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San Juan Basin Action Plan

# SOILS, PRIME AND UNIQUE FARMLANDS TECHNICAL REPORT

for the

Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town

HD 243 .N6 S265 1982 V.10 United States Department of the Interior

DEPARTMENT OF THE INTERIO

Bureau of Land Management New Mexico State Office Santa Fe, New Mexico

October 1982 Report 10 of 22

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BUREAU OF LAND MANAGEMENT NEW MEXICO STATE OFFICE P.O. BOX 1449 SANTA FE, NEW MEXICO 87501

October 1982

Dear Interested Citizen:

Attached is one of twenty-two technical reports developed as a basis for writing the Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town (NMGS EIS). (A list of the technical reports is attached.)

These technical reports provide detailed information on the existing environment, methods used for the impact analysis, and related data supportive of the analysis and conclusions presented in the EIS. These reports should be retained for use with the Draft and Final EIS and other documents related to BLM's San Juan Basin Action Plan (SJBAP).

The Draft NMGS EIS will be filed with the Environmental Protection Agency and released for public review on November 30, 1982. Comments on the Draft EIS will be due by close of business February 7, 1983, at the BLM New Mexico State Office. Because of the large volume of material presented in the technical reports, the BLM is distributing these reports in advance of the Draft EIS to provide sufficient time for public review. The technical reports will be available for public review at the places indicated on the attached list. Copies will also be available from the BLM New Mexico State Office, U.S. Post Office and Federal Building, Santa Fe, for a copy fee.

Informational public meetings are scheduled for December 1982 to provide a public forum to clarify questions and concerns about the SJBAP proposals and the related environmental documents, which will all have been issued by that time. The meetings are scheduled as follows:

- December 14, Civic Center, Farmington, 3 to 9 PM
- December 14, Convention Center, Albuquerque, 3 to 9 PM
- December 15, Chapter House, Crownpoint, 3 to 9 PM
- December 16, Holiday Inn, Gallup, 3 to 9 PM
- December 16, Kachina Lodge, Taos, 3 to 9 PM

In addition, formal public hearings will be held in January 1983 to solicit public comments on the SJBAP Proposals. These meetings are scheduled as follows:

- January 10, Chapter House, Crownpoint, beginning at 1:00 PM
- January 12, Civic Center, Farmington, beginning at 9:00 AM
- January 14 (and 15th if necessary because of the number of registrants), Four Seasons Motor Lodge, Albuquerque, I-40 and Carlisle Blvd., beginning at 9:00 AM (each day)

IN REPLY REFER TO

NM30840EIS 1792.73(934A) Questions on the public meetings, hearings, and the technical reports themselves should be directed to:

Leslie M. Cone NMGS Project Manager BLM, New Mexico State Office P.O. Box 1449 Santa Fe, NM 87501 (505) 988-6184 FTS 476-6184

Sincerely yours,

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Charles W. Luscher State Director, New Mexico

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# List of Technical Reports

- 1. Purpose and Need
- 2. Project Description
- 3. Alternatives to the Project
- 4. Site Alternatives
- 5. Permit Reconnaissance
- 6. Air Quality
- 7. Geologic Setting
- 8. Mineral Resources
- 9. Paleontology
- 10. Soils, Prime and Unique Farmlands
- 11. Hydrology
- 12. Water Quality
- 13. Vegetation
- 14. Wildlife and Aquatic Biology
- 15. Threatened and Endangered Species
- 16. Cultural Resources
- 17. Visual Resources
- 18. Recreation Resources
- 19. Wilderness Values
- 20. Transportation
- 21. Social and Economic Conditions
- 22. Land Use Controls and Constraints

#### Availability of Technical Reports for Public Review

Individual copies of the technical reports can be obtained for a copy fee. Inquiries should be directed to:

Bureau of Land Management, New Mexico State Office Title Records and Public Assistance Section (943B) U.S. Post Office and Federal Building P.O. Box 1449 Santa Fe, NM 87501 (505) 988-6107 FTS 476-6107

Copies of the reports are available for public review at the locations listed below. [Formal and informal cooperating agencies are denoted by an asterisk (\*).]

#### BUREAU OF LAND MANAGEMENT OFFICES

#### New Mexico State Office

<u>NMGS Project Staff</u> (934A) Room 122, Federal Building Cathedral Place P.O. Box 1449 Santa Fe, NM 87501 (505) 988-6184 FTS 476-6184

San Juan Energy Projects Staff (911) Room 129, Federal Building Cathedral Place P.O. Box 1449 Santa Fe, NM 87501 (505) 988-6226 FTS 476-6226

Public Affairs Staff (912) Room 2016 U.S. Post Office and Federal Building P.O. Box 1449 Santa Fe, NM 87501 (505) 988-6316 FTS 476-6316

Division of Resources(930) 509 Camino de los Marquez, Suite 3 P.O. Box 1449 Santa Fe, NM 87501 (505) 988-6212 FTS 476-6212

Albuquerque District Office 3550 Pan American Freeway NE P.O. Box 6770 Albuquerque, NM 87107 (505) 766-2455 FTS 474-2455 Farmington Resource Area Headquarters 900 La Plata Road P.O. Box 568 Farmington, NM 87401 (505) 325-3581

Taos Resource Area Office Montevideo Plaza P.O. Box 1045 Taos, NM 87571 (505) 758-8851

<u>Socorro District Office</u> 198 Neel Avenue P.O. Box 1219 Socorro, NM 87801 (505) 835-0412 FTS 476-6280

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(505) 827-3326

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<u>New Mexico State Engineer's Office</u>\* Bataan Memorial Building Santa Fe, NM 87503 (505) 827-2423

<u>New Mexico State Planning Office</u>\* 505 Don Gasper Avenue Santa Fe, NM 87503 (505) 827-5191 OTHER ORGANIZATIONS

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<u>Woodward-Clyde Consultants, Inc.</u> 3 Embarcadero Center, Suite 700 San Francisco, California 94111 (415) 956-7070

PUBLIC AND UNIVERSITY LIBRARIES

Reading copies of the NMGS EIS and associated technical reports will be available at the following public and university libraries:

#### State and Public Libraries

Albuquerque Public Library 501 Copper Avenue NW Albuquerque, NM 87102

Aztec Public Library 201 W. Chaco Aztec, NM 87401

<u>Crownpoint Community Library</u> c/o Lioness Club, P.O. Box 731 Crownpoint, NM 87313

<u>Cuba Public Library</u> Box 5, La Jara Cuba, NM 87027

Farmington Public Library 302 N. Orchard Farmington, NM 87401

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Bureau of Indian Affairs\* Navajo Area Office Box M - Mail Code 305 Window Rock, AZ 86515 (602) 871-5151 FTS 479-5314

Bureau of Reclamation\* Upper Colorado Regional Office 125 S. State Street P.O. Box 11568 Salt Lake City, UT 84147 (801) 524-5463 FTS 588-5463

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<u>Minerals Management Service</u>\* Resource Evaluation Office 411 N. Auburn Farmington, NM 87401 (505) 327-7397 FTS 572-6254

National Park Service\* Southwest Regional Office 1100 Old Santa Fe Trail Santa Fe, NM 87501 (505) 988-6375 FTS 476-6375

National Park Service\* Environmental Coordination Office Pinon Building, 1220 St. Francis Drive P.O. Box 728 Santa Fe, NM 87501 (505) 988-6681 FTS 476-6681 U.S. Fish and Wildlife Service\* Field Supervisor, Ecological Services 3530 Pan American Highway, Suite C Albuquerque, NM 87107 (505) 766-3966 FTS 479-3966

U.S. Geological Survey (WRD)\* 505 Marquette Avenue, Room 720 Albuquerque, NM 87101 (505) 766-2810 FTS 474-2817

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Navajo Tribe\* c/o Division of Resources P.O. Box 308 Window Rock, AZ 86515 (602) 871-6592

<u>Pueblo of Zia</u>\* General Delivery San Ysidro, NM 87053 (505) 867-3304

Soil Conservation Service\* 424 N. Mesa Verde Aztec, NM 87410 (505) 334-9437

<u>U.S. Corps of Engineers</u>\* P.O. Box 1580 Albuquerque, NM 87103 (505) 766-2657 FTS 474-2657

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<u>USDA, Forest Service</u>\* District Ranger Mt. Taylor Ranger District 201 Roosevelt Avenue Grants, NM 87020 (505) 287-8833 Harwood Foundation Library (Public) 25 LeDoux P.O. Box 766 Taos, NM 87571

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# SOILS, PRIME AND UNIQUE FARMLANDS TECHNICAL REPORT

for the

Environmental Impact Statement on Public Service Company of New Mexico's Proposed New Mexico Generating Station and Possible New Town

Prepared by

Woodward-Clyde Consultants

for the

U.S. Department of the Interior Bureau of Land Management



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# NEW MEXICO GENERATING STATION



1.0 INTRODUCTION

#### BACKGROUND

Included in the recent Council on Environmental Quality Regulations (1979) are several important objectives to reduce excessive paperwork in the preparation of environmental impact statements (EISs):

- Discuss only briefly issues other than significant ones.
- Emphasize the portions of the EIS that are useful to decision makers and the public and reduce emphasis on background material.
- Prepare analytic rather than encyclopedic EISs.

In order to accomplish these objectives and still provide the depth and background required for an analytic impact statement, this technical report has been prepared for the New Mexico Generating Station (NMGS) project. In this report, impacts that were not identified as significant but which are still considered important by the public or technical specialists are analyzed. Background material is provided for those issues and impacts that were considered necessary for the comparison of alternatives. Impacts that were not identified as significant or important by the public and by technical

preparers are summarized, and reasons for their elimination from detailed analysis are discussed.

#### SUMMARY DESCRIPTION OF PROJECT COMPONENTS

Public Service Company of New Mexico (PNM) proposes to construct a 2000-megawatt (MW) coal-fired electric generation plant approximately 35 miles south of Farmington, New Mexico, in San Juan County (Map 1-1). The proposed NMGS, at ultimate development, would have four 500-MW generating units. Each generating unit would include a turbine generator area, coal pulverizer area, boiler area, particulate removal system, SO<sub>2</sub> removal system, and chimney stack. The proposed arrangement of these and other power plant components is shown in Figure 1-1. For the environmental analysis, it was assumed that commercial operation of the first 500-MW unit would begin in 1990 and that other units would start operating during the 1990s.

Coal for NMGS would be acquired through long-term contracts with Sunbelt Mining and Arch Minerals (Proposed Action) or other producers in the San Juan Basin (alternative coal supply). Coal acquired from a joint venture of Sunbelt and Arch Minerals would be supplied from surface mines (referred to as the Bisti mine in this analysis) in the immediate vicinity of the proposed plant site. Coal acquired from other producers in the San Juan Basin would be hauled from mines located as much as 30 miles from the proposed plant site. Coal required for NMGS would average 7.5 million tons per year, or a total of 300 million tons over the 40-year project life.

The proposed fuel-handling system would involve hauling coal from the Bisti mine (or other mine locations) by truck to a receiving facility located adjacent to the NMGS site. Coal would then be transferred via conveyor belt from the receiving station to active or





Source: BLM 1982.

Map 1-1. GENERAL LOCATION OF PROPOSED ACTION

#### R13W|R12W

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Source: PNM 1982.



Figure 1-1. STATION LAYOUT

emergency storage piles. All coal-handling and processing operations after active storage would be enclosed. Surfaces of emergency storage piles would be treated with a nontoxic stabilizing agent, and all storage piles and coal-processing areas would be designed so that runoff from precipitation would be diverted to the plant's water treatment system. Any coal spills from conveyor belts would be promptly removed, and percolation beneath on-site stockpiles would be controlled. Alternative fuel-handling systems include the delivery of coal from the Bisti mine to receiving station by conveyor and storage of primary crushed emergency coal on Sunbelt property north of the NMGS site.

Atmospheric emissions from the plant would be controlled by systems designed to meet applicable federal and New Mexico regulations. Control systems being considered include:

- Particulates fabric filter (Proposed Action) and electrostatic precipitator
- SO<sub>2</sub> wet limestone scrubbing or lime spray drying
- NO<sub>x</sub> dual-register burner, tangentially fired steam generator, or controlled-flow/split-flame burner

Four types of waste would be derived from coal used in NMGS: bottom ash, fly ash, coal pulverizer rejects, and flue gas desulfurization (FGD) products (sludge). Under existing laws and regulations, none of these wastes are considered hazardous. Fly ash and FGD by-products would be mechanically mixed and hauled by enddump truck to previously mined portions of the coal mine. Disposal areas would be prepared for receiving ash by backfilling with mine overburden. Ash would then be dumped and spread in layers over the mine overburden. After the ash was placed and spread, it would be covered with layers of overburden and surface soil or topsoil and then a vegetative cover would be established. Bottom ash and pulverizer rejects would be collected for disposal in dewatering bins and then hauled by end-dump trucks for disposal into previously mined portions of the coal mine. Procedures for disposal would be the same as for fly ash.

The water management system would contain all equipment necessary to treat and supply all the plant makeup water and potable water. The power plant would be designed and operated as a zero-discharge plant; wastewater would be reused by cascading it to uses requiring successively lower water quality. Used water, degraded to the extent that it could not be economically treated for further in-plant use, would be used for transport and disposal of plant-generated wastes or would be discharged to evaporation ponds (Figure 1-1). Evaporation ponds would be lined with impervious material to limit seepage losses.

Water supplies available for NMGS are believed to be sufficient to construct an all-wet heat-rejection system, based on evaporative cooling, and to use forced-draft cooling towers (Figure 1-1). Coolingtower makeup water would be drawn from the nearby raw-water storage reservoir. The makeup water would replace the tower losses from evaporation, drift, and blowdown. If sufficient water could not be secured for a totally evaporative system, a water-cooling system employing both dry and conventional wet towers might be required.

The estimated water requirement for NMGS, with four units operating at rated capacity and a heat-rejection system equipped with wet-cooling towers, would be 35,000 acre-feet per year. In order to supply this quantity of water to NMGS, the Proposed Action would involve acquiring rights to 35,000 acre-feet of water per year from the San Juan River, storing the water in the Navajo Reservoir for release upon demand, and using the natural channel of the San Juan River for delivery of water to a diversion facility downstream. If the total quantity of water required for a wet-cooling system cannot be acquired from the San Juan River, the applicant proposes to develop a well field in the vicinity of NMGS. Water from this well field would be used to make up the balance of water required for a wetcooling system. A second alternative water supply system would be based on a total supply of 20,000 acre-feet per year from the San Juan River and the use of a combination of wet- and dry-cooling towers designed to perform within the supply constraint.

The Proposed Action for a water delivery system would include the construction of a diversion facility in the vicinity of Farmington; an alternative location would be near the State Highway 44 bridge crossing at Bloomfield (Map 1-2). Pumps at the diversion facility would discharge water into two 36-inch pipelines that would deliver water to a 4000-acre-foot storage reservoir near NMGS (Map 1-1) and ultimately to the power plant. The approximately 40-mile proposed pipeline (P1) would generally require 90-foot construction rights-of-way (ROW) and would parallel the new and old portions of Highway 371 (Map 1-1). An alternative water pipeline route, P2, would begin at an intake pumping station near Bloomfield and would end at the proposed terminal storage reservoir. A 49-mile alternative water pipeline route, P3, would also originate at an intake pumping station near Bloomfield and would terminate at the proposed storage reservoir near NMGS.

In order to deliver power from NMGS to various load centers, it would be necessary to integrate the plant into the existing bulk



Note: For more information, see the location maps in Appendix G of the EIS.

Source: BLM 1982.



transmission systems of PNM and neighboring utilities. Thus the proposed transmission system would consist of a 500-kilovolt (kV) loop linking NMGS with PNM's approved 500-kV Four Corners-Ambrosia-Pajarito (FC-A-P) line, located approximately 5 miles west of NMGS, and two 500-kV lines linking NMGS with the Albuquerque distribution and load center at the proposed Rio Puerco Station (Map 1-1). The NMGS-Albuquerque system would be installed in phases: the 500-kV loop in 1990 with commencement of commercial operation of Unit 1, the first 500-kV line with Unit 2 in 1993, and the second 500-kV line with Unit 4 in 1998.

Four routes are considered technically and economically feasible for construction of the 500-kV transmission system. Route T2 is proposed for the first 500-kV line and route T1 is proposed for the second 500-kV line; routes T3 and T4 are alternatives to the Proposed Action. The total distance traversed would be similar for the two proposed and two alternative corridors: 101 miles (T2), 107 miles (T1), 105 miles (T3), and 126 miles (T4). With the exception of tower sites, the proposed 200-foot ROW could support other compatible land uses, such as grazing. PNM would keep the transmission line ROW closed and would patrol the line by helicopter each month. Lands disturbed by heavy equipment and temporary access roads would be restored to their original condition.

Table 1-1 displays construction work force estimates over time. Construction employment for station facilities would reach peaks of 1515 employees in 1987 and 1530 employees in 1992. Operations employment at station facilities would increase steadily, from 30 employees in 1989 to 900 employees in 1999 when all four units are expected to be on-line.

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Table 1-1. NMCS CONSTRUCTION AND OPERATION EMPLOYMENT

		Annua 1 Change	+85	+715	+830	-125	-560	+336	+290	+234	-304	-182	+362	-205	967-	-24	-55
	Total		85	800	1630	1505	944	1280	1570	1804	1500	1318	1680	1475	616	955	006
		Total 1	1	ł	ł	ł	30	200	250	274	410	480	650	700	724	860	006
		Unit 4	1	1	ł	ł	ł	ł	ł	ł	I	ł	ł	I	24	160	200
	eration	Unit 3	1	I	ł	ł	1	1	ł	ł	ł	30	200	250	250	250	250
	ð	Unit 2		ł	ł	· 1	ł	ł	1	24	160	200	200	200	200	200	200
		Unit 1	1	ł	ł	1	30	200	250	250	250	250	250	250	250	250	250
NMCS		Total	85	800	1630	1505	914	1080	1320	1530	1090	838	1030	775	255	95	0
	-	Unit 4	1	1	1.	I	I	1	ł	ł	30	435	076	775	255	95	I
	struction	Unit 3	1	ł	I	ł	I	07	570	1260	955	325	6	ł	1	ł	ł
	Con	Unit 2	1	1	1	30	450	076	750	270	105	ł	1	1	ł	1	1
		Unit 1	85	800	1515	1180	360	100	ł	ł	1	1	1	ł	1	ł	1
	500-kV Trans-	Line	1	I	ł	104	ł	I	1	1	ł	78	ł	1	ł	ł	1
	Intake Pipeline	and Reservoir	ł	I	115	295	1	1	1	1	ł	I	1	1	I	1	I
		Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999

Source: PNM 1980, unpublished data.

According to PNM (unpublished data, 1980), estimated construction employment skill requirements would be as follows:

<u>Skill</u>	Percent of Total <u>Construction Work Force</u>
Boilermakers	9.4
Pipefitters	14.2
Electricians	14.4
Carpenters	5.6
Ironworkers	10.0
Operators	10.0
Laborers	9.0
Teamsters	4.1
Cement masons	0.8
Millwrights	3.3
Insulators	4.0
Sheetmetal workers	1.1
Painters	1.2
Others	0.5
Supervision	12.4

The above estimates are averaged for construction of all four units.

SAN JUAN BASIN ACTION PLAN OVERVIEW AND RELATIONSHIP OF THE NMGS EIS TO ACTIONS INCLUDED IN THE PLAN

The proposed site for the NMGS is located in the San Juan Basin of northwestern New Mexico. The Bureau of Land Management (BLM) is responsible for the management of much of the land and mineral resources in this area, and currently has six separate but

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interrelated proposals under consideration within the basin. In order to respond to these, the BLM has developed a San Juan Basin Action Plan (SJBAP). This plan provides for the organizational arrangements whereby the environmental analyses and decision making can be implemented in a timely and efficient manner. The plan describes the process for preparation of three site-specific EISs (including the NMGS EIS) and three Environmental Assessments (EAs):

- Coal Preference Right Lease Applications (EA)
- San Juan River Regional Coal Leasing (EIS)
- Wilderness Study Areas (WSAs) (EIS)
- New Mexico Generating Station (EIS)
- Ute Mountain Land Exchange (EA)
- Bisti Coal Lease Exchange (EA)

In addition to these documents, the action plan provides for the preparation of a Cumulative Overview (CO). The CO is intended to focus on the cumulative impacts that would result from the proposed actions analyzed in the EISs and EAs listed above and therefore to facilitate public review and decision making. As a result of this organization, the impact analysis in the NMGS EIS and technical background reports concentrates on the impacts expected to result from the specific NMGS components proposed. The cumulative impacts expected to result from the proposed NMGS, in addition to the cumulative impacts of other proposals to be developed in the same time period, are described in the CO.

BASELINE CONDITIONS ASSUMED FOR THE NMGS TECHNICAL REPORT IMPACT ANALYSES

The site-specific impact analysis for this technical report was based on the affected environment and available resources that would be existing at the time of construction and operation of the NMGS facility. Since construction at the NMGS facility would not begin until 1985, certain assumptions regarding project development in the San Juan Basin were necessary. Two levels of project development were considered, along with criteria for each, in developing a status for the various non-SJBAP actions proposed for the San Juan Basin area.

- Baseline 1 The projects considered in this level of development are those that have approval and are to be built or under construction in 1985. This level represents the projected existing environment without the proposals included in the SJBAP.
- Baseline 2 The projects considered in this level are in some phase of the application stage. In this level, Baseline 1 projects are added to any projects in Baseline 2 along with any revision in resource production or uses (e.g., coal).

Where differences in Baselines 1 and 2 affect the results of impact analyses, discussion is provided. If no differences are identified, it should be assumed that consideration of the two different baselines did not alter the impact analyses.

A complete list of projects and comprehensive location maps for Baselines 1 and 2 are provided in Appendix C of the NMGS EIS.

#### ORGANIZATION OF THE REPORT

Section 2.0 of this technical report describes the assumptions and methodological approach used in the assessment of potential impacts of the Proposed Action on the affected environment. In C700A.S2 (PNM I & PNM II) - 10

addition, Section 2.0 contains a definition of the study area and identification of data sources.

Section 3.0, Affected Environment, contains baseline data on existing conditions in the study area, as well as projections of future conditions without the Proposed Action. Information on historical trends is presented where it is useful in providing a basis for predicting most likely future trends. The description of projected future trends takes into consideration the changes in the environment that are expected to occur as a result of the projects identified in Baseline 1. This provides a reasonable estimate of the future existing environment against which the potential impacts of the Proposed Action and alternatives can be assessed.

Section 4.0 describes the potential effects of implementing the Proposed Action and alternatives. Impacts identified are measured against indicators of significance in order to estimate the importance of the impact to the affected human environment. (Potential impacts associated with alternatives to the Proposed Action are compared in Section 9.0.)

In Section 5.0, mitigation measures are suggested. These measures would help to alleviate the potentially significant adverse impacts or enhance the beneficial impacts identified in the Section 4.0 analysis. Those potentially adverse impacts for which no appropriate mitigation measures have been suggested are discussed in Section 6.0 as "unavoidable adverse impacts."

2.0 FRAMEWORK FOR ANALYSIS

#### SOILS

#### Geographic Area of Influence

Direct impacts to the soils resource would occur primarily on areas directly disturbed (e.g., NMGS site, pipeline and transmission line ROWs and associated surface facilities, reservoir site, and borrow areas) during construction, operation, and maintenance of the Proposed Action or alternatives.

Indirect impacts to the soils resource would result primarily from increased off-road vehicle (ORV) access to previously inaccessible areas. Construction of new ROWs (e.g., pipeline and transmission lines) would allow some previously inaccessible areas to be accessible to ORVs. The degree and areal extent of such disturbances are unknown, but would probably be limited to about 5 miles on each side of new ROWs.

#### Indicators of Impact Significance

Indicators of impact significance included the degree and areal extent of disturbances, erosion susceptibility, and reclamation potential of the areas that would be directly affected during construction, operation, and maintenance of the various project components. Impacts to the soils resource were considered significant if there is a high probability that soil erosion would not be held to

acceptable levels and disturbed areas would not be able to revegetate. An "acceptable" soil erosion level is defined as the amount of soil loss that would not significantly affect the long-term productivity and stability of disturbed areas. Findings were based on analyses of soils and terrain traversed and on erosion control and reclamation measures presented in the project description (see Chapter 1.0 of the EIS).

Determination of potential problem soil areas was accomplished by analyzing published soil maps and surveys and through discussions with applicable resource agency personnel (Soil Conservation Service and BLM). Construction and erosion control/reclamation measures presented in the project description were assessed as to their adequacy for protecting against significant impacts to the soils resource. Erosion control and reclamation measures were proposed for consideration of inclusion in the project description or BLM ROW stipulations when findings from the analysis warranted.

#### Methods for Data Collection

A thorough literature search of existing soils data within the applicable portion of the San Juan Basin region was conducted. The applicable soils data sources used include Soil Conservation Service (SCS) soil surveys/publications and SCS Form 5, Soil Interpretation Tables; SCS/New Mexico State University, Agricultural Experiment Station, research reports; and a PNM-contracted soil survey for the NMGS site.

An aerial reconnaissance and partial ground survey of proposed and alternate project components was performed. SCS and BLM personnel were contacted for additional soils information.

# Interrelationships with Baselines 1 and 2

Consideration of the energy and resource-related projects in Baselines 1 and 2 generally does not change the potential soils resource impacts attributable to the NMGS project. The one exception is the interrelationship between the NMGS project and the Navajo Indian Irrigation Project (NIIP). Potential impacts are discussed under the applicable project components.

# PRIME AND UNIQUE FARMLANDS

#### Geographic Area of Influence

Significant impacts to Prime or Unique Farmlands would occur only on areas that would be taken out of production by surface facilities associated with the Proposed Action or alternatives (e.g., NMGS, San Juan River intake, pipeline pump stations, reservoir site, or transmission towers/substations). This is based on the premise that topsoiling would be performed on all temporarily disturbed irrigated cropland areas.

#### Indicators of Impact Significance

Impacts were considered significant if any Prime or Unique Farmlands would be taken out of production by surface facilities associated with the Proposed Action or alternatives.

#### Methods for Data Collection

Appropriate SCS offices were contacted for information regarding the locations of Prime and Unique Farmlands in the project area. Data sources included the Prime Farmland list (by soil mapping unit) for San Juan County and locational descriptions provided by SCS personnel. Additionally, SCS/New Mexico State University, Agricultural Experiment Station, research reports were used to ascertain potential Prime Farmland areas within the proposed and alternate transmission corridors.

# Interrelationships with Baselines 1 and 2

Consideration of the energy and resource-related projects in Baselines 1 and 2 generally does not change the potential impacts to Prime and Unique Farmlands. The one exception is the interrelationship between the NMGS project and the NIIP. Potential impacts are discussed under the applicable project components.
3.0 AFFECTED ENVIRONMENT

## SOILS

Soils maps (1:24,000 and 1:62,500 scales) for the proposed NMGS site, proposed and alternate main water pipelines, and proposed and alternate terminal storage reservoirs are available for review at the BLM New Mexico State Office in Santa Fe. Maps (1:250,000 scale) showing the soils identified within the proposed and alternate transmission corridors are also available for review at that location.

The soils in the San Juan Basin that would potentially be affected by the proposed NMGS project or alternatives have resulted primarily from erosion and weathering of sedimentary parent materials (e.g., sandstone, shale, and siltstone). Surface textures are primarily sandy, but range from fine sand to clay. Many of the identified soils are moderately to highly susceptible to wind-induced soil erosion, while water erosion susceptibility is generally low to moderate.

Overall, the soils identified in the project area are not very productive because of low available moisture, low organic matter content, and undesirable physical and chemical characteristics.

## Proposed NMGS Site

The proposed NMGS site is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). The area is underlain by deep Tertiary fill resting on rocks of Late Cretaceous age. Annual precipitation generally ranges from 6 to 10 inches at the site. Five different soil associations were identified at the proposed NMGS site. Table 1 lists and characterizes the identified soils.

The soils identified within the proposed NMGS site are primarily deep, and well to somewhat excessively drained. Surface textures of the soils identified at the site range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, intermittent drainageways, and escarpments. The terrain slopes range mainly from nearly level to moderately sloping, but a small, steep area of Badland-Rock Outcrop is present on the south-central portion of the site. Badland-Rock Outcrop comprises approximately 2 percent of the total site area. Topsoil availability at the site is limited due to generally shallow soil surface layers, and the majority (approximately 80 percent) of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. These soils are characterized by a low to high wind erosion hazard, and a primarily moderate water erosion hazard. Sandy-textured soils such as Sheppard, Fruitland, Stumble, and Duneland are highly susceptible to wind erosion. Soils which contain a high percentage of clay or silt particles are normally the most susceptible to water erosion, but unstabilized sandy soils occurring in drainages (e.g., Riverwash) are also highly susceptible to water erosion. The soils at the site are mildy to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell

Table 1. CHARACTERISTICS OF THE SOILS IDENTIFIED AT THE PROPOSED NCS

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65 ass 'K' 'T' Connents	<ul> <li>3.24 5 Moderate to high wind erosion hazard, mod</li> <li>10 5 erate to low water erosion hazard, good t</li> <li>4L .32 1 poor topsoil, 6-10 inch precipitation zon</li> <li>These soils are mildly to strongly alkali</li> <li>(Huerfano portion is sodium affected), an</li> <li>shrink-swell potential is low to moderate</li> </ul>	<ul> <li>4L .37 5 Low to high (Fruitland portion) wind ero- 3,5 .28 5 sion hazard, moderate water erosion hazar</li> <li>5 .28 5 fair to good topsoil, 6-10 inch precipita tion zone. These soils are mildly to strongly alkaline (calcareous), and shrink swell potential is low to moderate.</li> </ul>	<ul> <li>24 5 Low to high (Stumble portion) wind erosio</li> <li>.37 5 hazard, moderate water erosion hazard, po</li> <li>.32 1 to fair topsoil, 6-10 inch precipitation</li> <li>to fair topsoil, 6-10 inch precipitation</li> <li>to scills are moderately to</li> <li>strongly alkaline (Notal-Huerfano portion</li> <li>is sodium affected), and shrink-swell</li> <li>potential is low to high (Notal portion).</li> </ul>	<ul> <li>NA NA Low and high (Duneland portion) wind ero- .15 5 sion hazard, high (Riverwash portion) and low water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Riverwash portion is frequently flooded, and shrink- swell potential is low.</li> </ul>	<ul> <li>NA NA Wind erosion hazard is low, Badland portiv</li> <li>NA NA is susceptible to water erosion, topsoil generally nonexistent (i.e., poor topsoil 6-10 inch precipitation zone. Potential runoff on Badland portion is very rapid.</li> </ul>
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Depth to Bedrock (inches)	60+ 10-20	\$ <del>\$</del> \$	60+ 10-20 10-20	\$ \$	<b>a o</b>
Soil Series	Shiprock Sheppard Huerfano	Turley Fruitland Blancot	Stumble Notal Huerfano	Riverwash Dune land	Badland Rock Outcrop
Approximate Acreage	911	288	65.	114	z
Soil Association and Description	hiprock-Sheppard-Huerfano: Deep to shallow, ell to somewhat excessively drained, fine andy loam, fine sand, loamy fine sand, sandy lay loam, sandy loam, and clay loam soils. hese soils formed on nearly level to strongly loping mesas, plateaus, and upland valley loping mesas, plateaus, and upland valley ottoms from sandy alluvial and colian materi- ls derived from sandstone; and from alluvium, esiduum, and loess derived from shale and iltstone.	<u>urley-Fruitland-Blancot</u> : Deep, well drained, .lay loam, loam, fine sandy loam, and sandy oam soils formed on level to moderately steep lluvial fans, upland valley sideslopes, and esas from mixed alluvium derived from sand- tone and shale.	tumble-Notal-Huerfano: Deep, somewhat exces- ively and well drained, loamy sand, loam, andy clay loam, silty clay loam, clay, silty lay, and sandy loam soils formed on level to oderately sloping alluvial fams, upland valle; ideslopes and bottoms, drainage-arys, and mesas ron alluvium and residuum derived from sand- tone, shale, and siltstone.	<u>ivervaeh-Duncland</u> : Deep, poorly to excen- ively drained, unstabilized sandy, silty, layey, and gravelly alluvium occurring on leve and nearly level floodplains, streambeds, and rroyos; and unstabilized eolian sand occurring a nearly level to steep mesas, plateaus, and ejor drainageways.	<u>adland Rock Outcrop</u> : Nonstony, moderately loping to extremely steep barren shale uplands hat are dissected by deep intermittent drain- geways and gullies; and barren sandstone ex- osures on moderately sloping to extremely teep ridges, benches, and escarpuents.

NA = Not available or not applicable.

1 Sources:

Aucharan, B. 1978. Soils field research, soils map. Prepared (under contract) for Public Service Coupany of New Mexico. Albuquerque, New Mexico.
 U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part.
 Applicable SCS Form 5 - Soil Interpretation Tables.

December and January only (i.e., water table is lower most of year).

3-3

C700AS.3 (II) - 3

potential. These soils are used primarily for livestock grazing and wildlife habitat.

## Water Supply System

<u>Proposed Main Water Pipeline Pl</u>. Pipeline route Pl is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation along Pl is usually about 8 inches. Twenty-three different soil phases, series, associations, or complexes were identified along this route. Table 2 lists (by mileposts) and characterizes the identified soils.

