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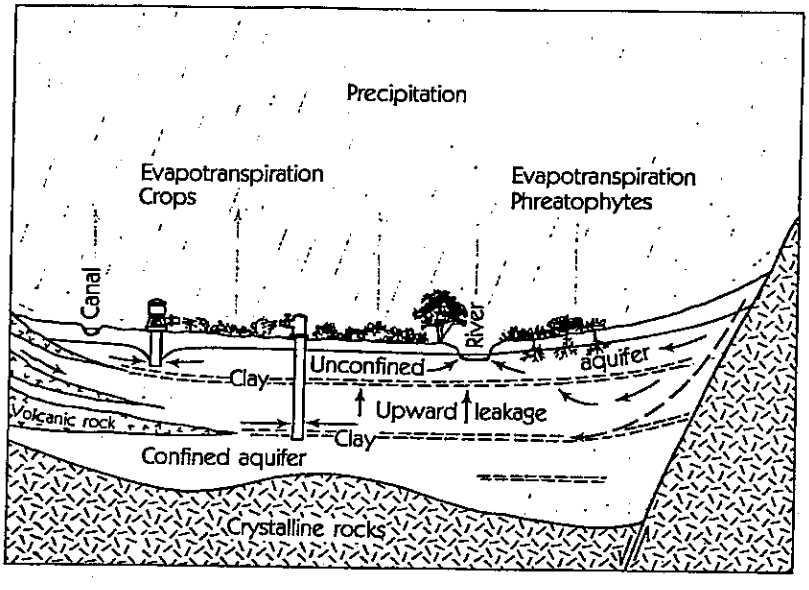
ASSESSMENT OF THE SHALLOW AQUIFER IN SALT LAKE VALLEY



JANUARY 1985

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ASSESSMENT OF SHALLOW AQUIFER QUALITY IN SALT LAKE COUNTY

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January, 1985

Partially funded under a Federal Clean Water Act
Planning Grant
From The United States Environmental Protection Agency

TABLE OF CONTENTS

Section	Title	Page #
i	Table of Contents	i
ii	List of Figures & Tables	ii
iii	Acknowledgments	iii
I	Introduction	1
II.	Executive Summary	5
III	Purpose and Scope	
A.	Objectives	8
B.	Methodology	12
C.	Quality Assurance	14
	1). Laboratory	14
	2). Field	15
IV.	The Shallow Aquifer Monitoring Network	
A.	Depth to Ground-water	19
B.	Surface Hydrology	20
C.	General Land Use	22
D.	Soil Permeability	25
E.	Extent of Recharge and Discharge	
F.	Location of Wells & Well Characteristics	31
V.	Quality of the Shallow Aquifer	
A.	Shallow Groundwater Assessment	33
B.	Quality Assurance/ Discussion/Results	33
C.	Site Specific Investigations & Data	
	1) AMOCO Oil Company, Salt Lake City Refinery	48
	2) Vitro Uranium Mill Tailing Site	55
	3) Salt Lake City-County Landfill	59
VI.	References & Bibliography	66
VII.	Appendices	
A.	USGS Data Report REFERENCE	A1
B.	SLCCHD letter	A2
C.	Draft Review Comments	A3

LIST OF FIGURES

FIGURE #	TITLE	PAGE
1.	Movement of Groundwater Contaminant Plumes	9
2.	Attenuation of Pollutants Over Distance	9
3.	Downward Percolation of Contaminants	9
4.	Monitoring Wells in Relation to Cone-of-Depression Effects	9
5.	Monitoring Wells Screened in Upper Saturation Zones	9
6.	Monitoring Wells Screened Below Lighter-Than-Water Contaminant Zones	9
7.	Monitoring Wells Yielding Diluted Contaminants	9
8.	Shallow Aquifer Assessment Field Sampling Procedures	15
9.	Depth to Shallow Groundwater	21
10.	Surface Hydrology	23
11.	General Land Use	26
12.	Rapid Soil Permeability	27
13.	Generalized Geologic Structure: Groundwater Bearing Deposits	28
14.	Probable Directions of Groundwater	29
15.	General Shallow Groundwater Conditions	30
16.	Location of Shallow Aquifer Monitoring Wells	32
17.	Logs of Selected Wells	34
18.	Location of Shallow Aquifer Monitoring Wells; Amoco Oil Company - Salt Lake City	50
19.	Location of Monitoring Wells; Vitro Uranium Mill Tailings Site	58
20.	Location of Monitoring Wells; Salt Lake City-County Landfill	62

LIST OF TABLES

TABLE #	TITLE	PAGE
1.	Prioritized Wells With Parameter Designations	13
2.	Water Quality Data - Shallow Aquifer Assessment	36
3.	Quality Assurance Data - Shallow Aquifer Assessment	44
4.	Physical Well Data; Amoco Oil Company - Salt Lake City Refinery	51
5.	Shallow Groundwater Quality; AMOCO Oil Company - Salt Lake City Refinery	52
6.	Physical Well Data; Vitro Uranium Mill Tailings Site - Jacobs Wells	56
7.	Physical Well Data; Vitro Uranium Mill Tailings Site - Dames & Moore Wells	57
8.	Shallow Groundwater Quality - Vitro Uranium Mill Tailings Site	60
9.	Shallow Groundwater Quality - Salt Lake City-County Landfill	64

ACKNOWLEDGEMENTS

The following members of the Water Quality Staff worked in the following capacities for the duration of the assessment.

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Primary Consulting Agencies

United States Gelogical Survey	Ted Arnow Joseph Gates Kidd Waddell Ralph Seiler
Utah Geological/Mineralogical Survey	William Lund Robert Klauk
Utah State Engineer	Jerry Olds

Acknowledgements (Cont'd)

Utah State Division of Environmental Health	Mary Maxell, PhD. Jerry Riding
Utah State Division of Environmental Health, Bureau of Water Quality	Michael Reichert Roy Gunnell
Utah State Division of Environmental Health, Bureau of Hazardous Waste	Dale Parker, PhD. Kent Gray Jim Salmon Nancy Winters
Salt Lake City/Counth Health Dept.	Terry Sadler Bill Davis Dave Nelson Kent Miner Jewell Snow Frank Nabrotsky Ron Hansen Ron Burton Elwood Loveridge
United States Environmental Protection Agency	Douglas Lofstedt Roger Dean James Baker, PhD. Lee Dooley, Consultant Joan Schaum Tom Stibel
Utah State Medical Laboratory	Ralph Helfer, PhD.

The project personnel express special thanks to the private landowners, listed in well ownership tables, who consented to the use of their property for well drilling and monitoring activities. Also, valuable guidance and project review were provided by members of the Watershed and Water Supply Policy Committee, and Gerald H. Kinghorn, former director of the Salt Lake County Department of Water Quality and Pollution Control.

I. INTRODUCTION

The Federal Clean Water Act provided planning grants to designated area-wide water quality planning agencies for the purpose of conducting studies which identify the nature and extent of water pollution and its sources in priority drainage basins. The Salt Lake County Council of Governments completed the initial "208" Water Quality Management (WQM) Plan in 1978,[1] and subsequent conditions to its approval began to be addressed by the succeeding grantee, the Salt Lake County Division of Water Quality and Pollution Control.[2] One condition of the WQM Plan to be addressed by the new agency was an assessment of ground-water pollution in the Salt Lake Basin.[3]

Early in 1981, Salt Lake County received a grant from the Environmental Protection Agency (EPA) for the purpose of conducting ground-water assessment activities. Preliminary work plans for the study were generated during the winter of 1981, and subsequently revised in the summer of 1981. After an exhaustive period of consultation and training with EPA, the final revised work plan was executed together with a cooperative agreement involving the U.S. Geological Survey (USGS).

Salt Lake County provided staff support for important deep aquifer data gathering activities prior to the cooperative agreement. This support consisted of researching state and local well locations and data for inclusion into the larger USGS deep aquifer network.

The cooperative agreement was executed in an effort to fully integrate and coordinate ground-water study efforts between the Salt Lake County Water Conservancy District, U.S. Geological Survey, Salt Lake County Water Quality, and the Utah Geological and Mineralogical Survey. Initial criticism of duplicated effort was avoided through this agreement, and staff time and expertise were greatly economized. In view of the work plan contracted between USGS and Water Conservancy, many aspects of the County's EPA-approved work plan were accommodated. For example, the bulk of work needed for further assessment of the deep aquifer was covered in the USGS/Conservancy agreement. Furthermore, the aquifer "interface" outputs described in the County's EPA-approved work plan could only come forth at the conclusion of the Conservancy/USGS water quality tasks. The cooperative agreement between USGS and Salt Lake County Water Quality subsequently covered completion of the shallow aquifer assessment.

The structure of the ground-water work plan and sampling methodology was designed to:

1. Provide base datum for ground-water quality which would typify general shallow ground-water quality across Salt Lake Valley.
2. Provide data for conditions in proximity to existing non-point pollution sources.

Initial decisions for location of new wells were made on the basis of these goals. It was deemed important to characterize valley-wide shallow aquifer quality and quantity, as well as locate potential leachate plumes requiring further site-specific analysis.

U.S. Geological Survey personnel coordinated closely with Federal and County Water Quality planning personnel in the selection of new well locations.

A. PURPOSE AND SCOPE

The tasks outlined by USGS were consistent with tasks contained within the Salt Lake County workplan. Water level measurement was added as part of the data-gathering effort (see Appendix 1, Table 2). Methodology for site and parameter selection was jointly established through coordination between technical personnel at the Utah State Division of Environmental

Health, U.S. Geological Survey, U.S. Environmental Protection Agency and Salt Lake County Water Quality and Flood Control.

Both field and laboratory Quality Assurance Plans (QAP) were similarly coordinated. Two sample sets were gathered, one by U.S.G.S., one by Salt Lake County. Special care was taken by all parties to insure that specific quality assurance quidelines were met. The decision between EPA and Salt Lake County to obtain an additional sample set resulted in two data reports, which have been combined here as one.

B. SHALLOW AQUIFER MONITORING NETWORK

Existing wells numbered few. Additional wells had to be drilled. A composite factor map was drawn to reflect important variables to be considered for new well locations. These variables included shallow groundwater depths, surface hydrology, land use (with emphasis on hazardous waste sites), soils, recharge/discharge zones and others

C. SHALLOW AQUIFER SAMPLING: QUALITY AND QUANTITY.

From the composite process described above, new wells were located and priority weight established. Certain wells were sampled for organics. Water levels were measured. Water Quality data from site specific investigations were examined.

D. CONCLUSIONS AND RECOMMENDATIONS

Potential Non-point pollution scources - the existence of leachate plumes - are identified. Recommendations for further sampling are made.

It is important that the data base for shallow aquifer conditions be continually expanded. Two data sets do not provide adequate evidence upon which important water use decisions can be based. Long-term data (four - five years) would begin to provide the necessary ingredients to a valid definition of "nature and extent" of ground water pollution.[4] A five year effort (based on one round of laboratory and field sampling cost for 1983) for the present shallow aquifer network would cost approximately $15,000. This is an average of only $3,000 per year. Quarterly samples over a five year period are estimated at about $60,000 or an average of $12,000 per year.[5]

With the anticipated reliance on groundwater resources to further supplement future water demands, this cost is relatively small. Potential contamination of deep aquifer reservoirs from shallow aquifer contaminants may present serious diseconomy to our future water resource development policies. Modest expenditures for continued data gathering will vastly improve the quality of critical water policy decision making.

II. EXECUTIVE SUMMARY.

A. INTRODUCTION.

The Salt Lake County Division of Water Quality & Flood Control was designated by the Governor of the State of Utah, under provisions of the Federal Water Pollution Control Act, to be the primary planning & coordinating agency for water pollution control identification and implementation.

This planning responsibility includes the identification of the nature and extent of pollution to classified waters within the Salt Lake Basin, and groundwater requires similar pollution assessments as surface water. Several studies have been performed on the "Deep Confined" aquifer that provides much of the water supply for the County. Little heretofore has been known about the "Shallow Unconfined" aquifer that lies atop the deep aquifer, separated by relatively impermeable clay layers. The new emphasis on hazardous or toxic wastes percolating into the deep aquifer from the shallow aquifer from old landfill or dump areas necessitated more information on the quality and quantity of the shallow groundwater regime. Further, new studies on the availability of the deep aquifer to provide more municipal water supply through "conjunctive use" of ground with surface water implies that pollution may be the single most inhibiting factor to maximizing water use.

The grant-funded shallow aquifer assessment was fully coordinated with the Salt Lake County Water Conservancy District and the United States Geological Survey (USGS). The structure of the County's EPA-approved work plan was designed to provide base data on the general quality of the shallow groundwater resource and begin to collect some information in proximity to suspected non-point pollution sources. Monitoring locations for existing well sampling and new well development were chosen jointly by USGS, EPA, and Salt Lake County personnel.

B. PURPOSE AND SCOPE.

Polluted shallow groundwater may percolate or "discharge" into natural or artificial waterways or may percolate through fractured clay layers into the principal groundwater reservoirs, thus reducing or limiting the present or future use of the water for culinary, recreational, wildlife, fishery, agricultural, or industrial purposes. The orininal scope of the workplan included an examination of the critical "interface" or hydrological relationship between the shallow and deep groundwater regimes. This phase will be delayed for further data acquisition by USGS.

The objectives of the present assesment included measurement of water levels in the shallow aquifer and noting surface water which influences those levels; Identifying soil and land use conditions that influence the permeability of surface water into the groundwater regime; Mapping known water levels in the shallow aquifer and inventorying existing wells and their characteristics; Enlarging the shallow groundwater well network; Monitoring the quality of the shallow aquifer; Report data from site-specific shallow groundwater investigations on-going in the basin; Recommend additional studies of specific locations where shallow aquifer contamination may exist.

The methodology for obtaining shallow groundwater samples dictated a broad spectrum of water quality parameters. The need for an area-wide assessment of quality conditions required that the full range of chemistry be analyzed. All major anions and cations were included, in addition to volatile organics and phenols. At locations where dumps or landfills were known to exist and leachate contamination suspected, the Environmental Protection Agency placed a priority designation on the well. Analysis was concentrated on the presence of hazardous wastes or toxic contaminants such as trace metals.

In order to insure the integrity and accuracy of sample data, a stringent quality assurance program was required by EPA for both field and laboratory processes and procedures. This involved uniform procedures for sample gathering in the field, preparation of samples for transport, filtering and analysis, along with budgeted provisions for duplicate samples, spiked samples, and blank samples to check laboratory integrity.

C. SHALLOW AQUIFER MONITORING NETWORK.

The majority of wells sampled in the study had to be drilled in cooperation with USGS. Fifty-five (55) wells were ultimately developed for inclusion into the assessment, but only 32 were sampled for water quality. All were measured for water level.

Factors used to determine where new wells should be drilled and which ones should be sampled included: Depth to groundwater conditions (from area soil surveys); Surface hydrology (main creek channels and irrigation canals); General land use (mainly impermeable urban limits and landfills or dumps known to exist throughout the basin); Soil permeability; Recharge, discharge, and perched aquifer zones (identified earlier by USGS). A composite map was produced which displayed these factors together, and well site selection was jointly made by the cooperating agencies.

D. QUALITY OF THE SHALLOW AQUIFER.

Wells were drilled and logged in general terms, and during the one-year duration of the monitoring period, two samples were taken from the entire 32 well network. Because of the time and duration of groundwater movement, sampling should continue seasonally over a period of years-usually three to five-in order to determine the characteristics of the aquifer. Quarterly sampling is planned at some future date. Based on limited knowledge gained from only two samples at each well (a total of 64 sets of data), the following observations can be made:

1) A wide range of ph (acid to alkaline content) exists in the shallow groundwater regime, with mean ph substantially more acidic than that found in the deep aquifer. This may indicate general decrease in shallow aquifer quality when compared with the deep aquifer.

2) High specific conductivity, total dissolved solids, hardness, and associated cation (metal) concentrations were observed in the Northern and Northwest quadrant of the Salt Lake Valley. Similar conditions were observed at specific wells along the Jordan River. Such conditions may indicate a highly mineralized condition of the shallow aquifer.

3) Higher nitrate levels were encountered in the Northern valley quadrants and in areas close to problem land uses, such as landfills, dumps, and animal waste areas.

4) Arsenic, Iron, and Manganese were the most frequently measured metals appearing at " higher than background " levels. Arsenic levels occurred most frequently near the International Airport and near the Jordan River between 7800 and 9000 South Streets; Iron occurred in the Northernmost valley region and also near the Jordan river between 7800 and 9000 South Streets; Manganese was found most often in downtown Salt Lake City areas and also near the river between 7800 and 9000 South Streets. The general nature of the shallow aquifer inquiry does not enable the assignment of any specific source to these metal contaminants, nor is there significant statistical support for source identification.

5) Elevated levels of organics--volatiles and phenols--were identified at specific locations during the assessment, but further intensive monitoring and detailed analysis is necessary to determine the risk to human health or impacts to aquatic or terrestrial biota.

During the groundwater study, several site-specific assessments were reviewed and reported. These assessments are being carried out-for the most part-under the requirements of the Resource Conservation & Recovery Act (RCRA) and EPA Superfund programs. They include the AMOCO Oil Company Salt Lake City Refinery Storage Area, the Vitro Uranium Mill Tailings Site, and both old and new Salt Lake City-County Landfill sites. Data for all but Vitro is incomplete, and further analysis precludes sound judgement about known environmental impacts.

E. CONCLUSIONS & RECOMMENDATIONS.

Two samples from a thirty-two well network do not enable the determination of sound scientific conclusions. The thirty-two wells are widely distributed throughout the valley floor and were primarily designed to collect areal data. A few wells located near tailings, dumps or landfills require intensive monitoring, multiple well construction, clustered well design at variable depths, detailed logging of substrate content, frequent sampling, and determination of water level fluctuations over a three to five year period before valid conclusions can be made as to the nature and extent of contamination.

The data gathered during this brief study do show a general decrease in shallow aquifer water quality in the areas of the Salt Lake Valley near the Jordan River and in the Northern to Northwest quadrant. An on-going data gathering effort is in place, funded jointly by Salt Lake County Flood Control & Water Quality and City-County Health Department, that will gather quarterly samples over an undetermined duration. The effort should attempt to establish a base datum of three to five years. Meanwhile, Superfund Regulations administered by EPA will require specific land uses to closely monitor the effects of groundwater leachate on culinary wells, the shallow aquifer, and surface waters.

III. PURPOSE AND SCOPE

The purpose of the shallow aquifer assessment is two-fold. The first is to describe the quality of shallow groundwater on a sub-regional basin scale. The second purpose seeks to define polluted groundwater conditions which are presently or potentially impairing water uses protected under the State of Utah Waste Disposal Code.[6]

Polluted groundwater may discharge to surface streams and impair the uses for which the stream is protected. Local priority surface waters are protected for culinary supply, recreation and aesthetics, aquatic wildlife, agriculture and industry.[7]

Groundwater leachate plumes may also be drawn through semi-permeable confining layers into culinary well "cones of depression", resulting in contamination of valuable municipal water supply.[8] Figures 1-7 display basic concepts of the groundwater pollution process.

Present efforts by the U.S. Bureau of Reclamation and State of Utah to classify groundwater reservoirs and their critical boundaries depend on the extent to which pollution plumes are known to exist and on the influence they may have in the future.

The scope of the workplan approved by EPA for Salt Lake County includes an analysis of this critical shallow/deep aquifer interface. However, on-going research by the Salt Lake County Water Conservancy District and USGS will address this interface at a later date. At that time, computer modelling of withdrawal rates and underground transport of leachate into withdrawal zones should prescribe critical limits to this deep/shallow aquifer interface.[9]

A. OBJECTIVES: SHALLOW AQUIFER ASSESSMENT

In coordination with State Health and EPA, and in coordination with

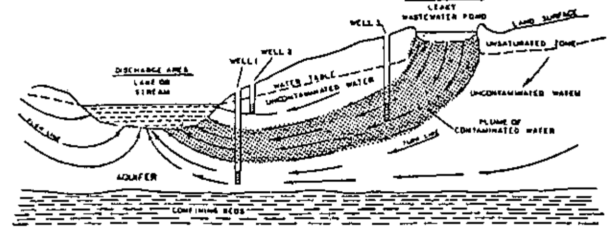


Figure 1: Plumes of contaminated water move along discrete paths between the points of recharge and discharge. The plume is not subject to dilution by the natural ground water. Three monitor wells are shown to indicate that well placement relative to the plume is important in evaluating potential movement of the contaminated water both laterally and vertically.

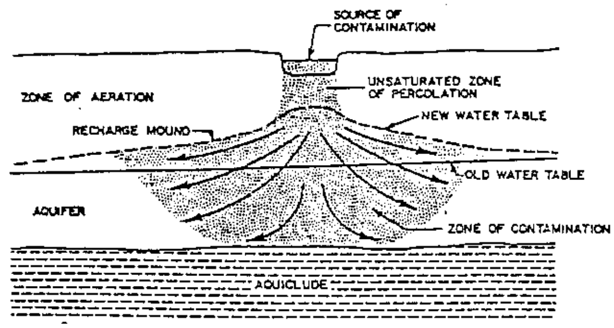


Figure 3: Downward percolation of large volumes of contaminated fluids can result in the development of a recharge mound in the water table beneath a pond or landfill. The mounding of the water table will reduce the thickness of the unsaturated zone beneath the site and, thereby, decrease the attenuation potential of the soil in the vertical dimension.

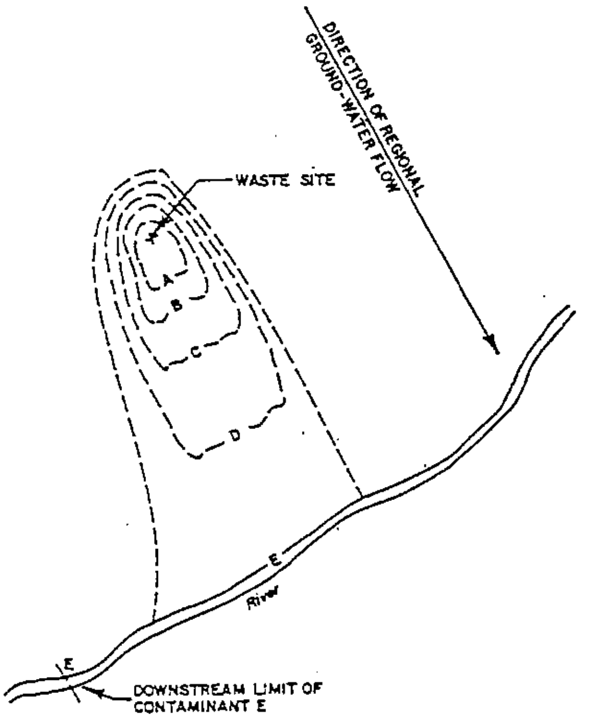


Figure 2: A plan view, representing a specific time in the life of a waste site, shows that specific contaminants (A to E) move different distances in the groundwater system. Contaminant A, which might be biological matter, is attenuated within a short distance; Contaminant E, which might be chloride, is not attenuated.

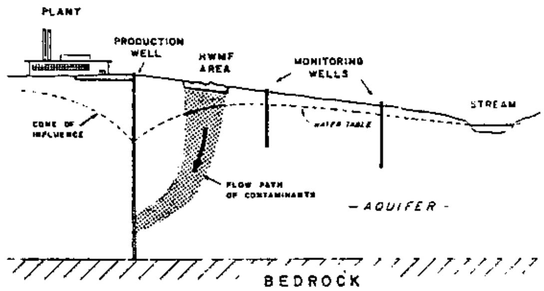


Figure 4: Monitoring wells at lower topographic elevations in the direction of natural ground water flow may not be effective if contaminants are captured by the cone of influence of a nearby pumping well.

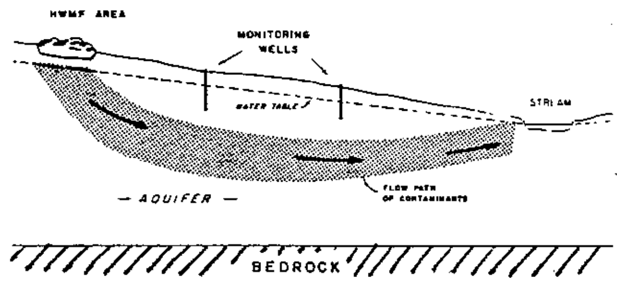


Figure 5: Monitoring wells screened in the upper part of the zone of saturation may not detect contaminants moving through a lower section of the aquifer.

