

# Hydro Logic, Inc.

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Mr. John Westra, P.E.  
Western Regional Manager  
Idaho Department of Water Resources  
2735 Airport Way  
Boise, Idaho 83705

Re: Draft M3 Eagle Test/Production Wells and Aquifer Test Prospectus

Dear Mr. Westra:

Thank you for your time in meeting with me concerning the proposed M3 Eagle planned community in the North Eagle Foothills. As we discussed, M3 Eagle is seeking permission to site, drill, construct, develop, and hydraulically test up to two deep "test / production" wells in advance of an approved water right permit. The purpose for the well(s) is to design and carry out a regional-scale, long-term aquifer test (days-to-weeks) at a meaningfully high discharge rate in order to continue M3 Eagle's hydrogeologic characterization of the Pierce Gulch Sand Aquifer and to confirm Hydro Logic, Inc.'s conclusions with respect to ground water development potential beneath the M3 Eagle property. The results from the testing would be presented in support of M3 Eagle's pending municipal "future needs" water right application at IDWR and to add to the body of scientific hydrogeologic knowledge in the North Ada County area. A second goal is to provide meaningful information to the IDWR for its future administration of all water resources in Northern Ada County. In our recent meeting, you requested an outline "prospectus" of M3 Eagle's proposed well drilling and aquifer testing plan for consideration by IDWR. To that end, I have prepared the following outline-style proposed order of events. This is in not intended to be our formal proposal to IDWR, which will be more comprehensive and detailed but, rather, the following outline is the bullet-point draft synopsis requested by you for preliminary discussion at IDWR.

Provided the general concepts are acceptable to IDWR, we will develop the prospectus and include it in a "package" submittal to the Department which would include maps, drilling permit applications, bonding, etc.

**1) PROJECT LOCATION:**

- a. The proposed exploratory and water supply wells, one of which will be the pumping well for the aquifer test, will all be located in Big Gulch approximately two miles NW of Highway 16.
- b. In general, the location is in T5 N, R 1W, Section 27.

**2) EXPLORATORY TEST WELL DRILLING:**

- a. Two, direct mud-rotary exploratory bores would be drilled in the south west portion of the M3 Eagle property in Big Gulch.



- b. The exploratory wells will be drilled to the base of the Pierce Gulch Sand Aquifer to a depth of approximately 500 feet below land surface.
- c. Representative samples of the drilled geologic section will be obtained from quality-controlled sampling by a trained geologist during drilling.
- d. A lithologic log of the drilled section will be developed and presented as a cross-sectional sketch.
- e. A water resources-suite of borehole geophysical logs will be run in the mud-filled bore and correlated to the drill-cuttings.
- f. Natural gamma-ray, single point resistance, normal resistivity, caliper, and fluid temperature would constitute the minimum suite of logs.
- g. Based on the results of the test borings, one or both of the test bores would be reamed to a larger diameter and a supply well constructed.
- h. If only one production well is drilled, the other test well would either be turned into a monitoring well or it would be properly abandoned.

**3) LOCATION OF THE PUMPING WELL:**

- a. The location of the pumping well would be selected based on the following criteria:
  - i. Position in the central "corridor" of the Pierce Sand Aquifer across the M3 Eagle property.
  - ii. Proximal to future proposed uses and the initial phases of the proposed community.
  - iii. Central to the existing observation well network and the highest density of domestic wells near the site.
  - iv. In a location close enough to the Terteling Springs Aquifer (also known locally as the Willow Creek Aquifer) to be able to test theories on hydraulic disconnection between the two aquifers.
  - v. Good access for drilling and pump-testing rigs.

**4) SUPPLY WELL DRILLING, CONSTRUCTION, AND DEVELOPMENT:**

- a. All M3 Eagle water supply wells will be constructed to high standards and shall exceed the minimum standards of IDWR's Well Drilling Rules and the administrative rules for Public Drinking Water System Wells of the IDEQ.
- b. The supply well(s) will be drilled using direct mud-rotary techniques and constructed with full-depth (from land surface to the top of the Pierce Gulch Sand Aquifer) annular seals of high-solids bentonite grout (lower portion) and cement grout (vadose zone).

