UDA
State Ground-Water Program

1996
Summary Report

UTAH
DEPARTMENT OF
AGRICULTURE
AND FOOD

State Ground-Water Program 1996

By

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Acknowledgments

The 1996 State Ground-Water Program has been successful because of the contributions of many people. The UDA's ground-water steering committee has given guidance and support to this new program to ensure its success. Members of the committee are Commissioner Cary Peterson; Directors Randy Parker, Dick Wilson, and Ahmad Salari; Section and Program Leaders George Hopkin and Gary King; and field staff Jay Roundy and Mark Quilter.

A critical part of the program is the collection, distribution and maintenance of analytical data. Anne Miller Johnson, Administrative Services has given helpful suggestions for proper data management and produced all the maps in the report showing sampling site locations.

The program has received excellent support from the two laboratories used in analyzing samples. The State Chemist, Ahmad Salari with his staff chemists Mohammed Sharaf and Lydia Concepcion, provided prompt analysis of the 268 pesticide samples collected during the year. Jan Kotuby Amazcher, of the Utah State University Analytical Laboratories performed inorganic analysis. Her laboratory was very efficient and prompt in making analysis and in answering questions about the reports.

A special thanks goes to Jay Roundy for his help in the field sampling. Jay was a tremendous support in getting the program moving. Jay is shown on the front cover bailing a well in central Utah. (The bailing system was designed by Jay using his favorite fishing pole that was broken earlier on a fishing trip.) He is no longer with UDA and is missed.

The UACD, Extension Service, and NRCS personnel have been a great support in the field. They have helped select, navigated to, and reported about the sampled wells. Allyson Grandy of Water Rights has also helped in selection of well sites by providing GIS digital files showing well location and ownership.

Virginia Sligting has been the catalyst in the final preparation of this report. Her editing has made the report much more accurate, usable and readable.

Final thanks goes to the well owners, who, without their trust, this program would not have functioned.

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STATE GROUND WATER PROGRAM REPORT 1996

The State Ground-Water Program is funded by the legislature to assist private well owners and other agencies, organizations and concerned citizens in having a better understanding of water quality. The provisions of the Clean Water Act exclude irrigation wells, livestock wells, and other private wells, although these wells account for the majority of ground water use in the State of Utah.

This report covers activities of the Utah Department of Agriculture's (UDA) State Ground-Water Program for 1996. It summarizes goals and objectives, gives a historical overview of activities, proposes changes to improve the program in the future, and provides tables listing the chemical analysis of each sampling site taken during the 1996 sampling season.

Cooperative Effort

The UDA works closely with other agencies and concerned groups in the development of open ground-water data bases. This information assists cooperators in planning, managing, and developing the ground water resources. Working through the Geographic Information System Advisory Committee (GISAC), UDA has proposed that a concordance be made to cross references all ground-water data bases in the State of Utah. Through GISAC the major data base managers have been identified and meet regularly to design and implement strategies. Data from the Utah Division of Water Rights' (WR) and the Utah Division of Drinking Water has been correlated into this program. As time progresses US Geological Survey (USGS) data will be reviewed and tied into the program.

The UDA has a memorandum of understanding (MOU) with the Utah Division of Water Rights for collecting ground water data from the Pahvant and Curlew valleys. Sample analyses were done for inorganic and organic contaminants that influence water quality. Guidance from the Utah Division of Water Rights has helped in selecting sampling areas and sharing data.

The UDA also works closely with Department of Environmental Quality (DEQ) in providing expertise into the State Pesticide Management Plan and other ground-water programs. This relationship benefits UDA by allowing agriculture's voice to be heard and their ideas considered during the planning process. The UDA is an intricate link between DEQ and the farmers and ranchers of the state in environmental issues.

The State Ground-Water Program uses the local Utah Agriculture Conservation District members (UACD) to locate sample areas. Their knowledge of the area has been very beneficial in the selection of wells, meeting well owners, and distributing information. The State Ground-Water Program has received excellent exposure as UDA staff gave presentations at the Annual Water Users Workshop, the Utah Non-point Source Pollution Conference, the Utah Association

of Conservation District's (UACD) Conference and other meetings around the state. The UDA also has produced a video that describes the ground water program.

DEVELOPMENT OF UDA'S GROUND-WATER SAMPLING PROCEDURES

In 1995 UDA staff did some trial sampling of ground water and drains. These samples were taken to test laboratory and sampling procedures. It was decided that Utah State University Analytical Laboratories would conduct all inorganic tests and UDA's Chemical Laboratories would screen for pesticides. Equipment needs, well selection procedures, transportation methods, labor requirements, sampling techniques, data collection methods, sample documentation, and sample reporting were all evaluated.

During this trial period it was determined that:

- special sampling equipment was needed.
- improper sampling techniques can contaminate samples.
- Geographic Positioning System (GPS) data needed to be simplified.
- GPS operators needed more experience in the use of the GPS.
- a mirror provided better light than a flashlight to see the bottom of the well.
- samples can be taken from the back-flow valves on the discharge line by carefully using a crowbar to depress the ball valve.
- there was a need to work more closely with UACD local leaders in planning sampling trips, so all well owners are notified.
- paper work needed to be redesigned to make it more convenient for field and laboratory use.
- taking a digital picture of each well helped to match laboratory reports to the right well location.

Areas Sampled

During 1996, 268 wells, drains, and springs, in ten areas of the state were sampled The areas included Beaver, Utah, Wasatch, Weber, Juab, Millard, Box Elder, San Juan, Rich, and Iron
counties. Each of the sampling areas will be addressed individually in this report with a map showing sample locations and a table listing the chemical analysis data for each of the sample sites.

The laboratory data **shaded** on each table shows which values exceed either drinking water, livestock, irrigation, or Clean Water Act standards. Appendix I lists the critical values for each standard.

Beaver County

The Beaver sample sites were selected to monitor the effects of shallow ground water on the Beaver River and particularly to identify sources of phosphate. With aid of UACD District Officer, Floyd Yardley, 20 sample sites were selected. These sites formed a crescent around the south, southwest, and western areas of Beaver City (see sample locations on Map #1). Samples were taken on: April 15, August 6, October 8, 1996 and February 14, 1997. The samples taken on April 15 were analyzed for a pesticide residue. Because pesticides were not detected, it was not necessary to take additional samples. The chemical analyses are listed in Tables 1a through 4b. Map #1 shows the location of all sample sites.

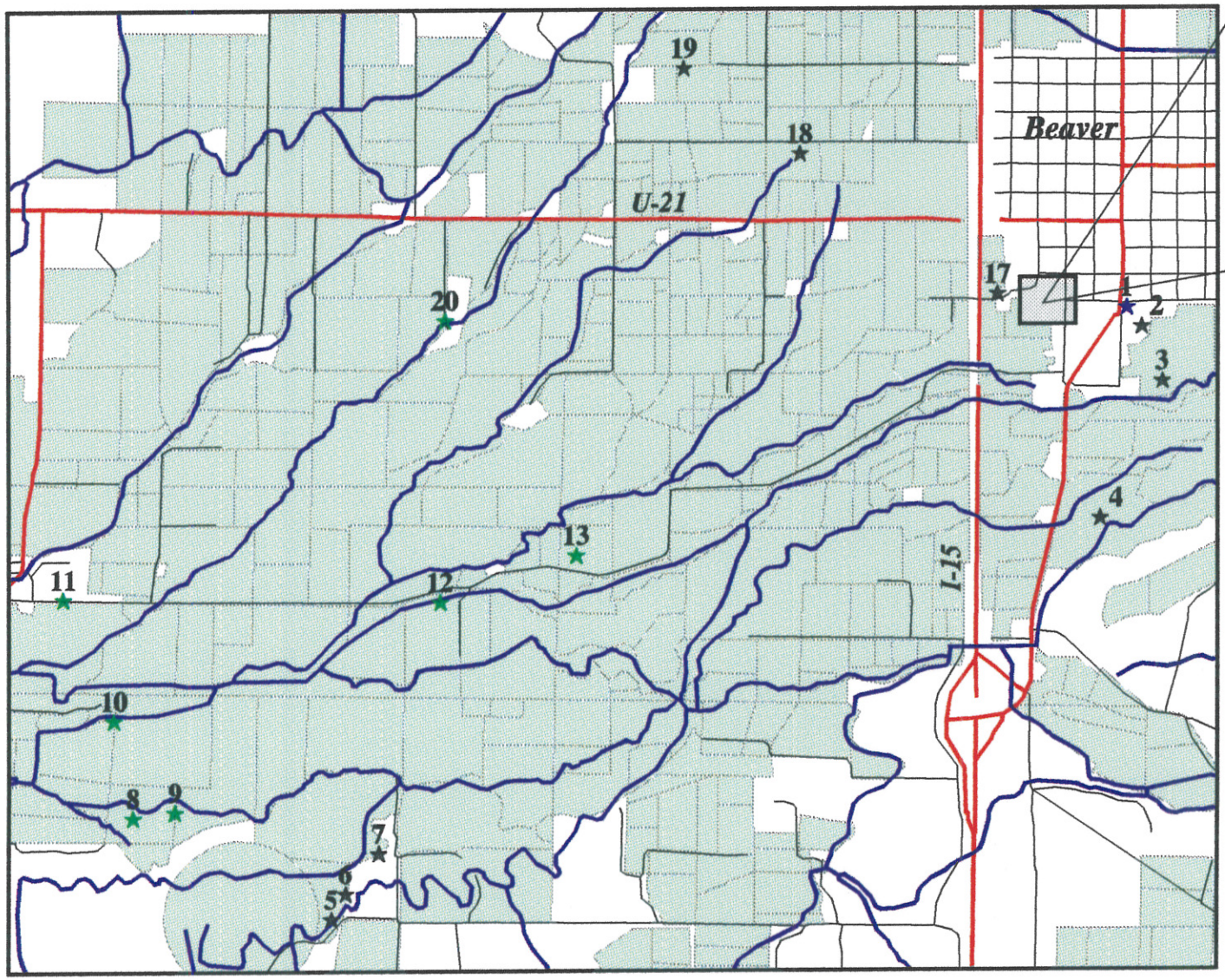
The only detections of phosphate found were in drain samples which originated in the city of Beaver. The sample sites, which have phosphate levels greater than 0.05 ppm, were: drain (number 1) south of the city, a spring (number 2) southeast of the south drain, a spring inside a house south of the city (not plotted on the map), three drains west of the city (numbers 14, 15, and 16), and a spring (number 17) west of the city drain. The phosphate levels ranged from 0.05 ppm (detection limits) to 0.19. Three drains west of the city were all above 0.11 ppm of phosphate. The Clean Lakes standard for phosphate is 0.05 ppm. Phosphate levels were below the 0.05 limit in all springs around agriculture areas. This indicates that phosphate loading for Beaver River could be coming from the city. The three drains west of the city appear to be a major recharge into the stream.

Nitrate was found in most samples taken, but only three springs have high nitrate levels. These three springs (numbers 5, 6, and 7), flow out of a bench southwest of Beaver. Located on the top of the bench is a sheep and cattle feed area, the city's sewage treatment system and alfalfa fields. One spring is not influenced by the livestock feed area. This spring has nitrate levels ranging between 3.0 - 4.0 ppm. The other two springs flow from the base of a bench directly under the feed lot. These springs have nitrate readings of 7 - 10 ppm which is approaching the EPA's drinking water limits. The source of the nitrate is unknown. The feed operation has very little precipitation to drive surface nitrate through the soil. There may be a possibility that the nitrate is a result of surface runoff. However, to avoid surface influences, samples were taken as close to where the spring breaks the surface as possible. These three springs also have elevated boron levels of 0.5 - 0.7 ppm. None of the other samples have detectable levels of boron.

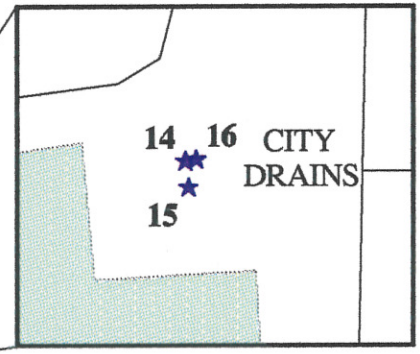
The only other concern is the manganese detected in seven sites in the area. Manganese has an EPA secondary standard of 0.05 ppm for drinking water. These samples range from 0.2 - 0.16 ppm with the higher values showing up in samples taken during the summer. Two sites (numbers 11 and 20) have high values for each of the four times they were sampled. The secondary standard is for "aesthetics" of the drinking water and is not health related. These samples were <u>not</u> from wells used for drinking, so there is not a problem. All other analyses were below maximum contaminate levels (MCL) recommended for drinking water, and below other standards for watering livestock, and irrigating crops.

1996 UDA Ground Water Sample Locations

Beaver County, Utah



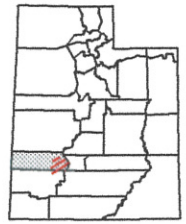
DETAIL OF SHADED AREA



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Field Boundaries*
- *Agricultural Lands*
- *Sampling Sites - Drains*
- *Sampling Sites - Springs*
- *Sampling Sites - Wells*

WATERSHED LOCATION



MAP #1

Utah Department of Agriculture GIS
March 17, 1997

Table 1a - Beaver County

Map 1

Irrigation and infiltration qualities for south, southwest, and western areas of Beaver City, Beaver County, Utah. Samples taken on April 18, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.0	290	35.72	7.37	11.07	2.1	0.51	0.44
2	7.0	230	28.64	5.74	8.71	1.78	0.41	0.39
3	7.1	170	20.08	4.66	6.22	1.36	0.27	0.33
4	7.1	320	41.03	10.28	9.10	2.5	0.41	0.33
5	7.6	1500	144.38	44.36	86.19	4.28	2.51	1.61
6	7.4	1950	193.83	65.01	96.52	6.07	2.41	1.53
7	7.3	1550	164.05	50.55	82.91	7.85	2.37	1.45
8	8.0	260	23.86	4.37	21.08	1.78	1.02	1.04
9	8.0	260	24.39	4.93	18.41	1.78	0.87	0.89
10	8.0	270	29.64	4.36	16.67	1.78	0.80	0.76
11	7.9	300	29.84	5.16	20.26	1.86	0.97	0.90
12	7.9	250	22.05	4.82	19.71	1.5	0.90	0.99
13	7.9	250	25.91	5.38	15.88	1.07	0.65	0.74
14	7.1	330	40.24	7.91	14.83	2.5	0.71	0.56
15	7.0	310	37.98	7.52	14.11	2.21	0.66	0.55
16	7.0	310	37.21	7.33	15.25	2.21	0.72	0.60
17	7.0	340	43.79	8.66	14.12	2.57	0.66	0.51
18	6.7	310	40.24	8.11	9.72	1.86	0.43	0.37
19	6.6	270	34.34	7.07	8.80	1.5	0.38	0.36
20	7.8	270	24.80	4.74	23.13	1.78	1.10	1.11
21	6.8	360	43.85	9.04	13.54	2.21	0.61	0.49

* Sample Sites: wells, drains and springs

** R_N : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 1b - Beaver County

Map 1

Other elements and ions associated with water quality for irrigation, surface water, and livestock for south, southwest, and western areas of Beaver City Beaver County, Utah. Samples taken on April 18, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al ppm	B ppm	Cl ppm	Fe ppm	K pp	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.00	7.5	0.00	0	0.00	2.1	0.08	4.17	13.7	0.25	0
2	0.00	0.00	5.0	0.00	0	0.00	1.2	0.11	2.34	14.1	0.19	0
3	0.24	0.00	4.7	0.26	0	0.00	0.2	0.00	3.18	13.9	0.13	0
4	0.00	0.00	9.6	0.00	0	0.00	1.0	0.00	4.29	18.3	0.21	0
5	0.00	0.45	239.4	0.00	13	0.00	3.5	0.00	58.44	30.5	1.15	0
6	0.00	0.51	313.9	0.00	14	0.00	7.6	0.00	66.19	30.0	1.53	0
7	0.00	0.73	167.0	0.00	12	0.00	10.2	0.00	46.14	29.3	1.22	0
8	0.00	0.00	5.3	0.00	8	0.00	0.1	0.00	9.44	33.6	0.19	0
9	0.00	0.00	5.8	0.00	7	0.00	0.2	0.00	8.84	32.8	0.21	0
10	0.00	0.00	4.2	0.00	8	0.03	0.0	0.00	11.51	33.5	0.16	0
11	0.00	0.00	4.8	0.00	8	0.06	0.0	0.00	14.09	33.5	0.21	0
12	0.00	0.00	6.8	0.00	5	0.00	0.2	0.00	8.36	26.7	0.11	0
13	0.00	0.00	9.5	0.00	0	0.00	0.2	0.00	8.01	23.3	0.12	0
14	0.00	0.00	8.6	0.00	0	0.00	2.0	0.12	4.99	13.3	0.27	0
15	0.00	0.00	8.2	0.00	0	0.00	2.1	0.10	4.87	13.4	0.26	0
16	0.00	0.00	8.6	0.00	0	0.00	1.8	0.11	4.81	13.2	0.26	0
17	0.00	0.00	9.5	0.00	0	0.02	2.5	0.12	4.61	12.8	0.28	0
18	0.00	0.00	17.0	0.00	0	0.00	2.6	0.00	5.07	10.9	0.38	0
19	0.00	0.00	10.3	0.00	0	0.00	1.1	0.00	5.96	11.2	0.31	0
20	0.00	0.00	7.0	0.00	7	0.06	0.0	0.00	10.27	28.2	0.13	0
21	0.00	0.00	23.2	0.00	4	0.00	0.8	0.08	5.44	15.5	0.29	0

