Alternative Well Surface Seal Evaluation

Idaho Department of Water Resources

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Acknowledgements

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Alternative Minimum Sealing Requirements

Executive Summary

Surface seals are an essential part of the well construction process. Properly installed surface seals protect the well and ground water resource by preventing the migration of surface contaminants downward along the outside of the well casing. Improperly sealed wells provide a direct pathway for contaminants to reach ground water aquifers and provide a conduit to allow mixing of water between aquifers of different pressure, temperature or quality. Inadequate well seals can also facilitate pressure loss in artesian aquifers and waste of water into unsaturated formations. This occurs when the pressure from the artesian aquifer forces water into overlying dry formations through improperly sealed wells.

Idaho Well Constructions Standards Rules, IDAPA37.03.09 (Rules) require a minimum 38 foot well surface seal to minimize waste and contamination of the aquifer. Additional formation seals are required in artesian aquifers to mitigate pressure loss and to seal between aquifers of different pressure, temperature or quality.

The Rules allow an 18-foot minimum well surface seal when the well is 38 feet or less in total depth. The Rules also provide a waiver process to reduce the surface seal depth to less than 38 feet if the underlying geology has a shallow low permeability formation to which the well can be sealed (for example, a five foot clay layer). Additionally, the Rules specify that only an 18 foot surface seal is required in the Rathdrum Prairie Aquifer of northern Idaho. The Rathdrum Prairie Aquifer, whose boundaries are delineated in the Rules, consists of uniformly high permeability flood gravels and boulders that may render a 38 foot seal only marginally more protective than a shallower seal.

The Idaho Department of Water Resources (“IDWR” or “Department”) was asked by the Idaho Ground Water Association (“IGWA”) to identify and evaluate geographic areas of the State where hydrogeologic conditions might warrant alternatives to the 38-foot minimum well surface seal depth and to eliminate the waiver requirement in those areas. In response to this request, the Department evaluated several areas where hydrogeologic conditions have a potential to accommodate alternative minimum well surface seals. The objective of the evaluations was to determine if a minimum well surface seal of 38 feet is appropriate for the areas, or if an alternative seal depth is appropriate based on specific hydrogeologic conditions. The Department used a number of criteria to identify areas where hydrogeologic conditions have potential for alternative sealing depths. Criteria included input from licensed well drillers regarding local geology, published geologic maps and reports, regional IDWR well inspector experience and areas of known or suspected contamination. Using these criteria, the Department evaluated hydrogeologic conditions in three areas of the state to determine if alternative seal depths are justified. The three areas include:

- the northern Long Valley area of Valley County (or the Donnelly Area),
- the upper Big Wood River Valley of Blaine County, and
- the Island Park Area of Fremont County.

The Donnelly Area was evaluated at the request of local licensed drillers who suggest geological conditions require a majority of wells be drilled marginally deeper than 38 feet and that an 18 foot surface seal is adequate due to multiple shallow clay layers.

The upper Big Wood River Valley was evaluated based on IDWR regional well inspector experience and because, since the Rule change in 2009 the Department approved nine waiver requests for a shallower seal depth in the unconfined alluvial aquifer of the valley.

The Island Park Area in eastern Idaho was evaluated because it is an area where the Department has justified a modified, and deeper well seal depth for nearly twenty years. In 1996, the Island Park Area experienced an outbreak of Shigella sonnei bacteria which caused significant illnesses. The bacterial outbreak was later attributed to contaminated drinking water from a ground water source (CDC, March 22, 1996/Vol. 45/No. 11). The groundwater in the Island Park Area is vulnerable to surface contamination including sewage. Based on the incident of illness and the vulnerable fractured bedrock aquifer (rhyolite and basalt), the Department has required full length seals from ground surface to the production zone since 1996. In some cases these full length seals are in excess of 100 feet. No additional outbreaks have been reported since the Department has required deeper surface seals. The area has been included in this evaluation to determine if the modified well seal depth requirements are still justified.

Donnelly Area Evaluation

The Donnelly Area evaluation focuses on two subdivisions; referred to herein as Wagon Wheel and Norwood subdivisions, located in Long Valley west of State Highway 55 on the north end of Cascade Reservoir and southwest of Donnelly (figure 1). Wells in Wagon Wheel and Norwood subdivisions are drilled primarily for domestic purposes, including many summer homes and cabins. A local Valley County licensed driller with extensive experience in the area suggested that the geology may be appropriate for an 18 foot seal in those subdivisions. The request for consideration of a shallower seal depth is based on the following premises: 1) one or more confining clay layers are encountered above 38 feet that provide for an adequate formation to seal into, and 2) most of the wells are completed at or only slightly deeper than 38 feet.

Evaluation Methodology

Geologic and hydrogeologic data were evaluated from well driller reports on file with the Department and from the Surficial Geologic Map of the Donnelly Quadrangle, Valley County, Idaho published by the IGS. Department geologists collected additional data by logging the stratigraphy of six wells drilled in the area during summer and fall of 2014, to better characterize the geology and hydrogeology.

The study areas and well distribution are presented in figure 2. Driller report information obtained through the IDWR well data base for three hundred seventeen (317) wells in the Wagon Wheel subdivision and two hundred forty five (245) wells in the Norwood subdivision was included in this evaluation. Driller reports were evaluated to ascertain values for total depth and water level and to evaluate the stratigraphy.

Well depth and water levels are summarized in Table 1. The data indicates that average static water level is 14 feet in both Wagon Wheel and Norwood; average well depth is 53 feet in Wagon Wheel and 74 feet in Norwood. The percentage of wells 38 feet or less in total depth is 28% in Wagon Wheel and 15% in Norwood.

Table 1: Well Attributes, Wagon Wheel and Norwood

	Well Depth (feet)			Water Level (feet)			% wells 38 ft or less
	Minimum	Maximum	Average	Minimum	Maximum	Average	
Wagon Wheel (317 wells)	21	995	53	1	100	14	28
Norwood (245 wells)	30	635	74	0 (artesian)	56	14	15

ALTERNATIVE SEAL DEPTH EVALUATION, 2014
Wagon Wheel and Norwood Subdivisions
Donnelly Area, Long Valley Idaho

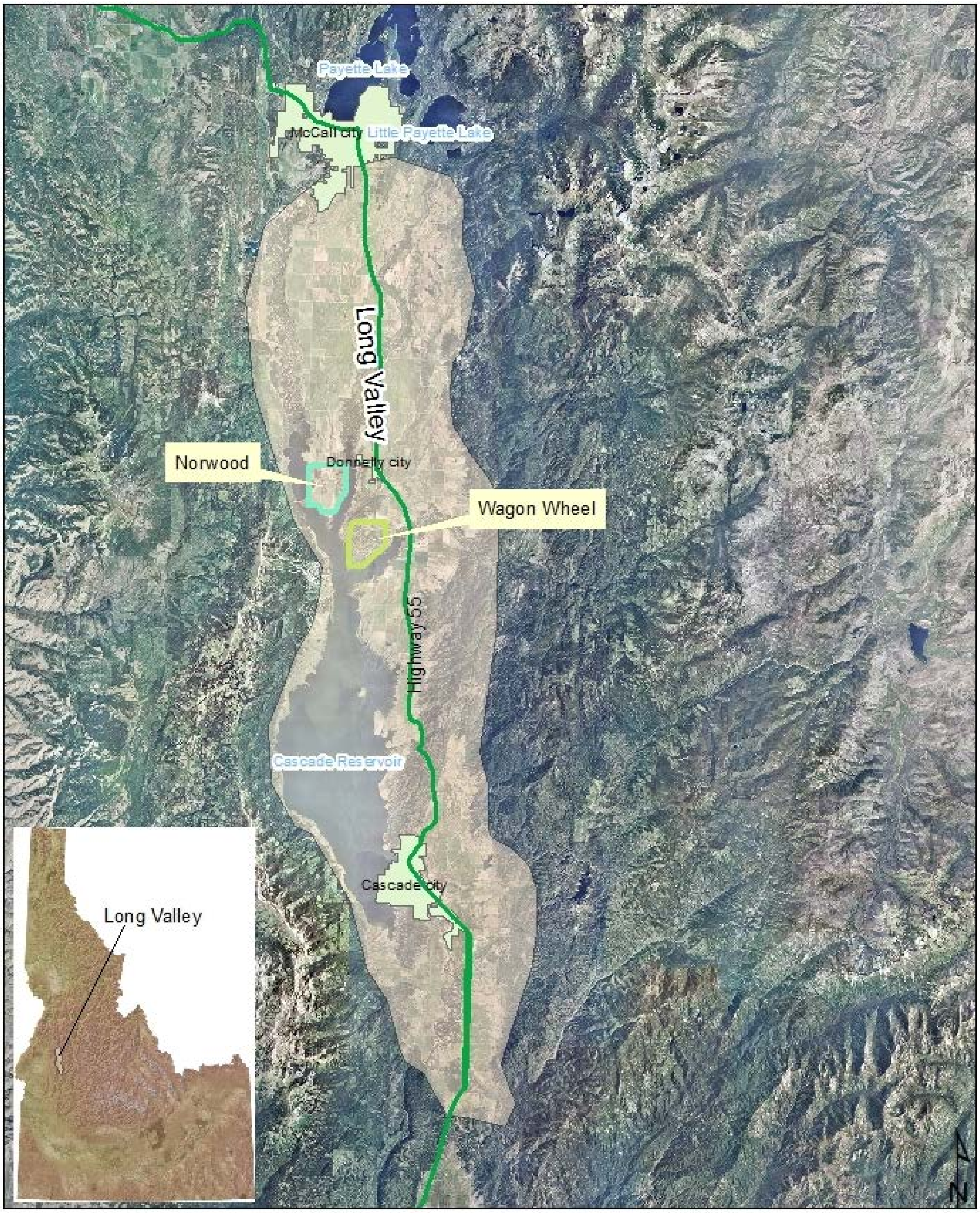

Figure 1: Wagon Wheel and Norwood Subdivisions

ALTERNATIVE SEAL DEPTH EVALUATION, 2014
Wagon Wheel and Norwood Subdivisions
Donnelly Area, Long Valley Idaho

