IRRIGATION DATA

LONG RANGE PROGRAM

NAVAJO

Los Angeles, Calif.

January 29, 1944

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IRRIGATION DATA FOR LONG RANGE PROGRAM

NAVAJO RESERVATION
PART ONE - BASIC DATA

SECTION 1 - RESOURCES

Location, Date Established and Area of Reservation -

The Navajo Reservation, Coconino, Navajo and Apache Counties, Arizona, San Juan and McKinley Counties, New Mexico, and San Juan County, Utah, occupies a large area in the N.E. corner of Arizona, the N.W. corner of New Mexico, and the S.E. corner of Utah. The reservation is approximately 200 miles across from east to west and 150 miles from north to south, completely surrounding the Hopi Reservation, which is approximately 56 by 70 miles. It extends to the Colorado River on the northwest and to the San Juan, Montezuma Creek, and the Colorado line in the north, about 45 miles into New Mexico on the east, approximately to the A.T. & S.F. Railroad on the south, and somewhat beyond the Little Colorado on the southwest. In addition there are the Navajo community areas of Star Lake near Chaco Canyon National Monument, 50 miles northeast of Grants, N.M.; Canoncito, 15 miles east of Laguna, N.M.; Puertecito, 40 miles south of Laguna, on the Rio Salado, and Ramah, about 40 miles southeast of Gallup. The last three are under the United Pueblos jurisdiction. These are made up principally of trust and fee patents and purchases. There are also other allotments on the public domain outside the reservation. The nearest towns are Winslow, Holbrook and Gallup on the A.T. & S.F. Railroad, 10 miles, 18 miles, and 11 miles, respectively, south of the reservation, and Farmington on the D. & R. G. Railroad near the N.E. corner.

After the Navajos were returned from Fort Sumner they received, under the treaty of June 1, 1868, a block of land covering 3,328,000 acres in Eastern Arizona and Western New Mexico, south of the Utah-Colorado line.

Executive Order of Oct. 29, 1878, added a strip of land west of the treaty area.

Executive Order of Jan. 6, 1880, added a strip south and east of the treaty area.

Executive Order of Dec. 16, 1882, established the Hopi Reservation of 2,472,166 acres, for use of the Hopis and such other tribes as the Secretary saw fit to settle thereon. Hopi Land Management District No. 6 includes 641,797 acres. The remainder, 1,830,369 acres, is being used by the Navajos.

Executive Order of May 17, 1884, granted the Paiute strip in Utah and Arizona south of the San Juan River. A small area south of the San Juan in the vicinity of Fruitland, originally included in Executive Order of Jan. 6, 1880, and excluded by Executive Order of May 17, 1884, was recovered by Executive Order of Apr. 24, 1886.

Under the Allotment Act of Feb. 8, 1887, approximately 4700 patented allotments of 160 acres each were made from about 1908 to 1930.

Executive Order of Jan. 8, 1900, added about 1,750,000 acres in the vicinity of Tuba City. The Tuba City townsite and adjacent land were bought from the Mormons in 1903.

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Executive Order of Nov. 14, 1901, established the Leupp area.

Executive Orders of Nov. 9, 1907, and Jan. 28, 1908, created the Pueblo Bonita Reservation. This area was restored to public domain by Executive Order of Dec. 30, 1908, and Executive Order of Jan. 6, 1911, excepting the many allotments which had been made to the Indians under the Act of 1887.

Executive Order of Mar. 10, 1905, modified by Executive Order of May 15, 1905, and Act of Mar. 1, 1933, established the area in Utah north of the San Juan.

Executive Orders of Nov. 9, 1907, and Jan. 28, 1908, added approximately 1,500,000 acres to the southern part of the reservation.

Executive Orders of Jan. 19, 1918, May 23, 1930, and Act of June 14, 1934, added the Grey Mountain area west of Cameron and south of the Little Colorado River.

Act of May 25, 1930, also added the area north of the Little Colorado and east of the Colorado River.

Executive Orders of Nov. 19, 1892, -- 1908, and Act of Aug. 17, 1922, restored to public domain part of the Paiute strip established by Executive Order of May 17, 1884, but this was re-established by Act of Mar. 1, 1933.

Act of June 14, 1934, made additions to the reservation north of Winslow and in the vicinity of Houck.

In addition to areas acquired by Executive Orders and Acts of Congress, large areas have been purchased, with gratuity funds prior to Dec. 31, 1938, and thereafter from tribal reimbursable funds.

Purchases to 12/31/38

State	Acreage	Price Paid	Av. per Acre
Arizona	476,240.21	$ 756,499.53	$1.588
New Mexico	187,382.16	378,029.84	2.017
Utah	1,920.11	5,212.00	2.741
Total	665,542.48	$1,139,741.42	1.712

The record to 12/31/38 shows that there were 3732 patented Indian allotments of approximately 160 acres each in trust status on the public domain in New Mexico and 75 Indian homestead entries of 640 acres each on the public domain. The Navajos also had obtained fee patents by citizen homestead entries and small-holding claims for approximately 980 acres.

The area of the reservation, according to the 1942 Statistical Supplement, was as follows:

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State	Total	Trust Allotted	Tribal	Govt. Owned
Arizona	11,414,450	90,545	11,323,905	-
New Mexico	3,508,252	599,275	2,[illegible],242	516,715
Utah	1,211,043	10,720	1,200,[illegible]	-
Total	16,133,725	700,540	15,216,470	516,715

This apparently includes the Hopi Reservation, except 801,942 acres in Hopi Land Management District No. 6, which is shown under Hopi in the statistical data. It is understood that District 6 now includes 641,797 acres, which would reduce the Navajo-Arizona and total by 139,835 acres.

Elevation and Climate -

The elevation of the reservation varies from 2800' at the mouth of the Little Colorado to 10,416' on Navajo Mountain in the northwest. Carrizo Mountain in the northeast rises to 9420', and the Chuska range in the east central part reaches 9575'. About 6 per cent of the area is below 4000', 50 per cent between 4000' and 6000', 32 per cent between 6000' and 7000', 10 per cent between 7000' and 9000', and 2 per cent is over 9000'. Other elevations are given in the following table:

The climate is generally that of the Colorado Plateau, but is variable, being greatly influenced by topography. The general effect of elevation is greatly modified by secondary topographic features. The air is dry and the daily range of temperature is great.

