RECONNAISSANCE

SOIL AND EROSION SURVEY

TOLANI LAKES AREA

NAVAJO DISTRICT - SOUTHWEST REGION

1936

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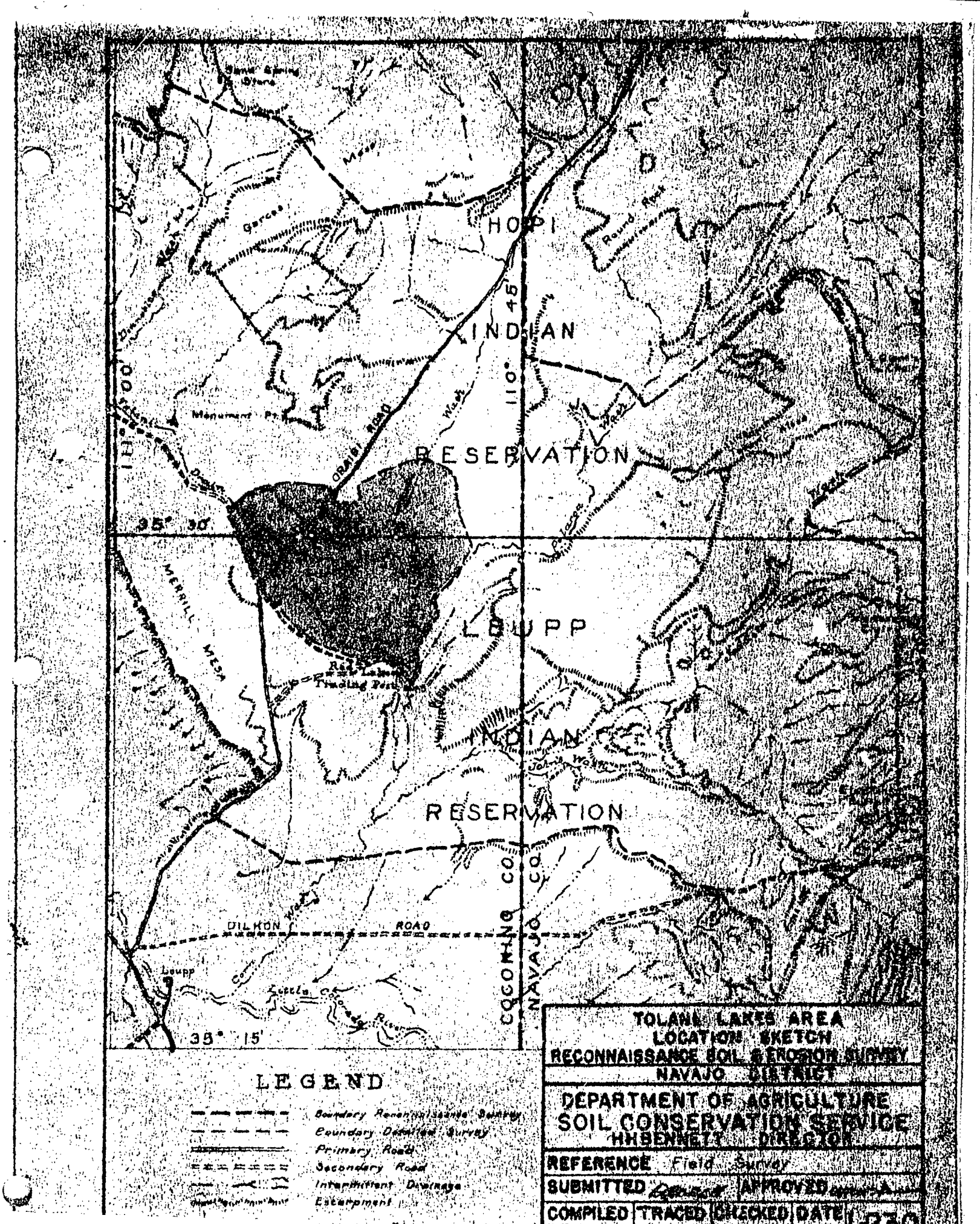
HOPI
INDIAN
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MERRILL MESA
Monument Pt.
Round Rock
Trading Post
DILKON ROAD
Leupp
Little Colorado River
COCONINO CO.
NAVAJO CO.
35° 30'
35° 15'
110° 45'
LEGEND
Boundary Reconnaissance Survey
Boundary Detailed Survey
Primary Road
Secondary Road
Intermittent Drainage
Escarpment
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TOLANI LAKES AREA
LOCATION SKETCH
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THE TOLANI LAKES AREA

The Tolani Lakes Area lies 30 miles north of Winslow, Arizona, partly in Coconino County and partly in Navajo County, both in northeast Arizona. It is readily accessible via the Oraibi Road which connects with U. S. Highway No. 66 at Moqui or Leupp Corner, 10 miles west of Winslow. The Red Lakes Trading Post is located near the southwest central portion of the area. Approximately 576 square miles were included in the original reconnaissance survey, but only 514.45 square miles or 329,248 acres are included in this survey, or just that land lying within the jurisdiction of the Leupp Chapter. Slightly more than 268 square miles are located on the Hopi Indian Reservation.

The boundaries roughly coincide with those of the Red Lakes Chapter except where modified by priority rights which are recognized by Navajos and Hopis alike. Natural boundaries for the most part define the area. They do not follow surveyed lines, although such boundaries have been established in the past. Old maps show that the boundary between the Leupp Indian Reservation and the Hopi Indian Reservation is located on longitude 35° 30' north. Red Lakes Chapter also includes additional lands west of 111° W latitude on the Western Navajo Indian Reservation, but this area is not included in the survey.