- c. The well will be fully penetrating within the aquifer and completed using continuous wire-wound well screen for maximum efficiency and well development.
- d. The well(s) will be thoroughly developed using several techniques to remove residual drilling fluids, to restore damage to the aquifer from drilling, and to maximize permeability within the sands and artificial sand filter in close proximity of the well screens.
- e. Part of the development process will be to pump the well at discharge rates above the sustainable yield of the well to ensure the minimum of continuing development during testing due to pumping.
- f. M3 Eagle would secure bonding in favor of the Department in an amount sufficient to cover proper abandonment of the completed wells. In addition to the bonds, Hydro Logic, Inc. would submit a proposed abandonment plan for each well drilled along with a contractor's estimate to carry out the abandonment. The bonding would remain in effect until final approval of the water right for the wells.

**5) AQUIFER TEST DISCHARGE RATE:**

- a. Prior to aquifer testing, the well(s) will be hydraulically tested with a constant-rate discharge test and a stepped-discharge test for purposes of determining the maximum sustainable yield for the test and to evaluate well efficiency (frictional well losses) for later analysis.
- b. The well will be fitted with a test pump capable of pumping the maximum sustainable yield from the well(s).
- c. It is anticipated that the pumping well(s) will be capable of at least 1,000 gpm but a higher discharge rate will be used if possible; to 2,000 gpm.
- d. In general, the well will be pumped at the highest discharge rate possible.

**6) DISCHARGE CONSIDERATIONS:**

- a. Owing to the location of the well site, remote from any developed utilities and infrastructure, there are no existing pipelines, storm drains, canals, or ditches available to transport the pumped water away from the pumped well.
- b. Piping of the pumped water, to avoid the possibility of eventual downward return flow to the aquifer, is not economically feasible because over two miles of pipe (or hose) would be required.
- c. Analysis of available drilling data, suggests that significant thicknesses of low-permeability sediments, and unsaturated zone, do exist between land surface and the top of the production aquifer.

- d. The concern over this relates to the fact that we expect the expanding cone of depression from the pumping well to encounter unconfined conditions along the upper (easterly) edge of the Pierce Gulch Sand Aquifer. Were this to happen, we would expect the rate of drawdown in the well to lessen or even stop. What we want to avoid is any confusion over whether such an attenuation in the drawdown could be caused by our own recharge to the aquifer by the discharged water leaking vertically back to the aquifer (a loop).
- e. Our current plan will be to simply discharge to the natural drainage in Big Gulch and allow the discharged water to drain away from the site. The existing evidence for low-permeability strata beneath the site can be confirmed by the two exploratory test wells to be drilled.

7) **OBSERVATION WELLS:**

- a. M3 Eagle has had three multi-level piezometer nests/ observation wells drilled and constructed on the property and all zones in these facilities would be equipped with digital pressure transducers and data-loggers.
- b. Spring Valley Ranch drilled and completed a series of three eight inch wells in Big Gulch and Little Gulch that will be similarly equipped.
- c. Four existing stock-watering wells have been inspected and tested by Hydro Logic, Inc. in Big Gulch and Little Gulch and these wells will be used as monitoring wells.
- d. It is anticipated that at least two single family domestic wells will be measured during the test. There are very few domestic wells in the vicinity of the test and we have good quality, sealed test wells of known construction nearby to the largest density of domestic wells. Our professional conviction is that domestic wells make very poor monitoring wells in most cases because of the uncertain (or unknown) details of well construction and, typically, the need of the homeowner to use of the wells during testing. Another large factor is the liability of getting sounding tapes lodged in the submersible power cables and pump columns of these small diameter wells. However, to the southeast of the pumping well, there are no designated monitoring wells. In this area, and within a mile of the pumping well, are about a half dozen domestic wells. We will make every effort to gain access to one or two of those wells and, if they can be not used during the test period, we would arrange to install water level instrumentation and/or to take hand measurements during the test.
- e. Two deep 8-inch diameter wells in Upper Big Gulch, completed into the saturated sands of the Terteling Springs Formation, will also be equipped with continuous monitoring equipment to test our concept of a hydraulic disconnection between those two aquifers.

