# ATER and RELATED LAND RESOURCES
# UMBOLDT RIVER BASIN
## NEVADA



REPORT NUMBER FIVE

# NORTH FORK SUB-BASIN

AUGUST 1963

Based on a Cooperative Survey

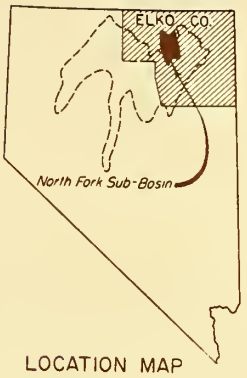
*by*

THE NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

*and* THE UNITED STATES DEPARTMENT OF AGRICULTURE

Economic Research Service - Forest Service - Soil Conservation Service

cc: Beuttler 10/3/63




LOCATION MAP


LEGEND

Sub-Basin Boundary

National Forest Boundary

COVER PHOTOGRAPH -
LOOKING NORTH FROM CALIFORNIA MOUNTAIN ALONG THE INDEPENDENCE RANGE, THE MAIN WATER-PRODUCING AREA OF THE NORTH FORK SUB-BASIN. CALIFORNIA CREEK IN THE FOREGROUND, PRATT AND FOREMAN CREEKS IN THE DISTANCE. THESE WATERSHED LANDS ARE ALL WITHIN THE HUMBOLDT NATIONAL FOREST.
N-698-3 FIELD PARTY PHOTO

NORTH FORK SUB-BASIN

# HUMBOLDT RIVER BASIN SURVEY

ELKO COUNTY, NEVADA

AUGUST 1963

SCALE IN MILES

USDA SCS PORTLAND, OREG. 1963 M-3970

REGISTER

REPORT NUMBER FIVE
NORTH FORK SUB-BASIN
AUGUST 1963

Will you please detach and fill out this form; mail it to us, so that we may send you any additions, changes, or corrections.

Humboldt River Basin Field Party
P.O. Box 982
Elko, Nevada

Name _____

Address _____

_____

_____

# WATER AND RELATED LAND RESOURCES

# REPORT NUMBER FIVE

# HUMBOLDT RIVER BASIN

# NEVADA

## NORTH FORK SUB-BASIN

Based on a Cooperative Survey
by
The Nevada Department of Conservation and Natural Resources
and
The United States Department of Agriculture

Forest Service - Soil Conservation Service - Economic Research Service

August 1963

# FOREWORD

This is a report for the people of Nevada, and particularly for the people of the Humboldt River Basin, concerning water and related land resources in the North Fork Sub-Basin. It is the fifth of a series of reports which will result from a cooperative survey of the Humboldt River Basin by the Nevada State Department of Conservation and Natural Resources and the U. S. Department of Agriculture. It was prepared by the Soil Conservation Service and the Forest Service of the Department of Agriculture.

The State of Nevada seeks constantly to assist local people and their organizations in the conservation, development and management of water resources. It has particular regard for the relationship of water to land and to human resources. This is exemplified by the creation of the Nevada State Department of Conservation and Natural Resources. A primary responsibility of that Department is to cooperate with Federal agencies and local groups and to coordinate State-Federal activities that help solve water and related land problems for the people of Nevada.

The responsibilities of the Nevada State Department of Conservation and Natural Resources, and the cooperative research work already under way in the Humboldt River, set the stage for Federal-State cooperation in developing information on opportunities for improving the use of the land and water resources of the Basin. Accordingly, cooperation was initiated with the U.S. Department of Agriculture under a Plan of Work dated June 3, 1960 with agencies of the Department and of the State of Nevada participating in the survey. It is important here to point out that responsibility for matters concerning State water rights and determination of water supply as it might affect State water rights was assumed by the State of Nevada.

This survey of the Humboldt River Basin is for the primary purpose of determining where improvements in the use of water and related land resources, some of which have social and economic aspects, might be made with the assistance of projects and programs of the U. S. Department of Agriculture. A major part of the survey is focused on situations where improvement might be brought about by means of Federal-State-local cooperative projects developed under the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress as amended). This cooperative survey is in keeping with long established tradition in the Department of Agriculture of cooperation with states and local entities in the conduct of its work. Further, such cooperation is a most important responsibility of the Nevada State Department of Conservation and Natural Resources.

The U. S. Department of Agriculture-State of Nevada Plan of Work in the Humboldt River Basin offers opportunities for participating in the survey by other Nevada State agencies and Federal agencies. The Bureau of Land Management, as an example, has cooperated with respect to the national land reserve. Thus, the survey is not limited but is rather as broad in scope and agency participation as is required to meet the agreed upon objectives.

The entire Humboldt River Basin is being studied by segments identified as sub-basins. This report contains much information for study and use in understanding and

solving some of the existing water and land resource problems in the North Fork of the Humboldt River drainage. The report presents opportunities for Federal-State-local project-type developments under the Watershed Protection and Flood Prevention Act, together with other opportunities for development and adjustment.

I wish to recognize the excellent work of the U. S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources in this cooperative effort. I consider that this report will serve the best interest of the people in the Humboldt River Basin and the State of Nevada.

Grant Sawyer

Governor of Nevada

# HUMBOLDT RIVER BASIN SURVEY

## NORTH FORK SUB-BASIN REPORT

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## ORGANIZATION OF REPORT

The report on the North Fork Sub-Basin is divided into three main sections. The first section is an overall report on the sub-basin; the remaining two sections consist of Appendix I and Appendix II, respectively.

Appendix I is attached to all the report copies, and contains pertinent material concerning the sub-basin which is of value to the general reader.

Appendix II is produced in a relatively limited number of copies. Its small appeal to the general reader renders it unsuitable for inclusion with the report copies for general distribution. However, this type of material does have potential value as an information reservoir for technicians, administrators, and resource managers concerned with the North Fork Sub-Basin. Copies of this appendix are available upon request.

# SUMMARY

The resources of the lower portions of the North Fork Sub-Basin were regularly exploited by the white man during the fur-trading and emigration periods along the Humboldt main stem from 1828 to 1869. However, use of the sub-basin's upper reaches did not begin until the development of the adjoining Cope, Tuscarora, and Bull Run Mining Districts during the period 1869-1890. During this period the upper reaches of the sub-basin served as access corridors for the stage and freighting roads from Elko to the mining districts, and as hay-production areas for the enormous numbers of draft-stock traveling these roads. The range livestock era started about 1870, with the establishment of the Murphy cattle ranches, and has continued to the present time.

The sub-basin is situated in the approximate center of Elko County, and drains into the Humboldt River about 15 miles northeast of Elko. Its principal drainages are the North Fork of the Humboldt River and its tributaries emanating from the Independence Mountains within the Humboldt National Forest, and Pie Creek, Dorsey Creek, and Beaver Creek. It contains approximately 692,300 acres, or 1,082 square miles.

Big sagebrush-grass or low sage-grass constitutes the predominant cover over much of the sub-basin, giving way to mixed browse, aspen, and conifers in the Independence Mountains. From about 10 miles above the junction of the North Fork with the Humboldt River northward to the vicinity of Devil's Gate, irrigated hay headows interlaced or intermingled with willow stringers and phreatophytic rabbitbrush and greasewood occupy the bottomlands. The same is also true for the upper North Fork and its tributaries, above the North Fork-Beaver Creek confluence.

The dominant agricultural activity in the sub-basin is the raising of livestock. The privately-owned lands are used for the production of irrigated crops and range forage. The national land reserve is used primarily for spring-fall and summer range for livestock, and as year-long range for big game and other wildlife. Land classification, fire protection, and recreation use comprise other important phases of the Bureau of Land Management's program on the reserve lands. The Forest Service administers the lands within the Humboldt National Forest to coordinate the various resource uses (range, wildlife, water production, recreation, etc.) without impairment of the productivity of these vital watershed areas.

Of the 667,400 acres of usable range land (exclusive of barren or inaccessible lands), 513,000 are currently in the low forage production class, 142,300 in the medium class, and 12,100 are in the fairly high forage production class. Livestock numbers on sub-basin ranches, based upon Forest Service permits and Bureau of Land Management licenses for 1963, were estimated at 15,400 cattle and horses and 14,800 sheep. Federal lands provide most of the spring-fall and summer feed required; the Federal and intermingled private range lands furnish forage for approximately 86,000 AUM's of cattle and horses and 7,500 AUM's of sheep. The balance of feed is provided by two or more months of grazing on private range land, crop aftermath, adjacent irrigated pasture, and three to four months on hay.

The average annual precipitation varies from 8.62 inches in the vicinity of Elko

to approximately 35 inches along the crest of the Independence Mountains. The average frost-free period (28 degrees F) is estimated to vary on the irrigated land between 100 days in the south to 80 days in the northern part of the area.

Surface irrigation supplies are derived primarily from snowmelt. About 69 percent of the gross water yield originates in the Jack Peak area of the Humboldt National Forest.

The annual water balance studies made by the Field Party indicate that during an 80 percent frequency flow year the approximate gross water yield is 40,100 acre-feet. Of this total, 13,300 acre-feet are used to produce hay or pasture, and 8,900 acre-feet are used by phreatophytes, leaving a remainder of 17,900 acre-feet discharging into the Humboldt River.

The principal water use in the sub-basin is for irrigation. Culinary and stock water use, while of strategic importance with respect to location, quality, and availability, do not require very large quantities. There are a number of ponds, wells and seeps used for stockwater.

The hay lands and phreatophyte areas are located principally along the stream bottoms, with some hay land on high flood plains. Most of the native hay and pasture land is irrigated continuously during the period of high seasonal stream flow. The remainder receives water at periodic intervals whenever it is available for use. On-site water use by trees, shrubs, and grasses on the watershed are important. Downstream values are dependent upon a healthy watershed, to prevent flood, sediment, and debris damage.

On-the-farm irrigation efficiency is quite low; it is estimated at 20 percent. Seepage loss from surface flow was observed to be high in ditches and creek channels flowing over alluvial fans. More late-season irrigation water would be available to lands in the sub-basin if this loss were lessened or eliminated.

There is a limited amount of improved irrigation development in the area, consisting of some land smoothing, land leveling, drainage, diversion structures, spreader ditches, one irrigation water well, four irrigation water storage reservoirs, and two overnight storage reservoirs. However, the bulk of the irrigation is principally by a semi-controlled type of wild flooding. Very limited use has been made of border irrigation. Water supplies from surface streams vary widely throughout the irrigation season, which makes water regulation difficult. Meadow hay and pasture forage receive part of their water needs from shallow ground water.

Soils problems occur throughout the sub-basin. The bottomland soils are principally Alluvials and Humic Gleys. The soils problems here are flooding, high water table, poor drainage, and salt and alkali concentrations. The valley terrace soils are principally Alluvial; their problems are excess drainage, in the case of gravel-based soils, and poor drainage in the case of the hardpan soils. In the mountain areas there are soils that are shallow to bedrock or gravel.

Since 1910, the earliest year of recorded flood damage in the sub-basin, there

have been six years in which floods have caused major damage. These damages have been in the form of watershed erosion, cropland sedimentation, and stream and gully erosion. Major damages have also been inflicted on roads, bridges, and buildings, both in the sub-basin and below it (North Fork - originated flood crests on the Humboldt main stem).

As the population increases, and with improved roads and trails, the sub-basin's recreation potential will become better known and developed. The Independence Mountains-Double Mountain area is now one of the principal deer-harvest regions in the Humboldt Basin, and this type of recreation use is also bound to increase. With fuller recognition and development of the largely untapped potentials for camping, picnicking, back-country travel and fishing, recreation use should become one of the sub-basin's outstanding features. This use would be considerably enhanced with construction of the proposed Devil's Gate dam and reservoir by the Corps of Engineers on lower North Fork.

Regular Department of Agriculture and other Federal and State programs can provide assistance in accomplishing many needed improvements in the sub-basin. The regular programs of the Forest Service and the Bureau of Land Management provide for improvement on the Federal lands those agencies administer to the extent that currently available funds permit.

A review of the sub-basin indicates that the water and related land resource problems in at least one watershed - Pie Creek - are such that they can best be handled on a project basis. In this area improvement measures can be designed which will provide for watershed protection, increase range forage production, supply supplemental irrigation water, and reduce erosion and sediment damage on the irrigated lands. A preliminary evaluation of the works of improvement proposed for this watershed area indicated project-type development possibilities sufficient to warrant a more detailed study.

# HUMBOLDT RIVER BASIN SURVEY

# NORTH FORK SUB-BASIN REPORT

## AUTHORITY AND ORGANIZATION

The need for continually improving the conservation and use of water and related land resources has long been recognized by Federal, State, and local agencies. A recent pertinent development of this continuing interest is River Basin studies under Section 6 of Public Law 566, as amended and supplemented.

The Secretary of Agriculture is authorized under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act to cooperate with other Federal and with State and local agencies in making investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs. In Nevada such a survey is under way by the U.S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources.

General direction for the U.S. Department of Agriculture in the conduct of the studies and preparation of the report was provided by a USDA Field Advisory Committee composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service. The USDA River Basin Representative served as advisor and consultant to the Committee.

General direction for the State of Nevada was provided by the Director of the State Department of Conservation and Natural Resources.

A Field Party composed of representatives of the Soil Conservation Service and the Forest Service completed the field work and prepared this report.

## HISTORICAL INFORMATION

### Settlement

Most of the early use of the lower portions of the sub-basin during the fur trade and westward emigration periods occurred in connection with the use of the adjacent main stem of the Humboldt. This period of use will be found in the report of the Elko Reach.

The upper portions of the North Fork saw little of the white man until the discovery of silver chloride ore bodies on the upper East Fork of the Owyhee River adjacent to North Fork by the James (Jesse) Cope party of prospectors in May 1869. The Cope Mining District was set up, and Mountain City was laid out as its center.

Columbia, Cornucopia, and Tuscarora started their heavy production of silver in the period from 1869-77. These mining camps were adjacent to the upper North Fork, and their mining, milling and subsistance needs exerted a marked influence in the rapid development on the upper North Fork. In July 1869 the Independent described the North Fork

as a beautiful, fertile, but nameless valley, "the paradise of Nevada", on the proposed road to the Cope District, in which no settler had yet pitched his tent. Within eight months, this picture had changed markedly.

The Elko and Idaho Toll Road, half of the construction cost ($10,000) was donated by Elko merchants in July 1869, was completed by William (Hill) Beachey, the stagecoach king, and his associates in October 1869. The road ran north from Elko along the North Fork drainage and through Mountain City to the Idaho line. At this point it connected with the Idaho Central Toll Road to Silver City and Boise City.

To care for the needs of the toll road patrons and the Concord stages, as well as the long strings of "sagebrush clipper" freight wagons plying the road, nine large stage stations were established between Elko and Mountain City. Five of these stations were in the sub-basin meadows of North Fork, Ganz Creek, Pie Creek, and Dorsey Creek. One of these stations (Coryell's) is still in use. Known now as the Dinner Station, it is the headquarters for the Dinner Station Ranch (see photograph 1).

*Photograph 1. - Dinner Station Ranch headquarters, Nevada Highway 11 between Elko and Mountain City, looking north. The large stone building on the left was the general store and dining room during the staging days between Elko, Mountain City and Tuscarora. The large building on the right was the barn for stage horses, changed here on all runs. The old Tuscarora stage road may be seen leaving the highway to the right of the dining room.* FIELD PARTY PHOTO

In April 1870 a new stage road to Mountain City was opened from the Coryell (Dinner) Station on Dorsey Creek, via Independence Valley and the Columbia mines. By 1875 this road had become the main route from Elko to Tuscarora and Cornucopia, when these mining camps began to boom. By this time, Mountain City and the Cope District had started the long decline from which they were not to recover until the Rio Tinto copper discoveries and subsequent boom, 1932-1948. The road from the Dinner Station to Tuscarora and Cornucopia became the through stage route north of Elko, with the line from the Dinner Station north to Mountain City, Gold Creek and Idaho points being relegated to a secondary status. Stages on this line ran only to the Dinner Station where they met the Elko-Tuscarora stages.

An idea of the immense volume of freight and passenger traffic over the roads north and south from the railroad at Elko to the mines may be gained by reading the newspapers of the period. The Elko Independent in June 1869 stated that 30 to 40 Central Pacific freight cars loaded with machinery and supplies were being unloaded daily. The railroad's daily Elko receipts then, both freight and passenger, exceeded $5,000 per day. By August 1869, when the traffic to the Cope, Cornucopia, and Columbia mines north of Elko was assuming significant proportions, these receipts had grown to $5,000 per day for freight alone.

Some time during the latter part of Tuscarora's boom period, probably in the early or mid-1880's, the circuitous, snowdrift-plagued route from Elko over Adobe Summit to the head of Sixteen Mile Creek was practically abandoned. Only the heaviest, slowest freight wagons or cattle herds being driven to the railroad at Elko in the fall from ranches in northern Nevada or southern Idaho continued using it. A new route was laid out from Elko (Sixth Street; later shifted to Fifth Street) over the Adobe Range west of Mouse Mountain at Tuscarora (Elko) Summit, joining the old route at the Sixteen Mile Stage Station. Horse changing stations for the Tuscarora Stages were set up at the Sixteen Mile, Dinner, and Eagle Rock Stations, with additional meal or overnight stops at the Oldham (Fox Springs) and Stuart (Reid) stations, west of the Dinner Station. The stages for North Fork, Gold Creek, and Idaho points continued to meet the Elko-Tuscarora stage there.

About 1912, with the advent of the motor car, the Tuscarora summit road from Elko to upper North Fork and southern Idaho points was improved by the county, and became the first auto highway into this country. It continued to be the only auto road until 1935, with one exception. In the early 1920's a short-cut route was constructed from the Mahala Creek crossing of the North Fork-Mountain City road southeast across Coal Mine Pass and down Coal Mine and Twelve Mile Creeks to the Humboldt main stem at Ryndon. This road was completed by the county around 1923.

In 1935, the Nevada Highway Department started construction of present Nevada 43, to provide a better highway access between Elko and the booming Rio Tinto operations of the Mountain City Copper Company, as well as with southern Idaho points. The old Cope route over Adobe Summit was followed as far as the Owyhee Meadows at Wildhorse Dam. North of there, however, the toll road's approach to Mountain City from the north and east by way of Sunflower Flat was abandoned. The new road was constructed directly down Owyhee Canyon from Wildhorse Dam to Mountain City, being completed in 1939-40.

In connection with all this road relocation, the Elko-Tuscarora Summit-Sixteen Mile-Dinner Station-Eagle Rock Station section of the Tuscarora road was abandoned entirely. In 1936 present Nevada 11 to Tuscarora was constructed from its junction with Nevada 43 to the head of Taylor Canyon on the sub-basin's west rim. Both Nevada 11 and 43 were paved in the late 1940's.

The first agricultural use of the sub-basin started, as previously noted, with the raising of hay and small grains to subsist the livestock used in the staging and freighting traffic through the sub-basin to the mines of the Cope, Bull Run, and Tuscarora Districts. After the full flowering of the Tuscarora boom in 1875, truck garden crops were raised in the vicinity of lower Winters Creek, and hauled to Tuscarora via the Winters Creek short-cut road across the Independence Range.

The North Fork range resource was quickly recognized for not only its quantity but its quality. About 1870, early in the era of large cattle ranches in eastern Nevada, Dan Murphy took over and stocked with Texas longhorn cattle the country embracing the present Devil's Gate, Haystack, and Rancho Grande ranches in the sub-basin. He also operated along the Bruneau River from Charleston north far into Idaho, with summer range on Beaver Creek and what is now the Gold Creek District of the Humboldt National Forest. His winter range was on the Diamond A desert on the Bruneau in Southern Idaho, which was named after the Diamond A, one of his earliest and principal brands. Mr. Murphy was one of the sons of Martin Murphy, of the famous Stevens-Murphy-Townsend emigrant party which traversed the Humboldt in 1844 enroute to California, and which was the first emigrant train to cross the Sierra Nevada at Donner Pass. He became one of the largest ranchers and landowners in the west, owning or controlling lands all the way from Mexico, Arizona, New Mexico and California into Nevada and Idaho. His Nevada ranch headquarters were at Halleck, which from the early 1870's until the early 1900's was the railroad shipping point for the Murphy-Morgan Hill Ranches. During this period it was a bustling, boistrous, roistering cow town, known all over the State.

With Mr. Murphy's death in the late 1880's his son-in-law Morgan Hill took over his ranching operations. The "White Winter" of 1889-90 was especially severe in the North Fork-Beaver Creek-Bruneau country, with heavy livestock losses. The result was a drastic curtailment of many of the large range cattle operations, including the Murphy-Morgan Hill interests. Present day ranch holdings here are scaled to much smaller dimensions.

