April 13, 2011

HARMONY
DESIGN & ENGINEERING

Curt Moore
Staff Planner
Teton County Idaho
150 Courthouse Drive
Driggs, ID 83422

Dear Curt:

On behalf of Teton County Idaho, we have performed a technical review of the report "Level 1 Nutrient-Pathogen Evaluation for Cattle Creek Ranch" prepared by Intermountain Aquatics and delivered to Harmony Design & Engineering on March 8, 2011. Per Teton County Code Title 9 – Subdivision Ordinance, Appendix A entitled "Nutrient-Pathogen Evaluation Technical Guide for On-Site Wastewater Treatment Systems in Teton County, Idaho"; the following items need to be addressed in order to meet the minimum required elements for a County NP evaluation. Note that many of these items were also requested by the Idaho Department of Environmental Quality in their letter dated February 22, 2011.

1. Compliance Boundary: Due to the hydraulic connection between impacted groundwater and surface water on the site, phosphorous and nitrate transport should be evaluated using the surface water bodies on the property as the compliance boundary. Discuss the impact of the project on TMDLs in the Teton River.

2. Map: Please provide a map that shows the project with proposed lot configuration, property lines, on-site wastewater treatment systems, water supply wells, surface water features, and the location of surrounding wells within 500 feet of the property boundaries. We also recommend including required setbacks from surface water and wells on the map.

3. Pathogen Fate: Please include an evaluation of pathogen fate and nutrient migration based on the soil and surface geologic conditions at the site.

4. Background Data: Instead of using an average groundwater nitrate concentration for the two IDWR monitoring wells of 0.7 mg/l for the background level, I would recommend using the highest measured concentration in well A0009959 in Teton Springs of 1.15 mg/l. As noted in the report, the nitrate concentration has been steadily increasing in this well, and we would expect that this trend would continue as future development continues. Also, this well is located hydraulically upgradient of the project site and the other well, A0011174, is located parallel. Additionally, the report by Nicklin Earth and Water (2003) indicates a background nitrate concentration of 2.42 mg/l just south of the project site and would justify using a higher value.

   Include information on surface water quality in the report and use this background data in the evaluation of phosphorous and nitrate transport to surface water. Ideally, samples would be taken on the project and analyzed. If this is not an option, data that has been collected by

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Friends of the Teton River and available on their website can be used. (http://www.tetonwater.org/Watershed-Restoration-&-Research/Research-and-Monitoring/Water-Quality)

5. Vertical Separation: The soil in the test pits was classified as a C soil by Eastern Idaho Public Health. Discuss minimum vertical separation distances for this soil type in the report and require that mounded soil absorption systems be used to maintain these distances if necessary.

6. Hydraulic Conductivity: Consider conducting a sensitivity analysis on hydraulic conductivity within the expected range of values for the soil types present in the upper part of the aquifer. This is recommended since the uncertainty about this key parameter is high and it has a significant influence on the results of the mass balance spreadsheet.

7. Aquifer width perpendicular to flow: The width of the septic drainfields perpendicular to groundwater flow direction should be used instead of the property width.

8. Cumulative Impacts: An evaluation of groundwater nitrate concentrations at the downgradient boundary of the overall subdivision should be conducted to evaluate the cumulative impacts of the three proposed lots.

In accordance with Appendix A, test pits should be excavated at a minimum depth of 10 feet on the site. The report states that three test holes were excavated to a depth of approximately 6 feet. The required depth helps determine the presence of either groundwater or fractured bedrock within 10 feet of the ground surface and the potential for contamination to deeper, water-bearing aquifers. Since groundwater was present at a depth of 5 to 6 feet (which equilibrated to 17 to 22 inches) we will not require that the holes be re-excavated to the 10 foot depth.

We evaluated the potential for cumulative impacts from surrounding developments that have completed Nutrient-Pathogen evaluations. The closest development with an approved NP evaluation is "The Roost" subdivision. The Roost NP evaluation was completed in 2008 and the subdivision is located off of 6000S, less than 1 mile northeast of the Cattle Creek Ranch project site. The nitrate concentration downgradient of The Roost is 3 mg/L, below the 5 mg/L level which would require an additional level of study. It is also noted that the two subdivisions are on approximately the same groundwater contour and will have little impact on each other. Therefore, a Level 2 study is not being recommended for Cattle Creek Ranch at this time.

Please let me know if you have any questions regarding the information in this letter.

Sincerely,

Jennifer Zung, PE, CFM
Harmony Design & Engineering

IDEQ LEVEL 1 NUTRIENT-PATHOGEN EVALUATION NITROGEN MASS-BALANCE SPREADSHEET

V. 1.3 5/2/2002

This spreadsheet is based on the mass balance approach documented in: 1985.Bauman, B.J. and W.M. Schaefer.Estimating Ground-Water Quality Impacts From On-Site Sewage Treatment Systems. In Proceedings of 5th Northwest On-Site Wastewater Treatment Shortcourse, September 10-11, 1985. University of Washington, Seattle, WA. Pages 23-41. See **Instructions for Use** below.

INPUT

Water Budget	Input Value	Default Value	
Hydraulic Conductivity (ft/day)	248.000	Site-specific	
Hydraulic Gradient	0.008	Site-specific	
Mixing Zone Thickness (ft)	15	15	Default
Aquifer Width Perpendicular to Flow (ft)	300	Site-specific	
Parcel Area (acres)	12.34	Site-specific	
Percent of Parcel That Is Impervious (Percent)	8	Site-specific	
Current/Acceptable Number of Homes in Parcel	3.0	Site-specific	
Septic Tank Effluent (gallons/d/home)	300	300	Default
Natural Recharge rate (inches/yr)	2.2	Site-specific	
Nitrogen Budget (all concentrations represent nitrate nitrogen)			
Upgradient Ground Water Concentration (mg/l)	0.7	Site-specific	
Septic Tank Effluent Concentration (mg/l)	27.0	45.0	Provide Justification
Denitrification Rate (decimal fraction)	0	0	Default
Nitrate in Natural Recharge (mg/l)	0.3	0.3	Default

OUTPUT

Yearly Water Budget	Volume (m^3)	% of Total
Ground Water	9.23E+04	96.0
Effluent	1.24E+03	1.3
Recharge	2.57E+03	2.7
Total Water Volume	**9.62E+04**	

Point of Compliance Nitrate Concentration Goal (mg/l)	1.7
Avg. Downgradient Nitrate Concentration in GW (mg/l)	1.0
Current/Acceptable Lot Size (Acres)	4.1

Yearly Nitrogen Budget	Mass (mg)	% of Total
Background GW Nitrate Mass	6.46E+07	65.3
Septic Tank Effluent Nitrate Mass	3.36E+07	33.9
Recharge Nitrate Mass	7.70E+05	0.8
Total Nitrate Mass	**9.90E+07**	

Instructions for Use

Input parameter values appropriate to conditions at the site under consideration are entered in the blue shaded cells on the *INPUT* side of the spreadsheet. These input values form the basis for calculating yearly water and nitrogen budgets. Default values for selected parameters are provided, as described in the accompanying N-P guidance. Selecting values other than these defaults will require providing adequate justification. Sources of water and nitrogen include ground water inflow from upgradient, natural recharge on pervious portions of the site, and from septic tank effluent. The total yearly nitrogen mass input is then divided by the total yearly volume of water available to recharge groundwater to arrive at an estimated **Average Downgradient Nitrate Concentration in GW** (shown in the *OUTPUT* side of the spreadsheet).

