LOUGHLIN
WATER ASSOCIATES LLC

January 27, 2021

Lake Rockport Estates
c/o Jones & DeMille Engineering
Attn: Ted Mickelson, P.E.
775 W Spring Creek Pl #200a
Springville, UT 84663

Subject: **Well Siting Report**
Lake Rockport Estates, Summit County, Utah
for Lake Rockport Estates

Dear Ted:

We are pleased to present you with our well siting report for Lake Rockport Estates, Summit County, Utah. We prepared this report in accordance with our proposal to you dated October 13, 2020.

INTRODUCTION

We understand that Lake Rockport Estates:

- Is Utah Division of Drinking Water (DDW) public water system (PWS) number UTAH22104, and is classified as a transient, non-community water system by the DDW;
- Obtains drinking water from Well #2 and has not used Well #1 since 2010; and
- Seeks to site, permit, design, drill and construct another PWS well for the water system.

OBJECTIVE AND SCOPE OF SERVICES

Our objective is to help Lake Rockport Estates select a location (or locations) that we believe have the greatest potential for developing groundwater from a well (or wells) for the water system. As part of our scope of work, we:

- Reviewed available geologic and hydrogeologic information;
- Inventoried water wells in the area and their yields;
- Identified and assessed potential target aquifers;
- Identified and assessed potential well sites and depths;
- Estimated the yield and water quality of potential wells;
- Conducted a site visit to evaluate field conditions;

- Identified source protection issues;
- Estimated the cost of exploration and production wells; and
- Summarized our findings in this well siting report.

BACKGROUND

Bryant (1990 and 1992) compiled existing maps and produced new mapping of the geology from Salt Lake Valley to the Uinta Mountains, including the area surrounding Lake Rockport Estates at scales of 1:100,000 and 1:250,000, respectively. Hurlow (2002) compiled and modified previous mapping of the area to produce a 1:100,000-scale geologic map as part of his study of the geology o the Kamas Coalville region and its relation to groundwater conditions. The Utah Geological Survey (UGS) is preparing geologic maps of the Wanship (Anderson, in preparation) and Coalville 7.5-minute quadrangles which will likely be published in 2021.

Lake Rockport Estates are located west of Rockport Reservoir, which was formed by the construction of Wanship Dam on the Weber River. Lake Rockport Estates are within the West Hills and located between Kent Canyon (to the north) and Threemile Canyon (to the south). The West Hills are a highland area between Kamas Valley to the east, Snyderville Basin to the west, and Silver Creek canyon to the north. Silver Creek drains a portion of Snyderville Basin and then flows northeasterly through Silver Creek canyon and joins the Weber River just downstream of Wanship Dam. Downstream of Wanship, the Weber River flows northerly through the valley towards the town of Coalville. The Weber River eventually flows west through the Wasatch Mountains and into Great Salt Lake.

Figures 1 and 2 show the topography of the area around Lake Rockport Estates.

REGIONAL GEOLOGY

The geology of the region is complex with bedrock ranging in age from Precambrian (older than about 540 million years) to Tertiary (about 67 to 2.6 million years). Prior to late Triassic time (older than about 240 million years) the regional setting was a shallow-marine continental shelf, which then transitioned to a low-relief continental interior with depositional settings that changed from fluvial (river), lacustrine (lake), and finally to eolian (vast sand dune desert) by early Jurassic time (about 200 million years ago).

Beginning in middle Jurassic time (about 175 million years ago) subduction of the Pacific plate under the North American plate created regional tectonic compression which resulted in the Sevier Orogeny where bedrock sheets were thrusted (pushed) in an eastward direction that uplifted mountains in western Utah through late Cretaceous time (about 100 million years ago). Concurrently, rising sea levels flooded the interior portion of the continent and created an inland sea, which accumulated sediment from erosion of the uplifted mountains.

Continued tectonic compression during early Tertiary time (about 50 million years ago) uplifted the Uinta Mountains during the Laramide Orogeny and the Colorado Plateau.

Regional uplift caused relative sea levels to decline and the inland sea transitioned to lacustrine and fluvial environments by early Tertiary time.

Relaxation of the compressional orogenic forces resulted in the formation of normal faults and other structural weaknesses in the earth's crust. Subduction zone volcanism in the region began during mid-Tertiary time (about 35 million years ago). Volcanism and the formation of stratovolcanoes and calderas ensued resulting in the regional deposition of ash and other pyroclastic material.

Basin and Range extension followed, which started about 17 million years ago, and created numerous predominantly north-south trending normal fault zones, including the Wasatch fault. Extension resulted in the formation of (1) basins (grabens) where subsidence allowed for the accumulation of thick sequences of sedimentary deposits and (2) fault-block mountain ranges, such as the Wasatch Mountains. The Colorado Plateau continued to rise and tilt northeastward. Volcanic activity continued which formed shield volcanoes, lava flows and cinder cones throughout western Utah.

Regionally-extensive lakes, such as Lake Bonneville, intermittently filled Basin and Range valleys during Quaternary time (approximately the last 2.5 million years). Much of the present-day topography in high-elevation areas such as the Wasatch and Uinta mountain ranges was created by glaciers during Pleistocene time (about 2.5 million to 10,000 years ago), which carved cirques and "U" shaped canyons into the bedrock and deposited coarse grained, poorly-sorted glacial material.

LOCAL GEOLOGY

Northcentral and northeastern Utah, including the area around Lake Rockport Estates, is within the Middle Rocky Mountain physiographic province, which is bound to the west by the Wasatch fault and the Basin and Range physiographic province. This portion of the Middle Rocky Mountain physiographic province is part of a fold-and-thrust belt that formed during the Sevier and Laramide orogenies. Several northeast-southwest trending thrusts are stacked on top of each other in the area. The names of the thrusts are (from north to south) the Cherry Canyon thrust, the Dry Canyon thrust, the Crandall Canyon thrust, and the Rockport thrust. The thrust sheets are younger to the south. Kent Canyon is located along the Dry Canyon thrust and Threemile Canyon is located along the Crandall Canyon thrust.

