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NOTE: This is a revised copy of the report on this area. Former copies should be destroyed.

A. T. Strahorn,
Chief Soil Expert.

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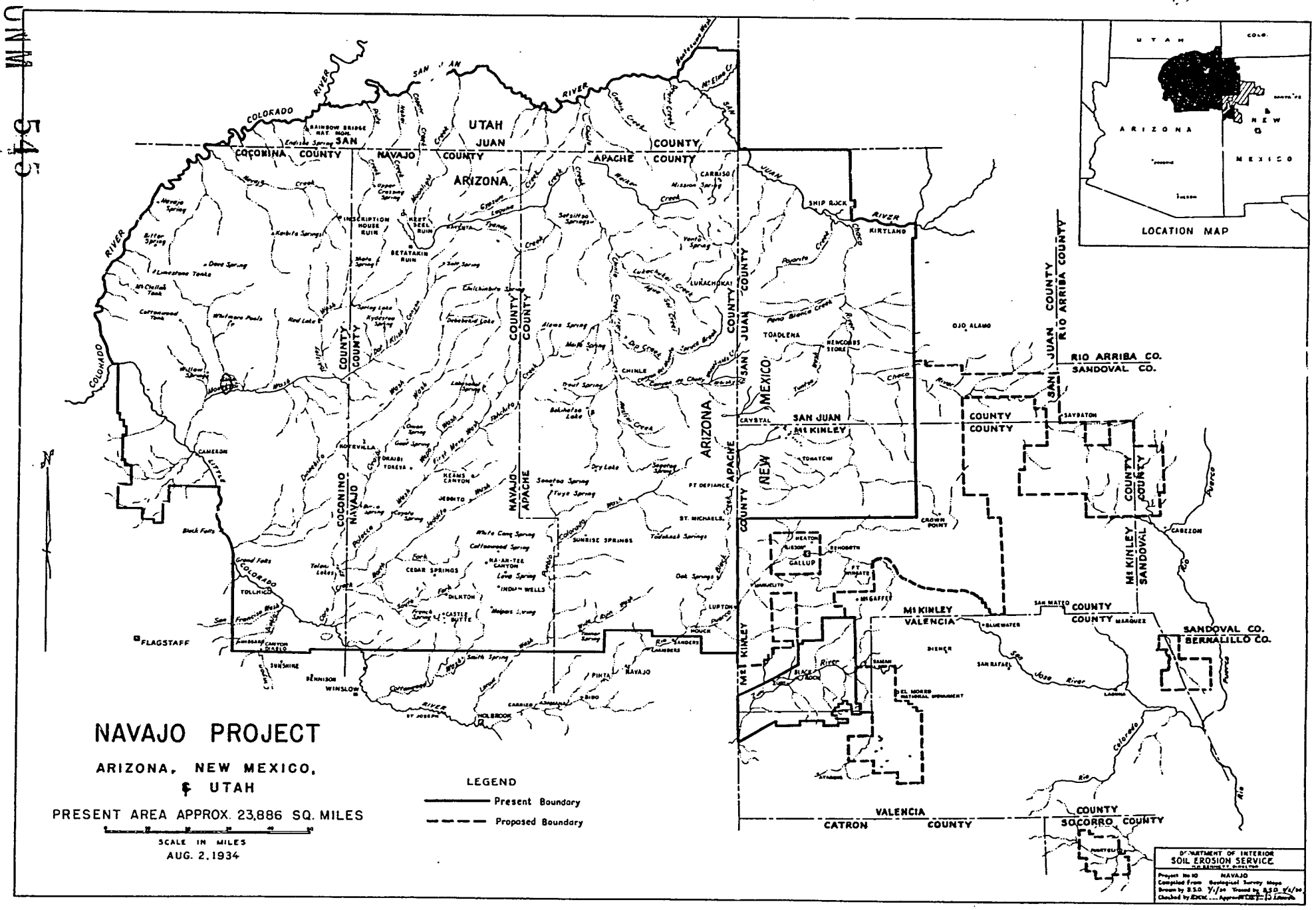

NN005500

REPORT OF SOIL AND WATER ON
PROPOSED AGRICULTURAL AREA
MOHAVE DEMONSTRATION AREA.

General.

