MUNICIPAL AND INDUSTRIAL
WATER SUPPLY AND USES
in the
KANAB CREEK/VIRGIN RIVER BASIN

(Data Collected for Calendar Year 1997)

Prepared by

Utah Department of Natural Resources
Division of Water Resources

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ACKNOWLEDGMENTS

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D. Larry Anderson, Director

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EXECUTIVE SUMMARY

This document describes the municipal and industrial (M&I) water supplies and uses for the Kanab Creek/Virgin River Basin. Total M&I water supplies and uses for the basin are computed by tabulating the results of the portions of the three counties that comprise the basin: Iron, Kane and Washington. County data are compiled by meeting and surveying each public community and non-community system. The results reported herein represent totals for the 1997 calendar year.

The basin's maximum annual potable water supply under present conditions for Public Community Systems is 57,315 acre-feet. Springs account for 10 percent of this total, wells 67 percent, and surface sources 23 percent. The reliable system source capacity for these systems is 35,424 acre-feet. Table I presents this data.

TABLE I
KANAB CREEK/VIRGIN RIVER BASIN
Maximum Culinary Water Supplies for Public Community Systems
(Units in Acre-Feet)

Source	IRON County	KANE County	WASHINGTON County	Total
Springs	64.5	816.3	4,982.3	5,863.1
Wells	128.6	5,232.8	33,117.8	38,479.2
Surface	0.0	0.0	12,973.2	12,973.2
TOTALS	193.1	6,049.1	51,073.3	57,315.5
Reliable System Source Capacity	84.0	2,790.4	32,549.7	35,424.1

M&I water use can be divided into two categories: potable (culinary) and non-potable (secondary). Potable water is delivered by public community, public non-community, self-supplied industrial, and private domestic systems. Non-potable uses include residential and institutional secondary water usually delivered by separate irrigation companies and secondary water used by self-supplied industries. Table II presents water use data for the potable and non-potable categories delivered by public community systems. The table shows that the residential indoor category

accounts for 16 percent, residential outdoor 42 percent, commercial 25 percent, institutional 16 percent, and light industrial 1 percent of the total public community system water use (42,093 acre-feet) in the basin.

TABLE II
KANAB CREEK/VIRGIN RIVER BASIN
Water Use for Public Community Systems
(Units in Acre-Feet)

Source	IRON County	KANE County	WASHINGTON County	Total
Potable Uses:				
Residential Indoor	21.0	490.5	6,416.8	6,928.3
Residential Outdoor	44.4	728.5	12,291.1	13,064.0
Commercial	2.2	241.5	8,631.9	8,875.6
Institutional	1.1	377.3	1,699.3	2,077.7
Industrial/Stockwater	0.0	12.9	513.9	526.8
TOTAL CULINARY	68.7	1,850.7	29,553.0	31,472.4
Non-Potable Uses:				
Residential	39.9	706.1	3,703.9	4,449.9
Commercial	0.0	0.0	1,586.1	1,586.1
Institutional	0.0	104.0	4,480.3	4,584.3
Industrial/Stockwater	0.0	0.0	0.0	0.0
TOTAL SECONDARY	39.9	810.1	9,770.3	10,620.3
TOTAL WATER USE	108.6	2,660.8	39,323.3	42,092.7

Table III presents the total M&I water use in the Kanab Creek/Virgin River Basin. Public community systems deliver the majority of the potable water in the basin. The table shows that the total potable M&I water use in 1997 is 31,748 acre-feet. Non-potable M&I water use for the basin is 10,672 acre-feet. Therefore, total M&I (potable and non-potable) water use in the basin is about 42,413 acre-feet.

For 1997, population from public community systems in the Kanab Creek/Virgin River Basin was 85,535. Residential potable per capita water use is 208 gallons per capita per day (gpcd). Non-potable water use amounts to 46 gpcd resulting in uses of 254 gpcd for residential purposes within the public community systems of the basin. Furthermore, by adding commercial, institutional and industrial uses, public community systems use jumps to 329 gpcd for potable uses and 111 gpcd for non-potable uses for a total of 439 gpcd. Lastly, with a population of 85,675 (including

the private domestic category), the total basin M&I per capita water use including all categories and types of systems is 442 gpcd. The long growing season, which affects municipal outside watering, accounts for much of this above average value.

TABLE III
KANAB CREEK/VIRGIN RIVER BASIN
Total Municipal and Industrial Water Use for all Categories
(Units in Acre-Feet)

Source	IRON County	KANE County	WASHINGTON County	Total
Potable Suppliers: Public Community Systems	68.7	1,850.7	29,553.0	31,472.4
Public Non-Community Systems	27.4	23.9	92.0	143.3
Self-Supplied Industries	0.0	0.0	92.4	92.4
Private Domestic	5.0	10.0	25.0	40.0
TOTAL CULINARY	101.1	1,884.6	29,762.4	31,748.1
Non-Potable Suppliers: Secondary Irrigation Companies	39.9	810.1	9,770.3	10,620.3
Non-Community Systems	0.0	41.0	4.0	45.0
Self-Supplied Industries	0.0	0.0	0.0	0.0
Private Domestic	0.0	0.0	0.0	0.0
TOTAL SECONDARY	39.9	851.1	9,774.3	10,665.3
TOTAL WATER USE	141.0	2,735.7	39,536.7	42,413.4

INTRODUCTION

Authority

The Utah Division of Water Resources has overall responsibility for completing studies, investigations, and plans directed at the responsible development and utilization of the water resources of the state of Utah. The State Water Plan, prepared and distributed in early 1990, provided the foundation and overall direction to establish and implement the state policy framework of water management. As part of the state water planning process, detailed plans are prepared for each of the 11 hydrologic basins in the state. The Kanab Creek/Virgin River Basin is one of these 11 reports. Each basin water plan will identify potential conservation and development projects and describe alternatives to satisfy the problems, needs, and demands. As part of this effort, background data reports are completed for each river basin. These include a water-related land use report and a water budget report.

Scope

The subject of this data report is a determination of present municipal and industrial (M&I) water supplies and uses within this basin. The data presented in these reports may be used in the Sate Water Plan for the Kanab Creek/Virgin River Basin as well as other division reports and studies. The basin is shown in Figure 1. Information considered includes related investigations recently completed by the Division of Water Resources and the Division of Water Rights.

Data Collection

This study was begun in January 1997 by Division staff. The *1997 Municipal and Industrial Water Use Forms,* distributed by the Division of Water Rights, in cooperation with the Division of Water Resources and the Division of Drinking Water, were used and is the basis for the study. In all counties the data collection process is as described in the following section, *Water Supply and Use Methodology*. Water

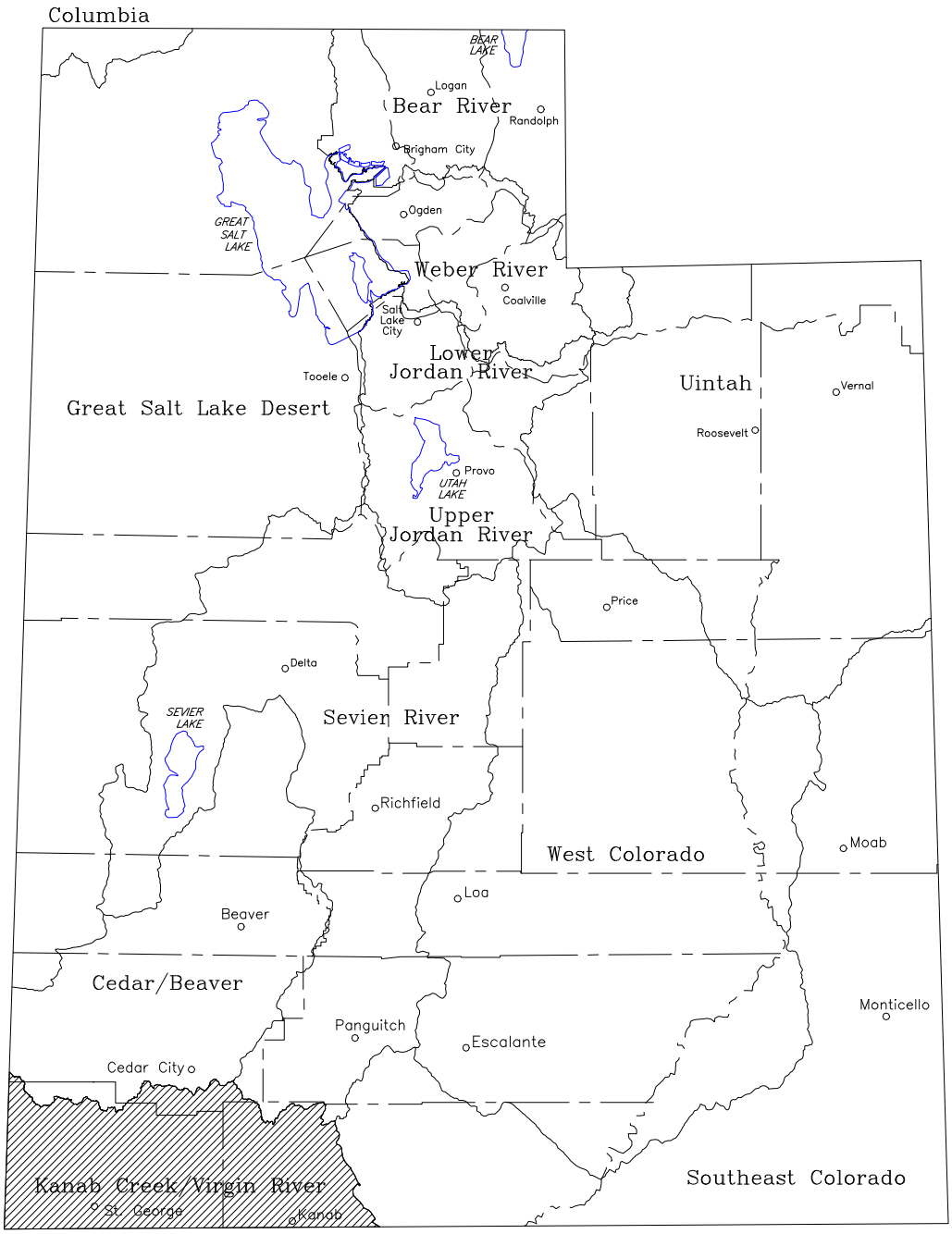


Figure 1. Location of the Kanab Creek/Virgin River Basin.

rights discussions presented herein were prepared based on conversations with Kerry Carpenter, Area Engineer from the State Engineer's Office that covers the Kanab Creek/Virgin River Basin.