The bedrock units along the west side of Rockport Reservoir consist of steeply to moderately northwest dipping Mesozoic-age units that have been displaced by thrust faulting and are unconformably overlain by Tertiary-age volcanic and conglomerate rocks along and west of the West Hills crestline. To the east of the West Hills crestline the Mesozoic-age bedrock units are mostly exposed at the surface. The Cretaceous-age Kelvin Formation underlies most of the Lake Rockport Estates area. The Kelvin Formation consists of sandstone that is interbedded with shale and siltstone with a basal conglomerate unit. The Kelvin Formation was deposited in a fluvial (river and stream) setting where sediment was eroded from uplifted terrain to the west (from the Sevier orogeny) then transported eastward and deposited in a foreland basin.

The Tertiary-age conglomerate bedrock units are Paleocene to late Eocene in age (65 to 35 million years ago) and were deposited by streams that eroded uplifted terrain from the Sevier and Laramide orogenies. The volcanic rocks consist of lava flows, volcanic mudflow breccias and tuffaceous units that were erupted from a stratovolcano located in the southern portion of the West Hills during late Eocene and Oligocene time (35 to 30 million years ago). Landslide and other mass wasting deposits have also been mapped throughout the area.

Figures 3 and 4 show the geology of the Lake Rockport Estates area and Table 1 describes the major geologic units.

HYDROGEOLOGIC SETTING

Groundwater in the vicinity of Lake Rockport Estates is found in consolidated bedrock units and unconsolidated valley-fill and alluvial deposits along stream channels. Groundwater originates as precipitation that falls on the ground surface, where a portion of the precipitation infiltrates into the ground to become groundwater. Groundwater recharge in the area likely occurs from infiltration of precipitation, infiltration of surface water from canals and streams, and infiltration of unconsumed irrigation water. Septic system effluent likely also provides a small amount of groundwater recharge. Most precipitation falls at higher elevations and most recharge occurs during winter and spring runoff when the snowpack melts. Groundwater discharge occurs from evapotranspiration, seepage to streams and canals, spring discharge, and withdrawal from wells.

Groundwater flows in the direction of the hydraulic gradient, generally from recharge areas at higher elevations, which receive the bulk of seasonal precipitation, toward discharge areas at lower elevations. A portion of the precipitation infiltrates into shallow alluvium or weathered, near-surface bedrock, and then percolates downward toward the zone of saturation. Within the zone of saturation, groundwater flows through more permeable layers or through fractures and bedding in bedrock. Groundwater flow in bedrock units can be complex due to the heterogeneity of fractures and joints in the bedrock and local groundwater flow paths often follow the orientation of connected fractures.

When delineating the recharge area of a spring or well, we typically assume that:

- Faults can act as barriers to groundwater flow across the fault, but can also be conduits to groundwater flow parallel to the fault;
- Certain geologic contacts can be boundaries to groundwater flow where an aquifer is overlain or underlain by an aquitard;
- Surface water divides coincide with underlying groundwater divides; and
- Groundwater within boundaries flows down gradient toward the spring or well.

Groundwater in the Kevlin Formation and other Mesozoic-age bedrock units along the west side of Rockport Reservoir likely flows in a northeasterly direction towards Rockport Reservoir and the Weber River. The groundwater flow direction is likely parallel to the strike of the sedimentary rock layers, which is also roughly parallel to the trend of the thrusts in the area.

AREA WELLS

Figures 1 through 3 show the locations of wells in the area that we selected as part of this study. Table 2 summarize information for the selected wells. We obtained copies of Well Driller's Reports (well logs) for the wells in Table 2 from the online database of the Utah Division of Water Rights (DWRi). Copies of the well logs are retained in our files.

Note from Table 2 that:

- We selected 53 wells, including Lake Rockport Estates Well #1 and Well #2;
- Well depths range from 15 to 980 feet with most wells being less than about 600 feet;
- Reported yields from the wells range from 0 to 1250 gpm with most of the yields being 50 gpm or less; and
- Only six wells have reported yields of 100 gpm or greater; and
- Wells completed in the Kelvin Formation generally have yields that are 50 gpm or less.

RECOMMENDED GROUNDWATER DEVELOPMENT AREA

As previously stated, the Kelvin Formation underlies most of the Lake Rockport Estates area. The unconsolidated deposits and Tertiary-age conglomerate and volcanic rocks are likely too thin and limited in areal extent to be sustainable aquifers. Therefore, a new well for Lake Rockport Estates will need to be drilled and completed in the Kelvin Formation.

We assessed the Kelvin Formation in the vicinity of Lake Rockport Estates, including bedrock outcrop patterns, lithology, and fracture density. We found that the lower portion of the Kelvin Formation and the upper part of the conglomeratic unit of the Kelvin Formation contains several relatively thick sandstone beds that are resistant to erosion and have formed a ridgeline that extends from the top water tank for Lake Rockport Estates northeasterly to the east side of Rockport Reservoir. Upon inspection of the sandstone beds in outcrops, we found them to contain abundant fractures that likely store and transmit groundwater where saturated.

We identify the primary target aquifer for a well to be the sandstone beds in the lower portion of the Kelvin Formation. We believe the lower section of the Kelvin Formation contains more sandstone than other sections of the formation and has the greatest potential to provide the highest yield from a well completed in the Kelvin Formation.

