27017-ws004-2016

DRINKING WATER SOURCE PROTECTION PLAN
BIG SPRING
SOURCE NO. WS004

TOWN OF SPRINGDALE WATER SYSTEM
SYSTEM NO. 27017
SPRINGDALE, UTAH

June 2017

Prepared by:
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BIG SPRING (WS004)
TOWN OF SPRINGDALE WATER SYSTEM (27017)
SPRINGDALE, UTAH

June 2017

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EXECUTIVE SUMMARY

This Drinking Water Source Protection (DWSP) Plan has been prepared for Big Spring (Source No. WS004) in the Town of Springdale Water System (System No. 27017) to comply with the Utah Drinking Water Rule R309 – 600 entitled *Source Protection: Drinking Water Source Protection for Ground-Water Sources* (Utah DWSP Rule).

A delineation report was developed to provide the Town of Springdale Water System with a map that delineated the four DWSP zone boundaries required by the Utah DWSP Rule for the groundwater management purposes. An inventory of existing potential contamination sources (PCSs) has been completed. The identification and assessment of current controls have been developed for the existing PCSs. A management program for the existing PCSs and a management program to control or prohibit any future PCSs to be located within the protection zones of the springs have been prepared.

This report also includes an implementation schedule, a resource evaluation, a recordkeeping section, a contingency plan, a public notification, and a section regarding the pesticide and volatile organic chemical (VOC) monitoring waivers.

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BIG SPRING

TOWN OF SPRINGDALE WATER SYSTEM
SPRINGDALE, UTAH

June 2017

1.0 INTRODUCTION

This Drinking Water Source Protection (DWSP) Plan report for Big Spring (Source No. WS004) in the Town of Springdale Water System (System No. 27017) was prepared in compliance with the Utah Drinking Water Rule R309 – 600, *Source Protection: Drinking Water Source Protection for Ground-Water Sources*. According to the State of Utah Division of Drinking Water, or Utah DDW, a DWSP plan for a single water source should include a delineation report, an inventory of potential contamination sources (PCSs), an assessment of PCS hazards, a management program for existing PCSs, a management program for future PCSs, an implementation schedule, a resource evaluation, a recordkeeping section and a optional section regarding pesticide and volatile organic chemical (VOC) monitoring waivers (Utah DDW, 2012). A contingency plan and a public notification are required for an entire water system.

1.1 System Information

System Name	Town of Springdale Water System
System Number	27017
System Type	Existing Public Community
Address	Town of Springdale 118 Lion Boulevard Springdale, Utah 84767

1.2 Source Information

Big Spring is located on the west bank of the North Fork of the Virgin River in Springdale (**Figure 1**). The source information is summarized as follows:

Source Name and Number	Big Spring, WS004
Water Right Number	81-2413
Point of Diversion	S 1070 feet W 960 feet from NE Corner of Section 32, Township 41 S, Range 10 W, Salt Lake Base and Meridian

Source Type	Spring, existing source, inactive

1.3 Designated Person

Name and Title	Robby Totten, Public Works Superintendent
Address	118 Lion Boulevard Springdale, Utah 84767
Phone	(435) 772-3434 (Office) (435) 619-8496 (Cell)

2.0 DELINEATION REPORT

Two procedures to delineate source protection areas are described in the DWSP Rule R309-600: the preferred delineation procedure and the optional two-mile radius delineation procedure. In this study, the preferred delineation procedure was applied in the delineation of the following four protection zones for the groundwater management purposes:

1. Zone 1 is called the **accident prevention zone**, consisting of an area within a 100-foot radius from the wellhead or margin of the spring collection area. No future pollution sources will be allowed to be located in this area.

2. Zone 2 is called the **attenuation zone**, comprising an area within a 250-day groundwater time of travel (TOT) to the wellhead or margin of the spring collection area. The public water system (PWS) should prohibit the future location of pollution sources within zone two, unless the potential pollution source agrees to implement design or operating standards which prevent discharges to the groundwater.

3. Zone 3 is called the **waiver criteria zone**, comprising an area within a 3-year groundwater TOT to the wellhead or margin of the spring collection area. This zone was established to match the source monitoring waiver reevaluation period of 3 years. The waiver was designed for analysis of water samples collected from the drinking water source for VOCs and pesticides. Waivers for these two parameter groups can be issued to systems that delineate protection zones and list the potential contamination sources within these zones. Since waivers are reevaluated every three years, systems should delineate a 3-year groundwater TOT protection area around their sources on which to base their waiver.

4. Zone 4 is called the **remedial action zone**, comprising an area within a 15-year groundwater TOT to the wellhead or margin of the spring collection area. Its purpose is to provide protection to the drinking water source and to afford sufficient time for remediation or developing a new source in case of a contamination incident.

This section discusses the geology and aquifer characteristics, spring collection data, hydro-geologic method, and the DWSP zone boundary delineation.

2.1 Geologic Data

The geology and hydrogeology around and in the vicinity of Springdale were previously addressed by several sources, including Doelling, et al (2002), Willis et al (2002), and Doelling and Davis (1989).

2.1.1 General Topography

The general area around Springdale is located within the Colorado Plateaus physiographic province near its western margin. The province consists of a series of plateaus, mesas, and buttes which reflect the geologic units and their structures. Interrupting the horizontal or gently dipping strata are major faults, monoclinal folds, and groups of anticlines and synclines, domes and basins. Streams have eroded deep canyons or precipitous escarpments in many areas. General altitudes drop from north to south in this area. A series of high plateaus mark the western boundary of the Colorado Plateaus in Utah. Zion National Park is near the western edge of the Grand Staircase, which starts at the Grand Canyon in Arizona and "stair-steps" northward to the high plateaus of southern Utah.

The largest water producing area is around the headwaters of the North Fork of the Virgin River and its tributaries. Big Spring is far downstream of this area. Following the topography of the drainage basin, the North Fork of the Virgin River drains southwesterly and is confluent with the East Fork of the Virgin River 1.5 miles south/southwest of Springdale.

2.1.2 Local Geological Setting and Groundwater Resources

A portion of the geologic map including the study area is shown in **Figure 2**, which is modified from the Interim Geologic Maps of the Springdale East and Springdale West Quadrangles (Doelling, et al, 2002, and Willis, et al, 2002). A copy of the associated descriptions of geologic

map units is attached in **Appendix A**. The Town of Springdale and its surrounding areas are dominated by various sedimentary rocks and recent mass-movements and related deposits. Exposed geological units in this area range from the Triassic to Quaternary in age.

In this area, bedding of the geologic formations is fairly flat and no faults, folds, anticlines, synclines, and monoclines are shown on the map. Landslides or slump scarps can be seen in several locations.

Groundwater supplies come from both the unconsolidated and consolidated aquifers. Natural recharge to the groundwater in Virgin River area is mostly by infiltration of precipitation as well as seepage from the streams passing over recharge areas of the aquifer outcrops. Most of the springs receive their supply from deep percolation of precipitation that falls on adjacent higher areas within the local watershed. The Navajo Sandstone (Jn) is the principle aquifer in southern Utah. Navajo Sandstone is massive, cliff-forming, cross-bedded, locally highly jointed sandstone, as thick as 2,200 feet and forms cliffs, deep canyons, and impressive spires, promontories, and monoliths. Shallower aquifers exist in unconsolidated alluvial fan, colluvial, mass-movement and related deposits. These deposits are generally poorly sorted clay, silt, sand, gravel, and locally rock-fall blocks and boulders. Water of Big Spring flows from the young alluvial fan and colluvial deposits (Qafc) underlain by Petrified Forest Member of Chinle (TRcp) that consists of smectitic shale, siltstone, claystone, sandstone, and pebble to small cobble conglomerate (**Figure 2** and **Appendix A**).

2.2 Spring Collection Data

Big Spring was developed long time ago and there is no information available regarding the collection system of the spring. For the purpose of delineation, it is assumed that the lowest bottom elevation of the collection system is 15 feet below the spring surface elevation, which is approximately 3,810 feet above mean sea level (MSL). Currently, flow from the spring is 130 gallons per minute (gpm).

2.3 Aquifer Characteristics

Based on the geologic data shown in **Figure 2** and discussed in Section **2.1**, and the observations from a site visit conducted by Sunrise personnel, it is estimated that the groundwater from the mountains west/northwest of Springdale generally flows towards the North Fork of the Virgin River through the Navajo Sandstone and the alluvial fan and colluvial

deposits aquifers, and “spills” near the river. The main source of groundwater recharge is infiltration of precipitation in the mountains. The North Fork of the Virgin River locally acts as a groundwater boundary and it is likely that the spring obtains the influence of surface water.

2.4 Hydrogeologic Methods and Delineation of DWSP Zones

Detailed aquifer data (such as, hydraulic conductivity, groundwater hydraulic gradient, and flow direction) were not available for calculation of TOT zone boundaries of Big Spring. Therefore, hydrogeologic mapping was selected as the preferred method to estimate the protection zone for the spring because of the availability of hydrogeologic information to identify the physical and hydrologic features that control groundwater flow within the aquifer in the general area.

2.4.1 Zone 1

The accident prevention zone (DWSP Zone 1) for Big Spring is set at an arbitrary fixed radius of 100 feet from the margin of its collection area. Due to the scale of the topographic map, Zone 1 for the spring is too small to be accurately depicted on the map showing the DWSP area.

2.4.2 Down-Gradient Boundary for Zones 2, 3, and 4

The down-gradient boundary of the DWSP area of Big Spring was determined using the North Fork of the Virgin River. The river is a natural boundary of the spring water and its water surface is lower than the estimated bottom elevation of the collection system (Section **2.3**).

2.4.3 Topographic Mapping

The lateral and up-gradient extents of the potential recharge area were preliminarily determined based on geologic data, spring collection assumption, aquifer characteristics (as described in Section **2.1** through Section **2.3**) and the USGS topographic maps (USGS, 1980A and 1980B). Based on the conservative assumption that groundwater flow generally mirrors the surface gradient and the groundwater hydraulic gradient is equal to the surface slope, the groundwater divides or potential recharge area boundaries should be coincident with the topographic divides (watershed boundaries). Groundwater outside of the watershed boundaries are not likely to flow into this area (the spring does not capture recharge from the areas outside the watershed). The preliminarily delineated protection zone boundary is shown **Figure 1** (dashed line) and would be confirmed or modified by use of the catchment area calculation (Section **2.4.4**).

2.4.4 Catchment Area Calculations

In most hydrogeologic settings, the spring discharge rate is related to the area contributing precipitation to the aquifer and recharge rate. Using estimates of recharge rate and the discharge rate from the spring, the area of topographic catchment basin required to provide the spring discharge can be estimated. This approach was studied by Utah and federal government geologists and published in a research paper entitled Investigation of Hydrogeologic Mapping to Delineate Protection Zones Around Springs – Report of Two Case Studies (Jenson, et al, 1997), and was applied in the estimate of protection area for Big Spring.

Average annual precipitation in the project site is estimated to range from 12 to 16 inches (305 to 406 mm/year) based on an analytical climate model PRISM, the Parameter-elevation Regressions on Independent Slopes Model from the Oregon Climate Service (Daly et al., 1998). See the 30-Yr National Precipitation: Annual Map that is included in **Appendix B**. More detailed climate data were obtained from the National Western Regional Climate Center. The weather station located in the vicinity of Big Spring is Zion National Park (429717). The average annual precipitation at this station (**Appendix B**) is 15.06 inches (383 mm/year). It is assumed that 10% of the average annual precipitation, about 1.5 inches (38.3 mm), contribute to the recharge to Big Spring (Jenson, et al, 1997). The discharge of the spring is 130 gpm (8.20 liters/sec). Using the method of Todd (1980), a plot of catchment area as a function of estimated recharge and discharge rates for Big Spring (**Figure 3**) indicates that a catchment area of approximately 600 hectares (2.3 mi^2) would be necessary to provide enough water for the spring to yield 8.20 liters/sec or 130 gpm. The preliminary protection zone is only 1.2 mi^2, so it needs to be enlarged.

2.5 Map Showing Boundary of the DWSP Area

After a "trial and error" procedure, the delineation was finalized. The 2.4 mi^2 catchment area or DWSP Zones 2, 3 and 4 (boundary shared) for Big Spring was plotted as shown in **Figure 1**. The dimensions of this area are summarized in **Table 1**.

Table 1. Dimensions of the DWSP Area

Description	Minimum Down-Gradient	Maximum Up-Gradient	Maximum Width
Direction	South	Northwest	Northeast-Southwest
Distance (feet)	430	10,700	7,700

3.0 INVENTORY OF POTENTIAL CONTAMINATION SOURCES

A checklist of PCSs, as listed in Chapter 5 of Source Protection User's Guide prepared by the Utah DDW (Utah DDW, 20012), was completed with help from the Town of Springdale and through review of USGS topographic maps, historic aerial photographs and site inspections, and is attached in **Appendix C**.

3.1 List of Potential Contamination Sources

The delineated Big Spring DWSP area covers the majority of Springdale and a portion of Zion National Park. Identified PCSs are shown in **Figure 1** and summarized in **Table 2**.

Table 2. Summary of PCSs

PCS	Total Number of PCSs	PCSs in Zone 1	PCSs in Zones 2, 3, and 4
Active / abandoned wells	1	0	1
Cemetery	1	0	1
City facilities, hotels, restaurants, theaters, tourist shops, and other businesses	Figure 1	0	Figure 1
Clinic	1	0	1
Fire station	1	0	1
Old gas station (now tourist shop)	1	0	1
Park	1	0	1
Residential chemical uses	Figure 1	0	Figure 1
Streets and residential roads	Figure 1	0	Figure 1
State Route 9	1	0	1
Sewer lines	Figure 1	0	Figure 1
Submersible pump	1	0	1

3.2 Hazard Identification

3.2.1 Active/Abandoned Well

Hummingbird Well is located in the DWSP area (**Figure 1**). Wells, if improperly maintained or used, may allow contaminants to be introduced into the groundwater system by improperly disposing of chemical substances.

3.2.2 Cemetery

One cemetery is located in the middle of Springdale. The potential hazards associated with the cemetery include improper application of chemical fertilizer and pesticides.

3.2.3 City Facilities, Hotels, Restaurants, Theaters, Tourist Shops and Other Businesses

The city facilities (one Town Hall, one library and community center), many hotels (two with restaurants), many restaurants, one restaurant with theater, many tourist shops and the Dixie Amphitheater are located in DWSP Zones 2, 3, and 4 (**Figure 1**). The potential hazards from this type of PCS are similar to those associated with residential chemical uses (See Section **3.2.8**).

3.2.4 Clinic

One medical clinic is located near the city facilities at the north portion of Springdale (**Figure 1**). Hazardous medical solvents, chemical solutions and other wastes may enter the groundwater system by infiltrating the soil cover of drainage ditch.

3.2.5 Fire Station

One fire station is located at the west side of the State Route 9, approximately 1,000 feet northwest of Big Spring (**Figure 1**). The potential hazards from the fire station are gasoline, soap solution and sprays containing oily dirt (used for the fire engine cleanup).

3.2.6 Gas Stations

Four gas stations are located along the State Route 9 (SR-9, **Figure 1**, or Zion Park Blvd). The potential hazard from the PCS is gasoline and diesel.

3.2.7 Park

One city park is located at the mouth of Blacks Canyon (**Figure 1**). The potential hazards associated with the park include improper application of chemical fertilizer and pesticides.