As values are input into the blue shaded cells the totals and percent of total for various components of the water and nitrogen budgets are calculated and shown on the *OUTPUT* side of the spreadsheet. The **Avg. Downgradient Nitrate Concentration in GW** is also calculated. The Density button allows the calculation of both the Acceptable Number of Homes in the Parcel (shown in the *INPUT* area) as well as the acceptable lot size. Clicking the Density button opens an input box that allows the input of the **Point of Compliance Nitrate Concentration Goal.** The number of homes in the parcel is then adjusted to meet the specified goal.This calculation can be redone iteratively along with changing other site input parameters to examine the resultant impact on nitrate concentrations.

Aquifer Width Perpendicular to Flow: For land development projects not completely oriented perpendicular to ground water flow, the site specific aquifer width value is determined using the average property width that is perpendicular to flow.

Ranges of Hydraulic Conductivity (K) for Unconsolidated Sediments (feet/day)	
Silt and sandy silt	0.003 to 0.3
Silty sands and fine sands	0.03 to 3
Well-sorted sands and glacial outwash	3 to 300
Well-sorted gravel	30 to 3000
Typical Range of Hydraulic Gradient	0.0001 to 0.1

Natural Recharge Rate (NRR) can be estimated from total annual precipitation (TAP) using the equation: NRR (inches/yr) = $(TAP)^2 * 0.0046$
TAP is input in inches/yr.

SITE INFORMATION

Cattle Creek Ranch	Site Name
T4N; R45E; Sec 33 (Single Family Individual Lots)	Parcel Identification
3/26/2011	Date
Intermountain Aquatics: Eric August, PE	Prepared By

Disclaimer: Considerable care was exercised in developing this software. However, the Idaho Department of Environmental Quality makes no warranty regarding its accuracy and shall not be held liable for any damages resulting from its use.

REFERENCES

Bradford SA, Tadassa YF, Pachepsky Y., 2006, Transport of giardia and manure suspensions in saturated porous media, Journal of Environmental Quality, 749-57.

Gerba, C.P. and G. Bitton. 1984. Microbial Pollutants: Their Survival and Transport Pattern to Groundwater, Groundwater Pollution Microbiology, John Wiley & Sons, New York, NY.

Idaho Department of Environmental Quality, 2011, Technical Guidance Manual for Individual and Subsurface Sewage Disposal Systems.

Ling, T.Y., Achberger, E.C., Drapcho, C.M., Bengtson, R.L., 2003.Quantifying adsorption of an indicator bacteria in a soilwater system, ASAE 45, 669–674.

Soupir, M.L., 2008, Fate and Transport of Pathogen Indicators from Pasturelands, Ph.D. thesis, Virginia Polytechnic Institute.

U.S. Environmental Protection Agency, 2002, Onsite Wastewater Treatment Systems Manual, EPA/625/R-00/008.

INTERMOUNTAIN AQUATICS INC.
ENVIRONMENTAL CONSULTING & HABITAT RESTORATION

January 3, 2011

Greg Eager
DEQ Idaho Falls
Regional Office
900 N. Skyline, Suite B
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Mike Dronen
Eastern Idaho Public Health District
820 Valley Center Drive
Driggs, ID 83422

Teton County Idaho
Planning and Zoning
150 Courthouse Dr. Room 107
Driggs, ID 83422

Please find the enclosed Level I – Nutrient Pathogen Study for the proposed Cattle Creek Ranch subdivision near Victor Idaho. It should be noted that this subdivision is being proposed by my family to develop a ranch compound that will be shared by my family, parents and siblings. The NP study was prepared by Eric August, water resource engineer for IMA and every effort was made to remain objective and scientific throughout the process. If you have any questions regarding the study or its conclusions please call Eric directly at (303)527-0191. Please send any written comments directly to me at Intermountain Aquatics. Thank you for your time in reviewing this project.

Sincerely,

Katie Salsbury

Katie Salsbury

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INTERMOUNTAIN AQUATICS INC.
ENVIRONMENTAL CONSULTING & HABITAT RESTORATION

Date: March 30, 2011

To: William Teuscher – Water Quality Engineer, Idaho Department of Environmental Quality

Cc: Curt Moore, Wendy Danielson – Teton County

From: Eric August, PE

RE: Response to comments received from DEQ and revisions to NP Study for Cattle Creek Ranch

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A Level 1 NP Study was submitted to Teton County in January of 2011. Teton County requested that DEQ review the report and comments were received in a letter from William Teuscher (Idaho DEQ) dated February 22, 2011. In response that those comments, the following changes were made to the original report:

1. The mass-balance spreadsheet was updated with the following changes:

    a. Advanced treatment will be used and therefore the nitrate effluent concentration of 27 mg/L was used instead of 45 mg/L.

    b. Modeled the cumulative impact of all three lots instead of only the smallest lot. This was achieved by increasing the parcel area to the combined area of all three lots (12.34 acres) and increasing the number of homes on the parcel to three.

    c. Narrowed the aquifer width to the smallest buildable width. Original aquifer width used was 500 ft; revised to 300 ft.

    d. Adjusted the hydraulic conductivity based on a weighted average of soil layers found within the modeled mixing zone thickness (15-ft). These soil layers included the silty clay loam layer from the surface to an average 20" depth, clay layer from 20" – 45" and gravel layer below. The hydraulic conductivity value used in the calculation for the gravel layer was the same as that used in the original study (330 ft/day). The average of hydraulic conductivity values reported in the soil survey for the upper silty clay loam was used (0.8 ft/day). The clay layer was assumed to have a hydraulic conductivity of 0.02 ft/day. Using a weighted average based on soil layer thicknesses, a value new hydraulic conductivity value of 248 ft/day was used in the mass-balance spreadsheet.

    The result of these four changes to the mass-balance spreadsheet resulted in an average downgradient nitrate concentration of 1.0 mg/L. This value remains lower than the point of compliance nitrate concentration goal of 1.7 mg/L (1 mg/L above background). The modeled increase of 0.3 mg/L is less than 1 mg/L, and therefore is considered negligible.

2. The Teton River is a TMDL limited segment, however it is noted that the segment of interest (from Trail Creek to Hwy 33) is only listed for sediment. The segment below Hwy 33 is

TMDL listed for both sediment and nutrients. Nevertheless, it is recognized that nutrients are a concern and phosphorus impacts should be looked at more carefully due to the suspected connection between groundwater and surface water on the subdivision. In attempt to quantify the impacts of phosphorus to adjacent surface waters, rough calculations were performed for phosphorus loading from the drain fields to adjacent surface water.