General Description of the Basin

The Utah portion of the Kanab Creek/Virgin River Basin includes approximately 3,500 square miles of land in the southwest corner of the state. Utah's portion of the basin extends from the Utah/Arizona state line on the south to the Bull Valley and Harmony Mountains to the north. On the west, the study unit extends from the Utah/Nevada state line east to the divide between Johnson Wash and Kaibab Gulch Tributaries. The basin spans most of Washington County and part of Iron and Kane counties. Virgin and Kanab are the two hydrologic subareas that form the basin.

Elevations vary from a high of 10,375 feet at Black Mountain in the Cedar Mountains and 10,365 feet at Signal Peak in the Pine Valley Mountains to 2,297 feet and 2,461 feet where the Beaver Dam Wash and Virgin River cross the Utah/Arizona state line. Notable features of the basin include Zion National Park, Snow Canyon State Park and Coral Pink Sand Dunes State Park and a portion of Grand Staircase-Escalante National Monument. Figure 2 shows a detailed map of the basin.

The basin has 39 public community water systems (including Freedonia, Arizona). These systems serve 85,535 people (almost all of the 85,675 total basin population). Figure 3 shows the location of these systems. In addition, the basin claims 19 public non-community systems. These systems serve National Recreation Areas, State Parks, campgrounds, isolated commercial establishments, and roadside rest stops and parks. The basin also has one self-supplied industry.

M&I water use is steadily increasing within the basin. The entire basin is currently experiencing accelerated growth. Tourism, industry and climate drive most of this growth and this trend is likely to continue well into the future.

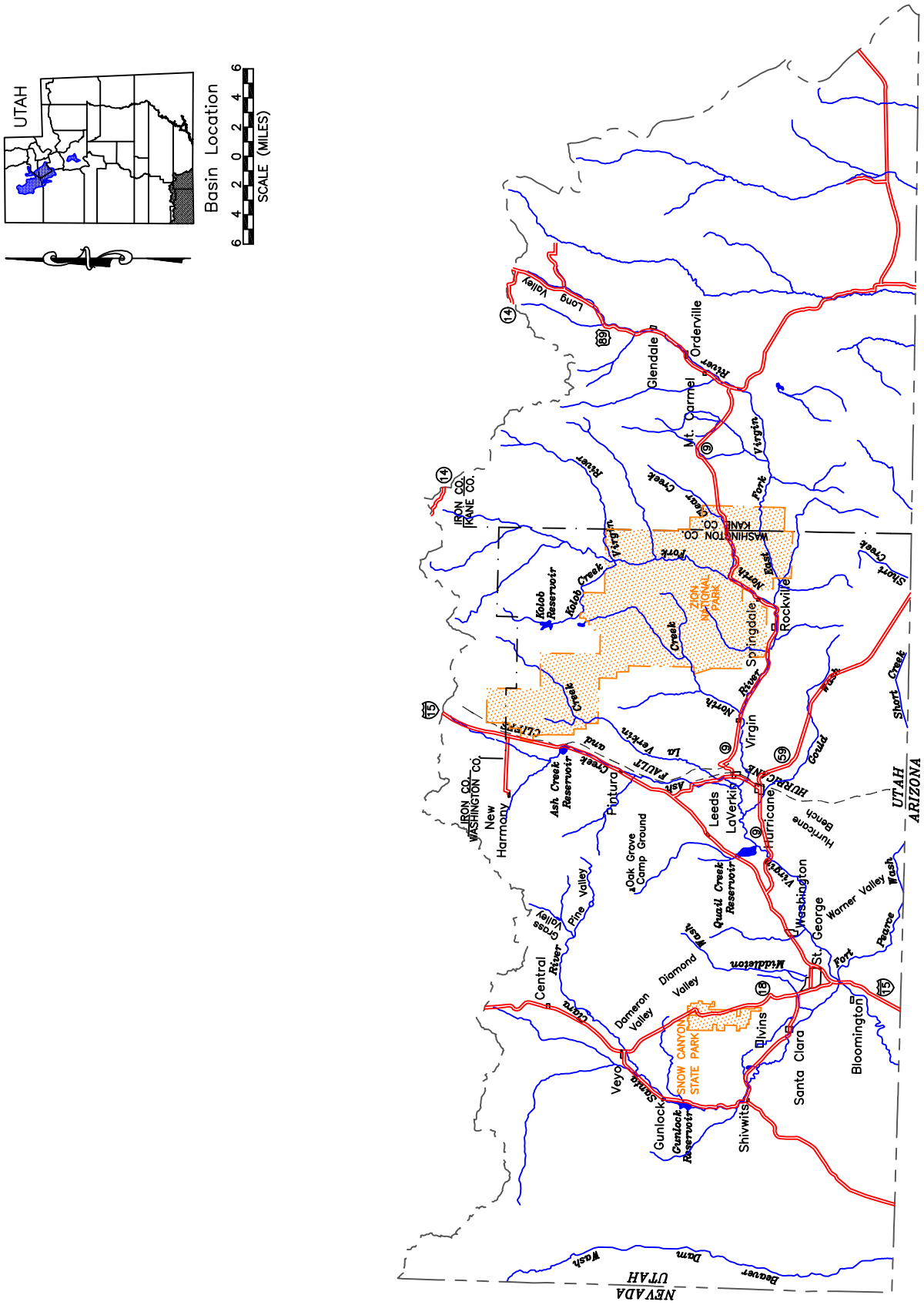


Figure 2. Kanab Creek/Virgin River Basin Drainage Map.

Figure 3 Public Community Systems Within the Kanab Creek/Virgin Basin

WASHINGTON COUNTY

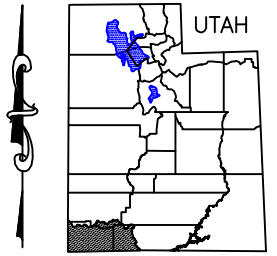
1. Angell Springs Special Service District
2. Casa De Oro Water Company
3. Central Culinary Water Company
4. Dammeron Valley Water Works
5. Diamond Valley Acres
6. Dixie Deer Special Service District
7. Eldorado Hills Mutual Company
8. Gunlock Special Service District
9. Harmony Farms Water Users
10. Hildale/Colorado City
11. Hurricane
12. Ivins
13. Kayenta Water Users, Incorporated
14. La Verkin
15. Leeds Domestic Water Users
16. Little Plains
17. Mountain Springs Water Company
18. New Harmony Water System
19. Pine Valley Mt. Farms
20. Rockville Pipeline Company
21. Santa Clara
22. Silver Reef Special Service District
23. Springdale
24. St. George City
25. Toquerville
26. Veyo Culinary Water Association
27. Virgin
28. Washington
29. Washington County WCD – Hurval
30. Winchester Hills Water Company
31. Zion Canyon Water System

KANE COUNTY

32. Alton
33. Canyon Country Subdivision
34. East Kanab Water Company
35. Glendale
36. Kanab
37. Orderville
38. Fredonia (Arizona)

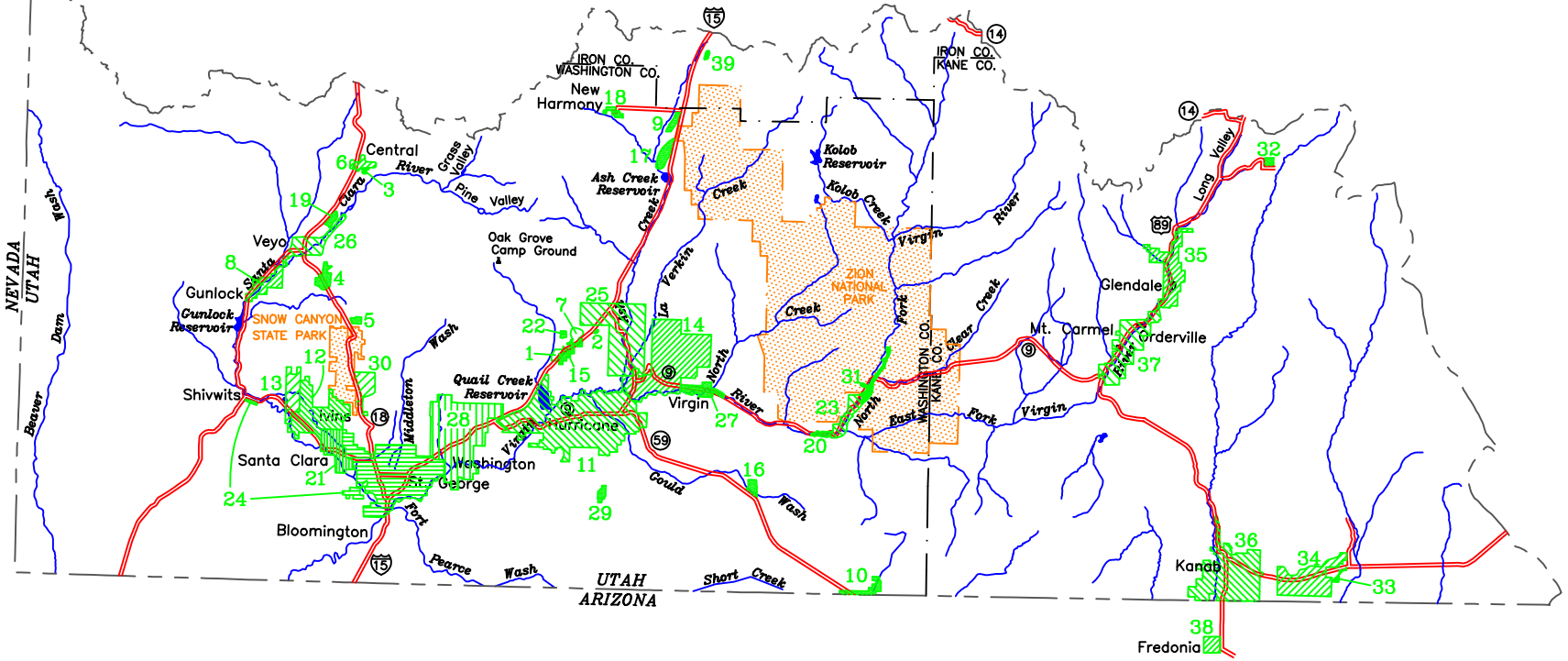
IRON COUNTY

39. Kanarraville Water System



Legend

Limits of Public Community System Boundaries



WATER SUPPLY AND USE METHODOLOGY

Background

Over the past 40 years the Division of Water Resources has employed various procedures to obtain needed M&I data. In recent years, these procedures have become more comprehensive. When the division began water planning in the 1960's, available data consisted mainly of supplies and uses for the entire state. At that time Utah's agriculture uses far exceeded M&I uses. M&I water use was generated by multiplying estimated per capita rates and by census population data.

