MEMORANDUM

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DATE: April 7, 2016

SUBJECT: M-108-03 The City of Idaho City, Staff Analysis supporting reuse permit issuance.

Executive Summary

The City of Idaho City's (Idaho City's) reuse system was first permitted for the application of recycled water to rapid infiltration basins (RIBs) in 1993, and the RIBs have been operated year round ever since. The yearly influent volume to the treatment lagoon is normally greater than 40 million gallons (MG), high seepage rates and other losses result in only 22.6 MG annually going to the rapid infiltration basins (RIBs). A seepage test conducted in 2012 revealed that the lagoon is leaking at a rate higher than the allowed rate of 0.25 inch/day. As a result, Idaho City entered into a voluntary Compliance Agreement Schedule (CAS) to complete a Facility Plan and make upgrades to the wastewater collection and treatment facilities.

The facility has sometimes struggled to meet the hydraulic loading and nitrogen concentration limits established in Section F of the current permit, LA-000108-02; hydraulic loading was allowed up to 140,000 gallons per day and the 30 day average total nitrogen concentration was limited to 20.0 mg/L. This staff analysis considers the results of recent environmental monitoring and Idaho City's operational history and proposes new site specific limits in draft permit M-108-03. It also recommends a modification of the recycled water distribution in the RIBs to provide more even distribution.

Staff also recommends modifications to the required environmental monitoring, including changing the surface water monitoring location back to Mores Creek instead of the drainage channel that runs through the reuse site, and the installation of a new monitoring well that would allow the determination of local ground water flow by triangulation.

The distance from the RIBs to areas open to public access is less than the 100 foot buffer zone distance listed in the current permit LA-000108-02 and a nearby residence is within its prescribed 300 foot buffer zone. This staff analysis proposes that the disinfection limit be made more stringent or that the application area be reconfigured so that the nearby residence would be outside of Idaho Department of Environmental Quality's (DEQ) guidance buffer zones.

Staff recommends renewal of the reuse permit for a 5-year term.

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1 Introduction

The purpose of this memorandum is to satisfy the requirements of IDAPA 58.01.17.400 for issuing recycled water reuse permits. It briefly states the principal facts and significant questions considered in preparing the draft permit and provides a summary of the basis for the draft permit conditions.

Idaho City was first permitted for municipal wastewater reuse on January 11, 1993 under permit LA-000108-01. This permit was renewed on October 6, 2010 as LA-000108-02, which expired on October 6, 2015. A voluntary compliance agreement schedule (CAS) was executed on January 13, 2014 to bring the facility into compliance with lagoon seepage limits, with an amended CAS (A-CAS) executed on October 1, 2014 and a further amendment issued on March 31, 2016, both extending required completion dates.

A pre-application workshop between Idaho City and the Idaho Department of Environmental Quality (DEQ) was held on March 13, 2015. A letter of needs generated by the discussion at this meeting was sent to Idaho City from DEQ on March 17, 2015. The permit renewal application was received by DEQ on April 9, 2015. DEQ determined the application complete on May 8, 2015, which was set as the effective date of the application. Additional permit renewal material was received by DEQ on May 15, 2015. An inspection of the facility was made by DEQ on May 26, 2015. A letter notifying the permittee of a preliminary decision to issue the permit was sent on August 5, 2015.

2 Site Location and Ownership

Idaho City's reuse system is located to the southwest of downtown Idaho City, within city limits (see Figure 2 and Figure 3 in the Appendix). Land ownership within city limits is predominately privately held, but land to the south and southeast of the facility is held by the Forest Service. Land bordering Mores Creek downstream of the facility is largely privately owned.

3 Process Description

Municipal wastewater collected from around 500 Idaho City residents is sent to the Idaho City wastewater treatment facility. The population served by the facility has been nearly the same since the treatment facility was first permitted (Pharmer Engineering 2015a) (DEQ 2010). Treatment is provided by a single 2.5 MG aerated lagoon, with 3 sections separated by a baffled curtain. In 2008, the lagoon was shown to decrease biological oxygen demand (BOD) from 131.3 milligrams per liter (mg/L) to 21.3 mg/L, but only decreased total Kjeldahl nitrogen (TKN) from 25.3 mg/L to 21.0 mg/L (DEQ 2010). The effluent from the lagoon is disinfected with gaseous chlorine before being sent to one of four RIBs. The RIBs are currently planned on being rotated sequentially on a weekly basis, though before 2010 each basin was active for a month before being rested for three months (DEQ 2010). Each RIB has an elevated border which encloses an area of 0.47 acres, but because infiltration rates in the RIBs are very similar to the application rates, recycled water does not normally infiltrate across the entire surface area of the

RIB. Vegetative growth in the RIBs indicates that recycled water normally spreads across half the surface of MU-108-04 (see Figure 3) and less than half at all other RIBs.

4 Site Characteristics

4.1 Site Management History

The Idaho City Sewer District constructed the original wastewater treatment facility in 1968 at the current site on tailings from dredge mining and sold the facility to Idaho City in 1978 (Unknown 1991). The RIBs were added to the treatment system in 1991 (DEQ 1992). The system first received a reuse permit in 1993.

4.2 Climatic Characteristics

The most consequential climatic characteristic to consider when operating a RIB treatment system is the frequency of freezing. While none of the 30-year average maximum daily temperatures are below freezing, 60 percent of the average daily minimum temperatures are below freezing (DRI, Idaho City, Idaho 30 Year Daily Temperature and Precipitation Summary 2015a). The climate at Idaho City does not appear to be restricting the operation of the RIBs, since there have not been any reports at the facility of infiltration being restricted due to freezing conditions. Any changes to the distribution systems of the RIBs will need to take into account the potential for freezing.

The pattern of infiltration and inflow (I/I) described in Section 4.6.2 is corroborated by the average monthly precipitation. Out of an annual average precipitation of 23.4 inches, around 30 percent falls during March through May and 80 percent in the seven months from November to May, which are also the months that have highest hydraulic loading rates as shown in Figure 1 (DRI 2015b).

4.3 Soils

While the top inch of soil at the Idaho City facility may be made up of decomposed plant material, everything below is cobbles, gravel, or sand (NRCS 2009). Sand was added during the construction of RIB 4, while gravel was added to the other three basins. The cation exchange capacity of the soil measured during the original permitting process was very low, at around 0.2 milliequivalents/100 grams; therefore, the soil would have limited ability to hold ammonia cations for nitrification in the RIBs (Unknown 1991). Nitrification normally occurs in RIBs after the wetting cycle, as the adsorbed ammonia is nitrified during the drying cycle when oxygen is reintroduced to the soil (EPA 2006). Conversion of ammonia to nitrate through nitrification is normally a necessary precursor to removal of nitrogen via denitrification.

The saturated transmissivity of the soil at Idaho City is very high, between 6 and 20 inches an hour, and there is less than an inch of available water holding capacity (NRCS 2009). The soils have all the characteristics that would lead to rapid infiltration through the basins. The high infiltration rates and low water holding capacity of the Idaho City RIB’s soil may prevent the

anoxic conditions necessary for denitrification from forming. The soils also allow hydraulic loading rates that are two to four times higher than the maximum infiltration rate recommended for effective nitrogen removal of 6 inches per day (EPA 2006). The ground water and percolate monitoring results presented in Section 4.5 do not provide conclusive evidence for the extent of nitrogen transformation or removal in the soil column before the recycled water percolates to the ground water. It is possible that modifying the RIBs to decrease the infiltration rate would improve treatment performance, and such a modification is suggested to be required in Item 5 of Section 9 in this document.

4.4 Surface Water

Mores Creek is located approximately 420 feet to the southwest of RIB 1 (MU-108-01), and as the creek bends around the facility there is only 160 feet separating it from the active treatment lagoon. The treatment facility is within the 100-year flood plain (FEMA 2015). Mores Creek has beneficial uses for cold water aquatic life, salmonid spawning, primary contact recreation, and as a source of domestic drinking water (Monnot 2009). Mores Creek currently has Total Maximum Daily Load (TMDL) limits for temperature and sediment, which are two of the pollutant types that the RIBs would be most able to mitigate. A five-year review is currently being conducted on the Boise-Mores Creek Subbasin Assessment and TMDL.

A drainage channel, which appears to have water in it year round and is as close as 20 feet from the wetted area of the RIBs, runs between the RIBs and the lagoons. The channel may have been dug to convey water through the city or was formerly part of Mores Creek before the area was disturbed for mining. Immediately downstream of the drainage channel water backs up and forms a wetland like area before discharging to Mores Creek.

A recent survey of the elevations of the important features at the facility showed that the ground water table is very close to the elevation of the drainage canal, suggesting that there is a potential interconnection between the ground water and the drainage channel (Pharmer Engineering 2015a). The direction of ground water flow has not been determined, as discussed in the Section 4.5, but it is possible that ground water flowing to the south or southwest could have an interconnection with Mores Creek.

The yearly averages of the drainage channel's quarterly monitoring are presented in Table 1, with the results from individual quarterly sampling events are included in Appendix B. Between 2010 and 2014 the concentrations of nitrate and ammonia in samples taken from the drainage channel were higher in the downstream sampling location at a 95 percent confidence level (see Appendix D), with downstream concentrations higher or the same as upstream during all sampling events for both of the nitrogen species analyzed and during 75 percent of the sampling events for phosphorus. Results from analyses for *E. Coli* did not show the same upstream to downstream differential; 65 percent of the *E. Coli* measurements were higher or the same in the downstream location. Because water is typically backed up in the drainage channel's upstream sampling location, bacteria may be more likely than other parameters to be introduced there from outside sources without sufficient mixing to make comparisons to the downstream location valid. Surface water samples did not include temperature or pH measurements, preventing an analysis of whether ammonia toxicity limits were exceeded. However the highest ammonia concentration measured in the drainage channel between 2010 and 2015 was 1.57 mg/L, would only have

exceeded the chronic toxicity limit if the temperature was above 70 degrees Fahrenheit, unlikely for that February sample.