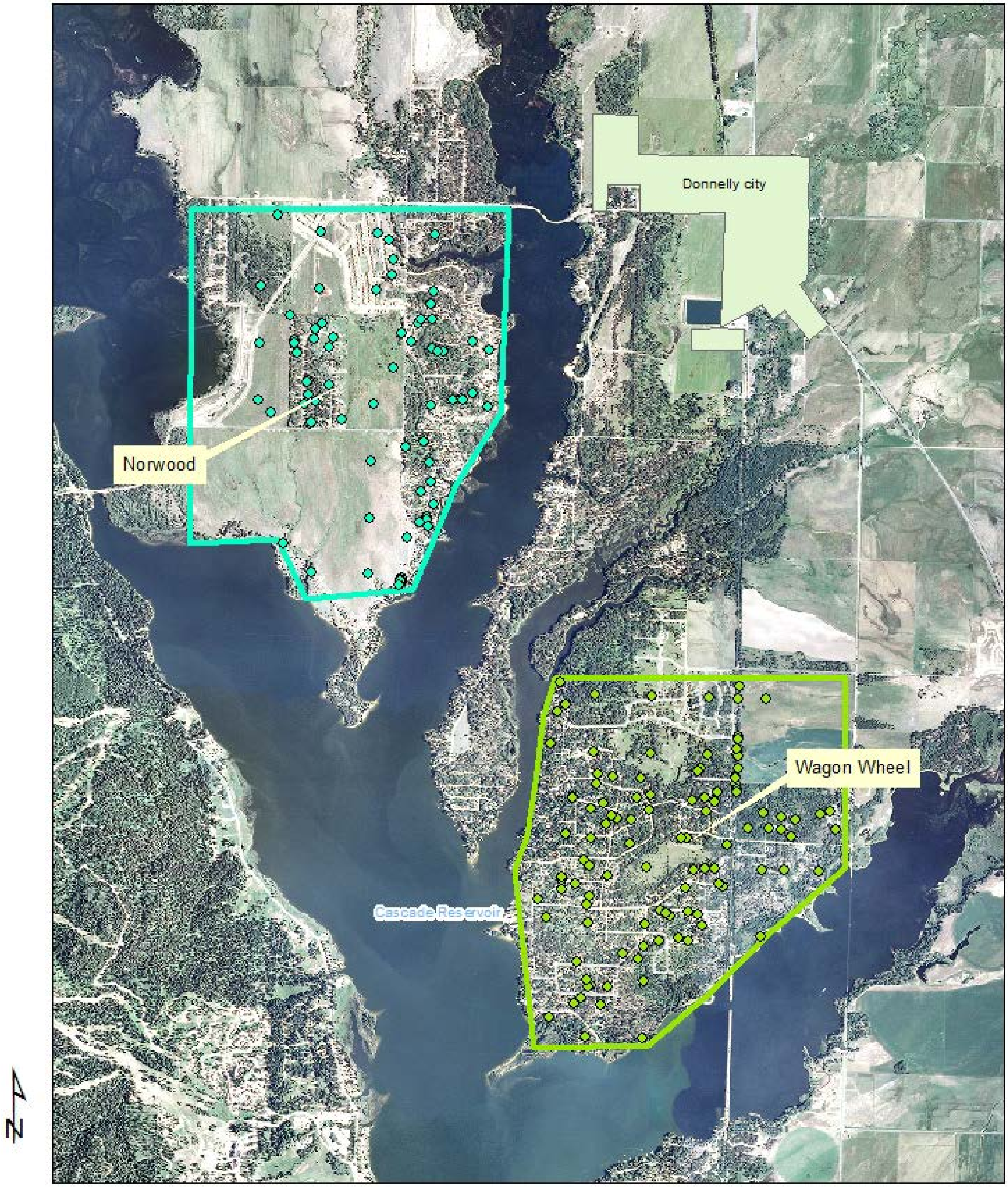

Figure 2: Wagon Wheel and Norwood Well Density

Results

Geology

Stratigraphy in Wagon Wheel as mapped by the Idaho Geological Survey ("IGS") consists of undivided glacial outwash (Qop) composed of coarse sand with a silty fine sand matrix (figure 3). Driller reports in Wagon Wheel characterize the geology as predominantly sand with clay layers ranging from one to several feet thick at various depths.

Stratigraphy in Norwood as mapped by IGS consists of glacial outwash deposits (Qopo), consisting of silty sand with local areas of clay and silt. Stratigraphy reported on driller reports in Norwood is predominantly sand and sandy clay with clay layers ranging from one to two feet thick commonly reported.

Descriptions of the geology provided from IGS indicate that, in general, the Qopo unit mapped in Norwood is finer grained than the Qop unit mapped in Wagon Wheel.

Hydrogeology

Six wells were logged by Department geologists for this study (figure 4). Table 2 provides basic data on the six wells logged by the Department including: total depth of the well, depth water was first encountered and static water level. The following general geologic description of the stratigraphy encountered in the wells applies to both Wagon Wheel and Norwood.

Table 2: Wells Logged by Department Geologists

Well Number	Total well depth	Depth water is encountered	Static Water level	Subdivision/Location
D0067210	39	33	21	Wagon Wheel
D0067211	65	60	20	Norwood (Morning Dawn #2)
D0067212	95	52	29	West Mountain Rd
D0067213	50	40	20	West Mountain Rd
D0067352	67	15	26	Norwood (Coho Estates)
D0067379	29	23	9	Wagon Wheel
Average	57.5	37	20.8	

Samples of drill cuttings from all six wells logged are unconsolidated, poorly sorted, glacial sediments ranging from silt to coarse sand and pebbles in a silty clay matrix with interspersed silt and clay lenses. Evaluation of the drill cuttings indicates much of what is described in driller reports as clay is more accurately classified as silt and fine sand with minor amounts of clay, and may be described as dirty or muddy sand. A conceptual diagram of the generalized geology is provided in figure 5.

ALTERNATIVE SEAL DEPTH EVALUATION, 2014
Wagon Wheel and Norwood Subdivisions
Donnelly Area, Long Valley Idaho