The soils of this area are almost entirely alluvial resulting from outwash materials from the adjacent sandstone uplands. The resulting soils are mainly fine sandy loams and loamy fine sands. The much folded Navajo sandstones lying to the north act as a water reservoir. The water which falls as rain slowly percolates through the sandstones strata finally appearing as seeps and springs along the escarpment wall. The percolating waters dissolve the soluble salts from the sandstones and shales, these salts appear in seep spots as salt incrustations. The open structure of the soils included within the agricultural area, however, makes possible the use of this water with very little danger if proper irrigation methods are used.

Soils.

The soils included within the agricultural area as outlined by Mr. Quate were formed by a gradual accumulation of outwash materials from the adjoining uplands. The soil profile is quite homogeneous. Only minor textural differences were encountered in the borings. Mr. Quate's plans call for a maximum cut of 18 inches in levelling and terracing. Recent alluvial soils formed under arid conditions have not been subjected to weathering, therefore, they do not have the sterile subsoil that one would encounter in older soils, or soils formed under humid conditions. Fifty borings were made within this area and no clay or sterile sands were encountered. Due to the open structure aeration progresses to great depths in arid soils. In view of these findings, levelling to the required depth will have no appreciable effect upon the fertility of the soil. The map which is enclosed with this report shows the location of borings and the textural log of each hole.

Water.

Water for irrigation will be developed largely from springs. Salt analysis of these spring waters are given in the following table:

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These analysis by J. F. Breazeale, Arizona Experiment Station.

Lab. No.	37	38	39	40	41	42	43	44	45	46	47	48
								L-4	L-10	S-1	T-1	
Field No.	M-7	M-8	M-9	M-12	V-1	V-2	V-15	L-9	L-15	S-6	T-2	K-17
Total Salts	196	177	188	323	238	330	311	487	568	250	180	153
Calcium	22	22	22	30	15	15	37	67	67	30	30	15
Magnesium	4	4	4	7	tr	tr	10	15	19	7	7	tr
Sodium	21	36	30	21	88	85	53	74	83	37	16	18
Carbonates	24	53	25	19	84	50	17	23	17	22	24	17
Bicarbonates	104	41	76	97	59	88	85	85	183	103	66	73
Chlorides	16	16	14	16	38	72	74	140	114	34	22	20
Sulphates	5	5	5	35	34	20	35	84	85	15	13	10

All these samples contain Carbonates or Black Alkali, the amounts, however, cannot be considered dangerous on the sandy soils found on this area. Water of this class while not the most desirable for irrigation may be safely used if precautions are taken to prevent the accumulation of salts. These precautions are: (1) selection of soils with open subsoils. (2) Flood irrigation using sufficient water to keep the salts moving downward. This means that soils with poor under drainage must be avoided.

The lower safety limit of this area is outlined on the accompanying sketch map. The diagrammatic soil section illustrates the occurance of silt lenses and clay substratum along the outwash fan(see map for section included.) When this area is put under irrigation there will be a tendency for the water table to rise, this will be especially true where the sandy soils are underlain by impervious clays. The ascending waters bring the dissolved salts to the surface where they are accumulated as the water evaporates.

The working plan as outlined by Mr. Quate calls for planting seeps to trees. Such plantings are foredeemed to failure. The salts carried in solution by the seepage waters will tend to concentrate in these areas - only plants of a hight salt tolerance will have any chance of survival. Qualitative tests have shown a predominate of sodium salts in these seepage waters.

Structures.

The reservoir site was investigated thoroughly with regard to soil texture and reaction. The dam site proper was sectioned to a depth of 21 feet. The accompanying textural log shows the findings. Alkali conditions very similar to those encountered at The Cove Demonstration Area were found here. Tunnelling and subterranean erosion is very much in evidence at the site selected. A 7 foot boring in the arroyo bed at the dam site shows that the underlying stratum consists of a porous sand. The water table was encountered at 19 feet below the surface proper. Loss through seepage will probably run quite high because of the sand underlying the arroyo bottom. Alkali tests were made upon the materials that are to be used for making the fill. The salt concentrations run quite high (see analysis of samples 4-5-6). The materials consist largely of fine sand, sand and gravel with very little

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binding material. The suggestion was made to Mr. Quate that some form of cut-off well be included in his plans. In view of the fact that this will be a permanent storage reservoir, it will be well to plan a structure that will withstand these unfavorable conditions.

