WORK REPORT

DETAILED CONSERVATION

SURVEY

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NAVAJO'S IRRIGATION PROJECT

LAND MANAGEMENT UNIT 5

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B.I.A.-I.C.O. NAVAJO SERVICE

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ALL SERIES NAMES

are provisional

PENDING FINAL CORRELATION

by

THE INTERBUREAU CORRELATION COMMITTEE

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INTRODUCTION

Natoni's Irrigation Project is located in the northwest portion of Land Management Unit 5, in the Coconino County, Arizona.

It is 20 miles north of Leupp, Arizona and 14 miles northwest of the Red Lake Trading and Day School by airline. It is approximately 35 miles from Leupp by road.

A secondary trail branching from the Oraibi-Leupp road approximately 5 miles north of the Red Lake turnoff leads to the project.

The 761 acres, all Federal owned, included in the Conservation Survey are below the Fly-line and lie between the Dinnebito and Oraibi Washes immediately above their confluence.

Initial investigations were made by Dave Chitwood and H.F. Johnson in November 1940. The detailed survey was made by L.A. Eronaugh and H. F. Johnson the week of March 10 to 15, 1941.

The purpose of the survey was to gather and compile data necessary to evaluate the quality and quantity of land adapted to irrigation below the heading.

The elevation of the area is approximately 4900 feet.

The topography is the typical gently sloping old alluvial fan type that is locally undulating as a result of wind action. A series of low benches having an average differences in elevation of about four feet are characteristic of the more gentle slopes.

Alkali sacaton (Sporobolus airoides) is the predominate grass found over most of the area. Big rabbit brush (Chrysothamnus bigelovii) occurs in the local areas. Greasewood (Sarcobatus vermiculatus) occupies the hummocks where the most dispersed subsoil is exposed.

CLIMATE

No climatological data are available at the project. Records are available from Flagstaff, Grand Canyon, Leupp, Tuba City and Winslow, Arizona. Table No. I is a summary of this data in tabular form. An estimation of the climatological data for Natoni's is also included. The long growing season permits cultivation of most long season crops. The high temperatures makes the growing of the cooler climate crops such as head lettuce and celery uncertain.

Table I. Climatological Data from Weather Stations in or near L.M.U. 5 *

Station & Length of Complete Record	Elevation (Feet)	Length of Growing Season (Days)	Average Annual Temperature (F°)	Average Maximum Temperature (F°)	Average Minimum Temperature (F°)	Extreme Minimum Temperature (F°)
Flagsteff 27	6907	116	45.4	60.0	30.8	-25
Grand Canyon 21	6866	139	47.3	62.4	32.3	-22
Leupp 9	4700		53.4			-12
Tuba City 22	4500	179	54.7			-15
Winslow 18	4848	165	54.3	70.7	37.8	-10
Natoni's **	4900	160	53.0	68.0	36.0	-12

Table I. (cont)

Extreme Maximum Temperature (F°)	Average Annual Precipitation (in.)	Average Date Last Killing Frost in Spring	Average Date First Killing Frost in Fall	Latest Date of Killing Frost in Spring	Earliest Date of Killing Frost in Fall
92	22.8	June 6	Sept. 30	July 5	Sept. 9
98	13.13	May 21	Oct. 1	June 17	Sept. 5
105					
104	6.94	April 23	Oct. 19	May 9	Sept. 19
106	8.73	May 4	Oct. 16	June 2	Sept. 27
104	7.0	May 7	Oct. 14		

* University of Arizona, College of Agriculture. Agriculture Experiment Station Bulletin No. 130, "The Climate of Arizona", By H.V. Smith. Data from Establishment of Station to 1930, inclusive.

** Estimated

AGRICULTURE HISTORY AND PRACTICES

There is no evidence that farming has been practiced within the area in the recent past. Natoni has constructed several temporary structures on the Dinnebito Wash and produced crops to the west of this area intermittently for several years, his success seemingly depending upon the time of flash floods which invariably distroy his diversions.

