MEMO

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Date: May 31, 2012

To: Gary Spackman, Hearing Officer

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Subject: Sufficiency of Water Supply for Water Right Applications and Transfers along the I-84 Corridor

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Overview

This memorandum has been prepared in response to the request for staff memorandum dated January 24, 2012 in the matter of applications for transfer/new water rights No. 73811, 73834, 63-32499, 61-12095, 61-12096, 63-32703, 61-12256, and 63-33344. The following information was requested:

1) Suggest and justify a study boundary.
2) Present data and information within the boundary.
3) Conclude the sufficiency of the water supply within the boundary for existing and new uses.

Introduction

There are six pending water right applications and two transfers for planned communities and irrigation projects along the I-84 corridor near the Ada County/Elmore County line (Figure 1). Groundwater is the water source. The anticipated depths of the production zones for the proposed wells are 800 to 1,200 feet below ground level (ft-bgl). The total combined maximum appropriation rate is 84.76 ft^3/sec (cfs), 67.84 cfs in applications and

16.92 cfs in transfers. This is in addition to a combined maximum rate of 14.02 cfs for two permits already issued but not yet fully developed.

The area of proposed large-scale residential and irrigation development is bisected by the administrative boundary that separates Basins 61 and 63. In addition, many of the proposed developments lie along the northwest boundary of the Mountain Home Ground Water Management Area (GWMA) and are approximately five miles northwest of the Cinder Cone Critical Ground Water Area (CGWA). Significant water level declines resulted in the establishment of the CCCGWA on May 7, 1981 and the Mountain Home GWMA on November 9, 1982.

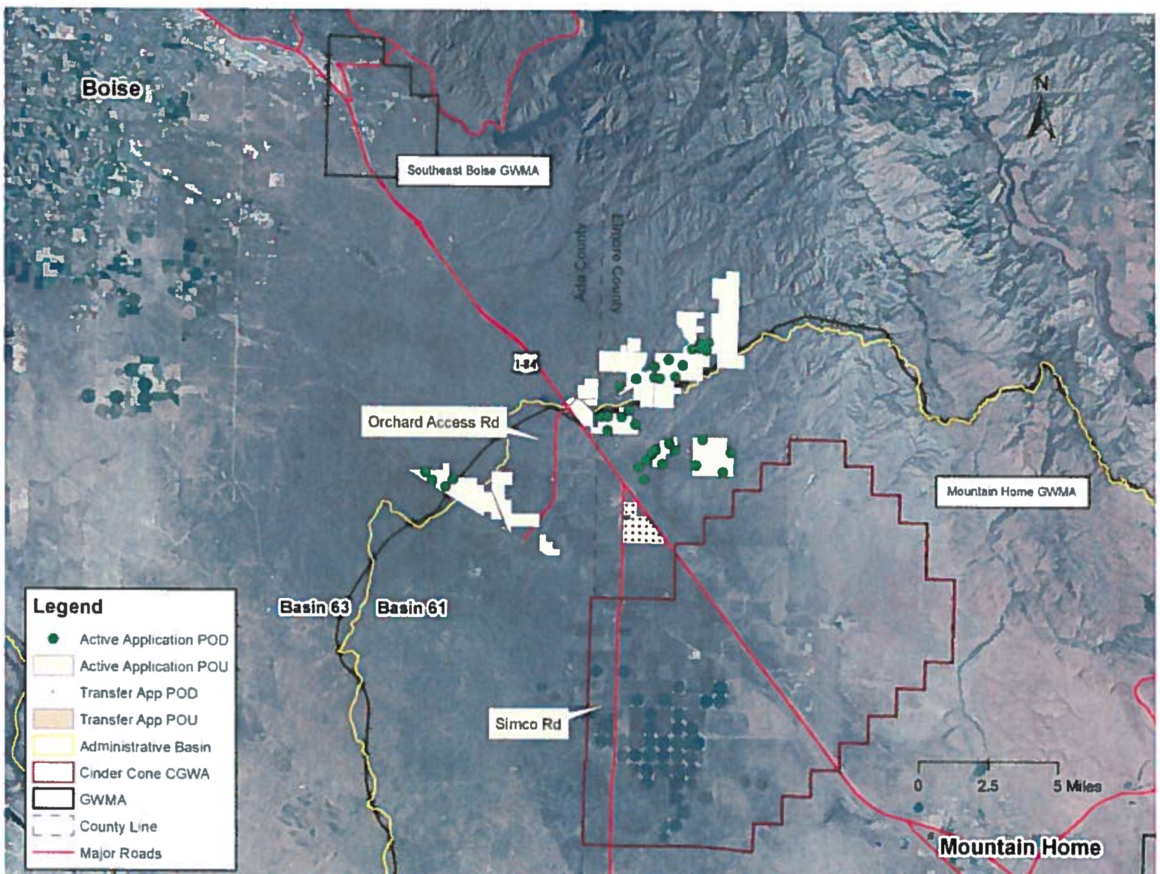


Figure 1. Consolidated hearing place of use (POU) and point of diversion (POD) locations.

Technical Review

Responses to the request for analysis are presented below.

Item 1

- Suggest and justify a study boundary.

The suggested consolidated hearing study boundary is an 11-mile wide swath oriented parallel to the southwesterly direction of regional groundwater flow. The study boundary extends from the granitic uplands to the northeast, across the Mountain Home Plateau to the rim of the Snake River Canyon (Figure 2). For comparison, an adjacent swath of similar geometry and hydrogeologic setting was created which encompasses the Cinder Cone CGWA (Figure 3). Comparing information from the study area to information from a nearby area that has had significant groundwater development for several decades provides context for assessing the potential hydrologic impacts of the proposed applications.

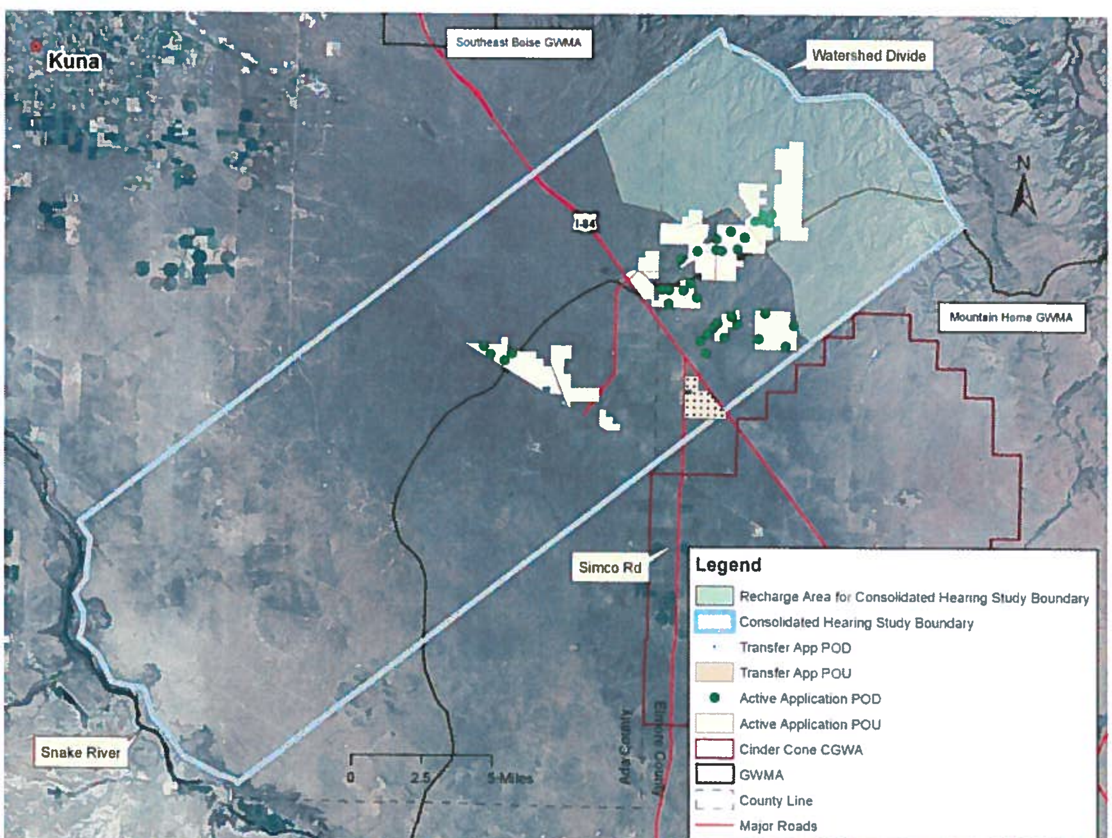


Figure 2. Consolidated hearing study area boundary.

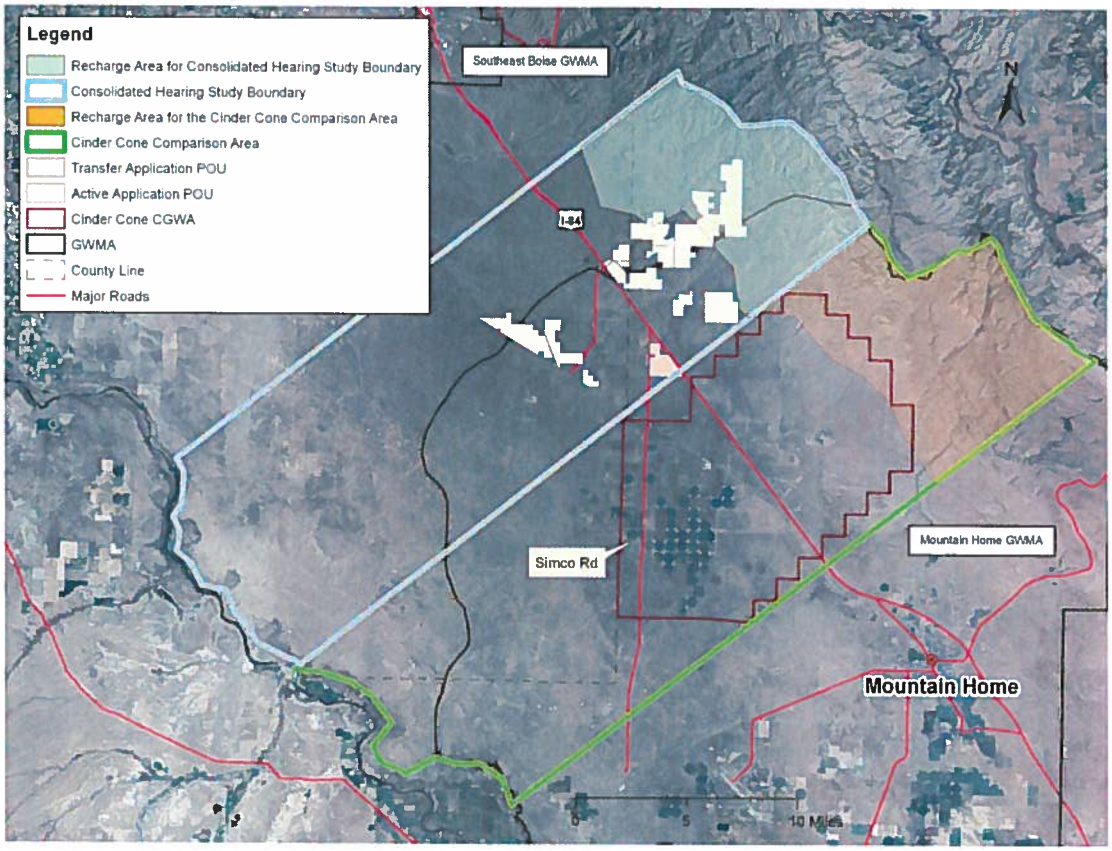


Figure 3. Consolidated hearing study area boundary (blue line) and adjacent Cinder Cone comparison area boundary (green line).

Study area boundaries are as follows:

- The southwestern boundary is the rim of the Snake River Canyon.
- The southeastern boundary is a NE-SW line that runs along the northwestern boundary of Cinder Cone CGWA study area.
- The northwestern boundary parallels the southeastern boundary and is generally perpendicular to groundwater flow contours (Figure 4).
- The northeastern boundary is the watershed divide between the South Fork of the Boise River and the western Snake River Plain.

The following are justifications for the study area:

- The boundary encompasses all proposed POUs and PODs.
- The study area includes the hydrogeologic system from the recharge area to the discharge area.
- The study area is large enough to encompass all of the applications, but does not include areas influenced by surface water diversions from the Boise River.
- The study area does not include the Cinder Cone CGWA; however, recharge areas and overall boundary dimensions were based on consideration of the Cinder

Cone CGWA study (IDWR, 1981) because it also involved an assessment of the impacts of groundwater development in a similar hydrogeologic setting.

