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LANDSCAPE ARCHITECTURE, GIS
NATURAL RESOURCE SERVICES

February 26, 2024 Delivery via email

Teton County Idaho
Jade Krueger
Planning Administrator
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Harmony Design & Engineering
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Ted Van Holland, PE
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RE: Response to Remaining Comment on Hydraulic Gradient for Irish Acres Subdivision Level I Nutrient-Pathogen Evaluation

Dear Ms. Krueger, Ms. Zung, and Mr. Van Holland,

This letter is a follow up per our discussion on February 15, 2024. In that meeting, we left with one item needing further investigation for use in the mass-balance spreadsheets for the Level I study for Irish Acres. That item is the hydraulic gradient of the shallow aquifer of the site.

The final report: Ground-Water Model for the Upper Teton Watershed by Nicklin Earth & Water, Inc. dated March of 2003 has been provided as a reference by Harmony Engineering for this parameter. This is an excellent study of the groundwater system for the entire Upper Teton Watershed. However, this study was not designed to provide site specific data for NP Evaluations. We feel that it is appropriate to use this document as a general guideline for the direction of groundwater flow as well as the general magnitude of the slope of the groundwater surface. However, groundwater models, especially of the size of this one, can only be calibrated and expected to operate within an order of magnitude of accuracy.

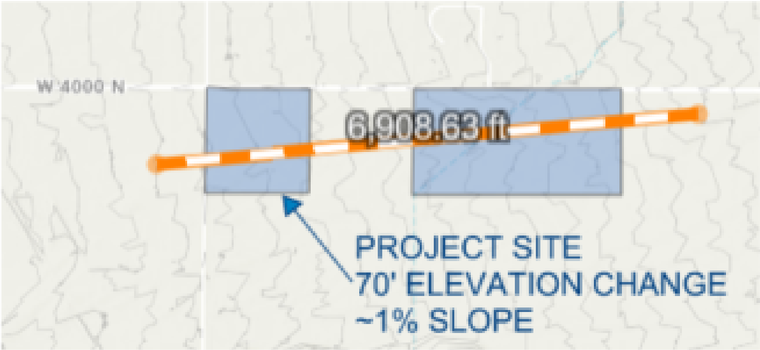
Taking this into account and our conversation on February 15th, we have taken the groundwater levels that were used in the report to set up a general area for study. We created a potentiometric map of the groundwater in the subdivision area. This map was to go as far west as the Teton River to see how groundwater levels are trending in that direction. Water levels were utilized from the Idaho Department of Water Resources (IDWR) well database.

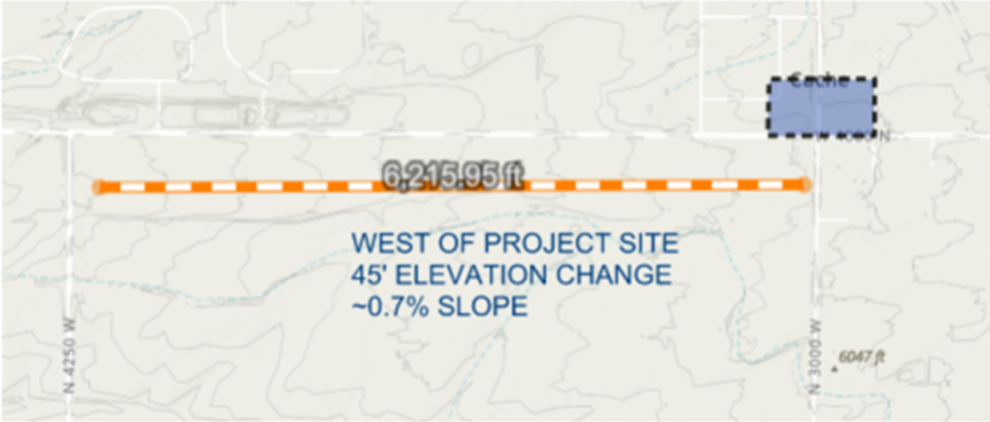
It is recognized that this data source has its limitations. As Mr. Van Holland pointed out in our meeting, drillers do not log static water level data with the purpose of using that data for future groundwater modeling efforts in mind. Also, these wells are drilled at different times of the year, throughout different years. Finally, the NP Evaluation is assessing impacts on the shallow aquifer because this is where degradation to groundwater would first occur. Many of the wells are focused on deeper aquifer units so the well reliably productive over a long period of time and not subject to the variability that can be seen in a very shallow aquifer.