In discussing his plans, Mr. Quate said that he had included within his plans certain methods of controlling the small sand dune in the canyon above the dam site. He was of the opinion that much of the sand washed down by the stream came from this source. Our inspection leads us to believe that the principal source of sand is an old lake bed through which the stream cuts. Seepage and side erosion is responsible for much of the remaining sediments. In view of these findings construction of terraces and wind fences in this small dune area are hardly justified.

A study of the canyon flood indicates that run-off from the mesa is very low. There are no indications of recent severe cutting. With the exception of a few overfalls the bottom of the drainage way is well protected by vegetation. The folded sandstones and sand dunes of the mesa surface take care of most of the rain water, by absorption. There seems to be no need of structures above the canyon.

The extension or development of additional agricultural areas should be made only after a careful and detailed study of the proposed areas. Only soils well adapted should be selected as the land supply far exceeds the available water supply.

M. R. Isaacson.

Comments:

In the case of water represented by samples 38 and 42 the need for unusual care in using this water for irrigation needs to be strongly emphasized. The water should always be used in larger quantities, so as to maintain a constant leaching action through the soil. It would be a safe procedure to reduce the duty of this water by at least two times. That is, assuming a drop duty of one acre foot during the irrigation season, the duty could well be reduced to two acre feet. No attempt should be made toward any agricultural development below the safety limit shown by Mr. Isaacson. The water-table along the safety limit is already high and, with the proposed change in irrigation practices, there will be some tendency toward a rise in the underground water level. If this develops and if the local topography permits, it will be well to consider reducing the level of the water by means of some type of drain.

A. T. Strahorn.

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LOG OF TESTS HOLES FOR MDENAVE
DEMONSTRATION AREA DAM SITE

Sample Number	Depth in Inches	Texture	Alkali P.P.M.	Notes
1	0-12	Loamy fine sand	770	
	12-24	"	4600	Slight compaction at 13" to 1[illegible]
	24-36	"	4400	Compaction starts at 33"
	36-48	compacted find sandy loam	3550	
	48-60	"	2650	
	60-72	fine sandy clay	3550	
	72-84	"	3400	
2	0-12	fine sand	850	
	12-24	fine sandy loam	1500	
	24-36	loamy fine sand	1400	
	36-48	fine sandy clay	1380	compaction starts at 45"
	48-60	fine sand	1120	compaction ends 51"
	60-72	fine sand	1050	
	72-84	fine sand	1480	Visible accum. of salt contains some clay
3	0-12	fine sandy loam		Compact
	12-24	"		"
	24-36	"	No	"
	36-48	"	Alkali	"
	48-60	"	Samples	"
	60-72	"	Taken	Salty layer
	72-84	"		
	84-96	"		
	96-108	"		
	108-120	"	See	Gravels at 113"
	120-132	gravelly fine sandy loam	Samples	Cemented
	132-144	"	Land 2	"
	144-156	fine sandy loam		less compact
	156-168	"		"
	168-180	fine sand	2000	no compaction
	180-192	"	1500	"
	192-204	"	1180	"
	204-216	"	900	"
	216-228	"	720	wet
	228-240		200	no compaction
	240-252*		No sample	Excessive water
4	-0-2 *		3700	Fill materials dum- fine sand and gravel-
5	2-8"*		6200 1400	contains very little binding materials.
6	8-12"*			

*Composite Samples.

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FIELD NO.	MAP NO.	DEPTH IN INCHES	TOTAL SALTS P. P. M.	TEXTURE
7	7	0-12	1400	fine sandy loam
		12-24	1300	"
		24-36	1070	loamy fine sand
8	8	0-12	470	fine sandy loam
		12-24	600	"
		24-36	900	"
9	9	0-12	800	"
		12-24	1090	"
		24-36	700	loamy fine sand
10	10	0-12	200	fine sandy loam
		12-24	840	"
		24-36	900	loamy fine sand
11	11	0-12	800	fine sandy loam
		12-24	1000	"
		24-36	1060	"
12	12	0-12	1020	"
		12-24	1090	loam
		24-36	1520	fine sandy loam
13	13	0-12	1100	fine sandy loam
		12-24	1800	"
		24-36	1460	loamy fine sand
14	14	0-12	1000	fine sandy loam
		12-24	1300	"
		24-36	1350	sandy clay
15	15	0-12	200	loamy finesand
		12-24	600	"
		24-36	200	"
16	16	0-12	300	loamy sand
		12-24	800	fine sandy loam
		24-36	1100	loam
17	17	0-12	750	loamy fine sand
		12-24	1020	"
		24-36	1350	fine sandy loam
18	18	0-12	1100	loamy fine sand
		12-24	4000	fine sandy loam
		24-36	4400	"
19	19	0-12	820	fine sand
		12-24	820	fine sandy loam
		24-36	780	"
20	20	0-12	700	"
		12-24	350	loamy fine sand
		24-36	1020	fine sandy loam
21	21	0-12	1200	fine sandy loam
		12-24	1280	fine sandy loam
		24-36	1350	"
22	22	0-12	1700	"
		12-24	960	"
		24-36	1100	"