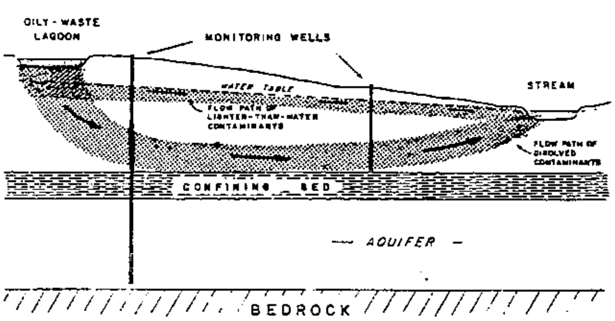


Figure 6: Monitoring wells screened in a lower aquifer or in the plume of dissolved contaminants may not detect lighter-than-water components of contamination.

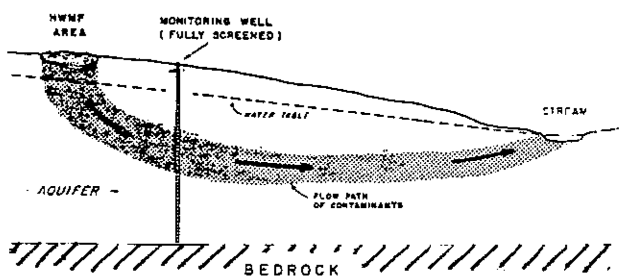


Figure 7: Samples from monitoring wells screened through the entire zone of saturation may yield a mixture of contaminated water diluted with clean water from unaffected sections of the aquifer.

Source: Geraghty & Miller, Inc.

USGS, objectives should address the following data requirements under Phase I inquiry:

1. Literature and well data search.

2. Characterize physical shallow groundwater system. Emphasize with other environmental variables:

   a. Map nature and extent of known shallow groundwater conditions.

   b. Identify surface hydrology and seasonal relationship with groundwater levels, i.e., influence of canal and creek peak discharge.

   c. Land use effects on possible groundwater and surface water quality and quantity, with emphasis on hazardous waste non-point sources.

   d. Identify soil conditions with rapid rates of permeability which may transmit pollutants.

3. Characterize chemical, biological or organic conditions of shallow groundwater quality and quantity:

   a. Identify existing well location, ownership, depth, screening, etc

   b. Tabulate existing data.

   c. Using factors identified in 2 above, prioritize well monitoring sites for specific parameter selection.

   d. Monitor water levels (quantity).

   e. Monitor water quality. (Using parameters suggested by EPA)

Outputs under the Phase I inquiry include:

1. References for previous shallow groundwater monitoring efforts.

2. Composite shallow groundwater factor map displaying priority well locations.

The revised groundwater work plan originally called for integration of shallow and deep aquifer interfaces. This task has been postponed until the USGS deep aquifer assessment is complete and solute transport/withdrawal models run. Specific interface-type outputs will then be available.

Phase II of the Shallow Aquifer Assessment involved evaluation of data generated during Phase I and determination of further sampling needs. Additional chemical and organic analyses were advised for sites downgradient of potential non-point sources, or for those sites possessing high nitrate concentrations. Present EPA priority on high human health risk pollutant sources guided more attention to old landfills or areas meeting hazardous waste definitions under the Resource Conservation and Recovery Act (RCRA).

An outgrowth of the Phase II assessment was examination of groundwater data produced from site-specific monitoring required under RCRA. Examples of this examination include the following site-specific assessments:

1) AMOCO waste storage facilities located in northern Salt Lake.

2) Rose Park superfund cleanup site, monitored by AMOCO.

3) Vitro Uranium Mill Tailings, currently under study by the Federal Department of Energy (DOE).

4) Salt Lake County Landfill facilities located just east of the Kennecott tailings pond.

Additional site-specific assessments were initiated during the shallow aquifer assessment. Among these were:

1) Kennecott copper mine overburden assessment in Salt Lake Valley.

2) Portland Cement facility monitoring, scattered throughout Salt Lake Valley.

3) Sharon Steel Mill Tailings superfund assessment

Outputs of the Phase II Shallow Aquifer Inquiry include:

1- Description of selection criteria employed by Salt Lake County, State of Utah and EPA in determining priority well selection.

2- Listing of well characteristics.

3- Mapping, which displays the occurrence of particular priority parameters.

4- Implementation of additional shallow well sampling.

Interpretation of sample data must be limited to two data sets. Further sampling of all parameters is necessary for construction of a reliable data base for use in future withdrawal and solute-transport models. However, some obvious problem areas merit concentrated study at a future date.

B. METHODOLOGY

Consistent with the purpose and objectives of the study, two levels of method for site selection and parameter sampling were pursued. Need for an area assessment of typical shallow groundwater quality required broad parameters, while potential site-specific non-point source areas (mainly potential hazardous waste sites), required more specific analysis. Table 1 shows the wells prioritized by the project team, together with designations for anions (mainly nutrients such as nitrates and phosphates), cations (heavy metals such as cadmium and mercury), volatile organics (such as dichloroethane, chloroform) and phenols. Hazardous waste sites are typically associated with phenols and organics where benzenes, halomethanes and trihalomethanes are prevalent. Heavy metals are typically linked with landfills, mill tailings or other mining related activities. Anions are associated with biological waste such as wastewater disposal, fertilizers or animal waste concentrations.

Selection of "priority" wells required concurrence with EPA objectives, and both volatile organics and phenols were sampled at these sites in addition to standard cations and anions. This method was intended to meet non-point source identification requirements of the Clean Water Act. New wells should periodically be added to survey other non-point sources, such as stormwater detention basins and sand and gravel pits.

TABLE ONE

SALT LAKE COUNTY SHALLOW AQUIFER ASSESSMENT

SECOND ROUND SAMPLING, PARAMETER, QUALITY ASSURANCE & COST SCHEDULE: BY

S. F. JENSEN & T. WAY 6/22/83

Well Identification #			Water Quality Parameters			
USGS		EPA*	ANIONS	CATIONS	ORGANICS (VOLATILE)	PHENOLS
B-1-1	9 ADC		X	X		
	26 BAD	18	X	X	X	X
	26 CDA		X	X		
	32 CCD	3	X	X	X	X
	35 DCB		X	X		
B-1-2	34 AAB	1	X	X	X	X
C-1-1	2 DCA		X	X		
	4 DDB	4**	X	X	X	X
	11 BAC		X	X		
	15 CAA		X	X		
	24 CDC	8**	X	X	X	X
	26 DCA	9**	X	X	X	X
	28 CAB		X	X	X	X
	30 ACA		X	X	X	X
	31 ABB		X	X	X	X
C-2-1	12 BDA	11	X	X	X	X
	14 DBD	12*	X	X	X	X
	15 ABC	13	X	X	X	X
	26 ABB	14*	X	X	X	X
	34 DDA-3		X	X		
	35 BAA	15*	X	X	X	X
	35 BAB		X	X		
C-3-1	1 BBC	16*	X	X	X	X
	3 ACC		X	X		
	34 AAA		X	X		
D-1-1	18 DAD		X	X		
	31 DBA		X	X		
D-2-1	8 BBA		X	X		
D-3-1	5 CDB	17	X	X	X	X
	6 BCB		X	X		
	31 CDA		X	X		
	32 AAA		X	X		
TOTALS	32	13	32	32	16	16

*EPA 1st Priority Wells
**EPA 2nd Priority Wells

Quality Assurance Samples

	ANIONS	CATIONS	ORGANICS (VOLATILE)	PHENOLS
Field Blank	1	1	1	1
Duplicate	3	3	3	3
Blind QC (spike)	1	1	0	0
GRAND TOTALS	37	37	20	20

C. QUALITY ASSURANCE

A Quality Assurance (QA) component of the study was required for both laboratory and field procedures. Salt Lake County followed Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (December, 1980),[10] and reviewed QA specifics with EPA staff to insure their consistency with The Quality Assurance Program Plan for EPA Region VIII (January, 1982).[11] The goal of the EPA Quality Assurance Program is to generate data that is scientifically valid, defensible and of known precision and accuracy.[12] USGS Laboratory QA has been developed in coordination with EPA involvment, and the State of Utah QA program has been approved by EPA as consistent with Region VIII EPA plans.[13] First Round samples were processed in the Denver Regional Laboratory of the U.S. Geological Survey. Second Round samples were processed by the Utah State Laboratory in Salt Lake City.

Field QA procedures were drafted jointly by USGS and Salt Lake County Water Quality personnel. EPA approved the procedures consistent with Region VIII policy prior to initiation of Round II sampling. Outlined Field procedures are attached as Figure 8.

FIGURE 8

DRAFT FIELD QUALITY ASSURANCE PROGRAM: SALT LAKE COUNTY SHALLOW AQUIFER ASSESSMENT FIELD SAMPLING PROCEDURES

June 27, 1983

The following description provides step-by-step procedures performed during field sampling for the Salt Lake County Shallow Aquifer Assessment. Three components are cover: (1) Water level measurement; (2) Well pumping and evacuation; (3) water quality sampling. The sampling description includes specific procedures for obtaining anions and cations, volatile organics and phenol samples. All data is recorded on the Water Quality Field Report Form.

I. Water Level Determination

A. Equipment: Peristaltic pump, 25' plastic pump tubing, metal tape measure, 3 gallon capacity plastic bottle.

1. Extend metal tape through hole in well cap approx. 6'. Remove tape and measure depth of water surface from top of well cap.
2. Extend metal tape into well to bottom or depth of sand of infill. Remove tape and calculate water depth.
3. Calculate well casing volume by multiplying depth X .16 (gallons/ft. of water). Pump at least two well casing volumes prior to sampling.

II. Well Pumping/Evacuation

A. Equipment: # gal. plastic container, lead-weighted tubing, peristaltic pump, 200 cc. plastic beakers, conductivity meter, centigrade thermometer.

1. Extend lead-weighted plastic tubing midway between surface water level and bottom of well or to top of sand or infill.
2. Begin pumping with peristaltic pump into 3 gallon plastic container. (Container is used for measuring purposes)
3. While pumping, collect first conductivity and temperature sample into 200 cc. plastic beaker.
4. Record water temperature on water quality field sheet.
5. Record conductance reading on water quality field sheet.
6. Conductivity meter is calibrated prior to each sampling day against prepared standards as described by manufacturers specifications(ref.).
7. Using conversion tables (ref.) correct conductivity reading to 25°C.
8. During pumping of two to three well casing volumes, prepare equipment and materials for water quality sampling.

III. Water Quality Sampling

A. Equipment: Same as I & II, 0.45 micron standard filter, filter aparatus, pH meter, pH buffer, sample bottles labeled and prepared with preservatives, cooler w/5lbs. ice, 1 gal. distilled water.

B. Filter Preparation:

1. Rinse filtering apparatus thoroughly with distilled water.
2. Install cellulose filter on filter appartus and tighten. Do not touch filter with finers

C. pH Measurement:

1. Field calibrate pH meter according to manufacturers specifications to pH 7 and pH 10. (ref) pH probe is stored in distilled water.
2. Draw second conductivity sample into 200 cc. beaker. Measure temperature, take conductivity reading, and adjust to 25°C.
3. Take preliminary measurement.
4. Draw third conductiveity sample, measure temperature and determine conductivity. If temperature and conductivity have been constant (i.e., representative of aquifer conditions rather than well conditions) proceed with Part D. If not, continue pumping and repeat Step C-4 until successive conductivities and temperatures are constant.

D. Sampling-Anions/Cations:

1. While pumping into 200 cc. beaker, take final pH temperature and conductivity readings. Record on field sheet. Record Well number/location, date, time, filtered or unfiltered, and acid treatment (if not for trace metals) on label outside bottle.
2. Rinse untreated bottle thoroughly with sample water.
3. Draw sample into bottle and replace cap (untreated, unfiltered sample).
4. For filtered samples, pump one sample volume through filter and then draw sample into acid prepared bottle. Watch tube and filter to avoid fouling filter with sediment or other possible debris. If fouling occurs, replace filter and resample.

E. Sampling-Volatile Organics:

1. Attach 100 ml. volumetric pipette to end of tubing and insert to center of water column.
2. Draw at least 300 ml. water through pipette then turn pump off.
3. Drain pipette into septum sample bottle filling from bottom up to avoid air contamination. Avoid exposure of sample to oxygen or plastics to the max.
4. Overfill bottle (inverse miniscus). Refit cap and wrap with foil to prevent organic destruction.
5. If any air is present in bottle (invert and watch for bubbles), discard and repeat sampling procedure.
6. Take duplicate sample as in E-1 through E-5.

F. Sampling-Phenols:

1. Attach string to pipette so that the pipette hangs vertically.
2. Insert into well casing and allow to fill with water using string as bailing retreiver.
3. Remove and drain pipette into sample bottle containing preservatives Copper Sulfate and Sulfuric Acid.
4. Repeat until adequate sample volume collected (1 liter).

G. General:

1. Ice all samples after collection.
2. Fill out laboratory sheets.
3. Deliver samples and lab sheets to Utah State Department of Health Laboratory, 44 Medical Drive, Salt Lake City, Room 127 before 4:30 each sample day.

SALT LAKE COUNTY FLOOD CONTROL & WATER QUALITY

WATER QUALITY FIELD REPORT

Date________ Time________ Sample#________ Project Name______________________
Station Number________________________________
Collected By__________________________________

FIELD MEASUREMENTS

AIR TEMPERATURE:____________________ oC
WATER LEVEL/CASING VOLUME:
Water Level: Hold________ft. - Cut________ft. = Depth to Water________ft.
Well Depth:________ft.
Casing Volume: Well Depth________ft. - Depth to Water________ft. = Depth of Water________ft.
Depth of Water________ft. x Constant________ = Volume______gal.

SPECIFIC CONDUCTANCE (Meter Type and #____).
Measurement *1.______umho @______oC = ______umho @25oC

2.______umho @______oC = ______umho @25oC

3.______umho @______oC = ______umho @25oC

4.______umho @______oC = ______umho @25oC

Specific Conductance:______umho @______oC = ______umho @25oC
(*Use additional pages if more than 4 preliminary measurements taken).

pH (Meter Type and #____________).
Measurement *1.________Units @________oC

2.________Units @________oC

3.________Units @________oC

4.________Units @________oC

pH:________________Units @________oC
(*Use additional pages if more than 4 preliminary measurements taken).

SAMPLES COLLECTED

TYPE OF SAMPLE TAKEN:
Anions________________________
Cations________________________
Volatile Organics______________
Phenols________________________
Others (Specify)_______________
____
____

QUALITY ASSURANCE SAMPLES:
Split Sample______________________
Replicate Sample__________________
Blank Sample______________________
Spike Sample______________________

OBSERVATIONS AND REMARKS:

IV SHALLOW AQUIFER MONITORING NETWORK

Some shallow aquifer wells existed prior to the cooperative study. The majority of the wells had to be drilled during the spring, summer, and early autumn of 1982. Utilizing assistance from Salt Lake County Flood Control and Water Quality, the U.S. Geological Survey drilled approximately 55 wells for observation of both quantity and quality conditions. The need to establish control over flow quantity and direction in the shallow aquifer required extensive water level data throughout Salt Lake Valley. Of the 55 stations, all were measured for water levels. Only 32 stations were selected for water quality analysis.

Location for the wells had to meet two basic criteria:

1) To obtain a characterization of general shallow groundwater quality.

2) To target potential non-point source contaminant plumes.

Haphazard location of these wells was to be avoided. Factors which would facilitate work plan objectives were separately described and composited to arrive at optimum well locations. These factors included:

1) Depth to shallow groundwater.

2) Surface hydrology

3) General land use - Emphasizing urban, rural, wetland, and waste disposal zones

4) Soil permeability

5) Recharge, discharge, and perched aquifer zones.

Based on analysis of these conditions the location and anticipated characteristics of the shallow wells could be better understood.

A. DEPTH TO GROUNDWATER

Shallow groundwater conditions to a maximum depth of 60" were documented by the Soil Conservation Service (SCS) in the Salt Lake Soil Survey as early as 1966.[14] Depth increments of 10" (0 - 30", 30" - 40", 40" - 50", 60" or greater) were estimated at locations occurring mainly within bottomlands or in proximity to surface water features or floodplains.

The Utah Geological and Mineralogical Survey (UGMS) incorporated SCS groundwater typology into a larger depth scale in 1982. [15] Depth increments at 0' - 5', 5' - 10', 10' - 20', and over 20' were delineated by UGMS, in addition to zones over 100' in depth and the occurrences of bedrock outcrops.

Figure 9 displays the incidence of shallow groundwater locations and relative depths. Variations of groundwater depth in the Class 1 zone (0' - 5') can be determined from soil mapping units in the Salt Lake Soil Survey.

B. SURFACE HYDROLOGY

Salt Lake Valley is intersected by no less than 16 perennial and intermittent freshwater streams. City Creek, Red Butte Creek, Emigration Creek, Parleys Creek, Mill Creek, Big and Little Cottonwood and Dry Creek are the principal perennial drainages to Salt Lake Valley from the Wasatch to the east. Butterfield, Midas, Bingham, and Barneys Creeks are the main intermittent drainages from the Oquirrh Range to the west. The Jordan River and Surplus Canal confluence these drainages at the valley bottom. Coon and Kersey Creeks flow directly into Great Salt Lake.

Eastside drainages are high quality streams protected for recreation, aesthetics, fishing, aquatic wildlife, and irrigation. They discharge over 151,000 acre-feet of mean annual inflow to the Jordan River and recharge 20,000 acre-feet per year to the principal confined aquifer. Pollutants entering these streams from shallow aquifer contamination could impair not only surface water use, but municipal sources as well.

Estimated runoff from unclassified intermittent streams draining the Oquirrhs is about 7000 acre-feet per year. Bingham and Butterfield Creeks are intercepted by mine tailings ponds which imply potential for surface

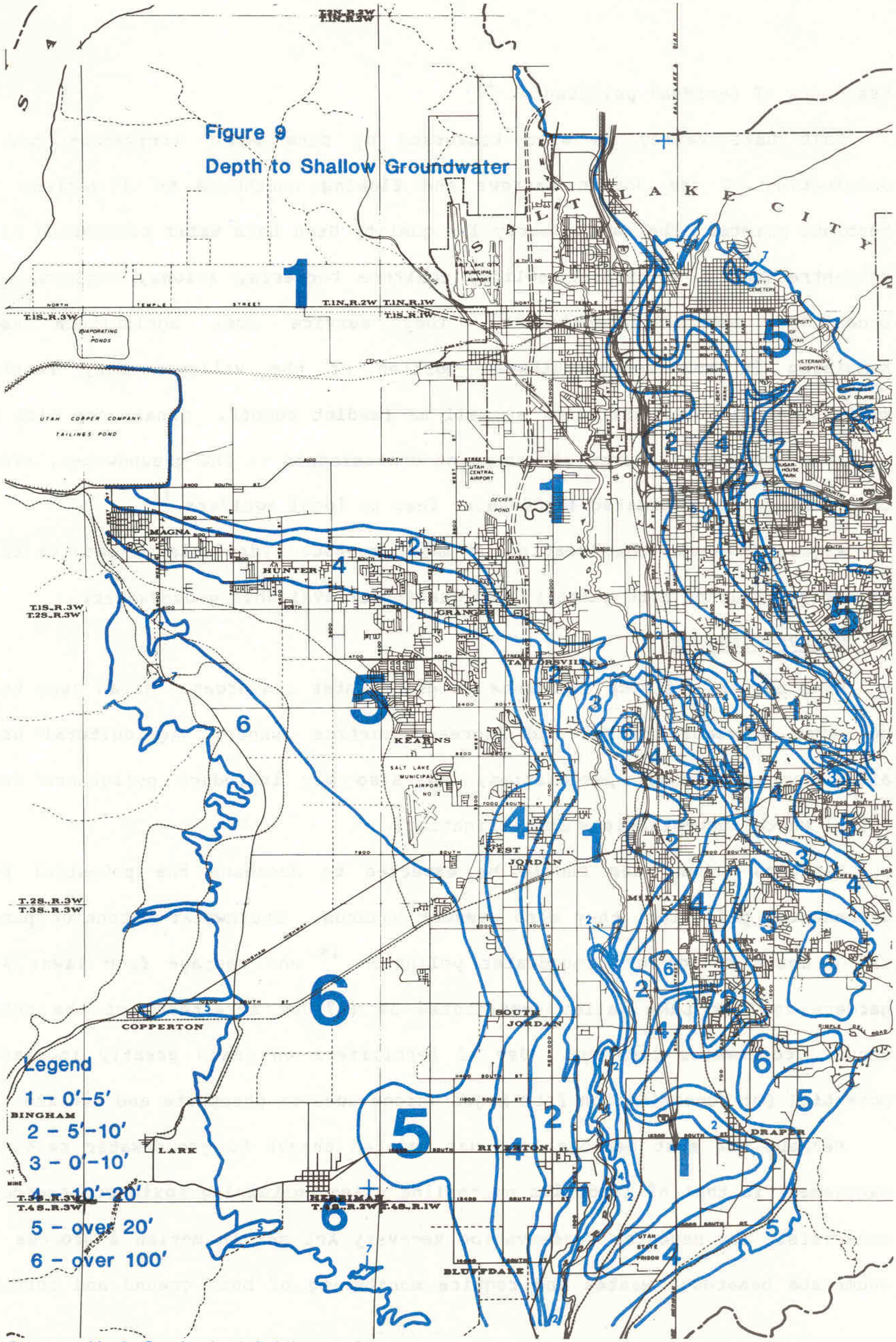


Figure 9
Depth to Shallow Groundwater

Source: Utah Geological & Mineral Survey transport of residual pollutants.[16]

Salt Lake Valley is also traversed by nine major irrigation canals originating at the Jordan Narrows and flowing northward to a variety of terminus points. The canals carry low quality Utah Lake water possessing high concentrations of dissolved solids, coliform bacteria, anions, cations, and occasional pesticides/herbicides. They service some agriculture uses remaining in the south-southwest portion of the valley. They receive irrigation tailwater pollution as well as feedlot runoff. Canals are also an important potential source of non-point contaminants to the groundwater, since they recharge an estimated 48,000 acre feet to local aquifers.[17]

Figure 10 shows the location of major surface hydrological features that directly influence both quantity and quality of available groundwater.

C. GENERAL LAND USE

Land use is a direct influence on groundwater resources. Urban uses tend to cover permeable ground and increase surface runoff. Agricultural uses allow for groundwater percolation, but also may introduce pollutants from animal waste concentrations and irrigation.

Although urban uses should be expected to decrease the potential for groundwater pollution, they also present hazards. Stormwater detention ponds are a known source of groundwater pollution [18] and seepage from lawns and gardens in Salt Lake Valley contributes 5% (17,000 acre-feet) of the total annual groundwater recharge. Use of fertilizers on lawns greatly increases potential for contamination from major anions such as phosphate and nitrate.

