PETITION FOR GROUND-WATER QUALITY CLASSIFICATION, MORGAN VALLEY, MORGAN COUNTY, UTAH

Submitted to Utah Water Quality Board by Morgan County

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INTRODUCTION

This is a formal petition to the Utah Water Quality Board submitted by Morgan County to classify ground-water quality in the valley-fill aquifer of Morgan Valley under "Administrative Rules for Ground Water Quality Protection R317-6, March 3, 2003," Section 317-6-5, Ground Water Classification for Aquifers, Utah Administrative Code.

Morgan Valley is a northwest-trending valley approximately 16 miles long and 2 miles wide (26 km and 3.2 km) with a valley-fill area of 28 square miles (70 km^2) (figure 1). Morgan Valley is in the Wasatch Hinterlands section of the Rocky Mountain physiographic province (Stokes, 1977), and is in the central part of the Weber River watershed. The study area watershed covers 312 square miles (800 km^2). Morgan Valley is bounded by Weber Canyon and the Wasatch Range to the west, and Upper Weber Canyon east of Morgan City to the east. Elevation ranges from 9706 feet (2958 m) at Thurston Peak, the highest point in Morgan County, to approximately 4835 feet (1474 m) at the town of Mountain Green, near Weber Canyon.

The Weber River enters the study area at the mouth of Upper Weber Canyon near Morgan City, flows northwest through the middle of Morgan Valley, and exits the study area near Mountain Green at the head of Weber Canyon (figure 1). Major tributaries include East Canyon Creek and Hardscrabble Creek at the southeast end of the study area, and Cottonwood Creek at the northwest end of the study area. Smaller drainages include the northeast-flowing Deep and Smith Creeks, and southwest-flowing streams in Big Hollow and Roswells Canyons.

Morgan County, like many bedroom communities to the Wasatch Front, is experiencing growth. From 1990 to 2000, the population of Morgan County increased 29%, from 5528 to 7129 (Demographic and Economic Analysis Section, 2001). In 2002, the population of Morgan

County was 7380, with Morgan City, the county seat, having 2680 residents, and the unincorporated areas in Morgan County having a population of 4700 (Demographic and Economic Analysis Section, 2003). By 2030, the population in Morgan County is expected to increase to 12,435; Morgan City and the unincorporated areas in Morgan County are expected to increase to 4261 and 8174, respectively (Demographic and Economic Analysis Section, 2000). Although Morgan City is on a community sewer system, most other development in Morgan Valley uses septic tank soil-absorption systems for wastewater disposal. These septic-tank systems are on valley-fill deposits that are a major drinking-water aquifer for the area. Preservation of ground-water quality and the potential for ground-water quality degradation are critical issues that should be considered in determining the extent and nature of future development in Morgan Valley. Local government officials in Morgan Valley have expressed concern about the potential impact that development may have on ground-water quality, particularly development that uses septic tank soil-absorption systems for wastewater disposal. Local government officials would like to formally identify current ground-water quality to provide a basis for defendable land-use regulations to protect ground-water quality.

FACTUAL DATA

Sufficient information is available to classify the valley-fill aquifer in Morgan Valley. Data required to formally petition the Utah Water Quality Board were partly obtained from previously published studies. Most of the information required for classification is contained on maps and data tables submitted with this petition, including:

- X Plate 1 - Ground-water quality map showing total-dissolved-solids concentrations.
- X Plate 2 - Ground-water quality classification map showing ground-water quality classification, well locations, and ground-water flow direction.
- X Plate 3 - Potential-contaminant-source map.

In addition, provided along with this petition is the following previously released publication containing valuable information about the Morgan Valley valley-fill aquifer:

- ■ Ground-water reconnaissance of the central Weber area, Morgan and Summit Counties, Utah (Gates and others, 1984).

GEOHYDROLOGIC CONDITIONS

Geologic Setting

Morgan Valley is situated in a structural trough shared by Ogden Valley to the north (Saxon, 1972). The Wasatch Range bounding Morgan Valley to the west consists predominantly of Precambrian metamorphic rocks of the Farmington Canyon Complex (Bryant, 1988). Most of the area surrounding Morgan Valley consists of Tertiary tuffaceous sandstone and tuff; Cretaceous to Tertiary conglomerate and conglomeratic sandstone with some siltstone, mudstone, and limestone; and Quaternary alluvial, colluvial, and mass-movement deposits (Hintze, 1980). Precambrian crystalline basement rocks and Paleozoic and Cretaceous sedimentary rocks crop out on the north side of Upper Weber Canyon (Hintze, 1980).