In outline the area is very irregular. It is about 35 miles long and varies from 12 to 25 miles in width. The western boundary is delineated by latitude 111° west and the rim of Merrill Mesa, a cuesta running in a southeasterly direction. The eastern boundary extends to the base of Montezuma's chair and Elephant Butte, two volcanic plugs standing 5.5 miles apart and one-half mile west of latitude [illegible] 30'. Elephant Butte, the southmost, is located 7 miles north of longitude 35° 15' north. The northern boundary is roughly outlined by portions of Carces Mesa, Tovar Mesa, latitude 110° 45' west and arbitrary connecting lines between these physiographic features. The south boundary is sharply defined for part of the distance by the cuesta south of John's Wash and arbitrarily limited by a line drawn around the base of the front slope extending south to the middle of Quadrangle 18.

The axis of the Tolani Lakes area lies in a northwest-southeast direction. Five washes enter the area from the northeast. They are, in order from west to southeast: The Dinnebito Wash, the Oraibi Wash, the Polacca Wash, the Jeddito Wash and John's wash. The three latter washes enter a common drain near the midpoint of the southern boundary and continue to the Little Colorado River as Corn Wash. The Jeddito Wash, together with a tributary arising in the east end of the area, enters John's Wash six miles below their junction. The confluence of John's Wash and the Polacca Wash is six miles below this one and marks the head of Corn Wash.

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The Dinnebito Wash traverses the area for a distance of approximately 12.4 miles from the extreme northwest end of the area to near the midpoint of the west end. The drain rising near the Tolani Lakes, and herein referred to as Tolani Drain for the sake of convenience, traverses the area in an almost true northwest direction for about eight miles, intersects the western boundary four miles north of 35° 30' north latitude and enters the Dinnebito Wash approximately two miles west of the area. Another drain also arising near the present lakes runs into the Polacca Wash 1.5 miles east of the Red Lakes Trading post. It is generally conceded to be a continuation of the Oraibi Wash.

The Oraibi Wash traverses the area in a S-SW direction to a point five miles north of the Red Lakes Trading Post where a dam diverts the flow west to the present Tolani Lakes. When the dam is removed the floods flow southward to the Polacca Wash.

The Tolani Lakes lie at the southern extremity of the Oraibi Wash in the trough formed by a series of highly dissected mesa escarpments and the back slopes of the cuesta that forms the south boundary of the area. The back slope has an estimated average slope of four percent and a width ranging from 3.5 to 5 miles. It extends to the south and southwest to the upper cuesta which has a southeast to east trend. The cuesta gradually loses its identity as such and becomes an escarpment severly eroded and dissected near the east side of Quadrangle 64 where it joins the escarpment of Ives Mesa. Both John's Wash and the Polacca Wash as well as a small ephemeral wash arising in a wind gap near the Oraibi Road dissect the cuesta in Quadrangle 18.

The lakes are shallow and obviously the last of a series of old lakes which are now completely silted. It has been estimated that there were 200 or more lakes in the Tolani Lakes locality at various times. At present, about five remain, four of which are little more than seasonal ponds.

All the runoff, not impounded by natural or artificial basins, from the back slope on the south and from the escarpments, talus slopes and saccaton flats north and west of Monument Point, flows into the Tolani Drain and thence into the Dinnebito Wash. One wash drains a considerable area of bare rock and shallow soil located between Monument Point and Garces Mesa. It fans out to form wide saccaton and chamisa flats adjacent to the Tolani Drain.

The Dinnebito Wash is intermittent but flows from the rainy season until early summer. That part of its drainage system lying within this area is less extensive than that of other washes and it is bounded on either side by severely eroded mesa escarpments and benches. The valley floor is narrow, a characteristic common to other washes in the region.

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Extensive clay flats are located on both sides of Oraibi and Polacca Wash, while a low mesa remnant lies between them and projects into the Tolani Lakes area some five miles as a flat ridge. A hilly dissected and irregularly eroded series of small ascending bench remnants separates the Polacca and Jeddito Washes. Clay flats extend east of Jeddito Wash to the foot of colluvial or residual slopes dissected by narrow, elongate mesa remnants radiating from the base of Montezuma's Chair. The southern limit of these flats is marked by the foot of the back slope rising to the north rim of John's Wash. This back slope ranges in width from 2.5 miles at the west end near Jeddito Wash to a very narrow strip at the east end near the Dilkon Road.

Jeddito Wash overflows its banks during the flood and spreads out on the north portion of the clay flats in Quadrangle 64. Flood waters rising in the upper reaches of the Jeddito overflow these flats only at rare intervals following periods of heavy precipitation. The course of Jeddito Wash is lost on the flats but is renewed in the tributary which drains that portion of the saccaton flats lying west of Elephant Butte.

The upper three-fourths of John's Wash is very narrow. It is located in the trough at the base of the back slope which is an extension of Ives Mesa. The extreme eastern section of this back slope is severely eroded and dissected by a network of small gullies. Two springs are located at distances of 7 and 9.3 miles east of the confluence with the Jeddito Wash.

Wide clay flats, bounded on either side by steep rocky slopes, extend on both sides of the Polacca north to its confluence with the Oraibi Wash.

Agriculture of the Tolani Lakes Area

Livestock production is the most important phase of agriculture in the Tolani Lakes area. Sheep, goats, cattle, and horses are raised, but here, as in all other parts of the Navajo Indian Reservation, the number of sheep far exceeds the combined number of all other classes of livestock. Part of the flocks are sold at the trading posts and most of the remaining annual increase is consumed by the families. This class of agriculture is credited with having made one Indian, Big Belly by name, worth some $10,000, according to information secured from personnel of the Leupp Indian Reservation. Most of the annual increase in beef cattle, which incidentally is generally of poor to fair quality, some wool, pelts, blankets and allittle jewelry are sold to further supplement the cash income of the people.

