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March 30, 2009

Gary Spackman
Idaho Department of Water Resources
322 East Front Street
Boise Idaho 83720-0098

VIA HAND DELIVERY

Subject: Water Right Application 61-12090 (in the name of Nevid LLC)

Dear Mr. Spackman,

Please find attached a response to IDWR memorandums regarding aquifer recharge along I-84 from Boise to Mountain Home. This response is being provided pursuant to the Applicant's Witness List and Exhibit disclosure for water right application 61-12090, and Motion for Extension to Exchange Exhibit, both submitted to IDWR and the Protestant on March 27, 2009.

Sincerely,

Christian R. Petrich, Ph.D., P.E., P.G.
Principal Engineer/Hydrologist

cc: Norm Semanko, Rose Law Group

SPF WATER ENGINEERING

MEMORANDUM

PROFESSIONAL ENGINEER REGISTERED 9011 STATE OF IDAHO CHRISTIAN R. PETRICH 3/30/09

REGISTERED PROFESSIONAL GEOLOGIST CHRISTIAN R. PETRICH 1088 STATE OF IDAHO

DATE: March 30, 2009

TO: Norm Semanko, Rose Law Group

FROM: Christian Petrich, Ph.D., P.E., P.G.
Jennifer Sukow, P.E., P.G.

RE: *Response to IDWR memos regarding aquifer recharge along I-84 corridor from Boise to Mountain Home*

A. Executive Summary

We have reviewed two recent memorandums prepared by IDWR pertaining to Application 61-12090 (also referred to as the Nevid application). This application requests a diversion of 5 cfs of ground water for use in the proposed Elk Creek Village development.

The IDWR memorandums provide estimates of potentially available water in the Indian Creek and Elk Creek Village areas. The memos are based on several assumptions that we believe are overly conservative. Our understanding is that IDWR will review and may refine its estimates of potentially available water in this general area. Increased hydrogeologic understanding and further refinements to water supply estimates are anticipated as part of Idaho's Comprehensive Aquifer Management Planning (CAMP) process.

We have recalculated the water balance for the Nevid application using the IDWR methodology (modified where appropriate). Using the general IDWR approach, we estimate that the amount of water available for application 61-12090 ranges between 2,400 AF and 8,400 AF per year. The annual ground water withdrawal proposed under application 61-12090 is approximately 580 AF. The average consumptive use is estimated to be 419 AF/yr. The proposed withdrawals are less than the low estimate of ground water available for appropriation. A more detailed summary with supporting information is provided below.

B. Introduction

The Idaho Department of Water Resources (IDWR) has prepared two memorandums that will be considered in the matter of Application to Appropriate Water No. 61-12090:

1. Evaluation of aquifer recharge in areas of planned community applications along the I-84 corridor from Boise to Mountain Home, prepared by Craig Tesch and Sean Vincent for Gary Spackman, dated February 24, 2009.

2. Evaluation of SPF Report entitled *Ground-Water Supply Evaluation for the Mayfield Townsite Property*, prepared by Dennis Owsley and Sean Vincent for Steve Lester, dated February 10, 2009. This memorandum was provided as an attachment to the Tesch and Vincent memorandum.

SPF Water Engineering, LLC (SPF) previously prepared a ground water supply evaluation for application 61-12090 (SPF, 2007b). To our knowledge, IDWR has not yet reviewed this evaluation. However, some of the comments in the above-listed memos pertain to the SPF ground water supply evaluation for application 61-12090. The purpose of this response is therefore to (1) address concerns raised by IDWR staff in the two above-listed memorandums with regard to application 61-12090 and (2) provide revisions to a water supply assessment prepared for application 61-12090.

The following section (Section C) summarizes our response to the IDWR memos. Comments specific to the Tesch and Vincent memo are provided in Section D (page 4). Specific comments regarding the Owsley and Vincent memo are provided in Section E (page 9). Section F (beginning on page 15) provides revisions to the SPF water supply evaluation for application 61-12090 to address general concerns raised in the IDWR memos.

C. Summary

We appreciate the effort taken by IDWR to better understand hydrogeologic conditions and recharge rates in aquifers in the east Ada County and west Elmore County areas. This memo addresses several of the concerns raised by IDWR that may apply to the Nevid application.

Our general conclusion remains that there is very likely sufficient ground water available for the proposed Nevid application. This conclusion is based on the following:

1. The amount of water available for appropriation under application 61-12090 ranges between about 2,400 and 8,400 AF per year.
2. The average annual ground water withdrawal under permit application 61-12090 is estimated to be approximately 580 AF, with an estimated average annual consumptive use of approximately 420 AF. These amounts are substantially less than the estimated recharge in this area.
3. The Tesch and Vincent memo suggests that annual recharge rates might range from -5 to 50.1 cfs. However, these recharge rates are based on water budget values (e.g., underflow) from a USGS regional ground water study and are of limited value for considering the proposed ground water diversions under application 61-12090 (or the 172 cfs of aggregate proposed diversions in eastern Ada County and western Elmore County).
4. Furthermore, the impacts of proposed ground water pumping can best be evaluated on the basis of annual withdrawal volumes, not aggregate maximum diversion rates. Average withdrawals for domestic and/or municipal purposes are almost always less than maximum diversion

amounts. For example, the average pumping rate required to divert 577 acre feet (AF) over a 1-year period is about 0.8 cfs (which is substantially less than the 5 cfs maximum diversion rate requested under application 61-12090. The average withdrawal rate represented by pending applications is much less than the maximum aggregate withdrawal rate of 172 cfs.

5. The 1-mile capture area for Mayfield Townsite pumping, estimated using the WhAEM model (which was used in the IDWR analysis), likely provides no greater certainty (or uncertainty) for recharge estimates than the 2-mile capture area used in SPF analyses for the Mayfield Townsite and Nevid applications.
6. We do not believe that the withdrawal of 577 AF per year by the Elk Creek Village will exacerbate ground water level declines in the Cinder Cone CGWA. Ground water flowing from the Elk Creek Village area is not currently captured by the cone of depression created by the Cinder Cone CGWA. Pumping of approximately 16,000 AF/year in the Cinder Cone CGWA area has not resulted in a cone of depression that extends into the Elk Creek Village area. It is therefore highly unlikely that a cone of depression created by withdrawals under application 61-12090 will extend into the Cinder Cone CGWA.
7. The WhAEM model likely leads to an over-prediction of water level impacts to the Cinder Cone CGWA from pumping in the Mayfield Townsite area (and, by extension, by proposed wells in the Elk Creek Village area). This results, in part, from the use of several underlying assumptions regarding the amount of tributary underflow (assumed to be zero), seepage from surface channels (assumed to be zero), and hydraulic continuity between the Elk Creek Village area and the Cinder Cone CGWA (no hydraulic boundaries assumed). Results from the WhAEM model should therefore not be used to evaluate extended impacts from pumping under application 61-12090.
8. We believe that a 5-percent precipitation infiltration rate is justified for the Elk Creek Village area because of porous soils and modest amounts of duripan. The 5-percent infiltration rate is also supported by the high seepage rates from the Indian Creek and Bowns Creek channels. The 5-percent infiltration assumption increases (albeit slightly) the amount of water available for appropriation in the Elk Creek Village area.
9. A water budget prepared for the Elk Creek Village area (SPF, 2007b) was revised based on IDWR comments on a similar water budget prepared for Mayfield Townsite. Results of the water budget indicate that there likely is sufficient water available for the diversions proposed under application 61-12090 without injuring existing water right holders.

D. Comments Pertaining to the Tesch and Vincent Memo

Craig Tesch and Sean Vincent (IDWR) conducted a preliminary evaluation (dated February 12, 2009) of water availability in the vicinity of proposed developments along the I-84 corridor between Boise and Mountain Home. Their review was based on information provided in the USGS Professional Paper 1408-G entitled "Geohydrology of the Regional Aquifer System, Western Snake River Plain, Southwestern Idaho" (Newton, 1991). Tesch and Vincent's conclusions included the following:

1. The net recharge in the general area containing the Mayfield Townsite ranges from -5.3 cfs to 50.1 cfs, depending on whether underflow from the Danskin Mountains is included.
2. The combined appropriation of 11 water right applications (172 cfs) exceeds this recharge range, and that this total appropriation greatly exceeds the "reasonably anticipated rate of future natural recharge."
3. Several developments within 5 miles of the Cinder Cone CGWA and Mountain Home GWMA could exacerbate conditions in these areas.