3.2.8 Residential Chemical Uses

There are many residential homes, either primary or secondary homes, located at both sides of highway State Route 9 (**Figure 1**). Many hazardous products and chemicals such as cleaners, oils and pesticides may be used in the residential areas. When discarded, these products are called household hazardous waste (HHW). HHW is discarded materials and products that are ignitable, corrosive, reactive, toxic or otherwise listed as hazardous by the EPA. Fertilizers may also be used on lawns and gardens. The main constituent in fertilizer is usually nitrogen. If the nitrate level in drinking water is too high, infants, up to the age of six months, can develop a fatal disease called blue baby syndrome (methemoglobenemia). Drinking water that contains 10 milligrams of nitrate-nitrogen per one liter of water exceeds the drinking water standard and should not be used, especially for infant formula.

3.2.9 Roads

SR-9 is a major road that runs through the Town to Zion National Park. Streets and residential roads used for normal traffic are located at southeast portion of the DWSP area (**Figure 1**). Potential hazards associated with roads are related to accidental spills and releases of petroleum and chemical products from vehicles traveling on the roads. Potential environmental risks associated with these roads to the spring are generally very low.

3.2.10 Sewer Lines

The residential homes and business buildings within the DWSP zones are all connect to the Springdale sewer system. The sewer lines carry waste from residential homes, commercial businesses, churches, schools, and office buildings in this area. The potential hazards include various kinds of household waste.

3.2.11 Submersible Pump Used to Pump Hummingbird Well

Hummingbird Well is equipped with a submersible pump. Submersible pumps may contain such lubricants as petroleum products, PCB or mercury.

3.3 Prioritized Inventory

The PCSs were prioritized in **Table 3** according to the nature of the potential source contaminant, volume of the potential contaminant and distance of the PCS from Big Spring.

Table 3. Prioritized Inventory of PCSs

Priority	PCSs	Contact	Address	Phone No.
1	Residential Chemical Uses	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
2	Springdale Chevron	Zion Enroute, LLC	1593 Zion Park Blvd Springdale, Utah 84767	(435) 772-3677
2	Springdale Texaco	Joanna Adamson	1490 Ambassador Way Salt Lake City, UT 84108	(801) 582-5112
2	Canyon Tire & Food Mart	Jerry Hatch	962 Zion Park Blvd Springdale, Utah 84767	(435) 772-3693
2	Zion Canyon Exxon	Zion Park Resort, Inc.	2159 S 700 E, Ste. 200 Salt Lake City, UT 84106	(801) 467-3600
2	Sewer Lines	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
3	Best Western Zion Park Inn/Switchback Restaurant (Hotel/ Restaurant)	Dean Cook (Inn)	1215 Zion Park Blvd Springdale, Utah 84767	(435) 772-3200
		Mike Marriott (Restaurant)	1249 Zion Park Blvd Springdale, Utah 84767	(435) 772-3700
3	Bit & Spur Restaurant	Trish Jennings	1212 Zion Park Blvd Springdale, Utah 84767	(435) 772-3498
3	Flanigans Inn and Spa/Spotted Dog Café (Hotel and Restaurant)	Larry McKown	450 Zion Park Blvd Springdale, Utah 84767	(435) 772-3244
3	Whiptail Grill	Travis Barney	445 Zion Park Blvd Springdale, Utah 84767	(435) 772-0283
3	Medical Clinic	Mike and Helen McMahan	120 Lion Boulevard Springdale, Utah 84767	(435) 772-3226
3	Rockville/Springdale Fire Protection District (Fire Station)	Ryan Ballard, Fire Chief	PO Box 159 Springdale, UT 84767	(435) 772-3220
3	Park	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
3	Cemetery	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434

3	City Facilities	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
3	Cliffrose Lodge and Gardens (Hotel 1)	Colin Dockstader	281 Zion Park Blvd Springdale, Utah 84767	(435) 772-3234
3	Quality Inn RV and Campground (Hotel 2)	Stewart Ferber	479 Zion Park Blvd Springdale, Utah 84767	(435) 772-3237
3	Dixie Amphitheater	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
3	Zion Adventure Co. (Tourist Shop 1)	Jonathan Zambella	36 Lion Boulevard Springdale, Utah 84767	(435) 772-1001
3	Old Tsunami Building (Tourist Shop 2)	Rene Goodnow	180 Zion Park Blvd Springdale, Utah 84767	(801) 223-3158
3	Zion Canyon Giant Screen Theater (Restaurant and Theater)	Bob Orton	145 Zion Park Blvd Springdale, Utah 84767	(435) 772-2400
3	City Facilities, Hotels, Restaurants, Theaters, Tourist Shops and Other Businesses	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
4	State Route 9	Carl Johnson, UDOT Region 4	1345 South 350 West Richfield, Utah 84701	(435) 896-1303
4	Dirt Roads	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
5	Hummingbird Well	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434
5	Submersible Pump	Robby Totten	118 Lion Boulevard Springdale, Utah 84767	(435) 772-3434

4.0 ASSESSMENT OF POTENTIAL CONTAMINATION SOURCE HAZARDS

There are four types of hazard controls. They are regulatory, best management and pollution prevention practices (BMPs), physical and negligible quantity controls. Hazards of PCSs identified within the DWSP zones of Big Spring, as described in Sections **3.2** and **3.3**, were assessed as following categories.

All the hazard controls related in this section will be reassessed on a three-year basis.

4.1 Active (Hummingbird) Well

Regulatory controls are applicable to this PCS. The Utah Division of Water Rights (Utah DWR) is in charge of enforcement of the following rules:

1. R655-4, UAC (Utah Administrative Code) – Water Well Rule. All wells within the DWSP zones are subject to State laws regulating drilling, repairing and pollution prevention.
2. R655-4-12, UAC – As part of the Water Well Rules, abandoned wells are to be capped and properly decommissioned.

These rules are promulgated pursuant to Utah Code Section 73-3-25. The purpose of these rules is to assist in the orderly development of underground water, insure that minimum construction standards are achieved in the drilling and repairing of water wells, prevent pollution of aquifers within the state, prevent wasting of water from flowing wells, obtain accurate records of well drilling operations, and insure compliance with the state engineer's authority for appropriating water. The wells can be considered as adequately controlled by Utah DWR regulations.

4.2 Cemetery

Best management and pollution prevention practices are applicable to the cemetery. This PCS cannot be considered as adequately controlled.

4.3 City Facilities, Hotels, Restaurants, Theaters, Tourist Shops and Other Businesses

Best management and pollution prevention practices are applicable to these PCSs. This category of PCSs cannot be considered as adequately controlled.

4.4 Clinic

Negligible quality controls are applicable to this PCS because: 1. the clinic office is very small; 2. this PCS is located 4,500 feet northeast of Big Spring; 3. it is connected to the Springdale sewer

system; and 4. no hazardous medical solvent and chemical solution have been found using in the clinic. Therefore, this medical clinic can be considered as adequately controlled.

4.5 Fire Station

Physical controls are applicable to this PCS. All the works within the fire station are conducted on the concrete floors. The used water during the fire engine cleanup discharges to the Springdale sewer system, which is unlikely to create any hazards that may contaminate the groundwater system. Therefore, it can be considered as adequately controlled.

4.6 Gas Stations

Nineteen (19) fuel tanks have been installed in four Springdale gas stations (Chevron, Texaco, Canyon Tire & Food Mart, and Zion Canyon Exxon) and are currently included in the Utah State Underground Storage Tank (UST) program. Nine of the tanks have been removed/closed. A copy of the related UST List sheet published by Utah Department of Environmental Quality Division of Environmental Response and Remediation is included in **Appendix D**.

Regulatory controls are applicable for the Gas Stations. The Utah Division of Environmental Response and Remediation (DERR) is in charge of enforcement of the following rules:

1. R311-200 through R311-211, UAC – Underground Storage Tank Rules. The Underground Storage Tank Rules protect groundwater resources by preventing and detecting leaks and spills from underground storage tanks. Sites that are contaminated by leaking underground storage tanks must be cleaned up. Also, a fund has been established in the State to make sure that the owners and operators of underground storage tanks can pay for correcting the problems they create if their underground storage tanks leak.
2. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA commonly called Superfund) - Section 19-6-301 through 19-6-325 of Utah Code Annotated - The Hazardous Substances Mitigation Act authorizes the executive director of the Department of Environmental Quality to regulate hazardous substances releases by making rules consistent with the substantive requirements of CERCLA to establish the requirements for remedial investigation studies and remedial action plans.
3. 40 CFR Part 300 of the Code of Federal Regulations - The National Oil and Hazardous Substances for Pollution Contingency Plan establishes the organizational structure and

specifies the procedures for remediating pollution when oil or hazardous substances are discharged or released into the environment.

4. SARA Title III - 40 CFR Part 355 of the Code of Federal regulations - SARA Title III provides early comprehensive emergency planning for responding to potential releases of toxic chemicals.

Facilities must notify the local emergency planning committee when an "extreme hazardous substance" is present in an amount greater than the appropriate "threshold planning quantity". These facilities are required to prepare or have available a material safety data sheet (MSDS) for each hazardous chemical and submit it to appropriate local emergency planning committee.

This regulation requires public access to information submitted to local emergency planning committees. Each emergency response plan, MSDS, inventory form, toxic chemical release form and follow-up emergency release notification is to be made available to the general public during normal working hours at the location designated for the local emergency planning committee.

This category of PCSs can be considered as adequately controlled through the regulations.

4.7 Park

Best management and pollution prevention practices are applicable to the park. This PAS cannot be considered as adequately controlled.

4.8 Residential Chemical Uses

Best management and pollution prevention practices are applicable to these PCSs. This category of PCSs cannot be considered as adequately controlled.

4.9 Roads

Regulatory controls are applicable to this category of PCSs. The following regulations are promulgated:

1. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA commonly called Superfund) – Sections 19-6-301 through 19-6-325 of the Utah Code Annotated – The Hazardous Substances Mitigation Act authorizes the executive director

of the Department of Environmental Quality (DEQ) to regulate hazardous substances releases by making rules consistent with the substantive requirements of CERCLA, to establish the requirements for remedial investigation studies and remedial action plans.

2. 40 CFR Part 300 of the Code Federal Regulations – The National Oil and Hazardous Substances Pollution Contingency Plan establishes the organizational structure and specifies the procedures for remediating pollution when oil or hazardous substances are discharged or released into the environment.
3. 40 CFR Part 355 of the Code of Federal Regulations – SARA Title III provides early comprehensive emergency planning for responding to potential releases of toxic chemicals.
4. The U.S. Department of Transportation and the Environmental Protection Agency have established controls and restrictions for transportation of hazardous chemicals.

However, the hazards from accidental spills along the roads cannot be considered as adequately controlled and have been addressed in the Contingency Plan (Section **10.0**).

4.10 Sewer Lines

Physical controls and regulatory controls are applicable to the sewer lines. According to Utah DWSP Rule R309-600, sewer lines that comply with the following criteria may be assessed as adequately controlled contamination sources.

(a) Zone one – If the conditions specified in R309-600-13(3) (i and ii) below are met, all sewer lines within zone one shall be constructed in accordance with R309-204-6(4) and must be at least 10 feet from the wellhead.

(i) There is at least 5 feet of suitable soil between the bottom of the sewer lines and the top of the maximum seasonal ground-water table or perched water table. (Suitable soils contain adequate sand/silt/clay to act as an effective effluent filter within its depth for the removal of pathogenic organisms and fill the voids between particle such as gravel, cobbles, and angular rock fragments); and

(ii) There is at least 5 feet of suitable soil between the bottom of the sewer lines and the top of any bedrock formations. (For the purposes of this rule, unsuitable soils or bedrock formations shall include soil or bedrock formations that have such low permeability that they prevent downward passage of effluent, or soil

or bedrock formations with open joints or solution channels that permit such rapid flow that effluent is not removed. This includes coarse particles such as gravel, cobbles, or angular rock fragments with insufficient soil to fill the voids between the particles. Solid or fractured bedrock such as shale, sandstone, limestone, basalt, or granite are unacceptable.)

(b) Zone One and Two – If the conditions identified in R309-600-13(3)(a) (i and ii) above cannot be met, any sewer lines within zones one and two or a management area shall be constructed in accordance with R309-204-6(4) and must be at least 300 feet from the wellhead or margin of the collection area.

The following information is provided to demonstrate that the two conditions (i and ii) above are met:

As described in Section **2.1**, Big Spring flows from the young alluvial fan and colluvial deposits (Qafc) consisting mostly of clay, silt, sand and gravel. Qafc is up to 40 feet in thickness. The spring collection area is located more than 10 feet from any sewer line and at least 40 feet below any sewer lines. The "at least 5 feet of suitable soil between the bottom of the sewer lines and the top of the maximum seasonal ground-water table" and "at least 5 feet of suitable soil between the bottom of the sewer lines and the top of any bedrock formations" criteria are complied with. Also, it is understood that all sewer lines in Springdale were constructed in accordance with Utah Rule R309-204-6(4).

Therefore, sewer lines within DWSP zones can be assessed as adequately controlled PCSs.

4.11 Submersible Pump

Negligible quantity control is applicable to the submersible pump installed in Hummingbird Well. Should petroleum products, PCB, or mercury be contained in the pumps and released to the groundwater, the quantity is negligible compared to the volume of the pumped water. Therefore, the submersible pump is considered as adequately controlled.

5.0 MANAGEMENT PROGRAM FOR EXISTING POTENTIAL CONTAMINATION SOURCES

The following management programs are prepared for the PCSs that are considered as not adequately controlled.

5.1 Cemetery

The primary management strategy for residential chemical use is ongoing public education. See Section **5.4**.

5.2 City Facilities, Hotels, Restaurants, Theaters, Tourist Shops and Other Businesses

The primary management strategy for residential chemical use is ongoing public education. See Section **5.4**.

5.3 Park

The primary management strategy for residential chemical use is ongoing public education. See Section **5.4**.

5.4 Residential Chemical Uses

The primary management strategy for residential chemical use is ongoing public education. A packet of information including the Household Hazardous Waste Fact Sheet, the Fertilizer Fact Sheet and the Pesticides Fact Sheet (**Appendix E**) prepared by the Utah DDW will be sent to homeowners within the protection zones of Big Spring. The fact sheets include the BMPs for handling HHW and proper use of fertilizers and pesticides.

5.5 Roads

The hazards from accidental spills along the roads have been addressed in the Contingency Plan (Section **10.0**).

6.0 MANAGEMENT PROGRAM FOR FUTURE POTENTIAL CONTAMINATION SOURCES

The land around Big Spring (Zone 1) is controlled by Town of Springdale, and no future activities that may cause subsurface contamination will be allowed within this area. Portions of the DWSP area are located on private lands under the jurisdiction of the Town of Springdale. Approximately 50% of the DWSP area is in Zion National Park managed by the U.S. National Park Service (USNPS). Therefore, the management program for future PCSs within the entire DWSP area will involve working with private homeowners, communities and the government agencies.

To control and prohibit future location of PCSs within the DWSP area in Springdale authorities, Town of Springdale will make the residents be aware of, through the public notification (Section **12.0**) and Fact Sheets (Section **5.0** and **Appendix E**), that they are in a management area of a drinking water source.

To control and prohibit future location of PCSs within the DWSP area in Zion National Park, Town of Springdale will send a copy of the approved DWSP Plan to the USNPS local office. The USNPS can then evaluate more thoroughly proposed land uses that may become pollution sources to Big Spring. It is believed that the USNPS officers understand the importance of protecting groundwater resources and follow the U.S. Public Law 100-4: the Clean Water Act and Utah 1993 Administrative Code R317-6: Administrative Rules for Ground Water Quality Protection, when they review new land development applications. If the Clean Water Act and Rules for Ground Water Quality Protection are followed, any future pollution sources can be controlled or prohibited.

A public notification regarding the DWSP for the Town of Springdale Water System (see Section **12.0**) will be included in the annual Consumer Confidence Report (CCR) and distributed to the public through a newsletter and published online: http://www.springdaletown.com.

