May 7, 2012

M E M O R A N D U M

FROM: John Tindall, P.E.
Engineering Manager, Coeur d'Alene Regional Office

TO: Daniel Redline
Regional Administrator, Coeur d'Alene Regional Office

SUBJECT: **Staff Analysis for Draft Reuse Permit WRU M-0109-04 (Municipal Recycled Water) Hayden Area Regional Sewer Board**

1. PURPOSE

The purpose of this memorandum is to satisfy the requirements of the Idaho Recycled Water Rules (IDAPA 58.01.17.400.05) for issuing reuse permits. This memorandum addresses draft Reuse Permit WRU M-0109-04, for the municipal treatment and recycled water system owned and operated by Hayden Area Regional Sewer Board. This is a reissued permit for Hayden Area Regional Sewer Board.

2. SUMMARY OF EVENTS

The Idaho Department of Environmental Quality (DEQ) received a permit application from Hayden Area Regional Sewer Board (HARSB) on March 24, 2008, which largely serves as the basis for the terms and conditions contained in the draft permit.

DEQ previously issued HARSB a wastewater land application permit on August 13, 2003 that expired August 13, 2008. HARSB has been operating the recycled water irrigation system substantially in conformance with the 2003 permit since it expired.

As required by the Idaho Recycled Water Rules, the draft permit will be presented for a public comment period. After the comment period has closed, DEQ will provide written responses to all relevant comments and prepare a final recycled water permit for HARSB.

The Staff Analysis for the 2003 permit dated August 6, 2003 is included in Appendix 2. This document provides a historical background on the past permits issued to HARSB. The 2012 Staff Analysis will focus on changes from the 2003 permit.

3. PROCESS AND SITE DESCRIPTIONS

The wastewater treatment process is the same as described in the 2003 Staff Analysis included in Appendix 1. The wastewater treatment plant (WWTP) located on Atlas Road in Hayden near the Coeur d'Alene Airport treats a combination of raw sewage and septic tank effluent from the city of Hayden, Hayden Lake Recreational Water and Sewer District (mainly serving homes around Hayden Lake) and portions of Kootenai County near the Coeur d'Alene Airport. The WWTP design flow is 1.5 million gallons per day (mgd) and the average effluent flows are about 1.13 mgd. The facility is permitted by EPA through NPDES Permit ID-002659-3 to discharge to the Spokane River year-round and from June 1 to September 30 but can only discharge to the river when the river flows are 2,000 cfs or greater. Historically, the facility discharges to the river through a 5-mile pressure sewer main south on Atlas Road from October through June or July. When not discharging to the river, the facility pumps the recycled water (treated and disinfected effluent) to a 476-acre farm located northwest

from the WWTP near the intersections of Boekel Road and Huetter Road in Rathdrum. Currently 300 acres are under irrigation, and alfalfa, oats and poplar trees are grown. Supplemental irrigation with ground water is also used on the farm as needed. The farm is over the Rathdrum Prairie Aquifer which is an EPA designated "Sole Source Aquifer" and categorized in the Idaho Ground Water Quality Rules as a "Sensitive Resource Aquifer". As a Sensitive Resource Aquifer, the aquifer cannot be degraded, as related to beneficial uses, from any point or nonpoint activities unless the degradation is approved by DEQ based on a socio-economic justification. The ground water is the main source of drinking water for the nearby communities. The HARSB irrigation system has been operating since 1996 and no ground water degradation has been documented from the irrigation of recycled water.

Vicinity and site maps are included in Appendix 1. The crops are irrigated either with recycled water from the 8 million gallon lagoon located at the farm or from an irrigation well owned by HARSB on the farm. The west center pivot irrigates 132 acres of alfalfa or oats and the east center pivot irrigates 114 acres of alfalfa or oats. The oats are grown for a season prior to replanting the alfalfa crop and the majority of the time, alfalfa will be grown. Drip irrigation is used to irrigate 54 acres of poplar trees of varied ages.

4. DISCUSSION

The following sections outline the site conditions and terms of the draft permit, based on the Idaho Recycled Water Rules and other applicable regulatory standards. See also the 2003 Staff Analysis in Appendix 2 for more details.

4.1. Soils

Soil at the irrigation site has been characterized by the United States Department of Agriculture National Resource Conservation Service (USDA-NRCS). Soil data were taken from the Web Soil Survey available online at http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx and descriptions are from the Soil Survey of Kootenai Area, Idaho (USDA-NRCS, 1981).

According to NRCS data, soils at the irrigation site primarily consist of Avonville (103) fine gravelly silt loam (0 to 7 percent slopes). Two (2) other soils are found in narrow bands on the site: Avonville (104) fine gravelly silt loam (7 to 20 percent slopes) and Narcisse (156) silt loam (0 to 5 percent slopes). All the soils are deep and well drained.

Available water capacity of these soils is low (average to 60 inches, 0.08 cm/cm) and erosion hazard is low. The Avonville soil is listed as suitable for four (4) tons per acre per year of a grass-legume hay (nothing listed for alfalfa).

The draft permit will require monitoring of the soils in each of the Hydraulic Management Units (HMUs) two (2) times per year (April or May and October) which is the same frequency as in the 2003 Permit. The parameters to monitored will be electrical conductivity, plant-available nitrate-N, pH, plant-available ammonia-N and plant-available phosphorus.

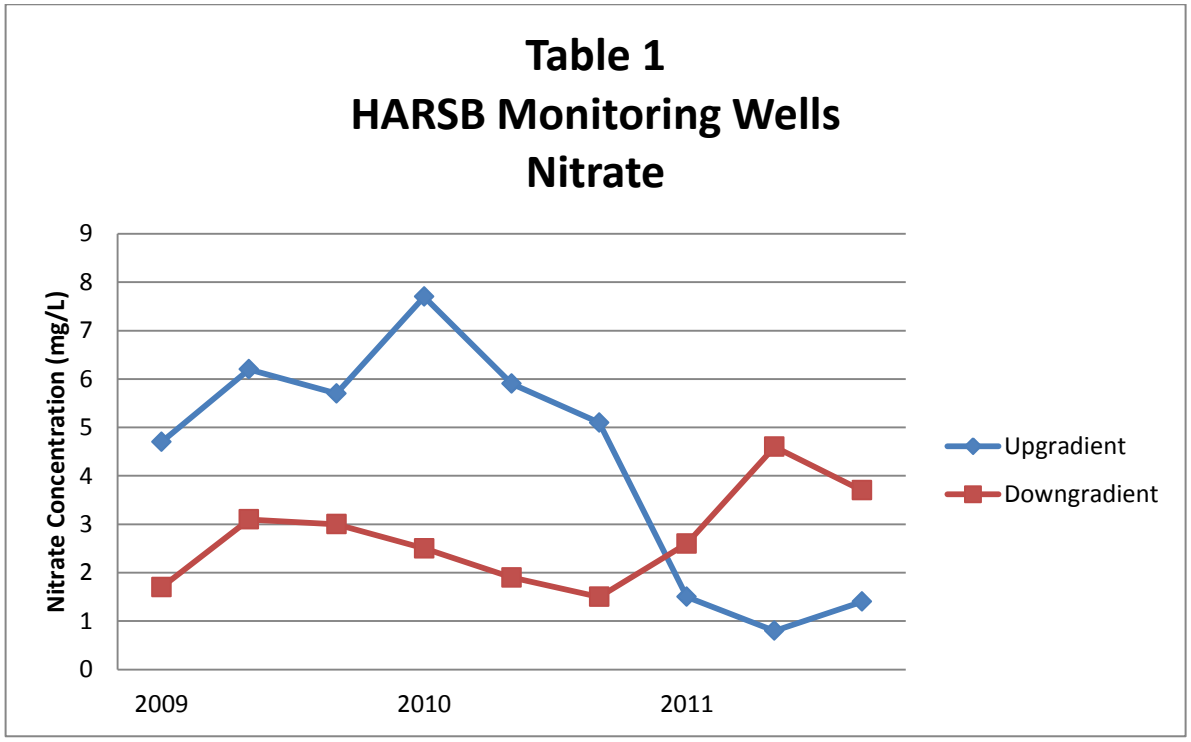
4.2. Ground Water

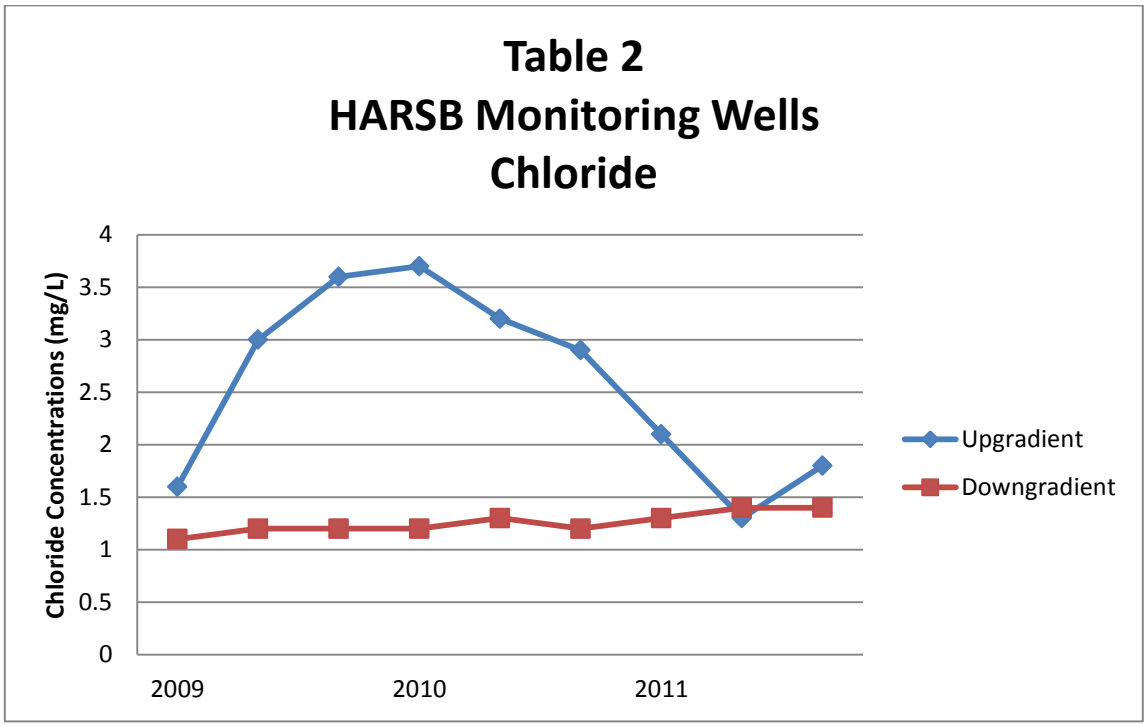
As discussed previously, the farm being irrigated is over the Rathdrum Prairie Aquifer. The irrigation of recycled water must comply with the Ground Water Quality Rule requirements for this "sensitive resource aquifer". The draft permit includes limits and monitoring requirements that address compliance with the Ground Water Quality Rule.

Depth to ground water under the farm varies between 296 feet to 280 feet below ground surface based on the static water level data gathered from the two (2) HARSB monitoring wells (see Site Map in Appendix 1) (HARSB, 2011). The general ground water direction of flow has been determined to be southwest or south-southwest (Golder, 2006). The HARSB monitoring wells are constructed so that samples can be taken within the top 12 feet of the water surface.

Ground water quality has been monitored by HARSB three times per year as part of the 2003 land application permit. The annual reports include this data. The HARSB downgradient monitoring well was constructed in June 2005 and the upgradient well was constructed in 2008. Nearby domestic wells were used prior to the construction of the monitoring wells but the domestic wells could not provide samples near the surface of the ground water because the intake screens are typically 50 feet below the ground water surface. The ground water monitoring network in the new permit will consist of the two (2) HARSB monitoring wells and samples will be taken at a depth of no greater than 12 feet below the surface of the ground water.

Sampling of both monitoring wells by HARSB started in 2009. This data represents the best comparison of changes to the ground water quality from the irrigation of recycled water. Figure 1 and Figure 2 below show the nitrate and chloride concentrations for 2009-2011.





As shown in Figure 1, except for 2011, the upgradient nitrate concentrations were higher than the downgradient concentrations. The reason for the higher upgradient concentration has never been determined. DEQ will continue to monitor the ground water quality data generated during five (5) year permit period to determine if there are any statistically significant impacts to the ground water from the irrigation of recycled water by the permittee. Figure 2 shows that most of the downgradient chloride concentrations were lower than upgradient concentrations.

Additional sampling of these monitoring wells will be necessary before any conclusions can be made regarding the impacts to ground water from the irrigation of crops with recycled water on the HARSB farm.

There will need to be a minimum 50-foot buffer radius around each of the HARSB monitoring wells where no irrigation occurs to avoid contamination of the wells (Golder, 2006).

The draft permit will require monitoring of the two (2) HARSB monitoring wells three (3) times per year (April, August and October) which is the same frequency as in the 2003 Permit. The parameters to monitor will be chloride, nitrate-N, total phosphorous, total dissolved solids (TDS), static water level and electrical conductivity.

4.3. Surface Water

The nearest surface water to the farm is the Alpine Lake about three (3) miles northeast of the farm. The Spokane River is about six (6) miles south of the farm (see vicinity map in Appendix 1).

4.4. Hydraulic Management Unit Configuration

HARSB proposes eight (8) hydraulic management units (MUs) for the irrigation site totaling about 300 acres. Four (4) of the MUs (246 acres) will be planted in either oats or alfalfa throughout the five (5) year permit period and irrigated using two (2) center pivots. Four (4) MUs (54 acres) are currently

planted with poplar trees of different ages and these MUs are irrigated using drip irrigation equipment. Table 1 shows the proposed serial numbers and acreages for the individual MUs. All the MUs are shown in Site Map in Appendix 1.

Table 1 HARSB Proposed MUs

Serial Number	Description	Acres
MU-109-06A	Alfalfa or Oats Irrigation Field (West Pivot)	66
MU-109-06B	Alfalfa or Oats Irrigation Field (West Pivot)	66
MU-109-07A	Alfalfa or Oats Irrigation Field (East Pivot)	57
MU-109-07B	Alfalfa or Oats Irrigation Field (East Pivot)	57
MU-109-04A	Poplars (Drip Irrigation)	3.7
MU-109-04B	Poplars (Drip Irrigation)	11
MU-109-04C	Poplars (Drip Irrigation)	27
MU-109-04D	Poplars (Drip Irrigation)	12

4.5. Wastewater Flows and Constituent Loading Rates

The following sections discuss wastewater flow rates and rationale for constituent and hydraulic loading rates appearing in the draft permit.