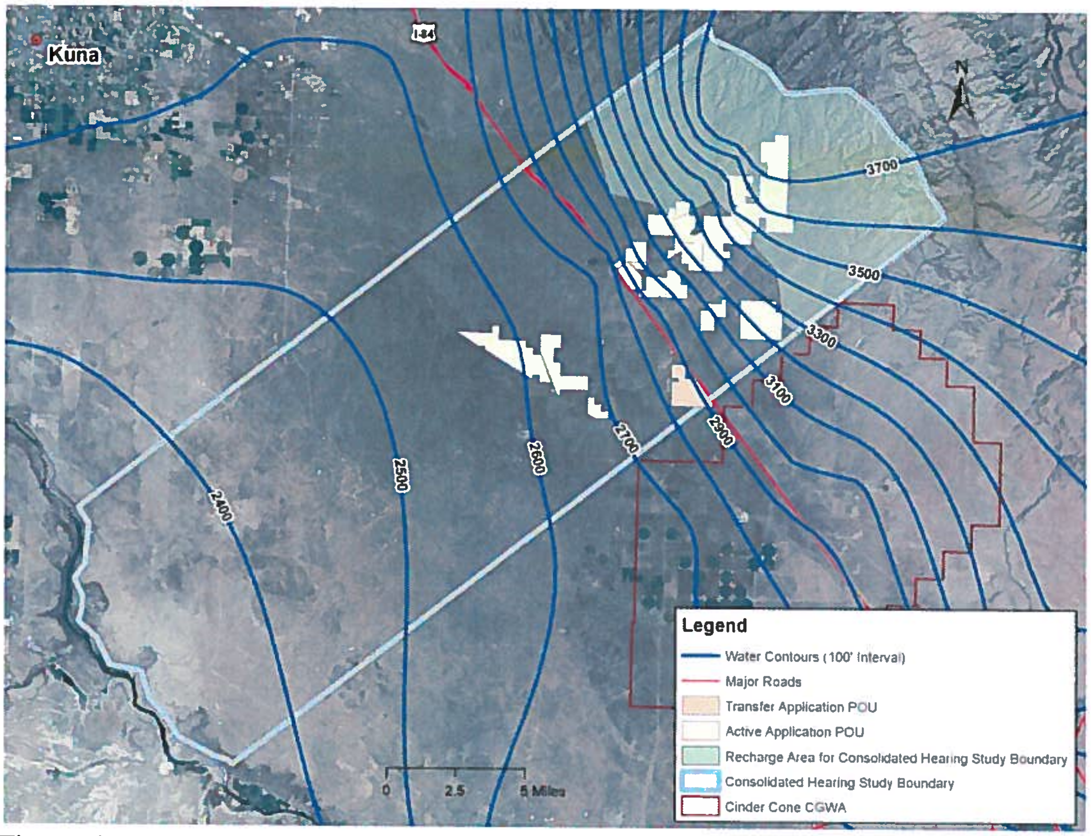


Figure 4. Water table contour map for October, 2011.

The northeastern portions of the Cinder Cone comparison area and the consolidated hearing study area comprise the primary recharge areas (Figure 3). For each, the recharge area includes all land above an elevation of 3,600 ft. The 3,600 ft contour roughly corresponds to the transition between the foothills and the plateau.

Assignment of the recharge areas based on elevation is the same approach that was taken in the development of a water budget for a previous study of the Cinder Cone Butte area (IDWR, 1981). The premise of the approach is that precipitation significantly exceeds the rate of evapotranspiration (ET) only at higher elevations. At lower elevations on the plateau, evapotranspiration on non-irrigated lands consumes almost all of the precipitation during most months of the year and there is, therefore, limited recharge from precipitation (Newton, 1991). It is recognized that some of the water that falls as precipitation in the highlands recharges the aquifer system outside the recharge areas via losing stream reaches on the plateau.

Item 2

- Present data and information within the boundary.

Study Area Hydrogeology

Previous studies have provided information describing the hydrogeologic setting (Ralston and Chapman, 1968; Ralston and Chapman, 1970; Young, 1977; Newton, 1991; Harrington and Bendixsen, 1999; Phillips et al., 2012; Liberty, 2012; and Welhan, 2012). In summary, the western Snake River Plain is a deep structural depression that is filled with sedimentary and volcanic rocks of Tertiary and Quaternary age (Newton, 1991). Mountains composed of granitic and volcanic rocks surround the plain on the northeast and southwest.

The regional aquifer targeted by the applications is comprised primarily of basalt flows interbedded with fine-grained sediments of the Bruneau Formation, a unit in the Idaho Group (Ralston and Chapman, 1968). Minor or less extensive perched aquifers occur in alluvial sand and gravels on the flanks of the mountain front and drain into the basalt-dominated portion of the aquifer (Bendixsen, 1994). Faults have been identified in the study area based upon interpretation of geology and surface geophysical data (Bond, 1978 and Liberty, 2012). The hydrogeologic significance of the faults is unknown. Geologic cross-sections based on information compiled from well driller's reports are presented in Appendix A.

The general groundwater flow direction in the regional aquifer is to the southwest towards the Snake River (Figure 4). The horizontal hydraulic gradient decreases in the vicinity of Interstate 84. Various mechanisms, including faulting, an influx of aquifer recharge, and a reduction in aquifer transmissivity have been proposed to explain the decrease (Welhan, 2012).

The predominant source of recharge to the ground water system is precipitation in the upland areas. In addition, a small portion of the precipitation that falls on the plain may contribute to the recharge of the aquifer system. Lastly, upwelling of geothermal waters may also recharge the cold water system (Welhan, 2012).

Water Levels in Wells on the Mountain Home Plateau

IDWR has maintained a groundwater level monitoring network on the Mountain Home Plateau since 1960. The monitoring network includes wells within the Mountain Home GWMA and the Cinder Cone CGWA.

Water level data from wells in the Cinder Cone CGWA were analyzed to evaluate water level changes (Figure 5). Water levels in 8 of the 12 wells were lower in the fall of 2011 than in the fall of 1981. These eight wells show decreases ranging from

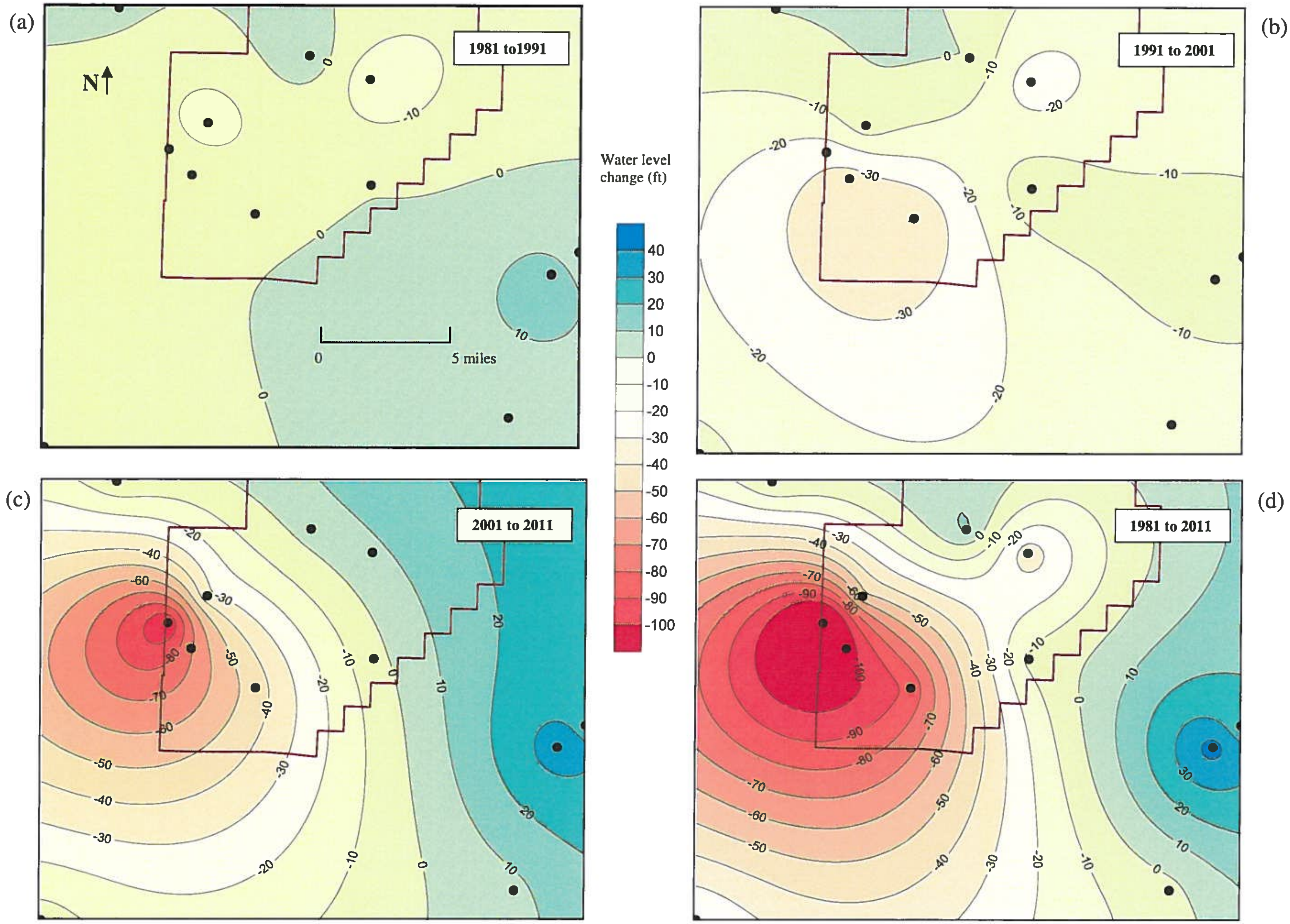


Figure 5. Groundwater level change maps for the Cinder Cone CGWA for the fall season between the years (a) 1981 and 1991, (b) 1991 and 2001, (c) 2001 and 2011, and (d) 1981 and 2011.

3.5 to 130.7 feet; declines greater than 50 feet were observed in four wells located in the southwest portion of the Cinder Cone CGWA (Appendix B).

Four of the twelve wells, primarily located northeast of the interstate, show an increase in water levels that ranges from 0.3 to 44.7 feet. The water level in one well (#01S04E-30AAC1) increased during the period 1967 to 2000 but it has been decreasing since that time (Appendix C, Plate B). Although this trend reversal could be attributed to propagation of the cone of depression from the Cinder Cone CGWA, other explanations are equally plausible (e.g., water level drawdown from a nearby pumping well).

IDWR established a water level monitoring network in the consolidated hearing study area in 2009 (Appendix C, Plates A and B). However, there is currently not enough data to establish long-term trends, with the exception of two USGS monitoring wells in the southern portion of the study area: Well #01S04E-10DAD1, which is northeast of Interstate 84, and Well #01S04E-30AAC1, which is southwest of Interstate 84 (see Plate B). Over the last ten years, the water level in Well #01S04E-10DAD1 has increased at an average rate of 0.14 ft/yr, and the water level in Well #01S04E-30AAC1 has declined at an average rate of 0.20 ft/yr; both trends were found to be statistically significant based upon a Mann-Kendall analysis (Helsel, 2006). Northwest-trending faults mapped in the area (Bond, 1978) or other structural features may contribute to the difference in trends between wells northeast of I-84 and those southwest of I-84.

Surface Water Data

The headwaters for several ephemeral streams exist in the upland recharge areas for the two study areas (Figure 6). These streams are generally intermittent, and flow is derived from precipitation and runoff events. Due to the permeable soils in this area, the majority of the stream flow discharges into the subsurface near the range front and this is a significant recharge mechanism.

Relatively recent gage data are available for several of the streams in the area (Table 1 and Appendix D). The streams and gage locations are identified on Figure 6. Because of the longer period of record, flow data for Cottonwood Creek (USGS gage #13204640) are also presented in the Appendix. The Cottonwood Creek gage was chosen because it is approximately 18.5 miles west and at similar elevation (3,780 ft-msl) to the Indian Creek gage (USGS gage #13211100) near Mayfield (3,620 ft-msl). Inspection of the hydrograph for the Cottonwood Creek gage (Appendix D) reveals that 2006 and 2011 were anonymously high water years, with annual runoff volumes that are 214% and 193% percent of the average for the 11-year period of record.

Indian Creek Reservoir is the primary reservoir in the study area and the comparison area. Water that flows into the reservoir typically is derived from the local watershed of Sheep Creek, although some of the flow within Indian Creek reaches the reservoir during extreme run-off conditions. The USGS recently conducted a water balance study of the reservoir and will complete a report on this subject in November 2012.