CONSERVATION SURVEY

The reconnaissance investigations of the area made in November 1940 covered approximately 1500 acres. This delineated in a general way the arable land to ascertain that sufficient land could be obtained and also serve as a guide to the extent of the Topographic Survey. No map was made at that time; however, the notes and samples taken were used in making the detailed study. The Detailed Conservation Survey was made on the soils below the Fly-line, extending to the low alkalied clay area to the south and east, to the Dinnebito Wash on the west, and ending where the area became narrow immediately above the confluence of the Oraibi and Dinnebito Washes to the southwest.

Engineering topographic maps on scale of 1" = 200' were used as base maps.

Five factors were mapped and indicated in a composite symbol; namely, soil type, slope group, erosion, land use and land class; the land class grouping is shown by cross hatching on the accompaning map; the other factors are shown in the symbol only.

The soils vary greatly in their productive capacity. However, most of the area considered non-irrigatable because of excess alkali was not mapped but instead serves as the boundary along the south and east edge. Approximately 423 acres or 56 percent are adapted to irrigated agriculture, and the remaining 327 acres or 44 percent are considered doubtful or marginal because of their excessive alkali content and high dispersion ratio.

SOILS

Four soil types are recognized, namely, loamy sand, sandy loam, sandy clay and light clay all Dinnebitso series. See Appendix I for a typical description of this series. A skeleton description of each soil sample taken is shown in Appendix II. Two areas of sandy clay loam soil type, one located along the Base line Station 140/00 and 160/00, the other in the northeast corner of the area southeast of Base line Station 111/24 are probably the best adopted to irrigation with the sandy loam and loamy sand areas, respectively, next. Figure III is a profile picture of the sandy clay type.

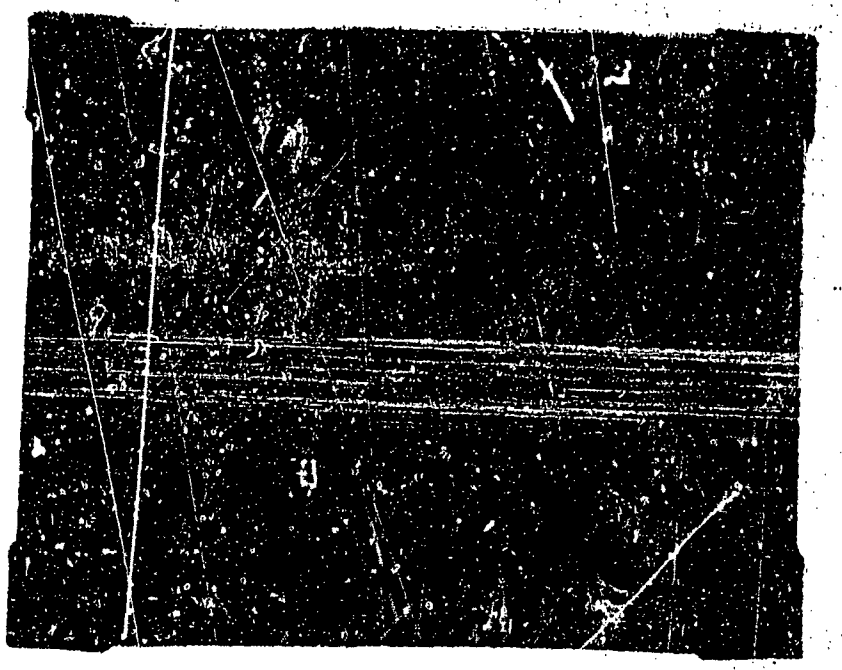
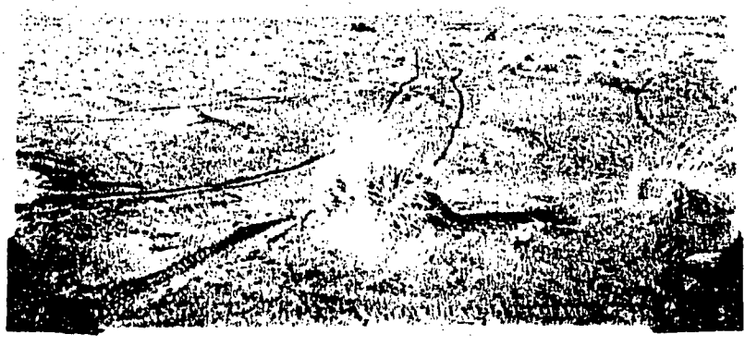
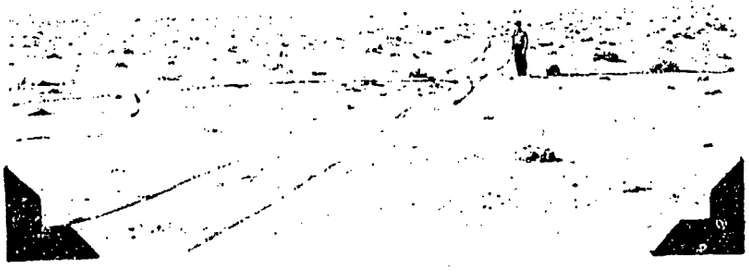


