January 8, 2014

**MEMORANDUM**

To: Chas Ariss, Recycled water Program Manager
Erick Neher, Idaho Falls Regional Administrator
Greg Eager, Idaho Falls Regional Engineering Manager

From: C. Mazzone, PE, Staff Engineer

Re: M-047-03 City of Ashton Staff Analysis supporting reuse permit issuance.

**Executive Summary**

The City of Ashton operates a Class I treatment municipal wastewater facility with 77 reuse acres handling an average of 10.11 million gallons of Class C effluent per year over the last four years.

Growing season hydraulic loading is within allowable rates, and non-growing season discharge to Sewer Creek is permitted through the EPA NPDES program.

This routine permit renewal seeks a ten year permit term based on low environmental impact as verified by facility annual reports and facility inspections. Annual report data is summarized where applicable in this Staff Analysis.

**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.

Dates relevant to this permit renewal are given below:

- The current permit LA-000047-02 was issued June 22, 2009 and expires June 22, 2014.
- The pre-application workshop was conducted during the August 12, 2013 facility inspection.
- The permit application was received on December 23, 2013.
- The DEQ Completeness Determination letter was issued the same day (December 23, 2013).

**1. Site Location and Ownership**

The facility and adjacent land application acreage is located ½ mile north of Ashton and ¼ mile west of the Highway 20/Tesoro Station intersection. All acreage is owned by the City.

The facility has an EPA NPDES permit (ID-002371-10) which allows discharge of treated water to Sewer Creek during the non-growing season (October 1 to March 31).

**2. Process Description**

Municipal wastewater is treated by aeration in the first two lagoons, facultatively treated in a third lagoon, and stored in the final, fourth lagoon. Wastewater is chlorine disinfected prior to slow rate land application through a solitary pivot sprinkler to one 77 acre management unit.

The EPA NPDES permitted surface water discharge is required due to insufficient lagoon storage volume to hold winter inflow.

Supplemental irrigation is available from a canal near the west boundary of the application field.

## 3. Site Characteristics

### A. Site Management History

The City of Ashton has been disposing of treated domestic recycled water via land application for over 35 years. The current 77 acre application unit replaced previous acreage and was first permitted in 2008.

Cropping has been an alfalfa/grass mix, and one 2009 rotation with a peas/oats/alfalfa mix.

### B. Climatic Characteristics

Site elevation is approximately 5220 feet above mean seal level. The area receives an average 19.17 inches of precipitation per year. The average high temperature is 54.7 degrees Fahrenheit; the average low is 28.3 degrees. The wind direction is predominantly from the SSW. Additional meteorological data can be found at: http://www.wrcc.dri.edu/summary/climsmid.html

Crop evapotranspiration for this location is the Ashton station located at latitude 44° 5' North and longitude: 111° 27' West; elevation is 5110 feet (http://data.kimberly.uidaho.edu/ETIdaho/).

The precipitation deficit (net irrigation water requirement) is: 1) alfalfa 30 inches; 2) spring grain 25 inches; and, 3) pasture 29 inches.

### C. Soils

The USDA Natural Resources Conservation Service (http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx) soil type is Kucera-Lostine silt loams, with 2 to 4 percent slopes. Characteristics of this soil are listed below.

Kucera:

- *Landform:* Loess hills
- *Parent material:* Silty alluvium and/or loess
- *Depth to restrictive feature:* More than 80 inches
- *Drainage class:* Well drained
- *Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.57 to 2.00 in/hr)
- *Depth to water table:* More than 80 inches
- *Frequency of flooding:* None
- *Frequency of ponding:* None
- *Available water capacity:* High (about 12.0 inches)
- *Farmland classification:* Prime farmland if irrigated
- *Hydrologic Soil Group:* B
- Typical profile:
    - *0 to 11 inches:* Silt loam