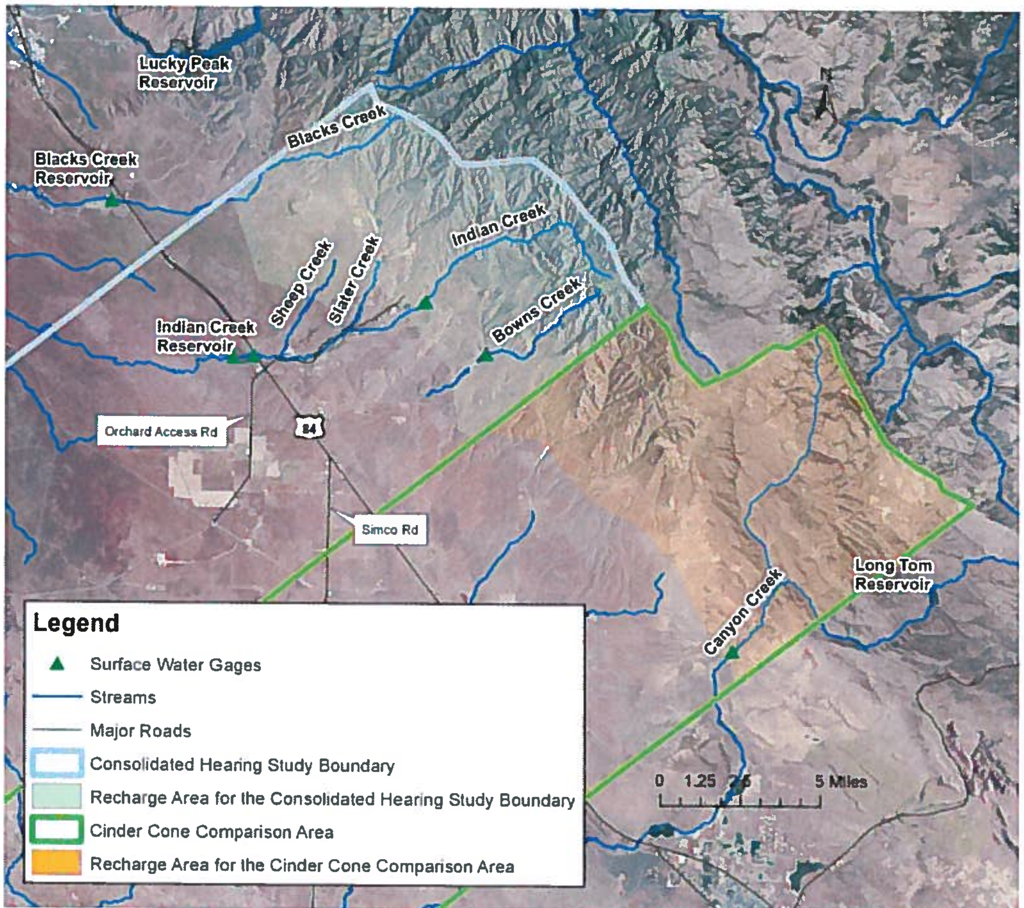


Figure 6. Surface water bodies and gages related to the study area.

Table 1. Runoff volumes for creeks in the area of the proposed residential and irrigation development.

Creek	Method	Date Range	Total Runoff [1] (acre-ft)
Blacks Creek	Transducer – Mean daily discharge	1/1/11 – 6/20/11	2,309
Bowns Creek	Transducer – Mean daily discharge	10/10/10 – 7/27/11	640
Canyon Creek	Staff Gage	1985-2012	24,658[2]
Cottonwood Creek (USGS #13204640)	Water Stage Recorder	2001 – 2011	1,183
Indian Creek (Mayfield)	Eight Flow Tracker measurements	3/12/08 – 6/13/08	2,065
Indian Creek near Mayfield (USGS # 13211100)	Transducer – Mean daily discharge	10/19/10 – 7/23/11	2,431
Indian Creek (Above Reservoir)	Transducer – Mean daily discharge	1/16/11 – 6/24/11	696

[1] Runoff volume for each creek was calculated by summing the daily mean discharge.

[2] Annual average runoff volume, which includes imported water from the South Fork of the Boise River.

Geochemical Data

The USGS collected groundwater samples from 14 wells in the study area. The samples were analyzed for a suite of inorganic constituents, carbon-14, and chlorofluorocarbons (CFCs). Age dating is being performed along a known groundwater flow path to help determine the relative timing of recharge to area aquifers. Future geochemical modeling by the USGS will help identify areas receiving recharge, interpret groundwater mixing, and provide corrected age dates. A final report will be completed by the USGS in early 2013.

Item 3

- Conclude the sufficiency of the water supply within the boundary for existing and new uses.

To address the sufficiency of the water supply issue, water budgets were developed for the consolidated hearing study area and for the adjacent Cinder Cone comparison area. Water budget development involved determining precipitation and evapotranspiration in the recharge areas and precipitation, crop irrigation requirements, and non-irrigation consumptive uses in the non-recharge areas. Details regarding each of the water budget components are presented in the following sections.

Precipitation in Recharge Areas

As previously mentioned, the primary recharge source for the study area is precipitation that falls on the uplands in the northeast portion of the study area. Precipitation in the recharge area may be consumed by evapotranspiration, leave the study area as surficial streamflow, evaporate from surface water bodies, or infiltrate either directly into the regional aquifer or through perched aquifers prior to entering the regional aquifer.

The average annual precipitation in the two recharge areas was quantified using PRISM precipitation data (PRISM, 2012). For the period 1971-2000, the average precipitation in the recharge area for the consolidated hearing study area was 1.66 ft, or 75,420 acre-feet per annum (AFA). In the Cinder Cone comparison area, the average precipitation was 1.70 feet, or 88,989 AFA over the recharge area (Table 3). Precipitation data are also available from the Arrowrock and Anderson Ranch Dam National Weather Service (NWS) stations (Allen and Robison, 2009). The annual precipitation at the two stations is 1.58 and 1.74 ft/yr, respectively. The weather station locations are identified on Figure 7.

Table 3. Water budgets for the consolidated hearing study area and the Cinder Cone comparison area.

Item	Component	Consolidated Hearing Study Area	Cinder Cone Comparison Area
1	Acres within Recharge Area	45,490	52,492
2	Precipitation (AFA) within Recharge Area	75,420	88,989
3	Actual Evapotranspiration (AFA) within Recharge Area	66,147	76,240
4	Acres within Non-recharge Area	177,447	181,307
5	Precipitation within Non-recharge Area (AFA)	175,662	162,111
6	Recharge from Precipitation in Non-recharge Area (AFA)	2,656	2,025
7	Irrigated Lands CIR (AFA) * Non-recharge Area	884	13,131
8	Surface Discharge Out of Area (AFA) 8a) Blacks Creek 8b) Indian Creek Reservoir Evaporation 8c) Canyon Creek Total Surface Discharge Out of Area (AFA)	 506 360 866	 9,877 9,877
9	DCMI Consumptive Use Breakdown Recharge + Non-recharge Areas (AFA): 9a) GW Rights 9b) Springs 9c) Surface Water 9d) Permit Volume Total DCMI Consumptive Use (AFA)	 317 6 170 2,566 3,059	 797 136 99 132 1,165
10	**Recharge (AFA) [Item#2-#3+#6-#8]**	11,063	4,897
11	**Recharge (cfs)**	15.27	6.76
12	**Net Recharge (AFA) [Item#10-#7-#9]**	7,120	-9,399
13	**Net Recharge (cfs)**	9.83	-12.97

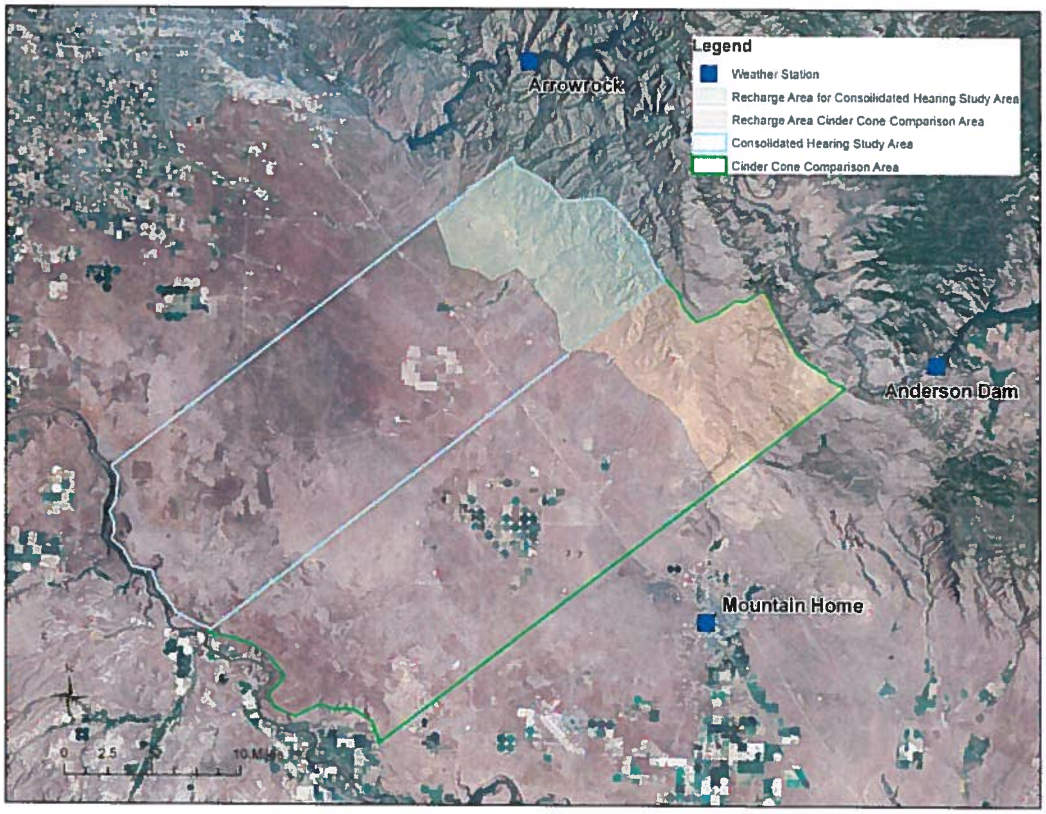


Figure 7. Weather stations in the vicinity of the study area.

Evapotranspiration in Recharge Areas

To determine the net potential recharge volume from precipitation, the evapotranspiration (ET) rates of vegetation in the recharge areas were quantified. The acreage of specific vegetation types was based on data from the 2011 National Agricultural Statistics Service Cropland Data Layer (USDA, 2012). ET estimates were based on average values for vegetation types obtained from ET Idaho from the Arrowrock and Anderson Dam stations. Since the average precipitation in each of the recharge areas (1.66-1.70 ft/yr) is between the annual precipitation at the Anderson Dam and Arrowrock Dam NWS stations (1.58-1.74 ft/yr), it is reasonable to use ET Idaho values from these stations to calculate ET for the recharge areas. Based on these two data sources, the average annual evapotranspiration in the recharge area for the consolidated hearing study area is 66,147 acre-feet and 76,240 acre-feet in the recharge area for the Cinder Cone comparison area.

Precipitation, ET, and Recharge in Non-Recharge Areas

PRISM data were also used to derive estimates of precipitation in the non-recharge areas to the southwest of the study area and the comparison area. The average precipitation for the period 1971-2000 is 175,662 AFA (0.99 ft/yr) in the study area and 162,111 AFA (0.89 ft/yr) in the Cinder Cone comparison area. The precipitation at Mountain Home is slightly less at 0.91 ft/yr from ET Idaho or 0.86 ft/yr from PRISM. Using ET Idaho values from the Mountain Home station for sagebrush and range grasses in the study area likely results in underestimation because actual ET is limited by the amount of precipitation. Due to a lack of site-specific ET monitoring, estimates of non-irrigated lands recharge for each of the non-recharge areas were developed based on previous estimates that were included in the water budget for a groundwater flow model of the western Snake River Plain (Newton, 1991). Note that non-irrigated lands recharge on the Mountain Home Plateau was assumed negligible for a previous assessment of groundwater resources in the Cinder Cone Butte area (IDWR, 1981).

For non-recharge areas of the study area and the Cinder Cone comparison area, Newton (1991) estimated that recharge ranges from 0.3% to 3.0% of annual precipitation. Using area-weighted recharge percentages from the model (Newton, 1991), recharge in the study area is 2,656 AFA (1.51% of the average annual precipitation), and 2,025 AFA (1.25%) in the Cinder Cone comparison area.