Perhaps the most serious land use related threat to groundwater resource management is that of landfills or tailing piles containing toxic or hazardous materials. The Resource Conservation Recovery Act set in motion a process to enumerate hazardous wastes and require monitoring of both ground and surface

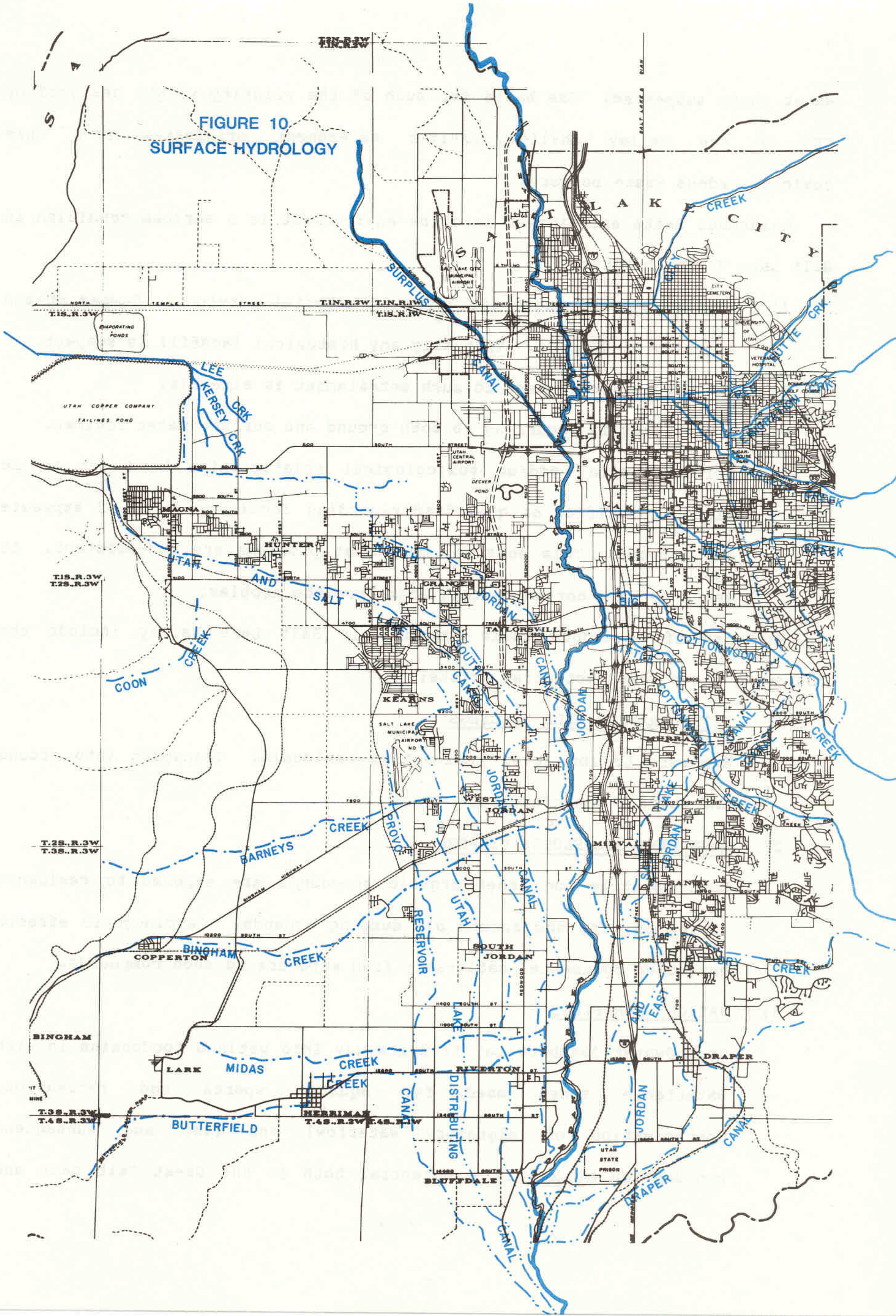


FIGURE 10
SURFACE HYDROLOGY

water where suspected. The basis for much of the priority weight assigned by EPA in the valley shallow aquifer assessment originates from this toxic/hazardous waste concern.

Hazardous waste entrainment into the environment is a serious condition in Salt Lake Valley because:

1) Little is known about the types of material perviously dumped or the location of dumping. Virtually any historical landfill is suspect.

2) The population exposed to such entrainment is sizeable.

3) Entrainment is occurring to both ground and surface water regimes.

4) Epidemeological and/or toxicological relationships have yet to be either quantified or qualified regarding local incidence of exposure and effects. This does not mean that problems are non-existent. It means we have not adequately addressed the problem.

Examples of hazardous waste exposure in Salt Lake Valley include the following cases where potential exists:

1) VITRO URANIUM MILL TAILINGS

Exposure to low level radioactive residuals. Transport into ground and surface water exists.

2) ROSE PARK OIL/SLUDGE DISPOSAL

Both volatile and other organic compounds are exposed to residents living on, in, and around old dumping grounds. Carcinogenic effects have been documented nationally from exposure to such compounds.

3) VARIOUS LANDFILLS

Groundwater leachate may find its way into wetland foodchains in high watertable zones used for aquatic sports and recreation. Contamination of migratory waterfowl and fish and subsequent consumption by man is a potential both in the Great Salt Lake and

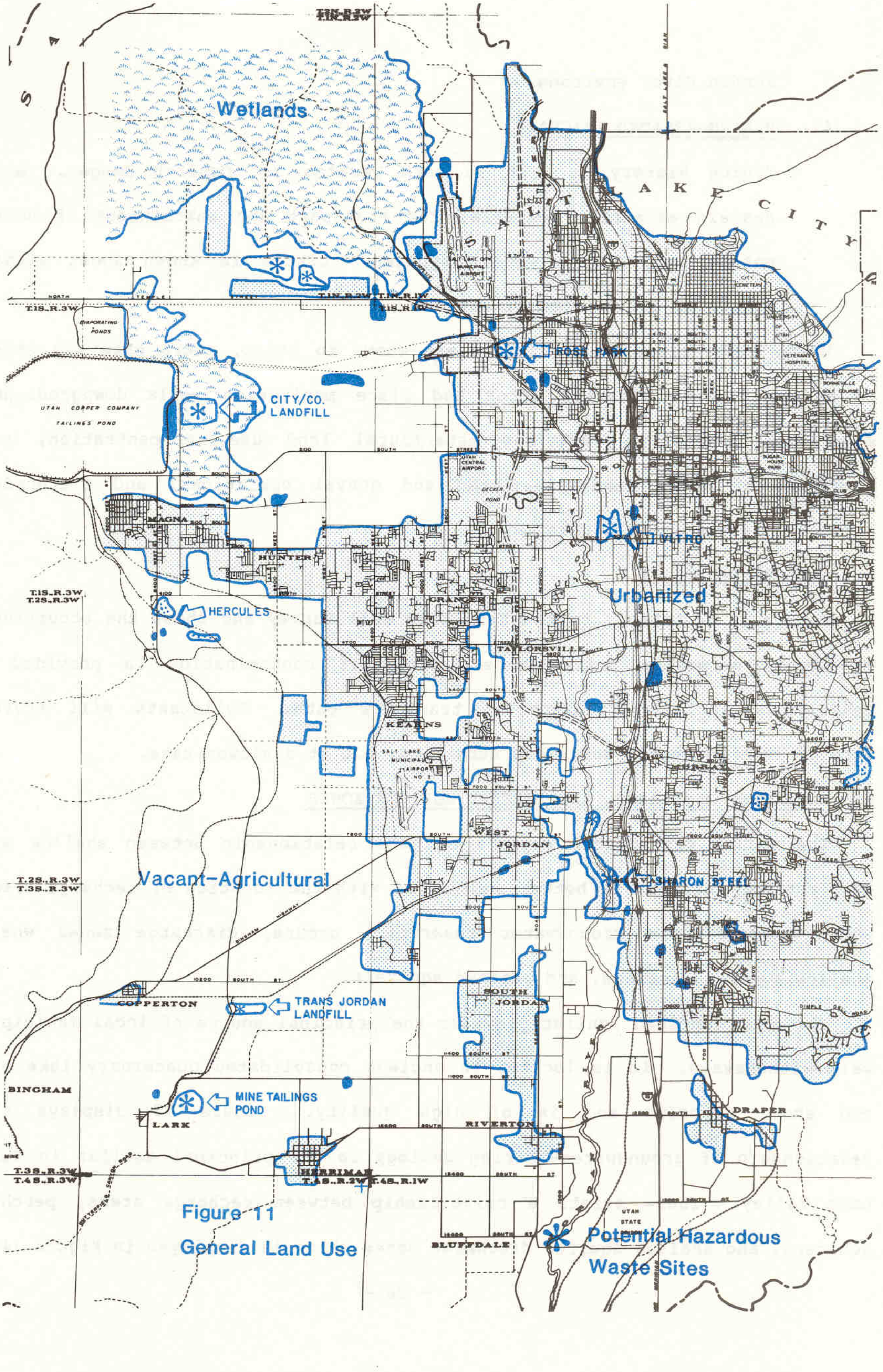


Figure 11
General Land Use

Jordan River environs.

4) MINING-RELATED LEACHATE

Mining history is rich in both Wasatch and Oquirrh Ranges. Both contain extensive potential for transport and entrainment of heavy metals into public water supplies. Little is known about either potential due to lack of data.

Where these kinds of facilities are known to exist, extra care was taken to assess highest priority sites and place monitoring wells downgradient. Figure 11 generally summarizes urban/rural land use, concentration, and locations of known landfills, sand and gravel operations, and overburden leachate sources in Salt Lake Valley.

D. SOIL PERMEABILITY

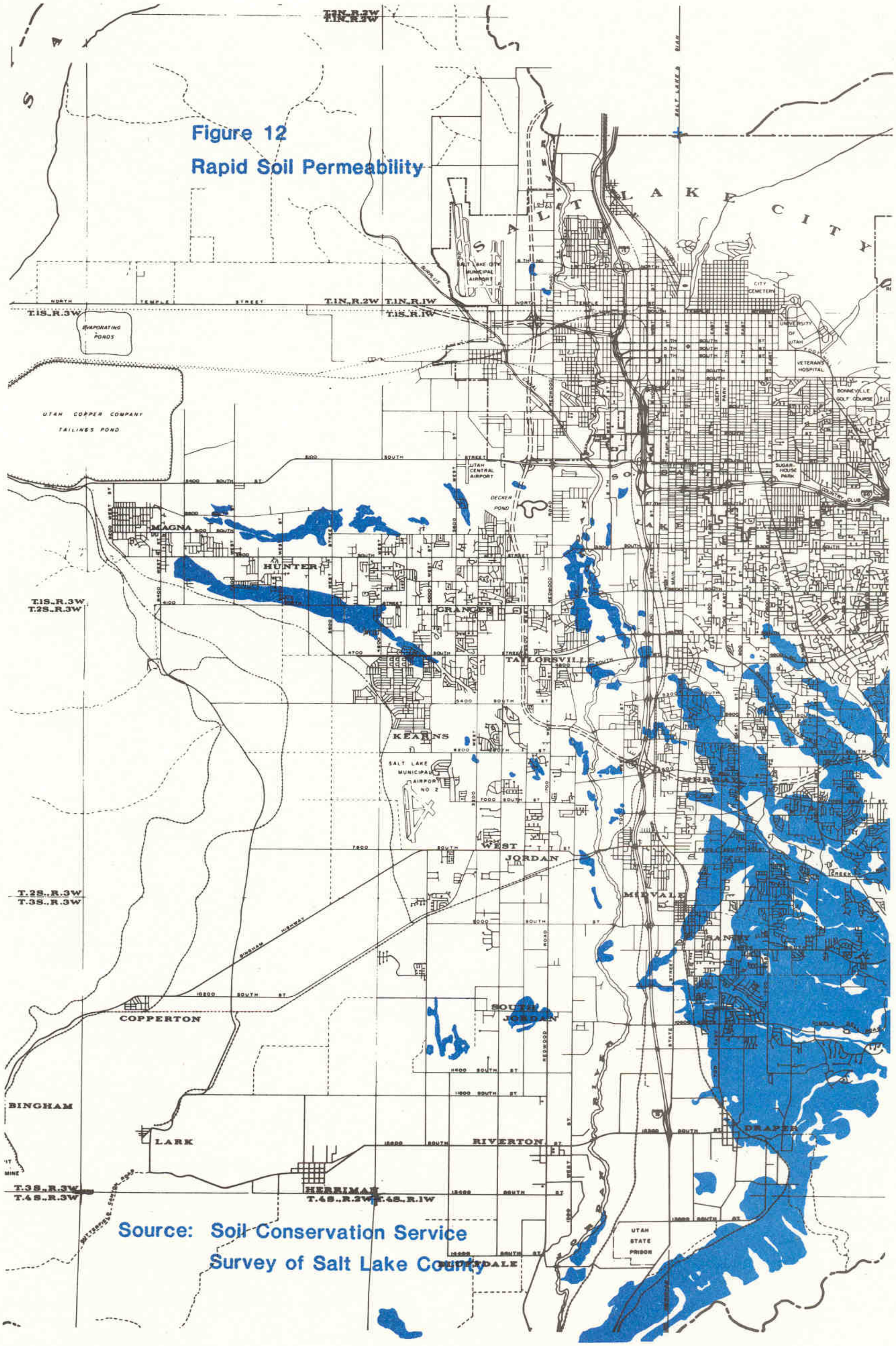
Figure 12 is taken from the Salt Lake Soil Survey and shows the occurrence of highly permeable soils where groundwater contamination is provided a readily available entrainment or transport path. Pollutants will travel through less permeable soils and substrate, but at a slower rate.

E. RECHARGE, DISCHARGE, AND PERCHED AQUIFER ZONES

The valley groundwater regimes and the relationship between shallow and deep aquifer resource is better understood with the location of recharge areas where seepage into groundwater reservoirs occurs, discharge zones where shallow aquifers surface, and perched aquifers.

The deep confined aquifer provides the principal source of local municipal well withdrawals. It is located in ancient consolidated quaternary lake bed and shore deposits and is of high quality. Figure 13 displays the relationship of groundwater-bearing geology to the principal aquifer in Salt Lake Valley. There exists a relationship between recharge areas, perched aquifers, and shallow aquifer discharge zones which is displayed in Figure 14.

Figure 12
Rapid Soil Permeability



Source: Soil Conservation Service
Survey of Salt Lake County

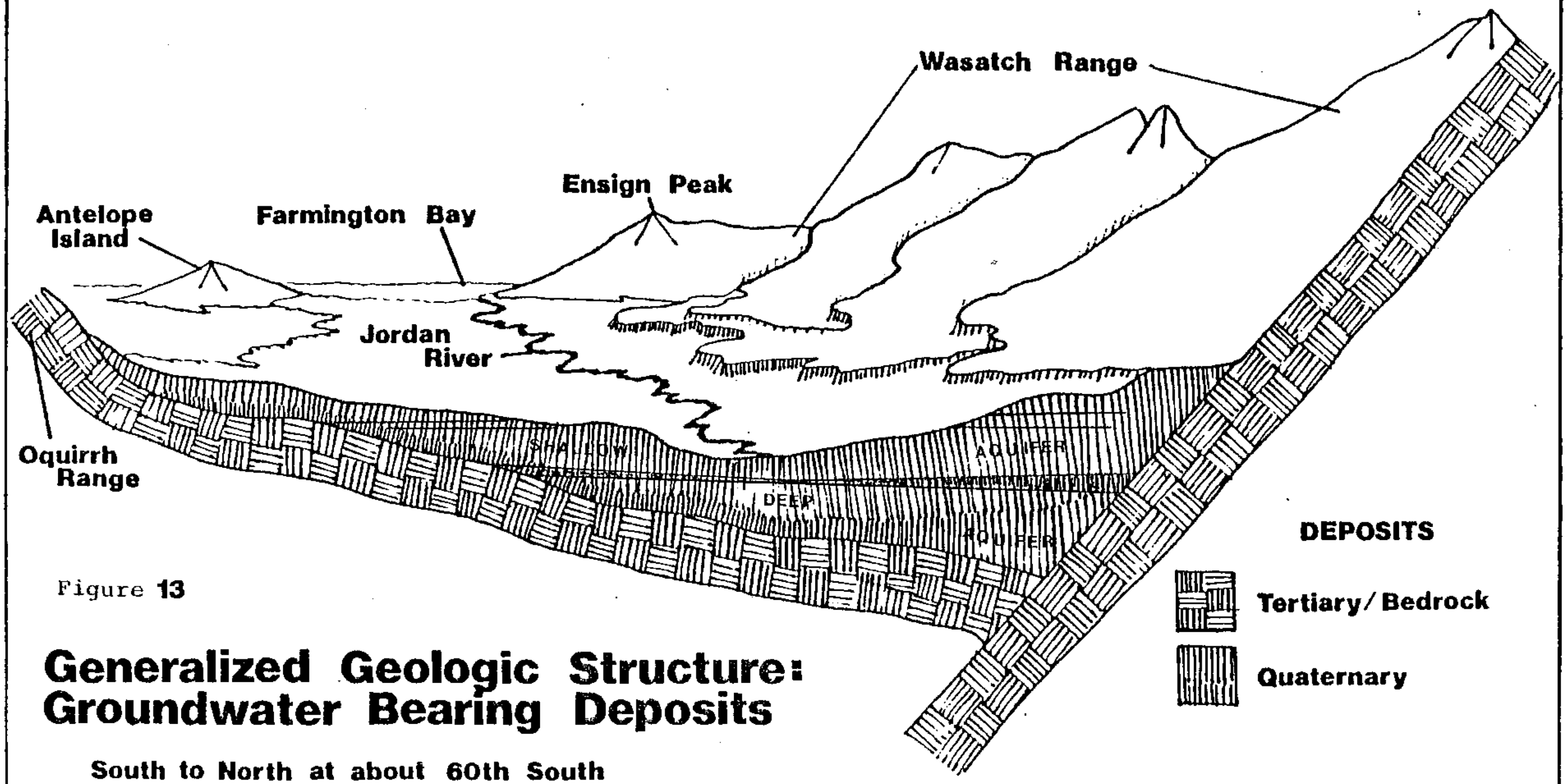


Figure 13

Generalized Geologic Structure: Groundwater Bearing Deposits

South to North at about 60th South

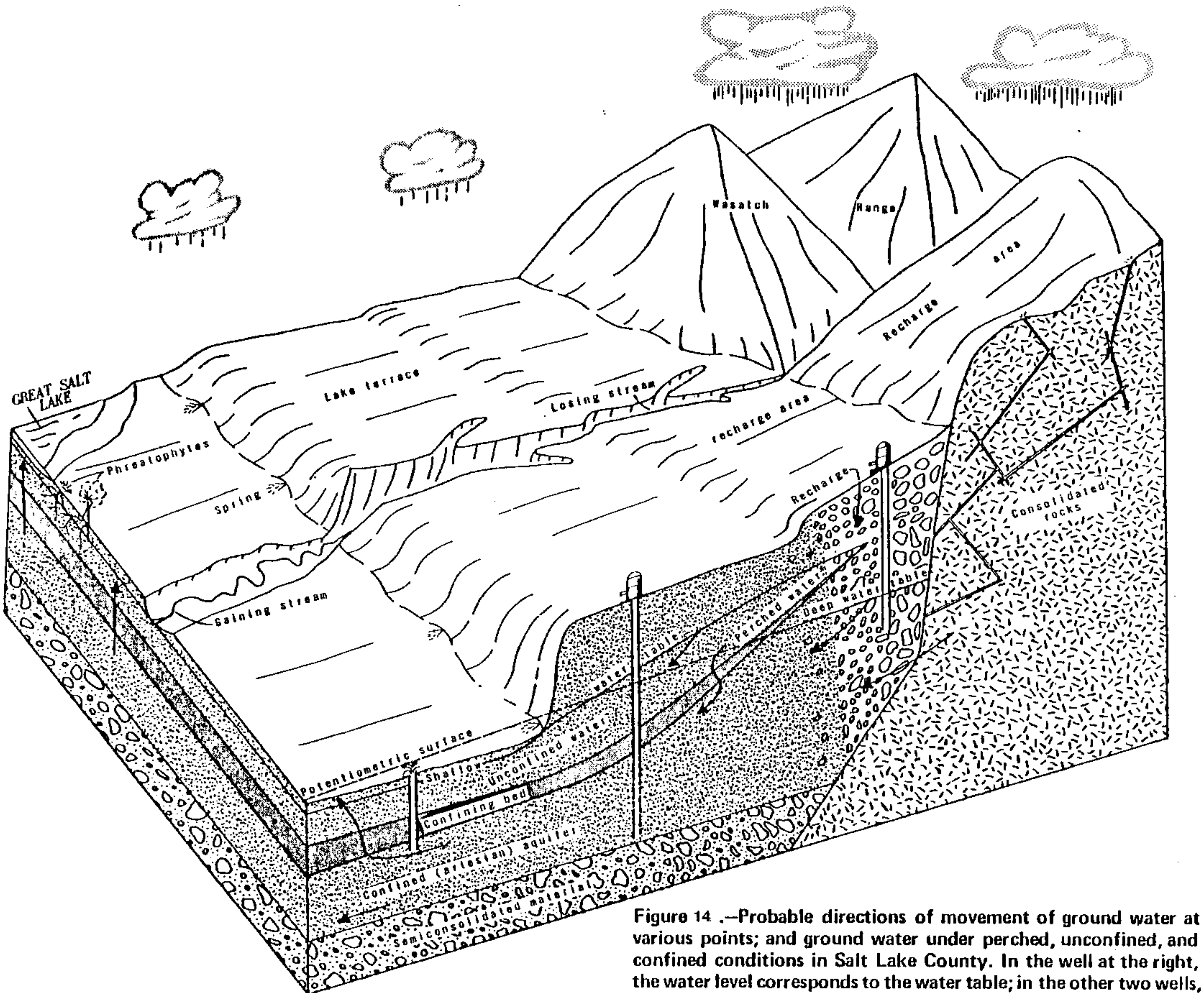


Figure 14 .—Probable directions of movement of ground water at various points; and ground water under perched, unconfined, and confined conditions in Salt Lake County. In the well at the right, the water level corresponds to the water table; in the other two wells, which tap the confined aquifer, the water rises above the confining layer to the potentiometric surface.