To help balance these imperfections of the data, parameters for well selection were limited to try and help with a more uniform and reasonable potentiometric surface that has additional detail over what as in the Nicklin report:

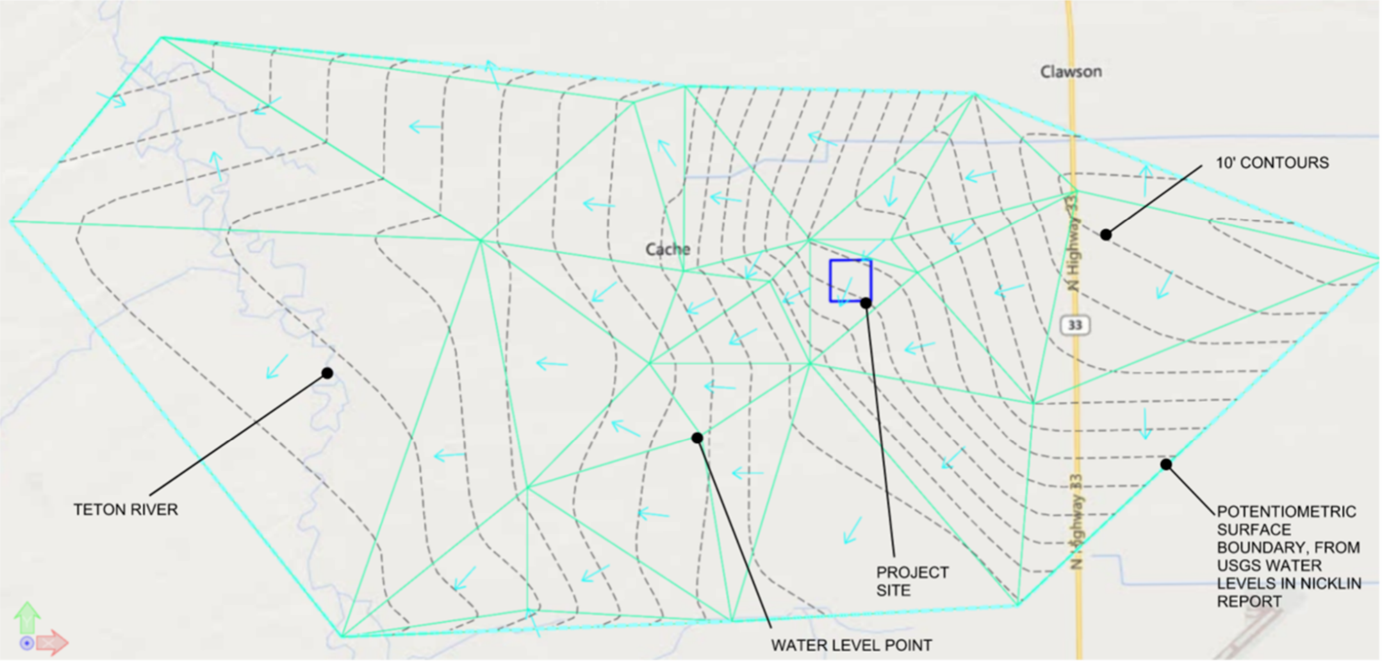
1. Like the Nicklin report, wells drilled prior to 1990 were not used.
2. IDWR has a lot of data and wells in the project vicinity. Many of the newer wells are within subdivisions. Well parameters had patterns in these subdivisions that led to water level mapping that was based on several data points (instead of one) and an average of those water levels were used in the potentiometric map.
3. In areas with groups of wells, there would be some with shallow groundwater levels (30 feet below ground surface or less), and those that were relatively deep (over 60 feet deep). Since the shallow aquifer is of interest, shallower groundwater levels were utilized. This keeps in line with the 15-foot mixing zone thickness in the mass balance spreadsheet and is more conservative.