The soils identified along the pipeline route Pl are primarily deep and well to somewhat excessively drained. Surface textures range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, drainageways, valley bottoms, valley sides, and alluvial fans. The terrain slopes range mainly from nearly level to moderately sloping, although a small area of moderately sloping to steep Badland would be traversed near Moncisco Mesa (between MP 15.45-16.8). Approximately 5.1 miles of Badland (nonstony, barren shale) and Badland-Rock Outcrop would be traversed by this pipeline route. Topsoil availability along this pipeline route is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. The Blackston (mileposts [MP] 0.05-0.10; adit/shaft portion), Persayo (MP 0.1-0.6; 0.65-0.75; 0.85-2.70; and 2.85-3.30) and Muff (MP 17.30-19.2; 22.85-22.90; and 23.40-23.50) soils are difficult to reclaim if the topsoil is removed and not replaced. Susceptibility to wind-induced soil erosion ranges from low to high, but it is primarily moderate to high. Susceptibility to water-induced

	Comment a	ow wind erosion hazard, moderate ater erosion hazard, fair topsoil too clayey), 8 inch precipitation one. Surink-swell potential is low o moderate, high corrosion hazard o uncoated steel, not well suited o urban development (wetness).	ow wind erosion hazard, low to high ater erosion hazard, poor topsoil area reclaim), 9 inch precipitation one. Strink-swell potential is low, igh corrosion hazard to uncoated teel.	oderate wind and water erosion har- rd, poor topsoil (area reclaim), 8 ach precipitation zone. Shrink- well potential is moderate, high orrosion hazard to uncoated steel.	oderate wind and water erosion har- rd, poor topsoil (Persayo portiou- rea reclaim), 8 inch precipitation one. Surink-swell potential is low o moderate, low to high corrosion azard to uncoated steel.	oderate wind erosion hazard, high ater erosion hazard, fair topsoil ercess salt), 8 inch precipitation one. Shrink-swell potential is low, oil is slightly saline, high cor- osion hazard to uncoated steel.	oderate wind and water erosion har- rd, poor topsoil (Persayo portion- rea reclaim), 8 inch precipitation one. Surink-swell potential is low o moderate, low to high corrosion azard to uncoated steel.	oderate wind erosion hazard, high ater erosion hazard, fair topsoil excess salt), 8 inch precipitation one. Surink-swell potential is low, oil is slightly saline, high cor- osion hazard to uncoated steel.
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Coll Direct	or Series	Herlog	Haplargids Blackston Torriorthents	Badland Rock Outcrop Pernayo	Fart Persayo Rock Outcrop	Avalon	Fart Peraayo Bock Outcrop	Avalon
Svil Phase Corrise Association	or Complex and Description	<u>Merlog</u> : Deep, somewhat poorly drained, loam and clay loam soils formed on level and nearly level floodplains and terraces from alluvium derived primarily from sand- stone and shale. Stratified sand, gravel, and cobbles below 60 inches.	Huplargids-Blackston-Torriorthents: Shal- low to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moder- ately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	<u>Badland Rock Outcrop-Persayo</u> : Shallow, well drained, clay loam, and silty clay loam soils formed on steep hills, ridges, and breaks in material derived primarily from shale. Includes steep, nonstony, barren shale on uplands that are dissected by deep intermittent drainageways and gul- lies, and barren sandstone outcrops on steep to very steep ridges, benches, and escarpments.	Farb Persayo Rock Outcrop: Wery shallow to shallow, ercessively and well drained, fine sandy loam, sundy clay loam, clay loam, and silty clay loam soils formed on gently sloping to moderately steep hills and breaks from residuan derived from sand- stone and shale. Includes barren sandstone outcrops on strongly sloping to moderately steep beaches, ridges, and breaks.	<u>Avalon</u> : Deep, well drained, loam soils formed on level to gently sloping measa and plateaus from alluvial and colian materials derived primarily from sand- stone and shale.	<u>Farb Persayo Rock Outcrop</u> : Wery shallow to shallow, excessively and well drained, fine samdy loam, sandy clay loam, clay loam, and silty clay loam soils formed on gently sloping to moderately steep hills and breaks from residam derived from sand- stone and shale. Includes barren sandstone outcrops on strongly sloping to moderately steep benches, ridges, and breaks.	<u>Avalon</u> : Deep, well drained, loam soils formed on level to gently sloping mesas and plateaus from alluvial and colian materials derived primarily from sand- stone and shale.
K	Symbol	*	1	2	<b>FA</b> .	Ā	2	₽ <b>X</b>
	Milepost	0.0-0.0	0.05-0.10 <sup>2</sup>	0.10-0.20 <sup>2</sup>	0.20-0.60	0.60-0.65	0.65-0.75	0.75-0.85

3-5

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MADE WATER FIFELINE BOURE FI

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WAIFE FIFELINE ROUTE PI (continued)

Connects	Moderate vind and water erosion har- ard, poor topsoil (Persayo portion- area reclaim), 8 inch precipitation zroe. Surink-swell potential is low to moderate, low to high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Moderate wind and water erosion haz- ard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink- swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Moderate vind and water erosion haz- ard, poor topsoil (area reclaim), 8 inch precipitation zone. Shrink- ewell potential is moderate, high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Strink-swell poten- tial is low, high corrosion hazard to uncoated steel.
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Depth to Bedrock (inches)	5-2X 10-2X 0	60+ 60+	\$	10-20 66+	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	60+ 10-28 64	\$\$\$
Soil Phase or Series	Farth Persayo Rock Outcrop	Fruit land Persayo Sheppard	Avalon	Fruit land Persayo Skeppard	Badland Rock Outcrop Persayo	Fruit land Persayo Sheppard	Sheppard Hayqueen Shiprock
Soil Phase, Series, Association, or Complex and Description	<u>Farb Persayo-Rock Outcrop</u> : Very shallow to shallow, excessively and well drained, fine sandy.losm, sandy clay losm, clay losm, and silty clay losm soils formed on gently sloping to moderately steep hills and breaks from residum derived from sand- stone and shale. Includes barren sand- stone outcrops on strongly sloping to mod- erately steep benches, ridges, and breaks.	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and eolian materials derived from sandstone and shale.	<u>Avalor</u> : Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loany fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residum, and eolian materials derived from sandstone and shale.	Badland-Rock Outcrop-Persaryo: Shallow, well drained, clay loam, and silty clay loam soils formed on steep hills, ridges, and breaks in material derived primarily from shale. Includes steep, nonstony, barren shale on uplands that are dissected by deep intermittent drainageasys and gul- lies, and barren sandstone outcrops on steep to very steep ridges, benches, and escarpuents.	Fuitland Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils founed on moderately sloping to moderately steep hills, uesas, plateaus, fans, and breaks from alluvium, residuum, and colian materials derived from sandstone and shale.	Sherpard Hayqueen-Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately slop- ing mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.
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Reaction (pH)	7.9-8.4	7.9-8.4 7.9-8.4 7.4-8.4	7.9-8.4	7.9-8.4 7.9-8.4 7.9-8.4	7.9-8.4	7.4-8.4 7.9-8.4 7.9-8.4	1484	7.4-8.4	1.9-8.4
Depth to High Mater Table (feet)	*	* * *	*	***	*	***	*	*	*
Slope (I)	2-8	III	2 <del>-8</del>	522	ĩ	311	ł	0-3	2
Depth to Bedrock (inches)	<b>\$</b>	\$\$\$	Ş	\$\$\$	Ş	\$\$\$	\$	<del>\$</del>	\$
Soil Phase or Series	Avalon	Sheppard Mayqueen Shiprock	Avalon	Shiprock Sheppard Mayqueen	Avalon	Shiprock Shepyard Mayqueen	Ĩ	Rhiprock	Avalon
Soil Phase, Series, Association, or Complex and Description	alon: Deep, well drained, sandy losm, ne sandy losm, and losm soils formed on ntly to moderately sloping mesas and atesus from alluvial and colian materi- s derived primarily from sandstone and ale.	erpard Maryueen-Shiptrock: Deep, some at excessively and well drained, loany ne sand, fine sand, and fine sandy loan ils formed on level to moderately slop- g meass and plateaus from alluvial and slian materials derived from sandstons, ale, and mixed sources.	alon: Deep, well drained, sandy losm, ne sandy losm, and loam soils formed on notly to moderately sloping mesas and attenue from alluvial and colian wateri- a derived primarily from sandstone and wele.	<u>ipproct-Sherpart Harqueen</u> : Deep, some- at excessively and well drained, loany ine sand, fine sand, fine sandy loan, and may loan soils formed on level to moder- cely sloping mesas and plateaus from al- vial and colian materials derived from motecore, shale, and mixed sources.	<u>alon</u> : Deep, well drained, sandy loen, d loam soils formed on moderately slop- g meass and plateaus from alluvial and olian materials derived primarily from undatone and shale.	iprock-Sherpard Hayquega: Deep, some- at excessively and well drained, loany ine sand, fine sand, fine sandy loan, and may loan soils formed on level to moder- tely sloping meass and plateaus from al- vial and colian materials derived from ndstone, shale, and mixed sources.	<pre>zek: Deep, well drained, lowm, and layer lowm soils formed on level and early level messe, plateaus, and ter- uces from alluvium derived primarily row sendstone and shale.</pre>	<pre>ipproxk: Deep, well drained, fine indy loss, and sendy losm soils formed a level and nearly level meass and pla- sume from alluvial and colian materials erived primarily from sendstone and shale.</pre>	<pre>(3.00: Deep, well drained, aandy loam, d fine aandy loam soils formed on gently loping measa and plateaus from alluvial d solian materials derived primarily tom sandstone and shale.</pre>
dan k	v/Ax A f B B B B B	ଆ ନ ୟ କ ଲ କ କ କ ଅ	A XA/V	//so/	¥	So 20	đ	d d	4
Milepost S	06-E-23.E	3.9 4.0	SE. 4-0.4	4.356.0 S	6.0-6.25	0. E1-25. ð	20. E1-0. E1	01.EI-20.EI	21.61-01.61

3-7

	day	Soil Phase, Series, Association, or Complex and Description	Soil Phase or Series	Depth to Bedrock (inchea)	Slope (X)	High Wate Table (feet)	r Soil Reaction (pH)	Salinity (undros/ cm)	Hydro- logic Group	WEG	H	F	Connent s
Milepoet 8	Sel 10	or topics and been prove Sherpourd Hayrqueen Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately slop- ing meass and plateaus from alluvial and colian materials derived from sendatone,	Sheppard Mayqueen Shiprock	\$\$\$	272	***	7.984	999	<b>4</b> 10 10	~~~	51.44	~~~	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncosted steel.
22. EI-02. EI	A	whale, and mixed sources. <u>Avalon</u> : Deep, well drained, andy losm, and fine sandy losm soils formed on gently sloping messas and platesus from alluvial and colian materials derived primarily from sandstone and shale.	Avalon	\$	2-5	*	7.9-8.4	<b>3-8</b>	<b>F</b>	m	E.	m	Moderate wind and water erosion har- ard, topsoil is fair (ercess salt), 8 inch precipitation zone. Shrink- swell potential is low, soil is slightly saline, high corrosion hazard to uncosted steel.
3.E1-25.E1	Sm/ Sd	Shiprock-Sheppard Havoucen: Deep, some- what excessively and well drained, loany fine sand, fine sandy loan, and sandy loan soils formed on level to moder- ately sloping mesas and plateaus from al- luvial and colian materials derived from sandstone, shale, and mixed sources.	Shiprock Skeppard Mayqueen	\$\$\$	522	***	7.4-8.4 7.9-8.4 7.9-8.4	999	xa ≪ xa	m H H	25.25	<b>~~</b> ~	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch pre- cipitation zone. Surink-swell poter- tial is low, high corrosion hazard to uncoated steel.
L. EL-2, EI	2	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level messas, plateaus, and ter- races from alluvium derived primarily from sandstone and shale.	bak	\$	1	*	4.8-4.1	a	<b>A</b>	Ŷ	ι.	'n	Low wind erosion hazard, moderate water enosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Surink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.
1.41-7.61	S4/8	<ul> <li>Sherpoard Havoucen-Shiprock: Deep, some- what excessively and well drained, losary fine sand, fine sand, and fine sandy losar soils formed on level to moderately slop- ing mesas and platesus from alluvial and colian materials derived from sandstone, shale, and mixed sources.</li> </ul>	Sheppard Mayqueen Shiprock	\$\$\$	252	***	7.9-8-4 4-8-4 1-4-8-4	999	<b>≼</b> ⊠ ⊠	225	રાં શ્વય	ν ν ν ν	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low, high corrosion hazard to uncosted steel.
241-14.5	D6/01	Dogk: Deep, well drained, loss, and clay loss soils formed on level to gently sloping ueses, platesus, and terraces from alluvium derived primarily from sandstone and shale.	Doak	\$	3	*	7.4-8-4	a	<b>A</b>	Ŷ	ις. ·	Ś	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Surink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncosted steel.
14.5-14.8	3	Sheppend Harqueen Shiprock: Deep, some- what excessively and well drained, lowny fine sand, fine sand, and fine sandy loem soils formed on level to moderately slop- ing meass and plateeus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Sheppard Nayquean Shiprodk	\$\$\$	772	***	7.9-6.7	999	<b>≪</b> m2 m2		2.4.4	הטט	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.
14.8-15.2	ສ ນ	Dosk: Deep, well drained, loss, and clay loss soils formed on level to gently sloping meass, plateaus, and terraces from alluvium derived primarily from sundstone and shale.	A L	3	4	*	7.4.8.	4	<b>A</b>	Ŷ	ب	Ś	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Surink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncosted steel.
15.25-15.	45 8	d <u>Shepoard Harqueen-Shiprock</u> : Deep, some- what excessively and well drained, lossy fine sand, fine aud, and fine sandy loss soils formed on level to moderately shop- ing and placed to moderately shop-	Sheppard Hayqueen Bhiprode	333	749	***	7.9-8. 7.9-8. 7.4-8.	444	<b>4 8 8</b>	мим •	मनन	~~~	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low, high corrosion hazard to tial is low, high corrosion hazard to

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Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER FIFELINE BOUR P1 (continued)

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Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE PI (continued)

	Man	Soil Phase Cariae According	Cost Base	Depth to		Depth to High Wate	r Soil	Salinity	Hydro-	į			
dilepost	Synto	or Complex and Description	or Series	(inches)	adors	(feet)	(pH)	(m) (m)	log1c Group	VEX: Class	1 <b>K</b> 1	ıL,	Coment e
15.45-16.8	M	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands	Badland	0	28 89	¥	¥	¥	¥	¥	¥	¥	8 inch precipitation zone.
		the are unsected by deep intermittent drainageweys and gullies.											
16.8-17.3	AZ	Avalour-Sheppard-Shiptrock: Deep, well and somewhat excessively drained, sandy loam, loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately sloping mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Avalon Sheppard Shiprock	\$\$\$	0 7 0 -5 -5	* * *	7.9-8.4 7.9-8.4 7.4-8.4	299	<b>24 4</b>	999	.37 .15 .24	ς in το	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.
.7.2-19.2	Ħ	<u>Huerfaro-Miff-Uffens</u> : Shallow to deep, well drained, sandy clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately slop- ing mesas and valleys from alluvian and residuan derived primarily from shale and siltstone.	Huerfano Muff Uffens	82-58 64 + 65	333	* * *	7.9-9.0 7.4-8.4 7.4-8.4	278	<b>A A A</b>	· 山 子 子 子 の の	.28	- 6 -	Moderate vind and water erosion haz- ard, topsoil is poor due to shallou- ness and excess salt/sodium (Muff portion-area reclaim), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-73%, high cor- rosion hazard to uncosted steel.
19.2-22.7	8	Sheppard Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loany fine sand, fine sand, sandy clay loan, clay loan, and clay soils formed on level to moderately sloping valley bottons, fams, mesas, and plateaus from eolian, alluvial, and residual materials derived from sundstone, shale, and siltstone.	Sheppard Huerfano Notal	\$ 5 4 5 4 5 4	6-3- 6-3-3- 6-5-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-3-	***	7.9-9.0 7.9-9.0 7.9-9.0	5×2	<b>4</b> 00	<b>2</b> 44	.15 .32 .32	S H S	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is fair to por, 8 inch pre- cipitation zone. Surink-swell poten- tial is low to high, exchangeable sodium content ranges from 15-75 for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
22.7-22.8	D	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping messas and plateaus from alluvium derived primar- ily from sandstone and shale.	Doak Uffens	\$ \$	22	**	7.4-8.4 7.4-8.4	2 I	# <b>D</b>	m m	ы. Я	2 I	Moderate wind and water erosion haz- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
22.8-22.85	8	Sheppard Hierfaro-Notal: Deep and shallow, somewhat ercessively and well drained, loany fine sand, fine sand, sandy clay loan, clay loan, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	50+ 50+ 50+	523	* * *	7.9-8.4 7.9-9.0 7.9-9.0	0×2	<b>∢</b> ⊖ ⊖	557	.15 .32 .32	N T N	Woderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
2.85-2.9	8	<u>Hherfaro Miff-Uffens</u> : Shallow to deep, well drained, sardy clay loan, clay loan, very fine sardy loan, and fine sardy loan soils formed on level to moderately slop- ing mesas and valleys from alluvium and residuam derived primarily from shale and siltstone.	Huerfano Miff Uffena	85 4 4 5 5 4 5 5 5 4 5 5 5 4 5 5 5 5 5 5	292	* * *	7.9-9.0 7.4-8.4 7.4-8.4	223	<b>A A A</b>	a a fi	.32 .28 .20		Moderate vind and water erosion haz- ard, topsoil is poor due to shallow- ness and excess salt/sodium (Muff portion-area reclaim), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-7%, high cor- rosion hazard to uncoated steel.
22.9-22.95	B	Doak-Uffeng: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvin derived primar- ily from sandstone and shale.	Doak Uffens	\$\$	22	* *	7.4-8.4	24	¤ Q	m m	£. 8.	<b>с</b> -	Moderate vind and water erosion har- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to underate, high corrosion hazard to uncoated steel.

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER FIFELINE ROUTE P1 (continued)

	tand, pre- oter- d to	haz- cess cip- ntial xn	zard, zard, pre- oter- s	nar- low- scip- rtial	zard, zard, pre- pten- d to	baz- cess cip- ntial xn	ьс. ., .	card, bre- bre-
Connent s	Moderate to high wind erosion ha low to moderate water erosion ha topsoil is poor to good, 8 inch cipitation zone. Shrink-swell p tial is low, high corrosion haza uncoated steel.	Moderate wind and water erosion ard, topsoil is fair to poor (ex clay or salt/sodium), 8 inch pre itation zone. Surink-swell pote is low to moderate, high corrosi hazard to uncoated steel.	Moderate to high wind erosion ha low to moderate water erosion ha topsoil is fair to poor, 8 inch cipitation zone. Surink-swell p tial is low to high, exchangeabl sodium content ranges frum 15-75 for Huerfano-Notal portion, high corrosion hazard to uncoated ste	Moderate vind and water erosion ard, topsoil is poor due to shal ness and excess salt/sodium (Muf portior-area reclaim), 8 inch pr itation zone. Shrink-swell pote is low to moderate, exchargeable sodium content is 25-757, high o rosion hazard to uncosted steel.	Moderate to high vind erosion ha low to moderate water erosion ha topsoil is poor to good, 8 inch cipitation zone. Shrink-swell p tial is low, high corrosion haza uncoated steel.	Moderate vind and water erosion ard, topsoil is fair to poor (ex clay or salt/sodium), 8 inch pre itation zone. Shrink-swell pote is low to moderate, high corrosi hazard to uncosted steel.	Moderate wind and water erosion ard, topsoil is fair (excess sal 8 inch precipitation zone. Shri swell potential is low, soil is slightly saline, high corrosion hazard to uncosted steel.	Moderate to high wind erosion ha low to moderate water erosion ha topsoil is poor to good, 8 inch cipitation zone. Shrink-swell p
ıL,	ν ν ν	1 2	ν <del>ι</del> ν	- 6 -	ν ν ν	1 2	e	ς S S S S S S S S S S S S S S S S S S S
۲ <b>۲</b> ,	.15 .24 .24	ર શ			.15	.8	۲ <i>٤</i> .	.15 .24 .24
WEC Class	222	<b>n</b> n	233	ц т т т т т т т т т т т т т т т т т т т	8 8 M	n n	e	999
Hydro- logic Group	<b>4</b> 29 29	8 0	<b>4</b> 00	8 A A	<b>4</b> 82 82	<b>M</b> A	<b>2</b>	<b>4</b> xa xa
alinity (muhoa/ cm)	aaa	0 <b>3</b>	0×2	8 F X	aaa	0 J	2-8	<u>a</u> aa
Soil S Reaction (pH)	7.9-8.4 7.9-8.4 7.4-8.4	7.4-8.4	7.9-8.4 7.9-9.0 7.9-9.0	7.4-8.0	7.9-8.4 7.9-8.4 7.4-8.4	7.4-8.4	4.9-6.7	7.9-8.4 7.9-8.4 7.4-8.4
Depth to High Water Table (feet)	* * *	* *	* * *	* * *	* * *	**	*	* * *
Slope (1)	572	22	0-3	565	2 <b>8</b> 8	33	2-5	5 7 Z
Depth to Bedrock (inches)	\$ \$ \$	\$\$	66 64 86	808 60-	\$ \$ \$	\$\$	\$	\$\$\$
Soil Phase or Series	Sheppard Mayqueen Shiprock	Doak Uffens	Sheppard Huerfano Notal	Huerfano Muff Uffens	Sheppard Hayqueen Shiprock	Doak Uffens	Avalon	Sheppard Mayqueen Shiprock
Soil Phase, Series, Association, or Complex and Description	Sheppard Mayqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstone and shale.	Sherpard Hierfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottons, fans, wesas, and plateaus from colian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Huerfaro-Muff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately shop- ing mesas and valleys from alluvinm and residuam derived primarily from shale and siltstone.	Sheppard Mayqueen-Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately shop- ing mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Doak-Uffens: Deep, well drained, very fine sandy loan, sandy clay loan, fine sandy loan, and clay loan soils formed on level to gently sloping mesas and plateaus from alluvium derived primer- ily from sandstone and shale.	<u>Avalon</u> : Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and colian materials derived primarily from sandstone and shale.	Sherpard Mayqueen Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately shop-
Map Symbol	3	Z	8	Ē	2	12	Av	8
Milepost	22.95-23.0	23.0-23.3	4. <del>2.</del> -22.	2. 12-4. 12	2.2.2	23.52	23.6-23.7	23.7-23.8

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Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE PI (continued)

Coments	Moderate wind and water erosion haz- ard, topsoil is fair (ercess salt), 8 inch precipitation zone. Shrink- swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Moderate vind and water erosion haz- ard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink- swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.	High and moderate vind erosion haz- ard, low to moderate water erosion hazard, poor to good topsoil, 8 inch precipitation zone. Surink-swell potential is low, high corrosion hazard to uncosted steel.	Moderate vind and water erosion haz- ard, topsoil is fair (excess salt), 8 inch precipitation zone. Shrink- swell potential is low, soil is slightly saline, high corrosion hazard to uncosted steel.	Moderate wind and water erosion haz- ard, good topsoil, 8 inch precipita- tion zone. Strink-swell potential is low, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Swink-swell poter- tial is low, high corrosion hazard to uncoated steel.	Moderate wind and water erosion haz- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
F	m	ν N N N	e	ν N N	m	Ś	~~~	- C
,K	ي ا	.15 .24 .24	ي ا	.15 .24 .24	ŗ.	-24	.15 .24 .24	ю. 8
WEC Class	m	999	e	<b>N W N</b>	m	m	200	m m
Hydro- logic Group	£	<b>4</b> 8 8	24	<b>4</b> 84 84	<b>P</b> 2	pa	<b>4</b> 8 8	¤ Ω
alinity (unhos/ cm)	5-8	aaa	2-8	2 2 2	2-8	Q	<u>aaa</u>	2 <b>z</b>
r Soil S Reaction (pH)	7.9-8.4	7.9-8.4 7.9-8.4 7.4-8.4	7.9-8.4	7.9-8.4 7.9-8.4 7.9-8.4	7.9-8.4	7.9-8.4	7.9-8.4 7.9-8.4 7.4-8.4	7.4-8.4 7.4-8.4
Depth to High Wate Table (feet)	*	* * *	*	* * *	*	*	***	**
Slope (1)	2-5	111	2-5	9 2 2 P	2-5	ĩ	ር <mark>ፑ</mark> ቪ	11
Depth to Bedrock (inches)	\$	\$\$\$	\$	\$\$\$	\$	\$	\$ \$ \$	\$\$
Soil Phase or Series	Avalon	Sheppard Mayqueen Shiprock	Avalon	Sheppard Shiprock Mayqueen	Avalon	Shiprock	Sheppard Mayqueen Shiprock	Doak Uffens
Soil Phase, Series, Association, or Complex and Description	<u>Avalon</u> : Deep, well drained, sandy loan, and fine sandy loan soils formed on gently sloping mesas and plateaus from alluvial and colian materials derived primarily from sandstone and shale.	Sheppeard-Mayqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	<u>Avalor</u> : Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and colian materials derived primarily from sandstone and shale.	Sheppard-Shiprock-Hayqueen: Deep, some- what excessively and well drained, loamy fine sand, fine sand, fine sandy loam, sandy loam, and sandy clay loam soils formed on level to moderately sloping mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	<u>Avalon</u> : Deep, well drained, sandy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and colian materials derived primarily from sandstone and shale.	Shiprock (variant): Deep, well drained, sandy loam, fine sandy loam, and sandy clay loam soils formed on level to gently slop- ing mesas and plateaus from alluvial and eolian materials derived primarily from sandstone and shale.	Sheppard Hayqueen-Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Douk-Uffeng: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loan soils formed on level to gently sloping mesas and plateaus from slluvium derived primar- ily from sandstone and shale.
Map Syubol	Av 5	S S	Av (	Sr Sr	Av	Sr	X	2
Milepost	23.8-23.8	23.85-23.	23.95-24.(	24.0-24.9	24.9-25.0	25.0-25.3	25.3-ಏ.1	26.1-26.25

ţ.s	d erosion hazard, ar erosion hazard, pod, 8 inch pre- rrink-swell poten- rrosion hazard to	d erosion hazard, ar erosion hazard, oor. 8 inch pre- urink-swell poten- erchangeable s from 15-75% ortion, high uncosted steel.	d erosion hazard, rr erosion hazard, pood, 8 inch pre- urink-swell poten- rrrosion hazard to	d erosion hazard, ar erosion hazard, poor, 8 inch pre- rrink-swell poten- es from 15-75% ortion, high uncosted steel.	d erosion hazard, er erosion hazard, pood, 8 inch pre- rrink-swell poten- rrosion hazard to	d erosion hazard, er erosion hazard, poor, 8 inch pre- mink-well poten- es from 15-75% ortion, high uncoated steel.	1 2006.
Counter	Moderate to high wir low to moderate wate topsoil is poor to g cipitation zone. St tial is low, high co uncoated steel.	Moderate to high win low to moderate wat topsoil is fair to p cipitation zone. S tial is low to high, sodium content range for Huerfano-Notal p corrosion hazard to	Moderate to high wir low to moderate wat topeoil is poor to g cipitation zone. S tial is low, high c uncoated steel.	Moderate to high wi low to moderate wat topsoil is fair to p cipitation zone. S tial is low to high, sodium content range for Huerfano-Notal p corrosion hazard to	Moderate to high wi low to underate wat topsoil is poor to a cipitation zone. S tial is low, high o uncosted steel.	Moderate to high vi low to moderate wat topsoil is fair to 1 cipitation zone. S tial is low to high sodium content range for Huerfano-Notal 1 corrosion hazard to	8 inch precipitatio
F	<b>~~~</b>	5-5	<b>~~</b>	545	<b>~~</b>	~~~	Ħ
¥	:: z z	32 55	રાંચ્ય	32 32 32	રા ચ ચ	32.55	N
WEG	0 0 <b>0</b>	なかる	9 N N	ななな	NNM	ななる	2
Hydro- logic Group	<b>4</b> #2 #2	4 A A	<b>4</b> 8 8	4 A A	<b>4</b> 10 10	400	1
alinity (muhos/ ca)	aaa	5×5	aaa	07 <b>I</b>	aaa	07 <b>I</b>	A
Reaction (pH)	7.9-8.4 7.9-8.4 7.4-8.4	4.8-9.7 0.9-9.7 0.9-9.7	7.9-8.4 7.9-8.4 7.4-8.4	4.8-4.7 7.9-9.0 7.9-9.0	7.9-8.4 7.9-8.4 7.4-8.4	4.8-4.7 1.9-9.0 0.9-9.1	Z
Depth to High Water Table (feet)	***	***	***	***	* * *	***	1
Slope (X)	111	6-7-8 0-7-8	111	2-8	111	6-2-3	a B
Depth to Bedrock (inches)	\$ \$ \$	+05-01 66 +0	\$\$\$	66 44 64	\$\$\$	66-20 10-20 10-20	0
Soil Phase or Series	Sheppard Mayqueen Shiprock	Sheppard Huerfano Notal	Sheppard Mayqueen Shiprock	Sheppard Huerfano Notal	Sheppard Mayqueen Shiprock	Sheppard Huerfano Notal	Bedland
oil Phase, Series, Association, or Complex and Description	d Hayqueen-Shiprock: Deep, some- cessively and well drained, loamy and, fine sand, and fine sandy loam ionmed on level to moderately slop- us and plateaus from alluvial and materials derived from sandstone, and mixed sources.	d-Hierfano-Notal: Deep and , somewhat excessively and well , loany fine sand, fine sand, ilay loam, clay loam, and clay ormed on level to moderately valley bottoms, fans, messa, teaus from eolian, alluvial, idual materials derived from oe, shale, and siltatone.	d tayqueen-Shiprock: Deep, some- cessively and well drained, losmy and, fine sand, and fine sandy losm ormed on level to moderately shop- us and plateaus from alluvial and materials derived from sandstone, and mixed sources.	d Huerfano-Notal: Deep and , somewhat excessively and well , loany fine sand, fine sand, lay loan, clay loan, and clay omed on level to moderately ; valley bottoms, fans, mesas, tesus from eolian, alluvial, idual materials derived from ne, shale, and siltatone.	d-Huyqueen-Shiprock: Deep, some- cessively and well drained, loany and, fine sand, and fine sandy loan braned on level to moderately slop- as and plateaus from alluvial and materials derived from sandstone, and mixed sources.	d Huerfano Notal: Deep and , somewhat excessively and well , loany fine sand, fine sand, lay loan, clay loan, and clay ormed on level to moderately valley bottoms, fams, uesas, teaus from eolian, alluvial, idual materials derived from ne, shale, and siltatone.	9: Moderately sloping to extreme- p, monstony, barren shale uplands a dissected by deep intermittent amount and culling.
5	So Sheppar time se soils f ing mes colian shale,	Sherpan shallow drained sendy c soils f eloping and res and res	Sheppar what ex fine as soils f ing mes colian shale,	Shepper shallow drained sendy c soils f sloping and pla and tree sund tree	Shepper what co fine as soils f ing ues eolian shale,	Sherpoar shallow drained andy c soils f soils f and res and res	Padland ly stee that ar drainee
Map Symbo	A 84/1	3 S	15 84	.35 sc	6. 23	8	THE SECTION
Hilepost	26.25-28	28.4-28.	28.85-29	29.15-29	29.35-29	29.6-30.	30.8-33

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER FIFELINE ROUTE P1 (continued)

(11) 72 .....

Table 2. CHARACTERISTICS OF THE SOILS DENTIFIED ALONG MAIN WATER FIFTINE ROUTE FI (continued)

Connent 6	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Surink-swell poten- tisl is low to high, erchargeable sodium content ranges from 15-755 for Huerfano-Notal portion, high corrosion hazard to uncoated steel.	8 inch precipitation zone.	Moderate to high vind erosion hazard, low to underate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Surink-swell poter- tial is low to high, exchangeable sodium content ranges from $15-73$ for Huerfano-Notal portion, high corrosion hazard to uncosted steel.	Low and high (Dumeland portion) wind erosion hazard, high (Riverwash por- tion) and low water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Riverwash portion is frequent- ly flooded, and shrink-swell poten- tial is low.	Low to high (Fruitland portion) vind erosion hazard, moderate water ero- sion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell poter- tial is low to moderate.	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6-10 inch pre- cipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.	Low to high (Fruitland portion) wind erosion hazard, moderate water ero- sion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell poten- tial is low to moderate.
H	v <b>→</b> v	¥	ν <b>τ</b> ν	¥ s	ν v v	~ ~ ~	~~~
,¥	.15	M	.15	NA .15	.37 .28 .28		.37 .28 .28
MPC Lass	41	¥	41 42	¥	3,4L 1,3,5 3,5	2,3 1 3,4L	3,4L 1,3,5 3,5
Hydro- logic Group C	<b>∢</b> ⊖ ⊖	¥	<b>≺</b> Ω Ω	₽ ◀	र्थ के क	¤ <b>4</b> Ω	න න න
(Intros/	5×2	¥	02\$	¥ ¥	141	303	5 ¢ 5
Soil S Reaction (pH)	7.9-8.4 7.9-9.0 7.9-9.0	W	4.8-9.7 0.9-9.7 7.9-9.0	N N	7.4-9.0	7.4-9.0	7.9-9.0 7.9-9.0 7.9-9.0
Depth to High Water Table (feet)	***	¥	* * *	6-2 <sup>2</sup> ×6	* * *	***	* * *
Slope (1)	0-73 0-33 0-3	8 8	5 2 3	2-40	25.2	0-8 1-12 0-3	0-5
Depth to Bedrock (inches)	\$ <del>5</del> <del>10</del> <del>2</del> 8	0	\$5 \$5 \$5	\$\$	\$\$\$	10-65 86 86	\$ \$ \$
Soil Phase or Series	Sheppard Buerfano Notal	Bedland	Sheppard Huerfano Notal	Riverwash Dune land	Turley Fruitland Blancot	Shiprock Sheppard Huerfano	Thr ley Fruitland Blancot
Soil Phase, Series, Association, or Couplex and Description	Sheppard-Huerfauo-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately soling valley bottoms, fans, mesas, and plateaus from eolian, alluvisl, and residual materials derived from	Eadland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Sheppard Hierfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from coliam, alluvial, and residual materiala derived from sandstore, shale, and siltatone.	Rivervash-Dmeland: Deep, poorly to ex- cessively drained, unstabilized sandy, silty, clayey, and gravelly alluvium oc- curring on level and nearly level flood- plains, streadeds, and arroyos; and un- stabilized eolian sand occurring on nearly level to steep mesas, plateaus, and mjor drainageays.	Turley-Fruitland-Blarcot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fams, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	Shiprock-Skeppard-Huerfano: beep to shal- low, well to somewhat excessively drained, fine sandy loam, fine sand, loany fine sand, sandy clay loam, sandy loam, and clay loam soils. These soils formed on nearly level to strongly slopping mesas, plateaus, and up- land valley bottoms from sandy alluvial and coliam materials derived from sandstone; and from alluvium, residum, and locas derived from shale and siltstone.	Turley-Fruitland-Blancot: Deep, well drained, clay loum, loum, fine sandy loum, and sandy loam soils formed on level to moderately steep alluvish fams, upland valley sideslopes, and mesas from mired alluvium derived from sandstone and shale.
Map Syubol	8	¥	8		TAB	ġ	TAB
Milepost	33.3-35.0	35.0-35.4	35.4-35.95	35.95-36.0	36.05-36.6	36.6-37.2	37.2-37.1:

Table 2. CHARACTERISTICS OF THE SOILS IDENTIFIED ALCHC MAIN WATER PIPELINE ROUTE P-1 (concluded)

Connent e	Wind erosion hazard is low, Badlard portion is susceptible to water ero- sion, topsoil is generally nonexis- tent (i.e., poor topsoil), 6-10 inch precipitation zone. Potential runoff on Badlard portion is very rapid.	Low to high (Fruitland portion) wind erosion hazard, moderate water ero- sion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcarecus), and shrink-swell poten- tial is low to moderate.	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6-10 inch pre- cipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, exchangeable addium content ranges from $15$ - $7$ X for Huerfan-Notal portion, high corrosion hazard to uncoated steel.	8 inch precipitation zone.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Surink-swell poter- tial is low to high, exchangeable sodium content ranges from 15-75% for Hierfaro-Motal portion, high corrosion bazard to uncoated steel.
H	N N	ν ν ν	v v 4	5 T 5	¥	v - v
,¥,	N	.37 .28 .28	.10 .32	.15 .32 .32	¥	.15
WEC	N N	3,4L 1,3,5 3,5	2,3 1 3,4L	544	¥	543
Hydro- logic Oroup (	9 9	20 21 21 21	<b>₩</b> ◀ Ω	<b>4</b> 00	¥	<b>▲</b> Ω Ω
ulinity l minos/ cm)	N N	222	40X	5×2	¥	5×5
Soil Sa Reaction ( (pH)	* *	7.9-9.0	7.9-9.0	7.9-9.0	¥	7.9-9.0 7.9-9.0 7.9-9.0
Depth to High Water Table (feet)	* *	* * *	* * *	* * *	N	***
Slope (X)	2 2	555	0-8 0-3	0-7 0-3	ξ.	-7 -7 -7 <del>-</del> 7
Depth to Bedrock (inches)	00	\$ \$ \$	10-25 26-25 26-25	50 50 50 50 50 50 50 50 50 50 50 50 50 5	0	\$ 5-3 5+3 5+3
Soil Phase or Series	Badland Rock Otterop	Turley Fruitland Blancot	Shiprock Sheppard Huerf ano	Sheppard Huerfano Nota l	Badland	Sheppard Huerfano Notal
Soil Phase, Series, Association, or Complex and Description	Badland Rock Outcrop: Nonstony, moder- ately sloping to extremely steep barren shale uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone exposures on moderately sloping to extremely steep ridges, benches, and escarpments.	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loam, and sandy loam soils formed on level to moderately steep alluvial fams, upland valley sides lopes, and mesas from mixed alluvium derived from sandstone and shale.	Shiprock-Sheppard Hilerfano: Deep to shallow, well to somewhat excessively drained, fine sandy loan, fine sand, loany fine sand, sandy clay loan, sandy loan, and clay loan soils. These soils formad on nearly level to strongly sloping mesas, plateaus, and upland valley bottons from sandy slluvial and eolian materials derived from sandstone; and from alluvium, residann, and loeas derived from shale and siltstone.	Sherpoard fluerfaro (Votal: Deep and shallow, somewhat excessively and well drained, loany fine sand, fine sand, sandy clay loan, tay loan, and clay soils formed on level to moderately sloping valley bottoms, fams, meaas, and plateaus from eolian, alluvial, and residual materials derived from sandstore, shale, and siltstore.	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainage-says and gullies.	Sherpoard Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fams, mesas, and plateaus from solian, alluvial, and residual meterials derived from sandstone, shale, and siltstone.
Map Symbol	麗	TAB	Ŗ	Я	A	8
Milepost	9.75-27.75	37.95-38.3	38.3-38.4	38.4-39.2	39.2-39.55	39.55-39.7
			3-14			

NM = Not available or not applicable.

l Sources:

U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Merico, eastern part. (For Mileposts 0.0-35.95 and 38.4-39.7).
 Buchanan, B. 1978. Soils field research, soils map. Prepared (under contract) for Public Service Company of New Merico. Albuquerque, New Merico. (And applicable SCS Form 5 - Soil Intrepretation Tables.) (For Mileposts 35.95-38.4.)

soil erosion is primarily low to moderate. The soils identified along the proposed Pl pipeline route are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. These soils are currently used primarily for livestock grazing, wildlife habitat, and to a lesser extent energy resource development. This pipeline route traverses the following undeveloped portions of NIIP: Block 6 (MP 4-7; 8-10); Block 7 (MP 7-8); Block 9 (MP 10-15); Block 11 (MP 23.5-25; 29-30.5); and Block 10 (MP 25-27.5). These areas have been determined to be irrigable.

<u>Main Water Pipeline Alternative P2</u>. Pipeline route P2 is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation along this route is usually about 8 inches. Thirty-one different soil phases, series, associations, or complexes were identified along this route. The identified soils are listed (by mileposts) and characterized in Table 3.