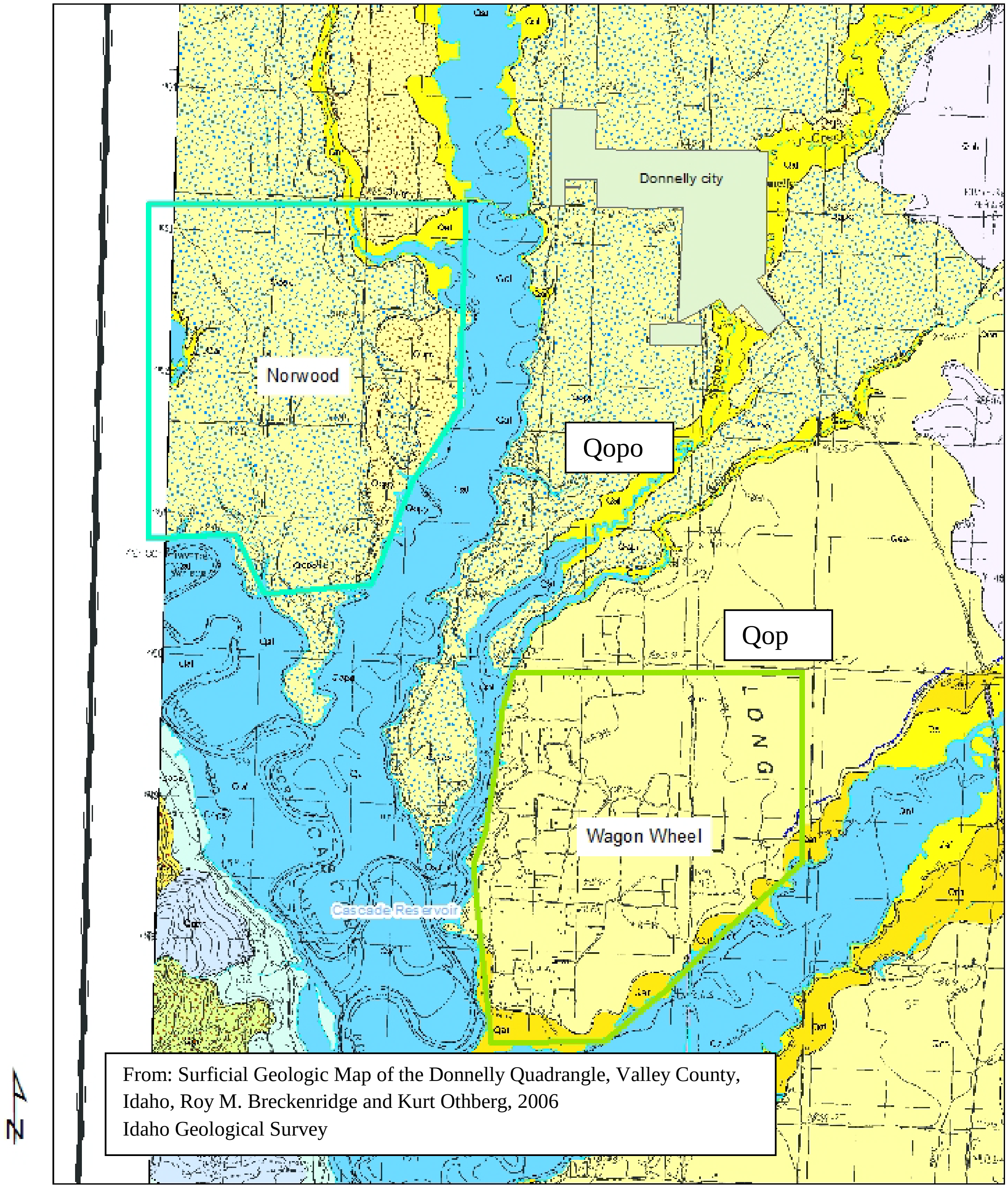

Figure 3: Mapped Geology, Wagon Wheel and Norwood

ALTERNATIVE SEAL DEPTH EVALUATION, 2014
Wagon Wheel and Norwood Subdivisions
Donnelly Area, Long Valley Idaho

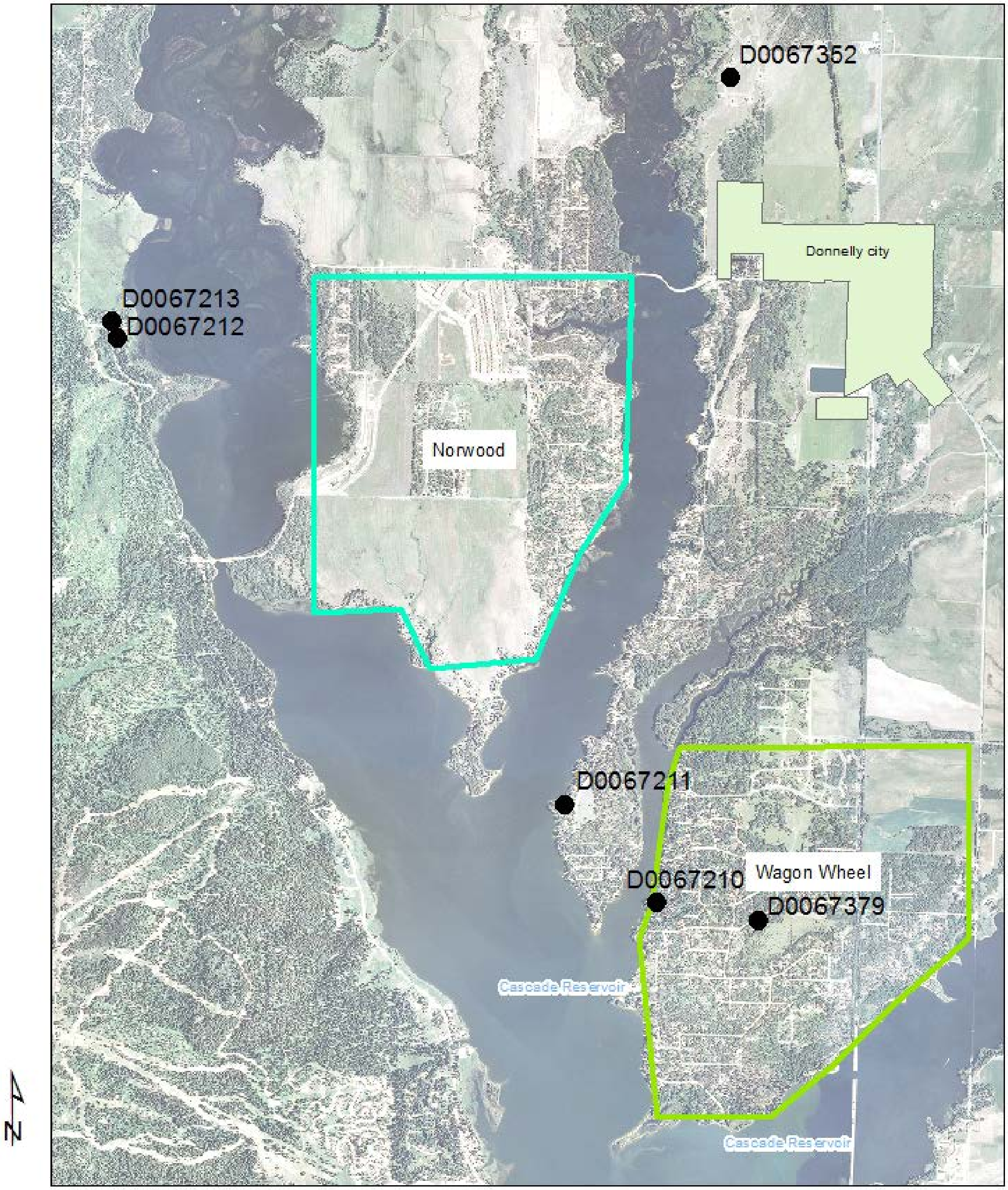

Figure 4: Wells Logged by Department Geologists

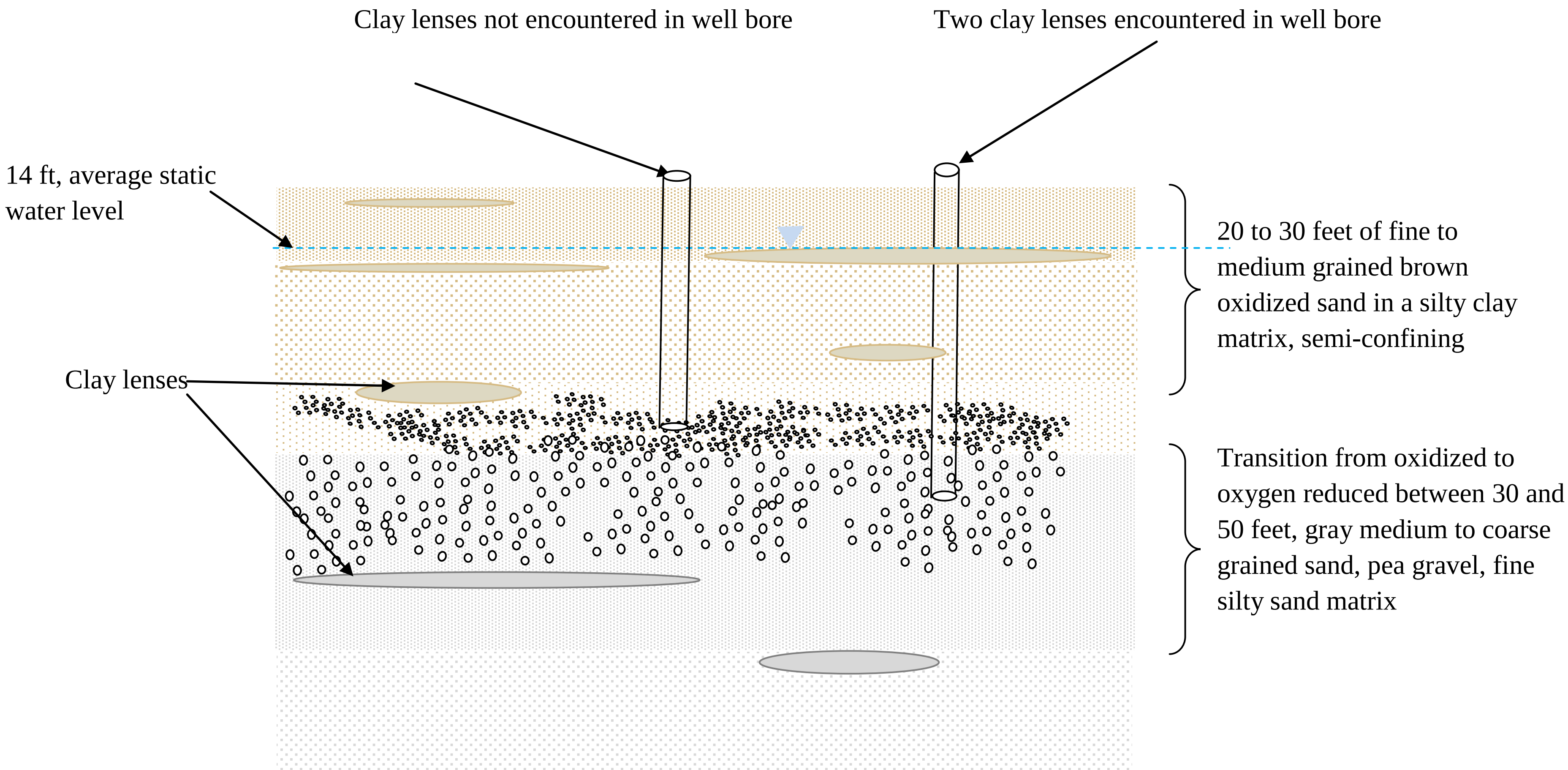

Figure 5: Conceptual Geology Diagram

The silt and clay vary in thickness from less than an inch to six feet and are not encountered in all wells. Although poorly sorted, the sequence represented in all six wells consists of finer grained sand in the upper 20 to 30 feet grading downward into coarser sand and gravel between 30 to 50 feet. This assemblage appears to result in a semi-confined aquifer. Wells completed in the deeper coarse grained sediments are artesian. A distinct color change from brown to blue or gray is commonly reported in both Wagon Wheel and Norwood between 30 to 50 feet but it is prevalent in wells deeper than 40 feet. This suggests oxidized sediment in the shallow portions of the well and reduced sediments deeper than 40 feet. Water produced from the oxygen reduced sediments has a hydrogen sulfide odor.