The winters are quite severe, with rather meager snowfalls in the lower regions, ranging to heavy on the mountain tops. Winter precipitation is deficient.

The summers are characterized by warm days, cool nights and sudden short storms of great intensity in widely scattered locations, with considerable precipitation in June, July and August. Occasional hail storms are often of great severity.

Wind storms are frequent, the prevailing direction being from the southwest. Whirling columns of dust are often in sight. There are extensive areas of sand dunes and rippled flats and rocks polished and etched by wind-blown sands. Vegetation buried in sand and fields of corn whipped to shreds are common.

Climatological records are incomplete; a summary of the principal available data at the various stations follows, using the four most important stations for which fairly complete data are available. These are located at widely scattered points typical of most of the irrigation projects.

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The temperature records for Fruitland, New Mexico, and Chinle, Fort Defiance--St. Michaels and Winslow, Arizona, show the following:

Fruitland, N.M., elevation 4800'; 32 years of record, 1891-1924; 1939-1942:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Av.
Ext. Max.	71	86	85	92	97	106	110	109	98	94	90	79	-
Ext. Min.	-21	-14	6	8	15	31	33	39	24	11	-1	-17	-
Mean	25.8	34.8	43.2	51.1	59.9	69.1	74.7	72.8	64.7	52.7	39.9	30.7	51.9

Chinle, Ariz., elevation 5538'; 25 years of record, 1909-1928; 1935-1942:

Ext. Max.	65	70	80	85	95	105	102	102	95	90	78	68	
Ext. Min.	-32	-22	1	10	19	26	38	40	25	18	6	-27	
Mean	27.6	35.9	41.3	49.0	58.4	68.6	74.1	72.1	65.5	5[illegible].7	39.1	29.3	50.7

Ft. Defiance, Ariz., elevation 6750'; 31 years of record, 1882-1890; 1897-1905; 1929-1942:

Ext. Max.	60	72	72	80	95	98	97	98	90	81	74	67	
Ext. Min.	-25	-26	-9	12	20	28	51	39	23	18	-[illegible]	-26	
Mean	25.6	27.4	29.9	46.5	54.0	64.5	69.1	67.8	59.5	48.3	[illegible]	27.6	47.4

Winslow, Ariz., elevation 4880'; 22 years of record, 1888-1889; 1892-1893; 1898-1900; 1908-1942:

Ext. Max.	74	78	87	94	105	106	107	104	102	91	81	71	
Ext. Min.	-18	-9	6	14	23	23	42	44	29	17	9	-19	
Mean	31.4	32.5	39.0	53.8	62.2	72.5	77.6	75.2	66.4	55.9	42.6	35.8	54.9

The frost-free growing period for Fruitland, based on a 27-year record ending 1942, is 157 days, from May 5 to October 9, with the latest killing frost of record on May 27, and the earliest on September 17. For Chinle, based on a 26-year record ending 1942, it is 139 days, from May 22 to October 8, with the latest killing frost of record on June 30, and the earliest on September 9. For Fort Defiance--St. Michaels, based on a 33-year record ending 1942, it is 153 days, from May 31 to October 1, with the latest killing frost of record June 19, and the earliest September 9. For Winslow, based on a 38-year record ending 1942, it is 172 days, from May 3 to October 22, with the latest killing frost of record June 2, and the earliest September 27.

The average precipitation is distributed as follows:

Fruitland; 33 years of record, 1891-1924; 1939-1942:

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
.52"	.63"	.47"	.54"	.44"	.22"	.87"	.75"	.80"	.72"	.44"	.53"	6.93"

Chinle; 25 years of record, 1909-1928; 1935-1942:

.46"	.47"	.44"	.42"	.34"	.38"	1.63"	1.38"	.87"	.68"	.53"	.54"	8.34"

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Fort Defiance, 31 years of record, 1852-1860; 1897-1905; 1929-1942:

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
.93"	1.02"	.79"	.72"	.57"	.72"	1.82"	2.25"	1.60"	.60"	.90"	.85"	12.76"

Winslow; 36 years of record, 1888-1889; 1892-1903; 1898-1900; 1908-1942:

.68"	.49"	.49"	.49"	.30"	.30"	1.61"	1.84"	.78"	.52"	.61"	.68"	8.79

The percentage of possible sunshine at Fruitland, for a 4-year period, 1939-1942, is 72; at Chinle, for a 20-year period, 1917-1928, 1935-1942, it is 57; at Fort Defiance-St. Michaels, for a 24-year period, 1917-1927, 1930-1942, it is 68; and at Winslow, for a 26-year period, 1917-1942, it is 67. The monthly averages are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Av.
Fruitland:	60	52	66	62	88	91	81	74	68	77	76	67	72
Chinle:	56	51	52	57	62	69	40	43	61	70	69	54	57
Fort Defiance-St. Michaels:	69	64	68	69	75	81	60	54	65	76	72	65	68
Winslow:	63	60	63	66	75	81	57	56	71	78	70	59	67

The approximate average number of hours between sunrise and sunset are as follows:

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Fruitland (lat. 36°-45'):	309	306	370	393	438	439	447	420	373	349	307	301	4,452
Chinle (lat. 36°-45'):	309	306	370	393	438	439	447	420	373	349	307	301	4,452
Fort Defiance (lat 35°-45')--St. Michaels (lat. 35°-39'):	311	304	370	392	435	436	444	418	373	350	310	304	4,450
Winslow (lat. 35°-01'):	313	305	370	392	434	434	442	417	373	351	311	305	4,450

The approximate average number of hours of sunshine, using the above percentages is:

Fruitland:	185	159	244	244	385	399	362	311	254	269	233	202	3,247
Chinle:	173	156	192	224	272	303	179	181	227	244	212	162	2,525
Fort Defiance-St. Michaels:	215	195	252	271	326	353	266	226	242	266	225	198	3,033
Winslow:	197	183	233	259	326	351	252	234	265	274	218	180	2,971

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Erosion is a serious factor in the development of this reservation and has been given a great deal of attention by the Soil Conservation Service. The soils, owing to the nature of the rock formations from which they are derived, are mostly of fine sand and silt, which is easily broken down by action of wind and water. Large areas of the reservation are being denuded of vegetation, the best soils whipped out and drifted into sand dunes by the wind and washed away by water. The valleys are cut by ever-increasing arroyos, farm lands eroded or covered with sand, reservoirs filled with silt, diversion structures washed out and canals broken by cross-washes. These conditions make agricultural operations very hazardous. The cost of irrigation works is very high and maintenance very difficult and expensive.