It was found in this exercise that shallow groundwater levels very closely parallel the slope of the ground surface. This is to be expected and the topographic slope was used in the first iteration of the study. The shallow groundwater levels range from 10 to 20 feet below ground surface (bgs) in most areas. When a groundwater well is located adjacent to a surface water feature, the water level dropped below 10 feet to as shallow as 4 feet bgs. The following images from the Teton County GIS system with contours and measurements show the change in ground slope as we proceed west of the site toward the Teton River. At the project site the topographic slope is approximately 1%, which has been confirmed by our onsite survey. As we proceed about a mile west, the slope decreases to about 0.7%. The groundwater surface followed this same general trend but is sloping a little less steep than the ground and continues to get less steep the closer and closer we get to the River. One USGS well elevation was kept on the map from the Nicklin report, which is west of the river, and it shows that the groundwater slope likely changes direction at the River.





The results from the potentiometric mapping are shown below. Individual well points around the project site result in slopes varying from 0.8% to just shy of 2.0%. Averaging these slopes up and down gradient of the site result in a hydraulic gradient of 0.9%.



Y2 proposes to use a groundwater slope of 0.9% for the mass-balance spreadsheets. This results in a rise of 1.0 mg/L or less for lots and combinations of lots previously submitted in the study. If Harmony determines that this potentiometric mapping is insufficient, then it is recommended that the septic systems in the subdivision be designed with an Advantex wastewater system or some equivalent secondary standards treatment system.

I would also like to note that during the meeting, Ms. Krueger mentioned that Y2 had failed to submit a work plan prior to the submittal of the NP Evaluation. This was not something that was intentionally neglected. Prior to conducting the NP Evaluation, we had correspondence in the form of meetings, emails, and phone calls with IDEQ and EIPHD to get an understanding of the requirements. We also contacted Teton County Planning when the first iteration of the NP Evaluation was completed in September of 2022 to see if it could be reviewed before other documents were completed and we were informed that all of the subdivision documents had to be turned in at once. This is not to blame anyone, and our confusion about the process at the time was part of it, but we in no way tried to circumvent this step or any other part of the subdivision process.

Thank you for your time on this project.

Sincerely,

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December 29, 2023 Delivery via email

Teton County Idaho
Jade Krueger
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RE: Response to 2nd Review of Irish Acres Subdivision Level I Nutrient-Pathogen Evaluation

Dear Ms. Krueger,

Thank you for your review of the Irish Acres Subdivision Level I Nutrient-Pathogen Evaluation.

We would like to note that the initial response to comments was submitted September 25, 2023. Idaho Department of Environmental Quality (IDEQ) responded to the updated Nutrient Pathogen Evaluation on September 27, 2023, concurring with the findings of the report. It seems very strange that there are two separate entities (one a regulatory agency and the other a consultant) reviewing these reports in parallel with different conclusions. Also, three months for a review of a response to comments is a very long time. It is very difficult and time consuming for the client to have these multiple reviews on varying time lines like this, especially when we were under the impression that the Nutrient Pathogen Evaluation was approved.

The comments from Harmony Design and Engineering have been reiterated below for clarification with responses below the comments. Those items which said that the previous comments were addressed were not included in this response.

1. *Compliance Boundaries*:
   Compliance boundaries in the evaluation have been expanded to include relevant combinations of proposed subdivision lots, consistent with DEQ guidance. The corresponding Level 1 spreadsheet model results are reported in Table 3 or the evaluation report. The table indicates that while several of the compliance boundaries considered are predicted to have an insignificant impact on nitrate concentrations, three of the compliance boundaries considered will have greater than 1 mg/l increase in modeled nitrate. An increase of greater than 1 mg/l of nitrate is considered to be a significant impact and a degradation to ambient groundwater quality by DEQ.

   Response – This comment is not understood. In the updated NP Evaluation submitted in September 2023, Table 3 did not indicate any lot or combination thereof that contributed to an increase in nitrate of 1.0 mg/L or more. Lots 1, 2, 7 and 4, 2, 8 predicted a downgradient concentration of 4.2, which was the highest predicted concentrations. The upgradient concentration is 3.4. So this was an increase of 0.8 mg/L. Also, please see the response to

comment 2. Updates to the potentiometric surface show that the maximum increase in nitrate is 0.6 mg/L, which is significantly less than the IDEQ threshold. Maybe the confusion was that the "Yes" in the third column of the table was missing in the previous report iteration. This has been corrected.