Figure No. I
Dinnehotso Loamy Sand Soil Type. Class "B" land. Looking southwest of Base line Station 111/24. Note the result wind action on the surface as exemplified by hummocks and small blow holes. The flag immediately back of the Pickup (at x) is on the Fly-line approximately where water will come out.

Figure No. II
Dinnehotso Light Clay Type. Class "C" land. Looking northwest toward Base line Station 166/52 700' away. The dispersed area in the front (y) is exposed subsoil and deliniates approximately the boundary between class "B" and "C" land.





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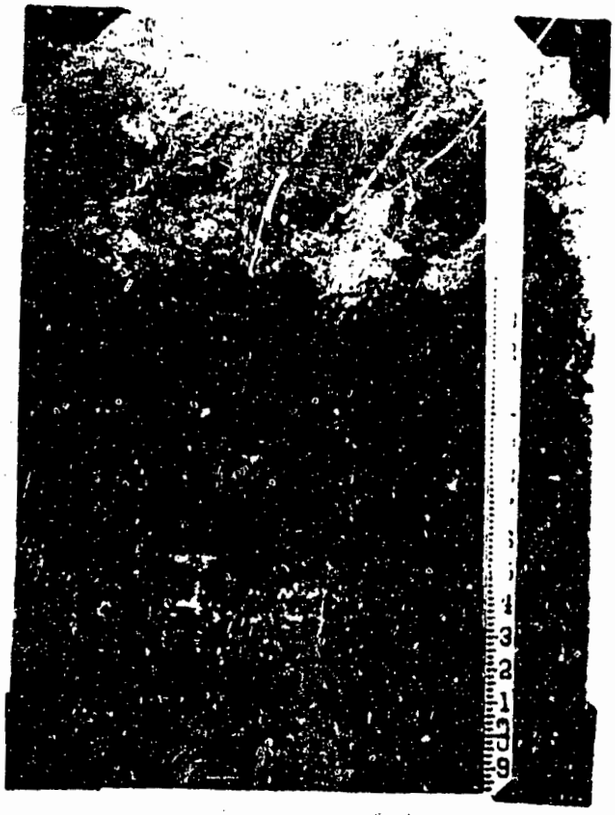