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Crop production is of minor importance and is confined to those localities most easily irrigated by flood water. Indian corn, a floury, vari-colored variety of maize, watermelons, squashes and gourds are commonly grown on the lighter-textured soils. Attempts to grow alfalfa in the area have been fruitless in most instances because of the seasonal flow of water. The most extensive farming areas are subject to annual overflows of flood water with their accompanying deposits of silt which smothers the crop.

Fifty farmers cultivate from one to twenty-two acres apiece in the area. Twenty one plows, 43 hoes, and two one-horse cultivators were included in the equipment located on the area. It is significant to note that both cultivators and two of the plows were found on farms situated on the highlands, one being on the back slope of Merrill Mesa and the other on a farm north of Monument Point. Two factors contribute to this shortage of cultivators on the area. First is the fact that some of the soils formsa "pavement" too hard to cultivate or for weeds to grow in. The other is that horse power cultivation is not common, because custom prohibits the use of modern cultural methods in raising corn.

Cultural practices are generally conducted in a rather unorganized fashion. Plowing is not practical on the hard soils or on any of those soils subject to inundation by the Oraibi and Jeddito Washes. At planting time, a cemented block of soil perhaps 18 inches across and 5 inches thick is pried up and the corn or melons are planted in the moist soil lying beneath. Plowing is practiced on the lighter and dryer soils and it may be done at any time from late fall until just before planting time. Some farmers use harrows and others use nothing more than a light float to level the land. One man on John's wash had already floated his land in early November.

The methods of utilizing flood water for irrigation are almost as varied as there are sources of flood water. On the Jeddito Wash only that land adjacent to the wash and subject to periodic overflow is utilized. No attempt to control the water is made either there or on Hohn's wash. In contrast, the diversion dam in the Oraibi Wash may be cited. There, the flood waters are diverted westward over the lands lying east of the present Tolani Lakes one year and southward to the Pellace Wash on alternate years, while the land previously flooded is intensively farmed. Therefore, this method of land management is based upon the ability to store sufficient water in the soils one year to produce a crop the following year. Actually, this ideal practice of flooding and farming in alternate years is not strictly followed.

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A few isolated farms use all the flood water from small drains but the majority use only a part of such water. The sole attempt to use dikes or terraces is found on the west bank of the Dinnebito Wash near the north boundary of the area. Low dikes are used to impound a portion of the flood waters in a manner similar to that employed in the basin method of irrigation by white men in the Southwest. The difference is that no laterals are employed to direct the water into the basins, for the volume of flood water is usually sufficient to overflow the basins without such diversion.

Climate

The Tolani Lakes Area is situated in a semi-arid region. Summer temperatures are high and the winters are cool. Snow rarely falls in the area. Strong southwest winds prevail throughout the year.

Soils of the Tolani Lakes Area

The soils of the Tolani Lakes area are developed from two general types of materials: alluvial fill and residual material derived from the Wingate, Todilto and Chinle formations. The soils are more or less modified by wind action, resulting from a general superficial aeolian movement on all light textured soils, and to a lesser degree on all friable heavy-textured soils. All light soils commonly show wind separation of the soil separates as well as gravitational translocation of the chemical and physical constituents from the surface horizon to a lower horizon.

In general, the bottom soils are heavier than the upland soils because the streams cannot carry any great amount of the larger soil separates over the relatively flat gradients encountered

Wind action on the residual soils on mesa tops is slight, but active dunes have been built up from soil transported by wind from the lower slopes on the southwest sides of the mesas. Soils found on colluvial slopes and the flat alluvial benches between the washes are light-textured as a whole. In shallow soils the zone of illuviation is closely associated with and often lies in the weathered or disintegrated parent material known as the "C" horizon. The residual soils derived from the Chinle shales are heavy and calcareous. Most of them have been more or less subject to eolian deposition of lighter textured materials.

When interpreting the soil symbols on the map it must be remembered that the soil number and the erosion symbols together indicate the different phases of the soil types mapped. Thus:

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$\frac{11}{\substack{240 \\ H147 \\ N}}$ or $\frac{(11)240}{\substack{H147 \\ N}}$ and $\frac{11}{\substack{470 \\ H147 \\ N}}$ or $\frac{(11)470}{\substack{H147 \\ N}}$

indicate soil type 11 light phase and heavy phase respectively. The two classes differ texturally but are very similar in other respects except as indicated by erosion symbols. The parent materials of these soils range from the Todilto arenaceous limestone, through the Wingate sandstone and siltstone to the limestone of the upper Chinle formation. Despite the inherent differences of the various parent materials, the soil-forming agencies have produced soils of remarkably similar characteristics.

Farming is confined to one large area near Bolani Lakes, one on Jeddito Wash near Montezuma's chair, two small areas on John's Wash and other isolated farms in the uplands. Light clays and clay loams and the heavier loams are farmed most extensively. The heaviest soils in cultivation are dark red clay loams in the uplands and along John's Wash. Such soils are not extensively farmed, however. Gray gritty sandy loams and sandy clays with a slightly cemented surface are successfully farmed on the Oraibi and Jeddito Washes. Excellent crops are grown on silty clays and clay loams on John's Wash and the Dinnebito Wash.

The alluvial soils are composed of stratified sediments with few exceptions. Little illuviation is evident in any of these soils, but weathering is evident in the crust mulch commonly found on most of them.

