0012

12/14/06 Drawing C/025/0005

Pam:

Here is the "Thumb Drive" for the Reconnaissance Determination of AVF for the Alton Petition Area, we talked about in today's meeting.

R Singh

303-844-1400
X1489

Reconnaissance Determination of Alluvial Valley Floor Status and Assessment of Selected Geomorphic Parameters in Selected Stream Valleys of the Alton Petition Area and Adjoining Lands, Garfield and Kane Counties, Utah

prepared for

U. S. Office of Surface Mining, Region V

Denver, Colorado

Jack Schmidt

Earth Resources Consulting

July 25, 1980

CONTENTS

ILLUSTRATIONS

TABLES

INTRODUCTION

In May, 1980, Jack Schmidt, Earth Resources Consulting, Helena, Montana, was requested to complete certain geomorphic evaluations in the Alton coal field, Utah. These investigations were related to allegations presented in a petition to designate lands unsuitable for mining, presented to the U. S. Office of Surface Mining by the Sierra Club, Environmental Defense Fund, Friends of the Earth, and seven land owners in Kane County. Schmidt was asked to conduct a reconnaissance alluvial valley floor determination study for the petition area and adjacent areas, make an evaluation of the nature of agricultural use of water, make an evaluation of erosion and sediment yield characteristics in proposed mining areas, and make an evaluation of the effect of erosion and sediment yield on downstream channels and associated stream diversions.

Schmidt spent a total of 14 days in the Kane County area, conducting necessary field work and collecting information from local Federal agency offices. The nature of Schmidt's work should be considered reconnaissance. Plate 1 shows routes traveled by Schmidt in the study area.

DATA POINT NUMBER SYSTEM

The system used in this report for locating data points is based on the Bureau of Land Management system of subdividing the Public Lands. Kane County, Utah, is in the Salt Lake Principal Meridian System. The first segment of a data point number is the township south of the Salt Lake base line; the second, the range west of the Salt Lake principal meridian; and the third, the section in which the data point is located (figure 1). The letters A, B, C and D following the section number locate the data point within the section. The first letter denotes the 160-acre tract; the second, the 40-acre tract; the third, the 10-acre tract; and the fourth, the 2.5-acre tract. The letters are signed in counter-clockwise direction, beginning in the northeast quadrant. Thus, in figure 1 the designation 40S5W16ABCA identifies the data point identified in the NE¼SW¼NW¼NE¼ Section 16, T.40S,R.5W.

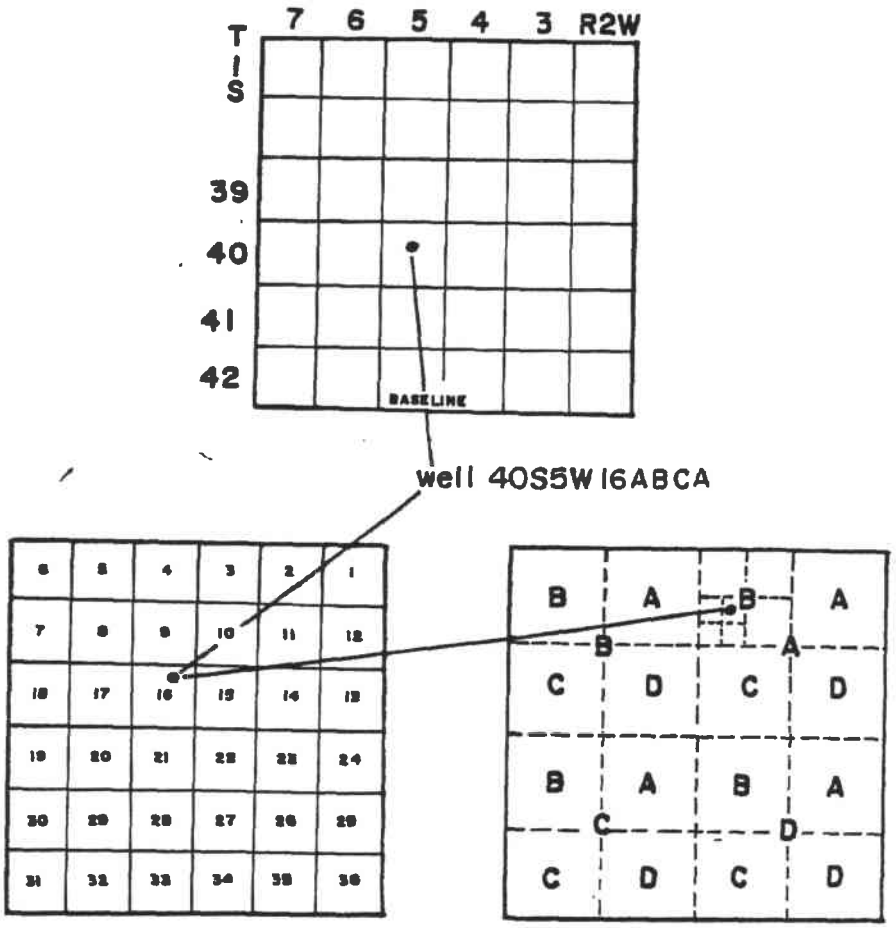


Figure 1 Data Point Numbering System

STUDY AREA & TOPOGRAPHIC CHARACTERISTICS

The study area includes the formal unsuitability petition area as well as those portions of the Kanab Creek and Johnson Wash watersheds above the Vermillion Cliffs. (Plate 1) Emphasis was placed on the Kanab Creek, Johnson Wash, and Deer Springs Wash watersheds and mapping of irrigated land use and reconnaissance alluvial valley floor status was conducted for those watersheds. Other portions of the study area were considered only briefly.

Gregory (1950) has described the region's topographic outline eloquently:

> "In its general relations the Zion Park region is part of the Colorado Plateaus, a geographic province comprising 100,000 square miles of strongly carved tabular relief here and there modified by volcanic masses. Its dominant topographic features are plateaus, cliffs, and canyons strongly contrasted in magnitude, form, and color, which so completely dominate the landscape that features unnoticed here would be picturesque landmarks in different surroundings. On large and small scale the topography is angular--terraces and vertical walls are common and curved outlines and gentle slopes are rare. Few regions are more rugged or more difficult to traverse. Unlike the eastern parts of the Colorado Plateaus, where generally flat surfaces are broken by such ridges of folded rocks as the Echo Cliffs, Comb Ridge, Waterpocket Fold, and San Rafael Swell and reach their highest altitudes in such piles of igneous rock as the Abajo, Navajo, and Henry Mountains, the pattern of the Zion Park region is relatively simple. The rocks are displayed as a series of platforms at various altitudes, bordered by cliffs of commanding height and so continuous that canyons which pass through them appear in distant views as insignificant breaks in a horizontal sky line. The landscape of all southern Utah might be described in terms of platform and cliff--plateaus hundreds of square miles in area and cliffs 1,000 to 2,000 feet high: terraces narrow or wide, short or miles long, outlined by escarpments a few hundred feet high; and long sharply cut benches outlined by the eroded edges of individual strata. Innumerable low benches stand on the terraces and cling to the cliffs and canyon walls, and even isolated buttes and mesas are outlined by vertical and horizontal lines. In crossing plateaus, climbing cliffs, or scaling walls, altitude is attained by ascending steps.
>
> In a regional sense the dominant topographic features of the Zion Park region are two platforms each thousands of square miles in area. (fig.2) The lower platform consists of the Uinkaret and

Kanab Plateaus, which border the Colorado River in Arizona. A mile above it stand the Markagunt and Paunsaugunt Plateaus, which extend far northward into central Utah. In the face of the higher plateaus terraces hundreds of square miles in area have been cut. The result is a gigantic stairway of uneven treads that leads from the flat surface of Lost Spring Mountain, near the Utah-Arizona line, to the equally flat top of the Pink Cliffs, some 40 miles distant . . .

Along the line of Kanab Creek four platforms constitute a series. The lowest is the Kanab Plateau, at an average altitude of 5,000 feet. From Kanab Canyon it extends eastward toward the Paria River and from the base of the Vermilion Cliffs southward to Grand Canyon. It is an area of broad, flat valleys crossed by flat ridges of east-west trend and isolated mesas outlined by steep cliffs. Where they emerge from the Vermilion Cliffs Johnson, Cottonwood, and Sand Creeks and other tributaries to the Kanab that cross the plateau flow in shallow trenches that make possible the recovery of water for irrigation at Johnson, Kanab, and Fredonia . . . the Kanab Plateau is but sparsely coated with vegetation and has few perennial streams and springs. It is essentially a grazing ground for stock. The next higher step in this series is the Wygaret Terrace, 6,000 feet abcve sea level --the area that extends from Sand Canyon eastward beyond Johnson Canyon, bounded northward by the White Cliffs and terminated southward at the crest of the Vermilion Cliffs. Its surface is roughly even except for rounded knobs that rise above it and short canyons sunk a few hundred feet below. On it grows a pygmy forest of pinon, juniper and sage and some shrubs and herbs suitable for the sheep and cattle that find water at the few springs and ephemeral ponds. Except on the floors of Kanab and Johnson Canyons, where water for a few ranches is available, the Wygaret Terrace is not used for agriculture. The third step in this eastern series of platforms and cliffs is the Skutumpah Terrace-a broad belt of nearly flat land crossed by southward flowing streams that head in canyons and end in canyons. This terrace extends from the Parunuweap Valley northeastward to the Paria River, a distance of 40 miles. Its southern edge is sharply outlined by the White Cliffs, its western edge by the Elkheart Cliffs. Northwards its general surface at an altitude of 7,000 feet merges into the low benches and escarpments, the foothills of the Paunsaugunt Plateau, the highest bench in the series, 9,000 feet above sea level. The Skutumpah Terrace and adjoining highlands is a grazing country, the site of a few ranches occupied during the summer by stockmen who make their homes in Alton, Glendale, and Kanab.

From the highway east of Fredonia, particularly where it ascends the slope of the Kaibab Plateau, this eastern stairway is revealed in all its magnificence. From the floor of Kanab Plateau, here almost bare of vegetation and painted in tones of chocolate and gray, rises abruptly the red wall of the Vermilion Cliffs, and behind it in turn the White Cliffs, the Gray Cliffs, the shining Pink Cliffs that rim the Paunsaugunt Pleateau, and the towering Table Cliffs of Aquarius Plateau beyond. At no place in the

Plateau province are the characteristic rock benches better displayed. Here may be had an uninterrupted view of a vertical mile of rock arranged in orderly layers, which seem to compete with each other in attaining brightness of color and variet of decorative form . . .

The characteristic streamways of the Zion Park region are meandering canyons which maintain their pattern regardless of their length, breadth, or depth. Valleys with broad flood plains and with sides that slope gradually from the edge of a stream to the adjoining uplands are lacking. The flat floors meet the steep walls nearly at right angles, and the tops of the walls are truncated at the level of interstream surfaces. Such trenches, especially those sunk into broad rock terraces, may be discovered only when their rims are reached; canyons as much as 20 miles long and 1,000 feet deep are not shown on reconnaissance maps. Some of the canyon floors are wide enough for fields and village sites, but generally there is room only for the streams that occupy them. A few canyons are narrow, deep trenches throughout their length; most of them show "narrows" and "wides", but these are not proportionate to depth. Some canyons have so few tributary canyons that their rims may be traversed for miles. Others are so abundantly provided with interlaced branches that the only feasible trail in some square miles of country is the floor of the master canyon. Kanab, Cottonwood, and Short Creek canyons, and Orderville Gulch, which break through the Kolob Terrace, are features of beauty and commanding proportions, but the glory of the region is Zion Canyon of the Virgin River- a trench 1,000 to 2,000 feet deep, which branches headwards into gashes equally profound but less than 50 feet wide.

Down the steep cliffs and across the broad terraces scores of streams carry surface water southward and southwestward to the Kanab and the Virgin and on to the Colorado Rivers. From the rim of the Paunsaugunt Plateau (9,000 feet) the Kanab descends southward through canyons in the White and the Vermilion Cliffs to the flatland at Fredonia (4,500 feet), then through a profound canyon to its mouth in the Grand Canyon (1,850 feet). Within the Zion Park region the Kanab and its few short tributaries drain 734 square miles. The Virgin River has its source in the edge of the Markagunt Plateau; there its tiny, swift tributaries bring surface water and big springs contribute much . . . Except for the few lakes and small pools in the meadow lands about springs, the water from rain passes readily along a well-marked course on its way to the sea. It is interesting to note that although the major streams flow southward, the regional slope of the rocks is northeastward.

The Kanab, the Virgin, and many of their tributaries that head in the High Plateaus have permanent water at their heads, and during most of the year water flows continuously in the larger channels. Many canyons normally present alternating stretches of stream and of dry bed. On both sides of Zion and Kanab Canyons, on Moccasin and Wygaret Terraces, and on the Unikaret and Kanab Plateaus, nearly all the drainage is ephemeral, the streams flowing only in immediate response to rain.

The topographic features of the Zion Park region are developed in both sedimentary and igneous rock. The plateaus and terraces are built mainly of sandstone in thick and thin layers, slightly tilted. Crater Hill, on Coalpits Wash; Gray Knoll, on Little Creek Mountain; Corral Crater, on Skutumpah Terrace; and Spendlove Knoll and Fire Pit, on Kolob Terrace are craters little modified by erosion. Their symmetrical form and the freshness of the lava flows about them date the eruptions as of relatively recent time.

As shown by the behavior of streams, by soil, and by vegetation, the climate of the region, particularly that of the areas below 7,000 feet, is semiarid. Deserts in the sense of large salt pans, alkali flats, and pavements of wind-worn stones are lacking, but areas of shifting sand dunes mark the heads of Cottonwood Canyon and Three Lakes Canyons and Short Creek, and sand is piled here and there at the bases of cliffs and canyon walls . . .

As scenery, the topographic features of the Zion Canyon region are unexcelled by any other part of the Plateau province, and as illustrations of the work of erosion they are of exceptional interest to students of land forms.

(p. 6-12)

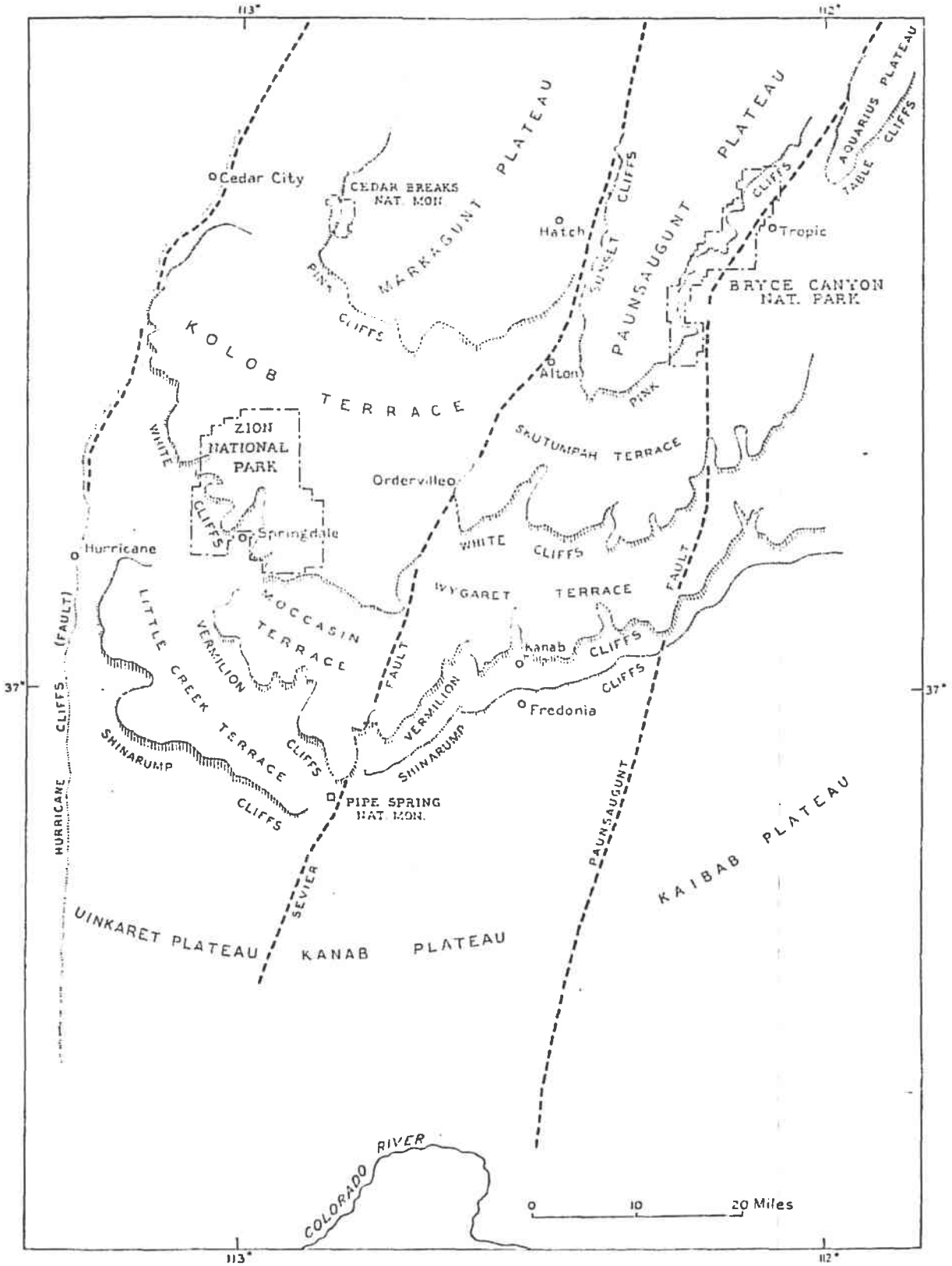


FIGURE 2.—Sketch map showing position of major plateaus, terraces, and lines of cliff in Zion Park region.
(Gregory, 1950)

GEOLOGIC AND HYDROLOGIC SUMMARY

Geologic units exposed in the study area range in age from Triassic to Holocene. Cordova (1980) notes that sandstone is the dominant exposed rock type of the region with progressively lesser amounts of unconsolidated rocks, siltstone, mudstone, shale, limestone, igneous rocks, conglomerate, and coal. Reference should be made to Cordova (1980), table 2, for a summarized listing of lithologic and hydrologic characteristics of the various formations. Generally, geologic formations dip to the north, northeast, and northwest at angles less than 5^{o} to 10^{o}. Faults are common in the study area. Most faults are normal and strike northeasterly or northwesterly. Major faults in terms of length and displacement include the Hurricane, Sevier, and Paunsaugunt. (Cordova, 1980)

The study area is drained by the Virgin River, Kanab Creek, and the Paria River. Only the East Fork Virgin River is within the study area; its headwaters are found on the western flank of the Paunsaugunt Plateau and the eastern flank of the Markaguent Plateau. Goode (1964, p.36-41) describes the hydrology of the East Fork drainage. Records for the U. S. Geological Survey gaging station, East Fork Virgin River near Glendale, indicate an average discharge for the period 1966-1978 of 17.7 cfs (cubic feet/second) or 12,820 af/yr (acre-feet/year). This equals an annual water yield of .26 cfs/mi^2/yr or 185.3 af/mi^2/yr. (U.S. Geological Survey, 1979).

