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EVALUATION OF GROUND WATER AS A WATER SUPPLY SOURCE
FOR THE CITY OF SODA SPRINGS

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IDAHO DEPARTMENT OF
ENVIRONMENTAL QUALITY

Prepared for the
City of Soda Springs

June 28, 1988

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INTRODUCTION

The purpose of this report is to present an evaluation of ground water as a potential water supply source for the City of Soda Springs, Idaho. The present water supply is from Formation and Ledge Springs (figure 1). The specific objectives of the study were outlined in a letter from A.A. Hudson and Associates dated March 21, 1988. These objectives are listed below.

1. Determine whether Ledge Spring and Formation spring originate from the same source.
2. Determine where, within the general area of Soda Springs, would be the best areas to drill a test well to provide better quality water of sufficient quantity to replace Ledge Springs and possibly Formation Spring. Special consideration should be given to city-owned property.
3. Develop a drilling and testing program to provide data on water quality and quantity from a test well.
4. Analyze the findings of the test well program in relation to the proposed water storage facility on Rabbit Hill.

In addition, Ted Sorenson indicated by telephone that the potential for drilling a shallow well at the site of Ledge Spring should be evaluated.

The scope of work of this project was limited to the review and analysis of available data. Material reviewed included: published hydrogeologic reports on the Soda Springs area, a portion of an unpublished report for the Monsanto property located north of the city and logs of wells drilled in the general vicinity of the city obtained from the Idaho Department of Water Resources.

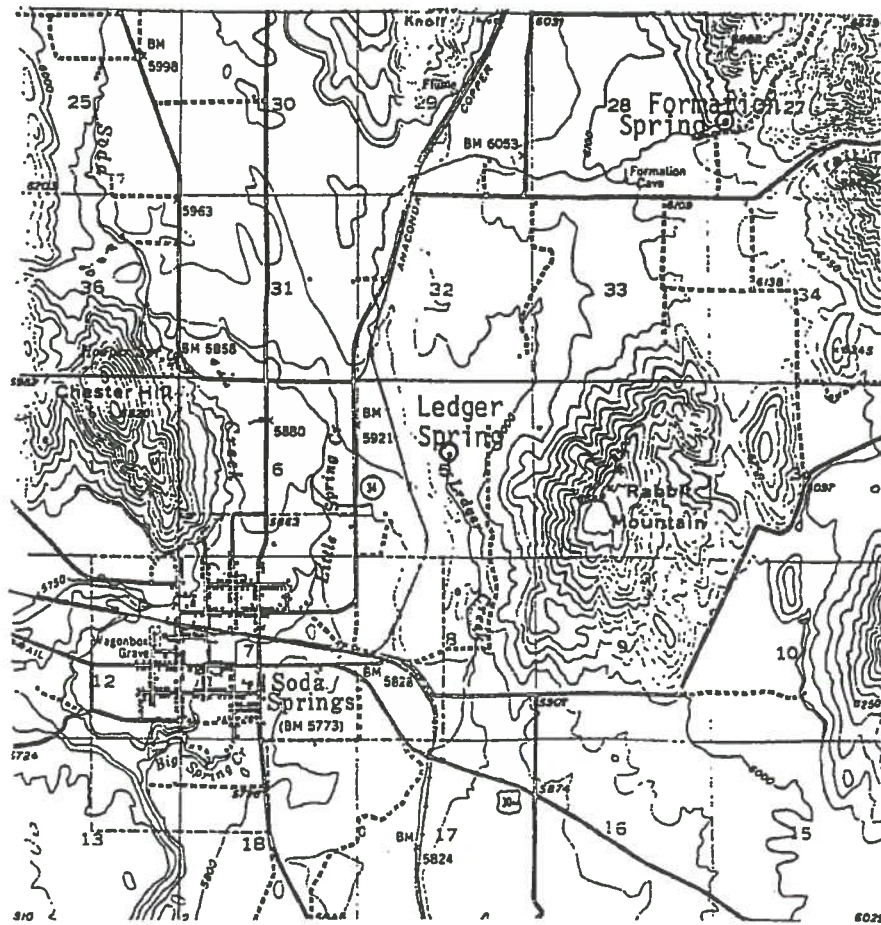


Figure 1. Location map of the Soda Springs area showing Formation Spring and Ledge Spring.