The six wells listed in table 2 first encountered water at an average depth of 37 feet and static water level averages 20.8 feet, indicating the production zone for wells in both Wagon Wheel and Norwood exhibit artesian conditions. The only well that does not exhibit artesian conditions is D0067352. Artesian conditions are reflected in a majority of the driller reports studied in detail during this evaluation.

Summary

The glacial outwash deposits underlying the Wagon Wheel and Norwood subdivisions provide for a complex stratigraphy and hydrogeology. Driller reports, published geologic maps and observations of drill cuttings by Department geologists show that the shallow geology consists of unconsolidated and poorly sorted sediments. In general the upper 30 to 50 feet consist of brown fine to coarse sand in a matrix of silt and clay grading with depth into coarser sand and gravel with decreasing clay. Wells completed in the coarse grained sediments near the base of this coarsening downward sequence are artesian. Sediments transition with depth from oxidized to reduced sediments as seen in the color change from brown to grey.

The water in the shallow oxidized sediments appears clear and has no noticeable odor. Water in some of the blue/gray reduced sediments has a significant sulfur odor. Local drillers have commented that they try to construct wells as shallow as possible to avoid the water with the sulfur odor.

Many of the wells in both the Wagon Wheel and Norwood subdivisions exhibit artesian conditions as shown on driller reports and in the wells logged by the Department. Table 2 shows that 5 of the 6 wells logged by Department Geologists have static water levels significantly higher than the depth where water was first encountered. The upper fine grained sediments are saturated, but produce only a few gallons per minute. Artesian pressure is encountered near the base of the oxidized sediments with copious water rising up the boring.

The data evaluated strongly suggests that two shallow subsurface aquifers are present in the Donnelly Area. Artesian conditions in many of the wells indicate that two aquifers are present based on different pressures. Water quality also suggests the presence of two aquifers. Water in the shallower portion of well borings is clean and has no odor while water encountered in the lower portion of some wells has a strong sulfur odor.

Conclusion and Recommendations

This study evaluated the subsurface geology and hydrogeology of the Wagon Wheel and Norwood subdivisions near Donnelly. The Rules require a 38 foot minimum surface seal unless the well is 38 feet or less in total depth. The study was initiated to determine if wells in this area can be constructed with an alternative 18 foot surface seal based on the geology and hydrogeology, without filing a waiver.

The premise under which this evaluation was conducted is:

1) That one or more confining clay layers are encountered above 38 feet that provide for an adequate seal, and

2) most of the wells are completed at or only slightly deeper than 38 feet.

Data collected during this evaluation indicates that these basic assumptions are not correct. The presumed confining layers of clay are discontinuous lenses, often very thin and not likely to be confining layers (see figure 5). The percentage of wells 38 feet or less in total depth is 28% in Wagon Wheel and 15% in Norwood. Average well depth is 53 feet in Wagon Wheel and 74 feet in Norwood. These numbers reflect a majority of wells with total depths significantly deeper than the original assumption that most are only slightly deeper than 38 feet.

This evaluation also indicates that there are artesian conditions present in the shallow subsurface. Wells which encounter artesian conditions are required to either have a continuous seal from land surface to the production zone, or a surface seal and a formation seal at whatever depth the confining layer occurs. Mixing of water between the oxidized and oxygen reduced water producing zones (different water quality) is not permitted by Rule. Wells completed into the oxygen reduced sediments should have a continuous seal to the production zone.

The minimum 38 foot well surface seal is an adequate well construction standard for the Donnelly Area based on the hydrogeologic conditions encountered through review of area well logs, and the six wells drilled and logged during this evaluation. If the well depth is 38 feet or less, then an 18 foot seal is appropriate. If the well is greater than 38 feet, a 38 foot seal is required unless the driller submits a waiver to justify a different sealing depth. Wells exhibiting artesian conditions should have a continuous seal to the production zone or a combination of a surface seal and formation seal into the confining layer to assure no mixing between the two aquifers showing different pressure and water quality. A blanket alternative minimum well surface seal is not recommended for Wagon Wheel and Norwood subdivisions based on the geologic and hydrogeologic data available.

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Surficial Geologic Map of the Donnelly Quadrangle, Valley County, Idaho published by the Idaho Geological Survey, 2006: Idaho Geological Survey, Roy M. Breckenridge and Kurt L. Othberg.

Shigella sonnei Outbreak Associated with Contaminated Drinking Water, Island Park, Idaho, Idaho August 1995: Centers for Disease Control, Morbidity and Mortality Weekly Report, March 22, 1996/Vol. 45/No. 11

Wood River Valley Evaluation

This evaluation focuses on the unconfined alluvial aquifer underlying the Wood River Valley in Central Idaho. The study area extends from Oregon Gulch in the north to Glendale Road south of Bellevue, Idaho (Figure 6). The valley is very narrow and surrounded by steep mountains rising to elevations greater than 11,000 feet above sea level. A licensed driller with significant experience in the Wood River Valley suggested that the geology of the unconfined alluvial aquifer may be appropriate for an 18-foot surface seal since the aquifer material consists of coarse sand, gravel and cobbles with no confining layers. An 18-foot surface seal is approved in Idaho Well Construction Standards Rules (Rules) within the established boundaries of the Rathdrum Prairie Aquifer, which consists of uniformly high permeability flood gravels and boulders. Licensed drillers in the Wood River Valley have submitted nine (9) waiver requests to the Idaho Department of Water Resources (Department) in 2013 and 2014 to install an 18-foot seal based on the geology of the unconfined alluvial aquifer. All nine waiver requests were approved by the Department. The distribution of the waivers granted is presented in Figure 7. This study evaluates the geology and hydrogeology of the unconfined alluvial aquifer to determine if an 18-foot seal surface seal would be appropriate throughout the study area.

Evaluation Methodology

Geology and hydrogeology of the Wood River Valley were evaluated from well driller reports on file with the Department, published geologic maps of the Wood River Valley, and US Geological Survey (USGS) publications regarding the hydrogeology of the Wood River Valley. Five hundred and fifty (550) well driller reports obtained through the Department's well database were evaluated as part of this study. Driller reports were evaluated to ascertain the geology of the unconfined alluvial aquifer and to determine the depth to bedrock.

Results

Geology

Bedrock geology in the Wood River Valley consists of folded and faulted Paleozoic sedimentary rocks, Cretaceous granitic rocks, and Tertiary Challis Volcanics. The bedrock geology is overlain by Quaternary alluvial deposits within the narrow valley consisting of coarse sediments, (Link, 2002). Figure 8 shows the distribution of the Quaternary sediments which comprise the unconfined alluvial aquifer (Ludington, et al, 2005).

The Surficial Geologic Map of the Wood River Valley describes the coarse alluvial sediments comprising the aquifer as channel and flood deposits consisting of sand, pebble and cobble river gravels with occasional boulders and very cobbly coarse sand deposits with a silt matrix (Breckenridge and Othberg, 2006).

Review of driller reports confirms that the geology of the unconfined aquifer consists of coarse sand, gravel cobbles and boulders with minor silt or clay. Approximately 60% of the