By the early 1980's, M&I diversions made up a larger percent of all statewide water uses and the entire water community began an increased focus on M&I water supplies and uses. The Division of Water Rights launched a program to collect yearly, statewide M&I data. The procedure involved mailing a survey designed to query each major public water supplier about their sources of water supply. In addition the United States Geological Survey (USGS) began M&I water use studies. The division relied on both data sources in it's planning efforts by the late 1980's.

With the preparation of the State Water Plan Basin reports, the division saw the need to check and improve the quality and quantity of the available data through two methods. The first was to join with the Division of Water Rights to improve their M&I data collection program. Secondly, the division began exploring the accuracy of the data through yearly field surveys described in the following four sections.

Present Methodology for Community Water Systems

Each year, division staff targets a particular hydrologic basin or study area for M&I water supply and use analysis. The division of Water Rights' most recent water use form is the primary analysis tool. As an example, the next three pages exhibit the 1997 form submitted by La Verkin City.

AK-1

Information jointly requested by:
Utah Division of Water Resources, 538-7264;
Division of Drinking Water, 536-4200; and
Division of Water Rights, 538-7392.

UTAH WATER USE DATA FORM

DATA FOR 1997

Return completed form to;
Utah Division of Water Rights
PO Box 146300
Salt Lake City, UT 84114-6300

System Name: LaVerkin City
Address: 111 South Main
LaVerkin, UT 84745

Population Served: 3,000 ID #: 1028/27009
Total No. Connections: 1140 County: Washington
Average Lot Size Served: 1/4 acre(s).
Estimated Percent of Lot Irrigated 50 %.

Contact Person: Dale Wilson, Water Comm Chairman
Form filled out by: DOUGLAS GUBLER
Phone Number: (801)635-2581
Phone Number: (435) 635-2581

RECEIVED
MAR 0 2 1998
WATER RIGHTS
SALT LAKE

I. STORAGE INVENTORY: Total treated storage capacity: 1,500,000 in gallons. Number of Tanks: 1

II. SOURCE INVENTORY:

1 Source Name: Ash Creek Spring Area Type: SP Location: Sec 11, T41S, R13W, SLB&M WR Number: 81-687, 81-1602
Method of Measurement: [X] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: 1,000 GALLONS

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL

Are there any spills/overflow? [ ] Yes, [ ] No If yes, estimate annual quantity _____. Where is source measured? [ ] Before overflow, [ ] After overflow
When do spills/overflow occur? _____ Are spills/overflow included in the quantities reported? [ ] Yes [ ] No

2 Source Name: Upper Ash Creek Springs Type: SP Location: Sec 11, T41S, R13W, SLB&M WR Number: 81-1073, 81-1602
Method of Measurement: [X] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: 1,000 GALLONS

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL
11,454	10,958	13,152	38,192	26,247	27,524	27,618	25,593	29,592	13,659	19,352	9,905	253,246

Are there any spills/overflow? [ ] Yes, [ ] No If yes, estimate annual quantity _____. Where is source measured? [ ] Before overflow, [ ] After overflow
When do spills/overflow occur? _____ Are spills/overflow included in the quantities reported? [ ] Yes [ ] No

3 Source Name: Toquerville Springs Type: SP Location: Sec 11, T41S, R13W, SLB&M WR Number: 81-2287
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL

Are there any spills/overflow? [ ] Yes, [ ] No If yes, estimate annual quantity _____. Where is source measured? [ ] Before overflow, [ ] After overflow
When do spills/overflow occur? _____ Are spills/overflow included in the quantities reported? [ ] Yes [ ] No

** If you are using other sources which are not shown above, please enter the appropriate data in the space provided below. **

4 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL

5 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL

6 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL

-6-

7 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL

8 Source Name: Type: Location: WR Number:
Method of Measurement: [ ] Master Meter, [ ] Estimate, [ ] Other _____
Units of Measurement: _____

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEARLY TOTAL

SOURCE COMMENTS: Water supply conditions were: [ ] Above normal, [ ] Normal, [ ] Below normal

III. WATER USE BREAKDOWN: (Please use sum of readings from individual meters. If quantities are not know, please estimate percentages. See instructions for definition of uses shown in bold.)

Units of Measurement: 1,000 GALLONS

Source of data: [X] Meter readings at the source; [ ] Meter readings at individual connections; or [ ] Estimated

Residential: Annual quantity of water delivered for **residential** purposes - 179,316. Total number of residential connections 1072.

Commercial: Annual quantity of water delivered for **commercial** purposes - 34,011. Total number of commercial connections 48.

Industrial: Annual quantity of water delivered for **industrial** purposes - 21,293. Total number of industrial connections 13.

Institutional: Annual quantity of water delivered for **institutional** purposes - 18,626. Total number of institutional connections 7.

Stockwatering: Annual quantity of water delivered for **stockwatering** purposes - _____. Total number of stockwatering connections _____.

Unmetered: Annual quantity of water delivered by **unmetered** connections - _____. Total number of unmetered connections _____.

Wholesale: Annual quantity of water delivered to other systems - _____. Please attach a listing of those supplied.

Other Uses: Annual quantity of water delivered for other purposes - _____. Total number of other connections 1140.

Describe other uses _____

IV. IRRIGATION SYSTEM (Separate lawn and garden irrigation system, **whether controlled by the drinking water supplier or not**)

Is your area served by a separate irrigation water system? [X] Yes, [ ] No If yes, please provide the following information:

What percent of your customers are served by a separate irrigation system? 50 % The water is delivered _____ % by ditch & 100 % by pressurized system

If system is operated by another entity, please give name of company, contact person & phone number: LAVERKIN BENCH CANAL COMPANY GORDON WOOD (435) 635-2554

Quantity of water delivered by the irrigation system: Units of measurement: ACRE FEET

Total water delivered: 2529

Estimated acreage served by the irrigation/secondary system: 440 acres.

Division staff contact the manager or operator of each community water system (as defined by the Division of Drinking Water) to schedule a data analysis meeting. Many times operators inadvertently omit necessary information of their yearly form. During such meetings, division staff attempts to retrieve missing data as well as obtain an overall feeling of the supplies and demands of the water system, in case estimates are necessary. Additionally, a secondary objective of these meetings is to educate the operator or manager to correctly complete the water use data form. Division staff supply a new form to those systems that either didn't receive one or didn't return one. This methodology has been used since 1994, and all of the community water systems for the various basins studied have provided the necessary M&I water supply and use data.

During the analysis, division staff determines the system's water supply and use. Two factors define water supply: 1) maximum water supply available under present conditions and 2) reliable system source capacity. The maximum water supply available under present conditions is defined as the water resource which is presently developed. The resource is limited by either a mechanical constraint (such as pump capacity or pipe size), a hydrologic constraint (such as reliable streamflow or groundwater safe yield) or a legal constraint (such as a water right or contract). The lesser amount of these three constraints is considered in this study as the maximum water supply available under present conditions. Determination of well pump capacities, spring flow estimates, treatment plant capacities, and water right information aid in the calculation of this value. It should be noted here that due to the complexity of water rights, contracts, exchanges, etc., a detailed search of water right limitations associated with each entity is not in the scope of this study.

The reliable system source capacity is defined as the capacity to meet peak day demands, expressed as an annual volume. The maximum water supply available under present conditions (defined earlier) deals with an average annual volume. Many water supply components in M&I systems (treatment plants, storage facilities, pump motors, etc.) are sized using demand during a peak 24-hour period. The

relationship between average day and peak day demand is important. It is for this reason that a more reliable system source capacity is determined to accurately reflect future M&I water conditions for each system. The relationship that is used is as follows:

