



Overview

- Overarching Issues
 - Staff's Role
 - Clarification of IDWR Drawdown Analysis
- Address April 1, 2009 Response to Staff Memorandum

Staff's Role

- Review submittals/conduct analyses to address topics identified by Hearing Officer
 - Identify inconsistencies w/ bearing on:
 - Hydrogeologic conceptual model
 - Assessment of hydrologic impacts
- Neutral party

Drawdown Analysis

- Reality check
- Image well analysis based on Theis (1935) Solution
 - Calculation – not calibrated model
 - Simplifying assumptions
 - Robust and commonly applied (e.g., City of Eagle)

Drawdown Analysis

- Transient equation
- Stressed aquifer tends to new, lower equilibrium level (assuming ample recharge)
- Time to new equilibrium unknown
- Drawdown is function of log time
- 1 year also used by IDEQ

Drawdown Analysis

- IDWR at 1 year and HLI "worst case" at 90 days
 - 8 feet
- HLI "best case" at 90 days
 - 4 feet
- HLI numerical model at 50 years (Hmatch)
 - 5 feet
- HLI numerical model at 50 years (Tmatch)
 - 7 feet

Drawdown Analysis

- HLI's numerical model results deemed reasonable for PGSA
- 50-year drawdown calculation was not used to assess reasonableness
- No analysis of impacts to hydraulically connected river reaches

Higher Standard?

- *"...this aquifer's boundaries are defined far beyond what, in our experience, is customarily deemed necessary in evaluating a water right application" (Exhibit 45, p. 25)*
- *"...it is not customary to require applicants for ground water permits to answer all questions regarding the recharge mechanisms for a basin; this would seem an onerous and unrealistic requirement" (p. 41)*
- *"M3 has spent over \$2,000,000 over the last 3 years studying the North Ada County hydrology" (p. 41)*

Higher Standard?

- IDWR grateful for data collection and analysis but not a quid pro quo
 - Not asked to consider cost
 - Sustainability and potential impacts independent of cost
- Other applicants also have performed expensive characterization studies (e.g., Avimor)

Higher Standard?

- HLI on existing standards:
 - *"the majority of the testing to date has been of too short of duration to be useful for aquifer analysis. Unfortunately, most of the existing testing has been of generally poor design, as well, and this has caused the data from both short and long term testing to be of limited value for aquifer characterization."* (Exhibit 69, p. 6)

Higher Standard?

- HLI on water right applications:
 - *"We believe that all water right applications should be obliged to provide the data needed to understand and manage the resource. Properly designed and conducted pumping tests are part of the process that provides these data. We believe that all applicants for withdrawal of significant quantities of ground water be required to provide the rigorous and defensible aquifer-test data that would be generated following the recommendations below. All ground-water users in the region, present and future, would benefit were these recommendations to be followed and become standard procedure."* (Exhibit 12, p. 241)

Higher Standard?

- HLI's recommendations include:
 - *"tests should be undertaken during late winter or early spring before irrigation pumping or canal flow has begun and when municipal demand is relatively low."* (Exhibit 12, p. 242)
 - *"The tests should be conducted using as large a pumping rate as is practical... Target rates of 2 to 6 cfs (approximately 900 to 2,700 gpm) or more, if possible, should be considered"* (Exhibit 12, p. 242)
 - *"Wells should be selected for the test based on location, position within the aquifer, well construction, availability of sound geologic and as-built construction information..."* (Exhibit 12, p. 242)
 - *"Pumping for at least one week (and up to a month, if possible) is recommended"* (p. 242)
 - *"At least a week of water level data recovery collection is recommended"* (p. 243)

Higher Standard?

- Staff agrees w/ need for quality data
- Staff did not stipulate:
 - Reanalysis of 15 aquifer tests performed by others
 - Construction of 7-layer flow model

Higher Standard?

- In lieu of large-scale, regional test, involving installation of two large-bore, fully penetrating wells, HLI conducted two smaller scale tests using partially penetrating test wells and pumping rates at the low end of the recommended range

Higher Standard?

- HLI on Kling irrigation well:
 - *"The Kling Irrigation Well is completed in the upper 109 feet of the Pierce Gulch Sand Aquifer which is about 275 feet thick at this location. The already small open-area of the well screen in the Kling Irrigation well is significantly and irreversibly clogged, is subject to sand production, and is not suitable for long-term use as a regional supply well. The Kling Irrigation well is poorly documented, poorly designed, and poorly constructed of marginal materials. Since the well was completed 19 years ago, a general deterioration of the well allowed by the marginal materials and caused partly by the inefficient design, has resulted in reduced well efficiency and yield. The proportion of water derived from various parts of the screen (and therefore the aquifer) is not known. The partial clogging of the well screen renders this analysis, and any future analysis, for aquifer coefficients uncertain."* (Exhibit 12, p. 214).

Higher Standard?

- HLI on SVR#7 well:
 - *"M3 did not construct SVR#7. It was already cased and therefore could not be effectively logged. The existing lithologic and geophysical logs for SVR#7 are of poor quality. They were obtained with an uncalibrated geophysical logging unit operated by a driller having what we consider to be insufficient training and understanding of geophysical principles."* (Exhibit 45, p. 7).

Higher Standard?

- HLI on SVR#7:
 - *"relatively small diameter"*(Exhibit 44, p. 49)
 - *"poorly constructed with perforated casing and a louvered well screen"* (Exhibit 12, p. 167)
 - *"details of construction for the SVR#7 well is somewhat limited with respect to the annular seal"*(Exhibit 44, p. 31)
 - *"the degree of penetration is not accurately known because of the well construction"* (Exhibit 12, p. 164)
- HLI's conclusion:
 - *"Ideally future aquifer tests should be conducted on wells that are properly completed in a significant portion of the aquifer and which are fully penetrating"*(Exhibit 12, p. 167)

Higher Standard?

- Reliance on data from partially penetrating, poorly constructed, poorly documented test wells is inconsistent w/ HLI's recommendations

Higher Standard?

- HLI describing SVR#7 test (before):
 - *"An opportunity presents itself" (March 3, 2008 email to staff)*
 - *"Although this does not take the place of our planned regional scale aquifer test, using an efficient large bore production well that fully penetrates the aquifer at a higher discharge rate, pumping this well for a somewhat prolonged period would provide us with some useful data and could help us to refine our aquifer testing plan" (March 3, 2008 email to staff)*

Higher Standard?

- HLI describing SVR#7 test (before):
 - *"We view this opportunity as a small scale test using monitoring wells close to the pumping well and no attempts will be made to contact well owners or to measure the wells of others as we intend to do in the regional scale aquifer test of our prospectus using a large bore production well."* (emphasis added, March 3, 2008 email to staff)

Higher Standard?

- HLI describing SVR#7 test (before):
 - *"It is not the mother of all aquifer tests. Rather it is an opportunity to extend an already planned well redevelopment pumping test into a research effort that could yield some meaningful results".* (March 3, 2008 email to staff)
 - *"I regret that you do not have more time to consider this proposal but we need to move forward with our contracted work while we have the rental test equipment on site. If the Department can approve this request, we commit to making every effort to obtain good-quality and meaningful data but we would literally need to know tomorrow in order to make arrangements..."* (March 3, 2008 email to staff)

Higher Standard?

- HLI describing SVR#7 test (after):
 - *"Our earlier recommendation for the need to conduct a major, regional scale aquifer test of the Pierce Gulch Sand Aquifer beneath the north Eagle Foothills has been met by the SVR#7 test. The data obtained from the SVR#7 nine-day test has been used to calibrate and update the existing M3 Modflow numerical ground-water model."* (Exhibit 44, p. 54)

Higher Standard?

- Regardless of scale, staff believes SVR#7 test ended prematurely and with inconclusive results
- Staff disagrees with HLI opinions:
 - *"extending the test would have added no significant information"* (Exhibit 45, p. 23)
 - *"Adjusting the drawdown data from the Big Gulch stock well to correct for this trend...generated a drawdown plot (Figure 6) with almost all of the apparent end-of-test increase in drawdown removed"* (Exhibit 45, p. 23)

EXHIBIT 45

Figure 6. Cooper-Jacob Analysis for the Big Gulch Stock Well with Water-Level Trend Corrections