HYDROGEOLOGY

The hydrogeologic setting of Soda Springs includes four major types of rocks (figure 2). First, the area is underlain at depth by a thick section of upper Paleozoic and lower Mesozoic strata, primarily sandstones, limestones and shales (noted as undifferentiated bedrock on figure 2). These older sedimentary rocks make up the Aspen Range to the east and the Bear River Range to the southwest. Second, Tertiary age sedimentary rocks of the Salt Lake Formation overlie the older sedimentary rocks at depth under the city and outcrop on Rabbit Hill. Third, Quaternary olivine basalt overlies the Salt Lake Formation sediments and outcrops over most of the valley area near Soda Springs. Fourth, deposits of gravel, sand and silt and deposits of calcareous tufa and travertine occur near the city and along the front of the Aspen Range. The tufa-travertine deposits were formed by the historic discharge of carbonate-rich water from springs originating from the older sedimentary rocks.

The western edge of the Aspen Range represents an abrupt truncation of the older sedimentary rocks by a major fault zone (Mayo, 1982). Figure 2 shows of locations of the major faults in the Soda Springs area. Armstrong (1969) suggests that 2,700 to 4,500 feet of offset is present along the fault zone on the western front of the Aspen Range. This major structural feature has important implications with respect to ground water flow systems, particularly those represented by Formation Spring and Ledge Spring. The thrust faults underlying the city are also important with respect to ground water occurrence and movement. The thrust faults are noted on figure 2 with the triangles on the upper plate side of the fault.

The area west of the major fault zone including the City of Soda Springs is composed of a sequence of basalts and sediments (Salt Lake