Specific comments in response to the Tesch and Vincent analysis include the following:

1. The water budget prepared by Tesch and Vincent uses underflow values estimated in a previous USGS study (Newton, 1991). However, the water budget used by the USGS was prepared for a regional-scale analysis that began in 1979 and, in our opinion, has limited applicability for determining sufficiency of supply for individual applications such as 61-12090.
   a. The USGS model was used to simulate ground water flow under the 144-mile-long, 50-mile-wide area of the Western Snake River Plain to a depth of 11,500 feet below ground surface. Successful model calibration was only achieved for the uppermost model layer (of 3 model layers). Insufficient hydrogeologic data for the middle and lower aquifer units prevented an acceptable calibration of the middle and lower model layers. The model was thus deemed useful for understanding general aspects of the western Snake River aquifer system but not for detailed management analyses.
   b. Although this study represented a respectable effort in the 1979-1991 period, applicability of the model and supporting water budget data for local-scale assessments (such as the Nevid application) is very limited.
2. Tesch and Vincent acknowledge that "some budget estimates [in the USGS study] have a range of uncertainty and are not well defined due to a lack of hydrologic data, particularly tributary underflow..." (pg. 4).
   a. Newton (1991) characterizes portions of the USGS water budget in this way:

      "The range of uncertainty associated with the estimated ground-water budget ... is large because the values used in budget estimates are not well defined. For example, ... rates of ET in non-irrigated areas cannot be estimated accurately owing to lack of data…"

"Estimates of recharge from precipitation generally are poor because the many factors that affect infiltration from precipitation are not well determined."

"…the distribution of underflow is poorly known."

b. Tesch and Vincent note that the tributary underflow component of the water budget has a large range of uncertainty.

   i. As noted in the IDWR memo, the lack of regional underflow data was acknowledged in the USGS (Newton, 1991) and Treasure Valley Hydrologic Project (Petrich, 2004) studies. We agree with Tesch and Vincent that tributary underflow rates into the aquifers underlying the Nevid area are uncertain.

   ii. However, qualitative (and possibly quantitative) assessments can be made for individual tributary basins.

   iii. While tributary underflow from unfractured granitic rocks may be negligible (SPF, 2007a)[1], recent anecdotal observations in the Indian Creek and Bowns Creek drainages suggest tributary underflow in tributary basin sediments and other areas along the Danskin Mountain front may be an important component of local recharge. Efforts to begin describing tributary underflow in the Indian Creek drainage are underway.

c. Therefore, the uncertainty associated with IDWR's estimate of water availability with respect to the 172 cfs of proposed applications is very high.

3. Tesch and Vincent compare the combined appropriation of 11 water right applications (172 cfs) against an estimated recharge range developed using the Newton (1991) water budget.

   a. Recharge rates such as those estimated in the USGS water budget are average rates.

   b. The use of maximum diversion rates for comparisons with average recharge rates is not a valid comparison. This is because the proposed diversion rates listed on applications are for anticipated peak withdrawals. Average withdrawals are almost always substantially less than maximum diversion rates.

   c. For example, the maximum requested diversion rate under application 61-12090 is 5 cfs. The anticipated annual volumetric withdrawal is approximately 577 acre feet (AF) per year, which represents an

[1] Referred to in the Tesch and Vincent memo on pg. 5.

average withdrawal rate of 0.80 cfs (16 percent of the requested maximum diversion rate). The consumptive use (419 AF) – a measure of anticipated actual aquifer impact – represents an average withdrawal rate of 0.58 cfs (12 percent of the requested maximum diversion rate).

   d. Similarly, the 10-cfs maximum diversion rate under permit 63-32225 (which is not included in the above-listed 172-cfs aggregate diversion rate represented by pending applications) for the nearby Mayfield Springs development is limited by IDWR to an annual volume of 1,815 AF. This volume is equivalent to a constant annual withdrawal rate of only 2.51 cfs.

4. Table 2 of the Tesch and Vincent memo compares the 8,000-acre reduction in irrigated acres in two subareas of the USGS model between 1980 and 2000 (pg. 5).

   a. Tesch and Vincent suggest that the changes may be explained by implementation of crop reduction programs, conversions to dry-land farming, and removal of land from agricultural production.

   b. Another explanation is that the land was not fully developed agricultural land in 1980 and never received the amount of water estimated in the USGS study. The implications of this would be that the USGS overestimated agricultural diversions and corresponding consumptive use. The net result of such an error would be higher-than-estimated recharge values.

5. Table 3 of the Tesch and Vincent memo presents a water budget for two subareas in the USGS model based on USGS data and METRIC-based evapotranspiration estimates. We have several concerns about conclusions drawn from this table, including the following:

   a. The largest component (underflow) represents inflows to the model subareas to a depth of 11,500 feet below ground surface in sedimentary, volcanic, and granitic strata that are poorly understood.

   b. We agree with Tesch and Vincent that the underflow value estimated by the USGS study and listed in Table 3 of the Tesch and Vincent memo (55.4 cfs) is very uncertain. Furthermore, estimated underflow to geologic strata excessively below target aquifers is of limited use in estimating water availability for the proposed applications.

   c. We believe that a more valid approach to estimating underflow potentially tapped by proposed wells is to quantify the difference between precipitation and evapotranspiration in contributing watersheds, which is the approach taken in the Mayfield Springs (SPF, 2007c), Mayfield Townsite (SPF, 2007a), and Elk Creek Village (SPF, 2007b) water supply assessments[2].

d. Conclusion No. 3 of the Tesch and Vincent memo (pg 8) states that "ignoring underflow, the net recharge for subareas four and eight is negative 5.3 cfs" and that "the negative 5.3 cfs [net recharge without underflow] estimate arguably is more meaningful for evaluating impacts to the resource if the rate of ground water outflow approaches the modeled rate of underflow."

   i. Net recharge, by definition, should include underflow.

   ii. An estimate of recharge that ignores underflow is not more meaningful for evaluating potential resource impacts. Because total aquifer discharge represents a combination of recharge *and* aquifer underflow, ignoring underflow will lead to estimates of negative aquifer inflows, which are not meaningful.

6. The Tesch and Vincent memo notes that several of the proposed developments in this area, including the Elk Creek Village, are within 5 miles of the Cinder Cone CGWA. The memo expresses concern that proposed ground water development will exacerbate ground water level declines in the Cinder Cone CGWA and Mountain Home GWMA. We do not believe that ground water withdrawals under the Nevid application will exacerbate ground water level declines in the Cinder Cone CGWA and Mountain Home GWMA, for the following reasons:

   a. Ground water in the vicinity of the Elk Creek Village flows in a southwesterly direction perpendicular to the water level contours shown in Figure 1. A cone of depression emanating from the Cinder Cone CGWA (coarsely illustrated with the 50-foot contours shown in Figure 1) does not intercept flow from the Elk Creek Village area. Furthermore, a water level change map in Figure 1 of the Tesch and Vincent memo does not show declines reaching the Elk Creek Village area.

   b. It is noteworthy that pumping in the Cinder Cone CGWA has not reached the Elk Creek Village area in 40 years of pumping. The extension of a cone of depression from the Cinder Cone area may be, in part, precluded from extending to the Elk Creek Canyon area by leaky hydraulic boundaries associated with faulting parallel to the Danskin Mountain Front (Figure 2). Seismic geophysics proposed for the summer of 2009 may help identify faulting in this area.

   c. Pumping from the proposed Elk Creek Village wells under application 61-12090 will reduce flows into areas southwest of the Elk Creek Village and west of the Cinder Cone CGWA. However, ground water

[2] Selected comments made by IDWR regarding the Mayfield Townsite water supply assessment (SPF, 2007a) are addressed in Section E.

withdrawals in the Elk Creek Village area will not impact ground water levels in the Cinder Cone CGWA unless the cone of depression from Cinder Cone pumping extends further to the west. This would entail substantial additional ground water level declines in the Cinder Cone CGWA, which likely would lead to less pumping and subsequently some ground water level stabilization.