**8) PUBLIC INVOLVEMENT:**

- a. As with M3 Eagle's hydrogeologic characterization studies to date, and its water rights applications, M3 Eagle intends to be very open about the proposed testing and would welcome the input and cooperation of any interested party.
- b. Water levels may be measured in domestic wells provided the wells are not in use during the testing and subject the well owner signing an access agreement and waiver of liability for any incurred damages.
- c. All acquired data will be made available on M3's web-site and posted to the IDWR's North Ada County web site.
- d. Just as with all of M3 Eagles scientific studies to date, public presentations of the test results will be scheduled and conducted. An overview of the aquifer test and drilling projects will be presented to IDWR's North Ada County Technical Advisory Committee.

**9) INVOLVEMENT / NOTIFICATION OF OTHER LARGE WATER USERS:**

- a. The City of Eagle, City of Star, United Water Idaho, Eagle Water Co., and others large water users wells are all at significant distances from the proposed pumping well (miles).
- b. Because direct interference effects from these water users' wells are not evidenced in M3 Eagle's water level monitoring network, it is considered unlikely that the proposed aquifer test will cause interference to those water user's wells.
- c. These water users will be advised of the test results and M3 Eagle will continue to give presentations to these entities.

**10) INVOLVEMENT WITH IDWR:**

- a. Applications for drilling permits for the proposed well construction(s) will go through the normal channels at IDWR's Western Regional office.
- b. A detailed prospectus of the planned aquifer test will be presented to IDWR for comment and acceptance prior to the testing.
- c. IDWR will be encouraged to cooperate in the testing and will be invited and welcome to observe any and all parts of the test.
- d. IDWR will be informed in advance of the proposed testing so that Department personnel may measure additional wells not planned for measurement by Hydro Logic, Inc.
- e. All data and reports resulting from the testing will be posted to the IDWR web-site for North Ada County Studies.

**11) TEST DURATION:**

- a. Until the new well(s) are completed and pump-tested, it is premature to anticipate the test duration. It is our opinion, after having completed re-analysis of sixteen area "aquifer tests" that 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. Test design, controlled pumping rates, and accurate measurements are the first priority for meaningful testing. Provided the test has a high level of quality control, and generally speaking, the longer the test the better.
- b. Based on our understanding of the aquifer, we anticipate that a 10-day drawdown test would most likely be adequate for our purposes. Measurement of pre-test antecedent water level trends and water level recovery would cause this exercise to be a month in duration; an expensive exercise to say the least.
- c. The duration of the aquifer test is best decided upon based upon the drawdown information as the test progresses. Therefore, it is our conviction that a pre-conceived notion of test duration is not an informed way to approach scientific study.
- d. For example, the recent City of Eagle 7-day pumping test could have been curtailed to 48 hours based on the wells monitored and the observations of the drawdown affects. In other words, pumping of that well longer than 48 hours did not yield useful results.
- e. M3 Eagle does not want to get itself in a situation where it has promised a test of a certain duration and the expense of the test pumping is not yielding meaningful results for the large amount of money spent.
- f. Similarly, if a motor malfunction were to happen 5 days into the test, we would not want to re-start the test. Instead we would want to measure recovery. With the large number of observation wells available in the test area, we are not anticipating that it will take more than three or four days for the cone of depression to impact the other wells; a situation that will allow projections and modeling of longer pumping periods using standard methods.
- g. We plan a 10-day test. Anything less than five days (before an unforeseen problem) would likely be repeated.

**12) TEST SEASON:**

- a. We are of the opinion that the winter months are the best time to conduct this aquifer test.

- b. The number of pumping wells in the Valley areas will be significantly less during winter and the frozen ground will afford good access in what can be axle-deep mud in this undeveloped area during rainy warmer periods.
- c. The aquifer pressures should be in a recovering (increasing) mode so that any pre-test trends are constant and can readily be measured and quantified to be able to subtract the trend from the test data. In other words, the aquifer pressures will not be fluctuating (declining in one part of the test and increasing in another part).
- d. By the time the exploratory wells are drilled and a water supply well can be drilled, constructed, developed, and tested, it will easily be January.
- e. Therefore, the testing will likely take place in January-to February time frame.