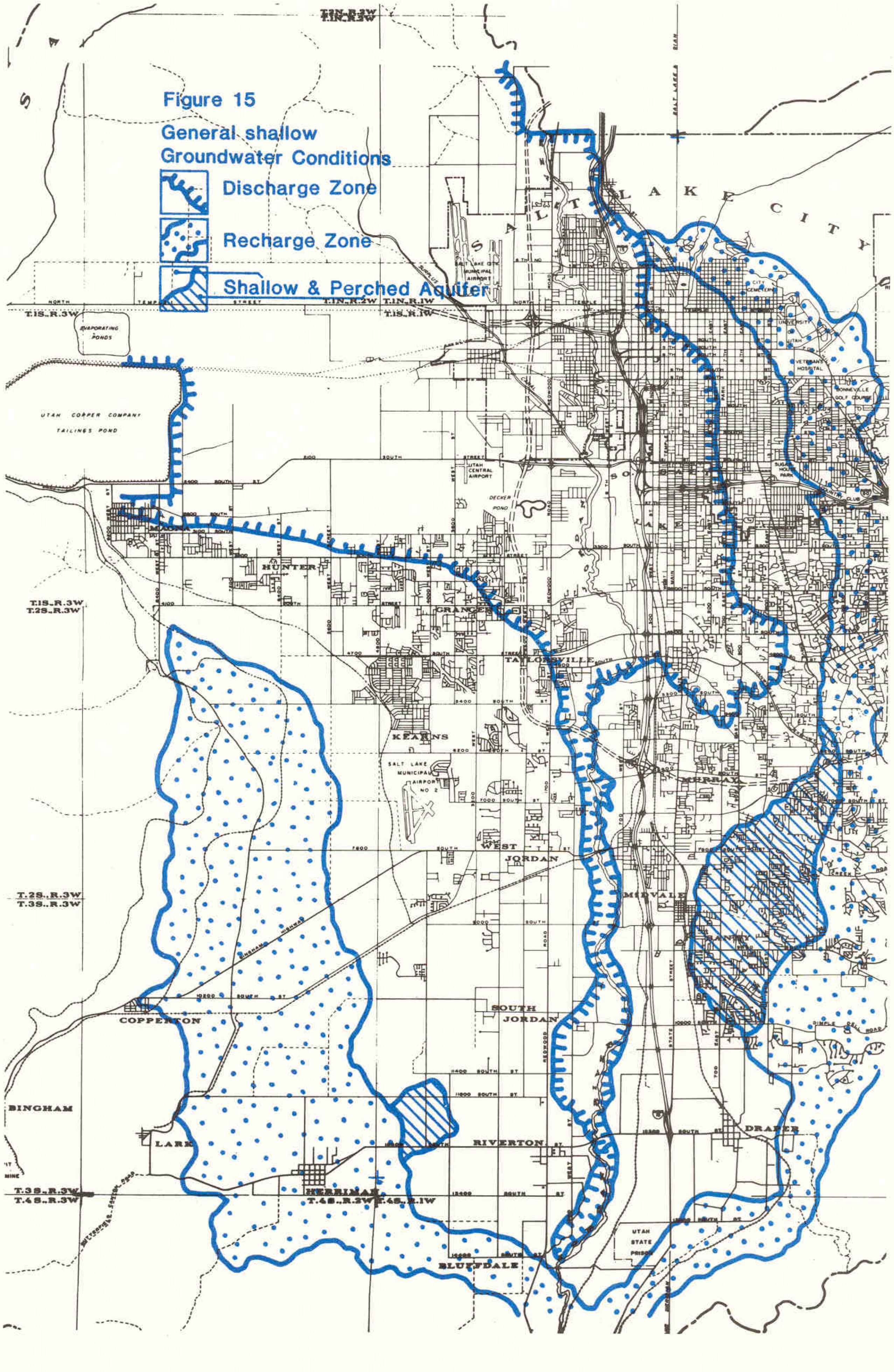


Figure 15
General shallow Groundwater Conditions

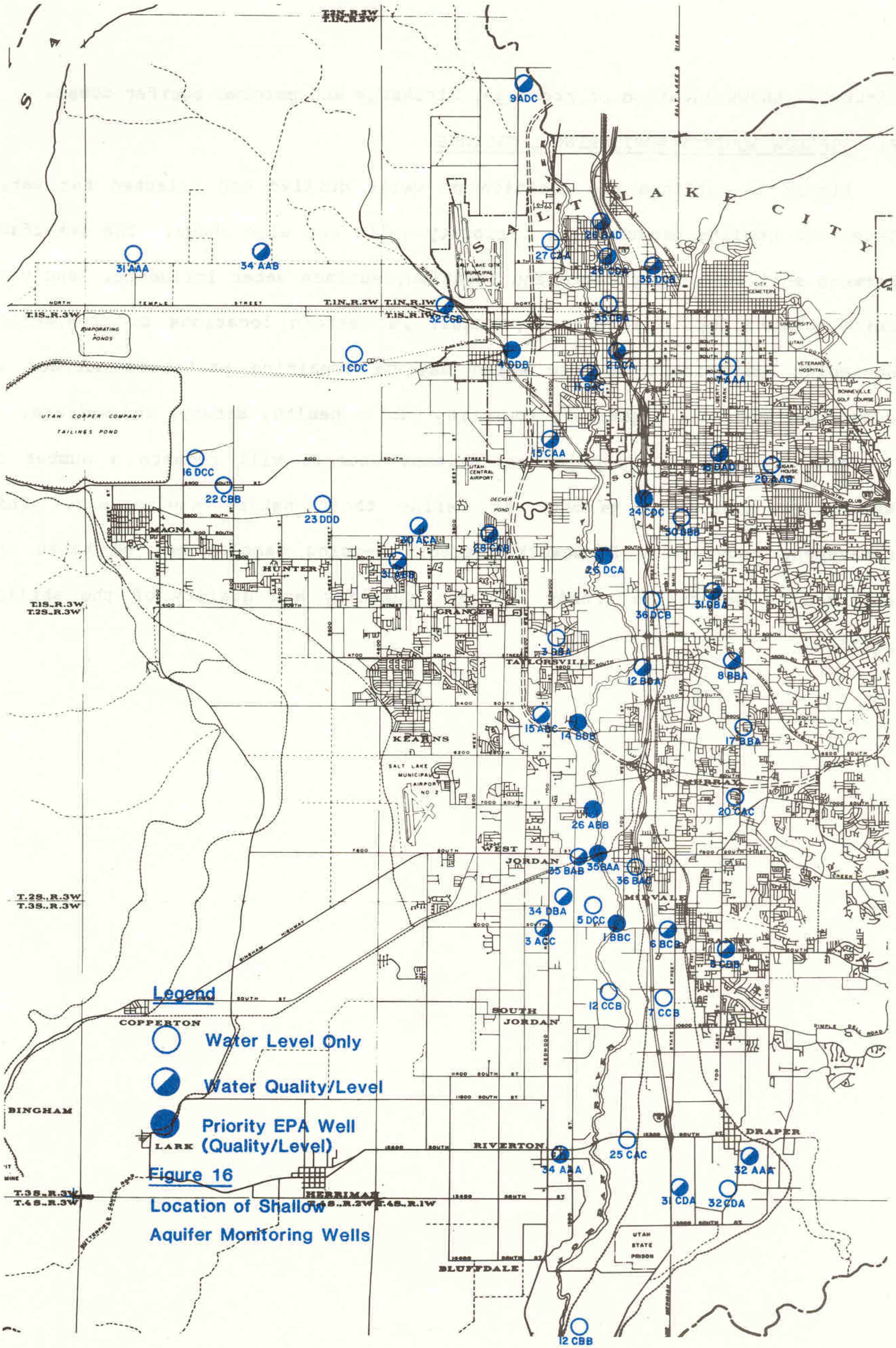


Figure 16
Location of Shallow Aquifer Monitoring Wells

Figure 15 shows location of recharge, discharge and perched aquifer zones.

F. SHALLOW AQUIFER MONITORING LOCATIONS

Figure 16 outlines the location of wells drilled and selected for water level and quality measurement. Priority wells are also shown. The interface between shallow aquifer depth and location, surface water influence. land use, soil permeability, and recharge, result in certain locations as prospective non-point contaminant sources which may be impairing protected surface or subsurface use, and negatively impacting public health, safety, and welfare.

The prospective non-point contaminant sources will require a number of successive monitoring efforts to define their nature and extent. This assessment provides a framework whereby on-going samples may be taken and analyzed to deterimine trends in water quantity and quality of the shallow aquifer.

V. QUALITY OF THE SHALLOW AQUIFER

A. Shallow Groundwater Assessment

As noted before, 55 new wells were drilled and monitored for purposes of quality and quantity assessment. Of the 55 wells, 32 were sampled for quality (7 were EPA designated wells) and all were sampled for quantity (water-level). The quantity of the shallow aquifer has been published in Table 2 of the USGS Report (Appendix).[18]

Wells were drilled in 1982 and sampled twice in 1983. Well log data for the 32 quality wells is shown in Figure 17. Water quality data is listed in Table 2. Quality assurance (QA) data, which consists of duplicate, replicate, spikes and blanks, are shown in Table 3.

B. Quality Assurance Assessment and Results.

Both field and laboratory quality assurance plans are required by EPA on groundwater assessments. The U.S. Geological Survey provided a field sampling QA program and the Utah State Medical Laboratory provided the laboratory QA program. Both QA programs were approved by EPA in the final workplan. Such programs are necessary to insure accuracy and integrity of data. During the shallow aquifer assessment, duplicates, spikes, and blanks were processed and submitted for analysis. Examination of QA data reveals the existence of blank sample contamination for TDS, Cl, SO4, and Phenols. Investigation of the matter with State Medical Lab personnel indicated the presence of filter contamination. Further details of the nature and extent of contamination are available from open files at the State Medical Laboratory.

Logs of Selected Wells

FIGURE 17

STATION	
(C-2-1) 12BDA	SAND - Dry; CLAY - Brown (Wet); BROWN MUCK; GRAY MUCK
(C-1-1) 31ABB	CLAY - Brown (Dry); CLAY - Brown (Wet); CLAY/PEA GRAVEL
(C-1-1) 30ACA	CLAY - Brown (Wet); CLAY - Gray (Wet); CLAY - Brown (Dry)
(C-1-1) 28CAB	
(C-1-1) 26DCA	SAND - Dry; SANDY CLAY Tan; CLAY - Brown (Wet); CLAY - Gray (Wet)
(C-1-1) 24CDC	CLAY - Black; GRAY MUCK; BROWN MUCK
(C-1-1) 15CAA	
(C-1-1) 11BAC	SANDY CLAY - Black (Dry); CLAY - Gray (Wet)
(C-1-1) 4DDB	CLAY - Brown (Dry); CLAY - Brown (Wet); SANDY CLAY - Gray (Wet)
(C-1-1) 2DCA	SAND - Moist; SAND/PEA GRAVEL; CLAY - Gray (Wet)
(B-1-2) 34AAB	CLAY - Brown (Dry); CLAY - Brown (Wet); SANDY CLAY - Gray (Wet)
(B-1-1) 35DCB	SANDY CLAY - Tan; CLAY - Gray (Wet)
(B-1-1) 32CCD	CLAY - Brown (Dry); BROWN MUCK; GRAY MUCK
(B-1-1) 26CDA	CLAY - Black; CLAY - Gray (Wet)
(B-1-1) 26BAD	SANDY CLAY - Tan; SAND - Gray (Wet)
(B-1-1) 9ADC	CLAY - Brown (Dry); CLAY - Gray (Wet)

Well Depth (Ft.): 0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 6-7, 7-8, 8-9, 9-10, 10-11, 11-12, 12-13, 13-14, 14-15, 15-16, 16-17, 17-18, 18-19, 19-20

Logs of Selected Wells

FIGURE 17 (cont'd)

STATION				
(D-3-1) 32AAA	TOP SOIL (Dry)	SAND/PEA GRAVEL	SAND - Brown (Moist)	
(D-3-1) 31CDA	TOP SOIL (Dry)	CLAY - Brown (Wet)		
(D-3-1) 6BCB	SAND - Black	SAND - Brown (Moist)	CLAY - Brown (Wet)	
(D-3-1) 5CDB				
(D-2-1) 8BBA				
(D-1-1) 31DBA	TOP SOIL (Dry)	CLAY - Brown (Dry)	CLAY - Brown (Wet)	CLAY - Gray (Wet)
(D-1-1) 18DAD	TOP SOIL (Dry)	CLAY - Black	CLAY - Brown (Wet)	
(C-3-1) 34AAA	CLAY - Brown (Wet)			
(C-3-1) 3ACC	TOP SOIL (Dry)	CLAY - Green (Wet)	GRAVEL	
(C-3-1) 1BBC	SAND/PEA GRAVEL CLAY - Brown (Dry)	CLAY - Black	SANDY CLAY - Black (Moist)	
(C-2-1) 35BAB	SAND - Dry	CLAY - Brown (Wet)		
(C-2-1) 35BAA	CLAY - Brown (Dry)	CLAY - Black	CLAY/PEA GRAVEL	SAND/PEA GRAVEL
(C-2-1) 34DDA	SAND - Dry	SANDY CLAY - Tan	SANDY CLAY - Gray (Wet)	CLAY - Gray (Wet)
(C-2-1) 26ABB	SAND - Dry	SAND/PEA GRAVEL		
(C-2-1) 15ABC	CLAY - Brown (Dry)	BROWN MUCK		
(C-2-1) 14BDB	SANDY CLAY - Black (Dry)	SANDY CLAY - Black (Moist)	CLAY/ PEA GRAVEL	GRAVEL

Well Depth (Ft.): 0–1, 1–2, 2–3, 3–4, 4–5, 5–6, 6–7, 7–8, 8–9, 9–10, 10–11, 11–12, 12–13, 13–14, 14–15, 15–16, 16–17, 17–18, 18–19, 19–20

TABLE 2. Water Quality Data - Shallow Aquifer Assessment

STATION	STORET	DATE	TIME	TEMP. (Deg. C)	Ph (SU)	COND. (uMHOS)	TDS (mg/L)	ALK. (mg/L)	HARD. (mg/L)	Cl (mg/L)	NO_3 (mg/L)	NO_2 (mg/L)	SO_4 (mg/L)
(B-1-1) 9ADC-1	405007111570901	830201		7.0	8.0	6590	4240	1250	170	1300	18.0	.850	240
(B-1-1) 9ADC-1	405007111570901	830801	1100	15.0	7.4	8008	4448	----	----	1650	7.2	-----	460
(B-1-1) 26BAD-1	404748111551401	830207		9.0	7.0	2530	2150	424	1300	120	.7	<.020	980
(B-1-1) 26BAD-1	404748111551401	830729	1100	17.0	6.5	2500	2730	----	----	94	2	-----	1340
(B-1-1) 26CDA-1	404710111551301	830117		11.5	7.5	1200	724	428	560	72	2.7	<.020	150
(B-1-1) 26CDA-1	404710111551301	830727	1230	14.5	7.4	1146	738	----	----	67	2.18	-----	142
(B-1-1) 32CCD-1	404616111585801	830201		8.0	7.6	8590	-----	----	----	----	5.0	<.020	----
(B-1-1) 32CCD-1	404616111585801	830727	1030	17.5	7.2	10611	6432	----	----	2900	.18	-----	478
(B-1-1) 35DCB-1	404621111550501	830202		11.0	7.6	3680	2670	1290	1400	160	86.0	.020	600
(B-1-1) 35DCB-1	404621111550501	830801	1230	16.0	7.0	3337	2190	----	----	190	36.5	-----	510
(B-1-2) 34AAB-1	404702112025201	830201		10.0	7.8	14400	-----	----	----	----	.1	<.020	----
(B-1-2) 34AAB-1	404702112025201	830726	1230	17.0	7.6	825	4502	----	----	2500	.32	-----	138
(C-1-1) 2DCA-1	404527111550102	830107		12.5	6.9	2320	1880	373	1400	67	13.0	.030	990
(C-1-1) 2DCA-1	404527111550102	830728	1045	17.0	6.7	2252	1994	----	----	55	14.57	-----	950
(C-1-1) 4DDB-1	404528111570901	830202		7.5	7.7	4370	-----	----	----	----	.1	<.020	----
(C-1-1) 4DDB-1	404528111570901	830802	1130	19.5	7.2	4070	2644	----	----	530	.04	-----	280
(C-1-1) 11BAC-1	404505111552501	830107		10.5	7.1	10900	8920	948	3500	1700	<.1	<.020	3900
(C-1-1) 11BAC-1	404505111552501	830728	1200	15.0	7.0	11704	10303	----	----	4650	1.84	-----	4030
(C-1-1) 15CAA-1	404357111562301	821029			7.2	3410	-----	----	----	----	-----	-----	----
(C-1-1) 15CAA-1	404357111562301	830802	1400	15.5	6.8	2302	1646	----	----	135	.06	-----	585
(C-1-1) 24CDC-1	404247111541001	830204		7.0	7.1	3220	-----	----	----	----	6.0	<.020	----
(C-1-1) 24CDC-1	404247111541001	830728	1430	17.0	7.0	3006	2432	----	----	385	6.67	-----	950
(C-1-1) 26DCA-1	404154111545901	830202		8.0	7.4	4230	3040	439	1500	650	51	<.020	950
(C-1-1) 26DCA-1	404154111545901	830801	1500	15.0	7.1	1848	1270	----	----	190	5.60	-----	360
(C-1-1) 28CAB-1	404207111574301	830202		13.0	8.0	1030	586	185	240	170	.1	<.020	95
(C-1-1) 28CAB-1	404207111574301	830804	1100	15.0	7.3	1047	588	----	----	170	.08	.26	95
(C-1-1) 30ACA-1	404223111592701	830207		9.5	7.6	4640	3150	1050	620	540	8.6	.020	870
(C-1-1) 30ACA-1	404223111592701	830803	1350	18.0	7.1	4716	3056	----	----	475	13.9	-----	795
(C-1-1) 31ABB-1	404142111594301	830207		10.5	7.4	1990	1330	416	580	260	5.8	<.02	320
(C-1-1) 31ABB-1	404142111594301	830803	1130	17.5	6.6	1737	1132	----	----	165	3.5	-----	236
(C-2-1) 12BDA-1	403949111540301	830203		11.0	7.3	2310	-----	----	----	----	5.5	<.020	----
(C-2-1) 12BDA-1	403949111540301	830721	1235	16.0	7.1	2229	1340	----	----	350	3.5	-----	146
(C-2-1) 14BDB-1	403853111552501	830203		9.0	6.3	2310	1750	103	900	210	.45	<.020	910
(C-2-1) 14BDB-1	403853111552501	830809	1330	17.0	6.0	1639	1062	----	----	205	1.18	-----	394
(C-2-1) 15ABC-1	403903111561601	830207		10.5	7.1	2240	1520	325	800	290	5.6	<.020	480
(C-2-1) 15ABC-1	403903111561601	830810	1030	17.0	6.7	2408	1664	----	----	325	5.04	-----	495
(C-2-1) 26ABB-1	403721111550601	830203		7.0	7.3	8960	-----	----	----	----	8.6	<.020	----
(C-2-1) 26ABB-1	403721111550601	830808	1100	18.0	6.8	7963	6138	----	----	1125	.4	-----	2575
(C-2-1) 34DDA-1	403552111554301	830117		10.0	7.1	3450	2480	426	1200	520	14	<.020	810
(C-2-1) 34DDA-1	403552111554301	830811	1400	16.0	6.7	2494	1666	----	----	330	10.00	-----	481
(C-2-1) 35BAA-1	403634111551301	830203		9.5	6.9	3160	2550	282	1600	300	.12	<.02	1200
(C-2-1) 35BAA-1	403634111551301	830811	1100	19.0	6.5	3560	2720	----	----	400	.06	-----	1215
(C-2-1) 35BAB-1	403632111552301	830117		12.5	7.0	2500	1660	332	780	370	1.7	.020	450
(C-2-1) 35BAB-1	403632111552301	830811	1300	16.0	6.8	3157	2262	----	----	410	.08	-----	755

TABLE 2 (cont'd)

STATION	STORET	DATE	TIME	TEMP. (Deg. C)	Ph (SU)	COND. (uMHOS)	TDS (mg/L)	ALK. (mg/L)	HARD. (mg/L)	Cl (mg/L)	NO_3 (mg/L)	NO_2 (mg/L)	SO_4 (mg/L)
(C-3-1) 1BBC-1	403533111543301	830204		10.5	6.7	2340	1520	892	950	250	<.1	<.02	180
(C-3-1) 1BBC-1	403533111543301	830816	1200	16.5	6.3	2730	1766	----	----	348	<.02	-----	266
(C-3-1) 3ACC-1	403517111561301	830114		13.0	7.2	2910	1600	455	870	180	25.0	.54	690
(C-3-1) 3ACC-1	403517111561301	830816	1400	19.0	6.6	4682	3108	----	----	145	238	-----	1113
(C-3-1) 34AAA-1	403117111554901	830117		12.5	7.1	3470	2810	316	1500	340	4.2	<.02	1300
(C-3-1) 34AAA-1	403117111554901	830818	1400	14.0	6.7	3538	2809	----	----	345	4.62	-----	1290
(D-1-1) 18DAD-1	404348111522201	830107		12.0	7.0	1460	778	318	570	160	7.9	<.02	220
(D-1-1) 18DAD-1	404348111522201	830805	1115	17.0	6.7	1474	952	----	----	27	10.6	-----	250
(D-1-1) 31DBA-1	404119111523501	830112		12.0	7.1	2040	1270	443	700	350	.22	<.02	170
(D-1-1) 31DBA-1	404119111523501	830808	1445	15.5	6.5	2558	1618	----	----	860	.28	-----	242
(D-2-1) 8BBA-1	404002111520601	830112		11.5	7.0	2120	1510	405	920	210	.19	<.02	550
(D-2-1) 8BBA-1	404002111520601	830809	1100	18.0	6.7	1846	1304	----	----	150	.06	-----	430
(D-3-1) 5CDB-1	403501111515501	830204		7.0	7.6	394	-----	----	----	----	2.9	<.02	----
(D-3-1) 5CDB-1	403501111515501	830817	1100	20.5	6.9	525	336	----	----	34	4.00	-----	61
(D-3-1) 6BCB-1	403520111531701	830112		14.5	7.3	1560	966	322	500	230	4.3	<.02	180
(D-3-1) 6BCB-1	403520111531701	830817	1300	16.0	7.0	1848	1072	----	----	220	35.40	-----	195
(D-3-1) 31CDA-1	403038111525501	830112		10.5	7.3	2830	1960	266	880	420	21	<.02	530
(D-3-1) 31CDA-1	403038111525501	830818	1130	15.0	7.1	2944	1978	----	----	405	25.00	-----	493
(D-3-1) 32AAA-1	403117111511601	830112		11.0	6.8	760	490	180	250	83	4.5	<.02	100
(D-3-1) 32AAA-1	403117111511601	830818	1230	12.0	6.5	1069	688	----	----	150	4.82	-----	134

TABLE 2 (cont'd)

STATION	As (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (ug/L)	Pb (ug/L)	Mn (ug/L)	Hg (ug/L)	Ni (ug/L)	Se (ug/L)	Ag (ug/L)	Ba (ug/L)	Zn (ug/L)	Ca (mg/L)
(B-1-1) 9ADC-1	---	---	---	---	540	---	90	---	---	---	---	---	---	20
(B-1-1) 9ADC-1	18	< 1	< 5	< 10	830	< 5	110	<.1	90	1.0	6	120	< 5	---
(B-1-1) 26BAD-1	60	< 1	< 10	9	540	1	60	<.1	---	---	---	---	---	390
(B-1-1) 26BAD-1	95	< 1	< 5	25	30	5	< 10	<.1	< 10	<.5	2	< 50	< 5	---
(B-1-1) 26CDA-1	---	---	---	---	< 3	---	1	---	---	---	---	---	---	42
(B-1-1) 26CDA-1	10	< 1	42	< 10	640	< 5	< 10	<.1	30	<.5	< 2	50	< 5	---
(B-1-1) 32CCD-1	300	---	---	---	---	---	---	---	---	---	---	---	---	---
(B-1-1) 32CCD-1	350	5	11	< 10	< 30	< 5	30	<.1	412	1.5	7	80	< 5	---
(B-1-1) 35DCB-1	---	---	---	---	10	---	10	---	---	---	---	---	---	26
(B-1-1) 35DCB-1	14	1	< 5	< 10	< 30	5	< 10	<.1	< 10	<.5	3	50	5	---
(B-1-2) 34AAB-1	3	---	---	---	---	---	---	---	---	---	---	---	---	---
(B-1-2) 34AAB-1	4	5	12	< 10	< 30	< 5	155	<.1	250	<.5	5	270	20	---
(C-1-1) 2DCA-1	< 1	< 1	10	2	30	2	510	<.1	---	---	---	---	---	470
(C-1-1) 2DCA-1	<.5	1	< 5	< 10	< 30	5	565	<.1	13	<.5	2	< 50	< 5	---
(C-1-1) 4DDB-1	130	---	---	---	---	---	---	---	---	---	---	---	---	---
(C-1-1) 4DDB-1	154	< 1	< 5	40	< 30	< 5	60	<.1	< 10	<.5	< 2	60	< 5	---
(C-1-1) 11BAC-1	---	---	---	---	190	---	560	---	---	---	---	---	---	310
(C-1-1) 11BAC-1	12.5	5	6	20	< 30	20	250	<.1	107	1.5	7	< 50	10	---
(C-1-1) 15CAA-1	---	---	---	---	---	---	---	---	---	---	---	---	---	---
(C-1-1) 15CAA-1	27	< 1	< 5	25	< 30	< 5	185	<.1	< 10	<.5	< 2	< 50	< 5	---
(C-1-1) 24CDC-1	4	---	---	---	---	---	---	---	---	---	---	---	---	---
(C-1-1) 24CDC-1	1.5	< 1	< 5	< 10	< 30	< 5	10	<.1	< 10	<.5	3	< 50	5	---
(C-1-1) 26DCA-1	44	< 1	10	9	30	< 1	30	<.1	---	---	---	---	---	170
(C-1-1) 26DCA-1	70	< 1	< 5	< 10	< 30	< 5	80	0.7	< 10	<.5	2	50	8	---
(C-1-1) 28CAB-1	40	< 1	< 10	< 1	130	< 1	100	<.1	---	---	---	---	---	40
(C-1-1) 28CAB-1	62	< 1	< 5	< 10	150	< 5	90	<.1	< 10	<.5	< 2	70	< 5	---
(C-1-1) 30ACA-1	110	< 1	< 10	10	20	1	100	<.1	---	---	---	---	---	51
(C-1-1) 30ACA-1	95	< 1	< 5	15	30	5	90	<.1	< 10	2.5	2	< 50	15	---
(C-1-1) 31ABB-1	16	< 1	10	3	30	2	10	<.1	---	---	---	---	---	90
(C-1-1) 31ABB-1	18	< 1	< 5	< 10	< 30	< 5	< 10	<.1	< 10	<.5	< 2	90	< 5	---
(C-2-1) 12BDA-1	2	---	---	---	---	---	---	---	---	---	---	---	---	---
(C-2-1) 12BDA-1	4.0	1	6	---	---	13	---	---	---	---	---	---	---	---
(C-2-1) 14BDB-1	50	< 1	< 10	< 1	37000	< 1	480	<.1	---	---	---	---	---	180
(C-2-1) 14BDB-1	54.0	< 1	< 5	---	---	< 5	---	---	---	---	---	---	---	---
(C-2-1) 15ABC-1	8	< 1	10	2	30	< 1	< 10	<.1	---	---	---	---	---	190
(C-2-1) 15ABC-1	10	< 1	< 5	---	---	< 5	---	---	---	---	---	---	---	---
(C-2-1) 26ABB-1	60	---	---	---	---	---	---	---	---	---	---	---	---	---
(C-2-1) 26ABB-1	54	< 1	< 5	---	---	< 5	---	---	---	---	---	---	---	---
(C-2-1) 34DDA-1	6	< 1	10	5	40	< 1	30	<.1	---	---	---	---	---	260
(C-2-1) 34DDA-1	8	< 1	8	---	---	< 5	---	---	---	---	---	---	---	---
(C-2-1) 35BAA-1	10	200	10	8	1900	46	1800	<.1	---	---	---	---	---	390
(C-2-1) 35BAA-1	390	43	5	---	---	27	---	---	---	---	---	---	---	---
(C-2-1) 35BAB-1	17	< 1	10	9	20	< 1	30	<.1	---	---	---	---	---	170
(C-2-1) 35BAB-1	20	< 1	< 5	---	---	< 5	---	---	---	---	---	---	---	---