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FIELD NO.	MAP NO.	DEPTH IN INCHES	TOTAL SALES P.P.M.	TEXTURE
23	23	0-12	600	loamy fine sand
		12-24	740	fine sandy loam
		24-36	840	sandy clay loam
24	24	0-12	840	loamy fine sand
		12-24	500	loamy fine sand
		24-36	-200	fine sand
25	25	0-12	710	fine sandy loam
		12-24	-200	loamy fine sand
		24-36	300	fine sandy loam
26	26	0-12	-20	loamy fine sand
		12-24	950	loamy fine sand
		24-36	660	fine sandy loam
27	27	0-12	-200	loamy fine sand
		12-24	-200	fine sand, loam
		24-36	-200	loamy fine sand
28	28	0-12	-200	loamy fine sand
		12-24	-200	fine sandy loam
		24-36	-200	"
F	29	0-12		fine sand
		12-24		loamy fine sand
		24-36		"
A	30	0-12		fine sand
		12-24		"
		24-36		loamy fine sand
B	31	0-12		fine sand
		12-24		fine sand
		24-36		loamy fine sand
		12-24		fine sand
		24-36		loamy fine sand
C	32	0-12	1260	fine sandy loam
		12-24	550	loamy fine sand
		24-36	-200	"
D	33	0-12		fine sandy loam
		12-24		fine sandy loam, heavy texture.
		24-36		"
E	34	0-12	400	fine sandy loam
		12-24	3000	silt loam
		24-36		
2-L	35	0-12	-200	fine sandy loam
		12-24	520	"
		24-36	-200	loamy fine sand
		36-48	-200	"
3-L	36	0-12	-200	fine sand
		12-24	730	"
		24-36	500	"
4-L	37	0-12	-200	loamy fine sand
		12-24	-200	"
		24-36	-200	"
		36-48	-200	fine sand
29	38	0-12	-200	loamy fine sand
		12-24	200	"
		24-36	400	fine sandy loam

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FIELD NO.	MAP NO.	DEPTH IN INCHES	TOTAL SALTS P.P.M.	TEXTURE
30	39	0-12	2750	loamy fine sand
		12-24	5600	fine sandy clay
		24-36	1600	fine sandy loam
		36-48	880	fine sand
		48-60	300	"
		60-72	1360	"
5-L	40	0-12	-200	"
		12-24	-200	"
		24-36	1250	"
		36-48	1350	loamy fine sand
31	41	0-12	840	loamy fine sand
		12-24	1920	fine sandy loam
		24-36	2450	fine sandy clay
32	42	0-12	-200	loamy fine sand
		12-24	-200	fine sandy loam
		24-36	-200	"
		36-48	450	loamy fine sand
		48-60	1200	loamy fine sand
		60-72	1300	fine sandy loam
		72-84	1300	fine sandy clay
33	43	0-12	5200	loamy fine sand, 6" clay
		12-24	6400	6" fine sandy loam
		24-36	3100	
34-	44	0-12	.01440	fine sandy loam
		12-24	.03600	clay
		24-36	650	clay
		36-48	1500	fine sandy clay
		48-60	1120	"

REPORT OF SOIL AND WATER
LITTLEFIELD SUB-AREA
MOENAVE DEMONSTRATION AREA.

Soil conditions at Littlefield are almost identical with those discussed in the Moenave report. Wind erosion has built up dunes which will necessitate deeper cuts and fill-in terracing. The mode of formation of these dunes however, will probably obviate any danger from sterile subsoils. This, however, does not apply to the dunes consisting primarily of sand lying directly west of the agricultural area as outlined by Mr. Hunter(See map).