Furthermore, when a new development is proposed within the DWSP area of Big Spring, the following will happen:

1. The Town of Springdale will determine the type of the PCS that will accompany that development.

2. If the development is in Zion National Park, the USNPS local office will be made aware that the development is within the management area of a Big Spring.
3. Each PCS will be assessed as controlled or not controlled. Individual homeowners and applicable PCSs will be added to the PCS inventory.

7.0 IMPLEMENTATION SCHEDULE

Once the Utah DDW approves this DWSP Plan, Town of Springdale will: 1. contact and send a copy of the Plan to the USNPS local office; and 2. contact and send the Fact Sheets to the homeowners within the DWSP zones. This process may take six months to one year. 3. The public notification will be distributed to the public through a news letter and published online as soon as possible.

8.0 RESOURCE EVALUATION

Town of Springdale will use the existing staff to implement the DWSP Plan. Therefore, no extra expense is anticipated. The other cost to implement this DWSP Plan is minimal and will be funded from monthly service charges or connection fees.

9.0 RECORDKEEPING

All the records regarding the DWSP Plan will be kept in the Town of Springdale office that is located at 118 Lion Boulevard, Springdale, Utah 84767. Town of Springdale will document changes as the Plan is continuously updated to show current conditions in the protection area. As the Plan is executed, Town of Springdale will document the implementation of each management strategy as it is implemented and update the DWSP Plan every six years.

10.0 CONTINGENCY PLAN

A Contingency Plan for the entire water system was prepared and submitted to the Utah DDW concurrently with the submission of the *Updated Drinking Water Source Protection Plan for North Fork of Virgin River* (Sunrise, 2010) and approved by the Utah DDW.

11.0 PESTICIDE AND VOC MONITORING WAIVERS

According to the Utah DDW (Utah DDW, 2008), there are three types of monitoring reduction waivers for either the pesticides or volatile organic chemical (VOC) parameter group available to public water suppliers: reliably and consistently waiver, use waiver and susceptibility waiver.

A use waiver can be issued for either the pesticides or VOC parameter group if a system can verify that none of the chemicals or pesticides in these parameter groups have been used in a given protection area in the past five years. If a source does not qualify for a use waiver, the Utah DDW will evaluate the historical laboratory results of water samples collected from the source and establish an appropriate water quality-monitoring program for VOCs and pesticides. If the laboratory results consistently demonstrate good water quality produced by the source, the Utah DDW may consider issuing a reliably and consistently waiver. If a system does not qualify for a use waiver and a reliably and consistently waiver has not been issued, a susceptibility waiver may be issued if the drinking water source meets the requirements listed in the Chapter 11 of the Source Protection User's Guide (Utah DDW, 2008).

Because residential homes are located within the DWSP zones of Big Spring, VOCs and pesticides may have been used in this area. Therefore, the spring does not qualify for a use waiver. Also, since the historical record shows that the spring has not produced good quality water, the spring does neither qualify for a susceptibility waiver nor a reliably and consistently waiver.

12.0 PUBLIC NOTIFICATION

A public notification for the entire water system was prepared and submitted to the Utah DDW concurrently with the submission of the *Updated Drinking Water Source Protection Plan for North Fork of Virgin River* (Sunrise, 2010) and approved by the Utah DDW.

13.0 REFERENCES

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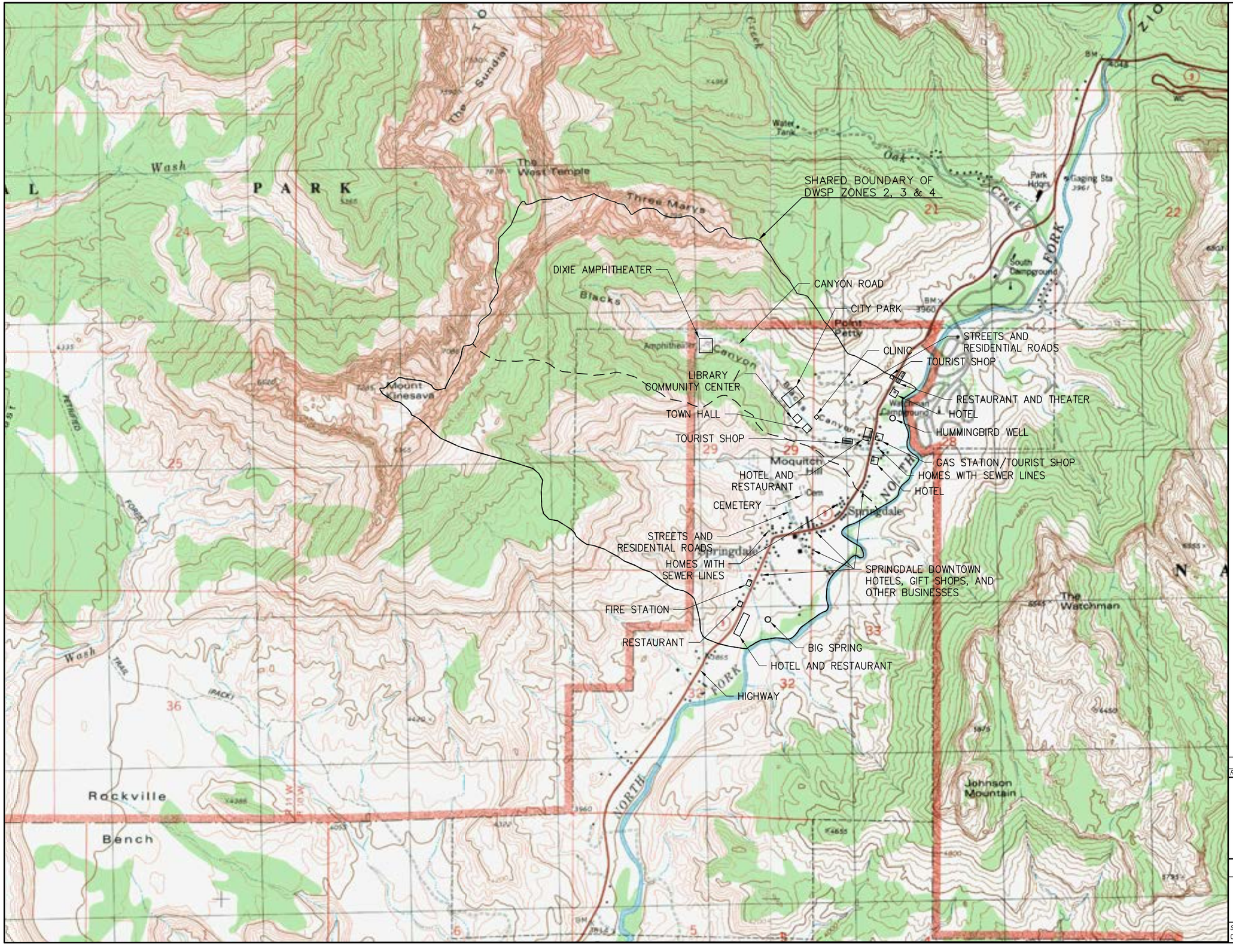
FIGURES



LEGEND

- PRELIMINARY DWSP ZONE BOUNDARY
- FINAL DWSP ZONE BOUNDARY
- WATER SOURCE
- POTENTIAL CONTAMINATION SOURCE (PCS)

REV NO.	COMMENT	DATE

SUNRISE ENGINEERING
12227 SOUTH BUSINESS PARK DRIVE, SUITE 220
DRAPER, UTAH 84020
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

TOWN OF SPRINGDALE

DWSP PLAN
BIG SPRING
LOCATION MAP WITH DWSP ZONES AND PCSS

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
00000	LQ	LQ	DS	of 000	FIGURE 1

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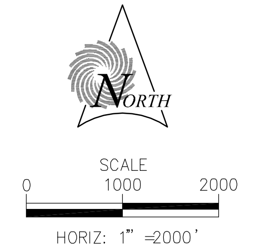


REV NO.	COMMENT	DATE

SUNRISE ENGINEERING

12227 SOUTH BUSINESS PARK DRIVE, SUITE 220
DRAPER, UTAH 84020
TEL 801.523.0100 · FAX 801.523.0990
www.sunrise-eng.com

TOWN OF SPRINGDALE

DWSP PLAN
BIG SPRING
GEOLOGIC MAP

SEI NO.	DESIGNED	DRAWN	CHECKED	SHEET NO.	
00000	LQ	LQ	DS	of 000	FIGURE 2

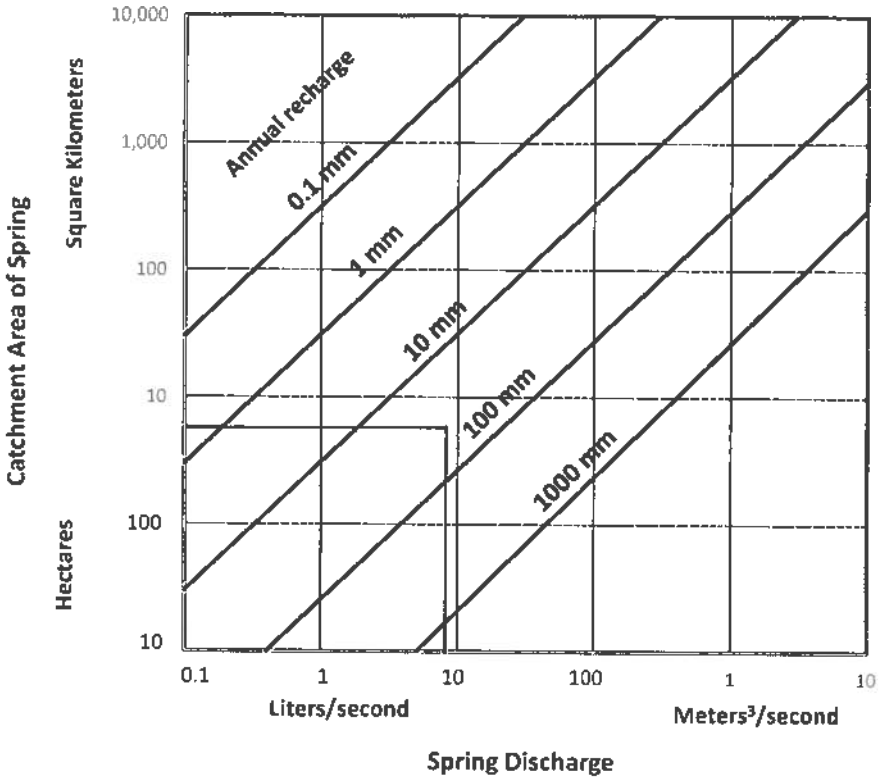


Figure 3 Estimate of Catchment Area for Big Spring

APPENDICES

Appendix A
Description of Geologic Units

Springdale West Quadrangle
Description of Map Units

QUATERNARY

Fill Deposits

Qf **Fill (Historical)** -- Fill in small dams and dikes; most road fill not shown; 0 to 30 feet (0-10 m) thick.

Alluvial Deposits

Low-level alluvial deposits of the Virgin River (upper Holocene) -- Moderately to well-sorted gravel, sand, silt, and clay in lenses and thin layers deposited by fluvial processes in larger, well-graded river valleys; generally reddish brown to pale brown; clasts are subrounded to well-rounded, mixed exotic (derived from sources many miles upstream) and locally derived (from within quadrangle area), and are mostly quartzite, sandstone, basalt, limestone, and chert; most clasts are pebble to small cobble sized; a few locally derived clasts are more than 3 feet (1 m) in diameter; differs from alluvial deposits in small side canyons in that clasts are significantly better sorted and a large percentage are exotic; forms river channels and terraces up to about 25 feet (8 m) above the modern river level; 0 to 30 feet (0-9 m) thick.

Working with low-level terrace deposits in the Springdale area, Hereford and others (1995) recognized four episodes of terrace construction that are distinguished by elevation above the active channel, development of soils and vegetation, dating of trees, and archeological artifacts. Terrace deposits shown on this map approximately correlate with Hereford and others' divisions, but are more generalized -- age and correlation of most terrace segments were determined from aerial photographs and only locally verified, and mapped terrace segments locally include segments from other fluvial episodes too small to map separately.

Qala **Level 1 (active channel) alluvial deposits (Historical)** -- Deposits in active river channel up to average annual high-water line about 4 feet (1.2 m) above modern river channel; deposited or reworked by the Virgin River mostly after A.D. 1980. Note: the river position shown on the gray topographic base map was based on 1973 aerial photographs; the position of the river channel shown on the geologic map (map unit Qala) was based on 1994 aerial photographs; during that time interval, the river channel has migrated significantly (unlike upstream in the Springdale East quadrangle [Doelling and others, 2002]).

Qatm **Level 2 ("modern") alluvial terrace deposits (Historical)** -- Deposits between about 4 feet (1.2 m) and 8 feet (2.4 m) above the active channel; generally vegetated with weeds and shrubs such as tamarisk; commonly covered every few years to decades by floods during unusually high spring runoff and following intense thunderstorms; Hereford and others (1995) referred to these sediments as the "modern" level and noted that they were deposited mostly between A.D. 1940 and 1980.

Qath **Level 3 ("historic") alluvial terrace deposits (Historical)** -- Deposits forming terraces 8 to 15 feet (2.4-4.6 m) above active channel; commonly mantled by fine-grained overbank silt, sand, and clay deposits; vegetated by cottonwood trees and mature shrubs; Hereford and others (1995) called these deposits the "historic" level; historic photographs show that the sediments of this level were deposited mostly between A.D. 1883 and 1926 (1926 to 1940 was a period of arroyo cutting) (Hereford and others, 1995).

Qats **Level 4 ("settlement and late prehistoric") alluvial terrace deposits (upper Holocene)** -- Deposits forming terraces 15 to 25 feet (4.6-8 m) above the active channel; generally forms a broad terrace along the Virgin River and in side canyons; where not cultivated, surface is covered mostly by sagebrush and is above the zone of abundant cottonwood trees in the river flood plain; in many areas terraces of this level are mostly covered by Qafc deposits; Hereford and others (1995) named this surface the "settlement surface" because it was the main surface for houses and cultivation by earlier pioneer settlers in the middle to late 1800s; they noted that the pioneer fields and settlements on these surfaces were occasionally flooded during unusually high spring runoff; the settlement surface contains no Ancestral Puebloan (Anasazi) Indian artifacts, indicating that the sediment was deposited after about A.D. 1200; Hereford and others (1995) noted that river deposition on this surface ended by about A.D. 1880 as renewed river and arroyo cutting lowered the river channel; as generalized for this map, this unit locally includes surfaces between about 25 and 33 feet (8-10 m), but locally as low as 20 feet (6 m) above the active channel, that are part of what Hereford and others referred to as "prehistoric" and that may date to A.D. 800-1200.

Qat3, Qat4, Qat5, Qat6

High-level alluvial terrace deposits (middle Holocene to middle Pleistocene) -- Moderately to well sorted, pale-gray to pale-brownish-gray cobble gravel with sand, silt, and clay in lenses and matrix; clasts are mostly exotic and consist of quartzite, basalt, sandstone, limestone, and chert; form terrace remnants that cap hills and bluffs near the Virgin River; show moderate soil development; locally partially mantled by windblown sand, colluvium, and talus; as mapped, locally includes a thin apron of colluvium that sloughed downslope from the terraces; terraces of several different levels are grouped into four map units based on height above the nearby active river channel: Qat3 between 30 and 90 feet (9-27m) above the channel, Qat4 from 90 to 140 feet (27-43 m), Qat5 from 140 to 190 (43-58 m),and Qat6 from 190 to 250 feet (58-76 m); 0 to 80 feet (0-24 m) thick.