Our recommended groundwater development area is shown on Figures 2, 3 and 5. We believe that a well drilled in our recommended groundwater development area that targets the lower portion of the Kelvin Formation would need to be completed to a depth of 1000 to 1500 feet to produce a yield of approximately 100 gpm (see Figure 4).

We expect the water quality from a well completed in the Kelvin Formation to meet primary drinking water standards. We understand that Lake Rockport Estates Well #2 has an iron bacteria issue, but we do not expect that iron bacteria will be an issue for a well completed in the lower portion of the Kelvin Formation.

Because the Kelvin Formation is interbedded and contains shale and siltstone units, we expect that a well completed in the recommended groundwater development area will meet the definition of a protected aquifer and that the location of any uncontrolled potential contamination sources (PCSs) will only be prohibited to Drinking Water Source Protection (DWSP) Zone One (100-foot radius around the well head). However, it is possible that a well drilled in the recommended groundwater development area will not meet the definition of a protected aquifer and that uncontrolled PCSs will not be allowed in DWSP Zone Two (250-day time-of-travel to the well). The primary PCSs of concern are septic systems, which by DDW definition are uncontrolled and are not allowed in DWSP Zone One of protected aquifers and DWSP Zone Two of unprotected aquifers. Therefore, we recommend that DWSP Zone Two be delineated for each potential well site prior to finalizing the site for a production well.

GROUNDWATER EXPLORATION AND DEVELOPMENT

We identify the following three approaches for groundwater exploration and development:

- Drill only a production well;
- Drill an exploration well, and if conditions are favorable, drill a production well under a separate drilling contract; and
- Drill an exploration pilot borehole, and if conditions are favorable, immediately drill a production well under the same drilling contract.

Subsurface conditions in the lower Kelvin Formation appear to be favorable for a yield of approximately 100 gpm from a well. However, due to the inherent uncertainty in subsurface hydrogeologic conditions in the recommended groundwater development area, we recommend that Lake Rockport Estates consider drilling an exploration borehole prior to drilling a production well. The purpose of the exploration borehole is to evaluate the depth to, character, potential yield, and water quality of subsurface geologic units. Drilling an exploration well first allows Lake Rockport Estates to evaluate subsurface conditions prior to proceeding with permitting, designing, drilling, and constructing a production well.

The permitting requirements for groundwater exploration and development depend upon the approach taken. A PWS (production) well must be permitted through the DDW and the DWRi. The DDW requires that a DWSP Preliminary Evaluation Report (PER) and technical specifications (preliminary well design) be submitted and approved by the DDW prior to drilling a PWS well.

The DWRi requires that the well site be an approved point of diversion (POD) for a valid water right, or that the well be drilled as a test or exploration well, or under a provisional permit. Obtaining approval by the DWRi to drill a test/exploration/provisional well is generally simple and requires submitting an application that is typically approved within a couple of weeks. A valid water right is not required to drill a test/exploration/provisional well, and as such water from the well must not be put to beneficial use until after there is a valid water right for the well. However, the well can be developed and test pumped. Submission and approval of a water right application to identify a new POD is required by the DWRi before water from the well can be put to beneficial use. The DWRi typically takes between six to nine months to review and make a ruling on a water right application. It may take longer if a water right hearing for the application is held.

PRODUCTION WELL

Drilling a production well requires a drilling plan approval from the DDW. However, the production well can be drilled, constructed, and tested under a provisional permit from the DWRi, but a water right application will need to be filed and approved prior to putting water from the well to beneficial use.

The only benefit of drilling a production well first is that it is the least expensive approach for drilling a well, but only if subsurface conditions are favorable. The main risk is if subsurface conditions are not favorable and the well does not meet production and/or water quality demands. Because of the uncertainty in the subsurface hydrogeologic conditions, we recommend that an exploration borehole be considered prior to drilling a production well.

EXPLORATION WELL AND PRODUCTION WELL

Exploration wells do not require a drilling plan approval from the DDW. However, we recommend that technical specifications be prepared for an exploration well to assist with bidding and contracting with a qualified Utah-licensed water well driller. The DWRi will need to approve a test/exploration well application prior to drilling an exploration well. If the exploration well is successful and subsurface conditions are favorable, then a production well can be drilled later and a water right application can be prepared and submitted to the DWRi.

The benefit of drilling an exploration well prior to a production well is that the data collected from the exploration well helps with designing the production well. If an exploration well is drilled then we recommend that the borehole be tested (zone tests or air-lift tests) to directly assess the water quality and potential yield of the aquifer. If subsurface conditions are not favorable the borehole can be abandoned and a different well site can be evaluated.

If subsurface conditions are not favorable, this is the least expensive approach. However, if subsurface conditions are favorable and a production well is drilled later under a separate drilling contract, then this approach is the most expensive because the exploration and production wells are permitted, bid, drilled and constructed separately.

PRODUCTION WELL WITH EXPLORATION PILOT BOREHOLE

A production well with an exploration pilot borehole has the same permitting requirements as a production well (drilling plan approval from DDW, test/exploration/provisional permit from the DWRi and/or a water right application approval).

Drilling a production well with an exploration pilot borehole combines drilling an exploration borehole with a production well. If this approach is used then we recommend that the exploration pilot borehole be tested (zone tests or air-lift tests) to directly assess the water quality and potential yield of the aquifer, so that the borehole can be abandoned if water quality or quantity is unacceptable.

The benefit of drilling a production well with an exploration pilot borehole versus drilling an exploration well followed by a production well is that the well is only permitted, bid, and drilled once. Subsurface data collected from the pilot exploration borehole is used to guide the final design of the production well.

ESTIMATED COSTS

We prepared the following cost estimates for an exploration well, a production well, an exploration well and a production well and a production well with an exploration pilot borehole.

