

Hydrogeologic Evaluation for Water Right Applications 63-34079 and 63-34080

Prepared for

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**SPF WATER
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Executive Summary

Applications for Permit 63-34079 and 63-34080 seek authorization to divert groundwater for supplemental irrigation purposes. Application 63-34079 seeks up to 1.9 cubic feet per second (cfs) for irrigation of 95 acres; Application 63-34080 seeks up to 1.46 cfs for irrigation of 73 acres. The proposed places of use under these applications currently receive surface water supply from Boise-Kuna Irrigation District.

The Boise Project Board of Control protested these applications, based on concerns that the proposed pumping would withdraw water from Lake Lowell. The proposed points of diversion (PODs) are located between approximately 5 and 6 miles southeast of Lake Lowell.

The purpose of this analysis was to review aquifer conditions in the vicinity of the proposed PODs and evaluate potential impacts of the proposed withdrawals on local groundwater levels and on Lake Lowell. The general conclusion from the analysis is that there is a sufficient groundwater supply for the proposed applications. Specific conclusions from this analysis include the following:

1. Based on review of static water levels and strata penetrated by surrounding wells, the proposed wells can be constructed in productive water-bearing zones that are sufficient to meet the flow requirements proposed on the applications.
2. Groundwater levels in the general vicinity of the proposed applications are stable (or rising), indicating the presence of groundwater available for appropriation.
3. The proposed well locations under applications 63-34079 and 63-34080 appear to be at least approximately ¼ mile away from any neighboring wells. Seasonal impacts from the proposed pumping under these applications are projected to be less than approximately 2.5 feet at a distance of ¼ mile from either of the proposed PODs.
4. The distance between the closest proposed POD and Lake Lowell is at least 5 miles. Based on TVHP model simulations, the long-term depletionary impact on Lake Lowell (i.e., under steady-state hydraulic conditions) will be approximately 2.6% of the volume withdrawn under the proposed applications.

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Appendix A: Applications 63-34079 and 63-34080

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1. INTRODUCTION

Applications for Permit 63-34079 and 63-34080 seek authorization to divert groundwater for irrigation purposes from points of diversion (PODs) located between about 5 and 6 miles from Lake Lowell. The Boise Project Board of Control (Boise Project) protested these applications, suggesting that “the location and proposed depth of the applicant’s well will most likely directly withdraw water from Lake Lowell.”¹

The purpose of this analysis was to assess the available groundwater supply in the vicinity of the proposed PODs and evaluate potential impacts from the proposed pumping on Lake Lowell. This report provides a description of Applications 63-34079 and 63-34080 (next section), summarizes local hydrogeologic conditions (Section 3), provides an assessment of potential impacts to local groundwater levels from the proposed withdrawals (Section 4), and provides an analysis of potential impacts to Lake Lowell as a result of the proposed pumping (Section 5).

2. DESCRIPTION OF APPLICATIONS

Application 63-34079

Application 63-34079, submitted on May 8, 2015 under the name Chris Emmert, requests authorization to withdraw up to 1.9 cfs (853 gpm) of groundwater for irrigation of 95 acres between March 1 and November 1 in Section 35 of Township 2N, Range 2W in southern Canyon County, Idaho (Figure 1 and Appendix A). The proposed well (in the southwest quarter of the northeast quarter of Section 35) will extend to approximately 225 feet below ground surface (bgs).

Application 63-34080

Application 63-34080, submitted on May 8, 2015 under the name Chris Emmert (and amended on September 25, 2015) requests authorization to withdraw up to 1.46 cfs (655 gpm) of groundwater for the irrigation of 73 acres between March 1 and November 1 in Section 1 of Township 1N, Range 2W in southern Canyon County, Idaho (Figure 1 and Appendix A). The proposed well, located in the southwest quarter of the northwest quarter of Section 1, will extend to approximately 225 feet bgs.

¹ Protest filed on October 22, 2015 by S. Davis on behalf of the Boise Project Board of Control.

Supplemental Supply

Lands proposed under both applications (63-34079 and 63-34080) currently receive surface water from Boise-Kuna Irrigation District as the primary irrigation water source. The applicant seeks to use groundwater prior to and after the surface-water delivery season, or to supplement surface water during times of peak crop demands. The applicant raises seed crops including onion seed, sweet corn seed, carrot seed, and beans for seed.

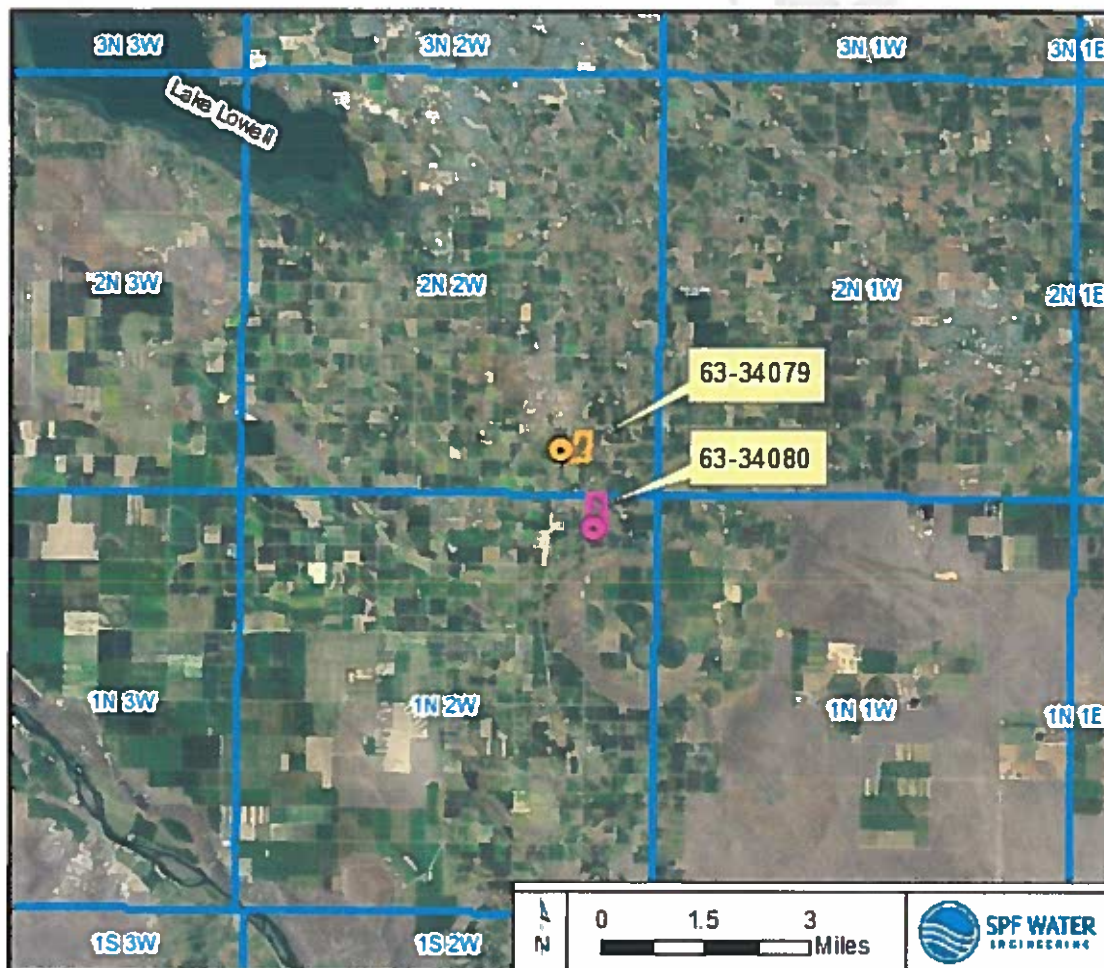


Figure 1. Emmert property location.

Estimates of Groundwater Diversions

Annual diversion volumes for the two applications were projected based on historical surface water deliveries, proposed crop types and rotations, and anticipated pumping patterns.

Groundwater diversions would supplement surface water delivered by the Boise-Kuna Irrigation District. The standard allotment in the Boise-Kuna Irrigation District is 3.75 AF per acre per year. However, an annual delivery of 2.6 to 2.9 AF has been more typical in recent years.²

The annual volume of groundwater to be withdrawn under Applications 63-34079 and 63-34080 was projected by estimating the difference between two annual Boise-Kuna Irrigation District allotments (2.6 AF and 3.75 AF) and the irrigation requirements for the crops proposed in these applications. Annual irrigation requirements were estimated as the precipitation deficit for the proposed crop types (onions, sweet corn, carrots, and beans for seed) and an assumed irrigation efficiency of 50% (gravity irrigation).