The age of river-terrace and other deposits that are graded to the Virgin River can be estimated using calculated long-term incision rates, combined with amount of soil development and lithification. Present height of remnants of well-dated basaltic lava that flowed into the ancestral river channel indicates about 1,300 feet (400 m) of incision in the last one million years, or 1.3 feet (0.4 m) per thousand years. Using this rate, Qat3 deposits are calculated between about 20,000 and 70,000 years old, Qat4 deposits between 70,000 and 110,000 years old, Qat5 deposits between 110,000 and 150,000 years old, and Qat6 deposits between 150,000 and 190,000 years old. However, these calculations do not take into account fluctuations in incision rates during this time, which could shift these age estimates significantly; in addition, low-level deposits show incision of 25 feet (8 m) or more in just the last few hundred years, though this type of variation probably reflects short-term cyclicity more than long-term incision rates; thus, Qat3 deposits, which would be affected most by short-term cyclicity, may be as young as middle Holocene.

Qa1 **Level 1 alluvial stream deposits (upper Holocene)** -- Stratified, fine- to coarse-grained, pale-orange to yellowish-brown sand with varying amounts of poorly to moderately sorted clay, silt, and subangular to subrounded pebble to small boulder gravel with sandstone, limestone, and basalt clasts; mapped along larger tributaries of the Virgin River; up to about 10 feet (3 m) above the active channel; less well sorted than Qala and Qatm deposits and does not include exotic clasts; generally less than 10 feet (3 m) thick.

Qa2 **Level 2 alluvial stream deposits (Holocene)** -- Same as Qa1deposits except forms incised terraces 10 to 30 feet (3-9 m) above the active channel and locally covered by windblown silt and fine-grained sand; as much as 20 feet (6 m) thick.

Qay **Younger alluvial deposits (upper Holocene)** -- Similar to and includes deposits equivalent to both Qa1 and Qa2 deposits, but correlation uncertain; includes deposits up to about 30 feet (9 m) above the stream channel.

Qao **Older alluvial deposits (Holocene to Upper Pleistocene)** -- Deeply incised and eroded remnants of older alluvial fan and stream channel deposits 20 to about 80 feet (6-24 m) above nearby washes; mapped in small side channels; 0 to 10 feet (0-3 m) thick.

Qam **Alluvial mud deposits (Holocene to upper Pleistocene)** -- Pale-yellowish-gray to reddish-gray clay and silt, with generally minor sand; locally includes lenses of pebble to cobble gravel; mantles broad gentle slopes on nonresistant units; derived primarily from weathering of Petrified Forest Member of Chinle Formation; 0 to 20 feet (0-6 m) thick.

Qagp **Alluvial gypsiferous deposits (Holocene to upper Pleistocene)** -- Pale- to medium-gray to reddish-gray gypsum, silt, clay, and, and pebble to cobble gravel; forms a moderately resistant punky gypsiferous soil cap over outcrops of Shnabkaib Member of Moenkopi Formation; caps surfaces 20 to 60 feet (6-18 m) above the local washes; 0 to 10 feet (0-3 m) thick.

Qaf2 **Level 2 alluvial-fan deposits (Holocene to upper Pleistocene)** -- Dissected remnants of pale-reddish-brown to reddish-gray, moderately to poorly sorted, boulder- to clay-sized sediment deposited on low to moderate slopes by debris flows and ephemeral streams; locally includes colluvial and talus deposits, and locally mantled by eolian sand; form mounds and erosional remnants up to about 50 feet (15 m) above washes; low-level (younger) alluvial fans are included in Qac and Qae deposits; 0 to 50 or more feet (0-15+ m) thick.

Qap2 **Alluvial pediment-mantle deposits (upper Pleistocene)** -- Dissected remnants of pale-reddish-brown to reddish-gray, moderately to poorly sorted, boulder- to clay-sized sediment that forms a planar cap over erosional remnants of Coal Pits Wash lacustrine and basin-fill deposits; these deposits probably developed after the basin filled with lacustrine and marginal lacustrine sediments, allowing ephemeral streams to reestablish across the surface; they were incised as the streams cut through the natural dam; 0 to 30 feet (0-9 m) thick.

Mixed Alluvial, Colluvial, and Eolian Deposits

Qafc **Young alluvial-fan and colluvial deposits (Holocene to upper Pleistocene)** -- Reddish-brown, poorly stratified, poorly sorted, coarse- to fine-grained sand and pebble to cobble gravel with silt and scattered boulders; clasts are angular to subangular and locally derived; deposited by debris flows and sheet wash at decrease in slopes and at mouths of small ephemeral channels that flow into Virgin River valley and major tributaries; mostly graded to and partially mantle Qath and Qats alluvial deposits, and commonly includes small secondary fans (not mapped separately) inset into main deposit that are graded to the active or modern channel; commonly interfingers with and covers alluvial stream deposits; forms most surfaces cultivated and built on by communities of Rockville and Springdale; in many areas debris flows have surged across these surfaces in historical times, sometimes causing considerable damage to buildings and roads; 0 to 30 feet (0-9 m) thick.

Qafco **Middle-level alluvial-fan and colluvial deposits (lower Holocene to upper Pleistocene)** -- Similar to Qafc deposits described above, except deposits are graded to older alluvial surfaces (Qat3 and Qat4), are incised by modern stream channels, and are no longer accumulating sediment; deposited by debris flows issuing from small side canyons; thickness probably less than 20 feet (6 m).

Qac **Mixed alluvium and colluvium (Holocene to upper Pleistocene)** -- Poorly to moderately sorted, poorly stratified sand, silt, and clay with scattered subangular to angular boulders, cobbles, and pebbles; brown to gray; deposited in minor drainages and topographic depressions primarily by ephemeral streams, slope wash, and creep processes; includes mix of alluvial materials carried down drainages and colluvial

materials derived from adjacent slopes; may be dissected up to about 20 feet (6 m) by modern ephemeral stream channels; thickness less than 30 feet (9 m).

Qaco **Older mixed alluvium and colluvium (lower Holocene to upper Pleistocene)** -- Similar to mixed alluvium and colluvium (Qac) described above, but deeply dissected by ephemeral stream channels.

Qae **Mixed alluvial and eolian deposits (Holocene to upper Pleistocene)** -- Locally derived, moderately to moderately well-sorted, mostly silt, clay, and fine sand with scattered lenses of subangular to angular gravel; deposited in shallow topographic depressions and on broad gentle slopes by slope wash and wind; includes small fans and colluvium from adjacent slopes; 0 to 20 feet (0-6 m) thick.

Qea **Mixed eolian and alluvial deposits (Holocene to upper Pleistocene)** -- Well-sorted, pale-reddish-brown to pale-yellowish-gray, windblown sand locally redeposited by alluvial processes; locally includes minor alluvial gravel; covers broad, gently sloping surfaces; deposits are relatively old and stable and are isolated from most erosion, allowing eolian sediments to gradually accumulate; scattered incisions through the deposits reveal stage II to IV pedogenic carbonate soil; generally less than 20 feet (6 m) thick.

Eolian and Residual Deposits

Qes **Eolian sand (Holocene to upper Pleistocene)** -- Well-sorted, pale-yellowish-gray to pale-reddish-gray, mostly fine-grained, windblown sand deposited in sheets, mounds, and dunes; derived primarily from the Navajo Sandstone; locally includes minor residual weathered rock from underlying unit; 0 to 20 feet (0-6 m) thick.

Qer **Mixed eolian and residual deposits (Holocene to upper Pleistocene)** -- Pale reddish-orange, windblown, well-sorted, mostly fine-grained sand with scattered to common angular to subrounded, residual sandstone blocks derived from the Navajo Sandstone; locally includes minor alluvial sand; occurs as sheets, mounds, and poorly formed dunes in shallow topographic depressions and on gently sloping surfaces mostly on Navajo Sandstone; 0 to 20 feet (0-6 m) thick.

Qre **Mixed fine-grained residual and eolian deposits (Holocene to upper Pleistocene)** -- Reddish-brown to pale-yellowish-gray, residual silt and fine sand with scattered subangular gravel deposited on flat surfaces eroded on lower part of Co-op Creek Limestone Member of the Carmel Formation; partly reworked by eolian processes; deposited by wind and as residual accumulation on weathered slopes; one small exposure on Altar of Sacrifice in northeast part of quadrangle; 0 to 10 feet (0-3 m) thick.

Colluvial, Mass-Movement, and Related Deposits

Qc **Colluvium (Holocene to upper Pleistocene)** -- Poorly sorted, nonstratified sand and silt with subangular to angular mostly sandstone blocks; color and clast composition vary with parent material; deposited primarily by creep and slope wash on moderate slopes; locally includes talus and alluvial deposits; generally less than 20 feet (6 m) thick.

Qmt **Talus (Holocene to upper Pleistocene)** -- Primarily very poorly sorted, coarse, angular blocks on steep slopes; fine-grained interstitial component varies from abundant to absent; composed of blocks derived from immediately upslope ledges and cliffs; locally contains small landslide and slump masses and boulders with diameters exceeding 30 feet (9 m); mantles steep slopes beneath cliffs and ledges; locally includes undifferentiated colluvium; commonly grades downslope into colluvial and other deposits; generally 15 feet thick (4.5 m) or less, locally up to 30 feet (9 m) thick.

Qmts **Talus sand (Holocene to upper Pleistocene)** -- Cone-shaped deposits of sand commonly mantling talus, colluvium, and other slope-forming units; locally contains small landslide and slump masses and boulders with diameters exceeding 30 feet (9 m); sand was mostly derived from eroding bare sandstone exposed upslope; locally concentrated by wind; up to 20 feet (6 m) thick.

Qmsh **Historical undifferentiated mass-movement slide and slump deposits (Historical)** -- Masses of rock and unconsolidated material that have undergone translational and/or rotational downslope movement; include zones of highly disturbed material, especially at landslide toes where movement is characterized by earth flow; typically associated with low-strength bentonitic mudstone and claystone in the Petrified Forest Member of the Chinle Formation and the Kayenta Formation; landslide features such as scarps and slide blocks are morphologically distinct; historical age documented by disturbed vegetation and open fractures; deposits may deflect stream flow; vary greatly in thickness, but most are estimated to be less than 50 feet (15 m) thick.

Qmsy **Younger undifferentiated mass-movement slide and slump deposits (Holocene to upper Pleistocene)** -- Masses of rock and unconsolidated material that have undergone translational and/or rotational downslope movement; bedrock strata within the blocks are commonly tilted and shattered; individual blocks may be as much as several hundred feet long; slip surfaces commonly develop in the clays of the Petrified Forest Member of the Chinle Formation and in silt and clay units in the Kayenta Formation; similar in character and occurrence to Qmsh, but landslide features such as scarps and slide blocks are morphologically less distinct as the result of weathering and erosion; locally includes deposits with historical movement; probably formed mostly during wet climatic regimes in the Pleistocene, but continue to move near springs and other wet areas, and where undercut or oversteepened by stream erosion or human activity; vary greatly in thickness, but most are probably less than 50 feet (15 m) thick.

Qmso **Older undifferentiated mass-movement slide and slump deposits (lower Holocene to Pleistocene)** -- Similar to Qmsy deposits but forms isolated mounds and erosional remnants of once larger landslide masses; locally may be more than 300 feet (90 m) thick.

Qmsc, Qms(n)
Undifferentiated landslide complex (Holocene to Pleistocene) -- Large complex mass of slump, slide, and earthflow deposits; forms large hummocky mounds and hills; includes older, younger, and historical landslide deposits; locally reactivated with historical movement along and upslope from incised channels; large mostly intact blocks of Navajo Sandstone mapped as Qms(n); 0 to 200 feet (0-60 m) thick.

Qms(b) **Collapsed blocks of basalt (lower Holocene to upper Pleistocene?)** -- Large blocks of Crater Hill basalt flow that collapsed and slid after softer underlying sedimentary rocks were eroded out by streams; age poorly constrained.

Qmcp1, Qmcp2, Qmcp3
Older mass-movement, colluvial, and alluvial pediment-mantle deposits (lower Holocene to Pleistocene) -- Remnants of poorly sorted rock-fall, small slump block and landslide, colluvial, and generally minor alluvial-fan debris that mantle and armor gently sloping, pediment-like benches cut across bedrock; consist of angular and subangular, up to house-sized boulders to fine-grained sand, and lesser amounts of silt and clay derived from local cliffs and ledges; color is dependent on source formations; materials become coarser upslope; preserved as remnants that form inclined benches near steep bedrock slopes at high levels; these benches may be either remnants of much larger surfaces that were graded to the ancestral Virgin River, which, at the time of deposition, must have been up to several hundred feet above its present position or, are the remnants of sloping erosional surfaces mantled and protected from erosion by the coarse deposits and were not graded to the river; mapped deposits locally include aprons of colluvium derived from the pediment-mantle deposits; as much as 30 feet (9 m) thick; graded to several levels that project up to 700 feet (210 m) above the modern river channel; here divided into low-level

(Qmcp1, in which the inclined surface projects less than about 100 feet [30 m] above the river), middle-level (Qmcp2, about 100 to 200 feet [30-60 m]), and high-level (Qmcp3, 200 to 700 feet [60-180 m]) deposits.

Lacustrine and Basin-Fill Deposits

Qlbc **Lacustrine and basin-fill deposits of Coal Pits Wash (upper Pleistocene)** -- Well-sorted, pale-yellowish-brown, to pale-reddish-brown, thin-bedded to laminated, planar-bedded clay, silt, sand, and marl; locally with soft-sediment slump features; form remnants draped across older alluvial, mass-movement, and bedrock deposits; locally as much as 150 feet (45 m) thick; coarser grained in distal areas where grades into alluvial and colluvial deposits; deposits rest directly on a basaltic ash in some areas; lake formed by basalt flow that filled Coal Pits Wash (north-central part of quadrangle) and impinged against older landslide deposits; estimated at about 100,000 years old; 0 to 150 feet (0-45 m) thick.

Qlg **Lacustrine and basin-fill deposits of ancestral Lake Grafton (upper Pleistocene)** -- Pale-gray, pale-yellowish-brown, and medium-greenish-gray, planar, thin-bedded to laminated clay, silt, sand, and marl; deposited directly on a basaltic ash; deposited in a large lake that formed behind a basalt dam formed by flows from the Crater Hill eruption that dammed the Virgin River; the lake extended upriver into the southern part of Zion Canyon; only one small exposure in NE1/4 section 3, T. 42 S., R. 11W.; about 60 feet (20 m) thick, though base is poorly exposed; estimated at about 100,000 years old.

Qbc, Qbcc, Qbca, Qbcr

Basaltic flows, cinders, ash, and rafted block of Crater Hill (upper(?) Pleistocene) -- Medium-gray (fresh surfaces), weathering to dark-brownish-gray to dark-brownish-black, olivine basalt to trachybasalt (table 1); vesicular to dense; locally jointed; forms prominent cinder cone with a large mound of cinders (Qbcc) that may have been deposited by a directed plume eruption or wind drift; basaltic ash (Qbca) is preserved in several areas to the northeast of the cone, and one locality to the southeast; upper surface of flows (Qbc) generally has large arcuate flow ridges and locally a large rafted and tilted block (Qbcr) once considered a separate cinder cone and vent (Nielson, 1977); strongly weathered upper surface mostly covered by eolian and alluvial deposits; rubbly base where exposed; flow is typically 40 to 80 feet (12-24 m) thick, but locally up to 400 feet (120 m) thick where it ponded in Virgin River and ancestral Coal Pits Wash channels; base is about 125 feet (38 m) above modern river channel (appears higher along State Highway 9 because the cliff face exposes a higher level of the dish-shaped flow); caps broad sloping bench in north-central part of quadrangle; estimated at 100,000 years old.