4.5.1. Wastewater Flows

From 2008-2011, the total volume of recycled pumped to the farm varied from 63.48 million gallons (MG) in 2011 to 136.09 MG in 2008. The difference is due to when the facility switches from discharge to the Spokane River and irrigation of the farm. The NPDES permit requires the facility to stop discharging when the river flow is 2,000 cfs or less and sometimes the facility switches to irrigation before the river drops below 2,000 cfs. The annual reports provide detailed breakdowns of the recycled water irrigated and the supplemental irrigation water used from the facility's ground water irrigation well.

The draft permit will require the facility to monitor the following: the monthly volumes of recycled water pumped from the WWTP; the monthly supplemental irrigation ground water volumes pumped to the storage lagoon or irrigated directly to the crops; and the monthly volumes of recycled water irrigated from the storage lagoon.

4.5.2. Constituent Loading Rates

4.5.2.1 - Hydraulic Loading Rates

In 2008, the facility started irrigating on May 30 which is the earliest in recent history. Using this year to evaluate the general capacity of the farm, the hydraulic loading rates for the field crops (alfalfa and alfalfa/orchard grass) varied from about 16 inches per acre to 25 inches per acre for the growing season (May-October). These rates are lower than the average precipitation deficit calculations for alfalfa from the ET Idaho 2009 Coeur d'Alene weather station (28 inches per acre) and considering irrigation system efficiency of 75%. In 2008, the poplars' hydraulic loading rates varied from 10 inches per acre to 46 inches per acre. The older trees have higher demands.

All the rates for the different poplar HMUs were lower (with the exception of the HMU with the oldest trees) than the average precipitation deficit calculations for three (3) year old poplars from the ET Idaho 2009 Coeur d'Alene weather station (42 inches per acre) and considering irrigation system efficiency of 90%. The poplar irrigation rates were determined using soil moisture probes.

HARSB anticipates that the currently irrigated acres will be adequate for the flows anticipated over the next five (5) years.

Minimizing the amount of irrigated recycled water that moves past the root zone during the growing season is an important feature of the draft permit for ground water protection. The past permit required the use of soil moisture probes in the HMUs and a minimum threshold of 10 centibars to indicate if a field could be irrigated. With the installation of the Rathdrum Prairie AgriMet Weather Station on the farm (see Appendix 1, Site Map) there is an opportunity to switch to a different method of tracking the amount of recycled water that can be irrigated. The weather station is maintained by the United States Bureau of Reclamation (USBR). The "Checkbook Method" for irrigation scheduling was developed by USBR to assist farmers in minimizing the amount of water irrigated and produce good crop yields. The Checkbook Method consists of a series of spreadsheets that are customized for a specific farm. In general, the Checkbook Method uses the following site-specific parameters to calculate the required irrigation rates (USBR, 2012):

1. **Soil Water Storage Capacities -** The amount of water available to the plant, typically expressed in inches/foot). This information is usually available from county Soil Survey maps published by the USDA Natural Resources Conservation Service.
2. **Root Zone Depth -** This depth will change as the crop grows. The depth of the crop's roots during the growing season can be monitored or tables can provide average values.
3. **Management Allowable Depletion -** This value, expressed in percent, is the portion of water in the root zone that plants can utilize before experiencing stress.
4. **Daily Estimates of Crop Water Use -** The AgriMet Weather Station provides this information on a daily basis in the "Crop Water Use Charts". AgriMet uses the 1982 Kimberly-Penman Evapotranspiration Model, combined with locally derived plant growth stage information, to produce estimates of daily crop consumptive water use.

The staff at the facility have discussed with DEQ staff changing from the use of soil moisture probes to the Checkbook Method. The facility staff have requested that they be allowed to irrigate less than what the Checkbook Method would indicate because they contend that they can grow an adequate crop with even less potential for recycled water leaching past the root zone. Alfalfa yields reported in the HARSB 2011 Annual Report varied from 2.1 to 3.3 tons/acre and the 10-year average (2001-2010) for Kootenai County is 2.7 tons/acre (USDA). The facility has historically irrigated less than estimated irrigation water requirements. Reasonable crop yields are also an indication that the crops are being managed for nutrient uptake. The Checkbook Method will help the facility decide when to irrigate.

In past years, the staff irrigated in September at relatively high rates for the time of year but still met the permit limits based on soil moisture probes readings. The problem for the facility in late September is that they have limited storage in the lagoon (8 million gallons), influent flow rates are about 1.2 mgd and crop irrigation water requirements are lower. This new method will help the staff plan for irrigation in September.

The draft permit will require that for the field crops (alfalfa and oats) the weekly hydraulic loading rates be less than or substantially equal to rates developed using the Checkbook Method with data from the Rathdrum Prairie AgriMet Weather Station (RTHI). The hydraulic loading

rates for the poplars will continue to be based on daily readings from the network of soil moisture probes currently in place and as specified in the 2003 permit.

4.5.2.2 - Nitrogen Loading Rates

Recycled water permits typically include nitrogen loading rate limits of "150% of Typical Crop Uptake" (DEQ, 2007). The 2003 permit limit for nitrogen loading was 125% of crop uptake from all sources (inorganic fertilizer, recycled water and soil) or 125% of the University of Idaho Fertilizer Guide. The allowance for greater than 100% of crop demand accounts for normal losses of applied nitrogen such as gaseous losses, leaching and immobilization (DEQ, 2007). Based on a review of the facility's annual reports since 2008, the facility has generally been in compliance with the permit limit. The nitrogen loading rates for alfalfa have varied between 13 lbs./acre/year to 103 lbs./acre/year. The nitrogen loading rates for poplars have varied between 10 lbs./acre/year to 40 lbs./acre/year and no inorganic fertilizer is applied to the poplars.

The past nutrient balances have not included any correction factor for nitrogen fixation by alfalfa. It is estimated that about 10% to 25% of the nitrogen needed by alfalfa is fixed by the plant from atmospheric nitrogen when the alfalfa is grown with adequate nitrogen available (DEQ, 2007). In addition, the plant available soil nitrogen at the beginning and end of the season has not been used in the nutrient balance calculations.

As discussed in Section 4.8 of the Staff Analysis, Compliance Activity CA-109-01 requires that an "Agriculture Management Plan" be prepared. This plan will describe how the facility is managing the nitrogen loading to the crop to minimize the losses of nitrogen below the root zone and protect ground water quality. Annual Reports will evaluate the field crop nutrient balances for the growing season.

The following items will need to be presented in both the Agriculture Management Plan and Annual Reports for the oats and alfalfa crops:

- Plant available nitrogen in the soil at the start and end of the season
- An alfalfa fixation rate will be used in the nutrient balance calculations for the growing season
- Nitrogen content from the plant tissue analysis and crop yields to estimate the nitrogen removed
- Inorganic nitrogen fertilizer added
- Plant available nitrogen from the irrigation of recycled water added

For the poplars, a nitrogen uptake rate from literature values will need to be used in the analysis.

The draft permit will include a nitrogen loading permit limit for oats and alfalfa that the sum of all nitrogen sources (recycled water, fertilizer, etc.) to be less than or equal to the estimated nitrogen required amounts ($N_{required}$) as shown in the equations below (DEQ, 2007):

- Oats - $N_{required} \leq \frac{N_{crop}}{e_f}$
- Alfalfa - $N_{required} \leq \frac{(1-N_{fixation}) * N_{crop}}{e_f}$

Where:
$N_{required}$ = plant available nitrogen loading rate (lbs./ac)
N_{crop} = nitrogen content in both harvested and unharvested above-ground portions of the crop (lbs./ac)
e_f = crop uptake efficiency factor (0.60 for oats and 0.75 for alfalfa)
$N_{fixation}$ = proportion of alfalfa nitrogen fixated (between 0.10 to 0.60)

The draft permit will include a nitrogen loading permit limit for poplars that the sum of all nitrogen sources be less than or equal to the following:

- Poplars - 150% of crop uptake based on literature values

4.5.2.3 - Phosphorous Loading Rates

The 2003 permit included a maximum phosphorous loading limit of 125% of crop uptake or 125% of the University of Idaho Fertilizer Rates. Based on a review of the facility's annual reports since 2008, phosphorous loading rates have generally been in compliance with the permit limit and varied between 1.5 to 24 lbs./acre/year. There are no nearby surface waters that could be impacted by phosphorous leaching into the ground water. The nearest downgradient (southwest to south-southwest) surface water is the Spokane River and it is more than 6 miles away. The Spokane River loses water to the Aquifer in Idaho so it would be about 16 miles before the ground water under the HARSB farm would enter the river.

The facility has demonstrated that if nitrogen loading rates are managed properly, phosphorous is also applied at reasonable rates. Maximum nitrogen loading rates permit limits will be included and therefore phosphorous will also be controlled.

The draft permit will not include a maximum phosphorous loading rate. Phosphorous loading rates will be reported in the annual reports. Total phosphorous will be added to the ground water monitoring parameters to determine if there are changes in the total phosphorous concentrations in the ground water across the site.

4.5.2.4 - Chemical Oxygen Demand (COD) Loading Rates
See the 2003 Staff Analysis in Appendix 2 for a discussion of why permit limits are not needed for COD.

4.6. Buffer Zones and Site Management

HARSB proposes to apply Class C recycled water to the irrigated acreage. The same buffer distances exist from the irrigation site to major features as in the 2003 permit (see Table 2). The current disinfection permit limit for this facility requires that the median number of total coliform organisms to not exceed 2.2 CFU/100 ml. as determined from the bacteriological results of the last five (5) days for which analyses were completed and no single sample can exceed 23 CFU/100 ml. in any confirmed sample. HARSB has requested a change to the total coliform permit limit to 23 CFU/100 ml. and 230 CFU/100 ml., respectively.

Table 2 lists the approximate distances from the irrigation site to major features.

Table 2 Distance to Major Features*

Feature	Site
Public wells	About 1 mile
Private well	186 feet (upgradient, (Golder, 2006))
Boekel Road	15 feet
Inhabited Dwelling	100 feet (from drip irrigation) and 330 feet (from center pivot)
Residential Property Line	50 feet

* At closest point

As shown in the Site Map in Appendix 1, the poplar trees are generally around the perimeter of the farm on the west, north and east. The poplars are drip irrigated which reduces the potential wind drift that can occur with center pivots. As presented in the "Buffer Zone Guidance" (DEQ, 2007), the recommended buffer distances from the irrigation site to inhabited dwellings are 50 feet for drip irrigation (also call "furrow" in the Guidance) and 300 feet for sprinkler irrigation with a disinfection level of 23 CFU Total Coliform/100 ml. Table 2 above shows that these buffer distances exist with the current configuration of the irrigation site and homes constructed near-by.

A change to the 23 CFU/100 ml. total coliform limit from the current permit limit of 2.2 CFU/100 ml. limit requires the irrigation site to be fenced.

It is recommended that private wells be at least 500 feet from an irrigation site to protect the well from contamination (DEQ, 2007). This general requirement is used when there is no information about ground water flow direction and other aquifer characteristics. The homes to the north and east of the irrigation site have private domestic wells and the closest is estimated to be about 120 feet from the irrigation site (to the north along Boekel Road). The flow of ground water has been evaluated for this irrigation site and determined to be southwest and south, southwest (Golder, 2006). Therefore, the risk of negatively impacting these domestic wells is low because they are upgradient from the irrigation sites.

In addition, the Ahrens Domestic Well (north of Boekel Road) has been sampled as an upgradient well since 2004 and the Annual Reports do not indicate any impacts from the irrigation of recycled water by HARSB (HARSB, 2008-2011).

The draft permit will include the disinfection requirements listed in the Idaho Recycled Water Rules (IDAPA 58.01.17.601.03) for Class C Recycled Water. The permittee will fence the entire irrigation site with a three-wire pasture fence or equivalent and this is proposed as a permit condition. Therefore the median number of total coliform organisms cannot "exceed twenty three (23) per one hundred (100) milliliters, as determined from the bacteriological results of the last five (5) days for which analyses have been completed". In addition, "no sample shall exceed two hundred and thirty (230) per one hundred (100) milliliters in any confirmed sample". Signs must be posted around the perimeter and state "Warning: Recycled Water-Do Not Enter" or equivalent. Berms and other BMPs shall be used to protect the well head of on-site wells.

The recommended minimum buffer distances are as follows:

- 300 feet from the center pivot-irrigated fields to inhabited dwellings
- 50 feet from the drip irrigation acreage to inhabited dwellings
- 0 feet from irrigation site to areas accessible by the public
- 100 feet from irrigation site to permanent and intermittent surface water
- 100 feet from irrigation site to private domestic water supply wells (upgradient from the irrigation site – north of Boekel Road and east of N. Atlas Road)
- 500 feet from irrigation site to private domestic water supply wells if not upgradient from the irrigation site
- 1,000 feet from irrigation site to public water supply wells

4.7. Lagoon Seepage Testing

The eight (8) million gallon storage lagoon at the HARSB farm was seepage tested in June 2011. The results indicated that the lagoon may be leaking at rates between 8,100 to 13,700 gallons/day (see 7/21/11 DEQ letter). The measured seepage rates (0.13 to 0.22 inches/day) were less than the maximum allowable seepage rate of 0.25 inches/day. The lagoon was constructed using two (2) HDPE liners and there is an underdrain system between the liners that can be checked to see if the upper liner

is leaking. Lagoon seepage rates of the magnitude measured could result in ground water quality impacts. A compliance activity will be included to evaluate if the estimated seepage rates are occurring and potential impacts.

4.8. Compliance Activities

CA-109-01: The facility's Plan of Operation (also known as an Operations and Maintenance, or O&M, Manual) requires modification as operations and regulatory requirements change. In Section E of the draft permit, Compliance Activity CA-109-01 requires the facility to submit for DEQ review and approval a revised Plan of Operation which includes, but is not limited to, all of the applicable information required by the latest revision of the Plan of Operation Checklist in the Reuse Program Guidance. The plan will include the following:

- Runoff Management Plan - Administrative and engineering controls for preventing recycled water runoff from the site.
- Quality Assurance Project Plan (QAPP) – An updated QAPP for all monitoring activities required by this permit
- Agriculture Management Plan – This covers the procedures to be followed for scheduling irrigation, fertilizer rates, cropping strategies and crop rotation
- Site Instrumentation Plan – This covers an update of the previously developed plan. The plan includes how to use all monitoring instruments and the procedures for calibration.