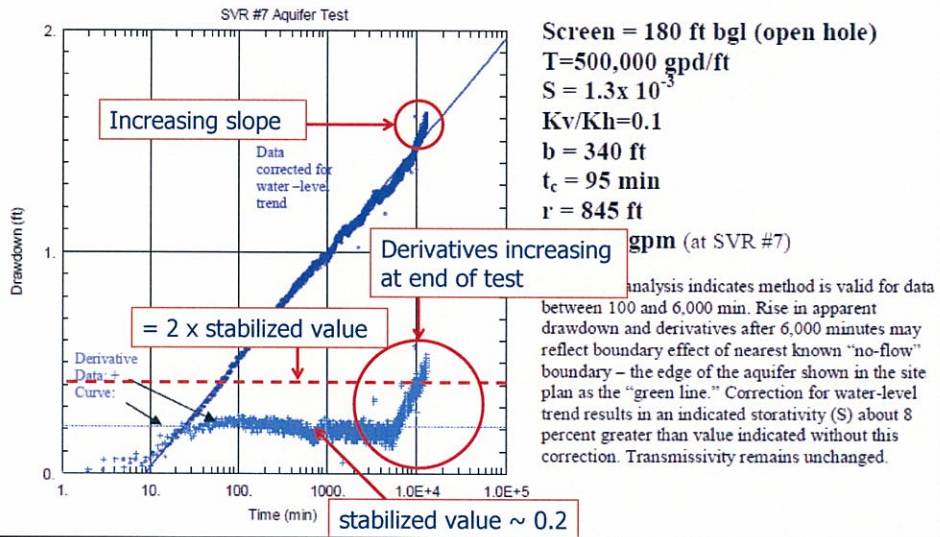
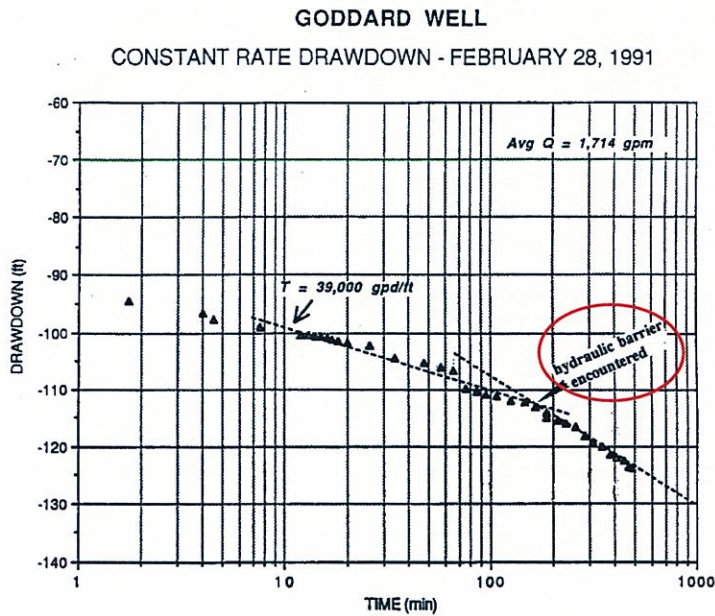


EXHIBIT 67



Higher Standard?

- A single negative boundary does not mean that production is not sustainable – Goddard#2 and Lexington Hills prove this.
- Boundary conditions should be evaluated thoroughly, however.
- Primary purpose for running a long term test (e.g., 30-days) is to establish aquifer boundary conditions.

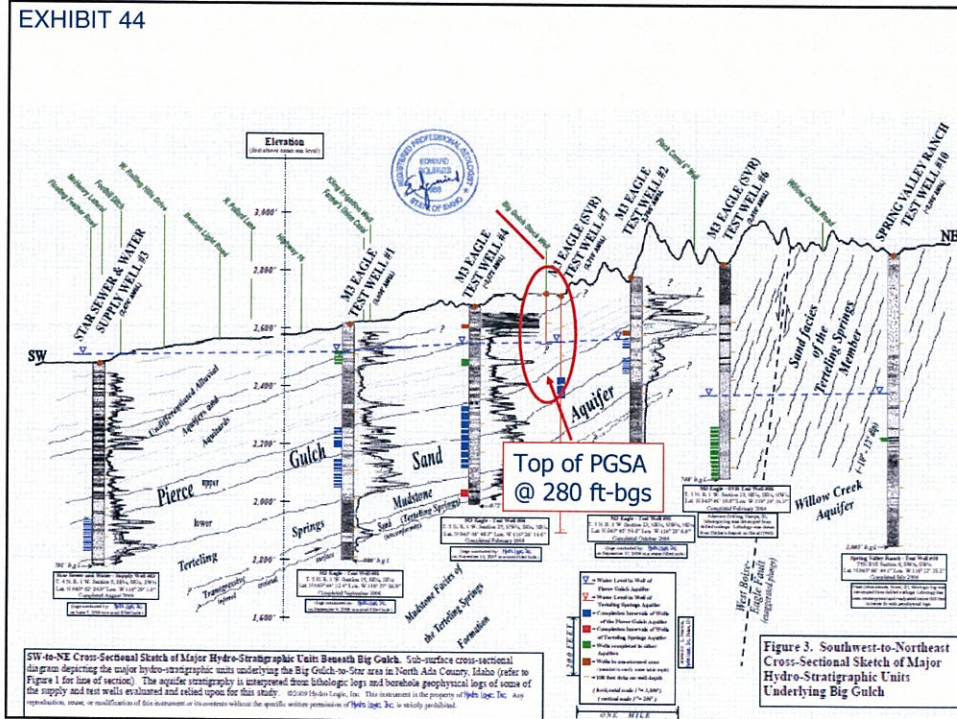
Higher Standard?

- Big Gulch Stock Well
 - Closest observation well and only well w/ more than 1 foot of drawdown (~1.7 ft.)
 - 180 ft. deep
 - Thought to be open hole completion
- PGSA extends from 180 to 520 ft-bgs (Exhibit 44, Table 1)

Higher Standard?

- HLI on data from the Big Gulch stock well:
 - “One potential issue with the interpretation of the data from the Big Gulch Stock Well is that it may be completed about 100 feet above the top of the Pierce Gulch Sand Aquifer. Our interpretation of the geophysical logs from SVR#7 indicate that the top of the Pierce Gulch Sand Aquifer lies approximately 240 feet below ground level while the limited information we have available for the Big Gulch Stock Well suggest it is completed (and open to an aquifer) 180 feet below ground level. Although this apparent discrepancy might be considered a complication, we believe it neither invalidates the analysis of data from this well nor our interpretation of aquifer properties...” (emphasis added, Exhibit 44, p. 30)

EXHIBIT 44



Complex stratigraphy?

- HLI took exception to staff's characterization of stratigraphy as being complex
- Numerous references to complexity and heterogeneity in supporting documentation

Complex stratigraphy?

- Wood and Anderson (1981) on stratigraphic relationships:
 - "*The stratigraphic relationships within the Idaho Group beneath the western plain are complex*" (emphasis added, Exhibit 19H, p. 23).

Complex stratigraphy?

- Wood and Clemens (2002) on distribution of sand aquifers:
 - *"The distribution of sand aquifers in the fluvial-lacustrine section is complex, but in just the last few years we are gaining a clearer understanding of the depositional history and gross features of the sedimentary architecture"* (emphasis added, Exhibit 19D, p. 71)

Complex stratigraphy?

- HLI on heterogeneity of aquifer system:
 - *"These apparent contradictions support the conclusion that the aquifer system is heterogeneous and does not match well with the simplified models envisioned for the analytical methods of analysis"* (Exhibit 12, p. 210).
- Staff's interpretation is that a heterogeneous system that cannot be described using a simplified model is a complex system.

Complex stratigraphy?

- HLI recently determined that fracture flow possibly is important in addition to porous media flow, but only in certain portions of the aquifer:

“The cemented nature of the aquifer along with relatively large transmissivities calculated from numerous aquifer tests supports the possibility of fracture flow in addition to porous media flow. This type of flow would allow for higher transmissivities in a somewhat cemented sand or sandstone aquifer, than would porous-media flow itself. We do not postulate that the entire Pierce Gulch Sand Aquifer is cemented because there are many instances of sand production in wells and borehole collapse to suggest otherwise. As a general rule, cementation appears to increase with proximity to the basin margin and in the vicinity of known structural faulting”. (emphasis added, Exhibit 44, p. 6).

Complex stratigraphy?

- Complexity suggested by seven layer flow model w/ 3 layers used to represent the PGSA

Complex stratigraphy?

- None of the geologic cross-sections in Exhibit #27 identify formal geologic units or correlate stratigraphy between boreholes.