Table 1. Yearly average of quarterly surface water monitoring at a location upstream (upper) and downstream (lower) of rapid infiltration basins

	Nitrate[a]		Ammonia[a]		Total Phosphate[a]		E. Coli[b]	
Year	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Average	*0.37*	*0.49*	*0.07*	*0.35*	*0.15*	*0.19*	*115.22*	*67.92*
2009	0.99	0.87	0.12	0.36	0.22	0.34	50[c]	70[c]
2010	0.24	0.80	0.11	0.73	0.17	0.21	29.75[c]	72.75[c]
2011	—	—	0.04	0.48	0.06	0.16	89.33	46.33
2012	—	—	0.04	0.24	0.15	0.19	70.75	76.25
2013	0.20	0.31	0.10	0.35	0.21	0.13	149.75	43.25
2014	0.21	0.26	0.05	0.14	0.12	0.12	220.25	112.75
2015	0.20	0.20	0.04	0.12	0.10	0.16	46.00	61.00

Source: (Pharmer Engineering 2015a)

a. Reported in milligrams per liter.
b. Reported as most probable number per 100 milliliters.
c. Fecal coliform was analyzed in 2009 and 2010.

It is difficult to extrapolate from the results of the drainage channel monitoring to what the reuse facility's impact to Mores Creek could be. Both the upstream and downstream concentrations measured in the drainage channel were low (around 50 percent of samples had nitrate concentrations less than the analytical practical quantitation limits), and the lower flow rate in the drainage channel means that it alone would not alter the water quality of the larger Mores Creek even to these low concentrations. Recent samples that have been taken from Mores Creek were only analyzed for nitrate, but typically the nitrate concentrations in both upstream and downstream samples were less than the practical quantitation limit and so not able to be used for determining current impacts to Mores Creek.

Mores Creek is the source water for the Wilderness Ranch Owners Association, Inc.'s (Wilderness Ranch) public water system (PWS# ID4080055) which has an intake located around 15 miles downstream of the Idaho City recycled water facility and within a four hour time of travel (DEQ 2014). Nitrate concentrations from the surface water intake at Wilderness Ranch have been far below the 10 mg/L maximum contaminant level (R. Lee, DEQ, to V. Greear, DEQ, personal communication). Wilderness Ranch water treatment plant also holds the only National Pollutant Discharge Elimination System (NPDES) authorization to discharge into Mores Creek. The NPDES permit regulates the discharge of total suspended solids (TSS) and chlorine residual (ID-0028312).

4.5 Ground Water/Hydrogeology

Drilling logs from wells installed near the Idaho City treatment facility show that there are multiple aquifers in the area, separated by intermittent clay layers (IDWR, Well Driller's Locator 2015b). The shallowest aquifer below the reuse facility, which extends from around 7 to 12 feet to around 30 to 40 feet below the ground surface, would be most influenced by recycled water

application (IDWR 2015b). Almost all of the nearby public and domestic wells are screened and draw from deeper aquifers.

Three monitoring wells are located in the shallow aquifer below the reuse site. Monitoring well 1 (MW 1) is located to the northeast of RIB 4, MW 2 between RIB 3 and RIB 4, and MW 3 to the west of RIB 1 (see Figure 3 for more precise locations). Since the three monitoring wells are located along a straight line they are not able to be used to triangulate the ground water flow direction. A recent survey of water table elevations in the monitoring wells indicated the aquifer drops 7 feet over the 550 feet across the RIBs, suggesting that ground water flows from east to west at the site (Pharmer Engineering 2015a). However, ground water may also be flowing from higher elevations, generally the foothills north of the treatment facility, towards Mores Creek, to the south. If ground water flow is mostly west to east, in the existing monitoring network MW 3 and MW 2 would serve as downgradient monitoring wells.

As can be seen in Table 2, MW 2 and MW 3 clearly display impacts from recycled water application, though only for TKN. The quarterly results shown in Appendix B may be able to show these impacts in even greater detail. Between 2010 and 2015, 100 percent of the quarterly ground water samples collected from MW 2 and 70 percent of the samples collected from MW 3 showed total nitrogen greater than that in MW 1. However, while 50 percent of the samples collected from MW 2 also had nitrate concentrations greater than those measured in MW 1, no other constituent sampled from MW 2 or MW 3 had measured concentrations greater than those in MW 1 for more than 20 percent of the samples. The highest total nitrogen concentration during those years was 7.4 mg/L, found in MW 2 which is positioned closer to where the recycled water infiltrates than MW 3.

Table 2. Ground water monitoring, annual average of quarterly monitoring, in milligrams per liter unless otherwise noted.

Year	Total Kjeldahl Nitrogen	Nitrate as N	Total Phosphate	Total Dissolved Solids	Chloride	Static Water Level[a]	Fecal Coliform[b]
2010 to 2015 Average for Each Monitoring Well (MW)							
MW 1	*0.69*	*0.25*	*0.59*	*122.60*	*7.08*	*7.28*	*2.00*
MW 2	*3.64*	*0.72*	*0.38*	*115.40*	*8.30*	*10.24*	*10.50*
MW 3	*1.68*	*0.43*	*0.41*	*98.50*	*3.83*	*13.40*	*2.00*
Monitoring Well 1							
2010	0.51	0.37	0.41	-	-	7.32	401[c]
2011	0.61	0.33	0.51	104.00	7.67	7.17	2.00
2012	0.64	0.20	0.61	138.00	7.50	7.46	2.00
2013	0.71	0.20	0.71	117.50	7.25	7.52	2.00
2014	0.76	0.20	0.60	125.50	6.00	7.13	2.00
2015	0.90	0.20	0.70	128.00	7.00	7.06	2.00
Monitoring Well 2							
2010	6.19	0.51	0.48	-	-	10.79	227.5[c]
2011	3.33	0.70	0.23	105.00	6.00	10.58	2.00
2012	3.50	0.40	0.31	115.00	7.75	10.48	2.00

2013	4.03	0.25	0.37	120.50	8.75	9.13	9.00
2014	3.01	1.25	0.36	117.50	7.00	10.23	29.00
2015	1.80	1.20	0.50	119.00	12.00	10.00	18.00
			Monitoring Well 3				
2010	2.26	0.93	0.26	-	-	13.67	142.8[c]
2011	2.42	0.25	0.44	108.00	8.67	13.85	2.00
2012	1.09	0.20	0.35	98.00	3.75	13.65	2.00
2013	1.65	0.20	1.00	92.50	2.75	13.54	2.00
2014	0.65	0.20	0.22	105.00	2.00	12.52	2.00
2015	2.00	0.80	0.20	89.00	2.00	13.17	2.00

Source: (Pharmer Engineering 2015a)
a. Reported in feet.
b. Reported in most probable number per 100 milliliters.
c. Total coliform was analyzed in 2009 and 2010.

Percolate monitoring drains under each RIB were also intended to determine impacts to the shallow ground water (though currently only the percolate sampling points under RIBs 2 and 4 are able to produce enough percolate to sample) (Pharmer Engineering 2015a). The differences between TKN and nitrate concentrations measured in a percolate sampling port and in the nearby MW 2, shown by Table 2 and Table 3, if both are operating correctly, may indicate that the two methods are measuring different phenomena. Even though most ground water and percolate samples were taken on the same date, the difference in the mobility of the nitrogen species in the vadose zone and ground water could produce a lag between when nitrate is measured in the percolate and in the ground water.

Table 3. Percolate monitoring, yearly averages, in milligrams per liter unless otherwise noted.

Year	Total Kjeldahl Nitrogen	Nitrate as N	Phosphate as P	Total Dissolved Solids	Chloride	Fecal Coliform[a]
Average	*4.5*	*41.3*	*3.5*	*478.5*	*25.6*	*2.6*
2009	3.0	29.8	1.3	-	-	2.00
2010	10.5	8.9	5.1	-	-	6.25
2011	12.6	36.5	10.5	332.5	24.5	2.00
2012	1.7	29.0	2.7	373.5	23.8	2.00
2013	2.1	66.4	2.1	578.5	29.5	2.00
2014	1.0	83.1	1.7	757.0	25.0	2.00
2015	0.9	35.7	1.5	351.1	25.0	2.00

Source: (Pharmer Engineering, 2015)
a. Reported as most probable number per 100 milliliters.

While the high concentrations of nitrates in the percolate might indicate that there is the potential for the nitrate concentrations to be increased downgradient of the RIBs, the highest nitrate concentration measured in the downgradient monitoring wells between 2010 and 2015 was 2.3 mg/L which is well below the 10 mg/L ground water quality standard (GWQS). The results from DEQ's *Water Reuse/Land Treatment System Model's Contaminant Transport Module* (see Appendix C) using the highest single sample percolate sample suggest that it is unlikely for any

downgradient receptor to have nitrate concentrations above the GWQS as a result of land application from current recycled water concentrations and loading rates.

Fecal coliform counts have been greater than the GWQS of <1 most probable number (MPN) per 100 mL at least once per year in MW 2, and occasionally in either of the other monitoring wells. The highest recorded fecal coliform count from between 2011 and 2015 was 110 MPN/100 mL. It is not possible to determine compliance with the limits since the fecal coliform analysis method was not sensitive enough to measure down to 1 MPN/100 mL.

Two public water systems (PWSs) that use ground water as their drinking water source are located in the Idaho City area, one 1.2 miles to the east of the Idaho City recycled water facility and the other 685 feet to the north (now inactive). Neither is directly downgradient of the reuse facility. The one active PWS collects ground water from far below the upper aquifer, and the routine sampling conducted by the PWS has not indicated the presence of coliform or nitrate at concentrations greater than the detection limit in the well (DEQ 2015). The only well in the area that is part of the Environmental Data Management System (EDMS) that has sample results available online are taken from a well that is upgradient of the facility and is screened from 67 to 128 feet below the surface. The measured nitrate concentrations from this well have not exceeded 0.1 mg/L (IDWR 2015a). From the available information, it does not seem that nitrate contamination is prevalent in the area.

The Idaho Department of Water Resources' Well Driller's Locator does show that it is possible that some nearby wells would be within a quarter mile of the reuse facility, and well logs show that one of these wells may draw from the upper aquifer. There has not been any investigation of whether these wells may come under the influence of recycled water applied to the RIBs. The draft permit contains a provision requiring that a well location acceptability analysis be performed at the site (see Item 4 in Section 9.2).