Modern modeling techniques for phosphorus and pathogen transport are not advanced enough to accurately predict groundwater transport and surface water mixing. To account for this, the revised NP Study attempted to assess the relative risk with conservative loading estimates from the proposed development into the nearest main receiving body, the upper Teton River. This was achieved by using simple, conservative calculations meant only to estimate the maximum potential impact of phosphorus. The goal of the calculations was to quantify, on an order of magnitude scale, the maximum potential increase in phosphorus concentrations in the receiving water. No attempt was made to estimate retention in the soils prior to discharge to surface water. The following steps and assumptions were made:

- To obtain a discharge value for the Teton River at the approximate point where effluent from the subdivision would occur, a paired watershed analysis calculation was performed. First, data from the nearest stream gage (USGS#13052200) was processed and the daily mean flow was calculated. Then the ratio of watershed area for the gage versus the effluent discharge location was applied to the gage daily mean flow to calculate the same for the area of interest. A value of 254 cfs was obtained.

- The phosphorus loading into adjacent surface water was calculated using the average phosphorus concentration, 9 mg/L, for septic effluent from Table 3.7 of the EPA On-Site Wastewater System Manual. This concentration was combined with the estimated 900 gpm for the subdivision (all three lots) to obtain a phosphorus loading of 0.03 kg/day.

- Simple mixing calculations were then performed using the information above. A calculated increase in phosphorus concentration in the Teton River as a result of the subdivision was estimated at 0.00005 mg/L.

It is noted that an increase of 0.00005 mg/L is two or three magnitudes of order lower than the detection limit for standard phosphorus lab tests. Although the calculated increase in phosphorus is extremely low, recommendations geared toward reducing the risk of phosphorus contamination of surface water is included in the report revisions. The original recommendations stand concerning setbacks from surface water and advanced treatment systems geared towards working in shallow groundwater systems. Beyond these original recommendations, it is strongly suggested that non-phosphate or low phosphate detergents and soaps be used in the homes at all times. It is also recommended that fertilizers containing phosphorus should be avoided in gardens and/or lawn areas on all the lots.

3. A letter from Michael Dronen (Eastern Idaho Public Health District) dated August 19, 2010 has been added to the Appendices of the revised NP Study.

4. Along with criteria listed in the Technical Guidance Manual (TGM), Michael Dronen was consulted regarding placement of drain fields and wells on the three proposed lots. The placement of these features was guided by the need to protect surface waters and comments received by DEQ. All wells and drain fields were placed entirely outside of 100-ft setbacks from surface water (see Figure 9). Both primary and secondary drain field locations are shown in this figure. Every effort was made to locate the drain fields in a staggered pattern relative to the direction of groundwater flow. This was done to minimize the chances of plumes from individual drain fields merging and concentrating the potential water quality impacts. Wells are separated from drain fields by a minimum of 100-ft based on TGM guidance and soils classified as Design Group C.

5. The Environmental Protection Agency – On-Site Wastewater System Manual (Section 3.7.1) was consulted and a literature review of pathogen fate and transport was conducted in order to more thoroughly address the risk of pathogen contamination from the drain fields. The fate and transport of pathogens is affected by the physical and chemical properties of water and soil, hydrology and microbial characteristics (Gerba, 1984). While a modeling study of pathogens is beyond the scope of this report, it can be said that based on soil types found on the property the risk of pathogen contamination to nearby surface waters or wells is minimal. The primary support for this is the upper soil layers of silty clay loam and clay found on the property (Design Group C soils). Numerous researchers have found that adsorption of bacteria and viruses increases with higher clay content. Ling et al. (2003) used an indicator bacterium (*Escherichia coli*) and found a high correlation between percent adsorption and clay content. Bradford et al. (2006) found that decreasing the median grain size resulted in lower peak effluent concentrations and increased deposition of *Giardia lamblia* in a saturated porous media. The higher retention of pathogens with finer grained media such as clay is thought to be associated with higher cation exchange capacity and organic matter content (Soupir, 2008). Despite the gravel in lower levels, the fine grain sizes found in the upper soil layers along with classification of the soils by EIPHD as Design Group C supports the judgment that pathogens will not be a water quality problem at the compliance boundaries.

The revisions discussed above do not change the original conclusion that the discharges from the proposed subdivision will comply with the Idaho Ground Water Rule and Idaho Water Quality Standards. As extra measures of water quality protection, the recommendations outlined in the original NP Study along with the new ones presented above should be implemented at the proposed subdivision.

ATTACHMENTS

1. Figure 8 - Revised Nitrate Mass-Balance Spreadsheet
2. Michael Dronen (Eastern Idaho Public Health District) dated August 19, 2010
3. Figure 9 - Locations of proposed wells and drain fields

LEVEL I NUTRIENT-PATHOGEN EVALUATION

Cattle Creek Ranch
Teton County, Idaho

Prepared for:
Mike & Barbara Morey
Morey Ranch LLC
6470 Cattle Creek Road
Victor, ID 83455

Prepared by:

Eric August, PE

INTERMOUNTAIN AQUATICS INC.
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TABLE OF CONTENTS

TABLE OF FIGURES

Introduction

The Idaho Department of Environmental Quality (DEQ) and the Eastern Idaho Public Health District (EIPHD) require property developers to investigate potential impacts to ground water and surface water from on-site wastewater treatment systems (IDAPA 59.01.02 and IDAPA 58.01.02). In addition to State requirements, Teton County requires property developers to investigate potential impacts to waters of the state when one or more of the criteria in Title 9, Section 9-3-2-C-3-B-i apply to a proposed development (Title 9. Appendix A). The proposed development meets two of the criteria outlined in Title 9 and therefore a nutrient-pathogen (NP) evaluation is required to meet state and local regulations.

The following report was prepared by Eric August, a registered professional engineer in the State of Idaho who has worked for Intermountain Aquatics (IMA) since 2004. IMA is an environmental consulting firm that specializes in natural resource data collection, analysis and restoration.

A comprehensive, scientific investigation of soils, geology and water resources in and around the area of the proposed development was made to determine potential impacts to waters of the state from on-site wastewater treatment systems.

Methods outlined in Title 9, Appendix A, *Nutrient-Pathogen Evaluation Technical Guide for On-Site Wastewater Treatment Systems in Teton County, Idaho* and the DEQ's *Technical Guidance manual for Individual and Subsurface Sewage Disposal Systems* were used to make the evaluation.

Prior to completing the NP evaluation, Eastern Idaho Public Health was contacted to perform an on-site evaluation of the proposed development. Results from this field investigation are included in the report.

Results from the evaluation were evaluated against the approval criteria outlined in Title 9, Appendix A:

> *In order to be approved an NP evaluation must demonstrate that the proposed on-site wastewater treatment system(s) will not significantly degrade ground water or surface water quality beyond an increase of 1.0 mg/l nitrate, or less above existing "background levels". (The development cannot cause concentrations of nutrients or pathogens in ground water or surface water to exceed those concentrations that exist at the site prior to the development). An increase of 1.0 mg/l nitrate, or less, predicted to occur at the compliance boundary is considered a negligible (not significant) impact.*
>
> *The NP evaluation must also demonstrate that pathogens will be attenuated in the subsurface before impacting surface or ground water.*

A Nitrogen mass-balance spreadsheet was used to estimate impacts from the development.

Subdivision Location & General Description

The Cattle Creek Ranch is a proposed 3-lot subdivision on 40.22 acres approximately one mile northwest of Victor. It is located in the NE¼ SW¼ Section 33, Township 4N, Range 45E, Teton County, Idaho (Figure 1). Approximately 60% of the property was mapped as wetlands in 2006 and test holes excavated in 2010 confirmed that groundwater is within 2 feet of the surface throughout. The property is gently sloping 0-1% east to west with the highest elevation around 6,055 feet and the lowest around 6,015 feet. Two main springs originate east of the development and run west along the north and south boundaries.