Adjustments for Surface Water Outflows

Two streams, Blacks Creek and Canyon Creek, have portions of their headwaters in the recharge areas and transmit water southwest and out of the study area and the Cinder Cone comparison area. The volume of water derived from precipitation within the recharge areas that flows out of the study area was deducted from the water budget. For Blacks Creek, data from the gage station indicates 2,309 acre-ft flowed out of the study area between January and June of 2011. Of that, approximately 977 acre-ft originated from precipitation in the recharge area. To account for the abnormally high runoff conditions in 2011, the quantity of water that leaves the study area on an average season was computed. Considering the 2011 runoff season flows were 193% of normal, the value was scaled back by a factor of 1.93, resulting in 506 acre-ft. For Canyon Creek, an annual average of 24,658 acre-ft was reported at the Canyon Creek gage between 1985 and 2012. Of that, approximately 9,877 acre-ft was derived from precipitation within the study area.

Indian Creek Reservoir is the primary reservoir in the area. Water that flows into the reservoir typically is derived from the Sheep Creek watershed, although some Indian Creek flow reaches the reservoir during extreme run-off conditions. A gage was set up to monitor the flow into Indian Creek Reservoir in January of 2011. The inflow during 2011 was approximately 696 acre-ft. Average inflow was also estimated by scaling back this value by a factor of 1.93, resulting in 360 acre-ft. It is assumed that the water that flows into Indian Creek Reservoir evaporates rather than infiltrating into the aquifer based on preliminary findings of a reservoir water balance study that is being conducted by the USGS. A report documenting the study findings is scheduled for publication by the USGS in November 2012.

Crop Irrigation Requirements

Crop irrigation requirement (CIR) values were taken from ET Idaho and multiplied by irrigated acres within the non-recharge areas for the study area and Cinder Cone comparison area. The acreage of specific vegetation types was based on data from the 2011 National Agricultural Statistics Service (USDA, 2012). CIR for the non-recharge areas are 884 AFA for the study area and 13,131 AFA for the Cinder Cone comparison area.

Other Consumptive Uses

Domestic and stockwater consumptive use was estimated based upon review of the IDWR water rights database files. Consumptive use for domestic households was assigned 0.8 AFA based on a family of four (Cook, et. al, 2001). In accordance with IDWR guidelines for water use (http://www.idwr.idaho.gov/WaterManagement/WaterRights/wateruse.htm), consumptive use for stockwater was determined by assigning 0.0022 AFA per sheep (2 gal/day), 0.0392 AFA per dairy cow (35 gal/day), and 0.0134 AFA per non-dairy cow (12 gal/day). Estimated total consumptive domestic and stockwater use in the study area is 493 AFA and 866 AFA in the Cinder Cone comparison area.

Diversion volume limits were used to provide conservative estimates of consumptive use for permitted, undeveloped, municipal and commercial uses. Consumptive use will likely be less than diversion volume limits by an unknown amount depending on water use and reuse practices. Permit volume limits amount to 2,566 AFA in the hearing study area and 132 AFA in the Cinder Cone comparison area.

Verification of IDWR recharge estimate

Welhan (2012) applied Darcy's law (see, for example, Freeze and Cherry, 1979) to develop recharge estimates for the regional aquifer system in the vicinity of the proposed water right POUs as part of a hydrogeologic assessment being conducted for the Comprehensive Aquifer Management Plan (CAMP) program. He prepared separate estimates for each of two hydrogeologic conceptual models that were developed to explain a steepening of the hydraulic gradient that occurs in the vicinity of Interstate 84. One conceptual model involved recharge from precipitation in the highlands with an additional influx of geothermal and/or perched water and the other involved a zone of decreased aquifer transmissivity near Interstate 84. Using available aquifer transmissivity values, he estimated that recharge to the regional aquifer along a 6.21-mile wide cross-section and oriented approximately perpendicular to the southwesterly groundwater flow direction (Figure 8) is 7,000 AFA for the conceptual model involving an additional influx of water and 12,600 AFA for the conceptual model involving decreased aquifer transmissivity. Proportionally scaling up the estimates from Welhan (2012) to the width of the study area (11 miles) results in a range of 12,400 AFA to 22,320 AFA.

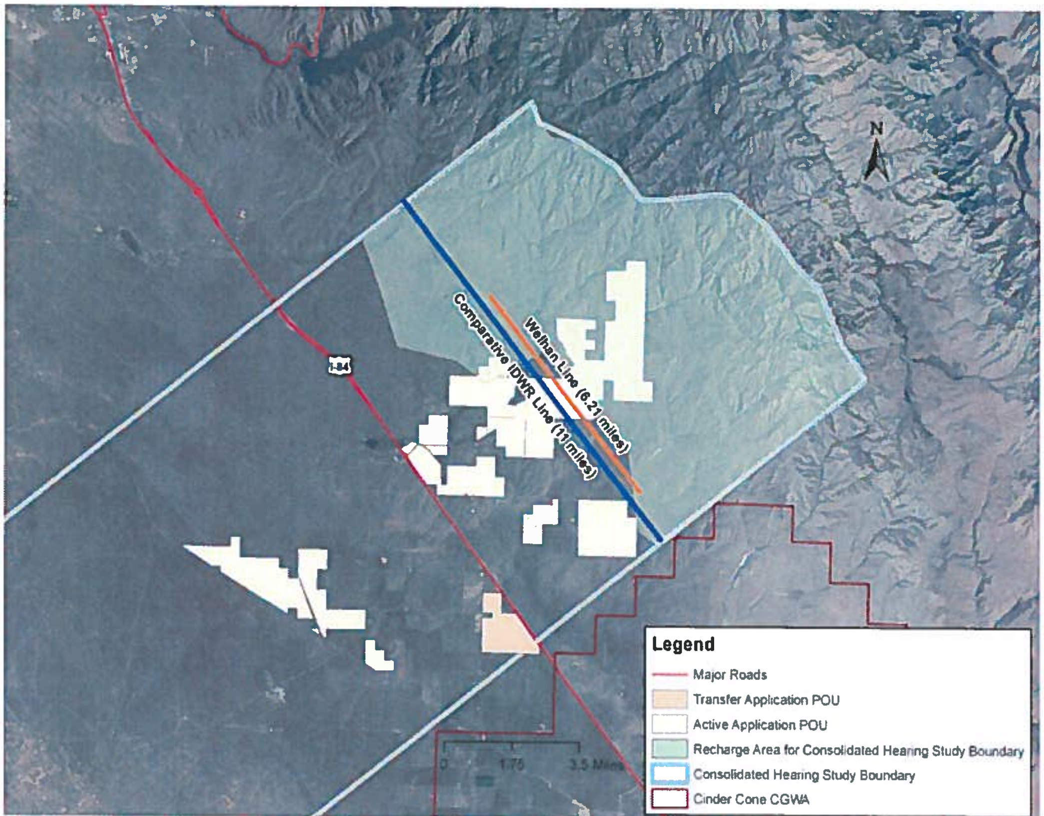


Figure 8. Darcy's law cross-section used by Welhan (2012) to develop recharge estimates.

Current consumptive uses reflected in the Welhan (2102) recharge estimate but not in the IDWR estimate (item 10 in Table 3) include CIR in the non-recharge area (item #7 in Table 3) and existing DCMI consumptive uses (items 9a, 9b, and 9c in Table 3). Adding the sum of these four components of the study area (1,377 AFA) to the width-adjusted estimates, results in estimates of 13,777 AFA and 23,697 AFA. The low end of this range is somewhat higher than the recharge estimate of 11,063 AFA in Table 3. The estimates compare well given the uncertainty inherent in the estimation of recharge, especially when using Darcy's law.

<u>Sufficiency of the Water Supply</u>

In this section, the water budget information developed in Table 3 is used to assess the sufficiency of the water supply. Comparisons are made between the computed net recharge rate for the consolidated hearing study area to the computed net recharge rate for the Cinder Cone comparison area and to the total appropriation amount for the study area. The validity of the former is enhanced by the fact that the method of calculation is the same for the two areas.

The net recharge rate for the study area (7,120 AFA) is positive, indicating that existing consumptive uses, including those for water rights that are not yet fully developed, are less than the rate of recharge. The net recharge rate is 16,519 AFA higher than the net recharge for the Cinder Cone comparison area (-9,399 AFA). Additional consumptive uses approaching the amount of the difference would be expected to result in water level declines similar to those observed in the Cinder Cone CGWA and, assuming hydrologic continuity, exacerbate conditions in the Cinder Cone CGWA.

Idaho Code stipulates that, with only a couple of exceptions, "*water in a well shall not be deemed available to fill a water right therein if withdrawal therefrom of the amount called for by such right would affect, contrary to the declared policy of this act, the present or future use of any surface or ground water right or result in the withdrawing of the groundwater supply at a rate beyond the reasonably anticipated rate of future natural recharge*" (Idaho Code §42-237a.g.). According to IDAPA 37.03.11, the "*reasonably anticipated rate of future natural recharge*" includes recharge from precipitation, underflow from tributary sources, stream losses, and incidental recharge of water used for irrigation and other purposes. Thus, based on the water budget presented herein, and assuming similar hydrologic conditions in future years, the reasonably anticipated rate of future natural recharge is 11,063 AFA and the maximum additional consumptive use that could be authorized within the study area is 7,120 AFA. On a continuous basis, this latter amount is equivalent to 9.8 cfs, which is considerably less than the maximum total appropriation amount of 84.76 cfs. Note, however, that the fraction of the maximum total appropriation that would be consumptively used depends, not on the rate limits, but rather on water use and reuse practices and the amounts withdrawn, information that is lacking for this analysis.

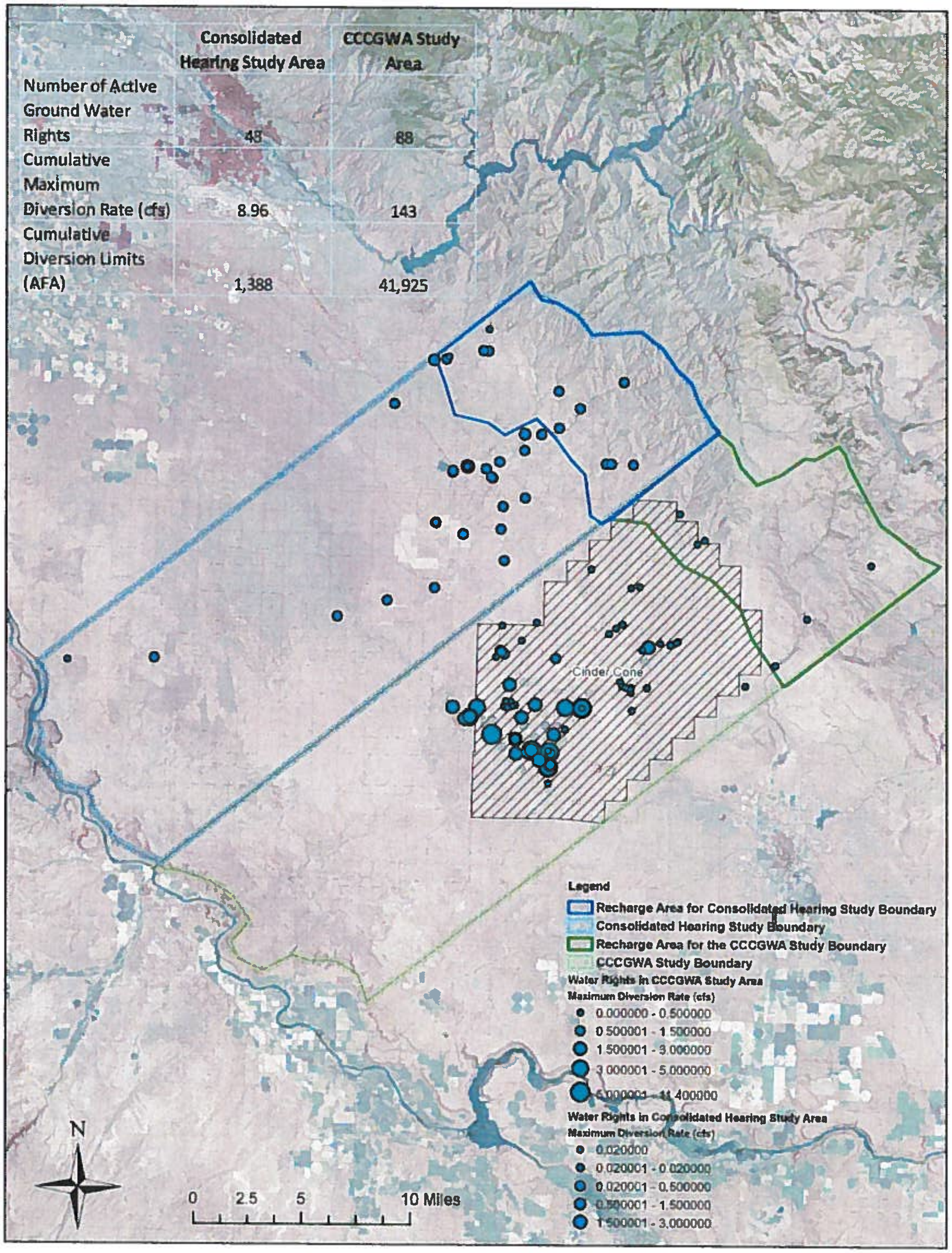
Inherent in the assumption that the future natural recharge rate would be roughly equivalent to the average based on precipitation data for the time period 1971-2000 is the assumption that the rate of inflow to the aquifer system would be unchanged by additional groundwater withdrawals that are the subject of the consolidated hearing. Induced underflow from tributary sources, for example, is assumed negligible because the recharge area extends all the way to the surface water divide and the granitic rocks that underlie the surface water divide are relatively impermeable. Similarly, induced inflow from the aquifer system adjacent the study area is assumed to be negligible and/or off limits for appropriation because of the existence of the Cinder Cone CGWA. In other words, lowering of the water table in the study area would not substantively increase the amount of water available for appropriation.