TABLE 2 (cont'd)

STATION	As (ug/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (ug/L)	Pb (ug/L)	Mn (ug/L)	Hg (ug/L)	Ni (ug/L)	Se (ug/L)	Ag (ug/L)	Ba (ug/L)	Zn (ug/L)	Ca (mg/L)
(C-3-1) 1BBC-1	51	<1	<10	<1	1100	<1	510	<.1	—	—	—	—	—	200
(C-3-1) 1BBC-1	460	<1	7	—	—	<5	—	—	—	—	—	—	—	—
(C-3-1) 3ACC-1	99	<1	10	2	4200	<1	670	<.1	—	—	—	—	—	230
(C-3-1) 3ACC-1	58	1	8	—	—	<5	—	—	—	—	—	—	—	—
(C-3-1) 34AAA-1	—	—	—	—	30	—	30	—	—	—	—	—	—	420
(C-3-1) 34AAA-1	6.5	<1	<5	—	—	<5	—	—	—	—	—	—	—	—
(D-1-1) 18DAD-1	<1	<1	<10	2	<3	1	<3	<.1	—	—	—	—	—	160
(D-1-1) 18DAD-1	<.5	<1	<5	10	30	<5	<10	<.1	<10	<.5	<2	<50	<5	—
(D-1-1) 31DBA-1	—	—	—	—	30	—	180	—	—	—	—	—	—	160
(D-1-1) 31DBA-1	2.5	<1	<5	—	—	<5	—	—	—	—	—	—	—	—
(D-2-1) 8BBA-1	4	<1	<10	1	850	<1	530	<.1	—	—	—	—	—	210
(D-2-1) 8BBA-1	2.0	<1	<5	—	—	<5	—	—	—	—	—	—	—	—
(D-3-1) 5CDB-1	5	—	—	—	—	—	—	—	—	—	—	—	—	—
(D-3-1) 5CDB-1	5.5	<1	<5	—	—	<5	—	—	—	—	—	—	—	—
(D-3-1) 6BCB-1	14	<1	<10	4	18	14	4	<.1	—	—	—	—	—	95
(D-3-1) 6BCB-1	15	<1	<5	—	—	<5	—	—	—	—	—	—	—	—
(D-3-1) 31CDA-1	—	—	—	—	40	—	10	—	—	—	—	—	—	140
(D-3-1) 31CDA-1	48	<1	<5	—	—	6	—	—	—	—	—	—	—	—
(D-3-1) 32AAA-1	—	—	—	—	17	—	3	—	—	—	—	—	—	62
(D-3-1) 32AAA-1	1.5	<1	<5	—	—	<5	—	—	—	—	—	—	—	—

TABLE 2 (cont'd)

STATION	Na (mg/L)	K (mg/L)	Mg (mg/L)	F (mg/L)	Silica (mg/L)
(B-1-1) 9ADC-1	1500	54	28	5.3	14
(B-1-1) 9ADC-1	—	—	—	—	—
(B-1-1) 26BAD-1	110	77	80	5.3	50
(B-1-1) 26BAD-1	—	—	—	—	—
(B-1-1) 26CDA-1	50	7.8	110	1.1	24
(B-1-1) 26CDA-1	—	—	—	—	—
(B-1-1) 32CCD-1	—	—	—	—	—
(B-1-1) 32CCD-1	—	—	—	—	—
(B-1-1) 35DCB-1	440	42	320	1.1	30
(B-1-1) 35DCB-1	—	—	—	—	—
(B-1-2) 34AAB-1	—	—	—	—	—
(B-1-2) 34AAB-1	—	—	—	—	—
(C-1-1) 2DCA-1	60	8.1	50	.7	19
(C-1-1) 2DCA-1	—	—	—	—	—
(C-1-1) 4DDB-1	—	—	—	—	—
(C-1-1) 4DDB-1	—	—	—	—	—
(C-1-1) 11BAC-1	1600	200	660	.6	31
(C-1-1) 11BAC-1	—	—	—	—	—
(C-1-1) 15CAA-1	—	—	—	—	—
(C-1-1) 15CAA-1	—	—	—	—	—
(C-1-1) 24CDC-1	—	—	—	—	—
(C-1-1) 24CDC-1	—	—	—	—	—
(C-1-1) 26DCA-1	430	81	250	1.2	31
(C-1-1) 26DCA-1	—	—	—	—	—
(C-1-1) 28CAB-1	120	20	34	.7	24
(C-1-1) 28CAB-1	—	—	—	—	—
(C-1-1) 30ACA-1	920	44	120	2.6	32
(C-1-1) 30ACA-1	—	—	—	—	—
(C-1-1) 31ABB-1	230	37	86	.7	39
(C-1-1) 31ABB-1	—	—	—	—	—
(C-2-1) 12BDA-1	—	—	—	—	—
(C-2-1) 12BDA-1	—	—	—	—	—
(C-2-1) 14BDB-1	180	15	110	3.1	27
(C-2-1) 14BDB-1	—	—	—	—	—
(C-2-1) 15ABC-1	180	25	80	.9	32
(C-2-1) 15ABC-1	—	—	—	—	—
(C-2-1) 26ABB-1	—	—	—	—	—
(C-2-1) 26ABB-1	—	—	—	—	—
(C-2-1) 34DDA-1	340	17	140	.5	33
(C-2-1) 34DDA-1	—	—	—	—	—
(C-2-1) 35BAA-1	190	17	140	2.9	17
(C-2-1) 35BAA-1	—	—	—	—	—
(C-2-1) 35BAB-1	250	12	87	.6	43
(C-2-1) 35BAB-1	—	—	—	—	—

TABLE 2 (cont'd)

STATION	Na (mg/L)	K (mg/L)	Mg (mg/L)	F (mg/L)	Silica mg/L)
(C-3-1) 1BBC-1 (C-3-1) 1BBC-1	200	32	110	.9	39
(C-3-1) 3ACC-1 (C-3-1) 3ACC-1	140	36	72	.3	30
(C-3-1) 34AAA-1 (C-3-1) 34AAA-1	280	33	98	.7	37
(D-1-1) 18DAD-1 (D-1-1) 18DAD-1	100	4.5	41	.2	14
(D-1-1) 31DBA-1 (D-1-1) 31DBA-1	180	13	73	.6	22
(D-2-1) 8BBA-1 (D-2-1) 8BBA-1	140	9.9	96	.4	21
(D-3-1) 5CDB-1 (D-3-1) 5CDB-1	—	—	—	—	—
(D-3-1) 6BCB-1 (D-3-1) 6BCB-1	150	14	63	.8	27
(D-3-1) 31CDA-1 (D-3-1) 31CDA-1	270	25	130	1.3	49
(D-3-1) 32AAA-1 (D-3-1) 32AAA-1	66	3.4	22	<.1	13

TABLE 2 (cont'd)

STATION	Methyl[illegible], Total (ug/L)	Methylenechloride, Total (ug/L)	Bromoform, Total (ug/L)	Chloroform, Total (ug/L)	Chlorodibromomethane, Total, (ug/L)	Dichlorobromomethane, Total (ug/L)	Dichlorodifluoro-methane, Total (ug/L)	Trichlorofluoromethane, Total, (ug/L)	Carbontetrachloride, Total, (ug/L)	Chloroethane, Total (ug/L)	1,1-Dichloroethane, Total, (ug/l)	1,2-Dichloroethane, Total (ug/L)	1,1,1-Trichloroethane Total, (ug/L)	1,1,2-Trichloroethane, Total (ug/L)
(B-1-1) 26BAD-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(B-1-1) 26BAD-1	----	----	----	----	----	----	<1	----	<1	----	<1	<1	<1	<1
(B-1-1) 32CCD-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(B-1-1) 32CCD-1	----	----	----	----	----	----	<1	----	<1	----	<1	<1	.01	<1
(B-1-2) 34AAB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(B-1-2) 34AAB-1	----	----	----	----	----	----	<1	----	<1	----	<1	<1	.01	<1
(C-1-1) 4DDB-1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
(C-1-1) 4DDB-1	----	----	----	----	----	----	<1	----	<1	----	<1	<1	.008	<1
(C-1-1) 24CDC-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	20	<1.0	<1.0	<1.0
(C-1-1) 24CDC-1	----	----	----	----	----	----	<1.0	----	<1.0	----	<1.0	<1.0	2.5	<1.0
(C-1-1) 26DCA-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-1-1) 26DCA-1	----	----	----	----	----	----	<1.0	----	<.10	----	<1.0	<1.0	.15	<1.0
(C-1-1) 28CAB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-1-1) 28CAB-1	----	----	----	----	----	----	<1.0	----	<1.0	----	<1.0	<1.0	.009	<1.0
(C-1-1) 30ACA-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-1-1) 30ACA-1	----	----	----	----	----	----	<1.0	----	.004	----	<1.0	<1.0	.01	<1.0
(C-1-1) 31ABB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-1-1) 31ABB-1	----	----	----	----	----	----	<1.0	----	.005	----	<1.0	<1.0	.013	<1.0
(C-2-1) 12BDA-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-2-1) 12BDA-1	----	----	----	----	----	----	<1.0	----	<1.0	----	<1.0	<1.0	.01	<1.0
(C-2-1) 14BDB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-2-1) 14BDB-1	----	----	----	----	----	----	<1.0	----	.003	----	<1.0	<1.0	<1.0	<1.0
(C-2-1) 15ABC-1	<1.0	<1.0	<1.0	8.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-2-1) 15ABC-1	----	----	----	----	----	----	<1.0	----	.006	----	<1.0	<1.0	<1.0	<1.0
(C-2-1) 26ABB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-2-1) 26ABB-1	----	----	----	----	----	----	<1.0	----	.003	----	<1.0	<1.0	<1.0	<1.0
(C-2-1) 35BAA-1	<1.0	<1.0	<1.0	2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(C-2-1) 35BAA-1	----	----	----	----	----	----	<1	----	.002	----	<1	<1	.006	<1
(C-3-1) 1BBC-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	11	<1.0	<1.0
(C-3-1) 1BBC-1	----	----	----	----	----	----	<1	----	.8	----	<1	<1	<1	1.2
(D-3-1) 5CDB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
(D-3-1) 5CDB-1	----	----	----	----	----	----	<1	----	.2	----	<1	<1	.4	<1

TABLE 2 (cont'd)

STATION	1,1,2,2-Tetrachloro-ethane, Total (ug/L)	Chloroethylene, Total (ug/L)	1,1-Dichloroethylene, Total, (ug/L)	Trichloroethylene, Total (ug/L)	Tetrachloroethylene, Total (ug/L)	1,2-Dichloropropane, Total (ug/L)	1,3-Dichloropropane, Total (ug/L)	Ethyl Vinyl Ether, Total (ug/L)	Benzene, Total (ug/L)	Chlorobenzene, Total (ug/L)	Toluene, Total (ug/L)	Ethylbenzene, Total (ug/L)	Dichlorodibromo-methane, Total (ug/L)	Phenols, Total (ug/L)
(B-1-1) 26BAD-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	----	8
(B-1-1) 26BAD-1	<1	<999*	<1	<1	.006	----	----	----	<999*	<999*	<999*	<999*	.3	<1
(B-1-1) 32CCD-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	3
(B-1-1) 32CCD-1	<1	<999*	<1	<1	.13	----	----	----	<999*	<999*	<999*	<999*	.01	2
(B-1-2) 34AAB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	35
(B-1-2) 34AAB-1	<1	<999*	<1	<1	.07	----	----	----	<999*	<999*	<999*	<999*	<1	<1
(C-1-1) 4DDB-1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	----	190
(C-1-1) 4DDB-1	<1	<999*	<1	<1	.003	----	----	----	<999*	<999*	<999*	<999*	.003	1
(C-1-1) 24CDC-1	<1.0	11	<1.0	8.0	3.0	<1.0	<1.0	<1.0	<2.0	<1.0	<1.0	<1.0	----	33
(C-1-1) 24CDC-1	<1.0	<999*	<1.0	4.2	2.7	----	----	----	<999*	<999*	<999*	<999*	<1	2
(C-1-1) 26DCA-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	32
(C-1-1) 26DCA-1	<1.0	<999*	<1.0	<1.0	.30	----	----	----	<999*	<999*	<999*	<999*	.08	<1
(C-1-1) 28CAB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	6
(C-1-1) 28CAB-1	<1.0	<999*	<1.0	<1.0	.01	----	----	----	<999*	<999*	<999*	<999*	.018	<1
(C-1-1) 30ACA-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	6
(C-1-1) 30ACA-1	<1.0	<999*	<1.0	<1.0	.066	----	----	----	<999*	<999*	<999*	<999*	.002	<1
(C-1-1) 31ABB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	5
(C-1-1) 31ABB-1	<1.0	<999*	<1.0	<1.0	.045	----	----	----	<999*	<999*	<999*	<999*	.014	<1
(C-2-1) 12BDA-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	4
(C-2-1) 12BDA-1	<1.0	<999*	<1.0	<1.0	.01	----	----	----	<999*	<999*	<999*	<999*	<1	5
(C-2-1) 14BDB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	660
(C-2-1) 14BDB-1	<1.0	<999*	<1.0	<1.0	<1.0	----	----	----	<999*	<999*	<999*	<999*	<1	1
(C-2-1) 15ABC-1	<1.0	<1.0	<1.0	<1.0	4.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	7
(C-2-1) 15ABC-1	<1.0	<999*	<1.0	<1.0	<1.0	----	----	----	<999*	<999*	<999*	<999*	<1	<1
(C-2-1) 26ABB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	10
(C-2-1) 26ABB-1	<1.0	<999*	<1.0	<1.0	.018	----	----	----	<999*	<999*	<999*	<999*	<1	<1
(C-2-1) 35BAA-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	4
(C-2-1) 35BAA-1	<1	<999*	<1	<1	<1	----	----	----	<999*	<999*	<999*	<999*	<1	<1
(C-3-1) 1BBC-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	400	<1.0	8.0	<1.0	----	44
(C-3-1) 1BBC-1	<1	<999*	<1	<1	<1	----	----	----	<999*	<999*	<999*	<999*	<1	2
(D-3-1) 5CDB-1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	----	----
(D-3-1) 5CDB-1	<1	<999*	<1	<1	.7	----	----	----	<999*	<999*	<999*	<999*	.2	2

* = Minimum Detection Limit is 1ppm(1000 ug/L)

TABLE 3. Quality Assurance Data - Shallow Aquifer Assessment

STATION	STORET	DATE	TDS (mg/L)	Cl (mg/L)	NO_3 (mg/L)	SO_4 (mg/L)	As (ug/L)	Cd (ug/L)	Cr (ug/L)	Pb (ug/L)
(C-1-1)26DCA-1	404154111545901	830801	1270	190	5.60	360	70	<1	<5	<5
DUPLICATE	404154111545901	830801	1244	170	4.90	350	67	<1	<5	<5
(C-2-1)26ABB-1	403721111550601	830808	6138	1125	.40	2575	54	<1	<5	<5
DUPLICATE	403721111550601	830808	6004	1150	.40	2520	64	<1	<5	<5
(D-3-1) 5CDB-1	403501111515501	830817	336	34	4.00	61	5.5	<1	<5	<5
DUPLICATE	403501111515501	830817	322	34	4.10	52	5.2	<1	<5	<5
QC SPIKE		830816	66	20.5	1.32	12.0	22	2.9	11	22
SPIKE RESULTS		830909	96	25	1.40	19	30	3	15	25
FIELD BLANK (Filtered)		830808	184	34	.04	114	<.5	<1	<5	<5
UNFILTERED BLANK		830808	<5	<1	.04	<10	<.5	<1	<5	<5

STATION	VOA7 (ug/L)	VOA9 (ug/L)	VOA11 (ug/L)	VOA12 (ug/L)	VOA13 (ug/L)	VOA14 (ug/L)	VOA15 (ug/L)	VOA16 (ug/L)	VOA17 (ug/L)	VOA18 (ug/L)	VOA19 (ug/L)	VOA23 (ug/L)	VOA24 (ug/L)	VOA25 (ug/L)
(C-1-1)26DCA-1	<1	.10	<1	<1	.15	<1	<1	<999*	<1	<1	.30	<999*	<999*	<999*
DUPLICATE	<1	.08	<1	<1	.12	<1	<1	<999*	<1	<1	.05	<999*	<999*	<999*
(C-2-1)26ABB-1	<1	.003	<1	<1	<1	<1	<1	<999*	<1	<1	.018	<999*	<999*	<999*
DUPLICATE	<1	.003	<1	<1	<1	<1	<1	<999*	<1	<1	.025	<999*	<999*	<999*
(D-3-1) 5CDB-1	<1	.2	<1	<1	.4	<1	<1	<999*	<1	<1	.7	<999*	<999*	<999*
DUPLICATE	<1	.2	<1	<1	.4	<1	<1	<999*	<1	<1	1.0	<999*	<999*	<999*
FIELD BLANK(Filt.)	<1	.003	<1	<1	<1	<1	<1	<999*	<1	<1	.003	<999*	<999*	<999*
UNFILT. BLANK	<1	.003	<1	<1	<1	<1	<1	<999*	<1	<1	.003	<999*	<999*	<999*

STATION	VOA26 (ug/L)	VOA27 (ug/L)	Phenols (ug/L)
(C-1-1)26DCA-1	<999*	.08	<1
DUPLICATE	<999*	.04	<1
(C-2-1)26ABB-1	<999*	<1	<1
DUPLICATE	<999*	.001	<1
(D-3-1) 5CDB-1	<999*	.2	2
DUPLICATE	<999*	.2	<1
FIELD BLANK(Filt)	<999*	<1	5
UNFILT. BLANK	<999*	<1	5

* = Minimum Detection Limit is 1ppm(1000 ug/L)

Legend

VOA7	Dichlorodifluro-methane, Total (ug/L)
VOA9	Carbontetrachloride, Total, (ug/L)
VOA11	1,1-Dichloroethane, Total, (ug/L)
VOA12	1,2-Dichloroethane, Total (ug/L)
VOA13	1,1,1-Trichloroethane Total, (ug/L)
VOA14	1,1,2-Trichloroethane, Total (ug/L)
VOA15	1,1,2,2-Tetrachloro-ethane, Total (ug/L)
VOA16	Chloroethylene, Total (ug/L)
VOA17	1,1-Dichloroethylene, Total, (ug/L)
VOA18	Trichloroethylene, Total (ug/L)
VOA19	Tetrachloroethylene, Total (ug/L)
VOA23	Benzene, Total (ug/L)
VOA24	Chlorobenzene, Total (ug/L)
VOA25	Toluene, Total (ug/L)
VOA26	Ethylbenzene, Total (ug/L)
VOA27	Dichlorodibromo-methane, Total (ug/L)

General Discussion.

Given two samples, taken at a 4 to 6 month interval, the following general observations can be made, together with some comparisons of up and down-gradient data. Given a larger data base, the observations can be verified or rejected but such data is not yet available:

1) The pH of the shallow aquifer ranges between 6.0 and 8.0 units. None of the wells exhibited a pH lower than 6.0 or greater than 8.0. The lowest observed mean pH was 6.1 units. A brief examination of tables of chemical analyses of groundwater in the principal aquifer in Salt Lake County (U.S. Geological Survey, April 1984) reveals only four ph values less than 7.0 and only one less than 6.9. Table 2 of the report shows that 18 of the 32 wells in the shallow aquifer had measured ph's less than 7.0. This may indicate widespread contamination of the shallow aquifer by either organic or mineral acids. Further extensive monitoring of the shallow aquifer is necessary to corroborate such contamination.

mineralencountered at specific wells located near the Jordan River.

2) High specific conductivity, Total Dissolved Solids, (TDS), hardness and associated cation concentrations were observed primarily at wells located in the northern quadrants reflecting highly mineralized quality of the shallow aquifers found in these areas. Other areas reflecting higher than average specific conductivity, TDS, hardness and associated cation levels were also encountered at specific wells located near the Jordan River.

3) Nitrate levels (mean greater than 10mg/l) were encountered in the northern quadrants of the County in addition to locations along the eastern fringes of the valley and near the prison (southwestern quadrant). These

elevated levels were found located in conjunction with suspected problem land use areas.

4) The only metals that appear to be detectable at higher than background levels are Arsenic (As), Iron (Fe) and Manganese (Mn). High arsenic and iron levels occur near the airport and near the Jordan River at about 7800-9000 South Street. High manganese levels occur in shallow wells in the downtown Salt Lake City area and in the areas of high iron and arsenic near 7800-9000 South Streets.

5) Elevated levels of organic parameters (27 volatile organics and phenols) do occur in some selected shallow aquifer observation wells,(such as 14BDB-1, and 1BBC-1) but the extent of adverse public health implications cannot presently be defined. Detailed site-specific investigation of these sites is necessary to further determine the extent of the problem.

Nine (9) sets of shallow observation wells were installed above and/or below specific land uses that were suspected to or at least have the potential to contaminate the shallow and/or deep aquifer(s). The increases (or decreases) of constituent levels is discussed below on a site-by-site basis.

1) Well (B-1-2)34AAB-1 is located downgradient from the inactive Salt Lake City landfill. The quality of the shallow aquifer at this location indicates high specific conductance and chloride (Cl), which could be due to location in a groundwater discharge area, and the highest barium (Ba) level of any sample.

2) Wells (C-1-1)4DDB-1 and (B-1-1)32CCD-1 are located up-and downgradient respectively, from an inactive landfill at approximately North Temple and 4000 West Street. Specific conductance, TDS, Cl-, NO_3, SO_4, (As) chromium (Cr), nickel (Ni) and silver (Ag) concentrations increased by approximately 2x, 2x, 5x, 10x, 2x, 2x, 2x, 40x and 3x, respectively, while copper (Cu) and (Mn)

concentrations decreased by approximately 1/4 and 1/2 respectively. The level of Ni in the downgradient well was the highest recorded during the sampling period.

3) Wells (D-1-1)31DBA-1 and (C-1-1)26DCA-1 are located up-and downgradient from an inactive landfill located at approximately 3900 South 100 West Streets. Concentrations of hardness, nitrate (NO_3) sulphate (SO_4), As, sodium (Na), potassium (K), magnesium (Mg) and flouride (F) incresed by approximately 2x, 10x, 4x, 20x, 3x, 3x, 3x and 2x, respectively, while concentrations of Mn decreased by about 1/2.