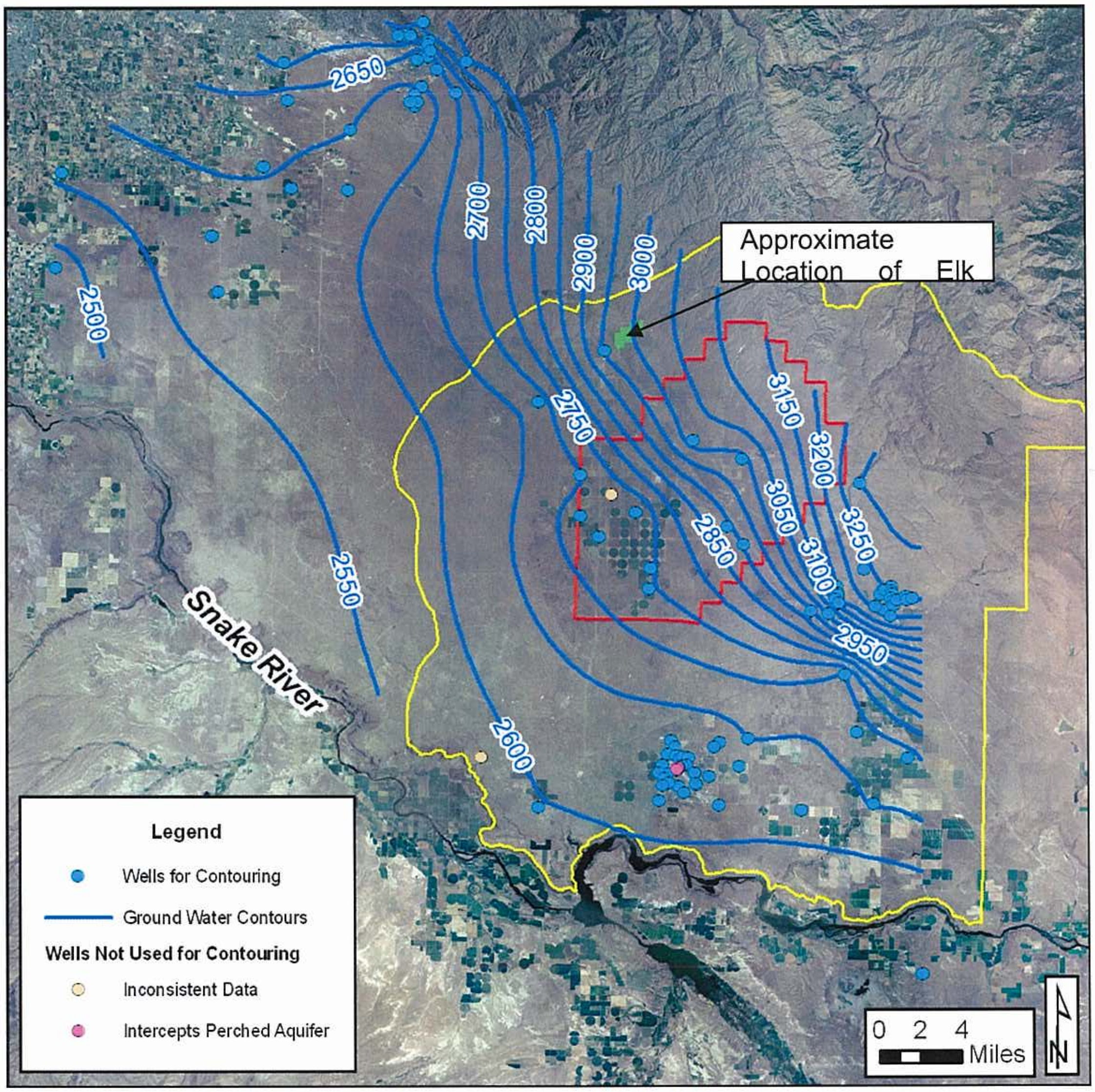

Figure 1. Ground water surface elevation contours (50-ft).

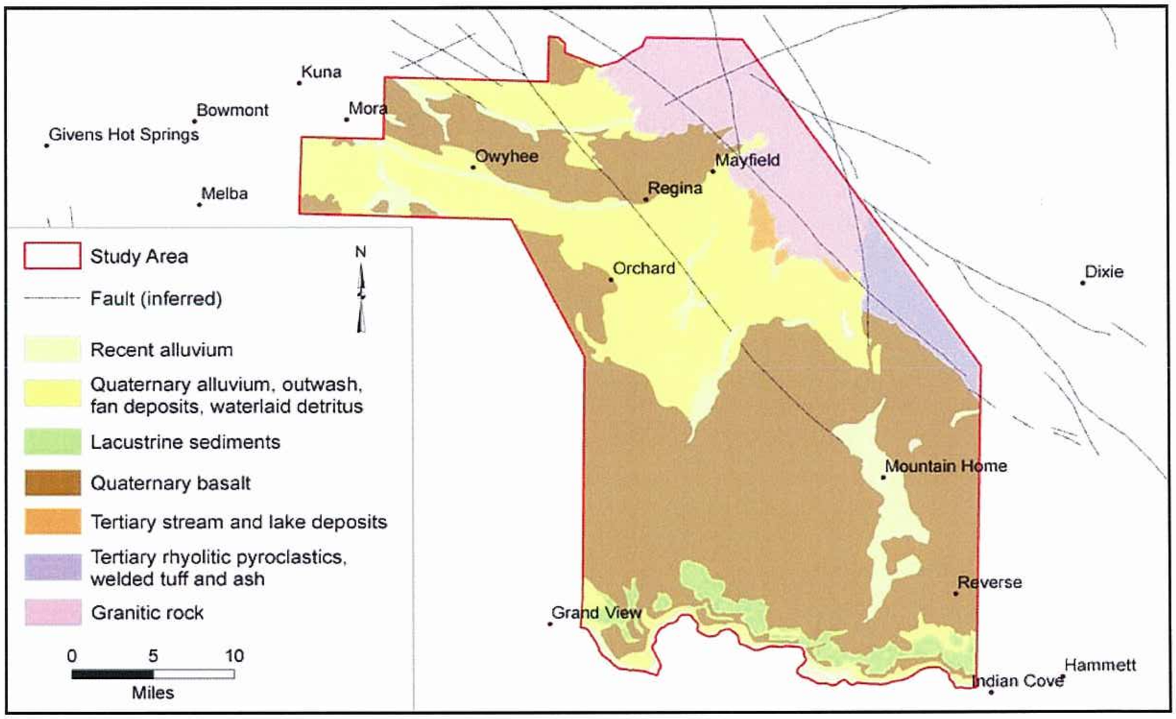

Figure 2. Surficial geology showing inferred faulting parallel to the Danskin Mountain front (Bond and Wood, 1978).

E. Comments Pertaining to the Owsley and Vincent Memo

In 2007 SPF prepared an assessment of likely water availability (SPF, 2007a) in conjunction with water right application 63-32499. This application requests 10 cfs for municipal purposes in the Mayfield Townsite area, which is located northwest of the Elk Creek Village site. Dennis Owsley and Sean Vincent of IDWR reviewed the Mayfield Townsite water supply assessment (memo dated February 10, 2009); their review was included as an attachment to the Tesch and Vincent memo (Section D).

To our knowledge, IDWR staff has not reviewed the water supply evaluation prepared for application 61-12090 (Elk Creek Village). However, some aspects of the Owsley and Vincent memo also apply to the Elk Creek Village assessment. This section therefore addresses concerns raised in IDWR's review of the Mayfield Townsite water supply assessment that likely apply to application 61-12090.