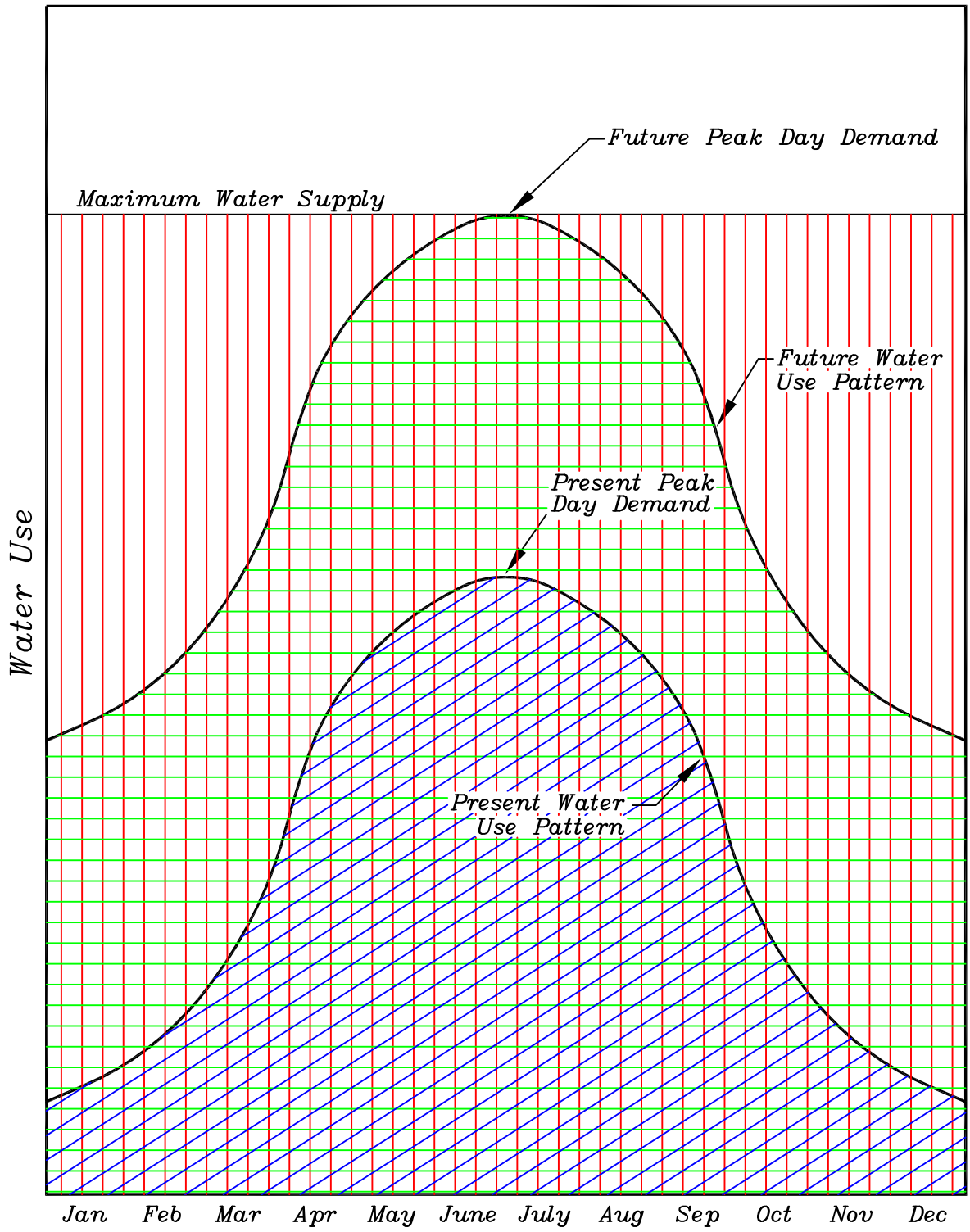
$$P_D = - 49.4 + 2.5\ A_D$$

where P_D is peak day demand and A_D is average daily demand

For each public community system, the average per capita use (described later) is used in the relationship above to determine a peak factor, and the maximum water supply available under present conditions is used to determine a peak day supply. These two values are then used in calculating the reliable system source capacity which represents the systems' annual maximum water supply's ability to meet peak day demand conditions. It also represents the volume of water which, when divided by the average annual per capita water use, gives the population that can be reliably served by the present system sources.

Figure 4 graphically presents the relationship between maximum water supply and reliable system source capacity. Current water use is shown in the figure as the volume under the lower curve. The future water use is shown as the volume under the upper curve. The maximum water supply under present conditions is shown by the volume under the upper line. Because this amount is associated with a maximum daily flow rate (limited by the water right or system capacity), the line in the figure must pass through the peak day demand point on the future water use curve. It is for this reason (and the fact that most culinary water system storage tanks are designed to store only about one days' worth of water demand) that not all of the maximum water supply is available to meet future water needs. Therefore, the reliable system source capacity, which is equal to the volume under the future water use curve, is a better indication for meeting future water needs. For most systems this value is about one half of the maximum water supply.

The reliable system source capacity is valuable in determining future water capacities of the particular community water system sources (wells, springs, etc.).



Present Yearly Water Use (Volume under curve)

Present Reliable System Source Capacity/Future Water Use (Volume under curve)
When this volume is divided by annual per capita water use, this yields the population that can be reliably served.

Maximum Source Capacity Available Under Present Conditions (Volume under line)

Figure 4. Water Supply and Use Hydrograph.

Although future water projections are not addressed in this study, the data provided here are used in the state water plans which the division is formulating for each major hydrologic basin in the state. These basin plans deal with considerable detail about future water demands and supplies.

The last part of the data collection process is to determine the present water use for each community water system. Present water use, as defined herein, includes the developed water which is actually diverted into the distribution system from surface or subsurface sources. The data collected represents the latest available complete calendar year from when the study is started. Water use is divided into four categories: residential, commercial, institutional and industrial. For comparative purposes the division chose these categories to correlate with the United States Geological Survey's (USGS) categories of domestic, commercial, industrial, and mining. The division's residential category is equivalent to the USGS domestic category and includes water used in residential homes for inside and outside uses. The USGS commercial category is equivalent to the division's combined commercial and institutional categories. The commercial category includes water use for retail establishments and businesses. The institutional category includes water use for government facilities, military facilities, schools, hospitals, churches, parks, cemeteries, golf courses, etc. The division's industrial category is equivalent to the combined USGS categories of industrial and mining which includes a wide variety of water uses associated with businesses that produce a specific product.

Residential Use

From the system operator, the staff collects data about the number of residential connections and the amount of water used by those connections. Water use in this category is divided into three subcategories: culinary-outside, culinary-inside, and secondary-outside use. The first step in calculating the amount of water used in each of these subcategories is determining the amount of outside irrigation. Because very few entities meter outside water use, division staff attempts to

determine the acreage that is actually irrigated by homeowners. Average lot size, percent irrigated, percent of residences that are supplied by separate secondary (pressurized and ditch) irrigation systems, water right-duty rates in the area, and other related information are used to estimate outside water use for each entity. Occasionally, delineation between lawns or gardens and farm fields becomes difficult. In these cases, the division's land use mapping program is utilized to take out the areas of the community that have been included as irrigated farmland.

Once residential outside water use is determined, it is subtracted from the given total residential water use. This amount is assumed to be the residential inside water use. When available, indoor water use can be estimated by looking at several residences' winter water bills and meter readings. When either of these methods yield an unreasonable value, then the staff uses a general range of between 75 and 120 gallons per capita per day (gpcd) for inside use and back-calculates outside water use from the total water use given.

Commercial Use

For most systems, the system operator can separate metered commercial water use data from the total water use. In cases where this data is not available or is extremely difficult to obtain, the division staff attempts to estimate commercial water use by inventorying commercial businesses in the area and using published commercial water use estimates. These publications come from the Division of Drinking Water and from reports published by the Utah State Water Lab. In some rural communities where there is a relatively small number of commercial connections, the businesses are visited by division staff and asked about their water use.

Institutional Use

Institutional water use is water used for city, county, state and federal government facilities, parks, golf courses, schools, hospitals, churches, military facilities, fire hydrant testing and other municipal losses in the water system. Because this water use is rarely metered, the process to acquire this data is a difficult one. Again, the system operator is asked to provide information about city facilities such as number and size of parks, schools, churches, and golf courses. Water right-duty rates for the area are used to calculate the amount of water these areas use. Also, estimates are made of leakage and testing of water system facilities and included in this category.

Industrial Use

Industrial use within community water systems is acquired with the same process used to obtain commercial water use data discussed earlier. Industrial water use is defined as water used in the production of a product. Therefore, such commercial establishments as dairies and mink farms are included in this category, provided a community system serves them.

Present Methodology for Non-Community Water Systems

Division staff attempts to contact each non-community system and make a personal visit. These systems rarely meter their water use, so estimates are made by division staff as to their actual annual water use. Questions are asked to determine type of facility, population served, water source information, irrigation of outside areas, etc. This data, along with other water -related publications, are used to determine water use. The maximum water supply for these systems is often not available and is not in the scope of this study.

Present Methodology for Self-Supplied Industrial Water Systems

For self-supplied industries, water use is acquired by using data given on the Division of Water Rights Industrial Water Use Form. The Division of Water Rights collects annual water use data from most of the major self-supplied industrial water users in the state. This data is confidential. Therefore, the data presented in this M&I study is only given as county totals. Again, the maximum water supply is often not available and is not in the scope of this study.

Present Methodology for Private Domestic Water Systems

Private domestic systems are residences that are not connected to any public community or non-community water system. They are usually supplied by individual wells. The water use data for this category is acquired by taking the State Office of Budget county population data and subtracting the population served by community water systems. The remainder is the population that is served by private domestic systems. A reasonable per capita rate (usually determined from the residential per capita rates from nearby community systems) is applied to this population to determine the total water use by private domestic systems. Since the maximum water supply for private wells is really an analysis of the total groundwater reservoir/recharge area, it is not in the scope of this study.

DEFINITIONS OF WATER TERMS

Some water terms peculiar to the water industry are briefly defined in order to better understand the information presented.

Water Supply Terms

Water is supplied by a variety of systems for many users. The general term supply is defined as the amount of water available. Most water supply systems are owned by a municipality, but in some cases the owner/operator is a private company or a state or federal agency. Thus, a "public" water supply may be either publicly or privately owned. Also, systems may supply treated or untreated water.

Maximum Water Supply Available Under Present Conditions - The annual volume of water which is the lesser of the hydrologic capacity of the water source, the physical capacity of the water system, or the use allowed by the water right. See Figure 4.

Reliable System Source Capacity - The actual annual quantity of the maximum water supply that is available to meet peak demands. When this number is divided by the average per capita usage, the resulting number represents the maximum population that the water source can serve. See Figure 4.

Municipal Water Supply - A supply that provides potable (culinary) water for residential, commercial, and institutional uses. The terms municipal, community and city are often used interchangeably.

Municipal and Industrial Water Supply - Includes all water (potable and non-potable) supplied for residential, commercial, institutional, light industry, and large self-supplied industries. This supply is available for public community systems, public

non-community (transient and non-transient) system, self-supplied industrial systems, unregulated Indian systems and private wells.

Potable Water Supply - Water meeting all applicable safe drinking water requirements for residential, commercial, institutional and industrial uses. Sometimes referred to as culinary water supply.

Non -Potable Water Supply - Water not meeting safe drinking water requirements. Secondary irrigation companies and self-supplied industries supply this water. Sometimes referred to as non-culinary water supply, but usually referred to as secondary water.

Public Community Water Supply - Includes potable water supplied by either privately or publicly owned community systems which serve at least 15 service connections or 25 individuals occupied year round. Water from public community supplies may be used for residential, commercial, institutional, and industrial purposes. This can include both indoor and outdoor uses.