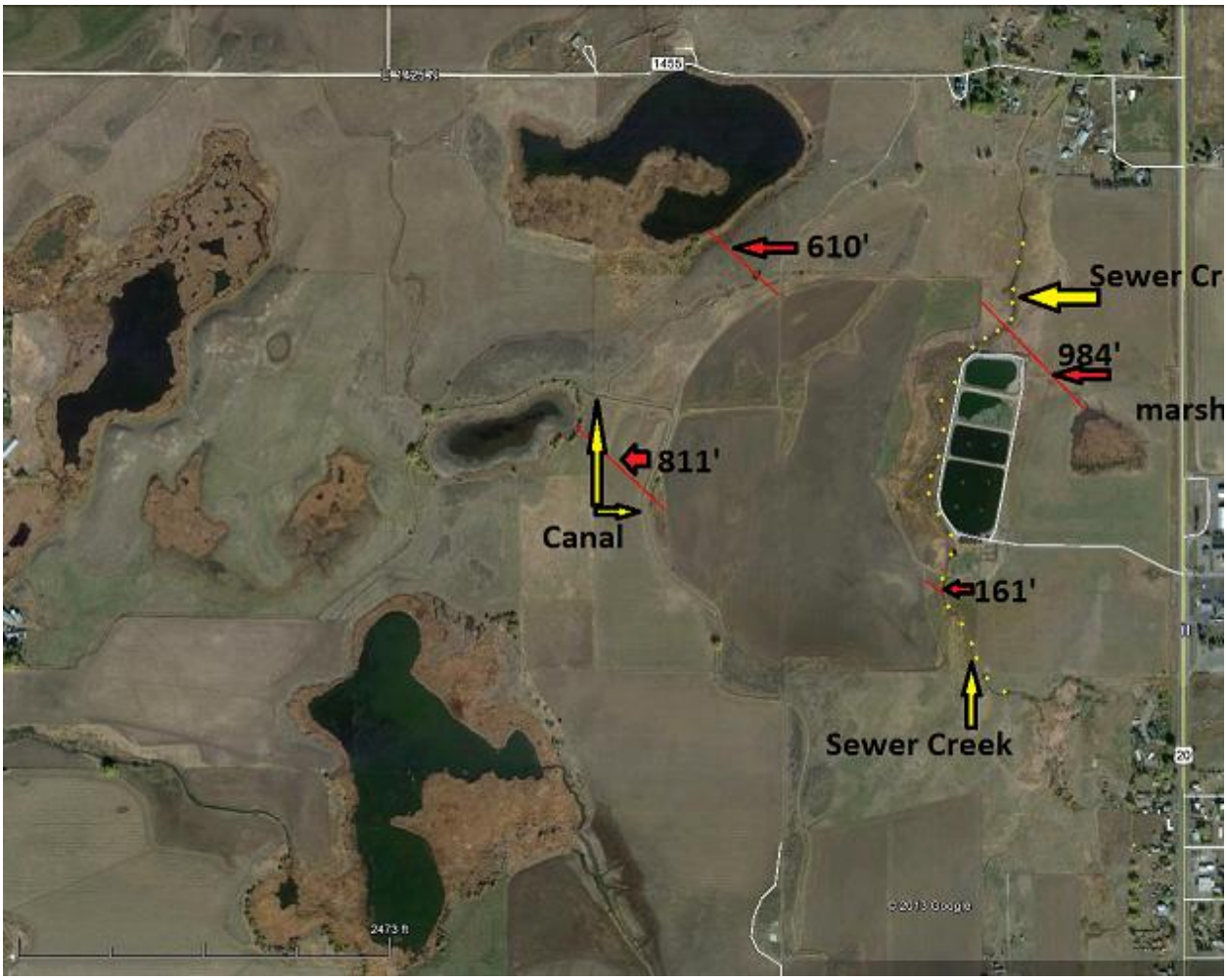
- *11 to 41 inches:* Silt loam
- *41 to 60 inches:* Silt loam

Lostine (only properties different that Kucera are listed):

- *Available water capacity:* Moderate (about 8.8 inches)
- *Hydrologic Soil Group:* B
- Typical profile:
  - *0 to 20 inches:* Silt loam
  - *20 to 36 inches:* Silt loam
  - *36 to 60 inches:* Sandy loam

**D. Surface Water**

The map below shows surface water nearby the reuse acreage. Red lined distances are marked in feet, and follow the general ground water flow direction (SE to NW). Note the drainage way (locally called Sewer Creek) which flows immediately west of the lagoons; not visible, however, is the berm running along the east side (also the downslope side) of the application area which stops any drainage from the HMU into Sewer Creek (slope at the site runs from west to east). Sewer Creek receives the non-growing season NPDES recycled water discharge, and eventually flows into Spring Creek – a tributary of the Ashton Reservoir on the Henry's Fork of the Snake River.



### E. Ground Water / Hydrogeology

Ground water is typically 4 to 8 feet deep to the first encountered water, and 3 feet deep to spring seasonal high ground water. Flow is SE to NW. The Snake River Plain Aquifer is 200 feet below the site, and flow is NE to SW.