CA-109-02: As discussed in Section 4.7 above, lagoon seepage rates reported from the June 2011seepage testing of the storage lagoon could have an impact on ground water quality. Compliance Activity CA-109-03 will require that a report evaluating this potential impact be submitted to DEQ for review and approval. The report will also discuss whether the facility is in compliance with the Idaho Ground Water Quality Rule as it relates to seepage from the lagoon. For the full text of the condition, see Compliance Activity CA-109-02, Section E of the draft permit.

CA-109-03: Per Subsection 300.01 of the Recycled Water Rules (IDAPA 58.01.17), any facility that intends to continue to operate as a recycled water facility must have a permit issued by DEQ. Subsection 400.01 of the Rules requires that a permit application be submitted to DEQ at least one hundred and eighty (180) days prior to the expiration of the facility's current permit. Compliance Activity CA-109-03 is proposed to cover this requirement.

5. RECOMMENDATION

Based on review of applicable state rules, staff recommends that DEQ issue draft recycled water permit WRU M-0109-04 for a public review and comment period. The draft permit contains effluent quality requirements for the recycled water treatment system, as well as terms and conditions required for operation of the reuse system in Section F. Monitoring and reporting requirements to evaluate system performance and to determine permit compliance have been specified in Sections G and H, and compliance activities have been incorporated into Section E of the permit.

6. REFERENCES CITED

Hayden Area Regional Sewer Board (HARSB), 2008, Wastewater Reuse Permit Renewal Application, March 20, 2008.

Allen, Richard G. and Clarence W. Robison, 2006 (Revised 2007). Evapotranspiration and Consumptive Irrigation Water Requirements for Idaho, Research Technical Completion Report, Kimberly Research and Extension Center, University of Idaho, Moscow, ID

DEQ, 2007. Department of Environmental Quality, Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater. September 2007.

Golder Associates, Inc., October 2006, "Well Sampling and Water Quality Evaluation, Data Review, Proposed Monitoring Well Construction and Data Collection Plan for the HARSB Wastewater Land Application Site".

HARSB, 2011. Hayden Area Regional Sewer Board, 2011 Water Reuse Report.

HARSB, 2010. Hayden Area Regional Sewer Board, 2010 Water Reuse Report.

HARSB, 2009. Hayden Area Regional Sewer Board, 2009 Water Reuse Report.

HARSB, 2008. Hayden Area Regional Sewer Board, 2008 Water Reuse Report.

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Web Soil Survey. Available online at http://websoilsurvey.nrcs.usda.gov/app/ accessed December 2011.

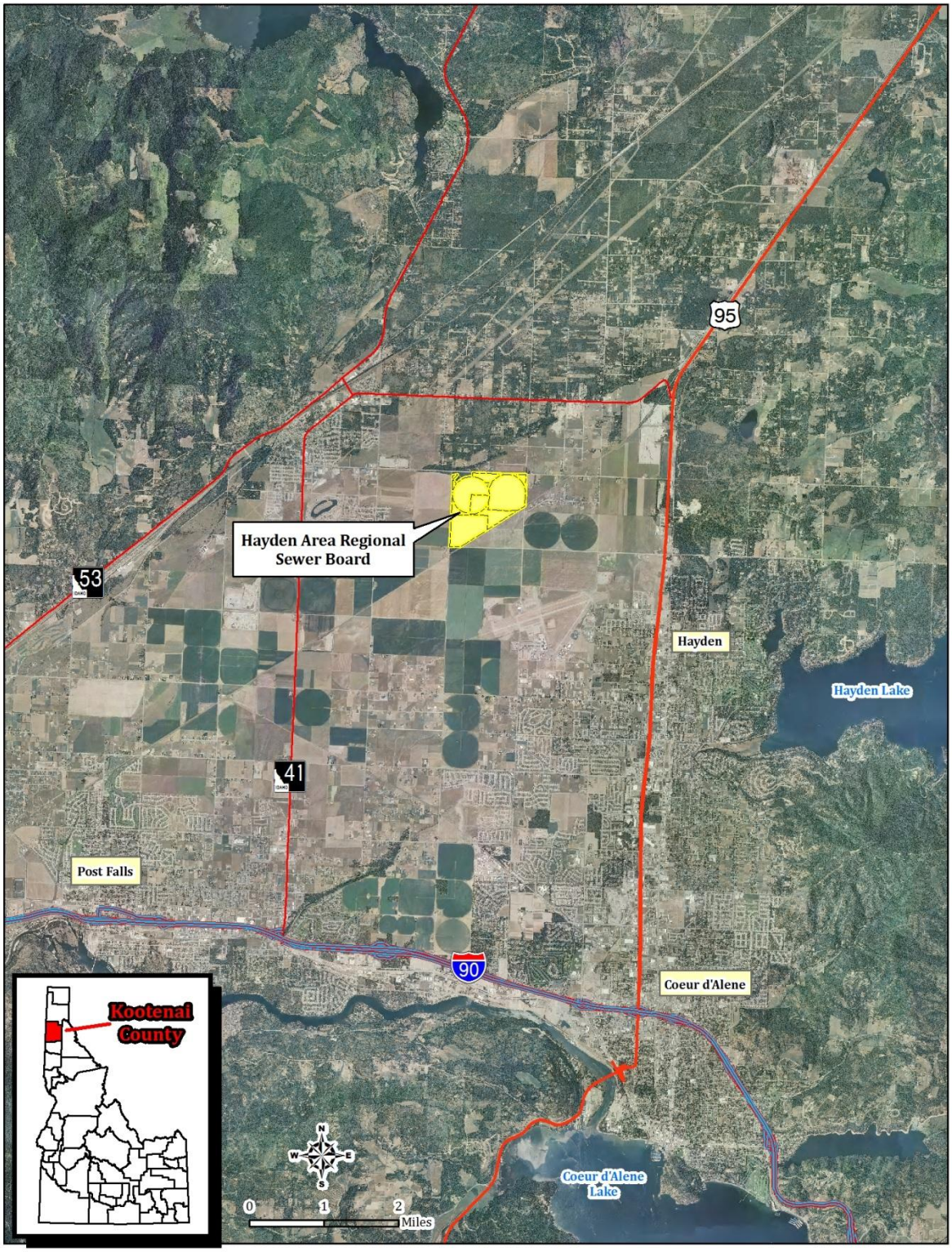
USDA-SCS, 1981. United States Department of Agriculture-Soil Conservation Service. Soil Survey of Kootenai Area, Idaho, April 1981.

USDA. National Agricultural Statistics Service.
http://www.nass.usda.gov/Statistics_by_State/Idaho/Publications/County_Estimates/index.asp

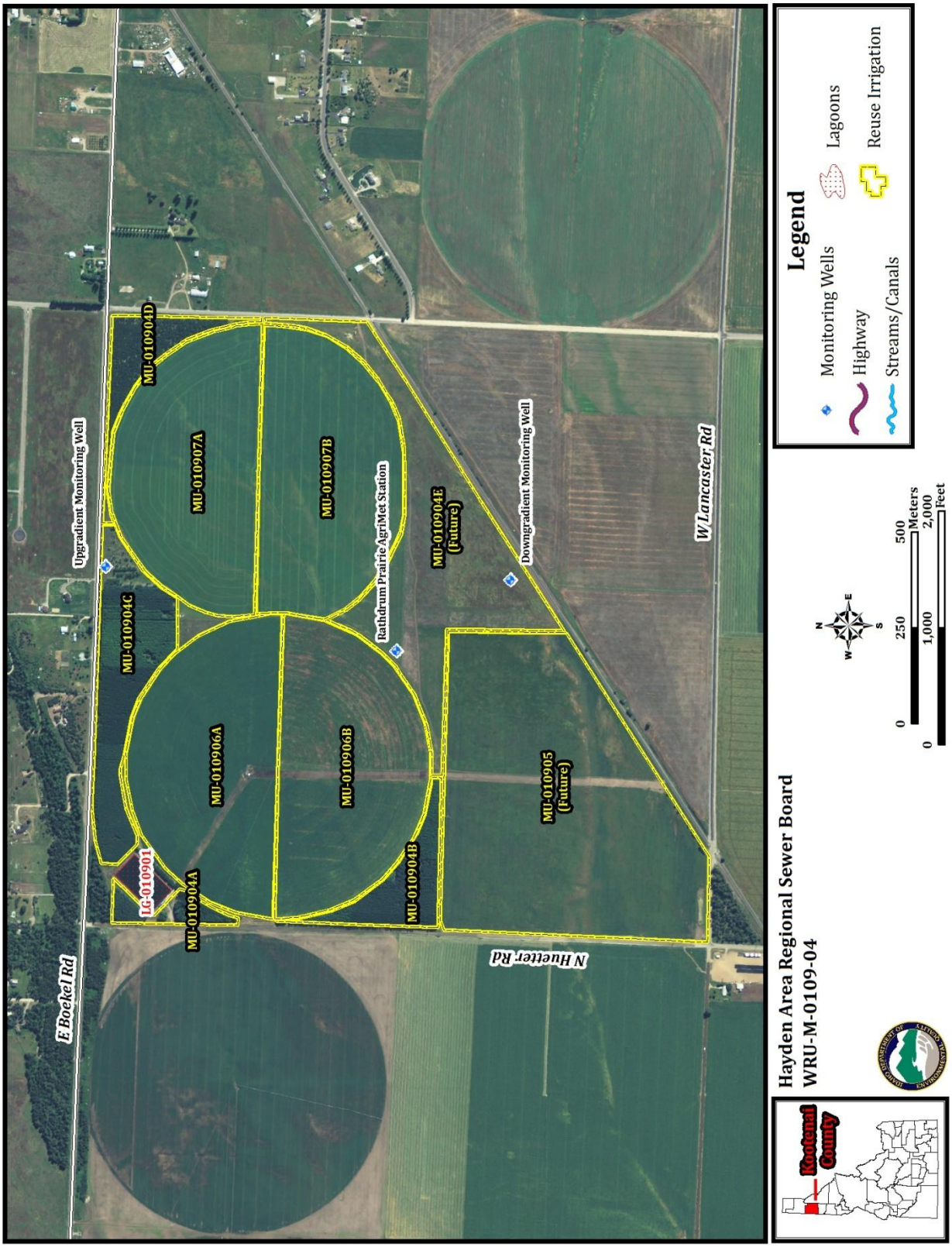
U.S. Bureau of Reclamation (USBR), AgriMet- The Pacific Northwest Cooperative Agricultural Weather Network.
Available online at http://www.usbr.gov/pn/agrimet/irrigation.html accessed May 2012

TRIM Record 2012AGH299

Appendix 1
Vicinity Map



Appendix 1
Site Map



Appendix 2
2003 HARSB Staff Analysis

Revised 8/6/03

M E M O R A N D U M

TO: Richard Huddleston, P.E., Wastewater Program Manager

FROM: John Tindall, P.E., Staff Engineer

SUBJECT: Staff Analysis of the Hayden Area Regional Sewer Board Wastewater Land Application Permit (Coeur d'Alene), LA-000109-03 (Municipal Wastewater) - Coeur d'Alene Watershed

Summary

The Hayden Area Regional Sewer Board (HARSB) provides wastewater collection and treatment services for several areas immediately north of the City of Coeur d'Alene. HARSB has an existing Wastewater Land Application Permit (LA-000109-02). Currently 282 acres are irrigated. The site is over the Spokane Valley-Rathdrum Prairie Aquifer, an EPA designated sole source aquifer. The District predicts that the current amount of irrigated acres will be adequate until the next permit is issued in five (5) years. Staff recommendations include wastewater sampling, instrument-based application rates, groundwater monitoring, and soil/plant tissue sampling.

Purpose

The purpose of this memorandum is to satisfy the requirements of IDAPA 58.01.17.400.04 (Wastewater-Land Application Permit Regulations) for issuing land application permits. It states the principal facts and significant questions considered in preparing the draft permit conditions or the intent to deny, with a summary of the basis for the draft conditions or denial with references to applicable requirements and supporting materials.

General Background

The Hayden Area Regional Sewer Board (HARSB) is a Joint Powers Agreement of Kootenai County, the City of Hayden, and Hayden Lake Recreational Water and Sewer District that provides wastewater collection and treatment services for the area immediately north of the City of Coeur d'Alene. The HARSB wastewater treatment plant (WWTP) treats domestic sewage to secondary standards using an oxidation ditch (extended aeration), and it is designed to treat flows up to 1.5 million gallons per day (MGD). The treatment plant effluent is discharged to the Spokane River part of the year and diverted to the land application system during the growing season. Blue grass, timothy grass, alfalfa and poplar trees are irrigated with the treated wastewater. An 8-million gallon lagoon at the land application site provides storage when the land application site is too wet. The current flows are about 1 MGD.

Under the provisions of the HARSB NPDES permit, the treatment plant may discharge treated effluent to the Spokane River from October 1 through May 31 and may discharge treated effluent to the Spokane River from June 1 through September 30 only when the river flow is 2,000 cfs or greater. For the five (5) year period covered by this permit, HARSB proposes to land apply wastewater on about 350 acres of the

476-acre site owned by HARSB (304 acres are currently being irrigated). In May 2003, HARSB received approval of the plans and specifications to add an 22 acres of poplar trees along the north border of the site starting at the northwest corner. It will take 1-2 years before these trees start uptaking substantial amounts of wastewater. For the 5-year period covered by this permit, HARSB has requested that 350 acres be included as irrigated area but only 304 acres has been approved for irrigation when the permit was written. DEQ approval will be required for any additional acreage proposed to be irrigated.

Since 1991, HARSB and DEQ have worked closely on the Rathdrum Prairie Wastewater Land Application project, a partially government funded cooperative pilot program to evaluate the effects of wastewater land application over the Spokane Valley-Rathdrum Prairie Aquifer (Rathdrum Aquifer), an EPA designated sole source aquifer. HARSB was issued a wastewater land application permit (LA-000109-01) in 1992 for an 18-acre site near the Coeur d'Alene airport, and a consultant evaluated that site for two growing seasons (1992 and 1993). The study, completed in 1994, found that wastewater could be applied over this protected aquifer without measurable impacts if the application was carefully controlled and monitored.