JURASSIC

Carmel Formation

Jccl **Lower unit of Co-op Creek Limestone Member** -- In quadrangle, only lowermost part of lower unit is preserved as an inaccessible outcrop at the top of The West Temple; description is based on exposures in adjacent quadrangles. Mostly thinly laminated to thin-bedded, pale-yellowish-gray weathering, calcareous shale and platy limestone; local rip-up clast conglomerate at the base; limestone is mostly micritic, but some beds are oolitic and sandy; has minor thin-bedded dolomite and sandstone; has locally abundant fossils, including pelecypods, gastropods, and crinoid columnals; *Pentacrinus asteriscus*, a Middle Jurassic crinoid, is common in some of the limestone beds; forms low, sloping, vegetated cap on top of the Temple Cap Formation; deposited in a marine (shallow sea) environment; probably less than 60 feet (18 m) preserved.

J-2 unconformity

Temple Cap Formation -- forms inaccessible outcrops capping Towers of the Virgin in northeast part of quadrangle; descriptions based on exposures in adjacent quadrangles.

Jtw **White Throne Member** -- Very light-gray to pale-orange, cliff-forming sandstone resembling the white Navajo Sandstone; consists of fine-grained, well-sorted, cross-bedded sandstone; has high-angle tabular-planar or wedge-planar cross-beds in sets as much as 20 feet (6 m) thick; deposited in an eolian environment; thickness varies due to unconformity at top; upper contact is sharp and marked by a reddish zone at the base of the Co-op Creek Limestone Member of the Carmel Formation; estimated at 80 to 100 feet (24-30 m) thick; thins westward.

Jts **Sinawava Member** -- Interbedded, fine-grained sandstone, silty sandstone, and mudstone; generally forms prominent reddish-brown to dark-red vegetated bench or ledgy slope; locally forms recessed cliff between the White Throne Member and the white Navajo Sandstone; red color locally streaks the white Navajo cliffs below; interfingers with the White Throne Member at the top; deposited in coastal sabkha and tidal-flat environments; estimated at 100 to 140 feet (30-42 m) thick; thins eastward.

J-1 unconformity

Jn **Navajo Sandstone** -- (undivided on cross section only) Massive, cliff-forming, cross-bedded, locally highly jointed sandstone; forms spectacular sheer cliffs, deep canyons, and impressive spires, promontories, and monoliths; consists mostly of well-sorted, fine- to medium-grained, quartzose sandstone; bedding consists of high-angle large-scale cross-bedding in tabular-planar, wedge-planar, or trough-shaped sets 10 to 45 feet or more (3-14+ m) thick; ironstone bands and concretions locally common; deposited in a vast eolian coastal to inland erg (dune field) environment with prevailing winds principally from the north; lower 200 to 400 feet (60-120 m) consists of a transitional interval with planar bedding, evaporite mineral casts, crinkly or wavy bedding, load structures (typically a few inches in amplitude), and bioturbation indicative of a coastal sabkha environment; upper contact is an unconformity that makes a sharp break below the slope of the red Sinawava Member; divided into three generalized non-stratigraphic units based on color and weathering habit; 1,800 to 2,200 feet (550-670 m) thick.

Jnw **White Navajo** -- Upper part of Navajo Sandstone; very pale-gray, yellowish-gray, orangish-gray, to white because of alteration, remobilization, and bleaching of limonitic and hematitic (iron-bearing) cement; generally forms a massive cliff; includes upper 400 to 800 feet (120-240 m) of the formation in Zion National Park.

Jnp **Pink Navajo** -- Middle part of Navajo Sandstone; generally less resistant than the white Navajo above and brown Navajo below; forms benches, steep slopes, and cliffs; pale-reddish-brown color is more uniform than in units above and below due to more uniformly dispersed hematitic (iron-bearing) cement; locally contains dark green cement (possibly celadonite - an iron-bearing micaceous mineral), and ironstone bands, concretions, and cement; 400 to 1,000 feet (120-300 m) thick.

Jnb **Brown Navajo** -- Lower part of the Navajo Sandstone; upper contact is at the top of a dark-brown, irregular and undulating band overlain by a broad light-colored band; generally forms a massive cliff; roughly correlative with the lower transitional beds of the Navajo; 400 to 600 feet (120-180 m) thick.

Jk **Kayenta Formation (entire formation in areas where Lamb Point Tongue of Navajo Sandstone not mapped, and on cross section; lower part (main body) in areas where Lamb Point and Tenney Canyon Tongues mapped separately)** -- Moderate to dark reddish-brown siltstone and sandstone similar to that described for the Tenney Canyon Tongue; contains 20 to 30 percent sandstone ledges in the Zion National Park area; forms steep ledgy slope grading up to ledgy cliffs at top; upper

contact gradational over a few feet but placed at top of slope- or ledgy cliff-forming, thin- to medium-bedded sandstone with siltstone partings, and at base of laterally continuous, thick- to massive-bedded, cliff-forming sandstone; deposited in an area of little relief near a terrestrial-marine transition zone alternating between mudflats and fluvial environments; locally has thin to medium ledgy sandstone beds similar to Springdale Sandstone in lower part; entire formation is between 550 and 700 feet (170-210 m) thick; lower part below the Lamb Point Tongue is about 290 to 400 feet (88-120 m) thick.

Jkt **Tenney Canyon Tongue of Kayenta Formation** -- Upper part of Kayenta Formation in areas where Lamp Point Tongue is present; lenticular beds of pale-reddish-brown to moderate reddish-orange siltstone and very fine-grained sandstone; minor claystone and limestone; forms a steep slope grading up to ledgy cliffs at top; 140 to 315 feet (43-96 m) thick where separated from the main body.

Jnl **Lamb Point Tongue of Navajo Sandstone** -- Mostly reddish-brown, fine- to very fine-grained, well-sorted, quartzose sandstone; prominently jointed; forms a vertical ledge in the upper one-third of the Kayenta Formation; strongly cross-bedded; contains scattered thin lenses of flat-bedded, pale-reddish-brown siltstone and claystone similar to Kayenta Formation beds; upper contact placed at top of thick, laterally consistent ledge interval; locally contains a 1-foot-thick (30 cm) bed of limestone near the top; deposited in an eolian erg and sabkha environment; thins and pinches out to west in the quadrangle; 0 to 60 feet (0-18 m) thick.

Moenave Formation

Jms **Springdale Sandstone Member of Moenave Formation** -- Mostly pale-reddish-purple to pale-reddish-brown, moderately sorted, very fine- to medium-grained, medium- to thick-bedded, cross-bedded sandstone; locally contains intraformational conglomerate consisting of rounded chips of mudstone and siltstone in a sandstone matrix; has large lenticular and wedge-shaped, low-angle, medium- to large-scale cross-bedding; secondary color banding that varies from concordant to discordant with cross-bedding is common in the sandstone; generally forms a vertical to irregular ledgy cliff; upper contact with Kayenta Formation is generally sharp and even; deposited in a fluvial environment of constantly shifting stream channels; 90 to 150 feet (27-46 m) thick.

Jmw **Whitmore Point Member of Moenave Formation** -- Grayish-red, pale-reddish-brown, and pale-greeenish-gray siltstone, fine-grained sandstone and claystone; sandstone beds are similar to sandstone in Springdale Sandstone; siltstone is commonly thin bedded to laminated in lenticular or wedge-shaped beds; claystone is generally flat-bedded; slope forming; the upper contact of the member is generally sharp but irregular where scoured by the overlying Springdale; locally contains fish scales and bone fragments; deposited in low-energy lacustrine and fluvial environments; about 60 to 85 feet (18-26 m) thick.

Jmd **Dinosaur Canyon Member of Moenave Formation** -- Uniformly colored, moderate to dark reddish-orange to pale-reddish-brown, thin-bedded siltstone, very fine-grained sandstone, and claystone; near the base, contains a minor amount of conglomerate similar to beds in underlying Petrifed Forest Member of Chinle Formation; forms an irregular slope slightly steeper than that of the Whitmore Point; the upper part is marked by a series of more resistant sandstone beds that help define the contact with the Whitmore Point Member above; commonly ripple-marked or mud-cracked; deposited on a broad, low, stream-meander floodplain that was locally shallowly flooded by water (fluvial mudflat); about 150 to 270 feet (46-82 m) thick.

J-0 unconformity

TRIASSIC

Chinle Formation

TRcp **Petrified Forest Member of Chinle Formation** -- Brightly variegated, light-brownish-gray, pale-greenish-gray, to grayish-purple, smectitic shale, siltstone, claystone, sandstone, and pebble to small cobble conglomerate; weathers as badlands; prone to landsliding; contains locally abundant fossilized wood; mostly slope-forming; upper contact is an erosional surface with only slight relief; contains locally prominent, thick, resistant sandstone and conglomerate ledges in lower and middle parts of unit; deposited in lacustrine, floodplain, and braided-stream environment; about 400 to 500 feet (120-150 m) thick.

TRcs **Shinarump Conglomerate Member of Chinle Formation** -- Interbedded, medium- to coarse-grained sandstone, pebbly sandstone, and pebble conglomerate; locally with silty sandstone, claystone, and smectitic claystone interbeds; locally contains abundant fossilized wood; forms resistant ledges to cliffs; clasts are mostly black, gray, tan, and white chert and quartzite; locally heavily stained by iron-manganese oxides, forming "picture stone"; upper contact varies from sharp to gradational; deposited in fluvial environment; about 60 to 135 feet (18-41 m) thick.

unconformity

TRm **Moenkopi Formation, undivided** -- Shown on cross section only; about 1,700 feet (520 m) thick.

TRmu **Upper red member of Moenkopi Formation** -- Moderate- to dark-reddish-brown, very fine- to fine-grained sandstone, siltstone, and mudstone; mostly thin bedded and evenly stratified with a few thick beds that form resistant ledges; common ripple marks and planar, low-angle, and climbing-ripple cross-stratification; common secondary gypsum in thin beds and as cross-cutting veinlets increasing downward; sharp, locally deeply incised erosional upper contact; deposited in tidal-flat environment; 200 to 280 feet (60-85m) thick.

TRms **Shnabkaib Member of Moenkopi Formation** -- Banded, light-gray to pale-red "bacon-striped," gypsiferous siltstone, bedded gypsum, mudstone, and calcareous mudstone; with thin interbeds of pale-brownish-gray dolomite, and moderate-reddish-brown siltstone; mostly nonresistant with thin resistant layers that form ledges; gypsum common as secondary cavity filling and cross-cutting veins; parts weather to a thick punky gypsiferous soil; upper contact placed at change from grayish mudstone to uniform reddish-brown siltstone and mudstone; deposited in shallow-marine to tidal-flat environment; total member is probably about 400 feet (120 m) thick.

TRmm **Middle red member of Moenkopi Formation** -- Interbedded, laminated to thin-bedded, moderate reddish-brown to moderate-reddish-orange siltstone, mudstone, and very fine-grained sandstone; white to greenish-gray gypsum beds and veins are common, especially in the lower part; upper contact is conformable and gradational and corresponds to the base of the first thick gypsum bed; deposited in tidal-flat environment; about 400 to 450 feet (120-140 m) thick.

unconformity

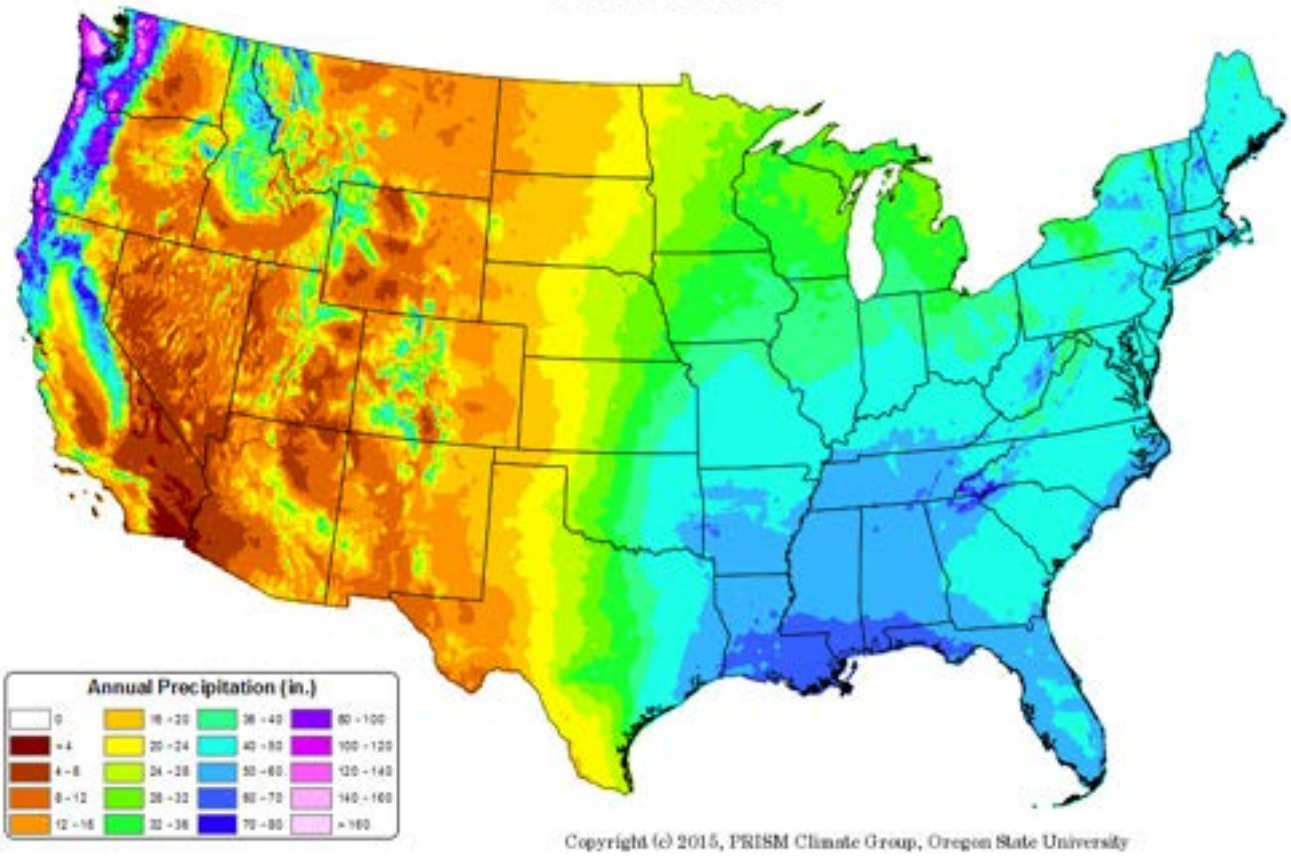
PERMIAN

P **Permian strata, undifferentiated** -- Shown in cross section only; includes Kaibab, Toroweap, and Queantoweap Formations; probably about 3,000 feet (600 m) thick beneath quadrangle.

Appendix B
Precipitation Data

30-yr Normal Precipitation: Annual

Period: 1981-2010



ZION NP, UTAH (429717)

Period of Record Monthly Climate Summary

Period of Record : 01/01/1904 to 06/09/2016

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	52.1	57.2	64.1	72.4	82.4	93.5	98.9	96.4	89.7	78.1	63.2	53.3	75.1
Average Min. Temperature (F)	28.1	32.5	36.9	43.2	51.7	61.1	68.2	66.5	59.8	48.9	36.4	29.3	46.9
Average Total Precipitation (in.)	1.63	1.81	1.81	1.24	0.76	0.43	1.04	1.50	1.09	1.12	1.20	1.43	15.06
Average Total SnowFall (in.)	3.2	1.7	1.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.0	8.7
Average Snow Depth (in.)	0	0	0	0	0	0	0	0	0	0	0	0	0

Percent of possible observations for period of record.
Max. Temp.: 99.8% Min. Temp.: 99.6% Precipitation: 99.9% Snowfall: 99% Snow Depth: 98.6%
Check Station Metadata or Metadata graphics for more detail about data completeness.