The sources of Kanab Creek are the various tributaries heading in the Pink Cliffs along the eastern and southern margins of the Paunsagunt Plateau. (Plate 1) All these tributaries cross

the petition area. Johnson Wash joins Kanab Creek about 6 miles south of Fredonia, Arizona. The general hydrology of the watershed has been described by Goode (1966, 1964) with supplemental data collected by Sandberg (1978). Cordova (1980) reports:

> Runoff from the upper Kanab Creek basin . . . occurs mainly during the spring snowmelt period . . . However, instantaneous peak discharges of several hundred to more than 1000 ft^3/s (30 m^3/s) have been recorded in the basin, commonly the result of summer cloudburst activity. Based on stream-channel-geometry measurements (Moore,1968) in Kanab and Johnson Canyon Creeks near the Arizona-Utah State line, total mean annual runoff from the upper Kanab Creek basin into Arizona is on the order of 50,000 acre-ft (62 hm^3)
>
> (p.26)

The Paria River heads in the eastern Paunsagunt Plateau, Escalante Mountains, and Kaiparowits Plateau.(Plate 1) The upper portion of the Paria flows through the study area. Major tributaries to the Paria which cross the petition area include Henrieville Creek, Bryce Creek, Yellow Creek, Willis Creek, Papoose Creek, Lower Podunk Creek, and Deer Springs Wash. Portions of the Podunk Creek and Deer Springs Wash drainages are described by Goode (1966).

IRRIGATION USE OF WATER

In the study area, irrigation water is supplied from streams, springs, and groundwater. Stream flow is the dominant source of water above the White Cliffs in areas such as Upper Kanab Creek, Skutumpah Creek, and Meadow Creek. Springs are an important source of irrigation water in Johnson Canyon and to a much lesser degree in Sink Valley. Wells have been developed in alluvial aquifers and in the Navajo Sandstone, notably in Johnson Canyon and at the confluence of Thompson and Skutumpah Creeks.

Spring Sources

Goode (1966,1964) and Cordova (1980) have located and discussed the nature of many spring areas in and near the petition area. Both authors have discussed the occurence of springs in upper Cretaceous strata at the base of the Pink Cliffs in the northern portion of the Alton petition area as well as in the Navajo Sandstone. General reconnaissance investigations carried out in June, 1980, indicate that neither Goode's nor Cordova's work constitutes a comprehensive inventory of spring locations in and near the petition area. A comprehensive inventory of spring locations near any proposed mining areas should be carried out to establish a firm understanding of baseline conditions.

Several springs at the base of the Pink Cliffs are directly developed for irrigation. For example, in Water Canyon, tributary to Lower Robinson Creek, spring waters in Upper Cretaceous strata are diverted into an irrigation canal which transports the water over two miles to pasture land in Sink Valley. (Plate 2) Spring waters in Rush Canyon are diverted to irrigate lands at the mouth

of the same canyon. At the base of the Pink Cliffs in the Paria drainage, springs are developed and their waters used for irrigation in the Paria Valley itself.

Springs whose source of water are the Navajo Sandstone are used to irrigate lands in Johnson Canyon and to a much lesser extent, in Kanab Canyon. The Jet Mackelprang ranch is notable in its almost complete dependence on spring flow to water pasture lands in Johnson Canyon. In fact, Mackelprang has no wells on his property. Spring water is also used to irrigate other lands in Johnson Canyon owned by the Kanab Stake Welfare Ranch and by Oscar Judd. In Kanab Creek Canyon below the White Cliffs, spring water is used to irrigate isolated terraces in 42S6W29A,D. West of Kanab Creek spring water is used to irrigate lands in Three Lakes Canyon, Cave Lakes Canyon, and Upper Cottonwood Canyon. Springs in each of these drainages come from the Navajo Sandstone. Data on water rights filings for all these spring sources are included in Appendix A.

Wells

Wells are an important source of irrigation and stock water in portions of the petition area. Extensive well development takes place in Johnson Canyon, from the upper diversion site downstream to beyond the canyon mouth. (Plate 2) Several wells have also been developed at the confluence of Skutumpah and Thompson Creeks. Irrigation wells are also located near Tropic in the Paria Valley and at the Deer Springs Ranch.

Conversations with ranchers indicate that groundwater has been developed in some areas where streamflow is already available, because groundwater is a more reliable source. For example, alfalfa in Johnson Canyon reportedly yields 2 cuttings with stream flow from the upper diversion while yields are 4 cuttings with groundwater irrigation.

The Utah State Engineer has halted granting any further water rights in the Johnson Canyon area due to the controversies regarding impact of well development in stream and spring flow.

Stream Diversions

Several stream diversions are located throughout the study area, particularly on the East Fork Virgin River, in Kanab, Johnson and Meadow Creek watersheds, and on the Paria River. Certain of the diversion sites in Kanab Creek, Johnson Creek, and Meadow Creek were examined in the field. The locations of diversion ditches are shown on Plate 2 and filed water rights are listed in Appendix A.

Common to all stream diversions visited is the method of diversion. At each site, a check dam has been constructed, using concrete or car bodies and debris. High flows commonly carry over the check dam while low flows are diverted. Actual diversion is accomplished at the face of the concrete check dam or with a hand dug channel directing flow to the irrigation canal. Check dams serve to maintain an artifically high base level in the channel at the diversion site. Below each check dam, the channel drops to its former level. Generally, downstream incision is less than 10 feet below the level of the diversion channel; however, in lower Johnson Wash, incision is about 40 feet and in Kanab Creek near Kanab, incision exceeds 50 feet. At some sites, the downstream channel is armored with gravel. Bedrock does not seem to have limited incision at any location except upper Johnson.

Goode (1964) has discussed stream diversions of East Fork Virgin River. Diversions of Kanab and Johnson Creeks are discussed below.

Kanab Creek - Kanab Irrigation Company Diversion

The Kanab Irrigation Company Diversion is located at 43S6W16BCC. The Irrigation Company has filed claim to 18 cfs and irrigates over 1300 acres south of the town of Kanab and generally east of the Kanab Creek channel. (Appendix A) An earth filled dam approximately 50 feet high blocks the entire Kanab Creek valley at the diversion site. (Table 1) Behind the dam sediment has entirely filled the reservoir and flows of any significant volume now continue across the reservoir surface, into a concrete spillway. Low flows are diverted into the irrigation ditch. Below the spillway the channel has cut into bedrock and then returns to the former channel level about 80 feet below the level of the valley flat. No bedrock was evident in the Kanab Creek channel below the bedrock spillway.

An historical perspective on the Kanab Irrigation Company diversions is provided by Carroll (1960):

> The history of water conservation and diversion in Kanab is a dramatic story of continuous struggle and fluctuating periods of hope and despair . . .
>
> The original source of supply of water was Kanab Creek, with a flow entirely insufficient for large scale agriculture. From the begining of her history Kanab was faced with the problem of obtaining water from supplemental sources or curtailing her growth.
>
> When Latter-Day Saint colonizers first came into the valley to settle, Kanab Creek was only a small stream, lined with willows, so small that one could easily step across it.
>
> According to the records, when President Brigham Young came to the settlement for the purpose of laying out the town, he told the people that they should do their farming south of the settlement. He said, "The canyon will gut out from one end to the other and from one side to the other, and you will have all the water you need for a flourishing city." He also said to let the cattle tramp out the water and that in time a canal would be built around the town that would water the entire valley.

TABLE 1

Stream Diversion Data - Alton Area Table

Diversion Site	Check Dam Construction	Downstream Incision Below Check Dam	Parties of Interest
Kanab Creek Kanab Irrigation District	concrete, earth-fill dam	50'	Kanab Irrigation District
Kanab Creek Lamb	debris	7'	Lamb
Kanab Creek Alton Farmers Assoc.	debris	6'	Alton Farmers Assoc
Johnson Wash lower site	concrete	40'	R.A. Van Hake 3/6 Myers/H.Hansen 1/6 L.Little 1/6 S. Jensen 1/6
Johnson Wash upper site	concrete	8'	De R. Bunting 2/5 F. Bunting) L. Judd) 3/5
Skutumpah Creek	debris	6'	J. Johnson
Thompson Creek	———	———	De R. Bunting J. Johnson
Meadow Creek	debris	10'	Deer Springs Ranch

Many of the settlers doubted the words of the President, and for two years concentrated on farming the land north of the settlement. They even cultivated land considerable distance north of the town site.

It was not long before the pioneers made a reservoir at Big Lake, far above the creek. They also dug a ditch from the creek about where the present dam site is and subsidiary ditches from it to the farms and to the town. Ditches were made on every street by which water could be run on to the lots. During 1872-1873, when the settlers were moving on to their individual lots, much plowing and planting was done . . .

During the spring after that first reservoir was built, water from the creek was used until it began to diminish in the later part of May; then the water which had been accumulating in the Big Lake reservoir was turned into the creek.

To make this diversion possible, the settlers constructed a log and dirt dam northwest of the village in 1871. . .

District ditches were made to carry the water to every part of town. But the supply was not plentiful . . .

in the spring of 1873, the Kanab Agricultural Association was formed to bring the farmers into a close cooperating group for the benefit of all. At that time a survey was made and about 250 acres south of town were divided among the settlers. . . . at a mass meeting it was decided that all farming should be done south of the settlement and that no water should be used north of town . . .

From the very beginning of efforts to make the best use of their limited water supply, the settlers had trouble with the ditches washing out. It was a difficult task to run the water down the creek to a point below the southwest portion of town and make a fill from which the water could be carried to the fields above. Repeatedly this fill and others in different locations were washed away by high waters . . .

After much hard work and loss of water, a dam was made at the 'Rocks', opposite the mouth of Three Lakes Canyon. Here the water was held back and run over a rock which the pioneers thought extended completely across the canyon. However, when floods came they washed around the rock.

Next a fill was put in a short distance south of Crocodile, and from this point a ditch was run down the west side of the creek to Three Lakes where it was flumed across the east side of the creek and then runs south along the creek to a 'little below Young's Point where it emerged from the flume and was carried by the Long ditch to town.' However, regardless of constant watching and guarding, the fill and the ditch were constantly being washed out or undermined by gophers. Finally the condition became so serious that another dam was built lower down on the stream.

But this dam lasted only a few years and was taken away by a flood that came sweeping down the canyon and covered a large portion of the valley with water. This condition started the creek to wash out. A fall which slowly worked its way northward, was first noticed at the Gap. At the end of the year it had reached a point above Kanab.

In an attempt to solve this problem and regain the use of the water, a group of enterprising citizens met on the

evening of December 14, 1881 and formed a corporation . . . known as the Kanab Irrigation Company . . .

The company started to build another dam and irrigation ditch in 1883 where the present dam site and ditch are. The dam was made with dirt and then logs were placed on the lower side in a riprap fashion. Due to a misunderstanding, the water was backed up before the spillway was completed; so a temporary spillway was made. The workers stopped one day in the midst of their labor to eat lunch and left the dam unguarded. They heard a great roar and rushed to see the entire mass of dirt and logs disintegrate before their very eyes.

This dramatic event was known as the great wash out. The creek bed was sunk 40 to 50 feet below the intake irrigation ditches and the underseepage caused the wall to become dry. The entire supply of water was cut off, since the dam afforded both culinary and irrigation water. Then in the same year came an even more devastating catastrophe. It was Sunday, July 29, while the people were in church, that a great flood swept down the canyon into the valley, removing masses of earth and trees and forming a deeper chasm where the original creek had flown . . .

A report of this flood by John Reider sent to the Deseret News states: A wave of debris ten feet high reached clear across the canyon. It destroyed 300 acres of hay and drowned several head of cattle . . . the city dam was washed out and the channel of the creek cut down about forty feet. The grist mill door was broken away and two feet of debris and sand lodged in the lower story. The face of the canyon was altered. About 1300 bushels of grain in the upper and lower fields were lost where the flood was about one mile in width. A great many springs were opened, showing an increase of water. On Monday following the flood a survey was made for a new town ditch to connect with the millrace . . .

The new ditch was finished and the water was brought into town on May 26, 1885.

All went well for about 5 years. The town was prospering. But in 1890 the winter snows and rains came down in another terrible flood. It washed away the 25-foot high dam which had been completed at great cost.

No less than $65,000 was spent on dams between 1883 and 1892. About this time, President Erastus Snow suggested that a rock dam be built below Three Lakes.
A hole was blasted in the rock to serve as head of the ditch . . . By 1891 the structure was 200 ft. long and about 200 ft. wide and 40 ft. in breadth at the top . . .But the dam, which was considered invulnerable to floods was washed away in 1900 and once again water was hauled in barrels from the creek. Again, in 1908-1909 the new dam went. Finally, a tunnel was made through solid rock and a 50 ft. spillway solved the problem.

Up to this time the people relied on their own resources. Each time the dam was taken, new assessments on the capital shares were levied. Now, the Kanab Irrigation Company took over. It took two years to finish the dam. When it was completed in 1911, it looked as if a huge mountain had been

placed across the deep gorge. Besides the many days of labor by man and teams, this dam cost in money $35,000 . . . Thus, in time, the dam, spillway, tunnels and ditches necessary to bring the water into town were completed. (Carroll, 1960, p. 123-12131)."

This history makes notes of the difficulty of stream diversions in a landscape where high sediment transport and great floods are important characteristics of stream hydrology. Similar difficulties with diversions and gullying have been experienced in Johnson Canyon.

Kanab Creek-Lamb Diversion

The Lamb Diversion is located below the Alton Ampitheater at 39S6W24ACA. The Lamb Diversion claims 2.55 cfs for irrigation of over 90 acres in the Kanab Creek Valley, in 39S6W24,25,26,35. (Plate 2, Appendix A) A check dam has been constructed at the Lamb Diversion site. The check dam is composed of car bodies and debris, and the sediment build-up behind the check dam is approximately 7 feet. A moderate amount of channel armoring with gravel is noticable below the check dam.

The diversion channel continues on the east side of Kanab Creek to a holding reservoir at 39S6W24D. At this point, a pipeline transfers water to a canal on the west side of the channel or alternately transfers water to a canal on the east side of the channel. No irrigation takes place downstream of Coal Hollow; however, dry land crops are grown south of this point. No information is available regarding the availability of waters south of Coal Hollow.

Upper Kanab Creek

The upper portion of Kanab Creek is diverted into the Alton Farmers Association ditch, in the vicinity of the confluence of Kanab Creek and Reservoir Canyon (38S5W33ACB, 33CAB). (fg. 3) The Association claims 12 cfs and claims to irrigate over 1200 acres of land in Kanab Creek in the Alton Ampitheater. (Appendix A, Plate 2) Goode, (1964) estimates that from 3 to 5 cfs are actually diverted into the ditch. At the upper diversion point Kanab Creek drops 6 feet below a check dam composed of debris. (fig. 4)

The Alton Farmers Association ditch is supplemented by flow from Reservoir Canyon and Roundy Canyon, and may be supplemented by flow from Rush Canyon.

Fig. 3 Kanab Creek upper diversion into Alton Farmers Association ditch

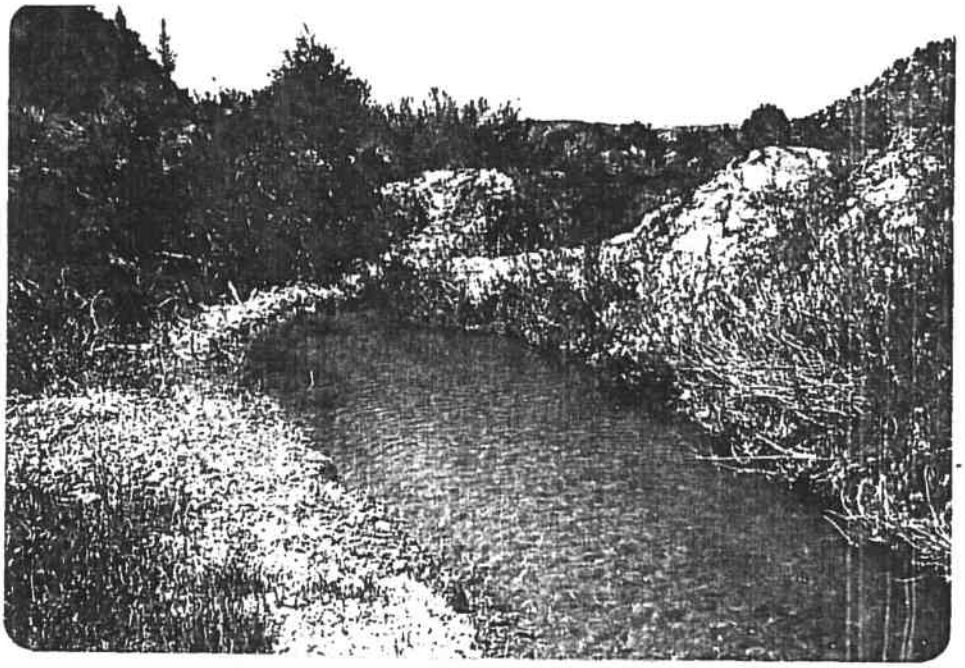


Fig. 4 Kanab Creek incision below check dam of upper Alton Farmers Association ditch

Lower Johnson Diversion

The lower Johnson diversion is located near the mouth of Johnson Canyon at 43S4½W18cc. A concrete check dam has retained enough sediment behind the dam to raise base level at the diversion site about 40 feet. (fig. 5,6) Johnson Wash channel has been channelized in this area for a distance of about .3 mile. The channelization has brought Johnson Wash onto bedrock at the valley floor margin, thus limiting further degradation of the channel. An earth berm at the mouth of Flood Canyon diverts stream flow northward so that its water may also be diverted into the Johnson diversion ditches. Undiverted Flood Canyon waters enter Johnson Wash just downstream of the Johnson Wash check dam.

Presently, R. A. Von Hake has a 3/6 interest in the diverted waters. The remaining waters are shared equally amongst S. Jensen, L. Little, and C. Myers/S. Hittson. Waters is available throughout the growing season since Johnson Creek is perennial in this area. The amount of water claimed by all parties is 15 cfs.