As this survey is little more than a careful reconnaissance survey, no attempt is made to classify or describe the soils with the same degree if detail which would be required on an intensive survey. Rather, generalized descriptions based on information acquired during the progress of the survey are made with the object of giving a comprehensive picture of the soils extant.

A soil series represents a group of soils which differ one from another in the texture of the surface soil but have all other properties or characteristics in common, such as color, origin, chemical composition, drainage, and the same character and sequence of horizons. A soil type is a division of the series and represents a soil which has a relatively uniform texture of the surface layer, and relatively uniform profile characteristics. As is generally the case, the grouping of the alluvial soils found along the washes strains this definition, because the one outstanding characteristic of such soils is the extreme variability in the succession of color and texture of the soil strata forming the profile. A soil profile is the composite arrangement of the soil from the surface to the lowest recorded depth, usually to the parent material. Soil types are textural grades which represent arbitrary divisions of soils based upon the size of their component grains.

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Twenty two soil types are grouped into six major groups analagous to series as follows: Mesa and Upland Soils, 3 types; Flat Alluvial Slope Soils, 2 types; Back Slope Soils, 2 types; Recent Alluvial Soils, 9 types; Older Alluvial Soils, 5 types; and Rough Broken Lands, Stony Lands, Shallow Soils, 1 type.

Erosion in the Tolani Lakes Area (General)

Erosion on the mesa tops is fairly well stabilized, but along the edges and on the lower ridges where grazing is heavier all types of erosion are more severe.

Wind erosion on light-textured soils is common. Both wind erosion and water erosion are prevalent on many of the heavy soils and sheet erosion frequently follows severe wind erosion on light soils. Sheep are responsible for aggravating the wind erosion prevalent on the upland soils. A positive correlation between the rate of grazing and wind erosion indicates that controlled grazing would minimize that condition.

It is difficult to estimate the degree of sheet erosion because it is so closely associated with wind erosion. Numerous blow-out holes and strips which expose the subsoil to active sheet erosion occur on the uplands. Gully erosion is prevalent on extensive areas of such exposed subsoil. It is particularly malignant on the Chinle formation. The large washes, such as the Oraibi, show relatively slight lateral extension but they are deep. The Oraibi Wash is 80 feet deep five miles above the diversion dam, and the other washes frequently cut down to or into the geologic formations to a depth of 65 feet or more.

Little can be done to check the erosion on the rough lands. The most promising conservation measure seems to be that of spreading the runoff from such areas on the more flat alluvial slopes and saccaton flats. This procedure is recommended as being particularly feasible on the lower Jeddito Wash red clay and saccaton flats.

SOIL TYPES OF THE AREA

Upland Soils

Type 11 is the most extensive soil type in the area and is the most important from the standpoint of the grazing it affords. It is located on the mesa tops and on sloping and rolling topography widely distributed over the Tolani Lakes Area.

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The type is characterized by 2 to 28 inches of loose to firm slightly calcareous surface layer of reddish brown to light red loamy fine sand or fine to very fine sandy loam. Numerous small soft white pellicles of lime carbonate are distributed throughout the horizon below the surface mulch on the typical areas found on the mesa tops, but this feature is not common elsewhere. The subsoil consists of a 2 to 8 inch layer of light gray to grayish red, highly calcareous, compact to weakly cemented sandy clay t clay loam. This is a transition zone which becomes progressively lighter textured with depth and grades into the disintegrated parent material of the Todilto and upper Chinle formation. The layer has accumulated the chemical and physical constituents leached from the surface. Small angular rock fragments distributed in this zone are commonplace. In those localities subject to moderately severe erosion, the transformation from surface horizon to parent material is very abrupt.

Dunes and hummocks are frequent on this type, but in all localities not subject to overgrazing the plant cover is adequate to stop all active wind erosion. Sheet and gully erosion is only evident on steep and overgrazed areas.

Type 11 supports a vegetative cover consisting of such plants as Indian Rice grass (Oryzopsis hymenoides), Utah tea (Ephedra Trifurca), and yucca on the hummocks and dunes, whereas, such plants as three-awn grass (Hilaria jamsii), spiney muhley (Muhlenbergia pungens), small rabbit bush (Chrysothamnus), snake weed (Gutterezia), and a small, black sage commonly referred to as sand sage (Artemesia filifolia) in various combinations depending upon the relative intensity of the grazing practiced in the locality.

Type 30 is derived from a combination of alluvial and eolian deposits and is most extensive on the slopes falling away from Tovar Mesa. Wind deposition has played a strong part in creating the light-textured surface layer. It is the second most extensive type exclusive of the rough broken lands.

Type 30 consists of 4 to 24 inches of light reddish brown to light chocolate red, loamy fine sand to fine sandy loam. It is underlaid by a deep layer of more compact, massive, slightly calcareous, darker colored fine sandy loam becoming progressively heavier to an average depth of 36 inches. Below this depth, it becomes lighter-textured until it encounters the residual sandstones and siltstones of the Wingate formation.

Plant cover on this type includes galleta grass, yucca, Utah tea and scraggy atroplex which grow on the heavier soils. Sand sage replaces yucca and Atroplex on the light-textured phase of this type. Type 30 affords a good grazing and is potentially a good grass soil.

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Type 38 is distributed on gently alluvial slopes north of the Tolani Lakes and to allimited extent east of the Jeddito Wash. It is the third most extensive soil type in the Tolani Lakes Area.

This soil is characterized by a loose, calcareous, 4-inch surface layer of light red fine sandy loam underlaid by compact, slightly cemented, reddish fine sandy clay loam which grades into a reddish find sandy loam at an average depth of 14 inches. The lime content decreases from 14 to 42 inches. The loose surface find sandy loam is completely blown off in some places. Such areas have been mapped 74G wherever 50 percent or more of the surface has been removed.