The property is located in Teton County's rural reserve, wetland overlay and priority wetland habitat overlay. It is has A-20 and A-2.5 zoning. The proposed subdivision includes three home sites, Lot 1 – 4.52 acres, Lot 2 – 3.74 acres, Lot 3 – 4.08 acres and surrounding open space totaling 27.88 acres (Figure 2). Development on the property will occur in upland areas while the rest will remain as open space and working agriculture. Individual on-site wastewater treatment systems and water supply wells are proposed.

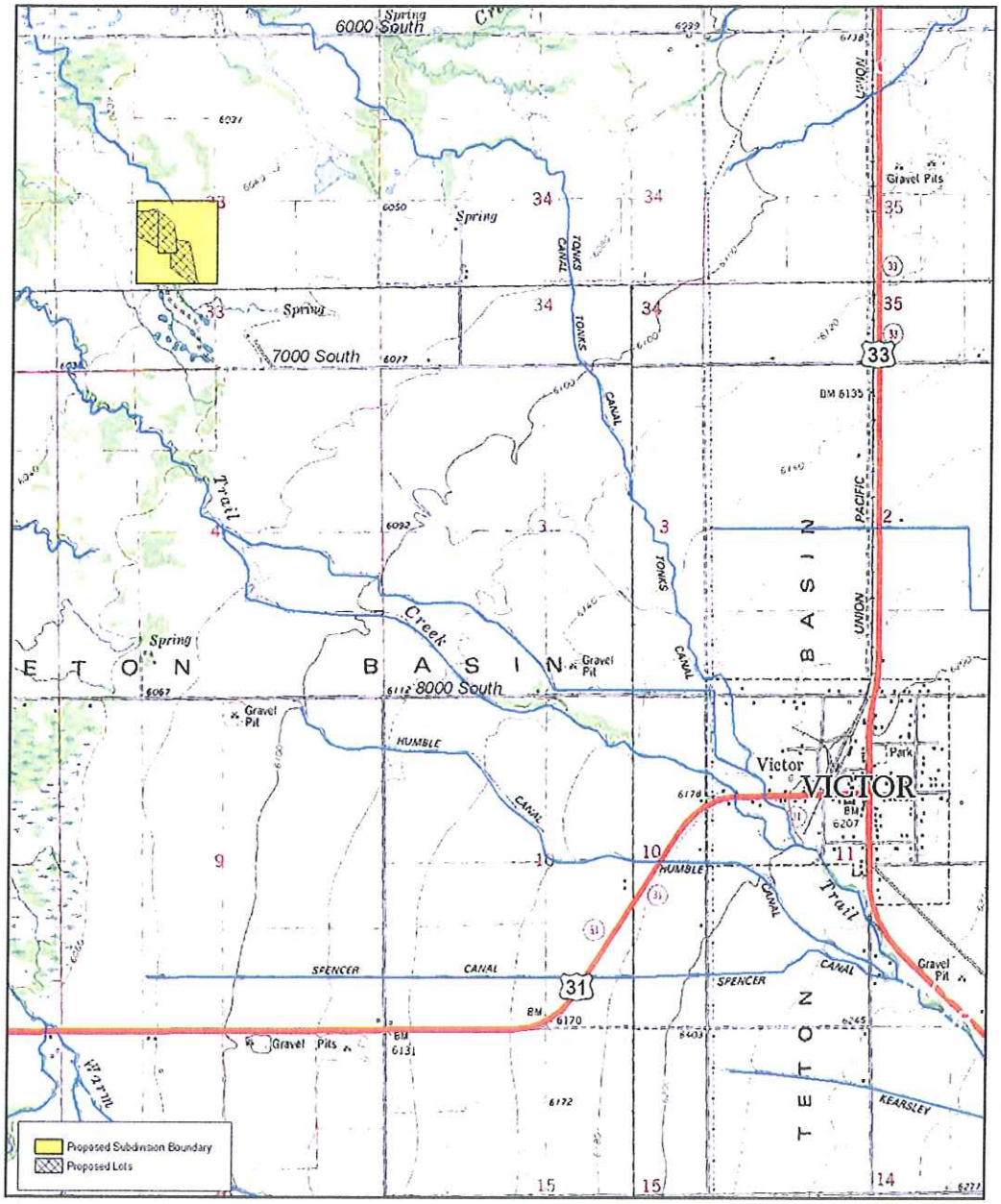
The property has been used for ranching since the turn of the century. A natural high water table provides excellent sub-irrigated pasture for livestock and upland areas are dominated by aspen trees. The developer is currently working with the Natural Resource Conservation Service under the Environmental Quality Incentives Program to implement best management practices to protect water quality from agricultural operations. These practices include fencing the spring creeks, planting willows, creating designated livestock watering areas and following a prescribed grazing management plan.

Field Investigation

Soils & Hydrology

A routine wetland delineation was completed on the proposed development and surrounding property in 2006. Twenty-six test pits were excavated to a depth of 18" to characterize soils and hydrology throughout the project area (Appendix B). These excavations confirmed that the Natural Resource Conservation Service soil survey for the area was accurate and that wetlands in the area have an elevated water table throughout the growing season (Appendix C). The proposed development is mapped as Quaternary aged alluvial fan deposits, consisting of unconsolidated sand, gravel and clay mixture (Mitchell, V.E. and Bennet, E.H., 1979). Soils mapped in the locations of the septic systems consist of Tonks Silty Clay Loam, a soil that has potential limitations for movement of water through the soil and a high depth of saturation. The evaluation of the test pits also indicated that wetland areas had a peak groundwater level <18" below the ground surface and that upland areas had a peak groundwater level >18" below the ground surface.