4) Wells (D-3-1)5CDB-1 and (D-3-1)6BCB-1 are located up-and downgradient from an inactive landfill at approximately 9000 South and 300 East Streets. Concentrations of specific conductance, Cl, NO_3. SO_4 and As increased by approximately 4x, 7x, 4x, 3x and 3x, respectively.

5) Wells (C-1-1)24CDC-1 and (C-1-1)26 DCA-1 are located upgradient from the inactive Vitro tailings site. The data can be used in conjunction with specific vitro site data discussed later.

6) Well (C-3-1)1BBC-1 and wells (C-2-1)26ABB-1 and (C-2-1)35BAA-1 are located up-and downgradient from the inactive Sharon Steel site (approximately 8000-7800 South 700 West Streets). Specific conductance, TDS, hardness, Cl, NO_3 SO_4, cadmium (Cd), Fe, lead (Pb), Mn and F increased by approximately 3x, 2x, 2x, 2x, 2x, 8x, 10x, 2x, 10x, 3x and 3x, respectively, while K concentrations decreased by about 1/2. However, the levels are quite high when compared with other monitoring sites located throughout the valley.

7) Wells (B-1-1)35DCB-1 and wells (B-1-1)26BAD-1 and (B-1-1)26 CDA-1 are located up-and downgradient from the Rose Park uncontrolled hazardous waste disposal site and in the vicinity of the AMOCO Oil Refinery (discussed

later). The Rose Park site has been extensively studied by US EPA and will therefore not be discussed here.

In summary, it appears as though leachate from old (inactive) landfills is entering the shallow groundwater system. This leachate, along with uncontaminated groundwater, is not being used for production purposes (domestic or industrial) but may be used as irrigation water where it enters irrigation systems in areas of groundwater discharge. Potential for impairment of stock animals and consumption by man may exist. Leachate is also probably entering surface water systems through the same mechanism, particularly in areas of upward artesian pressure where surface discharge of groundwater occurs.

Bioassay of benthic invertebrates and higher foodchain organisms, such as waterfowl or fish consumed by man, is adviseable to determine potential wildlife use or human health impairment.

Shallow aquifer quality monitoring should be continued by either health or water quality planning agencies at least on a quarterly (if not more frequent) basis, to provide data to more fully understand the hydrologic processes taking place.

C. SITE SPECIFIC INVESTIGATIONS AND DATA

1. <u>AMOCO Oil Company - Salt Lake City Refinery</u>

Shallow groundwater quality monitoring at the AMOCO Oil Company - Salt Lake City Refinery was initiated in 1981 by AMOCO. Wells were drilled and are sampled by the company. Samples are analyzed by a private laboratory. Results are sent to the State Department of Health, Bureau of Solid and Hazardous Waste. The wells are located on AMOCO property up and downgradient from three company facilities: stormwater impoundment, remote hazardous waste management area, and an oxidation and drying bed. The location of the wells are shown in Figures 18.

Physical well data (date installed, groundwater and surface elevations, etc.) are listed in Table 4. Note that groundwater elevations in March, 1983 for wells S-10A, S-7, S-8 and S-9A indicate that the groundwater elevation for the upgradient well (S-10A) is lower than the groundwater elevation for the downgradient wells (S-7, S-8 and S-9A). This has been noted by AMOCO and reported to the State. Upgradient well S-15 has a higher groundwater elevation than downgradient well S-14 which corresponds with elevations in adjacent wells (S-7, S-8 and S-9A). The discrepency water level in well S-10A could be due to localized depression in groundwater surface because the overall direction of groundwater movement in the area is from well S-15 towards S-7, S-8, S-9A, and S-14 (east to west). However, groundwater quality, discussed below, shows some discrepancy with this generalization.

Groundwater quality from the AMOCO monitoring wells is shown in Table 5. Quality data near the hazardous waste management area (upgradient wells S-12, S-13 and S-16 and downgradient wells S-9, S-10, S-11, S-17 and S-18) indicate no substantial increase in pH, NO_3, SO_4, Ag, As, Cd, Cr, Hg, Pb, Se, F. All radiologics, pesticides, herbicides, phenol, and total coliform levels were quite high. There is a substantial increase in temperature (about 10C), specific conductance (50%), Na (50%), Cl-(75%), total organic carbon (TOC) (15%) and total organic halide (TOX) (600%) levels. Background levels of specific conductance and TOC were high. Levels of Ba decreased about 50%.

Quality data near the stormwater impoundment (upgradient well S-1A) and downgradient wells (S-2, S-3 and S-4) indicate a substantial increase in specific conductance (20%), SO_4 (50%), Cl-(300%), F (30%), TOC (100), TOX (300%) and phenol (20%) levels with high background levels of these

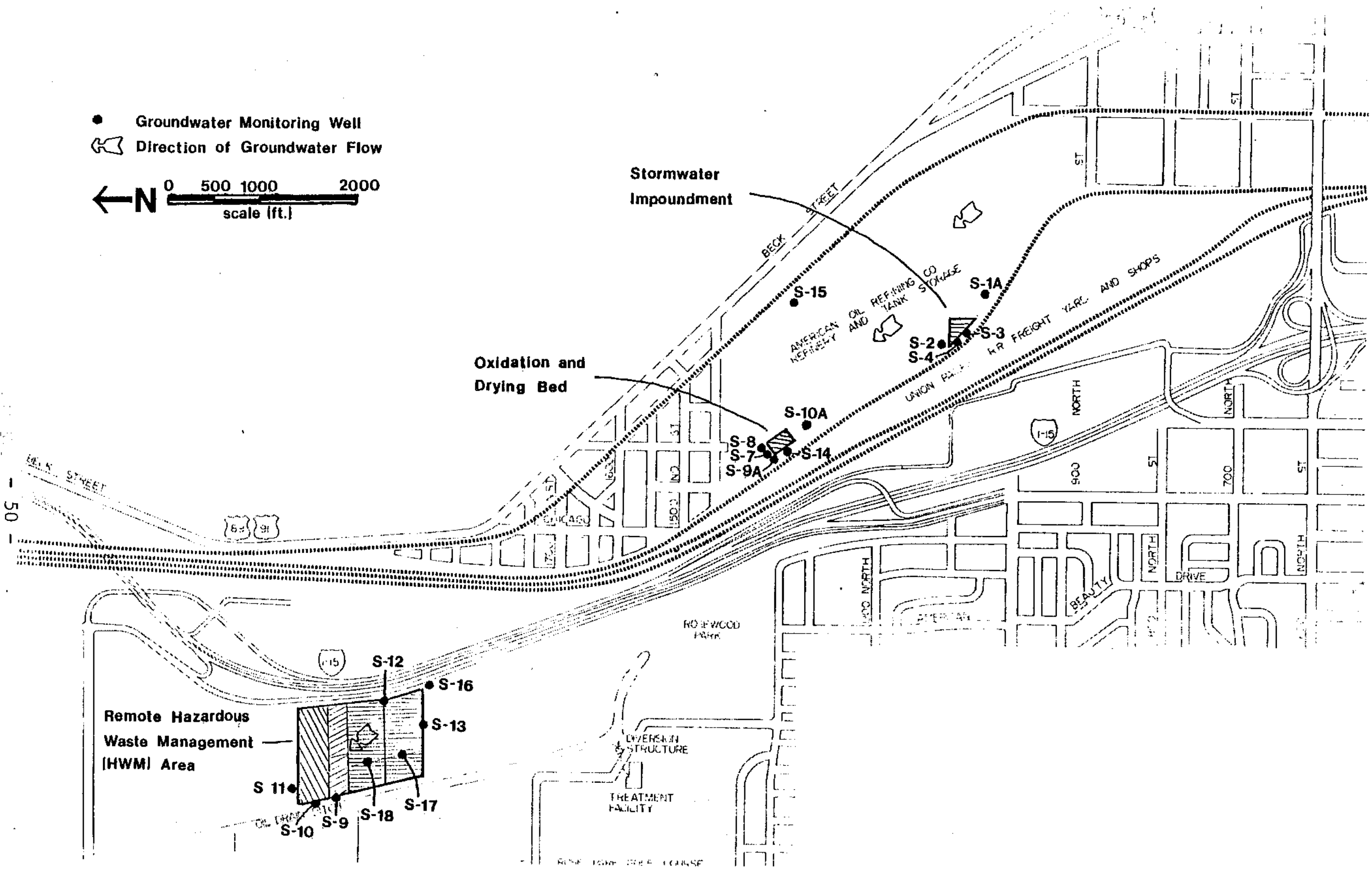


FIGURE 18. Location of Shallow Aquifer Monitoring Wells; AMOCO Oil Company - Salt Lake City Refinery

TABLE 4. Physical Well Data; AMOCO Oil Company - Salt Lake City Refinery

AMOCO WELL DATA

Well No.	Relative Location	Date Installed	Ground Elevation (ft. MSL)	Intake Zone Elevation (ft. MSL)		Groundwater Elevation March 14-18, 1983 (ft. MSL)
				Top	Bottom	
S-1A	UPGRADIENT	9/24/81	4225.00	4222.00	4208.00	4219.71
S-2	DNGRADIENT	9/11/81	4225.84	4220.84	4208.84	4218.49
S-3	DNGRADIENT	9/11/81	4225.32	4220.32	4208.32	4219.75
S-4	DNGRADIENT	9/11/81	4225.45	4220.95	4208.45	4218.22
S-10A	UPGRADIENT	9/25/81	4218.17	4214.17	4200.17	4216.87
S-7	DNGRADIENT	9/24/81	4218.34	4217.34	4202.34	4216.96
S-8	DNGRADIENT	9/24/81	4218.69	4216.19	4202.19	4216.98
S-9A	DNGRADIENT	9/24/81	4218.62	4215.62	4201.62	4217.10
S-12	UPGRADIENT	9/10/81	4213.68	4209.68	4194.68	4211.14
S-13	UPGRADIENT	9/25/81	4212.79	4209.79	4195.79	4210.61
S-9	DNGRADIENT	9/10/81	4210.78	4207.78	4190.78	4208.77
S-10	DNGRADIENT	9/10/81	4211.79	4209.79	4194.79	4209.07
S-11	DNGRADIENT	9/10/81	4210.29	4208.29	4193.29	4209.52
S-15	UPGRADIENT	3/9/83	4223.43	4209.39	4204.39	4220.77
S-14	DNGRADIENT	3/9/83	4224.29	4205.27	4203.27	4217.09
S-16	UPGRADIENT	3/10/83	4217.71	4202.45	4197.45	4212.16
S-17	DNGRADIENT	3/10/83	4213.53	4198.37	4193.37	4210.96
S-18	DNGRADIENT	3/10/83	4214.27	4199.07	4194.07	4211.04

Note: All well diameters are 2.0 inches. All screen slot sizes are 0.010 inches.

TABLE 5. Shallow Groundwater Quality; AMOCO Oil Company - Salt Lake City Refinery

Well No.	Date (yymmdd)	Temp (C)	pH (su)	Specific Conduct. (uMHO/cm)	NO_3-N (mg/L)	SO_4 (mg/L)	Total Coliform (MPN/100ml)	Relative Location
S-1A	811119	16.7	7.42	6200	.04	93	330	UPGRADIENT
S-1A	820316	15	7.51	5600	.16	1680	<2	UPGRADIENT
S-1A	820622	21	6.70	12000	<.01	540	<2	UPGRADIENT
S-1A	820921	17.8	6.45	4550	.39	420	<2	UPGRADIENT
S-2	811119	18.6	6.72	9400	.08	153	<2	DNGRADIENT
S-2	820316	16	6.77	12400	<.01	1050	<2	DNGRADIENT
S-2	820622	21	6.59	11000	<.01	1530	<2	DNGRADIENT
S-2	820921	19.4	6.27	5200	.42	1350	<2	DNGRADIENT
S-3	811119	18.6	6.70	6400	.08	129	50	DNGRADIENT
S-3	820316	16	6.54	11500	<.01	960	<2	DNGRADIENT
S-3	820622	19	6.35	5800	<.01	960	<2	DNGRADIENT
S-3	820921	20.5	6.14	4650	2.55	990	<2	DNGRADIENT
S-4	811119	19.1	6.59	7700	.03	81	70	DNGRADIENT
S-4	820316	15	6.6	11200	.06	1440	<2	DNGRADIENT
S-4	820622	18	6.30	7700	<.01	1800	<2	DNGRADIENT
S-4	820921	20.5	6.33	5000	.62	1200	<2	DNGRADIENT
S-10A	811119	12.8	7.29	5400	.03	120	8	UPGRADIENT
S-10A	820317	11	7.17	4400	.12	570	<2	UPGRADIENT
S-10A	820622	21	7.30	9000	<.01	690	23	UPGRADIENT
S-10A	820922	14.4	6.32	3850	.60	237	<2	UPGRADIENT
S-7	811119	14.8	7.15	6400	<.01	171	220	DNGRADIENT
S-7	820317	10	6.85	3150	<.01	300	<2	DNGRADIENT
S-7	820622	16	6.85	2300	<.01	105	<2	DNGRADIENT
S-7	820922	18.8	6.89	4650	.24	225	<2	DNGRADIENT
S-8	811119	14.7	7.12	3200	.12	275	170	DNGRADIENT
S-8	820317	9	7.01	2800	.16	99	130	DNGRADIENT
S-8	820622	20	6.83	2500	<.01	630	<2	DNGRADIENT
S-8	820922	18.3	6.94	2650	.22	48	<2	DNGRADIENT
S-9A	811119	15.2	7.27	2350	.10	99	49	DNGRADIENT
S-9A	820317	11	7.02	1950	.16	33	<2	DNGRADIENT
S-9A	820622	16	6.93	2000	<.01	450	<2	DNGRADIENT
S-9A	820922	17.8	6.93	2150	.35	75	<2	DNGRADIENT
S-12	811112	15	6.79	42000	.08	81	<2	UPGRADIENT
S-12	820315	9	6.78	37750	.21	420	<2	UPGRADIENT
S-12	820622	11	6.83	18800	.08	3000	<2	UPGRADIENT
S-12	820922	12.2	6.60	13775	.27	720	<2	UPGRADIENT
S-13	811112	13.6	7.14	28000	.02	186	2300	UPGRADIENT
S-13	820315	10	6.91	30000	<.01	165	4900	UPGRADIENT
S-13	820622	13	6.91	16600	<.01	1680	8	UPGRADIENT
S-13	820923	10.0	6.79	9500	.26	600	<2	UPGRADIENT
S-9	811112	14.4	6.95	18000	.08	294	33	DNGRADIENT
S-9	820315	7	6.91	18400	.73	430	<2	DNGRADIENT
S-9	820622	13	6.90	10800	<.01	60	<2	DNGRADIENT
S-9	820923	11.7	6.73	13850	<.01	960	7	DNGRADIENT
S-10	811112	16.1	6.98	39000	.06	120	2	DNGRADIENT
S-10	820315	9	6.7	40500	<.01	145	<2	DNGRADIENT
S-10	820622	15	6.78	20050	<.01	360	<2	DNGRADIENT
S-10	820923	14.4	6.64	22500	<.01	1230	<2	DNGRADIENT
S-11	811112	14.3	6.92	65000	.14	3	<2	DNGRADIENT
S-11	820315	6	6.62	61500	.18	385	<2	DNGRADIENT
S-11	820622	15	6.62	68000	.07	540	<2	DNGRADIENT
S-11	820923	12.8	6.65	49250	.01	1320	<2	DNGRADIENT
S-15	830315	11	6.57	8500	<.02	800	<2	UPGRADIENT
S-15	830628	14.4			ND	790	ND	UPGRADIENT
S-14	830315	11.5	6.88	5500	.04	930	<2	DNGRADIENT
S-14	830628	13.9			ND	710	ND	DNGRADIENT
S-16	830315				<.01	72	33	UPGRADIENT
S-16	830628	14.4			ND	85	ND	UPGRADIENT
S-17	830315				<.01	1420	5	DNGRADIENT
S-17	830628	14.4			ND	1660	ND	DNGRADIENT
S-18	830315				<.01	1920	13	DNGRADIENT
S-18	830628	16.7			ND	1500	ND	DNGRADIENT

TABLE 5. (cont'd)

Well No.	Date (yymmdd)	Ag (mg/L)	As (mg/L)	Ba (mg/L)	Cd (mg/L)	Cr (mg/L)	Fe (mg/L)	Hg (mg/L)	Mn (mg/L)	Pb (mg/L)	Se (mg/L)	Na (mg/L)	Cl (mg/L)	F (mg/L)	Relative Location
S-1A	811119	.020	.020	.060	<.001	.050	12.50	<0.00020	1.51	.110	<.001	415	668	3.52	UPGRADIENT
S-1A	820316	.020	.019	.040	<.001	.040	0.090	<0.00020	2.10	.020	<.001	425	381	3.40	UPGRADIENT
S-1A	820622	.020	.034	.040	.017	<.001	0.16	<0.00020	1.450	.13	<.001	560	1305	3.06	UPGRADIENT
S-1A	820921	.020	.032	.040	.010	.040	0.110	<0.00020	0.850	.080	<.001	540	988	2.98	UPGRADIENT
S-2	811119	.020	.176	.075	<.001	.050	0.24	<0.00020	0.18	.090	<.001	635	1323	4.46	DNGRADIENT
S-2	820316	.012	.129	.060	<.001	.040	0.080	<0.00020	0.090	.080	<.001	580	2290	4.82	DNGRADIENT
S-2	820622	.020	.146	.060	.008	<.001	0.18	<0.00020	0.100	.100	<.001	565	2890	5.32	DNGRADIENT
S-2	820921	.019	.110	.090	<.001	.010	0.120	<0.00020	0.060	.015	<.001	550	4820	5.16	DNGRADIENT
S-3	811119	.021	.084	.110	<.001	.030	5.13	<0.00020	0.51	.080	<.001	420	1406	2.41	DNGRADIENT
S-3	820316	<.001	.007	.100	<.001	.030	0.080	<0.00020	0.180	.040	<.001	495	3795	2.91	DNGRADIENT
S-3	820622	.002	.085	.060	.005	<.001	0.11	<0.00020	0.265	.040	<.001	425	1210	3.39	DNGRADIENT
S-3	820921	.002	.074	.110	.001	.005	0.100	<0.00020	0.225	.020	<.001	570	2060	3.34	DNGRADIENT
S-4	811119	.020	.069	.050	<.001	.050	5.55	<0.00020	1.26	.060	<.001	465	898	5.30	DNGRADIENT
S-4	820316	.020	.166	.020	<.001	.040	0.04	<0.00020	0.820	.050	<.001	455	1739	5.49	DNGRADIENT
S-4	820622	.010	.070	.030	.006	<.001	0.11	<0.00020	0.890	.050	<.001	460	1040	5.35	DNGRADIENT
S-4	820921	.020	.041	.030	.001	.006	0.100	<0.00020	1.020	.026	<.001	500	2320	5.43	DNGRADIENT
S-10A	811119	<.001	.018	.085	<.001	.020	1.98	<0.00020	0.20	.070	<.001	865	1154.4	3.68	UPGRADIENT
S-10A	820317	<.001	.005	.220	<.001	.030	0.092	<0.00020	0.140	.045	<.001	625	437	3.19	UPGRADIENT
S-10A	820622	<.001	.020	.180	.011	<.001	0.100	<0.00020	0.115	.040	<.001	1030	596.00	3.41	UPGRADIENT
S-10A	820922	<.001	.009	.190	<.001	<.001	0.050	<0.00020	0.110	.040	<.001	770	1007	3.56	UPGRADIENT
S-7	811119	.020	.049	.150	<.001	.040	9.05	<0.00020	0.46	.070	<.001	1450	1521	4.43	DNGRADIENT
S-7	820317	<.001	.030	.500	<.001	.020	2.65	<0.00020	0.57	<.001	.003	490	301	4.68	DNGRADIENT
S-7	820622	<.001	.042	.380	.004	.013	0.244	<0.00020	0.470	.030	<.001	320	217.20	4.86	DNGRADIENT
S-7	820922	<.001	.049	.554	<.001	<.001	0.260	<0.00020	0.375	.020	<.001	920	971	4.10	DNGRADIENT
S-8	811119	<.001	.030	.210	<.001	.030	4.25	<0.00020	0.57	.050	<.001	460	294	5.70	DNGRADIENT
S-8	820317	<.001	.036	.300	<.001	<.001	0.59	<0.00020	0.40	<.001	<.001	490	261	5.23	DNGRADIENT
S-8	820622	<.001	.031	.340	.005	<.001	0.080	<0.00020	0.360	.040	<.001	465	397.00	5.10	DNGRADIENT
S-8	820922	<.001	.027	.390	<.001	<.001	0.160	<0.00020	0.340	.019	<.001	555	425	5.49	DNGRADIENT
S-9A	811119	<.001	.048	.550	<.001	.060	24.00	<0.00020	0.52	.070	<.001	330	167	4.24	DNGRADIENT
S-9A	820317	<.001	.016	1.100	<.001	.020	1.100	<0.00020	0.220	<.001	<.001	220	166	3.70	DNGRADIENT
S-9A	820622	<.001	.018	1.060	.004	<.001	0.180	<0.00020	0.190	<.001	<.001	210	66.40	3.81	DNGRADIENT
S-9A	820922	<.001	.023	.995	<.001	<.001	0.060	<0.00020	0.155	.040	<.001	250	184	3.84	DNGRADIENT
S-12	811112	.050	.002	.100	<.001	.080	13.50	<0.00020	1.25	.170	<.001	6100	5100	2.88	UPGRADIENT
S-12	820315	.040	.003	.110	<.001	.075	10.65	<0.00020	1.10	.150	.002	4250	5950	3.22	UPGRADIENT
S-12	820622	.030	.029	.020	.035	<.001	2.330	<0.00020	0.792	.160	<.001	3000	4740.00	3.50	UPGRADIENT
S-12	820922	.030	.034	.035	.001	.050	2.300	<0.00020	0.950	.080	<.001	3700	2950	3.41	UPGRADIENT
S-13	811112	.030	.005	.100	.004	.070	18.50	<0.00020	0.81	.150	.020	3700	3827	2.90	UPGRADIENT
S-13	820315	.020	.006	.090	.002	.065	15.10	<0.00020	0.74	.013	.020	3400	3809	2.80	UPGRADIENT
S-13	820622	.020	<.001	.030	.025	<.001	0.550	<0.00020	0.295	.070	<.001	1680	4080.00	3.26	UPGRADIENT
S-13	820923	.020	<.001	.040	.001	.040	0.350	<0.00020	0.285	.080	<.001	3150	7200	3.03	UPGRADIENT
S-9	811112	.030	.025	.100	<.001	.080	28.00	<0.00020	1.15	.140	<.001	2100	2532	3.64	DNGRADIENT
S-9	820315	.066	.021	.095	<.001	.500	23.15	<0.00020	1.02	.130	<.001	2350	3164	3.15	DNGRADIENT
S-9	820622	.020	.055	.060	.022	.004	1.550	<0.00020	0.240	.080	<.001	60	2690.00	3.21	DNGRADIENT
S-9	820923	<.001	.012	.020	<.001	.038	6.650	<0.00020	0.230	.060	<.001	3150	5150.00	3.20	DNGRADIENT
S-10	811112	.070	.014	.150	<.001	.280	110.00	<0.00020	1.43	.660	<.001	5100	4729	2.63	DNGRADIENT
S-10	820315	.090	.048	.130	<.001	.250	53.60	<0.00020	1.30	.250	<.001	5200	6450	2.67	DNGRADIENT
S-10	820622	.030	.106	.030	.020	.003	5.660	<0.00020	0.680	.100	<.001	360	7610.00	2.61	DNGRADIENT
S-10	820923	<.001	.015	.025	<.001	.044	14.950	ND	0.560	.010	<.001	5400	9710.00	2.61	DNGRADIENT
S-11	811112	.090	.009	.100	<.001	.012	8.85	<0.00020	0.95	.300	<.001	13500	6780	1.12	DNGRADIENT
S-11	820315	.090	.008	.114	<.001	.120	6.75	<0.00020	0.85	.220	<.001	14000	8500	1.34	DNGRADIENT
S-11	820622	.080	<.001	.030	.080	<.001	0.470	<0.00020	0.530	.270	<.001	540	17900.00	1.25	DNGRADIENT
S-11	820923	<.001	.017	.010	.005	.100	2.660	<0.00020	0.490	.032	<.001	13500	20760.00	1.29	DNGRADIENT
S-15	830315	<.001	.013	.42	<.001	<.001	0.130		0.990	.007	<.001	1810	1851	2.94	UPGRADIENT
S-15	830628	ND	.013	.410	ND	.008	0.140	ND	0.740	.002	.005	1740	2600	3.15	UPGRADIENT
S-14	830315	<.001	.007	.11	.004	.002	0.270		0.105	.004	<.001	967	1404	3.51	DNGRADIENT
S-14	830628	ND	.020	.150	.003	.008	0.180	ND	0.130	.009	ND	93	1280	3.64	DNGRADIENT
S-16	830315	.004	<.001	.06	.009	.008	0.45		0.17	.005	<.001	450	2062	2.89	UPGRADIENT
S-16	830628	ND	ND	.090	ND	ND	0.590	ND	0.310	ND	ND	438	2030	2.78	UPGRADIENT
S-17	830315	.016	<.001	.05	.010	.026	0.31		0.65	.066	<.001	3450	1569	2.01	DNGRADIENT
S-17	830628	.002	.010	.030	.002	.011	0.300	ND	0.250	.002	ND	605	8500	1.75	DNGRADIENT
S-18	830315	.005	<.001	.05	.012	.020	0.288		0.35	.070	<.001	2160	1174	3.83	DNGRADIENT
S-18	830628	ND	.156	.060	.005	.012	0.160	ND	0.200	.005	ND	205	280	4.05	DNGRADIENT