* Sample Sites: wells, drains and springs

Table 2a - Beaver County

Map 1

Irrigation and infiltration qualities for south, southwest, and western areas of Beaver City, Beaver County, Utah. Samples taken on August 6, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	6.8	300	36.25	7.34	11.48	2.32	0.54	0.45
2	6.6	260	30.90	6.19	9.05	1.43	0.40	0.39
3	6.9	290	36.78	7.83	8.13	2.14	0.37	0.32
4	7.0	340	40.63	10.22	9.02	2.5	0.40	0.33
5	7.5	1480	138.51	43.00	90.41	5.35	2.70	1.72
6	7.5	1920	186.03	63.50	94.39	6.07	2.39	1.52
7	7.4	1550	157.35	48.42	81.15	7.85	2.35	1.45
8	7.2	280	19.27	3.36	28.46	1.78	1.39	1.57
9	7.3	260	24.41	5.09	18.21	1.43	0.83	0.88
10	7.6	270	28.87	3.96	16.62	1.96	0.83	0.77
11	7.4	320	32.73	5.72	18.69	1.78	0.86	0.79
12	7.3	260	22.26	4.90	20.86	1.78	0.99	1.04
13	6.9	260	25.90	5.34	15.66	1.43	0.70	0.73
14	6.9	380	47.95	9.50	14.40	2.86	0.66	0.50
15	6.8	340	40.08	7.99	15.20	2.5	0.72	0.57
16	6.8	360	44.29	8.78	15.63	2.5	0.73	0.56
17	6.9	345	44.10	8.70	12.01	2.5	0.56	0.43
18	6.6	300	36.50	7.36	9.27	1.96	0.43	0.37
19	7.0	270	31.85	6.69	8.80	1.78	0.40	0.37
20	7.7	275	24.69	4.69	23.05	1.96	1.13	1.11
21	6.8	390	45.64	9.53	13.15	3.03	0.62	0.46

* Sample Sites: wells, drains and springs

** R_{na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 2b - Beaver County

Map 1

Other elements and ions associated with water quality for irrigation, surface water, and livestock for south, southwest, and western areas of Beaver City, Beaver County, Utah. Samples taken on August 6, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.00	6.1	0.00	0	0.00	2.1	0.08	3.40	15.2	0.27	0
2	0.00	0.00	5.0	0.00	5	0.00	2.0	0.19	3.00	16.1	0.22	0
3	0.00	0.00	4.9	0.18	0	0.09	0.0	0.00	2.30	18.0	0.25	0
4	0.00	0.00	9.2	0.00	0	0.00	0.9	0.00	3.90	19.7	0.22	0
5	0.00	0.51	208.	0.00	13	0.00	3.8	0.00	45.6	33.0	1.16	0
6	0.00	0.56	314.	0.00	15	0.00	7.0	0.00	57.8	32.3	1.52	0
7	0.00	0.73	168.	0.00	11	0.00	9.3	0.00	39.3	30.7	1.24	0
8	0.00	0.00	6.5	0.00	8	0.00	0.0	0.00	7.70	37.7	0.19	0
9	0.00	0.00	5.8	0.00	7	0.00	0.2	0.00	8.40	34.8	0.22	0
10	0.00	0.00	4.4	0.00	8	0.03	0.0	0.00	10.2	36.1	0.16	0
11	0.00	0.00	4.0	0.07	8	0.11	0.0	0.00	14.5	34.6	0.22	0
12	0.00	0.00	7.3	0.00	5	0.00	0.0	0.00	8.30	28.2	0.12	0
13	0.00	0.00	10.1	0.00	0	0.00	0.0	0.00	7.70	24.5	0.13	0
14	0.00	0.00	7.1	0.00	4	0.00	2.8	0.13	4.50	14.7	0.33	0
15	0.00	0.00	8.0	0.00	0	0.00	1.9	0.10	4.80	15.1	0.29	0
16	0.00	0.00	8.4	0.00	4	0.00	2.0	0.10	4.40	15.1	0.32	0
17	0.00	0.00	6.0	0.00	4	0.00	2.8	0.14	3.70	14.3	0.29	0
18	0.00	0.00	13.2	0.00	0	0.00	1.8	0.00	4.40	12.0	0.36	0
19	0.28	0.00	10.9	0.36	4	0.08	0.1	0.00	5.60	13.4	0.30	0
20	0.00	0.00	6.8	0.00	7	0.08	0.0	0.00	10.0	30.0	0.13	0
21	0.00	0.00	10.5	0.00	6	0.00	0.7	0.09	4.40	18.0	0.32	0

* Sample Sites: wells, drains and springs

Table 3a - Beaver County

Map 1

Irrigation and infiltration qualities for south, southwest, and western areas of Beaver City, Beaver County, Utah. Samples taken on October 14, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.10	280.00	34.81	7.16	11.08	2.32	0.53	0.34
2	6.80	310.00	33.06	6.11	10.10	1.79	0.46	0.32
3	7.00	285.00	38.37	8.20	8.60	2.68	0.41	0.25
4	7.00	325.00	41.46	10.52	9.56	2.50	0.43	0.26
5	7.50	1550.00	151.16	47.70	98.05	6.07	2.81	1.38
6	7.40	1900.00	186.44	63.46	97.95	6.78	2.49	1.23
7	7.30	1600.00	162.17	50.85	86.36	7.14	2.43	1.18
8	---	no	sample	---	---	---	---	---
9	7.70	260.00	24.31	5.05	18.77	1.79	0.89	0.68
10	7.70	270.00	29.79	4.35	17.21	1.79	0.83	0.58
11	7.30	310.00	31.33	5.39	20.65	1.96	0.99	0.67
12	7.50	250.00	22.84	4.98	20.64	1.71	0.98	0.77
13	7.30	255.00	26.40	5.52	16.20	1.61	0.75	0.57
14	7.00	360.00	44.90	9.00	14.75	2.86	0.69	0.40
15	6.90	340.00	41.91	8.40	15.50	2.86	0.73	0.43
16	6.90	310.00	37.72	7.58	14.83	2.50	0.71	0.44
17	6.80	360.00	47.06	9.36	13.21	2.86	0.61	0.35
18	6.60	320.00	41.38	8.36	10.09	2.14	0.46	0.28
19	6.80	260.00	32.70	6.98	9.31	1.79	0.42	0.29
20	7.70	275.00	25.01	4.83	24.51	1.71	1.16	0.89
21	6.80	385.00	48.50	10.22	14.81	3.21	0.69	

* Sample Sites: wells, drains and springs
** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 3b - Beaver County

Map 1

Other elements and ions associated with water quality for irrigation, surface water, and livestock for south, southwest, and western areas of Beaver City, Beaver County, Utah. Samples taken on October 14, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3-N ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0	0.00	5.80	0.00	0	0.00	1.37	0.08	3.89	14.8	0.25	0.14
2	0	0.00	9.10	0.00	13	0.00	2.42	0.49	4.08	15.9	0.22	0.00
3	0	0.00	4.80	0.18	4	0.00	0.00	0.00	2.68	18.2	0.26	0.00
4	0	0.00	9.50	0.00	0	0.00	0.94	0.00	4.03	19.2	0.21	0.00
5	0	0.63	212.00	0.00	14	0.00	4.20	0.00	60.1	32.1	1.28	0.00
6	0	0.55	287.00	0.00	15	0.00	7.04	0.00	60.6	31.7	1.50	0.00
7	0	0.75	169.00	0.00	13	0.00	9.15	0.00	45.0	31.9	1.26	0.00
8	-	no-	sample	---	---	---	---	---	---	---	---	---
9	0	0.00	5.10	0.00	8	0.00	0.13	0.00	8.79	33.4	0.21	0.00
10	0	0.00	3.70	0.00	8	0.00	0.00	0.00	11.0	33.9	0.17	0.00
11	0	0.00	4.30	0.00	8	0.05	0.00	0.00	13.6	34.3	0.22	0.00
12	0	0.00	6.40	0.00	5	0.00	0.00	0.00	8.57	27.6	0.12	0.00
13	0	0.00	9.90	0.00	0	0.00	0.17	0.00	8.33	23.6	0.13	0.00
14	0	0.00	6.90	0.00	4	0.00	2.16	0.13	5.00	14.3	0.31	0.00
15	0	0.00	7.50	0.00	4	0.00	1.85	0.12	5.20	14.5	0.30	0.00
16	0	0.00	5.90	0.00	0	0.00	1.71	0.10	4.14	14.8	0.27	0.00
17	0	0.00	5.20	0.00	4	0.00	3.12	0.14	4.47	14.1	0.31	0.00
18	0	0.00	16.80	0.00	0	0.00	1.67	0.00	4.95	11.8	0.40	0.00
19	0	0.00	9.00	0.00	0	0.00	0.29	0.00	6.07	12.3	0.31	0.00
20	0	0.00	7.10	0.00	6	0.07	0.00	0.00	10.3	29.1	0.13	0.00
21	0	0.00	10.70	0.00	6	0.00	0.41	0.09	16.9	0.34	0.34	0.00

* Sample Sites: wells, drains and springs

Table 4a - Beaver County

Map 1

Irrigation and infiltration qualities for south, southwest, and western areas of Beaver City, Beaver County, Utah. Samples taken on February 4, 1997. **Shaded** values exceed established guidelines.

*Sample Site	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{na}	SAR
1	6.8	290	38.60	7.34	9.67	2.14	0.46	0.37
2	6.5	250	32.90	6.21	8.09	1.43	0.36	0.34
3	6.9	260	34.60	7.15	7.75	7.78	0.36	0.31
4	6.9	330	42.60	10.40	9.30	2.50	0.42	0.33
5	7.2	1420	140.00	40.90	71.70	4.64	2.19	1.37
6	7.1	1850	179.00	57.30	85.90	6.43	2.27	1.43
7	7.2	1550	153.00	44.90	73.50	7.50	2.20	1.34
8	7.0	260	23.90	4.82	16.80	1.43	0.79	0.82
9	7.0	260	17.60	2.93	28.60	1.43	1.36	1.66
10	7.1	270	29.70	4.28	16.90	1.43	0.84	0.77
11	7.2	300	30.60	5.20	19.80	1.78	0.93	0.87
12	7.2	250	22.10	4.83	19.90	1.07	0.94	1.00
13	7.2	245	25.50	5.21	15.00	1.07	0.68	0.71
14	6.9	330	39.40	7.64	14.50	2.14	0.70	0.55
15	6.8	325	38.30	7.38	15.70	2.28	0.76	0.61
16	6.7	310	37.79	7.26	14.40	2.14	0.69	0.56
17	6.8	345	44.10	8.59	14.80	2.43	0.69	0.53
18	6.7	290	37.40	7.42	9.13	1.61	0.42	0.36
19	6.6	260	33.00	6.80	9.14	1.43	0.41	0.38
20	6.9	270	23.90	4.61	21.60	1.43	1.06	1.06

* Sample Sites: wells, drains and springs

** R_{Na} Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 4b - Beaver County

Map 1

Other elements and ions associated with water quality for irrigation, surface water, and livestock for south, southwest, and western areas of Beaver City, Beaver County, Utah. Samples taken on February 4, 1997. **Shaded** values exceed established guidelines.

*Sample Site	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.00	9.4	0.00	0	0.00	1.8	0.05	7.80	14.80	0.27	0
2	0.00	0.00	9.2	0.00	0	0.00	2.1	0.06	8.40	15.20	0.22	0
3	0.00	0.00	6.7	0.10	0	0.02	0.0	0.00	6.60	15.50	0.22	0
4	0.00	0.00	10.3	0.00	0	0.04	0.8	0.00	9.10	19.40	0.22	0
5	0.00	0.53	224.	0.00	10	0.00	3.5	0.00	52.4	30.70	1.16	0
6	0.00	0.67	279.	0.00	12	0.00	6.7	0.00	64.0	30.50	1.45	0
7	0.00	0.72	168.	0.00	10	0.00	8.7	0.00	43.1	29.70	1.19	0
8	0.00	0.00	6.6	0.00	6	0.00	0.0	0.00	12.2	33.60	0.20	0
9	0.00	0.00	6.2	0.00	8	0.00	0.0	0.00	12.0	38.20	0.16	0
10	0.00	0.00	4.7	0.00	8	0.04	0.0	0.00	14.5	35.10	0.16	0
11	0.00	0.00	5.5	0.07	8	0.06	0.0	0.00	15.1	35.20	0.20	0
12	0.00	0.00	7.6	0.00	5	0.00	0.0	0.00	10.2	28.00	0.11	0
13	0.00	0.00	11.2	0.00	0	0.00	0.1	0.00	10.3	23.90	0.12	0
14	0.00	0.00	10.6	0.00	0	0.00	2.2	0.08	7.30	13.40	0.28	0
15	0.00	0.00	10.3	0.00	0	0.00	2.2	0.09	7.70	13.60	0.27	0
16	0.00	0.00	12.3	0.00	0	0.00	2.0	0.06	10.3	13.70	0.27	0
17	0.00	0.00	9.3	0.00	0	0.00	2.2	0.08	9.80	12.80	0.29	0
18	0.00	0.00	14.3	0.00	0	0.00	1.5	0.00	8.10	11.10	0.39	0
19	0.28	0.00	11.5	0.36	0	0.16	0.4	0.00	8.70	11.90	0.30	0
20	0.00	0.00	7.9	0.00	6	0.16	0.0	0.00	14.7	28.80	0.12	0

* Sample Sites: wells, drains and springs

Utah County

On May 1, 20 shallow wells and drains were sampled around the Benjamin area in Utah County. These sites were selected by the UACD zone coordinator to help analyze whether agricultural practices are affecting the water going into Utah Lake by adding nitrates. Chemical analyses are listed in Tables 5a and 5b. Map #2 shows the location of all sample sites.

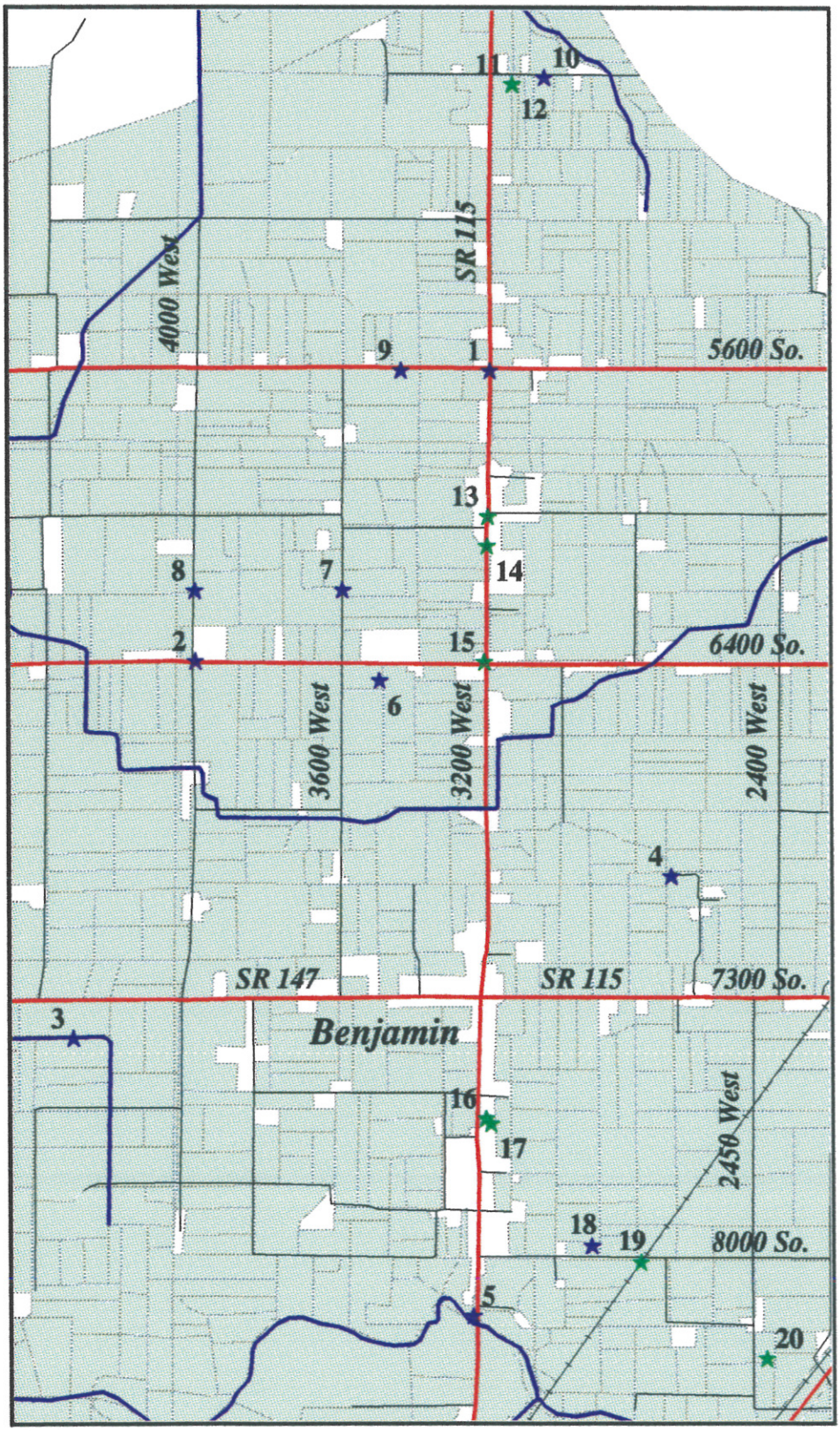
Only one well (number 14, Map #2) has elevated nitrate nitrogen reading of 6.7 ppm. The next highest value of nitrate nitrogen is 4.4 ppm. The remaining samples are below that level. These samples were not analyzed for phosphate. The low nitrate levels indicate that the cropping systems in this area are not contaminating ground water with nitrate.