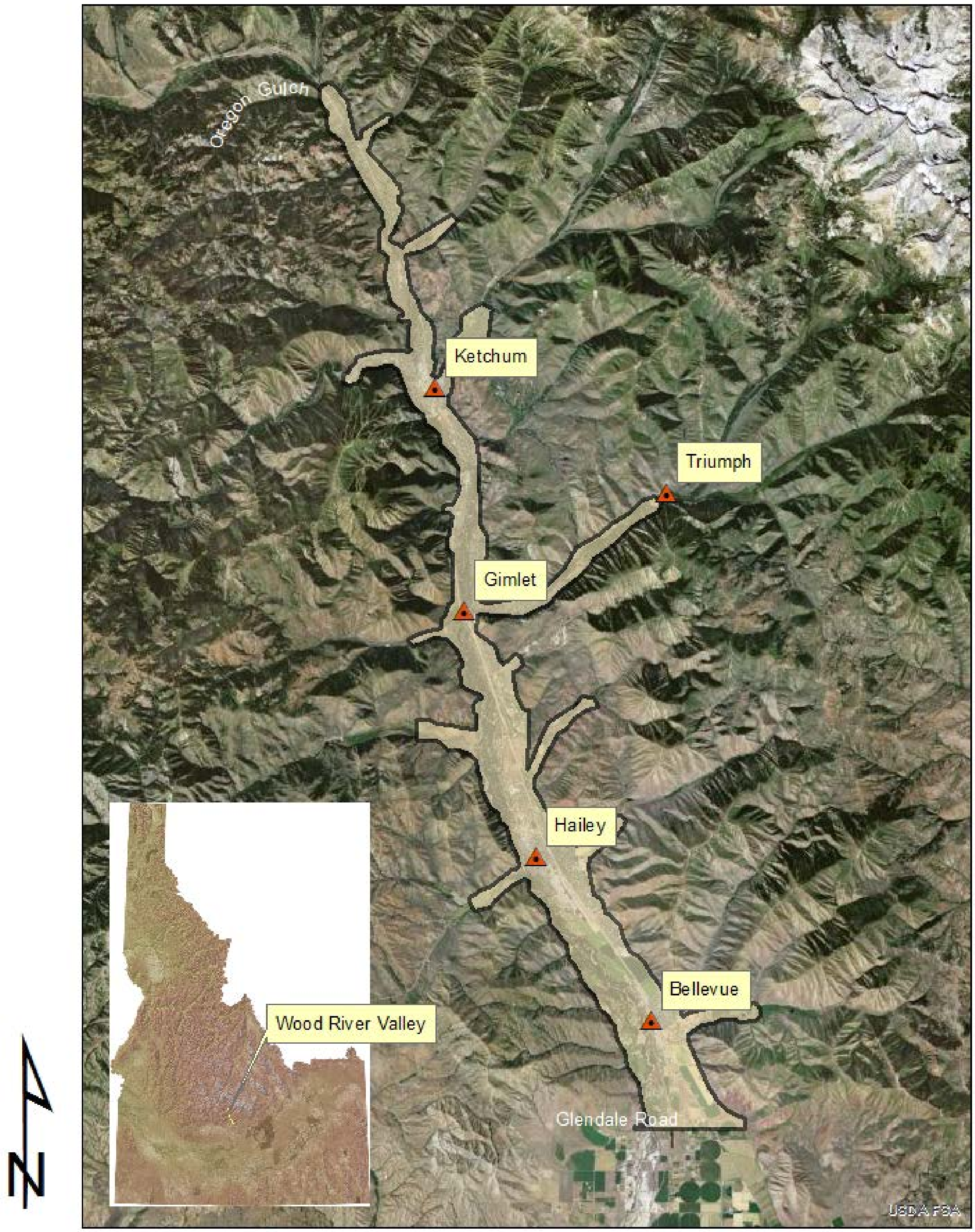

Figure 6: Study Area for the Wood River Valley Alternative Seal Evaluation

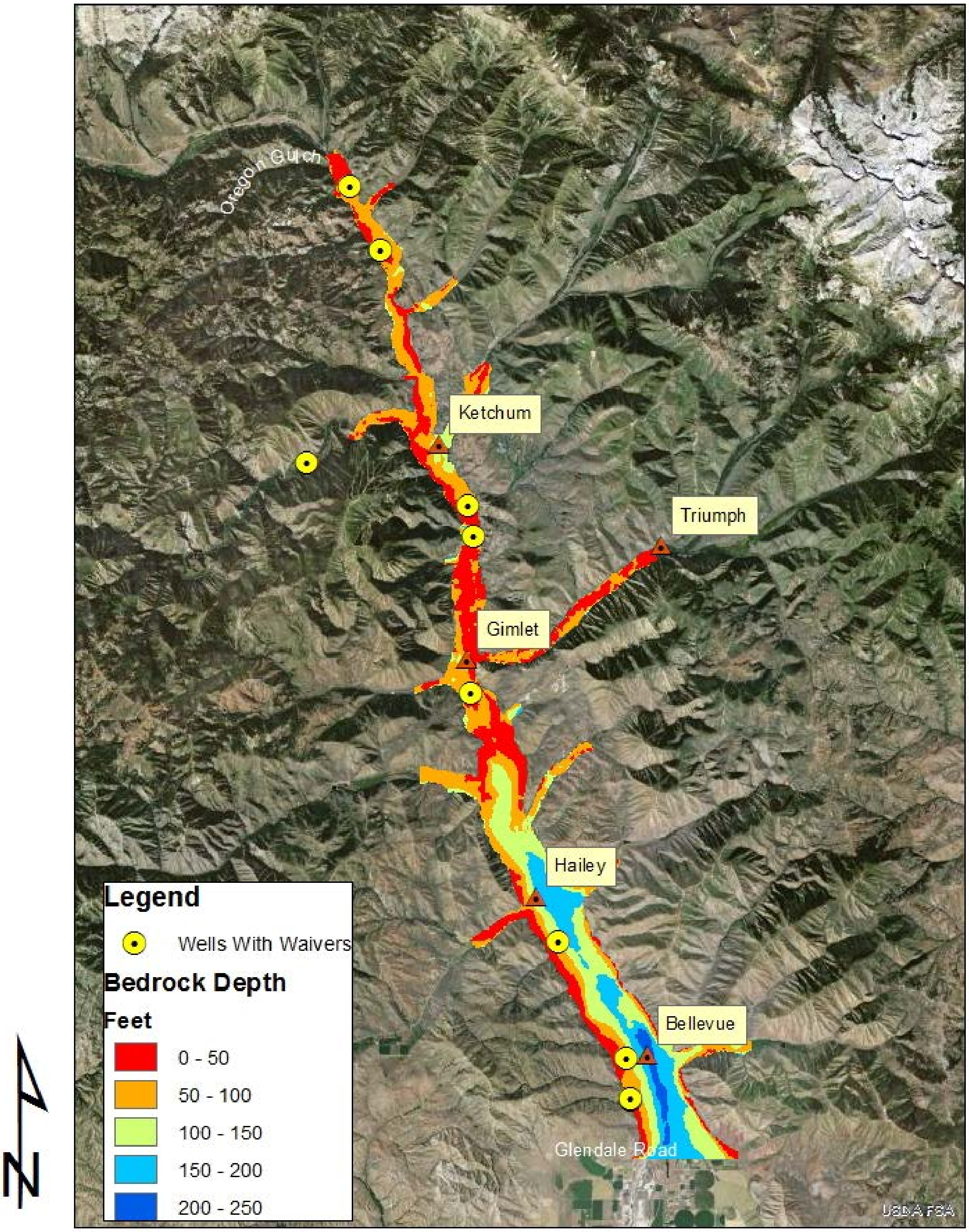

Figure 7: Thickness of Alluvial Sediments and Waivers issued in 2013 – 2014

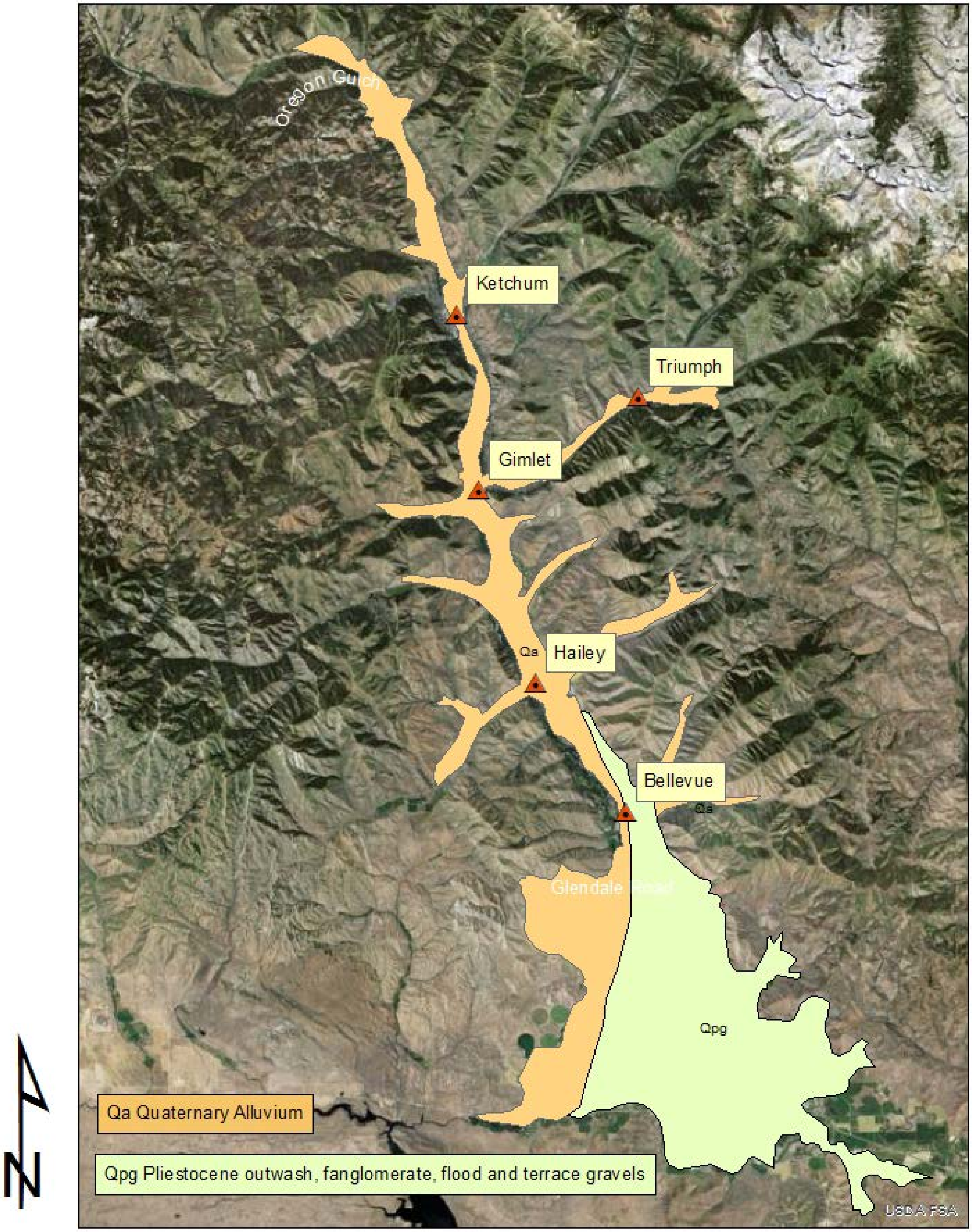

Figure 8: Map of the Wood River Valley Study Area showing the distribution of the Quaternary sediments comprising the unconfined aquifer

wells reviewed were drilled and constructed in the unconsolidated sediments. Approximately 40% of the wells evaluated encountered bedrock.