TABLE 5. (cont'd)

Well No.	Date (yymmdd)	TOC (mg/L)	TOX (mg/L)	Phenol (mg/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Radium (pCi/L)	Endrin (mg/L)	Lindane (mg/L)	Methoxy-chlor (mg/L)	Toxa-phene (mg/L)	2,4-D (mg/L)	2,4,5-TP (mg/L)	Relative Location
S-1A	811119	59.50	20.50	.114	1.5	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-1A	820316	76.20	4.20	.058	1.6	22.	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-1A	820622	65.70	3.100	.058	<2.0	16.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-1A	820921	69.10	2.200	.060	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-2	811119	118.50	25.80	.017	1.2	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-2	820316	110.00	26.3	.026	1.6	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-2	820622	118.60	21.500	.068	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-2	820921	137.40	20.200	.588	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-3	811119	120.70	24.20	.016	1.5	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-3	820316	116.00	25.50	.020	1.4	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-3	820622	121.50	24.300	.015	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-3	820921	148.30	25.500	.138	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-4	811119	115.80	25.60	.013	1.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-4	820316	134.70	26.20	.017	1.3	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-4	820622	140.50	22.700	.016	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-4	820921	197.30	19.800	.129	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-10A	811119	41.30	19.80	.140	2.5	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-10A	820317	71.9	1.95	.173	1.5	29.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-10A	820622	68.90	2.000	.145	<2.0	12.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-10A	820922	55.80	12.00	.425	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-7	811119	36.20	2.50	.103	1.9	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-7	820317	51.60	16.20	.114	<2.0	2.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-7	820622	52.80	11.500	.093	<2.0	<2.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-7	820922	57.40	9.60	.233	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-8	811119	26.50	13.10	.030	1.6	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-8	820317	77.80	12.90	2.79	3.8	2.2	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-8	820622	89.60	8.300	1.20	4.0	<2.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-8	820922	97.40	7.10	1.750	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-9A	811119	25.10	12.50	.033	1.4	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-9A	820317	39.00	18.50	.034	1.4	2.7	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-9A	820622	38.40	9.200	.045	<2.0	<2.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-9A	820922	51.20	10.90	.163	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-12	811112	40.90	4.50	<.001	1.7	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-12	820315	55.40	6.40	.009	1.8	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-12	820622	57.10	0.560	.050	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-12	820922	44.00	0.550	.033	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-13	811112	31.50	3.50	<.001	1.6	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-13	820315	171.40	3.10	<.001	1.4	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-13	820622	245.60	0.680	.042	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-13	820923	32.00	0.540	.050	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-9	811112	48.20	12.50	.014	1.6	3.6	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-9	820315	50.00	13.50	.018	27.0	1.2	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-9	820622	46.70	12.600	.030	12.0	<2.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-9	820923	42.00	10.100	.058	18.	1.5	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-10	811112	145.30	9.50	.006	1.4	2.8	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-10	820315	201.20	9.10	.013	27.0	1.5	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-10	820622	96.80	10.200	.030	<2.0	<2.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-10	820923	185.00	7.500	.129	20.	1.3	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-11	811112	64.70	24.50	.004	1.7	3.4	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-11	820315	73.00	23.20	.010	<2.0	1.8	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-11	820622	53.20	19.800	.021	<2.0	<2.0	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-11	820923	66.00	21.500	.150	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-15	830315			.204	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-15	830628			.160	ND	ND	ND	ND	ND	ND	ND	ND	ND	UPGRADIENT
S-14	830315			.167	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-14	830628			.150	ND	ND	ND	ND	ND	ND	ND	ND	ND	DNGRADIENT
S-16	830315			.006	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	UPGRADIENT
S-16	830628			.004	ND	ND	ND	ND	ND	ND	ND	ND	ND	UPGRADIENT
S-17	830315			.050	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-17	830628			.046	ND	ND	ND	ND	ND	ND	ND	ND	ND	DNGRADIENT
S-18	830315			.058	<2.0	<0.1	<0.1	<.0001	<.001	<.001	<.001	<.001	<.001	DNGRADIENT
S-18	830628			.036	ND	ND	ND	ND	ND	ND	ND	ND	ND	DNGRADIENT

constituents present except for TOC. Other parameter values do not indicate a substantial increase or decrease in levels.

Quality data near the oxidation and drying beds "upgradient" wells S-10A and S-15 and "downgradient" wells S-7, S-8, S-9A and S-14 indicate that well S-10A could very well be a downgradient well. If well S-10A is indeed an upgradient well, the data indicate a substantial decrease in the levels of the same parameters, with the exception of Cl, which shows a significant increase in levels near the stormwater impoundment area. Other parameter values do not indicate a substantial increase or decrease in levels. If well S-10A is indeed a downgradient well, there is not enough data to make a first-cut analysis.

2. <u>Vitro Uranium Mill Tailing Site</u>

Shallow groundwater quality data at the Vitro Site, as covered by this report, was collected during 1983 from 23 monitoring wells. Samples were collected by the City-County Health Department and analyzed at the State Health Department laboratory. Wells were installed by private contractors conducting studies for the Department of Energy. The Vitro Site is an abandoned uranium mill site and the remains (mill tailings with varying degrees of activity) are piled about the area. Deep wells (115-137 feet) were stationed around the perimeter of the site. Shallow wells (10-41.5 feet) were also stationed around the perimeter in addition to being clustered for sampling aquifers at specific depths. Physical well data is listed in Tables 6 and 7. Locations of wells are shown in Figure 19. Groundwater depth data is not available at this time.

Implications based on 1983 City-County/State Health data are discussed below. The small number of samples, especially at upgradient shallow wells, leads to a high variability in the means of constituent values. As with other

TABLE 6. Physical Well Data; Vitro Uranium Mill Tailings Site - Jacobs Wells

VITRO WELL DATA - JACOBS

Well No.	Total Depth (ft.)	Screened Interval (ft.)	Blank Interval (ft.)	Ground Elevation (ft.)	Location*
1	115	100-110	0-100	4244.96	U
2	135	119-129	0-119	4238.07	U
3	125	110-120	0-110	4234.13	C
4	137	105-115	0-105	4234.37	D
5	132	115.5-125.5	0-115.5	4234.92	D
6A	31.5	26-28	0-26	4244.61	U
6B	20	17-19	0-17	4244.68	U
6C	10	7-9	0-7	4244.71	U
7A	35	26-28	0-26	4237.97	U
7B	25	15-17	0-15	4238.02	U
7C	15	8-10	0-8	4237.98	U
8A	40	26-28	0-26	4233.13	C
8B	35	19-21	0-19	4233.13	C
8C	10	6-8	0-6	4233.13	C
9A	35	27-29	0-27	4233.17	D
9B	25	16-18	0-16	4232.97	D
9C	15	6-8	0-6	4233.02	D
10A	36.5	26-28	0-26	4234.60	D
10B	20	14.5-16.5	0-14.5	4234.65	D
10C	10	6-8	0-6	4234.55	D
11A	31.5	24-26	0-24	4234.52	D
11B	20	17-19	0-17	4234.62	D
11C	15	6-8	0-6	4234.82	D
12A	31.5	26-28	0-26	4235.90	C
12B	20	17-19	0-17	4236.06	C
12C	10	6.5-8.5	0-6.5	4235.95	C
13A	31.5	26-28	0-26	4235.70	D
13B	20	16-18	0-16	4235.75	D
13C	10	6-8	0-6	4235.75	D
14	41.5	18-38	0-18	4233.27	D
15	133	102-112	0-102	4233.73	D

Note: All depths from ground surface.

* U - upgradient
C - crossgradient
D - downgradient

TABLE 7. Physical Well Data; Vitro Uranium Mill Tailings Site - Dames & Moore Wells

VITRO WELL DATA - DAMES & MOORE

Well No.	Blank Interval (ft.)	Screened Interval (ft.)	Sand Pack Interval (ft.)	Grout Seal Interval (ft.)	Bentonite Seal Interval (ft.)
V-BD	0.0-85.0 95.0-98.0	85.0-95.0	82.0-97.0	0.0-80.0	80.0-82.0
V-BS	0.0-15.0 20.0-25.0	15.0-20.0	14.5-25.0	0.0-13.5	13.5-14.5
V-DD	0.0-80.0	80.0-90.0	75.0-90.0	0.0-73.0	73.0-75.0

Note: All depths from ground surface.

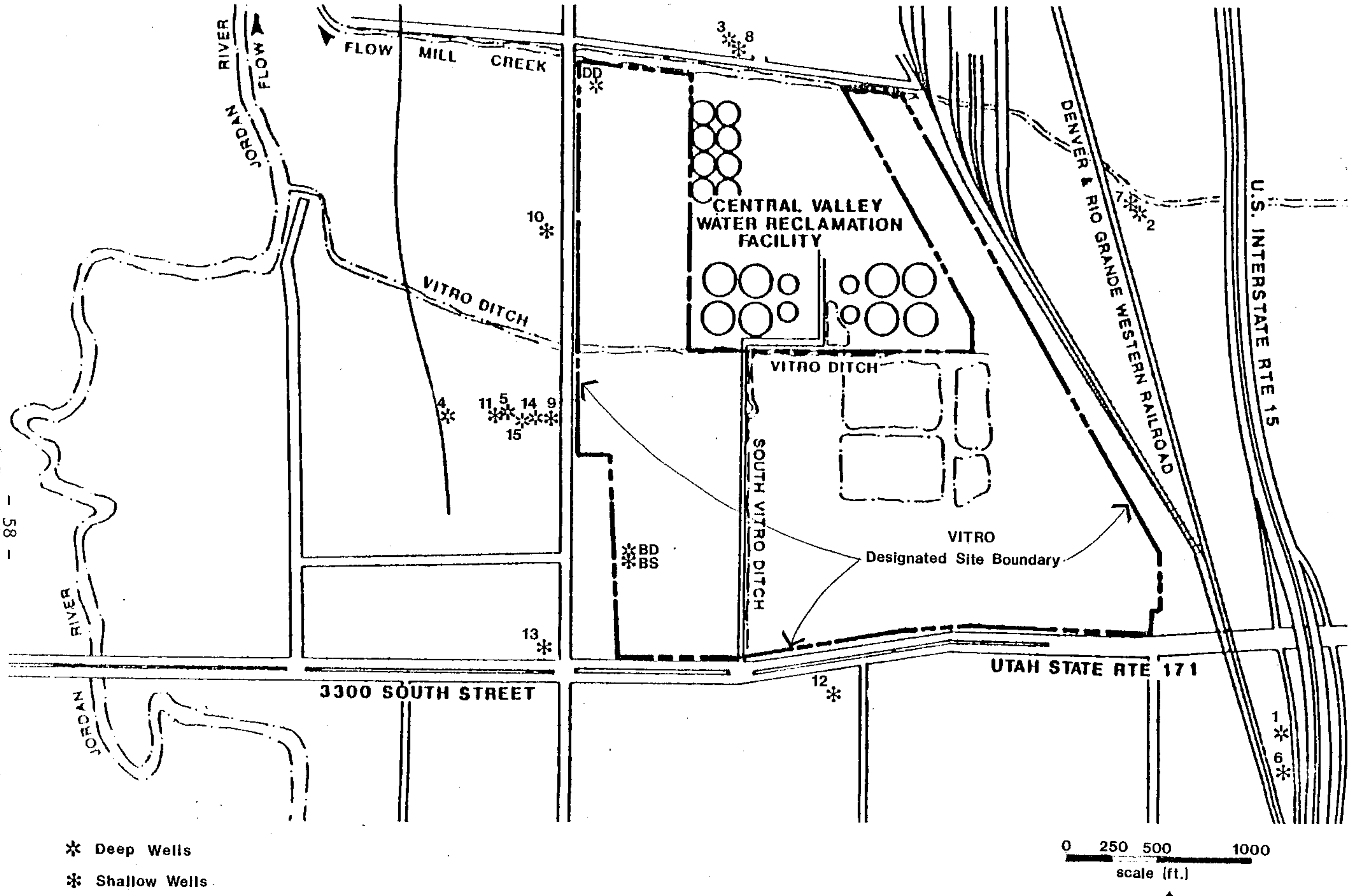


FIGURE 19. Location of Monitoring Wells; Vitro Uranium Mill Tailings Site

studies presented in this report, more data is necessary to more accurately describe the long-range implications in groundwater quality.

Groundwater quality data discussed in this report is listed in Table 8. There is no substantial decrease or increase in parameter concentration as groundwater traverses the site for all constituents collected from shallow wells except for As, Cr, Fe, Mn, U, gross alpha and gross beta. Apparently concentrations of As, actually decrease by about 1/3. However, Cr and Mn concentrations approximately double, Fe concentrations increase by about 20%, and gross alpha and beta concentrations increase by an order of magnitude (ten times). U concentrations also increase (somewhat dramatically) but a very small number of upgradient samples could skew the analysis.

The data suggest that in the deeper aquifer, concentration of Fe, Mn, gross alpha and beta and U, increase by approximately 3 x, 3 x, 3 x, and slightly while, AS concentrations decrease.

As stated above, much more sampling needs to be undertaken to better define the long-term impacts of the vitro remains.

Salt Lake City-County Landfill

Shallow groundwater quality monitoring near the current (post-1982) and old pre-(1982) Salt Lake City-County landfills began in late 1982. To date,two sampling runs have been made with a third scheduled for November 1983.Samples are collected from shallow monitoring wells (less than 25 feet) and are analyzed by the Salt Lake City-County Health Department. The wells are located up and downgradient from both sites. Well locations are shown in Figure 20.

Monitoring wells consist of 4-inch schedule 40 PVC pipe installed to a depth of 10 feet below water table. The deepest well is approximately 25 feet. The 10 feet extending below water table is slotted at 6 inch intervals

TABLE 8. Shallow Groundwater Quality - Vitro Uranium Mill Tailings Site

Well No.	Date (yymmdd)	Time	Depth	As (ug/L)	Ba (mg/L)	Cd (ug/L)	Cr (ug/L)	Cu (ug/L)	Fe (mg/L)	Pb (ug/L)	Mn (ug/L)
1	830312	1400	Deep	33	.14	<1	5	<10	.23	<5	105
2	830512	1200	Deep	22	.11	<1	<5	<10	.66	<5	110
3	830511	1330	Deep	1.0	.10	<1	<5	<10	.24	<5	65
4C	830609	1230	10'	12	<.05	<1	15	<10	.40	13	815
4	830822	1315	Deep?	14	.07	<1	<5	<10	2.20	<5	225
5	830509		Deep	1.5	.22	<1	<5	<10	.54	<5	335
5	830822	1115	Deep	1.5	.15	<1	<5	15	.30	<5	310
6A	830409	1300	30'	14	<.05	<1	5	<10	8.90	<5	1010
6A	830413	1400	30'	133	.28	<1	<5	<10	<.20	<5	160
7	830330	1730	Shal	70.0	.05	<1	<5	<10	5.00	<5	600
7C	830608	1345	10'	162	.06	1	6	<10	3.40	7	415
7A	830609	0920	30'	245.0	.07	<1	6	<10	.03	<5	60
8B	830311	1130	20'	3.0	<.05	<1	<5	<10	14.00	<5	515
9B	830408	1100	20'	1	<.05	<1	<5	<10	<.03	<5	3145
9C	830408	0945	10'	3	<.05	<1	<5	<10	.49	<5	1180
10	830329	1245	10'	11.0	<.05	1	6	15	.36	<5	360
10	830607	1400	10'	21.0	<.05	2	14	10	<.03	8	590
10	830607	1450	20'	14.0	<.05	2	11	<10	18.50	5	2590
10A	830608	1150	30'	4	<.05	4	13	<10	2.65	6	865
11A	830609	1120	30'	13.0	<.05	<1	30	<10	18.40	6	1285
11D	830609	1030	Shal	35	<.05	<1	30	<10	21.40	<5	1655
12C	830517	1145	10'	20	<.05	<1	<5	<10	<.03	<5	700
13	830406	0830	Shal	525	.07	<1	5	<10	<.03	<5	<10
13	830517	1345	Shal	<.5	.40	<1	<5	10	.41	<5	315
14	830602	0010	Shal	3.0	<.05	5	<5	<10	14.80	<5	1670
14	830602	1320	Shal	3	<.05	4	<5	<10	<.03	<5	1740
15	830521	1715	Deep	<.5	.30	<1	6	<10	1.50	<5	415
15	830523	0920	Deep	<.5	.37	<1	<5	<10	.08	<5	420
15	830823	1025	Deep	<.5	.31	<1	<5	<10	1.80	<5	380
BD	830606	1320	95'	13.0	.34	<1	5	<10	.60	<5	115
DD	830606	1205	90'	<.5	.17	<1	<5	<10	<.03	<5	25
DD	830607	1150	35'	190.0	<.05	<1	<5	<10	8.67	<5	745
BS	830610	0945	?	167.0	<.05	3	<5	<10	13.00	7	1780

TABLE 8. (cont'd)

Well No.	Date (yymmdd)	Time	Hg (ug/L)	Ni (ug/L)	Se (ug/L)	Ag (ug/L)	Zn (ug/L)	Mo (ug/L)	Gross Alpha (pCi/L)	Gross Beta (pCi/L)	Radium-226 (pCi/L)	U (ug/L)
1	830312	1400	<0.1	<10	<.5	<2	<5		4	<10.0	<0.5	0
2	830512	1200	<0.1	<10	<.5	<2	<5		<2.0	11	<0.5	1
3	830511	1330	<0.1	<10	<.5	<2	<5		<2.0	<10.0	<0.5	0
4C	830609	1230	<0.1	185	<.5	5	10		303	763	1	693
4	830822	1315	<0.1	<10	<.5	<2	10	<50	2	<10.0	1	1
5	830509		<0.1	<10	<.5	<2	<5					
5	830822	1115	<0.1	<10	<.5	<2	<5	<50	<2.0	<10.0	<0.5	0
6A	830409	1300	<0.1	86	<.5	<2	40					
6A	830413	1400	<0.1	<10	<.5	<2	<5					
7	830330	1730	<0.1	53	<.5	<2	5					
7C	830608	1345	<0.1	<10	<.5	<2	<5		25	298	<0.5	4
7A	830609	0920	<0.1	<10	<.5	<2	<5		<2.0	91	<0.5	2
8B	830311	1130	<0.1	19	<.5	<2	<5		5	<10.0	0	9
9B	830408	1100	<0.1	74	<.5	3	20		63	<10.0	1	59
9C	830408	0945	<0.1	77	<.5	<2	50		818	513	<0.5	1350
10	830329	1245	<0.1	44	<.5	<2	<5		59		<0.5	84
10	830607	1400	<0.1	86	.5	4	5		42	156	<0.5	68
10	830607	1450	<0.1	53	<.5	<2	<5		21	56	<0.5	15
10A	830608	1150	<0.1	<10	<.5	6	<5		19	420	1	2
11A	830609	1120	<0.1	430	<.5	6	15		63	770	<0.5	78
11D	830609	1030	<0.1	385	<.5	6	15		142	1093	<0.5	110
12C	830517	1145	0.1	<10	<.5	<2	20		6	<10.0	<0.5	16
13	830406	0830	<0.1	<10	<.5	<2	<5		8	89	<0.5	13
13	830517	1345	0.1	<10	<.5	<2	<5		9	12	1	0
14	830602	0010	<0.1	<10	<.5	4	<5		124	42	<0.5	112
14	830602	1320	<0.1	<10	<.5	4	110		362	127	<0.5	78
15	830521	1715	<0.1	<10	<.5	<2	<5	<200	7	36	1	1
15	830523	0920	<0.1	<10	<.5	<2	<5	<200	7	11	<0.5	0
15	830823	1025	<0.1	<10	<.5	<2	<5	<50	<2.0	<10.0	<0.5	0
BD	830606	1320	<0.1	<10	<.5	<2	<5		3	67	<0.5	0
DD	830606	1205	<0.1	<10	<.5	<2	<5		<2.0	49	<0.5	0
DD	830607	1150	<0.1	27	<.5	<2	5		130	<10.0	<0.5	461
BS	830610	0945	<0.1	<10	<.5	<2	20		139	32	0.5	202

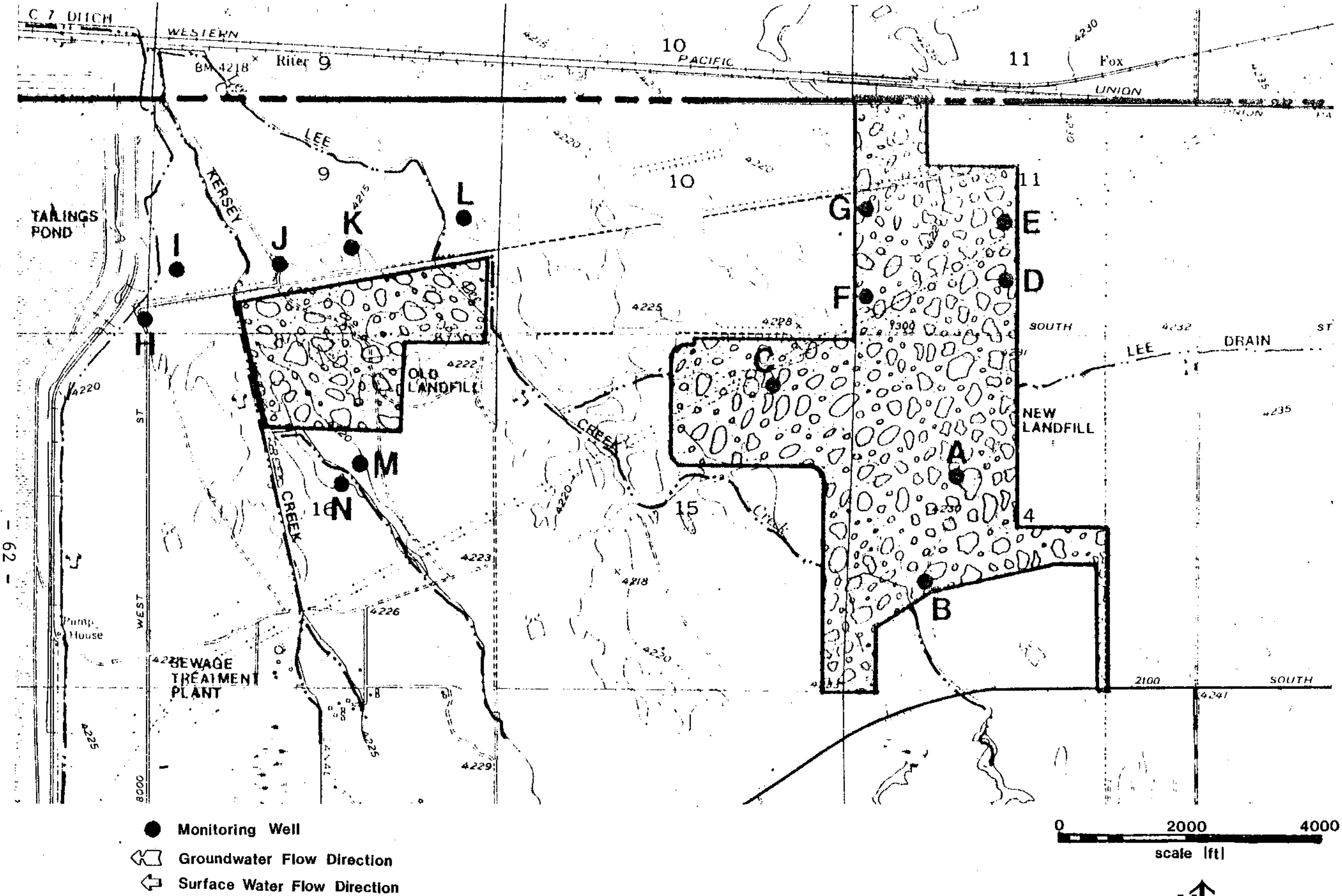


FIGURE 20. Location of Monitoring Wells; Salt Lake City - County Landfill

staggered on two sides, wrapped with fiber screen cloth and backfilled with pea gravel (3/8 inch maximum). The bottom is capped with a bonded PVC cap. The upper portion of the casing (ground elevation to water table) is not slotted and is backfilled with native soil compacted to 90% (ASTM). A one-foot minimum depth concrete seal caps the bore hole. A steel cover with a locked hasp secures the well. Depth of individual wells and depth to groundwater are not available at this time. Groundwater depths will be measured during the November sampling run.