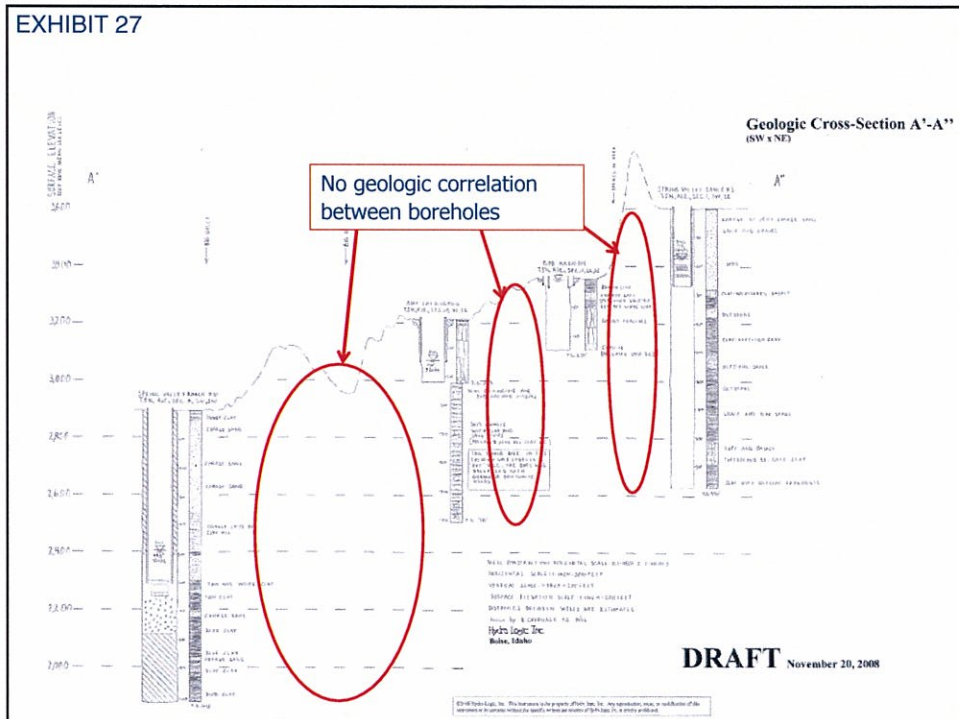
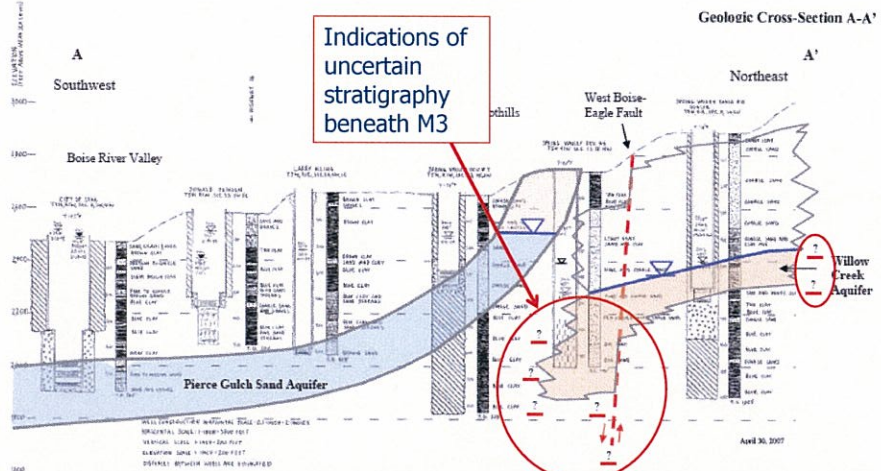


EXHIBIT 2

Figure 5. Geologic Cross-Section through the M3 Eagle Site

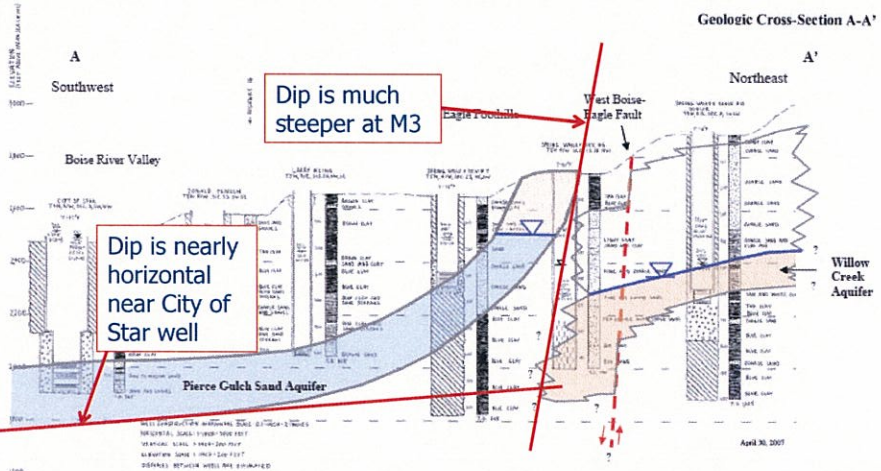


Southwest to northeast cross-section showing Pierce Gulch Sand Aquifer tapped by Valley and Upland wells. Note: Pierce Gulch Sand Aquifer continues to northwest, west and south off figure. Spring Valley #6 taps Willow Creek Aquifer separated by contact of clay underlying the Pierce Gulch Aquifer. Clay below the Pierce Gulch Aquifer in Spring Valley #7 is believed to be equivalent to clay above the Willow Creek Aquifer in Spring Valley #6. The coarser-grained upper portion of the Willow Creek Aquifer is ununsaturated at Spring Valley Ranch #10 because of relative uplift by West Boise-Eagle fault. The fault dips to the southwest at about 70 degrees but because of 10:1 vertical exaggeration (to allow well logs to be readable) true dip angle is not shown. The tops of the Willow Creek Aquifer and the Pierce Gulch Sand Aquifer in the northwest are defined by the water table. Unsaturated sands lie above the water table at these locations. The exact lateral extent of the Willow Creek Aquifer is not precisely known but is believed to be defined by a facies change to clay to the southwest and by granitic bedrock to the northeast. An accurate delineation of its boundaries was beyond the scope of this study and not considered to be critical to the assessment of the Pierce Gulch Aquifer. See Figure 1 for cross-section location.

Hydro Logic, Inc
Boise, Idaho

EXHIBIT 2

Figure 5. Geologic Cross-Section through the M3 Eagle Site



Southwest to northeast cross-section showing Pierce Gulch Sand Aquifer tapped by Valley and Upland wells. Note: Pierce Gulch Sand Aquifer continues to northwest, west and south off figure. Spring Valley #6 taps Willow Creek Aquifer separated by contact of clay underlying the Pierce Gulch Aquifer. Clay below the Pierce Gulch Aquifer in Spring Valley #7 is believed to be equivalent to clay above the Willow Creek Aquifer in Spring Valley #6. The coarser-grained upper portion of the Willow Creek Aquifer is ununsaturated at Spring Valley Ranch #10 because of relative uplift by West Boise-Eagle fault. The fault dips to the southwest at about 70 degrees but because of 10:1 vertical exaggeration (to allow well logs to be readable) true dip angle is not shown. The tops of the Willow Creek Aquifer and the Pierce Gulch Sand Aquifer in the northwest are defined by the water table. Unsaturated sands lie above the water table at these locations. The exact lateral extent of the Willow Creek Aquifer is not precisely known but is believed to be defined by a facies change to clay to the southwest and by granitic bedrock to the northeast. An accurate delineation of its boundaries was beyond the scope of this study and not considered to be critical to the assessment of the Pierce Gulch Aquifer. See Figure 1 for cross-section location.