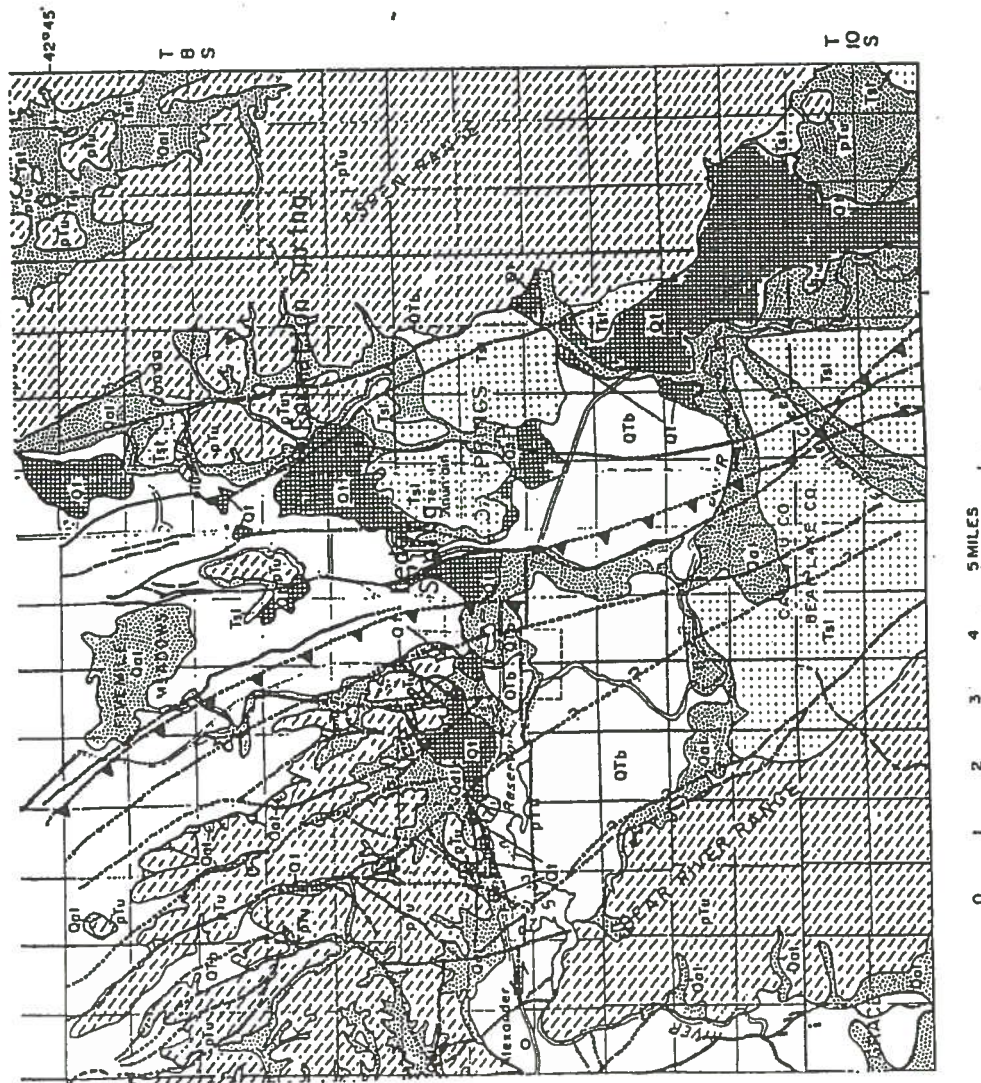


Figure 2. Geologic map of the Soda Springs area (from Dion, 1974).

Formation) with surfacial deposits of tufa/travertine. A generalized northeast-southwest cross section just north of the city is presented in figure 3 after Armstrong (1969). The cross section shows the contact between the basalts and the underlying sediments.

The complex geologic setting in the area surrounding Soda Springs is reflected in a complex pattern of ground water flow and surface springs. The dominant pattern of ground water flow near Soda Springs is from north to south reflecting water movement in the basalts from the Blackfoot Reservoir area south to discharge areas at Five Mile Meadows and the Bear River (Dion, 1974). Contours of equal ground water level in the basalt are shown on figure 4. A second more regional ground water flow system exists in the older sedimentary rocks within the Meade Thrust Block to the east and northeast of Soda Springs. Mayo (1982) describes this system as originating with recharge in the mountain ranges located east to the city (particularly the Webster Range). Discharge occurs along the western front of the Aspen Range controlled primarily by the complex structural features of the fault system. Important discharge points for this system include Woodall and Formation springs. Ledge Spring also is believed to originate from this system, based on water quality data (Ralston, 1984).

The limited well log data from the Soda Springs area provide additional information on the hydrogeology near the city (table 1). The sites for which well logs are available are grouped into three general areas. First, information is available for ten wells near the Monsanto plant site north of the city (T8S, R42E, Section 31). Second, logs are available for 17 private wells in and south of the city (T9S, R41E, Sections 12 and 13; T9S, R42E, Sections 6, 7, 8 and 18). The third group includes well logs for ten sites east of the city in T9S, R42E, Section 9.