1. IDWR delineated an alternative capture area for wells in the Mayfield Townsite area using the WhAEM model (U.S. EPA, 2007) for purposes of comparison with the SPF assumed 2-mile capture area. The 1-mile capture area estimated using the WhAEM model provides, in our opinion, no greater certainty (or uncertainty) for recharge estimates than the 2-mile capture area.

a. The WhAEM code simulates flow in a 2-dimensional (i.e., horizontal) aquifer system; ground water flow in the Mayfield area clearly occurs in a 3-dimensional (horizontal and vertical) flow system.

b. The assumed uniform areal recharge of 3 percent used in the WhAEM model ignores substantial recharge that occurs from stream channel seepage and tributary underflow.

c. The 200-foot aquifer thickness assumed by Owsley and Vincent is almost certainly less than the actual aquifer thickness in the Mayfield Townsite area.

   i. The depth to water in the ARK properties well (Well No. 48 in Figure 4 of the Mayfield Townsite water supply assessment) used by Owsley and Vincent for the WhAEM analysis was extended to a depth of 690 feet. The initial depth to water was recorded as 229 feet, implying a saturated thickness of 461 feet above the bottom of the well.

   ii. The Kenny Owings Well (Well No. 49 in Figure 4 of the Mayfield Townsite water supply assessment) was drilled to a depth of approximately 1,300 feet. This well penetrated multiple zones of fine-, medium-, and coarse-grained sediments to depths of at least 960 feet based on a log of cuttings from this well that were described by a Boise State University student in 1980. Geophysical logging indicated that these sediments extend to the total depth.

   iii. Based on observations in the ARK Properties and Kenny Owings Well, the actual aquifer thickness in the Mayfield Townsite area is substantially greater than the 200 feet assumed in the Owsley and Vincent analysis.

d. Faulting or other features creating hydraulic heterogeneity are not included in the WHAEM model.

e. Different assumptions about aquifer thickness, hydraulic parameters, and recharge amounts will either increase or decrease the size of an aquifer capture area.

   i. A specified recharge rate biases the estimation of capture area. For example, an assumed high value of recharge would lead to a small estimated capture area when using the WhAEM model. A low value leads to a broader simulated capture area. Thus, the use of recharge rates as a model input contributes to a pre-determination of capture zone.

   ii. For comparison purposes, a Theis analysis (Theis, 1935) was performed to determine the potential capture zone for pumping under application 61-12090. Using the same transmissivity used in the WhAEM model by IDWR (25,000 gpd/ft), an assumed storativity of 0.005, and an average withdrawal rate of 0.8 cfs (which provides for an annual withdrawal of 577 AF under the Elk Creek Village application), a water level decline of up to about 8 feet is possible at a distance of 2 miles after 1 year[3]. (Figure 3). This shows the possible extent of a capture zone. Note, however, that any recharge to the aquifer during the year of withdrawal would reduce (or eliminate) this long-term drawdown predicted using the Theis solution. The Theis solution, like the WhAEM model, is a 2-dimensional solution that does not account for boundary effects, vertical ground water flow, or hydraulic discontinuities.

iii. The WhAEM model, while appropriate for some wellhead protection analyses, is not ideal for defining recharge capture areas in complex hydrogeologic areas because of the dependence on pre-defined recharge rates and other simplifying assumptions.

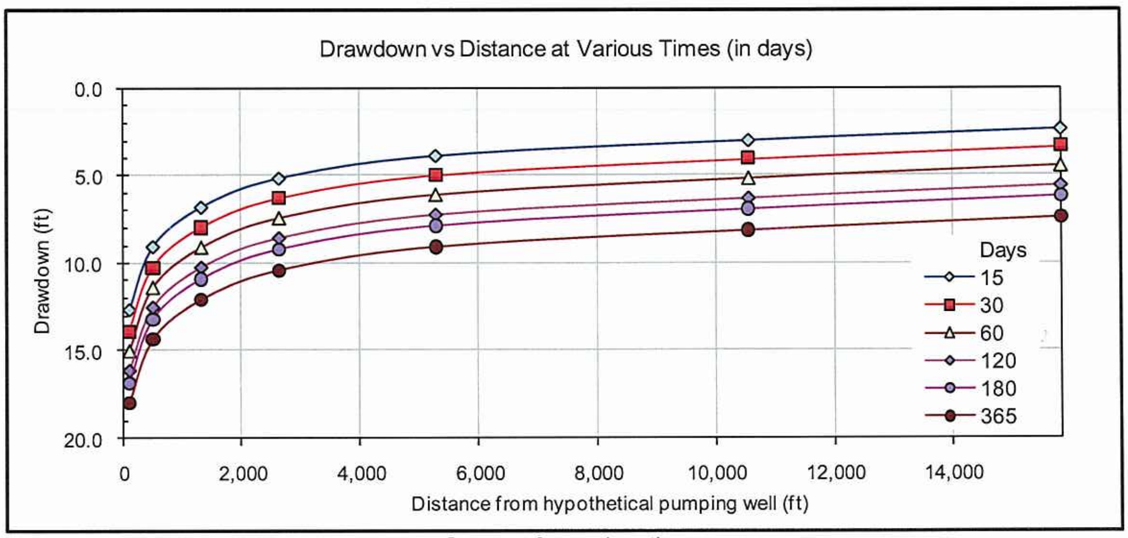

Figure 3. Theoretical drawdown after a period of one year.

[3] Assumptions inherent to the use of the non-equilibrium well equation (Theis, 1935) are that the aquifer is homogeneous and isotropic, uniform in thickness and areal extent, the aquifer receives no recharge, the pumping well penetrates the full aquifer thickness, water removed by discharge is removed instantaneously, the pumping well is 100 percent efficient, laminar flow exists throughout the aquifer, and that the water table or potentiometric surface has no slope. These assumptions are rarely completely satisfied under field conditions, but this method will often provide an indication of possible well drawdown in the absence of aquifer recharge.

f. The effect of a 1-mile capture zone is that it would intercept less recharge than an assumed 2-mile capture zone, and therefore represents a more conservative assessment of potential water availability. Despite our comments regarding the use of the WhAEM model (and its underlying assumptions), we have re-estimated potential recharge available to the Elk Creek Village wells using the 1-mile capture zone (see Section F).

2. The WhAEM model predicted additional steady-state water level declines of 130 feet at the Cinder Cone CGWA boundary resulting from Mayfield Townsite pumping. Similar (but lesser magnitude) declines could be predicted from Elk Creek Village pumping with a similar WhAEM analysis. However, too little about aquifer conditions (transmissivity, potential hydraulic boundaries, and recharge rates) is known for use of the WhAEM code in such an application.

    a. It is notable that ground water withdrawals in the Cinder Cone CGWA have had no discernable effect in the Elk Creek Village area. Withdrawals in the Cinder Cone CGWA of about 16,000 acre feet per year (AF/yr)4 have resulted in an average decline of about 37 feet between 1976 and 2000. Ground water withdrawals in the Cinder Cone area have not yet reached equilibrium; water levels are declining at a rate of approximately 2 feet per year. However, ground water levels in the Elk Creek Village area are stable or rising slightly (see Figure 4 in SPF, 2007b).

    b. Owsley and Vincent acknowledge that the effects of possible faulting between the Mayfield (and Elk Creek Village) and Cinder Cone CGWA could limit the propagation of pumping effects between these two areas.

    c. We believe that it is highly unlikely that withdrawals of up to 577 AF per year from the Village area will impact water levels in the Cinder Cone CGWA because

        i. Water level declines in the Cinder Cone CGWA have not extended to the Elk Creek Village area in approximately 40 years of pumping (which may be attributable, in part, to hydraulic discontinuities associated with faulting); and

        ii. The current cone of depression created by the Cinder Cone CGWA does not intercept ground water flowing from the Elk Creek Village area.