2. *Modeled Hydraulic Gradient Inconsistent with References*:

   The revised report utilizes the mapping from Kilburn (1964) to determine hydraulic gradient. However, it appears that a mistake has been made in interpreting the mapped groundwater elevation contours. Where the Kilburn map shows 10-foot interval contours, the report identifies that as 50-foot contours. The resulting hydraulic gradient magnitude is therefore believed in this review to be erroneous, creating a significant error in all modeled results. If this error were corrected to the 0.006 ft/ft gradient that the mapping indicates, most of the modeled results would increase the predicted nitrate impacts to be above the 1 mg/l significant impact threshold.

   Response – It is true that the mapping from Kilburn (1964) has varying contours across the figure. It was misinterpreted that the contours to the west of the subdivision were 50 foot and the contours to the east were 25-foot contours. As the reviewer states, the mapped contours in the subdivision area are only 10 feet.

   It appears that more site-specific data is appropriate for this parameter, since the mass balance spreadsheets are so sensitive to the slope. It does not seem correct that the groundwater surface slope would be so much flatter than the ground surface for an unconfined aquifer. Aerial imagery would indicate groundwater ponding to the west if that were the case.

   In order to see if the 0.006 ft/ft slope were reasonable, nearby drilling logs, that were already gathered for the report, were reviewed for depth to water levels. Nearby wells did have static water level data that could be utilized. This subdivision as well as one just to the east have had extensive topographic surveys completed. This topography, as well as the general slope trends from local USGS mapping were used to estimate the elevation of the ground surface and groundwater and create a potentiometric surface. This mapped surface has a slope of 1.5% from the northeast to the southwest and is shown in Figure 9 of the updated report.

   The mass balance spreadsheets were updated with this potentiometric surface slope. Also, the direction of groundwater flow was adjusted to match this mapped surface, which led to wider aquifer widths perpendicular to flow. Therefore, the nitrate concentrations are modeled to be lower than the previous iterations of this report.

This is the third iteration of this report. Comments on the report and subsequent adjustments have all led to the same conclusion that the proposed subdivision will not significantly increase nitrate concentrations in the shallow groundwater. IDEQ has concurred with the findings of the report. If Harmony still has issues with anything in the report, we request that we have a discussion as opposed to a several month-long review process that will delay this subdivision application further.

Sincerely,

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Enclosures: Updated Nutrient Pathogen Evaluation

September 22, 2023 Delivery via email

Teton County Idaho
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RE: Response to Review of Irish Acres Subdivision Level I Nutrient-Pathogen Evaluation

Dear Ms. Krueger,

Thank you for your review of the Irish Acres Subdivision Level I Nutrient-Pathogen Evaluation. Your comments have been reiterated below for clarification with responses below the comments.

Harmony Design and Engineering

1. *Compliance Boundaries*: The evaluation considered several potential compliance boundaries, including the subdivision in its entirety, and also each lot individually. The analyses do not examine the effects of certain combinations of adjacent lots aligned with the modeled gradient. An example would be a grouping of Lots 7, 2 and 1 as a unit, and apply the corresponding unit parameters in the spreadsheet model.

   Response – As requested, combinations of adjacent lots aligned with the modeled gradient have been evaluated and included in the updated report. Those lot combinations include:
   - **Lots 1, 2 and 7 (as suggested)**
   - **Lots 4, 3 and 8**
   - **Lots 5, 6, 9, and 10**

2. *Design Flow*: The subdivision proposed 10 lots and 10 homes were included in the evaluation. Each home was assigned the 300 gallon-per-day default parameter value of the model spreadsheet. This equates to a 4-bedroom house. The NP evaluation does not consider a guest house or greater bedroom count, or why the presumed 4-bedrooms per lot is representative of anticipated future development. If guest houses are expected and allowed, or the number of bedrooms anticipated may be greater than 4, there should be discussion of how that would affect the evaluation conclusions.

   Response – Each lot will be allowed to have a home and an accessory dwelling unit. Based on the zoning regulations, 4 bedrooms was used anticipating a 3 bedroom home and the possibility of an accessory dwelling unit.