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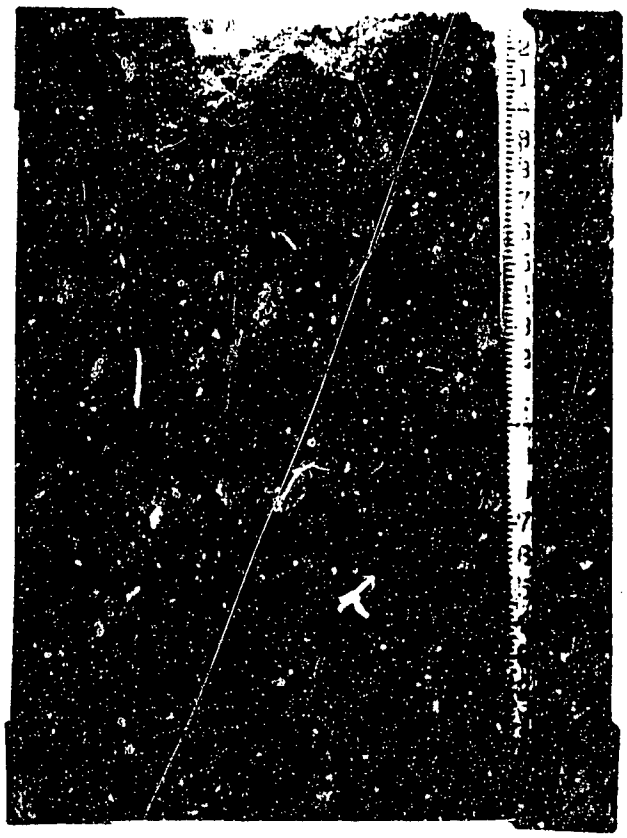

Figure No. III
Profile of Pinnacate Sandy Clay Loam Soil Type. At the sample location 27, 500' northeast of Base Line Station 166/52. Note approximately 1.3' of friable sandy clay loam over a clay subsoil.

As indicated by the analysis, see Table III, the textures within the delineations vary somewhat; that is small areas of sand and sandy loam occur within the loamy sand soil type, etc.

The soils are brown or reddish brown in color, very low in organic matter content, and rich in lime carbonate, gypsum, and various calcium, magnesium and sodium salts. Phosphate, while probably present in comparatively large quantities, occurs as an insoluble compound with calcium and is largely unavailable to plants. See Table III. The low organic matter content should be built up heavy applications of barnyard manure; green manure crops and legumes should be incorporated in the rotation as heavy as possible. It is suggested that small tracts be treated with treble super phosphate to observe if this stimulates plant growth sufficiently to warrant its extensive use on the project. Small alkali "slick spots" within cultivated areas will disappear

more rapidly if given heavy individual treatments of barnyard manure. The surface textures range from light to heavy; the texture of the arable land ranges from extremely light to medium, the heavier soil generally being excessively high in alkali.

The light textured surface soils will blow badly, absorb water very rapidly and cut badly if irrigated down very steep slopes even with small heads of irrigation water. See Figure I. However, universally they are underlain by a fairly well developed somewhat dispersed subsoil which should prevent water from percolating out of reach of plant roots too rapidly. This occurs at a depth varying from 18 to 30 inches. Care should be exercised not to remove all the surface soil in subjugation practices as the underlying subsoil will be very unproductive. The slick spots, noted throughout are exposed alkali subsoil.

Slope

The slope grouping is an array of slopes as outlined in Appendix IV. These are general and not as accurate in anyway as the topographic map.

Erosion

Wind erosion is active over most of the area. The classification given each soil type varied directly as to the amount of topsoil remaining. Since the topsoil is relatively shallow and is underlain by a somewhat dispersed subsoil, every precaution must be taken to keep it intact. Irrigation water should be applied as soon as possible after leveling and tilling to help prevent excessive wind removals.

Land Class

The limitations of each land class is outlined in the discussion under Appendix III.

No land is given class A because of the dispersion universally present in the profile. The class B and B- (minus) land, totaling 433 acres, see Table II, are recommended for irrigation.

The 323 acres of class C land are of doubtful value for irrigation, because the surface soil has been removed by erosion, leaving the unproductive, dispersed subsoil exposed.

No class D is mapped. Extensive areas which probably would fall in this class are found to the south and east of the survey. Sample 28 is very close to this land. See Table III for analysis of soil samples.

IRRIGATION, DRAINAGE AND ALKALI

Irrigation is necessary for the production of crops in this area. It

is proposed to irrigate from the Pinnebito Wash by direct diversion utilizing the permanent flow. As indicated by the analysis of water, Table IV, this water is relatively high in total salts and the ratio of sodium to calcium plus magnesium is approaching the limit generally recommended for use. However, it is believed to be safe because of the open, and generally light textured surface and substratum.

The total salt content is generally medium to low.