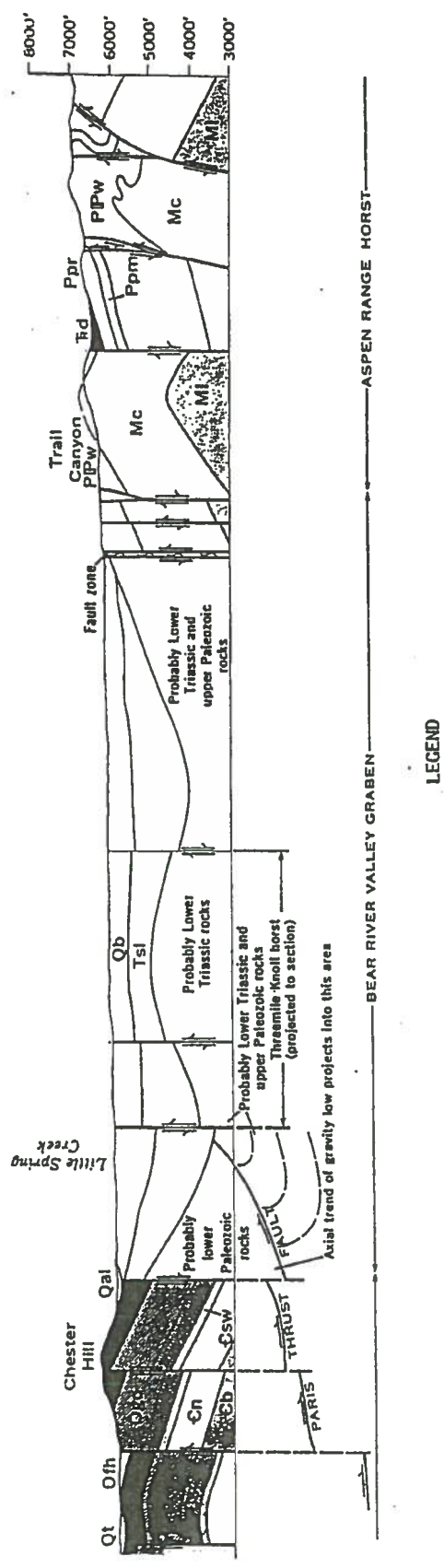


Figure 3. Northeast-southwest cross section near Soda Springs.