3. The Owsley and Vincent memo notes that SPF assumed an areal infiltration rate of 5 percent in the Mayfield Townsite water supply evaluation, compared to a 3 percent infiltration rate assumed in the USGS

[4] Based on METRIC-derived evapotranspiration in the Cinder Cone CGWA.

study (Newton, 1991). The same 3 percent infiltration rate was assumed in the Treasure Valley Hydrologic Project (Urban, 2004; Urban and Petrich, 1998). However, we believe that the 5 percent infiltration rate is justified for the Mayfield Townsite and Elk Creek Village areas.

a. Much of the Treasure Valley rangeland areas have a prominent duripan5 that limits deep-infiltration rates.

b. One would expect that alluvial sediments and overlying soils near the granitic Danskin mountain front would have substantially greater porosity than basinward sediments.

c. Soils in the assumed Elk Creek Village infiltration area overlying alluvial sediments have greater permeability than typical Treasure Valley soils.

   i. Soils with duripan layers cover about 22 percent of the estimated sedimentary infiltration area for the Elk Creek Village.

   ii. Soil unit 27 (Figure 4), which has low-permeability (i.e., duripan) characteristics, covers about 12.4 percent of the sedimentary portion of the Elk Creek Village infiltration area.

   iii. Thirty percent of Unit 94, which covers 33.5 percent of the sedimentary infiltration area, has duripan low-permeability characteristics.

d. Most of the soil (78 percent) in the sedimentary portion of the Elk Creek Village capture area consists of soils without duripan. We believe that higher permeability soil near the basin margin in this area justifies the 5 percent infiltration rate assumed in the Mayfield Townsite and Elk Creek Village studies.

4. SPF used rangeland evapotranspiration developed with SEBAL (Surface Energy Balance Algorithm for Land) based on 2000 data.

   a. The Owsley and Vincent memo correctly points out that

      i. The variability for rangeland ET estimates is high; and

      ii. SEBAL data do not include wintertime ET estimates.

   b. Owsley and Vincent used evapotranspiration estimates using ET Idaho6 data based on the Boise 7N weather station data. The resulting ET estimates for the Mayfield Townsite area are larger than those estimated by SPF.

   c. SPF used IDWR's comments regarding evapotranspiration in the Mayfield Townsite report to re-estimate evapotranspiration for the Elk

[5] http://soils.ag.uidaho.edu/soilorders/aridisols_08.htm

[6] *ET Idaho — Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho*, University of Idaho at Kimberlly, http://www.kimberly.uidaho.edu/ETIdaho/.

Creek Village capture zone area. The results from this refined estimate are presented in Section F.

Soil Unit	% of Area	Description	Infiltration Capacity (in/hr)	Duripan
94	33.5%	Lanktree_Chilcott loams, 0-12% slopes	0.00-0.20	30% of soil type
78	20.2%	Haw-Lankbush complex, 4-20% slopes	0.20-0.60	no
129	13.3%	Rainey-Van Dusen_Schoolhouse association, 30-60 % slopes	0.20-20.0	no
27	12.4%	Chilcott-Elijah silt loams, 0-12 % slopes	0.00-0.06	yes
59	9.7%	Farrot-Haw complex, 4-20% slopes	0.20-0.60	no
91	4.2%	Lankbush-Lanktree complex, 4-30% slopes	0.06-0.60	no
92	4.2%	Lankbush_Jenness association, 0-4% slopes	0.20-2.0	no
108	2.3%	Monroe-Jenness complex, 0-2% slopes	0.57-2.00	no
127	0.0%	Rainey-Schoolhouse-Oland association, 30-70% slopes	2.0-6.0	no

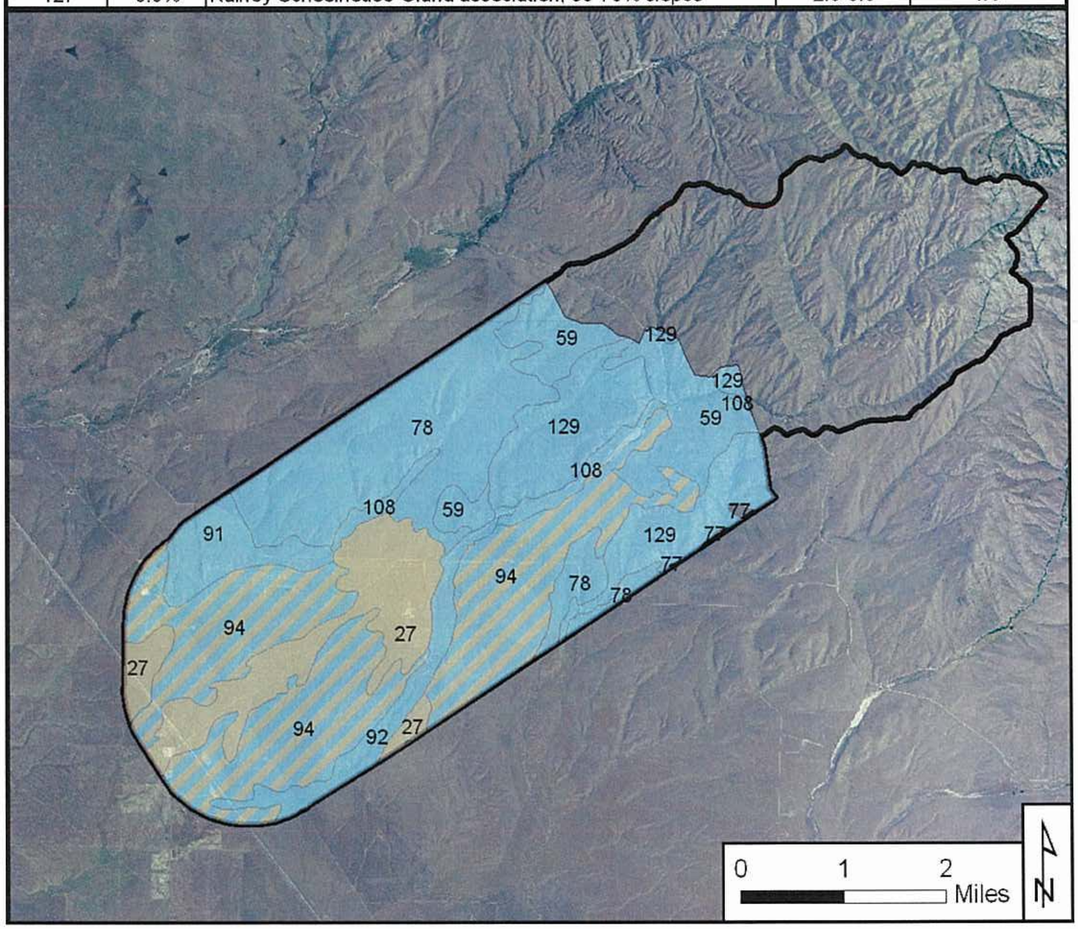

Figure 4. Soils in the Elk Creek Village area.

5. Owsley and Vincent estimated evapotranspiration in the vicinity of the Mayfield Townsite area using a 1999 vegetation coverage. Our understanding is that this coverage was prepared by or for the Idaho Department of Fish and Game. We believe that the vegetation coverage is not correct.

a. The coverage included substantially more agricultural acreage planted in alfalfa and more “low intensity urban” acreage than currently exists. The alfalfa acreage exceeds the irrigated area authorized under existing water rights. Some of the assumed diversion rates exceed allowable application rates.

b. The amount of evapotranspiration estimated for these lands was overestimated by IDWR.

c. A more appropriate evapotranspiration rate using ET Idaho might be an average rate represented by four vegetation categories: sagebrush, range grasses (bromegrass), range grasses (long season), and range grasses (early short season).

F. Revised Water Budget Information for Nevid Application

A partial water budget was prepared as part of the ground water supply evaluation for the Elk Creek Village (SPF, 2007b). This water budget was revised based on comments made by Owsley and Vincent in their review of the Mayfield Townsite water supply evaluation (see Section E). Specific refinements to the Elk Creek Village water supply evaluation included the following:

1. The recharge capture zone was decreased from a 2-mile radius around the Elk Creek Village property to a 1-mile radius.
2. Wintertime evapotranspiration was added to the annual evapotranspiration.
3. Evapotranspiration estimates were made using data from ET Idaho.