Water quality data for the two sampling runs is shown in Table 9. A cursory analysis of data was made by the Bureau of Water Quality, City-County Health Department for the County Public Works Department (operators of the landfills). A copy of this analysis is included in the appendix. Based on one or two samples per well, it is difficult to make sound quality judgments. Therefore, no further analysis of data is made in this report.

TABLE 9. Shallow Groundwater Quality - Salt Lake City-County Landfill

Well No.	Date (yymmdd)	Temp (C)	TDS (mg/L)	As (mg/L)	Cd (mg/L)	Cr (mg/L)	Fe (mg/L)	Hg (mg/L)	Mg (mg/L)	Pb (mg/L)	Se (mg/L)	Zn (mg/L)	Na (mg/L)
A	821110	11.2	9,500	—	<0.02	<0.02	0.24	0.001	40	<0.01	—	<0.05	3,750
A	830706	17.2	—	0.38	<0.002	<0.002	0.08	<0.001	10	0.005	<0.5	<0.02	3,000
B	821110	11.4	20,000	—	<0.02	<0.02	0.50	<0.001	42	0.02	—	<0.05	7,750
B	830706	13.6	—	0.02	<0.002	0.002	3.10	<0.001	38	0.013	<0.5	<0.02	1,000
C	821110	12.2	3,900	—	<0.02	<0.02	0.23	<0.001	78	0.01	—	<0.05	1,200
C	830706	15.8	—	0.38	<0.002	0.002	0.39	<0.001	19	0.008	<0.5	0.03	8,000
D	821110	12.6	13,000	—	0.04	<0.02	2.20	<0.001	175	0.04	—	0.49	4,250
D	830706	17.2	—	0.01	<0.002	<0.002	0.79	<0.001	35	0.005	<0.5	<0.02	2,150
E	821110	12.4	12,000	—	0.03	<0.02	0.18	<0.001	130	<0.01	—	<0.05	3,750
E	830706	14.0	—	0.05	0.002	<0.002	1.65	<0.001	75	0.027	1.0	0.02	4,200
F	821110	11.8	22,000	—	<0.02	<0.02	0.16	<0.001	26	<0.01	—	0.05	9,000
F	830706	15.2	—	—	0.002	0.003	7.50	—	88	0.009	<0.5	0.16	3,200
G	821110	14.5	12,500	—	<0.02	<0.02	2.50	<0.001	100	0.03	—	0.29	4,250
G	830706	16.8	—	0.34	<0.002	0.002	0.01	<0.001	34	0.008	<0.5	0.02	2,300
H	821110	12.5	7,000	—	<0.02	<0.02	0.16	<0.001	105	<0.01	—	<0.05	2,500
H	830706	14.6	—	0.24	<0.002	<0.002	0.60	<0.001	40	0.003	<0.5	<0.02	2,300
I	821110	11.8	7,500	—	<0.02	<0.02	4.00	<0.001	115	<0.01	—	<0.05	2,600
I	830706	14.2	—	0.28	0.004	<0.002	6.50	<0.001	18	0.005	<0.5	0.05	1,950
J	821110	10.8	22,000	—	<0.02	<0.02	0.16	<0.001	25	<0.01	—	0.05	8,750
J	830706	14.2	—	0.18	<0.002	<0.002	0.04	<0.001	10	0.003	1.0	<0.02	9,400
K	830706	15.4	—	0.13	0.002	0.002	0.53	<0.001	14	0.004	<0.5	<0.02	970
L	830706	15.0	—	0.03	<0.002	<0.002	0.28	<0.001	0.7	0.002	0.5	<0.02	1,500
M	821110	12.5	18,000	—	<0.02	<0.02	0.12	<0.001	110	<0.01	—	<0.05	7,250
M	830706	13.0	—	0.21	<0.002	<0.002	0.68	<0.001	25	0.011	1.0	0.04	3,500
N	830706	13.2	—	0.23	<0.002	<0.002	0.74	<0.001	33	0.007	<0.5	<0.02	5,000

TABLE 9. (cont'd)

Well No.	Date (yymmdd)	Cl (mg/L)	NO_2-N (mg/L)	NO_3-N (mg/L)	PO_4-P (mg/L)	SO_4 (mg/L)	TOC (mg/L)	DO (mg/L)	O&G (mg/L)	F. Coli (MPN/100ml)	T. Coli (MPN/100ml)
A	821110	4,400	<0.02	0.83	0.4	1,500	—	2.6	0.6	—	—
A	830706	2,950	0.044	1.93	0.63	1,000	28.9	4.4	—	<2	20
B	821110	9,000	<0.02	1.70	0.9	3,300	—	3.4	<0.1	—	—
B	830706	1,250	0.580	0.19	0.13	240	3.6	2.2	—	<2	<10
C	821110	1,800	<0.02	0.53	<0.01	300	—	3.0	0.3	—	—
C	830706	8,600	0.014	1.60	0.31	2,800	27.1	4.6	—	<2	<10
D	821110	7,500	<0.02	3.00	<0.1	575	—	8.2	0.3	—	—
D	830706	3,600	0.154	0.00	0.11	300	2.7	3.6	—	<2	80
E	821110	6,500	<0.02	1.00	<0.1	600	—	2.2	0.2	—	—
E	830706	6,350	0.400	0.96	0.37	1,100	6.8	3.3	—	<2	400E
F	821110	11,000	<0.02	2.40	0.8	2,300	—	3.6	1.2	—	—
F	830706	6,550	0.790	0.00	0.03	250	1.0	4.2	—	<2	20
G	821110	7,000	<0.02	0.28	0.1	350	—	6.6	1.1	—	—
G	830706	3,050	0.580	0.50	0.20	1,100	176.8	2.9	—	<2	UNS.
H	821110	2,750	<0.02	1.20	0.4	1,400	—	3.4	0.9	—	—
H	830706	2,250	1.180	0.93	0.59	1,700	9.0	3.0	—	<2	<2
I	821110	2,900	<0.02	1.10	<0.1	1,200	—	2.5	0.5	—	—
I	830706	2,300	0.053	0.48	0.42	600	79.9	1.8	—	<2	<2
J	821110	11,000	<0.02	2.20	0.7	2,300	—	2.5	4.6	—	—
J	830706	9,700	0.010	1.41	0.78	1,300	149.9	2.0	—	<2	<2
K	830706	1,200	0.044	0.86	0.39	120	32.1	1.6	—	<2	<2
L	830706	1,950	0.018	0.55	0.09	850	14.1	2.2	—	16	<2
M	821110	9,000	<0.02	0.76	0.1	1,900	—	2.8	1.9	—	—
M	830706	3,400	1.240	0.12	0.48	300	4.8	1.6	—	32	<2
N	830706	6,750	1.210	0.31	0.47	1,000	13.3	1.8	—	<2	16

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7. Utah State Department of Social Services, Division of Environmental Health, Standards of Quality for Waters of the State, Part II, Waste Disposal Code. Amended, 1978

8. Paula L. Magnuson, "Groundwater Classification" Region VIII EPA Groundwater Seminar, July, 1981

9. Kidd Waddell, U.S. Geological Survey. "Personal Communication" 1982

10. U.S. Environmental Protection Agency, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, Office of Research and Development, Washington, D.C. December, 1980

11. U.S. Environmental Protection Agency, Region VIII, The Quality Assurance Program Plan for EPA Region VIII Denver, Colorado. January, 1982

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13. Utah State Health Laboratory, "Quality Assurance Program Plan" Bureau of Environmental Chemistry, July, 1983

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15. Utah Geological and Mineralogical Survey, Depth to Shallow Groundwater, by Ben Everett. 1982

16. State of Utah Dept. of Natural Resources, Water Resources of Salt Lake County, Utah, USGS Technical Publication 31. 1971

17. Ibid.

18. R.L. Seiler and K.M. Waddell, Reconnaissance of Shallow-Unconfined Aquifer in Salt Lake Valley, Utah, U.S. Geological Survey, Salt Lake City, Utah (Unpublished report).

19. U.S. Environmental Protection Agency, Region VIII "Uncontrolled Hazardous Waste Disposal Site; Rose Park, Salt Lake County, Utah", Denver CO, 1983.

APPENDIX A

APPENDIX A IS AVAILABLE IN FINAL PRINTED FORM FROM
THE U.S. GOVERNMENT PRINTING OFFICE
OR THE U.S. GEOLOGICAL SURVEY

THE DOCUMENT CAN BE OBTAINED UNDER THE TITLE OF
"RECONNAISSANCE OF THE SHALLOW-UNCONFINED AQUIFER
IN SALT LAKE VALLEY, UTAH"
WATER RESOURCES INVESTIGATIONS REPORT #
83-4272

For additional information write to:
District Chief, U.S. Geological Survey, WRD
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, Utah 84104

Copies of this report can be purchased from:
Open-File Services Section, Western Distribution Branch
U.S. Geological Survey
Box 25425, Federal Center, Lakewood, Colorado, 80225
(Telephone 303-234-5888)

Appendix B

SALT LAKE CITY-COUNTY HEALTH DEPARTMENT

610 South 2nd East, Salt Lake City, Utah 84111
Phone: 532-2002

HARRY L. GIBBONS, M.D., M.P.H.
Director

Rec'd 11/3/83

11 October, 1983

Romney Stewart
Associate Public Works Director
2033 South State Street
Salt Lake City, Utah 84115

Dear Romney:

The complete samples results for July 6, 1983 of the Salt Lake County Landfill Groundwater Monitoring Wells have now been received. Some of the results have changed since the samples of November 10, 1982. These will be discussed in this letter.

The bacteriological results are not comparable to the November 10, 1982 samples, since the 1982 samples were contaminated, and some results were overgrown. The bacteriological samples of July 6, 1983 will have to be used as a background for all future samples.

It is anticipated that during November, 1983 all of the Kennecott area wells will again be sampled.

Chemical analyses are compared as follows:

Well C showed an increase in Chloride from 1800 mg/l to 8600 mg/l. All other wells were very similar, or dropped in Chloride level since the 1982 samples.

Nitrite levels (NO_2 as N) increased over 1982 mainly in wells E, F, G, H, KSL-1, KSL-2 and KSL-3. The increase in KSL-3 is not significant since KSL-1 and KSL-2 are upgrade from KSL-3 and they increased at approximately the same ratio.

Well C had a great increase in sulfate (SO_4) from 300 mg/l to 2800 mg/l. An increase in Sodium from 1200 mg/l to 8000 mg/l was also noted in Well C.

Well F showed the greatest increase in Magnesium from 26 mg/l to 88 mg/l. All other wells either decreased, or were close to the 1982 results.

Iron increased in Well B (.50 mg/l to 3.10 mg/l) and in Well F (.16 mg/l to 7.50 mg/l).

Zinc, Cadmium, Lead, Chromium and Mercury remained relatively the same in both samplings.

The majority of the results of the parameters tested decreased from 1982 to 1983. Perhaps the different levels of groundwater from 1982 to 1983 may have had some influence in the decrease in some parameter results, whereas more dissolving of Sodium, Sulfate, Chloride and Nitrate could have taken place. A better pattern may be seen after the next sampling results are compiled.

After reviewing your copy of the results, if you have any questions, please contact our office at 532-2002 Ext: 543.

Sincerely,

SALT LAKE CITY-COUNTY HEALTH DEPARTMENT

Frank V. Nabrotzky, Environmental Health
Quality Specialist
Bureau of Water Quality

FVN/pn

Encl: 3

Scott M. Matheson
Governor

STATE OF UTAH
DEPARTMENT OF HEALTH
STATE HEALTH LABORATORY
44 Medical Drive, Salt Lake City, Utah 84113

Francis M. Urry, Ph.D., Director
Room 207 801-533-6131

James O. Mason, M.D., Dr.P.H.
Executive Director
801-533-6111

DIVISIONS
Community Health Services
Environmental Health
Family Health Services
Health Care Financing and Standards

OFFICES
Administrative Services
Health Planning and Policy Development
Medical Examiner
State Health Laboratory

September 13, 1983

RECEIVED
SEP 16 1983
SALT LAKE COUNTY
FLOOD CONTROL & WATER QUALITY

Peter Borromeo
Salt Lake County Flood Control
2033 South State Street
Salt Lake City, Utah 84115

Dear Mr. Borromeo:

On or about August 24, 1983 we reported results for our sample number 832781, your field number 1019. Since that time, we have found contamination in our filtration system affecting mineral analysis.

The sample in the original container was reanalyzed with the following results:

Specific Conductivity	4.5μmhos/cm
Total Dissolved Solids	<5mg/l
Chloride	<1PPm
Sulfate	<10PPM
Arsenic	<0.5PPb
Cadmium	<1.0PPb
Chromium	<5.0PPb
Lead	<5.0PPb

We are sorry for any inconvenience the previous data may have caused your office.

Sincerely,

Ralph A. Helfer

Ralph A. Helfer
Chemist
Quality Assurance Section
Bureau of Laboratory Improvement

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80295

MAY 22 1984

Ref: 8WM-SP

Mr. Steven F. Jensen
Water Quality Program Manager
Salt Lake County Flood Control and Water Quality Division
2033 South State Street
Salt Lake City, Utah 84115

RE: Draft Assessment of Shallow Aquifer Quality in Salt Lake County

Dear Steve:

EPA has reviewed the referenced Section 208 assessment. It represents a commendable inter-agency effort which we hope will continue to be strengthened. Our comments are attached.

The assessment should prove to be valuable not only as a basis for longer term monitoring, but also as a basis for current ground water protection actions. If you have any questions, feel free to call.

Sincerely yours,

Richard T. Clozzett

Doug Lofstedt for
Utah Areawide Project Officer

Attachment

cc: Roy Gunnell
Utah Bureau of Water
Pollution Control

ATTACHMENT

EPA Comments on Draft Assessment of Shallow Aquifer Quality in Salt Lake County (October 1983)

Under Section III on page 5, we suggest that the last sentence of the fifth paragraph be clarified in a couple of areas. Many readers may not be familiar with the "solute transport" process. It also isn't clear what is being referred to by the "critical limits to this deep/shallow aquifer interface" which will be prescribed by computer modelling.

Section III should also include a brief rationale for selection of parameters and compounds which were analyzed.

We suggest the inclusion of more detailed soils information, particularly the organic content and local modifiers of pH. This would be needed to predict the mobility of hazardous compounds in the soil and water.

The symbols used on page 29 for identifying the wells should be described in the legend.

The assessment should be more specific on NPS identification, continued assessment, and implementation action now needed. What are the "certain locations" where nonpoint contaminant sources may be impairing surface and ground water (page 27)? I suggest a separate section for inclusion of specific ground water protection actions that need to be taken now (based on existing knowledge) and of priorities for continued monitoring. It should reference findings of both county and USGS sampling.

The USGS report mentions that some of the largest nitrogen concentrations were found near "animal pens" (page 21). This disclosure needs to be addressed in the county portion of the assessment. Where are these pens located? What size are they? What additional study and corrective action is needed?

Table 2 should note which set of data was taken by USGS and which was taken by Salt Lake County.

The reasoning for the absence of data for some parameters in Table 2 should be clarified. This apparent lack of data would contradict the statement at the bottom of page 3, and elsewhere in the assessment, which gives the impression that two sampling rounds were completed in which all of the same constituents were analyzed.

Under item 4 on page 42, it isn't clear what the term "accurate" means in the first sentence. The assessment needs to include and address the metals data from pages 21 and 22 of the USGS report.

The discussion of organic compounds (item 5 on page 42) states that "elevated levels... do not appear to occur at elevated levels...". This needs to be clarified and be more definitive. It needs to be consistent with USGS findings on page 24 of their report. The county assessment needs to be strengthened by discussing the relationship of detected contaminates to public health.

We commend the inclusion of the site-specific ground water studies underway (pages 44-61).

On page 51, the following partial sentence has a typographical error for correction: "(mill tailings with varying23egrees of activity)".

A map of the entire area with the plumes of contamination and their proximity to sensitive areas, such as drinking water sources, and wildlife or recreational areas is recommended, if not now, later after more study and funding.

United States Department of the Interior

GEOLOGICAL SURVEY

WATER RESOURCES DIVISION
Room 1016 Administration Building
1745 West 1700 South
Salt Lake City, Utah 84104

April 9, 1984

Steven F. Jensen
Water Quality Program Manager
Salt Lake County Division of
Flood Control and Water Quality
2033 South State Street
Salt Lake City, UT 84115

Dear Mr. Jensen:

I have reviewed the draft copy of the "Assessment of the Shallow Aquifer in Salt Lake Valley" as you requested in your letter of March 30.

The report needs editorial review to correct spelling, grammatical, and stylistic errors. The style is inconsistent and varies from very formal to extremely colloquial (e.g. On p. 21 it is stated that "Virtually any old landfill is suspect.").

In the section discussing the results of the chemical analyses I am left with the feeling you are glossing over some of the more significant results.

1) pH. On page 31 it is stated that pH ranged from 6.0 to 8.0 and it seems to me you imply that this is well within the range of the expected. A cursory examination of hundreds of chemical analyses of ground water in the principal aquifer in Salt Lake County reveals only four pH values less than 7.0 and only one less than 6.9. Table 2 of the report shows that 18 of the 32 wells in the shallow aquifer had measured pH's less than 7.0. This may indicate widespread contamination of the shallow aquifer by either organic or mineral acids.

2) Contamination by organic chemicals. On page 42 you state "Elevated levels of organic parameters...do not appear to occur at elevated levels in the shallow aquifer observation wells." What is the basis for this statement? Is it based on the detection limits of 999 ug/L for organic chemicals used by the Utah State Lab? With such high detection limits even gross contamination of the aquifer could go undetected. I feel it is a serious error to imply that contamination of the aquifer by organic chemicals is not a problem, especially since several organic compounds identified by the EPA as potentially carcinogenic were found at levels well above the detection limits of the USGS Central Lab. Table 2, for example, reports that 660 ug/L phenols, 400 ug/L benzene and several different types of polychlorinated hydrocarbons were found.

3) Quality Assurance Data. Why is there no discussion of the data in Table 3? As an example, among all the samples analyzed for phenols by the Utah State Lab, the highest levels detected were in the field blank. Furthermore, there is no explanation of what the headings in Table 3 mean. What is a VOA7?

I believe the direction of ground-water movement shown in Figure 18 is wrong. Water level data for wells (B-1-1)26bad-1 and (B-1-1)26cda-1 support the conclusion that flow is more nearly east to west than shown. Thus all your conclusions on page 45 about how water quality changes as it moves through the refinery may be based on a misinterpretation of the water-level data.

The USGS report placed as appendix A at the end of the Salt Lake County report is a draft version. Since the USGS report is now available in final form I feel it would be appropriate to use the final version rather than draft version as an appendix.

Thank you for the opportunity to review the report. This compendium of chemical and water-level data should be very useful to water managers, contractors, and anyone else needing information on the shallow aquifer.

Ralph Seiler
Hydrologist

LEROY W. HOOTON, JR.
DIRECTOR
JOSEPH S. FENTON
SUPERINTENDENT, WATER RECLAMATION
WENDELL E. EVENSEN, P.E.
SUPERINTENDENT
WATER SUPPLY & WATERWORKS

SALT LAKE CITY CORPORATION
DEPARTMENT OF PUBLIC UTILITIES
WATER SUPPLY & WATERWORKS
WATER RECLAMATION
1530 SOUTH WEST TEMPLE
SALT LAKE CITY, UTAH 84115

TED L. WILSON
MAYOR

RECEIVED
MAY 09 1984
SALT LAKE COUNTY
FLOOD CONTROL & WATER QUALITY

May 7, 1984

Mr. Steven F. Jensen
Water Quality Program Manager
2033 South State Street
Salt Lake City, UT 84115

Dear Steve:

RE: Review and Comment Request for Shallow Aquifer Assessment

Thank you for the opportunity of reviewing your report "Assessment of the Shallow Aquifer in Salt Lake Valley." Sorry that my comments are reaching you a little beyond the May 1, 1984, closing date.

In general, this is a very valuable report. I was especially glad to see the report zero in on specific sites and evaluate them for groundwater contamination in the shallow aquifer. My recommendation for the final report would be to have some comparison between the levels of contamination found and the maximum contaminant levels established in the National Interim Primary Drinking Water Regulation. This would be extremely meaningful. I noticed that some reference was made to those established contaminant levels in the incorporated, unpublished report by Seiler and Waddell. Perhaps they could be also be shown alongside the data obtained from your shallow wells.

Sincerely,

for Wendell E. Evensen

LEROY W. HOOTON JR.
Director

WEE:ww
38:33:2

STATE OF UTAH
NATURAL RESOURCES & ENERGY
Wildlife Resources

Scott M. Matheson, Governor
Temple A. Reynolds, Executive Director
Douglas F. Day, Division Director

1596 West North Temple • Salt Lake City, UT 84116 • 801-533-9333

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APR 11 1984
SALT LAKE COUNTY
FLOOD CONTROL & WATER QUALITY

April 5, 1984

Mr. Steven F. Jensen
Water Quality Program Manager
Salt Lake County Public Works Department
Flood Control and Water Quality Division
2033 South State Street
Salt Lake City, UT 84115

Dear Mr. Jensen: Steve

We have reviewed the document "Assessment of The Shallow Aquifer in Salt Lake Valley", and we note that fish and aquatic habitat are listed as items dependent on water quality in the valley. We also note that waterfowl and wetland qualities are mentioned as being items which reflect water quality conditions. Even though premium fisheries do not occur within the Salt Lake Valley, the potential exists if water quality in the lower reaches of valley streams can be improved. The importance of our Waterfowl Management Areas and other wetlands around the Great Salt Lake needs no documentation and water quality will directly affect the quality of those areas, dependent wildlife and the resultant recreational opportunities to a great number of Utahns.

In addition, we concur that one of the basic criteria for the Shallow Aquifer Monitoring Networks (page 16) is to target potential non-point source contaminant plumes.

We also believe any reduction in underground and aboveground pollution will enhance the survival and presence of many species of urban wildlife found within the riparian areas of all Salt Lake Valley streams. We commend you for this assessment as a good start on what could become a critical future issue: Improved water quality in Salt Lake Valley.

We appreciate the opportunity to review and comment on this document.

Sincerely,

Day

Douglas F. Day, Director
DIVISION OF WILDLIFE RESOURCES