal Gasification Plant (8). It is estimated that a total of 950 million tons of coal will be mined over a period of 25 years to support the 1,000 million cubic feet per day substitute natural gas complex planned by WESCO (9).

El Paso Natural Gas Company and Consolidation Coal Company lease the remaining 40,287 acres of the Navajo Fruitland field along the southern boundary of the Navajo Indian Irrigation Project. The lease contains estimated reserves of nearly 1 billion tons and it is scheduled for use with a 785 million cubic feet per day substitute natural gas complex planned by El Paso Natural Gas Company. Royalty arrangements of 20 cents per ton for coal used on the Reservation and 30 cents per ton for coal exported from the Reservation.

The Pittsburg and Midway Coal Mining Company lease the Gallup field, part of which is on the Navajo Indian Reservation lands about three (3) miles from the Arizona-New Mexico state line above Gallup, New Mexico. The part leased from the Navajo Tribe contains at least 75 million tons of strippable coal and the royalty is tied to the F.O.B. market price and will vary from 25 cents per ton up to 37.5 cents per tons. The Pittsburg and Midway Company provides coal for the Arizona Public Service Company Power Plant at Joseph City, Arizona. The Company mined 385,400 tons in 1970.

The Newcomb coal field is located on the Navajo Reservation and the Standing Rock field located partly on the Reservation, contain an estimated strippable

Table 7. Strippable Coal Reserves of the San Juan Basin in New Mexico.

Coal Field or Area	Depth of Overburden			
	Less than 150 feet		150 feet to 250 feet	
	Known	Inferred ¹	Known	Inferred ¹
-----Millions of short tons-----				
On or partially on the Navajo Reservation				
Gallup ²	270.0		88.0	
Newcomb		78.5		6.3
Navajo Fruitland	1,024.7		1,352.8	
Standing Rock ³		63.5		75.0
Subtotal	1,436.7		1,522.1	
Total on or Partially on Reservation		2,958.8		
Totally off the Navajo Reservation				
Chaco Canyon		31.0		
San Mateo		21.2		
Fruitland	93.0		65.0	
Zuni		6.2		
Crownpoint		15.0		
South Mount Taylor		1.4		
La Ventana		15.0		
Red Mesa		22.0		
Bisti		958.0		
Star Lake		365.0		
Subtotal		1,529.8		1,335.0
Total off Reservation		2,958.0		
Total	2,964.5		2,857.1	
Grand Total		5,821.6		

State Bureau of Mines and Mineral Resources, Strippable Low-Sulphur Coal Resources of the San Juan Basin in New Mexico and Colorado, New Mexico Institute of Mining and Technology, Socorro, New Mexico, 1971.

1. Inferred reserves are based on drill-hole or outcrop measurements more than a mile apart, and involve considerable extrapolation of data and projection of geological evidence. The inferred category encompasses a wide range of reliability, from that in areas in which drilling density is almost one hole per square mile but thickness variations are too great to permit accurate thickness contouring, to that in areas in which the reserve estimate is a speculation based on only a few measurements per township.
2. Approximately .50 percent of the acreage of the Gallup field is within the Navajo Reservation boundary.
3. The western portion of the Standing Rock field is within the Navajo reservation boundary.