Additional groundwater extraction would, however, decreases aquifer storage, particularly in the short term, and, eventually, decreases aquifer discharge to the Snake River. An indication of the expected transient water level response is provided by hydrographs for wells in the Cinder Cone CGWA monitoring network (Appendix B). Despite the fact that there has been a moratorium on new irrigation appropriations for more than 30 years, water level monitoring indicates that aquifer storage continues to decline in the Cinder Cone CGWA.

If, as assumed, inflow to the study area is unchanged, mass balance requires that increased withdrawals will decrease outflow to the Snake River by an equivalent amount at steady state. This applies to both the consolidated study area and the Cinder Cone comparison area.

The table in Figure 8 shows that the current cumulative volume limit for licensed water rights in the study area is less than five percent of the cumulative volume limit for licensed water rights in the Cinder Cone comparison area. In combination with the maximum rate for recently approved water right permits (14.02 cfs), the proposed additional maximum appropriation rate of 84.76 cfs represents a 1,102% increase in the permissible, instantaneous withdrawal rate in the study area.

Figure 9 relates the growth of the cumulative licensed water right volume limit for the Cinder Cone comparison area to water levels in two monitoring wells in the Cinder Cone CGWA. Since the study area and the Cinder Cone comparison area are within a similar hydrogeologic setting, the relationship between the growth of the cumulative volume limit and the water level trends provides an indication of the potential hydrologic impacts of rapid groundwater development in the study area. The data suggest an inverse relationship between the amount of groundwater development and the water levels in the regional aquifer.



	Consolidated Hearing Study Area	CCCGWA Study Area
Number of Active Ground Water Rights	48	88
Cumulative Maximum Diversion Rate (cfs)	8.96	143
Cumulative Diversion Limits (AFA)	1,388	41,925

Figure 8. Licensed water rights and maximum diversion rates in the study area and in the Cinder Cone comparison area.

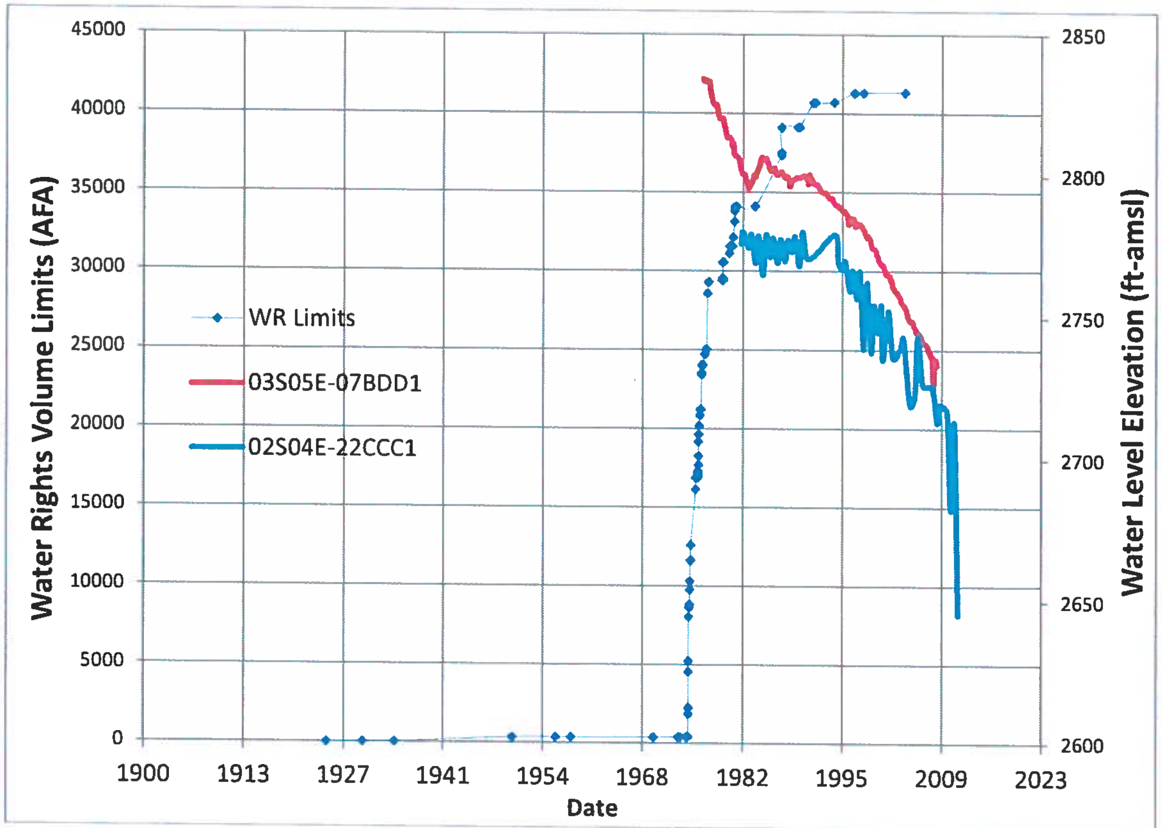


Figure 9. Cumulative water right volume limit in the Cinder Cone comparison area and water levels in wells 03S05E-07BDD1 and 02S04E-22CCC1.

Summary and Conclusions

The preceding analysis attempts to quantify the maximum amount of water that is available for appropriation in the study area. The validity of the analysis depends on the validity of the assumptions. While there is uncertainty in estimates of individual water budget components, use of the same assumptions and methodology for the Cinder Cone comparison area provides context for interpreting the results.

Specific conclusions are as follows:

1. Assuming future hydrologic conditions similar to those during the recent past, the reasonably anticipated rate of future natural recharge is 11,100 AFA.

2. The estimated net recharge rate for the study area is 7,100 AFA. The estimate is positive, indicating that existing consumptive uses, including those for water rights that are not yet fully developed, are less than the rate of recharge.

3. The net recharge rate (7,100 AFA) is an estimate of the maximum additional consumptive use that could normally be authorized within the study area. On a continuous basis, this amount is equivalent to 9.8 cfs, which is approximately an order of magnitude less than the maximum total appropriation amount being sought as part of the consolidated hearing (85 cfs).

4. In combination with the combined maximum appropriation rate for recently approved but not yet developed water rights (14 cfs), the proposed additional maximum appropriation rate of 85 cfs represents a 1,100% increase in the permissible, instantaneous withdrawal rate in the study area.

5. The magnitude of the recharge estimate for the study area is generally confirmed by extrapolation of results from an analysis that involved the application of Darcy's law.

6. Given uncertainties in aquifer properties and hydrologic boundary conditions, no attempt has been made to quantify hydrologic impacts of the proposed groundwater development. Instead, data from the Cinder Cone CGWA provide an indication of potential impacts. The data suggest an inverse relationship between the amount of groundwater development and water levels in the regional aquifer.

7. Ongoing water level declines more than 30 years after establishment of the Cinder Cone CGWA indicate that the groundwater supply on the Mountain Home Plateau is limited and support the conclusion that consumptive use within the Cinder Cone comparison area exceeds the rate of recharge.

8. Unless inflow to the aquifer system in the study area is increased, mass balance requires that increased withdrawals will decrease outflow to the Snake River by an equivalent amount at steady state.

9. Assuming hydrologic continuity, groundwater development in the study area would eventually exacerbate conditions in the Cinder Cone CGWA.

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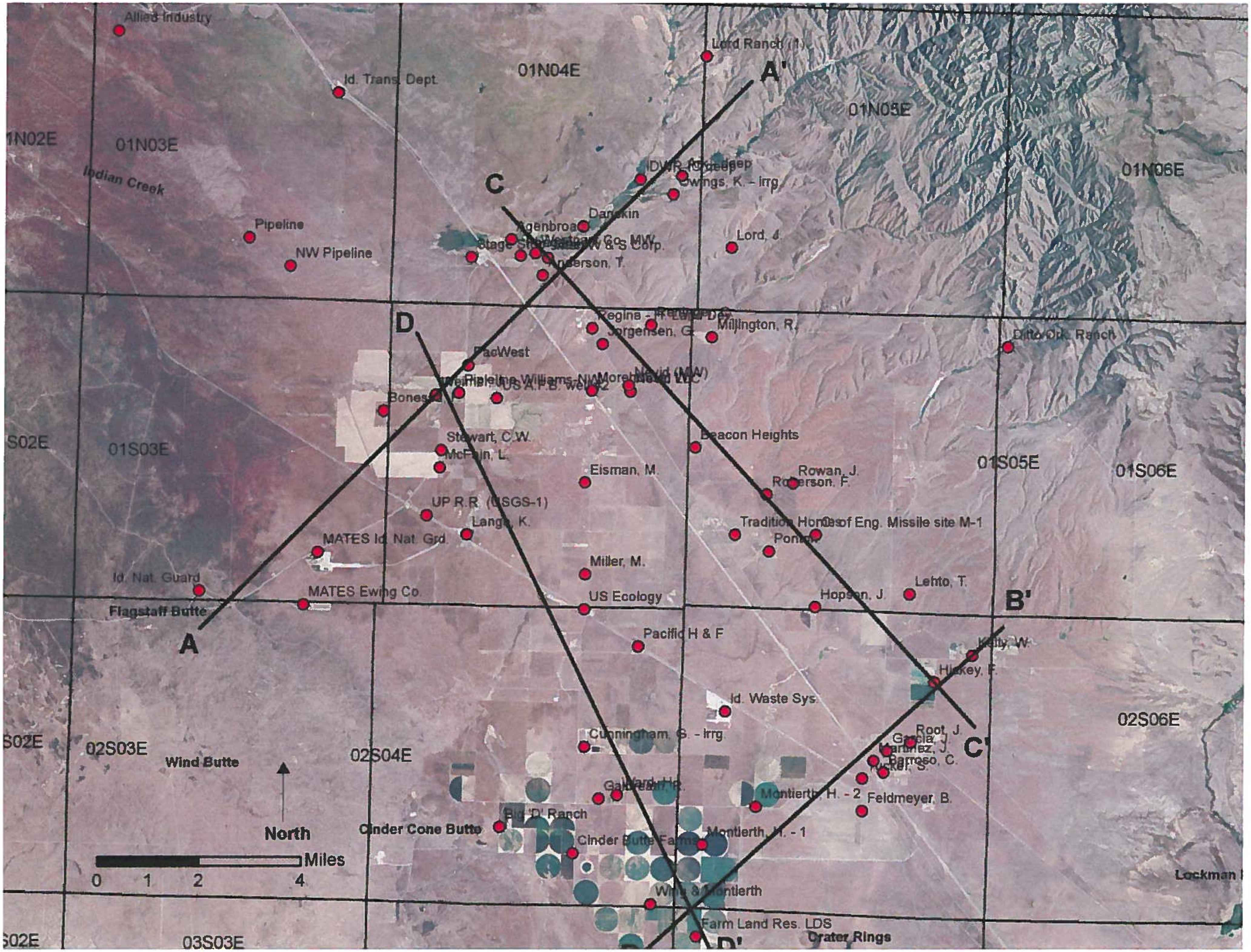
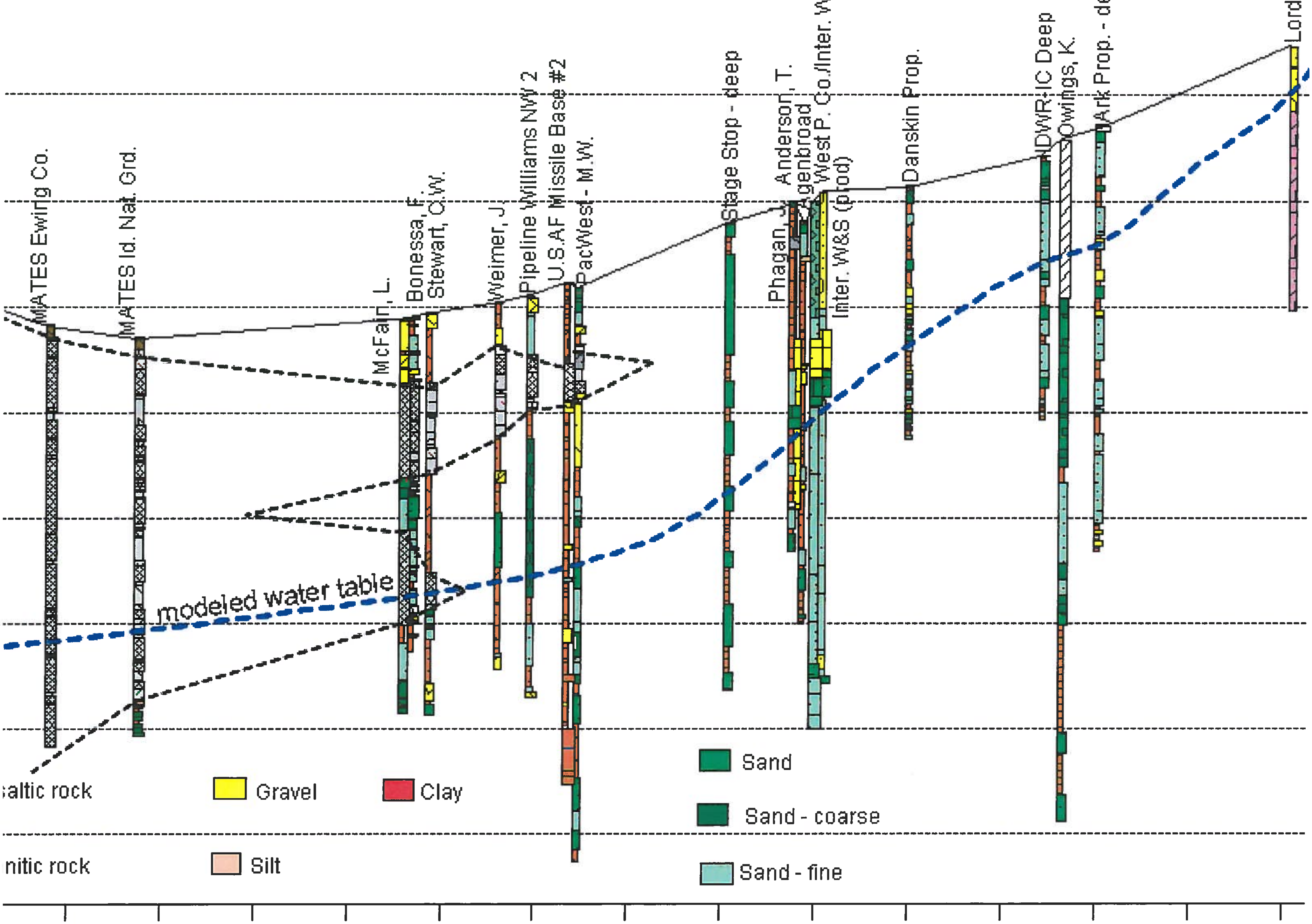
APPENDIX A
Geologic Cross Sections