**13) TEST PROTOCOL AND MEASUREMENT:**

- a. All measurements will be taken using calibrated, new, or near new electric water level sounders and/or steel water level measurement tapes.
- b. All significant observation wells and the pumping well will be equipped with designated monitoring tubes, and digital pressure transducers / data loggers set at one minute intervals and calibrated to hand-measured values. The digital monitoring equipment will be properly selected for the most accurate pressure range in the well to be measured. In other words, a 300-foot range pressure transducer would be used in the pumping well but a 15-foot range transducer would be used in a distant observation well to ensure accurate monitoring of small draw down effects at distance.
- c. All data loggers will be corrected for barometric effects by having two, on-site recording barometers set to the same monitoring interval as the water level instruments.
- d. Pre-test water levels will be monitored in all wells to determine barometric efficiency and any antecedent water level trends that would need to be subtracted from the data.
- e. Digital data, while extremely important, shall, not be solely relied upon for the test results. Rather, every attempt will be made to obtain manual readings, on an around the clock basis, to ensure high-quality measurements are available for analysis whether the digital data acquisition program obtains useable data or not (and to confirm/calibrate the digital data).
- f. Pumping water level measurements in the pumping well shall be hand-measured on a one-minute basis during the first hour of the test, every five minutes for the next two hours, 10-minutes for the next two hours, and every thirty minutes for the next two hours, and every hour there after up to 24 hours after the commencement of pumping. After the first 24 hours of pumping, the pumping

well will be measured 6 times daily for the second 24-hours of the test, three times per day for the second and third days of the test, and twice daily for the remainder of the aquifer test unless some apparent trend or water level change in the pumping or observation well water levels would indicate that more frequent measurements are warranted. Pumping well measurements will be made hourly for the entire test because of the necessity to have on-site personnel at the well. Some of these measurements will likely be made by the pump contractor after training and observed measurements by Hydro Logic, Inc.

- g. Each significant observation well will have a designated water level measurement tape and all well tapes shall be calibrated to each other prior to the test in the event that a malfunction occurs that requires that a given well be measured with a different tape.
- h. Draw down interference effects are expected to be small away from the pumping well. The observed effects of earth tides, and fluctuations in atmospheric pressure, have been shown to be present in the subject wells to an extent that these fluctuations may overpower draw down effects of only a few tenths of a foot. Therefore, it is critically important that precision meticulous measurements must be obtained on short time intervals throughout the test.
- i. Water level recovery data will be measured for at least the length of the aquifer test draw down period.

**1.4) DOCUMENTATION AND FINAL REPORT:**

- a. A comprehensive analysis and data synthesis of the pre-test water level trends, draw down test, and recovery measurements will be completed by Hydro Logic, Inc. following the conclusion of the test.
- b. A comprehensive report will be developed that details any data corrections for barometric efficiency, antecedent trends, and or earth tide effects. The report will include hydrographs for the pumping and observation wells and a description of the analytical models used and why those models were used.
- c. The aquifer coefficients of Transmissivity and Storativity will be calculated and the aquifer parameter of barometric efficiency will be derived for all observation wells.
- d. Estimations of regional aquifer pressure declines in response to the proposed M3 Eagle well field will be modeled including an analysis of potential impacts to existing wells.
- e. The final report, including our conclusions and recommendations, will be made available as part of the public record at IDWR.

- f. All raw digital and manual data will be made available to the IDWR and or any interested parties.

**15) GROUND WATER GEOCHEMISTRY SAMPLING:**

- a. After several days of pumping, water samples will be taken for a complete analysis of inorganic constituents and required analytes of the USEPA and IDEQ for Public Drinking Water Systems.

**16) PEER REVIEW:**

- a. We intend to seek an independent review of our analysis and report from the Hydrology Section of the IDWR and also by hydrogeologists with the University of Idaho and Boise State University.

**17) NOISE, INCONVENIENCE, AND SECURITY DURING THE TESTING:**

- a. No electrical service of any kind is available at the proposed site.
- b. The proposed site for the pumping well is remote from private residences and in a deep gulch such that no inconvenience to neighbors would be expected from the noise of the diesel-powered drive engine for the test; even at night.
- c. Similarly, the observation wells are all within undeveloped lands separated from the City of Eagle by a ridge of BLM lands so that night time measurements, headlights, etc should not be a nuisance.
- d. The M3 Eagle property is fenced with locked gates that will be kept closed during all testing such that any workers entering or leaving the project will open and lock each gate with each trip.

**18) SAFETY:**

- a. Safety protocols will be required for all on-site personnel and visitors.
- b. Ear protection will be required around the pumping well.

Thank you for your consideration of this prospectus. Please call with any questions you or your staff may have.

Respectfully,

Ed Squires