Conversations with two of the parties using the lower diversion (R. A. Von Hake, 1980, pers. comm.; S. Hittson & C. Myers, 1980, pers. comm.) indicate that there is significant concern about the impact of well development in upper Johnson Canyon on stream flow availability at the lower site. R. A. Von Hake claims that in the past he was able to raise 15 tons of alfalfa seed on his land, but that sufficient water is not now available. Von Hake claimed to irrigate 111 acres in his water rights filing (Utah State Engineer, 1974a), however, he is only able to irrigate about 40 acres at present. He claims that lack of water availability has rendered his land in 43S4½W19C and 30B not

Fig. 5 Lower Johnson Wash diversion site

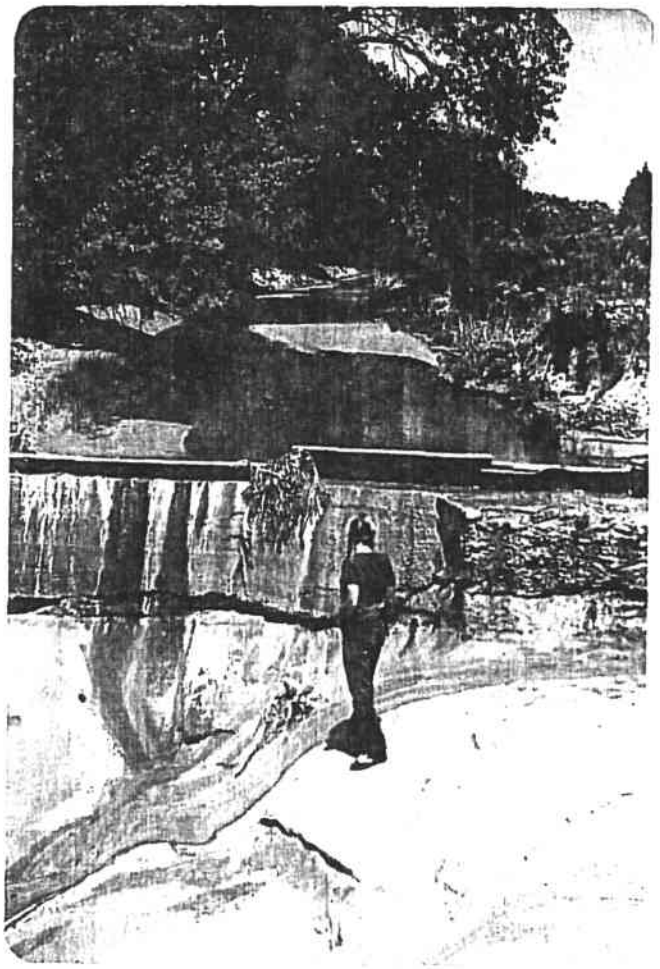


Fig. 6 View downstream of channel at lower diversion site

irrigable. C. Myers and S. Hittson claim that the water available at the diversion site significantly decreases with the initiation of pumping in the upper canyon.

Upper Johnson Diversion

The upper Johnson Wash diversion is located just below the bridge crossing in 42S5W11BD. A concrete check dam about 8 feet high has filled with sediment and thus represents an artificial baselevel. (fig. 7,8) The dam and diversions in their present form were constructed in 1958. The stream channel above and below the diversion have not been channelized.

Water at the diversion is allocated 2/5 to De Ralph Bunting for use west of Johnson Wash and 3/5 to Finley Bunting and Le Roy Judd for use east of Johnson Wash. Finley Bunting and Le Roy Judd share their water 1/1 for half the year: in winter and early spring, Bunting uses the water on a 2/1 basis. Normal availability of water at this site yields an irrigation season extending from February until April. During warm years, water is irrigated during the entire winter. In wet years, irrigation water may be available until May or very rarely until June, as in 1980. Generally, two cuttings of alfalfa are possible in Johnson Canyon under this type of irrigation scheme. (F. Bunting, 1980, pers. comm.)

Water yield drops dramatically when irrigation water begins to be diverted at Skutumpah and Thompson Creeks in April. In normal years, little water is available at the Johnson diversion once the upper basin irrigation begins. Diversion at upper Johnson seems to have little direct effect on irrigation use at lower Johnson. (F. Bunting, 1980, pers. comm.) Irrigation practice at upper Johnson has always been based on capturing 100% of the available intermittent flow. Irrigation practice at lower Johnson is based on diversion of the perennial flow whose source is springs in the stream channel about 3 miles downstream of the upper diversion.

Fig. 7 Check dam, upper Johnson diversion site

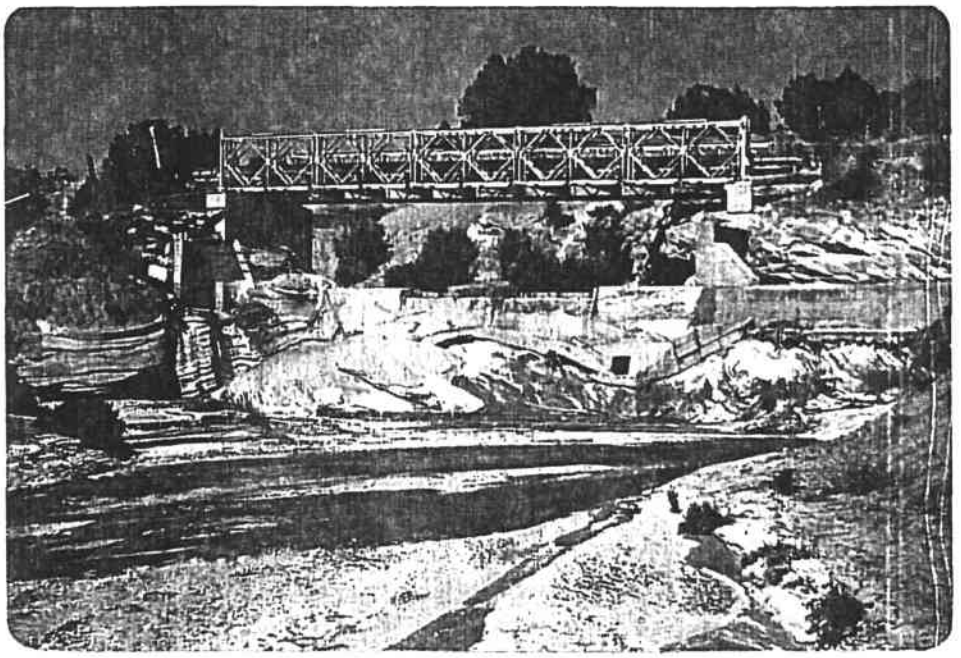
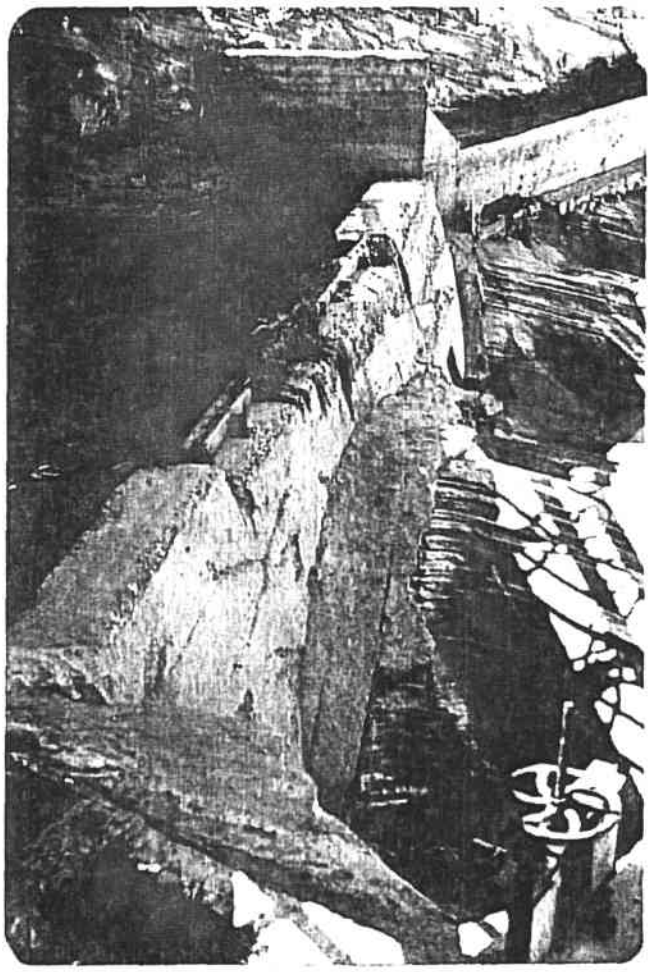


Fig. 8 Check dam and diversions, upper Johnson site



Skutumpah Diversion

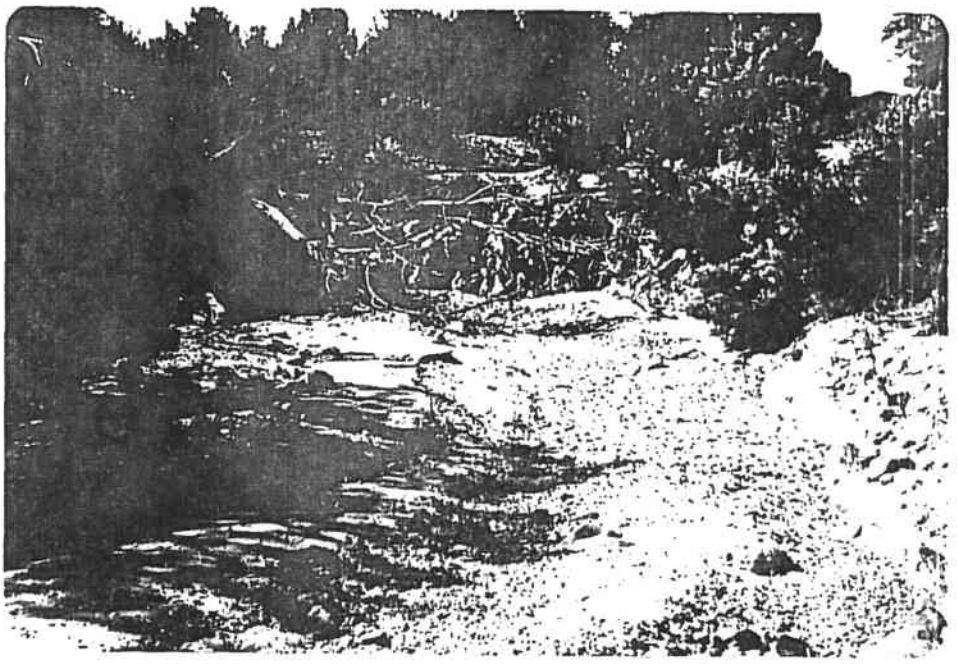
Skutumpah Creek is diverted at 40S4½W20DAC, about 0.25 miles below the Alton leasehold area. (fig. 9, 10) Water is taken by ditch over 1.25 miles to irrigate approximately 227 acres near the confluence with Thompson Creek. Some lands are jointly irrigated with Thompson Creek waters.

Water is diverted from April to October. The rest of the year, water is allowed to flow downstream. The check dam at the diversion site is composed of car bodies and debris. High flows continue downstream while low flows are diverted by a hand-dug trench that washes out with each large flood. Below the check dam the stream has cut about 6 feet and about 14 feet into the valley flat.

Jeff Johnson farms the majority of land in the area, supplementing stream water with well water. The combination yields about 3 tons/acre/cutting of alfalfa and 2 to 30 cuttings per year. Grain yields are about 300 bu/ac. (J. Johnson, 1980, pers. comm.)

Fig. 9 Skutumpah diversion, hand dug ditch channels flow into canal

Fig. 10 Check dam at Skutumpah diversion, note channel armoring below dam



AGRICULTURAL USE OF WATER BY PETITIONERS

Conversations were held with all petitioners except Larry Little, who was not in the Kanab area in early June, 1980. However, information supplied by J. K. Little provided a perspective on the L. Little operation. The principal lands of each petitioner are located in Johnson Canyon or at its mouth. The petitioners use groundwater from the Navajo Sandstone and from an unconsolidated aquifer, spring flow from the Navajo Sandstone, and stream flow from Johnson Wash, whose source is spring flow from the Navajo. Table 2 provides data on some wells and springs owned by the petitioners. Complete listings of their water filings for irrigation, stockwatering, domestic, have been compiled by the Utah State Engineer (1974a).

Specific descriptions of individual petitioners' water uses follow.

TABLE 2 DATA ON WELLS & SPRINGS OWNED BY PETITIONERS

Location	Owners' Designation	Yr. Constructed	Depth of Well (feet)	CASING Diameter (inches)	CASING Depth (feet)	well finish	Principal Aquifer	Altitude (feet)	Water Level Above(+) or Below land surface datum (feet)	Water Level Date	YIELD Rate (gal/min)	YIELD Date	Use of Water	Remarks and other Data Available
						WELLS								
:-43-5)														
cca-1	S. Lippincott	1973	150	16	60	x	Unconsolidated rocks	5,120	-	-	-	-	-	
cda-1	S. Lippincott No. 1	1973	110	16	100	P	do.	5,110	28.27	9/22/76	50R	2/19/73	I	
cdb-1	S. Lippincott No. 2	1973	115	16	110	P	do.	5,115	29.60	9/22/76	50R	3/3/73	I	
cdb-2	S. Lippincott No. 3	1973	110	16	110	P	do.	5,115	32.38	4/26/77	250R	11//73	I	
cac-1	S. Lippincott No. 4	1973	110	16	110	P	do.	5,120	31.49	9/22/76	180E	9/27/77	I	
dbb-1	L. Little	1957	120	10	105	P	do.	5,120	34.55	9/28/76	400R	7/2/57	I	
dcb-1	do.	1972	94	10	94	P	do.	5,100	19R	11/9/72	-	-	I	
ddc-1	do.	1972	94	10	94	P	do.	5,100	19R	11/4/72	-	-	I	
cbc-1	do.	1977	113	8	112	O	do.	5,145	22.94	10/1/77	-	-	I	
acd-1	do.	1960	125	16	-	P	do.	5,135	47R	10/31/60	265R	1960	I	
42-4½) 9bbc-1	S. Johnson	1967	585	6	137	x	Navajo Sandstone	6,060	559R	10//67	2.5	10/21/76	S	
cda-1	S. Johnson	1960	26.5	6	26	x	do.	5,500	10.67	10/14/76	-	-	U	
-43-4½) 9 cbc-1	C. Myers & S. Hittson	1976	100	8	100	P	Unconsolidated rocks	5,145	20.90	10/6/76	60R	7/31/76	H	

SPRINGS

Location	Name	Altitude	Aquifer	Discharge Rate	Discharge Date	Total for Year acre-ft.	Use of Water	
-43-5) bda-S1	J. Mackelprang	5,280	Navajo Sandstone	1.3	10/12/76	2.1	H	

TABLE 2 (cont.)

Explanation of Symbols

* assumed that S. Lippincott and L. & C. Lippincott are the same party.

** P - perforated

O - open end

I - irrigation

S - stock

U - unused, unknown, or destroyed

H - domestic

Susan Hittson - Cynthia Myers

Cynthia Myers and Susan Hittson own about 40 acres on Hells Bellows at the mouth of Johnson Canyon (43S5W24-DD), about 16.5 miles south of the Alton coal field leases. They also own land (about 40 acres) in Dunham Wash (40S4W9), a portion of which is underlain by Federal coal whose lease is held by Utah International, Inc. (U.S. Department of the Interior, 1979, p. A-I-5). The land at Hells Bellows, presently used as pasture, is irrigated by a well (100 feet deep) on the property as well as with a 1/6 interest in the lower Johnson Canyon diversion at 43S4½W18CC. (Hittson and Myers, 1980, pers. comm.)

Sylvan Johnson

Sylvan Johnson operates a ranch in Johnson Canyon. The ranch headquarters is located near "Movie Town" (42S5W35AC), about 12.5 miles south of the Alton coal field leases. The Johnson Ranch occupies portions of 42S5W23,24,26,35, and 36 (U.S. Agricultural Stabilization and Conservation Service, 1980?). No formal search was made to determine the acreage or legal description of Sylvan Johnson land holdings.

Johnson irrigates portions of 42S5W26C and 35A,D and 43S5W2A. All irrigated lands are located on the valley floor of the main canyon. Johnson's sources of irrigation water include wells, springs, and streamflow from Meadow Canyon. An irrigation well located at 42S5W26CDA is reportedly 380 feet deep and yields 390 gpm from the Navajo Sandstone (Table 2). Spring flow and stream flow in Meadow Canyon irrigate somewhat less than 50 acres of 42S5W35 and 43S5W2A (Appendix A). Johnson also owns at least two stock wells completed to the Navajo Sandstone. Domestic water is supplied from House Spring (42S5W35AD).

Leon Lippincott - Caroline Lippincott

The Lippincotts operate a ranch at the mouth of Johnson Canyon, and the ranch headquarters (43S5W25CA) is located about 17.5 miles south of the Alton coal field leases. The Lippincotts also own portions of the Dunham Wash and Slide Canyon watersheds, tributary to Deer Springs Creek, in 40S4W4,9, and 10 (L. and C. Lippincott, 1980, pers. comm.) Most of these lands are underlain by Federal coal whose leases are held by Utah International, Inc. (U.S. Department of the Interior, 1979, p.A-I-5).

Irrigated alfalfa and grass hay are raised in 43S5W25A,C and 26D. A well in 43S5W25AC, owned jointly with Larry Little irrigates the Lippincott land (48 acres) in 43S5W25A. Four wells in 43S5W25C irrigate the remaining land (135 acres). Cordova (1980) reports that each of these wells is completed into unconsolidated material with well depths ranging from 110 to 150 feet. (Table 2) Yields on these wells are estimated or reported to range from 50 to 250 gpm. The Lippincotts report that a dry hole was drilled along the southern portion of the 43S5W25/26 section line. Presently, the Lippincotts run 69 head of cattle.

Larry Little

Larry Little owns land at the mouth of Johnson Canyon, principally in 43S5W25 and also in 43S4½W30C. Most of the land is irrigated by wells, however, a 1/6 interest in the lower Johnson Canyon diversion is also held. Four L. Little wells are listed by Cordova (1980). Three are completed into unconsolidated material (94-120 feet deep) and one into the Chinle Formation (400 feet deep). (Table 2)

Jet Mackelprang

Jet Mackelprang operates a ranch in Johnson Canyon. The ranch headquarters is located near the abandoned townsite of Johnson (43S5W12BD), less than 14.5 miles south of the Alton coal field leases. Virtually all the Mackelprang land on the valley floor of Johnson Canyon is irrigated by stream flow and spring flow from Meadow Canyon or from springs which issue from the Navajo Sandstone at various points from Meadow Canyon south to Eagle Arch (43S5W12DB), a distance of over 2 miles. (fig. 11,12) The only land in Johnson Canyon not irrigated by Mackelprang is located west of Johnson Wash in 43S5W13A,D. In all, Mackelprang claims to irrigate 205 acres (Utah State Engineer, 1974a). The domestic source of water is a developed spring. The Mackelprang operation is notable in that the entire operation depends on spring water; there are no wells used on the property.