After the disastrous cattle losses of 1889-90, sheep began to move into the sub-basin. By 1906 several large sheep outfits had bought, leased, or homesteaded enough key acreage to control the summer range in not only the Independence Mountains but also the high country formerly used as Murphy summer range around Gold Creek and the headwaters of the Bruneau. In 1911 sheep ranchers homesteaded lower Beaver Creek, thereby controlling all the former cattle range on this drainage, and grazed it with huge numbers of sheep. In a few years the area was reduced from a well-vegetated range covered with desirable perennial grasses and forbs to its present sheet and gully erosion-raddled state.

In addition to the heavy use by resident sheep, many transient sheep outfits

scrounged feed in the sub-basin wherever they could find it, regardless of who claimed range ownership or control.

To protect the valuable watershed source area of the North Fork, the Independence Forest Reserve was established in May 1906. It was consolidated with the Ruby Forest Reserve in July 1908, at which time the name "Reserve" was dropped. The new combination was then given its present name: Humboldt National Forest. Forest headquarters were established at Elko. This action made possible the initiation of a grazing management program aimed at preventing further deterioration of the high water-yielding lands in the Independence Range. A managed grazing program on the remainder of the Federal lands in the sub-basin was not begun, however, until the establishment of the Grazing Service, now the Bureau of Land Management, in the Department of the Interior in 1935. At this time the Elko Grazing District was set up to manage these lands, presently called the national land reserve.

Three soil conservation districts operate in the sub-basin, and provide assistance to ranch operators in the conservation and development of the soil, water and range resources on privately owned lands. These are the Starr Valley and Owyhee Districts, organized in February 1946, and the Humboldt River District, organized in September 1950. The Humboldt River and Owyhee Soil Conservation Districts are furnished technical assistance by personnel of the Soil Conservation Service at Elko, while the Starr Valley District is provided assistance by personnel of the Soil Conservation Service at Wells.

### Floods

This sub-basin, along with the rest of the Humboldt Basin, has suffered from recurrent periods of flooding and high water, particularly along the lower North Fork reaches. The earliest flood year of record along the Humboldt River and its tributaries, including this sub-basin, was December 1861-January 1862. For further information on the history of the sub-basin's floods and high water periods, refer to the section on flood damage, page 19.

### Fires

The only recent large fire was the 1954 Sixteen Mile Creek fire on 6,080 acres of national land reserve and private land between the Dinner Station and Lone Mountain. The absence of large fire scars on the range and watershed lands of the sub-basin attests to the fact that to this time wildfires have not been significant causative agents of damage.

## PREVIOUS STUDIES

### Corps of Engineers

A reservoir dam has been planned and authorized for construction on the North Fork of the Humboldt River at the Devil's Gate site, 26.4 river miles above its mouth and some 18 miles northeast of Elko, Nevada. The structure would be of rolled earthfill, 124 feet high, and with a crest length of 400 feet. The reservoir would have a gross capacity

of 80,000 acre-feet and would cover an area of 1,640 acres when full. This reservoir would provide for flood control, irrigation, recreation, and sediment storage. A re-evaluation study by the Corps was recently completed and the project was found to be economically feasible.

### Other Studies

Other technical reports covering limited or specialized fields have been made at various times in the sub-basin. Their titles are listed in the reference section of this report.

## GENERAL SUB-BASIN CHARACTERISTICS

The North Fork Sub-Basin lies approximately in the central part of Elko County, draining into the Humboldt River about 15 miles northeast of Elko. The drainage area is generally rectangular in shape; its maximum dimensions are 47 miles long and 32 miles wide. It contains approximately 692,300 acres, or 1,082 square miles.

Physiographically the watershed includes three land forms: The mountain highlands, the valley uplands, and the valley lowlands. Throughout the mountain highlands, bedrock is exposed or lies at shallow depths. The uplands have been desiccated by rejuvenated cycles of erosion, and four surfaces are developed sloping away from the mountain fronts at one and one-half to four percent. The surfaces are graded to former stable elevations of the river. A fifth lower surface includes the river flood plain. Locally, remnants of the second and fourth surfaces occur, but they are indistinct. The other three surfaces are prominent and well developed throughout the sub-basin. The upper surface is a broad pediment covered with a veneer of hard, siliceous gravel. The lower surfaces are terraces. The valley lowlands include the floodplain and lowlands along the North Fork of the Humboldt River and its principal tributaries. They are underlain by unconsolidated to poorly consolidated Quaternary alluvium, and by partially consolidated Tertiary sediments.

Glacial features developed by minor alpine glaciation are present in the highest mountains. They include cirques, which are steep-walled, amphitheatrical recesses in a mountain caused by glacial erosion, and glacially carved valleys which continue downward from the cirques. In the northern Independence Mountains glacial till has accumulated at an elevation of about 8,000 feet. The serrate ridge along the summit of the northern Independence Mountains is formed by coalescing cirques. (See photograph 2.)

### Geology

The Paleozoic rocks in Nevada belong to two broad sequences of rocks with different lithology. The western sequence is composed of a large proportion of chert, slate, impure quartzite, graywacke, and chiefly andesitic metamorphosed volcanic rock. The eastern sequence consists predominantly of carbonate rocks and some quartzite, shale, and conglomerate.

*Photograph 2. - North end of the Independence Mountains (Pratt Creek north to Peterson Creek), west of Nevada Highway 46. Note evidences of minor alpine glaciation at the higher elevations, such as cirques, rounded valleys, and the presence of glacial till (terminal moraines) at their lower edges. Jack Peak in center of photograph.* N-698-10 FIELD PARTY PHOTO

Rocks of the western sequence occur in the northern Independence Mountains overlying rocks of the eastern sequence. The western sequence rocks were thrust onto the eastern sequence rocks by major low-angle thrust faulting.

Evidence of major low-angle thrust faulting is also present on the flanks of Lone Mountain and in the northeastern part of the Adobe Range. At Lone Mountain, thin-bedded to massive limestone, shale, and calcareous siltstone of the eastern sequence occur beneath overthrust clastic rocks, chert, shale, and volcanic rocks of the western sequence. Trace of the thrust is marked by a thick zone of breccia which crops out along McClelland Creek north of Lone Mountain.

Major block faulting formed the east and west margins of the northern Independence Mountains. Maximum vertical displacement of the northerly trending high-angle fault along the western margin is about 4,000 feet. The range is possibly tilted toward the west with the east marginal fault having more apparent displacement than the west marginal fault.

Partially consolidated sediments of the Humboldt formation were deposited during Tertiary (late Miocene and possible early Pliocene) time in the fault-block basins adjacent to the elevated mountains. They lie unconformably on consolidate Paleozoic sediments. Warping and block faulting occurred during and after deposition of this formation, and the beds are generally disturbed more near the margins of the faulted mountain blocks and less

farther from them.

Late Tertiary lava flows and related volcanic rocks were extruded onto deposits of the Humboldt formation and consolidated Paleozoic sediments, and sometimes were interbedded with deposits of the Humboldt formation. Erosion resistant volcanic rocks are widespread throughout the sub-basin, and typically crop out as broad areas of low to moderate relief. In some places tributaries of the North Fork of the Humboldt River have eroded narrow, incised canyons through the lava flows.

At the northern end of the Independence Mountains Miocene volcanic rocks occur which consist of rhyolitic welded crystal tuff with some agglomerates near the base. Their thickness is at least several hundred and perhaps over 1,000 feet. They were extruded possibly during deposition of the upper volcanic member of the Humboldt formation. In this area they overlie Paleozoic western sequence rocks.

## Ground Water

The chief source of ground water is precipitation on the mountain and upper valley slopes. Consolidated Paleozoic rocks including quartzite, siliceous argillite, chert, limestone, and minor volcanic rocks crop out in the mountains and underlie deposits of the Humboldt formation and Tertiary volcanic rocks. Water percolates through the consolidated rocks mostly in joints, fractures, crushed zones, and along bedding planes. Solution channels, which were formed by solution of the limestone along openings through which water can percolate, occur in the limestones.

Percolation of water through the Tertiary lavas and related volcanic rocks occurs in joints and fractures, and along the zone of contact between flows. Some tuffaceous pyroclastic deposits are porous, and under the ground water table they are saturated, but they have a low permeability and transmit water rather slowly.

Permeable horizons or lenses in unconsolidated quaternary alluvium probably constitute the most important ground water reservoir in the sub-basin. A secondary but important reservoir consists of permeable zones in partially consolidated Tertiary sediments.

## Soils

The soils throughout the sub-basin are varied as to depth, texture, and drainage. In the mountain highlands they are shallow to deep; medium to stony or rocky medium textured, and are well to excessively drained. The valley uplands have soils that are moderately deep, medium to stony or gravelly medium textured, and well drained. There are some areas where a hardpan can be found at moderate depths. The soils in the valley lowlands are generally deep, medium or fine textured and moderately well to poorly drained. There are areas in the southeast part of the sub-basin with strong alkali concentrations. (See tables 8 and 9, Appendix I.)

## Precipitation

The average annual precipitation at points in and around the sub-basin, as determined from the U.S. Weather Bureau records and the Federal-State-Private Cooperative Snow Survey measurements, is as follows:

| Station | Ave. precip. | Elevation | Years of record |
|---|---|---|---|
| Halleck | 8.1 | 5,229 | 33 |
| Elko | 8.6 | 5,075 | 93 |
| North Fork Maintenance Sta. | 9.9 | 6,200 | 36 |
| Tuscarora | 13.7 | 6,000 | 50 |
| | Storage Gage | | |
| Hanks Creek | 9.5 | 6,700 | 12 |
| Jack Creek Pass | 32.2 | 7,725 | 14 |
| Ganz Creek (Saval Ranch) | 11.0 | 6,360 | 12 |
| Adobe Summit | 9.2 | 6,600 | 9 |
| Willow Creek Summit | 10.8 | 6,370 | 9 |
| | Snow Survey Measurements (April Average) | | |
| Fry Canyon | 9.2 | 6,700 | 21 |
| Rodeo Flat | 8.7 | 6,800 | 21 |
| Tremewan Ranch | 0.8 | 5,700 | 20 |
| Big Bend | 9.8 | 6,700 | 35 |
| Gold Creek | 6.0 | 6,600 | 23 |
| 76 Creek | 11.8 | 7,100 | 13 |
| Upper Jack Creek | 10.9 | 7,250 | 21 |
| Lower Jack Creek | 2.5 | 6,800 | 19 |
| Jack Peak | 25.4 | 8,420 | 5 |
| Laurel Draw | 6.5 | 6,700 | 21 |
| Taylor Canyon | 3.5 | 6,200 | 21 |

The above data indicate that the average annual precipitation would vary from around nine to 15 inches for the irrigated land to 20 inches on Lone Mountain (8,000 to 9,000 feet) and 35 inches around Jack Peak (9,000 to 10,000 feet).

## Growing Season

There is one temperature recording station in the sub-basin. This station is located at the Saval Ranch; it has one and one-half years of record from August 1961. On the basis of temperature records for similar adjacent areas, the growing season (28 degrees F) for the irrigated lands is estimated to vary between 100 days in the south and 80 days in the northern part of the area.

## General Cover Conditions

The predominant plant cover over much of the sub-basin is big sagebrush (Artemisia tridentata)-grass. Within this type, low sagebrush (Artemisis arbuscula-Artemisia nova)-

grass is found on large claypan bench areas on the north and west slopes of the Adobe Range at the head of Sixteen Mile Creek, with interlacings of big sagebrush in the swales and on the deeper soils. The type also occurs on each side of the North Fork between Double Mountain and the Independence Mountains.

Extensive phreatophyte areas, principally rubber rabbitbrush (Chrysothamnus nauseosus) with some greasewood (Sarcobatus vermiculatus) have developed along the lower North Fork bottoms between Devil's Gate and the Humboldt River. Large rabbitbrush types are also found along the lower reaches of Twelve Mile, Dorsey, Pie, McClelland, and Ganz Creeks. Rabbitbrush stringer types are found along lower Beaver Creek, extending northward along most of the West Fork of Beaver Creek to its headwaters. Willow stringer areas line the North Fork channels from south of the Devil's Gate Ranch all the way to the headwaters of North Fork and its tributaries.

On the national forest lands in the Independence Range aspen (Populus tremuloides) stringer types, interspersed with small mixed grass-forb meadows, occupy the bottoms and small basins of all the North Fork tributaries, particularly from Pratt Creek southward to Winters Creek (see photograph 3). Small stringers or pockets of aspen are also found in the basins on the east exposures of Lone Mountain, as well as at the heads of Pie Creek, McClelland Creek, and Coal Mine Canyon.

Mixed sagebrush-browse-grass clothes the drier slopes and benches above the stream bottoms in the Independence Mountains. This type gives way to mixed stands of subalpine fir (Abies lasiocarpa) and limber pine (Pinus flexilis) in the high basins and on north and easterly exposures from Pratt Creek northward to the North Fork. (See photographs 3 and 4.)

The perennial grasses - bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis) and Nevada bluegrass (Poa nevadensis) - which once constituted the understory of the sagebrush-grass and mixed browse-aspen-grass cover types, have largely disappeared over much of the sub-basin. These desirable forage species are now found in significant quantities only on the national forest lands or on protected, remote, or inaccessible relict areas of the national land reserve and privately owned range lands. Through grazing overuse, primarily by domestic livestock, most of this perennial grass understory has been replaced by cheatgrass and such increaser (less desirable) forage species as big sagebrush, Sandberg bluegrass (Poa secunda) bottlebrush squirreltail (Sitanion hystrix) and small amounts of needlegrass (Stipa spp.).

Much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet meadows in the larger stream bottoms has disappeared through overuse and desiccation by channel cutting. These species have been largely replaced by relatively worthless rabbitbrush, with small areas of greasewood and saltgrass (Distichlis stricta) on the more saline or alkali-laden sites.

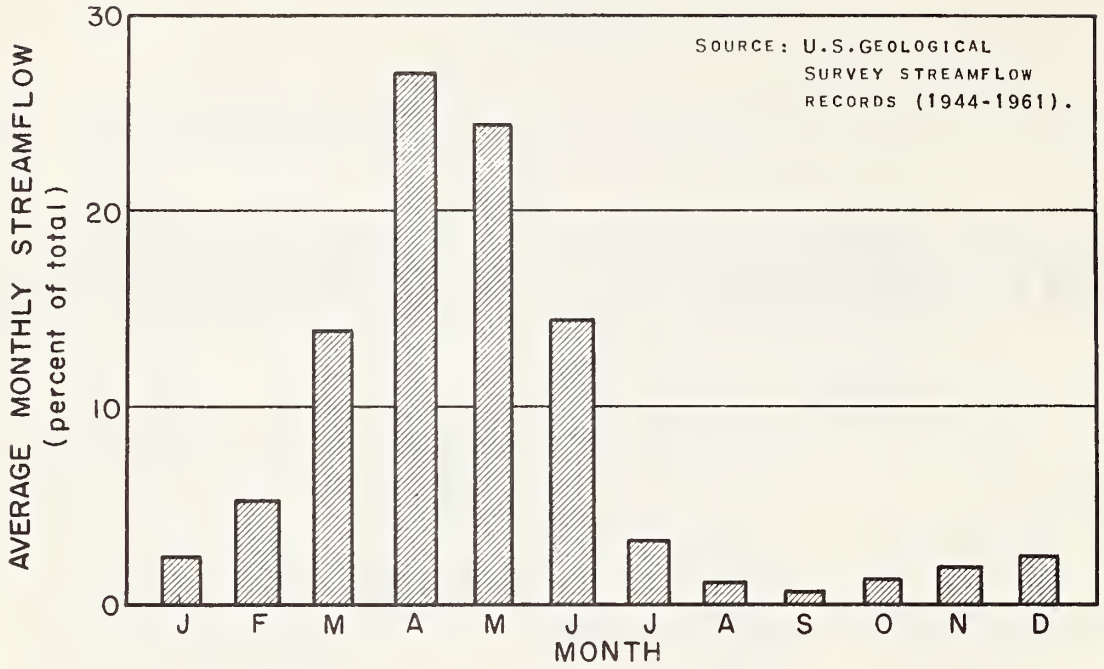
Over-populations of beaver on the headwaters of many streams emanating from the Independence mountains, such as Winters Creek, upper Ganz Creek, Pratt Creek, and the upper North Fork, are raising havoc with the aspen stands in these locations. Many groves of aspen, so important from a soil-binding as well as an aesthetic and recreational

*Photograph 3. - Aspen stringer type along lower Pratt Creek, Humboldt National Forest, looking west toward the highest crests of the Independence Mountains. Scattered individual trees and thin stands of limber pine may be seen along these crests, and on the slopes of Jack Peak, in the extreme right background.*

N-703-12 FIELD PARTY PHOTO

*Photograph 4. - Subalpine fir timber along bottoms and north exposures, upper MacAfee Creek, Humboldt National Forest. Note cirque headwall along the Independence Range crest in the background.* FIELD PARTY PHOTO

*Figure 2.-- Annual streamflow distribution, Devil's Gate near Halleck, North Fork Humboldt River*



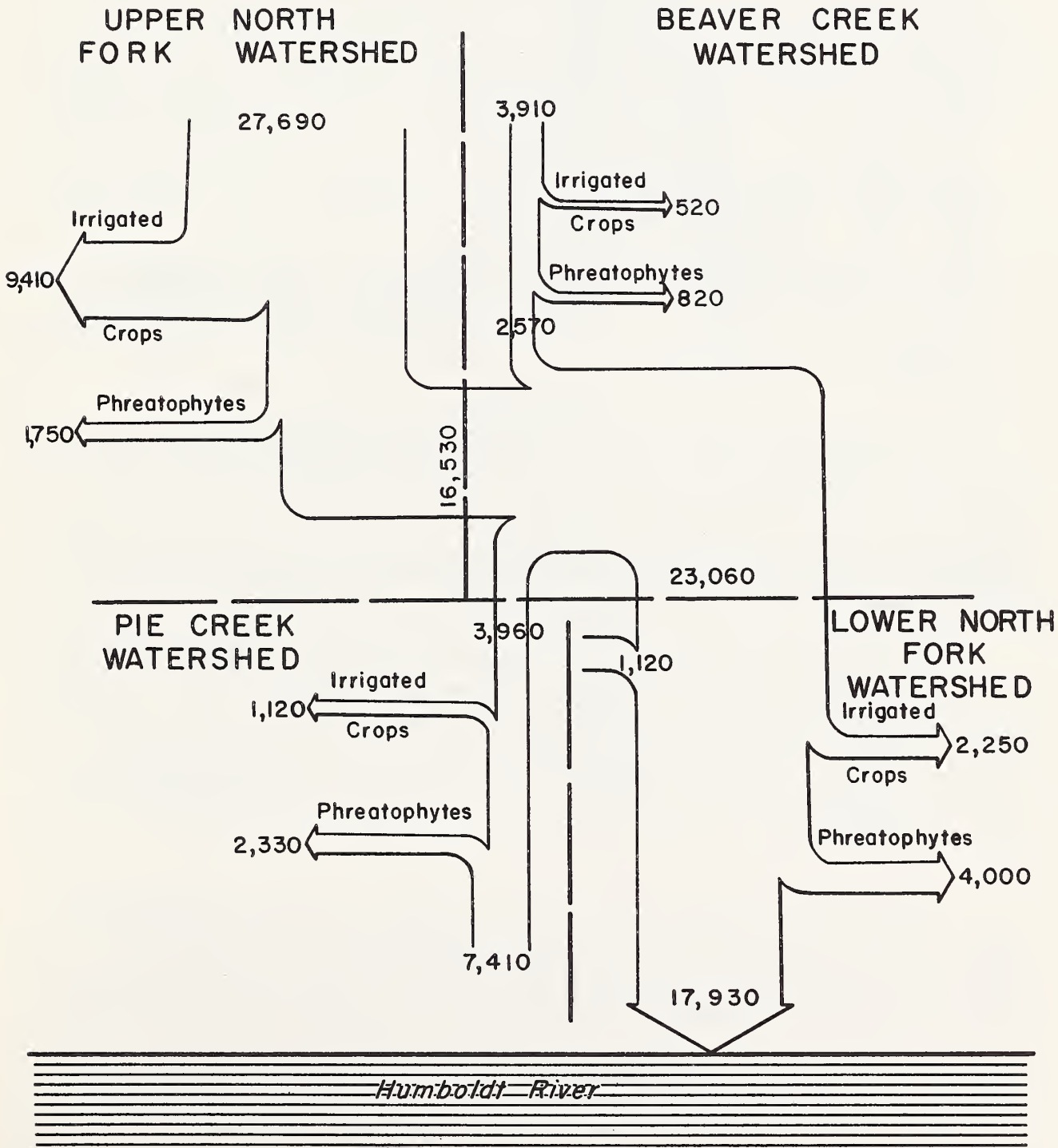

## Land Use

The national land reserve lands are used primarily for spring-fall and summer range for domestic livestock and as year-long range for big game and other wildlife. Land classification, fire protection, and recreation are important phases of the Bureau of Land Management program. The long range land program includes the encouragement of land exchanges, in order to establish a more desirable land pattern. The Bureau's proposed recreation development program is briefly outlined in table 4.