Two samples showed a detection of pesticide, well above the EPA's standards. The chemicals detected were 2,4-D and Dicamba. In reviewing our procedures for sampling shallow wells and drains, the source of the contamination became obvious. The lawn at the site had just been treated with 2,4-D and Dicamba. The garden hose on the lawn was used to draw water from the twelve-foot well (number 12) and contaminated the sample. Later in sampling a drain (number 18) the bucket that had been set on the treated lawn was used as the bailing device. To prevent and further contamination, a bailing system and a sampling ladle were purchased.

Another item of interest is the high electrical conductivity and chloride levels. These levels only occur in the drains and not in the shallow wells of the area. The increased salts, in the drainage water, add to the salinity of Utah Lake, but the salts are not of a nature that will promote algae blooms or eutrophication in the lake. Some residents in the area use this shallow water source for gardens and lawns to avoid using their culinary water. The high chloride levels would adversely affect these gardens.

1996 UDA Ground Water Sample Locations

Benjamin Area (Utah County), Utah



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Railroads*
- *Field Boundaries*
- *Agricultural Lands*
- ★ *Sampling Sites - Drains*
- ★ *Sampling Sites - Wells*

WATERSHED LOCATION

MAP #2

Utah Department of Agriculture GIS
February 28, 1997

Table 5a - Utah County

Map 2

Irrigation and infiltration qualities around the Benjamin area in Utah County, Utah. Samples taken on May 5, 1996. **Shaded** values exceed established guidelines.

*Sample Site	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.8	1920	83.63	78.09	249.89	10	5.85	4.72
2	7.1	1920	81.69	90.05	240.68	11.4	5.28	4.37
3	7.8	2600	110.28	118.44	312.20	10.4	6.00	4.92
4	7.3	1250	73.01	36.56	168.17	8.9	5.52	4.01
5	7.3	1300	82.47	58.44	124.03	8.2	3.31	2.55
6	7.2	1850	89.53	86.52	203.26	9.3	4.55	3.67
7	7.9	1600	55.54	64.41	219.05	9.6	5.61	4.74
8	7.4	2120	83.43	100.52	261.33	11.1	5.43	4.56
9	7.6	2000	81.65	76.72	252.52	10.1	5.96	4.82
10	8.0	1120	52.31	83.16	322.71	11.5	7.35	6.46
11	7.7	600	21.95	32.28	67.47	5.7	2.27	2.14
12	7.3	385	19.33	14.09	47.30	3.6	2.06	2.00
13	7.6	540	24.23	21.30	69.67	5.6	2.76	2.49
14	7.2	925	71.00	43.36	70.75	7.1	2.14	1.63
15	7.6	470	31.19	21.16	41.28	4.6	1.62	1.40
16	7.1	1380	75.00	82.77	130.66	11.4	2.98	2.47
17	7.6	760	65.85	28.18	54.58	4.3	1.92	1.42
18	7.1	1800	81.52	55.30	263.82	10.4	7.23	5.53
19	7.6	390	27.71	17.70	33.05	3.9	1.37	1.21
20	7.5	510	53.04	24.21	23.29	5.4	0.88	0.67

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 5b - Utah County

Map 2

Other elements and ions associated with water quality for irrigation, surface water, and livestock around the Benjamin area in Utah County, Utah. Samples taken on May 5, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.35	164.	0.00	5	0.00	2.6	98.30	10.01	1.34	0
2	0.00	0.45	139.	0.00	7	0.09	0.5	101.60	7.54	1.23	0
3	0.004	0.43	266.	0.00	8	0.14	1.8	171.20	10.41	1.48	0
4	0.00	0.25	47.7	0.00	5	0.13	0.3	54.30	12.59	0.70	0
5	0.00	0.20	112.	0.00	15	0.00	0.5	50.90	23.84	0.94	0
6	0.00	0.31	172.	0.00	4	0.04	4.2	94.10	8.58	1.38	0
7	0.00	0.39	128.	0.00	6	0.00	4.4	60.70	7.88	1.04	0
8	0.00	0.53	174.	0.00	9	0.05	0.7	121.80	7.01	1.29	0
9	0.00	0.43	164.	0.00	0	0.03	2.3	98.00	9.33	1.32	0
10	0.00	0.68	183.	0.00	0	0.02	2.4	106.10	7.83	1.20	0
11	0.00	0.17	24.8	0.10	0	0.05	0.0	0.00	14.25	0.36	0
12	0.53	0.00	10.5	0.30	0	0.00	2.5	5.30	8.97	0.23	0
13	0.00	0.00	16.4	0.08	5	0.05	0.0	0.00	11.91	0.42	0
14	0.00	0.00	53.1	0.00	7	0.00	6.7	20.90	9.13	0.74	0
15	0.00	0.00	10.5	0.12	8	0.11	0.0	0.00	20.52	0.35	0
16	0.00	0.36	64.8	0.00	0	0.14	1.1	42.80	7.40	1.10	0
17	0.00	0.00	50.5	0.00	9	0.05	0.0	34.80	28.24	0.33	0
18	0.00	0.45	168.	0.00	0	0.00	1.3	73.80	9.07	0.95	0
19	0.00	0.00	7.3	0.13	4	0.04	0.0	0.00	20.47	0.27	0
20	0.00	0.00	11.1	0.12	7	0.13	0.0	0.00	24.68	0.42	0

* Sample Sites: wells, drains and springs

Wasatch County

Wells, springs, and drains were sampled around Wallsburg, Charleston, Midway, and west of Heber City on June 13, 1996. Samples were taken to evaluate the effects of agricultural land-use on nitrates in ground-water and phosphates in surface waters from a ground-water discharge. The chemical analyses are listed on Tables 6a and 6b. Map #3 shows the location of all sample sites.

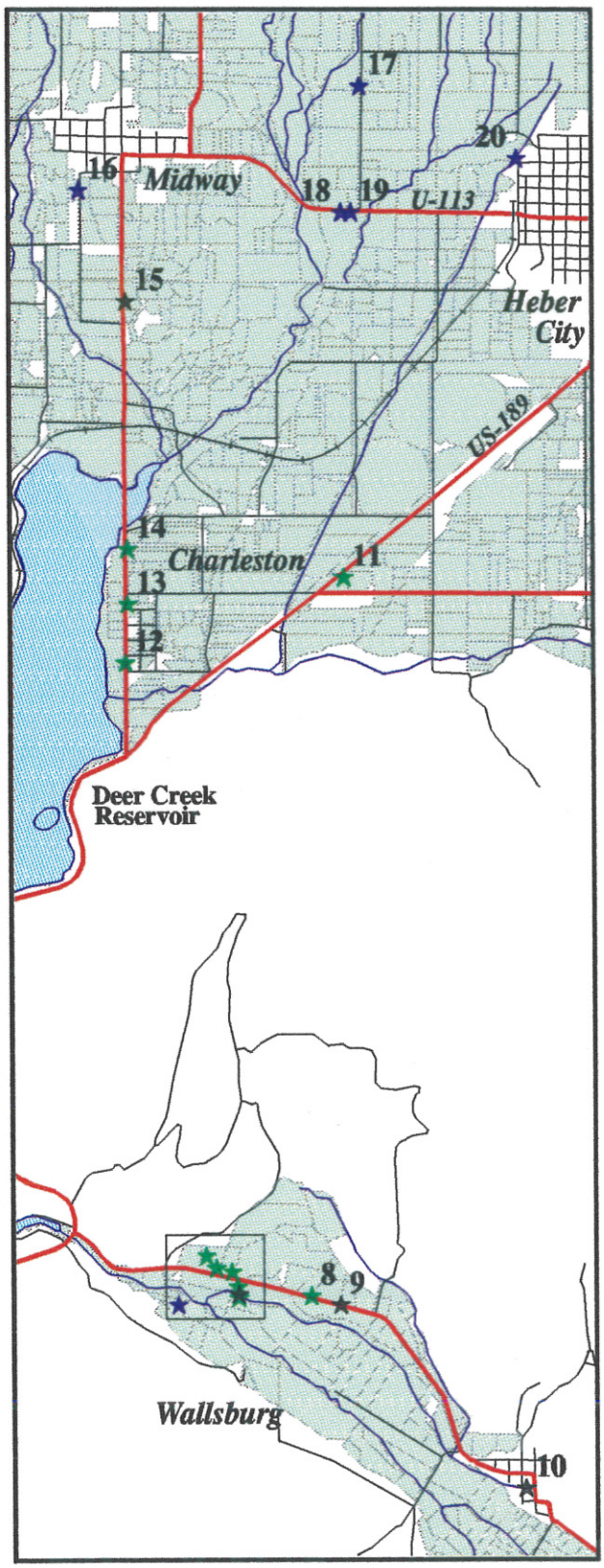
Two wells showed elevated nitrate levels (numbers 8 and 13), while only one shallow well (number 4) has levels below the detection limits of 0.1 ppm. Earlier studies in Heber Valley indicated nitrate in the ground water - likely from historic septic tank systems. A well (number 8) has 10.79 ppm nitrate nitrogen which exceeds the drinking water standard of 10 ppm. This is a 50 foot well used for culinary purposes. There are several houses in the rural area up gradient from the well. The area is served by septic systems. The second well (number 13) is a shallow hand dug masonry well. It has a high probability of receiving surface contamination because of its 5-foot diameter opening. It is located in a residential area of Charleston and is no longer in use except for watering lawns. The well is adjacent to the house increasing the chance of contamination. This well has a reading of 7.13 ppm nitrate nitrogen and 0.26 ppm phosphate which is well above the Clean Lake standards.

Several drains and wells have elevated phosphate levels. Five of the six were associated directly with residential drainage and septic systems. The final drain (number 1) is in the middle of an alfalfa field with a cattle feed lot west of the field, which may affect this drain. The drain is also at the discharge end of the Wallsburg valley and may be affected by up gradient residential septic systems.

A spring (number 15) with very low output had a detection of herbicide 2, 4D, just above the EPA's detection limit. This spring is in the middle of a dairy pasture. The possibility of surface contamination is very high so the spring was not resampled for pesticide contaminates. All other parameters were within existing standards.

1996 UDA Ground Water Sample Locations

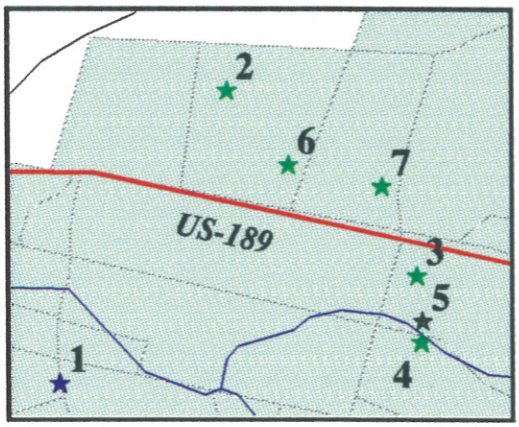
Heber City Area (Wasatch County), Utah



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Railroads*
- *Field Boundaries*
- *Agricultural Lands*
- *Water Bodies*
- *Sampling Sites - Drains*
- *Sampling Sites - Springs*
- *Sampling Sites - Wells*

AREA OF DETAIL



WATERSHED LOCATION

MAP #3

Utah Department of Agriculture GIS
February 07, 1997

Table 6a - Wasatch County

Map 3

Irrigation and infiltration qualities around Wallsburg, Charleston, Midway, and west of Heber City in Wasatch County, Utah. Samples taken on June 13, 1996. **Shaded** values exceed established guidelines.

*Sample Site	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.0	470	65.59	15.27	13.01	4.28	0.57	0.38
2	7.4	720	90.28	27.36	30.32	6.07	1.10	0.72
3	7.2	1220	139.96	57.37	58.29	12.14	1.58	1.05
4	7.2	780	91.08	38.53	24.61	7.14	0.79	0.54
5	7.3	600	72.24	26.24	20.83	5	0.76	0.53
6	7.4	560	70.87	22.24	20.97	4.64	0.81	0.56
7	7.5	600	78.31	22.43	19.04	5.36	0.74	0.49
8	7.4	680	73.56	28.45	18.04	4.64	0.63	0.45
9	7.3	530	59.00	26.61	17.56	4.64	0.63	0.48
10	7.3	610	79.18	22.15	18.77	4.82	0.73	0.48
11	7.0	450	58.76	17.79	9.09	3.57	0.37	0.27
12	7.3	510	73.62	15.78	14.03	4.64	0.61	0.39
13	7.0	610	78.47	20.62	11.97	4.28	0.47	0.31
14	6.9	530	74.24	18.87	10.48	3.93	0.42	0.28
15	7.6	1700	218.16	60.89	74.35	8.57	1.95	1.15
16	7.0	1620	226.16	51.85	72.64	8.21	2.05	1.13
17	7.4	240	35.22	7.75	4.43	1.78	0.20	0.18
18	6.9	570	64.78	11.64	28.80	2.5	1.24	0.87
19	7.3	240	33.61	7.61	4.61	1.43	0.20	0.19
20	6.9	370	50.92	9.58	9.79	2.32	0.37	0.33

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 6b - Wasatch County

Map 3

Other elements and ions associated with water quality for irrigation, surface water, and livestock for around Wallsburg, Charleston, Midway, and west of Heber City in Wasatch County, Utah. Samples taken on June 13, 1996. **Shaded** values exceed established guidelines.

*Sample Site	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.00	9.0	0.00	5	0.00	1.1	0.15	4.00	7.80	0.28	0.00
2	0.00	0.00	23.9	0.00	0	0.00	1.2	0.00	10.4	12.8	0.38	0.00
3	0.00	0.00	44.2	0.00	5	0.00	0.2	0.10	8.10	23.8	0.64	0.00
4	0.00	0.00	23.0	0.00	0	0.00	0.0	0.00	10.6	10.6	0.38	0.00
5	0.00	0.00	18.8	0.00	0	0.00	1.7	0.00	6.70	9.61	0.31	0.00
6	0.00	0.00	17.3	0.00	0	0.00	1.2	0.00	8.10	11.0	0.27	0.00
7	0.00	0.00	14.9	0.00	0	0.00	1.5	0.00	7.30	13.7	0.30	0.11
8	0.00	0.00	19.9	0.00	19	0.00	10.7	0.00	14.8	9.23	0.40	0.05
9	0.00	0.00	16.6	0.00	0	0.00	0.2	0.00	5.40	6.32	0.32	0.00
10	0.00	0.00	21.9	0.00	0	0.00	2.4	0.00	7.20	7.93	0.26	0.00
11	0.00	0.00	18.7	0.00	0	0.00	2.1	0.00	4.90	6.37	0.17	0.00
12	0.00	0.00	7.5	0.12	0	0.00	1.8	0.00	5.60	11.2	0.30	0.00
13	0.00	0.00	19.5	0.00	14	0.00	7.1	0.26	8.70	6.86	0.23	0.00
14	0.00	0.00	12.9	0.00	0	0.00	5.8	0.07	7.70	7.94	0.23	0.00
15	0.00	0.36	111.	0.07	26	0.00	4.5	0.00	123.	10.6	1.90	0.00
16	0.00	0.35	70.4	0.00	18	0.00	1.3	0.00	135.	8.35	2.17	0.00
17	0.00	0.00	4.9	0.08	0	0.00	0.2	0.00	6.40	4.20	0.17	0.00
18	0.00	0.00	78.0	0.00	7	0.00	1.2	0.12	6.90	11.2	0.28	0.00
19	0.00	0.00	5.4	0.22	0	0.00	0.3	0.00	7.00	4.51	0.16	0.00
20	0.00	0.00	16.7	0.00	4	0.00	2.5	0.14	6.10	10.8	0.24	0.00

* Sample Sites: wells, drains and springs

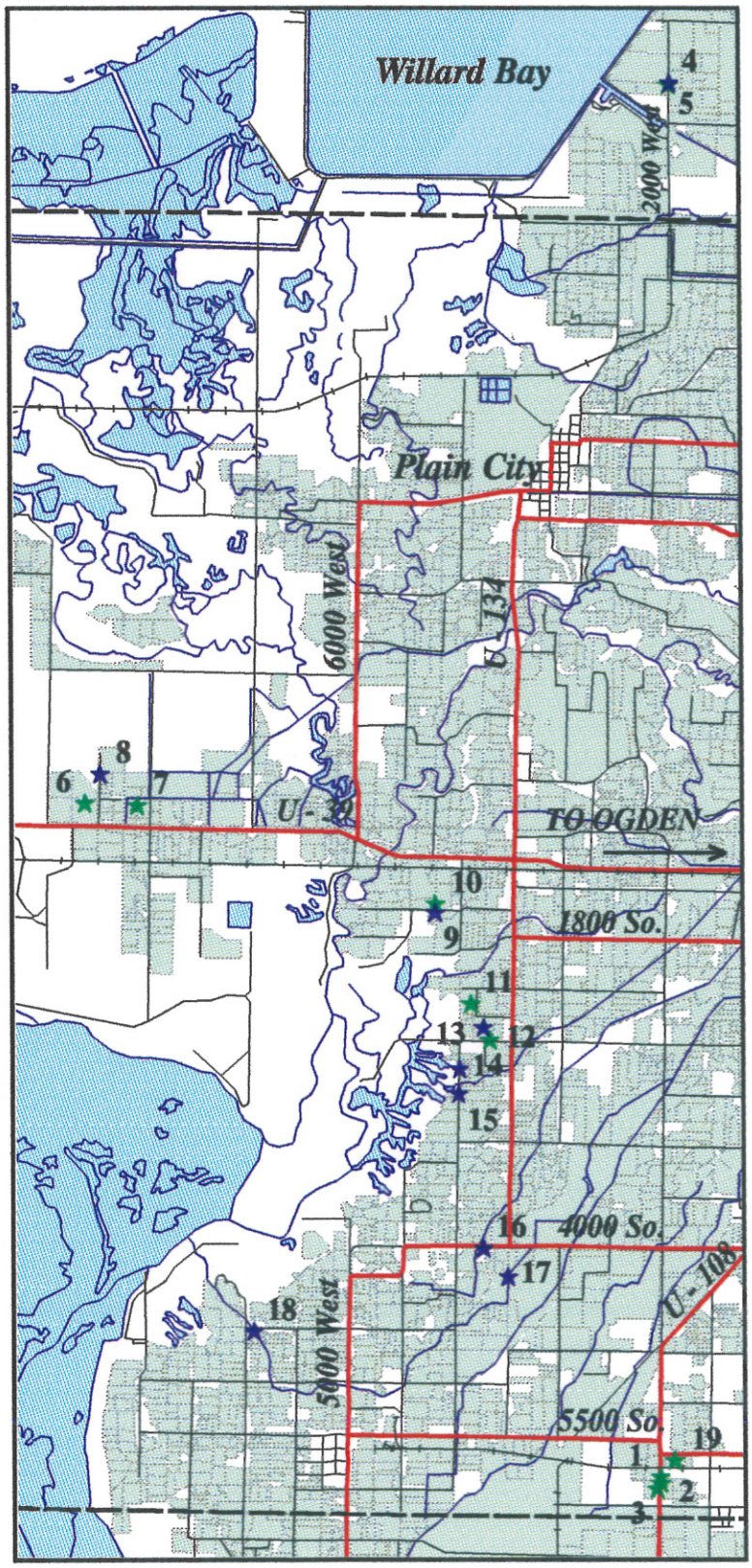
Weber County

Drains and wells were sampled in west Weber County on June 26, 1996. Nineteen sites were selected by the USU Extension Agent for Weber County. The emphasis of the sampling was to evaluate phosphate levels in the ground water. The chemical analyses are listed on Tables 7a and 7b. Map #4 shows the location of all sample sites.