Mackelprang owns Charolais and Hereford cattle on his ranch. His pasture land is mostly rye and intermediate wheatgrass, and he purchases alfalfa hay, rather than growing it himself. Mackelprang says he could get 4 cuttings of alfalfa given his water supply and the local growing conditions (J. Mackelprang, 1980, pers. comm.). The Utah State Engineer (1974a) has compiled all claims for the Mackelprang operation.

Fig. 11 Spring fed pond, Mackelprang ranch

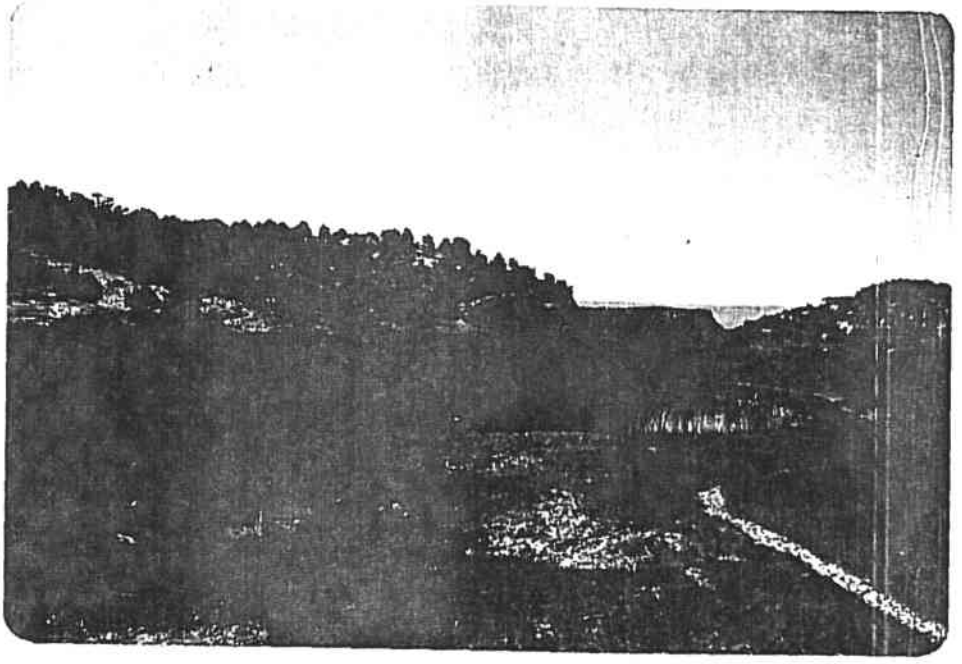
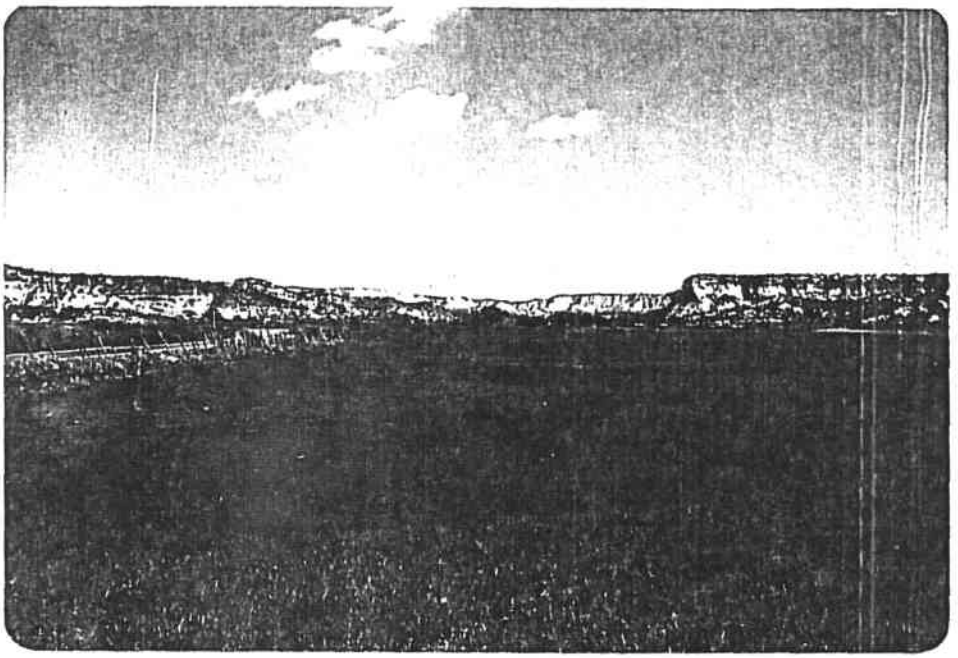


Fig. 12 View upstream Johnson Canyon



ALLUVIAL VALLEY FLOOR DETERMINATIONS

A reconnaissance investigation was made of the status of stream valleys in and near the petition area as "alluvial valley floors", as defined in PL95-87. (U.S. Congress, 1977) In conducting this reconnaissance investigation, reference was made to U.S. Office of Surface Mining (1979) and U.S. Office of Surface Mining (1978). Reference was also made to an unpublished revision of the alluvial valley floor technical guidelines (Schmidt, 1979). Because this investigation was being adapted to a region never before evaluated, certain revisions or interpretations of the reference materials were made. Those revisions are discussed below.

Reconnaissance identification procedures are intended to distinguish between those areas clearly not alluvial valley floors and those areas where detailed study might show that the areas would be formally designated as alluvial valley floors. Reconnaissance identification is thus intended to highlight those areas where detailed study is necessary. Alluvial valley floor identification does not necessarily mean that an area will be prohibited from mining. Only those areas outlined in §510(b)(5)(B), PL95-87 are prohibited from mining in the context of alluvial valley floors.

The following information was used in making reconnaissance alluvial valley floor determinations for the Alton area:

Black-and-white airphotos; scale 1:18500,
September, 1967;
U. S. Soil Conservation
Service, Kanab;

conversations with numerous ranchers as well as with professionals at the U.S. Soil Conservation Service, Agricultural Stabilization and Conservation Service, and Bureau of Land Management;

farm maps (drafted on air photos), U. S. Agricultural Stablization and Conservation Service, Kanab,

water rights filings (Utah State Engineer, 1974a,b);

geologic and hydrologic reports (Cordova, 1980; Doelling and Graham, 1972; Goode, 1966; Goode, 1964; Sandberg, 1978);

field reconnaissance.

No identification of alluvial valley floors has been made to date in southern Utah. In light of this fact, a survey was initially made to establish the nature of agricultural use of valley floors in the Alton area. The survey was also intended to establish the role of water in maintaining various agricultural uses of valley floors. Alluvial valley floors generally are those areas where water availability plays a special role in agricultural land use.

The most long-standing agricultural uses of valley floors in the area are for grazing. In 1863, Levi Savage brought a small band of sheep to Kanab, and he reported in his journal that grass was knee high all over the town and the surrounding hills. By 1870, there were many flocks and herds and in 1913 livestock numbers in Kane County had

reached the following levels:

110,000 sheep

15,000 cattle

10,000 goats

2,300 horses

In 1974, livestock numbers had declined to the following levels:

5,583 sheep

8,125 cattle

0 goats

199 horses

(U.S. Bureau of Land Management, 1977). Generally, the decline in livestock numbers is attributed to overgrazing and to some extent to a climatic shift towards aridity.

The role that valley floors play in grazing is best exemplified in the vegetative type and grazing capacity data for the Zion Planning Unit, Kanab BLM district. (Table 3). Pinyon-juniper is the dominant hillside vegetation and dominant type in the planning unit, yet its AUM (Animal Unit Month) contribution is not consistent with its land area. Sagebrush is the dominant cover in alluvial areas and contributes somewhat more AUM capacity. Grasses, where found, are the most productive type of vegetation.

Typical sagebrush vegetation types have grazing capacities of 20-40 acres/AUM. Pinyon-juniper types can exceed 100 acres/AUM and normally exceed 35 acre/AUM. The most productive vegetation types have capacities of 5 acres/AUM. The sagebrush type of alluvial flats, while more productive than the pinyon-juniper type, cannot be considered the most especially productive and critical type for supporting livestock grazing. (W. Mentoc, 1980, pers. comm.) There is also no indication that the sagebrush type is subirrigated. It

Table 3 : Vegetative Type and Carrying Capacity, Zion Planning Unit, Kanab District, Bureau of Land Management

Vegetative Type	% of Planning Unit area	% of Planning Unit AUM's
Pinyon-Juniper	65%	34%
Sagebrush	16%	22%
Mountain shrub	15%	26%
Grass	27%	17%
	98%	99% Total

(U.S. Bureau of Land Management, 1977)

is found on alluvial flats dissected up to 40 feet by an adjacent channel. Thus, the typical alluvial flat sagebrush vegetation type does not appear to be especially important for grazing activity, and more importantly, does not appear to be subirrigated.

There are some areas of subirrigated meadows at the base of the Pink Cliffs, as well in upper Kanab Creek, that are presumed to be of special importance to grazing. These areas are found where springs issue into alluvial flats, such as in upper Kanab Creek and Meadow Creek. (Goode 1966, 1964). Where subirrigation is known, or where basin characteristics are similiar to known subirrigation areas, preliminary determinations of alluvial valley floor status have been made.

Subirrigated areas and spring fed irrigation are also found in portions of Kanab and Johnson Canyons, in portions of the lower Navajo Sandstone. These areas are an important part of the agricultural activity of the area and were also basis for alluvial valley floor designations.

Irrigation

Since most stream valleys are deeply dissected and have no obvious subirrigation characteristics, most alluvial valley floor determinations have been made based on the existence of flood irrigation activities or the availability of flood irrigation waters. All existing stream diversions were mapped, using data supplied by the Utah State Engineer (1974a,b,) the Soil Conservation Services (SCS), Agricultural Stablization and Conservation Service (ASCS), local ranchers, and field identification. After plotting the diversions and irrigated lands, the regional pattern of irrigation use could be ascertained and evaluated in light of existing technical reports.

The aspects of the hydrology of streams in the Alton area have been described by Goode (1966,1964), Sandberg (1978) and Cordova (1980). Goode's investigations indicate perennial or significant intermittent flow is generated by springs which arise in upper Cretaceous sandstones and siltstones at the base of the Pink Cliffs. Goode (1964) reports spring sources throughout the upper Cretaceous sequence; however, he notes that the most important springs arise in the uppermost portion of the sequence stratigraphically and below steeply sloping portions of the Pink Cliffs topographically.

Goode (1964,1966) also reports that streams lose flow in the downstream direction. Goode (1964) reports no flow below Sink Valley in Sink Valley Wash and no flow in Kanab Creek over The Falls in summer, 1963, despite perennial flow in headwater tributaries. Sandberg (1978) describes the steady loss of stream flow between grazing stations on Mill Creek and Skutumpah Creek.

Not surprisingly, existing stream diversions have been located on streams whose basin topography and geology yield sufficient stream flow. Table 4 lists the basin lithology and area above existing stream diversions. All but two diversions above the White Cliffs are located in basins where the Tertiary Claron Formation outcrops. Reservoir Canyon is entirely underlain by the Wahweap Formation. Pole Hollow Creek is underlain by the Tropic Shale and Dakota Formation. Drainage areas above diversions vary in size depending on how close the diversion is to a spring source. Diversions below the White Cliffs are either intermittent in use (upper Johnson) or are located below known Navajo spring sources (Kanab Irrigation Co., lower Johnson).

Alluvial valley floors were identified in all valleys with existing stream diversion irrigation, and in all valleys whose

TABLE 4 : Basin Characteristics Above Existing Stream Diversions (with Fil[illegible])

Stream	Party of Interest	Location	Lithology of Basin*	Drainage Area (mi^2)
Kanab Creek	Kanab Irrigation Co	43S6W18BC	Qal,Qg,Qb,Tc,KK,Kw,Ks,Kts,Kd,Jc,Tn,Tk	213
Karab Creek	Alton Farmers Assoc.	38S5W 33ACB 38S5W 33CAB	Qal,Tc,KK,Kw	6½
Roundy Canyon	Heaton	38S5W31DAA	Qal,Tc,Kw,Ks,Kts	1½
Reservoir Canyon	Pugh	38S5W33BDB	Qal,Kw	2
Rush Canyon	Heaton	39S5W3BAC 4ABD	Qal,Tc,Kk,Kw,Ks	½
Water Caynon	Pugh	39S5W15BAB 39S5W16AAD	Qal,Tc,Kk,Kw	2 2
Swapp Hollow	Sorenson	39S5W28CAA 29ADC 29DBB	Qal,Tc,KK,Kw,Ks,Kt	2
Pole Hollow Creek	Swapp	40S5W5CBD	Ks,Kd	1
Lower Johnson & Flood Canyon	Von Hake L.L. Hittson & Myers	43S4½W18CC	Qal,Qg,Qb,Tc,KK,Kw,Ks,Kt,Kd,Tc,Tn,Tk	231
Lower Johnson	Jensen			179
Upper Johnson	De R. Bunting F. Bunting L. Judd	42S5W11BD	Qal,Qg,Qb,Tc,KK,Kw,Ks,Kb,Kd,Jc,Tn	120
Thompson Creek	De R.Bunting	40S4½W31BDD	Qal,Qg,Qb,Tc,KK,Kw,Ks,Kt,Kd,Jc	21
Skutumpah Creek	Robinson & Robinson	40S4½W20DAC	Qal,Qg,Qb,Tc,KK,Kw,Ks,Kt,Kd,Jc	15

*: Qal - alluvium
Qg - gravel
Qb - basalt
Tc - Claron Formation
KK - Kaiparowits Formation
Kw - Wahweap Formation

*: Ks - Straight Cliffs Formation
Kt - Tropic Shale
Kd - Dakota Formation
Jc - Carmel Formation
Tn - Navajo Sandstone
Tk - Kayenta Formation

basin lithology included the Claron or Kaiparowits Formations. The occurence of a diversion in Pole Hollow Creek, in a 1-square mile basin of Tropic Shale and Dakota Formation was considered anamolous and was not used as a basis for including similiar basins. This diversion was not investigated and it should be included in any furhter investigations. Pole Hollow presumably has ephemeral flow and was not identified as irrigated land by the SCS or ASCS. If further investigation were to show that the diversion is a successful one, a revision of alluvial valley floor determinations would have to be made.

Uncertainty exists regarding designations in losing stream reaches where there are no diversions. For example, Sink Valley Wash below Sink Valley has ephemeral streamflow and no diversions. Kanab Creek has no diversions from Lamb diversion to that of the Kanab Irrigation Company, a distance of 24 miles. There are no diversions between the Skutumpah/Thompson diversions and the upper Johnson diversion, a distance of at least 9 miles. For purposes of preliminary determination, each of these valleys has been designated an alluvial valley floor. The formal designation of each of these valley segments would depend on hydrologic data indicating whether the valley in question was integral to the downstream diversion.

Mapped alluvial valley floors are indicated on Plate 3 and specific justifications for each designation are included as Appendix B.

UPLAND EROSION AND SEDIMENT YIELD

Sediment yield has been estimated for the Alton EMRIA study area (U.S. Bureau of Land Management, 1975). Source area sediment yields were estimated using the Pacific Inter-Agency Sedimentation Committee method (1968). Estimated natural sediment yields in the 12 sq. mile area ranged between .1 and 1.5 acre feet per square mile. Lowest annual sediment yields were estimated for pediment surfaces, mesa tops, and revegetated bottom lands. Highest sediment yields were estimated for steep valley side slopes and steep hill and valley areas. Sediment yields in steeply sloping topography were estimated to be greater for sandy and silty soils than for clay and sandy soils. The EMRIA Study (Table 29) also estimated annual sediment yield from overburden areas following regrading and establishment of vegetation. Annual source area sediment yields were estimated to range from .1 acre feet per squre mile for sandstone and shale-derived materials on slopes of zero to 5% to .5 acre feet per squre mile per year for shale-derived overburden material on regraded at 30% slopes. Although no attempt was made to estimate total sediment yield from sub-basins, the obvious conclusion of the EMRIA studies is that sediment yield from regraded and revegetated areas would generally be less than existing natural sediment yields.

An alternative method of evaluating post-mining sediment yields was considered in this investigation. Use was made of the universal soil loss equation, adapted for use in western mined lands. (U. S. Soil Conservation Service, 1977). The SCS report provides the methodology for evaluating pre-and post-mining rates of rill and

sheet erosion. The data used in the USLE was obtained from an evaluation of soils for the Alton coal field (NUS Corp., 1980) and vegetation assessments of the area (Bonham and Morrison, 1980).

Briefly, the USLE provides an empirical method for estimating soil loss. Factors important in the use of universal soil loss equation include a factor evaluating rainfall erosiveness, (R) a factor considering soil erodibility, (K), a factor considering slope length, (L) and slope gradient, (S) a factor considering cover or crop management (c), and a factor considering erosion control practices.(P) Various scenarios were developed to estimate present soil loss and potential soil loss. These scenarios are outlined in Table 5.

The most obvious conclusion which can be gained from Table 5 is the critical importance of gravel veneers in limiting soil loss. Presence of a gravel veneer can limit soil loss by an order of magnitude. Given this fact, a careful evaluation must be made of the ability to selectively salvage gravel veneers and the ability to replace these veneers on reclaimed slopes. Should there be a net decrease in surface area covered by gravel and rock material, soil erosion should be expected to increase significantly.