Task Description	Exploration Well	Production Well	Exploration Well and Production Well	Production Well with Pilot Borehole
Well Drilling and Construction	$250,000	$600,000	$850,000	$775,000
Zone Testing	$30,000	$40,000	$30,000	$30,000
Engineering	$35,000	$55,000	$90,000	$65,000
Total	**$315,000**	**$695,000**	**$1,010,000**	**$870,000**

These estimates assume a well depth of 1500 feet and a diameter of 8 inches for the production well casing. Engineering includes DDW permitting, bidding, and contracting assistance and well drilling and construction oversight. Engineering does not include DWRi permitting.

Note that these estimates do not include engineering or construction costs for permanent pumps, well house, electrical power, piping, or other infrastructure required to equip and connect the well to a water system, and actual bids may be significantly lower or higher.

CONCLUSIONS AND RECOMMENDATIONS

Based on our hydrogeologic assessment and well siting study, we conclude that:

- The primary target aquifer for a well are the sandstone beds in the lower portion of the Kelvin Formation.
- The lower portion of the Kelvin Formation likely has the greatest potential for producing the highest yield from a well.
- It is likely feasible to develop a safe yield of approximately 100 gpm from a well completed in the lower Kelvin Formation if subsurface conditions are favorable.
- Our recommended groundwater development area is likely the most convenient location to drill a well into the lower portion of the Kelvin Formation.
- A production well completed in the recommended groundwater development area will likely meet the definition of a protected aquifer and produce water that meets primary drinking water standards.
- An exploration or pilot borehole should be considered prior to drilling a production well to confirm the depth to, character, potential yield, and water quality of the aquifer.
- Zone testing or air-lift testing should be conducted on an exploration or pilot borehole to directly assess the water quality and potential yield of the aquifer.

If you have any questions or need more information, please do not hesitate to call me at (801) 541-4426 (mobile).

Loughlin Water Associates, LLC

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Table 1 – Description of Geologic Units
Table 2 – Summary of Selected Wells

Figure 1 – Regional Map

Figure 2 – Topographic Map
Figure 3 – Geologic Map
Figure 4 – Geologic Cross Section
Figure 5 – Location Map

REFERENCES CITED

Anderson, Z.W., in preparation, Interim Geologic Map of the Wanship Quadrangle, Summit and Morgan Counties, Utah: Utah Geological Survey, Scale 1:24,000.

Bryant, B., 1990, Geologic Map of the Salt Lake City 30' x 60' Quadrangle, North-Central Utah, and Uinta County, Wyoming. U.S. Geological Survey Map I-1944, Scale 1:100,000.

Bryant, B., 1992, Geologic and Structure Map of the Salt Lake City 1° x 2° quadrangle Utah and Wyoming: U.S. Geological Survey Miscellaneous Investigations Series Map I-1997, Scale 1:125,000.

Hurlow, H.A., 2002, The Geology of the Kamas – Coalville Region, Summit County, Utah, and its Relation to Ground-Water Conditions: Utah Geological Survey Water Resources Bulletin 29.

TABLES AND FIGURES

TABLE 1
DESCRIPTION OF GEOLOGIC UNITS

Formation Name	Geologic Age	Thickness (feet)	Description
Alluvium (Qal)	Holocene	< 10	Boulder to pebble gravel, sand silt, and clay deposited in channels and flood plains of streams.
Landslide Deposits (Ql)	Holocene and Pleistocene	Not given	Poorly sorted; particle size ranges from clay to blocks, depending on material involved in sliding includes mudflow, debris-avalanche, and clump deposits.
Terrace Gravels (Qtg)	Holocene and Pleistocene	< 100	Pebble and cobble, gravel, sand and silt occuring above modern flood plains.
Keetley Volcanics (Tkb)	Oligocene and Eocene	< 1200	Intrusive and flow rock, breccia, lahar, and tuff, as well as volcaniclasitic and nonvolcanic sandstone and conglomerate. Intrusive rocks, flows and breccias range from black, red, brown to light gray. Light-gray to gray lahar, flow breccia, and tuff.
Older Conglomerate (Toc)	Oligocene and Eocene	< 1400	Boulder, cobble, and pebble conglomerate containing fragments of sandstone derived from Mesozoic and upper Paleozoic formations. Contains a few lahars and beds of tuff and volcanic gravel.
Lower Member of the Frontier Formation (Kfl)	Upper Cretaceous	3760	Light to dark gray marine shale, sandstone, conglomeratic sandstone, and silty shale; coal; and gray, light-red, grayish-red, and green claystone.
Aspen Shale (Ka)	Lower Cretaceous	180 to 300	Dark-gray shale and tan sandstone with interbedded light gray shale containing Teleost fish scales.
Bear River Formation (Kbr)	Lower Cretaceous	200 to 230	Yellowish-gray to pale-brown, thin to medium bedded sandstone, interbedded with gray to dark gray siltstone, carbonaceous shale and oyster coquina.
Upper Kelvin Formation (Kk)	Lower Cretaceous	2000 to 2500	Yellowish-gray, grayish-red, and light- to moderate-red sandstone; gray, reddish-brown, and grayish-red siltstone and claystone; and conglomerate. Conglomerate contains pebbles and cobbles of sandstone, siltstone, and minor amounts of limestone.
Conglomeratic unit of Kelvin Formation (Kkc)	Lower Cretaceous	600 to 750	Light-gray, pale-brown and grayish-pink pebble to cobble conglomerate and sandstone interbedded with moderate red, grayish-red and moderate-orange-pink calcareous mudstone with nodular light-gray silty limestone.

Notes:
Descriptions are based on Bryant (1990) and Anderson (in preparation).