The USGS evaluated the depth to bedrock below the alluvial sediments. Thickness of the alluvial deposits ranges from less than 50 feet to approximately 230 feet. Figure 7 shows the estimated depth to bedrock (Bartolino and Adkins, 2012).

Hydrogeology

The aquifer system in the Wood River Valley is comprised of a single unconfined aquifer. A separate deeper confined aquifer, within basalt lava flows, is documented south of Glendale Road (Bartolino and Adkins, 2012). Glendale Road is the southern extent of the Wood River Valley Alternative Seal Evaluation. The confined aquifer is not part of this evaluation.

Ground water in the unconfined aquifer flows from north to south with a steep gradient. Streams are reported to be hydraulically connected to the shallow unconfined aquifer system (Bartolino and Adkins, 2012). Depth to ground water is reported to be less than 10 feet below ground surface in the upper (northern) part of the valley. The depth to water increases southward to approximately 90 feet below ground surface. Hydrogeologic studies by the USGS indicate that the upper unconfined aquifer has high hydraulic conductivity and high transmissivity, which means that water flows freely through the coarse sediments both horizontally and vertically. The high hydraulic conductivity and high transmissivity are related to the coarse grained sediments and steep gradient of the Wood River Valley drainage. Most of the ground water produced from the Wood River Valley aquifer system is from the coarse-grained alluvial aquifer (Bartolino and Adkins, 2012).

Summary

The unconfined aquifer system in the Wood River Valley is composed of coarse grained sediments consisting primarily of sand, pebble and cobble river gravels with occasional boulders and a minor silt matrix. The thickness of the coarse sediments is estimated to range from approximately 50 feet to 230 feet thick. The USGS has estimated high hydraulic conductivity and high transmissivity in the alluvial aquifer system. These coarse aquifer materials with high permeability may render the 38 -foot seal only marginally more protective than an 18-foot seal because of the lack of any confining layers. The Department has reviewed and approved nine waivers over the past two years based on the coarse alluvial geology with high hydraulic conductivity. An 18-foot surface seal is approved in Idaho Well Construction Standards Rules (Rules) within the established boundaries of the Rathdrum Prairie Aquifer. Although the Wood River Valley and the Rathdrum Prairie have different geologic histories, both aquifers consist of sand, pebbles, cobbles and boulders with a high hydraulic conductivity.

Conclusions and Recommendations

This study evaluated the subsurface geology and hydrogeology of the unconfined alluvial aquifer in the Wood River Valley. The Well Construction Standards Rules require a 38-foot minimum surface seal unless the well is 38 feet or less in total depth. The study was initiated to determine if wells in the unconfined alluvial aquifer can be constructed with an alternative 18-foot surface seal based on the geology and hydrogeology, without applying for a waiver of the minimum standards. The unconfined aquifer is composed of uniformly consistent coarse grained sediments with no confining layers which may allow for an 18-foot seal. Similar hydrogeologic conditions occur in the Rathdrum Prairie Aquifer where an 18-foot seal is allowed pursuant to state Rules.

Data collected during this evaluation indicates that the Wood River Valley unconfined aquifer is composed of coarse alluvial sediments with a high hydraulic conductivity. Confining layers are not documented in the upper unconfined aquifer. In these geologic conditions a 38-foot seal may not be significantly more protective than an 18-foot seal due to the lack of confining layers and uniformly consistent coarse alluvium.

This study recommends that the minimum well surface seal be modified to 18 feet within the boundaries of the unconfined alluvial aquifer in the Wood River Valley as established by the USGS (Figure 9). Wells drilled through the alluvial aquifer and into the bedrock will need either a full-length seal to the production zone into the bedrock or a formation seal as required by the Rules. Seals in the bedrock are necessary to prevent comingling between the alluvial aquifer and any bedrock aquifer.

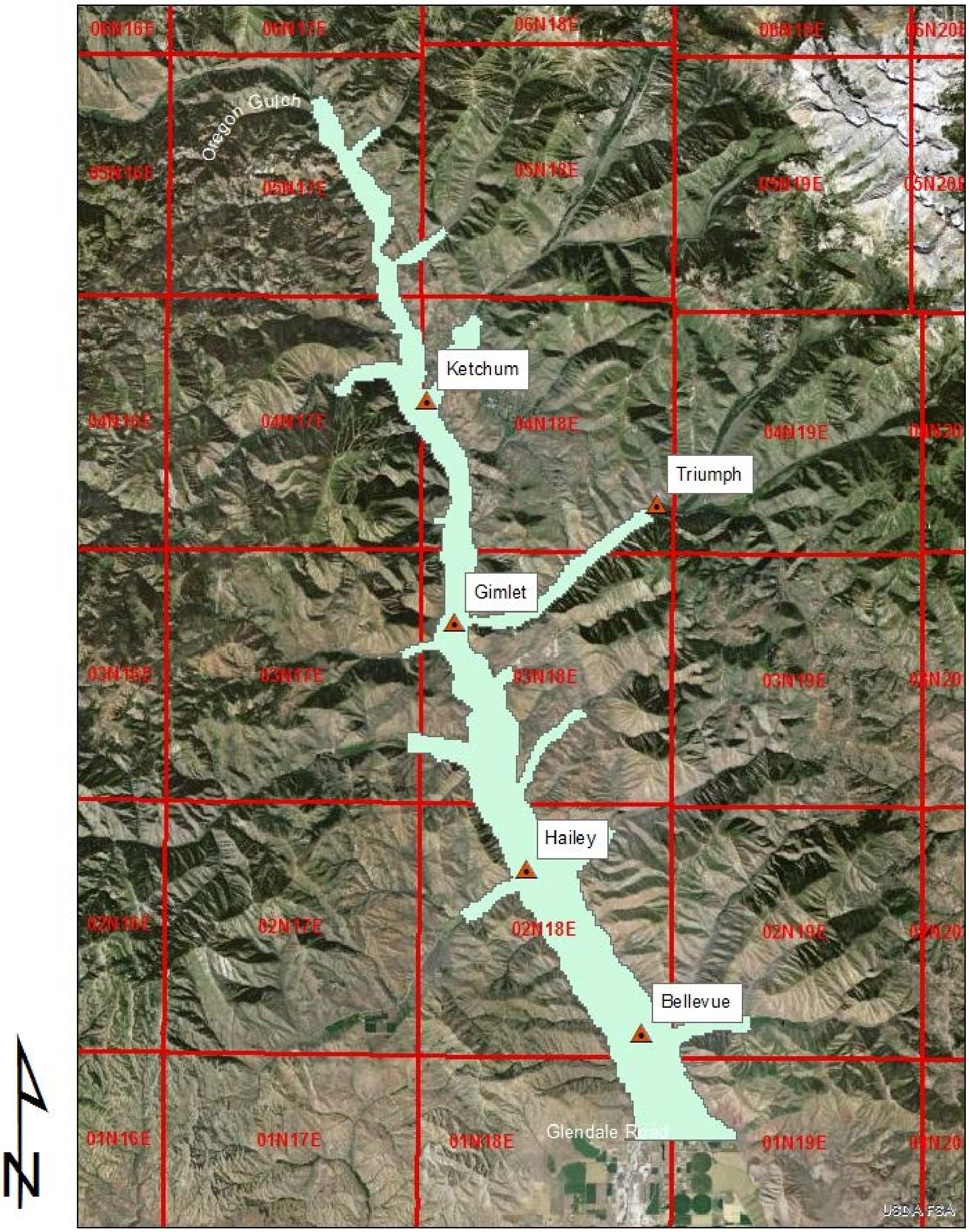

Figure 9: Map showing the boundaries of the unconfined alluvial aquifer within the modified 18-foot minimum Surface Seal Area

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Island Park Evaluation

This evaluation focuses on the Island Park Area in Fremont County, Idaho. The study area extends from the Montana Border on the north, the Wyoming border on the east, and generally follows the upper ridge of Big Bend Ridge on the eastern and southern borders (Figure 10). Island Park is the western part of the Yellowstone Volcanic Field. The area is often referred to the Island Park Caldera, (volcanic collapse feature), because of the prominent topographic basin. The Island Park topographic basin is a composite structure from three separate major volcanic eruptive cycles over the past 2 million years within the Yellowstone Volcanic Field (Christiansen, 1982).

Evaluation Methodology

Geology and hydrogeology of the Island Park Area were evaluated from well driller reports on file with the Idaho Department of Water Resources (Department), publications from US Geological Survey (USGS) regarding the geology and water resources of the Island Park Area, and published geologic maps of the Island Park Area. Approximately 350 well driller reports obtained through the Department's wells database were evaluated as part of this study. The driller reports were evaluated to ascertain the geology of the aquifer system in Island Park. Historical information is also evaluated regarding bacterial contamination in the mid-1990s. The Eastern Idaho Public Health District was also contacted regarding current bacterial contamination in the area.