4.6 Recycled Water Characterization and Loading Rates

4.6.1 Recycled Water Characterization

Table 4 presents annual averages of the results from the monthly monitoring of recycled water as it leaves the lagoon treatment system. Ammonia constitutes 75 percent of the total nitrogen in the recycled water, accompanied by an insignificant amount of nitrate. Concentrations of all constituents vary significantly throughout the year, normally reaching a minimum in March or April, coinciding with the high inflow rates discussed in Section 3. The current permit, LA-000108-02, established 30-day average limits of 20 mg/L for total nitrogen and 100 mg/L for total suspended solids (TSS), which in practice meant showing conformance with each monthly recycled water sample. The highest TSS concentration measured in monthly samples collected between 2010 and 2015 was 84 mg/L. However, total nitrogen concentrations exceeded the permit limit in 40 percent of the monthly samples collected during the same time period. The highest measured concentration was around 30 mg/L. Permit LA-000108-02 did not include annual loading rate limits for nutrients or solids in the recycled water entering the RIBs, but did establish monthly concentration limits of 100 mg/L for TSS and 20.0 mg/L for total nitrogen in conformance with requirements that were previously included in IDAPA 58.01.17, but are no

longer specified in the rapid infiltration requirements of the *Recycled Water Rules* (IDAPA 58.01.17.613).

Table 4. Annual average recycled water/rapid infiltration basin influent constituent concentrations, in mg/L unless otherwise noted.

Year	Total Suspended Solids	Ammonia	Total Kjeldahl Nitrogen	Nitrate as N	Total N	Total Phosphate	Chlorine Residual	Total Coliform[a]
2009	23.3	15.8	20.6	0.5	21.1	3.0	0.6	-
2010	25.2	15.0	19.5	0.2	19.7	2.5	0.3	1600.0
2011	32.9	12.9	17.4	0.4	17.7	2.5	1.1	7.5
2012	26.8	11.1	13.9	0.2	14.1	2.0	2.2	3.7
2013	29.7	15.1	19.0	0.3	19.2	3.3	0.8	526.2
2014	32.0	14.5	19.8	0.2	20.0	2.8	1.0	276.0
2015	27.0	10.2	15.8	0.3	16.1	2.8	0.75	543.0
Average	*28.1*	*18.0*	*0.3*	*18.3*	*13.5*	*2.7*	*1.0*	*492.7*

Source: (Pharmer Engineering 2015a)
a. Reported in most probable number per 100 milliliters.

Since 2010, total nitrogen concentrations measured in the quarterly samples have been as high as 30 mg/L, though the annual average nitrogen concentration was always at or less than 20 mg/L. Even though the nutrient concentrations in the recycled water vary seasonally, concentrations in the surface water, ground water, or percolate do not appear to have similar trends.

The TSS limit has been removed in draft permit M-108-03, since the *Recycled Water Rules* no longer require a TSS limit for RIBs and because the RIBs are able to work well under current TSS loading rates. Solids loading to the RIBs should originate in the recycled water only, no other waste solids should be added to the RIBs.

Draft permit M-108-03 has increased the maximum concentration limits for nitrogen to 30 mg/L and introduced a phosphorus limit of 6 mg/L, which are respectively the highest recorded concentrations during the monthly sampling between 2010 and 2015. Annual loading limits of 5,200 pounds of nitrogen and 765 pounds of phosphorus have also been introduced, which is the maximum loading between the years 2010 and 2015, plus the mass of each nutrient assumed to be seeping from the lagoon (using the seepage volume presented in Section 4.6.2). The limits would also include 15 percent tolerance from this value.

These limits were set to keep recycled water nutrient concentrations and loadings at historical levels, since operating at these levels has not led to exceedances of water quality standards. However, if future ground water or surface water monitoring do show impacts to downstream or downgradient water, the next permit may have more stringent limits or need to be accompanied by a surface water discharge permit.

4.6.2 Hydraulic Loading Rates

Hydraulic loading to individual RIBs has not normally been reported (only the total volume of effluent as it leaves the lagoon) since it was not required in LA-000108-02. The total hydraulic

loading, shown in Figure 1, was typically highest during the months with the highest I/I, December through May.

The RIBs are normally rotated weekly, so each RIB should receive roughly a quarter of the total flow, however the RIBs are sometimes not operational and the volume applied to each RIB could be much different. Before the middle of 2009, hydraulic loading to the RIBs was not measured, only the influent flow to the plant. Loading should be rotated sequentially between MUs every week according to the schedules suggested in Table 10-8 of the Environmental Protection Agency's *Process Design Manual: Land Treatment of Municipal Wastewater Effluents* (2006).

Table 5. Average hydraulic loading rates, 2010 to 2015, in million gallons.

Year	Recycled Water
2010	19.4
2011	25.2
2012	24.3
2013	17.8
2014	26.4
2015	24.9
Average	*23.0*

Source: (Pharmer Engineering 2015a)

As Figure 1 shows, influent to the treatment facility varies considerably from month to month with 43 percent of the 2014's total inflow to the lagoon occurring from March through May. The high inflow rates are likely caused by greater I/I resulting from higher precipitation and melting occurring during these months. Figure 1 also shows the consistent discrepancy between the volumes of influent measured going to the lagoon compared to that sent to the RIBs. In 2014 the RIB hydraulic loading was only 65 percent of the plant influent volume. The 15 MG difference between the volume of plant influent and the volume of recycled water sent to the RIBs is partly, and significantly, the result of seepage from the lagoon at a rate that exceeds Idaho rules. At the 0.61 inch per day seepage rate shown in Section 5.3, 6.4 MG of wastewater seeps from the lagoon, which is around a quarter of the total hydraulic loading to the RIBs. Idaho City is required to complete a facility plan in 2016 which will likely recommend improvements to the treatment and collection systems. Until then it will be difficult to project how future hydraulic loading will change, since a reduction in seepage losses would increase hydraulic loading, but a reduction of I/I would decrease the volume of wastewater sent to the plant.

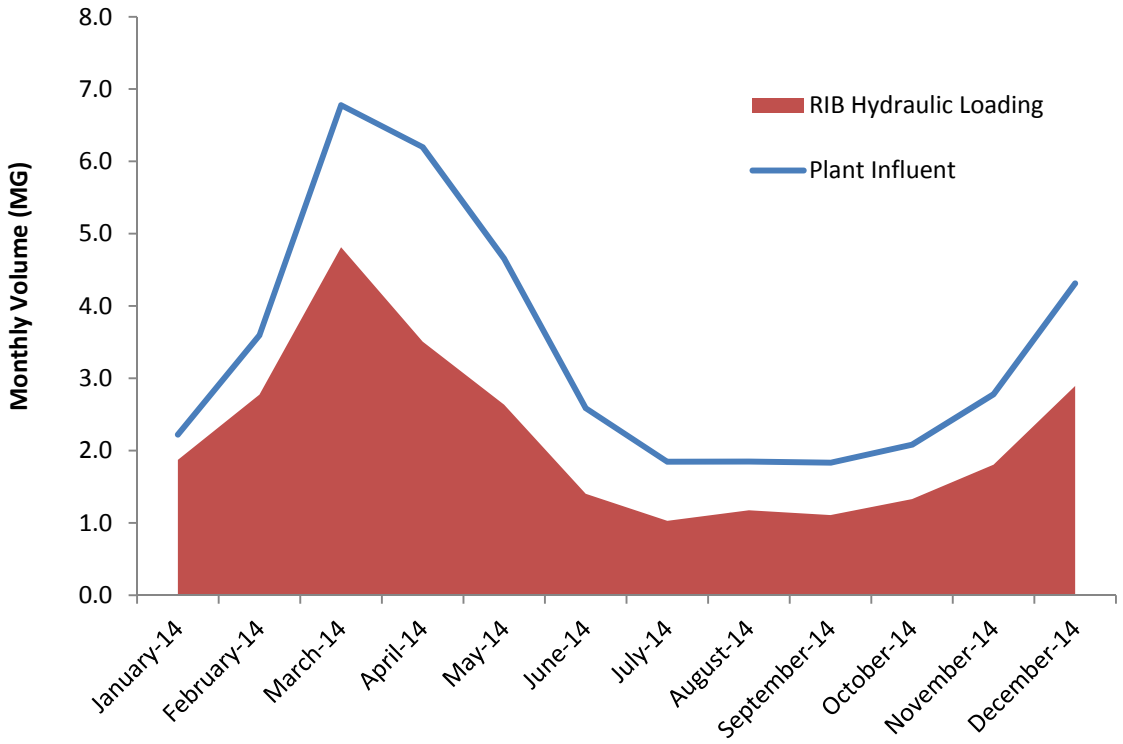

Figure 1. Monthly volume of wastewater to the lagoon and recycled water to the RIBs during 2014.

Influent flows to the treatment facility itself do not show any long term trends, since as described in Section 3, the population served by the facility has not changed much since the facility was first permitted for reuse. The facility was limited to 45.4 MG of recycled water application by the original permit LA-000108-01, which was also the volume of recycled water generated at the time (DEQ 1992). While the yearly influent volume has occasionally been higher, the plant influent volume was only 40.7 MG in 2014. In LA-000108-02, the hydraulic loading limit was changed to 140,000 gallons per day (gpd). This new limit was the daily average of the influent volume to the RIB and not based on the infiltrative or treatment capacity of the RIBs. Since it was set, the limit was exceeded 10 percent of the time during most years, almost exclusively between December and May, the months with the highest I/I.

Currently, recycled water only enters the RIBs after it overflows from the single treatment lagoon, meaning that the system is not set up to provide the control necessary to prevent exceedances of the hydraulic loading limit. The 140,000 gpd hydraulic loading limit has been removed in draft permit M-108-03, since it does not appear that hydraulic loading rates that exceed this hydraulic loading limit cause ground water mounding significant enough to impede infiltration, since depth to ground water in the monitoring wells appears to be fairly consistent throughout the year even though the volume discharged to the RIBs changes significantly. Monthly high hydraulic loading rates did not show significantly differing depths to ground water in MW 2. In 2014 the highest daily hydraulic loading rate was 265,900 gpd but still less than the 300,000 gpd that the system was originally designed for (Unknown 1991). Hydraulic loading should still be limited so as to not exceed the infiltrative capacity of any RIB. If seepage from the lagoon is significantly decreased without also decreasing I/I, hydraulic loading could become

higher than what the facility has experience operating at. Daily hydraulic loading should continue to be reported to show whether the flows to the RIBs are exceeding historic norms.

