Appendix A

Nutrient-Pathogen Evaluation Technical Guide for On-Site Wastewater Treatment Systems In Teton County, Idaho

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. The primary source of these requirements can be found in Idaho Ground Water Quality Rule, Idaho Water Quality Standards (IDAPA 58.01.02) and Individual Subsurface Disposal Rules (IDAPA 58.01.03) for surface water, and *Technical Guidance Manual for Individual and Subsurface Sewage Disposal Systems (*http://www2.state.id.us/deq/waste/tgm_sewage.htm), hereinafter called "Guidelines".

In addition to State requirements, Teton County requires property developers in Teton County 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 (and Applicability section below) apply to the proposed development. These criteria are detailed below in the "Applicability" section below.

The investigations must include a comprehensive, scientifically based evaluation of soils, geologic conditions, and water resources in and around the area of the proposed development. For approval of the on-site wastewater treatment systems, the site investigation (termed nutrient-pathogen (NP) evaluation) shall conclude that the effluent from the treatment systems will not adversely impact the waters of the state.

This document is intended to provide guidance to those required to perform NP evaluations under Teton County's oversight of proposed developments utilizing on-site wastewater treatment systems in sensitive water quality areas of the county.

Applicability

NP evaluations are designed to locate an appropriate number of on-site wastewater treatment systems on a given parcel of land, and to direct the placement of the individual on-site wastewater treatment systems and level of treatment in a way that will not significantly degrade the quality of Teton County's water resources.

NP evaluations are required for all proposed developments utilizing on-site wastewater treatment systems when:

1. Any portion of a proposed development is within the county's Wetland and Waterways Overlay area; or

2. There is evidence that groundwater comes within ten feet of the ground surface on the proposed development parcel some time of the year; or

3. There is evidence that soil depth to fractured bedrock is ten feet or less anywhere on the

proposed development parcel; or

4. The proposed development includes a food service, commercial, or industrial facility generating 600 gallons per day or more wastewater; or

5. The proposed development is within an area where the concentration of nitrate-nitrogen in groundwater is five mg/l or higher.

Following the completion of a Level 1 NP evaluation, Teton County may allow suitable alternative on-site wastewater treatment system designs to better protect water quality in lieu of performing a Level 2 NP evaluation, provided it meets the Level 1 requirements.

Qualifications

NP evaluations must be performed by a qualified professional with experience in subsurface resource evaluation practices. The work is typically performed by environmental consultants with backgrounds in geology, hydrogeology, soil science, geochemistry, or related engineering disciplines. The evaluation relates the predicted nutrient and pathogen movement in the subsurface to the type of on-site wastewater treatment system proposed, and the soil, geologic, and hydrologic conditions existing at the site. The qualified professional must be a Professional Geologist or Professional Engineer who is registered in the State of Idaho and has experience conducting studies similar to NP evaluations. To conduct a Level II NP evaluation, the qualified professional must have experience in groundwater modeling. The professional performing the evaluation must certify that the results and any recommendations on design or placement of on-site wastewater treatment systems satisfy the approval criteria, below.

Approval Criteria

In order to be approved 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" for example 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.

Nitrate is used as the substance to measure in the application of these guidelines; i.e. the fate of nitrate discharged to the subsurface. Nitrate is often the limiting factor in determining appropriate lot sizes and on-site wastewater treatment system design and placement because it is the most mobile constituent of concern in domestic wastewater and has an impact on public health when a maximum contaminant level (MCL) is exceeded (Subsurface Water Rules (IDAPA 58.01.11). Note that all references to nitrate concentration infers nitrate measured as nitrogen (NO_3 as N).

The evaluation of pathogens is performed by characterizing soil and geologic conditions to a level that enables the NP professional to verify that pathogens will be attenuated in the

subsurface before impacting surface or ground water. At the present time (July 2009), pathogen transport modeling cannot be done with enough certainty to be useful.