Water samples No. 44 and 45 are a composite of the springs(see Moenave report) which will be used to irrigate this area. The total salts run somewhat higher than the irrigation waters used at Moenave, this, however, does not make them inferior since the soluble calcium runs quite high. This will tend to counteract the effects of the carbonates or Black Alkali. Examinations of arroyo cuts indicate sandy soils to a depth of at least 20 feet. Precautions must be taken in irrigating to prevent the accumulation of salts. The water must not be spread too thin. The planting of trees in seepage spots is not recommended.

M. R. Isaacson.

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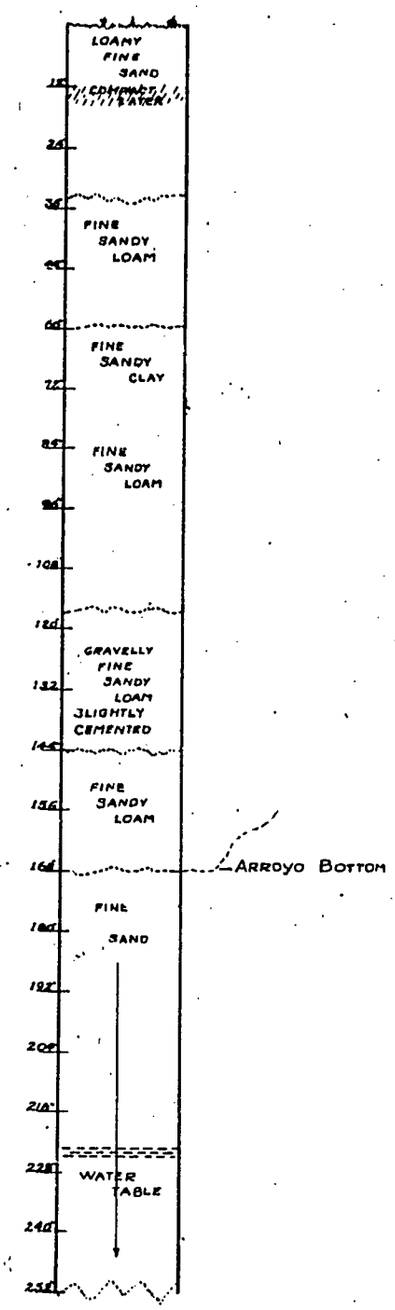

VERTICAL PROFILE
DAM SITE

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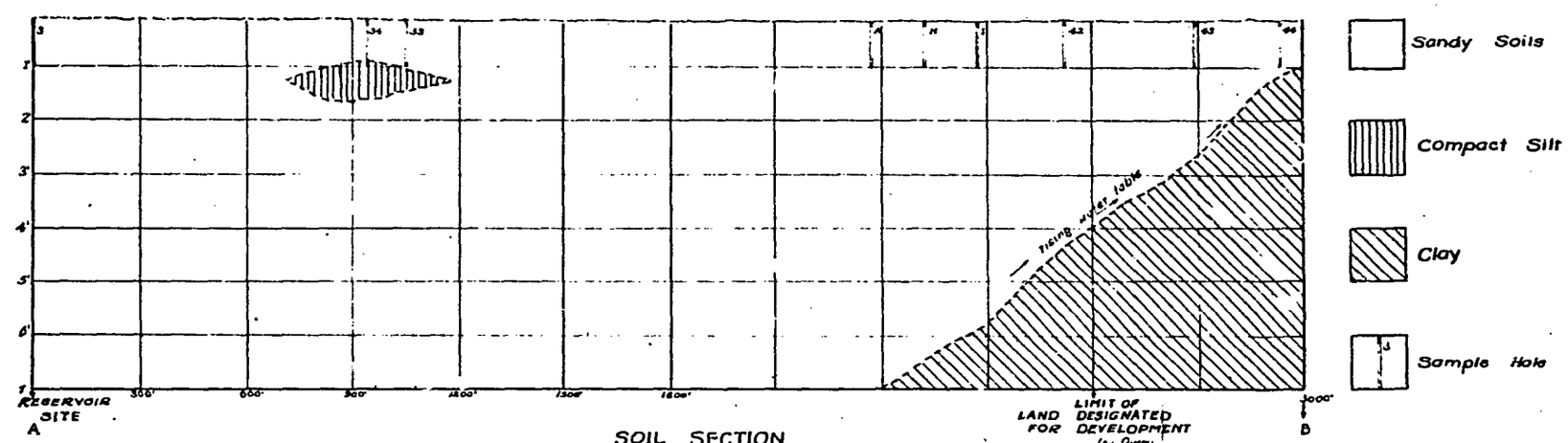