3. *Hydraulic Conductivity Estimate Above Reference Range*: The hydraulic conductivity used in all model simulations is 100 ft/day. Selection of this hydraulic conductivity value is not well supported. The author describes the 100ft/day value "conservative" for this use, noting that it is on the lower end of typical values for sand and gravel aquifers. The drilling logs cited and provided in the appendix make frequent mention of significant clay, which can greatly retard flow in porous media. There are several logs that have included pumping test data that could be used to infer a more supported hydraulic conductivity value. Evaluating this kind of existing data seems consistent with the Level I Nutrient-Pathogen criteria. Many of these rudimentary tests report production of 1 gallon per minute flow per foot of drawdown. While they lack rigorous description of methods or results, they should at least be compared with the assumed conductivity rate selected. The two best published estimates of conductivity covering this vicinity are from Nicklin (2003) and Cosgrove and Taylor (2007). Both of these assign values close to 25 ft/day for this location.

   Response – Hydraulic conductivity varies widely, even for a homogenous soil type. The hydraulic conductivity was primarily based on the type of soil encountered in the test pits. This is the most accurate information on the local soil on site, in the area of wastewater disposal. The soils in the test pits were described as fine to coarse sands with gravel. There was very little indication of fines, which results in a soil classification of a Poorly Graded Sand (SP) from this information.

   In reviewing general soil literature regarding hydraulic conductivity, it varies over four orders of magnitude. According to online resources, they assign a range from 7 to over 150 feet per day. Per McCarthy (2007) a clean sand/sand and gravel mixtures have a conductivity ranging from 28 to over 2800 feet per day. Per Lindeburg (2008) it lists poorly graded sands as having a conductivity >17 feet per day. According to the Idaho DEQ mass balance spreadsheet, well-sorted sands and glacial outwash have a conductivity of 3 to 300 feet per day, while well sorted gravels have 30 to 3000 feet per day values. So the total range of conductivities for the type of observed soil on site essentially has a range from 3 to 3000 feet per day. Looking at this range, 100 feet per day is more on the conservative side of this range. However, if it's 25, 100, or 1000 feet per day, it is really a case of professional judgement.

   In reviewing the drilling logs within ¼ mile of the proposed subdivision there is a general description of sand and gravel in some wells. The clays, gravels and sands are described in others. It appears that some areas have observed clay and others do not. Also, methods of determining clay in the field varies. I personally have worked on several geotechnical reports where the field logger mentions clay many times. However, after soil samples are analyzed, there is often no significant clay in the soil at all. Silts and really fine sands that clump due to moisture can often be mistaken for clay in field observations. Without proper sieve analysis and Atterburg limits tested, what was observed as a clay in the field may or may not be that in reality. The test pits showed no indication of clay and little to no fines, which is consistent with soil descriptions in well logs for 702556 and 701985. Also, since the test pits displayed a more coarse soil, areas with clay would not slow water flow (or the apparent hydraulic conductivity) down. Water would pool over the clay layers and flow around them, following the path of least resistance. Lenses of clay reduce hydraulic conductivity in pumping tests since it averages out the conductivity ranges in the tested vertical zone.

   Three pump tests were found in the logs within ¼ mile of the project boundaries. The permit numbers for these wells are 702846, 702556 and 702847. Using the attached simplified hydraulic conductivity estimation