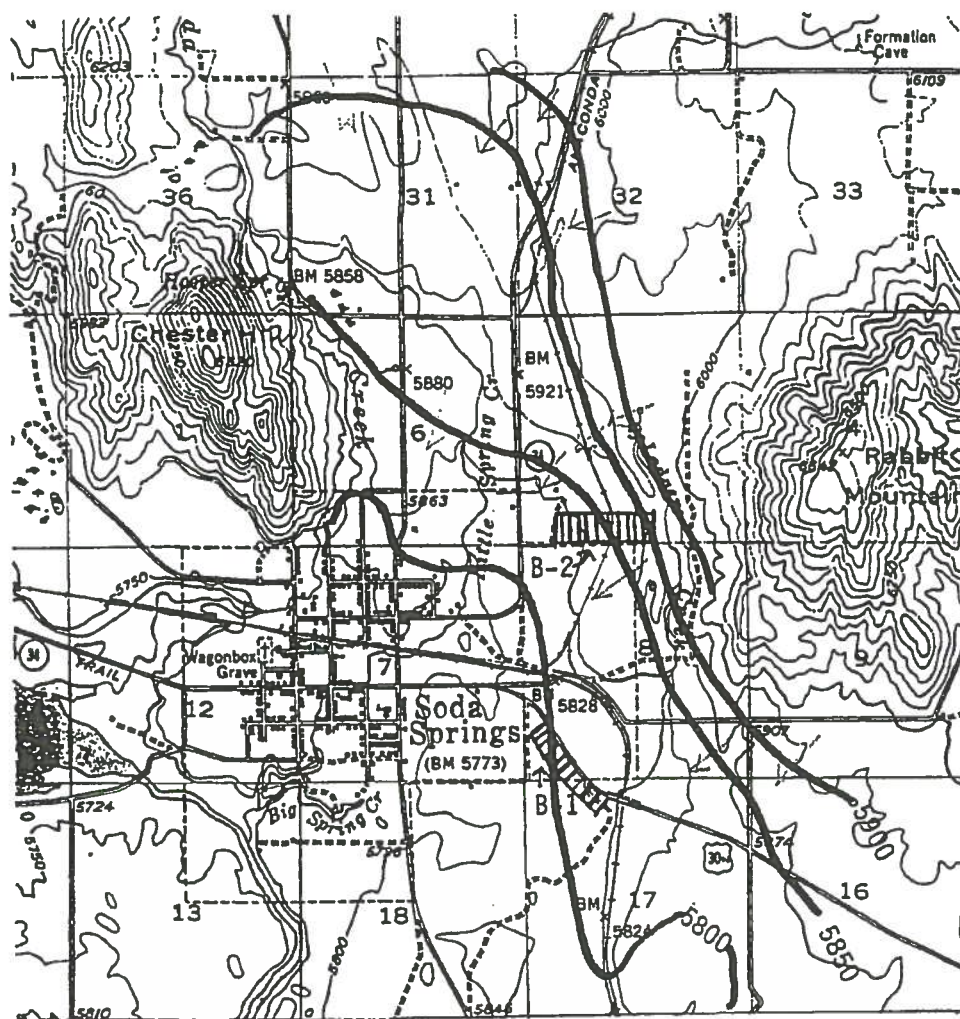


Figure 4. Water level contours and proposed drilling sites, Soda Springs.

Table 1

Summary of Well Log Data Near Soda Springs

Location	Depth (feet)	Depth to Water (feet)	Yield (gpm)	Geologic Material
8/42 31aa1	250	113	900	basalt
8/42 31cd1	60	15	---	basalt; water 17-60
8/42 31cd2	90	15	---	basalt
8/42 31da1	200	114	660	basalt
8/42 31da2	255	123	1950	basalt
8/41 31dc1	126	65	---	basalt; water 120-126
8/42 31dc2	250	1	---	basalt; water 123-125, 184-190 and 237-250
8/42 31dc3	221	65	---	basalt; water 90-94, 120-123 and 205-221
8/42 31dc4	126	3	---	basalt; water 120-126
8/42 32bd1	252	41	450	basalt
9/41 12bc1	88	4	80	mixture (?)
9/41 13bb1	65	15	150	basalt
9/41 13bc1	122	56	30	basalt; water 70-78, 90-92 and 101-122
9/41 13bc2	135	67	40	basalt
9/41 13cb1	130	72	---	basalt
9/41 13cb2	122	60	50	basalt; water 64-80 and 93-122
9/41 13cc1	138	82	30	basalt; water 112-135
9/41 13cc2	140	67	50	basalt; water 87-90 and 114-140
9/41 13cc3	165	87	40	basalt; water 142-165
9/42 6da1	105	27	35	basalt
9/42 7bb1	800	flow	116	basalt; water 48-58, 65-72, 77-82, 123-128; Salt Lake; water 252-265 and 405-411 limestone; water 662-670, 688-702 and 760-770 well open below 390
9/42 8cd1	135	62	---	basalt; water 104-135
9/42 9ac1	305	121	90	limestone
9/42 9bb1	415	160	30	sandstone (?)
9/42 9bc1	426	340	30	sandstone
9/42 9ca1	267	174	---	shale and limestone
9/42 9ca2	365	275	50	shale
9/42 9ca3	293	200	40	sandstone
9/42 9cb1	290	240	25	limestone
9/42 9cb2	219	170	10	sandstone (?)
9/42 9db1	247	143	---	limestone
9/42 9dd1	80	47	---	gravel

Table 1. Continued

Location	Depth (feet)	Depth to Water (feet)	Yield (gpm)	Geologic Material
9/42 18aa1	150	31	---	basalt
9/42 18ab1	45	23	30	basalt
9/22 18bd1	108	44	20	basalt; water 54-108
9/42 18dc1	160	65	80	basalt
9/42 18dc2	165	50	50	basalt; water 73-76, 91-106, 139-143, 150-151, 155-159 and 162-165

Most of the wells in the first two groups obtain water from basalt. The third group of wells obtains water from the older sedimentary rocks, particularly limestone.

A description of the geology in the vicinity of the Monsanto plant site is presented in the unpublished report on the area:

The plant site is located overlying silty clays which in turn overlie Pleistocene basalts of the Blackfoot Lava Field. The basalts are interbedded with cinder zones, silts, sands and gravels. The basalts lie unconformably over sandstones and conglomerates of the Salt Lake Formation. A hinge fault crosses the plant site striking northwest-southeast. The fault exhibits west side down relative displacement of between 20 to 80 ft. Subsidiary subparallel faulting may also be present west of the hinge fault (Golder, 1985, p.7-2).