4.6.3 Constituent Loading Rates

The annual constituent loading rates for Idaho City are shown in Table 6 for the years 2010 to 2015. Nutrient loading rates may not be as variable from year to year as they seem to be from Table 6, since the loading rates shown are the results of calculations made using each year's total hydraulic loading and annual average constituent concentration instead of a sum of monthly results. Therefore, the loading rates were not weighted by the highly variable monthly hydraulic loading rates.

Table 6. Average constituent loading rates, in pounds (lb) and pounds per acre (lb/acre).

	TSS		Total Nitrogen		Phosphorus	
Year	**lb**	**lb/acre**	**lb**	**lb/acre**	**lb**	**lb/acre**
2010	4,084	2,173	3,196	799	404	214
2011	6,916	3,679	3,728	932	524	278
2012	5,432	2,890	2,848	712	412	219
2013	4,404	2,342	2,848	712	492	261
2014	7,036	3,742	4,400	1,100	616	329
2015	5,607	2,982	3,343	1,778	588	313
Average	*5,908*	*3,143*	*3,930*	*1,117*	*578*	*307*

Source: (Pharmer Engineering 2015a)

5 Site Management

5.1 Buffer Zones

Buffer zones for protection of surface water, ground water, drinking water supplies, and the public are required by IDAPA 58.01.17.604. DEQ's *Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater* provides recommended buffer distances for various reuse scenarios and those relevant for the Idaho City site are shown in Table 7 (DEQ 2007). Future buffer zone limits could be for D or C depending on the level of disinfection that the facility actually delivers, but as the treatment system is currently configured it would need to meet Class C to comply with current buffer distances. Buffer distance may be increased by deactivating the two western most RIBs, though this would reduce the RIB drying period to less than is typical (DEQ 2012).

Table 7. Buffer Zones, in feet (buffer distances measured from RIB edges, not actual RIB surface area wetted).

	Existing Permit Buffer Requirements[1]	Guidance Buffer Zone Requirements[2] Class (E/D/C)	Actual Reuse Area[3]
Nearest Inhabited	300	300/300/50	80 (house east of

Residence			MU-10801)
Nearest Public Water System	1,000	1,000	645 feet (See Section 4.5)
Nearest Private Water Supply	500	500	Unknown
Areas Accessible to the Public	100	100/100/0	No buffer to the property north of the RIBS, 250 feet from Idaho Highway 21
Nearest Surface Water	50	Not applicable	480 to Mores Creek
Nearest Irrigation Ditches/Canals	50	Not applicable	20 to drainage channel
Fencing	Required	Cyclone/Cyclone/Woven	Barbed Wire Fencing
Posting	Every 500 feet, "Reclaimed Wastewater in use – Do Not Drink", or equivalent	Varies[4]	Not Measured

1. Current Buffer Zone Requirements in Reuse Permit LA-000108-02.
2. The DEQ Reuse Guidance Manual provides recommended buffer distances for various reuse scenarios. For this permit, the following scenario was used for determining buffer distances: Municipal, residential location, flood irrigation.
3. Measurements taken from *Google Earth*.
4. *Class E:* Every 250 feet and each corner of the outer perimeter of the buffer zone of the site, signs should read "Warning: Recycled Water – Do Not Enter" or equivalent. *Class D/C:* Signs should read "Warning: Recycled Water – Do Not Enter" or equivalent to be posted every 500 feet and at each corner of the outer perimeter of the buffer zone(s) of the site.

5.2 Runoff

No runoff management plan has been submitted for the facility. Section of 9.1.2 of draft permit M-108-03 requires that land applied recycled water be restricted to the premises. If the RIBs are cycled regularly, the RIB berms and high infiltration rates should prevent recycled water from running off of the application site.

5.3 Seepage Rate Testing

Table 8 contains a summary of seepage rate testing for the active lagoon at the Idaho City treatment facility, which shows that its most recently measured seepage exceeded the 0.25 inch per day limit. As a result of the seepage test failure, on October 1, 2014 Idaho City entered into a compliance agreement schedule (CAS) with DEQ to achieve compliance with the *Wastewater Rules* (IDAPA 58.01.16.493). The CAS requires that Idaho City submit a facility plan to DEQ that would recommend improvement of the wastewater treatment facility. If lagoon treatment is proposed in this facility plan, and DEQ approves of the proposal, then all new, repaired, or reconstructed lagoons would need to have seepage test procedures submitted to and approved by DEQ and then pass the test before being put into service.

Table 8. Seepage rate testing

Lagoon	Test Date Completion	Date of DEQ approval of test report	Seepage rate, inches per day	Allowable rate, inches per day	Date next seepage rate test is due
LG-108-01	9/9/2012	11/1/2012	0.610[a]	0.25	As set in CAS[b]

a. *Source:* (Pharmer Engineering 2015b)
b. Unless the CAS is amended, construction and seepage testing of any lagoon improvements must be made by December 31, 2019.

Information on seepage testing procedures are located at: *http://www.deq.idaho.gov/water-quality/wastewater/lagoon-seepage-testing.aspx*

5.4 Waste Solids, Biosolids, Sludge, and Solid Waste

To prevent unnecessary decreases to the RIB infiltration rates, only solids contained within the recycled water should be applied to the RIBs. Section of 9.1.4 of draft permit M-108-03 provides information regarding management of biosolids (from sewage sludge), other sludges, solid waste, and waste solids. Biosolids derived from sewage are regulated by the Environmental Protection Agency (EPA) under Federal Regulation 40 CFR 503.

5.5 Nuisance Odors

There have not been any odor complaints registered against the facility with DEQ; therefore the facility should not be required to submit a nuisance odor plan at this time.

5.6 Salts

Total Dissolved Solids (TDS) concentrations in the monitoring wells are typically low, at around 100 mg/L, and the only recent recycled water sample analyzed for TDS, in September 2013, was not much higher at 138 mg/L (Pharmer Engineering 2014a).

6 Monitoring

6.1 Recycled Water Monitoring

Since the TSS limit was removed in draft permit M-108-03, TSS monitoring will also be removed from the recycled water monitoring in the draft permit. Since TDS concentrations have consistently been below levels of concern, TSS would not need to be replaced with TDS monitoring.

Influent monitoring should be made for TKN, nitrate, and total phosphorus to evaluate the treatment of their current lagoon system, but should not be required in draft permit M-108-03.

6.2 Soil Monitoring

Infiltration rates at Idaho City have been sufficient and there is no reason currently to believe that they are decreasing; therefore, soil monitoring will not be added to draft permit M-108-03.

6.3 Ground/Percolate Water Monitoring

Ground water elevations, based on the survey performed for the re-permitting application (Pharmer Engineering 2015a) should be measured monthly instead of quarterly, so that the direction of ground water flow during all seasons can be more accurately determined. A new ground water monitoring well should be added to the current monitoring network to allow for a more precise determination of the direction of ground water flow around the RIBs. That analysis, along with a well location acceptability analysis of wells located within a half mile of the site would help determine whether the facility is degrading ground water.

Despite the difficulty of acquiring percolate samples, percolate monitoring should continue to be included in Idaho City's required monitoring. Improving the reliability of the percolate sampling ports should be part of the RIB upgrades. Percolate samples may indicate whether more even distribution of recycled water increases the RIB treatment performance. TDS was removed from the percolate monitoring since previous results do not show it to be a constituent of concern. Chloride could still act as a conservative tracer.

The microbiological indicator organism for both ground water and percolate water monitoring has been changed from fecal coliform to *E. coli* to make comparison to surface water monitoring easier.

6.4 Surface Water Monitoring

The surface water monitoring points should be moved from the drainage channel to Mores Creek. As described in Section 4.4, numeric surface water quality standards were not exceeded in the drainage channel during the previous four years of monitoring. Surface water located in Mores Creek, instead of the drainage channel, should be better positioned to determine whether surface water is being impacted through a ground water interconnection. The location and methods for surface water sampling should be described in the Plan of Operation and Quality Assurance Project Plan submitted for review by DEQ. The location of the upstream surface water monitoring point should be located where it is unlikely to be influenced by lagoon seepage. The downstream sampling point should be after the confluence with the wetlands that the drainage channel flows to, where it can be expected that the base flow and interflow of ground water that could have been impacted by reuse activities is well mixed, but also be upstream of any other point source discharge to the creek. *E. coli* should still be monitored, and DEQ should still be notified if coliform counts that exceed the primary contact recreation standard, however, further evaluation would be necessary to determine whether the exceedances originate from the treatment facility.

Ammonia analysis should be continued, along with nitrate and nitrite, which were first recommended by DEQ in 2013. The analysis method for nitrate should have a lower practical quantitation limit than has been used for recent samples. TKN, total phosphorus, total chlorine

residual, turbidity, dissolved oxygen, and total suspended solids should all be added to the constituents measured from the surface water samples. Temperature and pH should be monitored in the field to allow calculation of ammonia toxicity, as well as turbidity and dissolved oxygen. After the two years of monitoring, the permittee may request DEQ to determine whether a parameter can be removed from the required monitoring because it was measured at levels below regulatory concern.

6.5 Calculation Methodologies

The dates when the active RIB is switched should continue to be recorded and noted in annual reports to indicate how long the dose and rest cycles of the RIBs are. Nutrient loading calculations will be required to be submitted in annual reports and should be made as described in Section 4.4.14.1.1 of the *Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater*.

7 Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPP) is a written document outlining the procedures used by the permittee to ensure the data collected and analyzed meets the requirements of the permit.

In support of the agency mission, DEQ is dedicated to using and providing objective, correct, reliable, and understandable information. Decisions made by DEQ are subject to public review and may at times, be subject to rigorous scrutiny. Therefore, DEQ's goal is to ensure that all decisions are based on data of known and acceptable quality.

The QAPP is a permit requirement and must be submitted to DEQ as a stand-alone document for review and acceptance. The QAPP is used to assist the permittee in planning for the collection, analysis, and reporting of all monitoring data in support of the reuse permit and explaining data anomalies when they occur.