As directed by the Multiple Use-Sustained Yield Act (Public Law 86-517) of 1960 the Forest Service administers the lands within the Humboldt National Forest to coordinate the various uses of resources - outdoor recreation, range, timber, watersheds, and wildlife and fish - without impairment of the productivity of the land. Uses of these valuable watershed lands must be carefully integrated to avoid damage. About 69 percent of the water in this sub-basin originates on the high-elevation national forest watersheds in the Independence Mountains.

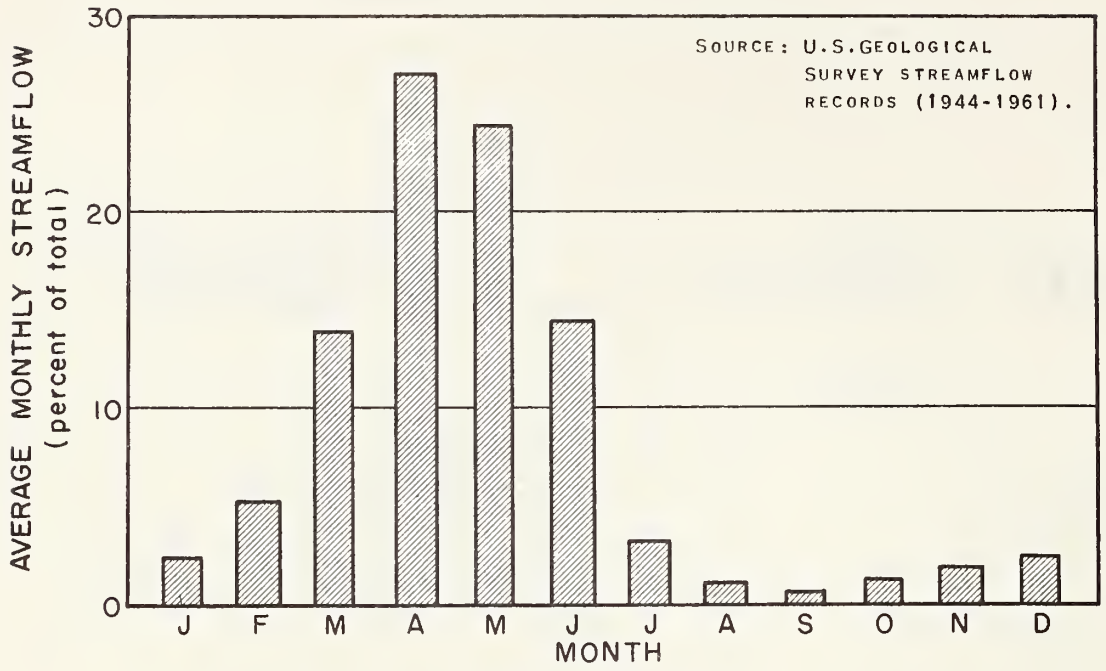
Private lands are used for the production of irrigated hay and pasture and range forage. Some of the range land is in the higher mountains, and is part of the water-yielding area. In many instances exchange of use agreements and private land permits are granted the owners of private intermingled lands and these areas are then administered with public lands by the Bureau of Land Management and the Forest Service. The bulk of the current grazing on national land reserve range is on community allotments; however, individual and small group allotments have been agreed upon, and are in the process of being fenced.

*Figure 1.-- Flow diagram of water yields and depletions in acre-feet for watersheds in North Fork Sub-Basin (80% frequency)*




SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

*Figure 2.-- Annual streamflow distribution, Devil's Gate near Halleck, North Fork Humboldt River*

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The acreage of land irrigated and the acreage of cropland harvested vary widely from year to year depending on precipitation and stream flow. About 14,900 acres are currently being irrigated; 14,100 acres are used for the production of meadow hay and pasture, and 800 acres for alfalfa. Practically all the irrigated land is used to produce winter feed for livestock.

## Water Rights

Determination of water rights was established by the Edwards Decree of 1935 and subsequent permits from the State Engineer's office. In general, the decree provides for a flow of 1.23 c.f.s. per 100 acres of decreed land, or at proportional rates. The following table shows the duty of water, the acre-feet of decreed water, and the acres of decreed land in the sub-basin:

| Class of Land | | Dates of use | Number of days | Decreed water (acre-feet) | Decreed land (acres) |
|---|---|---|---|---|---|
| Harvest crop | (A) | 4/15-8/15 | 120 | 52,238 1/ | 17,525 2/ |
| Meadow pasture | (B) | 4/15-6/15 | 60 | 357 | 238 |
| Diversified pasture | (C) | 4/15-5/15 | 30 | 378 | 512 |
| Total | | | | 52,973 | 18,275 |

1/ Includes 1,663 acre-feet under permit.
2/ Includes 681 acres under permit.

## Water Use

The annual water balance studies made by the Field Party show that during an 80 percent frequency flow year the approximate gross water yield (available water prior to irrigated crop and phreatophyte use) is used as follows:

| | Acres | Water use acre-feet |
|---|---|---|
| Irrigated crops | 14,900 | 13,300 |
| Phreatophytes | 11,800 | 8,900 |
| Outflow to Humboldt River | ------ | 17,900 |
| Total | | 40,100 |

### Surface Water

The dominant use of water is for irrigation. Culinary and stock water use, while of strategic importance with respect to location, quality, and availability, do not require very large quantities. There are a number of ponds and seeps used for stockwater.

The hay lands and phreatophyte areas are located principally along the stream bottoms, with some irrigated hay land on high flood plains. Most of the native hay and pasture land is irrigated continuously during the period of high seasonal stream flow. The

remainder receives water at periodic intervals when it is available.

While use of water for irrigation and other downstream needs is highly important, the on-site requirements are also significant. Trees, shrubs, and grass must have sizeable quantities of water to remain vigorous and keep the watershed in a strong hydrologic condition. Downstream values are dependent on a healthy watershed to prevent damages from floods, sediment and debris. The water used to satisfy on-site requirements, not shown in the above table, is that quantity which is retained in the soil. In addition, water is needed in lakes and streams for fish, aesthetic values, recreation activities, livestock, and game animals. Other on-site uses of water in the North Fork Sub-Basin are minor.

### Ground Water

Detailed ground water studies have not been made, except for single well locations. About 800 acres of alfalfa below Devil's Gate are irrigated in the spring by surface flow, and supplemented late in the season with water from one well and with water pumped from a pit in the North Fork bottom. The well has an estimated capacity of 1,200 g.p.m. Another irrigation well is being developed on this ranch.

Other ground water use is by phreatophytic plants (8,900 acre-feet) and several low capacity stockwater wells.

### Irrigation Methods

There is a limited amount of improved irrigation development in the area. These developments consist of some land smoothing, land leveling, drainage, diversion structures, spreader ditches, four irrigation water storage reservoirs, two overnight storage reservoirs, and one irrigation well.

Irrigation is principally by a semi-controlled type of wild flooding. Very limited use has been made of border irrigation. Water supplies from surface streams vary widely throughout the irrigation season, which makes the regulation of water difficult. During the high runoff period streamflow is either diverted or spreads out over meadow and pasture lands naturally. Ditches are used to spread the water over the land. By this method of irrigation water is generally kept on the fields much longer than is needed to saturate the soil; this results in low irrigation efficiency, loss of fertility, and lower yields. Meadow hay and pasture forage receive part of their water needs from shallow ground water.

## THE AGRICULTURAL INDUSTRY

Agriculture in the North Fork Sub-Basin is dominated by the range livestock industry. There are at present 10 operating ranches with headquarters in the sub-basin. Currently, livestock enterprises consist almost entirely of production and sale of lambs, wool, and feeder cattle. Livestock numbers on sub-basin ranches based on Forest Service permits and Bureau of Land Management licenses for 1962, were estimated at 15,400 cattle and horses and 14,800 sheep.

Federal lands provide most of the spring-fall and summer feed for the breeding herds. Of the total livestock feed required, the Federal and intermingled private rangelands furnish forage for approximately 86,000 AUM's of cattle and horses and 7,500 AUM's of sheep. The balance of feed is provided by two or more months grazing on private range land, crop aftermath, adjacent dry and irrigated pasture, and three to four months on hay.

### Markets

The livestock shipped from the area constitute the only agricultural export of significance. They are mostly sold on the ranch to outside buyers and shipped to destination by truck at the buyer's expense. Cattle sold are chiefly calves, long yearlings, and cull cows consigned to feed yards in the neighboring States. Lambs are sold to buyers who consign them directly to packers or to feed yards. Generally, about 60 percent of the lambs go direct to packing plants. It is estimated that more than 80 percent of the livestock go to California for slaughter or to the feed lots, with the remainder going to southern Idaho, Oregon and small numbers to feed lots in other western and mid-western states.

### Transportation

Transportation facilities available to the area are adequate. Two interstate rail lines, Southern Pacific and Western Pacific, serve the area and provide daily schedules from Elko and Wells to the west coast and to Oregon and Salt Lake City and points east. Both railroads offer livestock transportation service, with loading facilities at Elko and Halleck.

Several motor freight common carriers maintain terminals in Elko, provide pickup and delivery service at Halleck and Deeth, and interstate service to all parts of the nation. Livestock transportation service is provided by local truck carriers, as well as by a number of truck carriers from Idaho and California.

Transcontinental U.S. Highway 40 (Interstate 80) at Elko, Halleck, and Deeth links the area with all eastern and western points. U.S. Highway 93 at Wells links the area with all northern and southern points. Nevada Highway 43 traverses the sub-basin and links U.S. 40 at Elko with points in southern Idaho and Oregon. Numerous other roads and truck trails provide access to most parts of the area, at least during good weather.

Air transportation is available at Elko, with United Airlines providing a daily flight schedule - one east and one west.

## WATER-RELATED PROBLEMS IN THE SUB-BASIN

### Agricultural Water Management

#### Seasonal Distribution of Water

It is necessary that the water for the major acreage of cropland be applied during

the high runoff period. Irrigated lands, for the most part, receive but one irrigation from surface flow. The number of acres harvested for hay varies each year, depending on the available water supply. These conditions result in the production of low-yield forage plants which will tolerate wide extremes in soil moisture over extensive periods of time.

## Soils

Areas in which problems occur in soils are the valley bottomlands and the valley uplands or terraces.

The soils in the bottomlands are principally Alluvial and Humic Gley. They are usually deep, with some stratification, and are imperfectly to poorly drained. The problems are flooding, high water table, poor drainage, and salt and alkali concentrations.

The valley uplands or terrace soils are principally Alluvial. They are generally either shallow to gravel or to a hardpan. The problems are excess drainage in one condition and poor drainage in the other.

## Control of Water

There are four relatively small irrigation reservoirs in the sub-basin. Each of these serves but one owner. Storage development has been limited, partially because of the lack of good sites at desirable locations.

With lack of irrigation water storage, it becomes necessary to irrigate by direct diversion from streams. The water is spread over the fields by use of spreader ditches, which in most cases are spaced too far apart to obtain a uniform irrigation. Most of the ditches are not equipped with turnouts, drops, or headgate structures which would give adequate control of the water. Part of the fields which have been leveled are not currently being irrigated.

## Irrigation Efficiency

On-the-farm irrigation efficiency is quite low; it is estimated at 20 percent. Some of the conditions which contribute to this low efficiency are over-irrigation, undulating field surfaces, lack of water control structures, and poor seasonal distribution of water.

## Seepage Loss

Water loss from surface flow was observed to be high in ditches and creek channels flowing over alluvial fans. Except for the water used by phreatophytic plants, most of this seepage loss returns either down stream or to the Humboldt River.

More late-season irrigation water would be available to lands on the alluvial fans in the sub-basin, except for the seepage losses.

## Drainage

Salt and alkali concentrations and high water tables limit the type of crops that can be grown, and the yields of these crops, in certain areas of the sub-basin. Some of the trouble spots are caused by over-irrigation of lands upstream. They are individual enterprise problems.

## Flood Damage

The North Fork Sub-Basin, particularly in its lower reaches, has been subjected to many periods of flooding or high water. Of the two types of floods - wet-mantle and dry-mantle - which have produced damage, the wet-mantle has been by far the most destructive, in terms of recorded flood, erosion, and sediment damage. The dry-mantle type has occurred less frequently, typically during the summer months, and is usually localized at the stream sources on the higher watersheds.

### Wet-Mantle Floods

No specific mention of flood damage in the sub-basin has been found prior to the wet-mantle floods of 1910. Damages and livestock losses were undoubtedly incurred from the high waters of the system-wide March-June 1890 flood along the Humboldt, the product of the melting of massive snow accumulations from the "White Winter" of 1889-90.

February 18 - March 15, 1910. - North Fork headwaters, combined with those of Mary's River, inflicted downstream damage to the railroads above Elko and in Elko itself. Watershed vegetal and soil erosion damage occurred on North Fork, from its junction with Beaver Creek downstream to the Humboldt at Ryndon. Considerable loss of livestock was reported.

February 24 - March 5, 1917. - This wet-mantle flood, which affected only the upper Humboldt and its tributaries above Beowawe, caused some livestock loss, and extensive floodwater damages on upper North Fork above the Haystack Ranch through prolonged field inundation. Some structural damage there was also involved. On lower North Fork, the lowlands in the vicinity of Ryndon were deeply covered with water.

April 3 - May 1, 1942. - The greatest flood on the upper Humboldt since 1910, although not as extensive or severe in its downstream effects as was the 1943 flood the following spring. Flooding, channel cutting, and sediment damage developed along Dorsey, Pie, Beaver, and other upper North Fork tributaries. High waters on lower North Fork caused some flooding along U.S. 40 and the adjacent railroads, and contributed to extensive flooding in Elko.

January 21-27, 1943. - Upstream damages and losses were similar to those of 1942, but greater floodwater volumes were produced in the lower reaches of the North Fork. This resulted in the undermining of the low concrete U.S. 40 North Fork bridge the morning of January 23. It dropped into and dammed the stream for about seven hours. A section of adjacent highway fill finally gave way, and this North Fork crest, when added to

the already swollen Humboldt, caused the river to sweep over the levees erected in Elko after the 1942 flood there. Besides the heavy flood damages in Elko, caused primarily by the North Fork surge of water, $10,000 damages were inflicted to the highway bridge and its approaches at the North Fork. The highway remained completely closed for 11 days; this closure inflicted further damages to cities and towns all along the Humboldt and farther west through the loss of income involved in the stoppage of highway traffic.

February - May 1952. - A system-wide flooding of the Humboldt, resulting from the melting of enormous masses of snow accumulated during the winter of 1951-1952. Heavy flooding and prolonged inundation occurred along the North Fork, particularly on its lower reaches, with resultant soil and stream channel damage. However,flood conditions were not as severe as in either 1942 or 1943.

February 9-13, 1962. - The severest flood of record on the North Fork and its tributaries. Heavy sheet erosion, channel cutting, and sediment damage on Sixteen Mile, Dorsey, Pie, and Beaver Creeks, as well as on lower North Fork and its tributaries and Twelve Mile Creek. The road to the Devil's Gate ranch from U.S. 40 was washed out, as well as the stream gaging station and the bridge at Devil's Gate itself. Widespread damage was done to irrigation ditches, headgates, and cultivated fields, particularly on the Devil's Gate ranch. Some cattle were also lost here. The U.S. 40 highway bridge over the North Fork, built higher after the 1943 flood, had its eastern approaches undermined, resulting in a two-day closure of the highway (see photograph 5 and 6). This same North Fork crest, when it reached the Humboldt main stem at Ryndon, severely weakened the Western Pacific bridge there, contributing to its eventual loss the next day.

*Photograph 5. - Damage to North Fork Bridge, U. S. Highway 40, February 13, 1962. Looking west.* N-670-3 FIELD PARTY PHOTO

*Photograph 6. - Closeup of underside of North Fork Bridge, February 13, 1962, showing North Fork high waters and damage to bridge abutment on left side of photograph. Looking west.* FIELD PARTY PHOTO

## Dry-Mantle Floods

August 1961. - A series of almost State-wide daily thunderstorms during this period caused localized dry-mantle flooding on upper Beaver Creek east of Double Mountain. No instances of flood damages from these storms have been found for any other North Fork tributary, or for North Fork itself. The August 6 storm which produced overland flows and flooding around Elko and north from there did not result in even a slight stream level rise on the lower North Fork.

## Vegetation - Kind and Condition

### Range and Watershed

Watershed conditions in this sub-basin, although far from what they should be, are probably superior to any of the other Humboldt sub-basins, at least in the high-yielding watershed areas. Table 1 indicates the acreage by classes of present annual forage production, grouped by soils for each vegetal type and site. The rates in this table are indicative of the total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities.

These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

Table 1. -- Acreage of present annual forage plant production classes, grouped by soil associations for each vegetal type and site, North Fork Sub-Basin

| Vegetal type and site | Acreage of forage plant production classes | | |
|---|---|---|---|
| 1. Rabbitbrush-greasewood-grass; saline bottomland | Production classes (pounds per acre) 1/ 850-1,500 | 200-900 | 20-300 |
| Soil associations | (acres) | (acres) | (acres) |
| A5-H3 | ----- | ----- | 7,700 |
| H2-A2 | ----- | ----- | 7,100 |
| Subtotal | ----- | ----- | 14,800 |
| 2. Meadow grasses-forbs-sedges; semi-wet meadow | Production classes (pounds per acre) 1/ 1,200-3,000 | 600-2,000 | 200-1,000 |
| Soil associations | (acres) | (acres) | (acres) |
| A5-H3 | ----- | ----- | 2,200 |
| H1-H2 (80-20) | ----- | ----- | 7,100 |
| H1-H2 (90-10) | ----- | ----- | 2,300 |
| H2-H4 | ----- | ----- | 8,900 |
| Subtotal | ----- | ----- | 20,500 |
| 3. Big sagebrush-grass; upland benches and terraces | Production classes (pounds per acre) 1/ 250-600 | 100-450 | 20-250 |
| Soil associations | (acres) | (acres) | (acres) |
| B11-B5-B4-C2 | 300 | 2,300 | 12,200 |
| B11-B10 | ----- | 10,700 | 25,500 |
| B11-C2-S3-L3 | 6,200 | 6,600 | 64,500 |
| C6-B4-L11 | 700 | 49,800 | 96,900 |
| C4-B10-L1 | ----- | 6,800 | 3,400 |
| L12-B3-C1 | ----- | 3,400 | 1,300 |
| S3-S10 | ----- | ----- | 11,900 |
| S3-S10-L6 | ----- | ----- | 16,200 |
| S4-S10-Y2 | ----- | ----- | 42,900 |
| S4-Y2 | ----- | ----- | 21,700 |
| S10-S3-B11 | 3,300 | 2,300 | 48,900 |
| Subtotal 2/ | 10,500 | 81,900 | 345,400 |

Continued

Table 1. -- Acreage of present annual forage plant production classes, grouped by soil associations for each vegetal type and site, North Fork Sub-Basin -- Continued

| Vegetal type and site | Acreage of forage plant production classes | | |
|---|---|---|---|
| 4. Low sagebrush-grass; claypan bench | Production classes (pounds per acre) 1/ 200-500 | 100-250 | 50-150 |
| Soil associations | (acres) | (acres) | (acres) |
| B11-B5-B4-C2 | ----- | 500 | 12,300 |
| B11-C2-S3-L3 | ----- | ----- | 9,700 |
| C6-B4-L11 | ----- | 9,800 | 36,700 |
| S10-S3-B11 | ----- | 2,700 | 6,700 |
| Subtotal | ----- | 13,000 | 65,400 |
| 5. Browse-aspen-grass; intermediate mountain slopes | Production classes (pounds per acre) 1/ 300-650 | 150-350 | 50-200 |
| Soil associations | (acres) | (acres) | (acres) |
| C6-B4-L11 | ----- | 2,800 | 3,500 |
| C4-B10-L1 | ----- | 300 | 4,100 |
| C4-B10-L11 | ----- | 28,800 | 36,200 |
| L12-B3-C1 | ----- | ----- | 1,200 |
| Subtotal | ----- | 31,900 | 45,000 |
| 6. Browse-aspen-conifer-grass; steep mountain slopes and basins | Production classes (pounds per acre) 1/ 350-800 | 200-500 | 75-250 |
| Soil associations | (acres) | (acres) | (acres) |
| R3-L2-C1-Z | 1,600 | 15,500 | 21,900 |
| Subtotal 3/ | 1,600 | 15,500 | 21,900 |
| Total | 12,100 | 142,300 | 513,000 |

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

The rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher.

2/ Does not include 700 acres of barren or inaccessible.

3/ Does not include 9,300 acres of barren or inaccessible.

Source: Humboldt River Basin Field Party.