A second wastewater land application permit was issued March 1, 1996 (#LA-000109-02). The Board has been operating under this permit although it expired March 1, 2001.

The Board submitted a permit renewal application on April 11, 2001. After review of this application and some meetings, the application was determined to be complete on June 7, 2002. Based on these discussions, there will be some changes in the monitoring requirements from the previous permit.

Wastewater and Land Application Systems Description

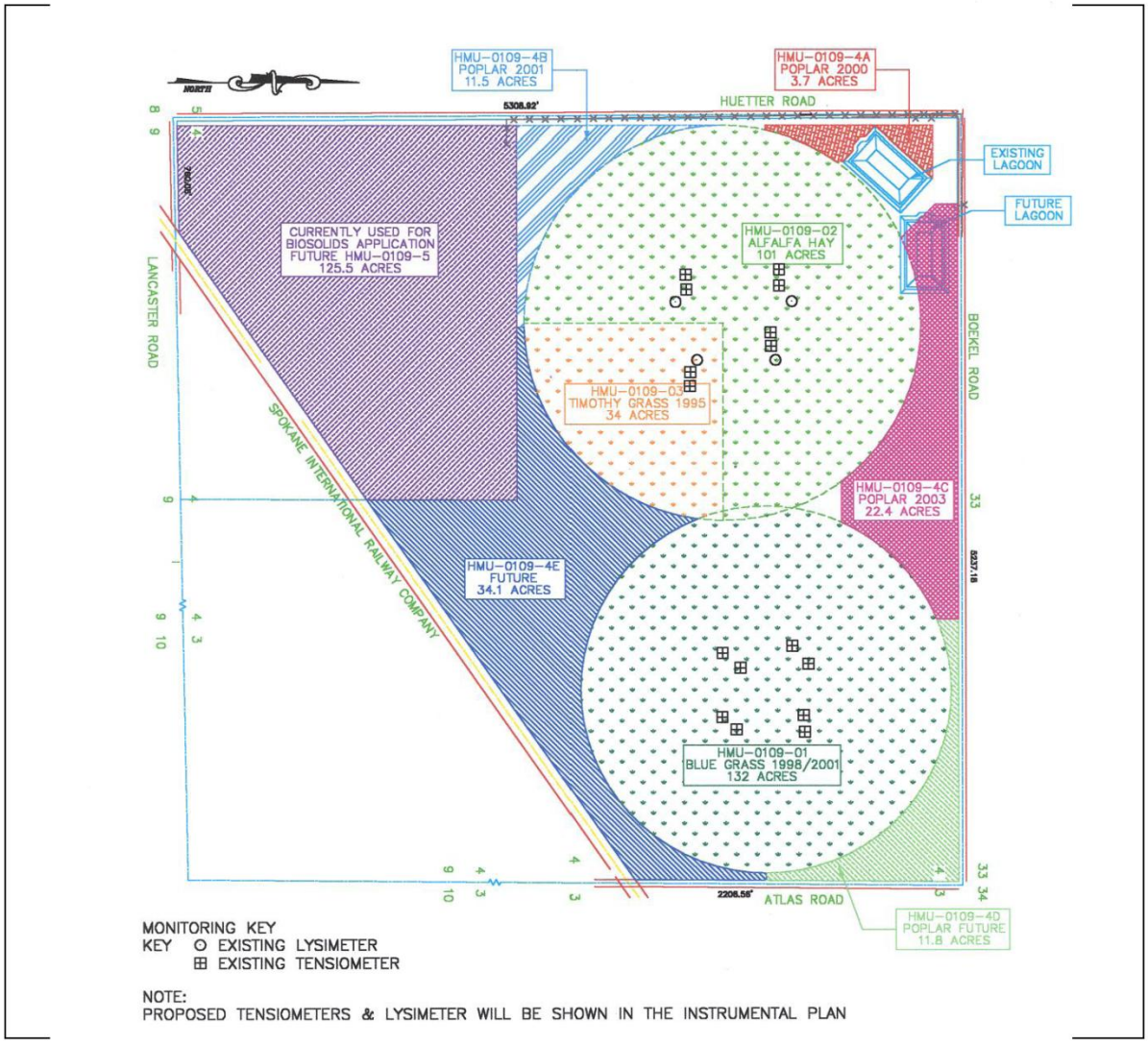
The HARSB wastewater plant treats both septic tank effluent and raw sewage using extended aeration in oxidation ditches achieving secondary treatment. During the period when river discharge is not allowed, the treatment plant effluent will be pumped to a storage lagoon on the land application site, and soil moisture probes will determine whether the fields require irrigation (readings of greater than 10 centibars). An 8-million gallon (MG) storage lagoon, with a double synthetic liner system, has been constructed and space is provided on the site for a second 8-MG lagoon. The disinfection system is gas chlorine with flow pacing. The HARSB proposes to meet an advanced secondary disinfection level (2.2 total coliform organisms per 100 ml). The WWTP staff has reduced the detention time through the treatment process and the result has been higher concentrations of ammonia in the effluent. The ammonia reacts with the chlorine to form mono- and dichloramines that are strong oxidizers. During the 2001 irrigation season, the facility consistently met the 2.2 total coliform limit by sampling prior to prior to discharge into the storage lagoon. As allowed per the regulations (58.01.17.600.07), the disinfection limits need to be met "at some location in the treatment process". Sampling from the center pivot has resulted in past permit violations due to regrowth in the lagoon. The regrowth may be due to wildlife (birds) that land in the lagoon.

Application Site Characterization

The proposed land application area includes 304 acres of the 476-acre parcel located in an existing agricultural area on the Rathdrum Prairie approximately three miles west from the City of Hayden (see "Land Application Site Map" on pg. 3). It is bounded on the north by Boekel Road, on the west by Huetter Road, on the east by Atlas Road, and on the south by railroad right-of-way. The most direct route to the site is from Boekel Road, approximately 2.5 miles west of Highway 95. This site is presently

RE: Staff Analysis, HARSB WLA Permit #LA-000109-03
August 6, 2003
Page 3

Land Application Site Map



SITE MAP
N.T.S.

planted in alfalfa (101 acres), timothy grass (34 acres), bluegrass (132 acres) and poplar trees (15 acres). In April 2003, HARSB submitted a proposal to add an 22 acres of poplar trees along the north border of the site starting at the northwest corner. The total acreage of poplar trees will be assumed to be 37 acres. The site slopes from east to west with an average slope less than 7%.

The Soil Conservation Service (SCS) map of this site show one dominant soil, Avonville (103) fine gravelly silt loam (0 to 7 percent slopes), and two other soils are found in narrow bands on the site: Avonville (104) fine gravelly silt loam (7 to 20 percent slopes) and Narcisse (156) silt loam (0 to 5 percent slopes). Both soils are deep and well drained. For calculations, the dominant soil parameters will be used. A surface soils investigation was conducted in 1994 by a geotechnical consultant hired by HARSB substantiates the SCS mapping. The soils investigation indicates that the soils meet minimum criteria for wastewater land application.

The bluegrass and alfalfa/timothy grass are irrigated using two (2) center pivots (1,295' and 1,253' long according to Amber Hall of HARSB covering 1,395' and 1,353', respectively, with the end guns). The poplars are irrigated using drip emitters spaced along the row of trees.

Proposed Application Site Buffer Zones

With an advanced secondary disinfection level (2.2 total coliform colonies/100ml), no buffer zone between the site and public access is needed and site fencing is not required. A summary of the current recommendations and the actual buffer zones from the proposed spray irrigation area with advanced secondary disinfection is provided in the Table 109-A.

Table 109-A
HARSB Buffer Zone Summary

	Currently Recommended	Actual Distance
nearest inhabited dwelling	100 ft	≅150 ft
public water supply (see pg. III-23 in "1988 Guidelines for Land Application of Municipal and Industrial Wastewater" found in the "Handbook for Land Application of Municipal and Industrial Wastewater, April 1996")	1,000 ft	1 mile
private water supply (see pg. III-23 in "1988 Guidelines for Land Application of Municipal and Industrial Wastewater" found in the "Handbook for Land Application of Municipal and Industrial Wastewater, April 1996")	500 ft	186 ft (upgradient)
public accessibility	0 ft	50 ft
surface water	100 ft	> 1 mile
temporary surface water	100 ft	> 1 mile

Several residences are located on the north side of Boekel Road across from the proposed site. The Board maintains a 50-foot buffer zone from Boekel Road for the spray irrigation center pivot where no irrigation

occurs. This buffer plus the road right-of-way places these homes over 100 feet from the irrigated area on the site. According to the Figure 1 in the April 2001 permit application, the nearest residence to the irrigation site boundary is 300 feet and this is along Boekel Road. The revised "Site Map" submitted by HARSB in June 2003 does not indicate the distance to the nearest home. Jim Taccogna, superintendent for the HARSB WWTP, said that the distance has been measured to be about 150' to the nearest home (Dole residence). If the Board ever proposes to change to a disinfection limit of 23/100 ml. total coliform, the distance from the homes would need to be verified and a fence installed. The proposed 22 acres of poplar trees will be planted along the north property line as shown on the "Land Application Site Vicinity Map". The buffer distance between homes and the trees will still be greater than 100 feet. No fence is proposed to be installed on the north boundary for these new trees.

The only variance from buffer zone guidelines found in the previous table is the separation distance from private water supply wells. There are some private domestic wells located within approximately ¼ mile of the land application site. The closest well, as shown in Table 109-B below, is the Dole Well (formerly called the Mejie Well).

Table 109-B
HARSB Land Application Site Domestic Well Location

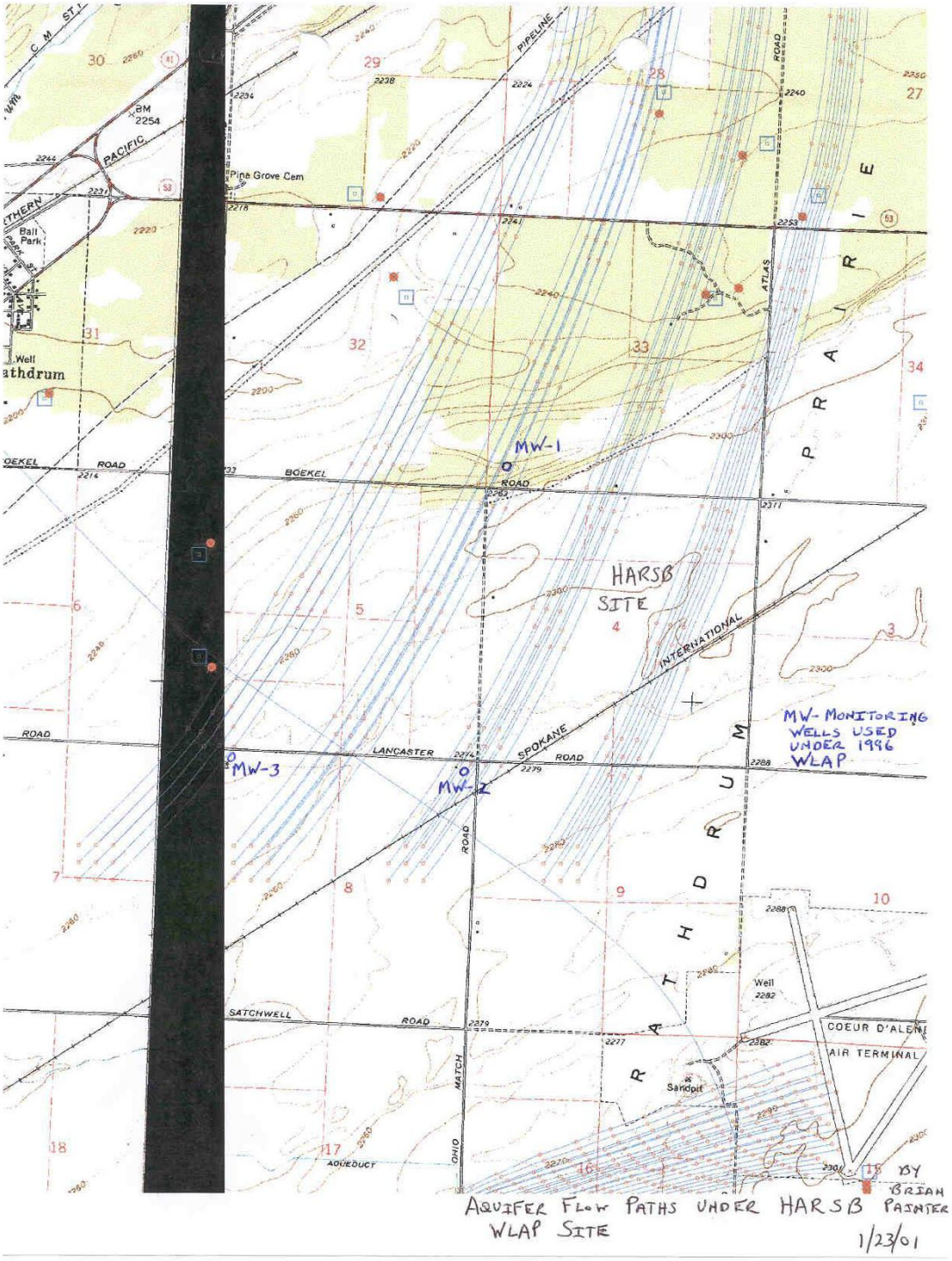
Well	Property Owner	Direction	Distance	Aquifer
2	Dole (Mejie)	north	186 ft	upgradient
7	Meyer	southwest	440 ft	downgradient

The Dole Well is located upgradient from proposed land application site in the aquifer flow because it is located north of Boekel Road (see attached modeled flow paths). Capture zone analyses previously performed by the HARSB's engineer show that this well will not be affected by wastewater land application activities. However, the Meyer Well (Well #7), has a capture zone within the portion of the aquifer under the land application site.

A mixing zone analysis was performed for Well #7 by the HARSB's engineer using a worst case condition: full application site development (1.5 MGD application rate) and conservative (higher than expected) constituent values. This analysis showed a small increase in groundwater constituent values, but these values remained well below drinking water standards. Well #7 has historically been included in the monitoring system and the 2002 results did not show anything unusual.