TABLE 2
SUMMARY OF SELECTED WELLS

Well ID	WIN	WRNUM	Easting	Northing	Drilled Depth (feet)	SWL Depth (feet)	SWL Date	Production Intervals (feet)	Test Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)	Comments	Geologic Unit(s)
1	2840	35-9397	462605.00	4510294.00	745	36.35	10/21/1996	160-745	1250	96	13.0		Tksc
2	NA	35-9397	462662.00	4514674.00	705	NR	NR	–	–	–	–		Tkb
3	30009	0435011M00	462680.00	4515401	980	328	8/10/2004	NR	100	–	–	Test hole abandoned	Tkb/Kk
4	29998	0435009M00	462863.00	4514451	600	310	8/7/2004	NR	NR	–	–	Test hole abandoned	Tkb
5	34844	35-11795	463154.00	4512639	300	82	10/11/2005	260-300	50	–	–	1 hour air lift	Kk
6	6466	35-7802	463372.00	4512377.00	345	208	6/6/1994	205-225	20	–	–	1 hour air lift	Kk
7	426840	35-6123	463448.00	4512027	280	100	2/22/1972	70-74; 130-135	12	85	0.1	1.5 hour bailer test	Kkc
8	12413	35-6612	463484.00	4512648.00	234	89	7/19/1979	NR	50	40	1.3	Tested with air compressor	Kk
9	18219	35-10330	463630.00	4511977	205	28	10/12/1998	160-200	50	20	2.5		Kkc
10	444420	35-13671	463659.00	4512604	285	122	10/16/2020	100-280	15	–	–	2.5 hour airlift test. Excellent lithologic descriptions from driller.	Kk
11	444139	35-13703	463711.00	4511509	720	316	7/15/2020	585-715	25	–	–	4.5 hour airlift test	Kk
12	441044	35-13255	463767.00	4511442	445	264	7/24/2017	310-430	10	20	0.5	4 hour pump test	Jp
13	440342	35-13000	463885.00	4512881	340	130	12/12/2016	260-340	10	–	–	2 hour airlift test	Kk
14	426953	35-6087	463910.00	4512587	115	8	5/24/1971	40-60; 80-100	50	10	5.0	1 hour bailer test	Kk
15	23307	35-10846	464041.00	4513318	525	425.9	3/20/2001	465-525	12	–	–	2 hour air lift	Kfl
16	30936	35-6884	464223.00	4513272	320	260	6/1/1980	NR	NR	–	–		Kk
17	443432	35-13476	464266.00	4516575	700	40	12/2/2019	220-280; 320-380; 400-420; 440-500; 620-640	65	54	1.2	24 hour constant rate test	Tkb
18	18348	35-11648	464268.00	4512298	488	202.8	11/17/1998	408-480	5	–	–	1 hour air lift	Kk
19	444058	35-13463	464352.00	4511511	405	27.2	6/18/2020	280-405	14	–	–	4.5 hour airlift test	Jp