Past exploitation and abuse of the range resource by both domestic livestock, and big game in some instances, have adversely affected the watershed cover. This abuse still continues in many portions of the sub-basin, notably on Beaver Creek, the stream bottoms of Sixteen Mile, Dorsey, lower Pie, the benchlands east and west of Nevada 43, and in the sub-basin's lower reaches. (See photographs 7 and 8.) Range and watershed conditions on these areas, and on the benchlands above them, are now a far cry from written descriptions of them in the early 1870's. North Fork and its tributaries were depicted as clear, trout-filled streams, surrounded by range lands "clothed with luxuriant grasses.....a delightful region, represented as the paradise of Nevada."

Extensive acreages of former semi-wet meadow and saline bottomland along the previously named drainages, and many minor drainages in the sub-basin, have dried out through deep gullying along the stream channels. This has led to the thinning or replacement of many stands of ryegrass and other grasses and sedges by rabbitbrush, saltgrass, or greasewood (see photograph 9).

The areas of medium or fairly high forage yields are found primarily on the less accessible middle and upper slopes of the mountains rimming the sub-basin on the west and the northeast. The most extensive acreage of these better forage production classes is found on the Independence Mountains within the boundaries of the Humboldt National Forest (see photographs 10 and 11). On the national land reserve lands, the better forage-producing ranges are found in the Independence Mountains, from Lone Mountain northward to the national forest boundary; on the north side of the Adobe Range; on the head of the East Fork of Beaver Creek, along the Stag Mountain ridge; and on the seeded areas on each side of Nevada 43 (see photograph 12).

*Photograph 7. - Range in low forage production class, North Fork of the Humboldt at its junction with Beaver Creek, looking north into the Beaver Creek basin ( under the large cloud shadows). Jarbidge Range in left center background, Stag Mountain in right background. Through continuous heavy overuse since 1911, the perennial grasses have been almost eliminated. Sagebrush has taken over, leaving large areas of bare soil severely damaged by both sheet and gully erosion.*

N-703-8 FIELD PARTY PHOTO

*Photograph 8. - Former saline bottom ryegrass meadow in low forage production class, lower Dorsey Creek, at its junction with Pie Creek, looking north. (Stag Mountain in center background.) These bottomland meadows were desiccated by the gully seen here on Dorsey Creek, and rubber rabbitbrush has largely replaced the former perennial grasses.* N-704-11 FIELD PARTY PHOTO

*Photograph 9. - Gully in channel condition Class 3 (poor), Long Canyon, west of Devil's Gate Ranch. This gully has desiccated the former ryegrass meadow along the stream bottom. Phreatophytic rubber rabbitbrush and other low-value plants have invaded the site.* N-703-9 FIELD PARTY PHOTO

*Photograph 10. - Range in medium forage production class, toward the head of Pratt Creek, Humboldt National Forest. Good percentage of such decreaser grass species as Idaho Fescue, Hesperochloa, and bluebunch wheatgrass present, but stand is too thin, with the grass clumps slightly hummocked and pedestalled, to place it in the fairly high forage production class.* N-704-2 FIELD PARTY PHOTO

*Photograph 11. - Range in fairly high forage production class, head of California Creek, looking east toward California Mountain, Humboldt National Forest. Dense vegetal cover of such decreaser grass species as bluebunch wheatgrass, Hesperochloa, and other desirable forage grasses, with little or no soil disturbance or loss.* N-698-5 FIELD PARTY PHOTO

*Photograph 12. - Crested wheatgrass seeding, national land reserve, north of the Dinner Station and west of Nevada Highway 43. The pioneer seeding in the upper Humboldt Basin, having been established in the early 1930's by the Intermountain Forest and Range Experiment Station (U.S. Forest Service). It is still productive, with vigorous individual plants, although the stand is thin, and big sagebrush and rabbitbrush are invading in some areas.* N-87-10 FIELD PARTY PHOTO

## Phreatophytes

The phreatophytes of low economic value consist largely of rubber rabbitbrush and greasewood, usually rabbitbrush here, in mixed or practically pure stands. The larger acreages of these types are located as discussed under General Cover Conditions. In addition to these, fringe areas or stringers of rabbitbrush are found on the upper Pie Creek and McClelland Creek tributaries (see photograph 13). Similar areas have also developed along the drainages on each side of Coal Mine Pass; in Long Canyon; and a rather extensive acreage along the lower Twelve Mile Creek bottom (see photograph 14).

Under or between these shrubs will usually be found an understory of Great Basin wildrye of varying density, with bottlebrush squirreltail, annual and perennial mustards, and other worthless forbs.

Extensive areas of willow, with understories of wild rose, perennial grasses and forbs, are located as described under General Cover Conditions. The location of the aspen types within the sub-basin is also described in that section. (See table 2.)

*Photograph 13. - Rabbitbrush stringer type, upper Pie Creek, west of Nevada Highway 43, looking north toward the old Milk-and-Pie Stage Station site.* FIELD PARTY PHOTO

*Photograph 14. - Great Basin wildrye meadow, upper Long Canyon, being invaded from sides by rubber rabbitbrush. The causative agent; meadow desiccation by a large gully just below the meadow, to the left, out of the photograph. Looking westward, upstream.* N-703-10 FIELD PARTY PHOTO

Table 2. -- Phreatophyte acreage and annual ground water use, North Fork Sub-Basin 1/

| Species | Height class | Density | Acreage cropland | Acreage range types 2/ | Annual ground water use 2/ (feet) | Annual ground water use 2/ (acre-feet) |
|---|---|---|---|---|---|---|
| Willow | 8-12' | .2-.3 | ----- | 1,130 | 2.2 | 2,490 |
| Rose | 3-8' | .2-.3 | ----- | 440 | 1.5 | 660 |
| Black greasewood | 3'+ | .04-.05 | ----- | 850 | .3 | 250 |
| Rubber rabbitbrush | 3'+ | .03-.08 | ----- | 6,460 | .4 | 2,580 |
| Great Basin wildrye | ----- | .2-.3 | ----- | 2,920 | 1.0 | 2,920 |
| Subtotal | | | | 11,800 | | 8,900 |
| Irrigated meadow hay and pasture 3/ | ----- | ------- | 2,600 | ------ | .3 | 780 |
| Wet meadow 3/ | ----- | ------- | 340 | ------ | .5 | 170 |
| Subtotal | | | 2,940 | | | 950 |
| Total | | | 2,940 | 11,800 | | 9,850 |

1/ These values when referred to in the text are rounded.

2/ These values are based on natural stand densities and 100 percent composition, for each species, except for the irrigated and wet meadows.

3/ Mixture of Great Basin wildrye, creeping wildrye, sedges, and other grasses.

Source: Humboldt River Basin Field Party.

### Timber Management

There are no commercial sawtimber stands within the sub-basin. On the national forest lands, stands of limber pine and subalpine fir are found in the Independence Mountains on the north exposures and in the high basins of the canyons from Pratt Creek northward to the North Fork. Their greatest importance is watershed protection, coupled with their aesthetic value, and they will be cut only to remove diseased, decadent, or insect-infested trees (see photographs 3 and 4). Aspen, like the conifers here, is most valuable as a protection type, or for its aesthetic value and shade in recreation areas. It is generally removed only in stand sanitation, or to eliminate hazard trees in camp or picnic areas. On sites where stands of aspen are decadent or stagnated, they may be cut for small sales of poles.

The Bureau of Land Management has no commercial timber cutting on the national land reserve lands within the sub-basin. There are no stands of pinyon here, or of commercially valuable juniper. Aspen occurs only in widely scattered stands; its greatest value is for watershed protection and aesthetic purposes.

### Fire Protection

Range and forest fires, although they have not in the immediate past caused any widespread watershed damage in the sub-basin, remain an omnipresent threat. With deterioration or destruction of the original plant cover, whether brought about by fire or other watershed abuse, the vegetal types coming in after the fire increase the fire hazard by providing flash fuels. Fires on the steep, brush-covered, thin-soiled slopes of the Independence Mountains could be seriously damaging to these important water-yielding areas.

Risks of fires caused by the rapidly increasing recreation and hunter use of the watershed lands will continue to mount. The significance of these water-yielding lands to the semi-arid valleys below makes fire protection a factor of increasing importance. Prevention or prompt suppression of potentially disastrous range or timber fires is now and will continue to be an important facet of resource and watershed management.

## RECREATION AND WILDLIFE

### Recreation Developments

As the population buildup continues, and with improved roads and trails, the recreation potential of the sub-basin, particularly of the Independence Mountains, will become better known. With the fuller recognition and development of the largely untapped potentialities for camping, picnicking, back-country travel, and fishing, recreation use will become one of the sub-basin's outstanding assets. This use would be considerably augmented and enhanced with construction of the Devil's Gate dam and reservoir by the Army Corps of Engineers on the lower North Fork (see photograph 15).

*Photograph 15. - Devil's Gate, lower North Fork of the Humboldt River, looking downstream (southward). The area in the foreground would be within the proposed Army Corps of Engineers' Devil's Gate Reservoir. The dam would be located across Devil's Gate itself.* N-703-3 FIELD PARTY PHOTO

Within the sub-basin there are several points of historical significance which warrant marking. They are all associated with the early-day toll roads and the stage and freighting activities incident to the development of the boom towns of Tuscarora, Cope, Cornucopia, and Columbia.

## Humboldt National Forest

At present there is only one recreation development on national forest lands within the sub-basin: the North Fork Campground. In planning for the multiple use of the national forest lands to meet the public's needs until the year 1970 (no projection presently available beyond that date) the recreation survey for the Mountain City Ranger District shows a need for the construction of several new camp and picnic areas. (See table 3.)

A seroius sanitation and fire problem is created each year when overly large numbers of deer hunters crowd into undeveloped areas along the stream bottoms from Winters Creek northward on the national forest. The country including Winters, Mahala, and California Creeks is the scene of the greatest concentrations, because of the good deer hunting there. The more primitive dispersal area camps listed in table 3 would be designed to correct this situation.

## National Land Reserve

Presently there are no developed recreation facilities on the national land reserve within the sub-basin. The Bureau of Land Management, in its recreation inventory report in 1959, proposes the development of several camp and picnic areas here. (See table 4.)

Table 3. -- Planned recreational site development, Mountain City Ranger District, Humboldt National Forest, within North Fork Sub-Basin 1965-2000

| Site name | Ranger District | N.F.R.S. 1/ site number | Development schedule (fiscal year) | Type of development | Acres of development | F.U.'s 2/ planned (approx.) | Multiple Use Management Zone |
|---|---|---|---|---|---|---|---|
| Gravel | Mt. City | 21 | 1975-2000 | Camp | 4 | 12 2/ | Travel influence |
| Beaver Ponds | Mt. City | 22 | 1965-1970 | Camp | 5 | 15 2/ | Travel influence |
| Middle North Fork | Mt. City | 23 | --------- | Camp 3/ | 7 | 9 | Travel influence |
| Upper North Fork | Mt. City | 24 | 1965-1970 | Camp | 4 | 10 | Travel influence |
| Peterson Creek | Mt. City | 32 | --------- | Camp 4/ | 6 | 12 | Intermediate |
| McAfee Creek | Mt. City | 33 | --------- | Camp 4/ | 6 | 12 | Intermediate |
| Pratt Creek | Mt. City | 34 | --------- | Camp 4/ | 15 | 30 | Intermediate |
| Foreman Creek | Mt. City | 35 | --------- | Camp 4/ | 12 | 25 | Intermediate |
| Winters Creek | Mt. City | 36 | --------- | Camp 4/ | 15 | 30 | Intermediate |
| Mahala Creek | Mt. City | 38 | --------- | Camp 4/ | 8 | 15 | Intermediate |
| Ganz Creek | Mt. City | 39 | --------- | Camp 4/ | 8 | 15 | Intermediate |

1/ National Forest Recreation Survey.

2/ Family Units, calculated at 3 units per acre.

3/ Existing Camp Site. No development contemplated.

4/ More Primitive Camps, to be used as dispersal areas for hunters, fishermen, etc. None to be developed prior to 1975. Development will not be as detailed as for the North Fork units.

Source: U.S. Forest Service, Humboldt National Forest.

Table 4. -- Potential developments, recreation inventory report, 1959, national land reserve, North Fork Sub-Basin

| Site name and type of development | Acres | Site devel. cost (dols.) | Access roads: Miles | Access roads: Construction cost (dols.) | Access roads: Right of way acquisition cost (dols.) | Access roads: Yearly maint. cost (dols.) | Trails: Miles | Trails: Devel. cost (dols.) | Water devel. cost (dols.) | Total devel. cost (dols.) | Area affected acres: BLM | Area affected acres: Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beaver Creek camp site | 1 | 500 | 18 | 4,500 | --- | 270 | -- | ----- | 300 | 5,300 | 80 | -- |
| Mason Springs cabin site | 1 | 4,600 | 5 | 2,000 | 600 | 175 | 20 | 1,000 | Inc. in site dev. cost | 8,200 | 160 | -- |
| Pie Creek camp site | 1 | 500 | 7 | 1,400 | 600 | 105 | -- | ----- | 300 | 2,800 | 80 | -- |
| Eagle Rock Stage Station camp | 1 | 500 | 4 | 1,000 | --- | 60 | -- | ----- | --- | 1,800 | 40 | -- |
| Eagle Rock Reservoir camp site | 1 | 500 | 3 | 750 | --- | 45 | -- | ----- | --- | 1,600 | 40 | -- |

Source: Bureau of Land Management, Elko District.

## Wildlife

### Deer and Other Big Game Hunting

The North Fork Sub-Basin is extremely important as a mule deer-hunting area. For a number of years this unit has furnished a significant portion of the deer taken by Nevada residents, both from Elko County and from the other counties of the state. Choice hunting spots are found on the east slopes of the Independence Mountains, with the Ganz Creek area as the focal spot for the heaviest hunting pressure. Late season hunters especially favor the Double Mountain and Beaver Creek country after the deer migration to winter range begins.

Most of the area provides summer range for deer, with the best forage and the highest deer concentrations found within the national forest boundaries. Scattered summer populations are found along the streams tributary to the North Fork. Deer winter in the lower North Fork area on the south slopes of Double Mountain, and the breaks above Devil's Gate. These wintering groups are scattered, with small numbers of deer in the individual groups.

Records obtained by trapping and marking deer, with later recoveries, indicate that deer from this sub-basin winter in such widely scattered areas as the Pequop Mountains, Carlin Canyon, Midas, the Wood Hills, the lower Adobes, the Toana Mountains, Twelve Mile Canyon, Merritt Mountain, and Union Summit in Eureka County.

Access roads for hunting are adequate in this area.

### Fishing

Six of the 12 main tributaries to the North Fork have been surveyed for their fisheries value. Some of the unsurveyed streams, such as Peterson, McAfee, California and Mahala Creeks, support trout in their upper reaches.

The streams which flow from the Independence Mountains are similar in two general respects: they all have small to medium flows and have steep to moderate gradients. The following table indicates the miles of surveyed fishable streams in the Independence Mountains:

| Creek | Miles |
|---|---|
| Foreman Creek | 5.5 |
| Ganz Creek | 4.0 |
| North Fork | 10.0 |
| Pie Creek | 2.0 |
| Pratt Creek | 4.0 |
| Mahala Creek | 3.0 |
| Total | 28.5 |

Most of these streams are diverted for irrigation water in the vicinity of the Humboldt National Forest boundary. If any water is left in the natural stream courses below the diversions, it is usually too scanty or too warm to support trout. Only where an occasional spring feeds the lower stream reaches, such as on lower Pie Creek, can enough water be found in most years for trout habitat. Table 5 furnishes information on the fishable streams planted in the Independence Mountains, dates and rates of planting, and species planted. The fishable streams there which have not been planted generally support a native cutthroat trout population.

The main North Fork channel below the Haystack Ranch has been stocked occasionally over the years. However, recurrent years of low stream flow, combined with critical water temperatures, have militated against the success of these plantings.

There are two privately owned reservoirs, Dorsey Creek (130 acre-feet) and Saval Ranch Pond (20 acre-feet), which are stocked with trout by the Nevada Fish and Game Department, and furnish public fishing. Of future interest is the possible construction of the dam at Devil's Gate and impoundment of an 80,000 acre-foot reservoir. The fisheries potential there would be dependent upon the extent of fluctuation in surface levels. However, it is entirely possible that this area could support 10,000 angler-days per year.

Small Game

The most characteristic small game species of the North Fork Sub-Basin is the sage grouse. It is common throughout the area except in the highest portions of the headwaters, where limited blue grouse populations occur.

The chukar partridge has apparently become well established in the canyon of the North Fork itself between the Haystack Ranch and the Devil's Gate Ranch. Hungarian partridges are uncommon, but are occasionally seen in the Pie Creek and Dorsey Creek drainages. Valley quail have been reported from the Devil's Gate area only. Mourning doves nest throughout the sub-basin and cottontails are common yearlong.

Waterfowl are relatively unimportant in this sub-basin, although a few broods of mallards and green-winged teal are annually produced in the meadows along the North Fork of the Humboldt River.

Table 5. -- Fish stocking history of the North Fork of the Humboldt River and its tributaries, North Fork Sub-Basin

| Year | Foreman Creek: Rainbow (lbs.) | Ganz Creek: Rainbow (lbs.) | North Fork Humboldt: Rainbow (lbs.) | North Fork Humboldt: E. Brook (lbs.) | North Fork Humboldt: Brown (lbs.) | Pie Creek: Brown (lbs.) | Pratt Creek: E. Brook (lbs.) | Dorsey Creek Reservoir: Rainbow (lbs.) | Dorsey Creek Reservoir: E. Brook (lbs.) |
|---|---|---|---|---|---|---|---|---|---|
| 1952 | --- | --- | --- | --- | --- | --- | 350 | --- | 205 |
| 1953 | 175 | --- | 351 | 339 | 752 | --- | --- | 175 | --- |
| 1954 | --- | --- | --- | 904 | 904 | 450 | --- | --- | 150 |
| 1955 | --- | 337 | 910 | --- | --- | 360 | --- | --- | --- |
| 1956 | --- | --- | --- | 1,350 | --- | 450 | --- | --- | --- |
| 1957 | --- | --- | --- | 500 | --- | --- | --- | 500 | 250 |
| 1958 | --- | --- | --- | 500 | --- | --- | --- | 700 | --- |
| 1959 | --- | --- | --- | 716 | --- | --- | --- | 136 | --- |
| 1960 | --- | --- | 750 | --- | --- | --- | --- | --- | 136 |
| 1961 | --- | --- | --- | 528 | --- | --- | --- | 248 1/ | |
| 1962 | --- | --- | 350 | 339 | --- | --- | --- | 456 | --- |

1/ This includes 136 pounds or 544 nine inch fish and 112 pounds or 10,080 three inch fish.

Source: Nevada Fish and Game Department.

## PROGRAMS OTHER THAN PROJECT-TYPE DEVELOPMENTS AVAILABLE FOR THE IMPROVEMENT OF WATER AND RELATED LAND RESOURCES

Lands in the sub-basin can be treated or can receive aid for treatment under existing U.S. Department of Agriculture and other Federal and State programs. The Forest Service and Bureau of Land Management are responsible for range, recreation, and watershed development on the Federal lands they administer. The owners of private land can receive aid for water and related land resources development by means of various programs under the U.S. Department of Agriculture.

Most of the area, except for Pie Creek Watershed, has water and related land resource problems which do not appear to lend themselves to project-type development.

### Technical Assistance and Cost-Sharing Under Public Law 46

Under the provisions of Public Law 46 the Soil Conservation Service furnishes technical assistance through Soil Conservation Districts, and the Agricultural Conservation Program of the Agricultural Stabilization Conservation Service provides cost-sharing. Under these programs, assistance in developing coordinated conservation plans and in applying conservation measures may be furnished for farms and ranches. These plans provide for surveys, land use adjustments, erosion control, water conservation, irrigation, drainage, flood prevention, and recreation development. Solution to the sub-basin problems on private land may be arrived at in part by these programs.

The Soil Conservation Service has the responsibility for leadership in the National Cooperative Soil Survey. With the assistance of several cooperative groups and agencies in this work, soils maps and soil survey reports will be published in the regular schedule of soil survey publications of the U.S. Department of Agriculture.