The soils identified along pipeline route P2 are primarily deep and well to somewhat excessively drained. Surface textures range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, hills, canyons, valleys, and alluvial fans. The terrain slopes range mainly from nearly level to moderately sloping, but areas of moderately steep Badland would be traversed near Horn Canyon (MP 4.4-5.35) and southwest of Gallegos Canyon (between MP 14.6-15.0). Approximately 5.0 miles of Badland (nonstony, barren shale) and Badland-Rock Outcrop would be traversed by this pipeline route. Topsoil availability along this pipeline route is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface

Table 3. CHARACTERISTICS OF THE SOILS DEWILFIED ALONG MAIN WATER PIPELINE ROUTE P2

Connent s	e vind and water erosion haz- peoil is good (Slickspots tre poor), 8 inch precipitation Surink-swell potential is low, ots areas contain 15-50% ex- ble sodium (addition of gypsum associated problems).	f erosion hazard, low to high rosion hazard, poor topsoil eclaim), 9 inch precipitation Rurink-swell potential is low, rrosion hazard to uncoated	e vind erosion hazard, mod- o high water erosion hazard, seoil (excess salt), 8 inch tation zone. Shrink-swell al is low, soil is slightly high corrosion hazard to 1 steel.	e to high wind erosion hazard, moderate water erosion hazard, is poor (Persayo portion-area , 8 inch precipitation zone. well potential is low to mod- uigh corrosion hazard to un- ateel.	l erosion hazard, low to high cosion hazard, poor topsoil sclaim), 9 inch precipitation Mrink-swell potential is low, rusion hazard to uncoated	e vind and water erosion haz- ssoil is fair (excess salt), recipitation zone. Shrink- tential is low, soil is ' saline, high corrosion to uncoated steel.	orecipitation zone.	<pre>M erosion hazard, low to water erosion hazard, poor 8 inch precipitation zone. well potential is low, portion presents high cor- wazard to uncosted steel.</pre>
	Moderate ard, top areas an zone. S Slickepo chungeah reduces	Low vinc water er (area ro area ro zone. { high con steel.	Moderate erate to fair top precipit potentia saline, uncoated	Moderate Now to motion topsoil reclaim Surink-serate, t erate, t coated s	Low vind water er (area re zone. 5 high cor steel.	Woderate ard, top 8 inch p swell po slightly hazard t	8 inch p	High vin moderate topsoil, Strink-s Stumble rosion h
F	Ś	N I N	m	5 1 5	¥ - ¥	e	¥	**s
Ĩ,	.24	NA	.37	.37 .37 .15	м .17 М	.37	¥	NA NA LI
WEC	m	¥ o ¥	4L,3	5473	R o R	۳	¥	N N N
Hydro- logic Group	ø	X a X	2	き ひ よ	N B N	<u>م</u>	¥	***
alinity (muhos/ cm)	3	N 77	2-8	224	N 77 N	2-8	¥	2 2 C
c Soil S Reaction (pH)	7.4-8.4	NA 7.9-8.4 NA	7.9-8.4	7.4-8.4 7.9-9.0 7.9-8.4	NA 7.9-8.4 NA	7.9-8.4	¥	NA NA 7.9-8.4
Depth to igh Water Table (feet)	*	¥ % ¥	*	* * *	***	*	¥	***
H Slope (X)	Ĩ	8 8 9 2 9 2 9 2 9	8	7 7 7 8 8 9	9 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	2-8	8	333
Depth to Bedrock (inches)	\$	10-60+ 60+ 10-20	<del>\$</del> 9	65+ 65+ 65+	10-60+ 60+ 10-28	\$	0	16 (ave.) 0 60+
Soil Phase or Series	Fruitland	Haplargids Blackston Torriortheats	Avalon	Pruitland Persayo Sheppard	Haplargids Blackston Torriorthents	Avalon	Badland	Cyps iorthids Badland Stumble
Soil Phase, Series, Association, or Couplex and Description	Fruitland-Slickspots: Deep, well and poorly drained, sandy losm soils formed on level to gently sloping fans and val- leys from alluvium derived primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are easily puddled and crusted.	Haplaryida-Blackston-Torriorthents: Shal- low to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moder- ately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	<u>Avalon</u> : Deep, well drained, loam, and sandy loam soils formed on level to mod- erately sloping mesas and plateaus from alluvial and colian unterials derived primarily from sandstone and shale.	Fruitland Fersaryo-Sherpard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on underately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and colian materials derived from sandstone and shale.	Haplargida-Blackston-Torriorthents: Shal- low to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moder- stely sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	<u>Avalon</u> : Deep, well drained, sardy loam, fine sandy loam, and loan soils formed on gently to moderately sloping mesas and plateaus from alluvial and coliam materi- sle derived primarily from sandstone and shale.	Badlard: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Cypeiorthide-Eedland-Stumble: Very shal- low to deep, well to excessively drained, sandy lown, lowny sand, and sand soils formed on moderately sloping to moderately steep hills, knolls, breaks, and valleys from materials derived from gypsum and from alluvium derived primerily from sandstone and shale. Includes prostony, burren shale areas hud the the dissect deep
Map Synbol	Fy	Ħ	Ay/Ax	E	Ħ	Av/Ax	A	5
Milepost	0.0-0.25	0.25-0.30	0.30-0.75	0.75-0.95	0.1-20.0	1.0-1.25	1.25-1.60	1.60-1.85

Table 3. CHARACTERUSTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

1

Syl	Map yurbol	Soil Phase, Series, Association, or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (3)	Depth to High Water Table (feet)	: Soil ( Reaction (pH)	Salinity (mrhos/ cm)	Hydro- logic Group	WEG	'X'	Ŀ	Connents
	2	Fruitland: Deep, well drained, loam, and sandy loam soils formed on moderately slop- ing alluvial fans and in valleys from allu- vium derived primarily from sandstone and shale.	Fruitland	ş	Ĩ	*	7.4-8.4	3	20	S	-28	~	Low wind erosion hazard, moderate water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink- swell potential is low, high cor- rosion hazard to uncoated steel.
	R	Stumble-Slickspote: Deep, somewhat er- cessively and poorly drained, loamy sand, and sand soils formed on level to gently sloping valley sides and fans from allu- vim derived primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are easily puddled and crusted.	Stumble	ş	6-5	*	7.9-8.4	4	×	2	<b>11.</b>	Ś	High wind erosion hazard, low water erosion hazard, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low, Slickspots areas contain 25-75% exchangeable sodium, high corrosion hazard to uncoated steel.
	z	Rivervaah: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, stream- beds, riverbeds, and in arroyos.	Riverwash	<del>\$</del>	5	¥	¥	¥	N	¥	¥	¥	Highly ausceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.
	2	Fruitland: Deep, well drained, loam, and sandy loam soils formed on moderately slop- ing alluvial fans and in valleys from allu- vium derived primarily from sandstone and shale.	Fruitland	\$	ĩ	*	7.4-8.4	4	<b>2</b> 3	Ś	.28	Ś	Low wind erosion hazard, moderate water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink- swell potential is low, high cor- rosion hazard to uncoated steel.
	HA.	Haplaryida-Blackston-Torriorthents: Shal- low to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moder- ately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	Haplargids Blackston Torriorthents	10-60- 60- 10-20	7 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	¥ % Z	7.9-8.4 NA	8 7 R	¥ & ¥	N ~ N	¥.17	N I N	Low wind erosion hazard, low to high water erosion hazard, poor topsoil (area reclaim), 9 inch precipitation zone. Strink-swell potential ia low, high corrosion hazard to uncoated steel.
	R	Rivervash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, stream- beds, riverbeds, and in arroyos.	Rivervash	<del>6</del> 9	3	N	¥	¥	¥	N	¥	¥	Highly susceptible to water erosion and revorking, frequently flooded, 8 inch precipitation zone.
	Xi	Fruitland Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fams, and breaks from alluvium, residum, and colian materials derived from sandstone and shale.	Fruit land Persayo Sheppard	60+20 60+20 60+	2 2 2 2 2 2	* * *	7.9-8.4 7.9-9.0 7.9-8.4	484 .	8 Q K	3 4F	.24 .37 .15	N H N	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-evell potential is low to mod- erate, high corrosion hazard to un- coated steel.
	M	<u>Budland</u> : Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gulliea.	Badland	0	2 8	¥	¥	¥	Ņ	¥	¥	¥	8 inch precipitation zone.
	M	Rivervash: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, stream- beds, riverbeds, and in arroyos.	Riverwash	\$	5	W	¥	¥	¥	¥	¥	W	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.

Connents	Moderate wind and water erosion haz- ard, good topsoil, 8 inch precipi- tation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.	8 inch precipitation zone.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Strink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to underate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to und- erate, high corrosion hazard to un- coated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-well potential is low to moderate, low soil strength, high corrosion hazard to uncosted steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Moderate wind and water erosion har- ard, topsoil is fair (excess salt), 8 inch precipitation zone. Surink- swell potential is low, soil is
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¥	¥7.	W	47 15 15	21 22 22	47. 21. 21.	र्थ द र	ĩ	ર્ય રા <del>ક</del>	15
ABG Lass	e	¥	n # n	9 7 7 F	nŧa	8 N N N	2	<b>MNN</b>	
ydro- ogic 1 roup C	p2	¥	¤ ∩ ◀	<b>≼</b> 80 80 .	# A <b>4</b>	21 <b>4</b> 12	m	m <b>⊲</b> m	-
inity H mhos/ 1 cm) Q	\$	¥	424	999	490	999	9	999 9	2-8
Soil Sal Reaction (pH)	7.4.8.4	¥	7.9-8.4 7.9-9.0 7.9-8.4	7.98.4 7.98.4 7.48.4 7.48.4	7.4-8.4 7.9-0 7.9-8.4	7.984 7.984 7.984	1484	7.98.4 7.98.4 7.98.4 7.98.4	A.8-6.7
Depth to Ligh Water Table (feet)	*	¥	***	* * *	* * *	***	*	***	*
E Slope (X)	2-5	9 2	333	115	333	5 2 2 5 2	Ę	333	2
Depth to Bedrock (inches)	\$	0	\$5 \$4 \$5 \$4	\$\$\$	55-25 54-25	\$\$\$	\$	\$\$\$	\$
Soil Phuse or Series	Fruitland	Bedland	Fruit land Persayo Sheppard	Sheppard Muyqueen Shiprock	Fruit land Persayo Sheppard	Shiprock Skeppard Mayquean	Dout	Shiprock Sheppard Mayqueen	Avelon
Soil Phase, Series, Association, or Complex and Description	Fruitland: Deep, well drained, sandy loam soils formed on gently sloping al- luvial fams and in valleys from alluvium derived primarily from sandstone and shale.	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageasys and gullies.	Fruitland-Persayo-Sheppurd: Deep and ahallow, well to somewhat excessively drained, sandy loan, fine sandy loan, clay loan, loany fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, messas, plateaus, fans, and breaks from alluvium, residuam, and colian materials derived from sandstone and shale.	Sheppard Hayqueen Shipprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing messas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loan, fine sandy loan, clay loan, loany fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, messas, plateaus, fans, and breaks from alluvium, residum, and colian materials derived from sandstone and shale.	Shiprock-Sheppard Havqueen: Deep, some- what encessively and well drained, loany frime sand, frime sand, frime sandy loan, and sandy loam soils formed on level to moder- ately sloping mesas and plateaus from al- luvial and colian materials derived from sandstone, shale, and mixed sources.	Doak: Deep, well drained, losm, and clay loam soils formed on level to gently sloping mesas, plateaus, and terraces from alluvium derived primarily from sandstone and shale.	Shiprock-Sheppard Mayqueen: Deep, some- what excessively and well drained, losary frime sand, frime sand, frime sandy losm, and sandy losm soils formed on level to moder- ately sloping mesas and plateaus from al- luvial and colian unterials derived from sandstone, shale, and mixed sources.	<u>Avalon</u> : Deep, well drained, andy loam, and fine sandy loam soils formed on gently sloping mesas and plateaus from alluvial and colian materials derived primarily from and abola
Map Symbol	*	a	K	3	z	30/Sp/ 8d/9m	2	84/80/ 8	AN .
Milepost	4.75-4.85	4.85-5.35	5.35-5.65	5.65-5.75	s.75-5.90	5.9 6.9	0. <i>1</i> -9. ð	7.0-7.45	7.1-24.1

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turity saline, high corro

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued) 1

Consents	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch pre- cipitation zone. Surink-well poten- tial is low, high corrosion hazard to uncosted steel.	Low wind erosion hazard, moderate water erosion hazard, topooil is fair (too clayey), 8 inch precipitation zone. Shrink-well potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.	High wind erosion hazard, moderate water erosion hazard, poor topsoil, 8 inch precipitation zone. Skrink- well potential is low, high cor- rosion hazard to uncosted steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topeoil is good to poor, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated ateel.	Low wind erosion hazard, moderate water erosion hazard, fair topsoil, 8 inch precipitation zone. Shrink- well potential is low to moderate, high corrosion hazard to uncoated ateel.	High wind eroeion hazard, low water eroeion hazard, poor topsoil, 8 inch precipitation zone. Shrink-swell potential is low, Slickspots areas contain 25-75% erchangeable sodium, high corrosion hazard to uncosted steel.	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low, high corrosion hazard to uncoated steel.
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Class		Ś	MAN	7	мии	Ś	2	Ħ	0 0 M
/ Hydro / logic Group	24 A	<b>x</b> 2	<b>M 4 M</b>	4	<b>2</b> 4 <b>2</b>	pa,	4	*	***
kalimity (umbos) (un	999	Q	<u>aaa</u>	a	<u>aaa</u>	à	Q	¥	<u>aaa</u>
Soil Soil (pH)	7.9-8.4	7484	7.9-8.4 7.9-8.4 7.9-8.4	7.9-8.4	7.9-8.4 7.9-8.4 7.9-8.4	7484	7.9-8.4	Ħ	7.9-8.4 7.9-8.4 7.4-8.4
Depth to High Water Table (feet)	***	*	* * *	*	* * *	*	*	z	* * *
Slope (X)	111	I	311	I	311	ĩ	2	1	111
Depth to Bedrock (inches)	\$\$\$	\$	\$\$\$	\$	\$\$\$	\$	\$	\$	\$ \$ \$
Soil Phase or Series	Shiprock Sheppard Mayqueen	Baik	Shiprock Sheppard Mayqueen	Hayqueen	Shiprock Sheppard Mayqueen	Boak	Stumble	Riverwash	Sheppard Hayqueen Shiprock
Soil Phase, Series, Association, or Compler and Description	Shiprock-Sheppard Havoucen: Deep, some- what excessively and well drained, losary fine sand, fine sand, fine sandy loan, and sandy loan soils formed on level to moder- ately sloping meass and plateaus from al- luvial and colian materials derived from sundstone, shale, and mixed sources.	Doak: Deep, well drained, loam, and clayey loam soile formed on level and nearly level mesas, plateaus, and ter- races from alluvium derived primarily from sandstone and shale.	Shiprock-Sheropard Hayqueen: Deep, some- what excessively and well drained, losany fine sand, fine sand, fine sandy losan, and sandy losan soils formed on level to moder- stely sloping mesas and plateaus from al- luvial and colian materials derived from sandstone, shale, and mixed sources.	<u>Mayqueen</u> : Deep, somewhat ercessively drained, losmy fine sand, and loamy sand soils formed on level to moderately slop- ing mesas and plateaus from alluvial and colim materials derived primerily from sundstone and shale.	Shiprock-Sherpard <u>Mayqueen</u> : Deep, some- what excessively and well drained, loany fine sund, fine sund, fine sandy loan, and sandy loan soils formed on level to moder- ately sloping meass and plateaus from al- luvial and solian materials derived from sundatone, shale, and mixed sources.	Doak: Deep, well drained, loam, and clay loam soils formed on gently sloping mesas, plateaus, and terraces from alluvium de- rived primarily from sandstone and shale.	Sturble Slickspots: Deep, somewhat ex- cessively and poorly drained, lossny send, and sand soils formed on level to gently sloping valley sides and fans from allu- vium derived primarily from sendstone and shale. Includes Slickspots areas which are strongly alkali affected, and are essily puddled and crusted.	Riverymanh: Deep, well to erressively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, stream- beds, riverbeds, and in arroyos.	Sheppard Hayqueen-Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately shop- ing mesas and plateaus from alluvial and colian materials derived from sandstone,
Map Symbol	Sd/So/ Sm	8	S4/So/ 8n	Ŧ	Stal/St/ So	<u>ප</u>	23	1	3
Milepost	7.75-8.8	6.8-9.1	9.9-1.9	L.01-29.9	E. EI-L.01	A 61-6.61	13.45-13.	r EI-22. EI	8.61-9.61

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Table 3. CHARACTERISTICS OF THE SOILS INCATTFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Table 3. CHARACTERISTICS OF THE SOLLS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Connert s	High wind erosion hazard, low water erosion hazard, poor topsoil, 8 inch precipitation zone. Surink-swell potential is low, high corrosion hazard to uncoated steel.	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Moderate vind and water erosion haz- ard, fair topsoil (Slickspots areas are poor), 8 inch precipitation zone. Shrink-swell potential is moderate, Slickspots contain 25-757 exchange- able sodium, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mol- erate, high corrosion hazard to un- coated steel.	8 inch precipitation zone.	Moderate vind and water erosion haz- ard, topsoil is fair to por (ercess clay or salt/sodium), 8 inch precip- itation zone. Sirink-swell potential is low to underate, high corrosion hazard to uncosted steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low, high corrosion hazard to uncoated steel.
Ŧ	S X	¥	5 H 5	5	v I v	W	5 1	ν ν ν
,K	.15 NA	¥		.28	.24 .37 .15	¥	۲£. ۲۵	.15 .24 .24
WEC Class	× ×	¥	了如う	4	n f n	¥	<b>ო</b> ო	0 0 M
Hydro- logic Group	4 ¥	¥	8 Q <b>4</b>	<b>д</b>	¤ ∩ <b>≺</b>	¥.	× 0	<b>≺</b> ≈ ≈
alinity (unhos/ cm)	Q ¥	¥	222	5	282	¥	9 J	999 9
r Soil S Reaction (pH)	7.9-8.4 NA	¥	7.9-9.0 7.9-9.0 7.9-8.4	0.4-4.7	7.9-8.4 7.9-9.0 7.9-8.4	W	7.4-8.4	7.9-8.4 7.9-8.4 7.4-8.4
Depth to igh Wate Table (feet)	* *	¥	* * *	×	* * *	¥	**	* * *
B Slope (1)	97.5	5	2 <u>7</u> 7 8 8	5	222	8	22	5 7 8 5 7 6 7
Depth to Bedrock (inches)	<del>ç</del> o	\$	\$ <del>5</del> \$ <del>5</del>	\$	66+ 10-20 66+	o	\$ \$	\$\$\$
Soil Phase or Series	Skeppard Badland	Riverwaah	Fruit land Persayo Sheppard	Turley	Fruitland Persayo Sheppard	Badland	Doalk Uffens	Sherpard Mayqueen Shiprock
Soil Fhase, Series, Association, or Couplex and Description	Sheppard-Balland: Deep, scmewhat ex- cessively drained, loany fine sand, and fine sand soils formed on moderately sloping to steep mesas, plateaus, and breaks from eolian meterials derived from mixed sources. Includes nonstony, barren shale areas on uplands that are dissected by drainageeuss and gullies.	<u>Riverwash</u> : Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, stream- beds, riverbeds, and in arroyos.	Fruitland-Persayo-Sheppard: Deep and shallow, well to scmewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residunm, and colian materials derived from sandstone and shale.	<u>Turley-Slickspote</u> : Deep, well draimed, clay loam soils formed on level to gently sloping alluvial fans from alluvium de- rived from primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are slowly permeable and easily puddled.	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, messa, plateaus, fans, and breaks from alluvium, residunm, and eolian materials derived from sandstone and shale.	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstone and shale.	Sherppard-Mayqueen-Shipprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.
Map Symbol	S	R	2	2	X.	A	2	3
Milepost	13.8-14.0	14.0–14.15	14.15-14.2	14.25-14.5	14.5-14.6	14.6–15.0	15.0-15.4	15.4-15.6

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

B	da	Soil Phase, Series, Association,	Soil Phase	Depth to Bedrock	slope	Depth to High Wate Table	r Soil Reaction	Salinit, (unhos,	y Hydro-	COM			
Syn	lodiny	or Complex and Description*	or Series	(inches)	3	(feet)	(Hd)	1	Group	Class	۰X,	1	Comment s
4	R	<u>Doak-Uffens</u> : Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstone and shale.	Doak Uf fens	\$\$	25	**	7.4-8.4 7.4-8.4	a z	¤ Q	<b></b>	х.	5 -	Moderate wind and water erosion har- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
S	3	Sheppard Maryqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus from alluvial and coliam materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	\$\$\$	325	***	7.9-8.4 7.9-8.4 7.4-8.4	a a a	<b>≮</b> ⊠ ⊠	999	.15 .24 .24	ν v v	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low, high corrosion hazard to uncoated steel.
8	2	Doak-Uffeng: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loem, and clay loam soils formed on level to gently sloping mesas and plateaus from alluviun derived primar- ily from sandstore and shale.	Doak Uf fens	\$\$	22	* *	7.4-8.4	a z	<b>M</b> Q	<b>~</b> ~	ю. 8	~ - ~	Moderate vind and water erosion haz- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
U)	3	Sherpard Hayqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Skeppard Mayqueen Shiprock	\$\$\$	2 4 8 5 7 8 6 7 8	* * *	7.9-8.4 7.9-8.4 7.4-8.4	a a a	<b>4</b> 8 8	9 9 9	.15 .24 .24	s s s s s s s s s s s s s s s s s s s	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poter- tial is low, high corrosion hazard to uncoated steel.
2	2	<u>Dosk-Uffens</u> : Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstone and shale.	Doak Uf fens	\$\$	25	* *	7.4-8.4 7.4-8.4	24	<b>8</b> Q		15 Q.	-	Moderate vind and water erosion haz- ard, topsoil is fair to poor (excess clay or salt/sodium). 8 inch precip- itation zone. Surink-swell potential is low to underate, high corrosion hazard to uncoated steel.
55 5	X	Sheppard Hayqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Sheppard Mayqueen Shiprock	\$\$\$	5 7 2 2 7	* * *	7.9-8.4 7.9-8.4 7.4-8.4	a a a	<b>4</b> 82 82	999	.15	ν v v	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poter- tial is low, high corrosion hazard to uncoated steel.
0	3	Dosk-Uffens: Deep, well drained, very fine sandy loan, sandy clay loan, fine sandy loan, and clay loan soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstone and shale.	Doak Uf feaus	\$ \$	11	* *	7.4-8.4	2 <b>2</b>	8 0	m m	15 R.	5 1	Moderate wind and water erosion haz- and, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
o	8	Shipprock: Deep, well drained, fine sendy loam, and sandy loam soils formed on level and nearly level mesas and pla- teaus from alluvial and colian materials derived primarily from sandstone and shale.	Shiprock	69	0-2	*	7.4-8.4	9	μ	ñ	-24	5	Moderate vind and water erosion haz- ard, good topsoil, 8 inch precipita- tion zone. Shrink-swell potential is low, highly corrosive to uncoated steel.
2	З	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sundsrons and shale.	Doak Uffens	\$	33	* *	7.4-8.4 7.4-8.4	23	8 0	m m	15. 8.	5 -1	Moderate wind and water erosion haz- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Surink-swell potential is low to moderate, high corrosion

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER FIFELINE ROUE P2 (continued)

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	Convent s	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topeoil is good to poor, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Wind and water erosion hazard is mod- erate, poor topsoil, 8 inch precipi- tation zone. Shrink-swell potential is low to moderate, moderate corro- sion hazard to uncoated steel.	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low wind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Surink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.	Moderate vind and water erosion haz- ard, good topsoil, 8 inch precipita- tion zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.	Moderate wind and water erosion haz- ard, topsoil is poor due to shallow- ness and ercess salt/sodium (Muff portiou-area reclaim), 8 inch precip- itation zoxe. Shrink-swell potential is low to moderate exchangeable sod
	F	ν v v	5 - 5	N I N	N	ν <b>τ</b> ν	Ś	Ś	
	'K'	.24 .15 .24		NA	W		.37	.24	.28
DEM	Class	5 7 3	3 4L 2	N c N	¥	3 4L 2	Ś	m	ti n n
Hydro- logic	Group	84 45	8 D 4	X a X	NA.	¤ Ω <b>⊀</b>	ea.	£۵	A A A
ulinity muhos/	3	<u>aaa</u>	2 & Q	¥ 7 ¥	W	4 & 4	a	a	- 2° 4
: Soil Se Reaction (	(Hd)	7.9-8.4 7.9-8.4 7.9-8.4	7.4-8.4 7.9-9.0 7.9-8.4	NA 1.4-8.4 NA	N	7.4-8.4 7.9-9.0 7.9-8.4	7.4-8.4	7.4-8.4	7.9-9.0 7.4-8.4 7.4-8.4
Depth to High Water Table	(feet)	* * *	***	* * *	¥	* * *	*	*	***
Slope	3	2-8 2-8 2-9	1 I I 2 I I	2 2 <u>7</u>	3	5 5 5 2 5 5	1	2-5	111
Depth to Bedrock	(inches)	\$ \$ \$	60+ 10-20 60+	0 10-20	<del>6</del> 9	65+ 66+	\$	ģ	87-40 80+40
Soil Phase	or Series	Shiprock Sheppard Mayqueen	Fruitland Persayo Sheppard	Badland Hunierco Rock Outcrop	Riverwash	Fruit land Persayo Sheppard	Doak	Shiprock	Huerfano Muff Uffens
Soil Phase, Series, Association,	or Couplex and Description	I Shiprock-Sherppard Hayqueen: Deep, some- what excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moder- ately sloping meass and plateaus from al- luvial and eolian materials derived from sandstone, shale, and mixed sources.	Fruitland Persayo-Siverpard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and eolian materials derived from sundstone and shale.	Badland-Wrnierco-Rock Outcrop: Shallow, well drained, fine sandy losm, clay losm, and sandy clay losm soils formed on level to moderately sloping hills, ridges, and mesas from alluvial and colian materials derived primarily from shale. Includes nonstory, barren shale areas on uplands that are dissected by deep intermittent drainageways and gullies, and barren sand- stone outcrops on moderately sloping to steep ridges, benches, and escarpmenta.	Rivervaah: Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, stream- beds, riverbeds, and in arroyos.	Fruitland Peraayo-Sixppard: Deep and shallow, well to somewhat exceasively drained, sandy loan, fine sandy loam, clay loam, loany fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuan, and eolian materials derived from sandstone and shale.	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and ter- races from alluvium derived primarily from sandstone and shale.	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on gen- tly sloping mesas and plateaus from allu- vial and colian materials derived primarily from sandstone and shale.	Huerfaro-Miff-Uffens: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately slop- ing mesas and valleys from alluvium and residuam derived primarily from shale and tstone
Kap	Syubol	5 Sav/Sd	×		RA	ĸ	۲ ۲	ઝ	8
	Milepost	17.55-18.0	18.05–18.1	18.1-18.2	18.2-18.3	18.3-18.45	18.45-18.6	18.65–18.7	18.7-18.9

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Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Connent s	Moderate vind and water erosion haz- ard, good topsoil, 8 inch precipita- tion zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.	Moderate vind and water erosion haz- ard, topsoil is poor due to shallow- ness and excess salt/sodium (Miff portion-area reclaim), 8 inch precip- itation zone. Surink-swell potential is low to moderate, erchargeable sodium content is 25-75%, high cor- rosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Mderate vind and water erosion har- ard, topsoil is poor due to shallow- ness and excess salt/sodium (Miff portion-area reclaim), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, exchangeable sodium content is 25-737, high cor- rosion hazard to uncoated steel.	Moderate wind and water erosion haz- ard, good topsoil, 8 inch precipita- tion zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poter- tial is low, high corrosion hazard to uncoated steel.	Low vind erosion hazard, moderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Strink-swell potential is low to moderate, low soil strength, high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poten- tisl is low, high corrosion hazard to uncoated steel.
I.	Ś	- 6 -	~ ~ ~ ~ ~	- 6 -	Ś	~~~ ~	Ś	~~~
μ,	.24	.32	.15 .24 .24	.28	.24	.15	.37	.15 .24 .24
WEG 11aae	m	17 m m	9 7 7	3 a ft	m	999	S	995
tydro- logic Group	23	000	<b>≺</b> ∞ ∞	8 A A	<b>F</b> 2	<b>4</b> 82 82	æ	<b>≮</b> ¤ ¤
linity l mhos/	Q	4 5 X 4 5 X	aaa	5 F F F	a	aaa	a	aaa
Soil Sa Reaction ( (pH)	7.4-8.4	7.4-9.0	7.9-8.4 7.9-8.4 7.4-8.4	7.9-9.0 7.4-8.4 7.4-8.4	7.4-8.4	7.9-8.4 7.9-8.4 7.4-8.4	7.4-8.4	7.9-8.4 7.9-8.4 7.4-8.4
Depth to High Water Table (feet)	*	* * *	* * *	* * *	*	* * *	*	* * *
Slope (I)	2-5	333	222	333	2-5	272	5	0-5 B
Depth to Bedrock (inches)	ģ	1020 20-40 60+	\$\$\$	28-45 64-45 64-45	\$	\$\$\$	\$	\$ \$ \$ \$ \$ \$
Soil Phase or Series	Shiprock	therfano Muff Uffens	Sheppard Hayqueen Shiprock	Huerfano Muff Uffens	Shiprock	Sheppard Mayqueen Shiprock	Doak	Sheppard Hayqueen Shiprock
Soil Phase, Series, Association, or Complex and Description	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on gen- tly sloping mesas and plateaus from allu- vial and colian materials derived primarily from sandstone and shale.	<u>Hierfaro-Miff-Uffens</u> : Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately slop- ing mesas and valleys from alluvium and residuam derived primarily from shale and siltstone.	Sheppard Mayqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to underately slop- ing meass and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Huerfaro Miff-Uffeng: Shallow to deep, well drained, sandy clay loam, clay loam, very fine sandy loam, and fine sandy loam soils formed on level to moderately slop- ing meass and valleys from alluvium and residam derived primarily from shale and siltstone.	Shiprock: Deep, well drained, fine sandy loam, and sandy loam soils formed on gen- tly sloping mesas and plateaus from allu- vial and colian materials derived primarily from sandstone and shale.	Sterpard Harqueen-Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan sofils formed on level to moderately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Duak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and ter- races from alluvium derived primarily from sandstone and shale.	Skeppard Mayqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.
Map Syubol	ઝ	Ħ	R	B	ઝ	3	B S	23
Milepost	18.9-19.0	19.0-19.2	19.2-19.3	7.91-£.91	19.7–19.9	19.9-20.5	20.55-20.	20.6-20.7

Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIFELINE ROUTE P2 (continued)

Connent s	Low wind erosion hazard, woderate water erosion hazard, topsoil is fair (too clayey), 8 inch precipitation zone. Shrink-swell potential is low to woderate, low soil strength, high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is good to poor, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Moderate vind and water erosion har- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Surink-avell poten- tial is low, high corrosion hazard to uncoated steel.	Moderate wind and water erosion haz- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Shrink-swell potential is low to uncherate, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncoated steel.	Moderate vind and water erosion haz- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Sirrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	Moderate to high vind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to
Ŀ	Ś	~ ~ ~ ~	5-1	~ ~ ~ ~ ~	5-1	~~~ <u>~</u> ~	5 -	<b>NNN</b>
<u>k</u>		.24 .15 .24		.15 .24 .24	.8	.15 .24 .24	۲ <u>.</u> ۵۵	.15 .24 .24
WDG Lass	Ś	~ ~ ~ ~	<b>ო</b> ო	999	<b>۳</b> ۳	2 7 M	<del>ر</del> س س	355
lydro- logic Group (	22	a ≮ a	R Q	<b>A</b> 12 12	84 Q	<b>≮</b> £2 £2	<b>#</b> Q	<b>₹</b> 88 8
unhos/ cm) <sup>o</sup> (	a	<u>aaa</u>	2 <del>4</del> 8 <del>4</del>	<u>aaa</u>	23	aaa	2 z	999
r Soil Sa Reaction ( (pH)	7.4-8.4	7.9-8.4 7.9-8.4 7.9-8.4	7.4-8.4 7.4-8.4	7.9-8.4 7.9-8.4 7.4-8.4	7.4-8.4	7.9-8.4 7.9-8.4 7.4-8.4	7.4-8.4 7.4-8.4	7.9-8.4 7.9-8.4 7.4-8.4
Depth to igh Wate Table (feet)	×	* * *	X X	* * *	**	***	* *	***
B Slope (I)	4	5 7 8 7 8 7 9	11	5 8 6-5 6-5	11	5 -5 0-5 8 0-5	11	7-8 0-5 0-5
Depth to Bedrock (inches)	ŝ	\$\$\$	\$ \$	\$\$\$	\$\$	\$\$\$	\$\$	\$\$\$
Soil Phase or Series	Doaik	Shiprock Shepard Mayqueen	Douk Uffens	Sheppard Mayqueen Shiprock	Doak Uffens	Sheppard Mayqueen Shiprock	Doak Uffenø	Sheppard Mayqueen Shiprock
Soil Phase, Series, Association, or Couplex and Description	Doak: Deep, well drained, loam, and clayey loam soils formed on level and nearly level mesas, plateaus, and ter- racea from alluvium derived primarily from sandstone and shale.	Shiprock-Sheppard Hayqueen: Deep, some- what excessively and well drained, loamy fine sard, fine sand, fine sandy loam, and sardy loam soils formed on level to mder- ately sloping mesas and plateaus from al- luvial and coliam materials derived from sandstone, shale, and mixed sources.	Dosk-Uffeng: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping meass and plateaus from alluvium derived primer- ily from sandstone and shale.	Steppard Mayqueen-Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to underately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Douk-Uffens: Deep, well drained, very fine sandy loam, sardy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstone and shale.	Steppard Hayqueen-Shiprock: Deep, some- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately slop- ing mesas and plateaus from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Dosk-Uffena: Deep, well drained, very fine sardy losm, sandy clay losm, fine sardy losm, and clay losm soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstore and shale.	Streppard Hayqueen-Shiprock: Deep, some- what excessively and well drained, loamy fine sand, fine sand, and fine sandy loam soils formed on level to moderately slop- ing mesas and plateaus frum alluvial and colian unterials derived frum andstore
Map Symbol	B	Sd/So/ Sm	8	3	2	3	2	3
Milepost	20.7-20.75	20.75-26.0	26.0-26.4	26.4-26.95	26.95-27.4	27.4-27.45	27.45-27.9	27.9-27.95

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Consents	Aderate wind and water erosion har- ard, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Surink-swell potential is low to moderate, high corrosion harard to uncosted steel.	Molerate to high wind erosion hazard, low to moderate weter erosion hazard, topsoil is good to poor, 8 inch pre- cipitation zone. Surink-swell poten- tial is low, high corrosion hazard to uncosted steel.	Moderate wind and water erosion har- and, topsoil is fair to poor (excess clay or salt/sodium), 8 inch precip- itation zone. Surink-swell potential is low to moderate, high corrosion hazard to uncosted steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, erchangeable sodium content ranges from 15-73X for Huerfano-Notal portion, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-awell poten- tial is low, high corrosion hazard to uncoated steel.	High wind erosion hazard, low water erosion hazard, poor topsoil (too sandy, excess fines), 8 inch precipi- tation zone. Strink-swell potential is low.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to good, 8 inch pre- cipitation zone. Shrink-swell poter- tial is low, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, exchangeable sodium content ranges from 15-735 for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
H	54	<b></b>	5 -1	5 T 5	~~~	¥	<b></b>	<b>~~~</b>
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99		m M M	<b></b>	日山山	<b>N N M</b>	¥	0 0 <b>0</b>	~ \$ \$
and the second sec	<b>#</b> 0		# <b>A</b>	4 A A	4 <b>1</b> 1	2		<b>4</b> 88
nity By hos/ log	สซี	a a a	27	022	<u>aaa</u>	1	<u>aaa</u>	azi
Boil Sali Leaction (mu (pH) o	4841	4.8-4.7 4.8-4.7 4.8-6.7	14-84	7. <del>9-</del> 8.4 0. <del>9-</del> 0 0. <del>9-</del> 1	7.9-8.4 7.9-8.4 7.4-8.4	ž	7.9-8.4 7.9-8.4 7.4-8.4	7.9-84 7.9-9.0 0.9-9.1
Depth to ligh Water Table F (feet)	**	***	**	***	***	*	***	***
Blope E	22	111 1	12	565	112	5-2	III	523
Depth to Bedrock (inches)	- \$\$	\$\$\$	\$\$	5-12 54-23 54-23	\$\$\$	\$	\$\$\$	\$ <u>6</u> 8 <del>0</del> 8 <del>0</del>
Soil Phase or Series	Doak Uffena	Shiprock Skeppard Mayqueen	Doak Uffeas	Sheppard Huerf ano Notal	Sheppard Hayqueen Shiprock	Dune Land	Sheppard Mayqueen Shiprock	Sheppard Huerf ano Notal
Soil Phase, Series, Association, or Complex and Description	Doak-Uffeng: Deep, well drained, very fine aendy loan, sandy clay loan, fine aendy loan, and clay loan soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from aendstone and shale.	Shiprock-Sheppard Hayqueen: Deep, some- what excessively and well drained, loamy fine sand, fine sand, fine sandy loam, and sandy loam soils formed on level to moder- ately sloping messas and plateaus from al- luvial and colian materials derived from sandstone, shale, and mixed sources.	Doak-Uffens: Deep, well drained, very fine sandy loam, sandy clay loam, fine sandy loam, and clay loam soils formed on level to gently sloping mesas and plateaus from alluvium derived primar- ily from sandstone and shale.	Sheppard-Huerfano-Notal: Deep and shallow, somewhat encessively and well drained, losany fine sand, fine sand, sandy clay losan, clay losan, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from solian, alluvial, and residual materials derived from sandstone, shale, and siltatone.	Sheppard Mayqueen Shiprock: Deep, scam- what excessively and well drained, loany fine sand, fine sand, and fine sandy loan soils formed on level to moderately slop- ing mesas and plateaus from alluvial and solian materials derived from sandstone, shale, and wired sources.	Dure Land: Deep, excessively drained, unstabilized colian sand and fine sand occuring on moderately sloping to steep meass, plateaus, and in major drainageasys.	Sheppard Hayqueen Shiprock: Deep, acum- what excessively and well drained, losary fine sand, fine sand, and fine sandy losan soils formed on level to moderately slop- ing mesas and plateaus from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Sheppard Huerfano-Motal: Deep and ahallow, acmedhat encessively and well drained, loany fine sand, fine sand, sandy clay loan, clay loan, and clay soils formed on level to moderately sloping valley bottoms, fans, messa, and plateaus from solian, alluvial, and residual materials derived from sandstone, shale, and siltatone.
Map Symbol	8	\$0/\$1	a	8	3	8	28	8
Hilepost	.0.82-28.02	<b>2.8.05–30.6</b>	<b>9.0</b> - <b>30.9</b>	30.9-31.3	7.16-6.16	31.75-31.	31.8-32.	32.5-33.