In the draft "Staff Analysis" prepared in December 2002, it was recommended that the new permit include a requirement for the Board to install a groundwater monitoring system located on the site. This network of at least three (3) wells (1 upgradient and 2 downgradient) would have been used instead of the current groundwater monitoring network of four (4) domestic wells and one (1) irrigation well. The installation of dedicated monitoring wells would allow for the collection of representative groundwater samples and improve the ability to detect impacts to the drinking water supply from the application of wastewater. The Board will be using this land application site for many years and data gathered from domestic wells is usually of limited value for determining impacts to groundwater from activities. During the internal DEQ review of the draft permit and "Staff Analysis", DEQ Director, Steve Allred, recommended that only one (1) downgradient monitoring well should be required and that domestic wells be used for the other downgradient well and upgradient well. The Meyer's well (#7 in Table 109-B above) could be used for the other downgradient well and a new upgradient domestic well will need to be

RE: Staff Analysis, HARSB WLA Permit #LA-000109-03
August 6, 2003
Page 6



used. Appendix 'B' includes a memo written by Joe Baldwin of DEQ dated 3/27/03 that explains the how the groundwater monitoring program should be set-up. This memo will serve as the basis for the groundwater monitoring requirements included in the permit.

Wastewater Quantity

Presently, wastewater flows from the HARSB treatment plant average about 0.9 MGD. Flows are predicted to increase to about 1.13 MGD by the year 2007 (according to Jim Kimball's 5/1/02 submittal). The HARSB wastewater flows are presented in Table 109-C. The season flows are computed using a 198 day application period (April 1 through October 15). HARSB requested in a 6/27/03 letter to DEQ that the application season also include April. Based on theoritical crop water needs, only a small volume of wastewater can be applied in April and October. Unlike many seasonal land applications in North Idaho, there is not a large volume of wastewater stored to be land applied during the growing season. The wastewater to be land applied is approximately what is generated during the growing season. Given the flexibility in both the NPDES permit and land application permit, land application sometimes does not occur until late in June and goes into October.

Table 109-C
HARSB Estimated Wastewater Flows

	Daily Flow	Season Flow
Existing Flow (2002)	0.9 MGD	178 MG
Year 2007 Flow	1.13 MGD	224 MG
Ultimate Design Flow	1.5 MGD	297 MG

Wastewater Quality

The HARSB proposes to land apply effluent from their secondary treatment plant. Results of effluent sampling are shown in Table 109-D together with the values used in this analysis. Trace metal analysis for 1993 showed values below the levels in the State drinking water standards, reflecting the absence of industrial contributions to the HARSB system. Tests in 1993 for synthetic organics showed all concentrations below the laboratory detection limit (0.05 parts per billion). The 1999 NPDES permit required monthly effluent metals testing for zinc, cadmium and lead. No data has been collected on Chemical Oxygen Demand (COD) values because BOD is run weekly for the NPDES permit and BOD testing was required under the previous land application permit.

Table 109-D HARSB Wastewater Quality Values		
Constituent	Average Values (From HARSB data)	Analysis Values (DEQ Staff Estimates)
Biological Oxygen Demand (BOD)	10 mg/l	10 mg/l
Chemical Oxygen Demand (COD)	-	20 mg/l
Total Dissolved Solids (TDS)	395 mg/l	-
Ammonia-Nitrogen	12 mg/l	-
Nitrate-Nitrogen	15.0 mg/l	-
Total Nitrogen	21 mg/l	30 mg/l
Total Phosphorus	5 mg/l	5 mg/l
Total Coliform Bacteria	2.2/100ml	2.2/100ml

Wastewater Loading Rates

The projected hydraulic application rates of 1.13 MGD will result in application site loading values shown in Table 109-E using the proposed maximum allowable 168-day application season (May 1 through October 15) and 304 acres, assuming that wastewater is evenly distributed to all the fields. Actual hydraulic application rates and the constituent loading rates will vary between the fields with the different crops but for the purpose of evaluating potential loadings, a uniform hydraulic application rate is assumed in Table 109-E. With the current acreage, the amount of wastewater generated cannot be applied or stored in the lagoon in April or October to eliminate the need for discharging to the Spokane River. By using all 15 days of October in the loading calculations, the estimates are conservative.

Table 109-E Annual Constituent Loadings (0.625 MG per acre per application season- Q=1.13 MGD w/304 acres)			
Constituent	HARSB WWTP Data Values (pounds per acre)	DEQ Staff Estimates (pounds per acre)	Guideline Allowable Loading Rates
Biological Oxygen Demand (BOD)	52 lbs./acre	52 lbs./acre	
Chemical Oxygen Demand (COD)	-	0.62 lbs./acre/day	50 lbs./acre/day
Total Dissolved Solids (TDS)	2,057 lbs./acre		
Total Nitrogen	109 lbs./acre	156 lbs./acre	125% of est. crop uptake
Total Phosphorus	26 lbs./acre	26 lbs./acre	125% of est. crop uptake

The estimated constituent loadings in Table 109-E for COD is well below the DEQ "Guideline Loading Rates". The COD loading is estimated to be less than 1 lbs./acre/day and effluent testing for this parameter will not be required.

The total nitrogen and phosphorous requirements for the four (4) crops vary depending on the source of the information. For bluegrass, staff proposes to use 190 lbs./acre of N as the demand ("North Idaho Fertilizer Guide, Bluegrass Seed", University of Idaho, Current Information Series #788). Based on limited soil data, the available nitrogen from the soil could be as high as 158 lbs./acre leaving only 32 lbs./acre to be provided by fertilizer (inorganic or wastewater). The farmer says he applies 136 lbs./acre of N (inorganic fertilizer) applied in the fall. Using the DEQ rule-of-thumb for nutrient application through wastewater of 125% of the crop uptake, the nitrogen that can be applied is 237 lbs./acre (190 x 1.25). Depending on how the information is viewed, the application of wastewater at the proposed loading rate may be in excess of the bluegrass nitrogen requirements. This question will be answered through Staff's proposed permit requirement to monitor soil and plant tissue and use this information along with the wastewater nutrient content to determine the amount of inorganic fertilizer to be applied (this will be discussed later in the "Staff Analysis"). For phosphorus, based on limited soil testing, the crop demand is estimated to be 18 lbs./acre of P ("North Idaho Fertilizer Guide, Bluegrass Seed", University of Idaho, Current Information Series #788). The amount of P applied through the wastewater may be in excess of this crop requirement. The soil/plant tissue monitoring will allow this question to be evaluated.

For alfalfa hay, 300 lbs./acre ("1992 Census of Agriculture", refer to the following website: http://www.nhq.nrcs.usda.gov/land/pubs/nlapp1a.html) is the estimated uptake based on 6 ton/acre yields (from Bob Dole, the farmer of the HARSB fields) and the recommended 50.4 lbs./ton uptake from the reference. Another reference recommends only applying nitrogen fertilizer during the seeding at 25-35 lbs./acre ("North Idaho Fertilizer Guide, Alfalfa", University of Idaho, Current Information Series #447). Bob Dole, the farmer who farms HARSB's fields, applies 39 lbs./acre of N over three (3) applications during the growing season. Referring back to Table 109-E, it is difficult to determine if the application of wastewater is applying an excess of nitrogen to the alfalfa crop. Again, the proposed soil/plant tissue sampling will allow this question to be evaluated. Recommended phosphorous application rates vary from 28 lbs./acre ("1992 Census of Agriculture") to 18 lbs./acre ("North Idaho Fertilizer Guide, Alfalfa", University of Idaho, Current Information Series #447). Using DEQ's rule-of-thumb for nutrient application rates of 125% of the crop demand, the allowable application rates would vary between 23-35 lbs./acre. Referring back to Table 109-E, the amount of phosphorous applied through the wastewater will not be in excess of the phosphorus demand.

For timothy grass, the annual average nitrogen and phosphorous uptake is estimated to be 205 lbs./acre and 28 lbs./acre, respectively, based on Warren Dole's estimated yield of 5 tons/acre (Fonnesbeck et al (1984) and Part 651, "Agricultural Waste Management Field Handbook"). Using DEQ's rule-of-thumb for nutrient application rates of 125% of the crop demand, the allowable nitrogen and phosphorous application rates would be 256 lbs./acre and 35 lbs./acre, respectively. Referring back to Table 109-E, the amount of nitrogen and phosphorous applied through the wastewater will not be in excess of the crop requirements. This does not take into account the nutrients available through the soil.

For the poplar trees, the annual average nitrogen uptake is estimated to be 264-352 lbs./acre (Process Design Manual, Land Treatment of Municipal Wastewater, October 1981). Some of that will be provided through the soil and the breakdown of leaves. Soil/plant tissue monitoring is not proposed in the areas where poplars are being grown because no inorganic fertilizer is applied. The DEQ rule-of-thumb

allowable application rates are 330-440 lbs./acre/yr. At the proposed loading rates shown in Table 109-E, the amount of nitrogen applied through the wastewater will not be in excess of the nitrogen demand. Phosphorous requirements for trees are estimated to be about 20 lbs./acre (see DEQ guidance titled "WLAP Permit Nutrient Limits, How to Determine Compliance", April 2002). The DEQ rule-of-thumb allowable application rate is 25 lbs./acre. At the proposed loading rates shown in Table 109-E, the amount of phosphorous applied through the wastewater will be close to the estimated phosphorus demand. Soil nutrients have not been considered in this discussion.

In summary, the only constituent of concern is nitrogen at the hydraulic loading rate proposed of about 0.96"/week (1.13 MGD on 304 acre) for bluegrass and alfalfa. Due to the uncertainties associated with the theoretical crop demands, soil/plant tissue monitoring will be proposed to try to understand if wastewater and/or inorganic fertilizer applications are being applied in excess of the crop demands. The previous permit (LA-000109-2) included requirements for soil water monitoring through lysimeters. The data collected over the past 6 years from the lysimeters has been difficult to interpret largely due to the uncertainties about the amounts of inorganic fertilizers applied by the farmer, Warren Dole. HARSB was not coordinating with the farmer to carefully consider the amount of inorganic fertilizer applied and minimize the amount of nitrogen leached into the lysimeters. Some of the nitrate concentrations found in the soil water were higher than the nitrate and total nitrogen concentrations in the wastewater.

After discussions in February 2002 with HARSB, Warren Dole and Dave Brown of the Kootenai-Shoshone Soil & Water Conservation District, it was decided that a combination of soil testing and plant tissue testing would be used along with the nutrient concentrations in the wastewater to determine how much inorganic fertilizer should be applied. The lysimeter testing would be discontinued. The new approach will look at the inputs and outputs to the site in an attempt to see if excess nutrients could be leaching past the root zone. In addition, HARSB will also be required to implement a comprehensive groundwater monitoring program that will include at least one dedicated downgradient groundwater monitoring well and a downgradient and ugradient domestic well suitable for use as monitoring wells.

Wastewater Land Application Over the Spokane Valley-Rathdrum Prairie Aquifer

Wastewater land application over the Spokane Valley-Rathdrum Prairie Aquifer, an EPA designated sole source aquifer, is guided by DEQ *Special Supplemental Guidelines for Spokane Valley-Rathdrum Prairie Aquifer Wastewater Land Application, January, 1995 (Special Guidelines)* which is a supplement to the DEQ *Interpretative Supplement to the Guidelines for Land Application of Municipal and Industrial Wastewater, April, 1994 draft (Interpretative Guidance)*. The application rates and conditions recommended in the *Special Guidelines* are summarized below:

- The "design wastewater application rate" is defined as the estimated crop water requirement minus the effective design precipitation. The "design precipitation" is defined in the guidance as a 5 to 10 year precipitation recurrence (page 8 of the *Special Guidelines*). Effective precipitation is computed as described in the *Interpretative Guidance*. The estimated crop water requirement will vary depending upon the crop. The average and design precipitation monthly totals were recalculated from what is shown on pg. 8 of the *Special Guidelines* based on a review of precipitation data from 1895-2003 for Coeur d'Alene. Five (5) year recurrence periods were used for the design precipitation based on a Gumbel Distribution.

- Since the design wastewater application rate is based on above average precipitation values, supplemental irrigation will usually be needed.

- For daily wastewater application, soil moisture instrumentation will be used to determine application rates and frequency. Soil moisture instrumentation will be installed on the site and will be monitored daily during the application season. The soil moisture threshold is 10 centibars that was used in the past permit. Probes need to be installed such that moisture conditions for each crop can be monitored and each crop will be considered a separate "hydraulic management unit" (HMU) in the permit. At each soil moisture monitoring site, an intermediate probe will be installed in the 'B' horizon (about 24" down) and a shallow probe installed in the 'A' horizon (about 16" down). Poplars of the same maturity need to monitored as separate groups. Staff recommends that if 25% of the probes in the monitoring sites within a HMU have readings of less than 10 centibars, irrigation in that HMU cannot occur. This is a change from the last permit that did not have any allowance for irrigation when any of the moisture probes had readings less than 10 centibars. A revised "Instrumentation Plan" will need to be submitted showing the location of all the probes. Currently there are four (4) moisture probe locations at each center pivot and three (3) locations for the poplars. This should be adequate for the monitoring required with this permit.

- During infrequent extreme climatic conditions when precipitation exceed the design precipitation values, wastewater may be applied at the design rate even if the soil moisture levels are high or saturated soil conditions are present.

For purposes of this analysis, the design wastewater application rate will be estimated and compared with the application information submitted by HARSB to determine if the land application system proposed by HARSB can be operated in accordance with the *Special Guidelines*.

The hydraulic balance prepared by DEQ staff for the HARSB land application system using alfalfa hay, pasture grass and orchard as the crops (these crops have "consumptive use" data found on the Kimberly, U of I web site for the Coeur d'Alene Station) is shown in the tables (A-1 through A-6) in Appendix 'A'. Four conditions were examined for a 6.5 month application period (April 1 through October 15- 198 days) to determine if adequate acreage is available: the average flows for the year 2002 (0.9 MGD) and the projected 2007 flow (1.13 MGD) for both the average and design precipitation. April and May are typically not months that land application would occur because the Spokane River flows are usually high enough to allow effluent discharge. In October, there is not much of a moisture demand. The permit will allow for application from April 1 to October 15 if the soil moisture conditions are met. A summary of the tables in Appendix 'A' is provided in Table 109-F.