Topography (1)

The Navajo Reservation is a part of the Colorado Plateau, a region of flat-lying or slightly tilted rocks, cut by canyons and surmounted by mesas and buttes on a grand scale. In general, the depth of canyons below 5500' is about equal to the height of the mountains above that elevation. Navajo and Carrizo Mountains are laccolithic in origin and rise domelike above the surrounding country. Chuska Mountains, Black and Segi Mesas are bordered by sheer cliffs of commanding proportions. There are many mesas of the second and third order and innumerable buttes of both igneous and sedimentary origin. Mesas, buttes, volcanic necks, canyons, washes and sand dunes are repeated indefinitely. Alcoves, recesses and erosion forms of great variety, color and rare beauty stand as ornamental carvings on the larger architectural features. Approximately 54 per cent of the area drains into the San Juan, 39 per cent into the Rio Puerco and Little Colorado, and 7 per cent into the Colorado River. A small amount drains into the Rio Grande from the Star Lake, Canyoncito and Puertecito areas outside the main reservation.

Geology and Soils (1)

Pre-Cambrian is exposed at only one point, Quartzite Canyon near Fort Defiance. During Permian time the land was near sea level and was probably repeatedly submerged.

The first recorded deposit of Triassic Age is the Shinarump conglomerate which followed the Permian deposits after a long erosion interval. During Jurassic time there was increasing aridity and elevation with bodies of water--salt, brackish and fresh--and sufficient forage for animals as indicated by evidences of dinosaurs. There was vigorous erosion, marked by the unconformity at the base of the Dakota, which has removed all traces of lower Cretaceous. During upper Cretaceous time streams were active and the Dakota was laid down. Repeated submergence and re-elevation occurred and shales and sandstones containing marine fossils and lignitic coal were deposited.

With the coming of the Tertiary the sea is believed to have been permanently excluded. Fresh water shells indicate lakes and cross-bedded sandstones suggest the work of winds. Volcanism was active and probably continued into the Quaternary. Major folds and consequent uplifts, several times repeated, have brought the land to its present position. Erosion became dominant during the Pliocene and reduced

(1) Extracts from W.S.P. 380, The Navajo Country, by H. E. Gregory. 1916.

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parts of the area to a peneplain. The gradient was increased later by a regional uplift, greatly reducing the area occupied by Mesozoic and Cenozoic strata. Other uplifts of 3000' to 4000' enable the streams to cut the canyons which form so conspicuous a feature of Navajo topography.

The pre-Cambrian is represented only at Quartzite (Blue) Canyon near Fort Defiance. The Carboniferous-Pennsylvanian is found in the Canyon of the San Juan and at Grand Falls and several other points along the Little Colorado. Strata of this buff and brown Kaibab limestone are well exposed. The Permian beds consist of arenaceous shales and thin bedded sandstone, brown to chocolate in tone, charged with lime and gypsum, known as Moenkopi and the massive cross-bedded De Chelly sandstone.

The upper Triassic is represented by Shinarump conglomerate consisting of coarse sandstone in cross-bedded lenses with fossil wood and by the Chinle formation of calcareous shales and sandstones highly colored in pink, purple, gray and brown, and eroded into badland forms of singular beauty.

The Jurassic-La Plata group consists of two formations of massive cross-bedded friable red sandstones of great thickness. The lower Wingate sandstone is, in many places, separated by a band of limestone or of calcareous Tedilto shale and sandstone from the upper Navajo sandstone. Above the La Plata group lies the McElmo formation of friable greenish-white sandstones and subordinate shales, easily eroded into scalloped and curtained cliffs and badlands.

The upper Cretaceous is represented by the Dakota sandstone, the Mancos shale, prevailingly argillaceous but containing many beds of sandstone and thin seams of coal, and the Mesa Verde, consisting of sandstones, shales and coal widely extended in Northeastern Arizona and Northwestern New Mexico.

The tops of Black Mesa, of Dutton, Chaco and Manuelito plateaus and the floor of Chuska Valley are formed of the resistant members of the Mesa Verde, within which are found deposits of coal of high commercial value.

Tertiary strata cap the Chuska Mountains and cover a portion of Black Mesa. These include the Tohatchi shale and Chuska sandstone, the volcanic flows on top of Chuska Mountains, those in the Hopi Buttes region and along the Little Colorado River. Volcanic necks and dikes are distributed widely over the reservation.

The Quaternary deposits of post Tertiary erosion are represented by extensive deposits of alluvium forming the floor of wide washes and fringing canyon and mesa walls. Sand dunes ranging in size from small mounds to crescentic ridges 30' to 50' in height are found at many points, except in the forested highland areas.

Soils,(1) two types of soils are found--residual or local soils, which have resulted from decomposition of the rocks immediately under the surface; and transported soils, which have been carried by natural agencies from their place of origin and redeposited. The scantiness of vegetation, severe showers, rapid runoff and strong winds, characteristic of this region, are unfavorable for the development and retention of soil in place, hence transported soil predominates.

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Residual soil, a few inches thick, is found on the flat tops of Chuska Mountains, of Defiance, Dutton and Chaco plateaus and of Black and Sogi mesas. Large patches are found also on Carrizo and Navajo Mountains, in Monument and Chuska Valleys, and to a less extent elsewhere.

Transported soil, however, is widespread. The broad washes and their innumerable tributaries are flooded with stream-borne debris to depths exceeding 100 feet. Alluvial soil is also displayed in fans and slopes along valley sides and in terraces clinging to canyon walls, and a small amount marks the beds of extinct and ephemeral lakes. Eolian soils are found along the Little Colorado in the Tusayan washes, on Moenkopi, Kaibito and Shato plateaus and in the Chinle Valley, and blow dust is found on highland and lowland alike.

The soil of the Navajo country is derived from rocks relatively poor in mineral plant food. Limestone underlies probably less than 5 per cent of the area. The shales and sandstones of the Moenkopi formation contain relatively little plant food and are, in most places, charged with gypsum and other objectionable salts. The Shinarump conglomerate furnishes no soil of value to plants and the shales of the Chinle formation develop characteristically into infertile, bad-land areas. The sandstones of the La Plata group and the McElmo formation are prevailingly quartzose and are sparingly provided with plant food.