Four hydrostratigraphic zones have been identified: a shallow Surficial Deposit Zone; an Upper Basalt Zone; a Lower Basalt Zone; and the Salt Lake Zone. Each zone is characterized by a combination of geology, hydrogeology and geochemistry (Golder, 1985, p. 7-4).

The available well logs and a notation in the unpublished report indicate that the most productive portion of the subsurface near the Monsanto plant is the upper basalt zone located about 60 feet below the regional water level. Monsanto production wells 1, 2 and 3 (31aa1, 31da1 and 31da2; table 1) have reported yields of 900, 660 and 1950 gpm from this zone. A Kerr-McGee well has a reported yield of 450 gpm from the same depth. The faults in the area appear to act as barriers for ground water flow in the basalt based on reported water quality data. Regional ground water flow is to the south.

Most of the wells drilled in and near the City of Soda Springs range in depth from 100 to 160 feet and obtain water from shallow basalt interflow contact zones. Reported yields range from 20 to 150 gallons per minute. None of these wells were drilled for large yield purposes.

A well drilled for geothermal heating purposes for the Soda Springs School provides considerable information on subsurface geology (9/42 7bb1; table 1). This well was constructed to a total depth of 800 feet and fully penetrates the basalt and the underlying sediments of the Salt Lake Formation. The well obtains water from the older sedimentary rocks, primarily limestones. According to the well log, water was encountered in the basalt at four intervals, the deepest correlating with the upper basalt zone found at the Monsanto site. The well has a reported artesian flow 116 gpm at 78 degrees F. from the limestone. The water is reported to be similar in quality to Hooper Springs.

The remaining group of wells is located east of the city in Wood Canyon. These wells all produce from the older sedimentary rocks, either limestones or sandstones. The reported yields range from 10 to 90 gpm.

Water quality data from sites near Soda Springs, presented in table 2, show that there is relatively little difference between the quality of Formation and Ledge Springs and that from three wells completed in the basalt (31aa1, 31da2 and 32bd1). The water in the basalt is believed to be a mixture of leakage from the Blackfoot Reservoir, spring water from the older sedimentary rocks and recharge from precipitation directly on the basalt. The similarity of the water quality data from the springs and the wells completed in the basalt suggests that a significant portion of the water in the basalt in the Soda Springs area originates from the older sedimentary rocks.

POTENTIAL FOR WELL DEVELOPMENT

The basalt that underlies the City of Soda Springs appears to be the best target aquifer for municipal well development based on data from

Table 2. Water quality data for the Soda Springs area.

Site	Sampling Date	Water Temp. (°F)	Electrical Conductivity (µmhos/cm)	Total Dissolved Solids (mg/L)	pH	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	Cl (mg/L)	F (mg/L)	HCO ₃ (mg/L)	SO ₄ (mg/L)	Hardness · CaCO ₃ (mg/L)
Ledge Spring ¹	7/17/84	48	650 & 850 ²	--	--	--	--	--	--	--	--	--	--
Ledge Spring ³	10/23/75	--	1,340	870	7.1	154	37.9	15.8	6.0	0.36	536.8	123.5	544
Ledge Spring ⁴	3/06/67	--	--	428	7.4	118	35	5	9	0.23	--	29	439
Formation Spring	7/24/84	52	920	--	--	--	--	--	--	--	--	--	--
Formation Spring ³	10/23/75	--	1,290	840	7.1	159	36.0	7.0	4	0.32	600.0	43.9	548
Formation Spring ³	5/03/74	--	1,307	902	7.0	156	42.7	5.5	2	0.45	666.0	29	568
8/42 31aa ¹	7/23/68	--	1,010	684	--	88	60	48	59	1.5	392	147	466
8/42 31da ²	9/24/87	--	972	548	--	109	52	25	31	0.38	491	84	486
8/42 32bd ¹	3/31/67	--	900	675	--	115	44	--	13	--	537	30	468

¹ Field values taken by B.L.M.

² Two spring discharge points.

³ Analyzed by Ford Chemical Laboratory, Salt Lake City, Utah.