The precipitation deficit³ for the listed crop types (Table 1) averaged approximately 2 AF/year, ranging from 1.46 AF/yr per acre (sweet corn) to 2.67 AF/yr per acre (carrots for seed).⁴ This average precipitation deficit, combined with an irrigation efficiency of approximately 50%, results in a typical irrigation requirement of approximately 4 AF/year per acre. Thus, on average, the Applicant would seek to divert approximately 1.4 AF and 0.25 per acre in years in which Boise-Kuna Irrigation District delivers 2.6 and 3.75 AF per acre, respectively, resulting in aggregate withdrawals ranging from 18 to 133 AF/year (Table 2). The groundwater diversion volume would be greater if the allocation is less than 2.6 AF per acre, or may vary from these values if the irrigation efficiency or crop mix is different than anticipated.

² Tim Page, *personal communication*, 5/12/2016.

³ Precipitation deficit is defined as the difference between the potential ET and the amount of infiltration (from precipitation) that resides in the root zone within the growing season. The available ET data is calculated using the ASCE standardized Penman-Monteith method (University of Idaho, 2010).

⁴ ET Idaho (<http://www.kimberly.uidaho.edu/ETIdaho/online.php>), based on Nampa Agrimet station (NMPI) data, obtained in May 2016.

Estimate of Irrigation Requirements for Applications 63-34079 and 63-34080								
Parameter	Mar	Apr	May	Jun	Jul	Aug	Sep	Growing Season
Precipitation deficit, snap and dry beans for seed (ft/mo)	0.00	0.00	0.00	0.33	0.75	0.25		1.32
Precipitation deficit, carrots for seed (ft/mo)	0.00	0.17	0.45	0.62	0.75	0.60	0.08	2.67
Precipitation deficit, onions for seed (ft/mo)	0.01	0.15	0.39	0.58	0.71	0.53	0.08	2.45
Precipitation deficit, sweet corn for seed, late plant (ft/mo)	0.00	0.00	0.01	0.26	0.75	0.43	0.01	1.46
Precipitation deficit, average of seed crops (ft/mo)	0.00	0.08	0.21	0.45	0.74	0.45	0.06	1.99
Delivery to meet precipitation deficit, assuming 50% irrigation efficiency (ft/mo)	0.01	0.15	0.42	0.90	1.48	0.91	0.11	3.98
Note: Negative precipitation deficit values were removed from the table and excluded from the growing season total.								

Table 1. Estimate of supplemental use.

Projected Groundwater Pumping Volume							
Boise-Kuna Irrig. Distr. Allocation (AF/acre) →		2.6	3.75	2.6	3.75	2.6	3.75
Application	Proposed Acres for Irrigation↓	Supplemental Crop Water Demand (AF/acre) ⁽¹⁾		Groundwater Pumping Requirement (AF/yr) ⁽²⁾		Groundwater Pumping Requirement (gpm) ⁽³⁾	
63-34079	95	1.40	0.25	133	24	188	34
63-34080	73			102	18	145	26
Notes: (1) Calculated as the difference between an irrigation requirement of 4.0 feet (see text) and the Boise-Kuna Irrigation District allocation. (2) Calculated as the supplemental crop demand multiplied by the anticipated POU. (3) Assume uniform pumping over 160 days.							

Table 2. Estimates of supplemental crop water demand and groundwater pumping requirement.

Proximity to Lake Lowell

At its closest point, Lake Lowell is approximately 5.0 miles and 6.3 miles northwest of the PODs proposed in Applications 63-34079 and 63-34080, respectively (Figure 1). The full-pool elevation of Lake Lowell is 2,530 feet above mean sea level (amsl).⁵ The ground-surface elevation at the site of the Application 63-34079 production well is approximately 2,642 feet amsl and approximately 2,665 feet amsl for the POD in Application 63-34080. The anticipated target depth for both production wells of 225 feet bgs would place the bottom of the production well between approximately 113 feet and 90 feet, respectively, below the full-pool elevation of Lake Lowell.

Constructed between 1906 and 1911, the original total storage capacity of Lake Lowell was considered to be 190,000 AF, with active storage of 169,000 AF.⁶ However, a sedimentation survey conducted in 1994 indicated a total storage-capacity estimate of 173,000 AF, with 159,400 AF active storage (representing a reduction in active storage of approximately 9,600 AF). There likely has been additional loss of storage capacity as a result of sedimentation since 1994.

3. AQUIFER CHARACTERISTICS

Geologic Setting

The general stratigraphy of the northwest-trending western Snake River Plain consists of interbedded layers of sand, silt, and clay overlying Miocene-age⁷ volcanic rocks (Wood and Clemens, 2004). Surficial geology in the general vicinity of the proposed places of use (POUs) and Lake Lowell includes (1) Quaternary-age⁸ Snake River Group sediments and basalt and (2) Miocene-age Idaho Group sand, silt, volcanic ash, and clay sediments (Bond and Wood, 1978; Mitchell and Bennett, 1979). Upper water-bearing zones within the Idaho Group sediments are separated from lower water-bearing zones by clay layers described as having a "bluish" color in drillers' reports (Wood and Anderson, 1981). Surficial geology in the vicinity of the Emmert

⁵ <http://www.usbr.gov/pn/hydromet/ramps/lowell/lowell.html>.

⁶ *Ibid.*

⁷ Extending from approximately 23 million years ago to 5 million years ago.

⁸ Occurring in the last 2 million years.

properties consist primarily of coarse-grained sediments and Pleistocene basalt outcrops (Figure 2).

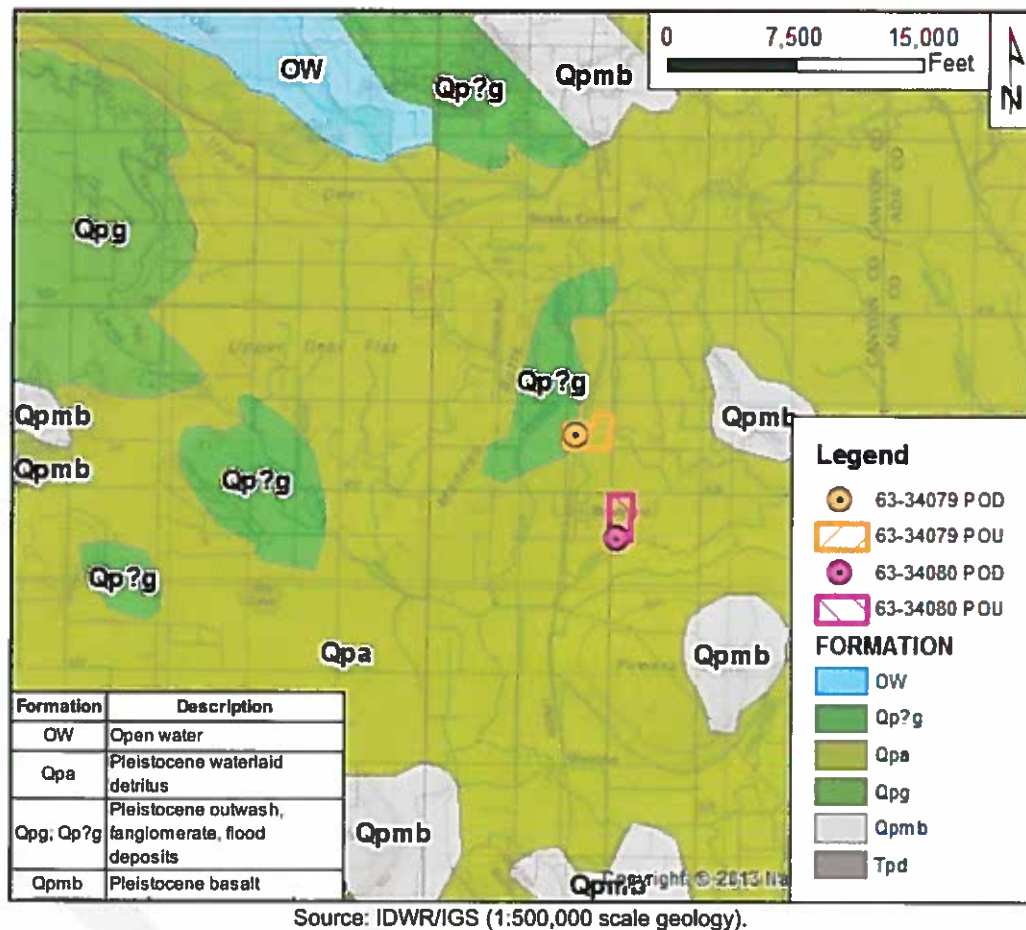


Figure 2. Surficial geology.