Public Non-Community Water Supply - Includes potable water supplied by either privately or publicly owned systems of two types; transient and non-transient. Transient systems are systems that do not serve 25 of the same non-resident persons per day for more than six months per year. Examples include campgrounds, RV parks, restaurants, convenience stores, etc. Non-transient systems are systems that regularly serve 25 of the same non-resident persons per day for more than six months per year. Examples include churches, schools and industries. This report combines transient and non-transient systems together and calls them all public non-community systems. Industries are reported under self-supplied industries.

Secondary Water Supply - Pressurized or open ditch water supply systems that supply untreated water for irrigation of privately and publicly owned lawns, gardens, parks, cemeteries, golf courses and other open areas. These systems, sometimes

called "dual" water systems, are installed to provide an alternative to irrigating with culinary water for these outdoor areas. This supply is often provided by irrigation companies. Self-supplied industries can also use secondary water for industrial processes.

Self-supplied Industrial Supply - Includes potable or non-potable water supplied by individual privately owned industries usually from their own wells or springs.

Water Use Terms

Water is used in a variety of ways and for many purposes. Water is often said to be "used" when it is diverted, demanded, withdrawn, depleted or consumed. But it is also "used" in place for such things as fish and wildlife habitat, recreation and hydropower production. The word *use* can be inserted where the word *supply* is written in most of the previous water supply terms to define the current demand associated with those definitions. Some additional water use terms are as follows:

Commercial Use - Uses normally associated with small business operations which may include drinking water, food preparation, personal sanitation, facility cleaning and maintenance and irrigation of facility landscapes. Retail businesses, restaurants and hotels are some examples.

Industrial Use - Uses associated with the manufacturing or production of products. The volume of water used by industrial businesses can be considerably greater than water used by commercial businesses. Manufacturing plants, oil and gas producers, mining companies, mink farms and dairies are some examples.

Institutional Use - Uses normally associated with general operation of various public agencies and institutions including drinking water, personal sanitation, facility cleaning and maintenance and irrigation of parks, cemeteries, playgrounds,

recreational areas, golf courses, and other facilities. Many times the amount used by cities for outside irrigation of public areas is not metered.

Municipal and Industrial (M&I) Use - Term includes all residential, commercial, institutional, and industrial uses. It includes total uses (potable and non-potable) supplied by public water systems (community and non-community), self-supplied industries, private domestic systems, and secondary irrigation companies.

Private-Domestic Use - Includes water from private wells or springs for use in individual homes, usually in rural areas not accessible to public water supply systems.

Residential Use - Water use associated with residential cooking; drinking water; washing clothes; miscellaneous cleaning; personal grooming and sanitation; irrigation of lawns, gardens and landscapes, and washing automobiles, driveways and other outside facilities. Single family homes, apartments, duplexes and condominiums are some examples.

Other Water Terms

Consumption - Water evaporated, transpired or irreversibly bound in either a physical, chemical or biological process.

Consumptive Use - Losses of water brought about by human endeavors when used for residential, commercial, institutional, industrial, agricultural, power generation, and recreation. Naturally occurring vegetation and fish and wildlife also consumptively use water.

Depletion - Water lost or made unavailable for return to a given designated area, river system or basin. It is intended to represent the net loss to a system. The terms

consumption and depletion are often used interchangeably but are not the same. For example, water exported from a basin is depletion to the basin system but is not consumed in the basin. The exported water is available for use in another system. Water diverted to irrigated crops in a given system, but not returned for later use, is depletion. Precipitation that falls on irrigated crops is not considered a part of the supply like surface water and groundwater diversions. For this reason, precipitation falling on and consumed by irrigated crops is not considered as being a depletion to the system.

Diversion - Water diverted from supply sources such as streams, lakes, reservoirs or groundwater for a variety of uses including cropland irrigation, residential, commercial, institutional and industrial. The terms diversion and withdrawal are often used interchangeably.

Withdrawal - Water withdrawn from supply sources such as lakes, streams, reservoirs or groundwater. This term is normally used in association with groundwater withdrawal.

WATER RIGHTS IN THE KANAB CREEK/VIRGIN RIVER BASIN

Although a detailed analysis of water rights is not part of this report, a water supply and use study would not be complete without a discussion on the current water right regulations in the area. The following discussion was obtained from the Division of Water Rights. It explains the current general water right regulations in the Kanab Creek/Virgin River Basin with regards to M&I uses.

Kanab and Johnson Creek

Surface water applications are closed to further appropriations. Underground water applications will be reviewed on and individual basis.

Virgin River

Both surface and underground waters of the basin are considered to be fully appropriate. However, some exceptions are described below.

The Gould Wash drainage (T42S, R12W and R13W) is still open to small (less than 2 ac-ft/yr) underground appropriations in the “Plains” area (on top of the Hurricane Cliffs, east of the escarpment), but the State Engineer is holding applications unapproved pending further information on the available resource. Transfers of underground rights across the escarpment are not permitted.

The Quail Creek drainage and the Middleton Black Ridge area (T41S and T42S, R13W to R15W, north of the river and between Mill Creek and Ash Creek) is open to underground applications deep in the bedrock. Each application is individually reviewed; most are being held pending further information on the available resource.

The flood plain area South and East of the Virgin River and West of the Hurricane Cliffs escarpment is open to small underground filings, but all larger applications are being held unapproved pending further resource data.

The Beaver Dam Wash drainage area is open to small underground water filings. However, it is unclear how much resource is available for development so applications are being held unapproved.

New diversions and uses must be accomplished by change applications filed on owned or acquired existing rights. Changes between surface and underground sources are generally not approved, but exceptions have been made in cases in which direct communication between the sources can be reasonably assumed, or in which there has been surface reservoir storage sufficient to show communication between surface and underground sources.

IRON COUNTY M&I WATER SUPPLIES AND USES

The Kanab Creek/Virigin River Basin portion of Iron County claims Kanarraville as its only incorporated community. Within this area, Kanarraville is the only public community system and the Kanarraville state highway rest stop is the only public non-community system. There are no self-supplied industries in this area. Location of the public community system is shown in figure 3.

Table 1 shows that the maximum annual water supply for public community systems in this portion of Iron County is 193 acre-feet; 65 acre-feet from springs, and 129 acre-feet from wells. Reliable system source capacity is less than half that amount at 84 acre-feet.

TABLE 1
IRON COUNTY
Potable Water Supplies for Public Community Systems

WATER SUPPLIER	Springs (Ac-Ft/Yr)	Wells (Ac-Ft/Yr)	Surface (Ac-Ft/Yr)	Total (Ac-Ft/Yr)
IRON COUNTY				
Kanarraville	64.5	128.6	0.0	193.1
IRON COUNTY TOTALS	64.5	128.6	0.0	193.1

Note: All values represent maximum system source capacities limited by water rights, hydrologic constraints, and/or system constraints.

Table 2 shows the reliable system source capacity along with a breakdown of potable water use for each public community system. This table shows that for Iron County the current annual use of 69 acre-feet of water is about 82 percent of the reliable supply of 84 acre-feet of water.

Secondary water is another important aspect of total M&I use. Table 3 gives the amount of secondary water used for various categories within the boundaries of the Kanarraville public community system. A separate irrigation company delivers secondary water to customers. Total secondary use is 40 acre-feet.

TABLE 2
IRON COUNTY
WATER USE AND SUPPLY FOR PUBLIC COMMUNITY SYSTEMS

WATER SUPPLIER	POTABLE USAGE						POTABLE PER CAPITA USAGE			MAXIMUM WATER SUPPLY AVAILABLE UNDER PRESENT CONDITIONS (Ac-Ft/Yr)	POTABLE ESTIMATED PEAK DAY VALUES				RELIABLE SYSTEM SOURCE CAPACITY UNDER PRESENT CONDITIONS (Ac-Ft/Yr)
	Residential Indoor Use (Ac-Ft/Yr)	Residential Outdoor Use (Ac-Ft/Yr)	Commercial Indoor and Outdoor Use (Ac-Ft/Yr)	Institutional Indoor and Outdoor Use (Ac-Ft/Yr)	Industrial/ Stockwater Indoor and Outdoor Use (Ac-Ft/Yr)	Total Potable M & I Use (Ac-Ft/Yr)	Population	Average Per Capita Water Use (Ac-Ft/Yr)	Average Per Capita Water Use (GPCPD)		Assumed Peaking Factor (PD/AD)	Peak Day Supply (MGD)	Peak Day Demand (MGD)	Peak Day Supply Over Demand (MGD)	
IRON COUNTY															
Kanarraville	21.0	44.4	2.2	1.1	0.0	68.7	250	0.275	245.3	193	2.2986	0.1724	0.1410	0.0314	84
										see note					
IRON COUNTY TOTALS	**21.0**	**44.4**	**2.2**	**1.1**	**0.0**	**68.7**	**250**	**0.275**	**245.3**	**193**	**2.2986**	**0.1724**	**0.1410**	**0.0314**	**84**
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P

* Note: Peak Day Demand exceeds the calculated Peak Day Supply. An assumption was made that in these cases the Peak Day Supply has been exactly met and should be set equal to the Peak Day Demand.
Although some systems may withdraw the maximum water supply available under present conditions, the hydrologic conditions will probably limit all systems collectively from withdrawing this quantity, as presented.

A, B, C, D, E, F, H, and K	These values are all input data.
G=B+C+D+E+F	This value represents only Potable M&I Water Use.
I=G/H	Average per capita potable water use.
J=I*892.682	Converts from Ac-Ft/Yr to GPD
L=(2.5*J-49.4)/J	The factor which when multiplied to the average per capita water use represents water use during peak demands.
M=K*892.682/1000000; (except as provided in the note above)	Peak Day Supply of potable water based on maximum reliable source capacity converted to MGD). Where the calculated Peak Day Supply of potable water is less than the Peak Day Demand of Potable Water, this value was set equal to the Peak Day Demand of potable water.
N=H*J*L/1000000	Peak Day Demand on potable water based on the total potable M&I water use multiplied by the peaking factor
O=M-N	The amount of Peak Day Supply of potable water above the amount of the Peak Day Demand of potable water.
P={M/(L*J)}*J*1120.22	Reliable system source capacity represents that volume of water, which when divided by the average annual water per capita use, gives that population that can be reliably served by the system sources under peak day demand conditions.