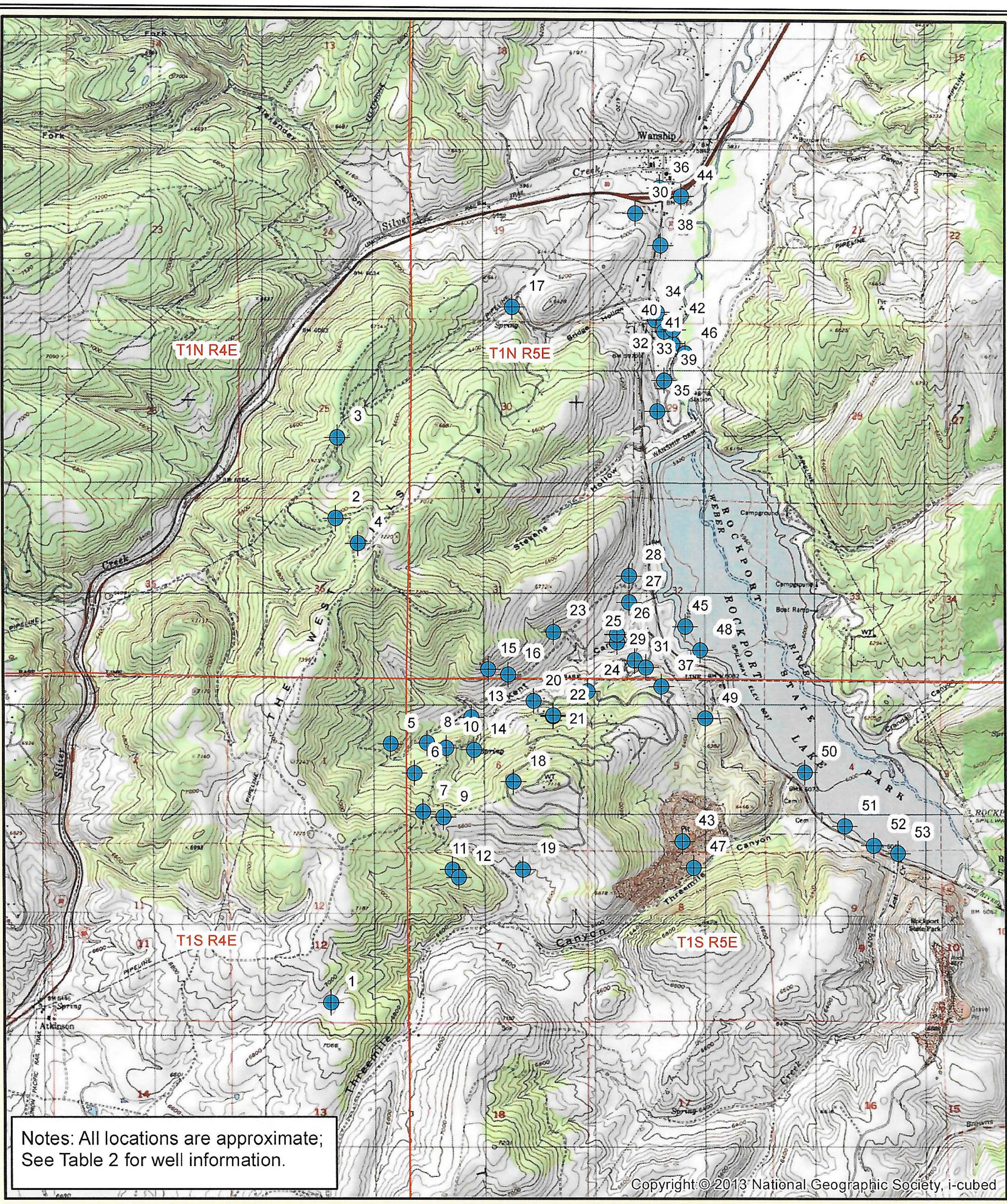
TABLE 2
SUMMARY OF SELECTED WELLS

Well ID	WIN	WRNUM	Easting	Northing	Drilled Depth (feet)	SWL Depth (feet)	SWL Date	Production Intervals (feet)	Test Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)	Comments	Geologic Unit(s)
20	428592	35-12017	464450.00	4513029	175	160	3/8/2006	200-275	15	30	0.5		Kk
21	430483	35-12149	464627.00	4512887	268	147.5	8/31/2007	200-260	50	–	–	2 hour airlift. Abandoned for WIN# 432049.	Kk
22	432049	35-12149	464630.00	4512900	600	88.4	3/26/2009	300-600	10	–	–	2 hour airlift	Kk
23	25248	35-7550	464635.00	4513653	200	37	5/29/2002	60-100; 140-180	15	25	0.6	2 hour test pump	Kk
24	440322	35-13133	464942.00	4513122	160	95	10/24/2016	120-160	50	–	–	5 hour airlift test	Kk
25	NA	35-6174	465212.16	4513561	250	86	10/16/1990	100-250	95	36	2.6	3 hour pump test	Kk
26	431355	35-12335	465212.51	4513632	755	147.5	6/1/2009	250-270; 290-310; 330-350; 430-450; 500-520	80	205	0.4	24-hour pump test	Kk
27	434229	35-12522	465321.00	4513918	340	121	10/5/2010	220-240; 260-280; 300-360	20	100	0.2	8 hour pump test	Kk
28	444595	35-13739	465322.00	4514158	282	116	12/3/2020	125-275	40	–	–	6 hour airlift test	Kk
29	443295	35-13596	465372.00	4513397	403	118	9/9/2019	150-390	15	–	–	4 hour airlift test	Kk
30	433828	35-12284	465383.00	4517420	386	83.5	5/20/2010	110-160; 180-190	20	–	–	8 hour airlift	Tkb
31	35649	35-13404	465473.00	4513335	240	30	5/16/2006	180-240	35	–	–		Kk
32	441678	35-11429	465561.00	4516513	420	51	4/17/2018	180-220; 240-280; 300-400	25	180	0.1	25 hour pump test	Keh
33	12450	35-6311	465566.00	4516461.00	300	NR	NA	120-300	10	–	–		Keh
34	7040	9435017P00	465577.00	4516528.00	125	2	9/15/1994	NR	NR	–	–		Keh
35	28191	35-492	465580.00	4515638	198	NR	–	118-198	150	–	–		Kfl
36	6342	35-12664	465600.00	4517650.00	192	16	8/15/1963	75-85; 127-136; 142-151; 160-180	40	55	0.7		Qal/Tkb
37	12414	35-6837	465610.00	4513166.00	425	90	6/8/1988	210-425	10	0	10.0	10 hour pump test	Kk
38	443997	35-12051	465612.00	4517130	422	30	6/8/2020	NA	1	–	–	TDS of 1600. Owner cancelled project.	Jp

TABLE 2
SUMMARY OF SELECTED WELLS

Well ID	WIN	WRNUM	Easting	Northing	Drilled Depth (feet)	SWL Depth (feet)	SWL Date	Production Intervals (feet)	Test Rate (gpm)	Drawdown (feet)	Specific Capacity (gpm/ft)	Comments	Geologic Unit(s)
39	12448	35-6522	465641.00	4515915.00	110	5	10/1/1978	90-110	20	10	2.0	Open borehole below 90 feet bgs	Kfl
40	439589	35-12313	465643.00	4516360	220	7	5/5/2016	110-210	100	–	–	4 hour airlift test	Kfl
41	441820	35-12316	465718.00	4516246	220	7	4/25/2018	110-210	100	–	–	4 hour airlift test	Kfl
42	12449	35-6313	465723.00	4516376.00	205	NR	–	30-205	80	–	–		Kfl
43	5763	9435001M00	465795.00	4511761.00	140	76	3/18/1994	115-135	NR	–	–	Monitor Well	Jp
44	2212	35-12664	465796.00	4517576.00	200	8	4/22/1982	75-110	70	45	1.6		Jp
45	12447	35-2827	465831.00	4513701.00	20	19	3/23/1936	NR	10	–	–	Submerged by Rockport Res.	Qal
46	2153	35-1572	465833.00	4516157.00	115	5	4/20/1962	NA	35	40	0.9		Kfl
47	30948	35-149	465899.00	4511527	285	15	4/15/850	135-200; 200-286	230	185	1.2	4 hour test	Kfl
48	12446	35-2406	465962.00	4513489.00	15	13	2/29/1936	NR	3	–	–	Submerged by Rockport Res.	Qal
49	437674	35-12839	466010.00	4512871	260	102	5/12/2014	170-250	50	–	–	4 hour airlift test	Kkc
50	12416	35-2384	466911.00	4512386.00	26	20	2/21/1936	NR	10	–	–	Submerged by Rockport Res.	Qal
51	12415	35-2410	467274.00	4511896.00	25	18	12/31/1936	0-25	3	–	–	Submerged by Rockport Res.	Qal
52	12603	35-2404	467537.00	4511728.00	40	18	2/29/1936	NR	3	–	–	Submerged by Rockport Res.	Qal
53	12412	35-2389	467755.00	4511657.00	22	20	12/31/1936	NR	12	–	–	Submerged by Rockport Res.	Qal