Aquifers

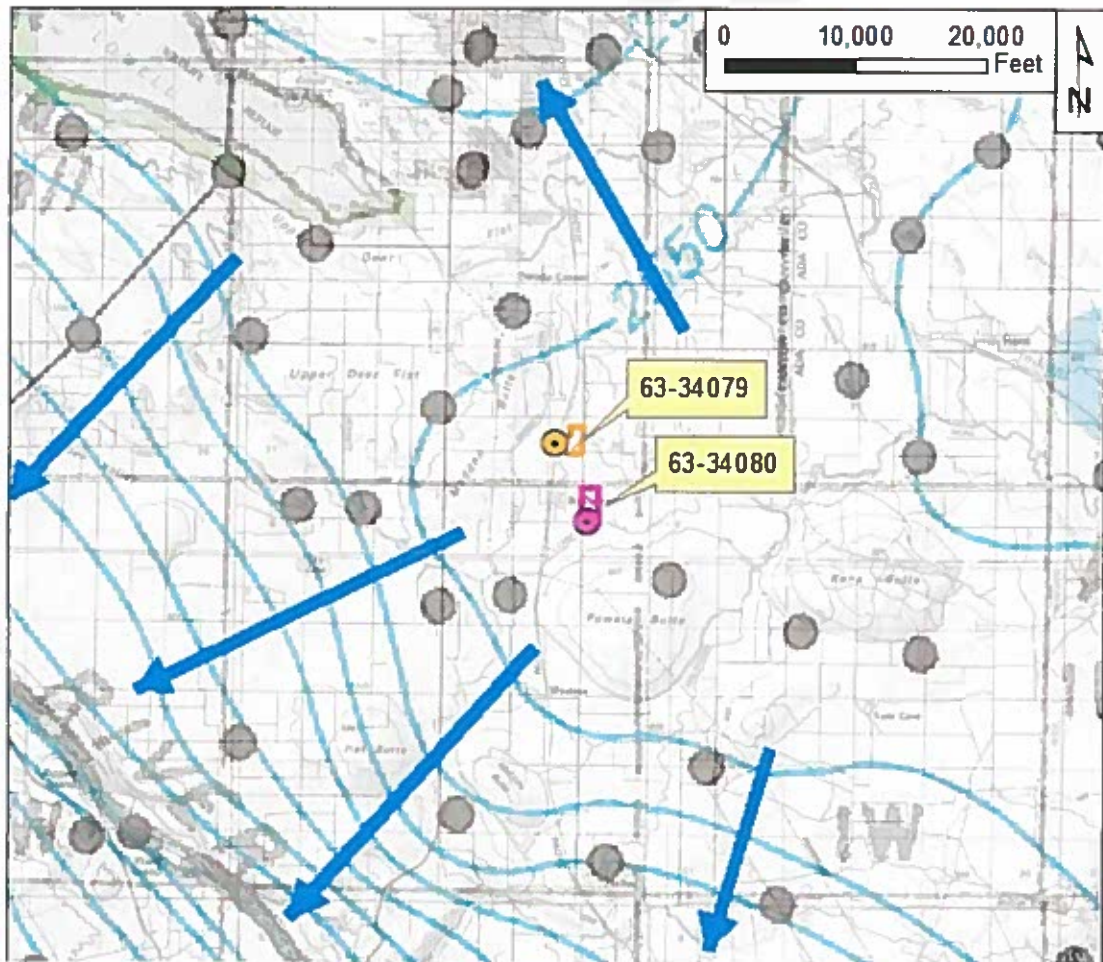
Aquifers are present in both Snake River Group and Idaho Group sediments underlying the Treasure Valley. In general, shallow, local flow systems have groundwater residence times ranging from days to tens of years; deep, regional flow systems have groundwater residence times ranging from hundreds to tens of thousands of years (Petrich and Urban, 2004).

In the vicinity of the Emmert property, wells are completed within unconsolidated Idaho Group deposits of lacustrine and fluvial origin. Productive zones are associated

with coarse sand and gravel, typically layered between fine-grained silt and clay deposits.

Groundwater Flow Direction

The Emmert property overlies a general groundwater-flow divide underlying the New York canal. Groundwater north of the property flows in a general northwesterly direction; groundwater south of the property flows in a general southwesterly direction (Figure 3).



Adapted from Lindholm et al. (1988).

Figure 3. Groundwater flow direction.

Well Drillers' Reports

Drillers' reports provide information regarding aquifer lithology and production rates. SPF conducted a search of the IDWR well-construction records in May 2016 to identify existing wells within approximately 0.5 miles of the PODs for Applications 63-34079 and 63-34080 (Figure 4 and Appendix B).⁹

Recorded Well Driller's Reports near 63-34079

Well drillers' reports for 65 domestic wells (of which 6 were recorded as well deepenings), 4 irrigation wells, and 1 injection well were found within approximately 0.5-miles of the POD for Application 63-34079. Of the 70 wells, depths range between 35 and 313 feet, with an average depth of 163 feet. Chris Emmert owns two of the existing wells within the 0.5-mile search radius, shown as Nos. 52 and 53 in Figure 4.

Generally, wells located within 0.5-miles of 63-34079 are completed within interbedded layers of bedrock and unconsolidated deposits (primarily sand and gravel). Production rates during testing performed at the time wells were installed range from 10 gpm to 600 gpm.¹⁰

Recorded Well Driller's Reports near 63-34080

Well driller's reports for 55 domestic wells, 1 irrigation well, 1 stockwater well, and 1 injection well were found within approximately 0.5-miles of the POD for Application 63-34080. Of the 58 wells, depths range between 60 and 750 feet, with an average depth of 189 feet.

Generally, wells located within 0.5-miles of 63-34080 are completed within sand and gravel deposits or basalt, depending on the encountered conditions.

⁹ Drillers' reports for wells in the IDWR database are catalogued based on locations provided by the driller. Some wells may have been omitted from this search because of incorrectly listed well locations, and some wells listed in this search area may be incorrectly located. Furthermore, existing wells for which drillers' reports were not submitted to IDWR are generally not identified in the IDWR well construction database. Also, many well locations are shown as being in the centroid of the quarter-quarter in which the well is located.

¹⁰ Production rates reflect well construction, pump capacity, and aquifer capacity.