Table 109-F
HARSB Annual Hydraulic Balance Summary for All Crops

Condition	Application and Area	Crop Water Needs	Available Effluent	Suppl. Irrigation	Required Storage
2002 Flow with Average Precip.	0.9 MGD 304 acres	238 MG	179 MG	59 MG	0
2002 Flow with Design Precip.	0.9MGD 304 acres	204 MG	179 MG	25 MG	0
2007 Flow with Average Precip.	1.13 MGD 304 acres	238 MG	224 MG	14 MG	0
2007 Flow with Design Precip.	1.13 MGD 304 acres	204 MG	224 MG	(20) MG	20 MG

Based on the information in Appendix 'A', the following conclusions may be drawn:

A) Using the Kimberly (U of I), Coeur d'Alene Station data for crop "consumptive use", "design precipitation" (5 year recurrence period using precipitation data for Coeur d'Alene from 1895-2003) and the 2007 flow (1.13 mgd), the current land application site (304 acres) will provide sufficient area for land application of all the wastewater generated in the months of June, July and August. Under these conditions the existing 8 MG lagoon would be sufficient to provide occasional storage.

B) Using "design precipitation" and 2007 flows, the 304 acres will not be adequate for discharge of all the wastewater generated in April, May and October. The lagoon would not be adequate to handle the excess volume generated. HARSB will continue to have to discharge to the Spokane River during these months under those conditions.

C) The current land application site (304 acres) can be successfully operated in accordance with the requirements in the *Special Guidelines* during the months of June, July and August.

D) There are some conservative estimates made in preparing the hydraulic balance analyses shown in Appendix 'A'. These include HARSB's need to begin land application starting June 1 when in most years a discharge to the Spokane River until mid-June or July is possible. Another is the possibility that mature poplar trees will require more than 23" of water during the four (4) month irrigation season. HARSB will again be required through the permit to monitor soil moisture using 10 centibars as the compliance threshold for determining if daily applications can occur. The value of the hydraulic balance analysis in this case is to assist HARSB in considering future upgrades (more lagoon storage or alternative methods of disposing of generated wastewater).

Groundwater Monitoring

As previously discussed, groundwater monitoring is proposed for this permit. Groundwater monitoring has been a permit requirement since the facility started land applying wastewater. Domestic wells

located in spots that were thought to be upgradient and downgradient of the site have been used. Results from the downgradient wells have never detected any impacts from the wastewater land application. The soil water data collected over the past 6 years from the lysimeters has been difficult to interpret largely due to the uncertainties about the amounts of inorganic fertilizers applied by the farmer, Warren Dole. HARSB was not coordinating with the farmer to carefully consider the amount of inorganic fertilizer applied and minimize the amount of nitrogen leached into the lysimeters. Some of the nitrate concentrations found in the soil water were higher than the nitrate and total nitrogen concentrations in the wastewater.

Due to the importance of maintaining the drinking water quality of the Rathdrum Prairie Aquifer and the occasional high nitrate concentrations (> 10 mg/l) in the soil water samples, there needs to be more accurate groundwater monitoring.

In the draft "Staff Analysis" prepared in December 2002, it was recommended that the new permit include a requirement for the Board to install a groundwater monitoring system located on the site. This network of at least three (3) wells (1 upgradient and 2 downgradient) would have been used instead of the current groundwater monitoring network of four (4) domestic wells and one (1) irrigation well. Installation of monitoring wells will provide more accurate data about the impacts to groundwater from the application of wastewater. The Board will be using this land application site for many years and data gathered from domestic wells is usually of limited value. During the internal DEQ review of the draft permit and "Staff Analysis", DEQ Director, Steve Allred, recommended that only one (1) downgradient monitoring well should be required and that domestic wells be used for the other downgradient well and upgradient well. The Meyer's east well (#7 in Table 109-B) could be used for the other downgradient well and a new upgradient domestic well will need to be used. Appendix 'B' includes a memo written by Joe Baldwin, a hydrogeologist with DEQ, dated 3/27/03 that explains the how the groundwater monitoring program should be set-up. This memo will serve as the basis for the groundwater monitoring requirements included in the permit.

Joe Baldwin recommends the following:

- HARSB must add an additional domestic well to the monitoring network that is upgradient of the land application area. This well should be selected based on suitable well construction and should be near wells #2 or #3 (see Table 109-B) as identified in the 1996 permit application. If a suitable well cannot be found, then a dedicated upgradient monitoring well should be installed.
- A dedicated downgradient monitoring well shall be installed along the south side of the land application area. The purpose of this downgradient well is to confirm the water quality information collected from the domestic monitoring wells. Since elevated NO3-N (nitrate as nitrogen) concentrations have been detected in wells on the east side of the land application area, the monitoring well should be located south of the east pivot. If this downgradient well indicates ground water impacts above ambient concentrations, then an additional dedicated monitoring well shall be installed south of the west pivot.
- The ground water flow direction should be determined based on water levels from the three domestic wells before a downgradient monitoring well locations are selected. Land surface elevations in the three domestic wells currently used for monitoring shall be surveyed so that the flow direction predicted by the ground water flow model can be confirmed.
- The static water level data collected by HARSB staff from the groundwater monitoring wells (1998-present) shows there has been a 10-foot static water level decline. This observation should be confirmed and considered when designing the screened interval for the monitoring well. It is

DEQ's policy that monitoring wells should be screened in the 10 to 15 feet of the aquifer, with 5 feet of screen above the seasonal high water table.

- Laboratory analysis of major ions (calcium, magnesium, sodium, potassium, bicarbonate, chloride and sulfate) should be done for the monitoring wells at the beginning and end of the permit period. Laboratory analysis of total dissolved solids (TDS), chloride, electrical conductivity and NO3-N should be performed for all ground water sample events.
- The 1996 permit application listed all wells within a ¼ mile radius of the site, as suggested in the WLAP Guidance. There probably has been additional housing development around the site, so that new wells may have been constructed since 1996. Given the rapid ground water flow velocities in the Rathdrum Prairie aquifer and probably new wells, it may be prudent to update the well inventory and to inventory all wells within a larger radius of the site, such as ½ or one mile radius.
- Proposed monitoring well location(s) and design(s) should be reviewed and approved by DEQ prior to construction.

Leaching Loss

On 4/11/95, Jim MacInnis, DEQ Water Quality Engineer, ran "The Management Unit Hydraulic Balance Model" (whye5e.wk1, rev 11/10/94) for the proposed land application system to estimate leaching loss from the proposed site. This spreadsheet is included in Appendix 'C' and was taken from the 4/24/95 "Staff Analysis" prepared by Mr. MacInnis. The conclusions from this model still apply and the model summary indicates there will be a background leaching loss of 6.48 inches when no wastewater and no supplemental irrigation is applied to the site. This background leaching loss originates as winter and early spring precipitation. Since the land application site will be managed by soil moisture instruments, no significant increase in leaching loss is anticipated in an average year.

Conditional Use Permit

On March 22, 1995, the Board of Commissioners of Kootenai County approved HARSB's request for a Conditional Use Permit (CUP) to develop a spray irrigation and treatment site, which includes construction of a 16-million gallon wastewater storage lagoon, on HARSB's 476 acre land application site. The CUP was modified on 12/20/00 when the Kootenai County Commissioners approved the HARSB's request to allow planting poplar trees along Boekel Road, the north boundary of the site. DEQ staff finds neither conflict nor potential problems for HARSB's operation of the land application system on the proposed site in accordance with these requirements.

Recommendations for the Permit

The following items are recommended for the permit:

1) The application period shall be from April 1 to October 15 each year.

2) The disinfection level shall be advanced secondary disinfection (2.2 total coliform organisms/100 ml) for effluent applied to the land. The median value of the last five (5) results must not exceed 2.2 /100 ml. In addition, no single sample value shall exceed 23/100 ml. Samples will be collected two (2) times per week.

3) The permittee may apply between 238 to 204 million gallons of advanced secondary disinfected municipal wastewater (estimated crop water needs using average and design precipitation,

respectively) on 304 acres of the 476 acres of the HARSB's-owned site between April 1 to October 15 in accordance with the permit. The projected flows for the year 2007 are 1.13 mgd or 224 million gallons for this application season.

4) The permittee shall construct treatment and irrigation facilities in general accordance with the information submitted with the application for wastewater land application permit. The permittee shall prepare and submit for approval to the Department engineering plan and specifications for all wastewater facilities.

5) Within three months of permit issuance, the permittee shall prepare and submit a revised "Land Application Site Instrumentation Plan" to the Department for review and approval that provides details on the use of the following instruments:

   a) daily precipitation and temperature instruments; and,
   b) soil moisture instruments.

   Within six months of permit issuance, the permittee shall install all instrumentation required in the approved Land Application Site Instrumentation Plan and shall commence monitoring and data collection.

6) Soil moisture instrumentation shall continue to be used on the site and shall be monitored and recorded daily during the application season. Each "hydraulic management unit" (HMU) with its specific crop will be monitored with separate probes and generally one soil moisture monitoring site will be required for each 20-40 acres of irrigated crop (per the April 1996 report prepared by Kimball Engineering titled "Groundwater Monitoring and Site Instrumentation Plan"). Moisture will be monitored in the 'A' (shallow) and 'B' (intermediate) horizons at each site. Monitoring sites for the poplars must be located to provide representative data based on the age of the trees. For daily wastewater application, soil moisture instrumentation shall be used to determine application rates and frequency. The soil moisture threshold is 10 centibars. Staff recommends that if 25% of the soil moisture probe readings within a HMU are less than 10 centibars, then irrigation in that HMU cannot occur. Threshold values wetter than 10 centibars (less than 10 centibars) may be approved by the Department if satisfactory scientific evidence is present that wetter soil conditions will not increase wastewater movement past the root zone.

7) The precipitation and temperature measurement instruments shall be installed on the land site and shall be monitored and recorded daily during the application season. In the event that precipitation in any calendar week during the application season exceeds the prorated weekly design precipitation and insufficient lagoon storage is available, HARSB may, upon notification to the Department, apply wastewater to the site at a rate that does not exceed 1.0 inches per week without regard to the soil moisture levels.

8) Poplar trees or other trees and shrubs may be planted in and along the 50-foot buffer zone between the site and Boekel or Huetter Roads. These trees and shrubs may be irrigated with treated wastewater using a drip irrigation system or other non-spray irrigation system, as approved by the Department. Any planting of trees must be done in accordance with the conditions included in the March 1995 Kootenai County "Conditional Use Permit" (CUP) issued for the site and the December 2000 modification to the CUP.

9) The storage lagoon will need to be leak tested in accordance with the January 2002 DEQ policy within 12 months of the permit issuance.

10) The wastewater monitoring shall be:

Table 109-G
Recommended Wastewater Monitoring

Item or Parameter	Proposed Frequency
Total flow to treatment plant	**monthly**
Pond storage volume	**monthly**
Effluent testing at same location where sample for total coliform (chlorine residual)	**daily**
Effluent testing (total coliform)	**twice per week**
Effluent testing (Total Kjeldahl Nitrogen (TKN), ammonia-nitrogen, nitrate+nitrite-nitrogen, TDS, pH, total phosphorus)	**monthly**

11) The soil monitoring for each soil monitoring unit shall be done in conjunction with plant tissue sampling in an attempt to quantify the nitrogen balance (inputs and outputs). The farmer applies inorganic fertilizer at different times during the year and the information gathered from the soil, tissue and wastewater effluent monitoring will need to be used by the farmer to adjust the inorganic fertilizer applications. This coordination has not occurred to this extent in the past. As a consideration for eliminating the soil water testing, HARSB will need to be more actively involved with the farmer to assure that the amount of inorganic fertilizer and wastewater applied is not causing nitrogen to leach past the root zone.

There are four crops grown on the 304-acre wastewater land application site (alfalfa, timothy grass, bluegrass and poplar trees). The areas where each crop is grown will be considered a separate soil monitoring unit. Soil sampling will need to be done at a minimum two times per year (in the spring prior to fertilizing and in the fall after the last harvest preferably in September before the rainy season starts). The number of soil samples collected in each unit must be done in accordance with accepted practices to collect "representative" samples. HARSB must provide documentation for the soil sampling procedure proposed in the "Plan of Operation". Plant tissue samples from the alfalfa, timothy grass and bluegrass will be taken to determine how much nitrogen is being removed by the crop. Testing the poplars for nitrogen uptake will not be easy and will not be required at this time. The data from the soil and plant tissue will be the output and the wastewater and inorganic fertilizer nutrient loadings the input. If the amount of inputs is substantially more than the outputs for a growing season, then it will be presumed that nutrients are leaching past the root zone. Nitrogen will be the focus of this analysis because nitrate can impact the quality of the groundwater. Phosphorous will be tested in the soil to see if changes are occurring. HARSB's annual wastewater land application report will need to focus on the results of this data and if needed, adjustments made the following year on nutrient inputs from the wastewater and/or inorganic fertilizers.

Table 109-H below lists the proposed parameters to be monitored and the monitoring frequencies:

Table 109-H Recommended Soil Monitoring	
Item or Parameter	**Proposed Frequency**
Soil testing (Electrical conductivity, Nitrate-N, Ammonium-N, % organic matter, Plant available phosphorous, pH)	**Twice per year (spring before fertilizing and fall after harvest)**

12) Plant tissue samples will be taken from each crop (alfalfa, timothy grass and bluegrass) harvested from the fields during the growing season. Samples will be taken just prior to or immediately after harvesting. It will be important to only sample the portion of the crop removed from the fields. TKN and nitrate-N will be analyzed for each sample. Recommended plant tissue monitoring is shown in Table 109-I.

Table 109-I Recommended Plant Tissue Monitoring	
Item or Parameter	**Proposed Frequency**
Plant tissue of each crop removed (TKN, Nitrate-N)	**Prior to or immediately after harvesting**

13) One (1) downgradient dedicated groundwater monitoring well shall be constructed by HARSB within one (1) year of the permit issuance. The domestic well called Meyer's Well East (well #7 on Table 109-B) can be used as an additional downgradient well. One (1) new upgradient domestic well must be selected for monitoring within one (1) year of the permit issuance. If a suitable upgradient domestic well cannot be found then a dedicated upgradient monitoring well will need to be constructed. Land surface elevations in the three domestic wells currently used for groundwater monitoring shall be surveyed so that the flow direction predicted by the ground water flow model can be confirmed. The location of the wells, proposed sampling procedure and well construction plans and specifications will need to be reviewed and approved by the Department prior to starting construction on any dedicated monitoring wells. The design of the well locations should consider using the wells to estimate groundwater flow direction. Until the new monitoring wells are constructed and located , groundwater should continue to be monitored at the locations used in the past.