Figure 1. Vicinity Map



Cattle Creek Ranch

Figure 1: Proposed Project Area & Subdivision Boundary

USGS TOPOGRAPHIC MAPS
1: 24,000 QUAD
NATURAL RESOURCE ANAYLSIS & INVENTORY

1 inch = 2,000 feet

0 1,000 2,000 4,000

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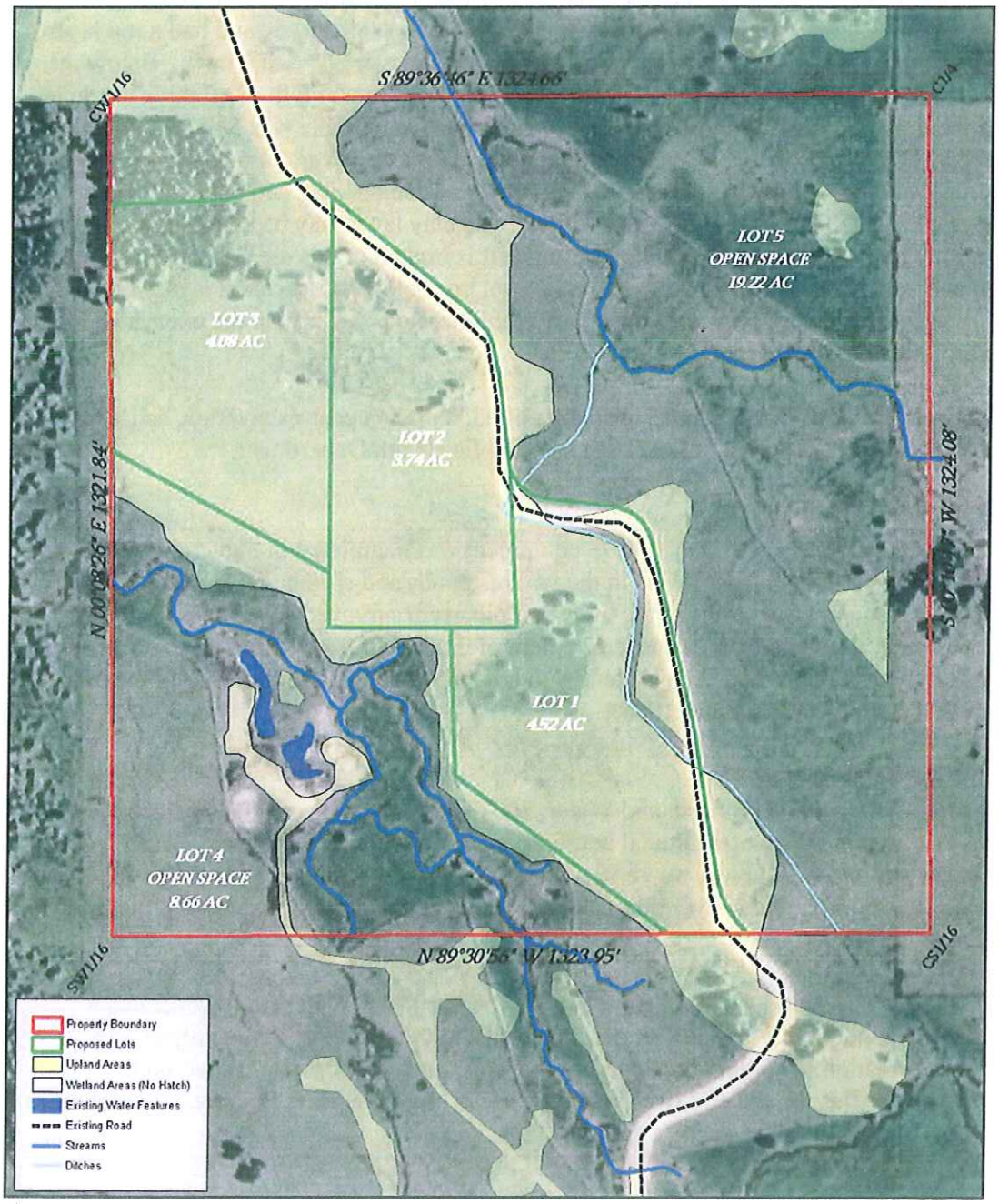
December 2010

Figure 2. Cattle Creek Ranch Development Plan



In August 2010, three test holes (one on each lot) were excavated to a depth of approximately 6 feet. Each hole was consistent with the soil survey and had a top layer of silty clay loam 17" – 22" thick, underlaid by a clay layer 20" – 30" thick. Below the loam and clay layers was a gravel layer that extended to the bottom of all three test holes. At the time of excavation the pit on Lot 1, the groundwater table was 5' – 6' below the surface at the break between the clay and gravel layers, however, 24 hours later the groundwater table had equilibrated at the break between the clay and silty clay loam layers, 17"– 22" below the surface. Although the clay layer may be acting as a cap to the groundwater at certain times of the year, once it is broken in this area, the groundwater appears to be under pressure and rises to a level just below the top loam layer. For the purpose of this study, the more conservative equilibrated, rather than the excavated, depth to groundwater was used.

The soils present in the test holes were classified, 24 hours post-excavation, as Design Group C by Mike Dronen of the East Idaho Public Health Department.

Groundwater Slope

A site survey using Total Station TDS equipment was completed in September 2010. In addition to surveying water levels in the various ponds and spring creeks located on the property, groundwater levels in the three soil pits were surveyed (Figure 4). From this survey data, an average groundwater gradient of 0.008 ft/ft from southeast to northwest was calculated. This data is consistent with a USGS report of groundwater in the upper part of Teton Valley (Kilburn 1964).

Hydraulic Conductivity

According to the Nicklin Earth and Water, 2003 study, the project site and surrounding areas are within the greater alluvial aquifer connected to the Teton River. Based on the soil test pits and site survey, we verified that the project site is located within a shallow unconfined aquifer and is hydrologically connected to the springs and ditches that run through the property.

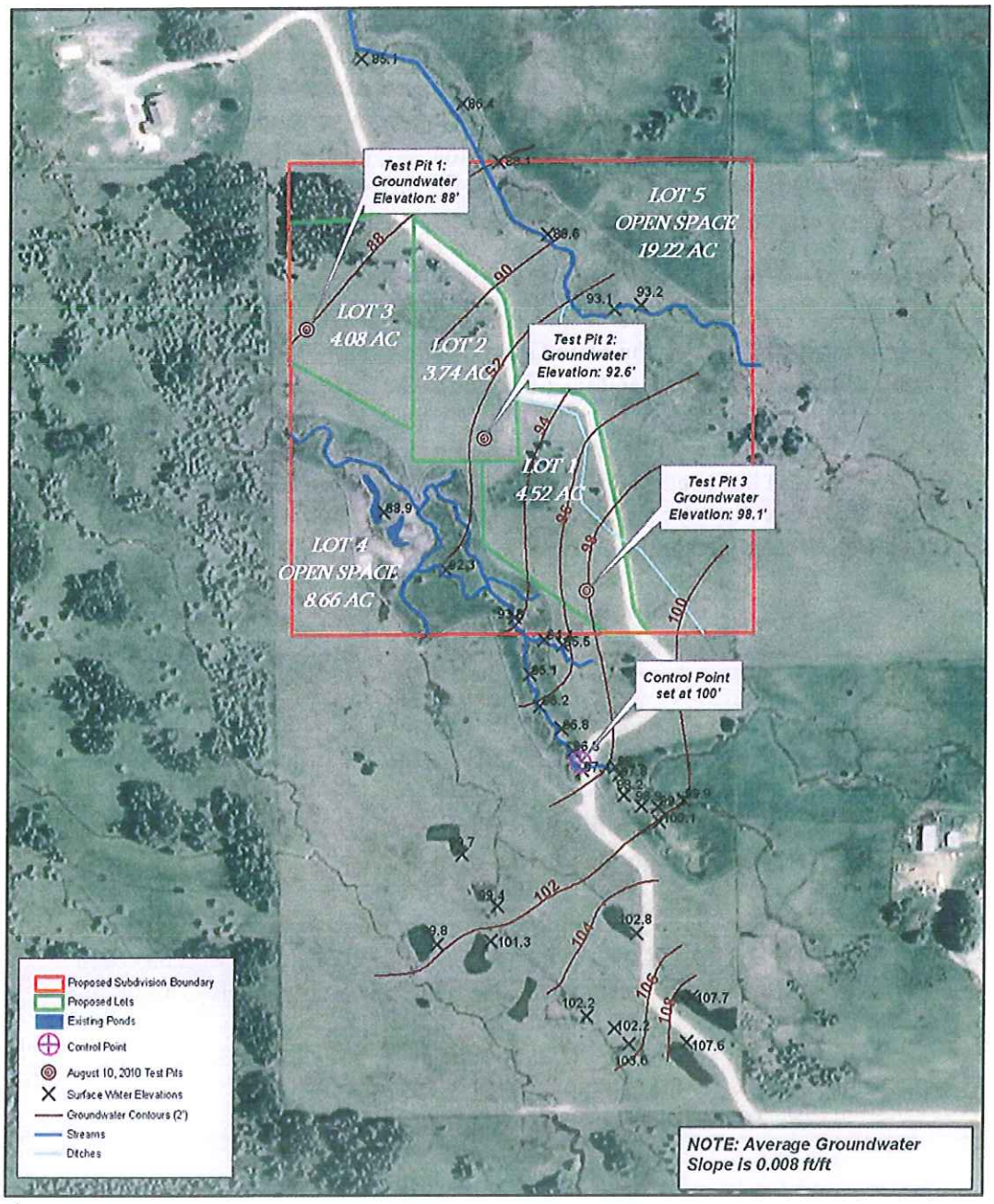
The groundwater model calibrated in the Nicklin Earth and Water study generated a hydraulic conductivity of 330 feet per day for the alluvial aquifer in the project area. This information in conjunction with textural classification of soils mapped on the property justifies the use of 330 feet per day in the Nitrogen Mass Balance Spreadsheet.