Results

Geology

The study area is part of the Yellowstone Volcanic Field which includes present day Yellowstone National Park and the Island Park Area. The majority of the volcanic field is comprised of rhyolitic tuffs. The major rhyolite formations are knows as the 2.0 million year old Huckleberry Ridge Tuff, the 1.3 million year old Mesa Falls Tuff, and the 0.6 million year old Lava Creek Tuff (Christiansen, 1982). Each of the three phases of voluminous rhyolitic eruptions were followed by collapse and formation of a caldera. The topographic basin known as Island Park is a composite structure from caldera collapse from each of the three major rhyolite eruptions. Cooling and fracturing of the rhyolite formations were followed by flooding of the basin by basalt lava flows within and on the margins of the basin. Basalt flows in the Island Park Area are reported to be relatively thin, between 5 and 20 meters thick (Christiansen, 1982). Glacial outwash was deposited following eruption of the Yellowstone Volcanic Group and related basalt flows. Streams in the area have reworked and transported the glacial deposits resulting in deposition of alluvial sediments (Figure 11).

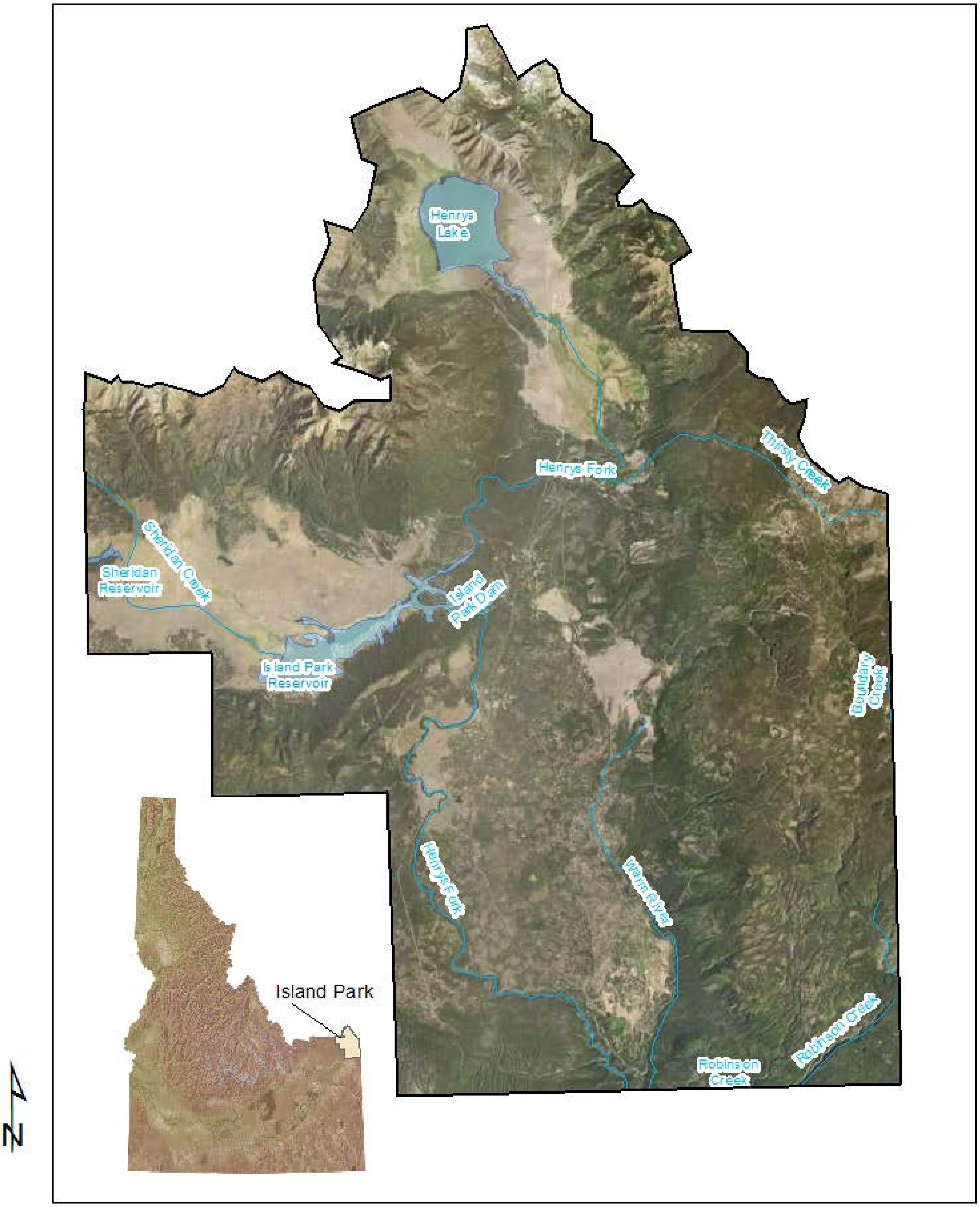

Figure 10: Island Park study area

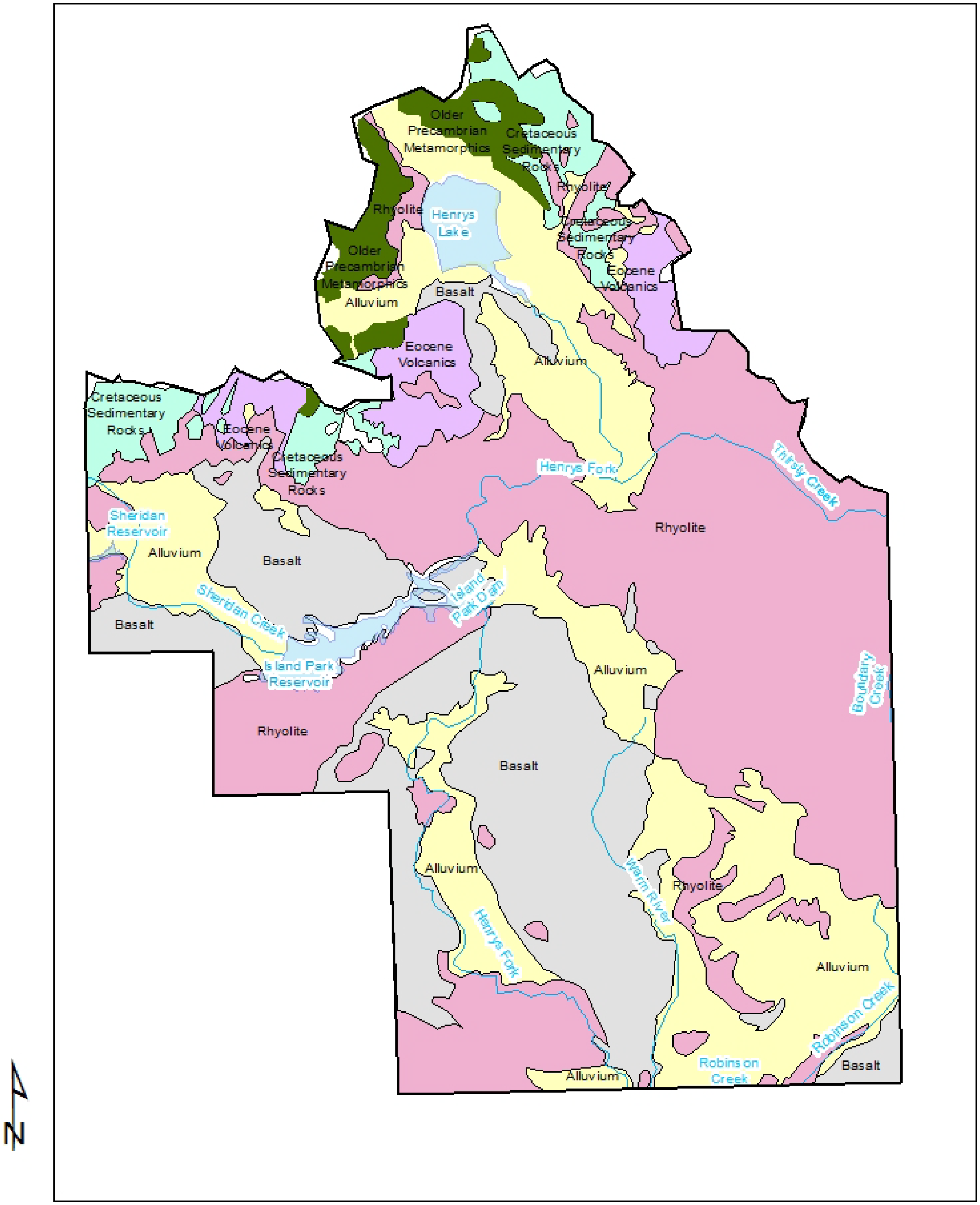

Figure 11: Geologic map of Island Park

Hydrogeology

The aquifer system(s) in Island Park is complex because of the geologic history of the area. The alluvial gravel aquifers near current streams produce ground water for domestic and recreational purposes in the area (Whitehead, 1978). The gravel deposits are relatively thin and are vulnerable to surface contamination. The fractured rhyolite and basalt bedrock are significant aquifers in the area and are often utilized for domestic and recreational purposes, including public drinking water systems. Most of the ground water in Island Park is reportedly under water table conditions (Whitehead, 1978). Ground water generally flows north to south in Island Park (Whitehead, 1978), although fracture flow in the bedrock geology and other geologic features can cause ground water flow to vary locally. The fracture systems of the bedrock are hydraulically connected to shallow alluvial sediments and surface water which cause them to be vulnerable to contamination.