Hydro Logic, Inc
Boise, Idaho

EXHIBIT 44

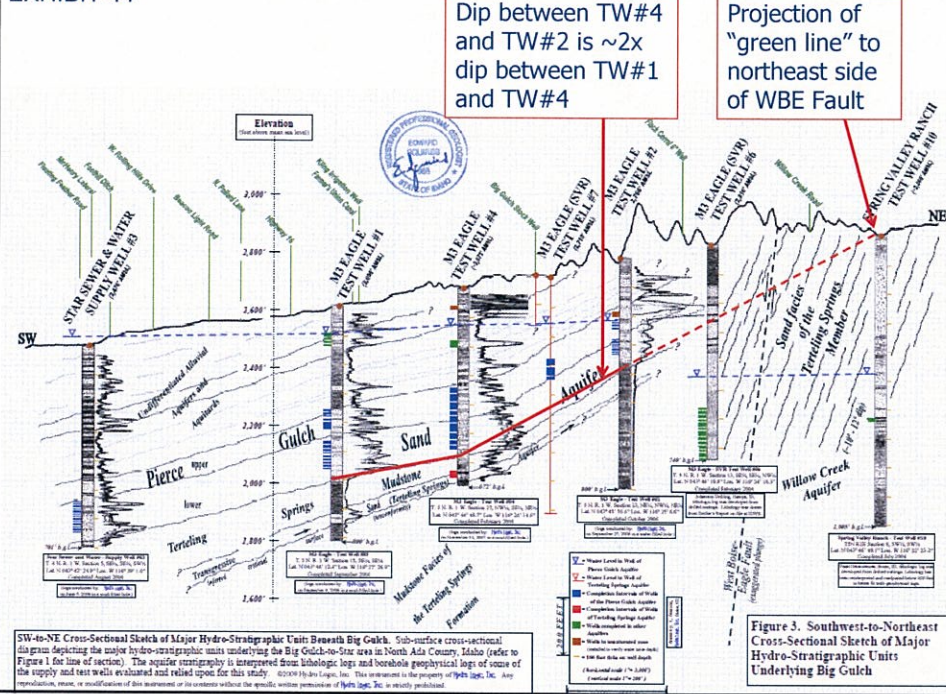


EXHIBIT 44

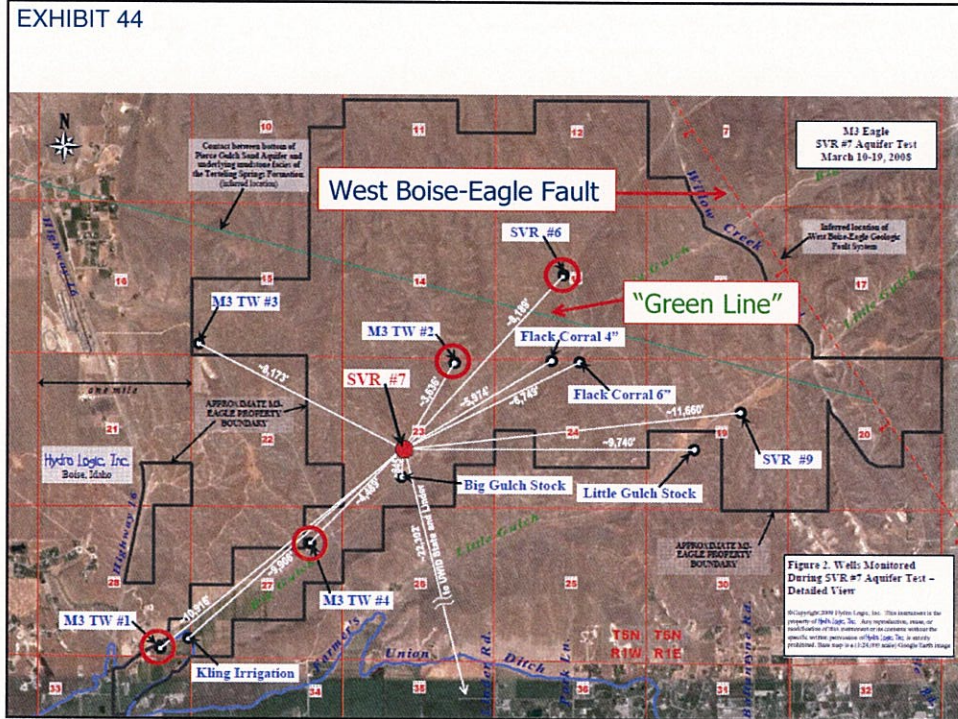
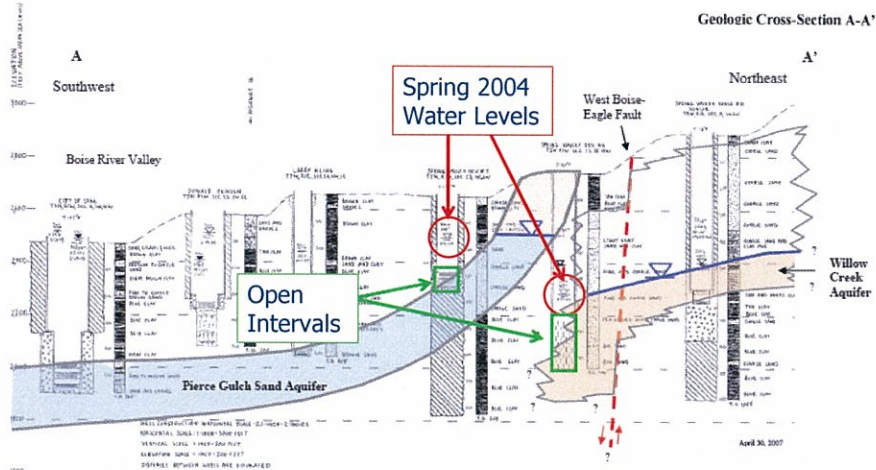


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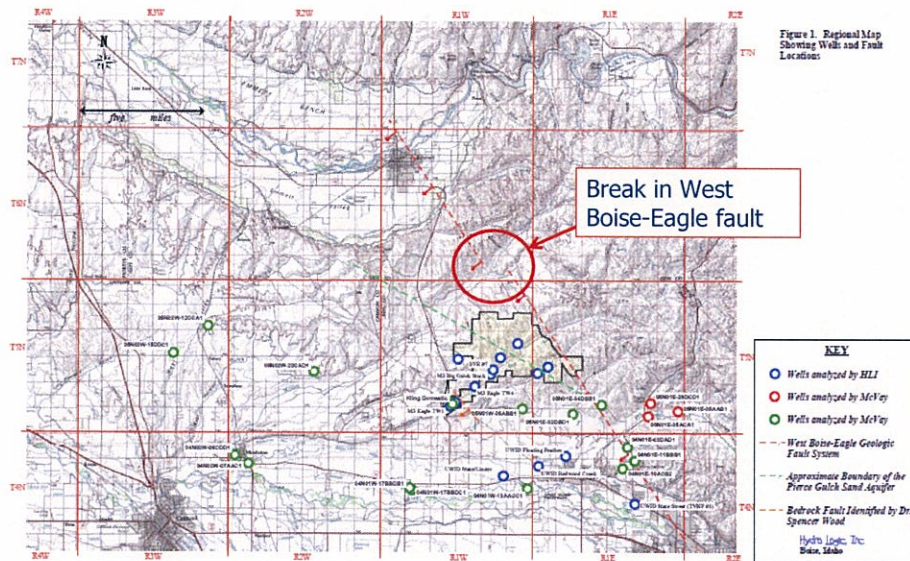
Hydro Logic, Inc.
Boise, Idaho

Complex Stratigraphy?

- Downward vertical hydraulic gradient occurs between shallow alluvial sand aquifer and PGSA in TW#1 nest (Exhibit 44, Table 2)
- Upward vertical gradient from PGSA to shallow aquifer in TW#4 (Exhibit 44, Table 2)
- Complex vertical gradient distribution makes tenuous the conclusion:

– “These measured vertical gradients that exist in the foothills region also serve to refute the prevailing notion of the foothills as a recharge area” (Exhibit 2, p. 6)

EXHIBIT 45



Complex stratigraphy?

- Complicated water level trend analysis for SVR#7 test:
 - Different "regional" trend for each PGSA well that exhibited measurable drawdown.
 - Two different trends estimated for some PGSA wells

Complex stratigraphy?

- HLI's description of trend analysis:
 - *"The water level trend visually identifiable at TW#2 and TW#4 appeared as a declining level over the course of the entire test (including the week before the test began). The peak of the 2008 water levels in the aquifer near these wells appeared to occur just prior to March. Beneath the eastern portion of the M3 property, however, the water levels appeared to be rising before the start of the test and declining at the end. Based on linear projections of the pre-test and post-test trends observed in SVR#7, Flack Corral 6-inch stock, Flack Corral 4-in stock and the Little Gulch Stock Wells, the 2008 peak in water levels in this area appeared to occur sometime during the period March 17 to 19. Because of the peak occurring during the test, two separate equations were generated for the estimated water level trend at each well; one for the rising-level period and one for the declining level-period. Trends could not be estimated for the aquifer near the pumping well (SVR#7) and the nearby Big Gulch Stock Well using the pretest data because pre-test pumping caused water levels to fluctuate, obscuring any visually discernable trends. Instead we used the data collected during the two months following completion of the test."* (Exhibit 44, p. 17).

Water Level Recovery

- HLI's response to Staff's concerns about water level recovery:
 - *"HLI has explained why the water levels in measured wells did not recover to pre-test levels during the recovery measurement period, including the annual fluctuation in regional water levels shown in all monitored wells in the area. It would be unusual (and a contradiction to standard well recovery analyses using methods based on the Theis equations) for water levels in Boise River Valley wells to fully recover in hydraulic tests within the same amount of time as the drawdown occurred. However, to assure IDWR that the aquifer did indeed recover, the attached Figure 5 shows that the water levels in TW#1 (completed in the PGSA about 50 feet from the Kling domestic well) recovered within 2 weeks."* (Exhibit 45, p. 19).

EXHIBIT 45

Figure 5. Comparison of Water Level Responses in TW #1 and TW #4
From Continuous Water Level Monitoring
Monitored For M3 Eagle By: Hydro Logic, Inc.

Figure 5.

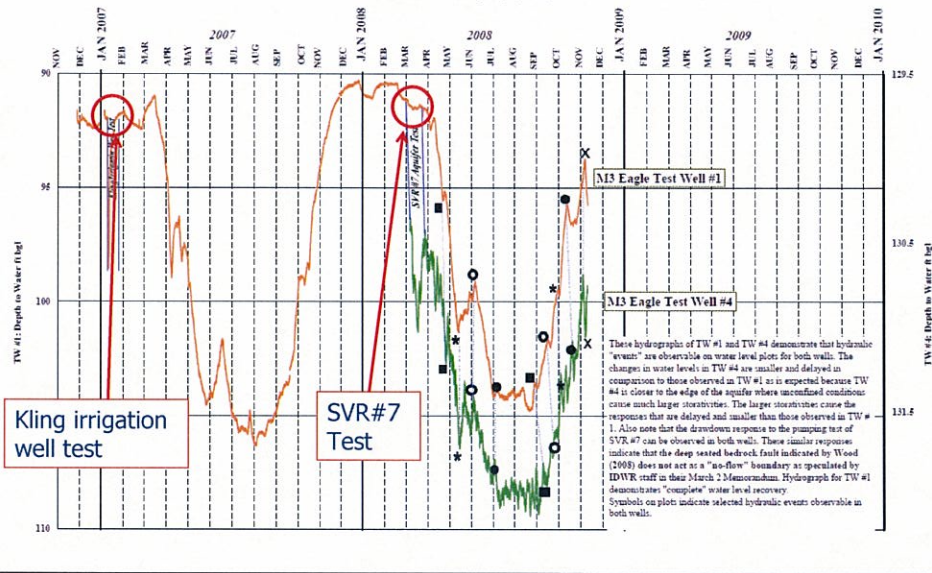
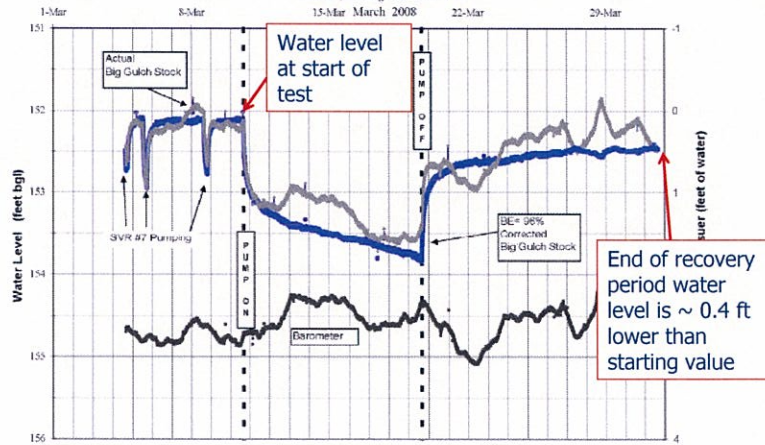