### Agricultural Water Management

There are many ways of improving water management on individual ranches throughout the sub-basin. Some of the treatments for various types of problems are listed below.

| Problems | Suggested Treatment |
|---|---|
| 1. Limited water supply. | a. Develop irrigation water by drainage of seeps, springs and high water table.<br>b. Control phreatophytic plant growth.<br>c. Construct overnight storage reservoirs, to better utilize small flows for irrigation.<br>d. Clear stream channels of all obstructions and install controllable diversions.<br>e. Investigate possibility of developing irrigation water wells.<br>f. Line or seal ditches through reaches of excessive seepage loss. |

| Problems | Suggested Treatment |
|---|---|
| | g. Stop applying water to fields after soil reaches saturation. |
| 2. Saline soils. | a. Install drains to lower water table.<br>b. Use only good quality water for irrigation to reduce salt concentration in the soil.<br>c. Use proper soil and water management practices. |
| 3. High water table. | a. Install suitable drainage.<br>b. Improve creek channels for drainage outlets, and to reduce frequent flooding of bottomland.<br>c. Check the possibility for pump drainage. This may increase water supply for irrigation.<br>d. Land smoothing to remove low ponding areas.<br>e. Line and seal ditches.<br>f. Stop applying water to fields after soil reaches saturation. |
| 4. Low efficiency use of water. | a. Level or smooth land for uniform water application (see photograph 16).<br>b. Reorganize distribution and irrigation systems (see photograph 16).<br>c. Line ditches through highly permeable soils.<br>d. Stop applying water when soil becomes saturated.<br>e. Plant high-yielding crops suitable for conditions, to reduce irrigated acreage now needed for hay production. |
| 5. Inadequate water distribution systems. | a. Remove "tight dams" and install controlled diversions.<br>b. Reorganize water distribution systems.<br>c. Use lined ditches or pipe lines through highly permeable soils.<br>d. Construct necessary control structures in ditches. |

*Photograph 16. - Land leveling, with border system of irrigation installed, Devil's Gate Ranch. Looking southward, with the snow-capped Ruby Mountains in the far distance.* N-332-11 FIELD PARTY PHOTO

## Vegetal Improvement

Stream bank cutting and channel erosion as well as watershed erosion on privately owned land indicate the need for action to reverse the trend toward meadow desiccation and land deterioration. Each of the following solutions would contribute in some measure to improvement of plant species and cover, which in turn will help reduce this erosion.

| Problems | Suggested Treatment |
|---|---|
| **Irrigated lands** | |
| 1. Low yields. | a. Establish higher-yielding forage crops suitable to the soil and water conditions, for hay and pasture.<br>b. Use irrigation methods that will permit more efficient use of water and create an environment for higher producing forage plants.<br>c. Use feed lots when fields are wet. |
| **Nonirrigated lands** | |
| 1. Range condition static or on decline. | a. Practice rotation-deferred grazing.<br>b. Use bottomland pasture to supplement available range. |

| Problems | Suggested Treatment |
|---|---|
| | c. Control low economic value plant growth to increase forage production.<br>d. Develop a program of seeding the rangelands.<br>e. Establish proper use practices.<br>f. Fence to enable better grazing control and proper range use.<br>g. Improve salting and water distribution for better grazing control. |

Watershed Protection and Erosion Control

The intermingled private range land in the south, as well as the valley upland range land throughout the sub-basin, is generally in poor condition. The sparse cover in this area is conducive to active erosion. The treatment required to reverse the condition trend in this area would include range seeding and control of sagebrush on selected sites, along with good management and proper use.

Channel and gully erosion is active throughout the sub-basin. Permanent type control structures and land treatment measures are needed to protect the existing meadows and restore desiccated meadowlands. In addition, bank sloping, seeding of banks, and channel fencing along selected areas will help heal the erosion.

Possibilities for Water Salvage

Ground water use by phreatophytic plants was estimated to be about 9,900 acre-feet annually. This includes the water used by Great Basin wildrye, creeping wildrye, and other wet meadow species used for hay and pasture in the valley bottoms. The acreage of alfalfa grown in the valley bottoms is comparatively small and therefore was not included.

Phreatophytic plants such as willows, greasewood, rabbitbrush, and wild rose, which are of low economic value, use an estimated 6,000 acre-feet of water annually. More effort should be made to control or replace these water-consuming plants by spraying, deep drainage, and blading. A large portion of this water could be salvaged by the control or replacement of these water consuming plants.

## Forest Service Programs

National Forest Land

Following passage of the Multiple Use-Sustained Act (Public Law 86-517) of June 12, 1960, the Nevada Subregion Multiple Use Management Guide was approved. In this Guide, five Management Zones - Crest, Intermediate, Valley Front, Travel Influence, Water Influence, and one Special Zone - have been delineated for coordination of uses. This is not restrictive zoning, but zoning to fully develop all resources in harmony with

each other.

Management direction and management guides are set up for each zone. Within this framework, a multiple use plan has been developed for each Ranger District on the Humboldt National Forest. In the ranger district multiple use plan, management decisions are made to coordinate uses of resources on individual areas of national forest land within the Humboldt River Basin.

In all cases, the guiding precept of the law provides for "the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people.....without impairment of the productivity of the land."

The Forest Service is cooperating in the National Soil Survey by surveying and mapping of national forest lands. The surveys will be completed as rapidly as time and funds permit.

The regular programs of the Forest Service will provide for many of the watershed land treatment and structural measures needed on the Humboldt National Forest to the extent that currently available funds permit. With the exception of the lands on Ganz Creek, which are within the Pie Creek watershed, none of the needed watershed improvement measures lend themselves to the project-type development. For that reason, the watershed improvement measures needed on the national forest, with the exception of those lands at the head of Ganz Creek, are included here.

Watershed Treatment Measures

1. Continue studies of the feasibility of eventual abandonment of the badly eroded North Fork-Coal Creek sheep driveway, and the installation of erosion control measures (contour trenching and seeding) thereon.

2. Close the steep slopes at the head of Peterson Creek to livestock use, and install erosion control measures thereon (contour trenching and seeding).

3. Adjust livestock numbers to an indicated safe carrying capacity, particularly on the North Fork Canyon cattle allotment and the Beadle's Creek sheep allotment (see photograph 17).

4. Consolidate the national forest land ownership pattern on the eastern slope of the Independence Mountains by a program of land exchange.

5. Improve sheep distribution and uniformity of forage utilization on all sheep ranges; limit use to once-over grazing.

*Photograph 17. - Gully erosion from snowbanks and heavy grazing use on thin soils and steep slopes, head of North Fork Canyon, approximately one mile east of the North Fork - Jack Creek Road summit, looking southward.*

N-704-7 FIELD PARTY PHOTO

6. Rigorous beaver control in North Fork Canyon, Pratt Creek, Winters Creek, Stump Creek, and Ganz Creek. This is imperative, not only from an erosion control standpoint, but to protect the recreation and aesthetic values of the hard-to-replace aspen stands in these canyons, particularly in North Fork. Almost irreparable damage has already been inflicted on the stands in Winters Creek. (See photograph 18.)

7. Maintain wildlife numbers in balance with their food supply.

8. Treat all roads contemplated, in use, or abandoned, to prevent erosion. This would involve in particular the erosion-proofing of approximately 15 miles of low-standard or primitive roads in Jim, California, Foreman, and Pratt Creeks.

9. Off-road cross-country motorized vehicular travel should be controlled, particularly in the steeper terrain.

10. Retire or reconstruct to a suitable standard, on a limited access basis only, the road up Pratt Creek into the Crest Zone in the vicinity of Jack Peak.

11. Fence the management units on the North Fork cattle allotment, to improve livestock distribution and forage utilization.

*Photograph 18. - Aspen grove destroyed by beaver, middle section of Winters Creek, Humboldt National Forest. This is typical of the damage being inflicted by beaver on many of the aspen stands along the North Fork and its tributaries in the Independence Range.* N-698-7 FIELD PARTY PHOTO

## State and Private Lands

Under the auspices of the Clark-McNary Act, the Forest Service cooperates with the Nevada Division of Forestry in its Northeast Elko Fire Protection District and its farm forestry program.

## Bureau of Land Management Programs

### National Land Reserve

The Bureau of Land Management is responsible for the administration and management of approximately 60 percent of the North Fork Sub-Basin. Highlights of the Bureau's range management program include the protection, proper use, and improvement of the national land reserve. In addition, the Bureau cooperates with the Nevada Division of Forestry's Northeast Elko Fire Protection District in fire presuppression and control activities on the intermingled public and private lands.

Adjudication of grazing privileges in this sub-basin has been completed. At the present time, individual and small group allotments have been agreed upon. The fencing of the allotments is in progress and is anticipated to be completed by 1965. After the allotments are fenced, management plans will be devised for each allotment to insure proper use of the forage resources.

The soil and moisture program is integrated with the grazing program and consists

of stabilization and rehabilitation projects necessary to conserve soil, water, and closely related resources. The work also includes improvement of vegetation through natural revegetation, control of undersirable forage plants, and the seeding of more desirable plants as well as soil surveys and hydrological studies on pilot watershed areas. The weed control program on the national land reserve is designed to arrest the invasion of new weed species which are poisonous or mechanically injurious to domestic livestock or threaten the agricultural economy of the area. Another facet of range and watershed management which requires immediate attention is the erosion-proofing or revegetation and retirement of old, abandoned, or low-standard roads, the contributory source of a considerable amount of washing and gullying at present. It is planned that the construction of all new roads will be done to proper standards and with adequate drainage.

Land classification, fire protection, and recreation are important phases of the Bureau of Land Management program. The long range land program includes the encouragement of land exchanges, in order to establish a more desirable land pattern. The Bureau's proposed recreation development program is briefly outlined in table 4.

The national land reserve in the North Fork Sub-Basin, along with intermingled private lands, provides an important winter range for deer, particularly on lower North Fork, Long Canyon, Twelve Mile Creek, and the Coal Mine-Jackstone Creek area. Deer from the Independence Range, Gold Creek, and the Jarbidge Mountains migrate into these areas during the winter months. The Bureau of Land Management has reserved sufficient forage for a reasonable number of big game animals, but a definite deer harvest problem exists on the national land reserve because of limited access to much of the area, and the lateness of the season when the deer move into it.

## Fire Protection

Two Federal agencies and one State agency are charged with the responsibility for fire prevention and suppression within the sub-basin. The Mountain City Ranger District of the Humboldt National Forest is responsible for the protection of the national forest lands in the sub-basin. The Elko District of the Bureau of Land Management is responsible for the protection from fire on the national land reserve. The State of Nevada, through its Clarke-McNary Northeastern Nevada Fire Protection District, protects the private lands, and assists the two Federal agencies with their fire suppression job.

The following factors have helped to keep abreast of the increasing fire risks and hazards:

1. The introduction of new techniques, including more widespread and agressive fire protection.

2. More and better suppression equipment. The three agencies concerned have established an air tanker base at Elko, to be used on the suppression of wild fires.

3. The recognition of high hazard areas from the study of past fire occurrence maps and fuel type maps.

4. Use of improved national fire danger rating sustems.

5. Improved fire detection and radio communications.

6. Inclusion of cooperator ranch crews in Federal and State fire control organizations.

## WATERSHEDS WITH OPPORTUNITIES FOR PROJECT-TYPE DEVELOPMENT

The Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, as amended) authorizes the Secretary of Agriculture to give technical and financial help to local organizations in planning and carrying out works of improvement in watershed or subwatershed areas of 250,000 acres or less. These projects are for: (1) flood prevention; (2) the agricultural phases of water management; (3) recreation development; and (4) other purposes, such as municipal and industrial water supplies, and improvement for fish and wildlife. Project works of improvement include land treatment measures and individual structures having not more than 5,000 acre-feet of floodwater detention capacity, or not more than 25,000 acre-feet of capacity for all purposes.

Watershed projects provide a means for coordinated scheduling of needed improvements on public and private lands which otherwise would only be accomplished over a longer period of time under regular public land programs.

The problems in at least one watershed in this sub-basin, Pie Creek, are such that they can best be handled on a project basis. A project in this watershed would provide for watershed protection, reduce erosion, supply late irrigation water, and a possible recreation development.

### Pie Creek Watershed

Pie Creek watershed includes all the drainages tributary to Pie Creek south of its confluence with North Fork of the Humboldt River.

The Independence Mountains from Ganz Creek south are the primary source of water for this area. The annual water balance study indicated that the gross water yield for an 80 percent frequency flow would be approximately 7,400 acre-feet. From this total an estimated 1,100 acre-feet are used by irrigated crops and pasture, 2,300 acre-feet are used by phreatophytes, and approximately 4,000 acre-feet discharge into the North Fork.

The predominant plant cover over much of the watershed is big sagebrush-grass. The grasses consist of cheatgrass, Sandberg bluegrass, bottlebrush squirreltail, and small amounts of needlegrass. The perennial grasses - bluebunch wheatgrass, Idaho fescue, and

Nevada bluegrass - which once constituted the plant understory of this site have largely disappeared.

Much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet meadow in the larger stream bottoms has disappeared through overuse and desiccation from channel cutting. These species have been largely replaced by relatively worthless rabbitbrush, with small areas of greasewood and saltgrass on the more saline or alkali sites.

At present 69 percent of the range is in a low forage production class, 26 percent in the medium, and five percent in the fairly high forage production class. The proposed treatment measures will increase the acreage in fairly high forage production by over 12 times.

It is proposed that an earth-fill dam be constructed across Pie Creek about three and one-half miles south of its confluence with North Fork. A dam 45 feet high and 300 feet long at its crest would require an estimated 40,000 cubic yards of fill. The reservoir behind this dam would hold the estimated 80 percent discharge, or 4,000 acre-feet of water.

Three thousand acre-feet of this stored water would be used to irrigate about 800 acres of improved hay and pasture forage, as covered by existing water rights. The balance of the stored water would be available for recreational development, which would not be a consumptive use. The croplands would require revised irrigation systems, land smoothing or leveling, diversions, supply and lateral ditches, and the necessary irrigation control structures.

A preliminary evaluation of the works of improvement proposed for this watershed indicated project-type development possibilities sufficient to warrant a more detailed study. (For more detailed information see Appendix I, page 55.)

# REFERENCES

## Books, Handbooks

### History


Camp, Charles L. 1960. James Clyman, frontiersman. The Champoeg Press, Inc., Portland, Oregon. 353 p.

Chittenden, H. M. 1954. The American fur trade of the far west. Academic Reprints, Stanford, Cal. 2 Vols. 1029 p.

Cline, Gloria Griffen. 1963. Exploring the Great Basin. Univ. of Okla. Press, Norman. 254 p.

DeVoto, B. 1942. 1846, year of decision. Houghton-Mifflin, Boston. 538 p.
1948. Across the wide Missouri. Houghton-Mifflin, Boston. 483 p.

Egan, William M. 1917. Pioneering the west, 1846 to 1848. Major Howard Egan's diary. Howard R. Egan Estate, Richmond, Utah. pp. 194-225.

Ewers, John C. 1959. Adventures of Zenas Leonard, fur trader. Univ. of Okla. Press, Norman. 172 p.

Fletcher, F. N. 1929. Early Nevada. The period of exploration, 1776-1848. A. Carlisle & Co. of Nev., Reno. 183 p.

Goodwin, C. L. 1930. John Charles Fremont, an explanation of his career. Stanford Univ. Press, Cal. 285 p.

Gudde, Erwin G. 1962. Bigler's chronicle of the west. Univ of Cal. Press, Berkeley. 145 p.

Hine, Robert V. 1961. Edward Kern and American expansion. Yale University Press.

Korns, J. Roderick. 1951. West from Fort Bridger. Utah State Hist. Soc., Salt Lake City, Utah. XIX. 297 p.

Mills, Lester W. 1956. A sagebrush saga. Art City Publishing Co., Springville, Utah. 112 p.

Morgan, Dale L. 1943. The Humboldt, highroad of the west. Farrar Publishing Co., N. Y. 374 p.
1959. The overland diary of James A. Pritchard. The Old West Publishing Co. 221 p.

Murbarger, Nell. 1956. Ghosts of the glory trail. Desert Magazine Press. 291 p.

Myles, Myrtle. 1951, 1956. Pioneer Nevada. Harold's Club, Reno. 2 Vols. 364 p.

Myrick, David. 1962. The railroads of Nevada and eastern California. Howell-North Press, Oakland. 343 p.

Nevins, Allan. 1939. Fremont, pathmaker of the west. D. Appleton-Century Co., N. Y. 649 p.

Paden, Irene. 1944. Wake of the prairie schooner. The Macmillan Co., N. Y. 514 p.
1948. The journal of Madison Berryman Moorman, 1850-1851. Calif. Hist. Soc., San Francisco. 145 p.
1949. Prairie schooner detours. The Macmillan Co., N. Y. 295 p.

Phillips, Paul C. 1961. The fur trade. Univ. of Okla. Press, Norman. Vol 2. 696 p.

Pigney, Joseph. 1961. For fear we shall perish. E. P. Dutton & Co., N. Y. 312 p.

Rich, E. E. 1961. Hudson's Bay Company, 1670-1890. The Macmillan Co., N. Y. Vol. 3. 573 p.

Rogers, F. B. 1938. Soldiers of the Overland. The Grabhorn Press, San Francisco. 278 p.

Stewart, George R. 1953. U.S. 40, a cross section of the U.S.A. Houghton-Mifflin, Boston. 309 p.
1953. The opening of the California Trail. Schallenberger's journal. Univ. of Calif. Press, Berkeley.
1960. Ordeal by hunger. Houghton-Mifflin, Boston. 394 p.
1962. The California Trail. McGraw-Hill Co., N. Y. 339 p.

Thompson, T. H. and A. A. West. History of Nevada, 1881 (1958 Reprint). Howell-North Press, Oakland. 680 p.

Geology

Misch, P. 1960. Regional structural reconnaissance in central-northeast Nevada and some adjacent areas; observations and interpretations: guidebook to the geology of east central Nevada, Intermountain Association of Petroleum Geologists and Eastern Nevada Geological Society. pp. 30-31.

Hydrology

Hoyt, W. G. and W. B. Langbein. 1955. Floods. Princeton Univ. Press.

U.S. Dept. of Agriculture. 1955. Water (The Yearbook of Agriculture). U.S.D.A. 751 p.

U.S. Forest Service. 1959. Land treatment measures handbook. U.S.F.S.

U.S. Soil Conservation Service. 1955. Engineering handbook, Supplement A, section 4: Hydrology. U.S.S.C.S.

U.S. Soil Conservation Service. 1961. Watershed protection handbook. U.S.S.C.S.

## Bulletins, Periodicals, Papers

### Climatology

Brown, M. 1960. Climates of the States. Nevada. U.S.W.B. Bull. 60-26. 15 p.

U.S. Weather Bureau. 1930. Climatic summary of the United States to 1930, inclusive. Section 19: Nevada. U.S.W.B. Bull. "W". 34 p.

U.S. Weather Bureau. 1952. Climatic summary of the United States for 1931 through 1952. Nevada. U.S.W.B. Bull. 11-22. 27 p.

U.S. Weather Bureau. 1953-1961. Climatological data. Nevada. U.S.W.B. annuals.

U.S. Weather Bureau. 1958. Precipitation data from storage gage stations. (Summary) U.S.W.B. Bull. 70-26 (Nevada). 52 p.

U.S. Weather Bureau. 1958-1962. Storage gage precipitation data for western United States. U.S.W.B. annuals.

### Geology

Cohee, G. W. 1962. Tectonic map of the United States. U.S.G.S. and Amer. Assoc. of Petrol. Geologists.

Granger, A. E., Bell, M. M., Simmons, G. C., and F. Lee. 1957. Geology and mineral resources of Elko County, Nevada. Nevada Bureau of Mines, Reno. Bull. 54. 190 p.

Sharp, R. P. 1939. The Miocene Humboldt formation in northeastern Nevada. Jour. Geol. 47-2: 133-160

Webb, Barbara, and Roland V. Wilson. 1963. Progress geologic map of Nevada. Map 16. Nevada Bureau of Mines, Reno, Nevada.

### History

Cline, Gloria G. 1960. Peter Skene Ogden's Nevada explorations. Nev. Hist. Soc., Reno. 111-3: 3-11.

U.S.D.A. Nevada Humboldt River Basin Surv. Field Party. 1962. Chronology of flood years and high water years, Humboldt River. U.S.D.A. 46 p.

Hydrology

Blaney, Harry F. 1952. Determining evapotranspiration by phreatophytes from climatological data. Trans. A.G.U. 33-1: 61-66.

Croft, A. R. and L. V. Monninger. 1953. Evapotranspiration and other water losses on some aspen forest types in relation to water available for stream flow. Trans. A.G.U. 34-4: 563-574.

U.S. Soil Conservation Service and Nevada Dept. of Cons. and Nat. Resources, Div. of Water Resources. 1962. Summary of snow survey measurements, 1910-1961. 150 p.

Soils

McCormick, John A. and E. A. Naphan. 1955. Understanding the irrigated soils of Nevada. Univ. of Nev. Agr. Expt. Sta. Circ. B.

U.S. Dept. of Agr. 1958. Salt problems in irrigated soils. Agr. Inf. Bull. 190.

Vegetation

Robertson, J. H., and Clark Torrell. 1958. Phenology as related to chemical composition of plants and to cattle gains on summer ranges in Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 197. 38 p.

Robertson, J. H., Jensen, E. H., Peterson, R. K., Cords, H. P., and F. E. Kinsinger. 1958. Forage grass performance under irrigation in Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 196.