Russian thistle (Salsola pestifer) and chamisa (Atroplex canescens) constitute the major portion of the vegetative cover. The type is of little value for grazing and of no value for cultivation.

Type 33 is more subject to sheet erosion than the other two upland soils.

Backslope soils

Type 20 is confined to the back slope extending north from John's Wash and, therefore, one of the less extensive types. It is a residual derivative of the Chinle formation.

The surface soil of type 20 consists of a calcareous, light red, friable, clay having an imperfect block structure to a depth of 8 inches. A very thin surface crust-mulch not more than an inch thick is common. Underlying this surface soil to a depth of 38 inches is a compact, massive, more calcareous, light red clay with the middle third of the horizon impregnated with angular limy rock fragments. Below 38 inches is a layer of very pale brick red to grayish yellow, friable, highly calcareous clay intermixed with angular limestone fragments. This zone is impenetrable with the soil auger. The entire horizon is more calcareous than that of the other soils in the immediate vicinity. A high salt content is indicated by the shadscale (Atroplex cumcata) and sacaton (Sporobulus airoides) type vegetation.

Limited grazing is afforded on the type and little more productiveness is to be expected because the soil is relatively shallow and the slope is too great to permit flooding if water were available. Some gully and sheet erosion is found on the type.

Type 21 occurs only in certain parts of the backslopes which are subject to eolian deposits of light texture. The residual clay subsoils are from the Chinle formation. Only 1,440 acres of this type were mapped. It is a soil producing considerable grazing, however.

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Type 21 has a surface layer of light red, less to firm, slightly calcareous, sandy loam 13 inches deep underlaid by 17 inches of pink highly calcareous, very hard, blocky, residual sandy clay which is plastic when wet. The clay grades into a highly calcareous, stony, light-blue to lavender-mottled clay of similar character.

Balleta grass, Indian rice grass, alkali saccaton, salt grass (Distichlis spicata) and cutteresia together with occasional tamarisk and Chrysothamnus compose the plant cover of this type.

All classes of erosion are slight on Type 21.

Flat Alluvial Slope Soils

Type 41 is most commonly distributed over the area extending north from Tolani Lakes. Hard-surfaced flats have little vegetation on them other than scattered hummocks of saccaton. In all, 7.72 square miles of this type were mapped, Some grazing is afforded by the more friable classes in this type. But as a whole it does not compare favorably with the preceding types.

The surface 6 inches on typical areas of Type 41 consists ofa loose, highly calcareous, reddish fine sandy clay to sandy clay loam containing a number of small lime carbonate particles. The subsurface layer consists of 4 to 8 inches of hard, compact, highly calcareous, sub-angular to irregularly cubed, chocolate-red to light red sandy clay or fine sandy clay loam grading into the subsoil at a depth of 13 to 16 inches. The subsoil consists of a slightly calcareous, moderately compact, light-textured, reddish-yellow or yellow fine sandy loam which continues to a depth of 42 inches or more.

Barren flats on this soil type do not have the loose surface layer and are generally subject to sheet erosion. Soils on such flats have a slightly higher salt content, but none exceeds 0.148 percent.

The friable classes have a plant association of three-awn grass, Indian rice grass, shakeweed and scattered chamisa.

The type is not adapted to cultivation.

Type 42 is confined to local depressions and flat or nearly level localities widely distributed in the Tolani Lakes area. It is less productive than Type 41. 8.84 square miles of the type are found in the survey.

Type 42 is characterized to a depth of 18 to 40 inches by a calcareous, slightly cemented surface layer of crumb to sub-angular, light red to chocolate-red clay or fine sandy clay loam which has a crumb or sub-angular structure becoming more friable with depth. The edges of the fractures appear sandy. A loose surface crust mulch is developed in the localities least subject to erosion. White lime carbonate pellets occur in the profile in poorly drained localiteis. On

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well-drained areas chocolate-red silty clay and silty clay loam strata are encountered in the profile below a depth of 18 inches.

Some sheet erosion is evident on the type because the surface is generally more or less impervious to water. This feature is governed largely by the class of clay separates constituting the surface layer and the amount of salts present.

Type 42 has virtually no vegetation growing on the poorly drained localities but large alkali saccaton hummocks are found on the better drained areas.

The type is unsuited for agricultural purposes, as it is too heavy and intractable.

Recent Alluvial Soils

Type 35 is one of the most extensive types in this group of soils. Although it affords some grazing it is one of the most worthless in the area.

Type 35 is composed of river wash. The light classes are subject to wind erosion.

Certain limited areas located on the arroyo fans have soils suitable for farming.

Vegetative cover, if any, consists of Russian thistle and chamisa.

Type 51 embraces only 7.74 square miles and is distributed principally along the Orcibi and Polacca washes.

The type is characterized by a loose, granular, calcareous, light brown and reddish brown to chocolate brown clay or clay loam layer 4 to 6 inches thick. The subsoil consists of more compact and calcareous, sub-angular or blocky to massive, reddish brown to chocolate colored clay or sandy clay loam which continues to a depth of 42 inches or more. Occasional very thin strata of gray clays are encountered at various depths below 6 inches. The clays are very sticky when wet.

Erosion on this type is slight.

The sparse plant cover consisting of Russian thistle, scrubby chamisa and greasewood and an occasional clump of saccaton is insufficient to be of great value for grazing. The soil is too heavy to be placed under cultivation.