TABLE 3
IRON COUNTY
Secondary (Non-Potable) Water Use Within Public Community Systems

WATER SUPPLIER	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Secondary Use (Ac-Ft/Yr)
IRON COUNTY					
Kanarraville	39.9	0.0	0.0	0.0	39.9
IRON COUNTY TOTALS	39.9	0.0	0.0	0.0	39.9

Note: Separate irrigation companies provide secondary water to the water supplier unless indicated by an '*'.

Table 4 gives water use for public non-community system and private domestic systems. Kanarraville state highway rest stop is the only non-community system in this area. There are no self-supplied industries and only a small number of private domestic wells. All of these uses amount to 32 acre-feet.

TABLE 4
IRON COUNTY
Water Use for Public Non-Community Systems, Self-Supplied Industries and Private Domestic Systems

Non-Community System	POTABLE USAGE					SECONDARY USE (Ac-Ft/Yr)
	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Potable Use (Ac-Ft/Yr)	
IRON COUNTY						
Kanarraville State Highway Rest Stop	0.0	0.0	27.4	0.0	27.4	0.0
SELF-SUPPLIED INDUSTRIES	0.0	0.0	0.0	0.0	0.0	0.0
PRIVATE DOMESTIC	5.0	0.0	0.0	0.0	5.0	0.0
IRON COUNTY TOTALS	5.0	0.0	27.4	0.0	32.4	0.0

Total potable M&I water use in the county is 101 acre-feet, while secondary use is 40 acre-feet; giving a total M&I water use of 141 acre-feet. Since the current population of the basins' portion of Iron County is about 270 the total M&I per capita use is 466 gpcd. Table 5 gives various per capita rates for public community systems. Appendix A shows the data for each public community system that is presented in the tables.

TABLE 5
IRON COUNTY
Average Per Capita M&I Water Use for all Public Community Systems

CATEGORY	Average Per Capita Use (Ac-Ft/Yr)	Average Per Capita Use (GPCD)
Residential Potable Use	0.262	234
Residential Potable Plus Secondary Use	0.421	376
Total Potable Use	0.275	245
Total Potable Plus Secondary Use	0.434	388

Note: Total Potable categories include residential, commercial, institiutional and industrial uses.

KANE COUNTY M&I WATER SUPPLIES AND USES

The Kanab Creek/Virgin River portion of Kane County includes the incorporated communities of Alton, Glendale, Orderville and Kanab. Within this area are 7 public community systems, 6 public non-community systems, and no self-supplied industries. Included in this study is the water system from the town of Freedonia, Arizona which receives some water supplies from Utah. Location of the public community systems are shown back in figure 3.

Table 6 shows that the maximum annual water supply for public community systems in Kane County is 6,049 acre-feet; 816 acre-feet from springs and 5,233 acre-feet from wells. Reliable system source capacity is less than half that amount at 2,790 acre-feet.

TABLE 6
KANE COUNTY
Potable Water Supplies for Public Community Systems

WATER SUPPLIER	Springs (Ac-Ft/Yr)	Wells (Ac-Ft/Yr)	Surface (Ac-Ft/Yr)	Total (Ac-Ft/Yr)
KANE COUNTY				
Alton	19.4	0.0	0.0	19.4
Canyon Country Subdivision	0.0	129.0	0.0	129.0
East Kanab Water Company	0.0	721.0	0.0	721.0
Glendale	108.6	0.0	0.0	108.6
Kanab	112.0	3,395.0	0.0	3,507.0
Orderville	103.2	657.2	0.0	760.4
Freedonia (Arizona)	473.1	330.6	0.0	803.7
KANE COUNTY TOTALS	816.3	5,232.8	0.0	6,049.1

Note: All values represent maximum system source capacities limited by water rights, hydrologic constraints, and/or system constraints.

Table 7 shows the reliable system source capacity along with a breakdown of the potable water use for each public community system. This table shows that for

TABLE 2
KANE COUNTY
WATER USE AND SUPPLY FOR PUBLIC COMMUNITY SYSTEMS

WATER SUPPLIER	POTABLE USAGE						POTABLE PER CAPITA USAGE			MAXIMUM WATER SUPPLY AVAILABLE UNDER PRESENT CONDITIONS (Ac-Ft/Yr)	POTABLE ESTIMATED PEAK DAY VALUES				RELIABLE SYSTEM SOURCE CAPACITY UNDER PRESENT CONDITIONS (Ac-Ft/Yr)
	Residential Indoor Use (Ac-Ft/Yr)	Residential Outdoor Use (Ac-Ft/Yr)	Commercial Indoor and Outdoor Use (Ac-Ft/Yr)	Institutional Indoor and Outdoor Use (Ac-Ft/Yr)	Industrial/ Stockwater Indoor and Outdoor Use (Ac-Ft/Yr)	Total Potable M & I Use (Ac-Ft/Yr)	Population	Average Per Capita Water Use (Ac-Ft/Yr)	Average Per Capita Water Use (GPCPD)		Assumed Peaking Factor (PD/AD)	Peak Day Supply (MGD)	Peak Day Demand (MGD)	Peak Day Supply Over Demand (MGD)	
KANE COUNTY															
Alton	8.9	0.0	0.0	0.2	0.0	9.1	143	0.064	56.8	19	1.6304	0.0173	0.0132	0.0041	12
Canyon Country Subdivision	5.0	2.9	0.0	0.0	0.0	7.9	60	0.132	117.5	129	2.0797	0.1152	0.0147	0.1005	62
East Kanab Water Company	5.1	0.0	0.0	0.0	0.0	5.1	65	0.078	70.0	721	1.7947	0.6436	0.0082	0.6355	402
Glendale	27.3	20.0	0.7	12.3	0.3	60.6	325	0.186	166.5	109	2.2032	0.1192	0.1192 *	0.0000	61
Kanab	284.6	376.4	196.9	247.6	9.3	1,114.8	4,000	0.279	248.8	3,507	2.3014	3.1306	2.2903	0.8403	1,524
Orderville	46.2	79.8	41.7	72.2	3.2	243.1	550	0.442	394.6	760	2.3748	0.6788	0.5154	0.1634	320
Freedonia (Arizona)	113.4	249.4	2.2	45.0	0.1	410.1	1,350	0.304	271.2	0	2.3178	0.8485	0.8485 *	0.0000	410
										see note					
KANE COUNTY TOTALS	**490.5**	**728.5**	**241.5**	**377.3**	**12.9**	**1,850.7**	**6,493**	**0.285**	**254.4**	**5,245**	**2.3058**	**6**	**4**	**2**	**2790**
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P

* Note: Peak Day Demand exceeds the calculated Peak Day Supply. An assumption was made that in these cases the Peak Day Supply has been exactly met and should be set equal to the Peak Day Demand.
Although some systems may withdraw the maximum water supply available under present conditions, the hydrologic conditions will probably limit all systems collectively from withdrawing this quantity, as presented.

A, B, C, D, E, F, H, and K	These values are all input data.
G=B+C+D+E+F	This value represents only Potable M&I Water Use.
I=G/H	Average per capita potable water use.
J=I*892.682	Converts from Ac-Ft/Yr to GPD
L=(2.5*J-49.4)/J	The factor which when multiplied to the average per capita water use represents water use during peak demands.
M=K*892.682/1000000; (except as provided in the note above)	Peak Day Supply of potable water based on maximum reliable source capacity converted to MGD). Where the calculated Peak Day Supply of potable water is less than the Peak Day Demand of Potable Water, this value was set equal to the Peak Day Demand of potable water.
N=H*J*L/1000000	Peak Day Demand on potable water based on the total potable M&I water use multiplied by the peaking factor
O=M-N	The amount of Peak Day Supply of potable water above the amount of the Peak Day Demand of potable water.
P={M/(L*J)}*J*1120.22	Reliable system source capacity represents that volume of water, which when divided by the average annual water per capita use, gives that population that can be reliably served by the system sources under peak day demand conditions.

Kane County the current annual potable use of 1,851 acre-feet of water is a little more than one half the reliable system source capacity of 2,790 acre-feet of water.

Secondary water is another important aspect of total M&I use. Table 8 gives the annual amount of secondary water used for various categories within the boundaries of the public community systems. In Kane County, various irrigation companies deliver secondary water to customers. Total secondary use is 810 acre-feet.

TABLE 8
KANE COUNTY
Secondary (Non-Potable) Water Use Within Public Community Systems

WATER SUPPLIER	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Secondary Use (Ac-Ft/Yr)
KANE COUNTY					
Alton	204.0	0.0	0.0	0.0	204.0
Canyon Country Subdivision	0.0	0.0	0.0	0.0	0.0
East Kanab Water Company	0.0	0.0	0.0	0.0	0.0
Glendale	122.0	0.0	18.0	0.0	140.0
Kanab	158.1	0.0	0.0	0.0	158.1
Orderville	222.0	0.0	86.0	0.0	308.0
Freedonia (Arizona)	0.0	0.0	0.0	0.0	0.0
KANE COUNTY TOTALS	706.1	0.0	104.0	0.0	810.1

Note: Separate irrigation companies provide secondary water to the water supplier unless indicated by an '*'.

Table 9 gives annual water use for public non-community systems, self-supplied industries, and private domestic systems. Coral Pink Sand Dunes State Park is among the 6 listed non-community systems. There are no self-supplied industries. There are quite a few residences that use their own wells. Collectively these amount to 34 acre-feet of potable water and 41 acre-feet of non-potable water usage.

Therefore, the total potable M&I water use in the county is 1,885 acre-feet, while secondary use is 851 acre-feet; giving a total M&I water use of 2,736 acre-feet. Since the current population of Kanab Creek/Virgin River portion of Kane County is estimated at 6,433 the total M&I per capita use is 380 gpcd. Table 10 gives various

per capita rates for public community systems. Appendix B shows the data for each public community system that is presented in the tables.