The Cretaceous strata--Dakota, Mancos and Mesa Verde--contain a higher proportion of plant food than any of the other formations and the lavas (largely basaltic) furnish a soil of high fertility. However, in spite of its origin, the soil of the reservation is not lacking in fertility--a condition which is due largely to the arid climate. The plant foods, sparingly distributed in the rocks, are accumulated in the soils of the washes and alluvial fans and stored for long periods because continuous, vigorous ground-water movement is lacking, and the leaching of soluble constituents is correspondingly checked. The fertility of the soil is renewed by continuous redistribution of alluvium by showers, seasonal rains and wind, thus incorporating within the soil the vegetation which springs up rapidly where conditions allow.

Agronomy -

Dry-farming, as commonly known, is not practicable on the reservation, except in a few isolated places in the higher altitudes where certain crops can be raised without irrigation in favorable years. However, the practice of farming on sandy fans of the washes, which receive and hold moisture for long periods, has been developed to a remarkable degree. Crops, principally corn, are planted deep in large hills to reach the moisture and protect the interior stalks from the cutting action of wind-blown sand.

Irrigation farming has become the mainstay of agriculture and a large number of units have been developed or partially developed, most of them in the first instance, by the Indians in a small way. Assistance has been provided by the Government in the investigation, improvement and development of a large number of units.

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A great many crops are raised. However, the majority are of the subsistence variety, consisting of corn, beans, squash and garden vegetables. Many difficulties are encountered in making efficient use of the irrigation projects. The land is usually rough, requiring subjugation, and is subject to erosion along stream channels or by cross-washes. Head-works and canal systems rarely can be constructed so well that frequent damage is not caused by floods, requiring heavy maintenance. The water supply, except where storage is available, is of flashy nature, requiring close attendance and often causing considerable damage. The Indians do not have the facilities or do not attain perfection in farming operations, all of which results in low production per acre.

Summary Crop Report for Calendar Year 1942

Crop	Irrigated Acres	Yield Per Acre	Yield Total	Market Value Per Acre	Market Value Total	No. Indians Farming
Total	17,835			$16.65	$297,037	

SECTION 2 - PRESENT DEVELOPMENT & USE

Irrigation -

Irrigation on the Navajo Reservation dates from 1885, when some small ditches were constructed by the Indians. Investigations and surveys were made by the Indian Service as early as 1904. Several small projects were constructed within a few years after this, and development has continued at an ever-increasing rate. The work was carried on through the Albuquerque office of the Supervising Engineer until the beginning of the fiscal year 1936, when it was turned over to the reservation Superintendent. Cooperative work has been done on many projects by Irrigation, E.C.W., CCC-ID, S.C.S., and Rehabilitation.

The following tabulation shows, by States, all the units on which work has been done, investigations made or work proposed, with costs, irrigation data and estimates of cost to complete.

There are 120 units listed. Irrigation funds, totaling $2,908,902.35, have been expended on 93 of these, and other agencies have spent $254,150.75 on 41 units, plus an unknown amount on three units, eight of which were not covered by

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Irrigation funds, making a total of 101 on which funds have been expended. This includes several investigated or partly constructed but now abandoned, two Hopi projects, several school units, subsistence gardens, experimental well, drainage and quarters, 26 in all which are not strictly Indian irrigation projects. This leaves 75 active projects and 18 proposed projects on the list. Seventy of the active projects are completed or partially completed, with 26,198 acres ready for cultivation (the principal works are constructed for a considerably larger acreage). On 67 of these, 17,833 acres were cropped in 1942 with a crop value of $297,037.

Additional surveys, investigations and construction are proposed on 32 projects, of which only 15 are new in the sense that no funds have been expended on them heretofore. The total estimate of $2,558,700 is incomplete, as detailed surveys and plans have not been made in most cases and as it includes only the cost of surveys on 15 of the projects, some of which are quite large.

It is contemplated that the above estimate would complete the existing units to a point where the approximate ultimate acreage of 67,000 could be satisfactorily cropped.

The economic unit of irrigated land is probably about 10 acres per family under conditions which exist on the Navajo Reservation. This is more in the nature of a compromise subsistence unit, based upon the limited agricultural possibilities, rather than the full acreage required for economic independence. Even so, it would involve more than twice the acreage of irrigable land now in sight. When considered in connection with stock-raising, which is the major industry, the 10-acre unit affords a good measure of assistance in the economic status of the Indians.

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Proposed Work

ersion dam, canals and structures, $6,500; subj. 100 acres, $4,000; surveys, $200.
D' canal, inc. flume, wasteway, drop and T.O.'s, and subj. 300 acres.
bution system to conserve water.
rveys, plans and estimates.
ersion dam, 1 mile main canal, laterals and structures.
vement and extension 4,000', subj. 600 acres.

am and distribution system for 75 acres.
estimate for diversion dam and rehabilitation distribution system.

nsed account infeasible diversion.
div. dams, $5,000; canals, $4,000; subj., 350 acres, $14,000; surveys, $500.
for 100 acres if feasible.
3 miles canal, $9,000; subj. 800 acres, $18,500; surveys, $1,000.

and est. for improvement and extension to include Cornfields.
rsion dam, $1,000; improve distrib. system, $10,000; subj. 750 acres, $32,000.

ateral system and subj. 50 acres.
supply questionable.
investigations for possible irrigation development.
" " " " "

am, $4,000; canals, $700; structures, $800; surveys, $200.
protection. Project turned over to N.R.A.
supply questionable.
diversion dam, canals to 270 acres; subj. 270 acres.
teral system, wasteway, weir at intake, and subj. 1,200 acres.
ll, rehab. Priest Lake storage, and subj. 100 acres.
ribution system, 600' metal flume, pumping plant, and subj. 7,000 acres.
feeder canal, earthen laterals, windbreak and subjugation.

rings and raise several reservoirs.
diversion dam, wasteway, laterals, flood protection and subjugation.
75 acres.
rage dam, const. diversion dam, new canal & structures, & subj. 2,000 acres.
investigations to determine feasibility.

l through deep cut and reconstruct flumes.
n canal and subjugate 50 acres.
r a Hopi project—Hardrock.
diversion dam, construct laterals and structures, and subjugate 175 acres.