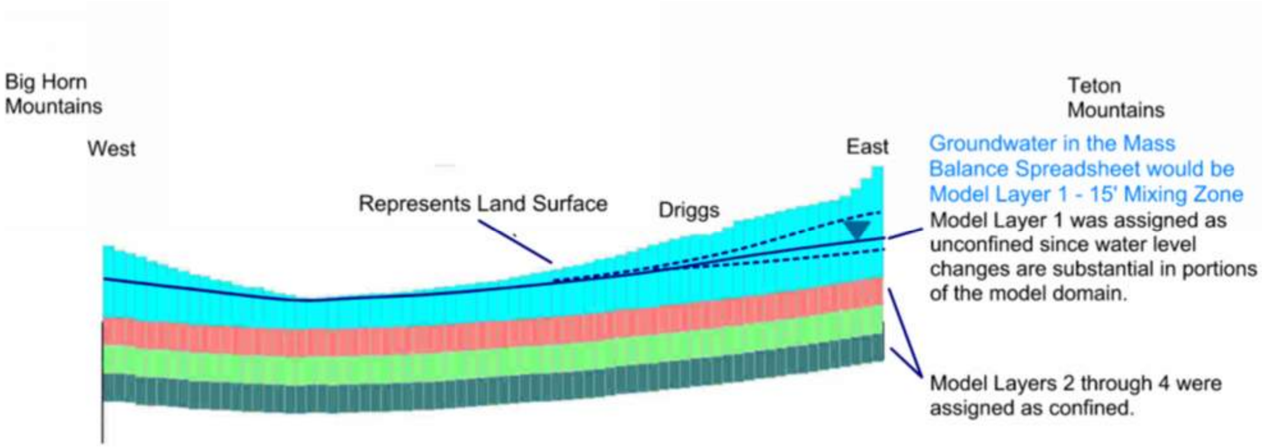
from Montana DEQ resulted in a range of hydraulic conductivities from 12 to 23 feet per day. As stated in the comment, the testing methods and results are not well documented. Also, the depth of pumping in these wells is much deeper than the mixing zone in the Nutrient Pathogen spreadsheet. There appear to be multiple layers in which hydraulic conductivity varies vertically. This is discussed further below in the review of the Nicklin report.

The suggested reports were obtained and reviewed in order to respond to this comment. In the Nicklin (2003) report, final calibrated model parameters shown in Figure 31, range from 14 to 925 ft/day. Figure 19 shows two hydraulic conductivity estimates to the southeast of Tetonia, in the project location. There is one in the range of 30 to 70 feet per day and another adjacent to it that is over 150 feet per day. Figure 30 shows a model range for clean sand hydraulic conductivity from 10 to 1000 feet per day. The 25 ft/day conductivity in the comment pertains to Model layers 2 through 4 in the report. Those layers are the deeper, confined aquifers. The shallow aquifer is of concern for this Nutrient Pathogen Evaluation and consistent with the 15-foot mixing zone in the spreadsheet. The Model Layer 1 conductivity for the project site is right in the transitional area where conductivity was assigned 80 and 150 feet per day.

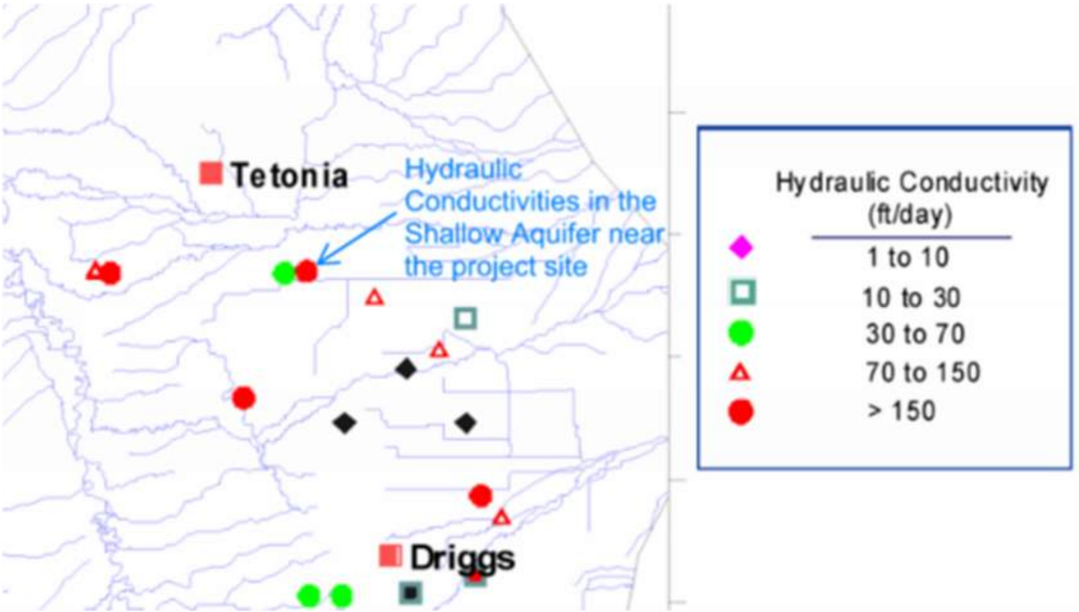
The wells with pumping data with the estimated range of hydraulic conductivities of 7 to 23 feet per day corelate with the Nicklin report and assigned model layer hydraulic conductivities. Those deeper model layers were also associated with confined aquifers. Many of the well logs show a higher stable water level than the initial water level noted in the log.