The compliance boundary is defined as one, or any combination of, the following:

- Individual lot boundaries - when non-centralized water supply wells are used (e.g. a single on-site wastewater treatment system cannot cause nitrate concentrations to increase more than 1.0 mg/l above pre-development levels as measured at the downgradient lot boundary when neighboring lots contain individual water supply wells).

- Downgradient boundary of the overall subdivision or development - when a centralized, or community, water system is used (e.g., nitrate concentrations cannot increase more than 1.0 mg/l above pre-development levels as a result of the combined effect of all on-site wastewater treatment systems as measured at the outermost boundary of the development when the development is served by a centralized water system).

- Surface water bodies - when subsurface conditions result in a hydraulic connection between impacted ground water and a surface water body within the boundary of the development. Phosphorus is usually the chemical of concern with respect to surface water quality. Direct coordination with EIPHD, DEQ, and the County's technical NP representative (see Title 9, Section 9-3-2-C-3-B-iii) is necessary to design an appropriate NP evaluation when surface water impacts are a concern.

Cumulative Impacts

The County may require an additional level of study when the existing nitrate concentrations are above 5 mg/l or where the proposed development in combination with existing or other pending developments could increase the existing concentration of nitrate in the groundwater to above 5 mg/l have a significant cumulative impact on water quality.

Nutrient-Pathogen Evaluation Process

Prior to performing an NP evaluation, the "property developer and/or his/her NP professional" (hereinafter "Applicant") shall meet with the DEQ, EIPHD, and the County's technical representative to discuss the elements and objectives of the NP evaluation. Teton County requires the Applicant to submit a work plan (a scope of work) to the County's technical representative for approval. The purpose of a meeting or work plan submittal is to ensure that unnecessary or inappropriate activities are not completed. Submittal of a work plan should expedite the NP evaluation approval process.

The general term "nutrient-pathogen evaluation" refers to a set of activities that includes the compilation of existing information, collection of site-specific information, and the completion of predictive contaminant fate and transport modeling for ground water.

A nitrogen mass-balance spreadsheet is a simplified screening tool, available from DEQ, to help the NP professional assess the expected nitrogen load from the proposed development. This spreadsheet is required for a Level 1 County NP evaluation and will determine whether a more detailed Level 2 NP evaluation is needed. The mass-balance spreadsheet allows the Applicant to adjust lot sizes, orientation with respect to ground water flow, and wastewater

treatment options to minimize ground water impacts.

The minimum required elements for a County NP evaluation follows:

- Well driller reports for wells within ½ mile radius of the project site.
- Map showing the project with proposed lot configuration, property lines, on-site wastewater treatment systems, water supply wells, surface water features, and location of surrounding wells within 500 feet of the property boundaries.
- Information on the depth to ground water and ground water flow direction.
- Information on soil and surface geologic conditions at the site for evaluation of pathogen fate and nutrient migration.
- Soil descriptions from test pits excavated at a minimum depth of ten feet at the site.
- Ground water quality data and surface water nitrate data in the vicinity of the project.
- Nitrogen mass-balance spreadsheet to estimate impacts from the development.

The applicant's experience and judgment are necessary to determine if other types of information are warranted due to the unique characteristics of a project.

Upon review of the Level 1 NP evaluation described above, the County may determine that further study is needed. In such case, the Level 2 NP evaluation shall follow the DEQ requirements for Level 2 NP evaluations, found at http://www.deq.state.id.us/WATER/assist_business/septic/nutrient_pathogen_eval_guide.pdf or a suitable alternative on-site wastewater treatment system design may be allowed by the County (see Applicability section above).

Procedure for Determining Groundwater Elevation

Peak groundwater table elevation can be assessed by a qualified professional observing redoximorphic features (soil mottling) in excavated test holes, or by a qualified professional installing ground water piezometers (observation wells) and measuring depth to groundwater at weekly intervals over the period of known or suspected high ground water (spring runoff or irrigation induced high ground water).