TABLE 9
KANE COUNTY
Water Use for Public Non-Community Systems, Self-Supplied Industries and Private Domestic Systems

Non-Community System	POTABLE USAGE					SECONDARY USE (Ac-Ft/Yr)
	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Potable Use (Ac-Ft/Yr)	
KANE COUNTY						
Best Friends Animal Sanctuary	1.3	7.0	0.0	0.0	8.3	41.0
Boy Scout Spring	0.0	0.0	0.2	0.0	0.2	0.0
Bryce-Zion KOA	0.0	7.8	0.0	0.0	7.8	0.0
Shingle Creek State Highway Rest Stop	0.0	0.0	3.0	0.0	3.0	0.0
State Park Systems						
Coral Pink Sand Dunes	1.0	0.0	1.6	0.0	2.6	0.0
Zi-Can Lodge	0.0	2.0	0.0	0.0	2.0	0.0
SELF-SUPPLIED INDUSTRIES	0.0	0.0	0.0	0.0	0.0	0.0
PRIVATE DOMESTIC	10.0	0.0	0.0	0.0	10.0	0.0
KANE COUNTY TOTALS	12.3	16.8	4.8	0.0	33.9	41.0

TABLE 10
KANE COUNTY
Average Per Capita M&I Water Use for all Public Community Systems

CATEGORY	Average Per Capita Use (Ac-Ft/Yr)	Average Per Capita Use (GPCD)
Residential Potable Use	0.188	168
Residential Potable Plus Secondary Use	0.296	265
Total Potable Use	0.285	254
Total Potable Plus Secondary Use	0.410	366

Note: Total Potable categories include residential, commercial, institiutional and industrial uses.

WASHINGTON COUNTY M&I WATER SUPPLIES AND USES

The Kanab Creek/Virgin River Basin portion of Washington County includes the incorporated communities of Hilldale, Hurricane, Ivins, La Verkin, Leeds, New Harmony, Rockville, Santa Clara, Springdale, St. George, Toquerville, Virgin and Washington. Within this area are 31 public community systems, 12 public non-community systems, and 1 self-supplied industry. Washington County Water Conservancy District wholesales water to Kayenta, St. George, Toquerville, Virgin and Washington as well as supplies retail customers. St. George City and Zion Canyon Water System supply water to Ivins and Springdale respectively in addition to the service of retail customers. Colorado City, Arizona is also included herein because it is connected with Hilldale, Utah and operates as one combined system. Location of public community systems are shown in figure 3.

Table 11 shows that the maximum annual water supply for public community systems in The Kanab Creek/Virgin River portion of Washington County is 51,073 acre-feet; 4,982 acre-feet from springs, 33,118 acre-feet from wells, and 12,973 acre-feet from surface treatment plants on Quail Creek Reservoir and the Virgin River. Reliable system source capacity is more than half that amount at 32,550 acre-feet.

Table 12 shows the reliable system source capacity along with a breakdown of the potable water use by public community systems. This table shows that for the Kanab Creek/Virgin River portion of Washington County the current annual potable water use of 29,553 is about 90 percent of the reliable supply of 32,550 acre-feet of water.

Secondary water is another important aspect of total M&I use. Table 13 gives the amount of secondary water used for various categories within the boundaries of the public community systems. In The Kanab Creek/Virgin River portion of

TABLE 11
WASHINGTON COUNTY
Potable Water Supplies for Public Community Systems

WATER SUPPLIER	Springs (Ac-Ft/Yr)	Wells (Ac-Ft/Yr)	Surface (Ac-Ft/Yr)	Total (Ac-Ft/Yr)
WASHINGTON COUNTY				
Angell Springs Special Service District	20.5	86.4	0.0	106.9
Casa De Oro Water Company	0.0	6.0	0.0	6.0
Central Culinary Water Company	6.1	6.1	0.0	12.2
Dammeron Valley Water Works	0.0	738.8	0.0	738.8
Diamond Valley Acres	29.0	264.7	0.0	293.7
Dixie Deer Special Service District	0.0	282.2	0.0	282.2
Eldorado Hills Mutual Company	0.0	42.0	0.0	42.0
Gunlock Special Service District	29.7	36.9	0.0	66.6
Harmony Farms Water Users	0.0	331.0	0.0	331.0
Hilldale/Colorado City *	0.0	2,237.7	0.0	2,237.7
Hurricane	2,276.0	2,418.7	0.0	4,694.7
La Verkin	714.4	0.0	0.0	714.4
Leeds Domestic Water Users	126.6	173.0	0.0	299.6
Little Plains	0.0	270.0	0.0	270.0
Mountain Springs Water Company	0.0	391.0	0.0	391.0
New Harmony Water System	27.9	400.0	0.0	427.9
Pine Valley Mt. Farms	0.0	189.0	0.0	189.0
Rockville Pipeline Company	0.0	108.6	0.0	108.6
Santa Clara	94.3	2,519.5	0.0	2,613.8
Silver Reef Special Service District	18.9	0.0	0.0	18.9
Veyo Culinary Water Association	409.6	98.0	0.0	507.6
Washington County WCD Hurricane Valley**	0.0	1,200.0	0.0	1,200.0
Kayenta Water Users, Incorporated	0.0	403.0	0.0	403.0
St. George City	304.8	14,556.1	10,000.0	24,860.9
Ivins	40.3	1,351.5	0.0	1,391.8
Toquerville	380.6	276.2	0.0	656.8
Virgin	0.0	223.8	328.2	552.0
Washington	0.0	3,945.0	2,000.0	5,945.0
Winchester Hills Water Company	0.0	433.6	0.0	433.6
Zion Canyon Water System***	406.9	0.0	0.0	406.9
Springdale	96.7	129.0	645.0	870.7
WASHINGTON COUNTY TOTALS	4,982.3	33,117.8	12,973.2	51,073.3

Note: All values represent maximum system source capacities limited by water rights, hydrologic constraints, and/or system constraints.

* 44.0 ac-ft water right in Utah - the remainder is from Arizona sources

** Washington County Water Conservancy District contracts 12,000.0 acre-feet of Quail Creek Reservoir water to St. George and Washington; 903.0 acre-feet of well water to Kayenta, Toquerville and Virgin; and 328.0 acre-feet of Virgin River water to Virgin.

*** Contracted amount of 96.7 acre-feet for Springdale

TABLE 2
WASHINGTON COUNTY
WATER USE AND SUPPLY FOR PUBLIC COMMUNITY SYSTEMS

WATER SUPPLIER	POTABLE USAGE						POTABLE PER CAPITA USAGE			MAXIMUM WATER SUPPLY AVAILABLE UNDER PRESENT CONDITIONS (Ac-Ft/Yr)	POTABLE ESTIMATED PEAK DAY VALUES				RELIABLE SYSTEM SOURCE CAPACITY UNDER PRESENT CONDITIONS (Ac-Ft/Yr)
	Residential Indoor Use (Ac-Ft/Yr)	Residential Outdoor Use (Ac-Ft/Yr)	Commercial Indoor and Outdoor Use (Ac-Ft/Yr)	Institutional Indoor and Outdoor Use (Ac-Ft/Yr)	Industrial/ Stockwater Indoor and Outdoor Use (Ac-Ft/Yr)	Total Potable M & I Use (Ac-Ft/Yr)	Population	Average Per Capita Water Use (Ac-Ft/Yr)	Average Per Capita Water Use (GPCPD)		Assumed Peaking Factor (PD/AD)	Peak Day Supply (MGD)	Peak Day Demand (MGD)	Peak Day Supply Over Demand (MGD)	
WASHINGTON COUNTY															
Angell Springs Special Service District	9.7	8.5	0.0	0.0	0.0	18.2	150	0.121	108.3	107	2.0439	0.0954	0.0332	0.0622	52
Casa De Oro Water Company	4.2	0.4	0.0	0.0	0.0	4.6	50	0.092	82.1	6	1.8985	0.0078	0.0078 *	0.0000	5
Central Culinary Water Company	3.4	3.0	0.0	0.0	2.1	8.5	40	0.213	189.7	12	2.2396	0.0170	0.0170 *	0.0000	9
Dammeron Valley Water Works	31.5	157.3	0.0	2.0	0.0	190.8	375	0.509	454.2	739	2.3912	0.6595	0.4073	0.2522	309
Diamond Valley Acres	50.4	120.0	0.0	11.2	0.0	181.6	600	0.303	270.2	294	2.3172	0.3756	0.3756 *	0.0000	182
Dixie Deer Special Service District	59.0	4.8	0.7	0.0	0.0	64.5	267	0.242	215.6	282	2.2709	0.2519	0.1308	0.1212	124
Eldorado Hills Mutual Company	6.8	7.7	0.0	0.0	0.0	14.5	40	0.363	323.6	42	2.3473	0.0375	0.0304	0.0071	18
Gunlock Special Service District	16.4	13.2	0.0	3.0	1.9	34.5	195	0.177	157.9	67	2.1872	0.0674	0.0674 *	0.0000	35
Harmony Farms Water Users	10.5	60.0	0.0	0.0	0.0	70.5	125	0.564	503.5	331	2.4019	0.2955	0.1512	0.1443	138
Hildale/Colorado City	350.7	294.7	69.1	26.6	4.6	745.7	5,000	0.149	133.1	2,238	2.1289	1.9976	1.4172	0.5804	1,051
Hurricane	621.8	1,394.0	647.1	132.6	0.0	2,795.5	7,400	0.378	337.2	4,695	2.3535	5.8732	5.8732 *	0.0000	2,796
La Verkin	215.3	335.0	104.4	57.2	65.3	777.2	3,000	0.259	231.3	714	2.2864	1.5863	1.5863 *	0.0000	777
Leeds Domestic Water Users	37.8	105.2	7.9	17.6	0.0	168.5	450	0.374	334.3	300	2.3522	0.3538	0.3538 *	0.0000	169
Little Plains	10.1	21.9	0.0	0.0	0.0	32.0	120	0.267	238.0	270	2.2925	0.2410	0.0655	0.1755	118
Mountain Springs Water Company	22.7	50.0	0.0	0.0	0.0	72.7	175	0.415	370.8	391	2.3668	0.3490	0.1536	0.1954	165
New Harmony Water System	14.7	74.7	0.0	18.1	0.0	107.5	175	0.614	548.4	428	2.4099	0.3820	0.2313	0.1507	178
Pine Valley Mt. Farms	18.5	98.1	0.6	0.0	0.0	117.2	220	0.533	475.6	189	2.3961	0.2507	0.2507 *	0.0000	117
Rockville Pipeline Company	22.4	26.3	0.0	0.0	0.0	48.7	230	0.212	189.0	109	2.2386	0.0973	0.0973 *	0.0000	49
Santa Clara	291.4	841.1	50.0	72.9	4.7	1,260.1	3,900	0.323	288.4	2,614	2.3287	2.6195	2.6195 *	0.0000	1,260
Silver Reef Special Service District	6.3	6.2	0.2	0.0	0.0	12.7	75	0.169	151.2	19	2.1732	0.0246	0.0246 *	0.0000	13
Veyo Culinary Water Association	42.0	140.8	30.7	80.0	49.1	342.6	500	0.685	611.7	508	2.4192	0.7399	0.7399 *	0.0000	343
Washington County WCD - Hurricane Valley	12.6	9.5	0.0	0.0	2.5	24.6	150	0.164	146.4	1,200	2.1626	1.0712	0.0475	1.0237	555
Kayenta Water Users, Incorporated	28.6	18.0	0.4	34.6	0.0	81.6	340	0.240	214.2	403	2.2694	0.3598	0.1653	0.1944	178
St. George City	3,486.4	6,969.0	7,095.0	1,011.7	373.5	18,935.6	41,500	0.456	407.3	24,861	2.3787	40.2086	40.2086 *	0.0000	18,936
Ivins	269.8	593.0	171.2	18.7	10.2	1,062.9	4,100	0.259	231.4	1,392	2.2865	2.1695	2.1695 *	0.0000	1,063
Toquerville	73.5	50.7	0.0	1.8	0.0	126.0	875	0.144	128.5	657	2.1157	0.5863	0.2380	0.3483	310
Virgin	30.2	22.1	1.1	1.1	0.0	54.5	300	0.182	162.2	552	2.1954	0.4928	0.1068	0.3860	251
Washington	568.5	706.9	368.1	114.2	0.0	1,757.7	7,250	0.242	216.4	5,945	2.2717	5.3070	3.5645	1.7425	2,617
Winchester Hills Water Company	63.0	136.5	0.0	0.0	0.0	199.5	750	0.266	237.5	434	2.2920	0.4082	0.4082 *	0.0000	200
Zion Canyon Water System	7.6	22.5	0.0	81.0	0.0	111.1	90	1.234	1,102.0	407	2.4552	0.3632	0.2435	0.1197	166
Springdale	31.0	0.0	85.4	15.0	0.0	131.4	350	0.375	335.1	871	2.3526	0.7773	0.2760	0.5013	370
										see note					
WASHINGTON COUNTY TOTALS	**6,416.8**	**12,291.1**	**8,631.9**	**1,699.3**	**513.9**	**29,553.0**	**78,792**	**0.375**	**334.8**	**51,073**	**2.3525**	**68.0663**	**62.0613**	**6.0051**	**32550**
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P