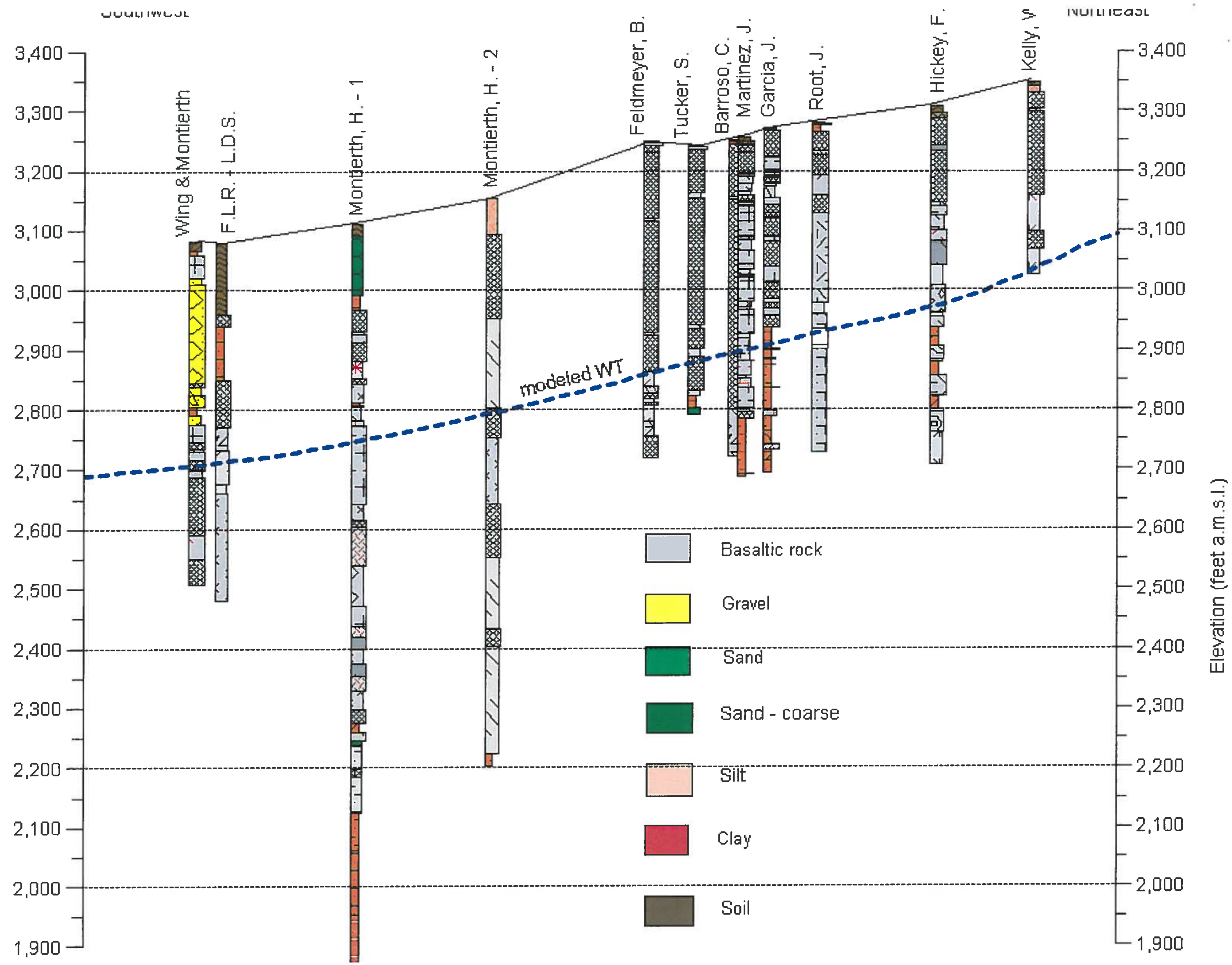


Allied Industry
Id. Trans. Dept.
01N04E
Lord Ranch (1)
A'
01N05E
1N02E
01N03E
Indian Creek
01N06E
C
Owings, K. - Irrg.
Pipeline
NW Pipeline
Lord, J.
Anderson, T.
D
Millington, R.
Jorgensen, G.
Ditto Crk. Ranch
PacWest
Navid (MW)
Bones
Beacon Heights
Stewart, C.W.
S02E
01S03E
Eisman, M.
Rowan, J.
01S05E
01S06E
UP R.R. (USGS-1)
Lange, K.
MATES Id. Nat. Grd.
Miller, M.
Lehto, T.
Id. Nat. Guard
MATES Ewing Co.
US Ecology
Flagstaff Butte
B'
A
Pacific H & F
Kelly, W.
Id. Waste Sys.
02S06E
S02E
02S03E
Cunningham, G. - Irrg.
Root, J.
02S04E
Wind Butte
C'
Barroso, C.
Feldmeyer, B.
Big 'D' Ranch
North
Cinder Cone Butte
Cinder Butte Farms
Miles
0
1
2
4
Lockman
Farm Land Res. LDS
S02E
03S03E
Crater Rings
D'

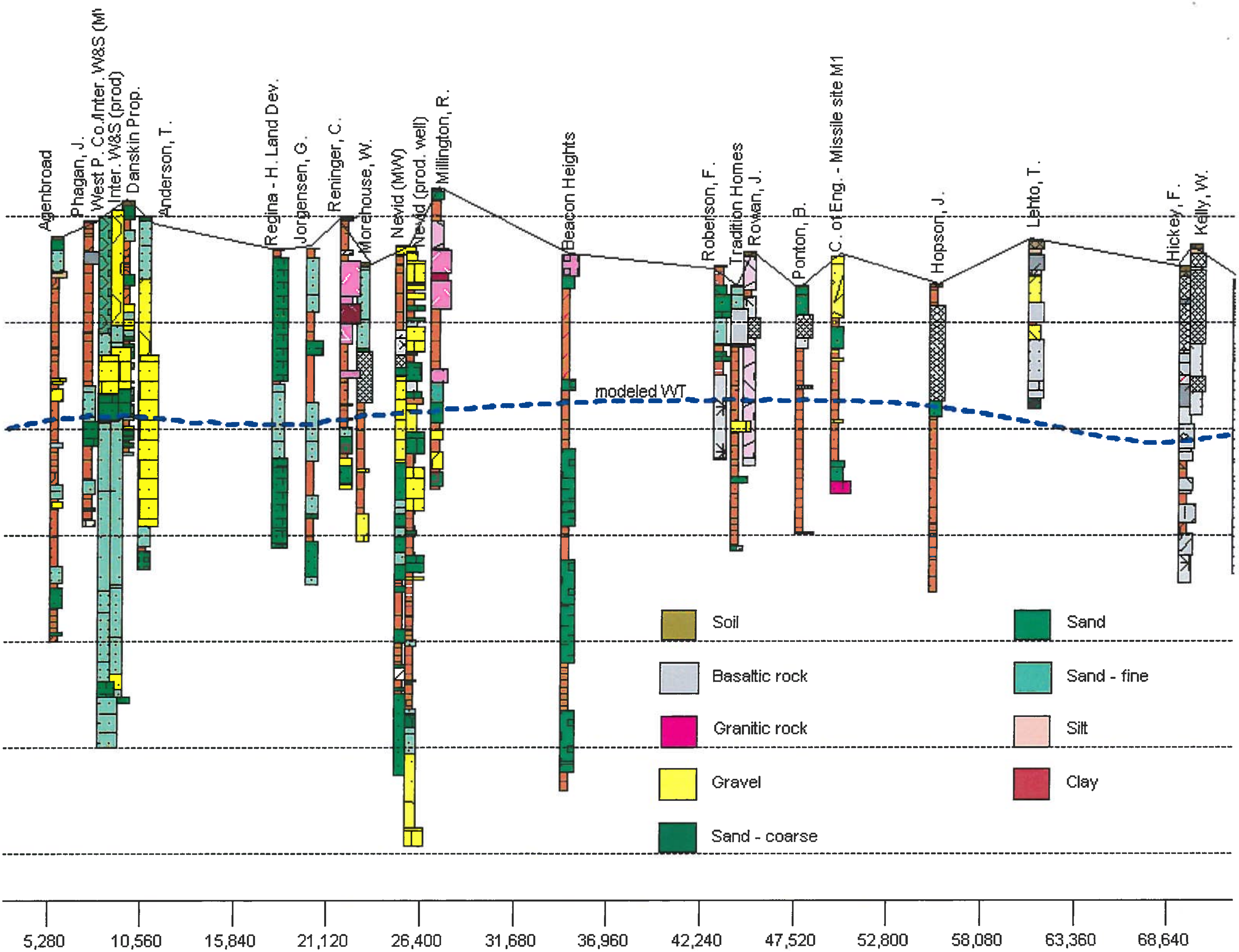
Cross-Section A-A'

(vertical exageration = 30x)