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...ady Cultivation	Cropped 1942	Crop Value	Est. Cost to Complete		Proposed We...
0	0	$ 0	$ 0		None.
0	0	0	10,700	N	Masonry diversion dam, canals and structures, $6,500; sub
224.5	199.5	2,125	31,700		Rehab. 3,000' canal, inc. flume, wasteway, drop and T.O.'
67	67	920	3,500		Pipe distribution system to conserve water.
0	0	0	1,000S		Complete surveys, plans and estimates.
0	0	0	10,300	N	Masonry diversion dam, 1 mile main canal, laterals and st
0	0	0	28,000		Canal improvement and extension 4,000', subj. 600 acres.
0	0	0	0		None.
0	0	0	5,300	N	Diversion dam and distribution system for 75 acres.
1,470	1,100	8,025	1,000S		Survey and estimate for diversion dam and rehabilitation
0	0	0	0		None.
0	0	0	0		"
0	0	0	0		None; abandoned account infeasible diversion.
138	121.5	1,395	23,500		Reconstruct div. dams, $5,000; canals, $4,000; subj., 35
0	0	0	2,700	N	Masonry dam for 100 acres if feasible.
837	302.2	1,091	27,500		Reconstruct 3 miles canal, $7,000; subj. 600 acres, $18,2
268.5	118	4,188	0		None.
0	0	0	0		"
1,481	1,630	25,098	1,000S		Surv., plans and est. for improvement and extension to i
215	154.5	2,045	45,000		Repair diversion dam, $1,000; improve distrib. system, $
0	0	0	0		None.
[illegible]	51	2,212	0		"
[illegible]	150	3,100	15,000		Construct lateral system and subj. 50 acres.
[illegible]	300	6,016	0		None, water supply questionable.
0	0	0	200S		Surveys and investigations for possible irrigation devel
57	50	782	200S		" " " " " "
0	0	0	5,700	N	Diversion dam, $4,000; canals, $700; structures, $800; s
0	0	0	0		None, flood protection. Project turned over to W.R.A.
234	200.2	3,695	0		None, water supply questionable.
130	45	695	10,500		Reconstruct diversion dam, canals to 270 acres; subj. 27
980	719.5	12,300	102,200		Complete lateral system, sluiceway, weir at intake, and
970	627.8	8,082	77,000		Extend canal, rehab. Priest Lake storage, and subj. 100
1,081.5	947	6,966	409,000		Extend distribution system, 800' metal flume, pumping pl
363.25	350.7	2,320	16,250		Reconstruct feeder canal, extend laterals, windbreak and
0	0	0	0		None.
0	0	0	0		"
85.5	85.5	2,985	9,000		Develop springs and raise several reservoirs.
640	578	9,440	20,500		Reconstruct diversion dam, sluiceway, laterals, flood pr
100	61	152	4,200		Subjugate 75 acres.
28.5	15.5	585	195,000		Enlarge storage dam, const. diversion dam, new canal &
51	50.8	987	300S		Surveys and investigations to determine feasibility.
0	0	0	0		None.
20	15.5	511	1,150		Rehab. canal through deep cut and reconstruct flumes.
42.25	41.8	972	3,100	N	Improve main canal and subjugate 50 acres.
0	0	0	0		This is now a Hopi project—Hardrocks.
172.25	172.2	2,368	15,800		Reconstruct diversion dam, construct laterals and struct
0	0	0	0		None.

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SUMMARY OF NAVAJO IRRIGATION PROJECTS
(Nos. refer to Nos. in Postwar Estimates 6/30/43)

No.	ARIZONA Name		Irrig. Cost to 6/30/43	CCC-ID Cost to 6/30/42	Ultimate Irrig. Area	Ready for Cultivati
106	Agua Sol	B	$ 0	$ 0	0	
2	Balanced Rock	P	0	0	100	
3	Beautiful Valley	A	0	4,504.56	300	234.5
4	Begashibito	A	10,755.41	0	200	67
6	Big Sage Mesa	P	1,106.84	0	600	
8	Bita Ho Chee	P	0	0	500	
9	Black Falls	A	2,345.76	51,666.80	600	
109	Canyon Diable	B	232.12	0	0	
14	Chilchinbito	P	0	0	75	
15	Chinle	A	21,658.75	5,501.00	1,720	1,470
	Chinle School	B	0	0	0	
110	Coldfields	B	0	0	0	
17	Corn Wash	P	685.05	0	0	
18	Cove	A	0	1,163.43a	350	138
19	Cow Canyon	P	0	0	100	
24	Donehotso	A	30,467.68	8,958.49	800	637
25 & 10	Fort Defiance & Bonita Ck.	A	0	5,938.44	268	268.5
	Fort Defiance School	B	15,087.61	0	0	
27	Ganado and Cornfields	A	197,196.55	32,769.61	2,825	1,451
31	Houck	A	17,380.86	0	750	235
111	Indian Wells	B	654.30	0	0	
106	Jeddito	A	31,296.75	0	52	52
35	Kinlochee	A	34,545.42	0	250	200
36	Klagetoh	A	23,425.14	0	400	350
37	Klethla Valley	A	437.93	10,5[illegible]5.00	250	
38	Lakasaked	A	54.93	40,238.00	200	57
39	Left Hand	P	0	0	?	
40	Loupp (Flood protection)	B	28,377.46	0	0	
43	Lower Donebito	A	61,414.78	839.95	300	234
44	Lower Moencopi	A	36,262.83	6,329.52	400	130
45	Lower Rock Point	A	208,877.62	0	2,000	800
47,68 & 94	Lukachukai-Tohotso, Priest Lake	A	2,248.78	4,485.80	1,000	970
48	Many Farms	A	299,479.86	6,688.00	8,460	1,081.[illegible]
50	Marsh Pass	A	71,849.97	7,976.00	400	363.[illegible]
	Marsh Pass School	B	2,138.40	0	0	
117	Mexican Waters	B	342.05	0	0	
52	Moenave	A	3,754.41	1,791.33	95	85.[illegible]
53	Moencopi (Tuba)	A	54,905.29	923.00	640	640
61	Nateni's	A	12,176.70	11,019.00	175	100
62	Natural Bridge	A	9,031.20	0	2,000	28.[illegible]
33	Navajo and Jones Canyon	A	167.13	14,526.00	100	51
	Navajo Tribal Fair	B	968.62	0	0	
63	Naslini	A	26,355.07	3,615.00	100	20
64	Oak Springs	P	0	0	50	42.[illegible]
65	Oraibi Wash (Hopi)	A	16,019.56i	1,297.00	450	
67	Paiute Canyon	A	7,021.22	0	175	172.[illegible]
112	Pinon	B	894.00	0	0	