Table 5 also shows the important role of slope length and gradient in soil erosion. As slopes increase in gradient and increase in length, soil loss increases significantly. The change in slope length and slope steepness would more significantly affect soil loss than changes in vegetative cover. Since no reclamation plan is available for the Alton mining areas, no assessment can be made of a mining company's ability to restore the landscape to its present distribution of various slope lengths and gradients. Any subsequent evaluations of reclamation plans however, must consider and discourage creation of excessive long slope lengths or steep

TABLE 5

Estimates of Hillslope Soil Loss

Natural Conditions

Site	R	K	SL	C[2]	A[3] (tons/acre/yr	
OSM#1 P-J-S-O 34B Soil	45	0.23	2.1	0.25(with gravel)	5.4	SL 2.1 = S 8% L 450
OSM#2 P-J-S 16 Soil	45	.31	2.4	0.81	27.1	SL 2A = S 6% L 1300
OSM#3 S 10 Soil	45	.20	3.0	.95	25.7	SL 3.0 = S 8% L 1000
OSM#3A S-J 10 soil	45	.21	.49	.91	4.2	SL .49 = S 2% L 2000
OSM#4 G16 Soil	45	.27	5.6	.08(with gravel)	5.4	SL 5.6 = 11.5% 700

Reclamation Scenarios

OSM#1
eliminate gravel cover
A = 21.5
maintain gravel, S10%, L500
A = 9.6
maintain gravel, S10%, L1000
A = 14.5

OSM#2
S 10%, L 1500
A = 80.2
S 5, L 1000
A = 13.6

OSM#3
S 10%, L 1000
A = 47.9
S 10%, L 500
A = 31.6
S 5%, L 500
A = 17.1

OSM#3A
slope 5% L 1500
A - 17.2
slope 5% L 1000
A = 13.8
slope 5% L 125
A = 5.2

OSM#4
eliminate gravel cover
A = 67.4
maintain gravel, S 15 L 500
A = 6.1
maintain gravel, S 10 L 500
A = 3.6

1 (NUS Corp, 1980)

2 cover percentages, for non-gravel soils, cover includes vegetation cover only

3 figures for comparison only

slope gradients.

Vegetation data (Bonham & Morrison, 1980) and conversations with U. S. Office of Surface Mining staff (R. Beavers, 1980, pers. comm.) indicate that revegetated areas will experience increased amounts of ground cover and decreased amounts of canopy coverage. This is due to the transformation of a pinyon-juniper forest with little ground cover to a grass shrubland community under reclamation conditions. Generally, however, the effect of this change on erosion will be to slightly increase the ability of vegetation to retard soil loss. This will be due to greater ground cover and thus the discouraging of formation of rills on slopes.

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Appendix A

Water Rights Filings for Irrigation Use,

Kanab and Johnson Creek Division

WATER RIGHTS FOR IRRIGATION (Stream Sources)
KANAB CREEK E. JOHNSON CRK DIVISION

NUC	SOURCE Point of Diversion	NAME and Address of PARTY	USE or FILING DATE	FLOW	PLACE of USE and AREA	PERIOD of USE	ANNUAL WATER ALLOWANCE
557	North Roundy canyon Creek 38S5W 31 CB	LW Heaton, et al Alton	1865	5.0 cfs	38S 5W 31 DC 2.3a * 38S5W 31 DD 35.0a 38S 5W 32 CC 6.8 a 39S5W 6 AA 28.5 " AB 4.4 " AC 3.0 80.0a	4/1-10/31	total yearly diversion 400 af from North Roundy and Kanab Creek CWUC 508
06	Kanab Creek #1 38S 5W 33 ACB #2. 38S 5W 33 CAB	Alton Farmers Assoc Alton	1865	12 cfs	38S5W 32 DA 3.4 " DB 13.9 " DC 10.9 " DD 3.3 38S5W33 BC 3.0 " BD 2.6 " CB 16.5 " CC 1.0 39S5W 5 AC 6.7 " BA 5.0 " BB 4.3 " BC 28.2 " BD 37.0 " CA 28.5 " CB 38.5 " CC 0.6 39S5W6 AA 3.8 AD 32.7 BC 1.5 CA 19.7 CB 29.3 CC 14.8 CD 35.8 DA 36.5 DB 12.3 DC 22.4 DD 18.7 39S5W 7 AB 1.5 BA 36.7 BB 27.5 BC 33.3 BD 29.2 CA 19.5 CB 36.0	4/1-10/31	

WATER RIGHTS FOR IRRIGATION (STREAM SOURCES)

WUC	DIVERSION	NAME & ADDRESS	USE OR Filing Date	PLACE OF USE AND AREA	PERIOD OF USE	ANNUAL WATER ALLOWANCE
206 (cont.)				3955W 18 BA 0.7		
				3955W 18 BB 9.9		
				3956W 1 AD 3.6		
				CA 5.7		
				CB 6.5		
				CC 34.9		
				DA 15.5		
				DC 20.6		
				3956W 2 DD 7.0		
				3956W 11 AA 23.0		
				AC 2.1		
				AD 33.0		
				DA 13.5		
				3956W 12 AA 33.4		
				AB 4.0		
				AC 16.4		
				AD 30.7		
				BA 24.5		
				BB 28.0		
				BC 31.6		
				BD 36.2		
				CA 37.1		
				CB 38.1		
				CD 5.7		
				DA 40.0		
				DB 23.5		
				DC 3.2		
				DD 34.9		
				1237.60		
				3855W 31 DC 2.3	557,606	
				DD 35.0		
				3855W 32 DB 6.8		
				3955W 6 AA(1) 22.5		
				AB(1) 4.4		
				AC 2.0		

Total yearly diversion from N. Roundy and Kanab Creek 400 ac-ft

WATER RIGHTS FOR IRRIGATION (stream sources)

WUC	Source of Diversion	Name & Address	Use or Filing Date	[illegible]	Place of Use and Area	Period of Use	Annual Water Allowance
606 (cont.)					3855W 32 DC 17.6 * DD 30.0 3855W 33 BE 6.9 3955W 5 AE 19.2 AC 10.5 BA 11.0 BD 1.5 97.6	2/28-10/6	total yearly diversion 459 af from Kanab Creek and Reservoir Hollow Stream (202)
02	Reservoir Hollow Stream 3855W 33 BC Center of Dam	Cecil C. and Verna Pugh Box 393 Kanab	1890	.333 c.f.s. and 45 ac-ft	3855W 32 DC 17.6 * 3855W 32 DD 30.0 3855W 33 CC 6.9 3955W 5 AE 14.2 AC 10.5 BA 11.0 BD 1.5 91.6	4/1-10/31 2/28-10/6	total yearly diversion 459 af from Reservoir Hollow Stream and Kanab Creek (60)
58	Rush Canyon Creek #1 3955W 3 AA #2 3955W 4 AB	Lloyd W. Heaton et. al.	1965	4.0 c.f.s.	3855W 33 CC 10.0 3855W 33 CD 0.1 3955W 4 BA 22.0 3955W 4 BE 14.8 3955W 5 AA 28.1 75.0	4/1-10/31	375.0 ac. ft.
90	Left Hand Fork Water Cyn. Creek #1 395 5W 15 BA #2 Water Canyon 395 5W 16 AA	Cecil C. and Verna Pugh Kanab	Diligence 1860 March 4, 1889	0.5 c.f.s.	3955W 20 CB 8.8 CC 29.5 CD 10.0 3955W 29 BB 24.6 BC 6.0 3955W 30 AA 0.3 AD 15.5 DA 12.0 106.7	4/1-10/31	533.50 ac. ft
					3955W 29 BB 0.6 *		total yearly diversion 3 af from Water Canyon Creek and Tarter Patch Spring (214)

4)

WATER RIGHTS FOR IRRIGATION (Stream Sources)

WUC	Place of Diversion	NAME + ADDRESS	USE or FILING DATE	FLOW	PLACE of USE and AREA	PERIOD of USE	ANN WATER ALLOWANCE
362	Swapp Canyon creek #1 3955W28 CAA #2 3955W29 ACB	EARL & COLLEEN SORENSON	1889	10.0 c.f.s.	3955W 29 AA 7.0 AB 16.5 AC 3.7 AD 3.5 30.7	4/1-10/31	153.5
					3955W 29 BA 8.8 * BC 10.0 BD 27.4 CA 0.6 CB 14.3 CC 29.8 3955W 32 BB 10.2 101.1		Total yrly diversion 505.5 ac. ft under claims 362-372
66	Right Hand Wash 3955W 29 AC	EARL & COLLEEN SORENSON	1899	10.0 c.f.s.	3955W 29 BA 8.8 * BC 10.0 BD 27.4 CA 0.6 CB 14.3 CC 29.8 3955W 32 BB 10.2 101.1	4/1-10/31	Total yrly diversion 505.50 ac. ft under claims 362-372.
63	Swapp Canyon Creek 3955W 29 DA	EARL & COLLEEN SORENSON	1889	10.0	3955W 29 AC 2.5 BD 6.4 DB 2.0 CA 5.0 15.9 3955W 29 CA 2.4	4/1-10/31 363	79.50 ac. ft Total yearly diversion 12.0 ac. ft under claims 363, 367
					3955W 29 CA 0.8 CB 0.3 1.1		Total yearly diversion 5.5 ac ft. under claims 363, 367, 368

(5)

WATER RIGHTS FOR IRRIGATION (Stream SOURCES)

WUC	SOURCE Pt. of DIVERSION	NAME + ADDRESS	USE or Filing Date	Flow	PLACE of USE and AREA	PERIOD of USE	ANNUAL WATER ALLOWANCE
364	Swapp Canyon Creek 3955W29DBB	Earl and Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W29 CA 14.0 ↓ CD 2.3 DB 0.8 17.1	4/1-10/31	85.5
					3955W29 CA 1.2 * CB 0.2 1.4		Total yearly diversion 7.0 ac ft under claims 364, 365
					3955W29 CA 0.8 CD 5.1 5.9		Total yearly diversion 29.50 ac ft under claims 364, 365, 369
					3955W29 CC 0.9 * CD 8.3 9.2		Total yrly diversion 46.0 ac ft under claims 364, 365, 369, 370.
					3955W29 CC 0.5 CD 1.0		Total yrly diversion 35.0 ac ft under claims 364, 365, 369, 370,
					3955W32 [illegible]		
					3955W [illegible] CC 5.9 13.9		Total yrly diversion 69.5 ac ft under claims 364, 365, 369, 370, 371, 372
367	Right Hand Wash 3955W29 CAB	Earl + Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W29 CA 8.4	4/1-10/31	Total yrly diversion 12.0 ac ft under claims 363, 364, 365, 367, 369, 370, 371, 372.
					3955W29 CA 0.8 * CB 0.3 1.1		Total yrly diversion 5.5 ac ft under claims 363, 367, 368
368	Right Hand Wash 3955W29 CAB	Earl + Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W29 CA 0.8 * CB 0.3		Total yrly diversion 5.5 ac ft under claims 363, 367, 368
65	Swapp Canyon Creek 3955W29 CAC	Earl + Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W29 CA 1.2 * CB 0.2 1.4	4/1-10/31	Total yrly diversion 7.0 ac ft under claims 364, 365
					3955W29 CA 0.8 CD 5.1 5.9		Total yrly diversion 29.5 ac ft under claims 364, 365, 369
					3955W29 CC 0.9 CD 8.3 9.2		Total yrly diversion 46.0 ac ft under claims 364, 365, 369, 370.
					3955W29 CC 2.3 CD 1.2		Total yrly diversion 35 ac ft under claims 364, 365, 369, 370, 371.
					3955W32 [illegible] 7.0	*	

WATER RIGHTS FOR IRRIGATION (stream sources)

NUC	Source Pt. of Diversion	NAME & ADDRESS	Use or filing Date	Flow	Place of Use and Area	Period of Use	Annual Water Allowance
365(cont.)					3955W 32 BB 3.0 BC 5.9 13.9		Total yrly diversion 69.5 ac ft under claims 364, 365, 369, 370, 371, 372.
369	Sink Valley Wash 3955W29CBE	Earl + Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W29CB CC 1.7 3.3 5.0	4/1-10/31	25.0 ac. ft.
					3955W29CC CD 0.9 4.1 5.0		Total yrly diversion 29.5 ac ft under claims 364, 365, 369, 370.
					3955W29CC CD 0.9 7.1		Total yrly diversion 46 ac. ft under claims 364, 365, 369, 370.
					3955W29CC CC 1.6 3955W32 BB 3.7		Total yrly diversion 35.0 ac ft under claims 364, 365, 369, 370, 371.
					3955W32 BB 3.0 BC 5.9 13.9		Total yrly diversion 69.5 ac ft under claims 364, 365, 369, 370, 371, 372.
370	Sink Valley Wash 3955W29CBD	Earl + Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W29CC 0.9 3955W29CD 8.3 9.2*	4/1-10/31	Total yrly diversion 46 ac ft under claims 364, 365, 369, 370.
					3955W29CC CC 2.3 CC 1.0 3955W32BB 3.7 7.0		Total yrly diversion 35.0 ac ft under claims 364, 365, 369, 370, 371
					3955W32BB BC 3.0 5.9 13.9		Total yrly diversion 69.5 ac ft. under claims 364, 365, 369, 370, 371, 372.
71	Sink Valley Wash 3955W29CCD	Earl & Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W29CC CD 2.3 1.0 3955W32BB 3.7 7.0*	4/1-10/31	Total yrly diversion 35 ac ft under claims 364, 365, 369, 370, 371.
					3955W32BB BC 3.0 5.9 13.9*		Total yrly diversion 69.5 under claims 364, 365, 369, 370, 371, 372.
72	Sink Valley Wash 3955W32BBA	Earl + Colleen Sorenson Orderville	1889	10.0 c.f.s.	3955W32BB BC 8.0 5.9 13.9*		Total yrly diversion 69.5 under claims 364, 365, 369, 370, 371, 372.

WATER RIGHTS FOR IRRIGATION (STREAM SOURCES)

NUC	Source Pt. of Diversion	Name and Address	Use or Filing Date	Flow	Place of Use and Area	Period of Use	Annual Water allowance
356	Sink Valley Wash 39S6W32BCC	Winnie R Swapp Kanab	1889	0.25 cfs	39S5W32 BC 1.0 CB 8.0 9.0	4/1-10/31	45.00 ac.ft.
71	Kanab Creek 39S6W24ACA	Sharon C. & Lorene C. Lamb Orderville	1892	2.55 cfs	39S6W24 CD 0.7 DC 13.8 39S6W25 AB 7.0 BD 10.0 CA 20.0 51.5	4/1-10/31	257.50 ac ft under claims 71 and 105.
105	Kanab Creek 39S6W24ACA	Farel E. Lamb Orderville	1864	2.55 cfs	39S6W25 BC 0.6 CB 10.8 CC 19.3 39S6W24 AA 7.4 39S6W35 DD 7.4 41.5	4/1-10/31	207.5 ac.ft.
2	Mill Creek 40S4½W20DDC	J. Grayden Robinson P.O. Box 133 Kanab	May 1, 1911	2.5 cfs	40S4½W32 AB 1.5 BA 8.0 9.50 40S4½W32 BD 58.2 CA 32.7 CB 3.7 CC 3.2 CD 9.7 77.5 41S4½W6 AA 5.0 AD 18.6 DA 8.0 DD 1.0 32.6 41S4½W6 AD 5.5 DA 11.5 17.0	4/1-10/31	Total yrly diversion 47.5 ac.ft under claims 2, 52 Total yrly diversion 387.5 under claims 2, 25, 52 Water Users claim a limited irrigation requirements of 387.5 ac. ft. Total yrly diversion 163.0 ac. ft. under claims 2, 25 Total yrly diversion 85.0 ac. ft. under claims 2, 25, 219, 220. 450.5 ac. ft.
157	Mill Creek 40S4½W20DDC	H.C. & Ann H. Robinson P.O. Box 52 Glendale, 84729	May 1, 1911	2.5 cfs	40S4½W32 CC 14.9 CD 7.6 41S4½W5 BB 14.2 BC 19.0 BD 2.7 CB 13.7 41S4½W6 AA 10.0 AD 8.0 90.1		
3	Thompson Creek 40S4½W31BAD	Hubert & DeRalph Bunting Kanab	June 29, 1911	0.72 c.f.s.	40S4½W31 BD 4.0 * CA 20.9 CD 7.5 DC 11.0 43.4		Total yrly diversion 217.00 ac.ft. under claims 3, 7.
7	Thompson Creek 40S4½W31BAD	Hubert & DeRalph Bunting Kanab	Jan. 27, 1919	0.30 c.f.s.	40S4½W31 BD 4.0 * CA 20.9 CD 7.5 DC 11.0		Total yrly diversion 217.0 ac.ft under claims 3, 7

(8)

WATER RIGHTS FOR IRRIGATION (STREAM SOURCES)

WUC	Source Pt. of Diversion	Name and Address	Use or Filing Date	Flow	Place of Use and Area			Period of Use	Annual Water Allowance
217	Thompson Creek 40S 4½W 31BDD	Hubert & De Ralph Bunting	June 28, 1911	0.72 cfs	40S 4½W 31	CA DC	0.8* 15.8 16.6	4/1-10/31	Total yrly diversion 83.0 ac. ft. under claims 217, 218
218	Thompson Creek 40S 4½W 31 BDD	Hubert + De Ralph Bunting	Jan. 27, 1919	0.30 cfs	40S 4½W 31	CA DC	0.8* 15.8 16.6	4/1-10/31	Total yrly diversion 83.0 ac. ft. under claims 217, 218
219	Thompson Creek 40S [illegible] W 31 BDD	J. Graydon Robinson P.O. Box 123 Kanab	Jan. [illegible], 1911	0.[illegible] cfs	40S 4½W 31 41S 4½W 6	DD AA AB	8.0* 6.5 6.5 21.0	4/1-[illegible]	Total yrly diversion 105.0 ac. ft. under claims 219-220.
					41S 4½W 6	AD DA	5.5* 11.5 17.0		Total yrly diversion 85.0 ac. ft. under claims 219, 220, 225
220	Thompson Creek 40S 4½W 31BDD	J. Graydon Robinson Kanab	Jan 27, 1919	0.30 cfs	40S 4½W 6	DD	8.0*		Total yrly diversion 105.0 ac. ft under claims 219, 220
					41S 4½W 6	AA AB	6.5 6.5 21.0		
					41S 4½W 6	AD DA	5.5* 11.5 17.0		Total yrly diversion 85.0 under claims 2, 25, 219, 220
354	Pole Hollow Creek 40S 5W 5CBC	Preston W. Swapp Kanab	1889	1.0 cfs	40S 5W 5	BB CC	13.5 6.5 20.0	3/1-11/30	100 ac. ft. Water Users claim #354 limited to irrigation requirements of 20.0 acres.
5	Johnson Creek 42S 5W 11BAA	Finley J., Anna W., [illegible] Vivian, Hubert, Mar[illegible] and De Ralph Bunting Kanab	Sept. 18, 1911	2.0 cfs	42S 5W 10	CD DC	12.0* 6.5	1/1-12/31	Water Users claim #5 limited to irrigation requirements of 160.0 acres
					42S 5W 11	BD BC CA CB	11.0 19.0 5.0 30.0		Total yrly diversion 2,105.50 ac. ft. under claims 5, 216
					42S 5W 14	BB BC	0.7 90.5		
					42S 5W 15	AA AB AC AD BA BB BA BB BC CC	1.0 [illegible] 40.0 18.4 [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible]		
					42S 5W 10	DD	10.7*		Total yrly diversion 691.5 ac. ft. under claims 5, 56, 216
					42S 5W 11	BD CA CC CD	[illegible] [illegible] 37.5 53.0		
					42S 5W 14	[illegible]	[illegible]		
					42S 5W 15	[illegible]	[illegible]		