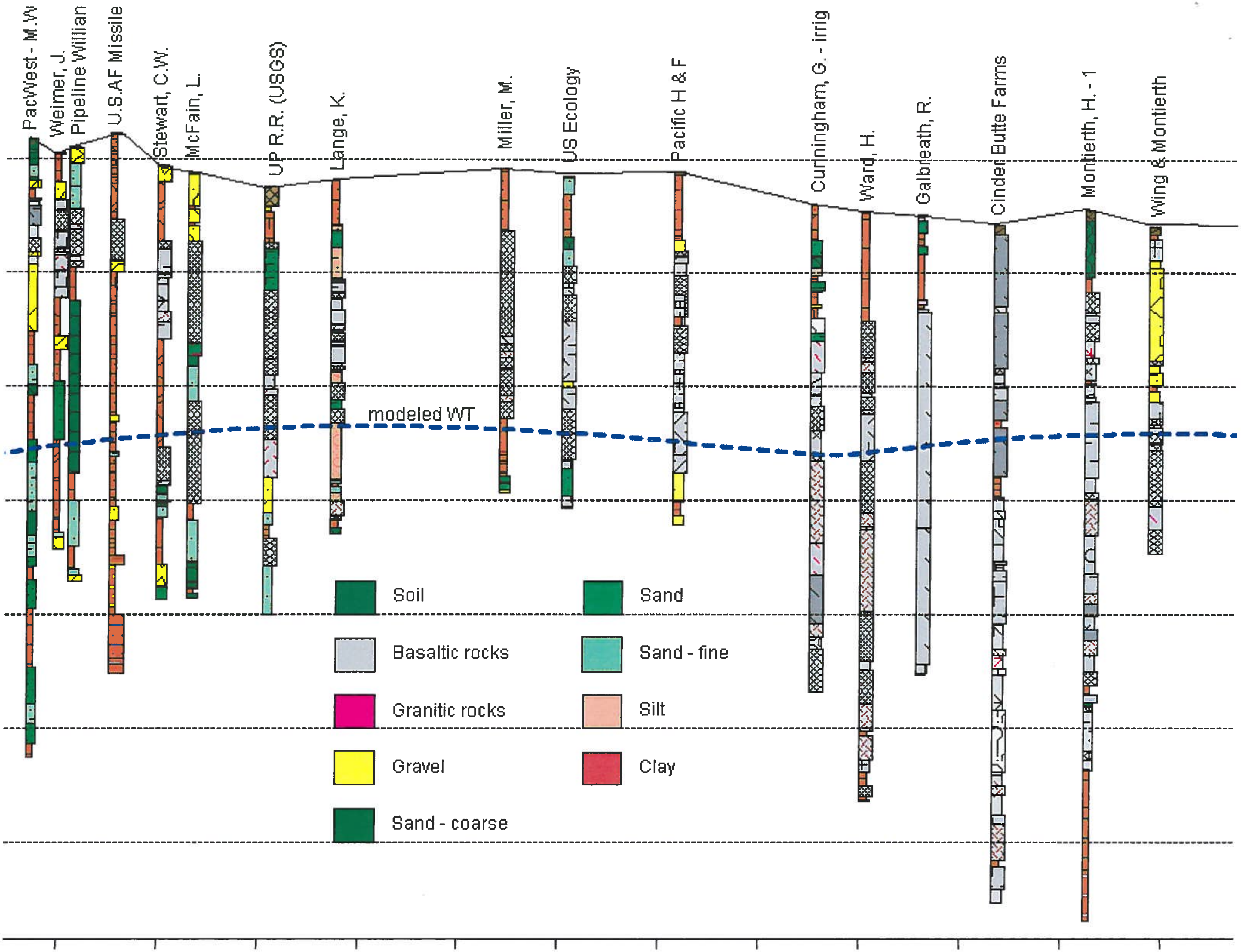




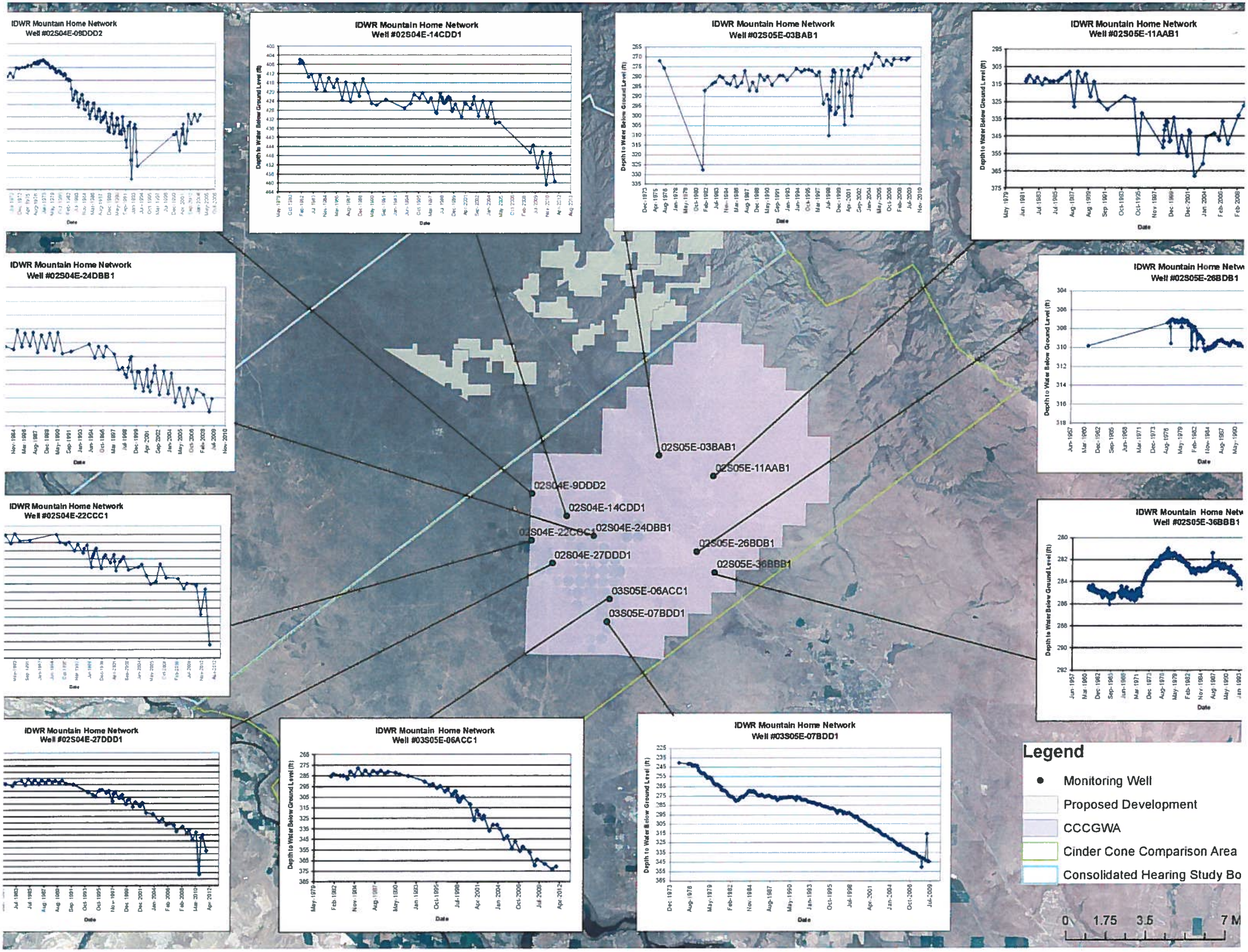
Southwest
Northeast
Wing & Montierth
F.L.R. + L.D.S.
Montierth, H. - 1
Montierth, H. - 2
Feldmeyer, B.
Tucker, S.
Barroso, C.
Martinez, J.
Garcia, J.
Root, J.
Hickey, F.
Kelly, V
modeled WT
Basaltic rock
Gravel
Sand
Sand - coarse
Silt
Clay
Soil
Elevation (feet a.m.s.l.)
3,400
3,300
3,200
3,100
3,000
2,900
2,800
2,700
2,600
2,500
2,400
2,300
2,200
2,100
2,000
1,900



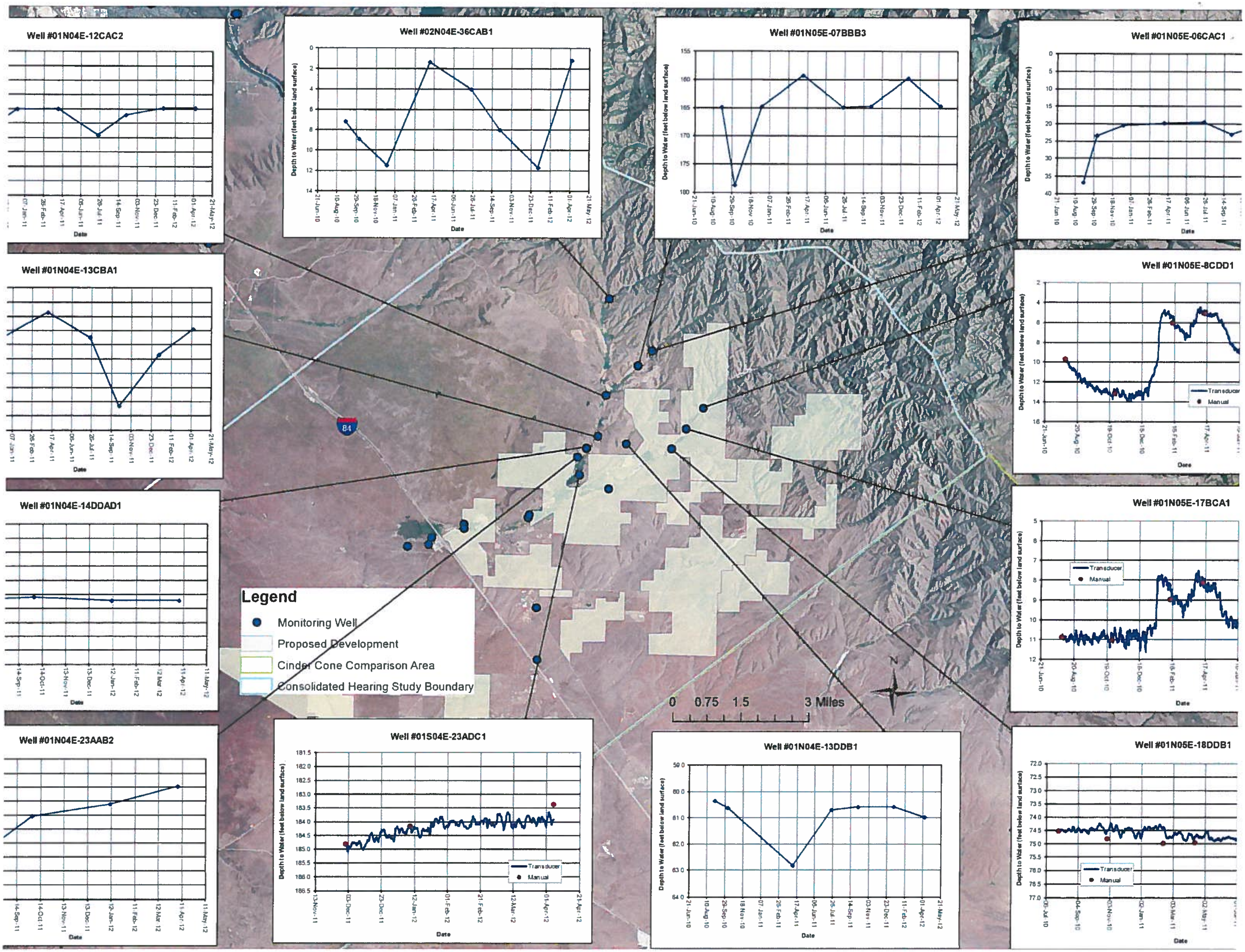
Agenbroad
Phagan, J.
West P. Co./Inter. W&S (M
Inter. W&S (prod)
Danskin Prop.
Anderson, T.
Regina - H. Land Dev.
Jorgensen, G.
Reninger, C.
Morehouse, W.
Nevid (MW)
Nevid (prod. well)
Millington, R.
Beacon Heights
Roberson, F.
Tradition Homes
Rowan, J.
Ponton, B.
C. of Eng. - Missile site M1
Hopson, J.
Lehto, T.
Hickey, F.
Kelly, W.
modeled WT
Soil
Basaltic rock
Granitic rock
Gravel
Sand - coarse
Sand
Sand - fine
Silt
Clay
5,280
10,560
15,840
21,120
26,400
31,680
36,960
42,240
47,520
52,800
58,080
63,360
68,640


PacWest - M.W
Weimer, J.
Pipeline Willian
U.S.AF Missile
Stewart, C.W.
McFain, L.
UP R.R. (USGS)
Lange, K.
Miller, M.
US Ecology
Pacific H & F
Cunningham, G. - irrig
Ward, H.
Galbreath, R.
Cinder Butte Farms
Montierth, H. - 1
Wing & Montierth
modeled WT
Soil
Basaltic rocks
Granitic rocks
Gravel
Sand - coarse
Sand
Sand - fine
Silt
Clay