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Table 3. CHARACTERISTICS OF THE SOLLS INVATIFIED ALONG MAIN WATER PIPELINE ROUTE P2 (continued)

Berties, Association     Boil Phase sud bearription     Depth to cr Series     Bedrock Bedrock     Blops       y aloping to extreme by deep intermittent     Badland     0     5-80       burren ahale uplands     Bedrock     Blops     10       by deep intermittent     Bherrand     0     5-80       billel:     Deep and     Sheppard     60+     2-8       brann, alluvial, and, fine sand, otian, alluvial, al derived from     Notal     60+     2-8       y loping to extreme and files.     Badland     0     5-80       y loping to extreme d siltetone.     Badland     0     5-80       y loping to extreme by deep intermittent     Badland     0     5-80       by deep intermittent     Badland     60+     0-2	eries, Asociation, Soil Phase Bedrock Blope Table to Table or Series (inches) (1) (feet) (feet) (inches) (1) (feet) (feet) (inches) (1) (feet) (feet) (feet) (inches) (1) (1) (1) (1) (1) (1) (1) (1) (1) (1	criter, Asociation, carles, Asociation, card Description     Boil Phase befreck     Boph to kinck     Boph attents (ind)     Boph attents (ind)     Boph attents (ind)     Boph attents (ind)     Boph attents (ind)     Boph attents (ind)     Both attents	errise, Association     Both to and Description     Both to constring, and Description     Both to constring, and Description     Both to constring, (pU)     Balinity is association       r and Description     constring, and Description     Soil Phase (pu)     Both to constring     Both to constring     Balinity is association     Main Mile (pU)     Constring     Balinity is association       y aloping to entreme by deep and Dillies.     Bappart Segment (pu)     0     5-80     M     M     M       Bill beye and Dillies.     Bappart Segment (pu)     0     2-8     7.9-9.0     4-8       Bill beye and Dillies.     Bappart Segment (pu)     00-2     2-8     7.9-9.0     4-8       Soil reaction Dian, Bluvial, all derived from on sittence.     Netal     0     2-80     7.9-9.0     4-8       y aloping to entreme barren shale uplands of the soul, ties and, the entited there and there and there and the entited there and there and the entited     0     5-80     N     M     M       y aloping to entreme barren shale uplands of the soul of the outerately     0     5-80     N     M     M       Marren shale uplands there and the entities     0     5-80     N     M     M       Marren shale uplands the outerately     0     5-80     N     M     M       Marren shale uplands the outerately     0     5-80	teries, Association, Soil Phase Bedrock Slope Table Reaction (minor) logic With Water Soil Subjection (minor) logic With Water Soil Phase Subjection (minor) logic With Water Soil Subjection (minor) logic With Water Soil Phase	Begin to carrier, Association, and beaction (mixed) logic Water Soil Bhase beford, Silope Tuble Reaction (mixed) logic Water Soil Subsection (mixed) logic Water Soil Bhase parts (incluse)     Beiling blattere Soil Soil Bhase beford, Silope Tuble Reaction (mixed) logic Water Soil Bhase parts (incluse)     Depth to carrier the section (mixed) logic Water Soil Soil Bhase parts (incluse)     Depth to carrier was also up to carrier (mixed) logic Water Soil Bhase parts (incluse)     Depth to carrier (mixed)     Mater Mater Mater Mater Soil Bhase parts (incluse)     Depth to carrier (mixed)     Dep	Beyth to and becription       Beyth to cost and and becription       Beyth to cost and
Soil PhaseDepth to BedrockBedrockSlopeSoil PhaseBedrock(inches)(i)Balland05-60Breppard60+2-80Berfano05-600Breppard05-600Breppard05-600Breppard60+02-8Bretfano05-60Bretfano05-60Bretfano02-8Bretfano60+0-2Bretfano60+0-2	Both to soil PhaseDepth to kuchcockBoth to slopeHaphuto teapBudhard05-60MaBudhard05-60MaBudhard00-22-85Budhard00-22-85Budhard05-60MaBudhard05-60MaBudhard05-60MaBudhard05-60MaBudhard05-60MaBudhard05-60MaBudhard00-0-20-35Budhard00-0-20-35Budhard00-0-20-3Budhard00-0-20-3Budhard00-0-20-3Budhard00-0-20-3Budhard00-0-20-3Budhard00-0-20-3Budhard00-0-20-3Budhard00-0-30-3Budhard00-0-3Budhard00-0-3Budhard00-0-3Budhard00-0-3Budhard00-0-3Budhard0-2Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budhard0-3Budh	Soil Phase tor SeriesDepth to (inches)Build Mater TableSoil (pil)Soil Phase tor SeriesBedrock (inches)Slope (inches)High Mater (act)Soil (pil)Malland05-60MMMStepperd therfano60+2-67.9-9.0Mutal00-2-67.9-9.0Mutal00+2-67.9-9.0Mutal05-60MMMutal05-60MMMutal05-60M1.9-9.0Mutal05-60MMMutal05-60M1.9-9.0Mutal05-60M1.9-9.0Mutal05-60M1.9-9.0Mutal05-60M1.9-9.0Mutal05-602-67.9-9.0Mutal02-82-67.9-9.0Mutal00+2-82-67.9-9.0Mutal00+0-22-62-9.0	Soil Phase Soil Phase TableDepth to ReductsReput to Routing N (inches)Reput to (inth Nater (pil)Soil Nater (pil)Salinity I and dSuppart Muter05-80NuNuNuNuSuppart Muter Muter05-80NuNuNuNuSuppart Muter Muter60+2-85-80NuNuNuNuMuter Muter05-80NuNuNuNuNuMuter Muter00+0-35-80NuNuNuNuMuter Muter05-80NuNuNuNuMuter Muter05-80NuNuNuNuMuter Muter05-80NuNuNuNuMuter Muter05-80NuNuNuNuMuter Muter05-80NuNuNuNuMuter Muter05-80NuNuNuNuMuter Muter05-80NuNuNuNuMuter Muter00+0-35-80NuNuNuMuter Muter00+0-35-80NuNuNuMuter Muter00+0-35-80NuNuNuMuter Muter00+0-35-80NuNuNuMuter Muter00+0-35-80NuNuNuMuter Muter <td< td=""><td>Boil Phase or Series     Depth to (inches)     Matter Soil Soil Salinity Hydro- (feet)     Matter Soil Salinity Hydro- (feet)       Bulland     0     5-80     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na</td><td>Both to cruck     Buttock (inches)     Buttock (inches)     Buttock (inches)</br></br></br></br></br></br></br></br></br></br></br></br></br></br></br></br></br></br></td><td>Both to ac Series         Both to keltrock         Right hate series         Soil Mater (inclusis)         Balling Hytho- (inclusis)         Right to (inclusis)         Righ to (inclusis)         Righ to (inclusis)</td></td<>	Boil Phase or Series     Depth to (inches)     Matter Soil Soil Salinity Hydro- (feet)     Matter Soil Salinity Hydro- (feet)       Bulland     0     5-80     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na     Na     Na     Na       Bulland     0     5-80     Na     Na     Na	Both to cruck     Buttock (inches)     Buttock 	Both to ac Series         Both to keltrock         Right hate series         Soil Mater (inclusis)         Balling Hytho- (inclusis)         Right to (inclusis)         Righ to (inclusis)         Righ to (inclusis)
Depth to Bedrock         Biope (inches)         Biope (inches)         Biope (inches)           0         0         5-80         0         5-80           10-20         0         2-8         0         0           60+         2-8         0         0         2           10-20         0         2-8         0         0           60+         2-8         0         0         2           60+         2         8         0         0           10-20         0         2         8         0           60+         2         0         0         2           0         0         2         8         0	Depth to Bedrock         Blope 8lope         High Mater           Bedrock         8lope         High Mater           0         5-80         Ma           10-20         0-3         %           60+         2-8         %           10-20         0-3         %           60+         2-8         %           10-20         0-3         %           60+         2-8         %           60+         0-2         %           60+         2-8         %           60+         2-8         %           60+         2-8         %	Depth to Bedrock         Blope Slope (inches)         Husput to Table         Soil Reaction (pH)         Soil (pH)           0         5-80         NA         NA         NA           0         5-80         NA         NA         NA           10-20         0-3         ×6         7.9-9.0         1.9-9.0           60+         2-8         ×6         7.9-9.0         1.9-9.0           60+         2-8         ×6         7.9-9.0         1.9-9.0           60+         2-8         ×6         7.9-9.0         1.9-9.0           60+         2-8         ×6         7.9-9.0         1.9-9.0           60+         2-8         ×6         7.9-9.0         1.9-9.0           60+         0-2         ×6         7.9-9.0         6.9	Depth to Betrock         Blope Bigh Water         High Water Reaction (mutos/1         Soil         Balinity B admins/ (mutos/1           0         5-80         NA         NA         NA         NA           0         5-80         NA         NA         NA         NA           10-20         2-8         X6         7.9-9.0         X4         C           60+         0-2         X6         7.9-9.0         X4         NA           0         5-80         NA         NA         NA         NA           10-20         0-3         X6         7.9-9.0         X4           0         5-80         NA         NA         NA           0         5-80         NA         NA         X4           60+         2-8         X6         7.9-9.0         X4           60+         0-2         X6         7.9-9.0         X4           60+         0-2         X6         7.9-9.0         X4           60+         0-2         X6         7.9-9.0         X4	Depth to Bedrock         High Mater (inches)         Soil (x)         Balinity Hydro- (rest)         High Mater (pil)         Soil (minos/ logic (rest)         Salinity Hydro- (runos/ logic (runos/ logic (runos/ logic         Hu         M <td>Depth to befrock (inches)         High Matter (x)         Soil Builty Hydto- (pd)         Balinity Hydto- coup Class           0         5-60         Ma         Ma         Ma         Ma         Ma         Ma           10-20         0-2         3-6         7.9-9.00         4-6         0         4.4.         3.3           0         5-60         Ma         Ma         Ma         Ma         Ma         Ma           10-20         0-3         3-6         7.9-9.00         4-6         0         4.4.         3.3           10-20         0-3         3-6         7.9-9.00         3-6         0         4.4.         3.3           10-2</td> <td>Bepth to befrock (inchea)         Respection (1)         Soil (incluse) (2)         Ration without logic (authout)         Ration without logic (authout)         NM         NM         NM         NM         NM           0         5-60         NM         NM         NM         NM         NM         NM         NM         NM           0         5-60         NM         NM         NM         NM         NM         NM         NM         NM           0         5-60         NM         NM         NM         NM         NM         NM         NM         NM           0         5-60         NM         NM</td>	Depth to befrock (inches)         High Matter (x)         Soil Builty Hydto- (pd)         Balinity Hydto- coup Class           0         5-60         Ma         Ma         Ma         Ma         Ma         Ma           10-20         0-2         3-6         7.9-9.00         4-6         0         4.4.         3.3           0         5-60         Ma         Ma         Ma         Ma         Ma         Ma           10-20         0-3         3-6         7.9-9.00         4-6         0         4.4.         3.3           10-20         0-3         3-6         7.9-9.00         3-6         0         4.4.         3.3           10-2	Bepth to befrock (inchea)         Respection (1)         Soil (incluse) (2)         Ration without logic (authout)         Ration without logic (authout)         NM         NM         NM         NM         NM           0         5-60         NM         NM         NM         NM         NM         NM         NM         NM           0         5-60         NM         NM         NM         NM         NM         NM         NM         NM           0         5-60         NM         NM         NM         NM         NM         NM         NM         NM           0         5-60         NM
	Blope         Hugh water           8lope         Hugh water           (x)         (feet)           (x)         (feet)           0-2         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-3         5           0-4         5           0-5         5           0-4         5           0-5         5           0-5         5           5         5           5         5           5         5           5         5           5         5           5         5           5         5           5         5           5         5           5         5           5         5           5	Blope     Husput to bigh Water     Soil       8lope     Table     Reaction       7.9-8.4     7.9-8.4       0-3     ×6     7.9-9.0       0-2     ×6     7.9-9.0       0-3     ×6     7.9-9.0       0-3     ×6     7.9-9.0       0-3     ×6     7.9-9.0       0-3     ×6     7.9-9.0       0-3     ×6     7.9-9.0       0-3     ×6     7.9-9.0       0-3     ×6     7.9-9.0	Bigh Water (1)         Boil Balinity E feet)         Balinity E (pil)         Balinity E (mitoal)           5-80         NM         NM         NM         NM           5-80         NM         NM         NM         NM           2-8         X6         7.9-9.0         X4           0-2         X6         7.9-9.0         X4	Blope     High Mater     Soil     Balinity Hydro- (minos/ logic       3lope     Table     Reaction (unitos/ logic     M       5-60     M     M     M     M       5-60     M     M     M     M       0-2     X6     7.9-9.0     X4     D	Blope     Hugh Water     Soil     Balinity Hydro- (pil)     Mater     Soil     Balinity Hydro- (mixe/ logic     MSC       5-60     Na     Na     Na     Na     Na     Na     Na       5-60     Na     Na     Na     Na     Na     Na     Na       2-8     X6     7.9-9.0     X4     32     315       0-2     X6     7.9-9.0     X4     32     315       0-2     X6     7.9-9.0     X4     32     315       0-2     X6     7.9-9.0     X4     32     315       0-3     X6     7.9-9.0     X4     32     315	Hupper to trapht Matter         Soil Table         Soil Metric         Soil Metric         Soil Metric         Soil Metric         Soil Metric         With Metric         Soil Table         Metric         Metric         Table         Yr         Tri           5-60         Nu         Nu <td< td=""></td<>
	Itable       Table       (foot)       X X X       X X X       X X X	Ligh Mater Soil 8 Ligh Mater Soil 8 Table Reaction (feet) (pH) ×6 7.9-9.0 ×6 7.9-9.0 ×6 7.9-9.0 ×6 7.9-9.0 ×6 7.9-9.0	High Water Soil Balinity E Table Reaction (umbos/) (feet) (pH) cm) c ×6 7.9-9.0 ×6 ×6 7.9-9.0 ×6 ×6 7.9-9.0 ×6 ×6 7.9-9.0 ×6 ×6 7.9-9.0 ×6 ×6 7.9-9.0 ×6 ×6 7.9-9.0 ×6	Hatter     Soil     Salinity Hydro- ligh Water       Hatter     Soil     Salinity Hydro- (pil)       Table     Reaction (unitos/ logic M       X     N     N       X     1.9-8.4     C       X     7.99.0     X4	Light Nature (feet)     Soil (pil)     Balinity Hydro- (mitoal/ logic Nec (mitoal/ logic Nec       NM     NM     NM     NM       NM     NM     NM     NM       X6     7.9-9.0     X4     D       X6     7.9-9.0     X4     M       X6     7.9-9.0     X4     D	Light Hatter TableSoil Raction (pil)Salinity Hytro- and Group ClassNrTriMuX67.9-9.0X4DX4.325X67.9-9.0X4DX4.325X67.9-9.0X4MuMuMuMuMuNuNuMuMuMuMuX67.9-9.0X4DX4.325X67.9-9.0X4MuMuMuMuMuNuNuNuMuMuMuX67.9-9.0X4DX4.325X67.9-9.0X4DX4.325X67.9-9.0X4DX4.325X67.9-9.0X4DX4.325X67.9-9.0X4DX4.325X67.9-9.0X4DX4.325X67.9-9.0X4DX4.325

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Table 3. CHARACTERISTICS OF THE SOILS IDENTIFIED ALING MAIN WATER PIPELINE ROUTE P2 (concluded)

Comment a	Wind erosion hazard is low, Badland portion is susceptible to water ero- sion, topsoil is generally nonexis- tent (i.e., poor topsoil), 6-10 inch precipitation zone. Potential rumoff on Badland portion is very rapid.	Low to high (Fruitland portion) wind erosion hazard, moderate water ero- sion hazard, fair to good topsoil, 6-10 inch precipitation zone. These soils are mildly to strongly alkaline (calcareous), and shrink-swell poten- tial is low to moderate.	Moderate to high wind erosion hazard, moderate to low water erosion hazard, good to poor topsoil, 6-10 inch pre- cipitation zone. These soils are mildly to strongly alkaline (Huerfano portion is sodium affected), and shrink-swell potential is low to moderate.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Swink-swell poten- tial is low to high, exchangeable sodium content ranges from 15-753 for Huerfaro-Notal portion, high corrosion hazard to uncoated steel.	8 inch precipitation zone.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, erchangeable addium content ranges from 15-753 for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
F	Z Z	~~~~	5 5 T	ν I ν	¥	N - N
Ϊ. K	<b>N</b> N	.37 .28 .28	.10 .32	.15 .32 .32	M	.15
WEG Class	¥ ¥	3,4L 1,3,5 3,5	2,3 1 3,4L	2 4L 4L	¥	41 41
lydro- logic Group (	<u>0</u> 0	<b>ж ж ж</b>	∞ ≺ ∩	<b>∢</b> Ω Ω	¥	<b>₹</b> ΩΩ
ulinity l and a	¥ ¥	727	20X	522	¥	272 8
r Soil Se Reaction ( (pH)	*	7.4-9.0 7.4-8.4 7.9-9.0	7.4-9.0	7.9-8.4 7.9-9.0 7.9-9.0	¥	7.9-8.4 7.9-9.0 7.9-9.0
Depth to High Water Table (feet)	**	* * *	* * *	* * *	¥.	* * *
Slope (1)	2 Z	599	0-8 1-12 0-3	2-8 0-3 0-2	8	0-7- 0-7- 0-7-
Depth to Bedrock (inches)	00	\$\$\$	10-20 10-20	10-20 60+	0	60+ 10-20 60+
Soil Phase or Series	Badland Rock Outcrop	Turley Fruitlærd Blancot	Shiprock Sheppard Huerfano	Sheppard Huerf ano Nota I	Badlard	Sheppard Huerfano Notal
Soil Phase, Series, Association, or Complex and Description	Badland-Rock Outcrop: Nonstony, moder- ately sloping to extremely steep barren shale uplands that are dissected by deep intermittent drainageways and gullies; and barren sandstone exposures on moderately sloping to extremely steep ridges, benches, and escarpuents.	Turley-Fruitland-Blancot: Deep, well drained, clay loam, loam, fine sandy loan, and sandy loam soils formed on level to moderately steep alluvial fans, upland valley sideslopes, and mesas from mixed alluvium derived from sandstone and shale.	Shiprock-Sherpard-Huerfano: Deep to shallow, well to somewhat excessively drained, fine sandy loam, fine sand, loamy fine sandy clay loam, sandy loam, and clay loam soils. These soils formed on nearly level to strongly sloping mesas, plateaus, and upland valley bottoms from sandy alluvial and colian materials derived from sandstone; and from alluvium, residuam, and loess derived from shale and siltstone.	Sheppard Huerfano -Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	<u>Badland</u> : Moderately sloping to extreme- ly steep, monstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Steppard-therfarr Notal: Deep and shallow, somewhat encessively and well drained, loamy fine sand, fine sand, amdy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltatone.
Map Synbol	2 8	TAB	ES	8	A	8
Milepost	40.65-40.8	40.85-41.2	4. 1 <del>.</del> - 2. 14	41.3-42.1	42.1-42.45	42.45-42.6

NA = Not available or not applicable.

<sup>1</sup>Sources: (1) U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part. (For Mileposts 0.0-38.85 and 41.3-42.6.) (2) Buchaman, B. 1978. Soils field research, soils map. Prepared (under contract) for Public Service Company of New Mexico. Albuquerque, New Mexico. (And applicable SCS Form 5 - Soil Interpretation Tables.) (For Milemosts 38.85-41.3.)

textures (e.g., too sandy or clayey) or excess salt/sodium. The Blackston (0.3 mile), Persayo (2.90 miles), and Muff (0.8 mile) soils traversed by the P2 route are difficult to reclaim if the topsoil is removed and not replaced. Susceptibility to wind-induced soil erosion ranges from low to high, but it is primarily moderate to high. Susceptibility to water-induced soil erosion is primarily low to moderate. The soils identified along this alternative main water pipeline route are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. These soils are currently used primarily for livestock grazing, wildlife habitat, and to a lesser extent irrigated cropland and energy resource development. This pipeline route traverses developed portions of NIIP Block 4 (MP 5.5-13 and 15.5-18). Additionally, this pipeline route traverses the following undeveloped portions of NIIP Block 11: MP 18-19, 28-30, and 31.75-33. These undeveloped portions have been determined to be irrigable.

Main Water Pipeline Alternative P3. Alternative pipeline route P3 is also within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation is usually about 8 inches along this route. Thirteen different soil phases, series, associations, or complexes were identified along P3. Table 4 lists (by mileposts) and characterizes the identified soils.

The soils identified along this alternative pipeline route are primarily deep and well to somewhat excessively drained. Surface textures range from fine sand to clay. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone on mesas, plateaus, hills, breaks, canyons, upland valleys, alluvial fans, intermittent drainageways,

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3

Comment a	Moderate vind and water erosion haz- ard, topsoil is good (Slickspots areas are poor), 8 inch precipitation zone. Surink-swell potential is low, Slickspots areas contain 15-50% er- chargeable sodium (addition of gypsum reduces associated problems).	Low wind erosion hazard, low to high water erosion hazard, poor topsoil (area reclaim), 9 inch precipitation zone. Shrink-swell potential is low, high corrosion hazard to uncoated steel.	Moderate wind erosion hazard, mod- erate to high water erosion hazard, fair topsoil (ercess salt), 8 inch precipitation zrne. Shrink-swell potential is low, soil is slightly saline, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zroe. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	High wind erosion hazard, low water erosion hazard, good topsoil, 8 inch precipitation zone. Shrink-swell po- tential is low, high corrosion hazard to uncosted steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	low to moderate wind erosion harard, moderate to high water erosion har- ard, fair topsoil (ercess clay/salt), 8 inch precipitation zone. Shrink- swell potential is low to moderate, high corrosion hazard to uncoated steel.	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
iT.	5	X - X	m	v - v	Ś	5 T 5	50 00	ν ν ν
'¥'	.24	NA	E	.24 .37 .15 .15	SL.	.15	E. 3.	ور. ۲. ۲. ۲.
WEC	£	¥ ~ ¥	4L,3	n ¥ n	7	n ¥ n	ν ġ	5 7 R
Hydro- logic Group	pa .	X n X	ja	¤ Q ◀	22	¤ Q ◀	<u>م</u> م	ka ≮ ka
alinity (mubos/ cm)	3	R 2 R	2 <del>-8</del>	280	a	330	5 7 <b>8</b>	999 9
r Soil S Reaction (pH)	7.4-8.4	NA 7.9-8.4 NA	7.9-8.4	7.9-8.4 7.9-9.0 7.9-8.4	7.4-8.4	7.9-8.4 7.9-9.0 7.9-8.4	7.9-8.4	7.4-8.4 7.9-8.4 7.4-8.4
Depth to igh Wate Table (feet)	×	×××	*	*** ,	*	* * *	**	* * *
H Slope (I)	3	<del>କ</del> କ କ 2. 3. 3.	8	2 2 3 2 3 3	0-2	333	22	9-15 9-15
Depth to Bedrock (inches)	Ş	10-60- 60- 10-20	Ş	\$ 5 8 4 8 4 8 4 8 4	<del>4</del> 9	60+ 20-28 60+	\$\$	\$\$\$
Soil Phase or Series	Fruitland	Haplargids Blackston Torriortheats	Avaloa	Fruit land Persayo Sheppard	Shiprock	Fruitland Persayo Sheppard	Doak Avalon	Doak Sheppard Shiprock
Soil Phase, Series, Association, or Complex and Description	Fruitland-Slickspots: Deep, well and poorly drained, sandy losm soils formed on level to gently sloping fams and val- leys from alluvium derived primarily from sandstone and shale. Includes Slickspots areas which are strongly alkali affected, and are easily puddled and crusted.	Haplargids-Blackston-Torriorthents: Shal- low to deep, well to excessively drained, cobbly sandy loam, cobbly sandy clay loam, gravelly loam, gravelly clay loam, cobbly loam, and clay loam soils formed on moder- ately sloping to steep terraces, mesas, and plateaus from alluvium derived from mixed sources.	<u>Avalon</u> : Deep, well drained, loam, and sardy loam soils formed on level to mod- erately sloping mesas and plateaus from alluvial and colian materials derived primarily from sandstone and shale.	Fruitland Persary-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on underately sloping to underately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and eolian materials derived from sandstone and shale.	Shiprock: Deep, well drained, loamy fine sand, fine sandy loam, and sandy loam soils formed on level and nearly level mesas and plateaus from alluvial and colian materials derived primerily from sandstone and shale.	Fruitland Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateeus, fans, and breaks from alluvium, residuam, and solian materials derived from sandstone and shale.	Doak Avalor: Deep, well drained, loan, and clayey loan soils formed on level to gently sloping means, plateans, and ter- races from alluvial and colian materials derived primarily from sandstone and shale.	Doak-Sheppard-Shiprock: Deep, well and somewhat ercessively drained, loan, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and colian materials derived from sandstone, shale, and mixed sources.
Hap Symbol	Fy	Ħ	Ay/AX	E	ស	¥	ž	29
Milepoet	0.0-0.25	025-0.30	67.0-05.0	82. I- <i>2</i> 7. 0	1.55-1.70	1.70-2.85	2.85-3.55	a. 5 2. E

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

1

Connents	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Pernayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	8 inch precipitation zone.	Low to moderate vind erosion hazard, top- moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zone. Surink- swell potential is low to high, high corrosion hazard to uncoated steel.	8 inch precipitation zone.	Moderate vind and water erosion haz- ard, poor topsoil (Persayo portion- area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to moderate, low to high corrosion hazard to uncosted steel.	8 inch precipitation zone.	Highly susceptible to water erosion and reworking, frequently flooded, 8 inch precipitation zone.	8 inch precipitation zone.	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Strink-swell potential is low to moderate, high corrosion hazard to uncosted steel.	8 inch precipitation zone.
F	ν H ν	¥	ς, c <sub>2</sub>	¥	A T A	¥	¥	¥	ν ν ν	ž
'K'	.24 .15 .15	¥	.32	¥	¥ 37	¥	¥	¥	.15 .15 .24	¥
WEC Lase	口下	W	6 4L	M	R H	¥	¥	¥	57 FM	ž
lydro- logic Group C	<b>₩</b> Ω <b>4</b>	¥	R Q	¥	<b>₹</b>	¥	¥	¥	84 <b>4</b> 8	ž
alinity H (muhos/ 1 cm) (	480	¥	0 <b>2</b>	¥	Q & ¥	¥	¥	¥	a a a	2
Soil Soil Soil Soil Soil Soil Soil Soil	7.4-8.4 7.9-9.0 7.9-8.4	¥	7. <del>9-</del> 9.0	W	7.9-9.0 7.9-9.0 NA	¥	ž	¥	7.4-8.4 7.9-8.4 7.4-8.4	X
Depth to igh Water Table (feet)	* * *	¥	**	¥	* * *	¥	¥	¥	* * *	N
H Slope (I)	2 2 2 2 2 2 2 2	8 8	0-2	ŝ	10-30	89 10	5	ŝ	0-15 0-15	289
Depth to Bedrock (inches)	65 - 20 65 - 20	0	\$ \$	0	890	0	ş	0	\$\$\$	•
Soil Phase or Series	Fruitland Persayo Sheppard	Badland	Blancot Notal	Bedland	Farb Persayo Rock Outcrop	Bedland	Riverwah	Bedland	Doak Sheppard Shiprock	Bedland
Soil Phase, Series, Association, or Complex and Description	Fruitland-Persayo-Sixppard: Deep and shallow, well to somewhat excessively drained, sandy lowan, fine sandy lowan, clay lowan, lowany fine sand, soils formed on underately sloping to underately steep hills, mesas, plateaus, fans, and breaks from alluvium, residnann, and eolian materials derived from sandstone and shale.	Badland: Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	<u>Blarcot-Notal</u> : Deep, well drained, losm, clay losm, silty clay losm, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium de- rived primarily from sandstone and shale.	Badland: Woderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageasys and gullies.	Farb-Persayo-Rock Outcrop: Very shallow to shallow, excessively and well drained, fine sandy loam, sandy clay loam and silty clay loam soils formed on gently shoping to moderately steep hills and breaks from residam derived from sand- stone and shale. Includes barren sandstone outcrops on strongly sloping to moderately steep benches, ridges, and breaks.	<u>Badland</u> : Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageeus and gullies.	<u>Riverwash</u> : Deep, well to excessively drained, unstabilized sandy, silty, clayey, or gravelly sediment on level to gently sloping floodplains, stream- beds, riverbeds, and in arroyos.	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep internittent drainageusts and gullies.	Doak-Sherppard-Shiptrock: Deep, well and somewhat excessively drained, losan, clay losan, losany fine sand, fine sand, and fine sandy loan soils formed on level to strongly sloping measas plateaus, and ter- races from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands thatected inter inter state drainage and sut
Map Synbol	M	A	Ħ	M	FA	M	R	A	2	M
tilepost	.0-9.25	9.9-22-6	4.9-10.4	0.4-10.6	10.6-10.85	0.85-11.3	4, 11-C, 11	.1.4-12.05	12.05-12.8	21.8-13.15

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A STREET

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WAITER PIPELINE ROUTE P3 (continued)

Milepost	Map Synbol	Soil Phase, Series, Association, or Complex and Description	Soil Phase or Series	Depth to Bedrock (inches)	Slope (X)	Depth to High Wate Table (feet)	r Soil Reaction (pH)	Salinity (mthos/ cm)	Hydro- logic Group	WEC	¥	ł	Conneatts
L.E1-21.E1	8	Dosk-Sheppard-Shiprock: Deep, well and some-hat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	\$ \$ \$	6-15 6-15	***	7.4-8.4 7.9-8.4 7.4-8.4	999	. ∞ < ∞	500		~~~	Icw to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Surink-well potential is low to moderate, high corrosion hazard to uncoated steel.
13.7-16.0	¥	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageauys and gullies.	Bedland	0	я Я	ž	N	¥	¥	¥	¥	¥	8 inch precipitation zone.
16.0-20.9	8	Doak-Sheropard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and coliam materials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	\$ \$ \$	0-5 0-15 0-15	* * *	7.4-8.4 7.9-8.4 7.4-8.4	<u>aaa</u>	<b>∞ ≺</b> ∞	5 7 R	.15 .15 .42	ν N N	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
20.9-21.1	19	<u>Blarcot-Notal</u> : Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium de- rived primarily from sandstone and shale.	Blancot Notal	\$ \$	5 5	**	7.9-9.0	2 J	<b>M</b> O	6 4L	.32	~ ~ ~	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zone. Shrink- swell potential is low to high, high corrosion hazard to uncoated steel.
21.15-21.12	8	Doak-Sherppard-Shiprock: Deep, well and somewhat excessively drained, loan, clay loan, loany fine sand, fine sand, and fine sandy loan soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and colian meterials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	\$ \$ \$		* * *	7.4-8.4 7.9-8.4 7.4-8.4	999	<b>⋈ ≮</b> ⋈	5 7 7 7	.15 21. 24.	<b>~~</b>	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Surink-swell potential is low to moderate, high corrosion hazard to uncoated steel.
ræ- <i>st.</i> æ	K	Fruitland-Fersavo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loan, fine sandy loan, clay loan, loany fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvian, residuan, and colian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	65 4 69 4 8 4	222	* * *	7.4-8.4 7.9-9.0 7.9-8.4	484	29 A 4	5 Fo		N I N	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Perasyo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.
e. <del>1</del> 2-24. 9	8	Doak-Sherppard-Shiprock: Deep, well and somewhat excessively drained, loan, clay loan, loany fine sand, fine sand, and fine sandy loan soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and colian meterials derived from sandstone, shale, and mixed sources.	Doak Sheppard Shiprock	\$\$\$	5-15	***	7.4-8.4 7.9-8.4 7.4-8.4	999	<b>छ ≼ छ</b>	5 N N N	.15 .15 .24	ν νν ν	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Strink-well potential is low to moderate, high corrosion hazard to uncoated steel.
24.9-25.4	X	Fruitland-Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and colian materials derived from sandstone and shale.	Fruitland Persayo Sheppard	66+ 80+ 80+		***	7.9-8.4 7.9-9.0 7.9-8.4	480	8 A 人	n f n	.24 .37 .15	ν <del>-</del> ν	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to $mod-$ erate, high corrosion hazard to un- coated steel.

Table 4. CHARACTERISTICS OF THE SOLLS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

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Comments	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Surink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zore. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zone. Shrink- swell potential is low to high, high corrosion hazard to uncoated steel.	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low to moderate vind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zone. Shrink- swell potential is low to high, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mod- erate, high corrosion hazard to un- costed steel.	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zone. Shrink- swell potential is low to high, high
H	ν ν ν ν	N H N	n n	ν N N	5 - 5	νı vı	N H N	~~
'X'	.15	.15 .15	. 32		.15	32	.24 .37 .15	32 25
WEC	лим	るかる	6L	мим	5 F M	6 41	日本日	66 4 <u>1</u>
Hydro- logic Group	<b>82 4 1</b>	804	<b>M</b> Q	<b>82 4 1</b>	8 Q 4	M D	2 A A	# C
alinity (muhos/ cm)	999 9	330	93	999	380	93	394	03
: Soil S. Reaction (pH)	7.4-8.4 7.9-8.4 7.4-8.4	7.9-8.4	7.9-9.0	7.9-8.4	7.4-8.4 7.9-9.0 7.9-8.4	7.9-8.4	7.9-8.4 7.9-9.0 7.9-8.4	1.9-9.7 0.9-9.1
lepth to igh Wate Table (feet)	***	***	* *	* * *	* * *	**	***	**
Slope H. (1)	0-15 0-15	333	5-5	5-1-5	222	55	222	22
Depth to Bedrock (inches)	\$\$\$	60+ 10-20 60+	\$ \$	\$ \$ \$	66+ 10-28 60+	\$\$	69 10-20 80+	\$\$
Soil Phase or Series	Doak Sheppard Shiprock	Fruitland Persayo Sheppard	Blancot Notal	Doak Sheppard Shiprock	Fruitland Persayo Sheppard	Blancot Notal	Pruit Land Perasyo Sheppard	Blancot Notal
Soil Phase, Series, Association, or Complex and Description	Dosk-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and coliam unterials derived from sandstore, shale, and mixed sources.	Fruitland-Persayo-Sherypard: Deep and shallow, well to somewhat excessively drained, sandy loan, fine sandy loan, clay loan, loany fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, uesas, plateaus, fans, and breaks from alluvium, residuam, and solian materials derived from sandstone and shale.	Blancot-Notal: Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fans and upland valleys from alluvium de- rived primarily from sandstone and shale.	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and coliam materials derived from sandstone, shale, and mixed sources.	<u>Fruitland Fersayo-Sheppard</u> : Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on underately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and solian materials derived from sandstone and shale.	<u>Blancot-Notal</u> : Deep, well drained, losm, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fams and upland valleys from alluvium de- rived primarily from sandstone and shale.	Fruitland-Fersayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, platesus, fams, and breaks from alluvium, residum, and eolian materials derived from sandstone and shale.	Blancot-Notal: Deep, well drained, loan, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fams and upland valleys from alluvium de- rived primarily from sandstone and shale.
Map Symbol	8	X.	S BT	2	5	8	K.	La
Milepost	25.45-25.7	25.7-26.05	26.05-26.4	26.45-28.1	28.15-28.2	28.25-28.3	28.28-28.4	28.4-28.6

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTE P3 (continued)

Connectt 8	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil ia poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	Woderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Shrink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil ia fair to poor (too clayey), 8 inch precipitation zone. Shrink- swell potential is low to high, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Shrink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zoce. Shrink- swell potential is low to high, high corrosion hazard to uncoated steel.
F	\$ T \$	~~~~	N T N	ν v v	~ T ~	ŚŚ	~ T ~	~ <b>~</b>
¥	.15	15 15 24			42 FE SI			
WEG . Class	5 fr a	5 7 7 7	547	5 7 M	n 4 n	6 6	5 fr	66 61
Hydro- logic Group	84 C) 4	xa <b>4</b> xa	29 A 4	24 <b>4</b> 24	8 Q <b>4</b>	8 Q	ありよ	# D
alinity (mmhos/	480	<u>aaa</u>	480	<u>aaa</u>	430	9 <b>Z</b>	480	9 J
r Soil S Reaction (pH)	7.4-8.4 7.9-9.0 7.9-8.4	7.4-8.4 7.9-8.4 7.4-8.4	7.4-8.4 7.9-9.0 7.9-8.4	7.48.4	7.9-8.4 7.9-9.0 7.9-8.4	7.9-9.0	7.4-8.4 7.9-9.0 7.9-8.4	7.9-8.4
Depth to igh Water Table (feet)	* * *	* * *	* * *	* * *	* * *	* *	***	* *
H Slope (X)	5 5 5 2 5 5	0-15 0-15 0-15	2 2 2 2 2 2	0-15 0-15 0-15	2 2 3 2 3 3	56	333	53
Depth to Bedrock (inches)	65 64 65	\$\$\$	+ <del>2</del> + + <del>2</del> + + <del>2</del> + <del>2 + <del>2</del></del>	\$\$\$	\$ <del>5</del> \$ <del>4</del>	\$\$	\$ <del>5</del> 86+33	\$\$
Soil Phase or Series	Fruitland Peraayo Sheppard	Doak Sheppard Shiprock	Fruitland Persayo Sheppard	Doak Sheppard Shiprock	Fruit land Persayo Sheppard	Blancot Notal	Fruit land Peragyo Sheppard	Blancot Notal
Soil Phase, Series, Association, or Complex and Description	<u>Fruitlant-Persayo-Sheppard</u> : Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loan, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breake from alluvium, residuum, and colian materials derived from sandstone and shale.	Doak-Sheppard-Shipprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loan soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and coliam materials derived from sandstone, shale, and mixed sources.	Fruitland-Ferago-Steppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loan, loany fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and colian materials derived from sandstone and shale.	Doak-Sherpard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Fruitland Ferseyo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loany fine sand, and fine sand soils formed on underately sloping to moderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residunn, and eolian materials derived from sandstone and shale.	<u>Blarcot-Notal</u> : Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fams and upland valleys from alluvium de- rived primarily from sandstone and shale.	Fruitland Persayo-Sheppard: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to uoderately steep hills, mesas, plateaus, fans, and breaks from alluvium, residuam, and colian materials derived from sandstone and shale.	<u>Blarcot Wotal</u> : Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fams and upland valleys frum alluvium de- rived primarily from sandstone and shale.
Map Symbol	X	2	75 FX	8	R.	х Х	<b>X</b>	R
Milepost	28.6-28.7	28.7-29.4	29.45-29.	29.75-31.	31.55-32.	32.4-32.6	32.65-33.	E. EE0. EE

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALONG MAIN WATER PIPELINE ROUTS P3 (continued)