EXHIBIT 44

Figure C-3. Actual and BE-Corrected Water Levels for Big Gulch Stock Well

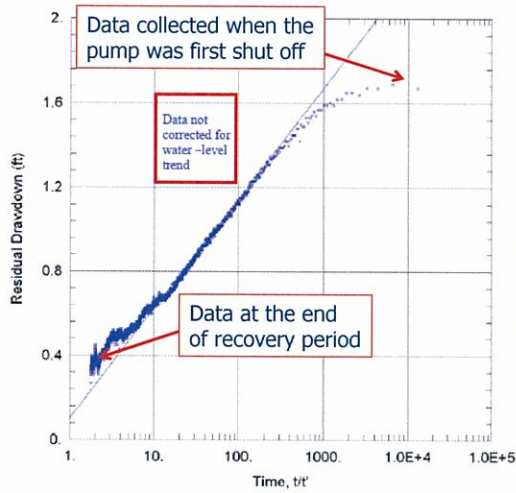
Big Gulch Stock Well
Actual and BE-Corrected Water Levels
Before, During and After Test



Distance from Pumping Well SVR #7 = 845 ft
Screen Depth = 180 to 180 ft ("open hole," no well screen)

EXHIBIT 44

Figure 26. Theis Recovery Analysis for the Big Gulch Stock Well with no Water-Level Trend Correction



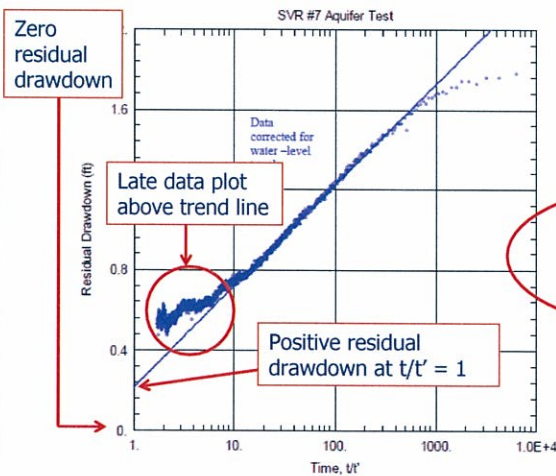
Screen = 180 ft bgl (open hole)
 $T=450,000$ gpd/ft
 $S/S' = 0.6$
 $Kv/Kh=0.1$
 $b = 340$ ft
 $r = 845$ ft
 $Q = 917$ gpm (at SVR #7)

S/S' less than 1 suggests "late" or "incomplete" recovery. However, seasonal (declining), regional, water-level trend over 12 days of recovery is most probable cause of apparent incomplete recovery.

Partial penetration corrections neither needed nor applied.

EXHIBIT 44

Figure 27. Theis Recovery Analysis for the Big Gulch Stock Well with Water-Level Trend Corrections



Screen = 180 ft bgl (open hole)
 $T=480,000$ gpd/ft
 $S/S' = 0.4$
 $Kv/Kh=0.1$
 $b = 340$ ft
 $r = 845$ ft
 $Q = 917$ gpm (at SVR #7)

HLI's analyst describing trend-corrected water level recovery plot

S/S' less than 1 suggests "late" or "incomplete" recovery. However, incomplete correction for seasonal (declining), regional, water-level trend over 12 days of recovery is most probable cause of apparent incomplete recovery.

Partial penetration corrections neither needed nor applied.

Water Level Recovery

- HLI's description of water level trend correction:
 - *"We inadvertently omitted a minus sign to the correction... By applying the minus sign to the correction, the revised recovery plot (Figure 7 below) now projects close to the total recovery point of the graph, as is expected through standard well pumping and recovery theory (Theis, 1935). The small difference between the actual plot and a perfect projection may be the result of incomplete correction for trend or it could be the effects of the edge of aquifer boundary discussed above and noted in our reports."* (Exhibit 45, p. 24).

EXHIBIT 45

Figure 7. Theis Recovery Analysis for the Big Gulch Stock Well with Revised Water-Level Trend Correction

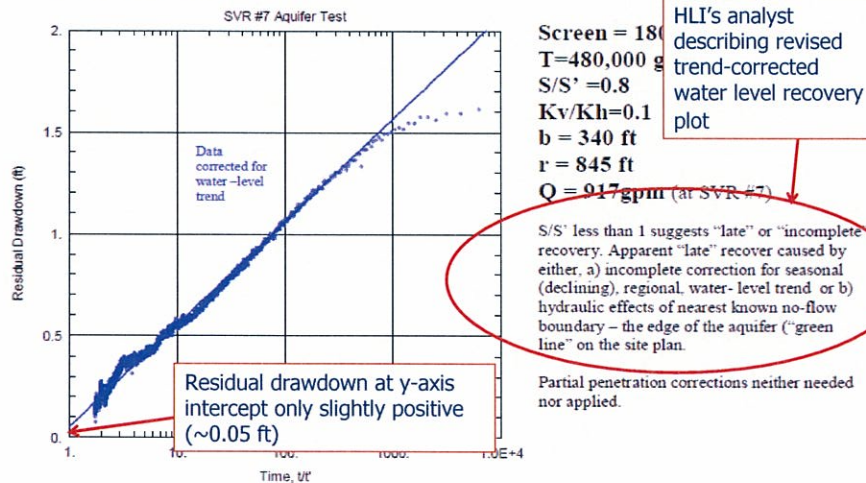
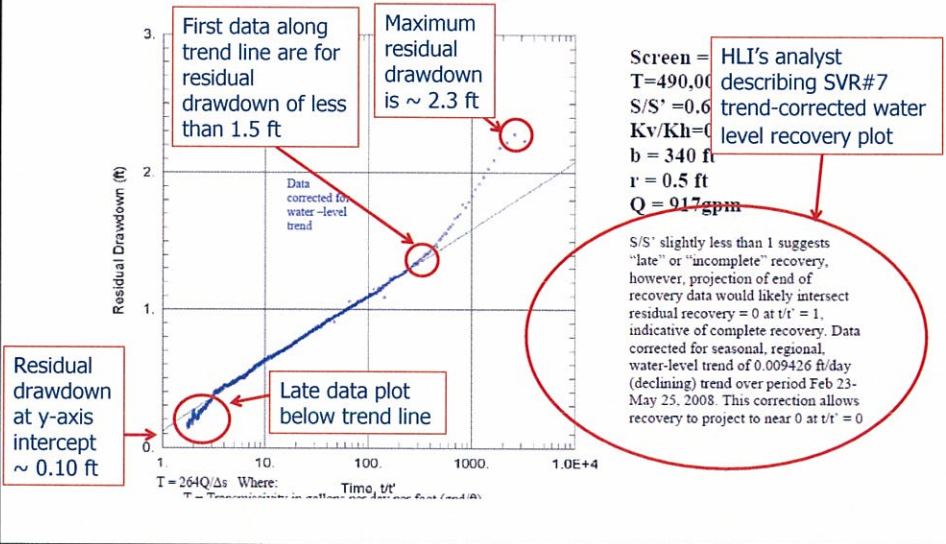


EXHIBIT 44

Figure 23. This Recovery Analysis for Well SVR #7 with Trend Correction



Water Level Recovery

- Residual drawdown values for the pumping well during the SVR#7 test appear to be too low:
 - First data to fall onto trend line are for residual drawdown values of less than 1.5 feet
 - The maximum residual drawdown value on Figure 23 in Exhibit 44 is approximately 2.3 feet
 - Maximum drawdown in SVR#7 after correcting for well loss is 7.51 feet according to Table 2 in Exhibit 44, which is more than 5 feet greater than maximum value shown on the water level recovery plot for the pumping well
- Large unexplained discrepancy suggests that data may not be representative of water levels in the pumping well

Aquifer Continuity

- HLI (2009) on aquifer continuity:
 - *"Again, the evidence in published reports, together with recent studies we have compiled, supports the conclusion that the PGSA is laterally extensive and hydraulically interconnected over a regional scale. All new evidence we have uncovered continues to point to this conclusion; we do not subscribe to the Staff's apparent belief that there is a lack of clarity with respect to this issue"* (Exhibit 45, p. 4)

Aquifer Continuity

- Wood and Squires (2001) on continuity of sand layers:
 - *"The cold-water aquifer system beneath the City of Boise is composed of sandy sediments interbedded with claystone and mudstone that were deposited near the shores of lakes which filled the western Snake River Plain during the late Miocene and Pliocene epochs (10 to 1.7 million years ago). The sand layers are the deposits of stream channels, beach sands winnowed by wave action, deltas built out into the lake, and possibly density-flows across the lake bottom from collapse of parts of the delta shelf. These depositional environments do not produce broadly distributed sand layers. Instead the sand layers are typically restricted in their horizontal and vertical continuity by interbedded mudstone or lateral termination into mudstone. The difficulty here lies with correlation of sand layers and determination of their shapes. Important is to predict whether sand layers found in wells have some sort of hydraulic connection, and which are not interconnected. By analogy to modern sedimentary environments and subsurface studies of others, our goal is to obtain at least a partial understanding of the three-dimensional geometrical shapes of sand aquifers. Structural downwarping coupled with normal faulting along the margins of the plain further complicates the stratigraphic section"* (emphasis added, Exhibit 19E, p. 1).