The somewhat poor physical condition of the soil, as indicated by the dispersion in almost every set of samples collected, is probably caused by the sodium present. This amount of dispersion, while avoided where possible, is not considered particulary serious if managed carefully with light textured soils having a relatively high content of lime, calcium carbonate ($Ca\ CO_3$).

There appears to be ample sand in the substratum to facalitate subdrainage. However, seepage from canals and the application of excess water may alter this. Areas most apt to become water logged are (1) the edge of the low benches, (2) the area of clay to the south and east side of the survey, and (3) the small swale immediately below the Fly-line in the vicinity Base line Station 170+00.

While the total salt content is generally low, the dispersion ratio of the subsoil is almost universally high. The pH is also high. However it is believed, because of the open nature of the substratum, that alkali will not become a major problem if the "slick spots" and high alkali areas are avoided as much as possible and careful management is practiced.

SUMMARY

433 acres under the survey, evaluated classes F and B- (minus) land are recommended for irrigation.

Wind erosion is probably the major hazard. Any of the soil newly worked and not in a moist condition will blow. Irrigation ditches will catch blowing sand and probably be very difficult to keep open for that reason. Excluding stock from an area to the windward side to permit vegetation to become established would undoubtly help stop the moving sand.

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Appendix III.

CRITERIA FOR GROUPING SOILS FOR IRRIGATION

Class A Land - Recommended Excellent

Class A soils consist of the highest type of arable lands. They are easy to cultivate, are not susceptible to excessive erosion and retain and supply enough moisture and contain sufficient plant nutrients for the maintenance of those physical, chemical and biological conditions in the soil that favor continued production of moderate to high yields of all farm crops adapted to the locality, provided sound farm management is practiced. They exhibit at least 18 inches of tillable surface.

Class B Land - Recommended Good

Lands in this class are also recommended for irrigation. However, they are not as desirable nor of such high general value as Class A lands inasmuch as they may be more difficult to till and may not have as wide a range of crop adaptation. From the standpoint of inherent soil characteristics and environmental features, the soils may require one or more easily applied, simple practices, such as strip farming or heavy manuring, to insure safe and permanent cultivation. They should have at least 12 inches of tillable topsoil.

Class B Minus (-) Land - Good, Except Droughty and Susceptible to Wind Erosion

Soils in this class closely resemble those in Class B, except that the surface is either loamy sand or sand, and the subsoil and substratum are also usually very light in texture. As a consequence, they are highly susceptible to wind erosion and quite often droughty.

These soils, where they have excessive sub-drainage, are sometimes the only class suited to irrigation if the water available is of very poor quality, because extremely sandy surfaces will tolerate a higher sodium to calcium plus magnesium ratio before "freezing up".

Class C Land - Marginal or Doubtful

Soils placed in this class are considered marginal or of doubtful quality for irrigation. They generally have one or more characteristics, such as slope, erosion, depth of soil mantle, extremes in surface textures, depth of water table, stoniness, and/or salt content which interfere with their use under irrigation. Soils in this class are often not sufficiently affected that their ability to produce is greatly lowered. An example of this condition is noted where black alkali "slick spots" occur intermittently in an area of what otherwise would be good land; for all purposes these spots are sterile and may either remain as they now are, grow larger, or gradually become productive, depending upon a great number of factors. Another quite common example of land in this class are the moderately heavy clays, rather poor in physical condition. These are very difficult to manage and require a great deal more effort to produce a crop; they are not adapted to as wide a range of crops and seldom produce as high yields as do Class A and B land.

In general, Class C soils do not produce satisfactory yields and cannot be depended upon to continue production without extensive, expensive treatment.

Class D Land - Not Recommended

Lands in Class D are not recommended for irrigation.

Appendix IV. **CONSERVATION SURVEY LEGEND***

COMPOSITE SYMBOL - - - - $\frac{\text{Soil Type}}{\text{Slope--Erosion (Sheet, Gully, Wind)}}$
Land Class

Soil Series and Type.
Types and symbols are shown on map and described in the report.