The Cosgrove and Taylor (2007) report assigned somewhere between 1 and 50 feet per day. This was used from a prior groundwater model. However, it appears that the study recommends a higher recharge rate than what was used in the Irish Acres Subdivision Nutrient Pathogen Evaluation. There is not a lot of background as to what site-specific information was used for this determination.

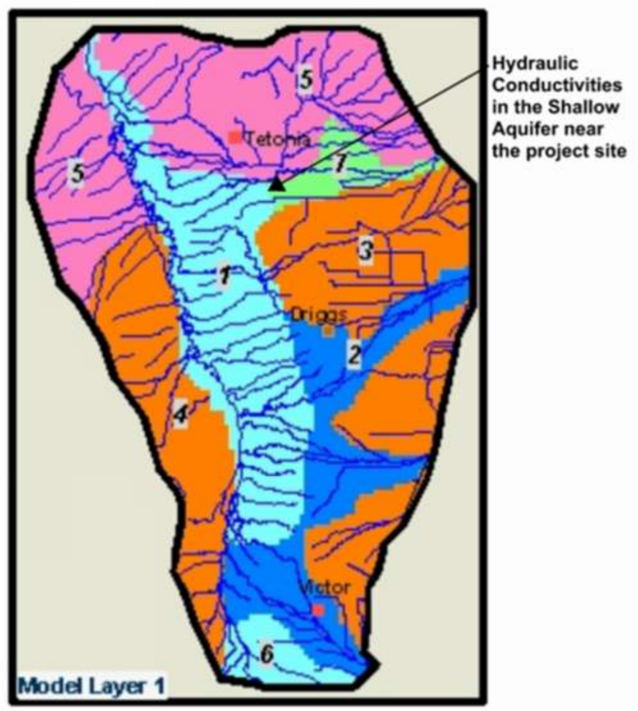
Hydraulic conductivity is an important parameter, and it can vary greatly. In reviewing the literature, the reasonable range is 3 to 3000 feet per day. Much of the information in the recommended literature and reviewing the pump data appears to be associated with a deeper aquifer zone. The mass-balance spreadsheet only considers the 15-foot mixing zone in its calculations. So, the hydraulic conductivity should be associated with this shallower soil layer. The test pits indicated a soil with a relatively higher conductivity, which is the best on-site data that we have. As a compromise, we have adjusted the hydraulic conductivity in the report to 80 feet per day, consistent with the Model Layer 1 conductivity assigned per the Nicklin report.



Big Horn Mountains
West
Teton Mountains
East
Represents Land Surface
Driggs
Groundwater in the Mass Balance Spreadsheet would be Model Layer 1 - 15' Mixing Zone
Model Layer 1 was assigned as unconfined since water level changes are substantial in portions of the model domain.
Model Layers 2 through 4 were assigned as confined.



Tetonia
Hydraulic Conductivities in the Shallow Aquifer near the project site
Driggs
Hydraulic Conductivity (ft/day)
1 to 10
10 to 30
30 to 70
70 to 150
> 150