Additional Data

Well Logs

Well driller reports within ½ mile radius of the project site were obtained from the IDWR online database (http://www.idwr.idaho.gov/) and used to help characterize the surrounding hydrology (copies of each report are compiled in Appendix C). A well log for the Morey home (IDWR Tag # 0045774 – August 2007), located northwest of the

Figure 4. Groundwater Survey



proposed subdivision is included in the report. The log report indicates a depth of 60 feet with a clay gravel profile and a static water level of 2 feet.

Wells on surrounding properties range in depths from 35 to 300 feet deep with static water levels ranging from 0 to 205 feet deep. A well log (IDWR Permit # 702257) for property directly east of Cattle Creek Ranch indicates a completed well depth of 35 feet and a static water level of 15 feet. This well log, along with surrounding well logs within a ½ mile radius, is completed in clay and gravels that is typical of a shallow alluvial aquifer. The location of these wells in relation to the proposed development is depicted in Figure 5.

Groundwater Quality

The IDWR website was used to obtain surrounding groundwater quality data. This information is available through the State Groundwater Quality Monitoring Program. IDWR samples two wells that are within 1-3 miles of the project site.

The first well is approximately 1.25 miles southwest of the property (Metal Tag # A0009959). This well has been sampled once a year, every four to five years starting in 1991. The table below displays all nitrate data available for this well. All water quality data for this well is contained in the Appendix.

Nitrate data for Well #A0009959

Sample Date	*Nitrate (mg/L)*
1991	0.53
1995	0.53
1999	0.43
2004	0.65

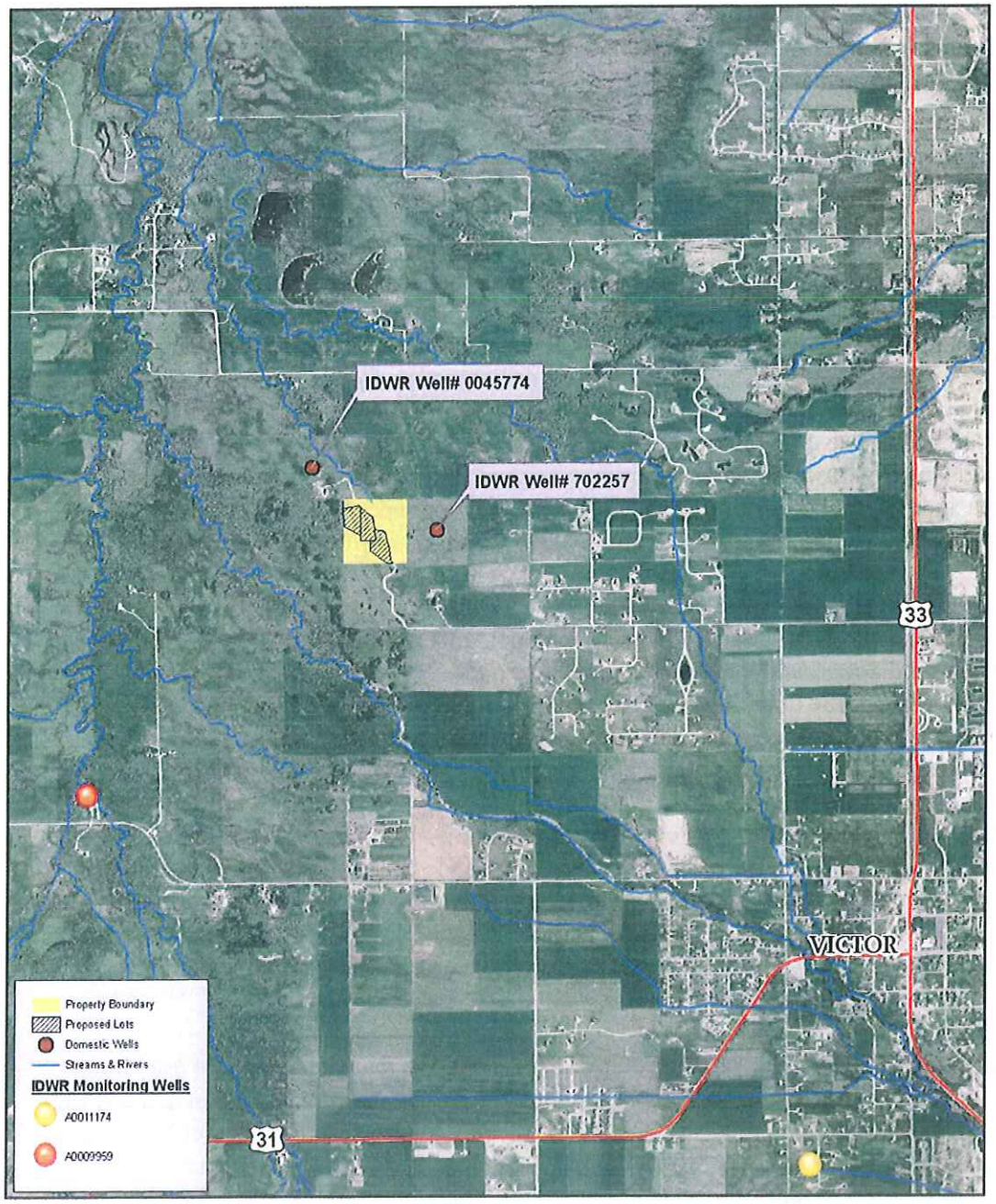
The average nitrate level recorded at this well was 0.53 mg/L, with a low of 0.43 mg/L measured in 1999 and a high of 0.65 mg/L measured in 2004.

The second well is located in the Teton Springs Development. It is approximately 3 miles Southeast of Cattle Creek Ranch (Metal Tag # A0011174). This well has been sampled at irregular frequencies starting in 1994. The table below displays all nitrate data available for this well.