Most of the alluvium in Morgan Valley greater than 10 feet (3 m) thick is located along the major tributaries and the flood plain of the Weber River (Gates and others, 1984). The alluvium is mainly derived from the Cretaceous and Tertiary sedimentary rocks that surround the valley. The main aquifer in Morgan Valley is in these alluvial valley-fill deposits, which consist primarily of clay, silt, sand, and gravel up to 200 feet (60 m) thick (Gates and others, 1984). The silt and clay, which may be derived primarily from weathering of the Tertiary Norwood Tuff, form discontinuous lenses in the valley-fill alluvium (Saxon, 1972). Eardley (1944) suggested Morgan Valley did not accumulate the large thickness of alluvium present in Ogden Valley to the north because Morgan Valley alluvium was eroded by the Weber River in response to uplift and faulting.

Ground-Water Conditions

Introduction

Ground-water resources, which are locally used for domestic and public supplies and livestock watering, are of secondary importance compared to surface water in Morgan Valley in terms of development issues (impoundment, diversion, and regulation) and annual supply. However, the data collected by Gates and others (1984) indicate that most reaches of the Weber River in Morgan Valley and the downstream reaches of East Canyon Creek are gaining reaches, and factors affecting surface-water resources in the Morgan Valley area can also affect ground-water resources.

Valley-fill Aquifer

Valley-fill alluvium is the most important aquifer in the Morgan Valley area due to its permeability and because it contains fresh water. Ground-water resources in Morgan Valley are developed by means of small-capacity wells for domestic use at farms and individual residences, and in large-capacity wells for public-supply and some industrial uses (such as Browning Arms

Company) (Gates and others, 1984). Many wells are screened in both Quaternary alluvium and Cretaceous and Tertiary semiconsolidated rocks such as the Norwood Tuff and Wasatch Formation (Gates and others, 1984).

Ground water in the unconsolidated alluvium is generally under water-table conditions (Saxon, 1972) (figure 2). Ground water moves from the valley margins toward East Canyon Creek and the Weber River, and then downstream toward the head of Weber Canyon (Gates and others, 1984).

Gates and others (1984) summarized the hydrogeology of Morgan Valley including recharge, discharge, and estimates of water volume stored in the valley-fill aquifer; the information described below is from their 1978 to 1980 study.

Recharge to the valley-fill aquifer in Morgan Valley is from precipitation, downward seepage from losing stretches of perennial and ephemeral streams (mostly along the valley margins), underflow to alluvium from older rock units, infiltration from irrigation, and seepage from irrigation canals located along the valley margins. In terms of quantity, the main sources of recharge are seepage from streams, infiltration from irrigation, and canal losses.

Discharge of ground water from the valley-fill aquifer in the Morgan Valley area is by seepage to the Weber River and East Canyon Creek; transpiration by phreatophytes, crops, and pasture vegetation; discharge from wells and springs; and underflow out of the valley through valley-fill alluvium at the head of Weber Canyon. Gates and others (1984) estimated the minimum ground-water discharge from the area is about 40,000 acre-feet per year (49 hm^3); this estimate does not include discharge from phreatophytes, which they estimated at about 5000 acre-feet per year (0.6 hm^3). Total ground-water discharge from wells and springs for public, domestic, and industrial use is estimated to be about 1200 acre-feet per year (1.5 hm^3). Ground-water underflow in valley-fill alluvium that leaves Morgan Valley in Weber Canyon is estimated to be about 1000 acre-feet per year (1.2 hm^3).

Gates and others (1984) estimated the volume of water stored in valley-fill in the study area to be 1,700,000 acre-feet (2100 hm^3), and assuming a specific yield of 0.10, the estimated theoretically recoverable ground water is 170,000 acre-feet (210 hm^3). This is about 50% of the annual flow of the Weber River at Gateway in Weber Canyon. Long-term water-level measurements from wells in Morgan Valley indicate long-term changes in ground-water storage have not occurred; this suggests that, during the 40 to 50 years prior to 1984, ground-water recharge and discharge have been in equilibrium. Hydrographs from wells in the study area show seasonal and year-to-year fluctuations in ground-water levels; this illustrates the relationships among ground-water levels, run-off, and seepage from irrigation canals. In many cases, ground-water levels are higher during late summer and fall than during the spring, showing the effects of recharge during the irrigation season.