Western Regional Climate Center, wrcc@dri.edu

Appendix C
Checklist of Potential Contamination Sources

Checklist of Potential Contamination Sources

Big Spring

Town of Springdale

Source #	Potential Contamination Source	Within Zone 1	Within Zone 2	Within Zone 3	Within Zone 4
1	Active and abandoned wells	None	1	1	1
2	Agricultural pesticide, herbicide and fertilizer storage, use, filling and mixing	None	None	None	None
3	Airport maintenance and fueling sites	None	None	None	None
4	Animal feeding operations with more than ten units	None	None	None	None
5	Animal watering troughs located near unfenced wells and springs that attract livestock	None	None	None	None
6	Auto washes	None	None	None	None
7	Beauty salons	None	None	None	None
8	Boat builder and refinishers	None	None	None	None
9	Chemical reclamation facilities	None	None	None	None
10	Chemigation wells	None	None	None	None
11	Churches, schools, hotels and restaurants	None	Fig. 1	Fig. 1	Fig. 1
12	Concrete, asphalt, tar and coal companies	None	None	None	None
13	Dry cleaners	None	None	None	None
14	Farm dump sites	None	None	None	None
15	Farm maintenance garages	None	None	None	None
16	Feed lots	None	None	None	None
17	Food processors, meat packers and slaughter houses	None	None	None	None
18	Fuel and oil distributors and storers	None	1	1	1
19	Furniture strippers, painters, finishers and appliance repairers	None	None	None	None
20	Grave yards, golf courses, parks and nurseries	None	2	2	2
21	Heating oil storers	None	None	None	None
22	Industrial manufacturers: chemicals, pesticides, paper and leather products, textiles, rubber, plastic, fiberglass, silicone, glass, pharmaceutical and electrical equipment, etc.	None	None	None	None
23	Industrial waste disposal/improvement areas and municipal wastewater treatment plants, landfills, dumps and transfer stations	None	None	None	None
24	Junk and salvage yards	None	None	None	None
25	Laundromats	None	None	None	None
26	Machine shops, metal platers, heat treaters, smelters, annealers and descalers	None	None	None	None
27	Manure piles	None	None	None	None
28	Medical, dental and veterinarian offices	None	1	1	1
29	Mortuaries	None	None	None	None
30	Mining operations	None	None	None	None
31	Muffler shops	None	None	None	None
32	Pesticide and herbicide storers and retailers	None	None	None	None

Checklist of Potential Contamination Sources
Big Spring
Town of Springdale

Source #	Potential Contamination Source	Within Zone 1	Within Zone 2	Within Zone 3	Within Zone 4
33	Photo processors	None	None	None	None
34	Print shops	None	None	None	None
35	Radiological mining operations	None	None	None	None
36	Railroad yards	None	None	None	None
37	Research laboratories	None	None	None	None
38	Residential pesticide, herbicide and fertilizer storage, use, filling and mixing areas	None	Fig. 1	Fig. 1	Fig. 1
39	Residential underground storage tanks	None	None	None	None
40	Roads, highways, and freeways	None	Fig. 1	Fig. 1	Fig. 1
41	Salt and sand-salt piles	None	None	None	None
42	Sand and gravel mining operations	None	None	None	None
43	School vehicle maintenance barns	None	None	None	None
44	Sewer lines	None	Fig. 1	Fig. 1	Fig. 1
45	Single-family septic tank/drain-field systems	None	None	None	None
46	Sites of reported spills	None	None	None	None
47	Small engine repair shops	None	None	None	None
48	Stormwater impoundment sites and snow dumps	None	None	None	None
49	Subdivisions using subsurface wastewater disposal systems (large and individual septic tank/drain-field systems)	None	None	None	None
50	Submersible pumps used to pump wells	None	1	1	1
51	Taxi cab maintenance garages	None	None	None	None
52	Tire shops	None	None	None	None
53	Toxic chemical and oil pipelines	None	None	None	None
54	Vehicle chemical supply storers and retailers	None	None	None	None
55	Vehicle dealerships	None	None	None	None
56	Vehicle quick lubes	None	None	None	None
57	Vehicle rental shops	None	None	None	None
58	Vehicle repair, body shops and rust proofers	None	None	None	None
59	Vehicle service stations and terminals	None	None	None	None
60	Wood preservers	None	None	None	None

BUSINESS NAME	BUSINESS CLASSIFICATION	MAILING ADDRESS	CITY	STATE	ZIP	PHONE	OWNER NAME
Zions First National Bank	Bank	P.O. Box 151	Springdale	UT	84767-0151	435-772-3274	Zions First National Bank
Budd Lee & Sons, Inc.	Contractor	2180 E 50 S	Virgin	UT	84779	435-635-2753	Lee, Allen B.
Barbara's Catering	Home Occupation-Class 1	PO Box 154	Springdale	UT	84767	772-0833	Ellard, Barbara
Springdale Development LLC (Gifford Park)	Home Occupation-Class 1	PO Box 1004	Springdale	UT	84767	435-772-3563	Allan R. Staker
Trust in Flow, LLC	Home Occupation-Class 1	PO BOX 468	Springdale	UT	84767	503-616-1177	DIANA H DOKOS
W.J. Bassett Repair	Home Occupation-Class 1	P.O. Box 385	Springdale	UT	84767-0385	772-3328	Bassett, Bill
Asset Real Estate LLC	Home Occupation-Class 2	PO Box 294	Springdale	UT	84767	(435)772-3786	Brion Sabbatino
Center Line Company	Home Occupation-Class 2	PO Box 86	Springdale	UT	84767	(435)772-3883	Steve T. Cluff
David Pettit Photography	Home Occupation-Class 2	P.O. Box 266	Springdale	UT	84767	772-3206	Pettit, David
Rock Odysseys LLC	Home Occupation-Class 2	2929 Centl Pkwy Apt. 5-162	N. Las Vegas	NV	89081	(435) 632-6549	Lee, Zachary
Sandy Bell Design, Inc.	Home Occupation-Class 2	PO Box 296	Springdale	UT	84767	772-3748	Sandy Bell
Schraut Land Survey	Home Occupation-Class 2	P.O. Box 322	Springdale	UT	84767	435-772-3223	Schraut, Mark S.
Springdale Soap Company	Home Occupation-Class 2	P.O. Box 322	Springdale	UT	84767	435-772-3223	Judith Schraut
William Ralph Gulledge Jr. MD PC	Home Occupation-Class 2	PO Box 247	Springdale	UT	84767	(817)929-1815	William Ralph Gulledge
Zion Canyon Spirit	Home Occupation-Class 2	P.O. Box 362	Springdale	UT	84767	772-0778	LINDSEY, BETINA
Bumbleberry Inn	Lodging	P.O. BOX 346	Springdale	UT	84767-0346	772-3224	Smith, Stanley J.
Cable Mountain Lodge	Lodging	PO Box 1022	Springdale	UT	84767	772-3366	Cable Mountain LLC
Canyon Consulting DBA Aloha Suites	Lodging	PO Box 189	Springdale	UT	84767	435-668-0400	Joshua D VanderWerff
Canyon Ranch Motel	Lodging	1074 S. 1470 E Suite 302	St. George	UT	84790	772-3357	Dave Stirland
Cliffrose Lodge & Gardens Inc	Lodging	P.O. Box 510	Springdale	UT	84767-0510	801-772-3234	Cliffrose Lodge & Gardens Inc
Desert Pearl Inn	Lodging	P.O. Box 407	Springdale	UT	84767	435-772-8888	Kent Palmer
Dolce Vita Suite	Lodging	POB 188	Springdale	UT	84767	772-3650	Clay, Ross & Norma
Ensign Hospitality	Lodging	655 E 400 S, Suite 201	Salt Lake City	UT	84102	772-3200	Kirk Barker
Ferber Resorts/Stewart Ferber	Lodging	POB 99	Springdale	UT	84767	772-3237	Ferber Resorts
Flanigan's Inn	Lodging	P.O. Box 100	Springdale	UT	84767-0100	772-3244	Larry McKown, Larry
Flanigans Villas	Lodging	P.O. Box 755	Springdale	UT	84767	772-0136	McKown, Julie
Host of Angels Corp.	Lodging	POB 29	Springdale	UT	84767	772-3457	Pitti, Joe
KRD Canyon Vista LLC	Lodging	P.O. BOX 351	Springdale	UT	84767	801-486-2019	Ken R Dailey, Ken R
La Quinta Inn & Suites	Lodging	PO Box 99	Springdale	UT	84767	435-627-5280	Stewart/Sydno Management Inc Ferber
Maa Pioneer Lodging, LLC	Lodging	PO 160	Springdale	UT	84767	772-3233	Maru. Bharat
New Driftwood Hospitality Co.	Lodging	P.O. Box 447	Springdale	UT	84767	772-3262	Dunzinger, Hans
Novel House Inn	Lodging	P.O. Box 188	Springdale	UT	84767	435-772-3650	Clay, Ross & Norma
Park Suites, LLC	Lodging	560 E. 500 S. Ste 200	Salt Lake CIty	UT	84102	801-433-9071	Kirk Barker
Red Rock Inn	Lodging	P.O. Box 273	Springdale	UT	84767-0273	772-3139	Crookes, Eileen
Springdale Hospitality	Lodging	655 E. 400 S., Suite 201	Salt Lake CIty	UT	84102	435-627-9191	Springdale Hospitality LLC
Springdale Lodging, LLC dba Majestic View Lodge	Lodging	581 East St. George BLVD	St. George	UT	84770	435-215-3130	Satesh Patel
Watchman Villas, LLC	Lodging	PO BOX 353	Springdale	UT	84767	435-705-4697	BRECK DOCKSTADER
Zion Gateway Inn, LLC	Lodging	P.O. Box 217	Springdale	UT	84767	772-3932	Patel, Vinod
Zion Park Motel	Lodging	P.O. Box 365	Springdale	UT	84767	772-3251	Young, Alma
Zion Vacation Home, LLC	Lodging	POB 59	Springdale	UT	84767	218-8149	Frum, Coriolan & Barbara
Harvest House Bed & Breakfast	Lodging/Bed & Breakfast	P.O. Box 125	Springdale	UT	84767	435-772-3880	Burns, Thomas & Mary Ann
Nama Stay, LLC	Lodging/Bed & Breakfast	PO Box 535	Springdale	UT	84767	(435)632-5255	Jonathan Zambella, Jonathan
Zion Canyon Bed & Breakfast	Lodging/Bed & Breakfast	P.O. Box 302	Springdale	UT	84767	435-772-9466	West, Larry & Liz
Zion Village Plaza	Lodging/Bed & Breakfast	PO BOX 60	Springdale	UT	84767	435-772-3301	J R MADSEN
Zion Brewery, LLC	Multi-Use	PO Box 333	Springdale	UT	84767	(435)772-0404	Aston Stow Co, LLC
Zion Canyon Campground & Quality Inn	Multi-Use	P.O. BOX 99	Springdale	UT	84767-0099	772-3237	Ferber, Dave

BUSINESS NAME	BUSINESS CLASSIFICATION	MAILING ADDRESS	CITY	STATE	ZIP	PHONE	OWNER NAME
The Bodhi Bridge	Non-Profit	PO BOX 468	Springdale	UT	84767	503-616-1177	DIANA H DOKOS
Zion Canyon Arts & Humanities	Non-Profit	P.O. Box 115	Springdale	UT	84767	772-3434 x 313	Zion Canyon Arts & Humanties
Zion Harvest	Non-Profit	P.O. Box 733	Springdale	UT	84767	772-0435	Zion Harvest
2 Amigos Lawn & Tree, LLC	Professional Sevice	181 W 380 N	LaVerkin	UT	84745	(435)952-9280	Rafael M Valdez
Coyote Industries, LLC DBA Zion Cycles	Professional Sevice	PO BOX 276	Springdale	UT	84767	435-772-0400	Scott Williams
Ellen Mckenna	Professional Sevice	PO BOX 154	Springdale	UT	84767	401-440-7066	Ellen McKenna
Zion Arborist	Professional Sevice	PO Box 511	Springdale	UT	84767	435-703-5855	Justin Bell
Zion Canyon Massage	Professional Sevice	PO Box 510	Springdale	UT	84767	(435)229-3400	KELLAN COX
Zion Canyon Medical Clinic	Professional Sevice	P.O. Box 248	Springdale	UT	84767-0248	435-772-3226	Carter, Mel
Zion Tow!	Professional Sevice	863 Royal Ceptor Way	Washington	UT	84780	815-218-7557	MELANIE MADSEN THATCHER
Baby Sumo	Restaurant	544 Belmont Dr	St. George	UT	84790	435-817-1072	Lien H Luu
Bit & Spur Assoc., Inc.	Restaurant	P.O. Box 130	Springdale	UT	84767-0130	772-3498	Joe Jennings
Blondie's Diner	Restaurant	P.O. Box 630266	Rockville,	UT	84763	772-0595	Cox, Shelley
Casas de Amigos, Inc	Restaurant	POB 204	Springdale	UT	84767	772-0422	Casas de Amigos, Inc
DBM Restaurants Inc.	Restaurant	POB 606	Hurricane	UT	84737	467-7406	Millington, David Bryan
Deep Creek Coffee Company, LLC	Restaurant	PO Box 276	Springdale	UT	84767	(435)668-3060	Gledhill, Heidi
Hannaventi Group, LLC dba Perks at Zion	Restaurant	2724 Vineyard Drive	Santa Clara	UT	84765	435-668-0446	Lori Hanna
Izzy Poco, LLC	Restaurant	PO Box 243	Springdale	UT	84767	801-647-8602	Izzy Poco, LLC
King's Landing Bistro	Restaurant	PO BOX 419	SPRINGDALE	UT	84767	702-526-1331	THOMAS KING
MeMe's Cafe	Restaurant	PO Box 218	Springdale	UT	84767	(435)772-0114	MATT RAYNER
Oscars Cafe and Restaurant Inc	Restaurant	P.O Box 102	Springdale	UT	84767	772-3232	Hank & Kathleen Moore, Hank & Kathleen
Park House Cafe LLC	Restaurant	POB 790378	Virgin	UT	84779	772-0100	Alison Paxman
R & B Hospitality (9 East)	Restaurant	PO BOX 790203	Virgin	UT	84779	702-526-6220	R & B HOSPITALITY GROUP, INC
Spotted Dog Cafe Inc.	Restaurant	PO Box 100	Springdale	UT	84767	772-3244	Larry McKown, Larry
Switchback Grille & Trading Co.	Restaurant	P.O. Box 124	Springdale	UT	84767	772-3700	Jon Michael Marriott
Switchback Jack's Social Club, LLC	Restaurant	P.O. Box 124	Springdale	UT	84767	772-3700	Marriott, J. Michael
Thai Sapa, LLC	Restaurant	PO Box 421	Springdale	UT	84767	772-0510	Brooks, Dennis
WATCHMAN ENTERPRISES, INC.	Restaurant	1165 N 1100 W	ST. GEORGE	UT	84770	772-3333	Woods, Don
Wildcat Willies, Inc.	Restaurant	POB 668	Springdale	UT	84767	229-0393 Lou cell	Inc. Wildcat Willies, Inc.
ZCC Enterprises, Inc.	Restaurant	PO Box 203	Springdale	UT	84767	772-0572	ZCC Enterprises, Inc.
Zion Canyon Brew Pub	Restaurant	PO Box 333	Springdale	UT	84767	772-0336	Brooks Pace
Zion Canyon Coffee Company	Restaurant	P.O. Box 1024	Springdale	UT	84767	772-0505	Tamera Burton
Zion Jitter Bean	Restaurant	PO Box 243	Springdale	UT	84767	801-647-8602	Jack Fotheringham
Zion Park Gift & Deli	Restaurant	P.O. Box 153	Springdale	UT	84767	435-772-3843	Stansfield, Byron & Myrlene
Zion Pizza & Noodle Co.	Restaurant	P.O. Box 189	Springdale	UT	84767-0436	435-772-3815	VanderWerff, Bruce
Zion Sandwiches, LLC	Restaurant	PO Box 243	Springdale	UT	84767	801-510-9150	Janese Fotheringham
Zozak Builiding Systems dba Sol Foods Supermarket	Restaurant	POB 840	Springdale	UT	84767	772-3100	Gregoric, Julie
Bumbleberry Gifts	Retail	POB 1021	Springdale	UT	84767	773-3287	Clark, Trisha & Ryan
Canyon Market	Retail	PO Box 449	Springdale	UT	84767	772-7805	Brent Heaton
Canyon Offerings, Inc.	Retail	P.O. Box 326	Springdale	UT	84767-0326	772-3456	Laura Doty
Canyon Outfitters	Retail	P.O. Box 153	Springdale	UT	84767	435-772-0252	Stansfield, Byron & Myrlene
David J. West Gallery	Retail	PO Box 477	Springdale	UT	84767	772-3510	David J. West Photography, LLC
DeZion Gallery	Retail	POB 40	Springdale	UT	84767	772-6888	Fairlamb Tina
Frontier Plunder Antiques, Inc.	Retail	P.O. Box 411	Springdale	UT	84767-0411	435-772-3045	Harriet Callahan
HooDoos General Store	Retail	PO BOX 840	Springdale	UT	84767	435-414-9834	MAX GREGORIC
Joy Craft & Design	Retail	PO Box 1003	Springdale	UT	84767	435-632-8429	Joy Stein

