GUIDELINES FOR PREPARING HYDROGEOLOGIC REPORTS ADDRESSING SUITABILITY FOR ALTERNATIVE WASTE- WATER DISPOSAL SYSTEMS IN ROCK IN DUCHESNE COUNTY, UTAH

by
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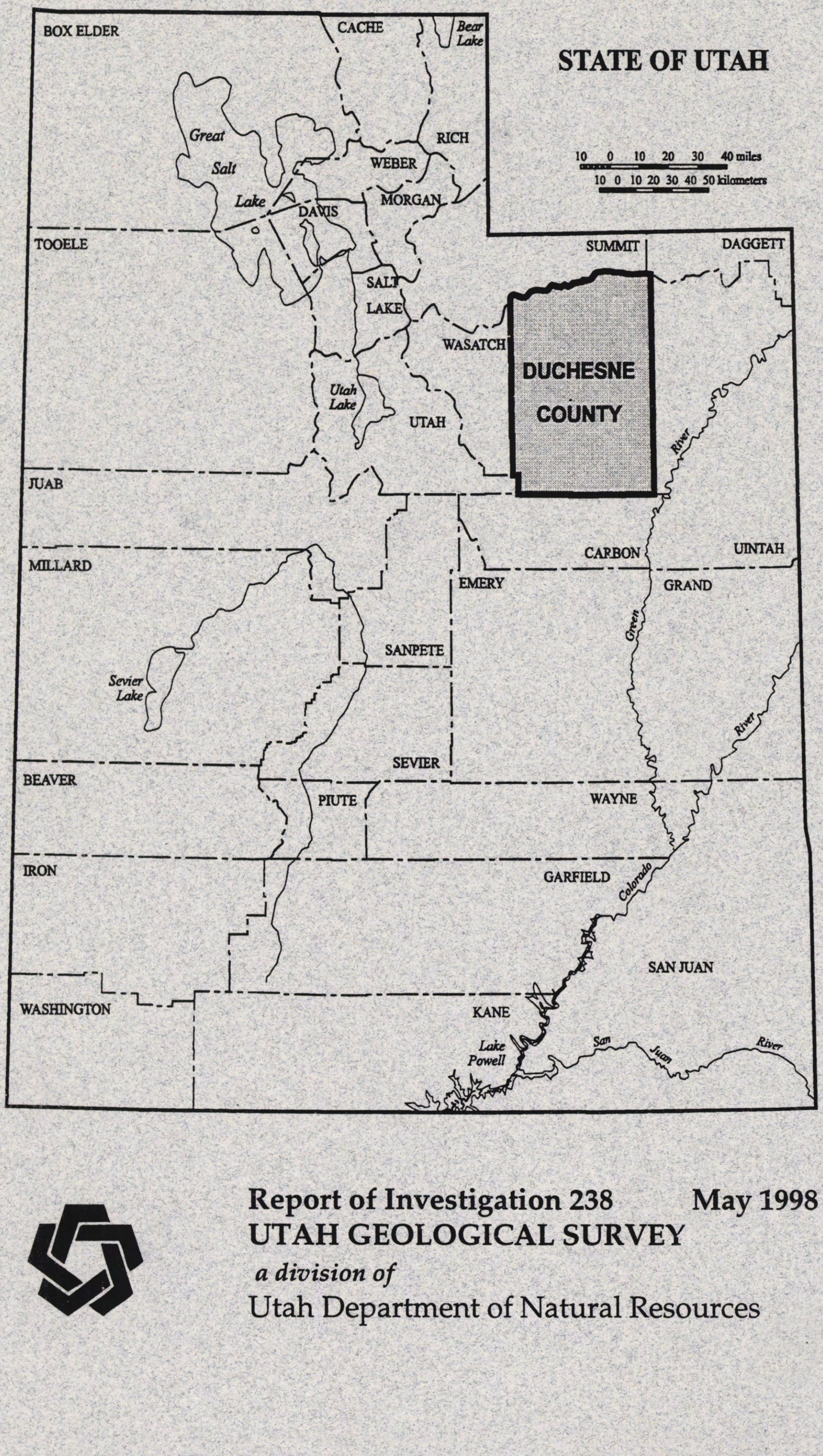

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ABSTRACT

Many lots in Duchesne County cannot presently be developed because exposed or shallow rock makes them unsuitable for conventional septic tank soil-absorption systems. Duchesne County and the Utah Division of Water Quality have developed designs for alternative waste-water disposal systems that may be used in rock if geologic conditions are suitable and humans will not be exposed to waste-water pathogens. Suitable geologic conditions include a 100-foot or greater depth to either poor quality or naturally protected ground water, adequate host-rock percolation rates, and topographic and geologic configurations that prevent waste water from surfacing or reaching culinary wells or springs within 250 days ground-water time of travel.