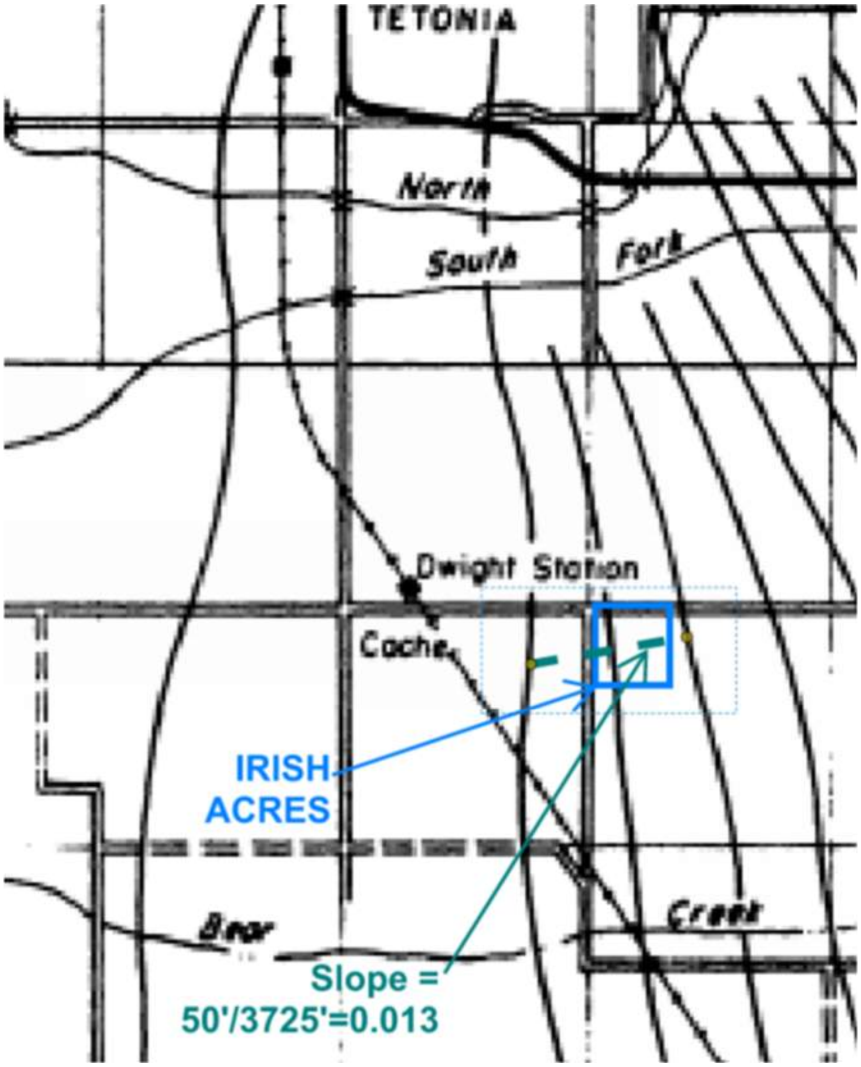


Final Hydraudic Conductivity Zonation

Zone	Hydraulic Conductivity (ft/day)
1	80
2	330
3	25
4	25
5	14
6	130
7	150

4. *Modeled Hydraulic Gradient Inconsistent with References*: The author assumes that the hydraulic gradient reflects the slope of the ground surface: 0.01 ft/ft. This generalized approximation seems a poor substitute for more specific references provided in mapping by Kilburn (1964), Nicklin (2003), and Cosgrove and Taylor (2007), which indicate that 0.006 is a representative value for this location. These maps do generally agree with the author's assertion that the direction of groundwater flow is east to west.

   Response – Nicklin (2003) states in section 4.1.6.3 that the hydraulic gradient assigned in their model ascertaining that the, "general flow direction is consistent with the land slope as typifies many basin aquifers". Figure 22 of the report has the project area mapped with 50 feet of water level contours over 3,725 feet, or a slope of 0.013 ft/ft. This is consistent with the ground slope in the project area. The 0.013 ft/ft gradient as utilized in the updated Nutrient Pathogen Evaluation. Please see the excerpt below.



5. *Phosphorus and Pathogen Impacts to Groundwater and Surface Water Not Addressed*: The report leaves out any meaningful discussion on the impacts of phosphorus and pathogens released in the on-site systems, as DEQ guidance recommends.

   Response – Phosphorus and pathogen impacts have been added to the report.

Idaho Department of Environmental Quality

6. Additional justification for the 100ft/day hydraulic conductivity should be given. The Nicklin model overlay should be consulted and reviewed to verify range of hydraulic conductivity, or a grain size analysis used for characterization of the hydraulic conductivity.

   Response – Please see response to comments #3.

7. The NP evaluation discusses the nutrient impacts to ground water using mass balance spread sheet. The NP evaluation has not addressed the fate transport of pathogens. The NP evaluations needs to be modified to address the fate transport of pathogens.

   Response – Please see response to comment #5.

Please feel free to us with any questions or concerns.

Sincerely,

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Enclosures: Hydraulic Conductivity Estimate Calculations from Pumping Test Data, Updated Nutrient Pathogen Evaluation