Procedure for Determining Nutrient-Pathogen Contamination

Determining the level of existing nutrient and/or pathogen contamination can be made by reviewing existing ground and surface water quality data. Data sources include the Idaho Department of Water Resources Statewide Ground Water Monitoring Network; the Eastern Idaho Public Health District the Idaho Department of Agriculture ground water monitoring data; and the Idaho Department of Environmental Quality ground and surface water monitoring results, sub-basin assessments, and Total Maximum Daily Load (TMDL) documentation.

Analysis Techniques

Analysis for the County NP evaluation should include: the use of an appropriate mixing zone;

the comprehensiveness of the evaluation of soils, geologic conditions, and water resources; the assessment of pathogen and phosphate attenuation; the justification and validity of assumptions utilized during analysis; the use of appropriate dispersivity values; the use of appropriate nutrient concentration in wastewater and the use of appropriate wastewater flow volume per drain field, and; the adequate assessment and discussion of model accuracy (including the flow component and other sensitive parameters.

Predictive Modeling

Ground water flow and contaminant transport modeling is used in NP evaluations as a tool to predict the impact of the proposed development on ground water quality. Surface water quality may also need to be considered if ground water discharges to nearby drains or creeks.

In most cases nitrate is the contaminant that dictates the necessary lot configuration, lot size, and on-site wastewater treatment system placement. Nitrate is used as a surrogate for other constituents in the modeling effort. Other elements of the NP evaluation (e.g. soil analyses) need to address the adequacy of pathogen and phosphorus attenuation.

It is imperative that the modeler develop a realistic site conceptual model by: (1) collecting adequate information on the subsurface geologic structure and aquifer properties and (2) considering factors such as the influence of nearby surface water bodies or pumping wells. When assumptions and professional judgment are used, provide clear, written justification for any assumptions used.

Nutrient Modeling

The model must simulate all sources of contaminant input simultaneously. Consult the DEQ Guidelines, Nutrient Modeling Parameters, for more detail on modeling requirements.

Below are some basic modeling requirements:

1. Model non-reactive chemical transport to conservatively simulate nitrate migration. Contaminant transport simulations should project plume migration at time periods of 5, 10, and 20 years after on-site wastewater treatment system use begin.

2. If the Applicant wants to consider the effects of recharge from precipitation or irrigation, the nutrient load associated with the recharge must also be investigated and included in the model.

3. Ground water flow direction: determined at the site by the installation of at least three monitoring wells constructed in the uppermost aquifer. An accurate elevation survey must be performed to establish the relative elevation of the monitoring wells.

4. Hydraulic conductivity, determined at the site by aquifer pumping tests, slug tests, or by use of an empirical formula based on grain-size distribution analysis. Samples should be collected from the uppermost aquifer at multiple well locations.

5. Aquifer thickness: determined by an analysis of on-site boring logs and well driller reports for nearby wells.

6. Background concentrations of nitrate determined by sampling on-site monitoring wells and by considering existing regional nitrate data.

7. Contaminant source introduction. The conservative approach calls for introduction of the total volume of septic tank effluent within the upper 15 feet of the aquifer. One hundred percent conversion of all nitrogen forms to nitrate at the water table is assumed. Adjustments to nitrate input concentrations may be considered for systems utilizing enhanced nutrient treatment, or where other site-specific factors (e.g., geochemical conditions resulting in de-nitrification) warrant adjustment.

Nitrate source locations may be modeled as injection wells placed in the locations of the proposed drainfields or as area recharge over zones sized to represent the drainfield footprint. For grid-based models, the grid must be sized to represent the size of the individual nutrient sources (both for wells and areal distributed nitrate introduction).

8. Aquifer porosity, determined by a laboratory analysis of soil bulk density (to calculate porosity) from samples collected at the property, or from text book values for typical aquifer materials.

9. Dispersivity. For purposes of NP evaluations, the default value shall be 20 feet for longitudinal dispersivity and 0.8 feet for transverse (horizontal) and 0.08 feet for transverse (vertical) dispersivity. Table 3 in the DEQ Guidelines provides a summary of default modeling parameters. Alternative values may be warranted in some cases, but must be supported by site-specific data.