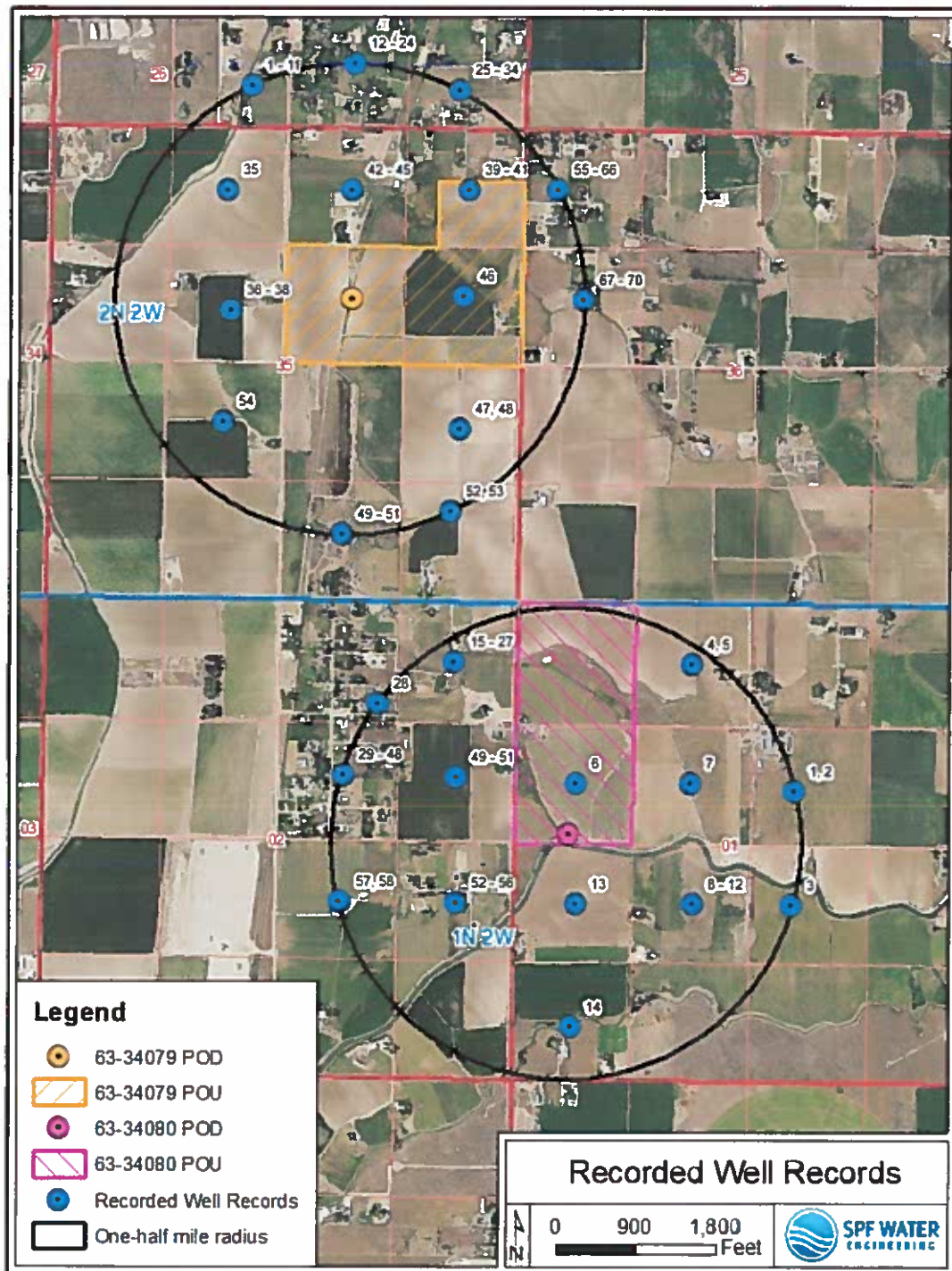


Figure 4. Water well records within 0.5 miles of applications.

Water Level Data

Groundwater level data for monitoring wells located in the 4 Townships closest to the proposed PODs (02N01W, 02N02W, 01N01W, and 01N02W) were obtained during May 2016 from IDWR's "Hydro.Online" database. Hydrographs (Figure 5) are provided for wells with at least 3 groundwater level measurements collected within a recent 5-year period will.

Hydrographs¹¹ for wells surrounding the PODs for the Applications show generally stable or, in some cases, rising groundwater levels over the last two decades (Figure 6 through Figure 9). Rising groundwater levels likely reflect seepage from surface channels (e.g., irrigation canals or laterals) and infiltration from irrigation activities. Rising groundwater levels indicate the availability of groundwater for appropriation.

4. LOCAL IMPACTS OF PROPOSED PUMPING

Existing Groundwater Rights

SPF conducted a search of the Idaho Department of Water Resources (IDWR) database in May 2016 to identify water rights located within 0.5 miles of the POD and encompassing the proposed POD for each application (Figure 10). Ten existing water rights were identified within approximately¹² 0.5 miles of Application 63-34079: 7 existing rights authorized domestic and/or stock uses, 1 authorizes diversions for commercial uses, and 2 authorize diversions for irrigation and domestic uses. Eight water rights authorize diversions within approximately 0.5 miles of the POD for 63-34080: 6 for domestic and/or stock uses, and 2 for irrigation uses.

¹¹ Hydrographs show groundwater level trends for the 20-year period between 1995 and 2015. Screened or open intervals, when available, are indicated with "OI". The scale for depth-to-water indicated (y-axis) is 40-ft, unless otherwise indicated.

¹² Locations of PODs under existing water rights are approximate because they are shown in IDWR's water-rights database as centroids in a 40-acre quarter-quarter.

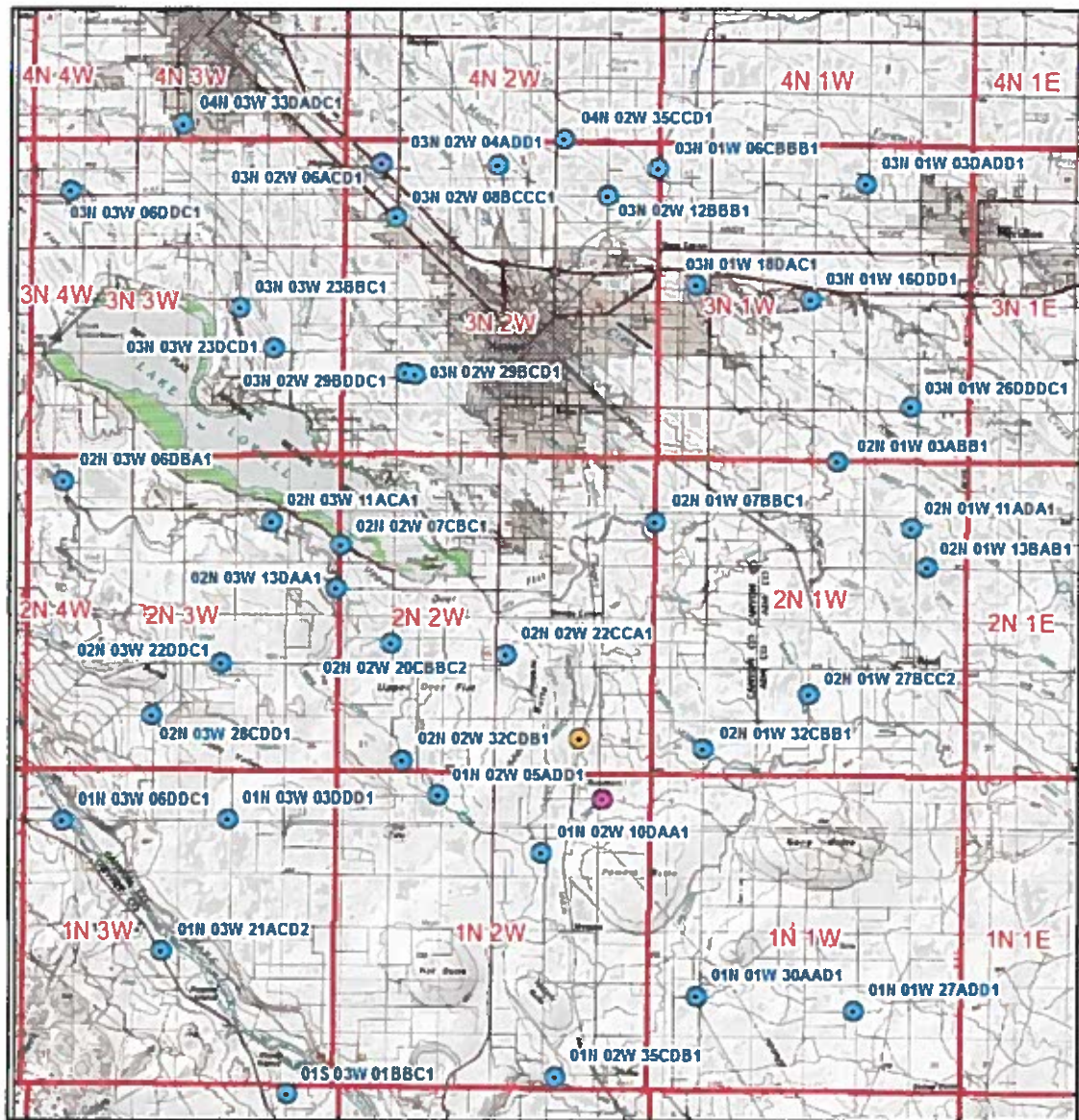


Figure 5. Groundwater level locations.

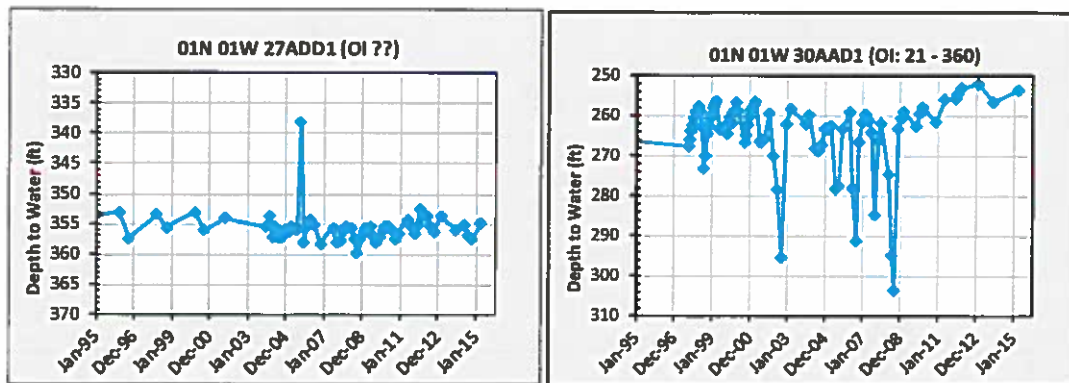


Figure 6. Groundwater levels, 01N 01W.