DEQ does not approve QAPPs, but reviews them to determine if the minimum EPA guideline requirements are met and that the reuse permit requirements are satisfied. The reason DEQ does not approve QAPPs is that the responsibility for validation of the facility sampling data lies with the permittee's quality assurance officer and not with DEQ.

The format of the QAPP should adhere to the recommendations and references in 1) the Assurance and Data Processing sections of the DEQ Guidance and 2) EPA QAPP guidance documents. EPA QAPP guidance documents are available at the following website: *http://www.epa.gov/quality/qapps.html.*

A QAPP was submitted with the permit application (Pharmer Engineering 2015a). An update of this QAPP will be required to fulfill the requirements of compliance activity CA-108-02 in draft permit M-108-03. Permit references should be changed to those of M-108-03 and include any new monitoring requirements of the new permit. A quality assurance and quality control officer who is independent of the data collection should also be designated. The QAPP should also be updated to address the discussion in Section 6.4 for nitrate analytical method sensitivity, and ensure that *E. coli* can be analyzed to 1 MPN / 100 mL in ground water and percolate samples.

Recycled water flow measurement elements listed in Table 7 of the submitted QAPP and sampling equipment in Table 8 should be updated to what is actually used at the facility. After these changes are made and DEQ determines that the QAPP fulfils the needs of CA-108-02, the cover page should then be signed by all of the required parties.

8 Site Operation and Maintenance

The City of Idaho City owns, operates, and manages the treatment facility and expects to continue to do so into the foreseeable future. A contract operator manages sampling and some other maintenance operation, while leaving many day to day operations with city employees.

The City's wastewater collection system is Class I and its wastewater treatment system is Class II. DEQ does not have a record of a signed contract between responsible charge operator and a backup on file to meet these classifications.

9 Compliance Activities

9.1 Status of Compliance Activities in Current Permit

1. CA-108-01. The Plan of Operation (PO) dated January 2013 was approved by DEQ on April 26, 2013.
2. CA-108-02. The monitoring data assessment report dated October 2014 was approved by DEQ on January 26, 2015. This assessment report concluded that the treatment system would not be able to meet the 20 mg/L total nitrogen lagoon effluent limit and that a facility planning study be should be completed to determine the best way to decrease the total nitrogen concentrations in the effluent.
3. CA-108-03. The results from the most recent seepage testing at Idaho City were received by DEQ on September 26, 2012. DEQ sent the notice of seepage test failure on November 1, 2012. See
4. Table 8 for the results from this testing.
5. CA-108-04. The permit renewal application was received by DEQ on April 9, 2012.

9.2 Compliance Activities Required in the New Permit

The following compliance activities are specified in the draft permit:

1. Submit an updated PO that incorporates the requirements of the new permit within six months of permit issuance. The current PO, described in item 1 of Section 9.1, would only need to be modified slightly to meet the requirements of M-108-03 and should include a description of surface water monitoring points as discussed in Section 6.4 and include sample monitoring sheets that would show how the active RIB would be regularly recorded (see Section 6.5).
2. Submit a revision of the QAPP included in the permit application within six months of permit issuance. The QAPP should include verification that the plan has been

implemented by the facility. See Section 7 for a discussion of the requirements of the updated QAPP.

3. Submit lagoon seepage rate test proposed schedule and procedure at least 42 days prior to the planned seepage test. Complete the seepage test in accordance with the CAS, signed on October 1, 2014, or as amended.
4. Submit a well location acceptability analysis (WLAA) eighteen months after M-108-03 is issued, and submit plans for the new monitoring well. This compliance activity should address the issues raised in Sections 4.5 and 6.3 and the WLAA should follow the procedure described in Section 6.6.4 of DEQ's *Guidance for Reclamation and Reuse of Municipal and Industrial Wastewater* modified by the suggestions of Section 9.3 in *Draft Idaho Recycled Water Guidance: Section 9 Rapid Infiltration Systems (DEQ 2012).*
5. Install a system to distribute recycled water evenly in each active rapid infiltration basin and report the results to DEQ 12 months after the permit is issued. The existing RIBs would need to be modified to meet the requirements of the Idaho *Recycled Water Rules* IDAPA 58.01.17.613.01.c.
6. Schedule a pre-application workshop one year prior to permit expiration.
7. Submit a permit renewal application six months prior to expiration of the existing permit.

10 Recommendations

Staff recommends the draft reuse permit be issued. The permit specifies hydraulic and constituent loading limits and establishes monitoring and reporting requirements to evaluate system performance, environmental impacts, and permit compliance.

11 References

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Pharmer Engineering. 2015a. *2015 Wastewater Land Application Renewal*. Boise, ID: Pharmer Engineering, L.L.C.

Pharmer Engineering. 2015b. *Idaho City Seepage Test - Wastewater Lagoon*. Boise, ID: Pharmer Engineering, L.L.C.

Pharmer Engineering. 2014b. *Monitoring Data Assessment Report CA-108-02*. Boise, ID: Pharmer Engineering, L.L.C.

Unknown. 1991. *"Application for Wastewater Land Application Permit for Idaho City Wastewater Treatment Facility."*

Appendix A. Site Maps

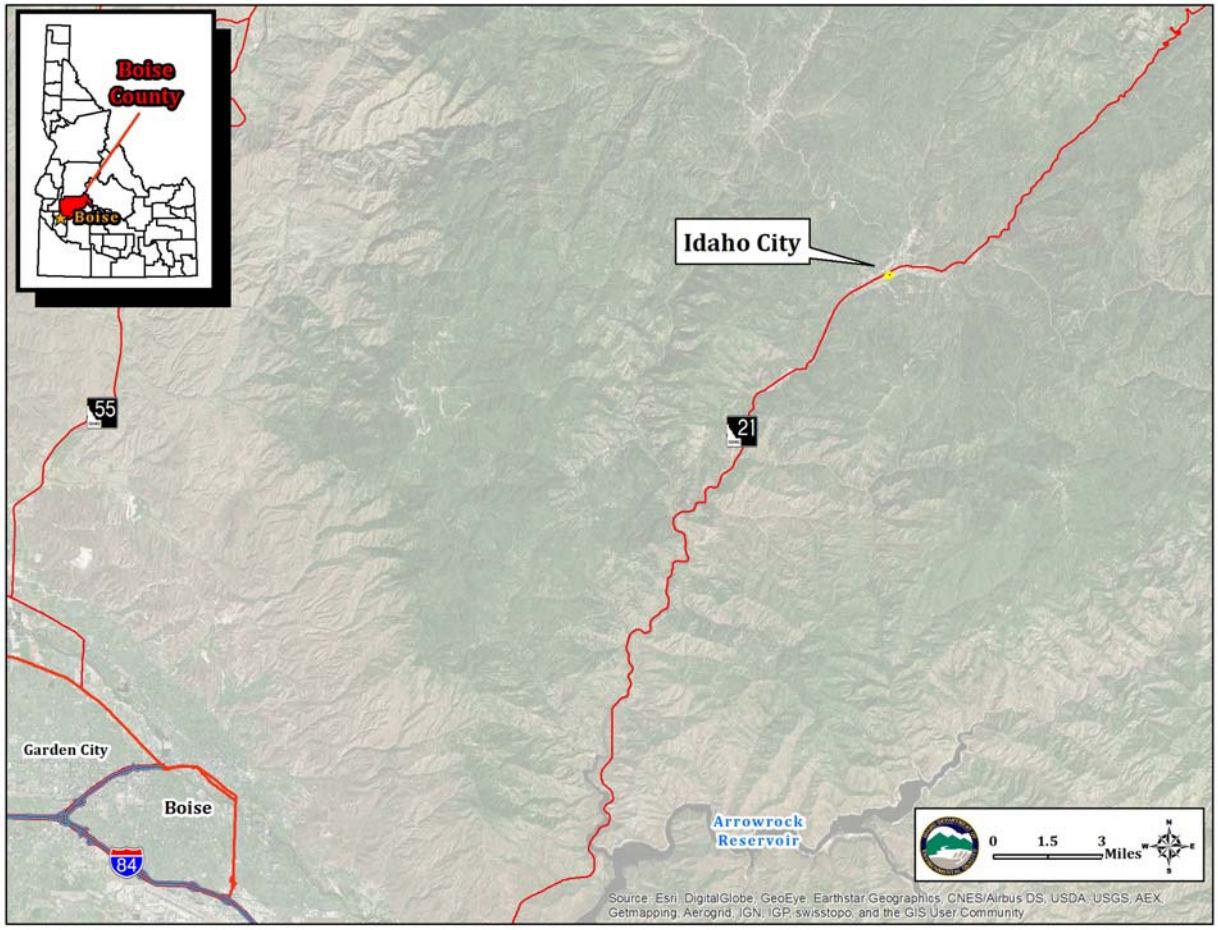


Figure 2. Regional view.