Type 52 consists of 5 to 12 inches of calcareous, granular or platy, friable, gray clay which becomes more compact with depth. It is underlaid by a stratified series of more compact blocks that are reddish brown calcareous clay loam, or reddish brown to pink massive

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blocks of fine sandy loam or loamy fine sand of no regular order of thickness. Sandy loams displace the clays in the subsoil as the alluvial slopes along the flood plains are approached. The thin strata of both clays and sandy loams in the subsoil are at times weakly cemented.

Russian thistle and saccaton grow on the areas having a shallower surface layer of gray clay, whereas chamisa replaces saccaton on those having deeper surface layers of gray clay.

Type 53 is distributed along either side of the Jeddito Wash. Only 0.56 square miles are mapped. It is important because it is one of the farming types.

Type 53 consists of an 18 inch surface layer of calcareous, gray, coarse sandy clay loam or sandy loam. The surface soil is underlaid by thinly stratified layers of brown clay, gray clay, gray silty clay, gray clay loam, chocolate-colored clay and very friable, light-red fine sandy clay. A thick bed of massive, friable, light-red, fine sandy clay occurs at an average depth of 36 inches.

The type is frequently flooded and some of the area has been subject to floods of sufficient severity to wash out the crops then growing on it.

Saccaton and Russian thistle are dominant on the lighter classes in this type, and chamisa is dominant on the heavier soils.

Type 54 is the most extensive of the Recent Alluvial Soils. It occupies an area of 12.7 square miles.

The type is characterized by a 3- to 39-inch surface layer of granular or platy, pink to light reddish-green clay or sandy clay which becomes more compact and blocky with depth. It is underlaid by gray to grayish yellow, hard, dense clay w to 16 inches or more thick. The whole horizon is calcareous.

Type 54 is strictly non-agricultural, but some grazing is afforded by the plant cover. Galleta grass, saccaton and chamisa grow on the light classes; saccaton, greasewood and Russian thistle on the heavy soils.

Type 55, which covers 7.28 square miles, is confined to the area north of the confluence of John's Wash and the Polacca and east of the Polacca Wash. It is of very little value either for grazing or farming.

The surface layer of type 55 is a loose, gray, calcareous, wind-blown clay loam to a depth of 8 inches. It becomes weakly platy and faintly stratified with thin, reddish brown strata of the same texture at 4 inches. On superficial examination the surface layer of

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clay loam generally appears to be sandy and readily forms small dunes and hummocks. From 8 to 15 inches the profile consists of weakly cemented fine sandy clay loam which shows cross-bedding due to wind action. A layer of gray, hard, platey clay which breaks readily into irregular cubes 2 to 4 mm. on a side underlies the clay loam to a depth of 22 inches. Below this is a 7-inch layer of massive, reddish brown, sandy loam with weak vertical cleavage. The next 29 inches is a compact, dark gray clay which develops a poorly defined nut structure and vertical banks when exposed in washes.

An alluvial fan consisting of lighter-textured soils has been farmed within the last few years but is not at present under cultivation.

Natural vegetation on Type 55 consists of extensive areas of Russian thistle with greasewood and chamisa growing near the washes and in the lesser drains.

Type 56 is one of the most extensive types of the Tolani Lakes area although it occurs only on the flats east of the lower Joddito Wash.

Type 56 is characterized by 24 inches of grayish red calcareous granular to compact clay underlaid by 18 inches of calcareous, reddish fine sandy clay grading into red sandy loam at a depth of 42 inches. At varying depths below this, altern te thin strata of brown, waxy and plastic clay, and hard, angular, red clay occur in the sandy loam.

Chamisa and greasewood growing to a height of 30 inches furnish some grazing on this type.

Type 57 comprises 5.57 square miles of the area along the Pelanoa Wash near the base of the hills. It is of value only for the limited amount of grazing that it affords.

The surface layer of Type 57 to a depth of 6 to 28 inches consists of loose to semi-flaky, calcareous, slightly blocky, red clay or sandy clay which grades into an underlying layer of massive reddish brown sandy loam at a depth of 26 to 42 inches. In certain small localities subsurface mounds of residual shinle clays merge with the subsoil at varying depths below 30 inches.

These latter areas bear a plant cover consisting of galleta grass, artemisia, Russian thistle and scraggy Atreplex. The more extensive areas underlaid by sandy soils bears a plant cover of sacaton grass, Atreplex and Russian thistle.

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Type 58 is confined to very limited areas along the Polacca Wash and is barren of vegetation.

This type is characterized by a 14-inch surface layer of stratified, hard, dark brown clay which becomes lighter-textured with depth. The subsoil is a dark olive gray clay of nut to crumb structure. The edges of fractures show a characteristic colloidal sheen. The entire horizon is freely effervescent with dilute hydrochloric acid.

Type 58 is wholly unsuited for agricultural purposes.

Older Alluvial Soils

Type 60 is typical of the alluvail soils located on the lower flood plains of Jeddito Wash and John's Wash. It is similar in some respects to type 61, also located on John's Wash, but is separated on the basis of natural vegetation and soil profile. Type 60 comprises 13.53 square miles of the flood plains.

The surface layer of Type 60 consists of 18 to 24 inches of weakly cemented, calcareous, pink to red clay with a granular crust mulch upper surface layer. The more friable classes drift readily and behave otherwise as sand when an automobile is driven over it. The subsoil to a depth of 42 inches or more is composed of a massive, calcareous, pink to red clay, and thinly stratified, very friable, pink clay and fine sandy loam strata of irregular thickness and order of occurrence. The heavy clays are very sticky when wet.

The heavy soils bear a good cover of saccaton and the lighter dune soils cover of sturdy chamisa and Russian thistley

Small gullies are cutting into the saccaton flats, but a few well-placed checks would halt head and lateral erosion and improve the saccaton pasture already available.