Nutrient Modeling Parameter Variances

Consideration of more realistic nutrient fate and transport phenomena may be used, however, the Applicant must justify that performing more complex modeling or using parameters that deviate from the default values or requirements is necessary. These project specific variances shall be discussed with the County's technical representative and with DEQ or EIPHD prior to utilization.

Model Boundary Conditions

It is generally desirable to confine the model domain with real physical boundaries, such as impermeable geologic contacts or hydraulically connected surface water features, however the distance to such permanent features may prohibit the use of physical boundaries as external model boundaries. Hydraulic boundaries shall be set far enough from the area of interest (i.e. the drainfield locations) so that they do not influence the flow pattern resulting from the introduction of wastewater from the drainfields.

Surface water features found in the model domain, such as agricultural drains, canals, springs, streams, rivers, lakes and reservoirs must be considered. Surface water features hydraulically connected to an underlying aquifer can be represented as a constant head, constant flux, or variable flux boundary.

In all cases, it is necessary to base boundary condition selections on the physical and hydraulic characteristics of the project location, and to document why the boundary conditions were

chosen. Flux boundaries must be as realistic as possible even if they are adjusted during model calibration. Data from regional or local water budget assessments are often necessary to assign reasonable flux boundaries.

Assessing the Model

The output from the flow component of the model (i.e. modeled heads) must be compared with on-site and regional ground water elevations to assess the accuracy of the model.

The NP evaluation report must include a discussion about the accuracy of the flow component and about any other parameters (flow or contaminant transport) that are particularly sensitive. Several model runs that include a range of input parameters may be warranted when the uncertainty about the value of key parameters is high.

Reporting

A thorough presentation of compiled historical data and the data collected from the project site shall be submitted in a written report along with a completed NP evaluation to the County's technical representative, DEQ, and EIPHD. The report shall include a qualified NP professional's interpretation and certification of the findings as well as recommendations for design or the need for further site evaluation. All interpretations need to be well supported by the NP evaluation data. A suggested outline for an NP evaluation report follows:

0.0 Identify: as Level 1 or Level 2.

1.0 Introduction: Evaluation is required by Teton County or by DEQ or both; list the name of the project, project location, legal description and current land uses; also discuss the intended site use and development design; anticipated wastewater characteristics; geographic, geologic, and hydrologic setting and water well inventory.

2.0 Field Investigation: describe the installation of borings, soil test pits, and monitoring wells; discuss the protocol used in sampling (all media involved), aquifer hydraulic conductivity testing, pathogen fate assessment, and contaminant fate and transport modeling for ground water; include documentation supporting assumptions made during model development.

3.0 Results: Discuss soil conditions; ground water elevation and flow characteristics; background water quality; hydraulic conductivity; nutrient- pathogen fate issues; model results; model uncertainty.

4.0 Conclusions: summarize the key elements of the evaluation.

5.0 Recommendations: provide recommendations for development layout; on- site wastewater treatment system design; water supply and well construction; and the need for further evaluation activities.

The presentation of recommendations on the part of the qualified NP professional constitutes certification that: (1) the data adequately support the recommendations and, (2) that

interpretations based on the data are accurate and represent sound, unbiased professional judgment.

The Applicant is responsible for submitting the NP evaluation to the County. Upon receipt the County will request DEQ review, comments, and provide recommendations on the NP evaluation. DEQ will provide its feedback to the Planning & Zoning Commission as agreed in the MOA. The County's technical representative will review the NP evaluation, including assessment of data collection, analysis techniques, and presented conclusions in the context of specific site characteristics, and will transmit written comments to the planning & zoning commission to become part of the public hearing document.

Conclusions

Teton County believes that these guidelines provide a reasonable approach to typical NP evaluation scenarios found in Teton County. They should be used in conjunction with sound scientific reasoning and judgment. Projects presenting unusual problems or issues should be discussed ahead of time with DEQ, EIPHD, and the County's technical representative.