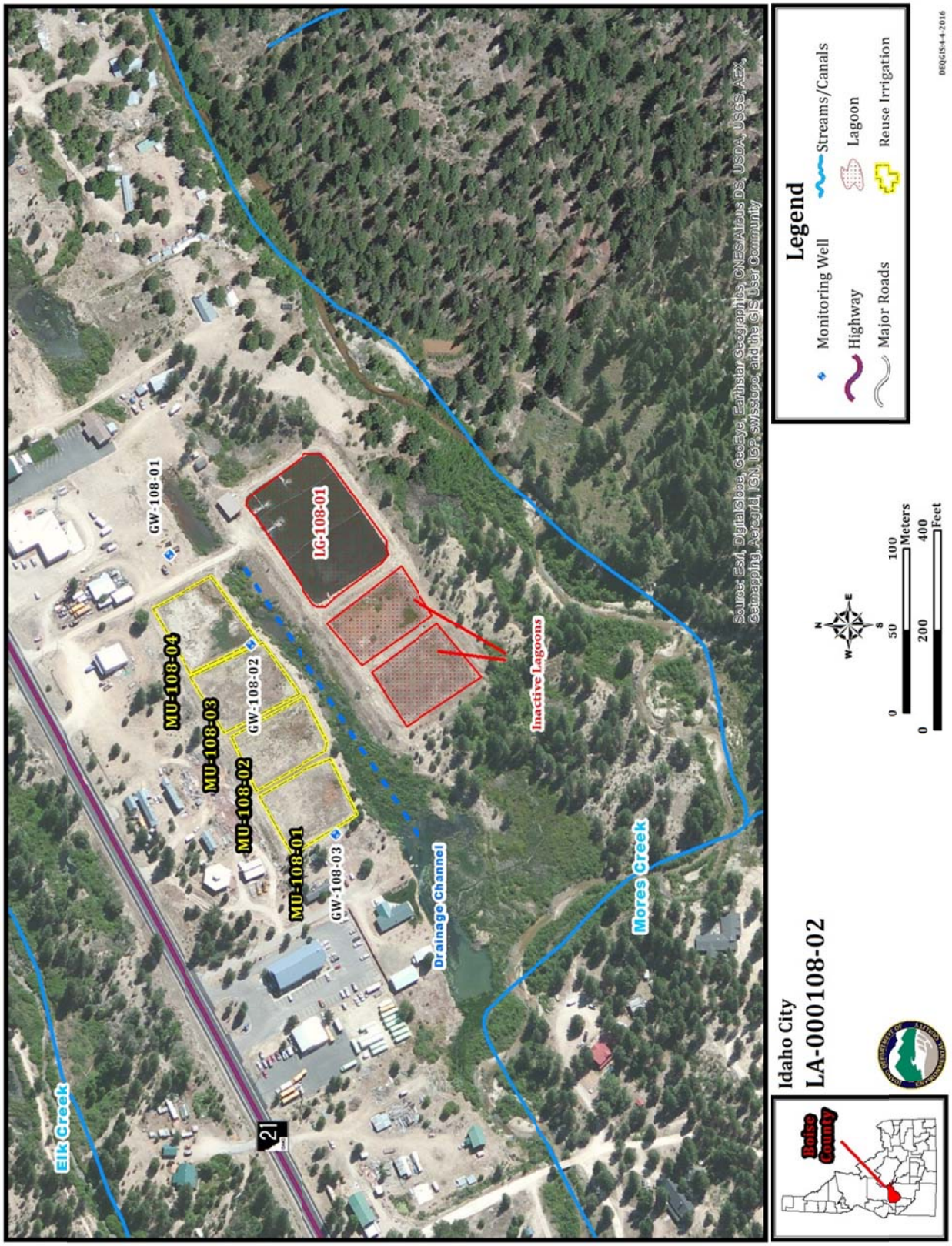


Figure 3. Site View

Appendix B. Supplementary Monitoring Results

Table 9. Quarterly Surface Water Monitoring Results (Unnamed Drain)

	Nitrate mg/L		Ammonia mg/L		Total Phosphate mg/L		E. Coli MPN/100 mL	
Sample Date	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**	**Upper**	**Lower**
2/18/2010	0.31[a]	0.62[a]	0.15	1.57	0.26	0.29	2[b]	4[b]
6/10/2010	0.21[a]	0.22[a]	0.13	0.32	—	—	17[b]	130[b]
9/23/2010	0.21[a]	0.85[a]	0.11	0.43	0.17	0.16	50[b]	17[b]
11/29/2010	0.21[a]	1.52[a]	0.05	0.58	0.07	0.17	50[b]	140[b]
2/14/2011	—	—	<0.04	0.99	0.05	0.18	130	38
6/16/2011	—	—	<0.04	0.11	0.09	0.11	—	—
8/29/2011	—	—	<0.04	0.32	0.06	0.20	69	8
11/16/2011	—	—	<0.04	0.50	0.05	0.13	69	93
2/28/2012	—	—	0.18	0.42	0.30	0.10	5	120
5/24/2012	—	—	<0.04	0.24	0.12	0.27	32	21
8/22/2012	—	—	<0.04	0.04	0.10	0.30	160	64
11/20/2012	—	—	<0.04	0.07	0.06	0.07	86	100
2/22/2013	—	—	0.15	0.39	0.28	0.10	45	88
5/22/2013	<0.20	<0.20	0.04	0.33	0.15	0.15	3	5
7/30/2013	<0.20	0.40	—	—	—	—	—	—
8/30/2013	<0.20	<0.20	0.06	0.40	0.10	7.41	550	6
9/23/2013	<0.20	<0.20	—	—	—	—	—	—
10/28/2013	<0.20	0.40	—	—	—	—	—	—
11/26/2013	<0.20	0.30	0.13	0.28	0.32	0.13	1	74
12/12/2013	<0.20	0.50	—	—	—	—	—	—
1/20/2014	<0.20	<0.20	—	—	—	—	—	—
2/25/2014	0.30	0.30	<0.04	0.36	0.08	0.10	1	22
5/22/2014	<0.20	0.30	0.08	0.09	0.24	0.11	1	28
6/25/2014	<0.20	<0.20	—	—	—	—	—	—
7/23/2014	<0.20	<0.20	—	—	—	—	—	—
8/14/2014	<0.20	0.50	<0.04	0.06	0.10	0.19	870	330
9/22/2014	<0.20	<0.20	—	—	—	—	—	—
10/27/2014	<0.20	<0.20	—	—	—	—	—	—
11/21/2014	<0.20	<0.20	<0.04	<0.04	0.05	0.06	9	71
12/18/2014	<0.20	0.30	—	—	—	—	—	—
2/19/2015	<0.20	0.20	<0.04	<0.04	0.08	0.10	3	10
5/28/2015	<0.20	0.30	<0.04	0.13	0.09	0.17	110	110
7/27/2015	<0.20	020	<0.04	<0.04	0.16	0.12	—	—
11/12/2015	<0.20	0.20	0.06	0.11	0.12	0.14	25	62

a. Nitrite + nitrate was measured.
b. Fecal coliform was measured.

Table 10. Quarterly Ground Water Monitoring Results

Sample	TKN	Nitrate as N	Total Phosphate	TDS	Chloride	Static Water Level (ft)	Fecal Coliform (MPN / 100 mt.)
			Monitoring Well 1				
10/31/2005	1.77	0.20	2.77	—	—	—	<2
3/29/2006	0.45	<0.2	0.09	—	—	—	1
6/28/2006	3.13	0.70	1.25	—	—	—	<2
9/12/2006	3.17	0.40	0.67	—	—	—	8
11/21/2006	4.09	1.10	2.06	—	—	—	5
2/23/2007	0.77	3.30	0.45	—	—	—	7
5/17/2007	1.89	0.20	1.72	—	—	—	<2
8/29/2007	2.21	2.00	1.40	—	—	—	>1,600
11/20/2007	1.62	7.30	0.60	—	—	—	110
2/22/2008	0.76	0.90	0.30	—	—	—	<2
5/20/2008	1.20	2.10	0.34	—	—	—	
12/5/2008	1.49	2.00	0.91	—	—	—	1600
2/18/2010	0.37	0.24	0.46	—	—	7.29	30[a]
6/10/2010	0.47	0.23	0.13	—	—	7.08	2[a]
9/23/2010	0.57	0.25	0.23	—	—	7.42	650[a]
11/29/2010	0.64	0.74	0.81	—	—	7.50	>1600[a]
2/14/2011	0.65	0.40	0.61	122.61	8.00	7.33	2
6/16/2011	0.64	0.20	0.60	121.27		7.17	2
8/29/2011	0.54	0.20	0.30	80.00	7.00	7.25	2
11/16/2011	0.61	0.50	0.53	128.00	8.00	6.92	2
2/28/2012	0.57	0.20	0.53	258.00	8.00	7.33	2
5/24/2012	0.67	0.20	0.53	258.00	8.00	7.33	80
8/22/2012	0.63	0.20	0.60	78.00	7.00	8.00	2
11/20/2012	0.69	0.20	0.56	122.00	8.00	7.00	2
2/26/2013	0.72	0.20	0.89	106.00	8.00	7.42	<2
5/22/2013	0.62	0.20	0.68	132.00	8.00	7.42	<2
8/30/2013	0.78	0.20	0.60	140.00	7.00	8.17	<2
11/26/2013	0.71	0.20	0.68	92.00	6.00	7.08	<2
2/25/2014	0.71	0.20	0.70	104.00	6.00	7.25	2
5/22/2014	0.57	0.20	0.52	122.00	6.00	7.17	2
8/14/2014	1.11	0.20	0.57	146.00	5.00	7.00	2
11/21/2014	0.64	0.20	0.60	130.00	7.00	7.08	2
2/19/2015	0.70	0.20	0.75	132.00	9.00	6.75	2.00
5/28/2015	0.70	0.20	0.72	116.00	6.00	7.25	2.00
11/12/2015	1.30	0.20	0.63	136.00	6.00	7.17	2.00
			Monitoring Well 2				
10/31/2005	41.80	0.70	5.64	—	—	—	—