Content a	low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Strink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	8 inch precipitation zone.	low to high wind erosion hazard, low to underate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Surink-swell potential is low to underate, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor (Persayo portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to mod- erate, high corrosion hazard to un- coated steel.	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zone. Shrink- swell potential is low to high, high corrosion hazard to uncoated steel.	Low to high wind erosion hazard, low to moderate water erosion hazard, fair to good topsoil, 8 inch precipi- tation zone. Surink-swell potential is low to moderate, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poter- tial is low to high, exchargeable addium content ranges from 15-755 for Huerfaro-Notal portion, high corrosion hazard to uncoated steel.	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zooe. Shrink- seell pote siel is low rothigh, high rosione to unstanted.
ŀ	ν v v	¥	ν v v	ν <del>ι</del> ν	νn	ν v v	5 T 5	~~~ <b>~</b> ~
ΪK'		¥	.15	.15	.32	.15 .15 .24		.32 .32
WEG Lass	5 7 F	¥	5 N N N	n H n	£ e	5 7 7 F	5 4 3	
tydro- ogic iroup C	<b>84 4</b> 69	M	<b>23 4 23</b>	R Q K	8 Q	84 A 8	<b>4</b> 00	# A
alinity H (unhos/ ] cm) 0	a a a	N	999 9	232	03	<u>aaa</u>	07J	03
Soil S. Reaction (pH)	7.4-8.4 7.9-8.4 7.4-8.4	¥	7.4-8.4 7.9-8.4 7.4-8.4	7.4.8.4 7.9-9.0 7.9-8.4	7.9-9.0	7.4-8.4 7.9-8.4 7.4-8.4	7.9-9.0	7.9-9.0
igh Water Table (feet)	* * *	¥	* * *	* * *	* *	* * *	***	**
B Slope (I)	0-5 0-15 0-15	8 8	P-15 P-15	2 2 2 2 2 2	5-6-	0-15 0-15	6-7- 6-7-3-8	56
Depth to Bedrock (inchea)	\$ \$ \$	0	\$ \$ \$	60+ 86+	\$\$	\$ \$ \$	85-3 5-3 5-3 5-3 5-3 5-3 5-3 5-3 5-3 5-3	\$\$
Soil Phase or Series	Doak Sheppard Shiprock	Badland	Doak Sheppard Shiprock	Fruitland Persayo Sheppard	Blancot Notal	Doak Sheppard Shiprock	Sheppard Huerfano Notal	Blancot Notal
Soil Phase, Series, Association, or Complex and Description	Doak-Sheppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and colian materials derived from sandstore, shale, and mixed sources.	<u>Badland</u> : Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Dosk-Sherppard-Shiprock: Deep, well and somewhat excessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strongly sloping mesas, plateaus, and ter- races from alluvial and eolian materials derived from sandstone, shale, and mixed sources.	Fruitland-Persayo-Sheppand: Deep and shallow, well to somewhat excessively drained, sandy loam, fine sandy loam, clay loam, loamy fine sand, and fine sand soils formed on moderately sloping to moderately steep hills, mesas, plateaus, fans, and breaks fron alluvium, residuum, and eolian materials derived from sandstone and shale.	<u>Blancot-Notal</u> : Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fams and upland valleys from alluvium de- rived primarily from sandstone and shale.	Doak-Sheppard-Shiprock: Deep, well and somewhat ercessively drained, loam, clay loam, loamy fine sand, fine sand, and fine sandy loam soils formed on level to strougly sloping mesas, plateaus, and ter- races from alluvial and eoliam materials derived from sandstone, shale, and mixed sources.	Sherpard Hierfano-Notal: Deep and shallow, scuewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately solis formed on level to moderately aloping valley bottoms, fams, meass, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Blancot-Notal: Deep, well drained, loan, clay loan, silty clay loan, and clay soils formed on level to gently sloping alluvial fams and upland valleys from alluvium de- rived primarily from syndstory and shale.
Map Symbo	2	£ ₹	25 DS	15 RX	45 BT	8	8	S BT
Milepost	4. ÅE-E. EE	34.4-34.6	34.65-35.	35.95-36.	36.15-36.	36.45-37.	<b>5.85-2.7</b>	38.3-42.3

Table 4. CHARACTERISTICS OF THE SOILS IDENTIFIED ALINC MAIN WATER PIPELINE ROUTE P3 (concluded)

Connent s	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, exchangeable sodiam content ranges from 15-755 for Huerfano-Notal portion, high corrosion hazard to uncoated steel.	Low to moderate wind erosion hazard, moderate water erosion hazard, top- soil is fair to poor (too clayey), 8 inch precipitation zone. Shrink- swell potential is low to high, high corrosion hazard to uncoated steel.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.	8 inch precipitation zone.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch pre- cipitation zone. Shrink-swell poten- tial is low to high, exchangeable sodium content ranges from 15-75% for Huerfano-Notal portion, high corrosion hazard to uncoated steel.
F	s I s	ŚŚ	v - v	¥	v - v
Ж	.15 .32 .32	.32	.15 .32 .32	¥	.15 .32 .32
WBC	545	6 <del>4</del>	5 4 3	¥	5 4 4
tydro- logic Group (	<b>₹</b> ΩΩ	<b>#</b> D	<b>4</b> 00	¥	<b>A</b> O O
ulinity l muhos/ cm)	042	24	023	¥	522
r Soil Se Reaction ( (pH)	7.9-8.4 7.9-9.0 7.9-9.0	7. <del>9-</del> 8.4 7. <del>9-</del> 9.0	7.9-9.0 7.9-9.0	¥	7.9-9.0 7.9-9.0 7.9-9.0
Depth to High Wate Table (feet)	* * *	* *	* * *	¥	* * *
Slope (X)	2-8 0-3 0-2	0-2	2-8 0-3 0-2	8 8	5-7-7-7-8 0-7-7-8 0-7-8
Depth to Bedrock (inches)	60+ 60+ 60+	\$\$	60+ 10-20 60+	0	60+ 10-20 60+
Soil Phase or Series	Sheppard Huerfano Notal	Blancot Notal	Sheppard Huerfano Notal	Badland	Sheppard Huerfaro Notal
Soil Phase, Series, Association, or Complex and Description	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loany fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately soling valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	<u>Blancot-Notal</u> : Deep, well drained, loam, clay loam, silty clay loam, and clay soils formed on level to gently sloping alluvial fams and upland valleys from alluvium de- rived primarily from sandstone and shale.	Sheppard-Huerfano-Motal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately solins formed on level to moderately and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Badland: Moderately sloping to extreme- ly steep, nonstony, barren shale uplands that are dissected by deep intermittent drainageways and gullies.	Sheppard-Huerfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to moderately sloping valley bottoms, fans, mesas, and plateaus from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.
Map Symbo	8	H	8	RA S	8
Milepost	42.35-43.	43.9-44.7	1.24-7-45.1	45.1-45.8	45.85-48.

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NM = Not available or not applicable. <sup>1</sup>Source: U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part.

and gullies. The terrain slopes range mainly from nearly level to strongly sloping, but a strongly sloping to steep Badland area would be traversed near the southern end of Kutz Canyon (between MP 13.7-16.0). Approximately 5.6 miles of Badland (nonstony, barren shale) would be traversed by pipeline route P3. Topsoil availability along this alternative pipeline route is limited due to generally shallow surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. The Blackston (MP 0.25-0.30) and Persayo (map units FX and FA in Table 4) soils identified along this route are difficult to reclaim if the topsoil is removed and not replaced. Susceptibility of the identified soils to wind-induced soil erosion ranges from low to high, but it is primarily moderate to high. Susceptibility to water-induced soil erosion is primarily low to moderate. The soils identified along this alternative pipeline route are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. These soils are currently used primarily for livestock grazing, wildlife habitat, and energy resource development.

<u>Proposed Terminal Storage Reservoir (R1)</u>. Three different soil associations (or land types) were identified at the proposed terminal storage reservoir site. Table 5 lists and characterizes the identified soils.

The soils identified at the Rl reservoir site are shallow to deep and well to somewhat excessively drained. Surface textures range from fine sand to clay loam. These soils are forming in alluvial, eolian, and residual materials derived primarily from shale, sandstone, and siltstone on a nearly level to moderately sloping mesa. More than 50 percent of the proposed reservoir site is Badland (nonstony, barren
Table 5. CHARACTERISTICS OF THE SOILS IDENTIFIED AT THE PROPOSED TERMINAL STORAGE RESERVOIR

Connent a	8 inch precipitation zone, potential runoff is very rapid, slight limitations for em- bankments, dikes, and levees.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 8 inch precipitation zone. Surink-swell potential is low to high, limitations for reservoirs, embankments, dikes, and levees are seepage and piping.	Moderate wind and water erosion hazard, topsoil is poor due to shallowness, excess salt/sodium (Muff portion-area reclaim), 8 inch precipitation zone. Surink-swell potential is low to moderate, limitations for reservoirs are minimal, limitations for	
F	2	s I s	1.01	
,K	W	.15 .32 .32	.28	
WEC Class	¥	45	3 9 F	
Hydro- logic Group	9	<b>₹</b> ₽₽	<b>A A A</b>	
Salinity (umbos/ cm)	W	0×2	\$ <u>*</u> *	
Soil Reaction (pH)	¥	7.9-9.0 7.9-9.0 7.9-9.0	7.9-9.0 7.4-8.4 7.4-8.4	
Depth to High Water Table (feet)	*	***	***	
Slope (3)	<b>8</b>	5 5 3	333	
Depth to Bedrock (inches)	0	60+ 60+	20-40 60+	
Soil Series	Badland	Sheppard Huerfaro Notal	Huerfano Miff Uffens	
Approximate Acreage	75	35	35	(145)
Soil Association and Description <sup>1</sup>	<u>Badland</u> : Moderately sloping to extremely steep, nonstony, barren shale uplands that are dissected by deep intermittent drainage- asys and gullies.	Sheppard Hiterfano-Notal: Deep and shallow, somewhat excessively and well drained, loamy fine sand, fine sand, sandy clay loam, clay loam, and clay soils formed on level to und- erately sloping valley bottoms, fams, messas, and plateaus from eolian, alluvial, and resid- ual materials derived from sandstone, shale, and siltstone.	therfano Hiff-Uffeng: Shallow to deep, well drained, sandy clay losan, clay loan, very fine sandy loan, and fine sandy loan soils formed or level to moderately sloping mesas and valleys from alluvium and residuum derived primarily from shale and siltstone.	(Total Acreage)

NA = Not gvailable or not applicable.

<sup>1</sup>Sources: (1) U.S. Soil Conservation Service (SCS). 1980. Soil survey of San Juan County, New Mexico, eastern part. (2) SCS Form 5 - Soil Interpretation Table (Badland only).

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shale). Topsoil availability at the site is limited due to shallow or nonexistent soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. The Muff soil is difficult to reclaim if the topsoil is removed and not replaced. The identified soils are characterized by a moderate to high wind erosion hazard and a low to moderate water erosion hazard. These soils are mildly to strongly alkaline. Shrink-swell potential of the identified soils is primarily low to moderate, but the Notal soil has a high shrink-swell potential. The identified soils present slight to moderate limitations for reservoirs, embankments, dikes, and levees (e.g., shallowness, piping, and seepage). These soils are currently used primarily for livestock grazing and wildlife habitat.

<u>Terminal Storage Reservoir Alternative (R2)</u>. Two different soil associations (SCS 1980) were identified at the alternative reservoir site. Map unit HU (Huerfano-Muff-Uffens) covers approximately 95 percent of the site, and map unit DN (Doak-Avalon) covers approximately 5 percent on the northern tip of the site.

The soils in map unit HU are shallow to deep, while map unit DN consists of deep soils. All of these soils are well drained, and the surface textures range from very fine sandy loam to clay loam. These soils are forming primarily in alluvium and residuum derived from shale and siltstone on a gently to moderately sloping upland drainage sideslope. The Avalon portion of map unit DN is also forming in eolian materials derived from sandstone and shale. Topsoil availability at the alternative reservoir site is limited due to generally shallow surface layers, and the majority of the existing topsoil is of poor to fair quality due to undesirable surface texture (too clayey) or excess salt/sodium. The Muff soil is difficult to reclaim if the topsoil is removed and not replaced. The identified soils are characterized by a moderate wind erosion hazard, and a primarily moderate water erosion hazard. These soils are mildly to strongly alkaline. The Avalon soil is moderately to highly susceptible to water-induced soil erosion. Since the Avalon soil covers a very small portion of the site (less than 2 percent), no significant water erosion problems would be expected to occur. Shrinkswell potential of the identified soils is low to moderate. The soils identified at this alternative reservoir site present slight to moderate limitations for reservoirs, embankments, dikes, and levees (e.g., shallowness, low strength, piping, and seepage). These soils are currently used primarily for livestock grazing and wildlife habitat.

#### Transmission Lines

<u>Proposed FC-A-P 500-kV Transmission Line Loop (T5)</u>. The corridor associated with this proposed transmission line loop falls within transmission corridor T4. See Table 9 (MP 0.0-5.0) for the applicable soils data.

First Proposed Transmission Corridor (T2). The first proposed transmission corridor is within the San Juan River Valley Mesas and Plateaus and the New Mexico and Arizona Plateaus and Mesas portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along T2, but most of this corridor receives between 6 and 14 inches. Fourteen different soil associations were identified within this corridor. Table 6 lists (by mileposts) and characterizes the identified soils.

The soils identified within the transmission corridor T2 are very shallow to deep, with surface textures ranging from gravelly loamy sand to clay. Permeability of these soils is very slow to rapid. Table 6. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE FIRST PACEOSED TRANSMISSION CORRIDOR (T2)

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Connents		Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Surink-swell potential is low to moderate, mild to moderately alkaline soils.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to atrongly alkaline soils.		Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.		Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.		Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Strink-swell potential is low to high, moderately to atrongly alkaline soils.			Low to moderate wind erosion hazard, moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.		Moderate to high vind erosion harard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Surink-suell potential is low to high, moderately to strongly alkaline soils.
Slope (I)		3	222		5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5 -		3.5.5		555			11		111 
Depth to Bedrock (inches)		10-20	60+20 60 -20		60+20 10-20		80 -20 10 -20		50 -27 20 -28		ly).	83	y).	\$ \$ \$ \$ \$ \$ \$
Soil Series		Hanierco	Steppard Haerfano Notal	0-0.75, respectively	Sheppard Huerfano Notal	0-0.75, respectively	Sheppard Huerfano Notal	0-0.75, respectively	Sheppard Hierfano Notal	0-0.75, respectively	.25-21.0, respective	Blamoot Notal	.0-0.75, respectivel	Sheppard Huerfano Notal
Soil Association and Description		Red Bard-Rock Outcrop Hunierco: Shallow, well drained, fine sandy losm soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and solian unterials derived primarily from sandstone and shale. Includes nonstony, burren shale areas on mod- erately sloping to extremely steep uplands that are dissected by deep intermittent drainageways and gul- lies; and burren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Skepperd Hierfano-Notal: Deep to shallow, well to somewhat excessively drained, lowny fine sandy clay lown, and silty clay lown soils formed on level to stoop mesas, plateaus, valley bottoms and fans from solian, alluvial, and residual materials derived from sendstone, shale, and siltatone.	Refer to Map Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.0	Sheppard Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from solian, alluvial, and residual materials derived from sandstone, shale, and siltatone.	Refer to Map Symbols - 6 and 8 (wileposts 0.75-4.25 and 0.6	Support Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loany fine sand, sandy clay loan, and silty clay loan soils formed on level to steep mesas, plateaus, valley bottoms and fans from solian, alluvial, and residual materials derived from sandstone, shale, and siltatone.	Refer to Map Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.6	Stepperd Huerfano-Notal: Deep to shallow, well to somewhat encessively drained, loamy fine sandy aandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms and fans from solian, alluvial, and residual materials derived from sandstone, shale, and siltatone.	Refer to Mup Symbols - 6 and 8 (mileposts 0.75-4.25 and 0.6	Refer to Nup Symbols - 6 and 5 (mileposts 0.75-4.25 and 17.	<u>Blarcot-Notal</u> : Deep, well to somewhat encessively drained, loam and silty clay loam soils formed on level to gently sloping fams, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.	Refer to Map Symbols - 5 and 6 (mileposts 17.25-21.0 and 0.	Support Huerfano-Notal: Deep to aballow, well to somewhat excessively drained, loany fine sand, sandy clay loan, and silty clay loan soils formed on level to steep mesas, platesus, valley bottoms and fans from solian, allurial and residual materials derived from
Mup Symbol		30	v	6/8	v	6/8	v	6/8	vð	6/8	6/5	'n	5/6	•
Milepost	Sen Juen County	67.0-0.0	0.75-4.25	4.25-5.0	5.0-5.75	5.75-8.75	0°01-52'8	10.0-11.0	٤.ધ-0.11	13.25-14.75	14.75-17.25	0. 17-22. 71	21.0-22.0	2.0-2.2

epost	Map Syntool	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (X)	Convents
um County	(continued)					
-24.75	6/8	Refer to Hup Symbols - 6 and 8 (mileposts 0.754.25 and 0.0-	-0.75, respectivel;	y).		
30.25	v	Sheppard Hiterfano Notal: Deep to shallow, well to somewhat excessively drained, losmy fine sand, eardy clay losm, and silty clay losm soils formed on level to steep messar, platesus, valley bottoms and fans from colian, alluvial, and residual materials derived from sandstone, shale, and siltatone.	Sheppard Hierfano Notal	\$ 5 8 8 8	311	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Surink-swell potential is low to high, moderately to strongly alkaline soils.
-32.0	6/5	Refer to Map Symbols - 6 and 5 (mileposts 0.75-4.25 and 17.	25-21.0, respectiv	ely).		
ler County						
0.2E	14	Persayo-lohmiller: Wery shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuam and alluviam derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohmiller	នុទ្ធ	25	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Surink-ewell potential is moderate, permeability is slow to very slow, calcareous.
35.75	v	<u>Peristaia-Valent</u> : Deep, fine sandy loam, very fine sandy loam, and loamy fine sand soils formed on nearly level to gently shoping uplands, and upland ridges from coliam, alluvial, and residual materials derived pri- marily from sandstone and shale. Includes underately steep to steep sandstone and shale outcrops, and Slick- spots or alkali-affected areas.	Penistaja Valent	33	11 1	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-17 inch precipitation zone. Burink-swell potential is low to moderate, permeability is moderate to rapid, moncalcareous.
F-38.5	6/14	Refer to Map Symbols - 6 and 14 (mileposts 35.0-35.75 and 3	2.0-35.0, respecti	vely).		
40.0	6/14/13	Refer to Map Symbols - 6, 14, and 13 (mileposts 35.0-35.75;	32.0-35.0; and 45	.5-46.25, real	pectively).	
0.14	14	<u>Persayo-lohniller</u> : Wery shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residnam and glluvium derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohniller	នុទ្ធ	25	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Shrink-ewell potential is moderate, permeability is slow to very slow, calcareous.
42.75	14/13	Refer to Map Symbols - 14 and 13 (mileposts 32.0-35.0 and 4)	5.5-46.25, respect	ively).		
45.5	14	<u>Persaro-lowiller</u> : Very shallow to deep, silty clay lows, silt lows, and silty clay lown soils formed on level to moderately steep broad valleys, uplands, excarpments, and breaks from residuan and alluvius derived from shale and sandatone. Includes barron or nearly barren shale outcrop areas.	Perazyo Lohmiller	ş3	25	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Surink-evell potential is moderate, permeability is slow to very slow, calcareous.
25.24	ដ	Hagerman-Travessills: Moderately deep to very shal- low, fine sandy loan, loan, and gravelly sandy loan soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuan derived from sandstone and in colian and alluvial sediments of mired origin. Includes steep sandstone (and some shale) outcrope.	Hagenaan Travessil la	8 <del>6</del>	3-25	Moderate to high wind erosion hazard, woderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permesbility is woderate to rapid, noncalcareous to slightly calcareous.
46.5	14	<u>Permayor-Iohuiller</u> : Wery shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuum and alluvium derived from shale and sundstone. Includes barren or nearly harren shale outeroo areas.	Pernayo Lobailler	ş3	5.5	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation zone. Surink-ewell potential is moderate, permeability is slow to very slow, calcareous.

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Table 6. CHARACTERISTICS OF THE SOILS INEWITFIED WITHIN THE FIRST PROPOSED TRANSPOSEDN CORRIDOR (T2) (continued)

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Connents		Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Strink-swell potential is low, permeability is moderate to rapid, noncelcaroous to slightly calcareous.				Low to moderate wind erosion hazard, moderate to high water erosion hazard, topsoil is fair to poor, 7-10 inch precipitation zone. Surink-swell potential is moderate to high, slow to very slow permeability, calcareous.		low to moderate wind erosion hazard, moderate to high water erosion hazard, topsoil is fair to poor, 7-10 inch precipitation zone. Shrink-swell potential is moderate to high, slow to very slow permeability, calcareous.		Low wind erosion hazard, moderate to high water erosion hazard, fair to good topsoil, 10-14 inch precipitation zone. Surink-swell potential is moderate to high, wildly to moderately alkaline soils.		Moderate vind and water erosion hazard, poor to fair topsoil, 10-14 inch precipitation zone. Surink-swell potential is low to high, moderately alkaline soils.	Low wind erosion hazard, moderate to high water erosion hazard, fair to good topsoil, 10-14 inch precipitation zone. Surink-swell potential is moderate to high, mildly to moderately alkaline soils.		Low wind erosion hazard, moderate to high water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Surink-swell potential is high, strongly alkaline soils.
Slope (X)		2. 2.				223		222		1-25		2-5	र्श्न-1 भ		11
Depth to Bedrock (inches)		20-40 4-20	vely).	ely).	vely).	5 - 5 5 - 5 5 - 5	ely).	9 <del>9</del> 9 9 <del>9</del> 9		+21-04 42-41	ely).	6-16 0-16	14-26 40-72+	ely).	\$\$
Soil Series		Hag erman Travess illa	5.5-46.25, respectiv	3.0-53.5, respectiv	3.0-53.5, respectiv	las lucas Litle Perasyo	2.0-35.0, respectiv	las lucas Litle Persayo		Litle Las lucas	.5-74.75, respectiv	Travessilla Persayo	Litle Ias lucas	.5-59.75, respective	Christianburg Navajo
Soil Association and Description		Hagemen-Travessilla: Moderately deep to very shal- low, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mess tops, valley bottoms, and flood plains in residuam derived from sandstons and flood plains in residuam derived from sandstons and in colian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Refer to Map Symbols - 14 and 13 (wileposts 32.0-35.0 and 4	Refer to Map Symbols - 14 and 15 (mileposts 32.0-35.0 and 5	Refer to Map Symbols - 13 and 15 (mileposts 45.5-46.25 and	<u>Les luces-litle Persayo</u> : Deep to very shallow, loss, clay, silty clay losm, and silt losm soils formed on nearly level to moderately sloping alluvial fans, val- ley sideslopes, uplands, ridges, and knolls from allu- vial and residual materials derived primarily from shale. Includes interbedded shale and sendstone exposures on steep escarpments and breaks.	Refer to Map Symbols - 15 and 14 (mileposts 53.0-53.5 and 3	<u>las lucas-litle Persayo</u> : Deep to very shallov, loss, clay, silty clay losm, and silt losm soils formed on nearly level to moderately sloping alluvial fans, val- ley sideslopes, uplands, ridges, and knolls from allu- vial and residual materials derived primarily from shals. Includes interbedded shale and sandstone exposures on steep escarpments and breaks.		<u>little-las incas</u> : Stallow to deep, well drained, loan, clay loan, and silty clay loam soils formed on level to moderately steep uplands and low hills from solian materials and shale.	Refer to Map Symbols - 2 and 6 (mileposts 57.5-59.75 and 63	Travessilla Persayo: Wery shallow to shallow, well drained, sandy loan, loan, and silty clay loam soils formed on gently sloping to moderately steep mesas and breaks from materials derived primarily from sandstone and shale.	<u>litle-las lucas</u> : Shallow to deep, well drained, loss, clay loss, and silty clay loss soils formed on level to moderately steep uplands and low hills from solian materials and shale.	Refer to Map Symbols - 1 and 2 (mileposts 76.25-76.5 and 57	Christianburg-Navajo: Deep, somewhat poorly and poorly drained, silty clay, and clay soils formed on level to gently sloping flood plains and terraces from alluvium. Includes Slickspots areas which are alkali-affected and susceptible to puddling.
Map Symbol	<sup>2</sup> (continued)	a	E1/41	14/15	21/61	S	15/14	SI SI	<sup>3</sup> (Part 1)	7	2/6	vo	7	1/2	1
Milepost	McKinley Comty	21. TA-2. 04	2.94-21.14	49.5-52.0	0° ES-0-23	3.6-0.63	51.55-25	5.12-21.22	Sandoval County	21.92-2.12	59.75-63.5	63.5-74.75	2.21-21.41	22.01-2.21	76.25-76.5

Table 6. CHARACHERISTICS OF THE SOILS INCATTFIED WITHIN THE FIRST PROPOSED TRANSMISSION COERDOR (12) (continued)

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Asta 76 35 36 5 and 71 0.82,75, respectively).

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Table 6. CHARACTERISTICS OF THE SOILS INEATIFIED WITHIN THE FIRST PROPOSED TRANSMISSION CORRIDOR (T2) (concluded)

<ul> <li>Stational Icourt<sup>4</sup> (Cart II)</li> <li>Stational Icourt<sup>4</sup> (Cart II)</li> <li>J. A-RL, J. 10</li> <li>Zhanoo Zhano and shift Lama axile framed on least to ander the point of the point and active the make and the make and the mathematic and validy the point and active the mathematic and validy planes. The point and active the mathematic and validy planes. The point and active the mathematic and validy planes. The point active the mathematic and valid planes. The point the mathematic and valid planes. The point the mathematic and valid planes. The mathematic and valid planes. The point the mathematic active planes. The mathematic active planes. The point the mathematic active planes. The mathematic active planes. The point the mathematic active planes. The mathematic acti</li></ul>	berrou Soil Series (inches	(2) (1)	Connents
7.0-62.13     10 <u>Extendential international</u> for shalls to deep, silly the set of the set of an advance.       8.175-63.15     10;     Effer to the system of this can advance and value advance.       8.175-63.15     10;     Effer to the system of this can advance.     10;       8.175-63.15     10;     Effer to the system of this can advance.     10;       8.175-63.15     10;     Effer to the system of this can advance.     10;       8.175-63.15     10;     Effer to the system of this can advance of the site advance.     10;       8.175-63.15     11;     Effer to the system of this can be advance of the site asset.     10;       8.175-63.15     11;     Effer to the system of this can be advance of the site asset.     10;       8.175-63.15     11;     Effer to the system of this can advance of the site asset.     10;       8.175-63.15     11;     Effer to the system of the site advance of the site asset.     10;       8.175-63.15     11;     Effer to the system of the site advance of the site asset.     10;       8.175-63.15     11;     Effer to the system of the site advance of the site asset.     10;       8.175-63.15     11;     Effer to the system of the site advance of the site asset.     10;       8.175-63.15     11;     Effer to the system of the site advance of the site asset.     10;       9.10;     11;     Ef			
<ul> <li>R.,7-86,75 [0], Refer to Nep Systel - 10 (allepost 77,0-82,75).</li> <li>R.,7-86,75 [1], Regificability them, and hear on the formed on level silver 60 to a trengy a long of the matter and the and heart (append means. For anterfail of volcanf, or basic (append means. For and fails to moder and the outcrope or more theread for anterfails (append for anterfail or basic (append for anterfails and basic forme and and or basic (append for anterfails and basic means. For anterfails and anterfails and anterfails and anterfails and and anter anterfails and anterfails and basic means. For anterfails and anterfails and anterfails and and anterfails and anterfails and anterfails and anterfails and anterfails and anterfails and anterfails</li></ul>	fersayo 6-18 Jurley 60+	5 2 2	Moderate wind and water erosion hazard, topsoil is poo 10-14 inch precipitation zone. Shrink-swell potential is moderate, permeability is slow, calcareous.
14 <u>Austh-Silver-Bookland</u> : Shallow to deep, story has, Apoda to strongly alory go id harm we sais formed on level to atrongly alory go id harm and haatic mesal from attrongly alory go id harm of a silver of the silver to atrongly alory on mean silve of hastic capod mesas.     00       80.75-86.75     11/14     Refer to May Symbols = 11 and 14 (milepasts 86.75-92.5 and 82.75-83.75, respectively includes basit concrept on mean silve to post and and includes the formed and alor basic capod mesas.     00       80.75-86.75     11     Refer to May Symbols = 11 and 14 (milepasts 86.75-92.5 and 82.75-83.75, respectively includes basit or basic solution in the solution of the solution derived from and and alor basic formed on marry level to mederately alorying albural fram, whiley the slower, ridges and and alor basic formed on a nearly level to mederately alorying albural fram, whiley there and and to concrept on while a steep to very steep that and and to concrept on while a steep to very steep that and and to a solution in the solution derived framed fram, whiley albural fram, whiley the slower, ridges and holds fram and and holds.     9-3- 2-3- 3-3- 3-3- 3-3- 3-3- 3-3- 3-3-			
<ul> <li>B. J5-96.15 11/14 Lefer to Map Symbols - 11 and 14 (mileposts 86.75-92.5 and 82.75-83.75, respectively loss. Jisty club loss, and sing to very shallow, cluy inte low nearly level to moleculey along a linvial fame, walley freewayo 6 index low molecular derived transmerication from anterchala derived from anterchala and atth to an aotil a formad on a general particle from anter and antile outcorpo on modernetly derived from anter and hoolla from anterchala derived from anter and hoolla from anterchala derived and attribution with an avel beneral versitie. The derived from anter and hoolla from anterchala derived from anter and hool and from the attrapt or and attract or anter and hool and from the attrapt or and the derived from anter and hool and from the attrapt or and derived hoot. The derived from anter and hoo anter anter and</li></ul>	Apache 10-20 Bilver 60	9- <u>1</u> 0 2-0	Low wind erosion hazard, moderate water erosion hazard topsoil is poor to good, 10-14 inch precipitation zone Surink-swell potential is low to high, permeability is slow to moderate, calcareous and noncalcareous soils.
86.75-92.5       11       Issilite Perestry: beep to very shallow, clay, it as luces formed on initia to moderately sloping alluvial fame, willey Peresopo       9-         10.81, sility clay loan, and still toom soils formed on initia toom seriely alloyer, trigger, and knolls from materials derived from weaterials derived to moderately atop uses, breaks, from an and sold toom a sility clay loan, and still toom soils formed on grantly sloping to moderately atop uses, breaks, from a soils formed on grantly sloping to moderately atop uses, breaks, from a organized and and store outcrops or moderately atop uses, breaks, from a soils formed or interbold and and store outcrops or moderately increased and into a soils formed or interbold and and too and site loan wile? From too a grantly sloping alluvial fam, walley for too and a soil a formed or interbold and and store and shale. Includes the proved is a soil a formed or interbold and and store and a soil a formed or interbold and and store and shale. Includes the proved of the slopes, uplands, tiges, and hoolis from anterials derived from searbines and the moderately along alluvial fam, walley for the soil a formed or interbold and and store and allow to moderately along allowing allow and and weaks.         94.25-99.5       7/11       Is a luces and and to moderately along allowing fam, walley formed or interested derived fam and store and allow to moderately along allowing allowing fam, walley from and to a locar and store and allow to moderately along allowing fam and weaks.       9.         94.25-99.5       7/1	FB.75, respectively).		
<ul> <li>92.5-94.25 II; Refer to Nep Symbol - 11 (milepont 86.75-92.5).</li> <li>13 Travessilla-Persayo-Bookland: Wary shallow to shallow, Travessilla 9-2 many loan, sility clay loan, and shalls. The indestroating to moderately a loging to moderately areas, breaks, tridges, and bronks treageness, breaks, tridges, and bronks treageness, breaks, tridges, and bronks the outcrops on moderately excession.</li> <li>94.25-98.25 II Ias Incen-liftle-Ferance: Deep to very shallow, clay, Ias Incens 40-box, sility clay loan, and silit loan soils formed on liftle 20-box, wiley loan, and silit loan soils formed on liftle 20-box, tridges, and bronks.</li> <li>94.25-98.25 II Ias Incen-liftle-Ferance: Deep to very shallow, clay, Ias Incens 40-box, sility clay loan, and silit loan soils formed on liftle 20-box, tridges, and brolks.</li> <li>94.25-98.25 III Refer to moderately sloping alluvial fram, valley Persayo for ide slopes, uplands, tridges, and brolks from materials derived from wethered shals. Includes steep to very tensyo for the proventy level to moderately aloging alluvial fram, valley Persayo for the strong trade and store outcrops.</li> <li>96.25-99.5 7/11 Refer to Nep Symbols - 7 and II (mileposts 99.5-101.0 and 86.75-92.5, respectively).</li> <li>99.5-101.0 7 Rough Breken Lean-fightod: Shallow to moderately deep, Bubolo 20-box, provelly fine sandy loan, gravelly excelly and soils formed on neurly level to moderately steep uplands dissocted by numerous intermittent drainages and to allow and soils formed on neurly level to moderately steep uplands dissocted by numerous intermittent drainages and soils formed on neurly level to moderately steep uplands dissocted by numerous intermittent drainages and to allow to moderately deep, bubols - 7 and II (mileposts 9.5-101.0 20-by and loan, gravelly excelly level to moderately steep uplands dissocted by numberous intermittent drainages and to allow to moderately deep uplands dissocted by numerous intermittent drainages and to allow to moderately with the model of the second</li></ul>	Litle 20-40 Litle 20-40 Persayo 6-18	222	Low wind erosion hazard, moderate to high water erosio hazard, fair to poor topsoil, 10-14 inch precipitation zone. Surink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
13     Travessilla Fersavor Bockland: Very shallow to shallow, Travessilla P-2 early loan, silty clay loan, and silt loan soils formed.     Persayo     3-2       94.25-98.25     11     Image to andreately at exp measa, breaks, ridges, and brouls from sendstone and shale. Includes interbeddd andatone and shale outcrops on moderately steep usesa, breaks, ridges, and brouls from sendstone and shale. Includes interbeddd andatone and shale outcrops on moderately steep to an early level to antravely steep escarpments and breaks.     3-2       94.25-98.25     11     Image Incending to moderately and shale. Includes interbeddd andatone and shale outcrops on moderately steep uses and breaks.     40       94.25-98.25     11     Image Incending to moderately at each breaks.     50       94.25-98.25     11     Image Incending to moderately and shale outcrops on moderately to moderately at each breaks.     50       94.25-98.25     11     Image Incending tigges, and houlls from weak on the interval on the interva			
94.25-98.25       11       Ias Incos-little Persay: Deep to very shallow, clay, Ias Incas       40         losm, silty clay losm, and silt losm soils formed on nearly level to moderately sloping alluvial fans, valley       Ias Incas       40         losm, silty clay level to moderately sloping alluvial fans, valley       Ferasyo       6         side slopes, uplands, ridges, and knolls from materials       Ferasyo       6         side slopes, uplands, ridges, and knolls from materials       Ferasyo       6         98.25-99.5       7/11       Refer to Map Symbols - 7 and 11 (mileposts 99.5-101.0 and 86.75-92.5, respectively).       9         99.5-101.0       7       Rough Broken Iend Habudo: Shallow to moderately deep, gravely       Babudo       20         99.5-101.0       7       Rough Broken Iend Habudo: Shallow to moderately deep, gravely       Babudo       20         99.5-101.0       7       Rough Broken Iend Habudo: Shallow to moderately deep, gravely       Babudo       20         99.5-101.0       7       Rough Broken Iend Habudo: Shallow to moderately deep, gravely       Babudo       20         99.5-101.0       7       Rough Broken Iend Habudo: Shallow to moderately deep, gravely       Babudo       20         99.5-101.0       7       Rough Broken Iend Habudo: Shallow to moderately deep, gravely       Babudo       20         99.5-101.0<	Travessills 8-20 Persayo 3-25	2-f 2-f	Moderate wind and water erosion hazard, topsoil is pool 10-14 inch precipitation zone. Surink-ewell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.
<ul> <li>98.25-99.5 7/11 Refer to Map Symbols - 7 and 11 (wileposts 99.5-101.0 and 86.75-92.5, respectively).</li> <li>99.5-101.0 7 <u>Rough Broken Land Eubudo</u>: Shallow to moderately deep, Rahudo 20-gravelly fine sandy loan, fine sandy loan, gravelly and soils formed on nearly level to moderately steep uplands dissected by numerous intermittent drainages and arroyos as well as breaks, ridoes, and to a lesser extent vallew bettome</li> </ul>	las lucas 40-60 Litle 20-40 Persayo 6-18	222	Low wind erosion hazard, moderate to high water erosio hazard, fair to poor topsoil, 10-14 inch precipitation zone. Surink-swell potential is moderate to high, permeshility is slow to very slow, calcareous.
99.5-101.0 7 <u>Rouch Hroken Land Fubudo</u> : Shallow to moderately deep, Hadudo 20-gravely fine sandy loam, fine sandy loam, gravely and soils formed on nearly level to moderately steep uplands dissected by numerous intermittent drainages and arroyos as well as breaks, ridees, and to a lesser extent vallev bettome	-92.5, respectively).		
and flood plains. These soils are forming primarily in unconsolidated alluvium.	20-36	Ĩ	Low wind erosion hazard, moderate water erosion hazard topsoil is poor, 10-14 inch precipitation zone. Surin evell potential is low, permeability is rapid, calcareous.

3

<sup>1</sup>U.8. Soil Conservation Service (303). 1979. General soil map, San Juan County, New Merico, eastern part. Soil survey of San Juan County, New Merico, eastern part.

1974. General soil map of McKinley County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 262. 1 2

1967. General soil map, Cabezon area, Sandoval County, New Merico. Soil survey, Cabezon area, New Merico.

Control with more control and for House America, Mar Marica State Informative Amrical functional Bration. Research Report 188. 1001

These soils are forming primarily in alluvial, eolian, and residual materials derived from sandstone, shale, and siltstone, and to a lesser extent in materials of volcanic origin (e.g., basalt). These soils are forming primarily on gently to strongly sloping mesas, plateaus, hills, ridges, knolls, valleys, intermittent drainageways, and floodplains. This proposed transmission corridor traverses numerous intermittent drainages as well as Badland (nonstony, barren shale) and Rock Outcrop (barren sandstone and lava) areas. Topsoil availability within this proposed transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy or clayey) or excess salt/sodium. Susceptibility to wind-induced soil erosion ranges from low to high, and susceptibility to water-induced soil erosion also ranges from low to high. Most of the soils identified within this proposed transmission corridor are alkaline and/or calcareous. Shrink-swell potential of the identified soils ranges from low to high. These soils are used primarily for livestock grazing, wildlife habitat, and to a lesser extent energy resources development.