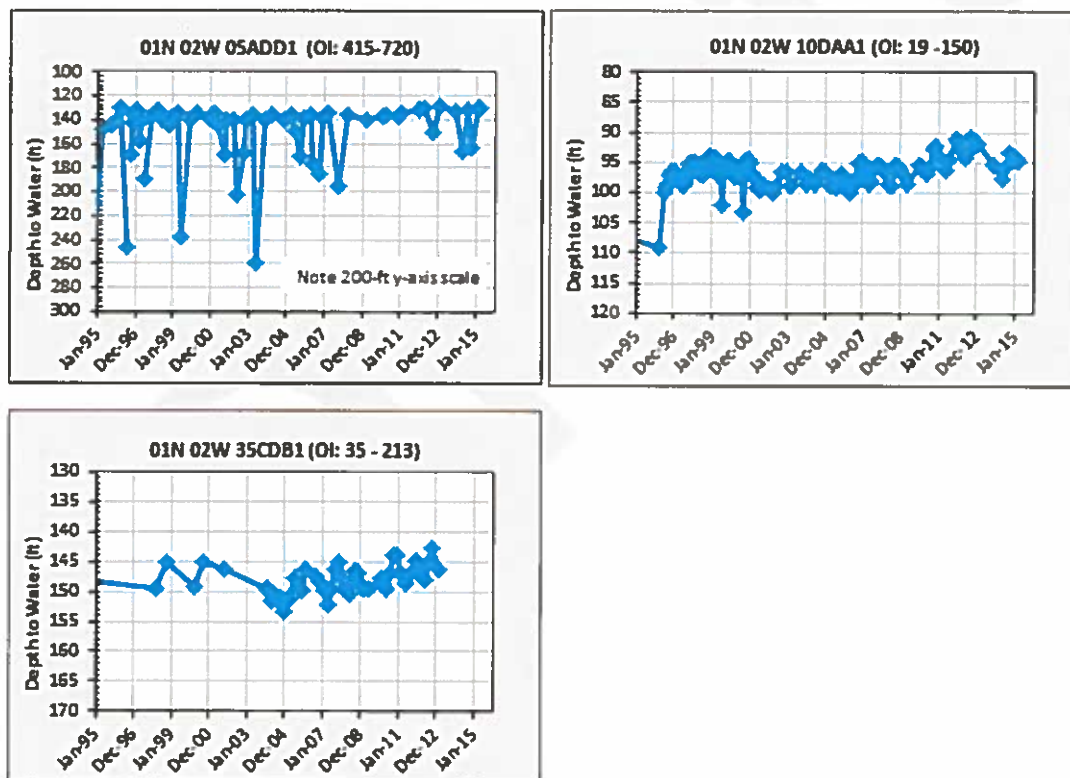


Figure 7. Groundwater levels, 01N 02W.

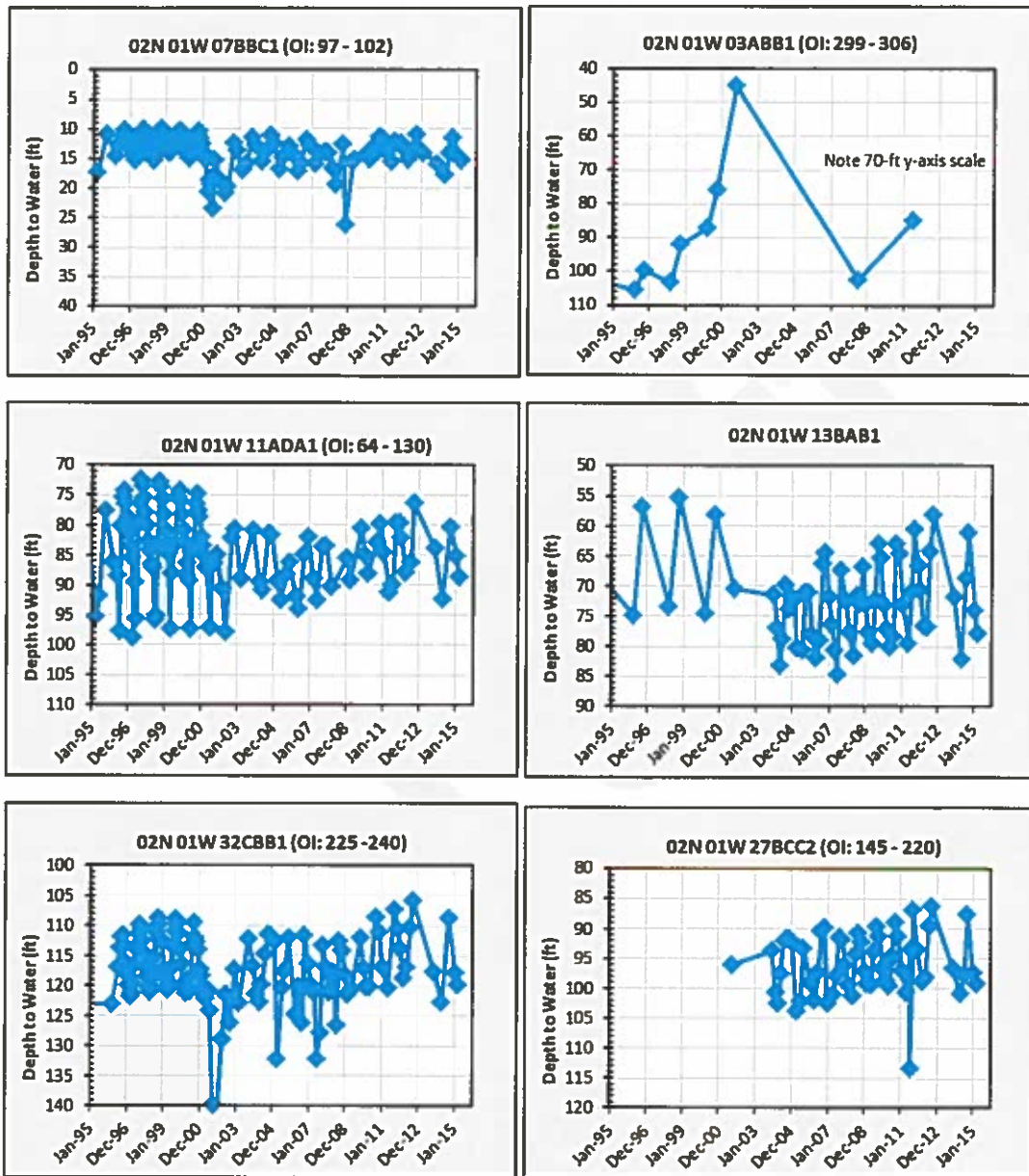


Figure 8. Groundwater levels, 02N 01W.

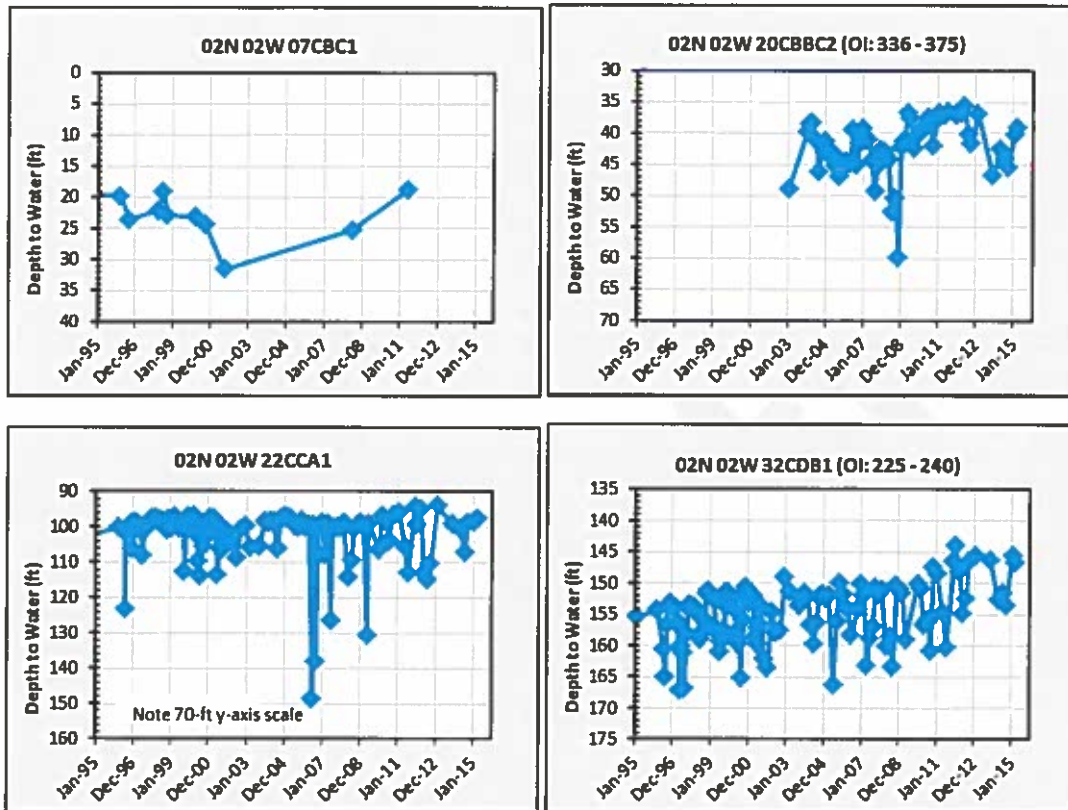


Figure 9. Groundwater levels, 02N 02W.