3/29/2006	18.40	0.40	0.46	—	—	—	—
6/28/2006	29.70	0.30	1.10	—	—	—	—
9/12/2006	34.80	0.30	1.40	—	—	—	—
11/21/2006	23.30	0.30	0.39	—	—	—	—
2/23/2007	14.20	1.10	0.83	—	—	—	—
5/17/2007	11.00	0.30	0.88	—	—	—	—
8/29/2007	20.00	0.80	1.10	—	—	—	—
11/20/2007	1.62	7.30	0.60	—	—	—	—
2/22/2008	11.30	1.60	0.47	—	—	—	—
5/20/2008	13.30	0.50	0.40	—	—	—	—
12/5/2008	26.50	0.40	0.22	—	—	—	—
2/18/2010	6.23	0.22	0.71	—	—	10.42	30
6/10/2010	6.92	0.22	0.25	—	—	10.42	2
9/23/2010	5.58	0.23	0.45	—	—	12.00	650
11/29/2010	6.04	1.36	0.50	—	—	10.33	>1600
2/14/2011	3.49	2.20	0.32	115.91	6.00	10.75	2
6/16/2011	4.68	0.20	0.18	131.99	—	10.58	2
8/29/2011	2.62	0.20	0.20	106.00	7.00	10.67	2
11/16/2011	2.53	0.20	0.20	104.00	5.00	10.33	2
2/28/2012	3.38	0.20	0.30	136.00	8.00	10.17	2
5/24/2012	3.81	0.20	0.31	72.00	8.00	10.67	30
8/22/2012	2.96	0.30	0.31	132.00	7.00	10.67	2
11/20/2012	3.83	0.50	0.32	120.00	8.00	10.42	2
2/26/2013	4.35	0.20	0.37	104.00	12.00	7.92	<2
5/22/2013	3.71	0.20	0.35	122.00	8.00	7.92	<2
8/30/2013	3.54	0.40	0.34	166.00	8.00	10.42	30
11/26/2013	4.53	0.20	0.41	90.00	7.00	10.25	<2
2/25/2014	3.51	0.30	0.43	98.00	8.00	10.33	2
5/22/2014	2.82	1.10	0.38	108.00	5.00	10.17	2
8/14/2014	2.58	1.30	0.24	138.00	7.00	10.08	110
11/21/2014	3.13	2.30	0.40	126.00	8.00	10.33	2
2/19/2015	2.20	1.40	0.39	96.00	11.00	9.75	2.00
5/28/2015	1.80	1.20	0.56	116.00	10.08	—	50.00
11/12/2015	1.50	1.00	0.54	146.00	13.00	10.17	2.00
			Monitoring Well 3				
10/31/2005	7.83	0.20	4.88	—	—	—	—
3/29/2006	4.67	2.40	2.30	—	—	—	—
6/28/2006	0.67	<0.2	0.18	—	—	—	—
9/12/2006	0.26	<0.2	0.06	—	—	—	—
11/21/2006	0.42	0.20	0.14	—	—	—	—
2/23/2007	0.30	0.30	0.12	—	—	—	—
5/17/2007	0.29	<0.2	0.35	—	—	—	—
8/29/2007	0.78	<0.2	0.19	—	—	—	—

11/20/2007	0.46	0.20	0.14	—	—	—	—
2/22/2008	0.26	0.29	0.14	—	—	—	—
5/20/2008	0.31	0.03	<0.05	—	—	—	—
12/5/2008	0.56	<0.2	0.18	—	—	—	—
2/18/2010	3.63	2.02	0.30	—	—	13.58	4
6/10/2010	1.21	0.53	0.13	—	—	13.67	13
9/23/2010	2.98	0.32	0.19	—	—	13.67	54
11/29/2010	1.20	0.84	0.41	—	—	13.75	500
2/14/2011	2.67	0.40	0.38	119.26	10.00	14.00	2
6/16/2011	1.64	0.20	0.53	107.20	—	13.67	8
8/29/2011	1.15	0.20	0.16	84.00	6.00	13.83	2
11/16/2011	4.20	0.20	0.68	132.00	10.00	13.92	2
2/28/2012	2.48	0.20	0.31	94.00	8.00	14.00	22
5/24/2012	2.75	0.20	0.65	66.00	6.00	14.00	14
8/22/2012	0.57	0.20	0.21	110.00	3.00	13.50	2
11/20/2012	0.48	0.20	0.33	106.00	3.00	13.58	2
2/26/2013	2.01	0.20	0.31	84.00	4.00	13.75	<2
5/22/2013	3.27	0.20	1.61	104.00	3.00	13.75	<2
8/30/2013	3.42	0.20	3.17	118.00	2.00	13.25	<2
11/26/2013	0.67	0.20	0.20	62.00	2.00	13.42	<2
2/25/2014	0.82	0.20	0.17	98.00	2.00	13.83	2
5/22/2014	0.73	0.20	0.34	98.00	2.00	13.42	2
8/14/2014	0.55	0.20	0.16	124.00	2.00	9.58	2
11/21/2014	0.49	0.20	0.21	100.00	2.00	13.25	2
2/19/2015	1.60	0.20	0.20	64.00	2.00	13.00	2.00
5/28/2015	0.30	0.20	0.12	92.00	13.25	—	2.00
11/12/2015	0.50	0.20	0.23	112.00	2.00	13.25	2.00

a. Total coliform was measured.

Appendix C. Contaminant Transport Modeling Results

Table 11. Model Inputs

INPUTS: GW Contaminant Transport Model: ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY and RETARDATION <Rev 5/17/2012>

Note: All Inputs are in Rows 4 - 46 and are in Cells with Red Font.

Project Description:	City of Idaho City; Permit no. LA-000108
Date:	11/10/2015
Prepared by:	A. Bussan (partially based on Pharmer (2015))
Scenario Description:	Nitrate-N Impacts

Mixing Zone Depth Calculation Inputs	Symbol	Units	Input	Data Sources and Comments
Land Treatment Swath Length Parallel to GW Flow	L	feet	632	Pharmer 2015
Land Treatment Swath Width Perpendicular to GW Flow	W	feet	140	Pharmer 2015
Percolate Volume	Qp	inches/ac	231	Pharmer 2015
Percolate Constituent Concentration:	Cp	mg/L	179	Highest percolate result
Upgradient GW Concentration:	Cgw	mg/L	0.3	Pharmer 2015
Aquifer Hydraulic Conductivity: High Range	K	feet/day	28300	Guidance Section 5.2.7
Aquifer Hydraulic Conductivity: Low Range	K	feet/day	283.5	Golder 11-28-08 p. 6
Aquifer Hydraulic Gradient	i	unitless	0.0045	Pharmer 2015 survey result
Aquifer Material	Domenico and Schwartz, 1998 - Gravel, coarse			

Aquifer Porosity (Suggested literature values, range given in percent)	ne	unitless	24 – 36%	Suggested value. Don't overwrite
Aquifer Effective Porosity (enter suggested or other value as a percent)	ne	unitless	25%	Golder 11-28-08 p. 6
Aquifer Thickness	da	feet	25	Typical values from well driller logs
Ground Water Transport Calculation Inputs	**Symbol**	**Units**	**Input**	**Data Sources and Comments**
Suggested LAMBDA (biodegradation constant) for non-decaying species)	λ	day-1	0	Suggested Value - Don't overwrite.
LAMBDA (biodegradation constant)	λ	day-1	0	
Soil Texture	--	--	Sand	Information not needed for this analysis
Suggested Soil Bulk Density Value (from RU Guidance)--->	Db	g/cm3	1.62	Suggested Value. Calculated Cell. Don't overwrite.
Soil Bulk Density (enter Suggested Value or Other Value)	Db	g/cm3	1.59	Information not needed for this analysis
Suggested Koc value (for conservative non-sorbing species)	Koc	cm3/g	0	Suggested Value - Don't overwrite.
Koc (organic carbon partition coefficient)	Koc	cm3/g	0	Information not needed for this analysis
Fraction of Organic Carbon	--	--	5.00E-03	Information not needed for this analysis
Spatial Coordinates of Concern (Origin is plume centerline at DG discharge boundary				
X (longitudinal)	x	feet	50	Distance DG to nearest Receptor (hypothetically to nearest house to RIB)
Y (latitudinal/transverse)	y	feet	0	
Z (depth)	z	feet	0	
Depth of Vertical Profile to Calculate and Observe	z	feet	25	Possible depth of aquifer
Time that the Source is Discharging	t	days	10000000	High value to model steady-state conditions
AREAL Model Calculation Domain (dimensions of area modeled)				
Length (ft)	L	feet	5000	Golder 11-28-08 p.7
Width (ft)	W	feet	3500	a width greater than the pivot width

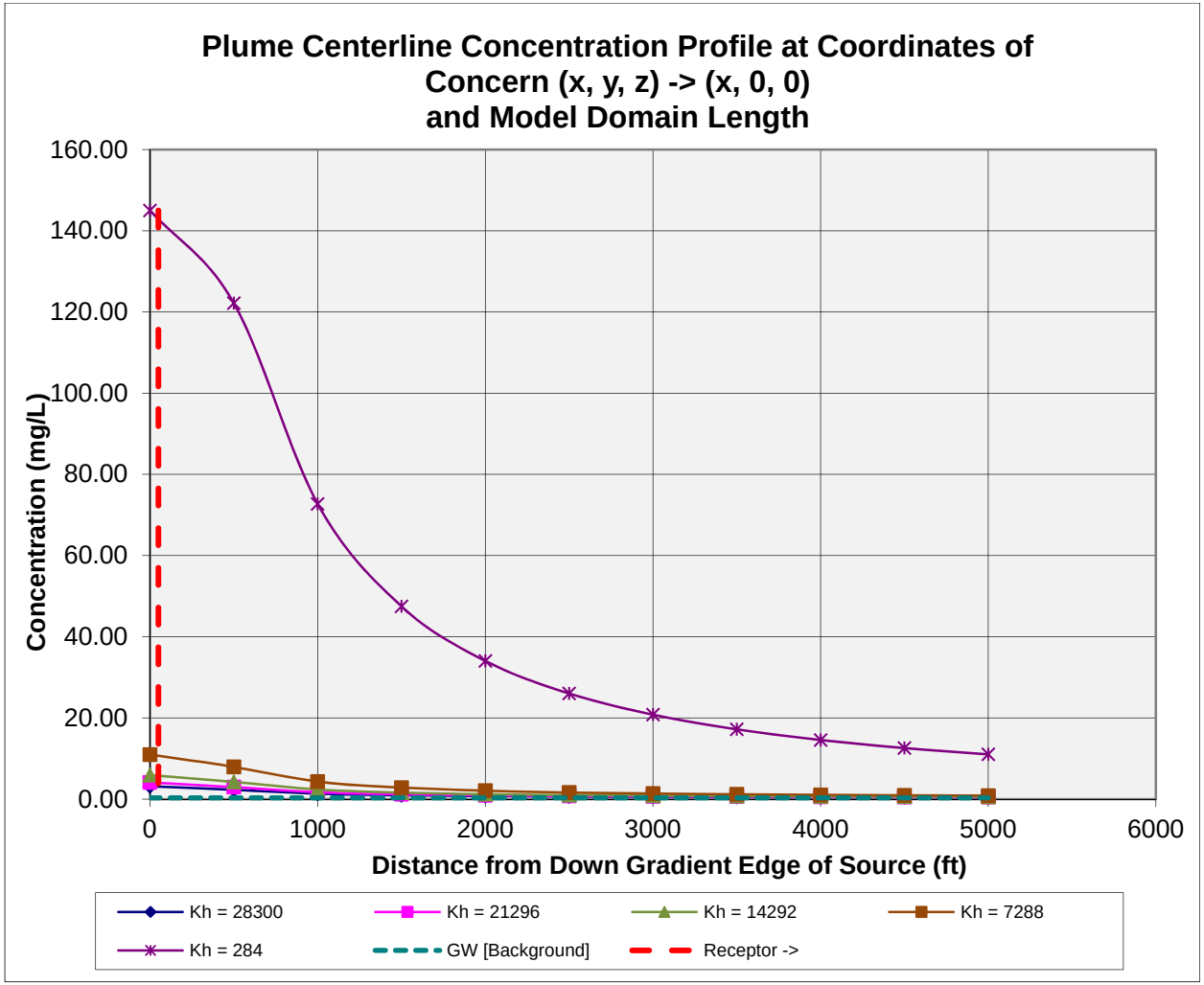
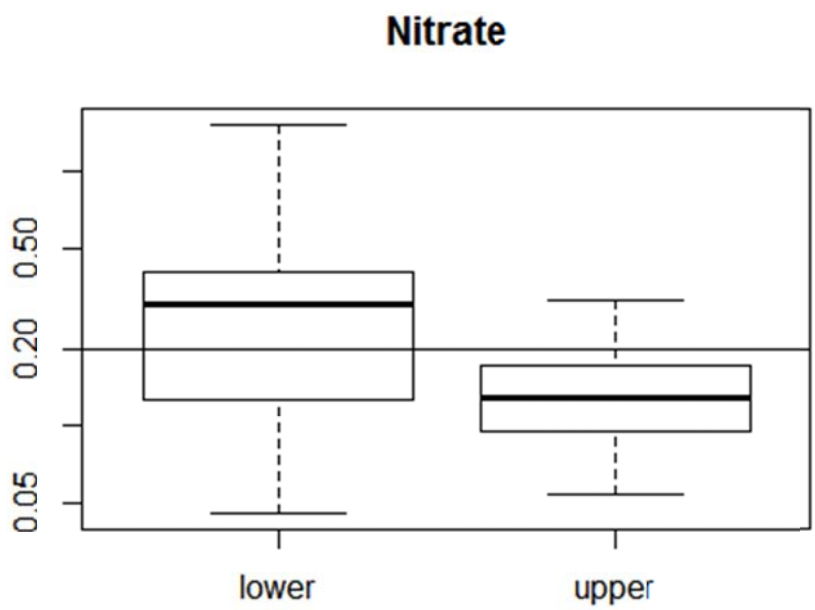