<u>Second Proposed Transmission Corridor (T1)</u>. The T1 transmission corridor is within the San Juan River Mesas and Plateaus and the New Mexico and Arizona Plateaus and Mesas portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along this proposed transmission corridor, but most of this corridor receives between 6 and 14 inches. Eighteen different soil associations were identified within this proposed transmission corridor. Table 7 lists (by mileposts) and characterizes the identified soils.

The soils identified within the transmission corridor Tl are very shallow to deep, with surface textures ranging from gravelly loamy

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Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPERD TRANSMISSION CORRIDOR (T1)

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Milepost	Map Symbol	Soil Association and Description	Soil Beries	Depth to Bedrock (inches)	Blope (I)	Connents
Sea Juan Count	к <sup>1</sup>					
2.0-0.0	8	Relland Bock Outcrop Minierco: Shallow, well drained, fine samly losm soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and colian unsterials derived primarily from sandstone and shale. Includes nonstony, harren shale areas on mod- erately sloping to extremely steep uplands that are dissected by deep intermittent drainagesays and gul- lies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Hanierco	10-20	Ï	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mild to moderately alkaline soils.
<b>0.5-11.5</b>	v	Sheppend-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, lowny fine sand, sandy clay lown, and silty clay loam soils formed on level to steep meass, plateaus, valley bottoms and fans from colian, alluvial, and residual materials derived from sendstone, shale, and siltatone.	Sheppard Huerfano Notal	\$ 61 95 °	5.5	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Surink-swell potential is low to high, moderately to strongly alkaline soils.
22. EL-2. II	e	Shiprock-Sherpoard-Doak: Deep, well to somewhat exces- sively drained, fine sandy loan, loany fine sand, and loam soils formed on level to moderately steep muses, plateaus, and terraces from alluvial and colian mate- rists derived from sandstone, shale, and mixed sources.	Shiprock Sheppard Doak	333	131	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6-10 inch precipitation zone. Surink-swell potential is low to moderate, wildly to moderately alkaline soils.
13.25-15.5	3/8	Refer to Map Symbols - 3 and 8 (mileposts 11.5-13.25 and 0.0	H0.5, respectivel	y).		
15.5-18.5	v	Sheppend-Huerfano-Hotal: Deep to shallow, well to somewhat excessively drained, losmy fine sand, sandy clay losm, and silty clay losm soils formed on level to steep meass, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Sheppard Huerfano Notal	\$ 5 8 8 8	555	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Surink-well potential is low to high, moderately to strongly alkaline soils.
18.5-19.5	6;	Refer to Map Symbol - 6 (milepost 0.5-11.5).				
	1	<u>Persavo-Fruitland-Sheppard</u> : Very shallow to deep, well to excessively drained, clay loam, sandy loam, and loany fine sand soils formed on level to steep hills, breaks, valley sides, fams, and plateaus from alluvial, residual, and coliam materials derived from shale, sendstone, and mixed sources.	Persayo Fruit land Sheppard	5 5 5 5 4 5	333	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Surink-swell potential is low to moderate, mildly to strongly alkaline soils.
0.12-2.01	1	Perserv-Fruitland-Sheppard: Wary shallow to deep, well to excessively drained, clay loam, sandy loam, and loany fine sand soils formed on level to steep hills, breaks, valley sides, fams, and plateaus from alluvial, residual, and colian materials derived from shale, sendstone, and mixed sources.	Ferago Fruitland Sheppard	8 8 8 9 9 9 9	4 0 0 3 8 3	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Surink-evell potential is low to moderate, mildly to atrougly alkaline soils.
21.0-22.25	Ś	Blancot-Notal: Deep, well to accmeasiat excessively drained, loss and silty clay loss soils formed on level to gently sloping fams, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.	Blancot Notal	33	22	Low to woderate wind erosion harard, woderate water erosion harard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
22.25-22.75	5/1	Refer to Map Symbols - 5 and 1 (mileposts 21.0-22.25 and 19.	5-21.0, respectiv	ely).		

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Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1) (continued)

cument a		rosion hazard, moderate water 11 is poor to fair, 6-10 inch Wrink-ewell potential is low strongly alkaline soils.	erosion harard, low to moderate topsoil is poor to fair, 6-10 me. Surink-well potential is y to strongly alkaline soils.		erosion hazard, low to moderate topsoil is poor to fair, 6-10 ke. Surink-swell potential is y to strongly alkaline soils.			erosion hazard, low to moderate topsoil is fair to good, 6-10 we. Surink-swell potential is y to moderately alkaline soils.	rosion hazard, moderate water il is poor to fair, 6-10 inch Wrink-swell potential is low strongly alkaline soils.		er erosion hazard, topsoil is poor, ion zone. Surink-swell potential ity is slow, calcareous.	erosion hazard, low to moderate topsoil is fair to poor, 10-14 e. Shrink-swell potential is ability is moderate to rapid,
3		low to moderate wind e erosion hazard, topsoi precipitation zone. S to high, moderately to	Moderate to high vind water erosion hazard, inch precipitation zon low to moderate, mildl		Moderate to high wind water erosion hazard, inch precipitation zon low to moderate, mildl			Moderate to high wind water erosion hazard, inch precipitation zon low to moderate, mildl	low to moderate wind e erosion hazard, topsoi precipitation zone. S to high, moderately to		Moderate wind and wate 10-14 inch precipitati is moderate, permeabil	Moderate to high wind water erosion hazard, inch precipitation zon low to moderate, perme noncalcareous.
Slope (3)		6-5	4 9 9 8 8 8		5 0 9 9 0 9			9-9-9- 9-5-30	5-5-		3.2	гı
Depth to Bedrock (inches)		33	10-20 60 64	aly).	10-20 66 4	(y).	ely).	333	33		6-18 64	83
Soil Series		Blancot Notal	Peraayo Fruitland Sheppard	.5-19.5, respectiv	Persayo Fruitland Sueppard	-22.5, respective	5-13.25, respectiv	Shiprock Sheppard Doak	Blancot Notal		Persayo Turley	Penista ja Valent
Soil Association and Description		<u>Blancot-Motal</u> : Deep, well to somewhat excessively drained, loam and silty clay loam soils formed on level to gently sloping fams, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.	<u>Persavo-Fruitland-Sheppard</u> : Very shallow to deep, well to excessively drained, clay loam, sandy loam, and loamy fine sand soils formed on level to steep hills, breaks, valley sides, fans, and plateaus from alluvial, residual, and colian materials derived from shale, sendstone, and mixed sources.	Befer to Nep Symbols - 3 and 1 (mileposts 11.5-13.25 and 18.	Persayo-Fruitland-Sheppard: Very shallow to deep, well to excessively drained, clay losm, sandy losm, and losmy fine sand soils formed on level to steep hills, breaks, valley sides, fans, and plateaus from alluvial, residual, and colian materials derived from shale, sandstone, and mixed sources.	Refer to Mup Symbols - 1 and 5 (mileposts 18.5-19.5 and 21.0	Befer to Map Symbols - 1 and 3 (mileposts 18.5-19.5 and 11.5	Shiprock-Sheppard-Doak: Deep, well to somewhat exces- sively drained, fine sandy losm, losmy fine sand, and losm soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and colian mate- rials derived from sandstone, shale, and mixed sources.	<u>Blancot-Motal</u> : Deep, well to somewhat excessively drained, losm and silty clay losm soils formed on level to gently sloping fams, valley sides, and valley bottoms from alluvium derived primarily from sandstone and shale.		<u>Persevo-Murlev-Bodland</u> : Wary shallow to deep, silty clay home, and silt home soils formed on level to moder- stely steep uplands, ridges, valley bottoms, and valley sides from residuan derived from shale and sandstone, and to a lesser extent from alluvium. Includes moder- stely to very steep barren shale outcrops.	<u>Penistsis-Valent-Bockland</u> : Deep, fine aandy losm, very fine aandy lowm, and loany fine aand aoils formed on nearly level to gently sloping uplands from eolian and alluvial deposits and to a lesser extent from residual materials derived from sandstone and other sedimentary rocks. Includes moderately sloping to moderately steep outcrops of sandstone and shale, and associated rough
Map Symbol	(continued)	Ś	-	3/1	-	1/5	1/3	ę	s	(Part 1)	9	80
Milepoet	Sen Jun Comty	2.221.12	2.2-2.12	25.5-26.75	26.75-28.0	28.0-29.5	29.5-30.0	30.0-31.5	2. EE-2. IE	Sandoval Comty <sup>2</sup>	33.5-34.5	34.5-36.75

the 34.5-34.75 and 33.5-34.5. respectively).

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Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1) (continued)

	Kap			Depth to Bedrock	Slope	
Milepost	Synbol	Soil Association and Description	Soil Series	(inches)	8	Connects
Surdoval County	<sup>2</sup> (Part 1) (cor	ttimed)				
0.14-21.16	20	<u>Penistaja-Valent-Rockland</u> : Deep, fine sandy losm, very fine sandy losm, and losmy fine sand soils formed on rearry level to genthy sloping uplands from colian and alluvial deposits and to a lesser extent from residual meterials derived from sandstone and other sedimentary rocks. Includes moderately sloping to moderately steep outcrope of sandstone and shale, and associated rough lands.	Penista ja Valent	33	ደ፲	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeshility is moderate to repid, moncalcareous.
41.0-45.5	01	<u>Persavo-Turler-Badland</u> : Very shallow to deep, silty clay losm, and silt losm soils formed on level to moder- stely steep uplands, ridges, valley bottoms, and valley sides from residuum derived from shale and samlstone, and to a lesser extent from alluvium. Includes moder- stely to very steep barren shale outcrops.	Persayo Turley	5- 5-	32	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-well potential is moderate, permeability is slow, calcareous.
45.5-46.75	10/8	Refer to Map Symbols - 10 and 8 (mileposts 33.5-34.5 and 34	5-36.75, respecti	vely).		
<i>21.02-21.3</i> 4	œ	<u>Penistais-Valent-Bockland</u> : Deep, fine sandy loan, very fine sandy loan, and loany fine and soils formed on nearly level to gently sloping uplands from colian and alluvial deposits and to a leaser extent from residual materials derived from sandstone and other sedimentary rocks. Includes moderately sloping to moderately steep outcrope of sandstone and shale, and associated rough lands.	Penista ja Valent	33	ደ፲	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeshility is moderate to rapid, noncalcareous.
<b>McKinley</b> Compy	<b>.</b>					
<b>č. š</b> č- <u>č</u> 1. 0č	٩	<u>Penistaja-Valent</u> : Deep, fine sandy loam, very fine sandy loam, and loamy fine and soils formed on nearly level to gently sloping uplands, and upland ridges from soliam, alluvial, and residual materials derived pri- marily from sandstone and shale. Includes moderately steep to steep sandstone and shale outcrops, and Slick- spots or alkali-effected areas.	Penista ja Valent	33	ደ፲	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to poor, 10-17 inch precipitation zone. Surink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous.
۶6. ۶-57.25	14	<u>Persayo-Iohuiller</u> : Very shallow to deep, silty clay loam, silt loam, and silty clay loam soils formed on level to moderately steep broad valleys, uplands, escarpments, and breaks from residuum and alluvium derived from shale and sandstone. Includes barren or nearly barren shale outcrop areas.	Persayo Lohuiller	8-79 4-79	25	Moderate wind and water erosion hazard, topsoil is poor to fair, 10-17 inch precipitation more. Surink-swell potential is moderate, permesbility is slow to very slow, calcareous.
Sandoval County	2,4 (Part II)					
57.25-64.75	e	Penistaie-Berent-Sundatone Outcrop: Deep and moder- ately deep, well to excessively drained, fine sandy loam, and loamy fine sand soils formed on level to moderately sloping uplands, meass, and ridges from colian materials and to a lesser extent from alluvium. Includes strongly sloping to moderately steep sand- stone outcrope and Slickspots areas (alkali-affected).	Perista ja Berent	90 €0+ 90 €0+	11	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to moderately alkaline soils.
64.75-69.75	8	<u>little-las lucas</u> : Shallow to deep, well drained, loam, clay loam, and silty clay loam soils formed on level to underately steep uplands and low hills from solian materials and shale.	Litle Las Lucas	14-24 40-72+	1-25 0-9	low wind erosion hazard, woderate to high water erosion hazard, fair to good topsoil, 10-14 inch precipitation zone. Surink-swell potential is moderate to high, wildly to moderately alkaline soils.

Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to show, slightly calcareous and calcareous soils. low wind erosion hazard, moderate to high water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Surink-swell potential is high, strongly alkaline soils. Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Surink-swell potential is moderate, permesbility is slow, calcareous. low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation zone. Surink-swell potential is moderate to high, permeability is slow to very slow, calcareous. Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation sone. Surink-ewell potential is moderate to high, permeability is slow to very slow, calcareous. Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation Moderate wind and water erosion hazard, poor to fair topsoil, 10-14 inch precipitation zone. Shrink-swell potential is low to high, moderately alkaline soils. zone. Surink-well potential is moderate to high, permeability is slow to very slow, calcareous. Comments Slope (X) 2-5 23 3-2 111 111 111 II Depth to Bedrock (inches) 29 49 69 6 78 69 6 78 69 8-48 6-18 5-56 6-18 8 5 5 6 84 6-16 Refer to Mup Symbols - 2 and 6 (mileposts 64.75-69.75 and 69.75-79.75, respectively). 33 Mefer to New Symbols - 11 and 10 (mileposts 81.0-81.5 and 33.5-34.5, respectively). Refer to Map Symbols - 10 and 11 (mileposts 33.5-34.5 and 81.0-81.5, respectively). Refer to Nap Symbols - 11 and 13 (mileposts 81.0-81.5 and 92.0-94.0, respectively). Refer to Map Symbols - 13 and 11 (mileposts 92.0-94.0 and 81.0-81.5, respectively). Christianburg Nevajo Travessilla Persayo Soil Series Travessilla Las lucas Litle Persayo Las lucas Litle Persayo Las luces Litle Pernayo Persayo Persayo Turley <u>Persayo-Turley-Badland</u>: Wery shallow to deep, silty clay lown, and silt lown soils formed on level to modernearly level to moderately sloping alluvial fams, valley nearly level to moderately sloping alluvial fans, valley nearly level to moderately sloping alluvial fame, valley Clutistianburg-Neyvajo: Deep, somewhat poorly and poorly drained, silty clay, and clay soils formed on level to gently sloping flood plains and terraces from alluvius. clay loam, and silt loam soils formed on level to moder-ately steep uplands, ridges, valley bottoms, and valley sides from residuum derived from shale and sandstone, side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very side slopes, uplands, ridges, and knolls from materials Travessilla Persayo Rockland: Very shallow to shallow, sandy loam, silty clay loam, and silt loam soils formed on gently sloping to moderately steep messa, breaks, ridges, and knolls from sandstone and shale. Includes Includes Slickspots areas which are alkali-affected and side slopes, uplands, ridges, and knolls from materials formed on gently sloping to underately steep mesas and breaks from materials derived primarily from sundstone interbedded sundatone and shale outcrops on moderately steep to extremely steep escarpments and breaks. and to a lesser extent from alluvium. Includes moderderived from weathered shale. Includes steep to very las Incas-Litle-Persayo: Deep to very shallow, clay, las Lucas-Litle-Persavo: Deep to very shallow, clay, las lucas-litle-Persayo: Deep to very shallow, clay, derived from weathered shale. Includes steep to very Travessilla Persayo: Very shallow to shallow, well drained, sandy loam, loam, and silty clay loam soils loam, silty clay loam, and silt loam soils formed on loan, silty clay loan, and silt loan soils formed on loam, silty clay loam, and silt loam soils formed on ately to very steep barren shale outcrops. Soil Association and Description steep shale and sandstone outcrops. steep shale and sundations outcrops. steep shale and sandstone outcrops. susceptible to puddling. and ahale. Sandoval County <sup>2</sup>, <sup>4</sup> (Part II) (continued) Hap 11/10 10/11 EL/11 11/61 2/6 9 2 -I E Π Π 69.75-79.75 96.25-100.0 2.08-21.91 94.0-96.25 80.5-81.0 81.0-81.5 85.0-86.0 91.0-92.0 81.5-82.5 82.5-85.0 0"16-0"98 92.0-94.0 Hilepost

Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRIDOR (T1) (continued)

Table 7. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE SECOND PROPOSED TRANSMISSION CORRECT (T1) (concluded)

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Connent a			Low wind erosion hazard, moderate water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Shrink- swell potential is low, permeability is rapid, calcareous.		Moderate to high wind erosion hazard, low to moderate water erosion hazard, por topsoil, 10-14 inch precipi- tation zone. Shrink-swell potential is low to moderate, permeability is moderate to rapid, noncalcareous and calcareous soils.	an County, New Mexico, eastern part.
Slope (1)			Ĩ		III	ry of San Ju
Depth to Bedrock (inches)			36- 28	ctively).	20-36 10-20 20-36	. Soil surve
Soil Series			Birbudo	d 104.25-108.0, respe	Madurez Caliza Wink	Mexico, eastern part
Soil Association and Description	continued)	Refer to Map Symbol - 11 (milepost 81.0-81.5).	Rouch Broken Iand-Brhudo: Shallow to moderately deep, gravelly fine sandy loam, fine sandy loam, gravelly sandy loam, and gravelly loamy sand soils formed on nearly level to moderately steep uplands dissected by numerous intermittent drainages and arroyos as vell as breaks, ridges, and to a lesser extent valley bottoms and flood plains. These soils are forming primarily in unconsolidated alluvium.	Refer to Map Symbols - 7 and 5 (mileposts 100.0-102.75 and	<u>Madurez-Caliza-Wink</u> : Shallow to moderately deep, loamy fine sand, fine sandy loam, gravelly sandy loam, and very gravelly sundy loam soils formed on nearly level to moderately sloping uplands and ridges from unconsol- idated alluvium.	Service (SCS). 1979. General soil map, San Juan County, New
Map Synbol	4 (Part II) (c	u;	۲	7/5	S	Conservation 8
Milepost	Sandoyal County	100.0-102.75		102.75-104.25	104.25-108.0	Sources: <sup>1</sup> U.S. Soil

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1974. General soil map of McKinley County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 262. e

1967. General soil map, Cabezon area, Sandoval County, New Mexico. Soil survey, Cabezon area, New Mexico. •

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sand to clay loam. Permeability of these soils is very slow to rapid. These soils are forming in alluvial, eolian, and residual materials derived primarily from sandstone, shale, and siltstone. These soils are forming primarily on gently sloping to strongly sloping mesas, plateaus, hills, ridges, knolls, valleys, intermittent drainageways, and floodplains. This proposed transmission corridor traverses numerous intermittent drainages, as well as Badland (nonstony, barren shale) and Rock Outcrop (barren sandstone) areas. Topsoil availability within this proposed transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of fair to poor quality due to undesirable surface textures (e.g., too sandy, clayey, or gravelly) or excess salt/sodium. Susceptibility to wind-induced soil erosion ranges from low to high, and susceptibility to water-induced soil erosion also ranges from low to high. Most of the soils identified within this proposed transmission corridor are alkaline and/or calcareous. Shrinkswell potential of the identified soils ranges from low to high. These soils are used primarily for livestock grazing, wildlife habitat, and to a lesser extent energy resource development.

Transmission Corridor T3. Alternative transmission corridor T3 is within the San Juan River Valley Mesas and Plateaus and the New Mexico and Arizona Plateaus and Mesas portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along this transmission corridor alternative. Seventeen different soil associations were identified within this corridor alternative. Table 8 lists (by mileposts) and characterizes the identified soils.

The soils identified within transmission corridor T3 are very shallow to deep, with surface textures ranging from loamy fine sand to clay. Permeability of these soils is very slow to rapid. These soils Table 8. CHARACTERISTICS OF THE SOILS IDENTIFIED WITHIN THE TRANSPORSION CORRIDOR ALTERNATIVE . T3.

Boil Association and Description         Soil           Boil Association and Description         Soil Association and Description         Soil           By any local areas and plateau from address and possible derived primerily from suddrose and an asterials derived primerily from suddrose and an and an anterials derived primerily from suddrose and an anterials derived primerily from suddrose and an anterials derived primerily from suddrose and an anterial derived primerily from suddrose and an anterial derived from suddrose and plateau, willy Chyl base, and silve chyler blateau, willy Chyl base, and silve chyler blateau, willy Chylerae and an anterial derived from suddrose, adult, and residual materials derived from suddrose, adult, and terraces from a luvial, and terraces the soul luvial, and terraces the sould be and solution while the and, and terraces from a luvial and column the from suddrose, adults, and siletone.         Ship terraces the sould be and, and the sould be and, and terraces the sould be and a luvial, and terraces the sould be and a low a	Depth to Bedrock Slope Series (inches) (1) C		erco 10-20 0-8 Moderate vind and wate 6-10 inch precipitatio is low to moderate, mi	pard 60+ 0-40 Moderate to high wind femo 10-20 0-3 water erosion hazard, 1 60 0-2 inch precipitation zo low to high, moderate!		<pre>rock 60 0-8 Moderate to high wind pard 60+ 0-30 water erosion hazard, 60+ 0-5 inch precipitation so low to moderate, wild!</pre>	tespectively).	pard 60+ 0-40 Moderate to high wind framo 10-20 0-3 water erosion hazard, 1 60 0-2 inch precipitation zo low to high, moderate	ierco 10-20 0-8 Moderate vind and wat 6-10 inch precipitati is low to moderate, w	respectively).	ppard 60+ 0-40 Moderate to high vind rfamo 10-20 0-3 water erosion hazard,
	Soil Association and Description 801		Redland-Rock Outcrop-Honierco: Shallow, well drained, fine samdy loam soils formed on level to underately aloping knolls, meass, and plateaus from alluvial and coliam materials derived primarily from sandstone and ahale. Includes nonstony, barren shale areas on mod- erately sloping to extremely steep uplands that are dissected by deep intermittent drainageasys and gul- lies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breeks, and lokes.	Sherpoint Huerfano-Notal: Deep to shallow, well to Sherp somewhat ercessively drained, loany fine sand, sandy clay loan, and silty clay loan soils formed on level Huerf to steep mesas, plateaus, valley bottoms and fans from eolian, alluvial, and residual materials derived from sendstone, shale, and siltatone.	Refer to Map Symbol - 6 (milepost 0.75-1.25).	Shiprock-Sheppard-Doak: Deep, well to somewhat excession of a sively drained, fine sandy losmy fine sand, and Sheph loam soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and colian materials derived from sandstone, shale, and mixed sources.	Refer to Map Symbols - 6 and 8 (mileposts 0.75-1.25 and 0.0-0.75, r	Sheppard Huerfaro Notal: Deep to shallow, well to Shep accordant encessively drained, losany fine sand, sandy clay losan, and silty clay losan soils formed on level Huer to steep messs, plateaus, valley bottoms and fams from colian, alluvial, and residual materials derived from sandstone, shale, and siltatone.	<u>Bedland Rock Outcrop Monierco</u> : Shallow, well drained, fine sandy loan soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and colian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on mod- erately sloping to extremely steep uplands that are dissected by deep intermittent drainageasys and gul- lies; and barren sandstone outcrops on moderately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Refer to Map Symbols - 6 and 8 (mileposts 0.75-1.25 and 0.0-0.75, r	Suppord Hierfano Notal: Deep to shallow, well to Sher somewhat excessively drained, loany fine sund, sandy Hier clay loam, and silty clay loam soils formed on level Nota
	Milepost	San Aun County	0.0-0.75	0.75-1.25	1.25-3.5		3.54.0	4.0-5.5	5.56.0	6.0-6.5	22.11-2.9

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Milepost	Map Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (I)	Comments
McKinley Comt	¥2					
0.91-22.71	1/2	Refer to Map Symbols - 1 and 2 (mileposts 19.0-24.0 and 27.	25-28.0).			
0.42-0.91	1	<u>Persavo Camborthids</u> : Wary shallow to moderately deep, silt loss, silty clay loss, and fine samby loss soils formed on nearly level to strongly sloping uplands in residuan derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrope.	Persayo Camborthide	8 <del>6</del> 8 <del>8</del>	1-15 1-8	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation more. Shrink-well potential is low to moderate, per- mesbility is slow to moderate, calcarsous.
24.0-25.75	7	<u>Persayo Billinge</u> : Wary shallow to deep, silty clay losm soils formed on level to strongly sloping uplands, alluvial fams, valley sides, and flood plains in resid- um and alluvium derived from shale.	Peraayo Billinga	8-8	55	Moderate wind erosion hazard, low to high water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Burink-swell potential is moderate, permeability is very slow to slow, calcareous.
27.12-51.22	1	<u>Persayo Camborthids</u> : Wary shallow to moderately deep, silt loam, silty clay loam, and fine sandy loam soils formed on nearly level to strongly sloping uplands in residuan derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrope.	Pernayo Camborthida	9 8 8 8	1-15 1-8	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Strink-swell potential is low to moderate, per- mesbility is slow to moderate, calcareous.
21.25-28.0	7	<u>Persaro-Billings</u> : Wery shallow to deep, silty clay loam soils formed on level to strongly sloping uplands, alluvial fams, valley sides, and flood plains in resid- uem and alluvium derived from shale.	Persayo Billings	8-8 9-	55	Moderate wind erosion hazard, low to high water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Surink-swell potential is moderate, permeability is very slow to slow, calcareous.
28.0-30.0	1	<u>Persavo Carborthids</u> : Very shallow to moderately deep, silt losm, silty clay losm, and fine sandy losm soils formed on nearly level to strongly sloping uplands in residuan derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrope.	Persayo Camborthida	9 8 8 8	1-12 1-8	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potential is low to moderate, per- mesability is slow to moderate, calcarsous.
30.0-32.0	51	Hagerman-Travessills: Moderately deep to very shal- low, fine sandy loam, loam, and gravelly sandy loam solis formed on nearly level to moderately steep uplands, mess tope, valley bottoms, and flood plains in residuan derived from sandstone and in colian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrope.	Hagernam Travessilla	9 8 7	55	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rupid, noncalcarsous to slightly calcarsous.
32.0-32.5	7	<u>Persavo-Billings</u> : Wary shallow to deep, silty clay losm soils formed on level to strongly sloping uplands, alluvial fans, valley sides, and flood plains in resid- uem and alluvium derived from shale.	Pernayo Billings	8-9 9-	55	Moderate wind erosion hazard, low to high water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Surink-swell potential is moderate, permeability is very slow to slow, calcareous.
32.5-36.25	ដ	Hagermen-Travessills: Moderately deep to very shal- low, fine sendy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tope, valley bottoms, and flood plains in residam derived from sandstone and in colian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrope.	Hageman Travessills	9 A A 4	5. 25	Moderate to high wind envelon hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation aone. Shrink-well potential is low, permeability is moderate to rupid, noncalcareous to slightly calcareous.
36.25-42.5	10;	Iobmiller-Ban Mateo: Deep, clay loam, clay, silty clay loam, loam, and sandy loam soils formed on level to gently sloping valley bottome, flood plains, and terraces from alluvium derived primarily from send- stone and shals.	Lohmiller Ben Meteo	\$\$	33	Moderate wind and water erosion hazard, topsoil is fair to good, 10-17 inch precipitation zone. Skrink-swell potential is low to high, permeability is very slow to moderate, calcarsous.

Refer to Map Symbol - 13 (milepost 30.0-32.0).

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Table 8. CHARACHERISTICS OF THE SOILS IDENTIFIED WITHIN THE 'N' TRANSMISSION CORRILOR ALTERNATIVE (T3) (concluded)

Connents		Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.		Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-swell potentia is low, permeability is rapid, slightly calcareous.	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Shrink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.		Moderate vind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Surink-swell potentia is low to moderate, permeability is slow to rapid, slightly calcareous and calcareous soils.		Moderate wind and water erosion hazard, poor to fair topsoil, 10-14 inch precipitation zone. Shrink-swell potential is low to high, moderately alkaline soils.		
Slope (X)		1-5 3-25		ŝ	1-5 3-25		3-25		3-25 9-25		
Depth to Bedrock (inches)		8 7 8 4		8-4	8 8 4	rely).	8-4-9		6-16 0-16	ble 6).	
Soil Series		Hagerman Travessil la		Travessilla	Hagerman Travessilla	.5-66.25, respect iv	Travessilla Persayo		Travessilla Persayo	Corridor (T2) (Tal	
Soil Association and Description	ed)	<u>Hogerman-Travessilla</u> : Moderately deep to very shal- low, fine sandy loam, loam, and gravelly sandy loam soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residum derived from sandstone and in coliam and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Refer to Map Symbol - 13 (milepost 30.0-32.0).	Rock land-Travessilla: Very shallow to shallow, fine sandy losm, and gravelly sandy losm soils formed on moderately sloping to moderately steep upland areas and mesa tops from materials derived primarily from sandstone and shale. Includes sandstone (and other sedimentary rock) outcrops on steep to extremely steep mesa sideslopes, escarpments, and breaks.	Hagemen-Travessilla: Moderately deep to very shal- low, fine sandy losm, losm, and gravelly sandy losm soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuum derived from sandstone and in colian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrops.	Refer to Map Symbols - 13 and 16 (mileposts 30.0-32.0 and 61	Travessilla-Persayo: Very shallow to shallow, fine sandy losm, gravelly sandy losm, silty clay losm, and silt losm soils formed on gently sloping to moderately steep flood plains, alluvial fans, valley slopes, mesas, ridges, canyon walls, escarpments, and breaks from allu- vium and residuum derived primarily from sandstone and shale. Includes outcrops of interbedded sandstone and shale on steep escarpments and breaks.		Travessilla-Persayo: Very shallow to shallow, well drained, sandy losm, losm, and silty clay losm soils formed on gently sloping to moderately steep mesas and breaks from materials derived primarily from sandstone and shale.	Refer to Mileposts 70.5-101.0 of First Proposed Transmission	
Map Symbol	, <sup>4</sup> (continue	ព	13;	18	13	13/16	16	4	v		
Milepost	McKinley County <sup>2</sup>	42.5-47.5	47.5-49.75		49.75-60.0	60.0-61.5	61.5-66.25	Sendoval Comty	66.25-75.5	75.5-106.0	Sources:

- 1971. General soil map of Sandoval and Los Alamos counties, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 188.

. 1967. General soil map, Cabezon area, Sandoval County, New Mexico. Soil survey, Cabezon area, New Mexico.

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are forming primarily in eolian, alluvial, and residual materials derived mainly from sandstone and shale, and to a lesser extent siltstone. These soils are forming primarily on gently sloping to moderately sloping mesas, plateaus, valley bottoms, valley sideslopes, intermittent drainageways, floodplains, alluvial fans, and breaks. This transmission corridor alternative traverses numerous intermittent drainages, as well as sandstone and shale outcrop (Badland) areas. Topsoil availability within this alternative transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of poor to fair quality due to undesirable surface textures (e.g., too sandy, gravelly, or clayey) or excess salt/sodium. Susceptibility of these soils to wind-induced erosion ranges from low to high. Susceptibility to water-induced soil erosion ranges from low to high, but it is primarily moderate. The majority of the soils identified within this corridor are alkaline and/or calcareous. Shrink-swell potential of the identified soils ranges from low to high. These soils are currently used primarily for livestock grazing and wildlife habitat, and to a lesser extent energy resource development.

<u>Transmission Corridor T4</u>. Alternative transmission corridor T4 is within the San Juan River Valley Mesas and Plateaus, New Mexico and Arizona Plateaus and Mesas, and Arizona and New Mexico Mountains portions of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation generally ranges from 6 to 17 inches along this route. Seventeen different soil associations were identified within this transmission corridor. Table 9 lists (by mileposts) and characterizes the identified soils.

The soils identified within transmission corridor T4 are very shallow to deep, with surface textures ranging from loamy fine sand to clay. Permeability of these soils is very slow to rapid. These soils

Table 9. G Milepost San Juan Cour 0.0-4.5 4.5-5.25	Symbol Symbol 6/8 8	Soil Association and Description Boil Association and Description Refer to Map Symbols - 6 and 8 (mileposts 7.0-7.5 and 4.5 Readland Rock Outcrop Monierco: Shallow, well drained, fine sandy loss soils formed on level to moderately sloping knolls, messs, and plateaus from sandstone and shale. Includes monstony, burnen shale areas on mod- shale. Includes monstony, burnen shale areas on mod-	Soil Series Soil Series Honierco	Depth to Redrock (inches)	Blogs Blogs	Comments Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Surink-swell potential is low to moderate, mild to moderately alkaline soils.
5.25-6.0	ö"n	erately aloping to entremely areap upanus that dissected by deep intermittent drainageaays and gul- lies; and harren sandatone outcrope on moderately aloping to entremely steap cliffs, ridges, breaks, and ledges. Refer to Map Symbol - 8 (milepost 4.5-5.25). Shiprock-Eleppard-Doak: Deep, well to somewhat excer- sively drained, fine sandy loam, loany fine sand, and loam soils formed on level to moderately steep messs, platenus, and terraces thon alluvial and solian mate- riot data devel to moderately atteep messs.	Shiprock Skeppard Doak	333	2 2 2	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6-10 inch precipitation mone. Strink-swell potential is low to moderate, wildly to moderately alkaline soils.
6.0.6.25	80	Redlard Rock Outcrop Monierco: Shallow, well drained, fine sandy loam soils formed on level to moderately sloping knolls, mesas, and plateaus from alluvial and colian materials derived primarily from sendstone and shale. Includes nonstony, barren alale areas on mod- erately sloping to extremely steep uplands that are dissected by deep intermittent drainagesays and gul- lies; and barren sandstone outcrops on moderately slow, outcomely at each of the areas.	Monierco	10-20	3	Moderate wind and water erosion hazard, poor topsoil. 6-10 inch precipitation mone. Strink-swell potential is low to moderate, wild to moderately alkaline soils.
0. 7-22. 8	8/6	and ledges. Refer to Map Symbols - 8 and 6 (mileposts 4.5-5.25 and 7	.0-7.5, respectively	÷		
2.6-0.1	v	Stepperd Huerfano-Notal: Deep to shallow, well to someduat encessively drained, loany fine sand, sandy clay loan, and silty clay loan soils formed on level to steep mesas, platesus, valley bottoms and fans from colian, alluvial, and residual materials derived from sandstone, shale, and siltatone.	Sheppard Huerfano Notal	50 50 10-50	555	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, moderately to strongly alkaline soils.
7.5-8.0	6/8	Refer to Map Symbols - 6 and 8 (mileposts 7.0-7.5 and 4.	5-5.25, respectively	·		

Milepoet	Man Bynabol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Blope (I)	Comments
Sen Juan Comt	x <sup>1</sup> (continued)					
8.0-14.5		Bedland Rock Outcroor Monierroo: Shallow, well drained, fine sandy loam soils formed on level to underately sloping knolls, mesas, and plateaus from alluvial and colian materials derived primarily from sandstone and shale. Includes nonstony, barren shale areas on und- erately sloping to extremely steep uplands that are dissected by deep intermittent drainageauys and gul- lies; and barren sandstone outcrops on underately sloping to extremely steep cliffs, ridges, breaks, and ledges.	Monieroo	10-20	e e	Moderate wind and water erosion hazard, poor topsoil, 6-10 inch precipitation zone. Shrink-well potential is low to moderate, mild to moderately alkaline soils.
14.5-20.25	v	Sheppard Huerfano Mbtal: Deep to ahallow, well to somewhat encessively drained, lossny fine sand, sandy clay losm, and silty clay losm soils formed on level to steep mesas, plateaus, valley bottoms and fans from colian, alluvial, and residual materials derived from sandstone, ahale, and siltatone.	Sheppard Huerfano Notal	<del>2</del> 2 2 2 2 2 3	311	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Surink-swell potential is low to high, moderately to strongly alkaline soils.
McKinley Comt	r'2					
20.25-25.0	3;	Refer to Map Symbol - 3 (milepost 25.0-27.5).				
	-	Chipete Sherpoard Shiprock: Shallow to deep, silty clay, clay, loany sand, loany fine sand, and fine sand soils formed on level to strongly sloping up- lands, ridges, and valley sideslopes from alluvial, colian, and residual materials derived primarily from shale and sandstone.	Chipeta Sheppard Shiprock	56-28 5 4 4 5 4 4	515	Low to high wind and water erosion hazard, topsoil is poor, 10-17 inch precipitation zone. Surink-swell potential is low to high, permeability is very slow to rapid, calcareous and noncalcareous soils.
25.0-22.5	m	Rock Iand-Billings: Wery shallow to deep, silty clay loam, silt loam, silty clay, clay, sandy loam, and loamy fine aand soils formed on nearly level to mod- erately steep ledges, benches, escarpments valley bottoms, and valley sides from materials derived from sandstone, shale, and other sedimentary rocks. Includes numerous steep to entremely steep outcrops of sandstone and shale.	Billings	\$	3	Low to moderate wind erosion hazard, high water erosion hazard, poor topsoil, 10-17 inch precipitation some. Surink-swell potential is moderate, permeability is very slow to slow, calcareous. Some areas within the Billings portion may contain toxic amounts of soluble salts, subject to piping and severe gully erosion.
0.6223.02	#	Persayo Camborthide: Very shallow to moderately deep, silt losm, silty clay losm, and fine sandy losm soils formed on nearly level to strongly sloping uplands in residuam derived primarily from sandstone. Includes steep to extremely steep sandstone and interbedded shale outcrope.	Persayo Camborthida	8 <del>2</del> 9 8	1-12 1-19	Moderate to high wind erosion hazard, moderate water erosion hazard, poor topeoil, 10-17 inch precipitation mone. Surink-avell potential is low to moderate, per- membility is slow to moderate, calcarsous.
	ព	Rafer to Map Symbol - 13 (milepost 35.75-36.75).				