Results from these changes are summarized beginning on page 21. The data and methods used to develop the revised water budget are described in the following paragraphs. The following paragraphs correspond with Sections 4.1.1 through 4.2 in the original Elk Creek Village water supply evaluation (SPF, 2007b).

<u>Contributing Basins</u>

Four watershed areas define surface water flow in and upgradient of the property, shown in Figure 5. However, these surface water drainages do not necessarily define subsurface flow divides. Aquifers in the area extend beyond, and can be influenced by, recharge and discharge from areas outside of these watershed areas. For this analysis it was assumed that the capture area for aquifers in the project area and the area of well withdrawals near the Elk Creek Village property is the area upgradient and within approximately 1 mile of the Elk Creek Village property but limited by contacts with granitic rocks (Figure 5). The assumed capture area for areal infiltration is approximately 12,000 acres.

Precipitation in granitic areas in the upper Sand Hollow Creek and Bowns Creek watersheds is expected to contribute to aquifer recharge in the project area via (1) seepage from surface channels into underlying sediments and (2) shallow underflow. Seepage of channel flows continues as the channels cross from primarily granitic to primarily sedimentary areas. These upper watershed areas include approximately 5,400 additional acres (Figure 5).

Precipitation

Average annual precipitation estimates, based on data obtained from IDWR, range from approximately 12 to 14 inches per year in lower elevations of the water budget area to 24 to 28 inches of precipitation at the highest elevations (Figure 6). The average annual precipitation volume over the entire water budget area is approximately 24,300 acre feet. The average annual precipitation over the assumed area of areal infiltration is approximately 14,800 acre feet.

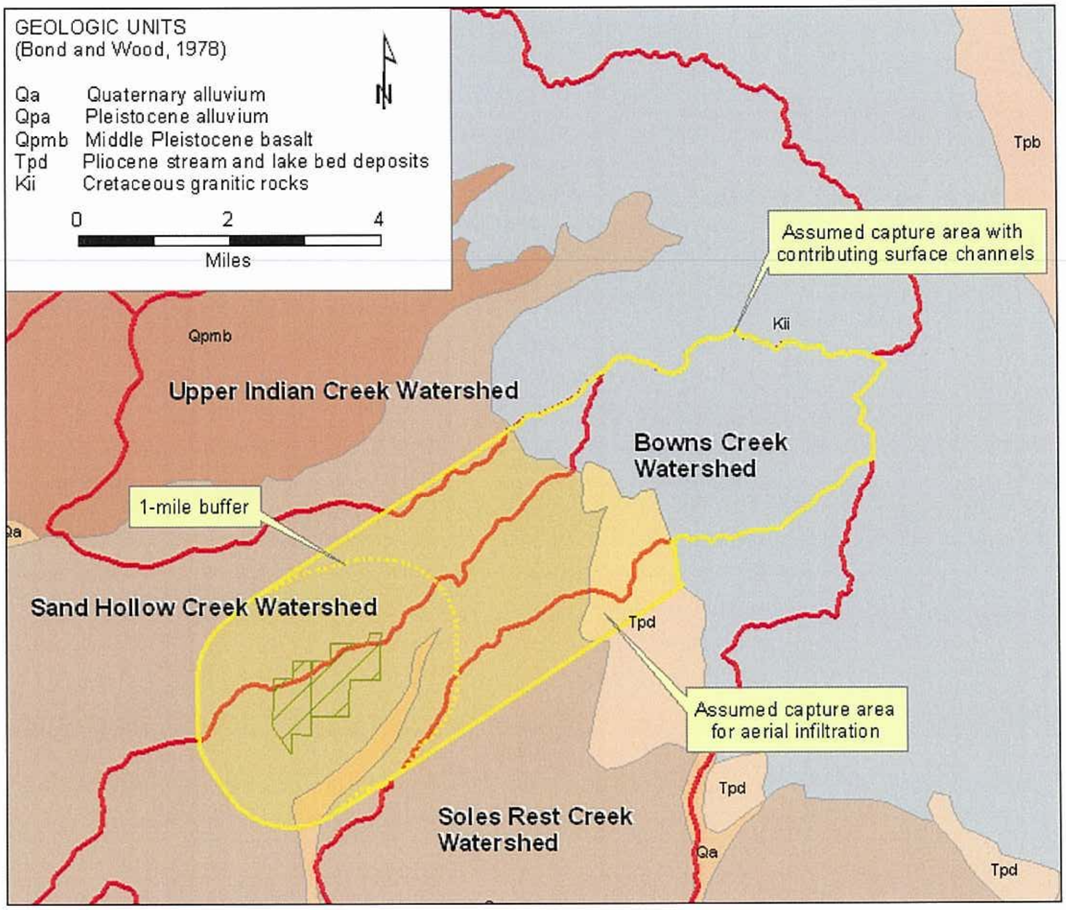

Figure 5. Assumed capture area for areal infiltration and contributing watershed areas for surface channel seepage. Surficial geology from Bond and Wood, 1978.

Evapotranspiration

Evapotranspiration was estimated using two different methods. The first estimate of evapotranspiration was obtained using METRIC evapotranspiration data[7] from the year 2000 and winter evapotranspiration estimates from ET Idaho. The second estimate was made using annual ET Idaho data.