(9)

WATER RIGHTS FOR IRRIGATION (Stream Sources)

WUC	Source Pt. of Diversion	Name & Address	Use or Filing Date	Flow	Place of Use and Area	Period of Use	Annual Water Allowance
216	Johnson Creek 42S5W11BAA	Finley J. Anna W.; Ray [illegible] Vivian, H[illegible] Mo[illegible] and Deta [illegible] E[illegible]	1930	10.0 [illegible]	see claim No. 5 *	11/1-12/31	Water Users Claim Nos. 56 and [illegible] limited to irrigation requirements of 400 acres. Total yrly diversion [illegible] ac.ft. under claims 5, 56, 216.
270	Meadow Canyon Creek #1 42S5W35DAA #2 42S5W35DAB	W. Lamar & Florian W. Johnson Kanab	1898	750 ac.ft	42S5W 35 DA 3.3 * DB 11.8 DC 2.0 DD 14.0 43S5W 2 AA 11.0 AD 0.8 42.9	4/1-10/31	• Water User's Claim Nos 269 + 270 limited to irrigation requirements of 42.9 acres. • Water User's Claim Nos 46, 75, 269, 270 limited to irrigation requirements of 114.2 acres. Total yrly diversion 214.5 ac ft under claims 46, 75, 269, 270.
75	Meadow Canyon Creek #1 42S5W35DAA #2 42S5W35DAB	Justi, J. & Frances Mackelprang Kanab	April 28, 1909 1898	750 ac.ft	42S5W35 AC 0.1 AD 0.5 DA 17.3 DB 0.1 DD 15.6 * 42S5W 1 BB 0.7 BC 18.8 CB 6.2 43S5W 2 DA 2.3 73.4 43S5W 1 CB 25.[illegible] CC 5.4 * 43S5W 2 DA [illegible] 31.[illegible] 43S5W 1 CC 5.0 * 43S5W 1 CC [illegible] 43S5W 12 [illegible] [illegible] * 43S5W 13 [illegible] [illegible] 1.2 AD 21.0 [illegible]	11/1-[illegible]	Total yrly diversion 367.0 ac.ft. under claims [illegible], 275, 276, 277, 278. Water Users Claim Nos. 274, [illegible], 277, 278 limited to irrigation requirements of 205 acres. Total yrly diversion 155.5 ac ft under claims 274, 275, 276 Total [illegible] diversion 25.0 [illegible] under claim 274 [illegible] 277 Total [illegible] diversion 446.[illegible] under claims [illegible] 275, 276, 277, [illegible]

(10)

WATER RIGHTS FOR IRRIGATION (1st 2am sources)

WUC	Source Pt. of Diversion	Name & Address	Use or Filing Date	Flow	Place of Use and Area	Period of Use	Annual Water Allowance
290	Dairy Canyon Creek #1 4255W35CBD #2 4255W 35CAB	J. Alvin & Harriet R. Judd Kanab	1898	250.0 ac.ft	4255W35CA 13.5 CD 11.0 DC 1.5 26.0	4/1-8/30	130.0 ac.ft. Water User's claim 290 limited to irrigation requirements of 52.0 acres claims Nos. 26, 290 limited to irrigation requirements of 115.8 acres Total yrly diversion 130. ac.ft under claims 26, 290
					4255W35CA 4.8 CD 1.2 DB 2.5 DC 17.5 26.0 *		
31	Johnson Creek and Flood Canyon Creek 4354½W18CCC	Sherman S. and Farrice Jensen Fredonia, Ariz 86022	Apr. 28, 1909 1/6 interest in flow - 1901	15.0 cfs	4354½W18CC lot 7 1.1 4354½W19BB lot 1 8.4 BC lot 2 11.5 4355W 13DD 0.9 4355W 24AA 12.6 AD 15.5 50.0	1/1-12/31	250.0 ac.ft.
37	Johnson Creek and Flood Canyon Creek 4354½W CCC	F. Marion and Iola H. Johnson Kanab	Apr 28, 1909 1/6 interest in flow - 1901	15.0 cfs	4354½W19CC lot 4 3.7 4354½W30BE lot 1 14.4 4355W 24DD 36.9 55.0	1/1-12/31	275.0 ac.ft
25	Johnson Creek & Flood Canyon Creek 4354½W18CCC	E. Canyon Irrigation Co P.O. Box 47 Kanab	Apr. 28, 1909 1/6 interest in flow - 1901	15.0 cfs	4354½W19CB lot 2 2.5 4354½W30 BC lot 2 10.9 CB lot 3 25.5 CC lot 4 10.3 4355W 24 DA 14.0 DB 3.5 DC 6.4 4355W 23 AA 21.6 AD 18.2 DA 4.1 125.8	1/1-12/31	629.0 ac-ft. wuc 325 limited to irrigation requirements of 125.8 acres.
29	Johnson Creek & Flood Canyon Creek 4354½W18CCC	Richard A. Von Hake P.O. Box 123 Kanab	do.	15.0 cfs	4354½W19 BC 6.4 CA 25.03 CB 24.5 CC 10.7 4354½W30 BA .5 4355W24 AD 17.4 DA 25.6 DB .5 111.33	1/1-12/31	556.50 ac.ft.

(11)

WATER RIGHTS FOR IRRIGATION (stream sources)

WUC	Source	Pt. of Diversion	Name & Address	Use or Filing Date	Flow	Place of Use and Area			Period of Use	Annual Water Allowance
6	Johnson Creek	4354½W31 BCB	Floyd L. + Ivac. Maddox Box 107, Kanab	Nov. 7, 1913	0.667 cfs	4355W36	DB AC AD CD DA DC	7.2 21.0 24.2 11.5 21.3 4.8 90.0	1/1-12/31	Total yrly diversion 450 ac.ft under claims 6, 45, 323. WUC 6 limited to irrigation requirements of 21.64 acres.
319	Johnson Creek	4354½W31 BCB	Lynn U. & Patricia Jan Goodfellow Kanab	Nov. 7, 1913	0.667 cfs	4355W36 4455W 16	CA CB CD DB DC EA ED	37.4 3.0 20.0 16.2 5.0 20.0 5.0 106.6	1/1-12/31	Total yrly diversion 533.0 ac.ft under claims 319, 322. WUC claim 319 limited to irrigation requirements of 21.64 acres.
322	Johnson Creek	4354½W31 BCB	Do.	1930	4.0 cfs	4355W36 4455W 16	CA CB CD DB DC EA ED	37.4 3.0 20.0 16.2 5.0 20.0 5.0 106.6	1/1-12/31	Total yrly diversion 533.0 ac.ft under claims 319, 322. WUC 322 limited to irrigation requirements of 84.96 acres.
323	Johnson Creek	4354½W31 BCB	Floyd L. & Ivac. Maddox Kanab	1930	4.0 cfs	4355W36	AD AC CD DA DB DC	24.2 21.0 11.5 21.3 7.2 4.8 90.0	1/1-12/31	Total yrly diversion 450 ac.ft under claims 6, 45, 323. WUC 323 limited to irrigation requirements of 450.0 acres.
276	Rock Canyon Creek	4355W1 BCD	Justin J. & France C. Mackelprang P.O. Box 611	1898	300 ac.ft	4355W1. 4355W2	CB CC DA	2.3 5.4 0.4 31.1	1/1-12/31	Total yrly diversion 155.5 ac.ft. under claims 274, 275, 276
260	Needle Rock Canyon Creek	4355W2ACA	Kanab Stake Church of Jesus Christ LDS Kanab	Apr. 28, 1907 1989	150.0 ac.ft	4355W2	AC AD DA DC	10.5 8.6 12.5 1.0 32.6	4/1-9/31	16½ ac.ft WUC Nos 260-264 limited to irrigation requirements of 125.0 acres
						4355W2	DA DD	5.3 10.3 16.6	4/1-9/31	Totaly yrly diversion 28.0 ac.ft. under claims 260, 261
						4355W1 4355W2 4355W11	CC DD AA	5.4 11.1 10.0		Total yrly diversion 199.50 under claims

NUC	Source & pt. of Diversion	Name + Address	Use or Filing Date	Flow	Place of Use and Area		Period of Use	Annual Water Allowance
260(cont)								
					43S5W11 AA	0.1*	4/1-10/31	Total yrly diversion 100.5 ac.ft. under claims 260-263
					43S5W12 BB	2.8		
					BC	15.5		
					BD	1.4		
					CA	0.1		
					CB	0.2		
						20.1		
					43S5W12 CA	11.3*		Total yrly diversion 54.0 ac.ft. under claims 260-264
					CB	0.5		
					CD	5.0		
						[illegible]		
8	Kanab Creek (Big Lake & Tributaries) 43S6W16 BCC	Kanab Irrigation Co., Kanab	1909 1955	19.0 cfs	43S6W [illegible] CB	14.92		
					CC	20.72		
					CD	16.89		
					[illegible]	15.66		
					DC	3.50		
					43S6W [illegible]	0.2		
					[illegible]	10.5		
					[illegible]	22.4		
					[illegible]	40.0		
					CD	36.8		
					DB	2.5		
					DC	21.3		
					[illegible]	15.4		
					43S6W [illegible]	15.33		
					[illegible]	[illegible]		
					[illegible]	[illegible]		
					[illegible]	[illegible]		
					[illegible]	6.0		
					BC	1.74		
					[illegible]	21.54		
					CA	10.71		
					CB	19.02		
					CD	6.8		
					DA	8.26		
					DC	33.6		
					DD	21.7		
					43S6W23 AA	34.0		
					AB	33.0		
					AC	37.0		
					AD	34.8		
					[illegible]	20.0		
					[illegible]	22.4		
					CA	38.0		
					CC	1.5		
					CD	40.0		
					DC	35.2		
					DD	24.0		

(13)

WATER RIGHTS FOR IRRIGATION (stream sources)

[illegible]uc	S[illegible]e Pt. of Diversion	Name & Address	Use or Filing Date	[illegible]ow	Place of Use & Area			Period of Use	Annual [illegible]ter Allowance
8 [illegible]ont.)					43S6W34	AB	8.6*		
						B[illegible]	13.2		
						B[illegible]	33.3		
						[illegible]	20.[illegible]		
						BD	27.0		
						C[illegible]	[illegible]0.0		
						C[illegible]	[illegible]		
						CD	4.2		
					44S6W 4	lot1AA	31.0*		
						lot2AB	33.5		
						AC	11.0		
						AD	3[illegible].[illegible]		
						lot3BA	[illegible].0		
						lot4 BB	4.0		
						BC	[illegible].7		
						BD	[illegible].7		
							1,233.13		Total yrly. diversion 6,115.[illegible] ac. ft. under claims 8, 19
					4[illegible]S[illegible]W3	CA	0.4*	1/1-12/31	Total yrly. diversion 827.0 ac.ft. under claims 8, 9, 19.
						CB	1[illegible].[illegible]		
						CC	7.7		
					44S6W 4	AC	[illegible].5		
						AD	1.0		
						BC	2.0		
						BD	7.9		
						CA	[illegible].0		
						CB	4.0		
						CD	0.1		
						DC	5.7		
						DD	22.9		
					44S6W9	AB	0.7		
						BA	17.3[illegible]		
							165.4		
					42N2W32	lot2AB	1.3*	1/1-12/31	Total yrly diversion 62[illegible].0 ac.ft. under claims 8, 9, 19, 7[illegible].
						lot3BA	& 1.0		
						lot4 BC	7.0		
						CA	32.[illegible]		
						CB	3[illegible].0		
						CC	17.2		
						CD	9.0		
						[illegible]	2.3		
							12[illegible]		
					(Gila & Sal[illegible] River Meridian-Arizona)				
9	Kanab Creek 43S6W16 BCD	Kanab Irr. Co. Kanab	April 14, 1[illegible]	1.0 cfs	44S6W 3	CA	0.4*		
						CB	18.6		
						CC	7.7		
					4[illegible]S[illegible]W 4	AC	7.[illegible]		

WATER RIGHTS FOR IRRIGATION (stream sources)

WUC	Source & Diversion	Name & Address	Use or Filing Date	Rate of Diversion	Place of Use and Area	Period of Use	Annual Water Allowance
7 (cont.)					44S6W 4 BD 7.9 CA 20.0 CB 4.0 CD 0.1 DA 3[illegible].6 DB [illegible].0 DC 6.7 DD 22.[illegible] 44S6W 9 AB 0.7 BA 17.3 165.4		Total yrly diversion 827.0 ac.ft. under claims 8,9,19
					[illegible]aw3a lot 1 1.3* lot 3 BA [illegible] lot 4 BB [illegible] [illegible] [illegible] CB 7.[illegible] [illegible] CD 9.[illegible] DB [illegible] [illegible] Gila & Salt River Base and Meridian Arizona		Total yrly diversion 625 ac.ft. under claims 8,9,19,72. wuc 9 limited to irrigation requirements of *157.25 acres
9	Kanab Creek 43S6W 16 BCC	Kanab Irr. Co. Kanab	Mar. 25, 1945	7.7 cfs	see wuc 7*	1/1-12/31	Total yrly diversion 6,115.65 ac.ft. under claims 8,19
					see wuc 8*	1/1-12/31	Total yrly diversion 827.0 ac.ft. under claims 8,9,19
					see wuc 8*	1/1-12/31	Total yrly diversion 625.0 ac.ft. under claims 8,9,19,72.
2	Moquitch Draw 44S6W 9 BDA	Ronald G & Evelyn Y. Mace Box 372 Kanab	1900	10.0 cfs	42S 10 W 32 lot 2 AB 1.3* lot 3 BA 2[illegible].0 [illegible] CA 3[illegible].2 CB [illegible] CC 17.2 CD 9.0 DB 2.3 125.0 Gila & Salt River Base and Meridian	1/1-12/31	Total yrly diversion 725.0 ac.ft. under claims 8,9,19,72

WATER RIGHTS FOR IRRIGATION (Well sources)

WUC	Source-Pt. of Diversion	Name and Address	Use or Filing Date	Flow	Place of Use and Area	Period of Use	Annual Water Allowance
25	Underground Water well 4054½W32ABB	T. Graydon Robinson Kanab	Aug. 11, 1947	0.895 cfs	4054½W32 BA 13.0* BD 3.5 16.5	4/1-10/31	Claim 25 limited to 30.0 ac. ft. Total yrly diversion 82.5* ac. ft under claims 25, 52.
					4054½W32 CD 28.2* CA 32.7 CB 3.7 CC 3.2 CD 9.7* 77.5		Total yrly diversion 387.5 ac. ft. under claims 2, 25, 52.
					4154½W6 AA 5.0 AD 8.6 DA 8.0 DD 1.0 38.6		Total yrly diversion 163.0 ac. ft. under claims 2, 25
					4154½W6 AD 8.5* DA 11.5 20.0		Total yrly diversion 85.0 ac. ft. under claims 2, 25, 219, 220
56	Underground Water well 4255W11BDC	Ro[illegible] Bunting Kanab	Jan 2[illegible] 1963	1.26 cfs	4255W10 DD 13.7* 4255W11 BD 8.5 CA 24.5 CC 7.5 CD 23.0 4255W14 BB 36.5 4255W15 AA 3.2 139.3	3/N-11/15	Total diversion 69 [illegible] under claims 5,56[illegible]16
9	Underground water, well 4255W23BBC	Finley [illegible] Anna W. Bunting Kanab	March 24, 1961	0.033 cfs	4255W23 BB 1.3	4/1-10/31	6.50 ac. ft
6	Underground water, well 4255W26CAD	W. Lamar & Florian W. Johnson Kanab	Sept. 22, 1960	1.05 cfs	4255W26 CA 13.0* CD 25.0 DC 1.0	4/1-10/31	Water User's Claim No. 46 limited to irrigation requirements of 39.0
					4255W35 AB 14.0 AD 13.0 BA 9.0 65.0		Total yrly diversion 325 ac. ft under claims 46, 75.
					4255W35 DA 3.3* DB 11.8 DC 2.0 DD 14.0 4355W2 AA 11.0 AD 0.3 42.9		Water User's claim No. 46, 75, 269 and 270 limited to irrigation requirements of 114.20 acres. Total yrly diversion 214.50 ac. ft. under claims 46, 75, 269, 270.

WATER RIGHTS FOR IRRIGATION (Well sources)

WUC	Source of Diversion	Name and Address	Use or Filing Date		Place of use and area			Period of use	Annual Allowance under
47	Underground Water, well 4255W26CCB	J. Alvin + Harriet R. Judd P.O. Box 24 Kanab	Dec. 15, 1960	0.013 cfs	4255W26CC	0.9		4/1-10/31	4.5 ac. ft.
26a	Underground Water, well 4255W26CCB	J. Alvin & Harriet R. Judd Kanab	Dec. 1, 1969	1.35 cfs	4255W26CC	1.7		4/1-10/31	319.0 ac. ft.
					4255W35 BA	11.4			
					BB	4.5			
					BC	1.2			
					BD	29.5			
					CA	15.5			
						63.8			
					4255W35 CA	4.8			
					CD	1.2			
					DB	2.5	*		
					DC	17.5			
						26.0			
					4255W35 BD	0.5	*		
					CA	0.5			
						1.0			

- Water Users Claim No. 26 limited to irrigation needs of 89.80 acres.
- Total yrly diversion 130.0 ac. ft. under claims 26, 290.
- Water User's Claim No 26, 290 limited to irrigation requirements of 115.8 acres.
- Total yrly diversion 5.0 ac. ft under claims 26, 291.

91	Underground Water, Well 4255W35CBA	J. Alvin & Harriet R. Judd Kanab	1990	0.0	4255W35	BC	3.4	4/1-10/31	2.0 ac. ft
					4255W35	BD	0.5 *		
						CA	0.5		
							1.0		

- Water Users Claim 291 limited to irrigation requirements of 1.4 acres.
- Total yrly diversion 5.0 ac. ft under claims 26, 291.