N

F. W. 95

Proposed Work

ed as infeasible.

canal and subjugate 350 acres.
and estimate for greater project, $2,000; and subj. 272 acres, $10,000.
luiceway and subjugate 300 acres.
flume and subjugate 200 acres.
-survey, map and investigate to see if further work needed.
ersion dam, canal, sluiceway, and subjugate.
reservoir to 600 ac. ft. and subjugate 300 acres.
diversion dam, construct canals, and subjugate.
diversion dam, improve canals, and subjugate.
ersion dam, feeder canal and storage reservoir.

tigation and estimate of cost.
vestigation to determine feasibility and cost.
-way diversion dam, 2 canals and structures, and subjugation.
structures, erosion control, flood protection, and subjugation.
00' canal from storage dam, surveys, plans and estimate.
n and improvement of entire project.
anal, structures on S. side canal, raise reservoir, and subjugation.
and reservoir from mesa washes.
nt until water supply determined.
vestigation to determine feasibility and cost of two units.
d improve main canals and structures and subjugate two units.

vestigation to determine what, if any, further work is desirable.

ed.
ystem for 40 acres.
n under extension of Fruitland Project.
ms, 2 feeder canals, raise storage dam, rehab. canals and subj. 2,000 acres.
ed.
ed.
ion system, $15,000; subj. 1,000 acres, $40,000.
reservoir and outlet gates.
/surveys, $500.
lam, $4,000; storage dam, $7,000; rehab. canals, $5,000; subj. 600 acres, $24,000;/
and estimate for diversion dam, canals, and subjugation.
to determine feasibility of project.
main, small drains, and subj. 2,000 acres.
n diversion dam, improve canal system, and subjugation.
acres, improve and extend canals, install 5 pumps, and subj. 600 acres.
upply questionable.
" "

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Site Area	Ready for Cultivation	Cropped 1942	Crop Value	Est. Cost to Complete		Prog
0	0	0	$ 0	$ 0		None; abandoned as infeasible.
0	0	0	0	0		"
50	312	164.9	1,953	10,000		Complete main canal and subjugate 350 acres.
00	423	284	5,212	12,000		Survey, plans and estimate for greater project, $1
00	271.5	191	1,987	10,000		Construct sluiceway and subjugate 300 acres.
00	82	69	706	6,000		Install metal flume and subjugate 200 acres.
00	274.25	274.2	7,124	400		Hopi project—survey, map and investigate to see i
50	0	0	0	25,500		Construct diversion dam, canal, sluiceway, and sub
00	164	139.1	2,147	37,700		Enlarge reservoir to 600 ac. ft. and subjugate 300
00	20.25	20.3	693	14,300		Reconstruct diversion dam, construct canals, and c
00	400	185.9	1,948	4,000		Reconstruct diversion dam, improve canals, and sub
	0	0	0	4,500	N	Construct diversion dam, feeder canal and storage
0	0	0	0	0		None.
00	0	0	0	500$	N	Survey, investigation and estimate of cost.
50	456	261	5,397	400$		Survey and investigation to determine feasibility
50	196.5	181	4,684	26,500		Construct two-way diversion dam, 2 canals and stru
00	66	18	579	14,000		Extend canal, structures, erosion control, flood p
00	0	0	0	3,000	N	Construct 2,900' canal from storage dam, surveys,
20	125	48	45	3,800		Rehabilitation and improvement of entire project.
40	62	82	1,606	31,700		New N. side canal, structures on S. side canal, re
50	35	21	676	5,500	N	Protect land and reservoir from mesa washes.
0	0	0	0	0		None at present until water supply determined.
00	0	0	0	500$	N	Survey and investigation to determine feasibility
50	918	533.7	6,899	42,000		New diversion dam, improve main canals and structu
00	55	30.5	480	500$		Survey and investigation to determine what, if any
0	0	0	0	0		None.
10/	13,722.75	10,085.00	$151,920	$1,329,600/		

Hopi share of Jeddito.

50	72.5	54.2	$ 753	$ 0		None; completed.
40	0	0	0	2,400	N	Distribution system for 40 acres.
00	200	40	552	0		None; will come under extension of Fruitland Proj
00	1,578	663.7	5,973	123,000		3 diversion dams, 2 feeder canals, raise storage d
0	0	0	0	0		None; abandoned.
50	10	10	5,140	0		" completed.
00	661	528.6	10,515	55,000		New distribution system, $15,000; subj. 1,000 acr
22	20	12	2,468	800		1.5 ac. ft. reservoir and outlet gates.
00	341	274	5,196	40,300		Masonry div. dam, $4,000; storage dam, $7,000; re
00	211	124.5	2,202	750$		Survey, plans and estimate for diversion dam, can
	0	0	0	200$	N	Investigation to determine feasibility of project
75	1,461	1,461.3	37,851	127,000		Canal to 4th unit, small drains, and subj. 2,000
00	905	526.5	6,128	59,300		Metal gates in diversion dam, improve canal syste
80	3,006	2,253.3	45,717	140,000		Drainage 500 acres, improve and extend canals, im
00	100	50	108	0		None, water supply questionable.
50	0	0	0	0		" " " "

F. W. 97

SUMMARY OF NAVAJO IRRIGATION PROJECTS
(Nos. refer to Nos. in Postwar Estimates 6/30/43)

No.	ARIZONA (contd.) Name		Irrig. Cost to 6/30/42	CCC-ID Cost to 6/30/42	Ultimate Irrig. Area	Ready for Cultivati
107	Polacca-Wepo Wash	B	$ 4,532.89	$ 0	0	
	Quarters	B	33,320.65	0	0	
69	Redhouse	A	3,855.48	901.00	350	312
70	Red Lake	A	39,752.16	0	3,000	425
71	Red Rock	A	2,050.40	901.00	300	271.5
72	Red Rock Valley	A	15,164.50	680.00	200	82
73 & 66	Reservoir Canyon (Hopi)	A	2,788.30j	0	300	274.2
74	Rocky Point	A	97.47	4,834.71	1,500	
75	Round Rock	A	56,022.36	0	600	168
78	Segihotsoci	A	1,863.70	0	100	20.2
79 & 98	Sehili	A	6,343.21	5,225.00	500	400
81	Slim Whiskers	P	0	0	?	
113	Sonsela Butte	B	1,707.12	0	0	
85	Tanner Springs	P	0	0	400	
86	Teesnospos	A	27,136.69	0	600	436
87	Tochinlini	A	4,603.79	0	250	186.5
88	Todenstani	A	7,106.78	0	200	66
93	Toh De Nee Ne Lake	P	0	0	300	0
95	Tolani Lakes	A	2,813.46	4,405.00	220	125
97	Tolthlakan	A	9,399.46	1,875.00	340	82
99	Tuba City School	A	0	0	40	25
114	Upper Oraibi Wash	B	633.96	0	0	
102	Wepo Wash	P	0	0	100	
103,23,43	Wheatfields, inc. {Greasewood and Lr. Wheatfields}	A	14,171.47	10,112.00	1,050	916
104	Whiskey Creek	A	273.54	0	100	55
115	Wide Ruins	B	1,481.90	0	0	
	Totals - Arizona		$1,465,365.55	$249,719.73	40,210/	15,722.7