Of the 19 sampling sites, only five did not have phosphate levels that exceeded the Clean Lakes standards. Most of these sample sites with high levels of phosphate were associated with residential areas and fairly shallow ground water. One agricultural drain also has elevated phosphate levels. The possible reasons for the high levels of phosphate could be the high population of septic tank systems in the area, the extensive plantings of row crops such as potatoes, onions, and corn, and the many dairies. It has been shown that crops such as potatoes and onions have very "leaky" root systems and allow the leaching of nitrates and phosphates. This is shown by the high nitrate levels of 18.1 and 15.1 ppm respectively in drains (numbers 13 and 18) under potato fields. Most of the water sampled is not used for culinary purposes, but is drained into the Great Salt Lake which is known as a "dead lake" with little biological activity. Therefore, the nutrient loading of the drainage ditches in the area is not of great concern.

1996 UDA Ground Water Sample Locations

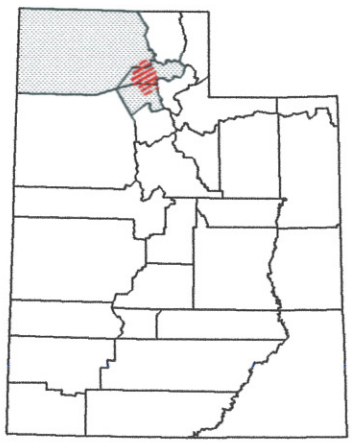
Portions of Box Elder, Davis, and Weber Counties, Utah



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Railroads*
- *Field Boundaries*
- *County Boundaries*
- *Agricultural Lands*
- *Water Bodies*
- ★ *Sampling Sites - Drains*
- ★ *Sampling Sites - Wells*

WATERSHED LOCATION



MAP #4

Utah Department of Agriculture GIS
February 07, 1997

Table 7a - Weber County

Map 4

Irrigation and infiltration qualities in west Weber County, Utah. Samples taken on June 26, 1996. **Shaded** values exceed established guidelines.

*Sample Site	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.4	930	25.40	41.19	95.69	7.85	3.00	2.73
2	7.4	1010	35.83	52.12	73.42	7.85	2.07	1.83
3	7.5	970	25.70	36.66	115.51	8.21	3.82	3.43
4	7.2	6300	172.41	27.22	898.43	9.28	33.02	16.78
5	7.6	2900	86.42	22.41	392.81	3.57	14.27	9.74
6	7.7	420	8.34	3.30	77.42	3.93	4.69	5.74
7	7.9	350	21.95	6.49	45.72	2.93	2.34	2.20
8	7.9	410	11.18	4.72	71.77	3.93	4.12	4.54
9	7.6	460	40.31	11.40	37.92	3.57	1.74	1.36
10	7.9	350	27.96	6.67	37.19	3.14	1.89	1.64
11	8.0	510	59.90	17.49	21.61	3.93	0.89	0.63
12	7.6	420	36.53	14.62	32.38	3.93	1.42	1.14
13	7.5	3400	50.74	84.71	506.61	17.49	11.52	10.11
14	7.2	1800	95.18	64.97	198.02	12.14	5.05	3.83
15	7.3	1900	90.11	66.74	209.45	12.49	5.28	4.08
16	7.2	1270	116.63	42.04	60.78	8.21	1.89	1.23
17	7.7	1450	68.37	61.70	141.37	9.28	3.70	2.98
18	7.5	1500	84.71	69.71	136.01	9.28	3.36	2.65
19	7.9	490	63.14	16.46	18.03	3.57	0.75	0.52
20	7.5	595	67..97	31.36	14.38	4.64	0.49	0.36

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 7b - Weber County

Map 4

Other elements and ions associated with water quality for irrigation, surface water, and livestock for west Weber County, Utah. Samples taken on June 26, 1996. **Shaded** values exceed established guidelines.

*Sample Site	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.26	58.2	0.08	20	0.02	0.0	0.40	0.00	14.8	0.29	0.00
2	0.00	0.21	78.3	0.00	21	0.04	0.0	0.20	0.00	15.4	0.39	0.00
3	0.00	0.31	56.0	0.00	21	0.04	0.0	0.17	0.00	14.6	0.25	0.00
4	0.00	0.96	1558	0.00	149	0.41	0.3	0.14	43.3	9.28	3.43	0.00
5	0.00	0.18	799.	0.13	42	0.35	0.0	0.00	0.00	10.6	1.07	0.00
6	0.00	0.17	14.5	0.00	10	0.03	0.0	0.18	0.00	8.95	0.06	0.00
7	0.00	0.00	16.8	0.00	0	0.03	0.0	0.00	0.00	8.51	0.21	0.11
8	0.00	0.16	15.2	0.00	8	0.04	0.0	0.14	0.00	8.84	0.08	0.05
9	0.00	0.00	28.7	0.00	5	0.00	0.7	0.24	3.50	6.49	0.26	0.00
10	0.00	0.00	16.0	0.09	0	0.03	0.0	0.00	0.00	7.79	0.27	0.00
11	0.00	0.00	24.4	0.00	0	0.00	0.2	0.00	7.20	3.19	0.24	0.00
12	0.00	0.00	15.3	0.10	5	0.10	0.0	0.07	0.00	8.75	0.22	0.00
13	0.00	1.18	391.	0.00	89	0.00	18.1	0.82	55.1	11.5	0.39	0.00
14	0.00	0.39	183.	0.00	33	0.00	5.0	0.37	23.2	12.7	0.53	0.00
15	0.00	0.47	185.	0.00	34	0.00	4.9	0.23	21.5	13.5	0.55	0.00
16	0.00	0.08	119.	0.06	54	0.26	3.1	0.07	22.7	9.86	0.51	0.00
17	0.00	0.40	132.	0.00	52	0.00	5.3	0.36	34.5	8.73	0.47	0.00
18	0.00	0.47	141.	0.00	21	0.00	15.1	0.27	27.9	14.5	0.57	0.00
19	0.00	0.00	29.2	0.00	0	0.00	0.4	0.00	7.50	3.36	0.24	0.00
20	0.00	0.00	8.5	0.00	0	0.00	2.5	0.00	19.7	5.11	0.46	0.00

* Sample Sites: wells, drains and springs

Juab County

On July 9, the local UACD leader assisted in the selection of 20 wells located in the farming area west of Nephi. Ground water in this area is primarily used for irrigation. This water supplements "early" spring surface water so that alfalfa and corn can be raised throughout the summer season. Map # 5 shows the location of all sample sites. The chemical analyses are listed on Tables 8a and 8b.

Irrigation Quality

The water generally in this area is saline with all electrical conductivity (EC) values exceeding 750 umhos / cm. The range of EC values is from 760 umhos / cm at well (number 1) to 4,850 umhos / cm at well (number 13). Well (number 1) is used for watering livestock so the EC value is not as critical. Although the EC values for the area are high, most crops can be grown except salt sensitive vegetables such as beans.

Three wells (numbers 5, 9, and 14) have bicarbonate (HCO_3) just below the critical level. Bicarbonate affects the way salts react in the soil and is taken into consideration in calculating the adjusted Sodium Adsorption Ratio R_{Na}. Bicarbonate in sprinkler irrigation water can cause white speckling on fruits which lowers the fruit's market appeal.

All but well (number 1) have R_{Na} levels that exceed irrigation standards. Seven wells (5, 9, 12, 11, 12, 13, 14) have SAR values that also exceed the irrigation standard. This indicates that all but seven wells are borderline. The SAR estimates the impact of how sodium will replace other minerals such as calcium and magnesium in the soil. Sodium causes the soil particles to deflocculate lowering soil permeability.

Sixteen wells have high chloride levels and two of the sixteen (numbers 10 and 13) are severe. Chloride is toxic to plants and lowers yield by destroying plant cells. All sixteen wells if used for sprinkler irrigation would affect crop yield. Using water high in chloride for surface irrigation will not cause as much damage as sprinkling irrigation.

Two wells have toxic levels of manganese (Mn). Both wells were very shallow (less than 30 feet), but they are not used for irrigation.

Livestock Quality

None of the sampled wells exceed any standards for watering livestock.

Drinking Water

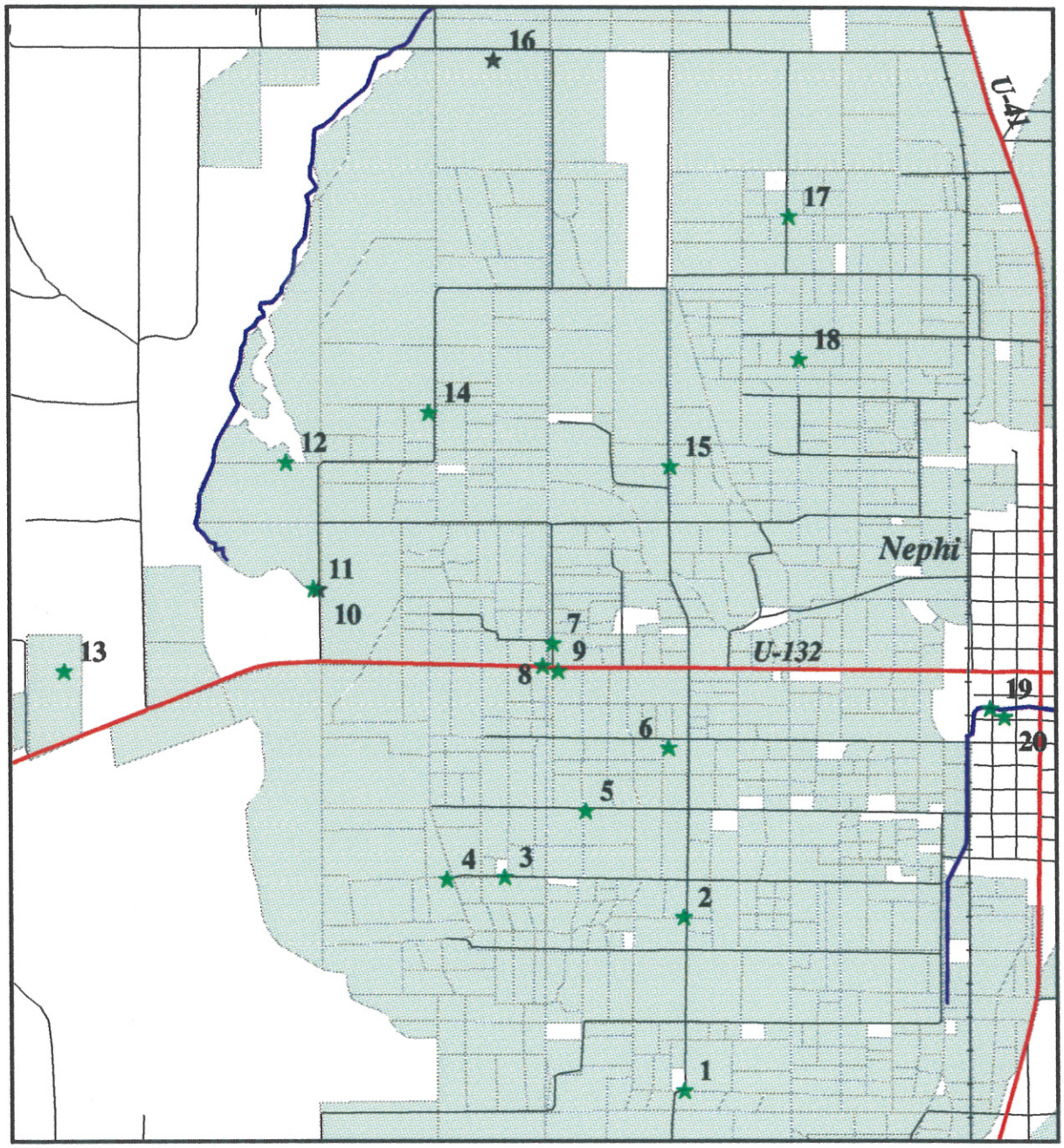
All wells exceed the aesthetic drinking water standard for EC. This is a flavor standard and not a health problem. Only one well (number 13) exceeds the health standard.

Five wells (numbers 5, 9, 10, 12 and 14) exceed the aesthetic standard for iron (Fe). Again this is not a health issue but one of flavor and color. Five wells (numbers 4, 5, 11, 12, and 14) also exceeded the aesthetic standard for manganese (Mn). One well (number 13) exceeds the aesthetic standard for sulfate.

Nitrates were detected in all wells, but only those wells having values greater than 0.09 are listed. The high of 7.3 ppm of nitrate found in one well (number 3) is approaching the area of concern. This is a drinking water well and in an area influenced by septic systems and feed lots.

1996 UDA Ground Water Sample Locations

Nephi (Juab County), Utah



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Railroads*
- *Field Boundaries*
- *Agricultural Lands*
- ★ *Sampling Sites - Springs*
- ★ *Sampling Sites - Wells*

MAP LOCATION

MAP #5

Utah Department of Agriculture GIS
February 07, 1997

Table 8a - Juab County

Map 5

Irrigation and infiltration qualities in an area west of Nephi, Juab County, Utah. Samples taken on July 9, 1996. **Shaded** values exceed established guidelines.

*Sample Site	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.6	760	61.04	35.75	36.64	3.57	1.15	0.92
2	7.2	1420	105.14	46.77	123.33	5.71	3.58	2.51
3	7.4	1600	115.61	54.46	115.37	3.39	3.06	2.22
4	7.3	940	64.48	18.45	101.99	4.64	4.16	2.88
5	6.8	1070	64.66	18.18	107.27	1.25	3.64	3.04
6	7.2	1550	136.82	37.48	141.71	7.57	4.55	2.77
7	7.4	1600	137.71	37.78	145.04	7.85	4.66	2.82
8	7.4	1400	119.13	33.89	137.58	7.57	4.64	2.86
9	7.1	840	10.69	13.24	126.52	1.43	4.79	6.11
10	7.8	2750	45.86	74.88	401.39	9.28	9.57	8.49
11	7.3	1700	101.69	46.47	198.49	6.78	5.80	4.09
12	7.8	1700	49.79	50.52	223.46	4.64	6.17	5.33
13	7.3	4850	225.81	114.27	533.25	2.50	9.99	7.21
14	7.2	1280	23.52	11.64	196.54	1.43	7.54	8.28
15	7.4	1120	74.83	35.03	98.36	4.64	3.17	2.35
16	7.4	1120	77.53	34.07	101.21	4.64	3.30	2.41
17	7.3	1550	135.99	37.33	144.03	8.21	4.69	2.82
18	7.3	1390	114.87	35.08	131.75	6.43	4.29	2.76
19	7.2	1550	138.00	39.15	145.57	7.50	4.59	2.82
20	7.2	1550	138.06	39.10	144.07	7.14	4.55	2.79

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 8b - Juab County

Map 5

Other elements and ions associated with water quality for irrigation, surface water, and livestock in an area west of Nephi, Juab County, Utah. Samples taken on July 9, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.00	105.	0.00	0	0.00	3.7	0.00	10.20	7.89	0.76	0.00
2	0.00	0.00	221.	0.00	0	0.00	5.1	0.00	29.50	10.9	0.93	0.00
3	0.00	0.00	327.	0.13	0	0.00	7.3	0.00	26.90	8.06	0.88	0.28
4	0.00	0.00	122.	0.00	6	0.07	0.2	0.48	12.30	5.83	0.32	0.06
5	0.00	0.00	232.	1.21	5	0.35	0.0	0.00	20.20	0.56	0.33	2.74
6	0.00	0.00	208.	0.00	4	0.00	3.4	0.00	29.10	10.2	0.67	0.03
7	0.00	0.00	220.	0.00	0	0.00	2.1	0.00	29.70	9.95	0.69	0.00
8	0.00	0.00	184.	0.00	0	0.00	1.4	0.00	26.90	9.96	0.60	0.07
9	0.00	0.00	180.	0.47	16	0.00	0.0	0.00	4.40	0.08	0.09	0.00
10	0.65	0.29	545.	0.33	35	0.00	1.0	0.47	25.50	2.78	0.89	0.00
11	0.00	0.00	288.	0.21	0	0.44	0.0	0.00	33.60	12.7	0.92	1.74
12	0.00	0.00	331.	0.39	13	0.11	0.0	0.00	39.10	10.9	0.90	0.37
13	0.00	0.00	1251	0.10	18	0.00	0.9	0.00	125.0	11.3	3.81	0.43
14	0.00	0.00	306.	0.72	17	0.06	1.3	0.00	2.00	0.59	0.20	0.12
15	0.00	0.00	155.	0.00	5	0.00	4.4	0.00	26.30	14.0	0.74	0.00
16	0.00	0.00	162.	0.00	4	0.00	2.7	0.00	23.40	12.5	0.75	0.00
17	0.00	0.00	206.	0.00	4	0.00	3.6	0.00	30.20	10.5	0.70	0.00
18	0.00	0.00	183.	0.00	4	0.00	3.6	0.00	26.50	10.2	0.70	0.48
19	0.00	0.00	204.	0.00	0	0.00	5.4	0.00	33.60	10.5	0.76	0.10
20	0.00	0.00	203.	0.00	4	0.00	6.1	0.00	33.70	10.8	0.73	0.00

* Sample Sites: wells, drains and springs

Millard County

The Pahvant Valley in Millard County was sampled on July 22. Forty wells were sampled by the Utah Department of Agriculture and the Utah Division of Water Rights (WR) staff. The Utah Division of Water Rights selected the wells and is in the process of doing a long term monitoring study of the changes in water quality and aquifer drawdown. The ground water is the primary source of irrigation water and the aquifer is heavily used.