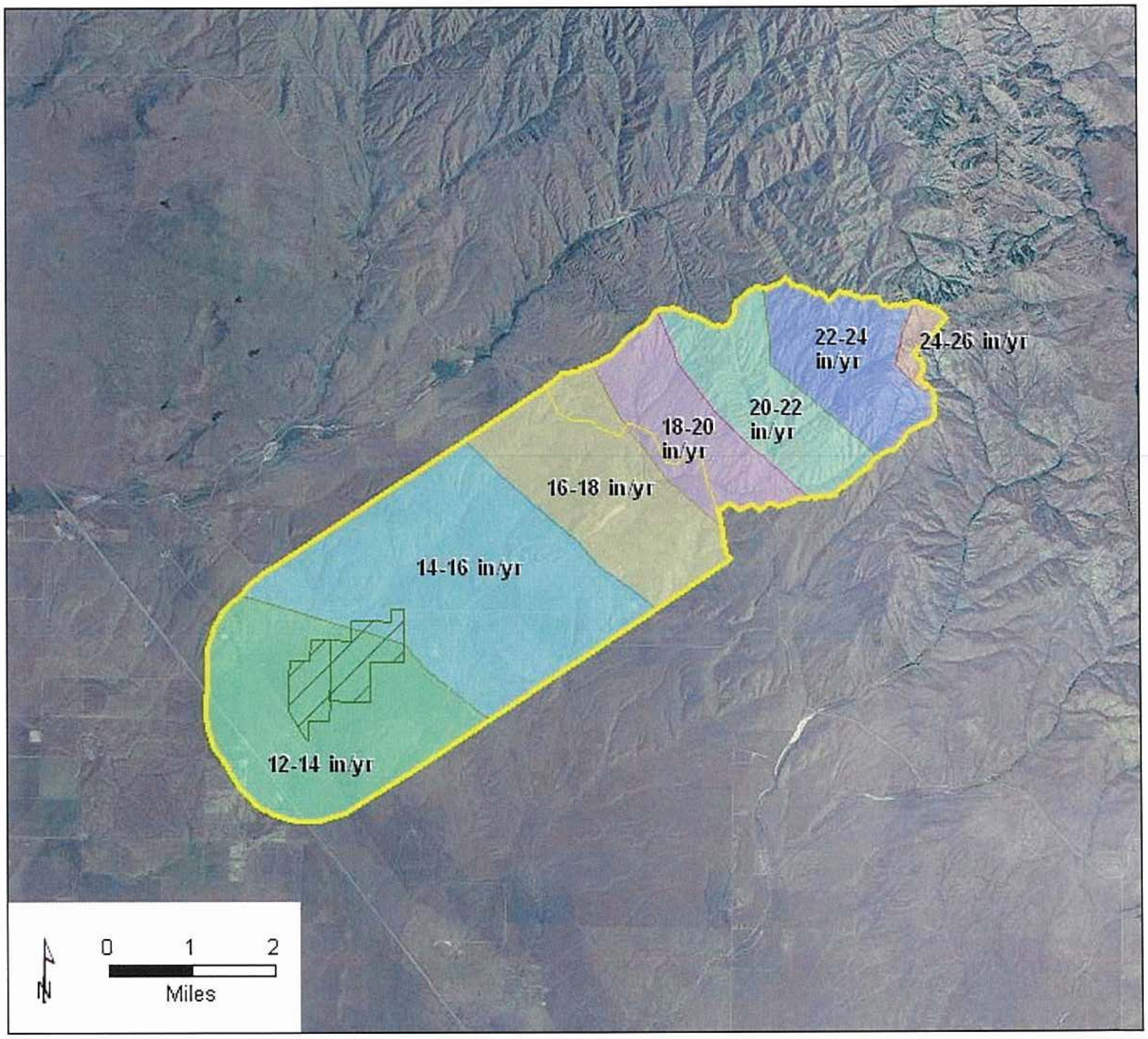

Figure 6. Annual precipitation rates in the project area.

Net evapotranspiration in the contributing area between March 1, 2000 and October 31, 2000 was estimated to be approximately 13,100 acre feet using the METRIC data. The average evapotranspiration rate in the contributing area during this period was

[7] Obtained from IDWR.

approximately 9.0 inches (or approximately 0.75 AF/acre). From ET Idaho, the average evapotranspiration during the wintertime months (November through February) for sage brush and rangeland at five area weather stations (Figure 7) is similar (ranging from 1.85 to 2.00 inches). An assumed average value of 1.93 inches during the wintertime months yielded an additional 2,780 AF of evapotranspiration for the Elk Creek Village area, resulting in a total estimated evapotranspiration of approximately 15,900 acre feet.

METRIC evapotranspiration data are not well calibrated for range land values[8]. The error associated with these data is uncertain, but could be 20 to 30 percent high or low.

The second estimate of evapotranspiration was calculated using annual ET Idaho data for sage brush and range grasses. There are no weather stations in the immediate vicinity of the Elk Creek Village property; the closest weather stations are shown in Figure 7. The Anderson Dam (3,240 feet) and Arrowrock Dam (elevation 3,880 feet) weather stations are located at elevations similar to that of the Elk Creek Village property (which lies at approximately 3,400 feet elevation). Average evapotranspiration rates for sage brush, bromegrass, long-season range grass, and early-season range grass are 1.23 feet and 1.26 feet per year at the Arrowrock Dam and Anderson Dam stations, respectively (Table 1). At an average evapotranspiration rate of 1.26 feet per year for the 4 vegetation types listed above, the total evapotranspiration for the contributing area surrounding the Elk Creek Village is approximately 21,900 acre feet.

The use of Anderson Dam weather station data may be conservative in the sense that it could yield a higher estimate of evapotranspiration than actually exists. This is because METRIC evapotranspiration data (Figure 7) show lower evapotranspiration rates in the Elk Creek Village area than near the Arrowrock Dam and Anderson Dam locations. While METRIC data may have inherent error in non-agricultural areas (resulting from lack of calibration), the relative spatial differences are likely to be relatively accurate[9].

The actual annual average evapotranspiration in the Elk Creek Village contributing area is likely to be between 15,900 and 21,900 acre feet.

<u>Aquifer Inflows</u>

Only a small portion of precipitation infiltrates through the soil; the remainder is lost to evaporation, transpiration by plants, or drains as surface runoff. Estimates of areal infiltration rates might range from about 2 to 8 percent. An average infiltration rate of 5 percent of precipitation was assumed for this analysis (see Section E). Factors supporting this assumption include (1) abundant sandy areas, (2) the presence of decomposed granitic soils, granitic fractures, and alluvial sediments in upland areas, and (3) higher rates of precipitation during months of lowest evapotranspiration (i.e. winter). However, infiltration of water into the granitic rocks in the northeastern highlands of the

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[8] Bill Kramber (IDWR) and Dr. Rick Allen (University of Idaho – Kimberly), personal communication, 2009.
[9] Dr. Rick Allen (University of Idaho – Kimberly), personal communication, 2009.

water budget area is likely small. The estimated average areal infiltration, based on the assumption that 5 percent of precipitation that falls on non-granitic materials and contributes to deep infiltration, is about 740 acre feet.

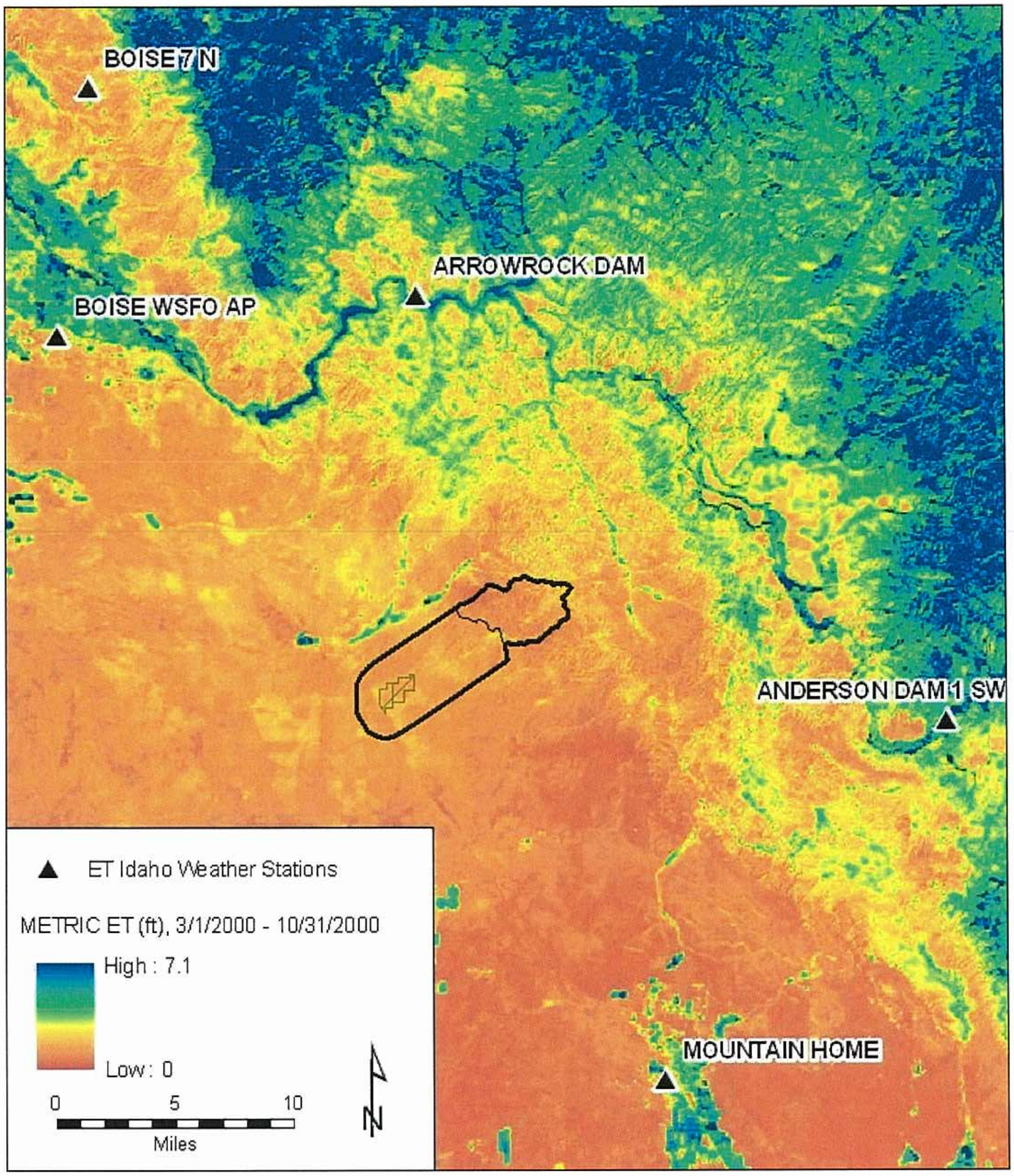

Figure 7. ET Idaho weather stations.