Notes:
WIN means Well Identifiation Number;
WRNUM means water right number;
Easting and northing are NAD 83;
SWL means static water level;
gpm means gallons per minute;
gpm/ft means gallons per minute per foot of drawdown;
negative number for static water level means water level was above ground surface and was artesian;
NR means not reported in well log;
NA or – means not available.



LOUGHLIN WATER ASSOCIATES LLC

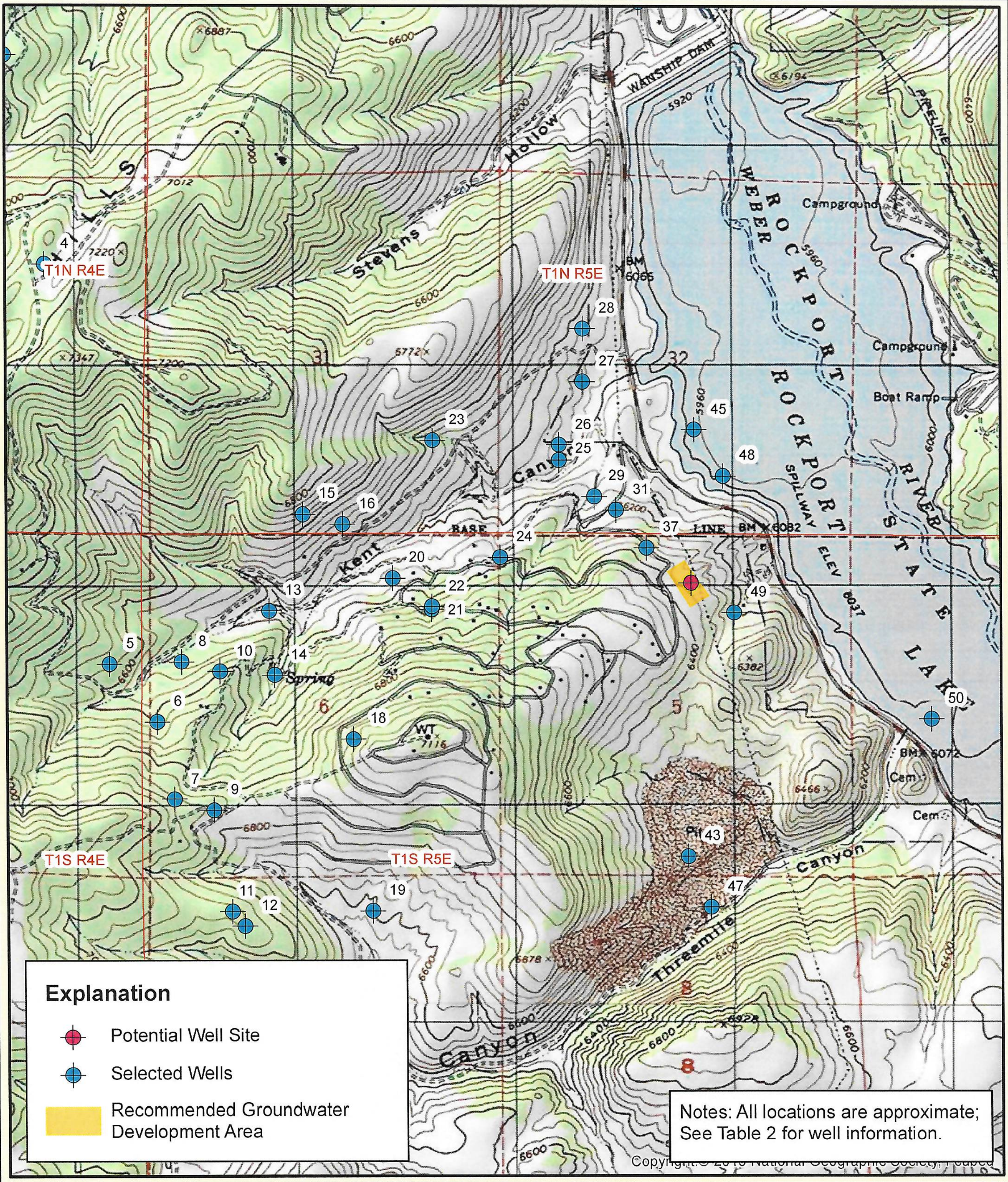
Prepared by Neil I. Burk, P.G.