Slope.
- A 0-2%
- B 2-5%
- C 5-10%
- D 10% and over

Erosion.

Normal Geologic Erosion.
- 0. No apparent erosion.
- W. Normal erosion (active).
  - Ws. Normal sheet erosion.
  - Wg. Normal sheet and gully erosion.
  - Ww. Normal wind erosion.

Accelerated Erosion.
Water Erosion.
Sheet Erosion.
1. Less than 25 percent of the topsoil removed.
2. 25 to 75 percent of the topsoil removed.
3. 75 percent or more of the topsoil removed, or all the topsoil and less than 25 percent of the subsoil removed.
4. All the topsoil and 25 to 75 percent of the subsoil removed.
5. All the topsoil and 75 percent or more of the subsoil removed; parent material may be eroded.
6. The symbol 6 is reserved for conditions of local significance, such as slips or catsteps.

Gully Erosion.
7. Occasional gullies: More than 100 feet apart.
8. Frequent gullies: Occurring less than 100 feet apart but including less than 75 percent of the delineated area.
9. Very frequent or large gullies. This symbol is used to designate an intricate network of gullies or an individual gully large enough to be outlined, or any mappable area of which more than 75 percent is gullied.

* Reference - "Soil Conservation Handbook", E. A. Norton, USDA Misc. Pub. No. 352, 1939.

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Appendix IV. (cont.)

Gully Erosion (continued)

Note: 7, 8, or 9. Shallow gullies: Can be crossed with tillage implements but would be obliterated by normal tillage.

(7) (8) or (9). Deep gullies that have penetrated into compact subsoil or through it into compact parent material.

7V, 8V, or 9V. Deep gullies that have penetrated into friable parent material.

Accumulations.

+ Recent accumulations.

15+ Denotes the depth of accumulation in inches (not often used).

⚠ Detrimental deposits indicated by the symbol within a triangle.

Wind Erosion.

Removals.

P. Less than 25 percent of the topsoil removed.

R. 25 to 75 percent of the topsoil removed.

S. 75 percent or more of the topsoil removed, or all of the topsoil and less than 25 percent of the subsoil removed.

T. All the topsoil and 25 to 75 percent of the subsoil removed.

U. All the topsoil and 75 percent or more of the subsoil removed; parent material may be eroded.

Accumulations.

F. Shallow accumulations, less than 6 inches, either level or in hummocks.

H. Moderate accumulations, level, 6 to 12 inches.

K. Moderate accumulations, hummocky, 6 to 12 inches.

L. Severe accumulation, 12 to 36 inches.

M. Small dunes, 36 to 72 inches high.

N. Large dunes, 72 inches, or more, high.

Note: The proportion of the area covered is indicated by following the class letter with the numeral 2 to indicate one- to two-thirds of the area affected, or 3 to indicate more than two-thirds of the area affected. No numeral following indicates less than one-third of the area affected.

Appendix IV. (cont.)

Undifferentiated Erosion.

0. This symbol indicates erosion undifferentiated as to character or degree, such as may occur on farm yards and similar areas.

Stabilized Erosion.

Stabilized erosion is indicated by overscoring the appropriate symbol, as $\overline{T}$ or $\overline{R}$, if it is evident that plant cover has recently reestablished normal erosion.

Land Classification (Irrigation only).

A. Excellent.
B. Good.
B-. Good, but highly susceptible to wind erosion.
C. Marginal.
D. Not recommended.

Note: Further discussion of land classes included in the report.

Land Use.

L. Cultivated land.
Ll. Orchard.
X. Idle land.
Xl. Waste land.
P. Pasture or range.
F. Woodland or timber.
$\overline{F}$. Grazed woodland.
H. Urban areas, farmstead, roads, etc.

Note: The land use symbol does not occur in the composite symbol, but as a separate symbol alone.

Miscellaneous Symbols.

Soil sample number and location.

Survey type boundary

Land use boundary (if different than the soil boundary)

Cobble stones on surface.

Rock outcrops.

Individual shallow gully.

Individual deep gully.

Individual deep, rapidly cutting gully.

AAA Alkali area.

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