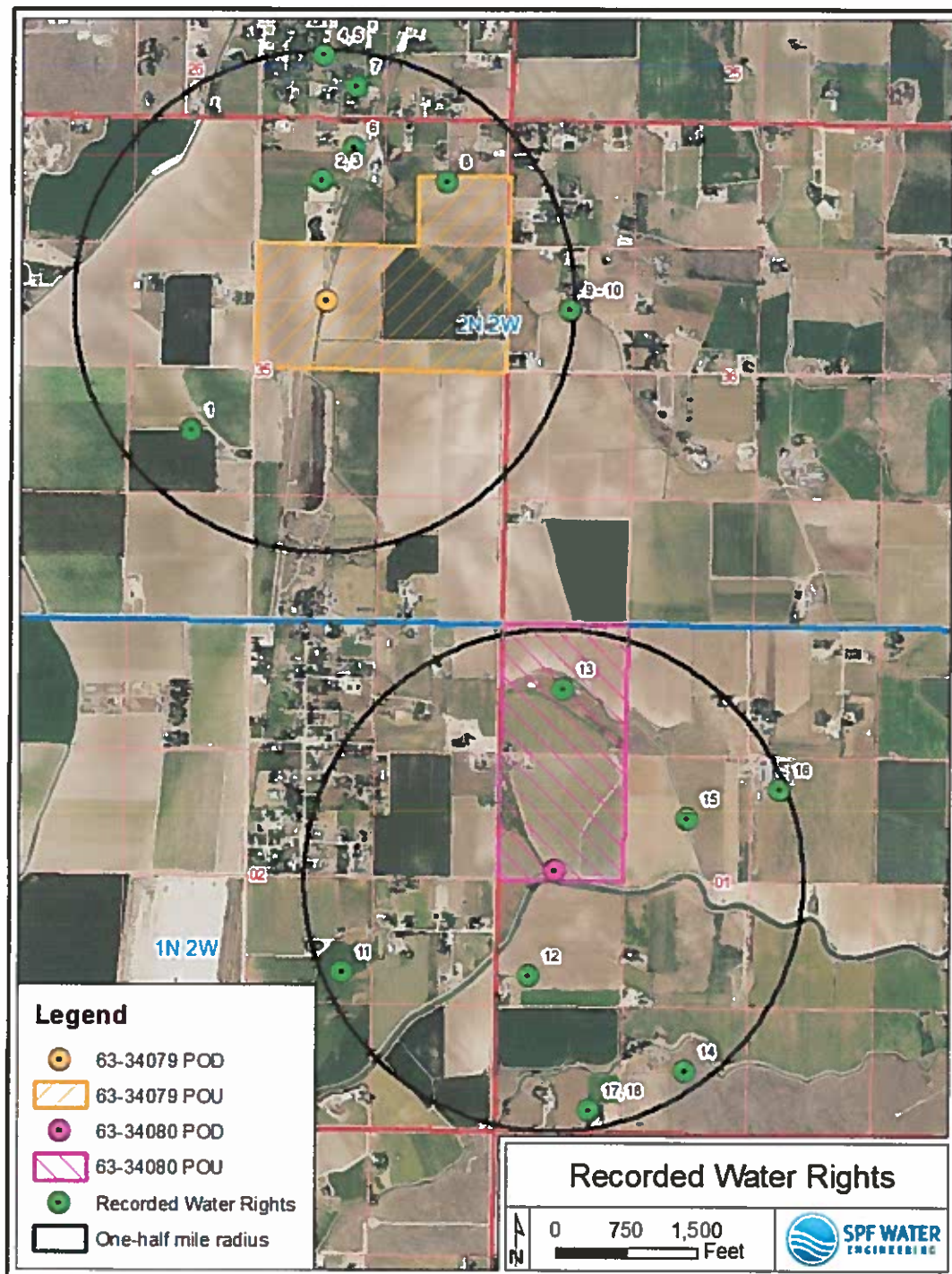


Figure 10. Water rights within 0.5 miles of the applications.

Theis Analysis

The Theis (1935) two-dimensional analytical solution was used to project drawdown from pumping associated with Applications 63-34079 and 63-34080. The method requires estimates of pumping rate, transmissivity, and storativity. The Theis analysis was performed using the highest and lowest pumping rates listed in Table 2. Estimates of aquifer transmissivity (Table 3) were based on calibrated Treasure Valley Hydrologic Project model (referred to hereinafter as the "TVHP model") hydraulic conductivity values (Petrich, 2004a) in the vicinity of the proposed diversions. It was assumed that most of the pumping would occur within a depth 200 feet of the water table; the median Model Layer 1 transmissivity in the vicinity of the proposed PODs is approximately 79,500 gallons per day per foot (gpd/ft). A single value for transmissivity was assumed to be representative of aquifer conditions for both applications. A storativity estimate of 0.005 (Freeze and Cherry, 1979) was used for the Theis analysis, which is a reasonable value for partially-confined aquifer conditions anticipated in vicinity of the applications.

Hydraulic Conductivity (TVHP Model)			
Model Layer	Low Kh	High Kh	Median Kh
	ft/day	ft/day	ft/day
1	36.2	80.8	53.1
Aquifer Transmissivity (based on 200-ft model layer thickness)			
Model Layer	Low T	High T	Median T
	gal/day/ft	gal/day/ft	gal/day/ft
1	54,200	120,800	79,500
This table is based on calibrated hydraulic conductivity values taken from the following model cells: (29,29), (30,29), (31,29), (29,30), (30,30), and (31,30).			

Table 3. Estimates of aquifer parameters (hydraulic conductivity and transmissivity) in the vicinity of the proposed PODs.

For application 63-34079, the projected drawdown at the end of the 245-day growing season is between approximately 1 and 2 feet at a distance of 0.5 miles from the pumping well for proposed low- and high-end pumping rates of 150 gpm and 250 gpm, respectively. For application 63-34080, the projected drawdown at the end of the 245-day growing season is between approximately 0.8 and 1.5 feet at a distance of 0.5 miles from the pumping well for proposed low- and high-end pumping rates of 110 gpm and 190 gpm, respectively. In both cases, the seasonal drawdown was projected to be less than approximately 3 feet at a distance of approximately 0.25

miles from the proposed PODs. In each case, it is anticipated that water levels will fully recover following the irrigation season.

Projected Approximate Drawdown (feet) with Distance from Application at 245-Days (Growing Season)			
Application	Pumping Rate (gpm)	0.25-mile	0.5-mile
63-34079	150	1.4	1.0
	250	2.4	2.0
63-34080	110	1.1	0.8
	190	1.8	1.5

Table 4. Projected drawdown summary.

The Theis solution approximates drawdown effects in two-dimensions only. The actual drawdown is expected to differ from the theoretical estimate, given that some vertical component of flow and well inefficiency effects are expected. Also, the solution does not take into account recharge, which would serve to reduce the projected drawdown from the proposed pumping.