INTRODUCTION

Many lots in Duchesne County cannot presently be developed because exposed or shallow rock makes them unsuitable for conventional septic tank soil-absorption systems (Mulvey and Lund, 1990). Duchesne County and the Utah Division of Water Quality have developed designs for alternative waste-water disposal systems that may be used in rock if geologic conditions are suitable and humans will not be exposed to waste-water pathogens. To demonstrate conformance with these criteria, hydrogeologic studies of proposed sites will need to be conducted and results submitted to the Uintah Basin Public Health Department (UBPHD). The purpose of this report is to provide guidelines for: (1) geologists preparing hydrogeologic reports pertinent to waste-water disposal in rock, and (2) geologists and UBPHD officials reviewing these reports.

These guidelines do not include systematic descriptions of all available techniques, and do not imply that all techniques be used on every project. Variations in site conditions may require more or permit less effort than is outlined here. Many sections of these guidelines have been modified from Utah Geological and Mineral Survey Miscellaneous Publication M, "Guidelines for preparing engineering geologic reports in Utah" (Utah Section of the Association of Engineering Geologists, 1986).

PREPARATION OF HYDROGEOLOGIC REPORTS

The purpose of the hydrogeologic report is to show that conditions are suitable for an alternative septic tank soil-absorption system in rock. Suitable geologic conditions include a 100-foot or greater depth to either poor-quality or naturally protected ground water, adequate host-rock percolation rates, and topography and geology such that waste water cannot surface or reach culinary wells or springs within 250 days ground-water time of travel.

General Information

The report should describe the general site setting. The following items should be addressed:

(1) Site location, size, and general setting with respect to major or regional geographic and geologic features. A site-location map should be provided on a topographic base at a scale of 1:24,000 or larger. Subdivision site plans, if already prepared, should also be provided.

(2) List of references used and names(s) of geologist(s) performing the study.

(3) Topography and drainage within or affecting the site.

(4) General description of site geology.

(5) Location(s) of proposed septic tank soil-absorption system(s) and any culinary springs or water wells in the general area.

Hydrogeologic Investigation

Geologic mapping of the site should be on a topographic base at a scale which shows sufficient detail to adequately define the geologic conditions present. Available geologic maps generally must be supplemented with site-specific observations. It may be necessary to study the geology in adjacent areas to adequately define geologic conditions significant to the site.

The report should describe the types of rock and surficial materials, geologic structures, and show the three-dimensional relationships on one or more appropriately scaled cross sections or fence or block diagrams. The locations of test holes (drill holes, test pits, and trenches) should be shown on maps and cross sections. Logs of test holes should be included in the report to permit technical reviewers to make their own interpretations.

The following checklist may be useful as a general, though not necessarily complete, guide for geologic descriptions.

1. Geologic Conditions

A. Rock types (such as granite, silty sandstone, clay, shale).

B. Relative age and, where possible, formation name (such as Wasatch Formation, Navajo Sandstone).

C. Pertinent physical characteristics and variability of rock units (such as color, grain size, voids, thickness, stratification).

D. Dip of beds and description of folds shown on map and in cross sections.

E. Occurrence, distribution, dimensions, aperture, infilling, orientation, and variability of faults and joints; influence of clay seams, fault gouge, and other infillings on hydrologic conditions.

F. Special hydrogeologic characteristics or concerns (such as stratigraphic, lithologic, and structural controls on vertical and horizontal hydraulic conductivity).

G. Identification of unconsolidated deposits, including depositional environment (alluvial, colluvial, eolian, glacial, lacustrine, residual, mass movement, volcanic [such as cinders and ash], and fill), grain size, compactness, cementation, relative age, distribution, and thickness.

2. Hydrologic Conditions

A. Locations of drainage courses, ponds, swamps, springs, and seeps.

B. Identification and characterization of aquifers; depth to ground water, seasonal fluctuations, type (confined, unconfined), potential for local perched aquifers above regional aquifers, water quality, ground-water-flow direction and rate, and recharge and discharge areas.

C. Topographic and geologic controls on the ground-water system.

Assessment Of Site Suitability

To show that a site is suitable for alternative waste-water disposal systems, the study must first demonstrate that conventional waste-water disposal systems cannot be used and all of the conditions listed below are met. I recommend that conditions be addressed in the order listed, and that the site be considered unsuitable and study terminated at any point where a condition is not met.

1. The depth to the regional water table or top of regional confined aquifer is 100 feet or greater.

2. Underlying regional aquifers have water with total-dissolved-solids concentrations greater than 1,500 mg/L (1,500 ppm), or have higher quality water and are protected by thick, regionally extensive confining layers and an upward ground-water-flow gradient.