BUSINESS NAME	BUSINESS CLASSIFICATION	MAILING ADDRESS	CITY	STATE	ZIP	PHONE	OWNER NAME
LaFave Gallery, Inc	Retail	PO Box 809	Springdale	UT	84767	(435)772-0279	LaFave, Kathleen L.
Lazy Lizard Boutique	Retail	P.O. Box 70	Springdale	UT	84767	435-772-3050	Linda Holmstead, Linda
Seth Hamel dba Enlighten Photography	Retail	PO Box 523	Springdale	UT	84767	(801)828-5899	Seth Hamel
Silver Bear Enterprises	Retail	P.O. Box 185	Springdale	UT	84767	772-3939	Chamberlain, Bert
Simply Footwear Utah, LLC	Retail	POB 354	Springdale	UT	84767	772-3500	Clay, Frank
Sorella Gallery	Retail	POB 1002	Springdale	UT	84767	772-0622	Teresa Browne, Teresa
The Zion Prospector	Retail	680 S. 180 W.	Hurricane	UT	84737	772-0472	Todd & Malinda Harris, Todd & Malinda
Thorsten Schneider Inc.	Retail	PO Box 827	Springdale	UT	84767	772-0577	BAERBEL SCHMIDT
Thorsten Schneider Inc.	Retail	POB 827	Springdale	UT	84767	216-6485	Thorsten Schneider Inc
Toaquim's Village, Inc.	Retail	P.O. Box 64	Springdale	UT	84767	772-2420	Heaton, Darin P.
Tribal Arts, LLC	Retail	P.O. Box 539	Springdale	UT	84767	435-772-3353	Tribal Arts, LLC
Virgin River Chocolates	Retail	PO Box 390	Springdale	UT	84767	(435)772-0485	W DAVID WATTS
Worthington Gallery, Inc.	Retail	P.O. BOX 37	Springdale	UT	84767	772-3446	Worthington, Greg
ZCC Enterprises, Inc	Retail	POB 203	Springdale	UT	84767	772-0572	Travis Barney
ZION ADVENTURE COMPANY, LLC	Retail	BOX 523	SPRINGDALE	UT	84767-0523	435-772-1001	RICK PRAETZEL
Zion Canyon Brew Pub, DBA Zion Brewery Gift Shop	Retail	PO BOX 333	Springdale	UT	84767	435-772-0336	Brooks Pace
Zion Canyon Visitor Center, Inc.	Retail	PO BOX 353	Springdale	UT	84767	435-703-3175	Zion Canyon Visitor Center, Inc.
Zion Outdoor, Downstairs, LLC	Retail	P.O. Box 189	Springdale	UT	84767	435-772-0630	Joshua D VanderWerff
Zion Outfitter LLC	Retail	1958 S Summerfield Ln	Washingotn	UT	84780	772-5090	Phyllip Heaton
Zion Park!	Retail	863 Royal Sceptor Way	Washington	UT	84780	815-218-7557	MELANIE MADSEN THATCHER
Zion Rock & Gem	Retail	P.O. Box 344	Springdale	UT	84767-0344	772-3436	Young, Shaunna
Junction Market X, LLC	Retail/Auto Service/Class A Beer	50 W Canyon Creek Rd	Alpine	UT	84004	(435)772-3677	Branden Hansen
Zion Canyon Shell (RJ's Truck Stop Inc.)	Retail/Auto Service/Class A Beer	PO BOX 190	Cedar CIty	UT	84721	435-586-6931	ANDREA JOHNSON
Zion MTN School Corp	Retail/Rental	PO Box 265	Springdale	UT	84767	633-1783	MICHAEL BANACH
Zion Quest, LLC dba Zion Guru	Retail/Rental	PO Box 535	Springdale	UT	84767	435-632-5255	Jonathan Zambella, Jonathan
Deep Canyon Adventure Spa	Spa	PO Box 100	Springdale	UT	84767	435-772-3244	L.J.R. Resorts L.L.C.
Zion Canyon Giant Screen Theatre	Theater	P.O. Box 206	Springdale	UT	84767	435-772-2400	Heaton, Steve
Jonathan David, Inc dba Nama Guides	Tours/Guiding	P.O. Box 535	Springdale	UT	84767	435-772-0853	Jonathan Zambella, Jonathan
Mild to Wild Rhino/ATV/Jeep Tours	Tours/Guiding	PO Box 381	Hurricane	UT	84737	(866)578-4265	Buddy James
Red Desert Adventure, LLC	Tours/Guiding	Box 5	Springdale	UT	84767	668-2888	Draper, Eric
Saw Zion, LLC dba Zion Guide Hub	Tours/Guiding	PO BOX 276	Springdale	UT	84767	669-4335	Scott Williams
Zion Outback Safaris, Inc	Tours/Guiding	PO Box 790352	Virgin	UT	84779	(435) 668-3756	Larry Pugh
Zion Rock & Mtn Guides LLC	Tours/Guiding	PO Box 623	Springdale	UT	84767	772-3303	Zion Rock & Mtn Guides, LLC
HooDoos Ice Cream Parlor		PO BOX 840	Springdale	UT	84767	435-414-9834	MAX GREGORIC
Zion Parking Solutions		PO BOX 327	Virgin	UT	84779	435-414-0480	JANET MIKA
Zozak Building Systems, Inc dba Sol Foods Hardware & Camping		PO Box 840	Springdale	UT	84767	772-3100	MAX GREGORIC

Appendix D
UST List

6/1/2010

Facility ID	Location Name	Location Address	Location City	Location Zip	Location County	Owner Name	Owner Address	Owner City	Owner State	Owner Zip	Owner Phone	Total Tanks	Closed Tanks
6000697	FLYING J #05101 ST. GEORGE	2841 S 60 E	SAINT GEORGE	84790	WASHINGTON	FLYING J INC	333 W CENTER ST	NORTH SALT LAKE	UT	84054	(801) 296-7716	5	0
6000780	ST GEORGE SEWER PLANT	3780 S 1550 W	SAINT GEORGE	84790	WASHINGTON	CITY OF ST GEORGE	931 E RED HILLS PARKWAY	SAINT GEORGE	UT	84770	(435) 634-5904	1	1
6000732	FABULOUS FREDDYS CAR WASH	134 S 1300 E (RIVER RD)	SAINT GEORGE	84790	WASHINGTON	FABULOUS FREDDY'S CARWASH	10091 PARK RUN DR STE 110	LAS VEGAS	NV	89145	(435) 652-4566	3	0
6000777	MAVERIK #370	2078 E RIVERSIDE DR	SAINT GEORGE	84790	WASHINGTON	MAVERIK COUNTRY STORES INC.	880 W CENTER STREET	NORTH SALT LAKE	UT	84054	(801) 335-3860	4	0
6000342	BLOOMINGTON MARKET	141 W BRIGHAM RD	SAINT GEORGE	84790	WASHINGTON	YOUNKER LAND & DEVELOPMENT LLC	141 W BRIGHAM RD	SAINT GEORGE	UT	84790	(435) 229-7529	3	0
6000775	FORT PIERCE SINCLAIR	3795 S RIVER RD	SAINT GEORGE	84790	WASHINGTON	PRICE HILL DEVELOPMENT	675 N 1300 E	SAINT GEORGE	UT	84770	(435) 673-9421	5	0
6000798	OLD AIRPORT	OLT AIRPORT SE OF SAINT GEORGE	SAINT GEORGE	84790	WASHINGTON	CITY OF ST GEORGE	931 E RED HILLS PARKWAY	SAINT GEORGE	UT	84770	(435) 634-5904	1	1
6000311	ANDRUS TRANSPORTATION	3185 E DESERET DR N	SAINT GEORGE	84790	WASHINGTON	ANDRUS TRANSPORTATION INC	3185 E DESERET DR	SAINT GEORGE	UT	84790	(435) 673-1566	1	0
6000751	MIRASTAR #62040	2610 S PIONEER STREET	SAINT GEORGE	84790	WASHINGTON	TESORO REFINING & MARKETING CO	3450 S 344TH WAY STE 201	AUBURN	WA	98001	(253) 896-8700	3	0
6000750	QUALITY EXCAVATION	1472 E 3950 S	SAINT GEORGE	84790	WASHINGTON	QUALITY EXCAVATION	1472 E 3950 S	SAINT GEORGE	UT	84790	(435) 634-0111	3	0
6000377	DUTCHMANS SINCLAIR	2300 W SANTA CLARA DR	SANTA CLARA	84765	WASHINGTON	NICK FREI	2300 W SANTA CLARA DR	SANTA CLARA	UT	84765	(435) 628-8482	3	0
6000306	FAA-SHIVWITS RMLR QVJ	SHIVWITS	SANTA CLARA	84765	WASHINGTON	FAA SALT LAKE SMO SAFETY OFFICE	2150 W 700 N BUILDING 1	SALT LAKE CITY	UT	84116	(801) 320-2059	1	1
6000691	LIGHTFOOTS SANTA CLARA	2275 W SANTA CLARA DR	SANTA CLARA	84765	WASHINGTON	LIGHTFOOTS INC	PO BOX 380200	IVINS	UT	84738	(206) 679-8814	3	0
6000046	JENKINS OIL CO. INC.	2753 W SANTA CLARA DR	SANTA CLARA	84765	WASHINGTON	JENKINS OIL	PO BOX 1356	CEDAR CITY	UT	84721	4355864819	3	3
6000531	SPRINGDALE CHEVRON	1593 ZION PARK BLVD	SPRINGDALE	84767	WASHINGTON	ZION ENROUTE LLC	1593 ZION PARK BLVD	SPRINGDALE	UT	84767	(435) 772-3677	5	2
6000400	SPRINGDALE TEXACO	445 ZION PARK BLVD	SPRINGDALE	84767	WASHINGTON	JOANNA ADAMSON	1490 AMBASSADOR WAY	SALT LAKE CITY	UT	84108	(801) 582-5112	4	
6000261	CANYON TIRE & FOOD MART	962 ZION PARK BLVD	SPRINGDALE	84767	WASHINGTON	JERRY HATCH	962 ZION PARK BLVD	SPRINGDALE	UT	84767	(435) 772-3963	6	3
6000260	ZION CANYON EXXON	1130 ZION PARK BLVD	SPRINGDALE	84767	WASHINGTON	ZION PARK RESORT INC	2159 S 700 E STE 200	SALT LAKE CITY	UT	84106	(801) 467-3600	4	4
6000658	ZION NATIONAL PARK	ZION NATIONAL PARK	SPRINGDALE	84767	WASHINGTON	NATIONAL PARK SERVICE	PO BOX 925	SPRINGDALE	UT	84767	(435) 772-3256	7	5
6000415	TOQUERVILLE MERCANTILE	176 N TOQUER BLVD	TOQUERVILLE	84774	WASHINGTON	REUBEN CLINGER	BOX 117	TOQUERVILLE	UT	84774	(435) 635-4756	2	2
6000131	SPANISH TRAIL SUPPLY	21 S MAIN ST	VEYO	84782	WASHINGTON	SPANISH TRAIL SUPPLY COMPANY LLC	21 S MAIN STREET	VEYO	UT	84782	(435) 668-7505	4	1
6000378	VEYO MERC	13 N MAIN ST	VEYO	84782	WASHINGTON	VEYO LAND & LIVESTOCK LLC	175 W 400 N	VEYO	UT	84782	(435) 574-3330	6	6
6000202	RED CLIFFS SINCLAIR	880 W RED CLIFFS DR	WASHINGTON	84780	WASHINGTON	HARDY ENTERPRISES INC	598 W 2600 S	BOUNTIFUL	UT	84010	(801) 298-1180	3	0
6000352	OLD TOWN & COUNTRY	471 W TELEGRAPH ST	WASHINGTON	84780	WASHINGTON	OLD TOWN & COUNTRY	471 WEST TELEGRAPH RD	WASHINGTON	UT	84780	(801) 368-6788	6	3
6000343	WASHINGTON SERVICE	214 W TELEGRAPH ST	WASHINGTON	84780	WASHINGTON	WASHINGTON SERVICE	214 W TELEGRAPH	WASHINGTON	UT	84780	(435) 673-1472	2	2
6000714	SERVICE STATION INC. TEXACO	1036 W MIDDLETON DR	WASHINGTON	84780	WASHINGTON	EUGENE E HAFEN	1036 W MIDDLETON DRIVE	WASHINGTON	UT	84780	(435) 656-8032	3	0
6000170	RIVERBEND EXPRESS	1391 W REDLEDGE RD	WASHINGTON	84780	WASHINGTON	NORMAN HOWARD	P O BOX 890	WASHINGTON	UT	84780	(435) 634-9800	4	2
6000655	HARTS GAS & FOOD	260 S GREEN SPRING DR	WASHINGTON	84780	WASHINGTON	HARTS GAS AND FOOD LLC	P O BOX 418	AMERICAN FORK	UT	84003	(801) 756-9681	3	0
6000796	MAVERIK #390	980 N HOODOO WAY	WASHINGTON	84780	WASHINGTON	MAVERIK COUNTRY STORES INC.	880 W CENTER STREET	NORTH SALT LAKE	UT	84054	(801) 335-3860	4	0
6000749	MIRASTAR #62041	675 W TELEGRAPH ST	WASHINGTON	84780	WASHINGTON	TESORO REFINING & MARKETING CO	3450 S 344TH WAY STE 201	AUBURN	WA	98001	(253) 896-8700	3	0
6000209	FREEWAY CHEVRON # 208910 (OLD TRI-MART #1063)	990 BUENA VISTA BLVD	WASHINGTON	84780	WASHINGTON	DARREL L. ANDERSON	990 BUENA VISTA BLVD	WASHINGTON	UT	84780	(435) 673-3675	8	4
6000330	FIRST STOP TESORO	195 E TELEGRAPH ST	WASHINGTON	84780	WASHINGTON	DARREL L. ANDERSON	1820 W 5870 N	SAINT GEORGE	UT	84770	(435) 673-6677	3	0
6000128	U.S.WEST 671564	100 S 200 W	WASHINGTON	84780	WASHINGTON	QWEST COMMUNICATIONS	250 BELL PLAZA STE 1601	SALT LAKE CITY	UT	84111	(801) 237-3006	1	1

Appendix E
Fact Sheets

Partnership for the Environment

Utah Department of Environmental Quality

Household Hazardous Waste Fact Sheet

What is Household Hazardous Waste?