36	Underground Water, Well 4354½W31DDD	Ferry F. and Hazel P. Hamblin Kanab	Apr. 7, 1955	.758 cfs	4354½W31	DA	1.0	4/1-9/30	145.5 ac. ft.
						DD	28.1		
							29.1		

02	Underground Water, Well 4355W25ACC	Lorna Cottam & Clara B. Grams 86.55% interest; E. Canyon Irrigation Co. 13.45% interest c/o E. Canyon Irr. Co. P.O. Box 47 Kanab	Apr. 22, 1955	0.98 cfs	4355W25	AB	1.3	3/1-11/30	416.5 ac. ft.
						AC	40.0		
						AD	5.0		
						BD	5.2		
						CA	0.7		
						DA	9.1		
						DB	21.0		
							83.3		

45	Underground water, well. 4355W36ADA	Floyd L. + Iva C. Haddox Kanab	Sept. 14, 1960	0.3 cfs	4355W36	AD	7.5	3/1-10/31	Total yrly diversion 450.0 ac. ft. under claims 6, 45, 323
					4355W36	AC	21.0		
						AD	34.3		
						BD	11.5	*	
						DA	21.3		
						DC	3.2		

- WUC 45 limited to irri-

(3)

WATER RIGHTS FOR IRRIGATION (well sources)

WUC	Source Pt. of Diversion	Name & Address	Use or Filing Date	Flow	Place of Use & Area	Period of Use	Annual Water Allowance
52	Underground Water, well 40S 4½W 32 ADB	J. Gradon Robinson Kanab	Aug. 24, 1961	.175 cfs	40S 4½W 32 BA 5.0 BB 17.4 BC 14.9 CB 11.5 CC 1.5 50.3	not listed	WUC 52 limited to sole supply of 66.3 acres.
					40S 4½W 32 AC 1.5 * BA 8.0 9.5		Total yrly diversion 47.5 ac.ft. under claims 2, 52.
					40S 4½W 32 BA 13.0 * BD 3.5 16.5		Total yrly diversion 82.5 ac.ft. under claims 25, 52
					40S 4½W 32 BD 28.2 * CA 32.7 CB 8.7 CD 9.7 CC 3.2 77.5		Total yrly diversion 387.5 ac.ft under claims 2, 25, 52

(2)

WATER RIGHTS FOR IRRIGATION ([illegible]RING SOURCES)

WUC	Source Pt. of Diversion	Name + Address	Use or Filing Date	Flow	Place of Use and Area		Period of Use	Annual Water Allowance
353	Swapp Ranch Spring Area #4 395 29 BC	Winnie R. Swapp Kanab	1889	10.0 c.f.s.	395 5W 29 BA	0.2*	4/1-10/31	Total yearly diversion 465.0 ac.ft. under claims 350, 351, 352, 353
					BB	7.2		
					BC	23.2		
					BD	0.3		
					CB	21.1		
					395 5W 30 AD	1.0		
					DA	20.0		
					DD	20.0		
						93.0		
375	Pulsifer Spring 395 5W 32-BCC	Winnie R. Swapp Kanab	1889	0.1 c.f.s.	395 5W 32 BC	2.4	4/1-10/31	25.0 ac. ft.
					CB	2.6		
						5.0		
16	Three Spring Runs #1 42S 7W 25 CCD #2 42S 7W 25 DCB #3 42S 7W 25 DCA	LeRoy E. + Helen Hollis 15241 Lemarsh St. Mission Hills, CA 91341	Dec. 4, 1946	0.5 [illegible]	42S 7W 30 CC•	4.4	3/1-11/30	•WUC 16 limited to irrigation requirements of 30.51 acres
					CD	7.7		Total yrly. diversion 193.25 ac ft under claims 16, 745
					DC	1.3		
					42S 7W 25 CC	5.85 *		
					CD	7.57		
					DC	4.13		
					42S 7W 26 DD	3.96		
						34.91		
75	Miner Spring 42S 5W 26 CAD	W. Lamar + Florian Johnson Kanab	1900	0.25	42S 5W 26 CA	•3.0*	1/1-12/31	•Water user's claim No. 75 limited to irrigation requirements of 26.0 acres.
					CD	25.0		Total yrly. diversion 325.0 ac ft under claims 46, 75.
					DC	1.0		
					42S 5W 35 AB	14.0		
					AC	13.0		
					BA	9.0		
						65.0		
					42S 5W 35 DA	•3.3*		•Water User's Claim Nos. 46, 75, 269 + 270 limited to irrigation requirements of 114.20 acres
					DB	11.8		Total yrly. diversion 214.5 ac ft. under claims 46, 75, 269, 270.
					DC	2.0		
					DD	14.0		
					43S 5W 2 AA	11.0		
					AC	0.8		
						42.9		
9	Meadow Canyon Spring 42S 5W 36 BCA	W. Lamar + Florian W. Johnson Kanab	1899	1.0 cfs	42S 5W 35 AC	5.2	1/1-12/31	31.5 ac. ft
					AD	0.8		Total yrly. diversion 214.5 ac ft. under claims 46, 75, 269, 270.
					DB	0.3		Water User Claim Nos. 269, 270 limited to irrigation requirements of 42.9 acres. Claim Nos. 46, 75, 269, 270 [illegible]
						6.3		
					42S 5W 35 DA	3.3		
					DB	11.8		
					DC	2.0		
					DD	14.0 *		
					43S 5W 2 AA	11.0		
					AD	0.8		
						42.9		

WATER RIGHTS FOR IRRIGATION (-pring sources)

WUC	Source Pt. of Diversion	Name & Address	Use or Filing Date	Flow	Place of Use and Area			Period of use	Annual Water Allowance
274	Meadow Canyon Springs 42S5W36BCA	Justin J & Frances C. Mackel-prang Kanab	1898	1.0 cfs	42S5W35	AC DC AD	5.7 0.3 0.3 6.3	1/1-12/31	31.5 ac.ft WUC's 274, 275, 276, 277, 278 limited to irrigation requirements of 205.0 acres. Total yrly diversion 367.0 ac.ft under claims 274, 275
					42S5W35	AC AD DA DC DD	0.1 0.5 17.3 0.1 15.6		
					43S5W1	BB BC CB	0.7 18.8 6.2		
					43S5W2	AA AD DA	8.6 3.2 2.3 73.4		
					43S5W1	CB CC	25.3 5.4	1/1-12/31	Total yrly diversion 155.5 ac.ft under claims 274, 275, 276.
					43S5W2	DA	0.4 31.1		
					43S5W1	CC	5.0		Total yrly diversion 446.0 ac.ft under claims 274, 275, 276, 277, 278
					43S5W1	CC	0.3		
					43S5W12	BB BC BD CA DB DC	8.0 0.5 17.6 12.6 5.5 1.3		
					43S5W13	AB AC AD DA	4.0 1.2 21.0 17.2 89.2		
126	Hollywood Bowl Spring Area 42S6W20DD	Thomas Grant & Effie P. Robinson Kanab	1864	0.022cfs	42S5W20	DD	0.7	1/1-12/31	3.5 ac.ft.
25	Weeping Rock Cave Spring 42S6W20DD	Thomas Grant & Effie P. Robinson Kanab	1864	0.011cfs	42S6W20DD		1.7	1/1-12/31	8.5 ac.ft
27	Crocodile Spring 42S6W21CC	Thomas Grant & Effie P. Robinson Kanab	1864	0.002cfs	42S6W21BB		1.9	1/1-12/31	1.46 ac.ft

(1)

WATER RIGHTS FOR IRRIGATION (Spring Sources)

WUC	Source Pt of Diversion	NAME and Address	USE or Filing Date	Flow	Place of Use and Area	Period of Use	Annual Water Allowance
124	Galzier Spring Area 4256WAB	Thomas G. + Effie P. Robinson Kanab	1864	0.056cfs	4256W29AA 10.0	1/1-12/31	50.0
128	Huckleberry Spring 4256W29DC	Do.	1925	0.050cfs	4256W29DC 5.5	1/1-12/31	27.5
78	Spring 4256W30DBB	Errol & Marilla M. Brown	1903	0.10 cfs	4256W30AC 1.9 * BD 0.3 OB 1.1 3.3	1/1-12/31	Total yrly diversion 16.5 ac.ft. under claims 77,78,79
79	Spring 4256W30	Do.	1903	0.25 cfs	4256W30 AC 1.9 * BD 0.3 OB 1.1 3.3	1/1-12/31	Total yrly diversion 16.5 ac.ft. under claims 77, 78, 79
129	Spring Hollow Spring Area 4256W29CD	Thomas G. & Effie P. Robinson Kanab	1925	0.033cfs	4256W29 DC 2.3	1/1-12/31	11.5 ac.ft.
77	Three Lakes 4256W30 BDA Natural Lake located 4256W30CBD	Errol G. & Marilla M. Broum Kanab	1903	0.50cfs	4256W30 AC 1.9* BD 0.3 DB 1.1 3.3	1/1-12/31	Total yrly diversion 16.50 ac.ft. under claims 77, 78, 79.
14	Johnson Lakes 4354 1/2W5BAC	Richard A. VonHoke P.O. Box 123 Kanab	1890	0.011cfs	4254 1/2W32CD 1.85 DA 6.05 DB 3.30 DC 5.00 4354 1/2W-5 lot 3 4.20 20.90	1/1-12/31	109 5 ac.ft.
3	Seep Wash Spring Area 4354 1/2 W 33 BAA	Do.	1898	0.175cfs	4354 1/2W33 BC 9.5 * BD 1.3 CA 1.65 CB 14.3 19.75	1/1-12/31	Total yrly diversion 98.75 ac.ft. under claims 73,89.
9	Seep Wash Spring Area underground water, drain & sump 4354 1/2 W33BAA	Do.	1910	.446cfs	4354 1/2W33 BC 2.5 * BD 1.3 CA 1.65 CB 14.3 19.75	1/1-12/31	Do.

(5)

WATER RIGHTS FOR IRRIGATION (spring sources)

WUC	Source & pt. of Diversion	Name and Address	Use or Filing Date	Flow	Place of Use and Area		Period of Use	Annual Water Allowance
277	Sulphur Spring 4355W1CCA	Justin J and France C Mackelprang Kanab	1898	0.089cfs	4355W1CC	5.00*	1/1-12/31	Total yrly diversion 250 ac.ft. under claims 274, 275, [illegible], 272
								WUC Nos. 274, 275, [illegible], 278 limited to irrigation requirements of 205 acres
					4355W1CC	0.3*		Total yrly diversion 446.0 ac.ft. under claims 274, 275, 276, 277, 278.
					4355W12 BB	8.0		
					BC	0.5		
					BD	17.6		
					CA	12.6		
					DB	5.5		
					DC	1.3		
					4355W13 AB	4.0		
					AC	1.2		
					AD	21.0		
					DA	17.2		
						89.2		
278	Reservoir Spring Area CCD	Do.	Apr 29, 1909 1898	190.0 a.ft	4355W1 CC	0.3*	1/1-12/31	Total yrly diversion 446.0 ac.ft. under claims 274-278.
					4355W12 BB	8.0		WUC Nos. 274-278 limited to irrigation requirements of 205.0 acres.
					BC	0.5		
					BD	17.6		
					CA	12.6		
					DB	5.5		
					DC	1.3		
					4355W13 AB	4.0		
					AC	1.2		
					AD	21.0		
					DA	17.2		
						89.2		
261	Frank Spring Area 4355W2 DAD	Kanab Stake Church of Jesus Christ of LDS	Apr. 28 1909 1898	200. ac.ft.	4355W2 DA	5.3	4/1-9/31	Total yrly diversion 78.0 ac.ft. under claims 260, 261
					DD	10.3		
						15.6		WUC 259-263 combined are for 600 ac.ft
					4355W1 CC	5.4*		WUCs 260-264 limited to irrigation requirements of 125 acres
					4355W2 DD	11.1		Total yrly diversion 199.5 ac.ft. under claims 260, 261, 262
					4355W11 AA	10.0		
					4355W12 BB	13.4		
						39.9		
					4355W11 AA	0.1*		Total yrly diversion 100.5 ac.ft. under [illegible]
					4355W12 BB	2.8		
					BB	13.5		
					BD	1.4		

Wuc	Source Pt. of Diversion	Name & Address	Use or Filing Date	Flow	Place of Use and Area	Period of Use	Annual Water Allowance
261 cont.)					4355W 12 CA 11.3 * CB 0.5 CD 5.0 16.8		
262	Cottonwood Spring Area 4355W 2 DCC	K. [illegible] Chg. of J.C. [illegible]	Apr 28, 1909 1893	100 ac.ft.	4355W 1 CC 5.4 * 4355W 11 AA 13.0 4355W 12 BB 13.4 39.9		Total yrly. diversion 199.5 ac.ft. under claims 260, 261, 262
					4355W 11 AA 0.1 * 4355W 12 BB 12.8 BC 12.5 BD 1.4 CA 0.1 CB 0.2 27.1		Total yrly. diversion 100.5 ac.ft. under claims 260-263.
					4355W 12 CA 11.3 * CB 0.5 CC 5.0 16.8		Total yrly diversion 199.5 ac.ft. under claims 260-264 WUCs 260-264 limited to irrigation requirements of 125.0 acres
263	Sam Fogg Spring Area 4355W 12 AAB	Do.	Do.	50.0 ac.ft.	4355W 11 AA 0.1 * 4355W 12 BB 12.8 BC 12.5 BD 1.4 CA 0.1 CB 0.2 27.1		Total yrly diversion 199.5 ac.ft. under claims 260-264
					4355W 12 CA 11.3 * CB 0.5 CC 5.0 16.8		Total yrly diversion 99.5 ac.ft. under claims 260-264
264	Wilson Spring Area 4355W 12 CBA	Do.	Do.	0.5 cfs	4355W 12 CA 11.3 * CB 0.5 CC 5.0 16.8		Do.
36	Horsethief Spring (developed from well) 4356W 1400B	E. Campo Irriga- tion Co. c/o John K. Little, Pres. Kanab	1914	0.0225 cfs	4356W 25 DA 0.05 DB 0.95 1.00	1/1-12/31	5.0 ac.ft.
06#	Upper Cottonwood Canyon Spring Area 4357W 3 CB	Don B. Riggs P.O. Box 56 Kanab	1894	0.136 cfs	4357W 3 CB 0.5 CC 7.75 4357W 10 BB 10.75	1/1-12/31	97.25 ac.ft.

(7)

WATER RIGHTS FOR IRRIGATION (spring sources)

WUC	Source pt. of Diversion	Name & Address	Use or Filing Date	FR	Place of Use and Area	Period of Use	Total Water Allowance
107	Farm Canyon Springs No. 1 & 2 #1 43S7W9DCA #2 43S7W9DBD	Elson B. Riggs Kanab	1894	0.0615cfs	43S7W9 DA 3.15 DB 2.95 DC 1.5 DD 1.0 8.60	1/1-12/31	43.0 ac.ft.

APPENDIX B

Justifications for specific reconnaissance
alluvial valley floor designations
Kanab & Johnson Creek basins

Kanab Creek (lower)
(flood irrigation)

Kanab Irrigation Co. diversion at 43S6W16BCC, claim 18 cfs, irrigate over 1300 acres.

Basin lithology:
Qal - alluvium
Qg - gravel
Qb - basalt
Tc - Claron Formation
KK - Kaiparowits Formation
Kw - Wahweap Formation
Ks - Straight Cliffs Formation
Kts - Tropic Shale
Kd - Dakota Formation
Jc - Carmel Formation
Tn - Navajo Sandstone
TK - Kayenta Formation
(Goode, 1964)

Kanab Creek (upper)
(subirrigation &
flood irrigation)

"Perennial only in its upper reaches; for most of its nearly 20 miles of length it flows only during spring runoff or after an extensive rainfall" (Goode, 1964)

Total yield of upper springs may be 3 to 7 cts; extensive wet meadows above Alton.

Springs issue from Upper Cretaceous sandstones, also from Claron Formation; springs more abundant below steep portions of Pink Cliffs. (Goode,1964)

Alton Farmers Association diversions at 38S5W33ACB and 38S5W33CAB claim 12 cts, generally use 3-5 cfs; (Goode,1964)
irrigate 1235 acres exclusively and 171.8 acres jointly with water from North Roundy Creek and Reservoir Hollow Creek.

S.C. Lamb + F.E. Lamb diversion at 39S6W24ACA claim 2.55 cfs; irrigate 93a of Kanab Creek terraces in 39S6W24,25,26,35, and 36.

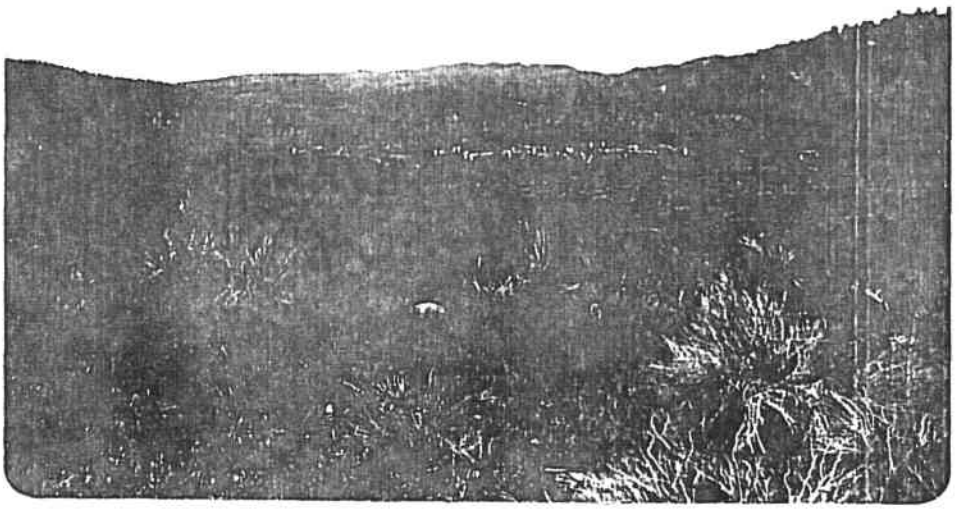


Fig. B-1 Subirrigated meadow at mouth of Dry Canyon on Kanab Creek terrac

Sink Valley Wash
(flood irrigation potential)

No perennial flow below Sink Valley.
No diversions below Sink Valley.
Terraces are cropped.

Basin lithology:
- Qal - alluvium
- Te - Claron Formation
- Kwk - Wahweap Kaiparowits Formations undifferentiated
- Ks - Straight Cliffs Formation
- Kts - Tropic Shale
- Kd - Dakota Formation

(Doelling - Graham, 1972)

Designated on basis of flood irrigation in upper basin and potential for relocating diversions, lithology of basin, and possible role as water supply for Kanab Irrigation Diversion during spring runoff period.