Aquifer Continuity

- Wood and Squires (2001) on hydraulic connectivity of aquifers:
 - *"In the past, aquifers were typically named for the geologic formations in which they occurred. However, the variety of depositional environments of the lake-stream systems and the changing environments with fluctuating lake level tells us that the sand units are complex. In previous reports (Whitehead, 1992), the aquifer systems are associated with a set of geologic formations originally defined by Malde and Powers (1962). The stratigraphic order and characteristic lithology of formations is a useful framework, because the changing lithology in some cases can be attributed to basin-wide geologic events or progressions of similar depositional environments across parts of the basin. However, it is unlikely that these formation units reliably relate to hydraulic connectivity of aquifers."* (emphasis added, Exhibit 19E, p. 6).

Aquifer Continuity

- HLI on current (2009) understanding of aquifer interconnectivity:
 - *"These conclusions are, of course, only preliminary and additional monitoring (currently on-going) will help to clarify and test our understanding of interconnectivity."* (Exhibit 44, p. 44)

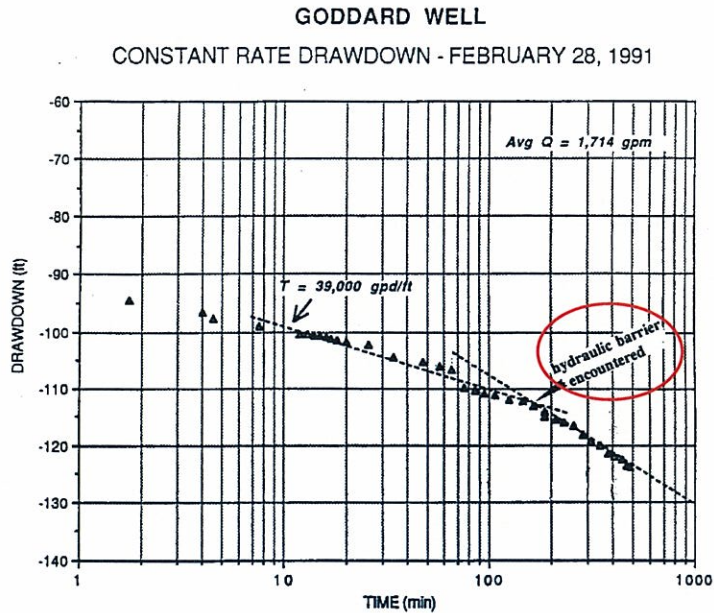
Aquifer Continuity

- HLI's assumption about Staff's opinion:
 - *"The Staff evidently does not dispute that PGSA ground water moves many miles from the east-southeast into the area beneath the M3 Eagle property north of Eagle, and that it comes from at least as far away as Garden City" (Exhibit 45, p. 13)*

Aquifer Continuity

- HLI's assumption about Staff's opinion (cont'd):
 - 1. Staff did not endorse continuity idea
 - 2. Dr. Ralston does not speak for staff
 - 3. Garden City is not modeled recharge area
 - 4. Concern about hydrologic significance of faulting remains
 - 5. Goddard #2 is between M3 and postulated recharge area

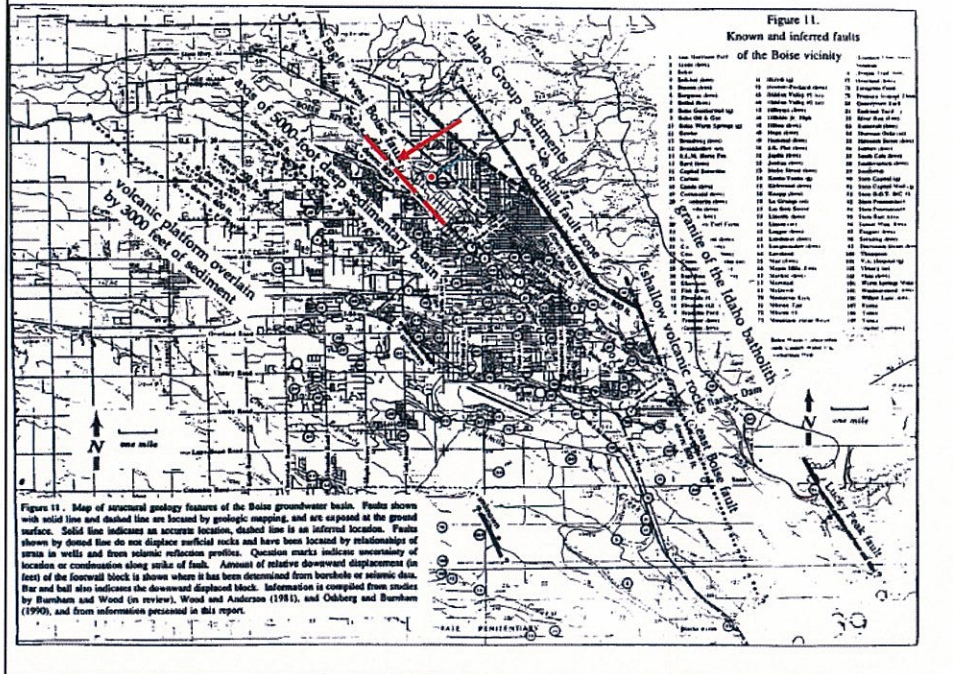
EXHIBIT 67



Aquifer Continuity

- 6. HLI has proposed new, modern day recharge area:
 - "where the PGSA rises up dip to the present-day Boise River gravels east of the United Water Idaho (UWID) Swift well" (Exhibit 45, p. 25).

EXHIBIT 67



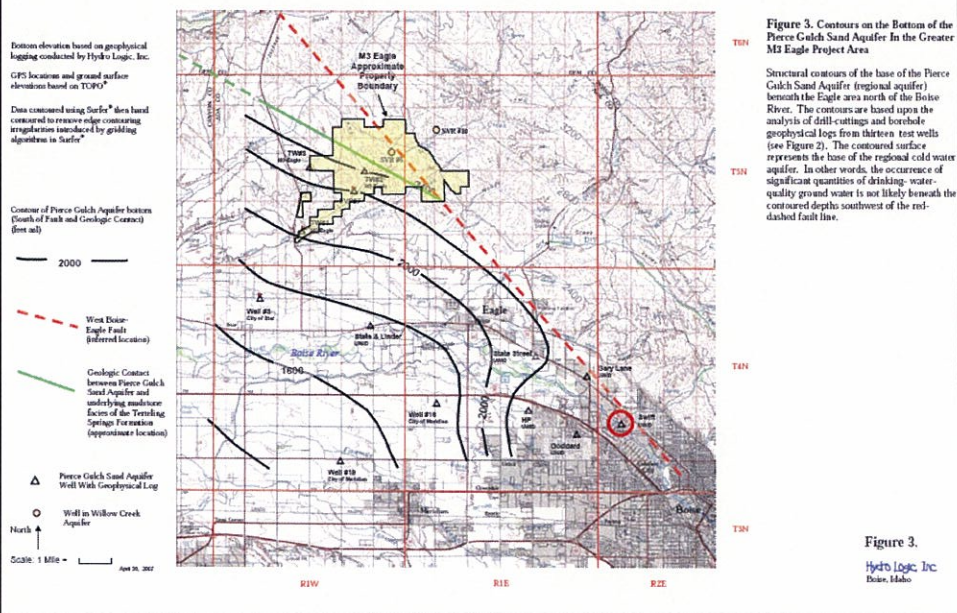
Aquifer Continuity

- 7. Staff's concern relative aquifer continuity:
 - Lateral continuity required to connect M3 to losing reach of Boise River and New York Canal
 - "HLI has not presented geologic data to support the existence of the PGSA beneath the Boise River or provided an explanation of how the canal and river losses end up recharging the PGSA instead of the shallow alluvial system" (Staff Memo, Exhibit 50, p. 19)

Aquifer Continuity

- HLI's response to staff's concern about continuity to east Boise recharge sources:
 - "HLI's 2007 report clearly shows the PGSA geophysical signature 400 feet beneath the river at the UWID Swift wells which are located on the banks of the Boise River at Lake Harbor. The base of aquifer map clearly shows that the PGSA continues up-dip under the Boise River at least well into west Boise and probably beyond" (Exhibit 45, p. 28)