3. Slopes at the septic tank soil-absorption systems are less than 25 percent.

4. There is no evidence of periodic surface-water flooding of the site.

5. There is no evidence of seasonal shallow ground water within 4 feet of the anticipated bottom of septic tank soil-absorption-system drain-field lines.

6. Host-rock test-pit percolation rates are faster than 60 minutes/inch.

7. Wastewater from septic tank soil-absorption systems cannot surface or reach culinary wells or springs within 250 days ground-water time of travel based on conservative (protective) estimates of aquifer properties and ground-water-flow paths.

If information such as ground-water quality or depth is not available, it must be collected or the site will be considered unsuitable. Explanations and supporting evidence from references and field observations should be provided to allow technical reviewers to evaluate reliability of data, interpretations, and conclusions.

Test-pit percolation rates can be determined by excavating a test pit into the host rock at the proposed location of each septic tank soil-absorption-system drain field using the methods of Mulvey and Lund (1990). Pit dimensions should average 5 x 5 feet and 10 feet deep (Mulvey and Lund, 1990). Test pit walls should be logged and described in detail, with descriptions of rock type, bedding, fracture patterns, and evidence for shallow ground water. The test pit should be "...filled 3/4 full of water and left overnight to saturate the rock to simulate conditions during the use of a wastewater disposal system" (Mulvey and Lund, 1990). The next day, the same pit should be refilled, if necessary, to the original level and measurements of water levels taken and recorded every 30 minutes for a 4-hour period (Mulvey and Lund, 1990) to get a test-pit percolation rate. To evaluate lateral water movement along fractures or bedding planes, a second test pit should be excavated at the same time as the first test pit about 5 feet downslope or downdip to observe movement of water (Mulvey and Lund, 1990). Any water flowing into the downslope or downdip test pit on the day after the initial filling of the upslope or updip test pit should be recorded to help determine the potential for surfacing of waste water.

Darcy's Law and measured or conservative (protective) estimates of aquifer properties and ground-water-flow paths can be used to estimate the distance and direction waste water could travel in 250 days. Most pathogens found in waste water die within 250 days. The equation for ground-water seepage velocity (Fetter, 1980) is as follows:

$$v_s = (K/n_e)(dh/dl)$$

where:

v_s = seepage velocity (length/time).

K = hydraulic conductivity (length/time).

n_e = effective porosity (unitless).

dh/dl = hydraulic gradient (length/length = unitless).

Use measured aquifer properties when possible. If not available, ranges of values for hydraulic conductivity and effective porosity are published in hydrogeology textbooks and journals and may be used to calculate ground-water velocity where site-specific values are unavailable. As a conservative approach, we recommend assuming an instantaneous travel time downward to the regional water table, and then using the hydraulic gradient of the aquifer for the time-of-travel calculation. Hydraulic gradients may be estimated from water levels in wells completed in the aquifer. A water-level-contour map by Schlotthauer and others (1981, plate 4) indicates that the regional hydraulic gradient in Duchesne County in fractured-rock aquifers is generally less than 0.04.

REVIEW OF REPORTS

Reports that conclude a site is suitable for waste-water disposal in rock using alternative septic tank soil-absorption systems should undergo a technical review to determine if the scope of work was sufficient and if the conclusions and recommendations are valid. Prior to a technical review, the UBPHD should perform a preliminary compliance review to determine if the report is complete and a technical review is necessary. The preliminary compliance review should determine that the report:

1. concludes the site is suitable;

2. documents percolation rates faster than 60 minutes/inch;

3. contains a site-location map on a topographic base at a scale of 1:24,000; or larger showing water wells, if any, in the area;

4. contains a site map or maps on a topographic base at an appropriate scale showing the location(s) of the proposed septic tank soil-absorption system(s) and percolation-rate test pit(s);

5. describes site geology and includes a geologic map;

6. describes hydrologic conditions of the site; and

7. identifies the geologist(s) performing the evaluation.

The technical review of the report should be conducted by a qualified geologist. The Utah Geological Survey can provide such reviews for Duchesne County.

REFERENCES

Fetter, C.W., Jr., 1980, Applied hydrogeology: Columbus, Ohio, Merrill Publishing Company, 488 p.

Mulvey, W.E., and Lund, W.R., 1990, Geologic evaluation of wastewater disposal in rock, Duchesne County, Utah: Utah Geological and Mineral Survey Special Study 72, 21 p., scale 1:100,000.

Schlotthauer, W.E., Nance, B.W., and Olds, J.D., 1981, Identification and characteristics of aquifers in Utah: Salt Lake City, Utah Division of Water Rights, 240 p.

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