Figure 4. Model Results

Appendix D. Surface Water Statistical Analysis[1]

Results of the Idaho City Surface Water data for the Drainage Canal

Nitrate



Non-parametric Wilcoxon test with censored data

```
##              N Observed Expected (O-E)^2/E (O-E)^2/V
## grad=lower 21    10.48     5.93      3.49      7.54
## grad=upper 21     3.64     8.19      2.52      7.54
##
##  Chisq= 7.5  on 1 degrees of freedom, p= 0.00604
```

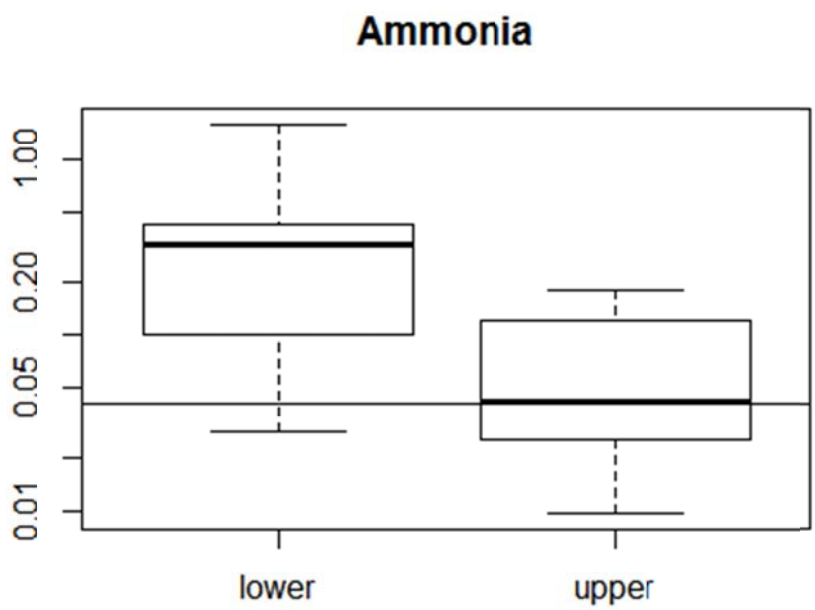
Non-parametric Wilcoxon signed rank (NDs at reporting limit)

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  nup and nlow
## V = 0, p-value = 0.003753
## alternative hypothesis: true location shift is not equal to 0
```

---

[1] Analysis performed by Brady Johnson on November 11, 2015 using the NADA package in R:
Lopaka Lee (2013). NADA: Nondetects And Data Analysis for environmental data. R package version 1.5-6. http://CRAN.R-project.org/package=NADA

Ammonia



Non-parametric Wilcoxon test with censored data

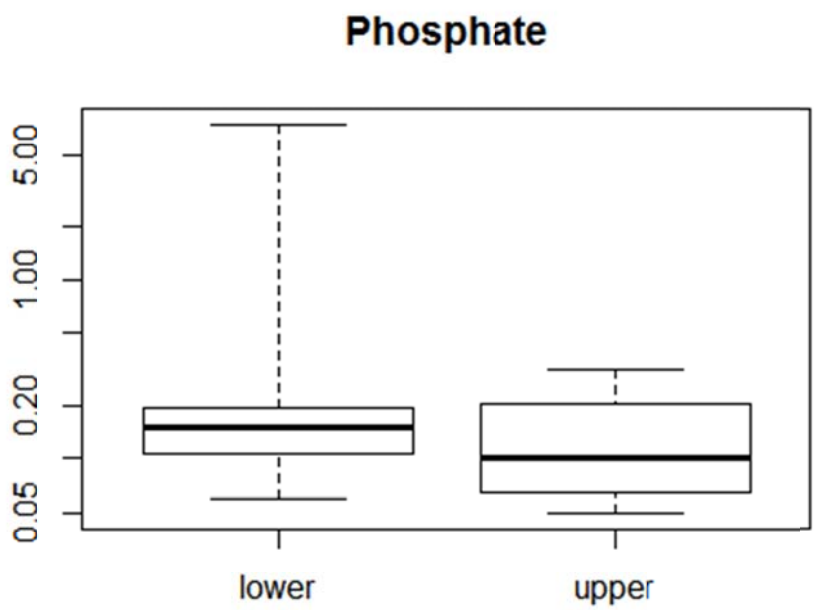
```
with(nh4.data,
     cendiff(conc,cen,grad))

##             N Observed Expected (O-E)^2/E (O-E)^2/V
## grad=lower 20     13.9     6.42      8.70      18.6
## grad=upper 20      5.1    12.57      4.44      18.6
##
##  Chisq= 18.6  on 1 degrees of freedom, p= 1.61e-05
```

Non-parametric Wilcoxon signed rank (NDs at reporting limit)

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  nh4up and nh4low
## V = 0, p-value = 0.0002137
## alternative hypothesis: true location shift is not equal to 0
```

Phosphate



Non-parametric Wilcoxon test with censored data

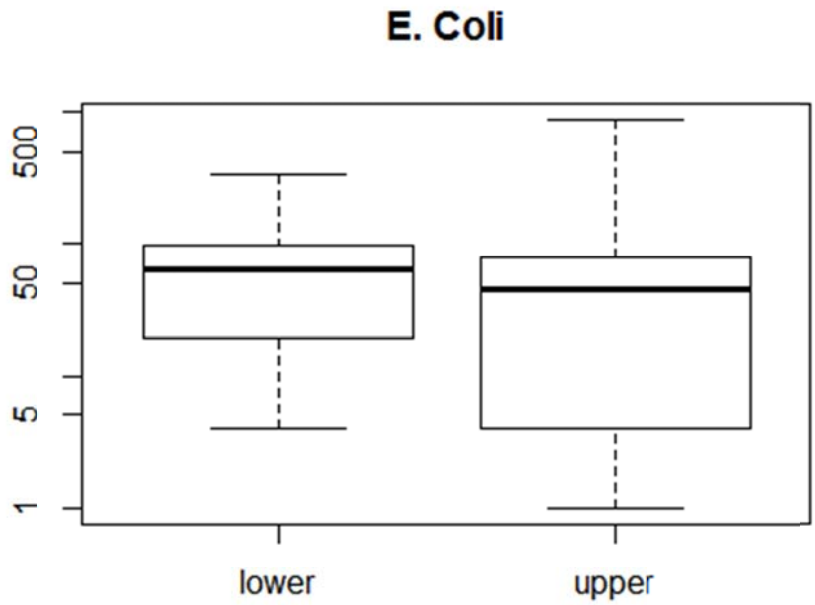
```
with(p.data,
     cendiff(conc,cen,grad))

##             N Observed Expected (O-E)^2/E (O-E)^2/V
## grad=lower 19    11.50     8.66     0.933      2.52
## grad=upper 19     8.71    11.55     0.699      2.52
##
##  Chisq= 2.5  on 1 degrees of freedom, p= 0.112
```

Non-parametric Wilcoxon signed rank (NDs at reporting limit)

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  pup and plow
## V = 58.5, p-value = 0.2482
## alternative hypothesis: true location shift is not equal to 0
```

E. Coli



Non-parametric Wilcoxon test with censored data

```
with(ec.data,
     cendiff(conc,cen,grad))

##              N Observed Expected (O-E)^2/E (O-E)^2/V
## grad=lower 19    10.61     8.97     0.297     0.819
## grad=upper 19     9.11    10.74     0.248     0.819
##
##  Chisq= 0.8  on 1 degrees of freedom, p= 0.365
```

Non-parametric Wilcoxon signed rank (NDs at reporting limit)

```
##
##  Wilcoxon signed rank test with continuity correction
##
## data:  ecup and eclow
## V = 87, p-value = 0.7628
## alternative hypothesis: true location shift is not equal to 0
```