Type 61 is found only on John's wash where 1.68 square miles are mapped. Lighter classes in this type are farmed successfully.

Type 61 is characterized by stratified layers of friable, calcareous, red and pink fine sandy loams, loams, and silty loam alternating with strata of calcareous, floury, red clay to silty clay. The type is related to others found in the vicinity but is lighter in texture.

Most of Type 61 is well to excessively drained. Lighter classes subject to overflow are farmed and prove very fertile.

Vigorous growths of Russian thistle cover much of the loams whereas thick growths of saccaton grass cover the heavy classes.

F. W. 457

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Head erosion is threatening to ruin the largest farm on the wash near latitude 110° 45' W. At this point, Sohn's wash is approximately 30 feet deep. Wind erosion introduces a problem in land usage on the lighter soil, but is inconsequential elsewhere.

Type 62 is confined to the lower extremity of the Sohn's Wash flood plain or sacaton flat. A little over 3 square miles are mapped.

Type 62 has a 5-inch surface layer of calcareous slightly cemented, granular, red clay with a surface mulch not more than 2 inches thick which in many places has been removed by wind. The calcareous subsoil to a depth varying from 10 to 25 inches consists of yellow sandy loam thickly banded with wind-deposited, red sandy loam. This is underlaid by a 10 to 18-inch layer of highly calcareous, very hard, dense, chocolate-red clay which is stratified with very light-red, chalky clay, both of which are very sticky when wet.

Sheet erosion is common where wind has removed the superficial surface mulch.

Portions of this type could be used for farming if water were available.

Type 70 is a heavy type found on extensive flats in 17 and 18. It is a grazing type of which there is 2.29 square miles mapped.

Type 70 is characterized by 10 to 12 inches of weakly platy or compact, easily fractured, chocolate-colored very fine sandy clay with a superficial surface layer of loose, fine granular grayish chocolate-colored fine sandy loam. The fine sandy clay grades into friable, weakly stratified to platy, chocolate red very fine sandy clay loam at an average depth of 1t inches. Underlying this layer at an average depth of 36 inches is a layer of smooth, massive, friable, chocolate to red silty clay. The entire profile is freely effervescent with dilute hydrochloric acid which indicates a moderately high lime carbonate content.

Sheet erosion on Type 70 is slight to moderate and other classes of erosion are negligible.

Grazing is available on such plants as spiney muhley growing on light-textured soils and sacaton, salt grass and chamisa which grow on the heavier-textured soils of this type.

Water spreading on this type would be advantageous from the standpoint of increased grazing capacity, but the soil is not adapted to cultivation.

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Type 72 is found along the old alluvial benches on the Pelasca and Oraibi Washes and it furnishes poor grazing. It comprises an area of 4.32 square miles.

The surface layer of the type consists of loose, granular, grayish red to reddish brown fine sandy clay underlaid by more compact, blocky, gray fine sandy clay to an average depth of 16 inches. Scattered aeolian deposits of reddish, fine sandy loam occur near the adjacent hills. The subsoil consists of coarsely or finely stratified, gray to yellowish brown fine sandy clay to fine sandy clay loam. The entire horizon is calcareous.

The type is not adapted either by texture or by position to cultivation. Scraggy chamiza and Russian thistle growing on the heavier soils within type 72 constitute the only grazing available. Utah tea and sand sage grow on the lighter soils.

Rough Broken Lands, Shallow Soils and Waste Lands

Type 85 includes all shallow, gravelly soils, and steep broken lands commonly derived from the Chinle and Todilto formations. Lands of similar topography derived from the Wingate and volcanic formations are also included in this type. Scattered aeolian hummocks of light red to light brown fine sandy loam are found on the more level areas. Otherwise, heavily eroded stoney clays and clay loams of varying shades of pink to lavendar are characteristic of the type. Frequent limy, pink, lavendar and blue shales with caps and outcrops of light blue and gray limestones occur on the steep slopes and crests of the Chinle formations.

With the exception of a very limited amount of grazing type 85 is valueless. Shadscale and Alkali sacaton grow on the slopes and flats not too severely eroded. Shallow soils on alluvial flats usually support a heavier cover of sacaton.

F.W. 459

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F. W. 460

Table I - Distribution of Soil Types in the Talend Lake Area

Type No.	Quad No. 16	17 (Square Miles)	18	64	Total Sq. Mi.	Total Acres
Upland Soils						
11	33.67	56.98	38.39	68.58	197.62	126,477
30	18.83	17.72	3.17	.96	40.68	26,035
33	.54	12.85	.00	16.13	29.52	18,893
Alluvial Slope Soils						
41	.00	6.40	1.13	.19	7.72	4,941
42	.18	7.44	.29	.93	8.84	5,618
Backslope Soils						
20				4.87	4.87	3,117
21		2.25			2.25	1,440
Recent Alluvial Soils						
[illegible]	3.00	4.85	3.18	.81	11.84	7,577
51		4.09	3.65		7.74	4,953
52	1.58				1.58	1,011
53			.56		.56	358
54	1.70	11.00			12.70	8,128
55	1.29	.51	5.48		7.28	4,659
56	.41	5.33		5.29	11.03	7,059
57		3.47		2.10	5.57	3,565
58	1.51				1.51	966
Older Alluvial Soils						
60		.77	3.32	9.44	13.53	8,659
61				1.68	1.68	1,075
62			3.15		3.15	2,016
70		2.00	.29		2.29	1,465
72	1.44	2.69			4.13	2,643
Rough Broken Lands, Stony and Shallow Soils						
85	13.11	29.35	25.90	36.88	105.24	67,363
DS*		23.19 *	9.93*		33.12*	21,197*
Totals:	77.86	190.89	98.44	147.86	514.45	329,248

*DS - Detailed Soil Survey. The soils are reported in detail by Mr. R. R. Finley.