The valley is divided into a south area (see Map #6) and a north area (see Map #7). The chemical analysis is reported on Tables 9a, 9b, 10a, and 10b, with Tables 9a and 9b for covering the southern area and Tables 10a and 10b for the northern area. Maps #6 and 7 show the locations of all sample sites.

Irrigation Quality

The water in this area is generally saline with all EC values exceeding 750 umhos / cm except well (number 1) for the southern area and wells (numbers 31, 32, 38, and 39) for the northern area. The range of EC values is from 570 umhos / cm at well (number 38) to 8,100 umhos / cm at well (number 6). Though the EC values for the area are high, most crops can be grown, except salt sensitive vegetables such as beans. Some areas require special irrigation practices and if not followed the economic return will drop. Farmers in the area have lost some farmland due to poor water quality.

All wells in the valley had bicarbonate (HCO_3) levels that are considered problematic. Bicarbonate affects the way salts react in the soil and are taken into consideration in calculating the adjusted Sodium Adsorption Ratio (R_{Na}). Bicarbonate in sprinkler irrigation water can cause white speckling on fruits which lowers the fruit's market appeal.

Seven wells (numbers 5, 6, 7, 17, 18, 23, and 35) have R_{Na} levels that exceed the standards, with two of the seven wells (numbers 18 and 35) marginally high. The most saline wells (numbers 5, 6, 7, and 17) are located in the lowest area of the valley west of Hatton. The two northern wells (numbers 23 and 34) are separated by several miles. Well (number 34) just barely exceeds the standard and since surrounding wells are ok it is not a great threat. Well (number 23) is used for livestock watering so it will not adversely affect soil production.

Five wells (numbers 5 6, 7, 17, and 23) have boron (B) levels that could be toxic to crops. Four wells (numbers 5, 6, 7, and 17) in the south area are clustered together. When using irrigation water from this area, special measures need to be taken to protect crops from excess boron. Well (number 23), in the north area, is a livestock well.

Sixteen wells have high chloride levels. Six of the sixteen wells have severe levels of chloride (numbers 5, 6, 7, 17, 18, and 23). Chloride is toxic to plants and lowers yield by destroying plant cells. If these wells are used for sprinkler irrigation, it would affect crop yield. Using water high in chloride for surface irrigation will not cause as much damage as sprinkling irrigation.

Well (number 18) has toxic levels of manganese (Mn) in the water.

Livestock Quality

Well (number 6) is almost at the upper limit for EC. Using this well water for livestock would probably cause weight loss.

Six wells have high levels of sulfate (numbers 5, 6, 17, 22, 23, and 30). A very high concentrations (approaching 1,500 ppm) of sulfate makes the water bitter and can cause diarrhea.

Drinking Water

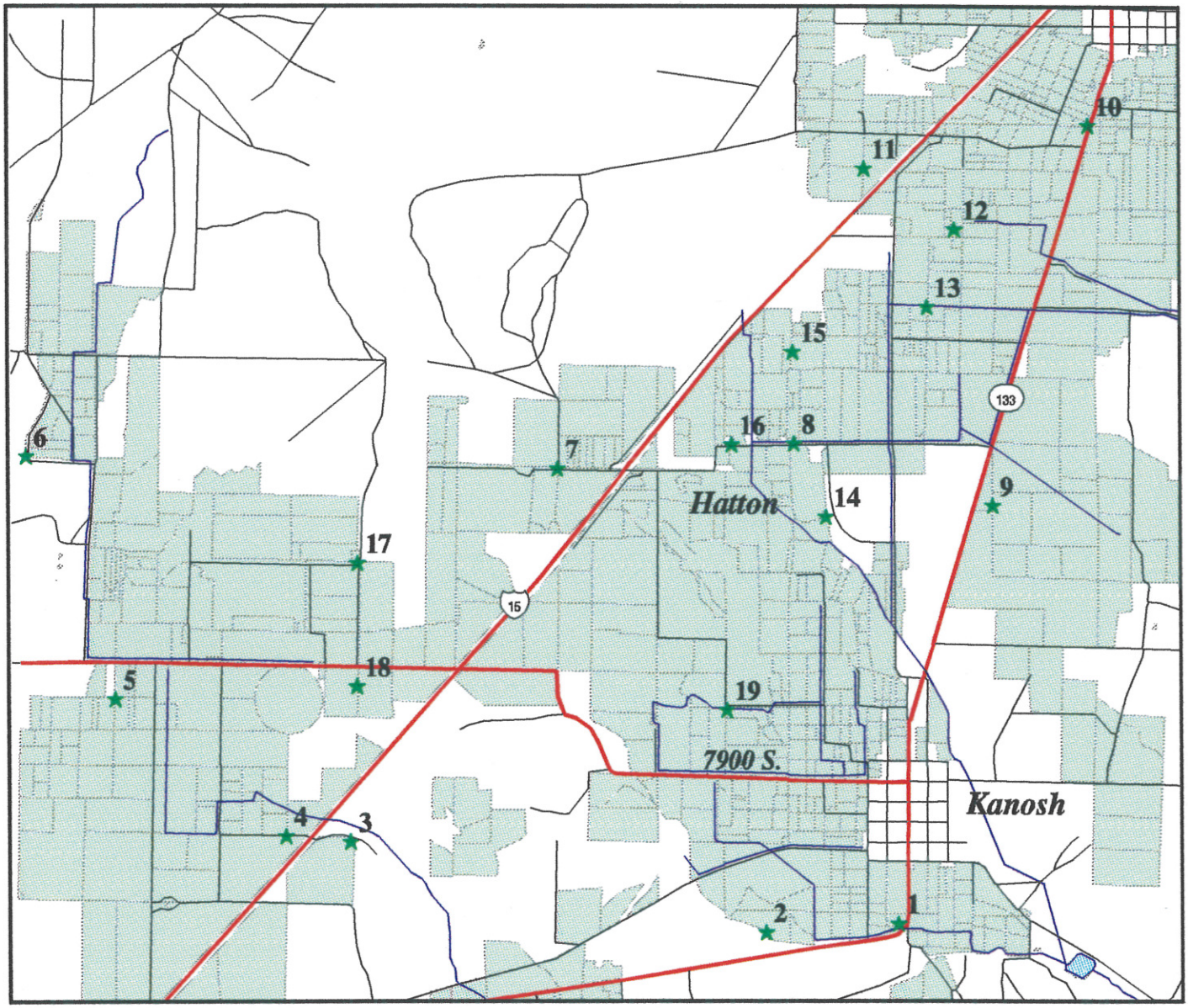
Wells (numbers 1, 9, 14, 19, 24, 26, 31, 32, 33, 38, and 40) all have EC readings indicating they are fit for drinking. The remaining 29 wells exceed aesthetic drinking water standard for EC. This is a flavor and color standard and not a health problem. Wells (numbers 5, 6, and 7) exceed the health standard for EC.

Wells (numbers 7 and 21) exceed the aesthetic standards for iron (Fe). Again this is not a health issue, but one of flavor and color. Four wells (numbers 7, 18, 21, and 23) also exceed the aesthetic standard for manganese (Mn). Eight wells (numbers 5, 6, 17, 21, 22, 23, 28, and 30) exceed the aesthetic standard for sulfate.

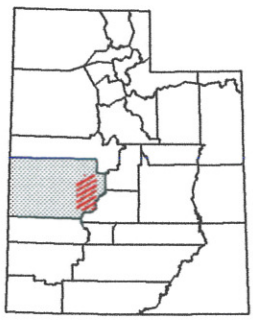
Nitrates were detected in all wells, but only those wells having values greater than 0.09 ppm are listed. Wells (numbers 37 and 40) have 13.9 ppm of nitrate which exceeds the drinking water health standard of 10 ppm. One well (number 23) also exceeds the standard with a reading of 11.4 ppm. Wells (numbers 3, 27, and 35) are high, but do not exceed the standard.

1996 UDA Ground Water Sample Locations

S. Pahvant Valley (Millard County), Utah



MAP LOCATION



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Railroads*
- *Field Boundaries*
- *Agricultural Lands*
- *Water Bodies*
- ★ *Sampling Sites - Wells*

MAP #6

Utah Department of Agriculture GIS
February 07, 1997

Table 9a - Millard County

Map 6

Irrigation and infiltration qualities for the south area of Pahvant Valley, Millard County, Utah. Samples taken on July 22, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.3	680	72.32	24.57	34.86	5.71	1.30	0.90
2	7.4	1310	105.15	51.60	76.93	3.93	1.97	1.54
3	7.4	1030	77.91	41.96	70.00	2.85	2.04	1.59
4	7.4	845	42.74	30.91	79.98	3.57	2.66	2.27
5	7.2	7300	462.21	285.57	545.39	4.28	6.77	4.92
6	7.0	8100	527.68	237.26	836.94	5.71	11.42	7.60
7	8.1	5700	30.52	88.08	835.48	4.64	18.04	17.35
8	7.3	850	100.46	35.22	30.19	6.06	0.99	0.66
9	7.5	755	78.94	24.13	42.01	4.28	1.56	1.06
10	7.2	970	74.80	23.99	80.44	4.64	3.00	2.07
11	7.2	980	104.57	34.83	44.13	4.64	1.43	0.95
12	7.2	1160	122.76	34.14	59.42	3.57	1.89	1.22
13	7.3	1140	115.01	33.66	74.77	5.35	2.47	1.58
14	7.3	755	91.14	32.79	24.07	6.07	0.81	0.55
15	7.4	930	104.76	37.93	37.55	5.71	1.19	0.80
16	7.4	1020	98.23	24.98	72.33	6.07	2.71	1.69
17	6.9	7650	412.80	105.25	928.98	7.14	18.64	10.56
18	7.8	1490	113.07	45.92	116.33	4.64	3.35	2.33
19	7.3	750	90.02	31.04	25.29	5.71	0.87	0.59

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 9b - Millard County

Map 6

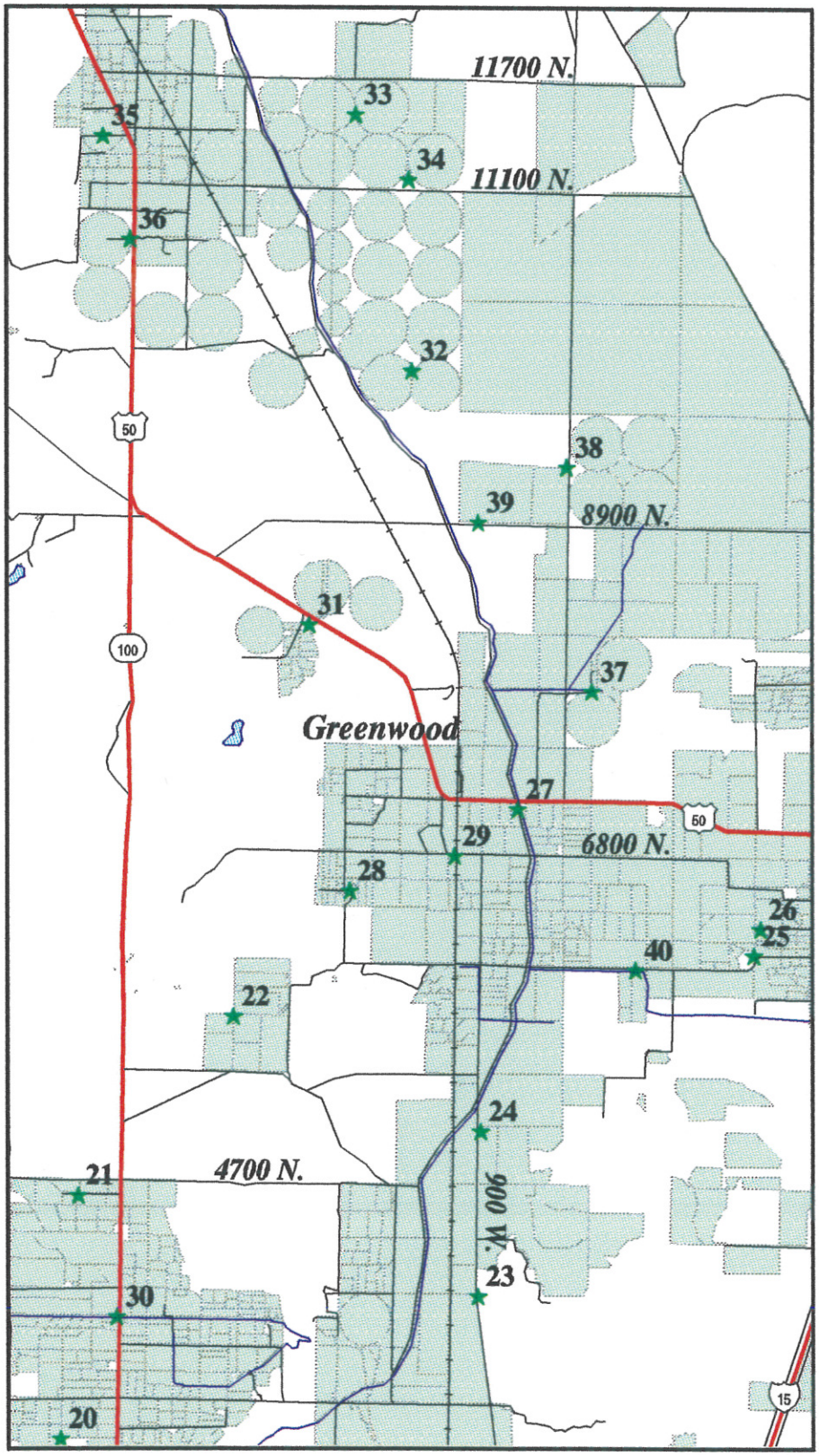
Other elements and ions associated with water quality for irrigation, surface water, and livestock for the south area of Pahvant Valley, Millard County, Utah. Samples taken on July 22, 1996. **Shaded** values exceed established guidelines

*Sample Site	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	Mo ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	32.6	0.00	0	0.00	0.00	0.7	0.00	9.60	8.05	0.30	4.47
2	0.00	245.0	0.00	0	0.00	0.00	3.9	0.00	24.8	10.5	0.54	0.58
3	0.00	104.0	0.00	5	0.00	0.00	8.4	0.00	64.2	9.78	0.53	0.13
4	0.00	105.0	0.00	4	0.00	0.00	5.0	0.00	20.8	10.9	0.55	0.04
5	1.00	1860.	0.00	37	0.00	0.00	2.5	0.00	296.	15.6	5.87	0.00
6	2.50	1730.	0.00	74	0.00	0.00	2.8	0.00	411.	16.9	7.67	0.00
7	2.30	1553.	0.41	64	0.18	0.00	0.0	0.00	0.40	0.47	0.81	0.00
8	0.00	46.2	0.00	0	0.00	0.00	5.5	0.00	13.7	9.57	0.49	0.08
9	0.00	75.2	0.00	0	0.00	0.00	3.1	0.00	13.2	8.12	0.00	0.05
10	0.38	126.0	0.00	13	0.00	0.00	2.6	0.07	19.1	5.90	0.50	0.00
11	0.00	111.0	0.00	4	0.00	0.00	5.5	0.00	25.1	9.09	0.50	0.00
12	0.00	172.0	0.00	0	0.00	0.00	4.4	0.00	38.5	7.36	0.46	0.00
13	0.00	122.0	0.00	5	0.00	0.00	4.0	0.00	39.1	9.71	0.46	0.00
14	0.00	39.4	0.00	0	0.00	0.00	3.3	0.00	10.9	8.64	0.40	0.00
15	0.00	88.6	0.00	0	0.00	0.00	5.0	0.00	23.5	8.76	0.42	0.00
16	0.15	104.0	0.00	0	0.00	0.00	3.9	0.00	22.7	8.74	0.45	0.00
17	4.01	1682.	0.00	125	0.03	0.00	0.9	0.00	303.	25.0	5.90	0.00
18	0.43	229.0	0.10	16	0.37	0.00	3.4	0.00	51.0	10.1	0.96	0.00
19	0.00	34.2	0.00	0	0.00	0.17	1.5	0.00	11.6	9.09	0.37	0.00