Robinson, T. W. 1952. Phreatophytes and their relation to water in western United States. Trans. A.G.U. 33-1: 57-61

1958. Phreatophytes. U.S.G.S. W.S.P. 1423. 84 p.

State of Nevada, Dept. Conserv. and Nat. Resour. 1960. Progress report, Humboldt River Research project. Nev. Dept. Conserv. and Nat. Resour. 42 p.

State of Nevada, Dept. Conserv. and Nat. Resour. 1961. Second progress report, Humboldt River research project. Nev. Dept. Conserv. and Nat. Resour. 38 p.

Subcommittee on Phreatophytes, P.S.I.A.C. 1958. A guide to the density survey of bottom land and streambank vegetation. PSIAC. 28 p.

U.S. Forest Service. 1952. Instructions for grazing allotment analysis on national forests of R-4. Region 4, U.S.F.S. 15 p.

U.S. Forest Service. 1960. Range allotment analysis procedures, Chapt. III. Region 4, US.F.S. 58 p.

U.S. Soil Conservation Service. 1962. Technical guide excerpt (range), Resource Area 17. U.S.S.C.S., Nevada.

Water Supply and Use

Chief of Engineers, U.S. Army. 1949. Humboldt River and tributaries, Nevada. U.S. Gov't. Printing Office, Washington, D.C.

Couston, John W. No date. Economic feasibility of upper stream storage on the Humboldt River watershed. A report of the Upper Humboldt River Storage Committee. Unpublished.

Hardman, Geo. and H. B. Mason. 1949. Irrigated lands of Nevada. Univ of Nev. Agr. Expt. Sta. Bull. 183. 57 p.

Houston, C. E. 1950. Consumptive use of irrigation water by crops in Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 185. 27 p.

1955. Consumptive use of water by alfalfa in western Nevada. Univ. of Nev. Agr. Expt. Sta. Bull. 191. 20 p.

Houston, C. E. and E. A. Naphan. 1952. Consumptive use of water in irrigable areas of the Columbia Basin in Nevada. U.S.D.A. S.C.S. 35 p.

Miller, M. R., Hardman, Geo., and H. G. Mason. 1953. Irrigation water in Nevada. Univ. of Nev. Expt. Bull. 187. 63 p.

Muth, Edmund. 1952. Humboldt River survey. State of Nevada, Office of the State Engineer, Carson City. 23 p.

1958. Nevada water laws. Title 48 - Water. Chapts. 32-538, inc., also Chapt. 542. State of Nevada, Dept. Conserv. and Nat. Res. 117 p.

U.S. Dept. of Agr. 1958. Determining the quality of irrigation water.

U.S. Geological Survey. 1951-1960. Surface water supply of the United States. Part 10, The Great Basin. U.S.G.S. W.S.P. annuals.

1960. Compilation of records of surface water of the United States through September 1950. Part 10, The Great Basin. U.S.G.S. W.S.P. 1314. 485 p.

U.S. Geological Survey - Nevada. 1961. The ground water situation in Nevada. Ground-Water Resources - Information Series Report 1. State of Nev., Dept. of Conserv. and Nat. Resources, Carson City. 20 p.

Young, Arthur A. and H. F. Blaney. 1942. Use of water by native vegetation. Cal. Dept. Public Works, Div. Water Resources Bull. 50. 154 p.

## Newspapers

Daily Silver State - Winnemucca, Nevada.

Elko Daily Free Press - Elko, Nevada.

Elko Independent - Elko, Nevada.

Eureka Sentinel - Eureka, Nevada.

Humboldt Register - Unionville, Nevada. Winnemucca, Nevada.

Humboldt Star - Winnemucca, Nevada.

Nevada State Herald - Wells, Nevada.

Nevada State Journal - Reno, Nevada.

Reno Evening Gazette - Reno, Nevada.

# APPENDIX I

Pertinent elaborative material of value to the general reader, for his reference and guidance in the use of the sub-basin report.

## CONTENTS

# INITIATION OF ACTION FOR PROJECT-TYPE DEVELOPMENT

## Accomplishing the Improvements, Public Law 566

The development of project operations would need to be initiated by a local sponsoring organization representing the landowners and operators. The sponsoring organization could initiate such action by submitting an application for watershed planning assistance to the Director of the State Department of Conservation and Natural Resources.

If a project were approved under the provisions of the Watershed Protection Act, and the operations procedures as developed by the U. S. Department of Agriculture, a local sponsoring organization would provide needed land rights for structural improvements, and assume the responsibility for contracting the structural work and for its subsequent operation and maintenance. Cost-sharing assistance may be made available for a portion of the land, easements and rights-of-way needed for recreational developments.

The landowners would have responsibility for the installation of land treatment measures on the privately owned lands. Cost sharing and credit assistance could be made available by the U. S. Department of Agriculture for such work.

The Bureau of Land Management and the Forest Service would assume responsibility for the installation of land treatment measures on the Federal lands which would be accomplished with the usual participation in costs by the range users.

Funds appropriated under the Watershed Protection Act may be made available to defray the cost of construction of the structural improvements for flood and sediment damage prevention. They may also be made available for installing land treatment measures on the Federal lands which are primarily for the improvement of vegetal cover (range seeding and brush spraying). Construction costs involving either recreation or irrigation development may be cost-shared from these funds up to 50 percent.

# PIE CREEK WATERSHED

## Physical Features of the Watershed

### Location

The Pie Creek watershed is in the southwest quarter of the sub-basin. It includes all the drainages tributary to Pie Creek south of its confluence with the North Fork of the Humboldt River.

### Water Supply and Use

#### Surface Water

The Independence Mountains from Ganz Creek south are the primary source of water for this project watershed. Runoff from snowmelt furnishes most of the irrigation water. There are four small irrigation storage reservoirs in this area. Each of these serves one owner. The Dorsey Creek reservoir (130 acre-feet) and Saval Ranch Pond (20 acre-feet) are dual purpose structures; they provide public fishing as well as irrigation water storage. In addition there are an unknown number of stock water developments, including ponds, springs and wells.

The annual water balance study indicates that the gross water yield for an 80 percent frequency flow would be approximately 7,400 acre-feet. From this total an estimated 1,100 acre-feet are used by irrigated crops and pasture, 2,300 acre-feet are used by phreatophytes, and approximately 4,000 acre-feet discharge into the North Fork.

#### Ground Water

Ground water development consists of at least eight stockwater wells in addition to those used for farmstead use. There have been no known ground water investigations made except on an individual site basis.

Percolation of water through the Tertiary lavas and consolidated Paleozoic rock occurs in joints, fractures, crushed zones, and along bedding planes, or the zone of contact between lava flows. Solution channels occur in the limestones, and in some instances transmit water readily. Some of the porous tuffaceous pyroclastic deposits have a low permeability rate.

Permeable horizons or lenses in unconsolidated Quaternary alluvium probably constitute the most important ground water reservoir. A secondary but important reservoir consists of permeable zones in partially consolidated Tertiary sediments.

#### Water Needs for Recreation Areas and Special Use Sites

At present there are no developed recreation areas or special use sites in the watershed. The Forest Service plans to develop a hunter-fisherman camp on Middle Ganz Creek

with about 15 units and covering eight acres. The Bureau of Land Management plans to develop three one-acre camp sites (Pie Creek, Eagle Rock Stage Station, and Eagle Rock Reservoir) and one cabin site (Mason Springs). These developments, when completed, will require an estimated 0.5 acre-foot of water.

## Geology

The Paleozoic rocks in Nevada belong to two broad sequences of rocks with different lithology. The western sequence is composed of a large proportion of chert, slate, impure quartzite, graywacke, and chiefly andesitic metamorphosid volcanic rock. The eastern sequence consists predominantly of carbonate rocks and some quartzite, shale, and conglomerate. At Lone Mountain, thin-bedded to massive limestone, shale, and calcareous siltstone occur beneath an overthrust sequence. Here the western sequence includes clastic rocks, chert, and shale, and volcanic rocks. At Lone Mountain the Paleozoic rocks are intruded by quartz, predominantly monzonite and quartz monzonite porphyry.

Partially consolidated sediments of the Humboldt formation were deposited during Tertiary (late Miocene and possible early Pliocene) time in intermontane basins. They lie unconformably on consolidated Paleozoic rocks. Warping and block faulting occurred during and after deposition of this formation. Generally, the beds are more disturbed near the margins of faulted mountain blocks.

Late Tertiary lava flows and related volcanic rocks were extruded onto deposits of the Humboldt formation and consolidated Paleozoic sediments. In some areas these flows were interbedded with deposits of the Humboldt formation. Erosion-resistant volcanic rocks are widespread through the watershed and typically crop out as broad areas of low to moderate relief.

## Soils

The soils in the watershed vary as to depth, texture and drainage. In the mountain highlands they are shallow to deep, medium to stony or rocky medium textured, and are well to excessively drained. The valley uplands have soils that are mostly moderately deep to deep, medium to stony or gravelly medium textured, and well drained. There are some areas where a hardpan can be found at moderate depths and there are some soils that are shallow to bedrock. The soils in the valley bottoms are generally deep, medium and gravelly medium to moderately fine textured, well to poorly drained, and have salt and alkali concentrations varying from none to slight.

## Vegetation

The predominant plant cover over much of the watershed is big sagebrush-grass. Within this type, low sagebrush-grass is found on large claypan bench areas on the north and west slopes of the Adobe Range at the head of Sixteen Mile Creek, with interlacings of big sagebrush in the swales and on the deeper soils.

The perennial grasses (bluebunch wheatgrass, Idaho fescue, and Nevada bluegrass)

which once constituted the bulk of the sagebrush-grass and mixed browse-aspen-grass understory have largely disappeared over much of the watershed. These desirable forage species are now found in significant quantities only on the national forest lands and on protected, remote, or inaccessible relict areas of the national land reserve or the privately owned range lands. Through grazing overuse, primarily by domestic livestock, most of this perennial grass understory has been replaced by cheatgrass and such increaser species as big sagebrush, Sandberg bluegrass, bottlebrush squirreltail, and small amounts of needlegrass.

Much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet meadows in the larger stream bottoms has disappeared through overuse and desiccation by channel cutting. These species have been largely replaced by relatively worthless rabbitbrush, with small areas of greasewood and saltgrass on the more saline or alkali laden sites.

Over-population of beaver on the headwaters of many streams emanating from the Independence Mountains, such as upper Ganz Creek, is raising havoc with the aspen stands in these locations. Many groves of this species, so important from a soil-binding as well as an aesthetic and recreational standpoint, are now in imminent danger of being completely destroyed.

## Land Status and Use

The land status and use breakdown is as shown below:

| Land Status | Acres | Land use | | | | | |
|---|---|---|---|---|---|---|---|
| | | Range land | | Irrigated land | | Barren or Inaccessible | |
| | | Acres | % | Acres | % | Acres | % |
| National Land Reserve | 121,100 | 120,200 | 62 | ----- | --- | 900 | 100 |
| National Forest | 4,600 | 4,600 | 2 | ----- | --- | --- | --- |
| Private | 70,100 | 68,600 | 36 | 1,500 | 100 | --- | --- |
| Total | 195,800 | 193,400 | 100 | 1,500 | 100 | 900 | 100 |

The private land is divided among an estimated 17 owners. This includes 8,700 acres belonging to the Southern Pacific Land Company.

The 1,500 acres of irrigated land are used to produce hay and pasture for the winter feeding of cattle grazing on the intermingled private and Federal lands.

## Climate

The average annual precipitation on the irrigated lands is estimated to vary between nine and 12 inches. Most of the moisture falls in the form of snow during the winter months; summer rainfall is very light. The growing season is assumed to vary between 90 and 100 days (28 degreesF). In elevations above 8,000 feet, average annual precipitation is estimated to be around 20 inches on Lone Mountain and 30 inches on the headwaters of Ganz Creek.

## Watershed Problems

### Agricultural Water Management

Generally by the end of May the irrigation water supply is depleted. During the period of runoff most of the native hay and pasture lands are being continually irrigated. These conditions are conducive to the low-yielding crops grown in the area. A small acreage receives a second irrigation with reservoir water.

Water is spread over the lands and diverted into ditches by obstructions in the stream channel. These uncontrolled diversions make it difficult to manage the water. There have been few significant surface irrigation developments in the watershed.

Agricultural water management problems which were found to be prevalent include:

1. Poor seasonal water distribution.
2. High water table in some areas.
3. Water supply used to produce low-yielding crops.
4. Lack of adequate water control structures.
5. Low water use efficiency.

### Flood Water, Erosion and Sediment Damage

Each of the wet-mantle flood periods subsequent to the system-wide Humboldt floods of March-June 1890 contributed to channel cutting, sedimentation and extensive flooding of the bottomlands along lower Sixteen Mile, Dorsey, Pie, and Ganz Creeks. Of particular note were the floods of 1910, 1917, 1942, 1943, 1952, and 1962. No specific records of damages from dry-mantle floods in the Pie Creek watershed have been found.

### Vegetation - Kind and Condition

#### Phreatophytes

In the proposed watershed area, through overuse or meadow desiccation by gullying, much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet meadows and bottomlands has disappeared from the larger streams, such as lower Sixteen Mile, Dorsey, McClelland, Pie, and Ganz Creeks, or is greatly diminished in density and volume. These pristine species have been largely replaced by an extensive cover of relatively worthless rubber rabbitbrush and sagebrush, with small stringers of willow along some of the creek channels. (See table 6.)

#### Range Forage Production

Table 7 furnishes information on the range forage production acreage, present and potential, for the Pie Creek watershed. At present, the range acreage in the medium or fairly high forage production class is found primarily on the less accessible middle and

Table 6. -- Phreatophyte acreage and annual ground water use, Pie Creek watershed 1/

| Species | Height class | Density | Acreage cropland | Acreage range types 2/ | Annual ground water use 2/ (feet) | Annual ground water use 2/ (acre-feet) |
|---|---|---|---|---|---|---|
| Willow | 8-12' | .2-.3 | --- | 130 | 2.2 | 290 |
| Rose | 3-8' | .2-.3 | --- | 50 | 1.5 | 70 |
| Rubber rabbitbrush | 3'+ | .03-.08 | --- | 3,010 | .4 | 1,200 |
| Great Basin wildrye | ----- | .2-.3 | --- | 770 | 1.0 | 770 |
| Subtotal | | | | 3,960 | | 2,330 |
| Irrigated meadow hay and pasture 3/ | ----- | ------ | 350 | ----- | .3 | 100 |
| Wet meadow 3/ | ----- | ------ | 140 | ----- | .5 | 70 |
| Subtotal | | | 490 | | | 170 |
| Total | | | 490 | 3,960 | | 2,500 |

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and 100 percent composition, for each species, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye, sedges, and other grasses.

Source: Humboldt River Basin Field Party.

Table 7. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Pie Creek watershed

| Vegetal type and site | Present annual forage plant production classes (acres) | | | Potential annual forage plant production classes (acres) | | | Treatment needed to reach potential |
|---|---|---|---|---|---|---|---|
| 1. Rabbitbrush-greasewood-grass; saline bottomlands | Production classes (pounds per acre) 1/ | | | Production classes (pounds per acre) 1/ | | | |
| Soil associations | 850-1,500 | 200-900 | 20-300 | 850-1,500 | 200-900 | 20-300 | |
| A5-H3 | ----- | ----- | 7,700 | 4,000 | 3,000 | 700 | Brush removal, erosion-proofing of roads, streambank and channel stabilization, proper management and stocking. |
| Subtotal | ----- | ----- | 7,700 | 4,000 | 3,000 | 700 | |
| 2. Meadow grasses-forbs-sedges; semi-wet meadow | Production classes (pounds per acre) 1/ | | | Production classes (pounds per acre) 1/ | | | |
| Soil associations | 1,200-3,000 | 600-2,000 | 200-1,200 | 1,200-3,000 | 600-2,000 | 200-1,200 | |
| A5-H3 | ----- | ----- | 2,200 | 1,500 | 500 | 200 | Brush removal, erosion-proofing of roads, streambank and channel stabilization, proper management and stocking. |
| H1-H2 (80-20) | ----- | ----- | 1,700 | 1,000 | 500 | 200 | |
| Subtotal | ----- | ----- | 3,900 | 2,500 | 1,000 | 400 | |
| 3. Big sagebrush-grass; upland benches and terraces | Production classes (pounds per acre) 1/ | | | Production classes (pounds per acre) 1/ | | | |
| Soil associations | 250-600 | 100-450 | 20-150 | 250-600 | 100-450 | 20-150 | |
| B11-C2-S3-L3 | 6,100 | 4,400 | 43,100 | 30,000 | 21,600 | 2,000 | Brush removal and seeding, fencing, erosion-proofing of roads, erosion control measures, streambank and channel stabilization, proper management and stocking, beaver control. |
| C4-B10-L1 | ----- | 6,800 | 3,400 | 7,000 | 2,400 | 800 | |
| C6-B4-L11 | ----- | 3,700 | 2,800 | 5,000 | 1,000 | 500 | |
| L12-B3-C1 | ----- | 3,400 | 1,300 | 3,000 | 1,200 | 500 | |
| S10-S3-B11 | 3,300 | 2,300 | 48,900 | 48,000 | 5,200 | 1,000 | |
| Subtotal 2/ | 9,400 | 20,600 | 99,500 | 93,300 | 31,400 | 4,800 | |
| 4. Low sagebrush-grass; claypan benches | Production classes (pounds per acre) 1/ | | | Production classes (pounds per acre) 1/ | | | |
| Soil associations | 200-500 | 100-250 | 50-150 | 200-500 | 100-250 | 50-150 | |
| S10-S3-B11 | ----- | 2,700 | 6,700 | 3,000 | 4,900 | 1,500 | Brush removal and seeding, selective spraying, erosion-proofing of roads, streambank and channel stabilization, proper management and stocking. |
| Subtotal | ----- | 2,700 | 6,700 | 3,000 | 4,900 | 1,500 | |

Continued

Table 7. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Pie Creek watershed -- Continued

| Vegetal type and site | Present annual forage plant production classes (acres) | | | Potential annual forage plant production classes (acres) | | | Treatment needed to reach potential |
|---|---|---|---|---|---|---|---|
| 5. Browse-aspen-grass; intermediate mountain slopes | Production classes (pounds per acre) 1/ | | | Production classes (pounds per acre) 1/ | | | |
| Soil associations | 300-650 | 150-350 | 50-200 | 300-650 | 150-350 | 50-200 | |
| C4-B10-L1 | ----- | 300 | 4,100 | 2,000 | 1,900 | 500 | Selective spraying, fencing, stockwater development, erosion-proofing of roads, erosion control measures, streambank and channel stabilization, proper management and stocking. |
| C4-B10-L11 | ----- | 22,700 | 5,400 | 20,000 | 6,100 | 2,000 | |
| L12-B3-C1 | ----- | ------ | 1,200 | 800 | 200 | 200 | |
| Subtotal | ----- | 23,000 | 10,700 | 22,800 | 8,200 | 2,700 | |
| 6. Browse-aspen-conifer-grass; steep mountain slopes and basins | Production classes (pounds per acre) 1/ | | | Production classes (pounds per acre) 1/ | | | |
| Soil associations | 350-800 | 200-500 | 75-250 | 350-800 | 200-500 | 75-250 | Selective spraying, erosion-proofing of roads, proper management and stocking. |
| R3-L2-C1-Z | 400 | 3,500 | 5,300 | 6,000 | 2,200 | 1,000 | |
| Subtotal 3/ | 400 | 3,500 | 5,300 | 6,000 | 2,200 | 1,000 | |
| Total | 9,800 | 49,800 | 133,800 | 131,600 | 50,700 | 11,100 | |

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 300 acres of barren or inaccessible.

3/ Does not include 600 acres of barren or inaccessible.

Source: Humboldt River Basin Field Party.

upper slopes of the Independence Mountains at the head of Ganz Creek, within the boundaries of the Humboldt National Forest. On the national land reserve lands, the better forage-producing ranges are found in the Independence Mountains, from Lone Mountain northward to the national forest boundary; on the north side of the Adobe Range; and on the seeded areas on each side of Nevada Highway 43.

## Opportunities for Development

### Agricultural Water Management

#### Structural Measures

It is proposed that an earth-fill dam be constructed across Pie Creek about three and one-half miles south of its confluence with North Fork. A dam 45 feet high and 300 feet long at its crest would require an estimated 40,000 cubic yards of fill. It may be possible to construct a spillway in natural rock for this height dam. The dam and reservoir site is on the edge of a lava flow which is badly fractured and broken. It is thought that the possibility of water loss through this formation would be high unless it was sealed by an earth blanket. A detailed geological investigation of the site would be necessary to determine the feasibility of the site.