Table II - Distribution of land According to Indian Reservation

Reservation			Square Miles		Acres	
Hopi	Quad	16	77.86		49,846	
	Quad	17	190.89		122,170	
		Totals:		268.15		171,616
Leupp	Quad	18	98.44		63,002	
	Quad	64	147.86		124,292	
		Totals:		246.30		187,294

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Table III - Analyses of Certain Soils in the Tafoni Lobes Area

Sample No. (Field)	Lab. No.	Soil Type No.	Depth (in.)	Total Salts (%)	Black Alkali (%)
1A	2125	41	0 - 6	.136	Trace
	2126		6 - 18	.148	Medium
2A	2127	21	0 - 12	.078	Trace
	2128		12 - 18	.02-	Medium
3A	2129	41	0 - 6	.091	None
	2130		6 - 24	.077	Trace
	2131		24 - 30	.02-	None
4A	2132	Leupp Area			
	2133	Leupp Area			
6A	2157	60	0 - 12	.072	None
	2158		12 - 24	.125	Trace
	2159		24 - 36	.131	Strong

Analyses by the wheatstone bridge indicate that the soils as a whole are low in alkali salts. Field tests show that they are all moderately to strongly calcareous. Poorly drained areas generally show an accumulation of black alkali in the zone of illuviation, but only in type 60 was a strong test secured. However, there is no indication that the black alkali has any detrimental effect upon the growth of Alkali Sacaton on that type.

Table IV - Analyses of the Waters from the Dinnebito, Palacca and Jeddito Washes

Origin (Wash)	No. Lab.	K*	Quality	Total Salts (ppm)	Total Salts Divided Into: Ca_4	Mg	Na	CO_3	HCO_3	Cl	SO_4	Sampled
Jeddito	642	6.7	F-	3,430	136.5	44	716	6	110	105	2,000	11-7-35
	647	7.6	P	3,908	430.0	136	571	6	252.5	112	2,400	12-20-35
Palacca	643	4.3	P	3,632	228	50	868	6	112	247	2,115	11-12-35
Dinnebito	644	12.6	F	2,044	181	41	419	13.5	120	40	1,300	11-18-35

*Note: K= Alkali Coefficient (*)

Greater than 18 - Good. Have been used successfully for many years without special care to prevent alkali accumulation.

From 18 to 6 - Fair. Special care to prevent alkali accumulation has generally been necessary except on loose soils with free drainage.

From 6 to 1.2 - Poor. Care in selection of soils has been found to be imperative and artificial drainage has frequently been found necessary.

Less than 1.2 - Bad. Practically worthless for irrigation.

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These water samples were taken for the purpose of determining the quality of water available for irrigation purposes. The Alkali Coefficient explained above was used to determine the suitability of the waters for irrigation. These data show that at the time of sampling the waters available for irrigation were only fair to poor. However, it must be remembered that the streams in question were low at the time and that the greater amount of water available is flood water of much lower salt content. This would tend to minimize the effect upon the soil by the waters running in the washes at the time the samples were taken.

(* Hardman, George, and Miller, Meridith R. 1934. The Quality of the waters of Southeastern Nevada, Drainage Basins and Water resources. The University of Nevada Agricultural Experiment Station Bulletin No. 136 p 20.)

SUMMARY

The Tolani Lakes area is in northeast Arizona. The Coconino-Navajo county line dissects it from the north to south and the Hopi-Leupp Indian Reservation line dissects it in an east-west direction. The area comprised by this reconnaissance survey is 514.45 square miles or 329,248 acres.

The Oraibi Road traverses the area from southwest to northeast and the Lilkon Road traverses the extreme southeast end. Both are improved dirt roads. Other roads are "flat-bladed" or simply wagon trails which form a network over the entire area.

The area includes flat nearly level land, sloping and undulating land, mesa tops, steep slopes, hill tops and rough broken land.

The area is very irregular in outline and generally rough in topography.

The general drainage is to the southwest but is interrupted by back slopes and ridges which introduce local variations. Five large washes drain the area. They are the Dinnebito, Oraibi, Palasea, Jeddito and John's Washes.

The climate is semi-arid with hot summers and cool winter temperatures.

Livestock production, of which sheep raising is the most important, is the principal source of income on the area. Such crops as corn, squash, gourds and watermelons are successfully grown. Farms are small and most of the work is performed by hand labor. Farming is confined to the nearly level and friable soils which are easily flooded.

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Irrigation practices are generally quite primitive as are other cultural practices. There, are, however, certain exceptions to the rule.

The soils of the area are derived from two general types of parent material; alluvial fill and residual Wingate, Todilto and Chinle formations. Strong winds prevailing from the southwest have modified many of the soils.

Twenty-two soil types are grouped into six major classes according to their location and mode of formation.

Wind erosion is general and most severe on the light and friable soils. Sheet erosion is closely associated with severe wind erosion on the upland types of soils. Gully erosion is severe only on the steep slopes, although the large washes attain a depth of 80 feet in some places.

The spreading of run-off waters over alluvial flats is recommended as a means of improving the grazing. Overgrazing by sheep is blamed for aggravating wind erosion on the uplands.

The soils as a whole are low in total alkali salts, but they are all calcareous. Poorly drained soils show a slight accumulation of black alkali in the subsoil.

Water samples taken in November and December indicate that the water available at the low stage in all the washes in only fair to poor in quality for irrigation purposes.

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NN001140