* Sample Sites: wells, drains and springs

1996 UDA Ground Water Sample Locations

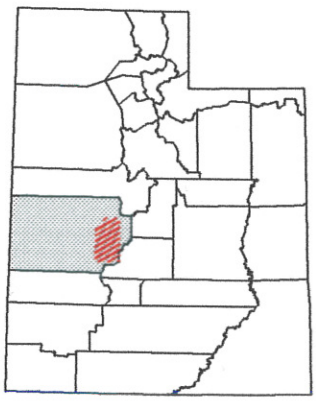
N. Pahvant Valley (Millard County), Utah



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Railroads*
- *Field Boundaries*
- *Agricultural Lands*
- *Water Bodies*
- ★ *Sampling Sites - Wells*

MAP LOCATION



MAP #7

Utah Department of Agriculture GIS
February 07, 1997

Table 10a - Millard County

Map 7

Irrigation and infiltration qualities for the north area of Pahvant Valley, Millard County, Utah. Samples taken on July 22, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
20	7.4	1020	61.06	50.32	69.29	3.93	1.91	1.59
21	7.5	1170	94.63	69.57	57.52	3.21	1.36	1.09
22	7.0	1600	288.01	71.09	47.28	4.28	1.12	0.65
23	7.2	1080	419.24	504.33	899.23	3.57	8.49	7.00
24	7.9	760	12.28	19.78	30.38	5.35	1.23	1.25
25	7.3	875	65.52	34.51	77.64	6.78	2.59	1.93
26	7.3	800	62.93	31.47	65.42	6.43	2.24	1.68
27	7.3	1500	132.27	69.85	55.02	3.93	1.32	0.96
28	7.3	1400	175.25	57.17	40.99	3.93	1.07	0.69
29	7.3	1470	160.22	63.47	50.92	4.64	1.28	0.86
30	7.3	1950	171.81	130.30	72.67	3.57	1.31	1.02
31	8.2	640	58.46	37.36	21.16	3.93	0.66	0.53
32	8.1	600	48.48	31.01	27.47	3.21	0.90	0.76
33	8.2	770	70.13	46.47	34.55	6.07	1.01	0.79
34	7.5	1020	92.20	39.08	41.69	2.32	1.23	0.92
35	7.8	1850	122.37	75.09	137.33	5	3.21	2.41
36	7.5	895	76.41	36.39	35.86	2.14	1.07	0.85
37	7.9	1040	95.36	49.29	32.89	3.93	0.92	0.68
38	8.2	570	36.02	29.35	34.54	2.86	1.16	1.03
39	7.9	700	55.83	36.59	24.58	3.21	0.76	0.63
40	7.4	1320	136.15	49.05	55.10	4.28	1.53	1.03

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 10b - Millard County

Map 7

Other elements and ions associated with water quality for irrigation, surface water, and livestock for the north area of Pahvant Valley, Millard County, Utah. Samples taken on July 22, 1996. **Shaded** values exceed established guidelines

*Sample Sites	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	Mo ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
20	0.00	109.0	0.00	10	0.00	0.00	0.4	0.00	55.8	17.4	1.96	0.00
21	0.00	64.9	0.33	6	0.09	0.00	0.0	0.00	119.	9.05	1.56	0.00
22	0.00	90.4	0.00	5	0.00	0.00	1.0	0.08	192.	10.4	1.96	0.00
23	1.18	3100.	0.81	20	0.11	0.00	11.4	0.00	246.	9.91	10.0	0.03
24	0.00	40.1	0.33	13	0.00	0.00	0.0	0.05	0.80	0.65	0.25	0.00
25	0.00	41.6	0.00	0	0.00	0.00	5.9	0.00	12.4	9.29	0.27	0.00
26	0.00	31.4	0.00	0	0.00	0.00	4.9	0.00	7.60	9.42	0.25	0.00
27	0.00	276.0	0.00	0	0.00	0.00	7.7	0.00	34.4	9.44	0.54	0.00
28	0.00	130.0	0.00	5	0.00	0.00	3.9	0.00	110.	8.23	1.41	0.00
29	0.00	171.0	0.00	4	0.00	0.00	7.4	0.05	81.1	9.68	1.12	0.00
30	0.00	223.0	0.00	5	0.00	0.00	1.8	0.00	185.	15.4	2.08	0.00
31	0.00	74.3	0.00	0	0.00	0.00	1.8	0.00	4.70	10.2	0.34	0.00
32	0.00	68.0	0.00	0	0.00	0.18	1.8	0.00	8.90	9.66	0.33	0.00
33	0.00	66.3	0.00	0	0.00	0.00	1.1	0.00	12.2	7.48	0.31	0.00
34	0.00	191.0	0.00	0	0.00	0.53	4.6	0.00	22.9	6.58	0.43	0.00
35	0.23	290.0	0.00	4	0.00	0.52	6.8	0.00	70.5	12.4	0.68	0.00
36	0.00	164.0	0.00	0	0.00	0.30	2.7	0.00	19.7	8.06	0.42	0.00
37	0.00	149.0	0.00	0	0.00	0.43	13.9	0.00	13.8	7.62	0.33	0.00
38	0.00	67.0	0.00	0	0.00	0.43	1.3	0.00	10.9	13.6	0.48	0.00
39	0.00	92.9	0.13	0	0.00	0.49	2.9	0.00	11.4	18.1	0.49	0.08
40	0.00	197.0	0.00	0	0.00	0.60	13.9	0.00	35.0	7.18	1.10	0.04

* Sample Sites: wells, drains and springs

Box Elder County

On August 20, 29 samples were taken in Curlew Valley in Box Elder County with the Utah Division of Water Rights. The water in this area is used extensively for irrigation. These samples were compared with 18 samples taken by the Utah Division of Water Rights on August 17, 1995. Map #8 shows the location of all sample sites. The chemical analyses are listed on Tables 11a and 11b.

Irrigation Quality

The water tested in this area is generally saline except in two wells (numbers 15, and 16). The remaining wells have EC values exceeding 750 umhos / cm. The range of EC values is from 500 umhos / cm at well (number 16) to 8,400 umhos / cm at well (number 10). Though the EC values in this area are high, most crops can be grown with proper irrigation planning and practices, except salt sensitive vegetables such as beans. Special care needs to be given to the use of water from wells (numbers 4, 5, 7, 8, 9, 10, 12, 20, and 28). Without determining proper leaching fraction ratios this water could affect the soil productivity.

Only one well (number 20) has bicarbonate (HCO_3) below the problem level. Bicarbonate affects the way salts react in the soil and is taken into consideration in calculating the adjusted Sodium Adsorption Ratio (R_{Na}). Bicarbonate in sprinkler irrigation water can cause white speckling on fruits which lowers the fruits market appeal.

All wells except (numbers 11, 13, 15, and 16) have R_{Na} levels that exceed the standard. Wells (numbers 14, 17, 25, and 26) are marginally above the standard. Many wells in this basin have extremely high SAR readings (> 9). SAR is an estimate of how sodium replaces other minerals such as calcium and magnesium in the soil. Sodium causes soil particles to deflocculate lowering soil permeability.

All wells except (numbers 11, 15, and 16) have high chloride levels. Nineteen wells have severe chloride levels. Chloride is toxic to plants and lowers yield by destroying plant cells. All wells, except (numbers 11, 15, and 16), would affect crop yield if sprinkler irrigation was used. Surface irrigation with water high in chloride will not cause as much damage as sprinkler irrigation.

Livestock Quality

One well (number 10) has an EC value and sulfate level above what is recommended for livestock. All other wells are below the standards for livestock.

Drinking Water

All wells except (numbers 15 and 16) exceed the aesthetic drinking water standard for EC. This is a flavor and color standard and not considered a health problem. Wells (numbers 4, 5, 7, 8, 9, 10, 12, 20, 27, and 28) are high in salts and exceed health standards for drinking water.

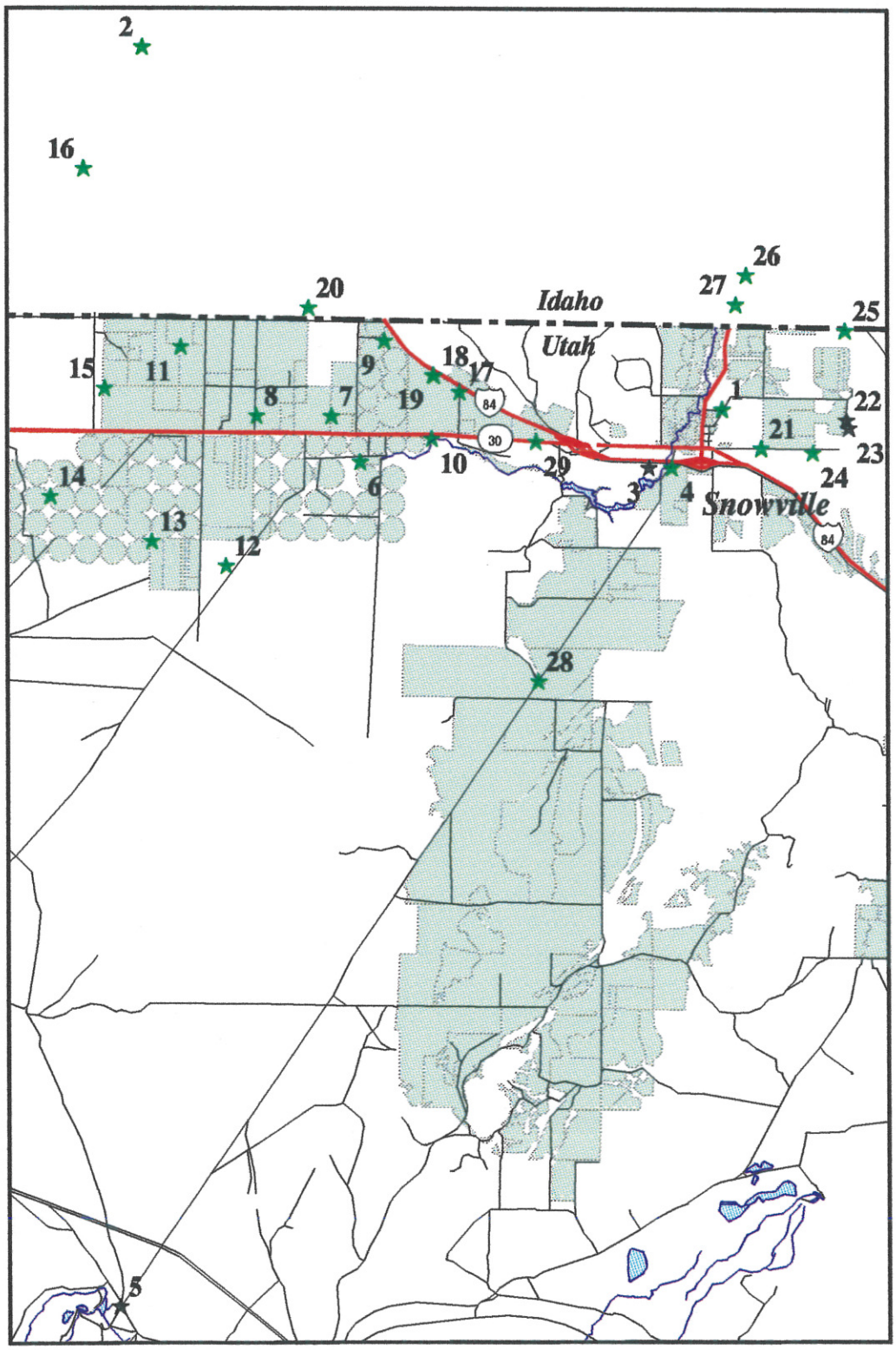
Well (number 3) exceeds the aesthetic standard for iron (Fe). Again this is not a health issue, but one of flavor and color. Well (number 20) also exceeds the aesthetic standard for manganese (Mn). Three wells (numbers 4, 10, and 27) exceed the aesthetic standard for sulfate.

Nitrates were detected in all wells, but only those wells having values greater than 0.09 are listed. Nirtrate values detected in the wells are very low except in well (number 10). This well is a drinking water well and exceeds the standard by a factor of four. Because of the high reading of nitrate, the well was resampled. Testing results were similar to those of the first sample.

1996 UDA Ground Water Sample Locations

Curlew Valley

Box Elder County, Utah Oneida County, Idaho



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Field Boundaries*
- *Agricultural Lands*
- *Water Bodies*
- *Sampling Sites - Springs*
- *Sampling Sites - Wells*

MAP LOCATION

MAP #8

Utah Department of Agriculture GIS
February 07, 1997

Table 11a - Box Elder County

Map 8

Irrigation and infiltration qualities for Curlew Valley, Box Elder County, Utah. Samples taken on August 20, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.4	1700	76.31	32.10	209.00	4.28	6.88	5.06
2	7.3	1750	119.41	52.31	338.00	5.36	9.25	6.49
3	7.4	1450	75.15	39.64	161.00	4.28	4.91	3.74
4	7.5	3250	170.63	85.66	343.00	5	7.53	5.35
5	7.4	4000	124.10	61.85	519.00	3.21	12.82	9.50
6	7.5	2050	129.13	61.77	176.00	4.64	4.47	3.19
7	7.2	3350	88.24	32.91	484.00	3.57	15.40	11.16
8	7.1	7000	520.38	155.44	488.00	2.32	7.93	4.82
9	7.4	3400	71.74	29.61	529.00	3.57	17.45	13.26
10	7.1	8400	425.85	286.08	810.00	5	10.07	7.44
11	7.3	880	89.72	21.03	34.97	2.86	1.31	0.86
12	7.5	3300	154.35	49.13	386.00	4.28	10.68	6.93
13	7.2	1700	164.65	43.89	87.36	2.86	2.49	1.56
14	7.6	1300	80.30	30.59	105.00	2.86	3.43	2.53
15	7.5	610	62.27	16.48	30.43	3.21	1.24	0.89
16	7.4	500	62.18	11.35	18.81	2.93	0.85	0.58
17	7.7	1600	103.99	49.57	140.00	3.21	3.82	2.83
18	7.5	1600	76.98	36.74	179.00	3.21	5.49	4.20
19	7.7	1800	48.18	21.60	300.00	3.64	11.15	9.02
20	7.4	6300	37.69	33.77	1094.00	1.07	29.04	31.17
21	7.6	1300	57.65	42.02	130.00	3.93	3.86	3.18
22	7.1	1600	74.24	32.81	208.00	3.21	6.65	5.05
23	7.3	1900	82.89	35.44	251.00	3.57	7.83	5.81
24	7.1	1700	120.98	56.16	350.00	3.57	9.11	6.59
25	6.9	1900	135.22	38.65	144.00	2.14	4.17	2.81
26	7.2	1370	95.16	41.51	120.00	6.43	3.67	2.58
27	7.8	2300	96.21	48.59	319.00	5.43	9.07	6.61
28	7.3	3200	55.25	24.82	524.00	3.93	18.69	14.71
29	7.3	2340	135.24	51.75	233.00	3.68	6.27	4.32

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality For Agriculture (Rev. 1)" page 63.

Table 11b - Box Elder County

Map 8

Other elements and ions associated with water quality for irrigation, surface water, and livestock for Curlew Valley, Utah. Samples taken on August 20, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.00	350.0	0.00	9	0.00	0.3	0.00	15.9	17.0	1.24	0.00
2	0.00	0.00	643.0	0.00	12	0.00	0.7	0.00	42.4	19.5	2.06	0.00
3	0.81	0.00	240.0	0.39	10	0.00	0.2	0.00	44.1	9.36	1.05	0.00
4	0.00	0.00	790.0	0.00	18	0.00	1.5	0.00	97.7	23.1	2.57	0.00
5	0.00	0.00	1121.	0.00	28	0.00	0.5	0.00	30.9	17.8	2.52	0.00
6	0.00	0.00	451.0	0.00	12	0.00	3.4	0.00	33.8	22.0	2.67	0.00
7	0.00	0.00	1152.	0.00	23	0.00	0.3	0.00	14.2	27.5	1.51	0.00
8	0.00	0.00	2180.	0.00	37	0.00	4.0	0.00	25.4	30.1	3.83	0.00
9	0.00	0.00	1010.	0.00	8	0.00	0.4	0.00	15.0	9.57	2.29	0.00
10	0.00	0.00	2293.	0.06	26	0.00	41.4	0.00	257.	12.8	4.90	0.04
11	0.00	0.00	163.0	0.00	11	0.00	1.5	0.00	7.93	31.2	0.55	0.00
12	0.00	0.00	857.0	0.00	21	0.00	1.1	0.00	40.6	25.9	1.44	0.00
13	0.00	0.00	420.0	0.00	13	0.00	0.8	0.00	15.1	26.8	1.01	0.00
14	0.00	0.00	331.0	0.00	23	0.00	0.4	0.00	8.43	37.2	1.27	0.00
15	0.00	0.00	71.4	0.00	7	0.00	0.6	0.00	7.87	30.4	0.46	0.00
16	0.00	0.00	48.1	0.00	5	0.00	0.7	0.00	5.77	23.2	0.27	0.00
17	0.00	0.00	391.0	0.00	4	0.00	0.8	0.00	12.7	10.0	1.92	0.00
18	0.00	0.00	261.0	0.00	4	0.00	0.7	0.00	10.9	9.69	1.00	0.00
19	0.00	0.00	422.0	0.00	5	0.00	0.3	0.00	11.0	9.03	1.34	0.00
20	0.00	0.00	1908.	0.00	16	0.13	0.3	0.00	2.29	2.07	1.42	0.00
21	0.00	0.00	271.0	0.00	26	0.03	0.0	0.00	10.2	37.9	1.27	0.00
22	0.00	0.00	366.0	0.00	7	0.00	0.1	0.00	12.7	7.68	1.84	0.00
23	0.00	0.00	457.0	0.00	7	0.00	0.0	0.00	13.9	7.27	2.14	0.00
24	0.00	0.00	625.0	0.00	12	0.00	0.7	0.00	69.2	22.4	2.15	0.00
25	0.00	0.00	469.0	0.00	17	0.00	3.2	0.00	13.5	8.87	1.14	0.19
26	0.19	0.15	167.0	0.00	23	0.00	1.7	0.10	28.0	18.8	0.84	0.18
27	0.00	0.32	271.0	0.00	11	0.00	0.4	0.00	108.	19.2	1.48	0.00
28	0.00	0.18	875.0	0.00	33	0.00	0.3	0.00	21.5	23.0	1.16	0.10
29	0.00	0.00	569.0	0.00	15	0.00	2.0	0.00	37.0	19.7	1.90	0.00

* Sample Sites: wells, drains and springs

San Juan County

The local UACD leaders assisted in locating seventeen wells east of Monticello, Utah . This area was selected to ensure information is available for southeast Utah. These wells were sampled on September 12 and 13. The crops in the area are primarily dryland crops. It was unique that so many wells in the area had detectable manganese, iron, and sulfur. The wells are used basically for livestock and culinary purposes. Map # 9 has the well locations for all sample sites. The chemical analyses are listed on Tables 12a and 12b.