* Note: Peak Day Demand exceeds the calculated Peak Day Supply. An assumption was made that in these cases the Peak Day Supply has been exactly met and should be set equal to the Peak Day Demand.
Although some systems may withdraw the maximum water supply available under present conditions, the hydrologic conditions will probably limit all systems collectively from withdrawing this quantity, as presented.

A, B, C, D, E, F, H, and K	These values are all input data.
G=B+C+D+E+F	This value represents only Potable M&I Water Use.
I=G/H	Average per capita potable water use.
J=I*892.682	Converts from Ac-Ft/Yr to GPD
L=(2.5*J-49.4)/J	The factor which when multiplied to the average per capita water use represents water use during peak demands.
M=K*892.682/1000000; (except as provided in the note above)	Peak Day Supply of potable water based on maximum reliable source capacity converted to MGD). Where the calculated Peak Day Supply of potable water is less than the Peak Day Demand of Potable Water, this value was set equal to the Peak Day Demand of potable water.
N=H*J*L/1000000	Peak Day Demand on potable water based on the total potable M&I water use multiplied by the peaking factor
O=M-N	The amount of Peak Day Supply of potable water above the amount of the Peak Day Demand of potable water.
P={M/(L*J)}*J*1120.22	Reliable system source capacity represents that volume of water, which when divided by the average annual water per capita use, gives that population that can be reliably served by the system sources under peak day demand conditions.

Washington County various irrigation companies deliver secondary water to most systems. Total secondary use is 9,770 acre-feet

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TABLE 13
WASHINGTON COUNTY
Secondary (Non-Potable) Water Use Within Public Community Systems

WATER SUPPLIER	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Secondary Use (Ac-Ft/Yr)
WASHINGTON COUNTY					
Angell Springs Special Service District	40.0	0.0	0.0	0.0	40.0
Casa De Oro Water Company	0.0	0.0	0.0	0.0	0.0
Central Culinary Water Company	21.0	0.0	0.0	0.0	21.0
Dammeron Valley Water Works	0.0	0.0	0.0	0.0	0.0
Diamond Valley Acres	0.0	0.0	0.0	0.0	0.0
Dixie Deer Special Service District	0.0	0.0	0.0	0.0	0.0
Eldorado Hills Mutual Company	0.0	0.0	0.0	0.0	0.0
Gunlock Special Service District	13.2	0.0	0.0	0.0	13.2
Harmony Farms Water Users	0.0	0.0	0.0	0.0	0.0
Hildale/Colorado City	134.8	0.0	0.0	0.0	134.8
Hurricane	1,015.8	0.0	503.0	0.0	1,518.8
La Verkin	268.0	0.0	0.0	0.0	268.0
Leeds Domestic Water Users	38.0	0.0	0.0	0.0	38.0
Little Plains	0.0	0.0	0.0	0.0	0.0
Mountain Springs Water Company	7.0	0.0	0.0	0.0	7.0
New Harmony Water System	147.8	0.0	0.0	0.0	147.8
Pine Valley Mt. Farms	0.0	0.0	0.0	0.0	0.0
Rockville Pipeline Company	50.0	0.0	0.0	0.0	50.0
Santa Clara	74.8	0.0	0.0	0.0	74.8
Silver Reef Special Service District	62.5	0.0	0.0	0.0	62.5
Veyo Culinary Water Association	19.6	0.0	0.0	0.0	19.6
Washington County WCD - Hurricane Valley	0.0	0.0	0.0	0.0	0.0
Kayenta Water Users, Incorporated	0.0	0.0	0.0	0.0	0.0
St. George City	851.8	1,558.1	3,412.8	0.0	5,822.7
Ivins	158.1	0.0	12.0	0.0	170.1
Toquerville	178.6	0.0	0.0	0.0	178.6
Virgin	25.8	0.0	15.0	0.0	40.8
Washington	512.4	28.0	527.5	0.0	1,067.9
Winchester Hills Water Company	0.0	0.0	0.0	0.0	0.0
Zion Canyon Water System	0.0	0.0	10.0	0.0	10.0
Springdale	84.7	0.0	0.0	0.0	84.7
WASHINGTON COUNTY TOTALS	3,703.9	1,586.1	4,480.3	0.0	9,770.3

Note: Separate irrigation companies provide secondary water to the water supplier unless indicated by an '*'.

Table 14 gives water use for public non-community systems, self-supplied industries, and private domestic systems. Zion National Park (3 separate systems) is among the 12 listed non-community systems. Western Rock Products, Inc. is the listed self-supplied industry. Some residences use private wells. All of these uses amount to 209 acre-feet of potable water and 4 acre-feet of non-potable water.

TABLE 14
WASHINGTON COUNTY
Water Use for Public Non-Community Systems, Self-Supplied Industries and Private Domestic Systems

Non-Community System	POTABLE USAGE					SECONDARY USE (Ac-Ft/Yr)
	Residential Use (Ac-Ft/Yr)	Commercial Use (Ac-Ft/Yr)	Institutional Use (Ac-Ft/Yr)	Industrial/ Stockwater Use (Ac-Ft/Yr)	Total Potable Use (Ac-Ft/Yr)	
WASHINGTON COUNTY						
Home Valley Park Subdivision	0.1	0.0	0.0	0.0	0.1	0.0
National Forest Systems						
Fourmile Bench Dump Station	0.0	0.0	0.1	0.0	0.1	0.0
Honeycomb Rocks Campground	0.0	0.0	0.7	0.0	0.7	0.0
Juniper Park Campground	0.0	0.0	0.4	0.0	0.4	0.0
Oak Grove Campground	0.0	0.0	0.4	0.0	0.4	0.0
National Park Systems						
Zion National Park - East Canyon	0.4	0.0	0.0	0.0	0.4	0.0
Zion National Park - Kolob Canyon	0.0	0.0	5.2	0.0	5.2	0.0
Zion National Park - Sinawava Temple	0.0	0.0	3.0	0.0	3.0	0.0
Pine Valley Irrigation Company	48.4	15.3	1.0	0.0	64.7	4.0
Pine Valley Ranchos	15.3	0.0	0.0	0.0	15.3	0.0
Woodland & Kolob Acres	0.5	0.0	0.0	0.0	0.5	0.0
Zion Panorama Subdivision	1.2	0.0	0.0	0.0	1.2	0.0
SELF-SUPPLIED INDUSTRIES*	0.0	0.0	0.0	92.4	92.4	0.0
PRIVATE DOMESTIC	25.0	0.0	0.0	0.0	25.0	0.0
WASHINGTON COUNTY TOTALS	90.9	15.3	10.8	92.4	209.4	4.0

* Western Rock Products, Incorporated

Therefore, the county's total potable M&I water use is 29,762 acre-feet. Non-potable use is 9,774 acre-feet. This gives a total M&I water use of 39,536 acre-feet. Current population of the county is 75,200. Then total M&I per capita use is 469 gpcd. Table 15 gives per capita rates for public community systems. Appendix C shows data for each public community system presented in the tables.

TABLE 15
WASHINGTON COUNTY
Average Per Capita M&I Water Use for all Public Community Systems

CATEGORY	Average Per Capita Use (Ac-Ft/Yr)	Average Per Capita Use (GPCD)
Residential Potable Use	0.237	212
Residential Potable Plus Secondary Use	0.284	254
Total Potable Use	0.375	335
Total Potable Plus Secondary Use	0.499	446

Note: Total Potable categories include residential, commercial, institiutional and industrial uses.