The reservoir behind this dam would hold the estimated 80 percent discharge, or 4,000 acre-feet of water. Three thousand acre-feet of this stored water would be used to irrigate about 800 acres of improved hay and pasture forage, as covered by existing water rights. The balance of the stored water would be available for recreation development, which would not be a consumptive use. The water would be used as a total irrigation supply for lands in Tule Valley, directly below the reservoir, and for lands along North Fork about three miles east of the confluence with Pie Creek, which is outside the watershed boundary. In addition this site may have possibilities as a debris basin, but would have little value for flood control.

It would be necessary to clear the Pie Creek channel below the dam, and the North Fork below the Pie Creek junction, of all obstructions so that water in excess of water rights stored in the reservoir could flow freely down stream.

#### Land Treatment Measures

There are an estimated 800 acres of cropland with water rights below the reservoir; 300 acres in Tule Valley and 500 acres along the North Fork. For maximum production, it has been estimated that these lands would require revised irrigation systems; 500 acres of land smoothing or leveling; 300 acres of drainage; 3,200 acres of phreatophyte control (rabbitbrush, willow and rose); nine miles of supply ditch; four diversions, and the necessary lateral ditches, headgates, drops, turnouts, etc.

Irrigated crop and pasture land not under the proposed reservoir totals an estimated 1,400 acres. Most of the land is irrigated by direct diversion from stream channels during the spring runoff period. Reorganization of irrigation systems, drainage, channel clearing,

and planting of improved forage crops would be needed to obtain greater production.

Watershed Protection and Improvement

The following measures are considered to be the minimum treatment necessary to promote watershed protection and improve the range:

1. Install channel and streambank stabilization on about 50 miles of channel. This treatment is needed particularly along Sixteen Mile, Dorsey, and Pie Creeks.

2. Install from 150 to 200 gully control structures at selected sites on the heads of drainages.

3. Treat all roads contemplated, in use, or abandoned, to prevent or stop erosion. Between 80 and 90 miles of this treatment are needed.

4. Sagebrush removal and range seeding on selected sites covering an estimated 42,000 acres which at present are in the low forage production class.

5. Brush overstory removal by blading on about 10,000 or 11,000 acres of saline bottomlands.

6. Control sagebrush to thicken the grass understory by selective spraying on about 90,000 or 100,000 acres.

7. Construct approximately 13 miles of allotment and management fences.

8. Construct numerous stockwatering developments (springs, wells, and ponds).

9. Control beaver in the aspen sites along drainages in the Independence Mountains.

10. Keep the rabbit and rodent population at a minimum, avoiding the high population peaks so destructive to forage.

11. Adjust domestic livestock numbers and seasons of use to an indicated safe carrying capacity where needed.

12. Maintain big game numbers in balance with their food supply.

## Benefits Expected

### Agricultural Water Management

The proposed storage reservoir would provide (1) a full-season irrigation water supply for about 800 acres of crop and pasture land, and (2) an opportunity for recreational development. In addition, it would allow the development of a more stable irrigation cropping program; would permit a higher quality hay to be grown; would be conducive to obtaining greater forage yields; would reduce the acreage needed for hay production; and would make higher irrigation efficiency and partial sediment control possible.

The cropland not under the proposed reservoir can produce greater yields with less erosion after the installation of the proposed treatment measures.

### Watershed Protection and Improvement

The treatment and structural measures would result in better protection for the watershed, reduce erosion, improve the range forage production, protect existing meadows and restore desiccated meadowlands, and reduce management problems. Table 7 reflects the potential range forage improvement that would be brought about. It is estimated that the acreage of range land in the fairly high forage production class can be increased by more than 13 times. There would be almost a threefold increase in terms of pounds of usable forage produced per acre, from the estimated present yield of approximately 11,700,000 pounds to 33,500,000 pounds.

## Conclusion

A preliminary evaluation of the works of improvement proposed for this watershed indicated project-type development possibilities sufficient to warrant a more detailed study.

## SOILS DESCRIPTION

The generalized soil survey of the North Fork Sub-Basin shows the location and distribution of different kinds of soils by associations of Great Soil Groups. Each Great Soil Group includes a number of soils with similar internal characteristics that reflect the environmental conditions responsible for their development. Great Soil Groups mapped in the survey include:

### Alluvial Soils (Symbol: A)

These are the soils that consist of essentially recent stream-laid deposits: alluvial fans, floodplains, terraces and basins. They have essentially no profile development, but a little organic matter may have accumulated. They are usually deep, stratified, variable with regard to drainage class, and occur under many different climates.

### Brown Soils (Symbol: B)

These are the soils which have dark brownish A horizons about six inches thick, textural B horizons 10 to 15 inches thick, and calcareous parent material of variable thickness. Some of these soils have cemented calcium carbonate layers in the C horizon and some of these soils may have the C horizon resting on bedrock. They are usually moderately deep to deep, well drained, and occur under a cool semi-arid climate with an average precipitation of eight to 20 inches. All the Brown Soils in the North Fork Sub-Basin occur at elevations above 5,000 feet, in the uplands.

### Chestnut Soils (Symbol: C)

These soils have dark grayish brown to very dark grayish brown A horizons about six to eight inches thick, textural B horizons 10 to 15 inches thick, and parent material that may or may not be calcareous. These soils usually have darker A horizons, more organic matter, and have been more strongly leached than have the Brown Soils. The parent material may or may not rest on bedrock. They are usually moderately deep to deep, well drained, and occur in a cool semi-arid climate with an average precipitation of about eight to 35 inches. Most of the Chestnut Soils in the North Fork Sub-Basin occur at elevations above 5,500 feet, in the uplands.

### Humic Gley Soils (Symbol: H)

These are the dark brown or black meadow soils that grade into lighter colored or rust-mottled grayish soil at depths of one to two feet. They are imperfectly to poorly drained, usually with seasonal fluctuating high water table, and occur along stream floodplains where they are subject to overflow. They occur in a cool semi-arid climate, and are found in the North Fork Sub-Basin at elevations below 7,000 feet.

### Lithosols (Symbol: L)

These soils have an incomplete profile, or no clearly expressed morphology. They

are shallow (less than 10 to 15 inches), and consist of freshly and imperfectly weathered masses of hard rock or hard rock fragments, and are largely confined to steeply sloping lands. In the higher rainfall areas of the sub-basin, some of these soils may have dark A horizons. They are usually excessively drained.

Regosols (Symbol: R)

These are soils which consist of deep unconsolidated deposits, in which few or no clearly expressed soil characteristics have developed. They are largely confined to colluvial accumulations on steep mountain slopes. Under eight to 10 inch rainfall, the Regosols may have only a weakly developed A horizon, while in higher rainfall areas they may have well developed dark A horizons six to 14 inches or more thick. In mountainous areas these soils may be underlain by bedrock 15 to 20 inches below the soil surface.

Sierozems (Symbol: S)

These are soils with pale grayish or light brownish surface soils and textural B horizons closely related in color to the surface soil. They are usually calcareous in the B horizon, and frequently also in the surface soil. They quite often have a cemented calcium carbonate hardpan at shallow to moderate depths below the B horizon. The B horizon in the Sierozem Soils in this sub-basin is usually weakly developed and difficult to identify. In mountainous areas the Sierozems may be underlain by bedrock at moderate depths. These soils are found in a semi-arid cool climate, with an average annual precipitation of about eight to 15 inches, and mostly at elevations below 7,000 feet.

Solonetz (Symbol: Y)

These are imperfectly drained soils with a very few inches of light grayish or brownish or brownish surface soil underlain by a hard columnar fine-textured horizon that is high in exchangeable sodium. They occur on floodplains, terraces, and some alluvial fans, usually small areas associated with saline-alkali Alluvial Soils, Humic Gley Soils, and Calcium Carbonate Solonchaks.

Rockland (Symbol: Z)

These are essentially non-soil areas, consisting of hard rock and hard rock fragments of granite, limestone and lava formations, which are extremely steep and inaccessible to livestock. They occur as outcrops, bluffs and cliffs with some talus areas below. Little or no weathering has taken place for soil formation. Vegetation on these areas is limited to natural fractures in the rock or small areas of deposited soil material.

## Mapping Units

Mapping units on the generalized soil survey map of the North Fork Sub-Basin are associations of phases of Great Soil Groups that reflect characteristics of soils significant to use and management. Each mapping unit symbol includes the designation of approximate composition for each Great Soil Group that comprises the association.

Example: $\frac{\text{L1-C1-R1}}{\text{60-20-60}}$

## SOILS TABLES

The following tables, 8 and 9, show the general soil characteristics and the interpretations for each Great Soil Group phase which was mapped in the sub-basin.

Table 8. -- Soil characteristics, North Fork Sub-Basin

| Soil Phase | Depth | Texture: Surface | Texture: Subsoil | Slope range % | Erosion | Salt & alkali | Drainage | Remarks |
|---|---|---|---|---|---|---|---|---|
| A2 | Deep | Medium and gravelly medium | Medium | 2-15 | Slight :10% mod. | None | Well | |
| A5 | Deep | Medium | Medium | 0-2 | Slight | None to slight | Mod. well to well | Seedable areas, 10% overflowed, some gullying |
| B3 | Moderately deep to deep | Medium, stony and very stony medium | Medium, moderately fine to fine | 4-30 | Slight :10% mod. | None | Well | Some stony soils |
| B4 | Deep | Stony medium moderately fine | Moderately fine to fine | 20-40 | Slight :10% mod. | None | Well | 5% Chestnut 5% Sierozem |
| B5 | Moderately deep to deep | Medium | Moderately fine to fine | 10-30 | Slight :10% mod. | None | Well | 15% stony medium, some seedable areas |
| B10 | Moderately deep | Medium stony | Fine over hardpan | 10-30 | Slight :5% mod. | None | Well | |
| B11 | Moderately deep | Medium | Fine over hardpan | 3-10 | Slight :5% mod. | None | Well | Some seedable areas |
| C1 | Moderately deep to deep | Stony medium and medium | Medium to moderately fine | 30-50 | Slight :15% mod. | None | Well | 10% very stony 10% deep Chestnut soils |
| C2 | Moderately deep to deep | Medium | Medium to moderately fine | 4-15 | Slight :10% mod. | None | Well | Some stony soils |
| C4 | Deep | Medium | Moderately fine to fine | 16-50 | Slight :5% mod. | None | Well | 20% stony |
| C6 | Moderately deep over bedrock | Medium and stony medium | Moderately fine and fine | 10-30 | Slight :5% mod. | None | Well | |

Continued

Table 8. -- Soil characteristics, North Fork Sub-Basin -- Continued

| Soil Phase | Depth | Texture: Surface | Texture: Subsoil | Slope range % | Erosion | Salt & alkali | Drainage | Remarks |
|---|---|---|---|---|---|---|---|---|
| H1 | Deep | Medium | Medium | 0-2 | Slight | Slight | Imperfect | Overflowed |
| H2 | Deep | Medium | Medium | 0-2 | Slight | None | Imperfect to poor | |
| H3 | Deep | Medium and fine | Medium to moderately fine | 0-2 | Slight | Slight | Poor | Overflowed |
| H4 | Deep | Medium | Medium to moderately fine | 0-2 | Slight | None | Poor | Overflowed |
| L1 | Shallow over bedrock | Stony and rocky medium | | 50-70 | Slight 20% mod. | None | Excessive | 10% rock outcrop |
| L2 | Shallow over bedrock | Stony and rocky medium to coarse | | 50-70 | Slight 20% mod. | None | Excessive | 10% rock outcrop |
| L3 | Shallow over bedrock | Stony and rocky medium | | 30-50 | Slight 15% mod. | None | Excessive | 10% rock outcrop |
| L6 | Shallow over bedrock | Stony and gravelly medium | | 20-30 | Slight 10% mod. | None | Excessive | 10% rockland |
| L11 | Shallow over bedrock | Stony and gravelly medium | | 10-30 | Slight 10% mod. | None | Excessive | 10% rockland |
| L12 | Shallow over bedrock | Stony medium | | 16-30 | Slight 5% mod. | None | Somewhat excessive | 10% rock outcrop |
| R3 | Moderately deep to deep | Stony and gravelly medium | Medium | 50-70 | Slight 25% mod. | None | Somewhat excessive | |
| S3 | Moderately deep to deep | Stony medium | Medium | 15-30 | Slight 15% mod. | Well | None | |
| S4 | Moderately deep to deep | Medium | Medium | 2-15 | Moderate gullying | None | Well | Some stony soils |

Continued

Table 8. -- Soil characteristics, North Fork Sub-Basin -- Continued

| Soil Phase | Depth | Texture: Surface | Texture: Subsoil | Slope range % | Erosion | Salt & alkali | Drainage | Remarks |
|---|---|---|---|---|---|---|---|---|
| S10 | Moderately deep over hardpan | Medium | Moderately fine | 10-30 | Slight 15% mod. | None | Well | Some seedable areas |
| Y2 | Deep | Medium and moderately fine | Moderately fine and fine | 0-3 | None | Strong alkali in subsoil | Moderately well | |
| Z | Rockland | ------ | ------ | ------ | ------ | ------ | ------ | |

Source: Humboldt River Basin Field Party.

Table 9. -- Interpreted soil characteristics, North Fork Sub-Basin

| Soil Phase | Precip. zone (inches) | Erosion hazard | AWHC 1/ (inches) | Soil Hydro-logic Group | Capa-bility subclass | Major land use | Dominant vegetation |
|---|---|---|---|---|---|---|---|
| A2 | 8-10 | Slight | 8 | B | VIc | Range | Rabbitbrush |
| A5 | 8-10 | Slight | 9 | C | IIw<br>VIc | Irrigated crops and range | Rabbitbrush- big sage-grass |
| B3 | 10-12 | Moderate | 8 | C | VIc<br>VIIc | Range | Big sage-grass, low sage-grass |
| B4 | 8-15 | Slight | 8 | C | VIIs | Range | Big sage-grass, low sage-grass |
| B5 | 12-15 | Slight | 6 | C | VIIs | Range | Big sage-grass, low sage-grass |
| B10 | 8-20 | Slight | 5 | D | VIIs | Range | Low sage-grass, big sage-grass |
| B11 | 8-15 | Slight | 5 | D | VIs | Range | Low sage-grass, big sage-grass |
| C1 | 10-35 | Moderate | 6 | C | VIIe | Range | Big sage-browse-grass |
| C2 | 8-15 | Moderate | 8 | C | VIc | Range | Big sage-grass |
| C4 | 10-20 | Slight | 8 | C | VIIe | Range | Big sage-browse-grass |
| C6 | 8-15 | Slight | 6 | C | VIIe | Range | Big sage-browse-grass, low sage-grass |
| H1 | 8-10 | Slight | 12 | B | IIw | Meadow hayland and pasture | Meadow grass |
| H2 | 8-15 | Slight | 12 | B | IIw | Meadow hayland and pasture | Meadow grass, rabbitbrush |
| H3 | 8-10 | Slight | 10 | D | IIIw | Meadow hayland and pasture | Big sage-rabbitbrush-grass, meadow grass |
| H4 | 8-15 | Slight | 10 | C<br>B | IIIw | Meadow hayland and pasture | Meadow grass |
| L1 | 10-20 | Moderate | 1.5 | D | VIIs | Range and watershed | Low sage-grass |
| L2 | 12-35 | Moderate | 1.5 | D | VIIs | Range and watershed | Low sage-grass |
| L3 | 8-15 | Moderate | 1.5 | D | VIIs | Range | Low sage-grass |

Continued

Table 9. -- Interpreted soil characteristics, North Fork Sub-Basin -- Continued

| Soil Phase | Precip. zone (inches) | Erosion hazard | AWHC 1/ (inches) | Soil Hydrologic Group | Capability subclass | Major land use | Dominant vegetation |
|---|---|---|---|---|---|---|---|
| L6 | 8-12 | Severe | 1.5 | D | VIIs | Range | Big sage-grass, low sage-grass |
| L11 | 8-15 | Moderate | 1.5 | D | VIIs | Range and watershed | Big sage-grass, juniper-grass |
| L12 | 10-12 | Slight | 1.5 | D | VIIs | Range and watershed | Big sage-grass, low sage-grass |
| R3 | 12-35 | Moderate | 5 | C | VIIe | Range and watershed | Big sage-browse-grass |
| S3 | 8-15 | Moderate | 4 | C | VIIe | Range | Big sage-grass |
| S4 | 8-10 | Moderate | 6 | C | VIc VIIe | Range, nonstony areas seedable | Big sage-grass |
| S10 | 8-12 | Moderate | 7 | C | VIc | Range | Big sage-grass, low sage-grass |
| Y2 | 8-10 | Moderate | 12 | D | VIIs | Range | Rabbitbrush-big sage-grass |
| Z | Rockland | ----- | ----- | ---- | ----- | ----- | ----- |

1/ Available water holding capacity.

Source: Humboldt River Basin Field Party.

# DEFINITIONS

## HYDROLOGIC SOIL GROUP

Watershed soil determinations are used in the preparation of hydrologic soil cover complexes, which in turn are used in estimating direct runoff. Four major soil groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation.

Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively well drained sand or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and slow infiltration rate. These soils have a slow rate of water transmission.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or clay layer at or near the surface; and (4) shallow soils having a very slow rate of water transmission.

## LAND USE CAPABILITY CLASSES AND SUBCLASSES

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) land suited for cultivation and other uses; and (2) land limited in use and generally not suited for cultivation. Each of these broad divisions has four classes which are shown by a number. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations, or none, whereas Class VIII has a great many.

Capability classes are divided into subclasses. These show the principal kinds of conservation problems involved. The subclasses are "e" for erosion, "w" for wetness, "s" for soil, and "c" for climate.

Capability classes and subclasses, in turn, may be divided into capability units. A capability unit contains soils that are nearly alike in plant growth and in management needs.

### Land Suited for Cultivation and Other Uses

**Class I** Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland or wildlife.

**Class II** Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

**Class III** Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

**Class IV** Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

### Land Limited in Use; Generally Not Suited for Cultivation

**Class V** Soils in Class V have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, woodland, range, or wildlife.

Class VI — Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

Class VII — Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

Class VIII — Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

## ANNUAL WATER BALANCE STUDY - 80% FREQUENCY

Annual water balance is defined for these studies as an accounting of the disposition of all precipitation which falls on a watershed by evaluating consumptive uses, losses, available water for streamflow, etc. In other words, a water balance has been developed for each drainage in the sub-basin using that portion of the hydrologic cycle beginning with the precipitation falling on the watershed and accounting for all hydrologic processes until either some water appears as runoff or is completely dissipated.

The annual water balance was calculated for an 80 percent frequency (expected to be equaled or exceeded eight out of 10 years). This frequency was used because normally such a water supply would be the quantity needed to justify land and irrigation improvements on ranches growing high-yielding crops.

Values obtained using this procedure are approximations. Accuracy would depend on the reliability of the basic soils, vegetation, and hydrologic data used, but would probably be in the range of 60 to 90 percent.

The available information for determining precipitation in the watershed areas above 6,000 feet consisted of snow survey records and storage gage precipitation data. These data gave an indication of the annual precipitation. The precipitation used in the water balance studies was determined as the quantity needed to produce the 80 percent frequency flow at the stream gaging stations after subtracting the different uses and losses.

Flow diagrams of water yields and depletions, with quantities in acre-feet, are shown in figure 1. Table 10 is a summary of the water balance studies by elevation zones for watersheds. The difference in water yield, inches per acre, is caused by the difference in (1) precipitation; (2) soil development; (3) condition and species of plant cover; and (4) to some extent, the difference in size and location of the drainage.

The annual water balance calculations by watersheds were made to find answers to the following questions:

1. What is the gross water yield of the watersheds in the sub-basin? Gross water yield is considered to be the available water prior to irrigation and phreatophyte use.

2. What is the approximate magnitude of water use and loss by each of the major ground cover types?

3. Where are the water-yielding areas in the sub-basin and in each watershed?

4. Can vegetal manipulation be used to increase water supply for beneficial use?

The sub-basin was divided into four watersheds in order to obtain a more accurate estimate of water yield, water uses and losses. They are: (1) Upper North Fork; (2) Pie Creek; (3) Beaver Creek; and (4) Lower North Fork.

The following stream gage records were used to check the water balance studies (see table 11):

1. North Fork Humboldt River at Devil's Gate, near Halleck, Nevada, 26 years of record.

2. North Fork Humboldt River, near Halleck, Nevada, eight years of record.

3. Miscellaneous measurements taken weekly during the irrigation season on some streams.

The results of the water balance studies indicated the following:

1. The 80 percent gross water yield (surface and subsurface) from the sub-basin was estimated to be 40,130 acre-feet.

2. The estimated surface and ground water use and discharge were as follows: Irrigated crops, 13,300 acre-feet; phreatophytes, 8,900 acre-feet; and discharge to the Humboldt River, 17,930 acre-feet.

3. Upper North Fork which drains the Independence Mountains contributes 69 percent of the gross water yield of the sub-basin.