Ground-water quality in the Morgan Valley is generally good and is suitable for most uses. Under drinking-water and ground-water protection regulations, ground water is classified based largely on total-dissolved-solids (TDS) concentrations as shown in table 1. Class IA and II water is considered suitable for drinking, provided concentrations of individual constituents do not exceed state and federal ground-water quality (health) standards. Class III water is generally suitable for drinking water only if treated, but can be used for some agricultural or industrial purposes without treatment; ground water that falls within classes IA or II based on TDS concentrations, but with individual constituents that exceed ground-water quality (health) standards, falls within Class III. Class IV water, though not suitable for drinking, may in some instances be mined for its dissolved minerals. Two other ground-water quality classes, Class IB (Irreplaceable) and Class IC (Ecologically Important), are not based on TDS concentrations.

Table 1. *Ground-water quality classes under the Utah Water Quality Board's total-dissolved-solids- (TDS) based classification system (modified from Utah Division of Water Quality, 1998).*

Ground-Water Quality Class	TDS Concentration	Beneficial Use
Class IA/IB[1]/IC[2]	Less than 500 mg/L[3]	Pristine/Irreplaceable/ Ecologically Important
Class II	500 to less than 3000 mg/L	Drinking Water[4]
Class III	3,000 to less than 10,000 mg/L	Limited Use[5]
Class IV	10,000 mg/L and greater	Saline[6]

[1]Irreplaceable ground water (Class IB) is a source of water for a community public drinking-water system for which no other reliable supply of comparable quality and quantity is available due to economic or institutional constraints; it is a ground-water quality class that is not based on TDS.
[2]Ecologically Important ground water (Class IC) is a source of ground-water discharge important to the continued existence of wildlife habitat; it is a ground-water quality class that is not based on TDS.
[3]For concentrations less than 7000 mg/L, mg/L is about equal to parts per million (ppm).
[4]Water having TDS concentrations in the upper range of this class must generally undergo some treatment before being used as drinking water.
[5]Generally used for industrial purposes.
[6]May have economic value as brine.

Ground-water samples collected by Gates and others (1984) indicate that ground water within Morgan Valley is fresh. Total-dissolved-solids concentrations from 57 samples collected in 1979 from wells completed in a variety of geologic units range from 127 to 754 mg/L and average 387 mg/L (Gates and others, 1984). Average total-dissolved-solids concentration is 361 mg/L for alluvium, 375 mg/L for the Norwood Tuff, and 478 mg/L for the Wasatch Formation.

Some wells in several areas of Morgan Valley, including the Hardscrabble Creek area, have yielded nitrate-plus-nitrite concentrations above 3 mg/L (Quilter, 1997); the source of the nitrate is currently unknown.

GROUND-WATER QUALITY CLASSIFICATION DATA

To facilitate this ground-water quality classification, the Utah Geological Survey sampled 52 wells during March 2004. Ground water from 50 of the wells was analyzed for general chemistry and dissolved metals and 51 wells for nutrients by the Utah Department of Epidemiology and Laboratory Services (appendix A); of these 52 wells, ground water from five wells was analyzed for organics and pesticides and ground water from two wells was analyzed for radionuclides (appendix A). The Utah Geological Survey also measured specific conductance of ground water for all wells, and converted this data to total-dissolved-solids values for two wells not analyzed for this constituent. These data were augmented by specific-conductance, total-dissolved-solids concentration, and selected data from other ground-water constituents from 25 samples (nine having total-dissolved-solids data) collected from public-supply wells and one spring as reported by the Utah Division of Drinking Water and 6 wells from the Utah Department of Agriculture and Food (appendix A).

Total-Dissolved-Solids Concentrations

The Utah Water Quality Board's drinking-water quality (health) standard for total dissolved solids is 2000 mg/L for public-supply wells. The secondary ground-water quality standard is 500 mg/L (U.S. Environmental Protections Agency, 2002), and is primarily due to imparting a potential unpleasant taste to the water (Bjorklund and McGreevy, 1971). Plate 1 shows the distribution of total dissolved solids in Morgan Valley's valley-fill aquifer. Based on data from ground-water samples from 66 wells and one spring (52 Utah Geological Survey, six wells Utah Department of Agriculture and Food, eight public water-supply wells and 1 public-supply spring), total-dissolved-solids concentrations in the valley-fill aquifer of Morgan Valley range from 92 to 1018 mg/L, with only one well exceeding 1,000 mg/L TDS and an overall average total-dissolved-solids concentration of 441 mg/L (appendix A, plate 1).