Refer to New Symbols - 10 and 13 (mileposts 33.5-34.0 and 35.75-36.75, respectively).

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TRANSMISSION CORRIDOR ALTERNATIVE (T4) (continued) 4 THE NURCIN CELLURAL 8.11.08 THE 8 I GTTCS CHARACTICS

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Table 9. CH	RACTERISTICS OF	LIA ADUIANO MOISSINAMAT '9' THT MINTIN USITITADU 8.1108 MHT'	ERMATIVE (TA) (com	(peni:		
Milepost	Nugo Synthol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Slope (X)	Connents
<u>McKinler Comt</u>	2 <sup>2</sup> (continued)					
0.45-2.55	9	Ichmiller-Sem Hateo: Deep, clay lowm, clay, silty clay lowm, lowm, and sandy lowm soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from sand- stone and abule.	Lohmil ler San Matao	\$\$	33	Moderate wind and water erosion hazard, topsoil is fair to good, 10-17 inch precipitation zone. Skrink-seell potential is low to high, permesbility is very slow to moderate, calcarsous.
34.0-35.75	E1/01	Refer to Map Symbols - 10 and 13 (mileposts 33.5-34.0 and 3	5.75-36.75, respec	tively).		
<i>21.3</i> E- <i>21.</i> 2E	a	Hagemen-Travessills: Moderately deep to very shal- low, fine sardy losm, losm, and gravelly sandy losm soils formed on nearly level to moderately steep uplands, meas tops, valley bottoms, and flood plains in residum derived from andstone and in colian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcorps.	Hageman Travess il la	84	2-1 25	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Surink-swell potential is low, permeability is moderate to rapid, noncalcareous to slightly calcareous.
36.75-38.75	E1/01	Refer to Map Symbols - 10 and 13 (mileposts 33.5-34.0 and 3	5.75-36.75, respec	.ively).		
38.75-60.0	ដ	Hagemman-Travessills: Moderately deep to very shal- low, fine samdy losm, losm, and gravelly samdy losm soils formed on nearly level to moderately steep uplands, mesa tops, valley bottoms, and flood plains in residuan derived from samdstone and in colian and alluvial sediments of mixed origin. Includes steep sandstone (and some shale) outcrope.	Hag erman Travess il la	8 7 8 4	-1 2-6	Moderate to high wind erosion hazard, moderate water erosion hazard, topsoil is good to poor, 10-17 inch precipitation zone. Surink-swell potential is low, permeshility is moderate to rapid, noncalcareous to slightly calcareous.
60.0-68.5	18	Rock Land-Travessilla: Wary shallow to shallow, fine sandy loam, and gravely sandy loam soils formed on moderately sloping to moderately steep upland areas and meas tops from materials derived primarily from sendstone and shale. Includes sendstone (and other sedimentary rock) outcrops on steep to extremely steep meas sideslopes, escarpments, and breaks.	Travessills	8.4	ž	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-sell potential is low, permeability is rapid, slightly calcarsous.
68. <del>5-</del> 68.75	i;	Les lucas-litle Persayo: Deep to very shallow, losm, clay, silty clay losm, and silt losm soils formed on nearly level to moderately sloping alluvial fams, val- ley sideslopes, uplands, ridges, and knolls from allu- vial and residual materials derived primarily from shale. Includes interbedded shale and sandstone exposures on steep escarpments and breaks.	Las lucas Litle Persayo	999 999 999 999 999 999 999 999 999 99	222	Low to moderate wind erosion hazard, moderate to high water erosion hazard, topsoil is fair to poor, 7-10 inch precipitation zone. Surink-swell potential is moderate to high, slow to very slow permeshility, calcareous.
	18;	Refer to Map Symbol - 18 (milepost 60.0-68.5).				

Table 9. CHARACTISEISTICS OF THE SOLIS IDENCIFIED WITHIN THE 'P' DANSHISSION CORDICK ALTERNATIVE (TA) (continued)

Comments	Moderate wind and water erosion hazard, poor topsoil, 10-17 inch precipitation zone. Surink-swell potential is low to moderate, permeability is slow to rupid, noncalcarsous.		Moderate wind and water enosion hazard, poor topsoil, 10-17 inch precipitation zone. Bhrink-swell potential is low, permeability is rapid, slightly calcarsous.		Moderate wind and water enosion hazard, poor topsoil, 10-17 inch precipitation zone. Shrink-well potential is low, permeability is rapid, slightly calcareous.				Low to moderate wind erosion barard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation mone. Surink-ewell potential is moderate to high, permeability is very slow, noncalcarsous.	
Blope (X)	ĩ		S.		2	tively).			0-10	
Depth to Bedrock (inches)	8	ely).	<del>4</del> -3	wely).	8	-68.75, respec	1y).	aly).	9 R	·ly).
Soil Series	ł	8.5-68.75, respectiv	Travessills	5.75-36.75, respecti	Travessil la	60.0-68.5; and 68.5	0.0-68.5, respective	8.5-68.75, respectiv	Thunderbird	8.5-68.75, respectiv
Soil Association and Description	Rock land-Bord: Very shallow to shallow, fine sandy loam, sandy loam, and gravelly sandy loam soils formed on nearly level to molerately steep meass, ridges, es- curpments, and breaks from residual materials derived primarily from sandstone, and to a lesser extent from soliam and alluvial materials of mixed origin. Includes numerous steep to extremely steep outcrops of sandstone and other sedimentary rocks.	Refer to Map Symbols - 18 and 19 (mileposts 60.0-68.5 and 64	Rock land-Travessills: Wary shallow to shallow, fine sandy losm, and gravelly sandy losm soils formed on underately sloping to underately steep upland areas and mess tops from materials derived primerily from sandatone and shale. Includes sandatone (and other sedimentary rock) outcrops on steep to extremely steep mess sideslopes, escarpments, and breaks.	Refer to Map Symbols - 18 and 13 (mileposts 60.0-68.5 and 35	Rock land-Travessills: Very shallow to shallow, fine sandy losm, and gravelly sandy losm soils formed on moderately sloping to moderately steep upland areas and mess tops from materials derived primarily from sandstone and shale. Includes sandstone (and other sedimentary rock) outcrops on steep to extremely steep moss sideslopes, escarpments, and breaks.	Refer to Map Symbols - 10, 18, and 19 (mileposts 33.5-34.0;	Refer to Map Symbols - 10 and 18 (mileposts 33.5-34.0 and 60	Refer to Map Symbols - 23 and 15 (mileposts 76.0-79.5 and 64	Rock land-Thunderbird: Shallow to underately deep, atory clay loam, atory loam, and loam soils formed on level to atrongly aloping messas, ridge tops, escarpments, and breaks from materials weathered from volcanic rocks (primarily basalt), and to a lesser extent from solian materials of mired origin. Includes numerous steep to extremely steep outcrope of basalt or occasionally sed- immutary rocks.	Refer to Map Symbols - 23 and 15 (mileposts 76.0-79.5 and 66
Map Symbol	(continued) 19	18/19	18	18/13	18	10/18/19	10/18	23/15	ព	21/12
Milepost	McKinley Comty	68.75-71.5	0.27-2.11	72.0-72.5	0.67-2.21	0.27-0.67	75.0-75.5	75.5-76.0	2.67-0.37	2.08-2.97

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Table 9. CHAR	ACTREESTICS O	THE SOLIDO NOISSINGNAT "4" BHT MINITU CELTINGUI SLIOS BHT 1	RUMITVE (T4) (con	timed)		
Milepost	Hup Symbol	Soil Association and Description	Soil Series	Depth to Bedrock (inches)	Blope (I)	Commute
<b>H.Finley Comty</b>	2 (continued)					
0. 36-2. 03	ព	Rock land-Thurderbird: Shallow to moderately deep, atomy clay loam, atomy loam, and loam soils formed on level to atrongly aloping measa, ridge tope, escarpments, and breaks from materials weathered from volcanic rocks (primarily basalt), and to a lesser extent from solian materials of mixed origin. Includes numerous steep to extremely steep outcrope of basalt or occasionally sed- imentary rocks.	Thurderbird	9 R	0-10	Low to moderate wind erosion hazard, moderate water erosion hazard, poor topsoil, 10-17 inch precipitation sone. Surink-swell potential is moderate to high, permeability is very slow, noncalcarsous.
Cibola County					•	
0.001-0.8	4	Rock land-Thunderbird: Shallow to moderately deep, story clay loss, story loss, and silt loss solis formed on level to strongly sloping basilt capped mesas, lava flows, and volcanic hills from materials derived pri- merily from basic volcanic rocks (basilt). Includes outcrops of basilt, sandstone, and other sedimentary bedrocks on steep to very steep mesa sides, escarpments, lava flow fronts, hills, and ridges.	Thurderbird	9 R	0-10	Low wind erosion hazard, moderate water erosion hazard, poor topsoil, 7-10 inch precipitation zone. Skrink- swell potential is moderate to high, permeability is very slow to slow, noncalcarbous.
100.0-102.25	5	Little-Clovis-Travessilla: Moderately deep to very shallow, silty clay loom, clay, fine sandy loom, loom, story sandy loam, and sandy loam soils formed on lev- el to moderately steep uplands, mesas, hills, ridges, breaks, escarpments, and flood plains from residuan derived from sandstone and shale, and to a lesser extent from alluvial and solian materials of similar origin.	Litle Clovis Travessilla	9 9 8 9 9 8 9 9 8	808	Low to moderate wind erosion hazard, moderate water erosion hazard, poor to fair topeoil, 7-10 inch pre- cipitation zone. Surink-evell potential is low to high, permeability is very slow to rapid, calcareous and noncalcareous soils.
Sandoval Comty	4.					
102.25-103.25	=	Las Incas-little-Persayo: Deep to very shallow, clay, losm, silty clay losm, and silt losm soils formed on nearly level to moderately sloping alluvial fams, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sendstone outcrope.	Las lucas Litle Persayo	6-18 6-18 6-18	III	Low wind emosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation more. Surink-swell potential is moderate to high, permeability is slow to very slow, calcareous.
103.25-104.0	n	Travessilla Persavo Rockland: Very shallow to shallow, samdy losm, silty clay loam, and silt loam soils formed on gently sloping to moderately steep mesas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Trrvessil la Fersayo	a	<del>2-</del> 2-	Moderate wind and water erosion hazard, tupeoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is repid to slow, slightly calcareous and calcareous soils.

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Table 9. CHAI	ACTERISTICS O	THE SOLLS INCRUTING WITHIN THE "4" THANKINGSTICH CORRECTION ALT	ZUMITIVE (T4) (con	timed) Depth to	22	
Milepoet	Symbol	Soil Association and Description	Soil Series	Bedrock (inches)	Slope (X)	Commerts
Sendoval County	(continued)					
104.0-105.0	£1/13	Refer to Map Symbols - 11 and 13 (mileposts 102.25-103.25 a	ad 103.25-104.0, r	espectively).		
105.0-105.5	=	Les luces-little Persayo: Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to underately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shals. Includes steep to very steep shale and sandstone outcrope.	Las lucas Litle Persayo	6-18 20-60 6-18	111	Low wind erosion hazard, moderate to high water erosion hazard, fair to poor topsoil, 10-14 inch precipitation more. Surink-evell potential is moderate to high, permembility is slow to very slow, calcareous.
105.5-108.5	ส	Travessilla-Persayo-Rockland: Wary shallow to shallow, sandy losm, silty clay losm, and silt losm soils formed on gently sloping to moderately steep meass, breaks, ridges, and knolls from sandstone and shale. Includes interbodded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessills Persayo	9-25 3-25	<del>24</del> 24	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Skrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.
108.5-109.0	2/13	Refer to Mup Symbols - 2 and 13 (mileposts 109.0-111.5 and	103.25-104.0, resp	ectively).		
S. 111-0.601	7	Christianburg Navajo: Deep, clay, silty clay loss, and sandy clay loss soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from shale.	Christianburg Nevajo	\$\$	33	Low wind erosion hazard, moderate to high water erosion hazard, poor topsoil, 10-14 inch precipitation zone. Surink-evell potential is high, permeability is very slow, calcareous.
0.211-2.111	2/13	Refer to Map Symbols - 2 and 13 (mileposts 109.0-111.5 and	103.25-104.0, resp	ectively).		
22.711-0.211	ย	Travessill <u>a Persayo Rockland</u> : Wary shallow to shallow, sundy loss, silty clay loss, and silt loss soils formed on gently aloping to moderately atequ mesas, breaks, ridges, and knolls from aundatone and shale. Includes interbedded sandatone and shale outcrope on moderately steep to extremely atequ escarpments and breaks.	Travessilla Persayo	8-20 3-25	3-25	Moderate wind and water erosion hazard, topsoil is poor, 10-14 inch precipitation zone. Skrink-ewell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.
<i>21.11-22.1</i> 11	7	Christianburg-Navaio: Deep, clay, silty clay loem, and sandy clay loam soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from shale.	Christianburg Navajo	\$\$	22	low wind erosion hazard, moderate to high water erosion hazard, poor topsoil, 10-14 inch precipitation zone. Brink-swell potential is high, permeability is very slow, calcareous.
117.75-418.25	2/13	Refer to Map Symbols - 2 and 13 (mileposts 109.0-111.5 and	103.25-104.0, resp	ectively).		
118.25-118.5	E	Travessilla-Persayo-Rockland: Wary shallow to shallow, sandy losm, silty clay losm, and silt losm soils formed on gently sloping to moderately steep meas, breaks, ridges, and knolls from sandstone and shale. Includes interbedded sandstone and shale outcrops on moderately steep to extremely steep escarpments and breaks.	Travessilla Persayo	8-20 3-25	2-7 2-7 2-7	Moderate wind and water erosion hazard, topeoil is poor, 10-14 inch precipitation zone. Shrink-swell potential is low to moderate, permeability is rapid to slow, slightly calcareous and calcareous soils.

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to ck Slope es) (2) Connents			0-3 Iow wind erosion bazard, moderate to high water erosio 0-3 hazard, poor topsoil, 10-14 inch precipitation zone. Shrink-swell potential is high, permeability is very slow, calcareous.	<ul> <li>3-5 Iow wind erosion hazard, moderate to high water erosic</li> <li>3-5 hazard, fair to poor topsoil, 10-14 inch precipitation</li> <li>8 1-9 zone. Shrink-swell potential is moderate to high, permeability is slow to very slow, calcareous.</li> </ul>	6 1-9 Low wind erosion hazard, moderate water erosion hazar topsoil is poor, 10-14 inch precipitation zone. Shrir swell potential is low, permeability is rapid, calcareous.	
Depth Bedroc (inche		pectively)	\$\$	6-1-40-40 6-1-40-40	র	
Soil Series		103.25-104.0, res	Christianburg Navajo	las lucas Litle Persayo	Entbudo	
Soil Association and Description		Refer to Map Symbols - 2 and 13 (mileposts 109.0-111.5 and	Christianburg-Navajo: Deep, clay, silty clay loam, and sandy clay loam soils formed on level to gently sloping valley bottoms, flood plains, and terraces from alluvium derived primarily from shale.	<u>I as lucas-little-Persayo</u> : Deep to very shallow, clay, loam, silty clay loam, and silt loam soils formed on nearly level to moderately sloping alluvial fans, valley side slopes, uplands, ridges, and knolls from materials derived from weathered shale. Includes steep to very steep shale and sandstone outcrops.	Rough Broken Land-Eurlodo: Shallow to moderately deep, gravelly fine sandy loam, fine sandy loam, gravelly sandy loam, and gravelly loamy sand soils formed on nearly level to moderately steep uplands dissected by numerous intermittent drainages and arroyos as well as breaks, ridges, and to a lesser extent valley bottoms and flood plains. These soils are forming primarily in unconsolidated alluvium.	
Map Symbol	(continued)	2/13	2	п	-	
Milepost	Sandoval Comty	118.5-119.5	119.5-120.25	120.25-122.25	122.25-124.0	

<sup>1</sup>U.S. Soil Conservation Service (SCS). 1979. General soil map, San Juan County, New Mexico, eastern part. Soil survey of San Juan County, New Mexico, eastern part.

1974. General soil map of McKinley County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 262. 2 e

1971. General soil map of Sandoval and Los Alamos counties, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 188. 1974. General soil map of Valencia County, New Mexico. New Mexico State University, Agricultural Experiment Station, Research Report 267. 4

are forming primarily in alluvial, eolian, and residual materials derived from sandstone, shale, siltstone, and to a lesser extent volcanic rock (e.g., basalt). These soils are forming primarily on gently sloping to moderately sloping mesas, plateaus, ridges, knolls, canyons, valleys, intermittent drainageways, floodplains, and alluvial fans. Transmission corridor T4 traverses numerous intermittent drainageways and numerous Rock Outcrop (sandstone, shale, and basalt) areas on strongly sloping to steep ridges, escarpments, and breaks. The main areas of steep terrain are in southern McKinley County (e.g., San Lucas Canyon area), southeastern McKinley County (between Canon de Marquez and Canon de Pedro Padilla), and in northeastern Cibola County (La Mesa del Canon Seco area). Topsoil availability within this alternative transmission corridor is limited due to generally shallow soil surface layers, and the majority of the existing topsoil is of poor to fair quality due to undesirable surface textures (e.g., too gravelly, stony, sandy, or clayey) or excess salt/sodium. Susceptibility of these soils to wind-induced erosion is primarily moderate to high, and susceptibility to water-induced soil erosion ranges from low to high. Approximately 50 percent of the soils identified within this transmission corridor are alkaline and/or calcareous. Shrink-swell potential of the identified soils ranges from low to high. These soils are currently used primarily for livestock grazing and wildlife habitat, and to a lesser extent for energy resource development.

#### PRIME AND UNIQUE FARMLANDS

#### Proposed NMGS Site

Since the proposed NMGS could potentially take agricultural land out of production for the life of the project, the NMGS site was evaluated to determine whether it includes any Prime and/or Unique Farmland. The soil survey of San Juan County (SCS 1980) was used in conjunction with the Prime Farmland list (soil mapping units) for San Juan County (SCS 1978b) for this evaluation. The soil types (BA and SC) present at the proposed NMGS site do not meet the criteria for Prime Farmland. Additionally, the proposed NMGS site does not contain any Unique or Statewide/Locally Important Farmland.

# Water Supply System

<u>Proposed Main Water Pipeline (P1)</u>. The proposed intake/pumping plant and the three intermediate pump stations associated with this pipeline could potentially take agricultural land out of production for the life of the project, so these project component locations were evaluated for Prime Farmland potential.

The soil type (Wr) present at the proposed intake/pumping plant is potential Prime Farmland (SCS 1978b and 1980). For this area to qualify as Prime Farmland it must be irrigated and used for cropland. This area is not used for cropland and is not irrigated, thus this area does not qualify as Prime Farmland. Additionally, this area contains no Unique or Statewide/Locally Important Farmlands. The soil types (FA, Ay, Sm, and Sd) present at the three intermediate pump station locations do not meet the criteria for Prime Farmland (SCS 1978b and 1980). The three intermediate pump station locations contain no Unique or Statewide/Locally Important Farmlands. Intermediate pump stations 2 and 3 are in an irrigable portion of the Navajo Indian Irrigation Project (NIIP) - Block 9, which is currently undeveloped (i.e., potential Statewide/Locally Important Farmland). Congress has cut off funding for NIIP indefinitely, thus it is very likely Block 9 will never be developed.

Main Water Pipeline Alternatives P2 and P3. The soil types (Fy, RA, and Fw) present at the intake/pumping plant locations associated with

these main water pipeline alternatives do not meet the criteria for Prime Farmland (SCS 1978b and 1980). The intake/pumping plant locations contain no Unique or Statewide/Locally Important Farmlands either.

The soil types (FX, BA, Sd, and DS) present at the intermediate pump station locations associated with these pipeline alternatives do not meet the criteria for Prime Farmland (SCS 1978b and 1980). These intermediate pump station locations also contain no Unique or Statewide/Locally Important Farmlands.

<u>Proposed Terminal Storage Reservoir (R1)</u>. The soil types (BA, SC. and HU) present at the proposed reservoir location do not qualify as Prime Farmland (SCS 1978b and 1980). The proposed site contains no Unique or Statewide/Locally Important Farmlands.

<u>Terminal Storage Reservoir Alternative (R2)</u>. The soil types (HU and DN) present at this alternative reservoir site do not qualify as Prime Farmland either (SCS 1978b and 1980). Additionally, the alternative reservoir site does not contain any Unique or Statewide/Locally Important Farmlands.

## Transmission Lines

The proposed and alternative transmission line corridors do not traverse any irrigated cropland, thus no Unique or Statewide/Locally Important Farmlands would be taken out of production by surface facilities associated with the transmission system.

<u>Proposed FC-A-P 500-kV Transmission Line Loop (T5)</u>. Transmission towers and substations associated with transmission lines could potentially take agricultural land out of production for the life of the project. Since tower locations are unknown at this time, the entire transmission corridors were evaluated for the presence of potential Prime Farmland.

The soil types (SC, BA, and RA) present within the proposed FC-A-P 500-kV transmission line loop corridor do not qualify as Prime Farmland (SCS 1978b and 1980).

First Proposed Transmission Line Corridor (T2). The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland. A Land Class For Irrigation (LCFI) of 1 qualifies as potential Prime Farmland (if irrigated), but the highest rating for the soils within this corridor segment is LCFI 2-3 (SCS 1973).

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

<u>Second Proposed Transmission Line Corridor (T1)</u>. The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 2-3 (SCS 1973).

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

<u>Transmission Line Corridor Alternative T3</u>. The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 4-6 (SCS 1973). C700AS.3 (II) - 16

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

<u>Transmission Line Corridor Alternative T4</u>. The soils present within the portion of this corridor in San Juan County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 6-2 (SCS 1973).

The soils present within the portion of this corridor in McKinley and Sandoval counties do not qualify as Prime Farmland (Fjefeth 1981, and Hacker 1981).

The soils present within the portion of this corridor in Cibola County do not meet the criteria for Prime Farmland, because the highest LCFI rating is 6-4-3 (SCS 1974).

4.0 ENVIRONMENTAL CONSEQUENCES

## SOILS

# Proposed NMGS Site

Construction of the proposed NMGS would disturb approximately 2400 acres of soils and topography, significantly affecting the existing soils (see Table 10). The soils at the NMGS site would be taken out of production for the life of the project. Depending on the amount of grading and excavation necessary, existing soil profiles could be completely altered or destroyed during site preparation. Topsoil (or salvageable soil) removal, stockpiling, and redistribution would result in an intermixing of the native topsoils. Depending on the specific topsoil removal plan chosen (e.g., selective or nonselective by soil types, salvage depths), topsoil may also be salvaged and mixed with less desirable subsoils or bedrock. Alteration of the existing soil profiles, and mixing of topsoil or salvageable soil would alter the physical, chemical, and biological characteristics of the native soils. For example, physical features affected include surface textures, soil structure, permeability, and infiltration rates; chemical features include pH, sodium levels, macroand micronutrients; biological features include the type and quantity of soil microorganisms.

The primary goal of a reclamation plan is to ensure that lands disturbed during construction or operation are restored to a stable,

productive, and aesthetically acceptable condition. Although a detailed construction and reclamation plan is not yet available, the applicant has proposed several general mitigation measures and reclamation procedures that would be employed at the NMGS site.

During site preparation, the entire plant area would be step graded, but existing contours would be preserved to the maximum practical extent to avoid excessive cut-and-fill operations. During construction, erosion control would consist of drainage ditches across disturbed areas that would tie into the existing surface drainage features. Siltation control measures would include sedimentation ponds, sediment traps, and controlled drainage slopes. Topsoil would be removed and stockpiled by construction equipment prior to required excavations. The topsoil stockpiles would be shaped and graded for drainage and erosion control. The stockpiled topsoil would be redistributed on spoil-disposal and disturbed areas prior to revegetation. All disturbed nonroad areas (not covered with asphalt, concrete, or gravel) would be reseeded with native grasses.

The effects of unavoidable impacts to the soils resource as a result of constructing NMGS would include: (1) accelerated soil erosion due to wind and water; (2) decreased soil stability; (3) decreased soil diversity in chemical, physical, and topographic aspects; (4) decreased soil fertility and productivity; (5) decreased soil development; and (6) decreased quantity, quality, and diversity of vegetative cover.

The soils data for NMGS in the Affected Environment section (including Table 1) of this background report indicate that some of the sites may be difficult to reclaim due to adverse physical and chemical soil properties, such as: undesirable surface textures, absence of and/or restricted topsoil supply, high erosion

susceptibility, excess salts, and alkalinity. In addition, the low precipitation at the site could inhibit reclamation efforts. Selection of seed species specifically adapted to local soils and climate, as well as timing and methods of reseeding, are essential prerequisites for successful revegetation on problem soil areas (e.g., soils with excess salts, high alkalinity, droughtiness). Excess salts and alkalinity problems could increase in some areas if excavated materials, which in some cases are more toxic than the overlying topsoils, were placed on the surface. Shale is mildly to strongly alkaline and extremely difficult to vegetate, thus shale should not be mixed with topsoil or placed on the surface.

Potential soils reclamation problem areas at NMGS are listed in Table 10 by soil association and the specific indicators of potential reclamation problems. Table 10 also lists potential mitigation measures which, if implemented, would increase reclamation success at the site. The applicant's Proposed Action includes most of the measures.

## Water Supply System

<u>Proposed Main Water Pipeline (Pl)</u>. Construction of the proposed main water pipeline Pl (including intake pumping plant and intermediate pump stations) would directly disturb approximately 474 acres of soil and topography (see Table 10). Construction of staging and work areas at pump station sites and stream, road, and canal crossings would cause a small amount of additional disturbance. Soil surface disturbance, excavation (trenching operations), and removal of vegetative cover would increase the present soil erosion rates and soil instability. These increases would continue until denuded areas were revegetated. If a moderately intensive erosion control and reclamation program were implemented following construction, most of

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Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS

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Potential Mitigation Measures for Consideration	A, B, D	A,B,D	A,B,C,D	A,B,C,D	U			A,B,C,D	A,B,C,D	A,B,C,D	1, A,B,C,D
Connents	Shiprock-Sheppard portion is highly susceptible to	wind erosion. Fruitland portion may be highly susceptible to wind erosion.	Stumble portion may be highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	Duneland portion is highly susceptible to wind erosion; Riverwash portion is highly susceptible to water erosion.	Badland areas (>15% slope) are highly susceptible to water erosion in excavated areas, if loose/broken up shale is left unprotected on the surface.		Adit/shaft area (i.e., precludes soils problems).	Persayo portion - area reclaim, shallow soils.	This phase of the Avalon series is highly suscep- tible to water erosion.	Sheppard portion is highly susceptible to wind erosion; Persayo portion - area reclain	Persayo portion - area reclain shallow soils.
oblems Steep 6 Terrain	1	ı	1	1	×	54 acres	X	1	1	1	•
eclamation Pr Area 5 Reclaim	1	1	1		1	0	x	X	ı	X	X
<u>f Potential Ru</u> High Water Erosion usceptibility	1	ı	1	×	×	168 acres	ı	I	×	I.	ı
Indicators o High Wind Erosion 3 Susceptibility <sup>3</sup> S	х	X	×	X	1	2346 acres	ı	I		X	ı
Approximate Milepost or Acreage	911	882	664	114	X	Totals <sup>8</sup>	0.05-0.2	0.2-0.6, 0.65-0.75, 0.85-1.95	0.6-0.65, 0.75-0.85	1.95-2.7, 2.85-3.05, 3.15-3.3	3.05-3.15
Map Unit or Soil Association <sup>2</sup>	Shiprock-Sheppard-Huerf ano	Tur ley-Fruit land-Blancot	Stumble-Notal-Huerfano	Riverwash-Dune land	Badland-Rock Outcrop		HA/BC	FA	Ay	FX	R
Project Component	STAN					Mater Supply System	PI				

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Table 10. SUMMARY OF POI	ENTIAL SOILS RECLANATION PROBLEM	AREAS <sup>1</sup> (continued)						
Project Component	Map Unit or Soil Association <sup>2</sup>	Approximate Milepost or Acreage S	Indicators o High Wind Erosion 3 usceptibility	E <u>Potential Rev</u> High Water Erosion , Musceptibility	clamation Prob Area 5	steep 6 Terrain	Connents	Potential Mitigation Measures for 7 Consideration
Mater Supply System (cont	inued)							
Id	3	3.3-3.65, 3.9-4.0, 4.35-6.0, 6.25-13.0, 13.15-13.2, 13.25-13.6, 13.7-14.1, 14.5-14.8, 15.25-15.45, 22.95-23.0, 23.55-23.55, 23.7-23.8, 23.85-23.95, 24.0-24.9, 25.3-26.1, 26.25-28.4, 28.85-29.15, 29.35-29.6	×	1	1	(	Sheppard-Mayqueen portion is highly susceptible to wind erosion.	A, B, D
	A	15.45–16.8	1	×	1	X	Badland areas (>15% slope) are highly susceptible to water erosion in trenched areas.	U
	AZ	16.8-17.3	Х	ı	1	ī	Sheppard portion is highly susceptible to wind erosion.	A,B,D
	Η	17.3-19.2, 22.85-22.9, 23.4-23.5	1	I	x	I	Muff portion - area reclaim.	A,B,C,D
	8	19.2-22.7, 22.8-22.85, 23.3-23.4, 28.4-28.85, 29.15-29.35, 29.6-30.8, 33.3-35.0, 35.4-35.95, 38.4-39.2, 39.55-39.7	×	1	1	I	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	A,B,C,D
	Riverwash-Dune land	35.95–36.05	×	×	1	1	Duneland portion is highly susceptible to wind erosion; Riverwash portion is highly susceptible to water erosion.	A,B,C,D
	Turley-Fruitland-Blancot	36.05-36.6, 37.2-37.75, 37.95-38.3	×	T	1	I	Fruitland portion may be highly susceptible to wind erosion.	A,B,C,D
	Shiprock-Sheppard-Huerfano	36.6-37.2, 38.3-38.4 Totals <sup>8</sup>	X 31.7 miles	- 1.6 miles	- 4.4 miles	- 1.35 miles	Shiprock-Sheppard portion is highly susceptible to wind erosion.	A,B,C,D

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Table 10. SUMMRY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS<sup>1</sup> (continued)

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Potential Mitigation Measures for Consideration	A,B,C,D	A,B,C,D	A,B,C,D	A,B,D	A,B,D	¥	U	A, B, D
Connents	Haplargids-Torriorthents portion may be highly sus-	Blackston portion - area reclaim. This phase of the Avalon series is highly suscep- tible to water erosion.	Sheppard portion is highly susceptible to wind erosion; Persayo portion - area reclaim.	Gypsiorthids-Stumble por- tion is highly susceptible to wind erosion.	Stumble portion is highly susceptible to wind erosion.	Riverwash is highly suscep- tible to water erosion.	Badland areas (>15% slope) are highly susceptible to water erosion in trenched areas.	Sheppard Mayqueen portion is highly susceptible to wind erosion.
olens Steep 6 Terrain	I	1	1	1	1	I	×	1
lamation Prol Area 5 Reclaim	×	1	X	1	ł	I		1.2
of Potential Rec High Water Erosion 4 Susceptibility	×	×	I	ı.	ı	x	×	1
Indicators High Wind Erosion 3 usceptibility	I	t	x	x	×	. 1	1	×
Approximate Milepost or Acreage S	0.25-0.3, 0.95-1.0, 2.3-2.5	0.3-0.75	0.75-0.95, 2.55-4.4, 5.35-5.65, 5.75-5.9, 14.15-14.25, 14.5-14.6, 18.05-18.1, 18.3-18.45	1.6-1.85	2.0-2.1, 13.45-13.55	2.1-2.25, 2.5-2.55, 4.7-4.75, 13.55-13.6, 14.0-14.15, 18.2-18.3	4.4-4.7, 4.85-5.35, 14.6-15.0	5.65-5.75, 5.9-6.9, 7.0-7.45, 7.75-8.8, 9.1-9.95, 10.1-13.3, 13.6-13.8, 15.4-15.6, 15.7-15.75, 15.8-16.0, 16.0-16.55, 17.55-18.05, 19.2-19.3, 19.9-20.55, 20.6-20.7, 20.75-26.0, 26.4-26.95, 27.4-27.45, 27.9-27.95, 28.05-30.6, 31.3-31.75, 31.8-32.5
Map Unit or Soil Association	cont inued) HA	Åy	X	ъ	83	RA	Ħ	3
Project Camponent	Water Supply System ( P2 <sup>9</sup>							

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Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS<sup>1</sup> (continued)

Potential Mitigation Measures for 7 Consideration	A,B,D	A,B,D	A, B, C, D	A, B, C, D	A, B, D	A, B, C, D	A, B, D	A,B,D		A,B,C,D	A, B, C, D
Connents	Mayqueen is highly suscep-	tible to wind erosion. Sheppard portion is highly susceptible to wind erosion.	Muff portion - area reclaim.	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly susceptible to shrink-swell.	Duneland is highly suscep- tible to wind erosion.	Duneland portion is highly susceptible to wind erosion; Riverwash portion is highly susceptible to water erosion.	Fruitland portion may be highly susceptible to wind erosion.	Shiprock-Sheppard portion is highly susceptible to wind erosion.		Haplargids-Torriorthents portion may be highly sus- ceptible to water erosion; Blackston portion - area reclaim.	This phase of the Avalon series is highly suscep- tible to water erosion.
olems Steep 6 Terrain	I	1	X	ı	T	1	I	I	2.0 miles	1	1
amation Prob Area 5 Reclaim	1	1	T	1	1	1	I	1	3.2 miles	×	1
<u>of Potential Recl</u> High Water Erosion 4 Susceptibility	1	ı	I	1	ı	×	I	J	2.6 miles	×	×
Indicators o High Wind Erosion 3 Susceptibility	×	X		x	×	х	X	x	28.4 miles	1	1
Approximate Milepost or Acreage	9.95-10.1	13.8-14.0	18.7-18.9, 19.0-19.2, 19.3-19.7	30.9-31.3, 32.5-33.1, 36.2-37.9, 38.3-38.85, 41.3-42.1, 42.45-42.6	31.75-31.8	38.85–38.95	38.95-39.5, 40.1-40.65, 40.85-41.2	41.2-41.3	Totals <sup>8</sup>	0.25-0.3	0.3-0.75
Map Uhit or Soil Association <sup>2</sup>	continued) Ma	SB	ΠH	Я	DZ	Riverwash-Duneland	Turley-Fruitland-Blancot	Shiprock-Sheppard-Huerfano		Н	Ay
Project Component	<u>Mater Supply System</u> (c P2 <sup>9</sup>									F3	

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Table 10. SUMMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS (continued)

Potential Mitigation Measures for 7 Consideration		A,B,C,D	A, B, D	A, B, C, D	A, B, C, D	A,B,C,D	¥	U	A,B,C,D
Connents		Sheppard portion is highly susceptible to wind erosion; Persayo portion - area reclaim.	This phase of the Shiprock series is highly susceptible to wind erosion.	Avalon portion is highly susceptible to water erosion.	Sheppard portion is highly susceptible to wind erosion.	Persayo portion - area reclaim, shallow soils.	Riverwash is highly suscep- tible to water erosion.	Badland areas (>15% slope) are highly susceptible to water erosion in trenched areas. This area includes slopes of about 35% (i.e., would require intensive stabilization measures).	Sheppard portion is highly susceptible to wind erosion; Notal portion is highly sus- ceptible to shrink-swell.
bl <del>ens</del> Steep 6 Terrain		T	1	1	1	ı	I	×	1
elamation Pro Area 5 Reclaim		×	ı.,	I	1	х	ı		1
<u>of Potential Rec</u> High Water Erosion 4 Susceptibility		1	I	X	1	I	X	X	
Indicators High Wind Erosion Bsceptibility		×	×	1	×	ı	ı	1	×
Approximate Milepost or Acreage Su		0.75-1.55, 1.7-2.85, 7.0-9.25, 24.9-25.45, 25.7-26.05, 28.15-28.25, 28.28-28.4, 28.6-28.7, 29.45-29.75, 31.55-32.4, 32.65-33.0, 35.95-36.15	1.55-1.7	2.85-3.55	3.55-7.0, 12.05-12.8, 13.15-13.7, 16.0-20.9, 21.15-23.75, 23.8-24.9, 25.45-25.7, 26.45-28.15, 28.7-29.45, 29.75-31.55, 33.3-34.4, 34.65-35.95, 36.45-37.5	10.6-10.85	4.11-5.11	13.7-16.0	37.5-38.3, 42.35-43.9, 44.7-45.1, 45.85-48.5
Map Uhit or Soil Association <sup>2</sup>	continued)	Ϋ́	Sh	DN	S	FA	RA	R	8
Project Canponent	Water Supply System (c	P3							

3.6 miles 7.42 miles 2.3 miles

33.97 miles

Totals<sup>8</sup>

	Potential Mirigation	Measures for 7 Consideration		ly A,B,C,D ion; vim, us-		tim. A,B,C,D	A,B,C,D tion.			ly A,B,C,D on; 11.		ly A,B,C,D ion; :11.	sion A, B, D	sion A,B,D	sion A,B,D	ıly A,B,C,D ilon.	A,B,C,D 1 is ter
		Connents		Sheppard portion is highl susceptible to wind erosi Muff portion – area recla Notal portion is highly s	ceptible to shrink-swell.	Muff portion - area recla	Avalon portion is highly susceptible to water eros			Sheppard portion is highl susceptible to wind erosi Notal portion is highly susceptible to shrink-swe		Sheppard portion is highl susceptible to wind erosi Notal portion is highly susceptible to shrink-swe	Moderate to high wind erc hazard.	Moderate to high wind erc hazard.	Moderate to high wind erc hazard.	las lucas portion is high susceptible to water eros	Low to high wind erosion hazard; Las Lucas portion highly susceptible to wat erosion.
	olens	Steep 6 Terrain		I	0	I	I	0		ı	0	i.	I	ı	1	ı	I.
	lamation Proh	Area 5 Reclaim		×	35 acres	Х	ī	71 acres		ı	0	I.	1	ı	ı	ı	1
	of Potential Rec. High Warer	Erosion 4 Susceptibility		ı	0	T	Х	4 acres		1	0	ı	ł	T	ı	X	x
	Indicators High Wind	Erosion 3 Susceptibility		X	35 acres	1	I	0		×	5 miles	x	X	X	X	I	x
EAS <sup>1</sup> (continued)	Approximate	Milepost or Acreage		35	Totals <sup>8</sup>	71	4	Totals <sup>8</sup>		0.0-5.0	Totals <sup>8</sup>	0.75-17.25, 21.0-32.0	35.0-38.5	38.5-40.0	45.5-46.25, 46.5-49.5	49.5-52.0, 53.0-57.5, 83.75-99.5	52.0-53.0
TENTIAL SOILS RECLAMATION PROBLEM AR		Map Unit or Soil Association <sup>2</sup>	it inved)	S		HU	DN		lors	Sheppard-Huerfano-Notal/ Badland-Rock Outcrop-Monierco		Sheppard-Huerfano-Notal	Penistaja-Valent	Penistaja-Valent/ Hageman-Travessil la	Hageman-Travessilla	Las Lucas-Litle-Persayo	Hagerman-Travessilla/ Las Lucas-Litle-Persayo
Table 10. SUMMARY OF PO		Project Carponent	Water Supply System (cont	Proposed Terminal Storage Reservoir		Terminal Storage	ANTIAL VICEINAL		Transmission Line Corrid	ß		۲ ۲					

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Potential Mitigation Measures for 7 Consideration		A,B,C,D	A,B,C,D	A,B,C,D m.		a; A,B,C,D 1.	A,B,D	A,B,C,D 1.	A,B,C,D	A,B,C,D 1.	ion A,B,D	ion A,B,D	ion A,B,D	y A,B,C,D Dn.	A.B.C.D
Connent s		Las lucas portion is highl susceptible to water erosi	Navajo and Las Lucas are highly susceptible to wate erosion.	Navajo portion is highly susceptible to water erosi		Sheppard portion is highly susceptible to wind erosio Notal portion is highly susceptible to shrink-swel	Sheppard portion is highly susceptible to wind erosio	Moderate to high wind eros hazard.	Moderate to high wind eros hazard.	Moderate to high wind eros hazard.	Las Lucas portion is highl susceptible to water erosi	Manaio anation in highly			
lems Steep 6 Terrain		ı	1	ı	0	1	I	1	I	I	ı	ı	I.	1	
amation Prob Area Reclaim		I	1	ı	Unknown	1	f	I.	t	I.	-	I.	I	t	
Potential Recl High Water Erosion 4 isceptibility		X	×	х	32.0 miles	1	1	1	ı	I	1	ı		X	:
Indicators of High Wind Erosion 3 Lisceptibility &		ı	r.	ı	37.3 miles	×	X	X	X	Х	Х	X	X	ĩ	
Approximate Milepost or Acreage Su		57.5-63.5, 74.75-75.5	75.5-76.25	76.25-77.0	Totals <sup>8</sup>	0.5-11.5, 15.5-18.5	11.5-15.5, 30.0-31.5	18.5-19.5	19.5-21.0, 22.25-22.75, 23.5-25.5, 26.75-29.5	25.5-26.75, 29.5-30.0	34.5-41.0, 45.5-50.75	50.75-56.5	57.25-64.75	64.75-69.75, 79.75-80.5	
Map Unit or Soil Association <sup>2</sup>	rs (continued)	Litle-Las Lucas	Christianburg-Navajo/ Litle-Ias Iucas	Christianburg-Navajo		Sheppard-Huerfano-Notal	Shiprock-Sheppard-Doak	Sheppard-Huerfano-Notal/ Persayo-Fruitland-Sheppard	Persayo-Fruitland-Sheppard	Shiprock-Sheppard-Doak/ Persayo-Fruitland-Sheppard	Penistaja-Valent-Rockland	Penistaja-Valent	Penistaja-Berent-Sandstone Outcrop	Litle-Las Lucas	
Project Component	Transmission Line Corrido	13				Ħ									

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SUMARY OF POTENTIAL SOILS RECLAMATION PROBLEM AREAS<sup>1</sup> (concluded) Table 10.