SOIL SECTION
(See Map)

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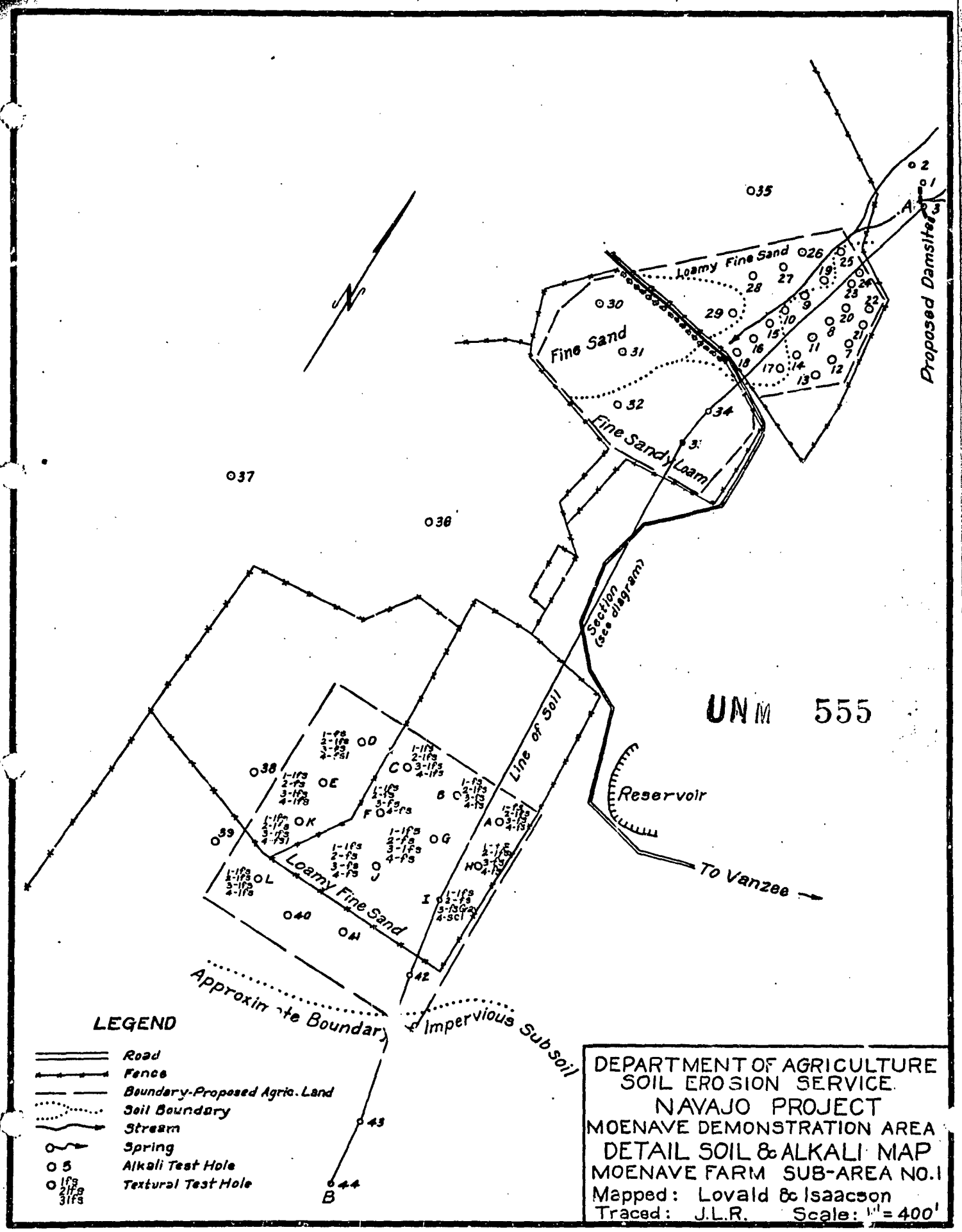

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DEPARTMENT OF AGRICULTURE
SOIL EROSION SERVICE
NAVAJO PROJECT
MOENAVE DEMONSTRATION AREA
DETAIL SOIL & ALKALI MAP
MOENAVE FARM SUB-AREA NO. 1
Mapped: Lovald & Isaacson
Traced: J.L.R. Scale: 1" = 400'