a-S.C.S., f-inc. Rehab. $2,486.14, i,j-Hopi projects, m-May include Hopi share of J

	NEW MEXICO					
5	Beclabito	A	$ 382.63	$ 1,163.43	150	72.5
7	Big Thumb	P	0	0	40	
11	Cambridge	A	95.13	0	300	290
12	Captain Tom	A	101,621.80	6,011.84	3,700	1,573
116	Casamero	B	7,565.35	0	0	
13	Chas. H. Burke School	A	12,001.71	0	150	10
16	Cheiska	A	69,722.53	3,680.40	1,000	661
20	Crown Point School	A	0	0	22	20
21	Crystal (inc. Lr. Crystal)	A	20,123.95	0	600	341
22	Cudei	A	291.52	0	600	211
23	Dalton Canyon	P	0	0	?	0
26	Fruitland	A	640,710.83	46,758.00	3,675	1,461
29	Grey Mesa	A	0	677.35a	1,000	905
30	Hogback	A	418,327.23	10,541.67	6,500	3,806
34	Juan's Lake	A	9,902.74	0	200	100
49	Mariano Lake	B	9,899.02	0	50	0

F.W. 98

Proposed Work

and investigation to determine cooperation with U.S.R.S. in Animas Project.
new well, $10,000; distribution system, $1,500; subj. 100 acres, $6,000.
masonry diversion dam, install sluice and head-gates, and subj. 200 acres.
net diversion dam for feeder canal.
silting of reservoir and poor soil do not justify expansion.

included in Hogback.
; investigation and plans for major project.

diversion dam and structures, build additional canal structures, and subjugation.
net 3 diversion dams, 5 mi. canal, and subj. 500 acres.

to obtain data on this project.
truct main canal, and subjugation.
e log crib div. dam with cone. Reconstruct Hudson Lake storage dam, stabilize main canal, and subjugation.
net distribution system, and subjugation.
l additional structures on main canal and subj. 500 acres.
l radial gates in div. dam, T.O.'s and checks in main canal, and subjugation.
litation and completion main canal.
storage dam and riprap slopes.
w[illegible], reconstruct canal system.
canals, and subjugation.

net intake in San Juan, rehab. canal system.
net diversion dam, canal structures, and subj. 1,000 acres.
net 5 ex 11 storage dam.
net storage dam and canal.

0 per annum for assistance on miscellaneous Indian tracts.

F.W. 99

NN000823

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Ready for Cultivation	Cropped 1942	Crop Value	Est. Cost to Complete	Proposed Wo
0	0	$ 0	$ 10,000	Survey and investigation to determine cooperation with U.
40	8	61	17,800	Drill new well, $10,000; distribution system, $1,800; sub
182	151.2	2,975	11,200	Revamp masonry diversion dam, install sluice and head-gat
190	134.5	3,701	25,200	Construct diversion dam for feeder canal.
36	30	381	0	None; silting of reservoir and poor soil do not justify e
0	0	0	0	None.
0	0	0	0	"
0	0	0	0	"
0	0	0	0	" included in Hogback.
0	0	0	65,000	Survey, investigation and plans for major project.
0	0	0	0	None.
796.5	581	5,187	25,600	Repair diversion dam and structures, build additional can
559.75	173.3	820	17,400	Construct 3 diversion dams, 3 mi. canal, and subj. 500 ac
0	0	0	0	None.
0	0	0	100	Survey to obtain data on this project.
50	30	463	10,700	Reconstruct main canal, and subjugation.
261.47	227.5	4,856	19,700	Replace log crib div. dam with conc. Reconstruct Hudson
250	102	546	9,000	Construct distribution system, and subjugation.
48.5	17	513	40,000	Install additional structures on main canal and subj. 500
255	170.7	983	12,950	Install radial gates in div. dam, T.O.'s and checks in ma
0	0	0	4,000	Rehabilitation and completion main canal.
0	0	0	5,000	Raise storage dam and riprap slopes.
4[illegible]	7.5	117	1,500	Revamp well, reconstruct canal system.
251.50	140.5	2,153	18,300	Rehab. canals, and subjugation.
12,100.22	7,757.30	$143,117	$902,300/	

1 Sanostee.

0	0	$ 0	$ 0	None.
70	0	0	10,500	Construct intake in San Juan, rehab. canal system.
300	0	0	42,000	Construct diversion dam, canal structures, and subj. 1,00
5	0	0	24,000	Construct 5 small storage dams.
0	0	0	5,500	N Construct storage dam and canal.
0	0	0	0	None.
375	0	0	81,800	$25,000 per annum for assistance on miscellaneous Indian
?	?	?	25,000	
28,197.97	17,833	$297,037	$2,338,700/	

ata sheet for 6/30/43.

jects. / Plus unestimated amounts.