N

0 4,000

Feet

**Lake Rockport Estates
Regional Map
Figure 1**

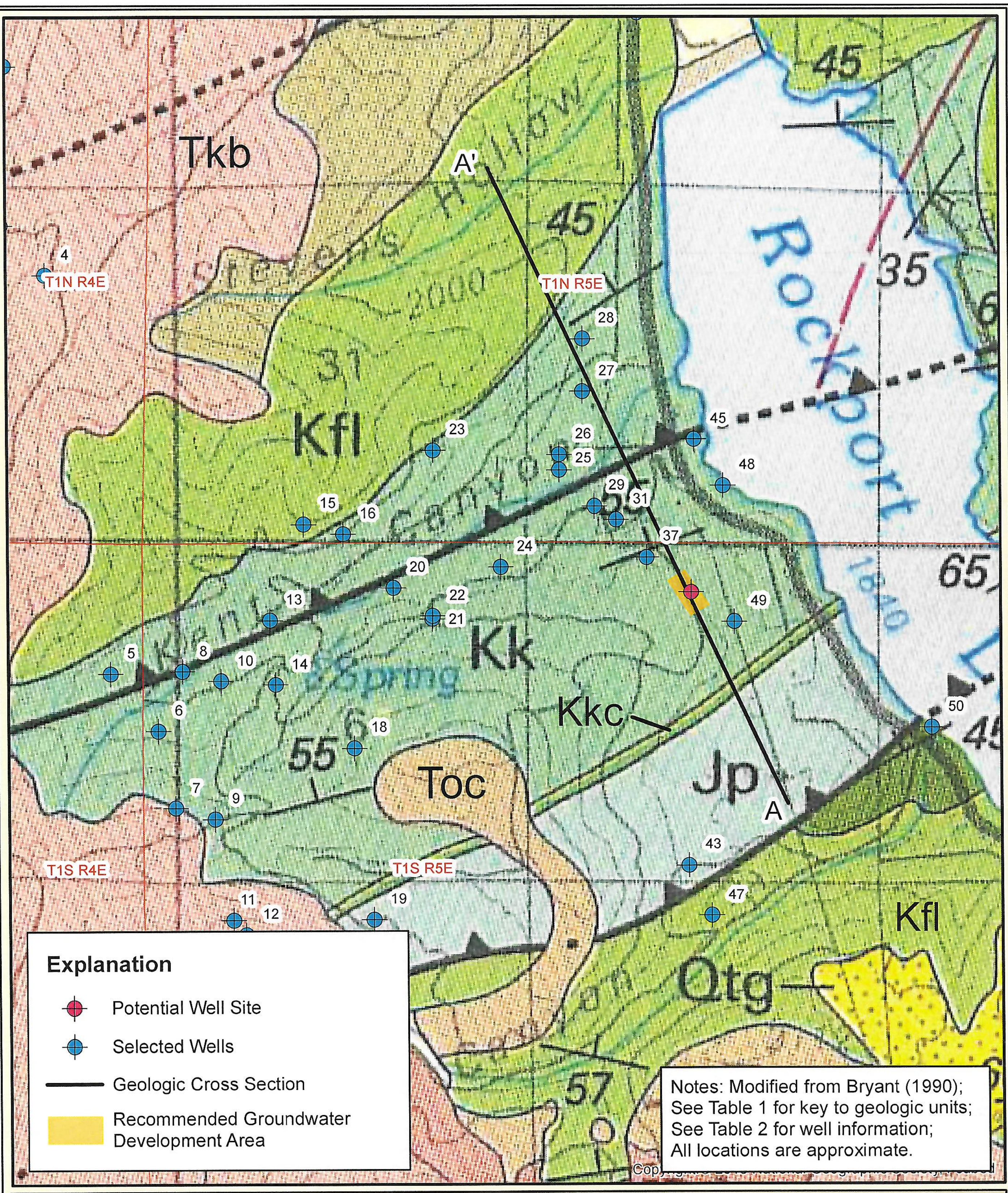


Prepared by Neil I. Burk, P.G.

N

0 2,000
Feet

Lake Rockport Estates
Topographic Map
Figure 2



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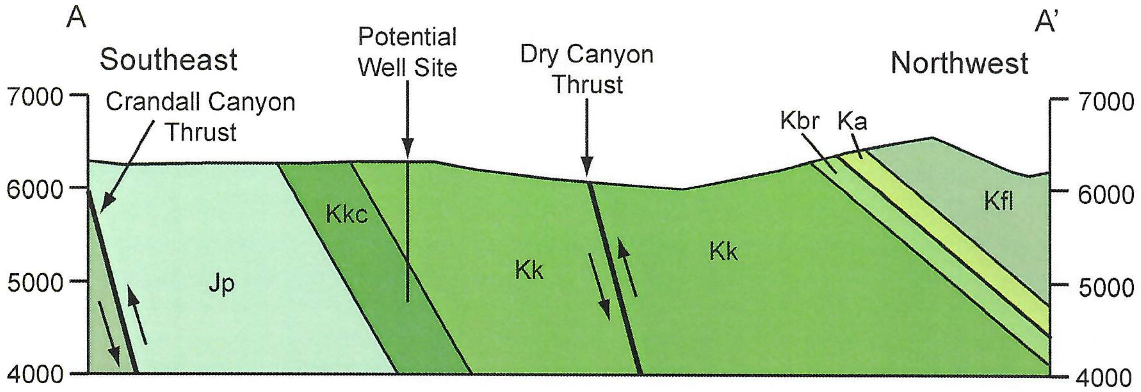
Lake Rockport Estates
Geologic Map
Figure 3



Notes:
All locations are approximate;
Surficial deposits are too thin to show;
See Table 1 (in text) for description of geologic units;
Based on unpublished Wanship geologic map (Anderson, in preperation);
Prepared by Neil I. Burk, P.G.

0 Feet 4000

Approximate Scale
No Vertical Exaggeration

Explanation of Geologic Units

Kfl - Lower members of the Frontier Formation
Ka - Aspen Shale
Kbr - Bear River Formation
Kk - Upper Kelvin Formation
Kkc - Conglomeratic unit of the Kelvin Formation
Jp - Preuss Formation

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Lake Rockport Estates
Geologic Cross Section
Figure 4