⁴ Analyzed by Idaho Department of Health and Welfare, Boise, Idaho.

existing wells and records of well yields in other basalt areas. The sandstones and limestones of the older sedimentary rocks are the second best target for well construction. The potential for well development in each of these rock types is discussed in this section.

Several questions must be considered with respect to location and development of a city well in the basalt. These include: 1) water quality, 2) well yield potential and 3) potential for interference with existing wells.

Several water quality issues are important with respect to development of a well in the basalt. The first is the natural water quality. Water quality data from wells completed in basalt are similar to the large springs in the area (table 2). There is no indication that the natural basalt water quality varies with location in the immediate Soda Springs area except for the "soda water" reported on the west side of the north-south fault through the area. The second water quality issue pertains to contamination of the shallow basalt ground water system. Ground water quality problems are common to many industrial operations. The magnitude and extent of any ground water quality changes associated with the industrial operations north of Soda Springs are unknown. The other potential source of ground water pollution is the sewage lagoon area. There are no unsewered areas of the City of Soda Springs to be of concern with respect to well location.

The well yield potential of the basalt underlying the city of Soda Springs is unknown. Several of the Monsanto wells are large producers (table 1). Most of the basalt wells south and east of the city produce less than 100 gpm; however, a high yield was not needed from most of these wells. The upper basalt zone as identified near the Monsanto plant

appears to be a logical target for municipal well development for the city. The potential for development of a 500 gpm well from this zone is good.

Care must be taken to minimize any interference a new city well might have on existing wells. A new well could cause considerable water level decline in an existing well if they are near each other (less than 500 feet apart).

The potential for well development from the older sedimentary rocks is directly dependent on locating the well so that it will intersect highly fractured sandstones and limestones of the Wells Formation. These rocks outcrop along the front of the Aspen Range and are the rocks from which the large springs (Formation, Woodall . .) issue. However, they do not outcrop near the city. The core of Rabbit Mountain probably is made up of rocks of the less permeable Thaynes Formation and thus is not a good drilling site for penetration of high yielding zones in the older sedimentary rocks.

EVALUATION OF ALTERNATIVE WELL SITES

The alternative well sites considered in this report are located on city property per a request by Alex Hudson in his letter of March 21, 1988. Two alternative sites appear feasible for location of a well with basalt as the target aquifer. These are shown as sites B-1 and B-2 on figure 45. There are no good target sites near the city for construction of a well into the more permeable sections of the older sedimentary rocks.

Site B-1 is located on the north side of the airport runway. Site B-2 is located in Kelly Park. The depth to water at the B-1 and B-2 sites should be about 50 feet. A test well at either site should be designed

for about 400 feet in order to fully test the section. The maximum yielding zone in the basalt is anticipated to be at less than 150 feet below land surface. Drilling at either of these sites could be stopped at this depth if sufficient water is intercepted.

A comparison of sites B-1 and B-2 suggest that there are advantages and disadvantages to each. First, ground water investigations at the Monsanto plant site suggest that "soda" water may be found in the basalts west of the approximately north-south fault that bisects the site. This fault was mapped as a thrust fault by Armstrong (1969) and is shown on figure 2. Site B-2 is clearly on the east side of the fault. Site B-1 is located near a site where the fault is mapped as having an offset because of later faulting. As mapped, site B-1 is on the east side of the fault. The area of B-1 appears to be geologically complex. Second, the ground water at site B-2 probably is a mixture of water discharged from Formation and Ledge Springs and water from the basalt moving southward from the Blackfoot Reservoir. Site B-1 has the same mixture of water but a longer travel time underground. Site B-2 has a greater chance of being impacted by water quality changes associated with waste disposal operations at the industrial sites located north of Soda Springs. Site B-1 is located more distant from the industrial sites.

Site B-1 is selected at preferred over site B-2 as a basalt well location primarily because of distance from potential industrial pollution sources. The actual well site could be located anywhere along the south side of highway 30 in the southwest quarter of section 8 (figure 4).