14) Groundwater monitoring shall be the following:

Table 109-J Recommended Groundwater Monitoring	
Item or Parameter	**Proposed Frequency**
All Groundwater Monitoring Wells (Chloride, Electrical conductivity, Nitrate-N, Total Dissolved Solids, Static water level)	**Three (3) times per year (April, August, October)**
All Groundwater Monitoring Wells (Major ions - calcium, magnesium, sodium, potassium, bicarbonate, chloride and sulfate)	**Immediately after the new monitoring network is established and in October 2008**

15) Warning signs shall be installed along the land application site boundary in accordance with Table 3 in the "Handbook".

16) The volume of wastewater applied to each hydraulic management unit will be monitored on a daily basis using flow meters.

17) The "Plan of Operation" for the land application site shall be revised and resubmitted to the Department for approval within six months of permit issuance. The "Plan of Operation" will include at a minimum:

    a) A crop plan for the entire site including the poplars;
    b) A revised map of the site showing acres irrigated, location of different crops, center pivot length with end gun coverage, soil moisture probe locations, roads/property boundaries and fences;
    c) Flow rates that can be delivered for the different fields;
    d) Details on piping used to deliver effluent from the WWTP to the site and the system for delivering the wastewater to the irrigation systems;
    e) Details on the supplemental irrigation water added to the lagoon and how to account for this in the loadings (hydraulic and nutrient) to the site;
    f) Details on measuring flows to each field; and
    g) Procedures for soil, plant tissue, groundwater and effluent monitoring and testing.

18) Supplemental irrigation water will also need to be monitored from April 1 to provide information on the total amount of water (wastewater and non-wastewater) applied to each field. Supplemental irrigation water delivered to the storage lagoon or directly into the irrigation system should be accounted for. This information will be used to determine the total volume of irrigation water applied during the growing season.

Summary

DEQ regional office staff have worked closely with the HARSB staff over the past two years to develop the criteria used in this analysis. Staff believes that a land application system constructed in accordance with the recommendations in this document will adequately protect the Spokane Valley-Rathdrum Prairie Aquifer, and staff recommends land application of wastewater be permitted contingent upon the recommendations presented in this report.

The "Staff Analysis" was revised after receiving comments from HARSB in a letter dated 6/27/03 to John Tindall.

References

"Wastewater Land Application Permit Renewal, Hayden Area Regional Sewer Board", Kimball Engineering, April 2001.

Memo from Joe Baldwin, DEQ Hydrogeologist, to Rick Huddleston, DEQ Wastewater Program Manager, dated 3/27/03.

RE: Staff Analysis, HARSB WLA Permit #LA-000109-03
August 6, 2003
Page 19

"Groundwater Monitoring and Site Instrumentation Plan, Hayden Area Regional Sewer Board Land Application System", Kimball Engineering, April 1996.

Process Design Manual, Land Treatment of Municipal Wastewater, US EPA, October 1981.

"Handbook for Land Application of Municipal and Industrial Wastewater", Idaho DEQ, April 1996.

"North Idaho Fertilizer Guide, Bluegrass Seed", University of Idaho, Current Information Series #788.

"Agricultural Waste Management Field Handbook", Part 651.

"North Idaho Fertilizer Guide, Alfalfa", University of Idaho, Current Information Series #447.

"1992 Census of Agriculture"

Western Regional Climate Center, Coeur d'Alene Precipitation Data 1895-2003

Appendix A

Table A-1a- **Alfalfa - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q= 0.9 mgd (2002 Average Flow)
(Average Precipitation with Year 2002 Use: 101 Irrigated Acres)

Month	Crop Water Use (in)	Average Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.53	1.74	1.16	1.37	3.8	5	27
May	5.6	1.99	1.55	4.05	11.1	14	28
June	6.15	1.81	1.47	4.69	12.9	16	27
July	7.71	0.73	0.66	7.05	19.3	24	28
August	5.68	0.91	0.74	4.93	13.5	17	28
Sept.	3.59	1.28	0.92	2.67	7.3	9	27
Oct.(15 days)	0.58	0.98	0.60	0	0.0	0	14
Total	31.84	9.44	7.10	24.76	67.9	85	179

Table A-1b- **Bluegrass/Timothy Grass - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q= 0.9 mgd (2002 Average Flow)
(Average Precipitation with Year 2002 Use: 166 Irrigated Acres)

Month	Crop Water Use (in)*	Average Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.61	1.74	1.16	1.45	4.0	5	27
May	4.64	1.99	1.47	3.17	8.7	11	28
June	5.36	1.81	1.40	3.96	17.8	22	27
July	7.16	0.73	0.64	6.52	29.4	37	28
August	5.65	0.91	0.74	4.91	22.1	28	28
Sept.	3.85	1.28	0.93	2.92	13.1	16	27
Oct.(15 days)	0.92	0.98	0.61	0.31	0.8	1	14
Total	30.20	9.44	6.97	23.23	96.0	120	179

* Using "Pasture" as closest crop type from Kimberly (U of I) Consumptive Use Data.

Table A-1c- **Poplars - Drip Irrigation (90% Efficient)**
HARSB Hydraulic Balance Calculations at Q= 0.9 mgd (2002 Average Flow)
(Average Precipitation with Year 2002 Use: 37 Irrigated Acres)

Month	Crop Water Use (in)*	Average Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	1.69	1.74	1.10	0.59	1.6	2	27
May	2.83	1.99	1.33	1.50	4.1	5	28
June	5.02	1.81	1.38	3.64	3.7	4	27
July	7.87	0.73	0.67	7.20	7.2	8	28
August	6.24	0.91	0.77	5.47	5.5	6	28
Sept.	4.25	1.28	0.96	3.30	3.3	4	27
Oct.(15 days)	0.92	0.98	0.61	0.31	0.8	1	14
Total	28.82	9.44	6.81	22.01	26.3	33	179

* Using "Orchard" as closest crop type from Kimberly (U of I) Consumptive Use Data.

Table A-2a- **Alfalfa - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q= 0.9 mgd (2002 Average Flow)
(Design Precipitation with Year 2002 Use: 101 Irrigated Acres)

Month	Crop Water Use (in)	Design Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.53	2.34	1.51	1.02	2.8	3	27
May	5.6	2.92	2.19	3.41	9.4	12	28
June	6.15	2.6	2.04	4.12	11.3	14	27
July	7.71	1.21	1.10	6.61	18.1	23	28
August	5.68	1.78	1.41	4.27	11.7	15	28
Sept.	3.59	2.05	1.42	2.17	5.9	7	27
Oct.(15 days)	0.58	1.54	0.93	0	0.0	0	14
Total	31.84	14.44	10.59	21.60	59.2	74	179

Table A-2b- **Bluegrass/Timothy Grass - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q= 0.9 mgd (2002 Average Flow)
(Design Precipitation with Year 2002 Use: 166 Irrigated Acres)

Month	Crop Water Use (in)*	Design Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.61	2.34	1.52	1.09	3.0	4	27
May	4.64	2.92	2.07	2.57	7.0	9	28
June	5.36	2.6	1.95	3.42	15.4	19	27
July	7.16	1.21	1.07	6.10	27.5	34	28
August	5.65	1.78	1.41	4.25	19.1	24	28
Sept.	3.85	2.05	1.45	2.40	10.8	14	27
Oct.(15 days)	0.92	1.54	0.94	0	0.0	0	14
Total	30.20	14.44	10.40	19.82	82.9	104	179

* Using "Pasture" as closest crop type from Kimberly (U of I) Consumptive Use Data.

Table A-2c- **Poplars - Drip Irrigation (90% Efficient)**
HARSB Hydraulic Balance Calculations at Q= 0.9 mgd (2002 Average Flow)
(Design Precipitation with Year 2002 Use: 37 Irrigated Acres)

Month	Crop Water Use (in)*	Design Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	1.69	2.34	1.44	0.25	0.7	1	27
May	2.83	2.92	1.87	0.96	2.6	3	28
June	5.02	2.6	1.91	3.11	3.1	3	27
July	7.87	1.21	1.11	6.76	6.8	8	28
August	6.24	1.78	1.45	4.78	4.8	5	28
Sept.	4.25	2.05	1.48	2.77	2.8	3	27
Oct.(15 days)	0.92	1.54	0.94	0	0.0	0	14
Total	28.82	14.44	10.21	18.63	20.8	26	179

* Using "Orchard" as closest crop type from Kimberly (U of I) Consumptive Use Data.
Actual uptake may be higher.

Summary Table A-3- **Alfalfa, Timothy Grass, Bluegrass and Poplars**
HARSB Hydraulic Balance Calculations at Q= 0.9 mgd (2002 Average Flow)
(Average Precipitation with Year 2002 Use: 304 Irrigated Acres)

	Crop Water Needs w/Irrigation Eff.(MG)	**Available Effluent (MG)**	**Supplemental Irrig. (MG)**
2002- Average Precip.	237.7	179	58.8
2002- Design Precip.	203.7	179	24.8

Table A-4a- **Alfalfa - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q= 1.13 mgd (2007 Average Flow)
(Average Precipitation with Year 2007 Use: 101 Irrigated Acres)

Month	Crop Water Use (in)	Average Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.53	1.74	1.16	1.37	3.8	5	34
May	5.6	1.99	1.55	4.05	11.1	14	35
June	6.15	1.81	1.47	4.69	12.9	16	34
July	7.71	0.73	0.66	7.05	19.3	24	35
August	5.68	0.91	0.74	4.93	13.5	17	35
Sept.	3.59	1.28	0.92	2.67	7.3	9	34
Oct.(15 days)	0.58	0.98	0.60	0	0.0	0	17
Total	31.84	9.44	7.10	24.76	67.9	85	224

Table A-4b- **Bluegrass/Timothy Grass - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q= 1.13 mgd (2007 Average Flow)
(Average Precipitation with Year 2007 Use: 166 Irrigated Acres)

Month	Crop Water Use (in)*	Average Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.61	1.74	1.16	1.45	4.0	5	34
May	4.64	1.99	1.47	3.17	8.7	11	35
June	5.36	1.81	1.40	3.96	17.8	22	34
July	7.16	0.73	0.64	6.52	29.4	37	35
August	5.65	0.91	0.74	4.91	22.1	28	35
Sept.	3.85	1.28	0.93	2.92	13.1	16	34
Oct.(15 days)	0.92	0.98	0.61	0.31	0.8	1	17
Total	30.20	9.44	6.97	23.23	96.0	120	224

* Using "Pasture" as closest crop type from Kimberly (U of I) Consumptive Use Data.

Table A-4c- **Poplars - Drip Irrigation (90% Efficient)**
HARSB Hydraulic Balance Calculations at Q=1.13 mgd (2007 Average Flow)
(Average Precipitation with Year 2007 Use: 37 Irrigated Acres)

Month	Crop Water Use (in)*	Average Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	1.69	1.74	1.10	0.59	1.6	2	34
May	2.83	1.99	1.33	1.50	4.1	5	35
June	5.02	1.81	1.38	3.64	3.7	4	34
July	7.87	0.73	0.67	7.20	7.2	8	35
August	6.24	0.91	0.77	5.47	5.5	6	35
Sept.	4.25	1.28	0.96	3.30	3.3	4	34
Oct.(15 days)	0.92	0.98	0.61	0.31	0.8	1	17
Total	28.82	9.44	6.81	22.01	26.3	33	224

* Using "Orchard" as closest crop type from Kimberly (U of I) Consumptive Use Data.
Actual uptake may be higher.

Table A-5a- **Alfalfa - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q=1.13 mgd (2007 Average Flow)
(Design Precipitation with Year 2007 Use: 101 Irrigated Acres)

Month	Crop Water Use (in)	Design Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.53	2.34	1.51	1.02	2.8	3	34
May	5.6	2.92	2.19	3.41	9.4	12	35
June	6.15	2.6	2.04	4.12	11.3	13	34
July	7.71	1.21	1.10	6.61	18.1	20	35
August	5.68	1.78	1.41	4.27	11.7	13	35
Sept.	3.59	2.05	1.42	2.17	5.9	7	34
Oct.(15 days)	0.58	1.54	0.93	0	0.0	0	17
Total	31.84	14.44	10.59	21.60	59.2	74	224

Table A-5b- **Bluegrass/Timothy Grass - Center Pivot Irrigation (80% efficient)**
HARSB Hydraulic Balance Calculations at Q= 1.13 mgd (2007 Average Flow)
(Design Precipitation with Year 2007 Use: 166 Irrigated Acres)

Month	Crop Water Use (in)*	Design Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	2.61	2.34	1.52	1.09	3.0	4	34
May	4.64	2.92	2.07	2.57	7.0	9	35
June	5.36	2.6	1.95	3.42	15.4	19	34
July	7.16	1.21	1.07	6.10	27.5	34	35
August	5.65	1.78	1.41	4.25	19.1	24	35
Sept.	3.85	2.05	1.45	2.40	10.8	14	34
Oct.(15 days)	0.92	1.54	0.94	0	0.0	0	17
Total	30.20	14.44	10.40	19.82	82.9	104	224

* Using "Pasture" as closest crop type from Kimberly (U of I) Consumptive Use Data.

Table A-5c- **Poplars - Drip Irrigation (90% Efficient)**
HARSB Hydraulic Balance Calculations at Q= 1.13 mgd (2007 Average Flow)
(Design Precipitation with Year 2007 Use: 37 Irrigated Acres)

Month	Crop Water Use (in)*	Design Precip. (in)	Effective Precip. (in)	Crop Water Needs (in)	Crop Water Needs (MG)	Crop Water Needs w/Irrigation Eff.(MG)	Available Effluent (MG)
April	1.69	2.34	1.44	0.25	0.7	1	34
May	2.83	2.92	1.87	0.96	2.6	3	35
June	5.02	2.6	1.91	3.11	3.1	3	34
July	7.87	1.21	1.11	6.76	6.8	8	35
August	6.24	1.78	1.45	4.78	4.8	5	35
Sept.	4.25	2.05	1.48	2.77	2.8	3	34
Oct.(15 days)	0.92	1.54	0.94	0	0.0	0	17
Total	28.82	14.44	10.21	18.63	20.8	26	224

* Using "Orchard" as closest crop type from Kimberly (U of I) Consumptive Use Data.
Actual uptake may be higher.