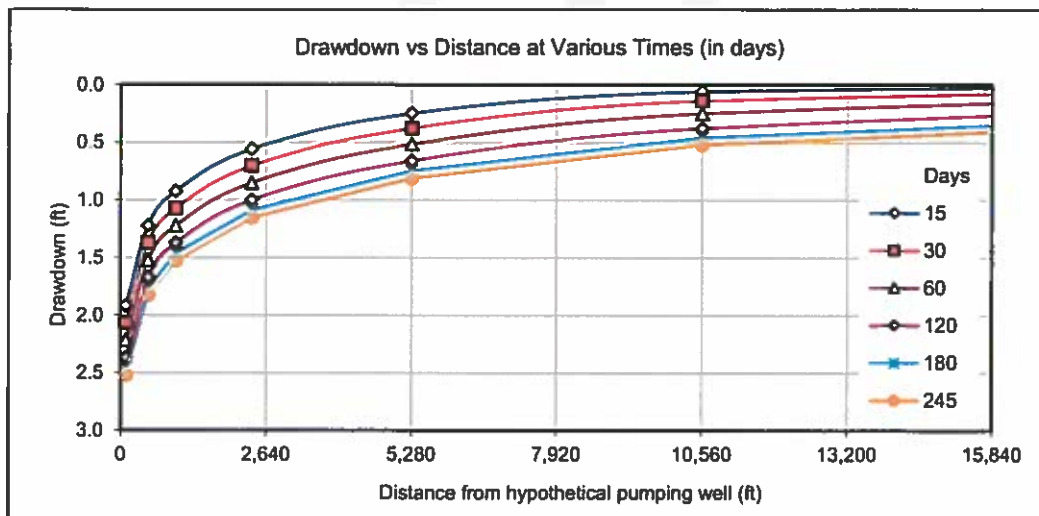


Figure 11. Predicted drawdown based on a pumping rate of 150 gpm, transmissivity of 79,500 gpd/ft, and storativity of 0.005 for Application 63-34079.

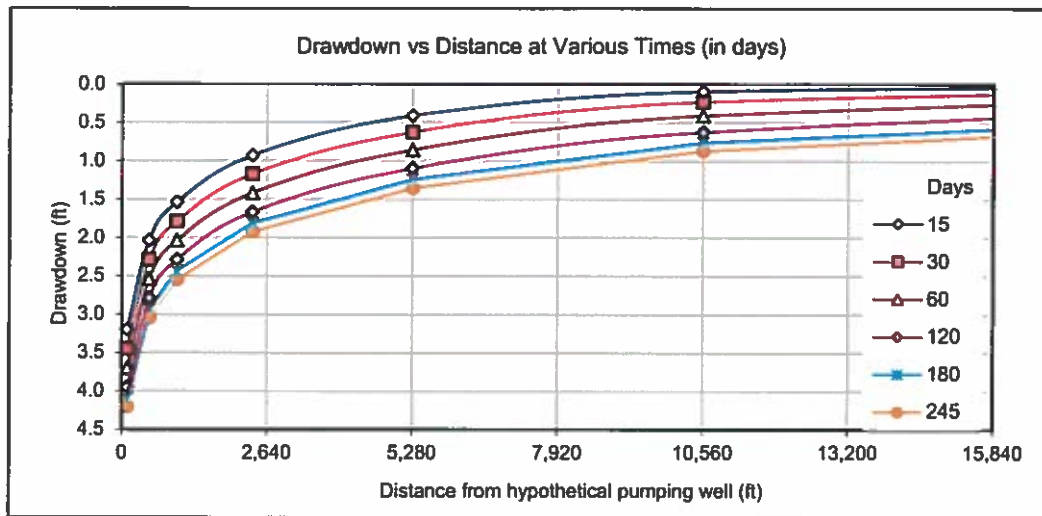


Figure 12. Predicted drawdown based on a pumping rate of 250 gpm, transmissivity of 79,500 gpd/ft, and storativity of 0.005 for Application 63-34079.

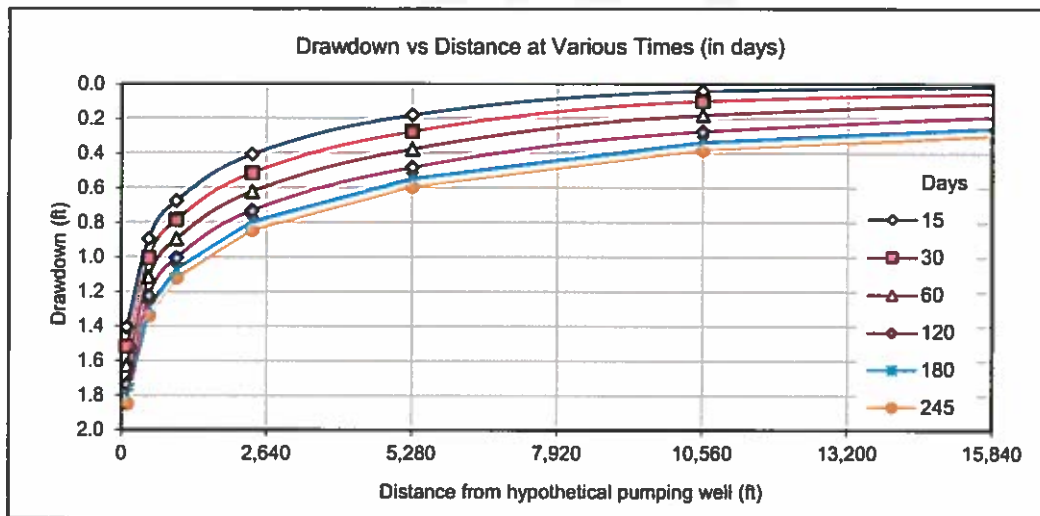


Figure 13. Predicted drawdown based on a pumping rate of 110 gpm, transmissivity of 79,500 gpd/ft, and storativity of 0.005 for Application 63-34080.

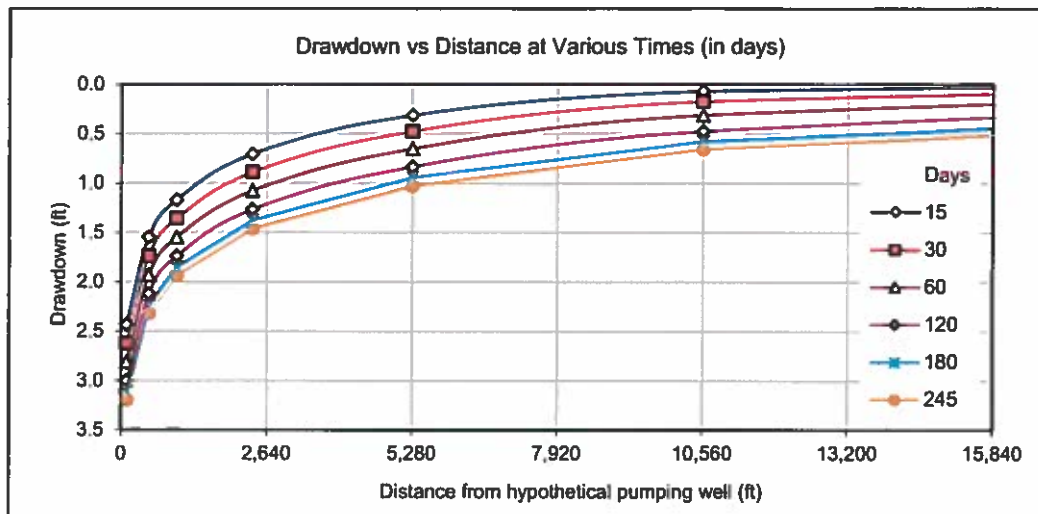


Figure 14. Predicted drawdown based on a pumping rate of 190 gpm, transmissivity of 79,500 gpd/ft, and storativity of 0.005 for Application 63-34080.

5. IMPACTS TO LAKE LOWELL

Of concern to the Boise Project Board of Control is the impact of the proposed pumping on stored water in Lake Lowell. This section describes the use of the TVHP groundwater flow model (Petrich, 2004a; Petrich, 2004b) to simulate potential impacts associated with diversions under Applications 63-34079 and 63-34080.

TVHP Model

The TVHP model was originally developed to simulate possible changes in recharge and the potential effects of regional increases in groundwater withdrawals. The model was reviewed during the development process by a Technical Advisory Committee and subsequently as part of the Treasure Valley Comprehensive Aquifer Management Planning (CAMP) process (Cosgrove, 2010). Seven existing numerical groundwater flow models were evaluated as part of the CAMP process:

- Lindgren Treasure Valley Model (1982)
- USGS Western Snake Plain Model (1991)
- Treasure Valley Hydrologic Project (2004)
- University of Idaho M3 Eagle Area Model (2007)
- Pacific Groundwater Group M3 Eagle Area Model (2008)
- Bureau of Reclamation Purdum Drain Model (2008)

- Bureau of Reclamation New York Canal Linked Ground-water/Economic Model (2009).