EXHIBIT 2



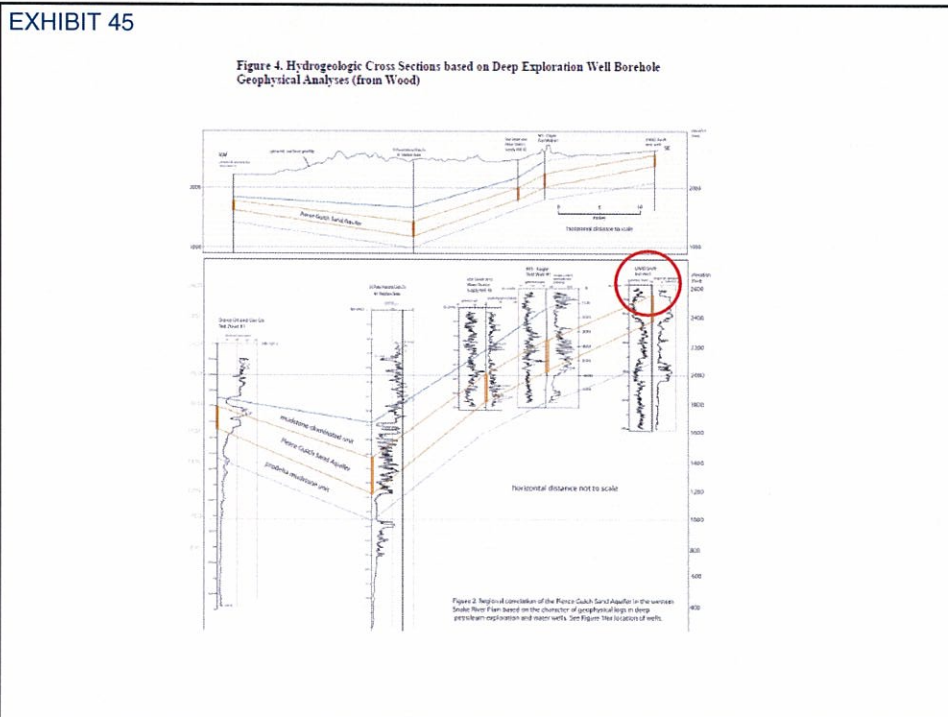
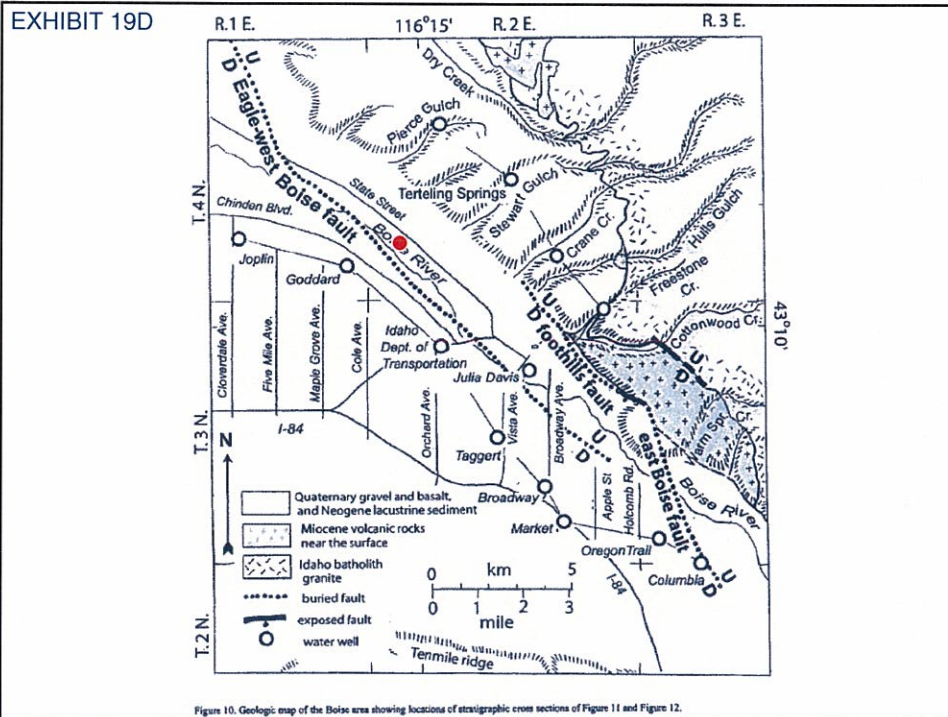
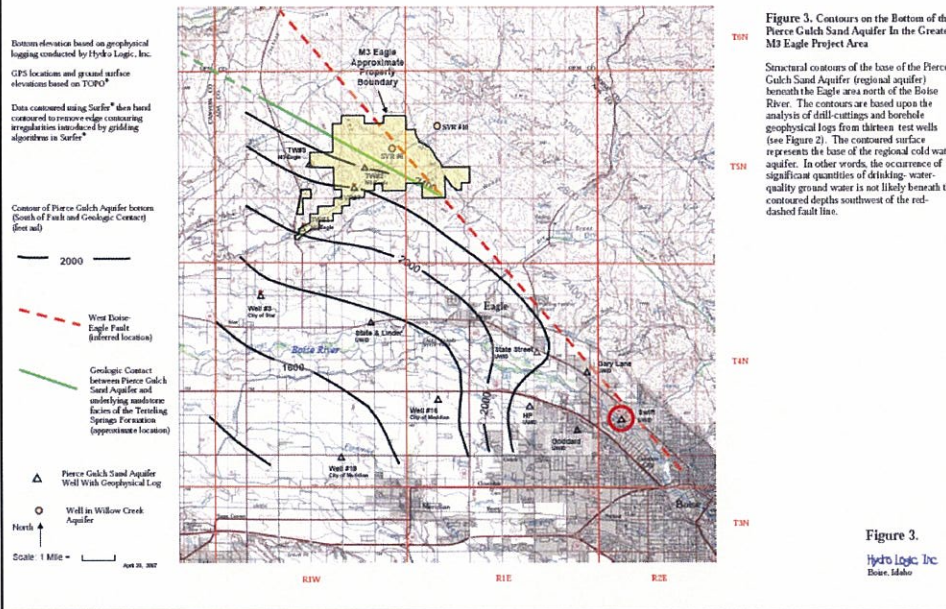


EXHIBIT 2



Aquifer Continuity

- 7. Continuity of hydrogeology from Lake Harbor through Boise to recharge area is assumed but not justified
 - Negative boundaries indicated in west Boise PGSA well
 - Squires, Wood, and Osiensky (1992) describing lateral extent of deeper cold-water aquifers:
 - *"the west Boise deep artesian aquifers should be truncated to the north or northeast by down-to-basin normal faults such as the West Boise/Eagle Fault and/or beveled off updip by an erosional angular unconformity. Virtually all well-completion/pump capacity tests of production wells in this region have shown indications of such negative hydraulic boundaries in the subsurface."* (Exhibit 67, p. 58)

Faulting

- HLI response to Staff's concerns relative faulting:
 - *"with perhaps one exception, there is no evidence that the major faulting in the deep volcanic basement rocks, including that detected by the magnetometer survey conducted by M3 Eagle in 2007, offsets, or even breaks, the shallower water bearing units including the PGSA. The available evidence actually shows the opposite, that the deep-seated faults do not propagate to land surface or penetrate the younger sediments above. An exception is the mapped, basin-bounding, West Boise-Eagle ("WBE") fault extending into, and apparently truncating, the sedimentary section" (Exhibit 45, p. 3)*

Faulting

- HLI response to Staff's concerns relative faulting (cont'd):
 - *"Major faulting that formed the western Snake Plain generally does not significantly cut or offset the younger sedimentary units (shallower than 1,000 ft) in the basin on the north side of the plain" (Exhibit 45, p. 9)*
 - *"HLI did commission seismic reflection and magnetometer surveys, mainly to determine deep structural features." (Exhibit 45, p. 10)*

Faulting

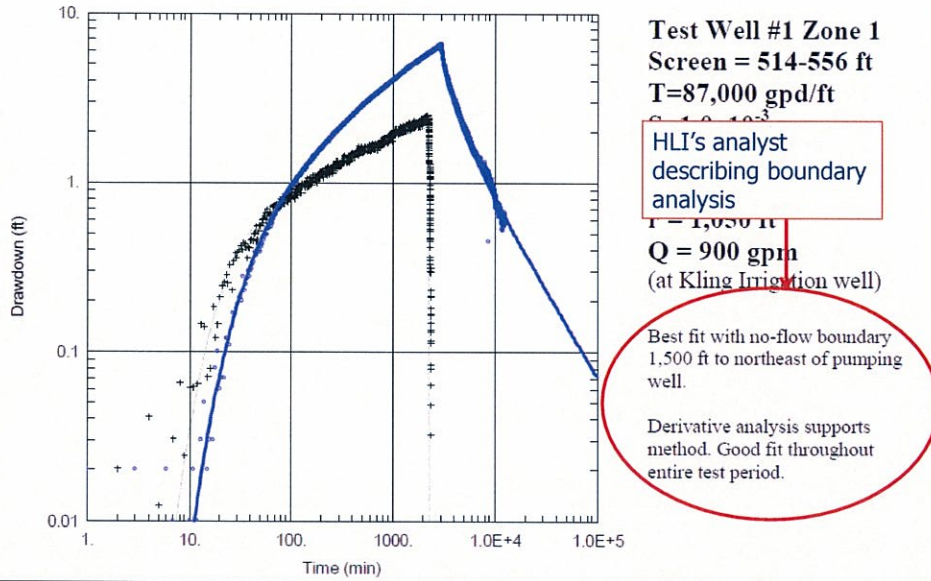
- Report describing focus of HLI's seismic survey:
 - *"The deep water table at the site means that the seismic signal must propagate through a significant thickness of unsaturated sediments prior to reaching the primary target, which in this case is the stratigraphy associated with the fresh water aquifer and the fault that appears to traverse the property"* (emphasis added, Exhibit 13, p. 1).