4. Phreatophytes of low economic value such as willow, wild rose, greasewood and rabbitbrush use an estimated 6,000 acre-feet of water annually.

Table 10. -- Summary of Water Balance Studies by elevation zones for watersheds in North Fork Sub-Basin for an 80% frequency

| Elevation zone (feet) | Upper North Fork | | | Pie Creek | | |
|---|---|---|---|---|---|---|
| | Acres | Water Yield in./ac. | Water Yield acre-feet | Acres | Water Yield in./ac. | Water Yield acre-feet |
| 9-10,000 | 3,300 | 16.94 | 4,660 | ----- | ---- | ----- |
| 8- 9,000 | 8,100 | 11.32 | 7,640 | 1,100 | 6.98 | 640 |
| 7- 8,000 | 26,300 | 5.75 | 12,600 | 13,400 | 3.00 | 3,360 |
| 6- 7,000 | 107,700 | .31 | 2,770 | 134,800 | .31 | 3,460 |
| 5- 6,000 | 12,900 | ----- | 20 | 46,500 | ---- | -50 |
| Total | 158,300 | | 27,690 | 195,800 | | 7,410 |
| Gross Water Yield: | | | 27,690 | | | 7,410 |
| Inflow: | | | ------ | | | ----- |
| Use : Irrigated cropland | | | -9,410 | | | -1,120 |
| Phreatophytes | | | -1,750 | | | -2,330 |
| Losses : | | | ------ | | | ----- |
| Discharge: To Beaver Creek watershed | | | 16,530 | To Beaver Creek watershed | | 3,960 |

Continued

Table 10. -- Summary of Water Balance Studies by elevation zones for watersheds in North Fork Sub-Basin for an 80% frequency -- Continued

| Elevation zone (feet) | Beaver Creek: Acres | Beaver Creek: Water Yield in./ac. | Beaver Creek: Water Yield acre-feet | Lower North Fork: Acres | Lower North Fork: Water Yield in./ac. | Lower North Fork: Water Yield acre-feet |
|---|---|---|---|---|---|---|
| 9-10,000 | ------- | ----- | ------ | ------ | --- | ----- |
| 8- 9,000 | ------- | ----- | ------ | ------ | --- | ----- |
| 7- 8,000 | 16,000 | .83 | 1,110 | 5,800 | .97 | 470 |
| 6- 7,000 | 126,500 | .26 | 2,770 | 35,400 | .28 | 820 |
| 5- 6,000 | 61,700 | ----- | 30 | 92,800 | --- | -170 |
| Total | 204,200 | | 3,910 | 134,000 | | 1,120 |
| Gross Water Yield: | | | 3,910 | | | 1,120 |
| Inflow: Upper North Fork | | | 16,530 | Beaver Creek | | 23,060 |
| Pie Creek | | | 3,960 | | | |
| Use : Irrigated cropland | | | -520 | | | -2,250 |
| Phreatophytes | | | -820 | | | -4,000 |
| Losses: | | | ------ | | | ------ |
| Discharge: To Lower North Fork | | | 23,060 | To Humboldt River | | 17,930 |

Source: Humboldt River Basin Field Party.

Table 11. -- Estimated and gaged annual streamflow in acre-feet on the North Fork of the Humboldt River

| Year | Annual streamflow | Year | Annual streamflow |
|---|---|---|---|
| 1899 | 174,000 | 1940 | 29,600 1/ |
| 1905 | 14,620 | 41 | 65,000 1/ |
| 06 | 48,400 | 42 | 91,600 1/ |
| 07 | 131,000 | 43 | 110,500 1/ |
| 08 | 23,900 | 44 | 35,720 |
| 09 | 42,800 | 45 | 70,890 |
| | | 46 | 56,890 |
| 1910 | ------ | 47 | 19,780 |
| 11 | 55,700 1/ | 48 | 20,060 |
| 12 | 62,000 | 49 | 47,240 |
| 13 | 41,000 | | |
| 14 | 82,800 | 1950 | 43,550 |
| 15 | 22,400 | 51 | 66,700 |
| 16 | 67,700 | 52 | 143,600 |
| 17 | 110,000 | 53 | 47,960 |
| 18 | 21,900 | 54 | 15,490 |
| 19 | 50,400 | 55 | 9,510 |
| | | 56 | 68,570 |
| 1920 | 35,600 | 57 | 65,640 |
| 21 | 91,400 | 58 | 76,770 |
| 22 | 80,000 1/ | 59 | 11,980 |
| 23 | 48,000 1/ | | |
| 24 | 21,900 1/ | 1960 | 29,540 |
| 25 | 68,600 1/ | 61 | 10,540 |
| 26 | 19,700 1/ | | |
| 27 | 53,600 1/ | 50% | 40,000 |
| 28 | 22,800 1/ | | |
| 29 | 21,000 1/ | 80% | 22,500 |
| 1930 | 20,000 1/ | | |
| 31 | 9,500 1/ | | |
| 32 | 68,000 1/ | | |
| 33 | 22,400 1/ | | |
| 34 | 9,400 1/ | | |
| 35 | 35,000 1/ | | |
| 36 | 66,000 1/ | | |
| 37 | 65,600 1/ | | |
| 38 | 47,200 1/ | | |
| 39 | 35,700 1/ | | |

Source: Humboldt River Basin Field Party.

1/ Annual streamflow values were interpolated and adjusted from frequency curves of streamflow on Mary's River, Humboldt River at Ryndon and Palisade, and the North Fork and South Fork of the Humboldt River.

Note: Streamflow values for 1899-1913 are U.S.G.S. gaged streamflow near Halleck and values for 1944-1961 are U.S.G.S. gaged streamflow at Devil's Gate.

## FOREST SERVICE REGION FOUR
## CHANNEL CONDITION CLASSIFICATION CRITERIA

The following describes a method of classifying the condition of perennial or intermittent stream channels. Channel condition, as used here, is measured by indicators of channel stability. Classification is not based on any one factor; all the criteria must be weighed before a decision is reached.

Class 1 - Good

1. Channel sides well vegetated.
2. No slumping of channel sides.
3. Very little or no cutting or deposition of channel bottom.
4. Aquatic vegetation on channel sides and bottom.
5. Algae on rocks.
6. Very little or no recent cutting or deposition along channel sides.

Class 2 - Fair

1. Channel sides partially vegetated.
2. Slumping of channel sides at constrictions and bends.
3. Some cutting of channel bottom at constrictions, bends and steep grades and deposition in areas where the water velocity is less, e.g. pools.
4. Aquatic vegetation scattered, mostly in areas where stream velocities are low.
5. Algae on rocks in places where the bottom is stable.
6. Some cutting of stream banks at constricted areas or at outside of bends; deposition at the inside of bends and at the confluence with other streams.

Class 3 - Poor

1. Very little vegetation on channel sides.
2. Slumping of channel sides common.
3. Cutting and deposition of channel bottom common, bottom obviously in a state of flux.
4. No aquatic vegetation.
5. No algae on rocks.
6. Large-scale cutting of stream banks common.

Channels in Rock

In some instances, the channel cross section may be carved in rock. In this case, some of the factors listed under the Fair or Poor class may be in evidence, e.g., lack of vegetation on banks and deposition at grade changes. In order to classify the condition of such channels on the basis of channel stability, they must be considered to be in the Good condition class.

# APPENDIX II

This appendix is produced in a relatively limited number of copies. It contains material germane to the North Fork Sub-Basin but which, because of its detailed or technical nature, is not attached to copies for general distribution.

Such material, however, has potential value as an information reservoir for technicians, administrators, and resource managers concerned with the North Fork Sub-Basin.

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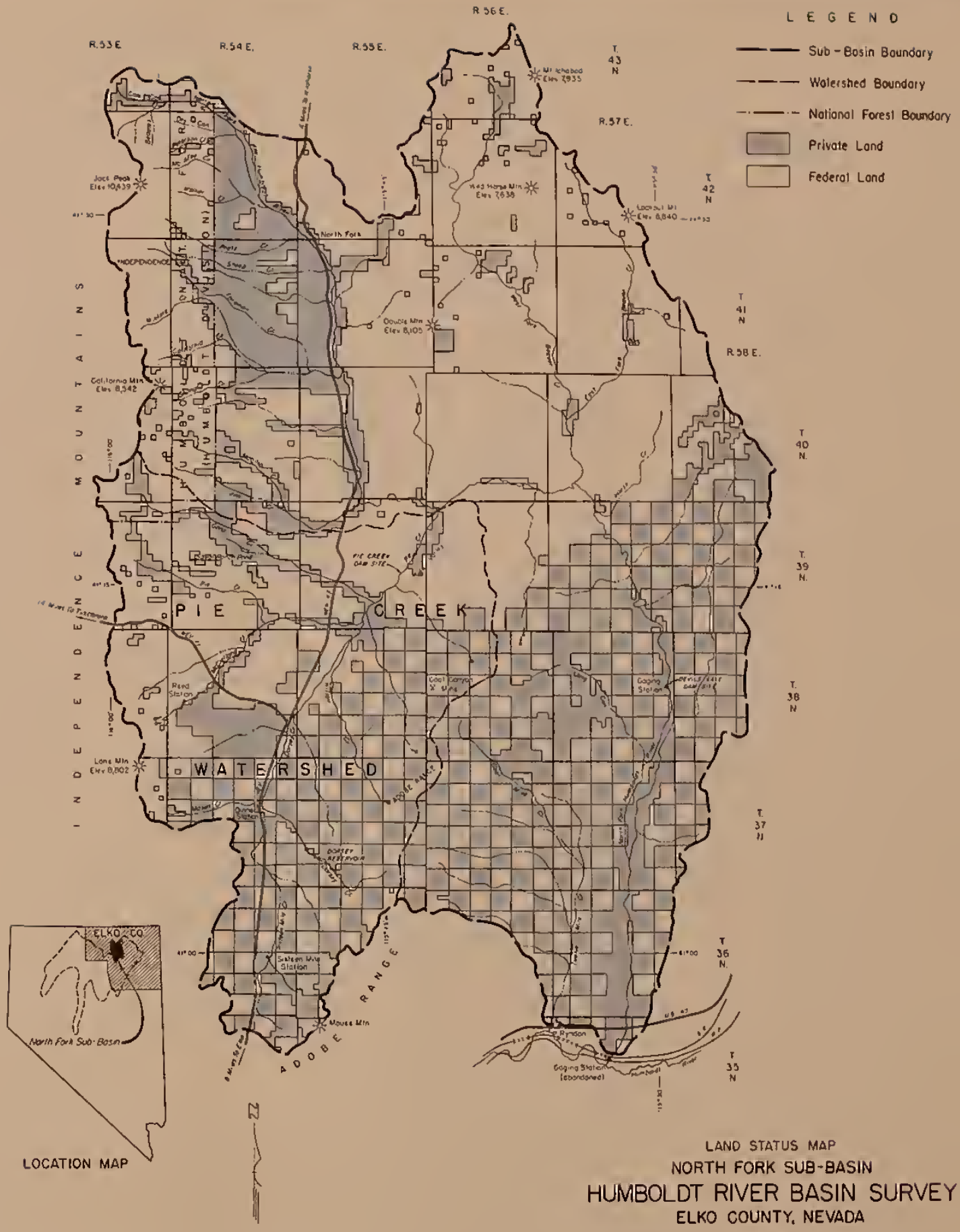



LAND STATUS MAP

NORTH FORK SUB-BASIN

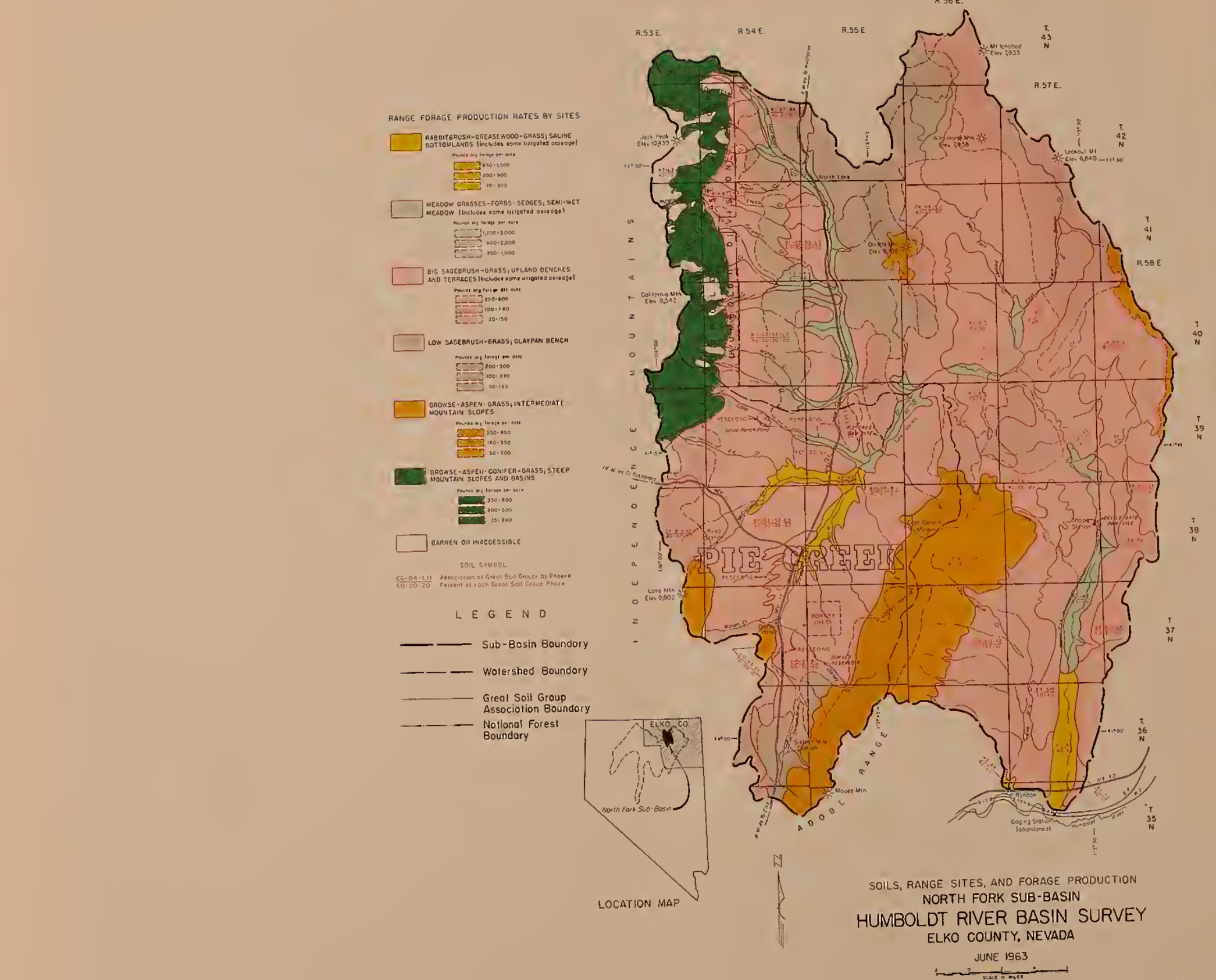
# HUMBOLDT RIVER BASIN SURVEY

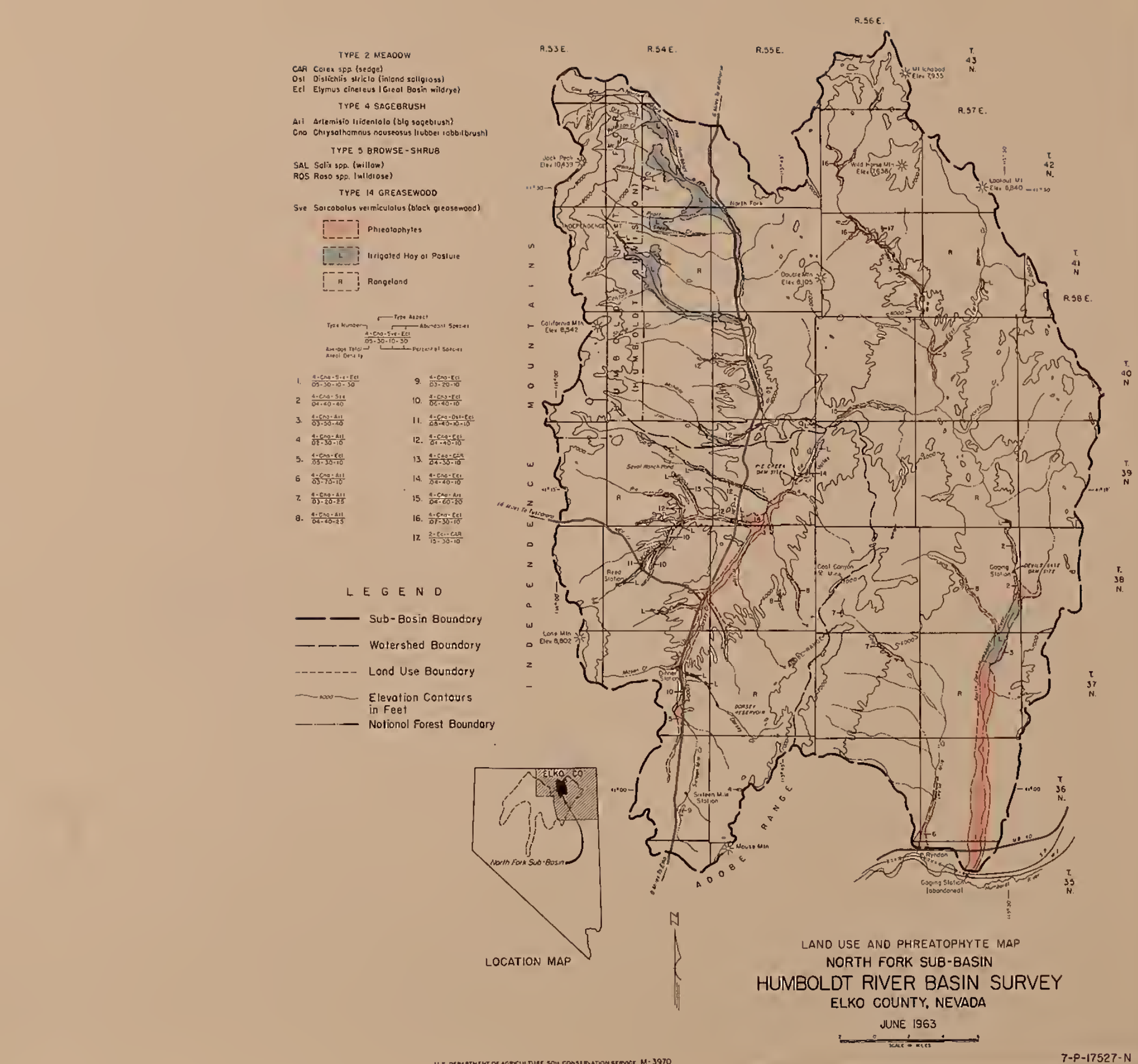
ELKO COUNTY, NEVADA

JUNE 1963

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE — M-3970

7-P-17527-N


RANGE FORAGE PRODUCTION RATES BY SITES
RABBITBRUSH-GREASEWOOD-GRASS; SALINE BOTTOMLANDS (Includes some irrigated acreage)
MEADOW GRASSES-FORBS-SEDGES; SEMI-WET MEADOW (Includes some irrigated acreage)
BIG SAGEBRUSH-GRASS; UPLAND BENCHES AND TERRACES (Includes some irrigated acreage)
LOW SAGEBRUSH-GRASS; CLAYPAN BENCH
BROWSE-ASPEN-GRASS; INTERMEDIATE MOUNTAIN SLOPES
BROWSE-ASPEN-CONIFER-GRASS; STEEP MOUNTAIN SLOPES AND BASINS
BARREN OR INACCESSIBLE
SOIL SYMBOL
LEGEND
Sub-Basin Boundary
Watershed Boundary
Great Soil Group Association Boundary
National Forest Boundary
LOCATION MAP
ELKO CO
North Fork Sub-Basin
INDEPENDENCE MOUNTAINS
ADOBE RANGE
PIE CREEK
R.53 E.
R.54 E.
R.55 E.
R.56 E.
R.57 E.
R.58 E.
T. 43 N
T. 42 N
T. 41 N
T. 40 N
T. 39 N
T. 38 N
T. 37 N
T. 36 N
T. 35 N
Mt Ichabod Elev 9935
Jack Peak Elev 10,839
Wild Horse Mtn Elev 9858
Lookout Mt Elev 6,840
Collarino Mtn Elev 9,542
Lone Mtn Elev 9,802
Mouse Mtn
Rhodes
Gaging Station (abandoned)
SOILS, RANGE SITES, AND FORAGE PRODUCTION
NORTH FORK SUB-BASIN
HUMBOLDT RIVER BASIN SURVEY
ELKO COUNTY, NEVADA
JUNE 1963
7-P-17527-N
U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE M-3970

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