Cosgrove concluded that the TVHP model was the best-developed regional model for CAMP purposes. The TVHP model was constructed using the three-dimensional, finite difference MODFLOW code (Harbaugh, 2000; McDonald and Harbaugh, 1988; McDonald and Harbaugh, 1996). The model was calibrated under steady-state hydraulic conditions using the automated parameter estimation code PEST (Doherty, 1998; Doherty, 2000). The model was constructed with four layers, with layers 1, 2, 3 and 4 having thicknesses of 200 feet, 200 feet, 400 feet, and 400 feet, respectively (Petrich, 2004a). Horizontal and vertical hydraulic conductivity parameters were calibrated to 200 averaged water-level observations and 6 actual and estimated vertical-head differences.

The TVHP model calculates a summary of flows (i.e., a water budget) into and out of the model domain at the end of each simulation. Model fluxes (i.e., flows) are aggregated by flows (1) into or out of constant-head cells (representing the Snake River), river cells (representing the Boise River), head-dependent boundary cells (representing Lake Lowell), and (2) into or out of cells with simulated wells, drains, and recharge. These water-budget components were used to evaluate the potential impact of pumping under Applications 63-34079 and 63-34080 on Lake Lowell.

Numerical Simulation of Application Groundwater Withdrawals

At question in this analysis is the possible impact of pumping under the proposed applications on Lake Lowell. Two model runs were conducted to address this question. The first model run consisted of a simulated increase in groundwater withdrawals of 235 AF (Table 2) based on an assumed annual supplemental diversion of 1.4 AF/acre. The second model run consisted of a simulated increase in groundwater withdrawals of 42 AF/year, based on a 0.25-AF/acre supplemental water requirement. Because the model simulates impacts on a steady-state basis, these withdrawals were simulated as uniform rates (ranging from an aggregate of 146 gpm in the first model run to 26 gpm in the second model run).

The simulated Lake Lowell depletion from a 235-AF groundwater withdrawal under Applications 63-34079 and 63-34080 consist of approximately 6.1 AF (Table 5). This depletion consists of an approximate 3.1-AF increase in seepage *from* Lake Lowell and a 3-AF decrease in aquifer discharge *to* Lake Lowell. Similarly, the simulated impact of a 42-AF groundwater withdrawal is approximately 1.1 AF (0.6-AF increase in seepage from Lake Lowell and a 0.5-AF decreased shallow groundwater discharge to Lake Lowell). In both cases, under steady-state hydraulic conditions, the simulated Lake Lowell depletion from increases in pumping under the proposed applications was approximately 2.6% of withdrawals (Table 6).

Simulated Annual Water Budget						
TVHP Base Calibration ⁽¹⁾			235 AF/yr Annual Withdrawal Increase ⁽²⁾			
	ft ³ /day	AF/yr	ft ³ /day	AF/yr	Difference w Base (AF/yr)	Percentage of 235 AF
In (inflows to aquifer)						
Constant head (seepage from Snake River)	28,891	242	28,891	242	0	
Wells (underflow)	108,000	905	108,000	905	0	
Drains (seepage from drains to aquifer)	0					
River leakage (seepage from Boise River)	5,784,138	48,467	5,785,246	48,476	9.3	3.9%
Head-dependent boundaries (seepage from Lake Lowell)	1,537,895	12,886	1,538,265	12,890	3.1	1.3%
Recharge (excluding recharge from underflow, wells, drains, river leakage, and head-dependent boundaries)	116,205,088	973,711	116,205,088	973,711	0	
Total in	123,664,008	1,036,211	123,665,488	1,036,224	-12	
Out (discharge from aquifer)						
Constant head (subsurface discharge to Snake River)	17,350,556	145,385	17,344,504	145,334	-51	-21.6%
Wells (groundwater withdrawals)	23,076,956	193,368	23,105,026	193,603	235	100.0%
Drains (subsurface discharge to drains)	36,667,716	307,248	36,648,220	307,084	-163	-69.5%
River leakage (subsurface discharge to Boise River)	46,486,872	389,525	46,486,192	389,519	-5.7	-2.4%
Head-dependent boundaries (subsurface discharge to Lake Lowell)	81,962	687	81,600	684	-3.0	-1.3%
Total out	123,664,064	1,036,212	123,665,536	1,036,224	-12	
In - Out	-56	0	48	0	0	
Percent discrepancy	0.00%	0.00%		0.00%	0.00%	
Notes: (1) Base simulation described in Petrich (2004) as "ss2bc" (2) Annual withdrawals of 133 AF/yr applied to cell (layer, row, column) 1,30,29 (63-34079) and 102 AF/yr applied to cell 1,31,30 (63-34080).						

Table 5. Simulated annual water budget with a 235-AF/year withdrawal increase under Applications 63-34079 and 63-34080.

Simulated Annual Water Budget						
TVHP Base Calibration ⁽¹⁾			42 AF/yr Annual Withdrawal Increase ⁽²⁾			
	ft ³ /day	AF/yr	ft ³ /day	AF/yr	Difference w Base (AF/yr)	Percentage of 42 AF
In (inflows to aquifer)						
Constant head (seepage from Snake River)	28,891	242	28,891	242	0	
Wells (underflow)	108,000	905	108,000	905	0	
Drains (seepage from drains to aquifer)	0					
River leakage (seepage from Boise River)	5,784,138	48,467	5,784,336	48,468	1.7	3.9%
Head-dependent boundaries (seepage from Lake Lowell)	1,537,895	12,886	1,537,961	12,887	0.6	1.3%
Recharge (excluding recharge from underflow, wells, drains, river leakage, and head-dependent boundaries)	116,205,088	973,711	116,205,088	973,711	0	
Total in	123,664,008	1,036,211	123,664,272	1,036,213	-2	
Out (discharge from aquifer)						
Constant head (subsurface discharge to Snake River)	17,350,556	145,385	17,349,474	145,376	-9	-21.6%
Wells (groundwater withdrawals)	23,076,956	193,368	23,081,970	193,410	42	100.0%
Drains (subsurface discharge to drains)	36,667,716	307,248	36,664,236	307,219	-29	-69.4%
River leakage (subsurface discharge to Boise River)	46,486,872	389,525	46,486,752	389,524	-1.0	-2.4%
Head-dependent boundaries (subsurface discharge to Lake Lowell)	81,962	687	81,897	686	-0.5	-1.3%
Total out	123,664,064	1,036,212	123,664,328	1,036,214	-2	
In - Out	-56	0	48	0	0	
Percent discrepancy	0.00%	0.00%		0.00%	0.00%	
Notes: (1) Base simulation described in Petrich (2004) as "ss2bc" (2) Annual withdrawals of 24 AF/yr applied to cell (layer, row, column) 1,30,29 (63-34079) and 18 AF/yr applied to cell 1,31,30 (63-34080).						

Table 6. Simulated annual water budget with a 42-AF/year withdrawal increase under Applications 63-34079 and 63-34080.

6. FINDINGS AND CONCLUSIONS

The general conclusion from this analysis is that there is a sufficient groundwater supply for the proposed applications. Specific conclusions from this analysis include the following:

1. Application 63-34079 requests authorization to withdrawal groundwater up to 1.9 cfs (853 gpm) for the supplemental irrigation of 95 acres in an area approximately 5.0 miles southeast of Lake Lowell.
1. Application 63-34080 requests authorization to withdrawal groundwater up to 1.46 cfs (655 gpm) for the supplemental irrigation of 73 acres in an area approximately 6.3 miles southeast of Lake Lowell.
2. Based on review of static water levels and strata penetrated by surrounding wells, the proposed wells can be constructed in productive water-bearing zones that are sufficient to meet the flow requirements proposed on the applications.
3. Groundwater levels in the general vicinity of the proposed applications are stable (or rising), indicating the presence of groundwater available for appropriation.
4. The proposed well locations under applications 63-34079 and 63-34080 appear to be at least approximately $\frac{1}{4}$ mile away from any neighboring wells. Impacts from the proposed pumping under these applications are projected to be less than approximately 2.5 feet at a distance of $\frac{1}{4}$ mile from either of the proposed PODs.
5. The distance between the proposed PODs and Lake Lowell is at least 5 miles. At this distance, it is unlikely that the Applicant will "directly withdraw water from Lake Lowell" as is suggested in the Boise Project protest to Application 63-34079 and 63-34080. However, based on TVHP model simulations, the long-term depletionary impact on Lake Lowell (i.e., under steady-state hydraulic conditions) will be approximately 2.6% of the volume withdrawn under the proposed applications.

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