Nitrate data for Well #A0011174

Sample Date	*Nitrate (mg/L)*
1994	0.49
1995	0.58
1998	0.65
2003	0.90
2008	1.15

Figure 5. Domestic & Monitoring Wells



The average nitrate level recorded at this well was 0.75 mg/L. It is noted that the nitrate levels in this well have steadily increased from 1994 to 2008. The location of these wells in relation to the proposed development is depicted in Figure 5.

Given the data for these two wells, a value of 0.7 mg/L was used for the Nitrogen Mass Balance Spreadsheet.

Results

Model Inputs & Assumptions

On the input side of the Nitrogen Mass Balance Spreadsheet, no variances from the default values were used. Among the site-specific inputs related to the water budget, the hydraulic conductivity, hydraulic gradient and aquifer width values were obtained from field investigations, existing data and well driller reports for nearby wells. To obtain the most conservative estimates of nitrate leaving the compliance boundaries, the smallest proposed lot size of 3.7 acres was used. A value of 8% was used for the percent of parcel that is impervious. The impervious area was calculated assuming a 3000 square-ft roof area and 6000 square-ft driveway area. Only one home per lot is proposed for this subdivision. A natural recharge rate of 2.2 inches/year was estimated using local climate data.

Among the nitrogen budget inputs in the model, only one site-specific value is needed, the up-gradient groundwater concentration of nitrate. As with the water budget, no variances from the default values were used as inputs. The up-gradient groundwater concentration of nitrate used was 0.7 mg/L, obtained from well water quality data explained in the previous section.

The point of compliance nitrate concentration goal of 1.7 mg/L (1 mg/L above background) was used in the model. The compliance boundary used was the individual lot boundaries. The conservative approach of allowing total volume of septic tank effluent within the upper 15 feet of the aquifer was used. In addition, it was assumed that 100% of all nitrogen forms to nitrate as the effluent is discharged to the aquifer.

Model Assessment

The IDEQ Nitrogen Mass-Balance Spreadsheet was the main analysis tool used in this study. The input parameters used in the spreadsheet have been well researched and field verified. None of the inputs are believed to be particularly sensitive; however the mass balance may not accurately reflect the risks associated with shallow groundwater systems. Please refer to subsequent sections for recommendations regarding this issue. The procedures outlined in Title 9, Appendix A of the Teton County Subdivision Regulations were followed and nitrogen was used as a surrogate for other contaminants because it is often the limiting factor in determining appropriate lot sizes. This is considered a conservative approach because nitrogen is typically the most mobile constituent in domestic wastewater.

Impacts to Down Gradient Nitrate Concentrations

The IDEQ Nitrogen Mass-Balance Spreadsheet was used to predict down gradient nitrate concentrations for individual lot boundaries (Figure 6). According to DEQ, if a development, at individual lot boundaries, has an increase of less than 1.0 mg/L it is considered negligible. Based on the existing density for Cattle Creek Ranch and output data on the Mass-Balance Spreadsheet, there will be an increase in down gradient nitrate concentrations of 0.1 mg/L above background, which is considered negligible.

Pathogen/Phosphorous Fate and Transport

The high ground water in this area makes pathogen and phosphorous fate and transport a great concern. In addition to high groundwater, there are numerous ponds and creeks on the property and the risk of contamination to surface water must be addressed. To mitigate these risks, a hundred feet setback from surface water is recommended for all septic tanks and leach fields in the subdivision (Figure 7). This recommendation is consistent with guidelines published in the Idaho DEQ *Technical Guidance Manual for Individual and Subsurface Sewage Disposal Systems* for sites with Design Group C soils.

It is also recommended that advanced treatment systems be used at all three lots. The soil absorption field is critical for retention of phosphorus and pathogens and should be designed with conservative criteria for sizing, separation from groundwater and capillary zone, control of water distribution, and other features known to affect performance (Jantania and Gross, 2006; Lombardo, 2006; USEPA 2010). Appropriate alternative adsorption systems for shallow groundwater situations may include mounded, capping fill, or chamber trench leach fields, non-soil absorption system, subsurface drip irrigation systems, or other technologies (Chang et al., 2010; Darby and Leverenz, 2004; Jantania and Gross, 2006; USEPA 2010).

IDEQ LEVEL 1 NUTRIENT-PATHOGEN EVALUATION NITROGEN MASS-BALANCE SPREADSHEET

V. 1.3 5/2/2002

This spreadsheet is based on the mass balance approach documented in: 1985.Bauman, B.J. and W.M. Schaefer.Estimating Ground-Water Quality Impacts From On-Site Sewage Treatment Systems. In Proceedings of 5th Northwest On-Site Wastewater Treatment Shortcourse. September 10-11, 1985. University of Washington. Seattle, WA. Pages 23-41. See **Instructions for Use** below.

INPUT

Water Budget	Input Value	Default Value	
Hydraulic Conductivity (ft/day)	330.000	Site-specific	
Hydraulic Gradient	0.008	Site-specific	
Mixing Zone Thickness (ft)	15	15	Default
Aquifer Width Perpendicular to Flow (ft)	500	Site-specific	
Parcel Area (acres)	3.7	Site-specific	
Percent of Parcel That Is Impervious (Percent)	8	Site-specific	
Current/Acceptable Number of Homes in Parcel	1.0	Site-specific	
Septic Tank Effluent (gallons/d/home)	300	300	Default
Natural Recharge rate (inches/yr)	2.2	Site-specific	

Nitrogen Budget (all concentrations represent nitrate nitrogen)			
Upgradient Ground Water Concentration (mg/l)	0.7	Site-specific	
Septic Tank Effluent Concentration (mg/l)	45.0	45.0	Default
Denitrification Rate (decimal fraction)	0	0	Default
Nitrate in Natural Recharge (mg/l)	0.3	0.3	Default

OUTPUT

Yearly Water Budget	Volume (m^3)	% of Total
Ground Water	2.05E+05	99.4
Effluent	4.15E+02	0.2
Recharge	7.70E+02	0.4
Total Water Volume	**2.06E+05**	

Point of Compliance Nitrate Concentration Goal (mg/l)	1.7
Avg. Downgradient Nitrate Concentration in GW (mg/l)	0.8
Current/Acceptable Lot Size (Acres)	3.7

Yearly Nitrogen Budget	Mass (mg)	% of Total
Background GW Nitrate Mass	1.43E+08	88.4
Septic Tank Effluent Nitrate Mass	1.87E+07	11.5
Recharge Nitrate Mass	2.31E+05	0.1
Total Nitrate Mass	**1.62E+08**	

Instructions for Use

Input parameter values appropriate to conditions at the site under consideration are entered in the blue shaded cells on the *INPUT* side of the spreadsheet. These input values form the basis for calculating yearly water and nitrogen budgets. Default values for selected parameters are provided, as described in the accompanying N-P guidance. Selecting values other than these defaults will require providing adequate justification. Sources of water and nitrogen include ground water inflow from upgradient, natural recharge on pervious portions of the site, and from septic tank effluent. The total yearly nitrogen mass input is then divided by the total yearly volume of water available to recharge groundwater to arrive at an estimated **Average Downgradient Nitrate Concentration in GW** (shown in the *OUTPUT* side of the spreadsheet).