Nitrate Concentrations

The ground-water quality (health) standard for nitrate is 10 mg/L (U.S. Environmental Protection Agency, 2002). More than 10 mg/L of nitrate in drinking water can result in a condition known as methoglobinemia, or "blue baby syndrome" in infants under six months (Comley, 1945), which can be life threatening without immediate medical attention (U.S. Environmental Protection Agency, 2002). This condition is characterized by a reduced ability for blood to carry oxygen. Based on data from ground-water samples from 82 wells and one spring, nitrate-as-nitrogen concentrations range from less than 0.1 to 12.8 mg/L, with three wells yielding ground water above the ground-water quality standard for nitrate and an overall average nitrate concentration of 2.7 mg/L (appendix A). Thirty-four percent of the wells yielded ground water exceeding nitrate concentrations of 3 mg/L; wells exceeding the water-quality standard are near Porterville and the mouth of Hardscrabble Creek canyon.

Other Constituents

Based on the data presented in appendix A, three wells exceeded primary water-quality standard of 10 μg/L for arsenic. Small amounts of arsenic can cause skin damage or circulatory system problems, and may increase the risk of cancer (U.S. Environmental Protection Agency, 2002). No wells exceeded primary or secondary ground-water quality standards for any constituent except total dissolved solids, nitrate-as-nitrogen, and arsenic (appendix A).

PROPOSED CLASSIFICATION

Under "Administrative Rules for Ground Water Quality Protection R317-6, March 3, 2003," Section 317-6-3, Ground Water Classes, Utah Administrative Code, Utah's ground-water quality classes are based on TDS concentrations as shown in table 1. Two other classes, IB and IC, are not based on ground-water chemistry. Class IB ground water, called Irreplaceable ground water, is a source of water for a community public drinking-water system for which no reliable supply of comparable quality and quantity is available because of economic or institutional constraints; this class has not been considered as part of this petition. Class IC ground water, called Ecologically Important ground water, is a source of ground-water discharge important to the continued existence of wildlife habitat. Ground-water protection levels for classes IA and IB, as set under "Administrative Rules for Ground Water Quality Protection R317-6, March 3, 2003," Section 317-6-4, Ground Water Class Protection Levels, Utah Administrative Code, are more stringent than for other ground-water quality classes.

Morgan County is petitioning the Utah Water Quality Board to classify the principal valley-fill aquifer in Morgan Valley as shown on plate 2. The classification is based on data from ground water from the 66 wells and one spring presented in appendix A. Total-dissolved-solids concentrations for eight well sites were calculated based on the relationship between specific conductance and TDS derived from data from 50 wells in Morgan Valley for which both values are known (figure 3, appendix A). Where insufficient data exists, extrapolation of ground-water quality conditions is required. We based the extrapolation on local geologic characteristics. The classes (plate 2) are described below. Wells having elevated nitrate and arsenic concentrations are not mapped as extensive contaminant plumes, and are dominantly isolated wells that are typically adjacent to water wells having low levels of these concentrations; we do not classify single wells, only areas of extensive contamination are considered as Class III.

Class IA- Pristine ground water: For this class, total-dissolved-solids concentrations in Morgan Valley range from 92 to 496 mg/L (appendix A). Class IA areas are mapped throughout most of Morgan Valley (plate 2). Areas having Pristine water quality cover about 98% of the total valley-fill material.

Class II- Drinking Water Quality ground water: For this class, TDS concentrations in the Morgan Valley valley-fill aquifer range from 510 to 1,018 mg/L (appendix A). Total valley-fill area coverage of Class II water quality is 2% (plate 2). Class II ground-water quality is found in the vicinity of Hardscrabble and Deep Creeks in southwestern Morgan Valley (plate 2).

CURRENT BENEFICIAL USES

In the Morgan Valley area, ground water from the valley-fill aquifer is an important source of domestic and municipal culinary water for people living within the valley; surface water is an important source of water used for agricultural irrigation (Gates and others, 1984). Domestic supply of municipal ground-water use in 2003 was 78%; commercial and industrial use was 7%, irrigation and stock water-use was about 3%, and other uses was 12%

WATER-SUPPLY WELLS

There are 312 approved water wells in Morgan Valley based on Utah Division of Water Rights records, 37 of which are public-supply wells (Mark Jensen, Division of Drinking Water, personal communication, August 2002). The location of all wells is shown on plate 2.