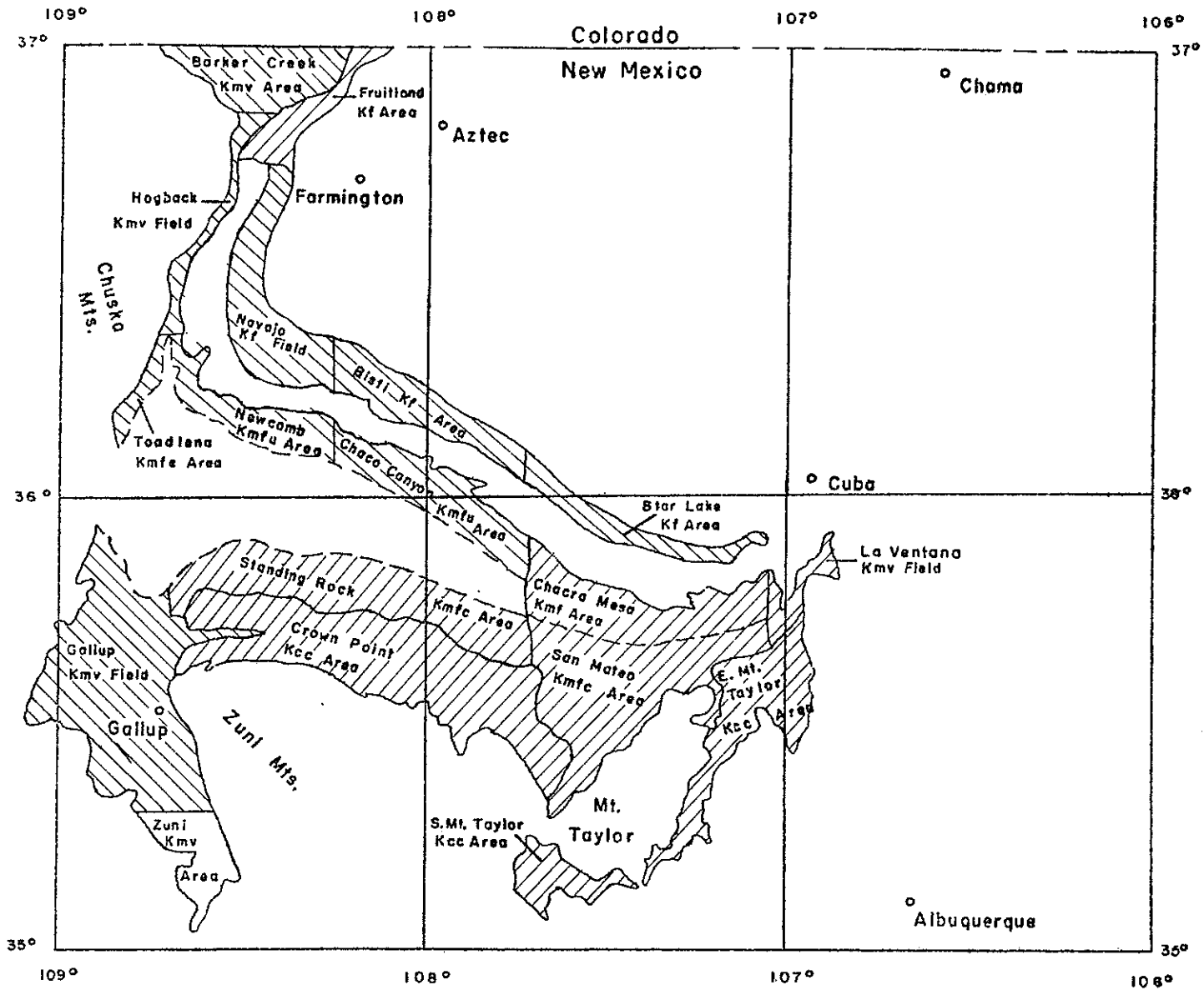


Figure 1: Fields and areas of strippable low-sulfur coal in San Juan Basin.

Source: New Mexico State Bureau of Mines and Mineral Resources

reserve of nearly 80 and 138 million tons respectively and have not been leased.

The Western Coal Company has non-Indian coal leases adjacent to the Navajo Reservation in New Mexico. These leases provide coal for the New Mexico San Juan Power Plant located between Farmington and Shiprock.

Bisti and Star Lake are two of the most important coal fields in the San Juan Basin off Navajo Reservation lands. The Bisti field is immediately adjacent to the Navajo Fruitland field on the Reservation. The Bisti and Star Lake fields together contain about 1.3 billion tons at less than 150 feet of overburden and another 1.2 billion tons between 150 and 250 feet.

Existing and Planned Coal Powered Thermal Electrical Generation Plants

The Four Corners Plant located at Fruitland is owned jointly by Arizona Public Service Company (87 percent) and the Public Service Company of New Mexico (13 percent). The Power Plant was completed in 1970 with a capacity of 2,085 million kilowatts. The plant has 39,000 annual acre-feet depletion right (Utah International, Inc.) and would deplete 8.66 million tons of coal annually if operated at 100 percent of capacity.

The plant employs approximately 315 people with an annual payroll of 4.5 million dollars. Another 478 people are employed by Utah International, Inc. in coal mining with an annual payroll of nearly 5 million dollars.

The New Mexico San Juan Power Plant, a joint venture of the Public Service Company of New Mexico and Tucson Gas and Electric, is in the development stage. Unit 2 started operations in September 1973 with a capacity of 341 million kilowatts. Unit 2 will deplete approximately 10,100 acre-feet of water and 1.30 million tons of coal annually. Unit 1 came on line in early 1975, Unit 3 in 1977, and Unit 4 in 1979, with the four unit complex having a capacity of 1,740 million kilowatts.

Unit 2 of the San Juan Plant employs 92 people with an annual payroll of over one million dollars. The four unit plant will employ approximately 180 people and another 444 will be employed in mining activities for a combined payroll exceeding 7.25 million dollars annually.

Planned Coal Gasification Plants

WESCO. Western Gasification Company (WESCO), a joint venture of Texas Eastern Transmission Corporation and Pacific Lighting Corporation, has proposed to construct and operate a coal gasification complex and the necessary support facilities. Two subsidiaries, Transwestern Coal Gasification Company and Pacific Coal Gasification Company, would be responsible for the plant design, construction, and operation. Utah International, Inc. would have the responsibility of providing coal and water resources required for the operation of the gasification plant. WESCO is currently planning for an ultimate production of 1,000 million cubic feet per day of substitute natural gas (SNG). The SNG production would be achieved over a 12-year period in four increments. The initial complex would produce 250,000 cubic feet of SNG each day in 1977 with the ultimate development to be reached in 1983.