As values are input into the blue shaded cells the totals and percent of total for various components of the water and nitrogen budgets are calculated and shown on the *OUTPUT* side of the spreadsheet. The **Avg. Downgradient Nitrate Concentration in GW** is also calculated. The Density button allows the calculation of both the Acceptable Number of Homes in the Parcel (shown in the *INPUT* area) as well as the acceptable lot size. Clicking the Density button opens an input box that allows the input of the **Point of Compliance Nitrate Concentration Goal**. The number of homes in the parcel is then adjusted to meet the specified goal.This calculation can be redone iteratively along with changing other site input parameters to examine the resultant impact on nitrate concentrations.

Aquifer Width Perpendicular to Flow: For land development projects not completely oriented perpendicular to ground water flow, the site specific aquifer width value is determined using the average property width that is perpendicular to flow.

Ranges of Hydraulic Conductivity (K) for Unconsolidated Sediments (feet/day)	
Silt and sandy silt	0.003 to 0.3
Silty sands and fine sands	0.03 to 3
Well-sorted sands and glacial outwash	3 to 300
Well-sorted gravel	30 to 3000
Typical Range of Hydraulic Gradient	0.0001 to 0.1

Natural Recharge Rate (NRR) can be estimated from total annual precipitation (TAP) using the equation: NRR (inches/yr) = $(TAP)^2 * 0.0046$
TAP is input in inches/yr.

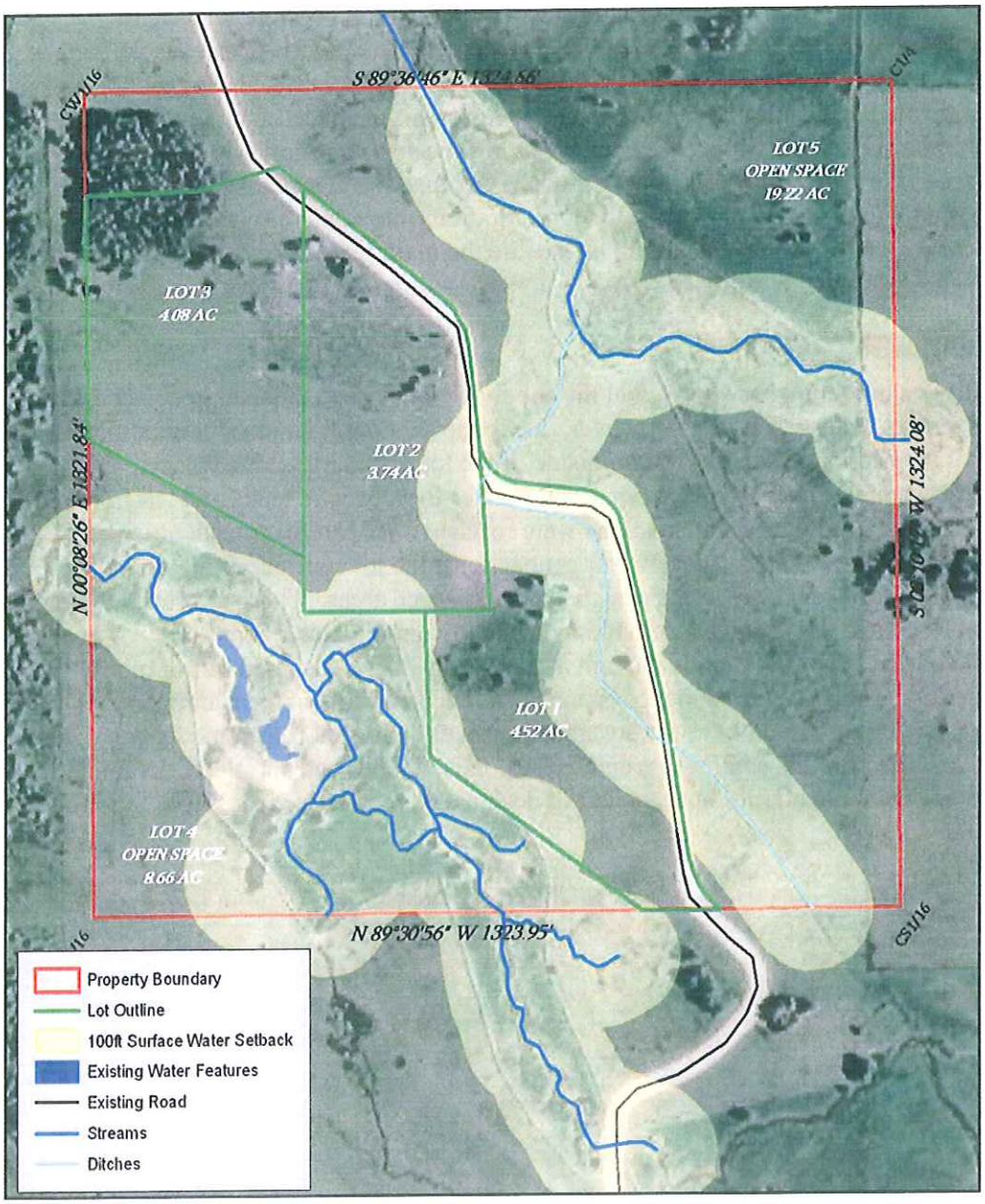
SITE INFORMATION

Cattle Creek Ranch	Site Name
T4N; R45E; Sec 33 (Single Family Individual Lots)	Parcel Identification
9/13/2010	Date
Intermountain Aquatics: Eric August, PE	Prepared By

Disclaimer: Considerable care was exercised in developing this software. However, the Idaho Department of Environmental Quality makes no warranty regarding its accuracy and shall not be held liable for any damages resulting from its use.

Figure 6. Nitrogen Mass-Balance Spreadsheet

Figure 7. Surface Water Setback



CONCLUSIONS

The Nutrient Pathogen analysis completed for the Cattle Creek Ranch Subdivision indicates a negligible increase in groundwater contamination. Nitrate impacts to groundwater from the proposed development will have a negligible impact as defined by Title 9, Appendix A of the Teton County Subdivision Regulations. These regulations encourage the Nutrient Pathogen analysis to focus on nitrate because it is typically the most mobile constituent in domestic wastewater. The analysis shows minimal nitrate increases of 0.1 mg/L, an order of magnitude lower than the acceptable increase. The subdivision's low density of homes, lot configurations and relatively low hydraulic conductivity values of the soils found on site are the main reasons for the limited nitrate impacts modeled in this study.

RECOMMENDATIONS

The nitrogen modeling has shown that the subdivision has been planned in a way that should protect water resources. However, due to the shallow groundwater conditions and potential connection to surface water outside of the lot boundaries, an advanced treatment system and hundred feet setback from surface water for all septic tanks and leach fields is recommended. These recommendations were reached after careful consideration of potential groundwater and surface water connections, the lot configurations, and the protection of surface waters in the designated open space areas. These advanced systems should be specifically designed to function in shallow groundwater conditions. A good example of this type of system is the unit at the Morey house designed by Harmony Engineering. The on-site treatment systems installed on all lots in the Cattle Creek Ranch Subdivision should have advanced pathogen and phosphorous removal capabilities to reduce impacts to the shallow groundwater, ponds, ditches and spring creeks found outside of the lot boundaries but in adjacent designated open space lands.

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