Irrigation Quality

The EC values range from 360 umhos / cm at well (number 11) to 4,600 umhos / cm at well (number 7). Since the wells are not used for irrigation, the high EC values are not critical.

All wells have bicarbonate (HCO_3) above the safe level. Bicarbonate affects the way salts reacts in the soil and are taken into considered in calculating the adjusted Sodium Adsorption Ratio (R_{Na}). Bicarbonate in sprinkler irrigation water can cause white speckling on fruits which lowers the fruits market appeal.

The R_{Na} that exceeds standard levels was found in all wells except (numbers 1, 8, 9, 10, and 11). All but one well (number 16) has SAR values that exceed the standard. This SAR value indicates well (number 16) is a borderline case. SAR values give an estimate of how sodium replaces other minerals such as calcium and magnesium in the soil. Sodium causes the soil particles to deflocculates, lowering soil permeability

Two wells (numbers 7 and 15) have high chloride levels, with well (number 17) being severe. Chloride is toxic to plants and lowers yield by destroying plant cells. If wells (numbers 7 and 15) are used for sprinkler irrigation, crop production would be effected. Using water high in chloride for surface irrigation will not cause as much damage as sprinkling irrigation.

Three of the wells (numbers 6, 9, and 11) have toxic levels of manganese (Mn).

Livestock Quality

Because four wells (numbers 3, 6, 7, and 8) have high sulfate levels that exceed standards it could present problems if used in watering livestock.

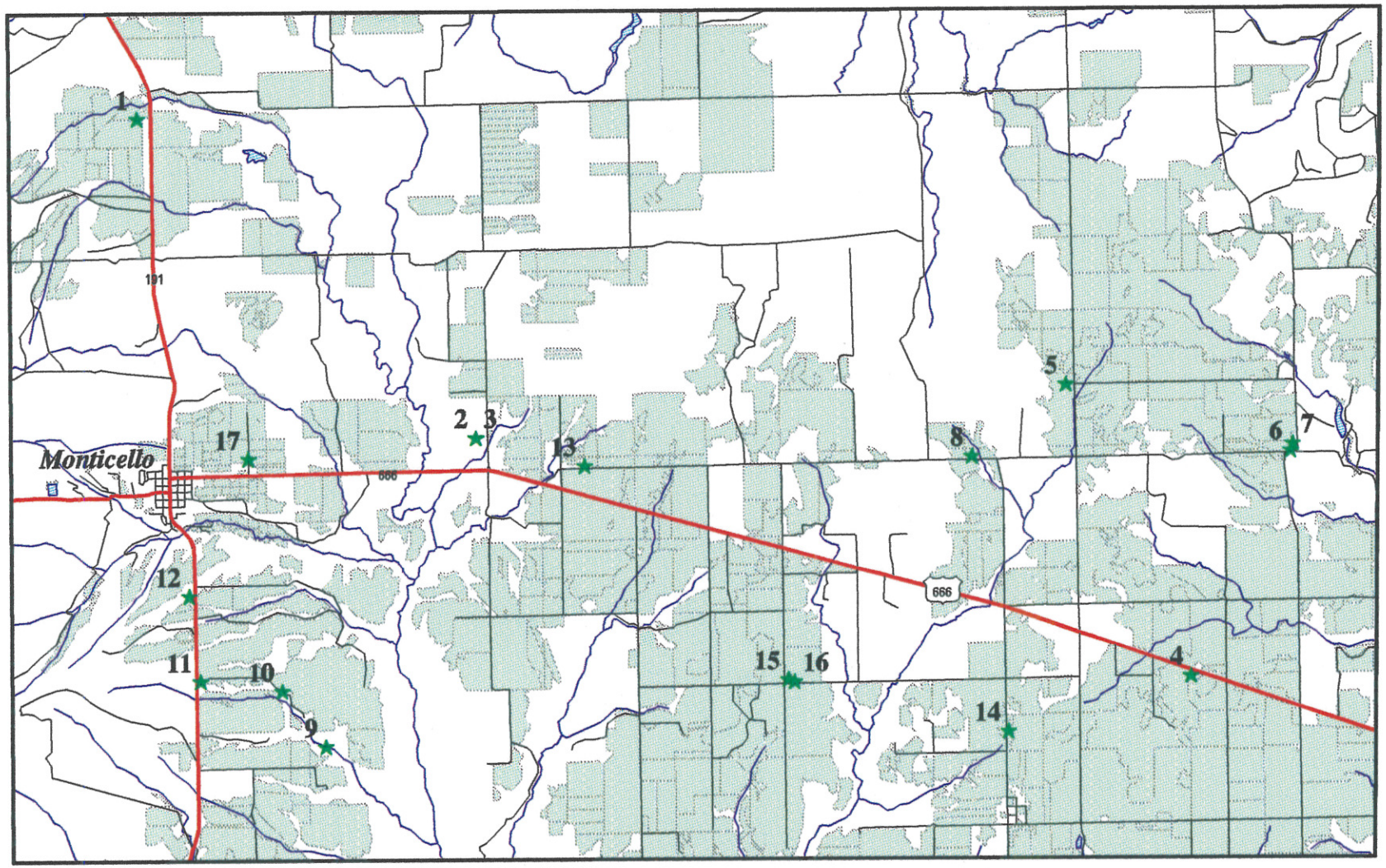
Drinking Water

The wells that exceed safe limits for irrigation also exceed the aesthetic drinking water standard for EC. This is a flavor and color standard and not considered a health problem. Wells (numbers 3, 6, and 7) exceed the health standard.

Wells (numbers 2 and 6) exceed the aesthetic standard for iron (Fe). Again this is not a health issue, but one of flavor and color. Wells (numbers 1, 6, 8, 9, 11, and 17) also exceed the aesthetic standard for manganese (Mn). Wells (numbers 3, 6, 7, 8, and 15) exceed the aesthetic standard for sulfate.

The highest nitrate level is 8.6 ppm in well (number 16) which is approaching the area of concern, but is still below the health standard. All other wells have very low in nitrate levels.

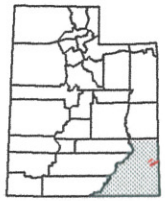
Utah Department of Agriculture GIS



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Field Boundaries*
- *Agricultural Lands*
- *Water Bodies*
- ★ *Sampling Sites - Wells*

MAP LOCATION



Monticello (San Juan County), Utah
Ground Water Sample Locations
February 07, 1997

MAP #9

Table 12a - San Juan County

Map 9

Irrigation and infiltration qualities east of Monticello, San Juan County, Utah. Samples taken on September 12, and 13, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.1	510	55.57	14.41	32.00	4.28	1.41	0.99
2	7.2	1100	6.12	4.12	230.00	6.43	14.30	17.62
3	7.7	3500	40.79	16.62	747.00	21.42	35.37	24.90
4	8.9	920	9.00	16.82	167.00	2.14	6.19	7.59
5	7.1	870	28.86	15.47	135.00	5	5.93	5.04
6	6.4	3900	321.00	242.00	250.00	5	3.38	2.56
7	6.8	4600	381.00	126.00	518.00	9.64	9.65	5.88
8	7.1	1600	203.00	48.39	85.00	6.43	2.43	1.39
9	7.6	410	46.32	9.12	27.91	2.5	1.28	0.98
10	7.5	410	49.48	8.50	28.41	3.57	1.41	0.98
11	7.5	360	54.37	6.71	13.90	2.86	0.71	0.47
12	7.4	1400	4.21	4.04	336.00	10	23.21	28.06
13	7.7	1160	10.42	4.57	258.00	6.25	15.74	16.76
14	7.5	1400	44.91	11.58	287.00	9.64	14.85	9.88
15	7.2	2700	226.00	93.74	226.00	4.64	4.76	3.19
16	7.4	1170	95.44	36.89	114.00	4.64	3.61	2.51
17	7.4	680	38.56	12.29	100.00	3.57	4.48	3.59

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 12b - San Juan County

Map 9

Other elements and ions associated with water quality for irrigation, surface water, and livestock for east of Monticello, San Juan County, Utah. Samples taken on September 12 and 13, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.0	0.06	0	0.16	0.0	0.00	19.88	4.58	0.95	0.04
2	0.00	13.0	1.00	0	0.00	0.0	0.00	64.81	3.51	0.26	0.00
3	0.19	55.2	0.00	8	0.00	0.8	0.00	216.00	3.39	2.42	0.00
4	0.00	48.2	0.09	3	0.00	0.2	0.00	68.26	0.47	0.67	0.00
5	0.00	12.8	0.14	8	0.03	0.0	0.00	44.85	3.27	0.81	0.00
6	0.00	143.	6.28	11	1.08	0.0	2.76	582.00	4.27	8.67	0.07
7	0.00	237.	0.00	9	0.00	3.7	2.80	578.00	4.66	10.7	0.00
8	0.00	7.4	0.00	5	0.15	0.3	0.00	168.00	4.17	3.57	0.00
9	0.00	0.0	0.08	0	0.27	0.2	0.00	23.73	4.04	0.89	0.08
10	0.00	6.2	0.00	0	0.00	0.0	0.00	3.43	12.3	0.46	0.11
11	0.00	0.0	0.00	0	0.28	0.0	0.00	14.17	4.10	0.51	0.04
12	0.00	21.7	0.00	0	0.00	0.0	0.00	59.27	3.64	0.22	0.05
13	0.00	19.7	0.06	6	0.00	0.3	0.00	72.88	3.13	0.43	0.48
14	0.00	53.4	0.00	7	0.00	1.4	0.00	59.27	4.98	0.67	0.24
15	0.00	447.	0.00	0	0.00	4.3	0.00	164.00	5.53	1.81	0.23
16	0.00	96.1	0.00	0	0.00	8.6	0.00	65.77	6.76	1.02	0.06
17	0.00	0.0	0.00	0	0.11	0.0	0.00	48.04	4.19	0.80	0.10

* Sample Sites: wells, drains and springs

Rich County

On October 3, 22 wells in Rich County were sampled. The sample area was selected with a recommendation from the Utah Division of Water Rights and sampled with the help of Cloyce Smith of the Natural Resources Conservation Service. The wells are primarily used for livestock and a few wells are used for private culinary purposes. Map #10 shows the location for all sample sites. The chemical analyses are listed on Tables 13a and 13b.

Irrigation Quality

Twelve wells have EC values high enough to require special management practices when used for irrigation. Only well (number 18) has a high enough values of EC to really inhibit crop growth. All wells except (number 18) have bicarbonate (HCO_3) above the safe level. Bicarbonate affects the way salts react in soil and are taken into consideration in calculating the adjusted Sodium Adsorption Ratio (R_{Na}). Bicarbonate in sprinkler irrigation water can cause white speckling on fruit which lowers the fruit's market appeal.

Wells (numbers 1, 7, 14, and 18) have R_{Na} levels that exceed the standards. Only wells (numbers 14 and 18) have SAR values that exceed the standards. This indicates that the SAR values for wells (numbers 1 and 7) are borderline. Well (number 18) is extremely high and would adversely affect soil production if the water was used for irrigation. The SAR values estimate the impact sodium replacement will have on other minerals such as calcium and magnesium in the soil. Sodium causes the soil particles to deflocculate lowering soil permeability.

Wells (numbers 11 and 18) have high chloride levels with well (number 18) being severe. Chloride is toxic to plants and lowers yield by destroying plant cells. If these wells were used for sprinkler irrigation, the water would lower crop yields. Using water high in chloride for surface irrigation will not cause as much damage as sprinkling irrigation.

Wells (numbers 3, 4, 9, 10, 11, 12, 15, and 18) have toxic levels of manganese (Mn).

Livestock Quality

Well (number 18) has high sulfate levels that would affect livestock. All the other wells should be fine for livestock use.

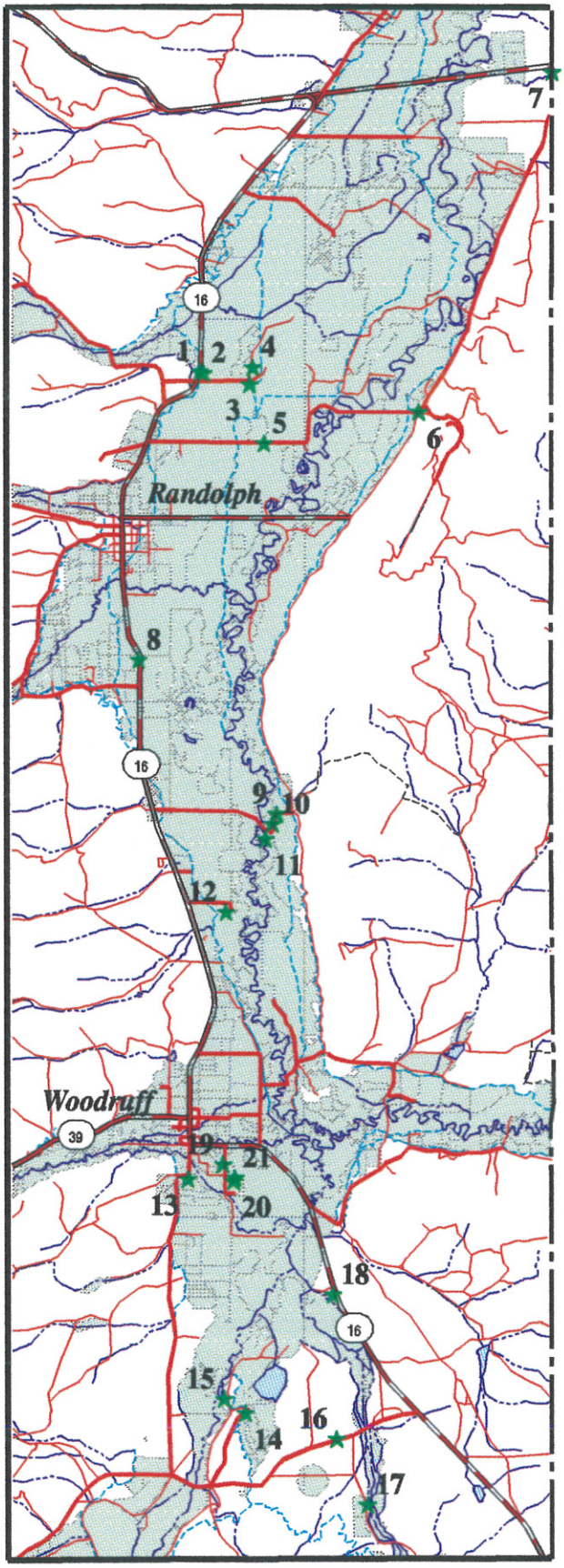
Drinking Water

Wells (numbers 1, 2, 7, 10, 11, 14, 15, and 18) exceed the aesthetic drinking water standards for EC. This is a flavor and color standard and not a health problem. Only one well (number 18) exceeds the health standard.

Wells (numbers 4, 9, 12, and 17) exceed the aesthetic standard for iron (Fe). Again this is not a health issue, but one of flavor and color. Wells (numbers 2, 4, 9, 10, 11, 12, 15, and 18) exceed the aesthetic standard for manganese (Mn). Well (number 18) exceeds the aesthetic standard for sulfate.

Nitrate levels that exceed the drinking water standard were detected in wells (numbers 1, 2, and 21.) These wells were influenced by feedlots and septic systems.