F. W. 100

SUMMARY OF NAVAJO IRRIGATION PROJECTS
(Nos. refer to Nos. in Postwar Estimates 6/30/43)

No.	NEW MEXICO (contd.) Name		Irrig. Cost to 6/30/43	CCC-ID Cost to 6/30/42	Ultimate Irrig.Area	Ready fo Cultivati
56	Monument Rock	P	$ 345.71	$ 0	?	
58 & 57	Malhelland Well	A	0	Unknown	60	40
58	Naschiti-Drolets	A	0	" g	200	182
59 & 41	" Nor.inc.Long Lake	A	28,364.44	8,265.00h	600	190
60	" Southern	A	6,878.00	0	250	86
116	Pueblo Bonito	B	393.91	0	0	
	Quarters	B	11,898.53	0	0	
	San Juan Drainage	B	6,620.97	0	0	
	San Juan Pumping	B	812.00	0	0	
76	San Juan Investigation	P	1,893.61	0	?	
	San Juan School	B	7,112.33	0	0	
77	Sanostee & Beautiful Mtn.	A	10,664.14	0	1,000	796.5
80	Sheep Springs	A	181.58	2,262.00	500	338.7
	Shiprock Wells	B	10,177.37	0	0	
83	Standing Rock	P	0	4,523.00	20	
84	Stinking Water	A	(1,260.00)k	0	50	50
89 & 88	Teadlena, inc. Hudson Lake	A	3,113.97	2,187.00	300	261.4
90	Tocito	A	15,257.26	0	250	150
91	Todilto Park	A	701.23	0	500	48.8
92	Tohalsizzy	A	(2,316.15)l	0	300	255
98	Torreon	A	4,571.90	Unknown	100	
100	Well 14-A-79	A	784.71	7,792.00	30	
101	Well 14-M-1	A	0	3,438.00	100	40
105	Zilbeted	A	1,789.71	0	300	251.8
	Totals - New Mexico		$1,401,205.07	$97,320.27/	22,547/	12,100.5

g-S.C.S., h-inc. Rehab. $3,072, k,l-Not on Cost Data sheet, may be included in "anon

	UTAH					
119	Allen Canyon	B	$ 73.65	$ 0	0	
58 & 1	Aneth	A	1,185.98	7,110.75	70	70
54	Montezuma Creek	A	9,033.64	0	1,000	300
56	Monument Valley	A	4,632.11	0	110	5
82	Sparky Canyon	P	0	0	?	
120	Tse-na-ah-na-chee	P	1,819.00	0	0	
	Totals - Utah		$ 16,744.38	$ 7,110.75	1,180	375
51	Navajo Subsist.Tracts,Az.& N.M.		$ 25,587.35	0	3,375	?
	Total Irrig. - Az., N.M. & Utah		$2,908,902.35	$354,180.75/	67,312/	28,197.5
	Water Supply - Az., N.M. & Utah		$1,265,116.28			
	GRAND TOTAL		$4,174,018.63, as shown on Summary Cost Data she			

A-Active, B-Abandoned, P-Proposed projects, S-Surveys only, N-New projects,

F.W. 101

SECTION 4 - SERVICES PROVIDED BY GOVERNMENT

Irrigation -

A great many of the existing irrigation projects were initiated by the Indians, who, during their wanderings over the reservation grazing their sheep and goats, planted small fields on the fans of washes where the crops could be irrigated by spreading the flood water by simple ditches. In time, more difficult projects were undertaken, requiring diversion of water from the washes and construction of canals to more and better land. Irrigation farming soon became a very important item in the economy of the Navajos and the Government began to assist the Indians in the laying out and construction of the more difficult projects, especially by providing engineering assistance and materials. In this work the Indians generally contributed most of the labor.

As the projects grew in size and difficulty and other reservation activities competed for labor, the Government undertook the entire construction of most projects, paying full wages and all material costs. This developed into the Government's taking care of maintenance during construction and, as the construction of most projects is now quite completed, the Government actually maintains most of the projects, especially the larger ones, where failure to do so for any length of time would jeopardize the entire project. The smaller projects usually run along for some time with very little repair work, but when major damages occur the Government must do the work, with or without Indian contribution. This is evidenced by the expenditure to June 30, 1943, of $685,534 for O. & M. from irrigation funds alone. This is about 23.5 per cent of the irrigation construction cost.

N

F. W. 102

PART TWO - OVERALL PLAN

SECTION 1 - GENERAL

General -

The Navajos are primarily dependent upon stock-raising, for which the reservation is best adapted, although necessarily limited in comparison with the population. Agricultural possibilities are secondary and also limited. Taken together and operated in accordance with the desires and capabilities of the Indians, these two occupations can be developed to provide the major part of a fair income for these people so long as the population does not increase materially. Other activities and resources also provide a considerable income.

SECTION 2 - DEVELOPMENT BY FEATURES

Irrigation -

The projects listed in the above tabulation constitute the greater part of the possible irrigation developments on the Navajo Reservation. However, it should be noted that the total acreage and estimated cost are not the true measure of these developments. Several of the larger proposed projects, such as Monument Rock and San Juan, and several small ones, have not reached the stage of investigation where either acreage or cost can be given with any degree of accuracy, hence the figures are not included in the totals. Aside from these, the totals show that 67,312 acres are classed "ultimate irrigable," with 26,198 acres ready for cultivation. The estimated cost, $2,338,700, plus, to complete is, with the exception of a few items for surveys and investigation of the indefinite projects, the amount required to complete the existing units and several of the smaller proposed units to a point where the approximate ultimate acreage can be utilized.

The names of the units and the principal essential data are shown on the above tabulation and, to avoid repetition, will not be repeated here.

F. W. 103

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SECTION 4 - ESTIMATED COSTS BY YEARS & FEATURES

(From Supt.'s Budget Estimate for 1945, submitted Aug. 25, 1943)

Irrigation

Project		Total	1945	1946	1947	1948	1949	1950	Addl.
Fruitland									
Distribution	$	45,000	15,000	15,000	15,000				
Subjugation		53,642	5,000	24,320	24,322				
Total	$	98,642	20,000	39,320	39,322				
Hogback									
Distribution	$	24,000	8,700	15,300					
Subjugation		73,000	3,000	22,000		33,000	15,000		
Drainage		15,000	600	14,400					
Pumping plant		25,000					25,000		
Total	$	137,000	12,300	51,700		33,000	40,000		
Ganado & Cornfields									
Subjugation	$	75,000	20,000	20,000	35,000				
Storage dam		20,420	20,420						
Total	$	95,420	40,420	20,000	35,000				
Many Farms									
Distribution	$	28,000	8,000	10,000	10,300				
Subjugation		402,220	7,000	15,000	140,220	30,000	30,000	30,000	150,000
Total	$	430,220	15,000	25,000	150,220	30,000	30,000	30,000	150,000
Misc. Projects		$1,739,789	27,700	50,000	100,000	150,000	150,000	150,000	1,112,089
Grand Total		$2,501,071	115,420	183,020	324,542	213,000	220,000	180,000	1,262,089

F. W. 104

CV-6417-201 NN000828