CONCLUSIONS

The basalt at site B-1 is the preferred target for construction of a new well for the City of Soda Springs. Recommendations for test hole construction and evaluation are presented in the following section.

Specific conclusions are stated below in response to the questions noted by A.A. Hudson and Associates in the letter dated March 21, 1988.

1. Determine whether Ledge Spring and Formation Spring originate from the same source. The water discharging from both springs is believed to originate from a long ground water flow system in the older sedimentary rocks. The primary question is whether Ledge Spring is a direct discharge from the older sedimentary rocks or a topographic low area where water from Formation Spring reemerges at land surface. Ore and Link (1987) suggest that Ledge Spring is a reemergence of water from Formation Spring. Baldwin (1988) also indicates this to be the case. This hypothesis is supported by the fact that Ledge Spring is not located along the major frontal fault as are most of the other large springs (Mayo, 1982). Ledge Spring flows from the toe of the tufa-travertine deposit and probably is water originally discharged at the Formation Spring site.
2. Determine where ... would be the best areas to drill a test well ... Sites B-1 and B-2 are described above.
3. Develop a drilling and testing program to provide data on water quality and quantity from a test well. The program is described in the next section.
4. Analyze the findings of the test well program in relation to the proposed water storage facility on Rabbit Hill. Both of the proposed well locations are in the eastern portion of the city. Site B-1 is

preferred over B-2 even though B-2 is closer to the proposed storage facility. Both sites would require piping to be tied into the present system.

5. Evaluate the potential for drilling a shallow well at the site of Ledge Spring. The geology of the Ledge Spring site has not been investigated in detail. The tufa-travertine material would not yield large quantities of water to a well. A well at this site probably would be successful if basalt was encountered at shallow depths. Site B-2 is close to Ledge Spring and represents drilling in this area.

RECOMMENDATIONS

A test well should be drilled at site B-1 to determine the ground water characteristics at the site. An air rotary rig is best suited for this project because of its relative ease at drilling through basalt and the option to obtain water samples as drilling progresses. The test hole should have a proposed maximum depth of 400 feet, but drilling should stop when a sufficient supply of water is encountered. Water samples should be collected on site whenever additional zones of water are intercepted. If possible, an electrical conductivity meter should be used to monitor water quality during drilling. Cutting samples should be obtained every five feet and at formation changes. The driller should keep a careful log of the material penetrated.

The test hole should be drilled using either a six or eight inch bit. Two-inch larger diameter surface casing should be set but not grouted in place during drilling. If successful, the test hole should be reamed and completed as a production well.

LIST OF REFERENCES

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- Baldwin, Joe, 1988, Memo to Bill Smith entitled "Soda Springs Water Supply;" Idaho Department of Health and Welfare, Division of Environmental Quality, April 14, 2 p.
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- Ore, H.T. and Link, P.K., 1987, Letter to Mike Panting, 2 p.
- Ralston, D.R., 1984, Potential for Impacts on Formation and Ledge Springs from Phosphate Prospecting Permit I-9350: Consulting Report prepared for J.R. Simplot Co., 20 p.

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October 21, 1994

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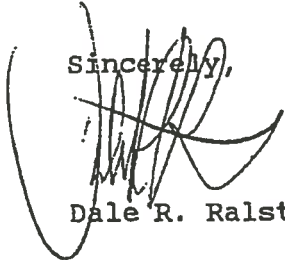
Dear Mr. Godfrey:

Per a request from Ray Nelson, enclosed please find one copy of the report entitled "Evaluation of Ground Water as a Water Supply source for the City of Soda Springs." I prepared this report for the city in June of 1988. I am also providing a copy of the report to Ray Nelson.

Please contact me if you have questions with respect to the report or would like assistance in locating and designing a new city well. I recommend that data on wells constructed since 1988 be evaluated prior to any decisions on a new well.

I may be reached by voice or FAX at 208-883-0533. Please note that my address is 1122 East B Street rather than 821 Indian Hills Drive as noted on the report. Thank you.

Sincerely,



Dale R. Ralston

cc: Ray Nelson with report