POTENTIAL CONTAMINANT SOURCES

Potential ground-water contaminant sources were mapped by Hansen, Allen, and Luce, Inc. (2001) and include some facilities related to mining, agricultural practices, industrial uses, fuel storage, and junkyard/salvage areas (appendix B, plate 3). A primary objective was to identify potential contaminant sources to establish a relationship between water quality and land-use practices. Approximately 319 potential contaminant sources are in the following categories in Morgan Valley:

(1) Mining, which includes abandoned and active gravel, phosphate, and carbonate mining operations.

(2) Agricultural practices, which consist of irrigated and non-irrigated farms, animal feeding operations, and cropland; active and abandoned animal feed lots, corrals, stables/barnyards; and animal wastes that are dominantly produced from feeding facilities, waste transported by runoff, and excrement on grazing or pasture land that potentially contribute nitrate.

(3) Junkyard/salvage areas that potentially contribute metals, solvents, and petroleum products.

(4) Government facility/equipment storage associated with a variety of sources such as salt storage facilities, and transportation/equipment storage that may contribute metals, solvents, and petroleum.

(5) Cemeteries, nurseries, greenhouses, ball parks, and golf courses that may contribute chemical preservatives, fertilizer, and pesticides.

(6) Storage tanks that may contribute pollutants such as fuel and oil.

(7) Equipment vehicle storage and maintenance that may contribute pollutants such as fuel and oil.

(8) Manufacturing and industrial uses that may contribute pollutants such as fuel and oil.

(9) Rural and residential homes that may contribute pollutants from septic tanks, fuel, household hazardous waste, equipment, and animal by-products.

(10) Remediation efforts that may contribute pollutants associated with hazardous material contamination remediation.

(11) Wastewater treatment plants and sewage lagoons which may contribute pollutants such as nitrates, fuel, and oil.

In addition to the above-described potential contaminants, septic tank soil-absorption systems in Morgan Valley are common and may potentially pollute ground water. The number of septic-tank systems is currently unknown in Morgan Valley (Weber-Morgan Health Department, verbal communication). Septic-tank systems may contribute contaminants such as nitrate and solvents. All approved water wells, shown on plate 2, are also considered potential contaminant sources.

EXISTING POLLUTION SOURCES

Existing pollution sources include those contaminants that have been documented and/or are currently being treated; potential contaminants address pollutants that have the potential to deteriorate ground water. There are no known existing source(s) of pollution in Morgan Valley.

GROUND-WATER FLOW

Ground-water flow is from the valley margins toward the Weber River, and then downstream (north and then west) toward the head of Weber Canyon (plate 2) (from Gates and others, 1984).

SUMMARY

Ground water is an important source of drinking water in Morgan Valley. Ground-water quality classification is a tool that can be used in Utah to manage potential ground-water contamination sources and protect the quality of ground-water resources. The results of the proposed ground-water quality classification for Morgan Valley indicate that the valley-fill aquifer contains mostly high-quality ground-water resources that warrant protection. Ninety-eight percent of the valley-fill area in Morgan Valley is classified as having Class IA ground water, and 2% is classified as having Class II ground water, based on chemical analyses of water from 52 wells sampled during March 2004 by the Utah Geological Survey, six wells sampled during May 2004 by the Utah Department of Agriculture and Food, and eight wells and one spring from 1996 to 2003 for data from the Utah Division of Drinking Water (TDS range of 92 to 1018 mg/L).

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APPENDICES

APPENDIX A

WATER-QUALITY DATA

Key to the symbols and footnotes for appendix B:

U = non-detect

a "-" indicates no data

UGS = Utah Geological Survey

UDAF = Utah Department of Agriculture and Foods

WMDHD = Weber Morgan District Health Department

UDW = Utah Division of Drinking Water

-0.100 indicates no detection (U) above reporting level as reported by the UDAF

Note- Analysis was performed, in UDAF water samples, for the following constituents, however concentrations were less than detection limits and are not reported: Berylium, Cadmium, Cobalt, Carbonate, Chromium, Lithium, and Nickel.

*These five wells were also sampled for pesticides and organics for which results for all samples are as “U”, non-detectable.

APPENDIX B

POTENTIAL CONTAMINANT SOURCES

Key to the symbols and footnotes for appendix B:

UST/LUST = Underground storage tank/ Leaking Underground Storage Tank

RCRIS = Resource Conservation and Recovery Information System

Equip = Equipment

Mnfg = Manufacturing

HHW = Household Hazardous Waste