Utah International, Inc. has a water right of 44,000 acre-feet of depletion annually which will be used by the WESCO Plants. Each 250 million cubic foot per day unit with current planning is expected to deplete 11,000 acre-feet of water and 9.13 million tons of coal annually. It is expected to have a combined plant and mine labor force of nearly 1,100 and an annual payroll of over 13 million dollars.

El Paso Natural Gas. The El Paso Natural Gas Company is planning on converting coal from their lease on the Navajo Indian Reservation to substitute natural gas according to the following schedule:

<u>Unit</u>	<u>Date</u>	<u>Total capacity</u> million cubic feet per day	<u>Water depletion</u> acre-feet annually	<u>Coal depletion</u> million tons annually
Burnham 1,				
Phase 1	1978	288	10,358	10.80
Phase 2	1979	325	11,660	12.20
Burnham 2,				
Phase 1	1980	613	22,020	23.06
Phase 2	1981	785	28,250	29.45

The complete complex is expected to provide over 2,000 jobs in plant operations and nearly 800 in mining activities. The combined annual payroll is expected to exceed \$35 million when the project is fully operational.

Water Use Relative to Employment and Income Opportunities

Based on information developed by WESCO and El Paso Natural Gas Company, with 1,000 acre-feet of depleted water used for coal gasification, on the average will create 82 jobs and annual wages of 1.25 million (Table 8).¹ Each 1,000 acre-feet of water also yields nearly \$187,000 in coal royalties to the Navajo Tribe.

Each 1,000 acre-feet of depleted water used for coal powered thermal electrical generation on the average will create approximately 25 jobs and annual wages and salaries of \$300,000.² Coal royalties to the Tribe would average about \$43,000 annually assuming new leases paid a royalty of 20 cents per ton.

Based on the Navajo Agricultural Products Industry long-range plan, each 1,000 acre-feet of water used for irrigation would, on the average, create 9 jobs and annual wages of \$55,000. Each 1,000 acre-feet of water used for

¹Economic information from both companies was grouped and averaged to arrive at this estimate.

²See footnote above.

Table 8. Comparison of Estimated Direct Income and Employment Effects of Alternative Uses of Navajo Indian Irrigation Project Water¹

Use	Direct Employment number	Direct Labor Income dollars	Direct Local Business Profits dollars	Navajo Tribal Income dollars
per 1,000 acre-feet of water depletion annual				
Coal gasification	82	1,250,000	minimal	187,000
Thermal Electrical Generation	25	300,000	minimal	43,000
Irrigation	12	80,000	8,000	35,000

¹Other alternative uses, such as footloose industries or recharging underground reservoirs, were not included in this analysis because either there was considerable doubt as to their economic feasibility or water was not one of the major resource requirements.

irrigation should also return approximately \$35,000 annually in business profits assuming an 8 percent opportunity cost for capital. Each 1,000 acre-feet of water used for irrigation should create about three (3) jobs and about \$25,000 in labor income and \$8,000 in business profits from purchases of goods and services other than labor in the local community. Coal gasification and electrical power generation industries make very few purchases in the local economy other than labor.

Each acre-foot of water used for coal gasification creates seven (7) times as many jobs and fifteen (15) times greater labor income than water used for irrigated agriculture (Table 8). Benefits paid directly to the Navajo Tribe are estimated at only four (4) times greater.

Water used for thermal electrical generation also has the potential of creating greater employment and income opportunities than if it is used for irrigation. Royalty income received by the Navajo Tribe is estimated at only slightly greater than projected business profits from agriculture.

It appears obvious that if immediate income and employment opportunities are of the greatest concern, and that no other resources (such as coal) are critically limited in supply, water should be diverted from agriculture to energy production uses. This also presumes that capital is available for energy development and a profitable market exists. Both of these conditions appear probable at the present time. However, there are other considerations such as the productive length of the development, depletion of non-renewable Navajo coal resources, and environmental impacts.

The planned gasification plants by WESCO and El Paso Natural Gas Company and the Four Corners Power Plant combined will deplete from 70 to 75 millions tons of coal annually under full production. The reserves on the Reservation under less than 150 feet of overburden are sufficient to support these plants for approximately 25 years. The coal reserves on the Reservation at depth from 150 to 250 feet are sufficient to support this level of mining activity for an additional 20 years. The Bisti and Star Lake fields off the Reservation have sufficient reserves to support this level of activity for another 30 to 35 years. There are presently no surface water rights available for development of the Bisti and Star Lake fields in the near future. The amount of Navajo Indian Irrigation Project waters that could be feasibly transferred to energy uses depends heavily upon the availability of coal reserves and the preferences of the Navajo people.