Utah Department of Agriculture GIS



Transportation - Roads

- *Primary - Interstate Highway*
- *Secondary - US & State Highway*
- *Connecting - County Road*
- *City Street and Unimproved Road*
- *Four-Wheel Drive Road*
- *Special Road Feature*
- *Other Thoroughfare*

Hydrography - Water Bodies

- *Water Body*

Hydrography - Water Courses

- *Perennial Stream*
- *Intermittent Stream*
- *Braided Stream*
- *Perennial Canal or Aqueduct*
- *Intermittent Canal or Aqueduct*

Water-Related Land Use

- *Agricultural Land*

Diversion Points

- ★ *Sampling Sites - Wells*

MAP LOCATION

Rich County, Utah

Ground Water Sample Locations

February 07, 1997

MAP #10

Table 13a - Rich County

Map 10

Irrigation and infiltration qualities for Rich County, Utah. Samples taken on October 3, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.2	1800	69.78	95.10	163.00	9.28	3.48	2.98
2	7.4	1310	58.95	76.08	95.63	8.57	2.26	1.94
3	7.2	539	28.61	29.17	19.91	2.5	0.66	0.63
4	7.5	625	49.18	31.81	15.80	3.57	0.52	0.43
5	7.6	500	60.33	22.03	9.62	4.64	0.37	0.27
6	7.5	730	67.87	29.13	34.19	4.64	1.19	0.87
7	7.2	1420	91.99	52.84	120.06	6.43	3.29	2.47
8	7.2	780	73.27	36.58	32.80	6.07	1.06	0.78
9	7.7	735	69.19	30.35	39.56	5.71	1.38	1.00
10	7.4	1050	67.72	52.72	76.21	7.85	2.12	1.69
11	7.1	1590	91.51	70.08	103.96	8.14	2.54	1.99
12	7.2	565	47.28	22.15	32.16	3.93	1.23	0.97
13	7.4	495	68.80	15.47	10.05	4.36	0.43	0.28
14	7.4	950	43.50	28.50	113.19	6.5	4.07	3.28
15	7.3	1380	82.03	90.92	59.26	8.03	1.29	1.07
16	7.7	540	29.73	22.31	45.57	3.93	1.73	1.54
17	7.7	490	35.26	29.68	19.02	4.0	0.65	0.57
18	7.2	6400	250.59	91.44	773.24	1.43	15.82	10.62
19	7.2	510	70.72	15.86	11.36	4.28	0.49	0.32
20	7.2	578	82.09	18.24	11.65	5.0	0.49	0.30
21	6.9	760	103.13	23.23	15.17	5.0	0.58	0.35

* Sample Sites: wells, drains and springs

** R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 13b - Rich County

Map 10

Other elements and ions associated with water quality for irrigation, surface water, and livestock for Rich County, Utah, October 3, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.370	153.0	0.00	6	0.00	19.6	0.00	47.9	17.0	1.87	0.00
2	0.00	0.170	111.0	0.00	0	0.00	11.5	0.00	24.3	18.7	1.21	0.00
3	0.00	0.00	94.3	0.12	6	0.29	0.1	0.00	0.00	1.08	0.14	0.00
4	0.00	0.00	84.7	0.67	5	0.18	0.0	0.00	4.90	3.18	0.28	0.00
5	0.00	0.00	15.5	0.00	0	0.00	0.8	0.00	5.50	6.14	0.27	0.00
6	0.00	0.00	55.2	0.00	0	0.00	0.0	0.00	29.9	5.83	0.44	0.00
7	0.00	0.00	130.0	0.00	5	0.00	2.5	0.00	80.5	7.28	0.88	0.00
8	0.00	0.00	33.1	0.00	0	0.00	0.2	0.00	11.0	9.13	0.37	0.00
9	0.00	0.009	41.8	0.33	0	0.62	0.0	0.00	10.4	5.89	0.27	0.00
10	0.00	0.00	67.7	0.16	0	0.20	0.0	0.00	19.6	7.00	0.49	0.00
11	0.00	0.00	186.0	0.16	24	0.51	3.7	0.00	35.7	7.71	0.44	0.05
12	0.00	0.00	44.0	0.30	0	0.49	0.0	0.00	3.80	4.87	0.21	0.00
13	0.00	0.00	11.2	0.00	0	0.00	0.1	0.00	5.00	6.45	0.24	0.09
14	0.00	0.240	68.3	0.00	7	0.00	1.1	0.00	22.7	19.6	0.83	0.00
15	0.00	0.00	129.0	0.00	6	0.81	0.3	0.00	38.0	11.1	0.70	0.00
16	0.00	0.00	28.2	0.15	5	0.00	0.0	0.00	7.50	3.45	0.75	0.00
17	0.00	0.00	8.6	0.42	5	0.00	0.0	0.00	9.80	3.73	0.88	0.00
18	0.00	0.420	1538.	0.28	50	0.18	0.0	0.00	224.	12.3	7.07	0.20
19	0.00	0.00	13.4	0.00	0	0.00	0.6	0.00	5.90	4.01	0.24	0.00
20	0.00	0.00	16.4	0.00	0	0.00	1.7	0.00	6.90	4.43	0.26	0.00
21	0.00	0.00	33.3	0.00	6	0.00	11.3	0.00	8.90	4.51	0.32	0.00

* Sample Sites: wells, drains and springs

Iron County

With a recommendation from the Utah Division of Water Rights, 20 wells were sampled in Cedar Valley in Iron County on October 9 1996. These wells in are used for irrigation, culinary purposes and livestock. Generally this water is well suited for irrigation and no serious problems were found. The chemical analyses are listed on Tables 14a and 14b. Map #11 shows the location of all sample sites

Irrigation Quality

The water in this area is generally saline with 15 of the 20 samples having EC values exceeding 750 umhos / cm. The EC values range is from 380 umhos / cm at well (number 5) to 2,100 umhos / cm at well (number 16). Though the EC values for the area are high, most crops can be grown, except salt sensitive vegetables such as beans.

All wells but (number 5) have bicarbonate (HCO_3) above the safe level. Bicarbonate affects the way salts react in soil and are taken into consideration in calculating the adjusted Sodium Adsorption Ratio (R_{Na}). Bicarbonate in sprinkler irrigation water can cause white speckling on fruits which lowers the fruits market appeal.

All R_{Na} and SAR values are acceptable to use the water for irrigation.

Well (number 2) has a high chloride level. Chloride is toxic to plants and lowers yield by destroying plant cells. Using water high in chloride for surface irrigation will not cause as much damage to crops as sprinkler irrigation. Well (number 7) has toxic levels of manganese (Mn).

Livestock Quality

Wells (numbers 9, 11, 14, and 16) have high sulfate levels that can have an impact on livestock production.

Drinking Water

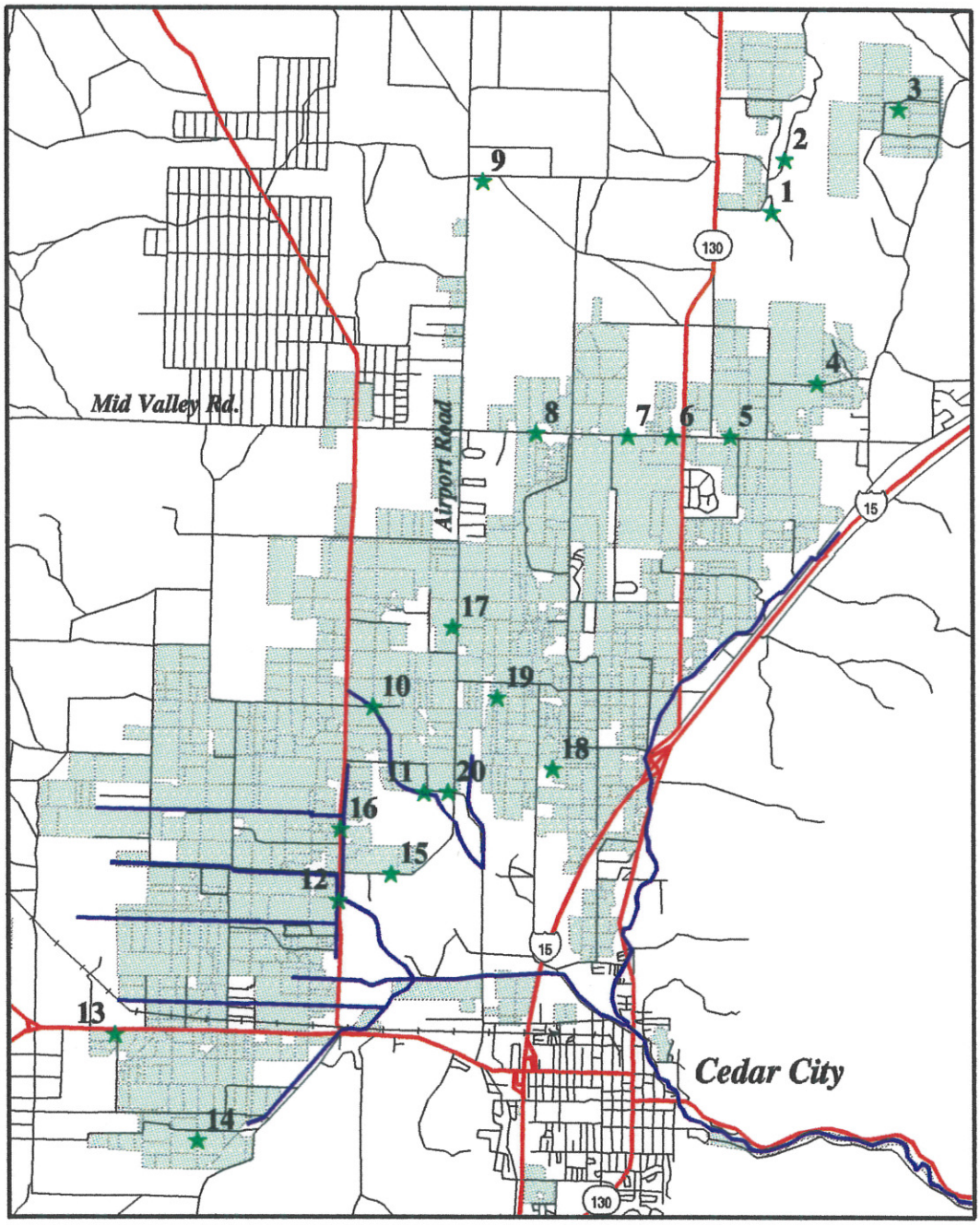
Wells (numbers 2, 3, 7, 9, 11, 12, 14, 15, 16, 17, 18, 19, and 20) exceed the aesthetic drinking water standard for EC. This is a flavor and color standard and not a health problem. None of the wells exceeded the health standard.

Wells (numbers 2 and 7) exceed the aesthetic standard for iron (Fe). Again this is not a health issue but one of flavor and color. Wells (numbers 2, 7, and 10) also exceed the aesthetic standard for manganese (Mn). Wells (numbers 7, 9, 11, 12, 14, 15, 16, 17, and 20) exceed the aesthetic standard for sulfate.

Nitrate was detected in all wells, but only those having values greater than 0.09 are listed. The high was 7.6 ppm nitrogen nitrates which is approaching the area of concern in well (number 9)

1996 UDA Ground Water Sample Locations

Cedar Valley (Iron County), Utah



LEGEND

- *Water Courses*
- *Primary Roads*
- *Secondary Roads*
- *Railroads*
- *Field Boundaries*
- *Agricultural Lands*
- ★ *Sampling Sites - Wells*

MAP LOCATION

MAP #11

Utah Department of Agriculture GIS
February 07, 1997

Table 14a - Iron County

Map 11

Irrigation and infiltration qualities for Cedar Valley, Utah. Samples taken on October 9, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	pH	EC umhos/cm	Ca ppm	Mg ppm	Na ppm	HCO_3 meq/L	**R_{Na}	SAR
1	7.4	625	46.60	30.76	33.69	3.75	1.15	0.94
2	7.2	1450	79.90	66.13	84.95	3.93	2.08	1.70
3	7.2	870	54.43	37.03	60.28	4.28	1.90	1.54
4	7.6	480	44.03	23.68	15.95	3.64	0.59	0.48
5	7.5	380	17.44	17.00	20.92	1.07	0.71	0.85
6	6.9	645	60.79	40.59	22.42	3.21	0.67	0.55
7	6.6	1220	100.35	87.55	50.65	1.78	1.06	0.89
8	7.0	770	72.52	49.74	26.83	2.07	0.71	0.59
9	7.8	1650	239.65	98.66	25.67	4.36	0.53	0.35
10	7.7	780	75.66	51.47	12.09	3.21	0.33	0.26
11	7.5	1780	214.57	123.69	17.01	3.07	0.31	0.23
12	6.9	1780	216.20	115.17	28.81	5.36	0.56	0.39
13	7.7	600	58.41	39.15	9.32	2.14	0.27	0.23
14	7.4	1600	153.57	91.93	75.13	2.86	1.57	1.18
15	7.1	1145	131.92	75.29	19.20	4.11	0.45	0.33
16	7.2	2100	268.30	146.41	34.72	6.07	0.60	0.42
17	7.2	1030	117.45	65.39	14.89	4.0	0.37	0.27
18	7.5	900	111.78	56.79	10.90	6.43	0.29	0.21
19	7.3	1055	117.97	67.03	16.39	6.78	0.41	0.30
20	7.2	1185	152.30	66.94	16.45	5.53	0.41	0.28

* Sample Sites: wells, drains and springs

**R_{Na} : Adjusted SAR for HCO_3 as described in "Water Quality for Agriculture (Rev. 1)" page 63.

Table 14b - Iron County

Map 11

Other elements and ions associated with water quality for irrigation, surface water, and livestock for Cedar Valley, Utah. Samples taken on October 9, 1996. **Shaded** values exceed established guidelines.

*Sample Sites	Al ppm	B ppm	Cl ppm	Fe ppm	K ppm	Mn ppm	NO_3 ppm	PO_4-P ppm	S ppm	Si ppm	Sr ppm	Zn ppm
1	0.00	0.00	33.1	0.00	5	0.00	0.6	0.00	23.6	18.4	0.83	0.00
2	0.00	0.00	211.	0.31	7	0.09	0.5	0.00	57.4	20.5	1.43	0.00
3	0.00	0.00	86.6	0.00	5	0.00	3.3	0.00	21.2	16.0	0.69	0.00
4	0.00	0.00	0.0	0.00	5	0.00	0.8	0.00	11.4	22.6	0.36	0.00
5	0.00	0.00	64.8	0.20	4	0.02	0.0	0.00	7.23	0.69	0.32	0.00
6	0.00	0.00	18.6	0.00	5	0.00	2.6	0.00	38.4	22.7	0.98	0.00
7	0.00	0.00	70.7	0.34	6	0.34	0.4	0.00	157.	3.14	1.59	0.00
8	0.00	0.00	13.8	0.00	0	0.00	1.0	0.00	79.3	13.4	1.42	0.00
9	0.00	0.00	23.1	0.00	4	0.00	7.6	0.00	200.	9.54	1.77	0.00
10	0.00	0.00	11.8	0.09	0	0.06	1.2	0.00	71.6	7.38	1.35	0.00
11	0.00	0.00	25.7	0.00	0	0.00	7.1	0.00	271.	9.35	2.48	0.00
12	0.00	0.00	32.4	0.00	0	0.00	6.1	0.00	217.	9.91	1.99	0.00
13	0.00	0.00	12.9	0.00	0	0.00	1.8	0.00	47.0	10.8	1.14	0.00
14	0.00	0.17	69.9	0.00	0	0.00	4.8	0.00	197.	16.3	2.87	0.00
15	0.00	0.00	11.5	0.00	0	0.00	4.2	0.00	130.	8.71	1.24	0.00
16	0.00	0.00	33.1	0.00	0	0.00	4.3	0.00	286.	10.2	2.31	0.00
17	0.00	0.00	16.7	0.00	0	0.00	4.2	0.00	101.	10.2	1.60	0.00
18	0.00	0.00	7.1	0.00	0	0.00	1.9	0.00	37.1	10.4	1.34	0.00
19	0.00	0.00	14.8	0.00	0	0.00	3.2	0.00	52.9	10.7	1.45	0.00
20	0.00	0.00	15.5	0.00	0	0.00	3.2	0.00	104.	8.48	1.22	0.00

* Sample Sites: wells, drains and springs

Appendix I:
Critical Values for Tested Parameters

Magnitude of Problem

Irrigation Parameters	Moderate	Severe
EC (Electrical Conductivity) Measures total salts in solution:	>750 umhoms/cm	> 3,000 umhoms/cm.
SAR (Sodium Absorption Ratio) Estimates activity of Sodium in the soil.	> 3 meq/l.	> 9 meq/l.
SAR_{adj} (R_{Na})		
Chloride.		
For sprinkler irrigation		> 3 meq/l. (145 Cl ppm)
For surface irrigation	> 4 meq/l.	> 10 meq/l.(355 Cl ppm)
Boron.	> 0.7 ppm	> 10.0 ppm.
HCO_3 (Bicarbonate).		
For sprinkler irrigation.	> 1.5 meq/l.	> 8.5 meq/l.
Al (Aluminum).	> 5.0 ppm.	
Cu (Copper).	> 0.2 ppm.	
Fe (Iron).	> 5.0 ppm.	
Mn (Manganese).	> 0.2 ppm.	
Zn (Zinc).	> 2.0 ppm.	
Se (Selenium).	> 0.02 ppm.	

Livestock		Human	
Min. Level		**Min. Level**	
EC (umhoms/cm)	> 8,332	EC (umhoms/cm)	> 3,333 (833.33*)
Sulfate	> 167 ppm	Nitrate (NO_3-N)	> 10 ppm
Nitrate (NO_3-N)	> 100 ppm	As (Arsenic)	> 0.05 ppm
Al (Aluminum)	> 5 ppm	Ba (Barium)	> 1.0 ppm
As (Arsenic)	> 0.2 ppm	Cd (Cadmium)	> 0.01 ppm
B (Boron)	> 5.0 ppm	Cr (Chromium)	> 0.05 ppm
Cd (Cadmium)	> 0.05 ppm	Cu (Copper)	> 1.0 ppm
Cr (Chromium)	> 1.0 ppm	Fl (fluoride)	> 2.0 ppm
Co (Cobalt)	> 1.0 ppm	Fe (Iron)	> 0.3 ppm*
Fl (Fluoride)	> 2.0 ppm	Pb (Lead)	> 0.05 ppm
Pb (Lead)	> 0.1 ppm	Mn (Manganese)	> 0.05 ppm*
Se (Selenium)	> 0.05 ppm	Se (Selenium)	> 0.01 ppm
Zn (Zinc)	> 25.0 ppm	Zn (Zinc)	> 5.0 ppm*
		Sulfate	> 83 ppm*

Critical values are from: Table 1, page 8 and Table 6, page 40 of "Water Quality for Agriculture", FAO Irrigation and drainage paper 29 revision 1; and USU information sheets, "Water Quality Analysis (For Irrigation)" and "Analysis of Water Quality for Livestock" EL 280.

*These values are for secondary Drinking Water Standards and for aesthetics water quality.