Summary Table A-6- **Alfalfa, Bluegrass and Poplars**
HARSB Hydraulic Balance Calculations at Q= 1.13 mgd (2007 Average Flow)
Use: 304 Irrigated Acres)

	Crop Water Needs w/Irrigation Eff.(MG)	**Available Effluent (MG)**	**Supplemental Irrig. (MG)**
2007- Average Precip.	238	224	14
2007- Design Precip.	204	224	-20

Appendix B

Memorandum

To: Rick Huddleston
Wastewater Program Manager

From: Joe Baldwin, Technical Services

Date: March 27, 2003

Subject: Hayden Area Regional Sewer Board (HARSB)LA-000109-03 wastewater land application site, monitoring well evaluation

---

1.0 Purpose

The purpose of this memorandum is to review current ground water monitoring well locations at the HARSB site and to document ground water quality issues around the site that indicate the need for an expanded monitoring well network.

2.0 Discussion

The HARSB facility currently is collecting water quality and water level information from three private domestic wells, the Meyer east (MW-3) and Meyer west (MW-2) wells and the Hern (formerly Badraun) well (MW-1). The direction of ground water flow at the site is believed to be from northeast to southwest, based on information from a DEQ ground water flow model developed by Brian Painter. The flow direction should be verified by constructing potentiometric maps using water level information from the domestic wells. Land surface elevations should be surveyed for the three domestic wells so that depth to water information can be converted to water level elevations.

A review of depth to water information from the three domestic wells shows that water levels near the site have declined about 10 feet from 1998 to the present. This water level decline should be confirmed.

Based on ground water flow directions from the flow model, MW-3 is far too the west to serve as a downgradient well for the land application site. MW-2 is located downgradient of the site but is about one half-mile south of the southern edge of the site. Monitoring wells should be located at the down gradient edge of areas under active wastewater land application. MW-1, which is located adjacent to the northwest corner of the site, is not upgradient of the site because of the northeast to southwest flow direction.

HARSB has sampled 7 private domestic wells around the site at various times over the past 7 years. Nitrate-N and chloride results from the most recent sample events are shown on figure 1. Five of the wells have nitrate-N concentrations in the range of 0.4 to 0.75 mg/L, but two wells on the east side of the site have nitrate-N concentrations ranging from 5.3 to 5.7 mg/L.

There are 5 Statewide monitoring wells within 4 miles of the HARSB site that have been sampled from one to three times over the past 12 years. NO3-N and chloride data from the most recent sample event at these wells is shown in figure 2. Three of the wells have NO3-N concentrations between 0.6 to 0.8 mg/L, while two wells have NO3-N concentrations of 2.3 and 2.8 mg/L. Taken together, these sample results

indicate there are variable water quality conditions in the aquifer around the HARSB site, and that in some areas NO3-N concentrations are half or more of the MCL

Contaminant concentrations in ground water will vary in the longitudinal, transverse and vertical directions downgradient of a contaminant source. Numerous studies have shown that contaminant mixing and dilution occurs to the largest extent in the longitudinal direction of ground water flow, and to the smallest extent in the vertical direction (see Gelhar and others, 1992 for a review of contaminant movement in aquifers). A mixing depth in the range of 10 feet would be expected for contaminants entering the Rathdrum Prairie aquifer downgradient of the HARSB site. Wells that withdraw water from depths greater than 10 feet below the water table may not adequately reflect contaminant concentrations near the water table. Review of construction information for 34 wells in the HARSB area show that the mean casing depth for these wells is 52 feet below the water table. Construction information for the three domestic wells sampled by HARSB is not available, so the adequacy of these wells as monitoring points cannot be determined.

As noted in the DEQ Staff Analysis, dated December 26, 2002, the HARSB wastewater land application site is located over the Spokane Valley-Rathdrum Prairie Aquifer, and EPA designated sole source aquifer. The need for an enhanced ground water monitoring network should be balanced with the monitoring, nutrient and hydraulic loading requirements at this site.

3.0 Conclusions

The following action items were identified following a staff meeting with the Director and evaluation of the above information:

- HARSB must add an additional domestic well to the monitoring network that is upgradient of the land application area. This well should be selected based on suitable well construction and should be in the vicinity of wells 2 or 3 as identified in the 1996 permit application. If a suitable well cannot be found, then a dedicated upgradient monitoring well should be installed.
- A dedicated downgradient monitoring well shall be installed along the south side of the land application area. The purpose of this downgradient well is to confirm the water quality information collected from the domestic monitoring wells. Since elevated NO3-N concentrations have been detected in wells on the east side of the land application area, the monitoring well should be located south of the east pivot. If this downgradient well indicates ground water impacts above ambient concentrations, then an additional dedicated monitoring well shall be installed south of the west pivot.
- The ground water flow direction should be determined based on water levels from the three domestic wells before a downgradient monitoring well locations are selected.
- As mentioned above, the 10-foot water level decline over the past 5 years should be confirmed, and should be considered when designing the screened interval for the monitoring well. It is DEQ's policy that monitoring wells should be screened in the 10 to 15 feet of the aquifer, with 5 feet of screen above the seasonal high water table.
- Land surface elevations in the three domestic wells currently used for monitoring shall be surveyed so that the flow direction predicted by the ground water flow model can be confirmed.
- Laboratory analysis of major ions (calcium, magnesium, sodium, potassium, bicarbonate, chloride and sulfate) should be done for monitoring wells at the beginning and end of the permit period. Laboratory analysis of total dissolved solids (TDS) should be added to the analyte list for all other ground water sample events.
- The 1996 permit application listed all wells within a ¼ mile radius of the site, as suggested in the WLAP Guidance. There probably has been additional housing development around the site, so that

new wells may have been constructed since 1996. Given the rapid ground water flow velocities in the Rathdrum Prairie aquifer and probably new wells, it may be prudent to update the well inventory and to inventory all wells within a larger radius of the site, such as ½ or one mile radius.

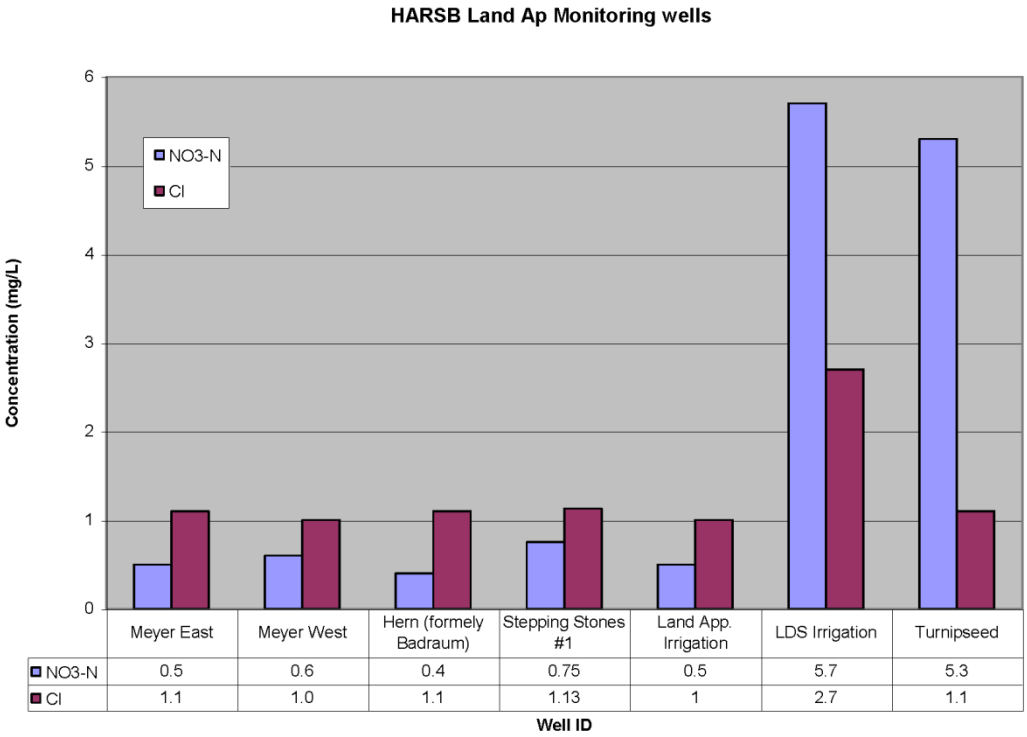
- Proposed monitoring well location(s) and design(s) should be reviewed and approved by DEQ prior to construction.

cc: John Tindall, Coeur d'Alene Regional Office

References

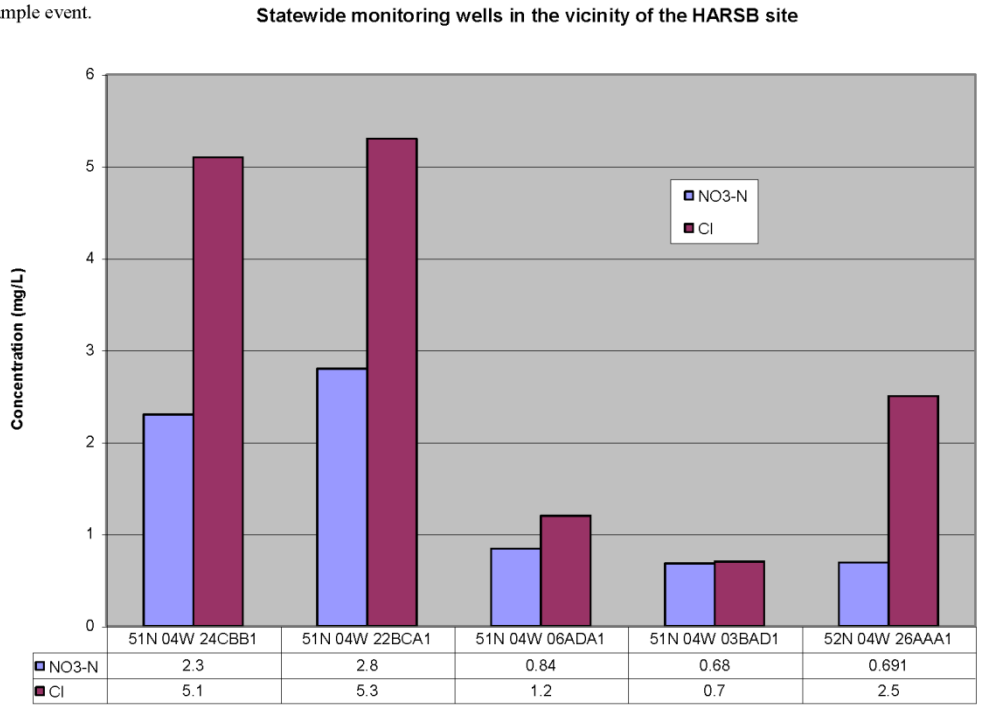
Gelhar, L.W., Claire Welty and K. R. Rehfeldt, 1992, A critical review of data on field-scale dispersion in aquifers; Water Resources Research, v. 28, no. 7, pp 1955-1974.

Figure 1. Nitrate-N and chloride concentrations at wells sampled by HARSB. Sample results are from most recent sample.



	Meyer East	Meyer West	Hern (formely Badraum)	Stepping Stones #1	Land App. Irrigation	LDS Irrigation	Turnipseed
NO3-N	0.5	0.6	0.4	0.75	0.5	5.7	5.3
Cl	1.1	1.0	1.1	1.13	1	2.7	1.1

Figure 2. Nitrate-N and chloride concentrations at Statewide monitoring wells in the HARSB area. Results are from the most recent sample event.



Appendix C

WASTEWATER-LAND APPLICATION CALCULATIONS SPREADSHEET

Attachment 2

Management Unit Hydraulic Balance Module

whye5e.wk1 - rev. 11/10/94 (Minor correction to "Water Needed to Apply" preventing negative numbers)

Facility --> **Hayden Area Regional Sewer Board**

Permit No.-> **LA-000109-02** Re-irrig @ AWC = 2.81

Run Date --> **04/11/95**

Month	(1) CU GS (inches)	(2) CU GS+NGS (inches)	(3) PPT (inches)	(4) PPTe (MG)	(5) Water Needed to Apply (MG)	(6) Waste Water Applied (MG)	(7) Fresh Water Applied (in/ac)	(8) Total Water App (eff) (inches)	Soil Water Storage (inches)	(9) Leaching Loss	
April	0	2.12	1.71	1.11	0.00	0.00	0.00	1.11	3.32	0.00	
May	2.61	2.61	2.06	1.36	11.72	0.00	0.00	1.36	2.07	0.00	
June	3.54	3.54	1.96	1.36	20.32	0.00	0.00	1.36	0.00	0.00	
July	5.46	5.46	0.92	0.74	44.07	0.00	0.00	0.74	0.00	0.00	
August	4.15	4.15	1.31	0.97	29.69	0.00	0.00	0.97	0.00	0.00	
September	2.44	2.44	1.19	0.81	15.26	0.00	0.00	0.81	0.00	0.00	
October		0.99	0.99	1.61	0.99	0.02	0.00	0.00	0.99	0.00	0.00
November		0.66	3.30	2.31	0.00	0.00	0.00	2.31	1.65	0.00	
December		0.36	3.65	3.29	0.00	0.00	0.00	3.29	4.33	0.25	
January		0.34	3.47	3.12	0.00	0.00	0.00	3.12	4.33	2.78	
February			0.48	2.48	2.23	0.00	0.00	0.00	2.23	4.33	1.75
March 0.00	0.36	2.29	2.06	0.00	0.00	0.00	2.06	4.33	1.70		
TOTALS	19.19	23.52	25.95	20.35	17.28	0.00	0.00	20.36		6.48	

0.00 WW + IRR inches

Latitude ----------> 48 (42 - 49 deg)

AWC ----------> 4.33 (60 in or root limiting layer)

Soil AWC Full in Spring-------> 1 (a proportion)

Soil AWC in Spring----------> 4.33 inches

Modfied Irr Eff ----------> 0.9 (a proportion)

Acres ----------> 258

Climate Station ----------> 101956

Crop Code ----------> DIV3

Applic Depth----------> 3 inches (assume 3)

f factor ----------> 1.00

Irr Eff-> 0.75

Prop. (e.g. 0.3) "Ei Water" Lost To:

Wind ---> 0.4

Runoff -> 0

Perc ---> 0.6

Mod Ei -> 0.9

-8.65 ac-in/ac NGS Hyd Rate

-60.63 MG NGS Hyd Limit