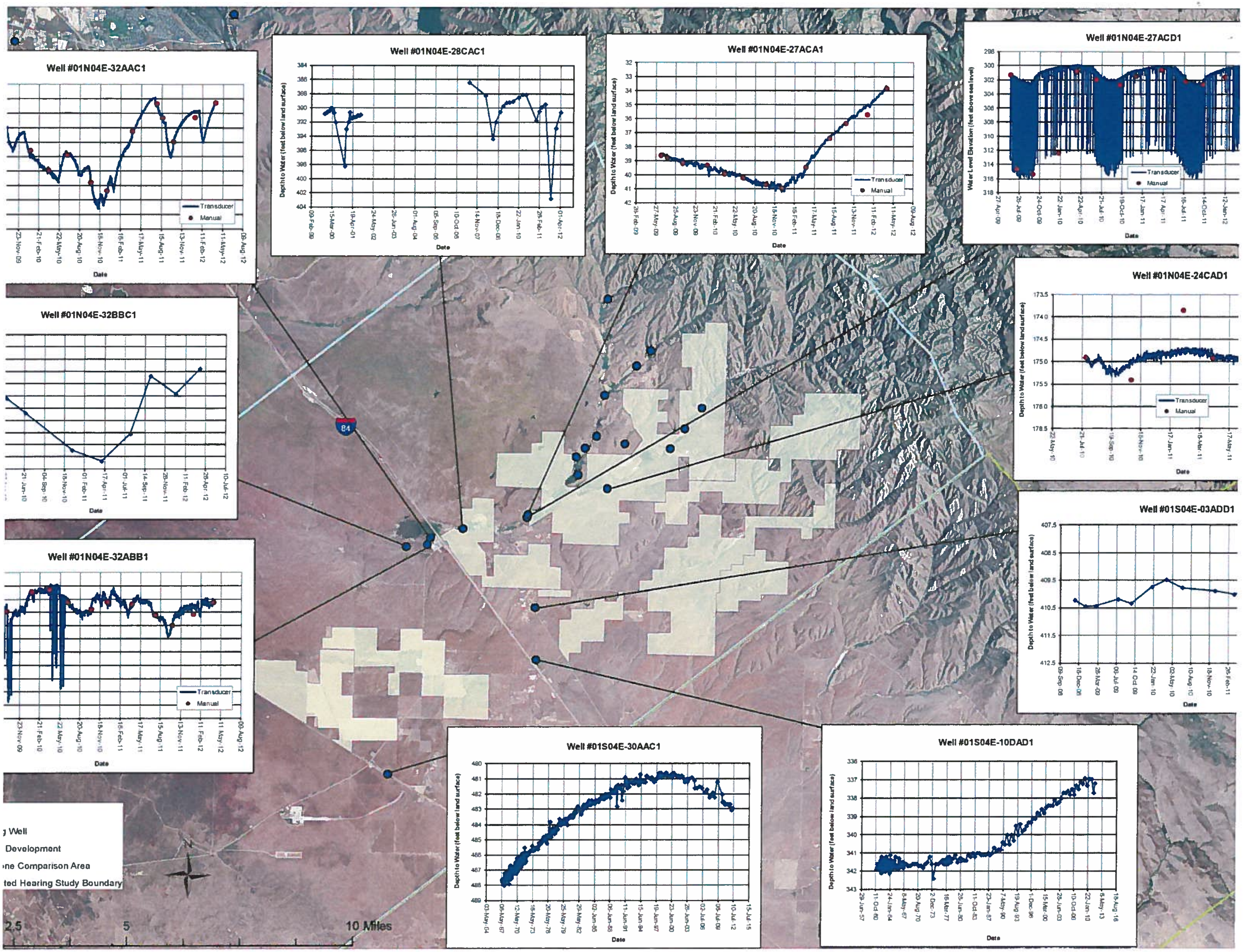
APPENDIX B
Cinder Cone CGWA Well Hydrographs


IDWR Mountain Home Network
Well #02S04E-09DDD2
IDWR Mountain Home Network
Well #02S04E-14CDD1
IDWR Mountain Home Network
Well #02S05E-03BAB1
IDWR Mountain Home Network
Well #02S05E-11AAB1
IDWR Mountain Home Network
Well #02S04E-24DBB1
IDWR Mountain Home Netw
Well #02S05E-26BDB1
IDWR Mountain Home Network
Well #02S04E-22CCC1
IDWR Mountain Home Netw
Well #02S05E-36BBB1
IDWR Mountain Home Network
Well #02S04E-27DDD1
IDWR Mountain Home Network
Well #03S05E-06ACC1
IDWR Mountain Home Network
Well #03S05E-07BDD1
Depth to Water Below Ground Level (ft)
Date
02S05E-03BAB1
02S05E-11AAB1
02S04E-9DDD2
02S04E-14CDD1
02S04E-24DBB1
02S05E-26BDB1
02S04E-27DDD1
02S05E-36BBB1
03S05E-06ACC1
03S05E-07BDD1
Legend
Monitoring Well
Proposed Development
CCCGWA
Cinder Cone Comparison Area
Consolidated Hearing Study Bo
0 1.75 3.5 7 M

APPENDIX C
Study Area Well Hydrographs

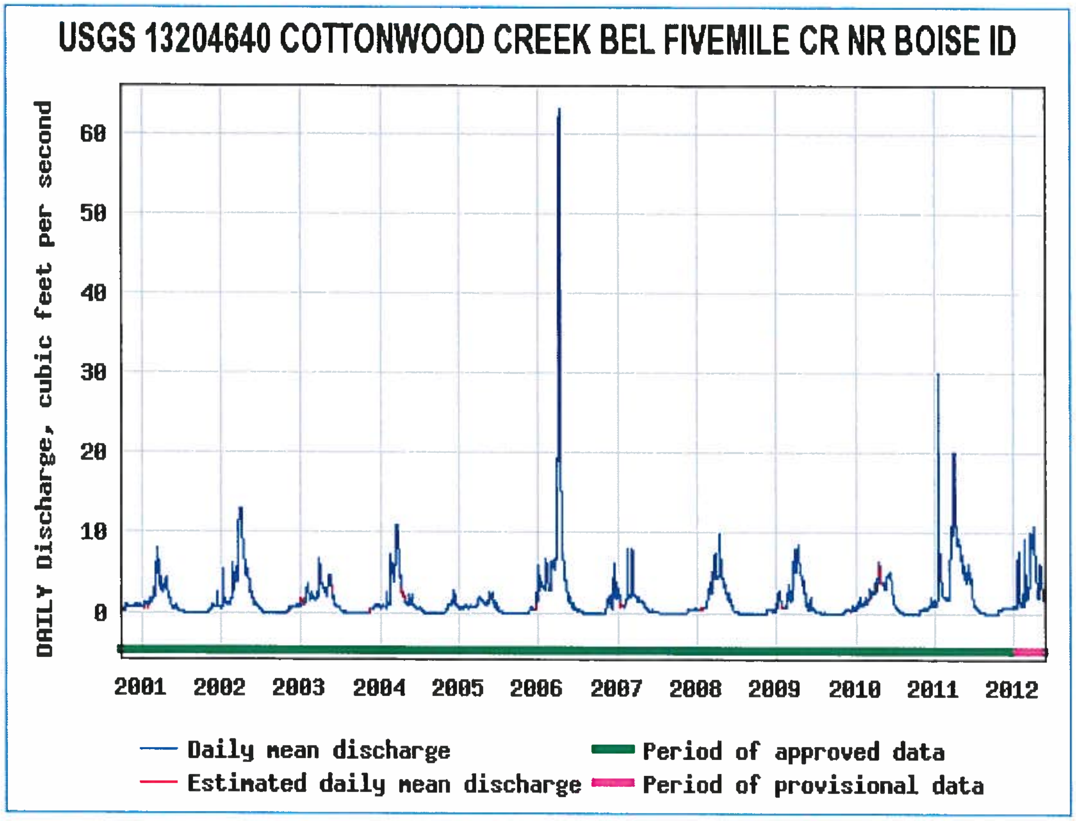


Well #01N04E-12CAC2
Well #02N04E-36CAB1
Well #01N05E-07BBB3
Well #01N05E-06CAC1
Well #01N04E-13CBA1
Well #01N05E-8CDD1
Well #01N04E-14DDAD1
Well #01N05E-17BCA1
Well #01N04E-23AAB2
Well #01S04E-23ADC1
Well #01N04E-13DDB1
Well #01N05E-18DDB1
Depth to Water (feet below land surface)
Date
Transducer
Manual
Legend
Monitoring Well
Proposed Development
Cinder Cone Comparison Area
Consolidated Hearing Study Boundary
0 0.75 1.5 3 Miles
N
84

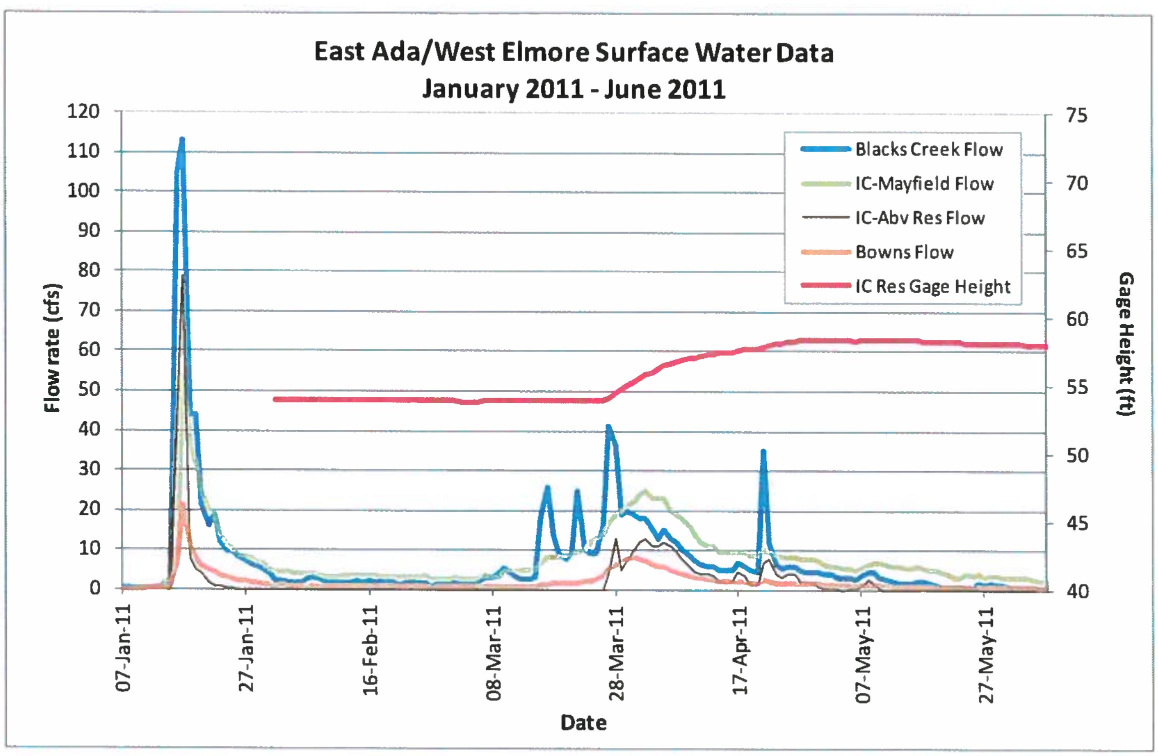


Well #01N04E-32AAC1
Well #01N04E-28CAC1
Well #01N04E-27ACA1
Well #01N04E-27ACD1
Well #01N04E-24CAD1
Well #01N04E-32BBC1
Well #01N04E-32ABB1
Well #01S04E-03ADD1
Well #01S04E-30AAC1
Well #01S04E-10DAD1
Depth to Water (feet below land surface)
Water Level Elevation (feet above sea level)
Date
Transducer
Manual
84
g Well
Development
one Comparison Area
ted Hearing Study Boundary
2.5
5
10 Miles
N

APPENDIX D
Surface Water Hydrographs



USGS 13204640 COTTONWOOD CREEK BEL FIVEMILE CR NR BOISE ID
DAILY Discharge, cubic feet per second
60
50
40
30
20
10
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Daily mean discharge
Estimated daily mean discharge
Period of approved data
Period of provisional data



East Ada/West Elmore Surface Water Data
January 2011 - June 2011
Flow rate (cfs)
120
110
100
90
80
70
60
50
40
30
20
10
0
Gage Height (ft)
75
70
65
60
55
50
45
40
Blacks Creek Flow
IC-Mayfield Flow
IC-Abv Res Flow
Bowns Flow
IC Res Gage Height
07-Jan-11
27-Jan-11
16-Feb-11
08-Mar-11
28-Mar-11
17-Apr-11
07-May-11
27-May-11
Date