Water that does not infiltrate or is not lost to evapotranspiration becomes surface runoff. Most of the surface runoff in the Elk Creek Village area becomes aquifer recharge through channel seepage or shallow subsurface underflow.

Basin evapotranspiration (approximately 15,900 to 21,900 AF) and areal infiltration (approximately 740 AF) are less than the estimated average basin precipitation (24,300 AF). Much of the difference (1,700 to 7,700 to AF) becomes surface runoff. Because of the lack of significant surface flow leaving the study area via Sand Hollow Creek and Bowns Creek, and minimal surface water diversions, a substantial portion of this water is expected to seep into the subsurface from the Sand Hollow Creek, Bowns Creek, and other tributary channels. Shallow subsurface underflow from upland areas also likely contributes to this component.

Crop	Station (Site Elevation, in feet)				
	Mountain Home 1W (3,150)	Boise WSFO (2,860)	Arrowrock Dam (3,240)	Anderson Dam (3,880)	Boise 7N (3,890)
Sage Brush	0.83	0.94	1.48	1.55	1.51
Range Grasses - bromegrass	0.82	0.94	1.15	1.17	1.27
Range Grasses - long season	0.85	0.95	1.35	1.39	1.47
Range Grasses - early short season	0.73	0.84	0.93	0.93	1.01
Average of 4 crops	0.81	0.92	1.23	1.26	1.31

Source: ET Idaho: http://www.kimberly.uidaho.edu/ETIdaho/

Table 1: Estimated actual evapotranspiration for 4 types of range vegetation (in feet per year).

A text-based search of the IDWR water rights database for water rights in T1N and T1S, R4E and R5E revealed two surface-water irrigation rights diverted from Sand Hollow Creek or Bowns Creek basins. Water right 61-2002 authorizes diversions of 0.5 cfs from Roost Creek for the irrigation of 25 acres, and water right 61-2051 authorizes diversions of 1 cfs from Bowns Creek for the irrigation of 50 acres. Diversions under these surface water rights, assuming an annual diversion volume of 4.0 AF/ac (which is likely high because these creeks do not flow during the entire irrigation season), are estimated to be approximately 300 acre feet. However, neither of these rights were claimed in the Snake River Basin Adjudication (SRBA), and it is highly unlikely that these rights will be used in the future. Nonetheless, this potential diversion volume reduces the surface runoff potentially available for channel seepage to approximately 1,400 to 7,400 AF.

The range of estimated recharge from channel seepage is substantial (1,400 to 7,400 AF), which reflects the uncertainty in evapotranspiration estimates for the study area. However, it demonstrates that a substantial volume of aquifer recharge is derived from stream channel seepage.

Aquifer Outflows

Most of the discharge from aquifers in this area consists of (1) withdrawals by wells and (2) underflow toward the Snake River. There are 21 wells listed in the IDWR well construction database with locations in the assumed capture boundary. Of these 21 wells, 18 are for domestic uses, two are for commercial purposes, and one is for stockwater. IDWR records do not indicate the presence of irrigation wells within the capture boundary. Assuming domestic use for 21 homes (at 0.3 AF/yr per household), commercial use from four wells (at 1.0 AF/yr per well), and stockwater use for 100 cattle (1.4 AF/yr), the annual average withdrawal of ground water is estimated to be approximately 10 AF/yr. Inclusion of the annual withdrawal rate in the water budget is conservative, because non-consumptive components of these withdrawals would result in returns (recharge) to the shallow subsurface.

The developers of the nearby Mayfield Townsite and Mayfield Springs properties have an existing permit and/or an application for ground water use that are senior to application 61-12090. The extent to which either the application will be granted by IDWR or permits developed by the applicants is not clear at this time. Because this revised water budget includes a reduced capture zone area, overlap with potential capture areas for the Mayfield Townsite and Mayfield Springs projects is significantly less than that shown in the earlier water supply evaluation (SPF, 2007b). Because those projects are located in the Indian Creek watershed, which does not significantly overlap the revised contributing area for this project, water use associated with those projects is not included in the revised water budget. Similarly, additional aquifer recharge occurring in the Indian Creek watershed is not included in the revised water budget for application 61-12090.

Water Budget Summary

A summary of estimated basin and aquifer inflows and outflows is provided in Table 2. Average annual recharge to aquifers in the vicinity of the Elk Creek Village site is estimated to be between 2,400 and 8,400 AF. Existing ground water withdrawals in the contributing area are estimated to be minimal (approximately 10 AF per year). Thus, the amount of water available for appropriation is estimated to be between 2,400 and 8,400 AF per year. The average annual ground water withdrawal under permit application 61-12090 is estimated to be approximately 580 AF, with an estimated average annual consumptive use of approximately 420 AF.

Potential Impacts to Existing Wells

We anticipate minimal impacts to existing wells as a result of proposed withdrawals under application 61-12090. Based on a review of drillers' reports listed in the IDWR well construction database, there are 1, 5, and 15 wells within ¼, ½, and 1 mile of the Elk Creek Village property, respectively. The single well within ¼ mile of the property is controlled by the Elk Creek Village property owners. Potential water level declines will be significantly less than the 10 feet shown in Figure 3 because of recharge in the Elk Creek Village area.

Summary: Ground Water Availability for Appropriation

Additional ground water appears to be available for appropriation in the Elk Creek Village area. This opinion is based on estimated recharge in excess of current uses (Table 3) and on steady (or slightly rising) water levels in the area (see Figure 5 in SPF, 2007b). Stable water levels suggest that water is available for appropriation. The amount of water available for appropriation is estimated to be between 2,400 and 8,400 AF per year. The average annual ground water withdrawals for uses proposed under application 61-12090 are approximately 580 AF, with an estimated annual consumptive use of 420 AF. The average annual use anticipated under application 61-12090 is less than the low estimate of ground water available for appropriation.

Component	Estimated Average Annual Volume (AF)
Precipitation in assumed capture area and upper Sand Hollow and Bowns Creek basins	24,300
Precipitation in assumed capture area	14,800
Estimated infiltration (5% of precipitation in assumed capture area)	700
Low estimate of evapotranspiration in assumed capture area and upper Sand Hollow and Bowns Creek basins	15,900
High estimate of evapotranspiration in assumed capture area and upper Sand Hollow and Bowns Creek basins	21,900
Estimated surface water diversions from Sand Hollow and Bowns Creek (water rights 61-2002 and 61-2051, which could require a volume of 300 AF/yr, were not claimed in the SRBA and will likely never be used.	0
Low estimate of surface channel seepage into shallow aquifers[1]	1,700
High estimate of surface channel seepage into shallow aquifers[2]	7,700
Estimated aquifer recharge (low estimate)[3]	2,400
Estimated aquifer recharge (high estimate)[4]	8,400
Estimated discharge to wells[5]	10
Available for appropriation (high estimate)	2,400
Available for appropriation (low estimate)	8,400

[1] Precipitation less areal infiltration, high evapotranspiration, and surface water diversions (24,300-700-21,900=1,700)
[2] Precipitation less areal infiltration, low evapotranspiration, and surface water diversions (24,300-700-15,900=7,700)
[3] Areal infiltration plus high infiltration estimate (700+7,700=8,400)
[4] Areal infiltration plus low infiltration estimate (700+1,700=2,400)
[5] See Section 3.1.6
[6] High recharge estimate less estimated discharge to wells (8,400-10=2,400 (rounded value))
[7] Low recharge estimate less estimated discharge to wells (2,400-10=2,400 (rounded value))

Table 2. Revised water budget summary

Document Info:
SPF Job Number: 591.0010

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