		Ameroximate	Indicators of I	Potential Recla	mation Prob	lens		Potential Mitization
Project Component	Map Unit or Soil Association <sup>2</sup>	Milepost or Acreage Sus	Erosion 3 ceptibility Sue	Erosion 4 ceptibility	Area 5 Reclaim	Steep 6 Terrain	M Councert s	leasures for . consideration
Transmission Line Corrid	ors (continued)							
22	Rock Land-Bil lings/ Chipeta-Sheppard-Shiprock	20.25-25.0	×	×		1	Sheppard portion is highly susceptible to wind erosion; Billings and Chipeta are highly susceptible to water erosion.	A,B,C,D
	Rock Land-Billings	25.0-27.5	1	X	ı	1	Billings portion is highly susceptible to water erosion.	A,B,C,D
	Hagerman-Travessilla	27.5-33.5, 34.0-60.0, 72.0-72.5	X	ı	ı	1	Moderate to high wind erosion hazard.	A,B,D
	las Lucas-Litle-Persayo	68.5-68.75, 75.5-76.0, 79.5-80.5, 102.25-103.75, 104.0-105.5, 120.25-122.25	1	X	1 .	1	Las Lucas portion is highly susceptible to water erosion.	A,B,C,D
	Rock Land-Thunderbird	76.0-77.5, 78.0-81.0, 94.25-96.0, 98.25-100.75	1	1	1	×	Sloping areas (>15% slope) may be highly susceptible to water erosion where graded and/or bladed. Thunderbird portion - moderate to high shrink-swell potential.	A,B,C,D
	Christianburg-Navajo	108.5-115.0, 117.25-118.25 118.5-120.25 <sup>704-31</sup> 8		X 7 75 milos	- Ihdoroza	- - 8.75 &	Navajo portion is highly susceptible to water erosion.	A,B,C,D
			sattin o.o	62 TTM (7. 17	TIMOTTO			

in many areas, a conservative approach was used in compiling this table. Undesirable soil characteristics are listed for whole soil associations, but the problem soil usually constitutes Typically more than one soil series or association is present for a specific area along the linear project components. Since it is not known what specific soil series would be traversed traversed. Additionally, problems could be encountered in some areas not listed in this table (i.e., available soils data are not necessarily adequate to predict all potential reclamaonly a fraction of the whole association. It is very probable that many of the potential reclamation problems listed would not be encountered, because the problem soils would not be tion problem areas).

<sup>2</sup>Sources: Refer to Tables 1 through 9 in this technical report.

<sup>3</sup>Based on WBG classes where: Classes 5-8 = 10w, 3-4L = moderate, and 1-2 = high.

 $4^{4}$  Based on K factor values where: <.2 = low, .2-.39 = moderate, and  $\geq.4$  = high.

available for the transmission line corridors are too general for use in identifying area reclaim locations; thus potential area reclaim problems were not identified. Topsoiling should <sup>5</sup>Areas that are difficult to reclaim if soil is removed for construction or other purposes. Source: applicable SCS Form 5 - Soil Interpretation Tables. Most of the soils data that are be considered as a potential mitigation measure for graded/bladed areas along transmission line ROMs.

<sup>6</sup>Source: USGS topographic maps (1:24,000; 1:62,500; and 1:250,000 scales). Criteria: >15% slope.

A = Mulch denuded areas or consider covering with jute fabric (primarily on dune areas) or riprap (drainages). B = Topsoiling. C = Water diversions (e.g., water bars). D = Reseding.

Areas with multiple problems are listed and counted under each applicable potential problem (i.e., some areas counted more than once).

<sup>9</sup>Mileposts 5.5-13.0 and 15.5-18.0 of alternative main water pipeline P2 are developed portions of Block 4 - Navajo Indian Irrigation Project (NIIP). The listed indicators of potential . If reclamation problems may not apply to these areas, because intensive corrective measures have been applied to these areas (e.g., addition of fertilizer, gypsum, sulphur, etc.) LIVII o maintain their p in order especial 1. topsoiling ). ese a tako re sh speq y selc s uli peli ain v term

the disturbed rights-of-way (ROW) should recover within three to five years (i.e., the native grass cover would be reestablished). The soils data in the Affected Environment section (including Table 2) of this background report indicate that some areas would be difficult to reclaim due to adverse physical and chemical soil properties such as: undesirable surface textures, poor topsoil, high wind erosion susceptibility, excess salts, and alkalinity. In addition, the low precipitation in this area could inhibit the success of reclamation efforts. In some areas it may be necessary to reseed several times, and special erosion control practices might be needed to stabilize soils (e.g., in sandy or dune-type areas) prior to successful revegetation. Water bars and possible other water diversion techniques would be used on sloping areas to reduce water erosion and help maintain soil stability. Selection of seed species specifically adapted to local soils (and climates), as well as timing and methods of reseeding, are essential prerequisites for successful revegetation on problem soil areas.

Excess salts and alkalinity problems could increase in some areas if trenched materials, which in some cases (e.g., shale) are more toxic than the overlying topsoils, were mixed with the topsoil or placed on the surface.

The sandy soils that occur intermittently from MP 2.0 to the end of the proposed main water pipeline route (P1) are of special concern due to their high susceptibility to wind-induced soil erosion. Intensive mitigation measures may be required to stabilize the ROW in these areas and successful revegetation may be difficult to accomplish. Special construction methods in dune areas should include burying the pipeline deeply and minimizing vegetation disturbance.

Badland (nonstony, barren shale) areas are traversed by this proposed water pipeline route (refer to Table 2), and these areas are

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virtually impossible to vegetate. In sloping Badland areas, water bars should be used to keep water from moving down and eroding materials out of the trench. Shrink-swell problems may be encountered in these Badland areas.

The Proposed Action calls for a second main water pipeline to be layed within the same ROW as the first pipeline, approximately five years after the first pipeline is laid. This would cause the same ROW to be disturbed again, just about the time it had recovered from the first disturbance. Conversations with local BLM personnel (Spears 1982) indicate that the ROW should be able to recover again, as long as it is reseeded again. Revegetation success would probably be lower after the second disturbance. Mileposts for potential soils reclamation problem areas along this pipeline route are listed in Table 10 by map unit or soil association and the specific indicators of potential reclamation problems. Table 10 also lists potential mitigation measures which would increase reclamation success in these areas.

The proposed main water pipeline Pl (including intermediate pump stations 2 and 3) traverses Blocks 6, 7, 9, 11, and 10 of NIIP, all of which are currently undeveloped. Congress has cut off funding for NIIP, thus it is not known if (or when) the aforementioned undeveloped blocks will be developed. Mileposts of the areas determined to be irrigable within these undeveloped NIIP blocks are listed in the Affected Environment section. If proposed main water pipeline Pl were ultimately selected and these NIIP blocks were developed prior to construction of Pl, special construction and reclamation measures should be used in these areas. Special measures for maintaining productivity should include laying both pipes (initial and second pipeline) simultaneously and topsoiling. Assuming Pl was ultimately the NIIP project should be reevaluated prior to construction. If NIIP funding had been restored and the aforementioned NIIP blocks were to be eventually developed, special construction and reclamation measures should be taken. Special construction and reclamation measures for these areas should include laying both pipes simultaneously, topsoiling, and reseeding, so that the potential productivity of these areas is not significantly reduced.

A monitoring program would be conducted over the life of the pipeline and would include visual identification of problem soil erosion areas and other areas not responding adequately to the revegetation program. Once identified, problem soil areas would undergo more intensive reclamation and mitigation in order to help ensure soil stability, structural integrity of the pipeline, renewed forage/crop production, and an aesthetically acceptable condition. The monitoring program would be conducted by BLM personnel or a reclamation specialist approved by the BLM. Identification of problem areas would also be conducted by the applicant during routine aerial patrols.

Indirect impacts to the soils resource could occur if construction of the pipeline ROW allows some previously inaccessible areas to be accessible to ORVs. The degree and areal extent of such disturbances are unknown, but would probably be limited to about 5 miles on either side of the ROW. Since this pipeline route generally follows State Highway 371, it would not provide very much new access to ORVs. General impacts to the soils resource which would result from increased ORV use are: soil compaction, reduced infiltration capacity, reduced vegetative cover, and increased erosion susceptibility. An effort should be made to limit ORV access along the pipeline ROW to reduce potential impacts to the ROW as well as surrounding areas.

Main Water Pipeline Alternative P2. Construction of main water pipeline alternative P2 (including intake pumping plant and intermediate pump stations) would directly disturb approximately 508 acres of soils and topography. Construction of staging and work areas at pump station sites and stream, road, and canal crossings would cause a small amount of additional disturbance.

The soils data presented in the Affected Environment section (including Table 3) of this background report indicate that the same impacts and reclamation problems discussed for the proposed main water pipeline route (P1) would be encountered along this route. Some of the sandy soils that occur intermittently over the entire length of this route are also highly susceptible to wind-induced soil erosion. This alternative route also traverses Badland areas (refer to Table 3).

Mileposts for potential soils reclamation problem areas (and associated mitigation measures for consideration) along this alternative water pipeline route are presented in Table 10.

Main water pipeline alternative P2 traverses developed portions of NIIP-Block 4 (MP 5.5-13 and 15.5-18). Intensive corrective measures (addition of fertilizer, gypsum, sulphur, etc.) have been applied to these areas in order to increase their productivity. If this alternative pipeline was ultimately selected, special construction and reclamation measures should be used in these areas. Special measures for maintaining productivity in these areas should include laying both pipes simultaneously and topsoiling. This alternative pipeline route also traverses undeveloped portions of NIIP-Block 11. These undeveloped portions (refer to Affected Environment section for applicable pipeline mileposts) have been determined to be irrigable. Congress has cut off funding for NIIP, and it is not known if (or when) Block 11 will ever be developed. Refer to the proposed main water pipeline (P1) for a discussion of special construction and reclamation measures which could apply to P2 under two different potential NIIP development scenarios.

If this alternative main water pipeline route were ultimately selected, a second pipeline would be laid within the same ROW within five years after the initial pipeline was layed. The monitoring program discussed for the proposed main water pipeline (P1) applies to this alternative route as well.

Potential indirect impacts to the soils resource from increased ORV access are the same as discussed for proposed main water pipeline (P1).

<u>Main Water Pipeline Alternative P3</u>. Construction of main water pipeline alternative P3 (including intake pumping plant and intermediate pump stations) would disturb approximately 574 acres of soils and topography. A small amount of additional disturbance would occur during construction of staging and work areas at pump station sites and stream and road crossings.

The soils data presented in the Affected Environment section (including Table 4) of this background report indicate that the same impacts and reclamation problems discussed for the proposed main water pipeline route (P1) would be encountered along this route. Many of the sandy soils that recur over the entire length of this alternative pipeline route are highly susceptible to wind-induced soil erosion. This alternative route traverses approximately the same amount of Badland areas as the proposed route (P1) and (P2) alternative route, but the areas of steeper terrain near the southern end of the Kutz Canyon (approximately 35 percent slope) would require more intensive mitigation to stabilize.

Mileposts for potential soils reclamation problem areas (and associated mitigation measures for consideration) along this alternative water pipeline route are presented in Table 10.

If this alternative main water pipeline were ultimately selected, a second pipeline would be layed within the same ROW with five years after the initial pipeline was layed. The monitoring program discussed for the proposed main water pipeline (P1) applies to this alternative route as well.

Potential indirect impacts to the soils resource from increased ORV access are the same as discussed for proposed main water pipeline (P1).

Proposed Terminal Storage Reservoir (R1). Construction and operation of the proposed terminal storage reservoir would take approximately 145 acres of soils out of production for the life of the project. Approximately 1.5 million cubic yards of material would be needed to construct an embankment (or dike) around 70 percent of the reservoir perimeter. Materials for construction of the embankment would be obtained from the reservoir area to the maximum practical extent, but the available soils data indicate that a significant volume of materials would have to be obtained from borrow areas outside the reservoir area. Over 50 percent of the proposed reservoir site is Badland (nonstony, barren shale), which can provide little if any materials suitable for embankment construction. The applicant's proposed erosion control and reclamation procedures for the reservoir and potential borrow areas are presented in Chapter 1 of the DEIS.

Acreages of potential soils reclamation problem areas (and associated mitigation measures for consideration) at this proposed reservoir site are presented in Table 10. The applicant's Proposed Action includes these measures.

<u>Terminal Storage Reservoir Alternative (R2)</u>. Construction and operation of the terminal storage reservoir alternative would take approximately 75 acres of soils out of production for the life of the project. Although the alternate reservoir site does not contain any Badland, the available soils data indicate that a large volume of borrow materials would be needed to construct an embankment for this reservoir as well. Additionally, the Muff soil (95 percent of site) is difficult to reclaim.

Acreages of potential sites reclamation problem areas (and associated mitigation measures for consideration) at this alternative reservoir site are presented in Table 10. The applicant's Proposed Action includes these measures.

## Transmission Lines

Proposed FC-A-P 500-kV Transmission Line Loop (T5). Construction of the proposed FC-A-P loop would directly disturb a maximum of 194 acres (not including portions within the boundary of NMGS) of soils and topography. Soil surface disturbance, excavation (tower sites), and grading, blading, trampling, and removal of vegetative cover would increase present soil erosion rates and soil instability. These increases would continue until denuded areas were revegetated. Grading and clearing of vegetation would be performed only where necessary for equipment access or safety considerations. The major disturbance to the soils resource associated with construction of the transmission lines would result from the blading required for construction of the temporary construction access roads (14 feet wide) along the ROW. Access roads would be closed to public travel and restoration measures would be applied after construction was completed. All graded or bladed areas would be reseeded, and erosion control measures would be applied where necessary. Most of the

construction ROW would not be cleared of vegetation, graded, or bladed; thus impacts to the soils resource would generally be minor and short-term. The soils data presented in the Affected Environment section (including MP 0.0-5.0 of Table 9) of this background report indicate that some bladed/graded areas would be difficult to reclaim. The types of reclamation problems that would be encountered on graded/bladed areas are generally the same as those discussed for the proposed main water pipeline (P1).

Mileposts for potential soils reclamation problem areas along this proposed transmission line are presented in Table 10. Table 10 also lists potential mitigation measures which, if implemented, would increase reclamation success. The applicant's Proposed Action includes many of these measures. Assuming that the measures would be moderately successful, most of these areas would recover within 3-5 years. Reclamation success on deeply graded/bladed areas could be enhanced by stockpiling topsoil on the side of construction access roads and replacing it during the restoration phase. The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

Potential indirect impacts to the soils resource from increased ORV access are the same as discussed for the proposed main water pipeline (P1). The applicant's Proposed Action states that transmission line access roads would be closed to public travel. If access roads were effectively closed, indirect impacts from ORVs would not occur.

First Proposed Transmission Corridor (T2). Construction of the first proposed transmission line would directly disturb a maximum of 2594 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography. As with the

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proposed FC-A-P loop, soil surface disturbance, excavation (tower sites), and grading, blading, trampling, and removal of vegetative cover would increase present soil erosion rates and soil instability. These increases would continue until denuded areas were revegetated. Blading required for construction of temporary access roads would constitute the major soils disturbance associated with construction of this transmission line. Clearing of vegetation, grading, and blading would be performed on a relatively small portion of the ROW, thus impacts to the soils resource would generally be minor and shortterm. Table 6 of this background report indicates that some bladed/graded areas would be difficult to reclaim. Potential reclamation problems (refer to Table 10), the applicant's proposed corrective measures, and anticipated recovery period are generally the same as discussed (or alluded to) for the proposed FC-A-P loop (T5). The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

Potential indirect impacts to the soils resource from increased ORV access are the same are discussed for the proposed transmission line loop (T5).

<u>Second Proposed Transmission Corridor (T1)</u>. A maximum of 2595 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography would be directly disturbed during construction of this alternative. Expected types and causes of direct and indirect soils impacts, potential reclamation problems (refer to Table 10) the applicant's proposed corrective measures, and anticipated recovery period are generally the same as discussed (or alluded to) for the proposed FC-A-P loop (T5). The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

Transmission Corridor Alternative T3. Construction of the transmission line alternative T3 would directly disturb a maximum of 2545 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography. Refer to the proposed FC-A-P loop (T5) discussion for expected types and causes of direct and indirect soils impacts, potential reclamation problems (refer to Table 10) the applicant's proposed corrective measures, and anticipated recovery period. The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line alternative.

Transmission Corridor Alternative T4. A maximum of 3054 acres (including construction access roads, Rio Puerco Station, and other associated facilities) of soils and topography would be disturbed during construction of this alternative transmission line. Expected types and causes of direct and indirect soils impacts, potential reclamation problems (refer to Table 10) the applicant's proposed corrective measures, and anticipated recovery period are generally the same as discussed for the proposed FC-A-P loop (T5). This transmission corridor traverses areas of steeper terrain than the other corridor alternatives. The primary areas of concern are in southeastern McKinley County (between Canon de Marquez and Canon de Pedro Padilla [MP 94-96]), and in northeastern Cibola County (La Mesa del Canon Seco area [MP 98-101]). Terrain restrictions in these areas might necessitate placing a new transmission line directly adjacent to the existing transmission line that runs through these areas. The soil associations (Rock Land-Thunderbird and Little-Clovis-Travessilla) in these steep areas are shallow to moderately deep (includes rock outcrops), and erosion susceptibility is low to moderate. If this alternative were ultimately selected, special care during construction and reclamation phases should be taken to protect the existing soils resource in the aforementioned steep areas. The monitoring program discussed for the proposed main water pipeline (P1) should also apply to this transmission line.

## PRIME AND UNIQUE FARMLANDS

The surface facilities associated with the Proposed Action and alternatives would not be located on Prime or Unique Farmlands, thus no long-term crop production losses on Prime or Unique Farmlands would occur. The intake/pumping plant associated with the proposed main water pipeline (Pl) would take approximately 35 acres of potential (not irrigated and not used as cropland) Prime Farmland out of production for the life of the project. Proposed main water pipeline (Pl) intermediate pumping stations 2 and 3 would preclude development of 2 acres of potential Statewide/Locally Important Farmland in Block 9 of NIIP. These potential impacts are not considered significant.



SPECIFIC MITIGATION MEASURES GENERATED BY THE IMPACT ASSESSMENT

5.0

Table 10 lists specific mitigation measures for consideration, as generated by the impact assessment. Mitigation measures for consideration are listed by project component, map unit of soil association, and mileposts (linear project components) or acreages. The types of mitigation measures proposed for consideration are: (1) mulching denuded areas or covering with jute fabric or riprap; (2) topsoiling; (3) water diversions; and (4) reseeding. These measures are listed (as applicable) for potential soils reclamation problem areas, where potentially significant impacts to the soils resource may occur if erosion control and reclamation measures are not implemented. The determination of potential soils reclamation problem areas was based on the following factors: (1) soils with high wind or water erosion susceptibility; (2) soils which are known to be difficult to reclaim; and (3) areas of steep terrain.

The available soils data which were used are not necessarily adequate to accurately predict all potential reclamation problem areas. Additionally, some of the areas listed in Table 10 would probably not be difficult to reclaim (i.e., determination based on available soils data and conservative approach).

In summary, Table 10 and the other soils data in this technical report should be used as a reference guide. BLM reclamation specialists will make an on-the-ground determination of appropriate

erosion control and reclamation measures to be stipulated, prior to issuance of the ROW grant. In addition, BLM reclamation specialists will formulate a soils monitoring program for sensitive soils area.

6.0 UNAVOIDABLE ADVERSE IMPACTS

Unavoidable adverse impacts to the soils resource resulting from construction of the Proposed Action or alternatives would include: (1) increases in soil erosion and soil instability on disturbed areas; and (2) decreases in short-term soil productivity. If a moderately intensive erosion control and reclamation program (including monitoring) were implemented following construction, increases in soil erosion and instability would generally be short-term impacts (e.g., 3-5 years).



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RELATIONSHIPS BETWEEN THE SHORT-TERM USE OF THE AFFECTED ENVIRONMENT AND THE ENHANCEMENT OF LONG-TERM PRODUCTIVITY

7.0

Assuming the erosion control and reclamation measures implemented following construction on temporarily disturbed areas were moderately successful, impacts to the soils resource should not result in significant long-term productivity losses. Construction and operation of the surface facilities associated with the proposed project would result in long-term productivity losses at these locations.



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IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

8.0

Short-term increases in soil erosion due to construction of the proposed project would not cause temporarily disturbed areas to be irreversibly converted to other uses, and the viability of these areas should not be significantly diminished. The BLM monitoring program that would be conducted over the life of the project would include identification of problem soil erosion areas. Once identified, problem soil erosion areas would undergo more intensive reclamation and mitigation, thereby helping to ensure that irreversible and irretrievable commitments of the soils resource would not occur. Surface facility sites would be reclaimed upon project termination; thus these areas would not be permanently or irreversibly committed to other uses.



9.0 COMPARISON OF ALTERNATIVES

A comparison of the mitigation/reclamation potential for the main water pipeline alternatives is contained in Table 11. This comparison provides the primary basis for ranking the main water pipeline alteratives in the following order of preference: P1--first; P2--second; and P3--third. Main water pipeline route P1 is also preferred over P2 because it would cause less disturbance (474 acres versus 508 acres during construction, including river intake and intermediate pump stations); P1 has better access for construction/maintenance (e.g., State Highway 371); and P1 would probably not impact any developed NIIP blocks. Main water pipeline route P3 is ranked last because it would cause the most disturbance during construction (547 acres); and it traverses the most miles of steep terrain, area reclaim soils, and soils which are highly susceptible to wind and water erosion.

Table 11 also provides the primary basis for ranking the terminal storage reservoir alternatives in the following order of preference: proposed-first; alternative--second. The alternative reservoir site would be more difficult to reclaim (95 percent area reclaim soils), and it is located on an upland drainage sideslope which is undesirable from an erosion/reclamation standpoint.

The information in Table 11 also provides the primary basis for ranking the transmission line corridor route alternatives in the

Table 11. COMPARISON OF RECLAMATION POTENTIAL FOR ALTERNATIVES

Transmission Line Storage Reservoirs Corridor Alternatives	Proposed Alternate T-1 T-2 T-3 T-4	35 ac 56.6 mi 37.3 mi 47 mi 50 mi	4 ac. 23.5 mi 32 mi 22.8 mi 23.3 mi	8.8 mi	35 ac. 71 ac	mod low mod-high mod-high mod-high low-mod	
ter Pipeline Alternatives	P-2 P-3 ]	28.4 mi 34 mi	2.6 mi 3.6 mi	2 mi 2.3 mi	3.2 mi 7.4 mi	mod low-mod	
Main Wat Route A	iteria for Comparison P-1	gh susceptibility to 31.7 mi 2 nd-induced soil erosion <sup>a</sup>	gh susceptibility to b 1.6 mi ter-induced soil erosion <sup>b</sup>	eep terrain <sup>c</sup> 1.4 mi	ea reclaim <sup>d</sup> 4.4 mi	tential for mitigation mod d successful reclamation <sup>e</sup>	

Based on WEG classes where: Classes 5-8 = low; 3-4L = moderate; and 1-2 = high.

9-2

 $\geq .4 = high.$ bBased on K factor values where: <.2 = low; .2-.39 = moderate; and

<sup>c</sup>Areas with terrain slope greater than 15 percent.

Transmission line corridor soils data dArea reclaim is an indicator of areas which would be difficult to reclaim. are too general to use for identifying these areas.

<sup>e</sup>Principle items considered in determination include relative topsoil suitability, terrain ruggedness, expected success of standard BLM erosion control measures, and potential for successful revegetation.

following order of preference: T3--first; T2/T1--second; and T4--third. Transmission line corridor alternative T3 would cause the least amount of disturbance during construction (2545 acres), while T2 and T1 would cause about the same amount (2594 and 2595 acres, respectively). Transmission corridor alternative T4 would cause the most disturbance during construction (3054 acres), and it would traverse about 9 miles of steep terrain (i.e., potential reclamation problems).



POSSIBLE NEW TOWN



1.0 AFFECTED ENVIRONMENT

#### SOILS

The possible new town site is within the San Juan River Valley Mesas and Plateaus portion of the Western Range and Irrigated Region (SCS 1978a). Annual precipitation at the site generally ranges from 6 to 10 inches. Two different soil associations were identified at the site. Table 1 lists and characterizes the identified soils. A map (1:250,000 scale) showing the soils identified at the possible new town site is available for review at the BLM New Mexico State Office in Santa Fe.

The soils identified at the possible new town site are shallow to deep, but are primarily deep. The surface textures of the soils identified at the site range from loamy fine sand to silty clay loam. These soils are well to somewhat excessively drained. The identified soils are forming in eolian, alluvial, and residual materials derived primarily from sandstone, shale, and siltstone. These soils are forming primarily on gently to strongly sloping mesas, plateaus, intermittent drainageways, terraces, and fans. Topsoil availability at the possible new town site is good, but the topsoil quality is primarily fair to poor. Susceptibility of these soils to wind-induced erosion is moderate to high, and susceptibility to water-induced soil erosion is low to moderate. The identified soils are mildly to strongly alkaline, and shrink-swell potential ranges from low to high.

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Table 1. CHARACTERISTICS OF THE SOILS IDENTIFIED AT THE POSSIBLE NEW TOWN SITE

Connents	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is poor to fair, 6-10 inch precipitation zone. Shrink-swell potential is low to high, mildly to strongly alkaline soils.	Moderate to high wind erosion hazard, low to moderate water erosion hazard, topsoil is fair to good, 6-10 inch precipitation zone. Shrink-swell potential is low to moderate, mildly to strongly alkaline soils.	
iT.	S H S	ν ν ν ν	
'K'	.15 .32 .37	.15 .37	
- WEG Class	. 4L	n – n	
Hydro- logic Group	<b>₹</b> ₽₽	<b>8 4 8</b>	-
Salinity (muhos/ cm)	044	295 4	
Soil Reaction (pH)	4.8-4.7 7.9-9.0 7.9-9.1	7.4-9.0 7.4-8.4 7.4-9.0	
Depth to High Water Table (feet)	* * *	* * *	
Slope (1)	0-40	0-5-0	
Depth to Bedrock (inches)	60+ 10-20 60	5 6 6 6 6	
e Soil Series	Sheppard Huerfano Notal	Shiprock Sheppard Doak	
Approximate Acreage	1,640	760	(2,400)
Soil Association and Description <sup>1</sup>	Sheppard-Huerfano-Notal: Deep to shallow, well to somewhat excessively drained, loamy fine sand, sandy clay loam, and silty clay loam soils formed on level to steep mesas, plateaus, valley bottoms, and fans from eoli- an, alluvial, and residual materials derived from sandstone, shale, and siltstone.	Shiprock-Sheppard-Doak: Deep, well to some- what excessively drained, fine sandy loam, loamy fine sand, and loam soils formed on level to moderately steep mesas, plateaus, and terraces from alluvial and colian mate- rials derived from sandstone, shale, and mixed sources.	(Total Acreage)

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<sup>1</sup> Source: U.S. Soil Conservation Service (SCS). 1979. General soil map, San Juan County, New Mexico, eastern part. Soil survey of San Juan County, New Mexico, eastern part.

These soils are currently used primarily for livestock grazing and wildlife habitat.

### PRIME AND UNIQUE FARMLANDS

Since the possible new town could potentially take agricultural land out of production permanently, the new town site was evaluated to determine whether it includes any Prime or Unique Farmland. The soil types (DS, BT, SC, and FX) present at the possible new town site do not qualify as Prime Farmland (SCS 1978b and 1980). Additionally, the site contains no Unique or Statewide/Locally Important Farmlands.


2.0 ENVIRONMENTAL CONSEQUENCES

### SOILS

Construction of the possible new town would directly disturb approximately 2400 acres of soils and topography, significantly affecting the existing soils. The entire possible new town site would probably be permanently changed from its preconstruction use (grazing and wildlife habitat) to an urban development.

Construction of utilities (e.g., water, gas, electrical power) and roads necessary for the possible new town would disturb an unknown amount of soils and topography. Additionally, an unknown amount of land in the vicinity of the possible new town could be adversely impacted by recreational pursuits (e.g., ORV use) of new town residents.

### PRIME FARMLAND

Construction of the possible new town would not impact any Prime, Unique, or Statewide/Locally Important Farmlands.



GLOSSARY

- <u>Alluvium</u>--Materials such as sand, silt, or clay, deposited on land by streams.
- <u>Area reclaim</u>--An area which is difficult to reclaim if soil is removed for construction or other purposes. Revegetation and erosion control are extremely difficult.
- <u>Calcareous soil</u>--Soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.
- <u>Clay</u>--As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.
- Drainage class (natural) -- Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly a result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

- <u>Excessively drained</u>--Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.
- <u>Somewhat excessively drained</u>-- Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.
- <u>Well drained</u>--Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well-drained soils are commonly medium textured. They are mainly free of mottling.
- <u>Moderately well drained</u>--Water is removed from the soil somewhat slowly during some periods. Moderately welldrained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.
- <u>Somewhat poorly drained</u>--Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from

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seepage, nearly continuous rainfall, or a combination of these.

- <u>Poorly drained</u>--Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.
- <u>Very poorly drained</u>--Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

Eolian soil material--Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Excess salts--Excess water-soluble salts in the soil that restrict the growth of most plants.

#### Farmlands:

Prime--Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and

oilseed crops, and is also available for these uses (e.g., not urban built-up land). Numerous specific SCS criteria must be met for a soil to qualify as potential Prime Farmland. For a soil to qualify as Prime Farmland (in the NMGS project area in New Mexico) it must meet the specific criteria and be irrigated.

- Unique--Land other than Prime Farmland that is used for the production of specific high value food and fiber crops. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality and/or high yields of a specific crop when treated and managed according to acceptable farming methods.
- Statewide/Locally Important-All irrigated cropland in New Mexico is considered to be Statewide/Locally Important.
- Hydrologic soil groups—Refers to soils grouped according to their runoff-producing characteristics. The primary consideration is the inherent capacity of soil denuded of vegetation to permit infiltration. The slope and the kind of plant cover are not considered. Soils are assigned to four groups (A through D). In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material.
- Loam--Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

<u>Permeability</u>--The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow	<0.06 inch/hour		
Slow	0.06 to 0.20 inch/hour		
Moderately slow	0.20 to 0.60 inch/hour		
Moderate	0.6 to 2.0 inches/hour		
Moderately rapid	2.0 to 6.0 inches/hour		
Rapid	6.0 to 20.0 inches/hour		
Very rapid	20.0 inches/hour		

<u>Reaction, soil</u>--A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction. The degree of acidity or alkalinity is expressed as:

Extremely acidic	<ph< th=""><th>4.5</th><th></th><th></th></ph<>	4.5		
Very strongly acidic	рН	4.5	to	5.0
Strongly acidic	pН	5.1	to	5.5
Moderately acidic	pH	5.6	to	6.0
Slightly acidic	рH	6.1	to	6.5
Neutral	рН	6.6	to	7.3
Mildly alkaline	рH	7.4	to	7.8
Moderately alkaline	pН	7.9	to	8.4
Strongly alkaline	рH	8.5	to	9.0
Very strongly alkaline	e <u>&gt;</u> pH	9.1		

<u>Residuum (residual soil material)</u>--Unconsolidated, weathered, or partly weathered mineral material that accumulated as consolidated rock disintegrated in place. <u>Saline soil</u>--A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium. Salinity ratings are based on the electrical conductivity of a saturated extract, as expressed in millimhos per centimeter (mmhos/cm) at 25°C. The degree of salinity is expressed as:

None	<2.0 mmhos/cm
Low	2.0 to 4.0 mmhos/cm
Moderate	4.0 to 8.0 mmhos/cm
High	8.0 to 16.0 mmhos/cm
Very high	>16.0 mmhos/cm

<u>Sand</u>--As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

<u>Sandstone</u>--Sedimentary rock containing dominantly sand-sized particles.

Shale--Sedimentary rock formed by the hardening of a clay deposit.

- <u>Shrink-swell potential</u>--The potential of a given soil to shrink when dry and swell when wet. Shrink-swell is associated with clay soils. Shrinking and swelling can damage roads, dams, buildings, foundations, and other structures. It can also damage plant roots.
- <u>Silt</u>--As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil

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textural class, soil that is 80 percent or more silt and less than 12 percent clay.

<u>Siltstone</u>--Sedimentary rock made up of dominantly silt-sized particles.

- <u>Slick spot</u>--A small area of soil having a puddled, crusted, or smooth surface and an excess of exchangeable sodium. The soil is generally silty or clayey, is slippery when wet, and is low in productivity.
- <u>Slope</u>--The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. In the Soils Background Report the following slope classifications are used:

Nearly level or level	0 to 2%
Gently sloping	2 to 5%
Moderately sloping	5 to 9%
Strongly sloping	9 to 15%
Moderately steep	15 to 30%
Steep	30 to 50%
Very steep	50 to 75%
Extremely steep	>7 5%

- <u>Soil loss tolerance ("T" factor)</u>--The "T" value is the amount of soil (tons/acre) that can be lost in a year from a particular soil series, while the soil continues to support sustained longterm productivity.
- <u>Subsoil</u>--Technically, the B horizon; roughly, the part of the solum below plow depth.

- <u>Topsoil</u>--The upper part of the soil, which is the most favorable material for plant growth. It is ordinarily rich in organic matter, and technically it corresponds to the A horizon.
- <u>Water erosion susceptibility</u>--Relative susceptibility of a given soil series to water-induced erosion. In this report, based on Soil Conservation Service K factors where: <0.2 = 1ow; 0.2-0.39 =moderate; and  $\geq 0.4 =$ high.
- <u>Wind erosion susceptibility</u>--Relative susceptibility of a given soil series to wind-induced erosion. In this report, based on Soil Conservation Service WEG classes where: Classes 5-8 = low; 3-4L = moderate; and 1-2 = high.

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. 1978a. Land resource regions and major land resource areas of the United States. (Map.)

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. 1978b. Mapping units of prime farmland in San Juan County, New Mexico (irrigated). (List.)

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