The Department reviewed approximately 350 wells logs in the area to evaluate the subsurface geology and hydrogeology in the area. Review of the driller reports suggests unconfined ground water conditions as reported by Whitehead (1978). In the northern portion of the study area, in the valley east of Henry's Lake, significant alluvial gravel deposits are present up to 200 feet thick. These sediments thin significantly to the south. The central and southern parts of Island Park have very thin alluvial deposits overlying the fractured volcanic bedrock. Most wells in the Island Park area are completed into the fractured rhyolite and basalt bedrock. Some wells are completed in the shallow alluvial deposits.

Ground Water Contamination

In August 1995 an outbreak of Shigella sonnei at a Resort in Island Park was reported to the Eastern Idaho Public Health District (EIPHD), Idaho Department of Health (IDH), and the Centers for Disease Control (CDC). The outbreak resulted in gastrointestinal infections. EIPHD and IDH contacted over 220 persons that stayed at the resort in August 1995. Eighty-two cases of illness were identified. The resort did not have a restaurant, so guests who became sick were thought to have consumed the tap water in their guest rooms or used the ice machine at the facility (CDC, 1996). Six people in a local residential community served by wells also became ill from the Shigella bacteria. The CDC report indicated that the water table in the area was significantly higher than normal from heavy spring rains. The sewer system shared by the resort and local community was found to be draining improperly. There were a number of undesignated pit toilets identified that were used by laborers associated with construction of homes, cabins and area infrastructure. Although the exact source of the contamination was never identified, the bacteria was associated with human waste and spread from contaminated well water (CDC, 1996).

Following the bacteria outbreak in 1995, the Department worked with the Idaho Department of Environmental Quality (DEQ) and EIPHD to sample wells, search for potential contaminant sources and to evaluate regulatory measures necessary to protect ground water. The Department met with the Fremont County Commissioners to discuss designation of an "Area of Drilling Concern" (ADC). Proposed boundaries of the Island Park ADC were to include resort and cabin sites and private property with potential for residential development from the Montana Border on the north, the Wyoming border on the east, and generally along the Big Bend Ridge line along Public Land Survey boundaries on the eastern and southern borders (Figure 12). The Commissioners were not supportive of the ADC designation because of potential negative effects on local development. However, the Commissioners did support additional well construction measures to better protect ground water resources within the proposed ADC boundaries where full length seals are now required.

The Department implemented changes to well construction standards in the Island Park Area in response to the contamination issues. Expedited well permits (start cards) were discontinued in the area so that individual permits could be conditioned to provide additional protective measures. Since 1996, Department well permits require that all wells drilled in the Island Park Area be fully cased to the depth at which water is obtained. The well casing must be grouted with neat cement or sealed with bentonite chips from the casing shoe/bottom of casing to the land surface. Since the deeper surface seals have been required, contamination has been greatly reduced. Some of the older poorly sealed shallow wells in the area continue to have periodic problems with bacterial contamination, but no additional widespread outbreaks have been reported (EIPHD, verbal communication December 29, 2014).

Summary

The Island Park Area is part of the Yellowstone Volcanic Field which has developed from three major volcanic eruptions of explosive rhyolite, and associated thin basalt lava flows. The topographic basin is a composite structure from caldera collapse following each of the three major eruptions of rhyolite. Glacial outwash was deposited in portions of the basin following eruption of the volcanic bedrock. Streams in the area have transported and reworked the glacial deposits resulting in deposition of alluvial sediments.

Analysis of well driller reports and well inspector observations indicate ground water in Island Park is unconfined. Wells have been completed in the alluvial sediments near streams and in the underlying fractured volcanic rocks. The fracture systems of the bedrock are hydraulically connected to shallow alluvial sediments and surface water which causes them to be vulnerable to surface contamination.

In 1996, the Department implemented more protective well construction requirements to prevent surface contamination from impacting wells. Fremont County Commissioners were supportive of the changes in well construction based on the bacterial contamination present in the ground water. The Department requires wells in Island Park to be fully cased and a surface seal installed from ground surface to the production zone. These measures have been successful in protecting area ground water from surface contamination.

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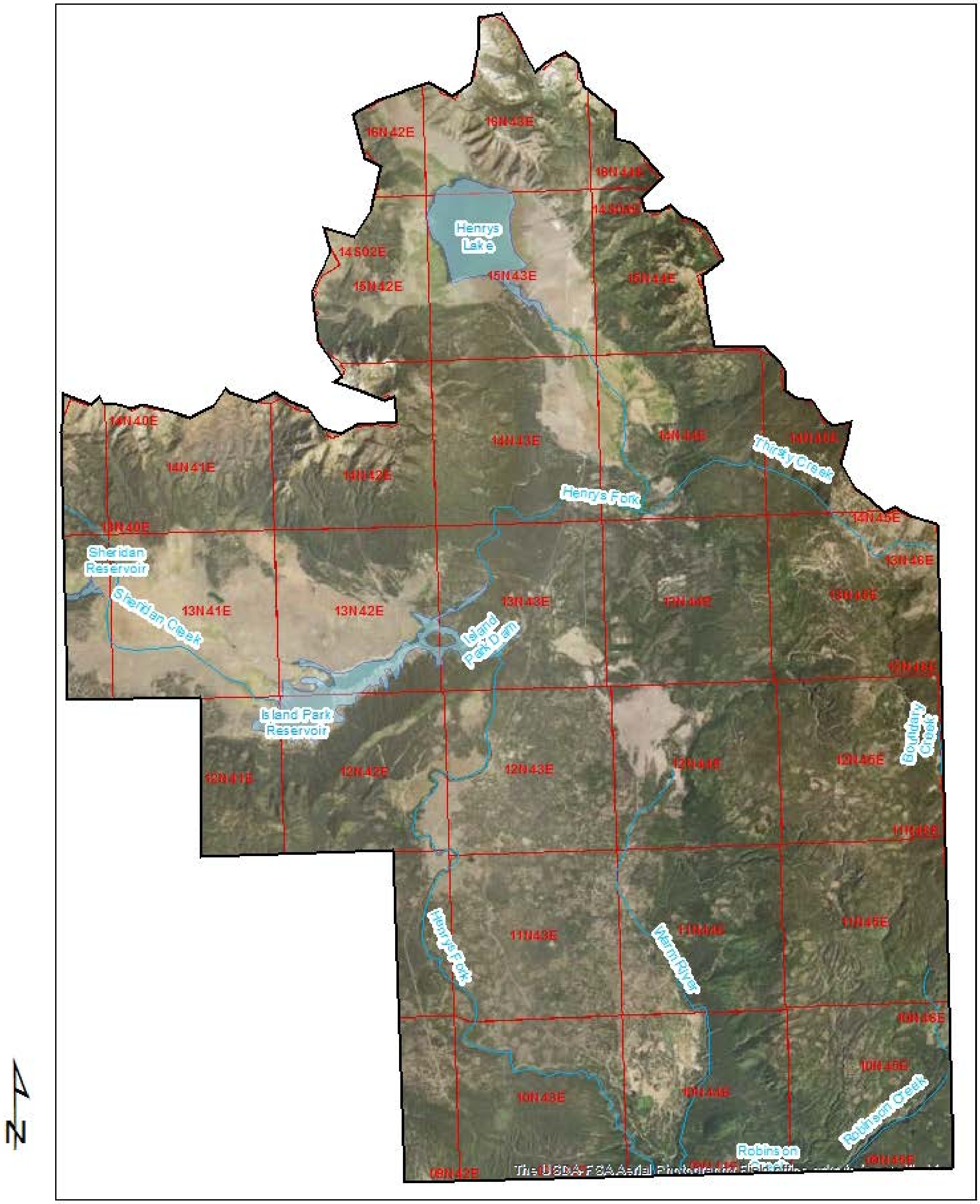

Figure 12: Boundaries of the study area which require full length seals.

Conclusions and Recommendations

This study evaluated the subsurface geology and hydrogeology of the aquifer(s) in Island Park. Ground water is unconfined and fractured bedrock is hydraulically connected to surface water. Ground water contamination in 1995 caused significant illness from a major outbreak of Shigella sonnei bacteria. Many older wells have minimum surface seals, if any, which allow for surface contaminants to migrate along the outside of the well casing, spreading the Shigella bacteria. Since 1996, the Department has required wells to be cased to the water table and sealed from the bottom of the casing to the ground surface.

EIPHD has indicated that bacterial contamination continues to impact some of the older wells in Island Park. Many well owners, including public water systems, treat the ground water either by chlorination or ultraviolet treatment to provide safe drinking water. EIPHD also indicated that since the improved well construction standards were implemented, the complaints concerning contaminated wells have been reduced significantly.

This study recommends that the Department continue a restriction on start cards so that well permits can be conditioned for specific casing and sealing requirements. Well permits in Island Park should continue to require wells to be fully cased to the depth at which water is obtained and to provide a full length surface seal from the bottom of the casing to land surface. The Department also recommends that any unused wells be properly decommissioned to eliminate potential pathways for surface contamination.

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