Sink Valley (subirrigation, flood irrigation)	Numerous filed spring sources used for irrigation.
	Sink Valley Wash has perennial flow only in the vicinity of the springs in Sink Valley. Most of the 11 springs or spring areas that were visited in the main part of Sink Valley yield about 2 to 4 gpm and two yield about 15 to 20 gpm. The total flow of the springs in Sink Valley is probably only 60 to 80 gpm but they support appreciable bog land..." (Goode,1964)

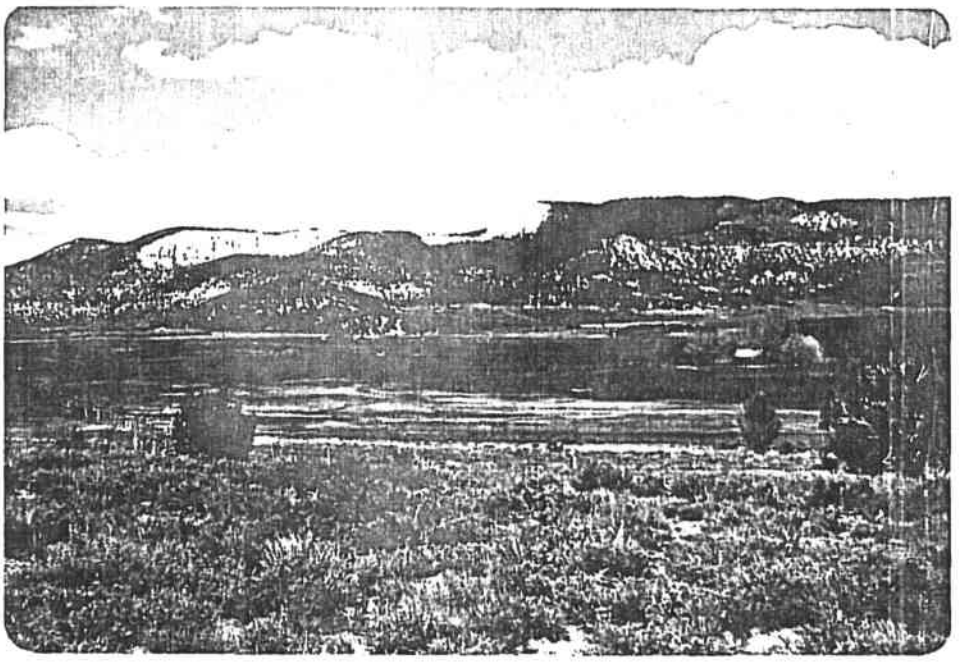


Fig. B-2 Sink Valley, Pink Cliffs in distance, most of foreground within Alton coalfield leasehold area

Swapp Hollow
(flood irrigation)

Basin lithology:
Qal - alluvium
Tc - Claron Formation
KwK - Wahweap-Kaiparowits Formations undifferentiated
Ks - Straight Cliffs Formation
Kts - Tropic Shale
(Doelling and Graham,1972)

Stream diversion filings, E. Sorenson at 39S5w28CAA, 39S5W29ADC, and 39S5w29DBB for 10 cfs, 132 acres in 39S5W29 and 32 also irrigated with springs in Sink Valley.

"Swapp Canyon. . . has no perennial flow to its mouth, but in July 1963 it had a flow in its middle reaches of about 13 gpm from uncatalogued springs near the top of the Tropic Shale."
(Goode,1964)

Lower Robinson Creek
(subirrigation, flood
irrigation potential)

Apparent subirrigation and developed stock watering ponds above Sink Valley in 39S5W16,10, and 21.

Hayfields on terraces of lower stream reach.

Basin lithology:
Qal - alluvium
TC - Claron Formation
KK - Kaiparowits Formation
Kw - Wahweap Formation
Ks - Straight Cliffs Formation
Kts - Tropic Shale
Kd - Dakota Formation
(Doelling and Graham,1972)

Dry Fork, Water Canyon and unnamed tributary of Lower Robinson Creek (subirrigation, flood irrigation water supply)

Basin lithology:

Qal - alluvium
Te - Claron Formation
Kwk - Wahweap-Kaiparowits Formations
Ks - Straight Cliffs Formation
Kts - Tropic Shale
(Doelling and Graham, 1972)

"Robinson Creek . . . has two principal branches, Dry Canoyn and Water Canyon. The head of Dry Canyon barely reaches a corner of the Pink Cliffs, and this canyon has not visible springs, although lush growths of vegetation, particularly scrub oak, suggest that groundwater in limited quantities is close to the surface. Water Canyon, on the other hand, has several springs whose aggregate yield was measured at 50 gpm."
(Goode,1964)

Stream and spring diversions in Water Canyon at 39S5W15BAB and 39S5W16AAD, C.C.Pugh, 0.5 cfs, 107 acres in 39S5W 20,29, and 30.

Unnamed tributary north of Alton and west of Kanab Creek
(flood irrigation)

Basin lithology:
Qal - alluvium
TC - Claron Formation
Kwk - Wahweap/Kaiparowits Formation
(Goode,1964)

Dam, diversion, and spreader dikes at 39S6W1 or ditches observed in air photos.

Roundy Canyon

Stream diversion at 38S5W31DAA, L.W.Heaton , supplemental supply to Alton Farmers' Assoc. ditch for 80 acres in 38S5W31,32 and 39S5W6; 5.0 cfs claimed.

Basin lithology:
Qal - alluvium
Tc - Claron Formation
Kw - Wahweap Formation
Ksc - Straight Cliffs Formation
Kt - Tropic Shale
(Goode,1964)

} minor portions of basin

Rush Canyon
(flood irrigation
and subirrigation)

L. W. Heaton diversions at 39S5W3BAC and 39S5W4ABD, irrigate 75 acres at 38S5W33 and 39S5W4,5; claim 4.0 cfs.

"Rush Hollow on August 29, 1963, had essentially continuous flow from its three principal alcoves almost to its mouth. On that date, a ditch supply water to a meadow about one-third mile from the mouth was flowing 90 gpm, and the aggregate yield of the many springs and seeps of the alcoves was 125 to 150 gpm about one-quarter mile below the alcoves."
(Goode,1964)

Basin lithology:
Qal - alluvium
Tc - Claron Formation
Kwk - Wahweap-Kaiparowits Formations
minor amounts { Ks - Straight Cliffs Formation
{ Kts - Tropic Shale
(Doelling, and Graham, 1972)

Reservoir Canyon
(flood irrigation)

Stream diversion at 38S5W33BDB
C.C. Pugh, supplemental irrigation water to 91.8 acres in 38S5w32,33 and 39S5w5 whose main supply is Alton Farmers' Assoc. ditch; .333 cfs and 45 af claimed.

Basin lithology:
Qal - alluvium
Kw - Wahweap Formation
(Goode,1964)

Kanab Creek and tributaries upstream of Rush Canyon and Reservoir Canyon (flood irrigation water supply, flood irrigation water availabity, subirrigation)

Principal water supply areas to Kanab Creek irrigation supply.
"(Spring) areas all supply flooded meadows as well as their contributions to Kanab Creek. Measurements of meadow areas ...suggest that a total of 30 to 40 acres is kept flooded by water in the uppermost reaches of Kanab Creek. In addition, this water undoubtedly supports much additional vegetation beyond the flooded areas." (Goode,1964)

Basin lithology:
Qal - alluvium
Tc - Claron Formation
KK - Kaiparowits Formation
Kw - Wahweap Formation
(Goode,1964)

Johnson Wash, below Skutumpah canyon (flood irrigation subirrigation)

Meadow Canyon, Dairy Canyon Flood Canyon, Johnson Lakes Canyon

Upper and lower diversion sites, extensive irrigation of valley flat.

Johnson Wash supplies irrigation water at diversions, while Navajo Sandstone supplies spring flow and sutains flow in lower portion of stream

Basin lithology:

Qal - alluvium
Qg - gravel
Qb - basalt
Tc - Claron Formation
KK - Kaiparowits Formation
Kw - Wahweap Formation
Ks - Straight Cliffs Formation
Kts - Tropic Shale
Kd - Dakota Formation
Jc - Carmel
Tn - Navajo Sandstone
TK - Kayenta Formation
(Goode,1964)

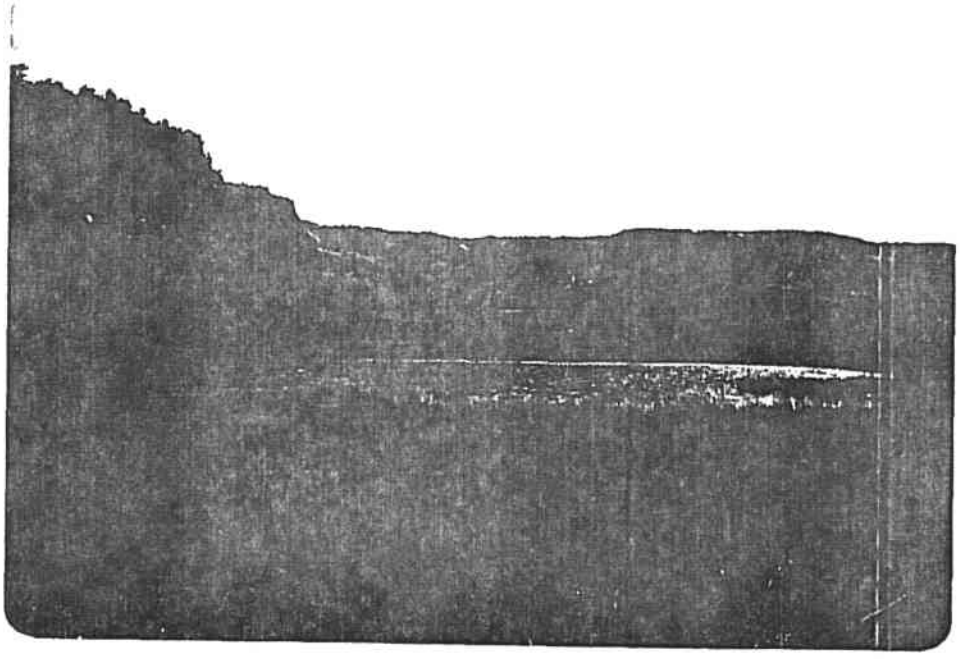


Fig. B-3 Spring fed reservoir at mouth of Dairy Canyon

Skutumpah Creek
(stream diversion irrigation and potential)

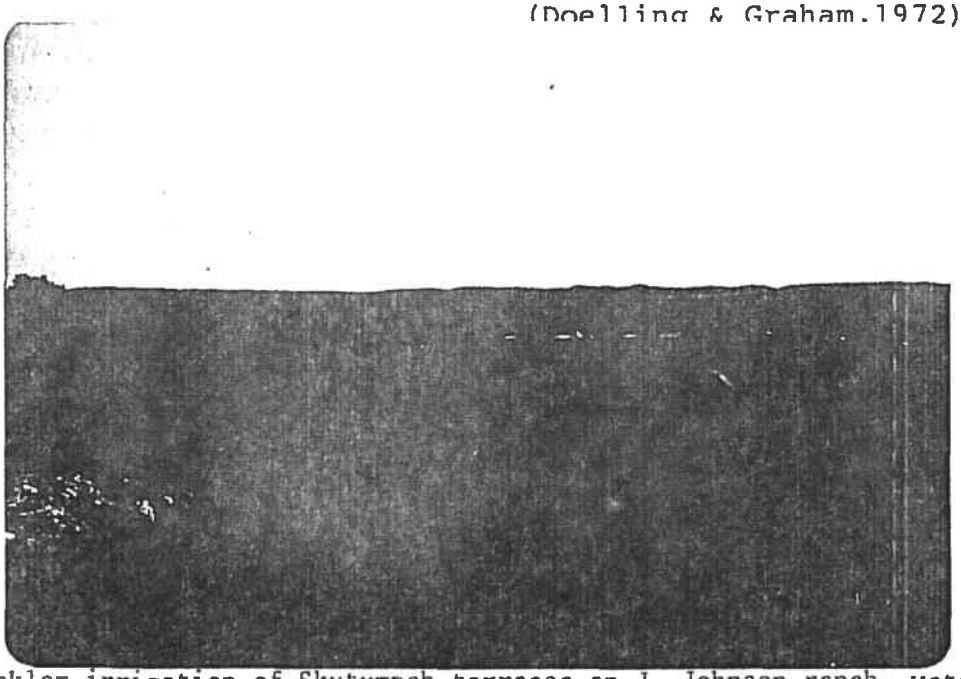
Perennial above confluence with Thompson Creek; ephemeral or intermittent in Skutumpah Canyon. (Goode,1966)

1976-77, channel dry for parts of summer at USGS gage, steady seepage losses in channel; annual flow 1976-77 250 af average annual flow 350 af (channel geometry estimate). (Sandberg,1979)

Stream diversion at 40S4½W20DAC water rights filings for J.G. Robinson and M. L. Robinson, presently irrigate terrace areas along Skutumpah Creek in 40S4½W32,' 41S4½W5,6.

Basin lithology:
- Qal - alluvium
- Qg- gravel
- Qb - basalt
- Tc - Claron Formation (Mill Creek drainage)
- KK - Kaiparowits Formation (Mill & Tenny Creek drainage
- Ksw - Straight Cliffs-Wahweap Formatio (Mill,Tenny, Mineral Creek drainag
- Kt - Tropic Shale
- Kd - Dakota Formation
- Jc - Carmel Formation

(Doelling & Graham,1972)



. B-4 Sprinkler irrigation of Skutumpah terraces on J. Johnson ranch, water source stream and wells

Mill Creek
(streem diversion irrigation potential + main supply to downstream irrigation)

Upstream continuation of Skutumpah Creek Skutumpah/Mill Creek perennial, most flow supplied by springs in Mill Creek especially in Water Canyon; Mill Creek Canyon has few springs; but a pipeline was once developed in canyon.
Sources of most springs Kaiparowits Sandstone below Pink Cliffs, also springs in Wahweap.
(Goode,1966)

Perennial, however seepage loses apparen at low flow through channel below main spring areas; "runoff entering the channel from side drainages did not significantly add to the base flow of the main stream but floods from those drainages added significant amounts of water below 40S4½W6AD; annual flow 256 af in 1976-77."
(Sandberg,1979)

Basin lithology:
Qal - alluvium
Qg - gravel
Tc - Claron Formation
KK - Kaiparowits Formation
Ksw - Straight Cliffs-Wahweap Formati
Kt - Tropic Shale
(Doelling and Graham,1972)

Tenny Creek (Tenny's Meadow area)
(subirrigation)

Meadow "well watered by springs"; all water from springs consumed by vegetation, no flow belowmeadows (7/30/64); 30 gpm reported from main springs (source-Straight Cliffs Sandstone), ditches & reported.
(Goode,1966)
Tenny Creek "intermittent"; "contributes more water to the main stream during periods of low flow than does any other tributary (to Skutumpah/Mill Creek)"; intermittent flow originates from seepage, has higher low flow sediment and dissolved load than Skutumpah/Mill Creek.
(Sandberg,1979)

Basin lithology:
Qal - alluvium
Qg - gravel
Qb - basalt
KK - Kaiparowits Formation
Ksw - Straight Cliffs & Wahweap Formations
Kt - Tropic Shale
(Doelling & Graham, 1972)

Thompson Creek
(stream diversion irrigation and potential)

Stream diversion at 40S4½W31BDD water rights filings for H. Bunting & J. G. Robinson, presently irrigate Thompson Creek and Skutumpah Creek terrances in 40S4½W31, 41S4½W5,6.

Channel dry above confluence with Skutumpah (7/28 & 8/25/64). (Goode,1964)

1976-77 annual flow about 337 af(d.a.9.8mi and 340 af (d.a.16.6 mi^2); average annual flow about 850 af (channel geometry method). (Sandberg,1979)

Thompson Creek is a "more reliable sourc for irrigation water" than Skutumpah Creek. (J.Johnson,1980, pers. comm.)

Basin lithology:
- Qal - alluvium
- Qg - gravel
- Qb - basalt
- Tc - Claron Formation
- KK - Kaiparowits Formation
- Ksw - Straight Cliffs-Wahweap Formation
- Kts - Tropic Shale
- Kd - Dakota Formation
- Jc - Carmel Formation

Fig. B-5 Lower Thompson Creek valley, DeRalph Bunting ranch, water sources for irrigated pasture and hayland are a well and stream

Oak Canyon (flood irrigation potential subirrigation potential)	abandoned field observed in 40S5W12A, water sources for these fields undermined. Basin lithology: Qal - alluvium Qg - gravel Tc - Claron Formation KK - Kaiparowits Formation Ksw - Straight Cliffs - Wahweap Formation Kt - Tropic Shale (Doelling & Graham, 1972)
Farm Canyon (flood irrigation potential subirrigation potential)	Basin lithology: Qal - alluvium Qg - gravel KK - Kaiparowits Formation (less than 10 acres) Kw - Wahweap Formation Ks - Straight Cliffs Formation Kt - Tropic Shale; (less than 10 acres) (Doelling & Graham, 1972)
	similarity to Oak Canyon

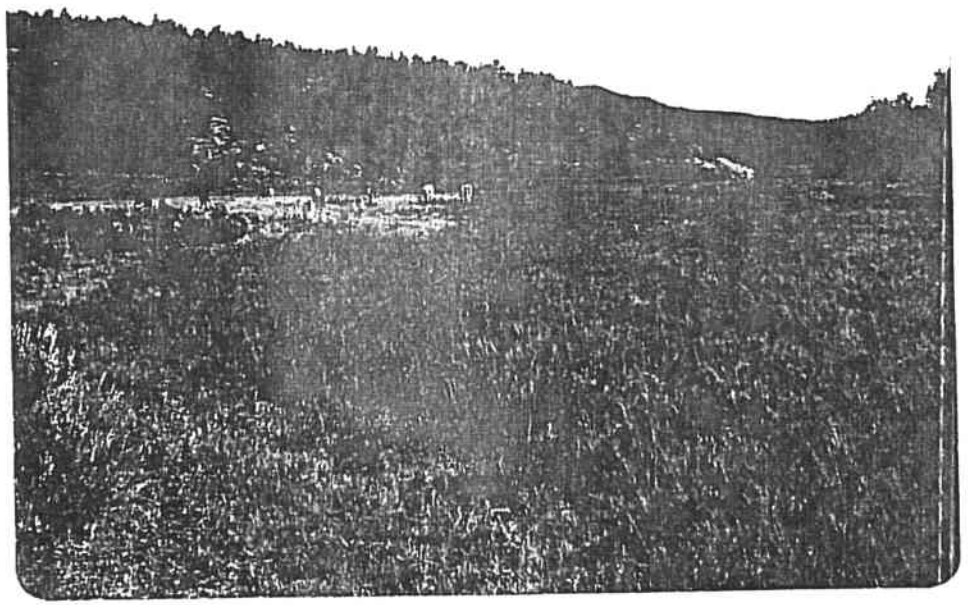


Fig. B-6 abandoned field at mouth of Birch Creek in Oak Canyon