Faulting

- HLI on newly identified fault:
 - *"the deep-seated bedrock fault indicated by Wood (2008) does not act as a no-flow boundary as speculated by IDWR staff"* (Exhibit 45, p. 8)
 - *"Since the Aqtesolv® analyses used to generate a curve match required the use of a fault acting as a no-flow boundary, and because other subsurface geophysical mapping by HLI suggests a buried fault trace, it appears likely that such a fault may be present in the vicinity of the Kling well and that it may control ground water movement in the aquifer to some extent."* (emphasis added, Exhibit 12, p. 212).

EXHIBIT 12

Figure 88. Theis Analysis for TW#1 Zone 1 – Kling Irrigation Two-Day Test
Test Conducted: January 9-11, 2007



Faulting

- HLI on newly identified fault (cont'd):
 - "Geophysical evidence (Wood, 2007) suggests that a structural fault may be present between TW#4 and the monitored wells lying to the west (TW#1, TW#3, and Kling Irrigation well). Such a fault, if present, could have attenuated and/or delayed the response in the portions of the Pierce Gulch Sand Aquifer lying to the west of the fault, caused by pumping the Pierce Gulch Sand Aquifer at a location east of the fault...In a manner similar to the SVR#7 test, pumping from the Kling Irrigation well (located west of the possible fault) caused no measureable drawdowns in wells lying to the east of the fault, supporting the concept of a structural fault." (Exhibit 44, p. 42)

Faulting

- HLI's summary statement:
 - *"In short, there is no support for a suggestion that faulting offsets the PGSA, much less that it serves as a no-flow boundary" (Exhibit 45, p. 8)*

Faulting

- Another statement about faulting:
 - *"Negative hydraulic boundaries can be confirmed by pumping tests of properly constructed wells in the aquifer under investigation when they are evidenced by an increased rate of drawdown. Significant negative hydraulic boundaries did not show up in the 9-day SVR#7 aquifer test or in the 30-day Lexington Hills test, both of which we consider to be of sufficient duration to have revealed boundaries. Indeed, as our previously-submitted reports show, positive (recharge) boundaries were evident in those tests." (emphasis added, Exhibit 45, p. 25)*

Faulting

- Another apparent contradiction:
 - *"As noted in the Hydrogeologic Overview section of this report, the West-Boise-Eagle Fault lies approximately one-half mile to the northeast of the Lexington Hills Well #1. Review of Well Driller's Reports and the hydraulic data included in the CH2M-Hill report indicate this fault acts as a no-flow barrier and edge to the Pierce Gulch Sand Aquifer. We incorporated the effects of this no-flow boundary into all the log-log type-curve analyses"* (Exhibit 12, p. 59)

Faulting

- Squires, Wood, and Osiensky (1992) describing potential hydrologic significance of shallow faults:
 - *"In addition to the basin-bounding fault zone of the Boise Front, which truncates the lateral extent of aquifer units, other faults within the sedimentary section of the valley impede groundwater flow and limit the lateral extent of aquifer units... The extent to which these faults cut the sedimentary sequence above 1,000 feet is not presently known. The amount of movement (offset) that has occurred along these faults and the degree to which they affect groundwater movement is poorly understood at present"* (emphasis added, Exhibit 67, p. 32).

Faulting

- HLI describing potential hydrologic significance of shallow faults:
 - “Major faulting that formed the western Snake Plain generally does not significantly cut or offset the younger sedimentary units (shallower than 1,000 ft) in the basin on the north side of the plain...Figure 2 shows in detail the nature of faults in the basin” (Exhibit 45, p. 9).

EXHIBIT 45

Figure 2. Subsurface Seismic Reflection Profiles: (from Wood)

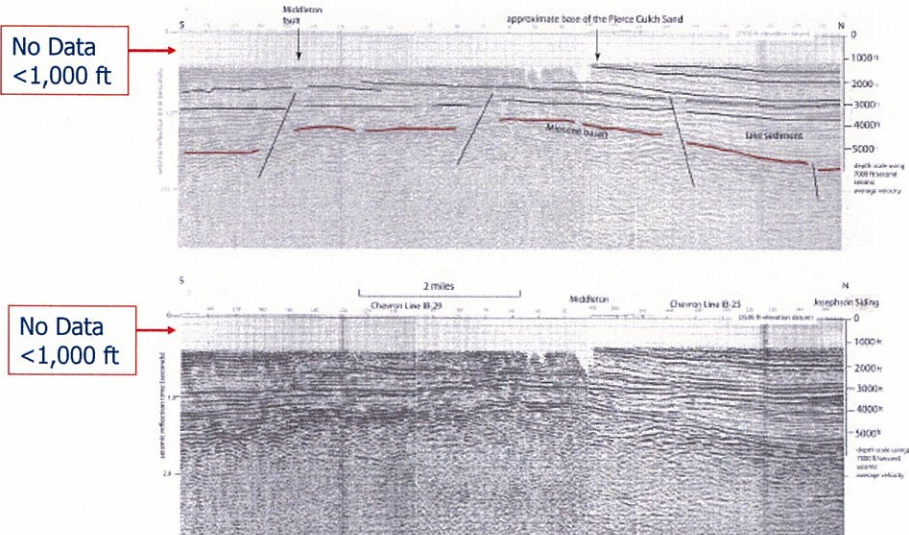


Figure 3. Interpretation of a north-south seismic reflection line through Midknox Hilltop to Josephine Siding. Seismic section shows the deep basin north of Midknox that likely extends to the Eagle area. Faulting does not extend to the level of the upper sedimentary section where the Pierce Cukh Sand regional aquifer is situated. Location of seismic line shown on Figure 1 of this report.

Faulting

- TVHP report describing potential hydrologic significance of faults:
 - *"In addition to complexity inherent in deposition and erosion, a series of major faults bisect the stratigraphic section along the northern basin margin. The hydrologic impact of these faults is poorly understood, but they are likely to be an important influence on ground water flow in the Boise-area aquifers"* (Staff Memo at 6, Exhibit 33G, p. 2)

Faulting

- Staff's perspective:
 - 1. A fault was identified on M3 property
 - 2. The fault package of computer program was used to analyze aquifer test data
 - 3. HLI decided to not address faulting in their last submittal:
 - *"The influence of structural basin-margin faulting, which is known to exist in the general vicinity, is not addressed here."* (Exhibit 44, p. 8).

Significance of Flow Direction

- HLI on the importance of flow direction:
 - *"The ground water proposed to be withdrawn by M3 Eagle for its development will be from subsurface flow that has already departed the Boise Basin, on its way to the Payette Basin, so that impacts to existing area water users in the lowlands near Eagle are predicted to be so small as to be insignificant." (Exhibit 2, p. 1).*

Significance of Flow Direction

- HLI on the importance of flow direction (cont'd):
 - *"PGSA groundwater in the M3 Eagle vicinity is tributary in large part to the Payette River, we do not anticipate measurable impact to the Boise River in the reaches downgradient from the Eagle site." (Response, Exhibit 45, p. 40)*

Residence Time Issue

- HLI on the source of water in transmissive and "strongly recharged" aquifer:
 - Water chemistry *"indicates that the PGSA groundwater originated almost exclusively from ancestral Boise River surface water"* (Exhibit 43, p. 4)
 - *"geochemistry analytical results indicate that the PGSA is a distinct regional aquifer containing ground water originating from the geologically ancestral Boise River"* (Exhibit 43, p. 5)
 - *"From this model, they estimated the PGSA groundwater from the Goddard No. 2 and HP wells to be about 2,960 years old. These sealed production wells are located about one mile south of the Boise River and have been pumped for at least a decade, so the estimated age should be accurate"* (Exhibit 45, p. 27)

Aquifer Testing

- HLI on aquifer test length:
 - *"generally speaking, the longer the test the better"* (Exhibit 69, p. 6)
 - *"It is a common misconception that 'the longer the test the better'"* (Exhibit 45, p. 23).

Criticisms of Staff's Review:

- Incorrect
- Inaccurate
- Speculative
- Misleading
- Inappropriate
- Deeply flawed
- No scientific basis
- Unintentional bias and significant errors
- cursory/incomplete
- Failed to address uncertainty

Closing Thoughts

- Many high quality data and analyses in support of application
- M3's efforts are appreciated
- Review of supporting info made difficult by:
 - Timing
 - Volume
 - Inconsistencies
- Staff stands by recommendation for high rate, long-term aquifer test