Many hazardous products and chemicals such as cleaners, oils and pesticides are used in the home every day. When discarded, these products are called household hazardous waste (HHW). HHWs are discarded materials and products that are ignitable, corrosive, reactive, toxic or otherwise listed as hazardous by the EPA. Products used and disposed of by a typical residence may contain more than 100 hazardous substances including:

- Batteries
- Cleaners
- Cosmetics
- Fluorescent light bulbs
- Glues
- Heating oil
- Insecticides and pesticides
- Ink
- Medicines
- Motor oil and automotive supplies
- Paints, thinners, stains and varnishes
- Polishes
- Swimming pool chemicals
- Smoke detectors
- Thermometers
- Fuel

HHW is a Serious Threat

The U.S. Environmental Protection Agency estimates the average American household generates 20 pounds of HHW each year. As much as 100 pounds of HHW can accumulate in the home and remain there until the resident moves or undertakes a thorough "spring cleaning."

Since the chemicals found in HHW can cause soil and groundwater contamination, generate hazardous emissions at landfills and disrupt water treatment plants, it is important to dispose of HHW properly. Many solid waste treatment facilities are currently required to screen for HHW to avoid operating under restrictive hazardous waste laws. Furthermore, many communities may be required to establish a HHW collection program in order to qualify for permits to manage storm water.

Safe Handling Tips

The best way to handle household hazardous materials is to completely use the product before disposing of the container. If this is not possible, then the next alternative is to return unused portions to your community household hazardous waste clean-up day. Keep products in their original package with all labels intact. If the container is leaking, place it in a thick plastic bag. Pack the products in a plastic-lined cardboard box to prevent leaks and breakage.

Household hazardous waste clean-up days are for household wastes only. No industrial or commercial wastes and no containers larger than five gallons are accepted. Explosives, radioactive

material and medical wastes are also unacceptable.

HHW can be dangerous to people and pets who come in contact with them. HHW can endanger water supplies, damage sewage treatment systems, and cause other environmental damage. Only use the products as directed. **DO NOT:**

- Flush HHWs down the toilet
- Pour HHWs down the sink
- Pour HHWs down a storm drain
- Pour HHWs on the ground

Contact your local health department or the Division of Solid and Hazardous Waste to determine whether your community has a household hazardous waste collection program.

Identify HHW

Reduce the amount of potentially hazardous products in your home and eliminate what you throw away by following these easy steps:

1. Before you buy:

- Read the labels and be aware of what they mean.
- Look for these words on labels; they tell you what products may need special handling or disposal.

Caution	Flammable
Combustible	Poison
Corrosive	Toxic
Danger	Volatile
Explosive	Warning

- Select a product best suited for the job.
- Buy only what you can use entirely.

2. After you buy:

- Read label precautions and follow directions for safe use.
- Recycle/dispose of empty containers properly.
- Share what you can't use with friends or neighbors.
- Store properly.
- Use recommended amounts; more is not necessarily better.
- Use the child-resistant closures and keep them on tightly.

For More Information, Contact:

Division of Solid & Hazardous Waste - (801) 538 - 6170
Division of Drinking Water, Source Protection Program - (801) 536-4200
Environmental Hotline - 1-800-458-0145
Sonja Wallace, Pollution Prevention Coordinator - (801) 536-4477

Partnership for the Environment

Utah Department of Environmental Quality

Fertilizer Fact Sheet

What Are The Potential Hazards?

Fertilizer applied to plants during crop, lawn, and garden maintenance may leach into the ground water and cause contamination. The main constituent in fertilizer is usually nitrogen. If the nitrate level of drinking water is too high, infants, up to the age of six months, can develop a fatal disease called blue baby syndrome (methemoglobenemia). Drinking water that contains 10 milligrams of nitrate-nitrogen per liter of water exceeds the drinking water standard and should not be used, especially for infant formula. Proper storage, application, and watering procedures should be included in fertilizer best management practices to prevent contamination of ground water.

Storing Fertilizers

The less fertilizer you buy, the less you will have to store. Therefore, only purchase the amount and kind of fertilizer that you need.

- Fertilizer should be stored in locked, dry cabinets.
- Keep fertilizer and pesticides on separate shelves.
- Don't store fertilizer with combustibles, such as gasoline or kerosine, because of explosion hazards.

Application Precautions

The chemical in fertilizer that can most easily pollute ground water is a form of nitrogen called nitrate. Nitrate moves readily in soil to the ground water strata. The best way to prevent the movement of nitrate into the ground water is to apply no more nitrogen than the crops, grass, garden plants, shrubs, or trees can use during the time that the plants are growing.

- Calibrate your spreader and sprayer to keep from applying too much fertilizer.
- Load fertilizer spreaders on the driveway or other hard surfaces so any spills can easily be swept up. Fertilizer that spills should be swept up and applied to the lawn or garden at the right time and amount. This allows the fertilizer to grow plants instead of washing off into the storm drain system and ultimately contaminating nearby streams and lakes.
- If you are using liquid fertilizer on your turf, add fertilizer to the spray tank while on the lawn. This way, if you spill the fertilizer, it will be used by the plants and not run off into the storm drain system.
- Do not spray or apply fertilizer near irrigation wells. Wells are conduits to the ground water.

Application Rates For Lawns

Utah State University's Extension Service recommends the following for Utah lawns: "It is important to fertilize on a regular basis every four to six weeks to maintain an attractive lawn. Begin

when lawns start to green in the spring, mid to late April. Earlier applications may cause a lawn to become greener faster, but may also increase spring disease problems. Summer applications of nitrogen fertilizer will not burn lawns, if you apply them to dry grass and water immediately. Fall applications are important for good winter cold tolerance, extended fall color, and fast spring green-up. A complete fertilizer containing nitrogen, phosphorus and potassium should be applied in the fall every three to four years. This will prepare the lawn for winter conditions and allow the phosphorus to penetrate into the root zone by the next growing season.

For a well-kept lawn in Utah, apply 1 pound of available nitrogen per 1,000 square feet each four to six weeks throughout the growing season. The following chart indicates how much of various fertilizer will supply one pound of nitrogen."

%N on Label	Pounds of Fertilizer Per 1000 Square Feet
12-15	7-8
18-21	5-5 ½
24-28	3 ½-4
30-34	3-3½
45-46	2-2 ¼

Types of Plants

One of the best ways to protect your ground water is to use plants that are drought-tolerant and that are adapted to your area. Drought-tolerant or low-water-use plants can continue to survive once they are established, even during times of little rainfall. Because you do not have to water these plants, there is less chance that nitrate and pesticides will be carried with the water through the soil and into the ground water.

If low-water-use plants are not practical, then try to use medium water use plants. Water these plants only when they begin to show drought stress. Some plants will wilt when they are drought-stressed, while other plants will show marginal leaf burn.

Watering

Over-watering plants can cause excess water to move through the soil. This water can flush fertilizer away from the root zone of your plants and into the ground water. The best way to avoid over-watering is simply to measure how much you are adding. Contact your county Extension Service to determine the best way to calculate how much water your plants need and how to measure the amount you are applying.

For More Information, Contact:

Division of Drinking Water, Source Protection Program - (801) 536-4200
Department of Agriculture - (801) 538-7100
Environmental Hotline - 1-800-458-0145
Sonja Wallace, Pollution Prevention Coordinator - (801) 536-4477

Partnership for the Environment

Utah Department of Environmental Quality

Pesticides Fact Sheet

What Are The Potential Hazards?

Pesticides applied to plants during crop, lawn, and garden maintenance may leach into the ground water and cause contamination. Proper storage, mixing, application, spill cleanup, watering, and disposal procedures should be included in pesticide best management practices.

Storing Pesticides

The fewer pesticides you buy, the fewer you will have to store. Therefore, only purchase the amount and kind of pesticide that is needed. Pesticides should always be stored in sound, properly labeled, original containers. ***Sound containers are the first defense against spills and leaks.***

- Ensure that there are no holes, tears, or weak seams in the containers and that the label is readable.
- Pesticides should be stored in locked, dry cabinets.
- Be sure to store dry products above liquids to prevent wetting from spills.
- Storage and mixing areas should not be located near floor drains of any kind.
- Storage facilities should have secondary containment, such as a berm or dike, which will hold spills or leaks at:
    1. 10% of the total volume of the containers, or
    2. 110% of the volume of the largest container, whichever is larger.

Mixing Pesticides

- Mix pesticides on an impermeable surface, such as concrete, so any spills will be contained.
- Mix only the amount that you will use:
    1. Measure the total square feet you intend to treat.
    2. Read the label on the pesticide container and follow the instructions. (These are often given in terms of amount of pesticide to use per thousand square feet.)
    3. By properly measuring and calculating, there should be little or no pesticide left in the spray tank when the job is finished and it will be applied at the recommended rate.

Applying Pesticides

Pesticides are used to kill or control weeds (herbicides), insects (insecticides) and fungi (fungicides) that attack plants. Some of these pesticides can move through the soil and into the ground water. Guidelines for the safe use of pesticides are listed below:

- Be willing to accept a low level of weed, insect, and plant disease infestation.

- Use pesticides only when absolutely necessary.
- Identify pests correctly. Use the proper pesticides.
- Read and follow the directions printed on the container labels. Remember, *the label is the law.*
- Calibrate your spreader and sprayer to keep from applying too much pesticide.
- Do not spray or apply pesticides near irrigation wells. Wells are conduits to the ground water.
- Do not spray or apply pesticides near your walks and driveway. This prevents them from washing off into the storm drain system.

Cleaning Up Spills

- Dry formulated pesticide spills should be swept up and applied to crops, lawns, and gardens at the rate specified on the label.
- Liquid pesticide spills should be soaked up using absorbent material (such as, soil, sawdust, and cat litter). The contaminated absorbent material should then be put in a sealed container and taken to a household hazardous waste collection site.

Watering

Over-watering your plants can cause excess water to move through the soil. This water can carry pesticides that can contaminate the ground water. The best way to avoid over-watering is simply to measure how much you are adding. Contact your county Extension Service to determine the best way to calculate how much water your plants need and how to measure the amount you are applying.

Disposing of Pesticides

If the pesticide was properly measured and mixed, there should be little or no spray left in the tank. The little that may be left can be safely sprayed over the area that was treated until it is gone. Disposal of "empty" pesticide containers and unused pesticides should be handled as follows:

- If you are using liquid pesticides, rinse the container three times. Be sure to pour the rinsing into your sprayer and not down a drain or onto the ground. Containers which have been emptied and rinsed can be discarded in the trash.
- Unused pesticides in their original containers can be recycled at household hazardous waste collection sites.

For More Information, Contact:

Division of Drinking Water, Source Protection Program - (801) 536-4200
Department of Agriculture - (801) 538-7100
Environmental Hotline - 1-800-458-0145
Sonja Wallace, Pollution Prevention Coordinator - (801) 536-4477

Partnership for the Environment

Utah Department of Environmental Quality

Septic Tank/Drainfield System Fact Sheet

What Are The Potential Hazards?

Septic systems can contaminate ground water if they are misused, improperly maintained, or improperly constructed. The major contaminant discharged from septic systems is disease-causing germs. These germs (bacteria and viruses) - can cause many human diseases. Another contaminant discharged from septic systems is nitrogen in the form of nitrate. If the nitrate level of drinking water is too high, infants, up to the age of six months old, can develop a fatal disease called blue baby syndrome (methemoglobenemia). Additionally, if toxic chemicals are disposed in a septic system, they can percolate through the drainfield and into the ground water.

How Does A Septic Tank/Drainfield System Work?

The basic septic system is composed of a septic tank followed by a drainfield. Wastewater flows out of the house and into the septic tank through the building sewer pipe. Once in the septic tank, most solids in the wastewater settle to the bottom of the tank to form a sludge layer. Other solids float and form a scum layer on top of the wastewater. Some decomposition of solid material takes place here, but the primary function of a septic tank is to trap solids and prevent them from entering the drainfield.

Wastewater treatment is restricted to a rather thin zone of unsaturated soil underlying the drainfield. Many of the harmful bacteria and microbes are filtered out as the wastewater passes through this soil. Some of the smaller microbes (viruses) and nutrients such as phosphorus and some forms of nitrogen are trapped and held (adsorbed) by soil particles. Once the effluent reaches the groundwater table, little treatment occurs. Soils can differ markedly in their pollutant removal efficiency. The ability to which soil can remove pollutants in the wastewater determines how many impurities will eventually reach the groundwater beneath the drainfield.

Site Evaluation And Construction

Current rules require a comprehensive evaluation of the soil and ground water before a septic system can be permitted for construction in a given location. This evaluation must be reviewed and approved by the local health department. The rules require that the bottom of the drainfield trenches be placed at least 12 inches (preferably 24 inches) above the water table. Additionally, there must be adequate amounts of unsaturated soil beneath the trenches to allow sufficient treatment of the wastewater.

Site Considerations

- Trees and deep-rooted shrubs should be as far away from the system as possible.
- Keep the water that runs off of foundation drains, gutters, driveways, and other paved areas away from the drainfield of your septic system.

- Keep the soil over the drainfield covered with grass to prevent soil erosion.
- Don't drive vehicles over the system.
- Don't cover the tank or drainfield with concrete or asphalt and don't build over these areas.

Proper Disposal Practices

- Use only a moderate amount of cleaning products and do not pour solvents or other household hazardous waste down the drains.
- Garbage disposals should not be used because they tend to overload the system with solids. If you have one, you should severely limit its use.
- Do not pour grease or cooking oil down the sink.
- Do not put items down the drain that may clog the septic tank or other parts of the system. These items include cigarette butts, sanitary napkins, tampons, condoms, disposable diapers, paper towels, egg shells, and coffee grounds.

Water Conservation

There are limits to the amount of wastewater a septic system can treat. If you overload the system, wastewater may backup into your home or surface over your drainfield. Problems caused by using too much water can occur periodically throughout the year or be seasonal. For example, the soil beneath your drainfield is wetter in the spring than it is in the summer and its capacity to percolate wastewater is somewhat diminished. If you wash all your laundry in one day, you may have a temporary problem caused by overloading the soil's capacity to percolate wastewater for that day. To reduce the risk of using too much water, try the following:

- Use 1.6 gallons (or less) per flush toilets.
- Fix leaking toilets and faucets immediately.
- Use faucet aerators at sinks and flow reducing nozzles at showers.
- Limit the length of your shower to 10 minutes or less.
- Do not fill the bathtub with more than 6 inches of water.
- Do not wash more than one or two loads of laundry per day.
- Do not use the dishwasher until it is full.

Septic Tank Cleaning

It is recommended that the solids that collect in your septic tank be pumped out and disposed at an approved location every three to five years. If not removed, these solids will eventually be discharged from the septic tank into the drainfield and will clog the soil in the absorption trenches. If the absorption trenches are clogged, sewage will either back up into the house or surface over the drainfield. If this happens, pump the tank will not solve the problem and a new drainfield will probably need to be constructed on a different part of the lot.

For More Information, Contact:

Division of Drinking Water, Source Protection Program - (801) 536-4200
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