## 4. Recycled Water Characterization and Loading Rates

### A. Recycled Water Characterization

Recycled water quality data are listed in the Table 4A below. Although TDS concentrations are high, there appears to be a decreasing trend since the lagoon treatment bacteria were introduced in 2011 to reduce sludge buildup.

**Table 4A. Recycled Water Chemistry**

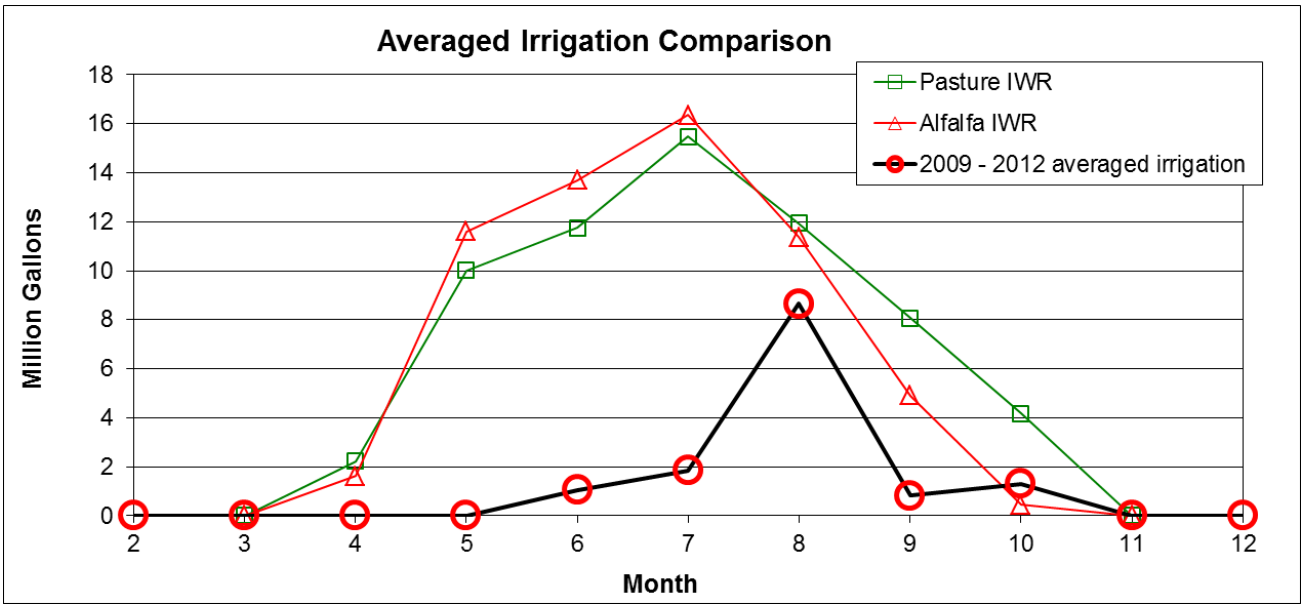
| Parameter | 2009 | 2010 | | | | | 2011 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13-Aug | 23-Jun | 6-Jul | 27-Jul | 18-Aug | 23-Aug | 25-Jul | 11-Aug | 1-Sep | 11-Jun | 11-Jul | 20-Aug |
| Coliform, Total, CFU/100 mL | | 1 | | **2419** | **291** | **866** | 2 | 1 | 6 | | | |
| N, nitrite, mg/L | 0.03 | 0.17 | | 0.20 | 0.07 | | 0.05 | 0.80 | 0.14 | | | |
| N, nitrate, mg/L | | | | | | | 0.50 | | | 0.18 | 0.41 | 0.37 |
| N, TKN, mg/L | 13.50 | 3.70 | | 6.20 | 9.90 | | 5.00 | 7.80 | 0.25 | 10.00 | 12.60 | 5.30 |
| pH | 8.10 | 8.70 | 7.20 | 7.40 | 9.20 | | 8.40 | 7.30 | 8.80 | 9.00 | 8.30 | 8.90 |
| P, mg/L | 3.23 | 3.26 | | 2.82 | 2.10 | | 1.14 | 2.56 | 4.40 | 2.27 | 1.90 | 0.84 |
| TDS, mg/L | 560 | 528 | | 762 | 472 | | 492 | 608 | 522 | 366 | 558 | 300 |
| ***Summary*** | | | | | | | | | | | | |
| Total nitrogen averaged | 13.525 | 6.75 | | | | | 4.85 | | | 9.62 | | |
| Phosphorus averaged | 3.23 | 2.73 | | | | | 2.70 | | | 1.67 | | |
| TDS averaged | 560 | 587 | | | | | 541 | | | 408 | | |

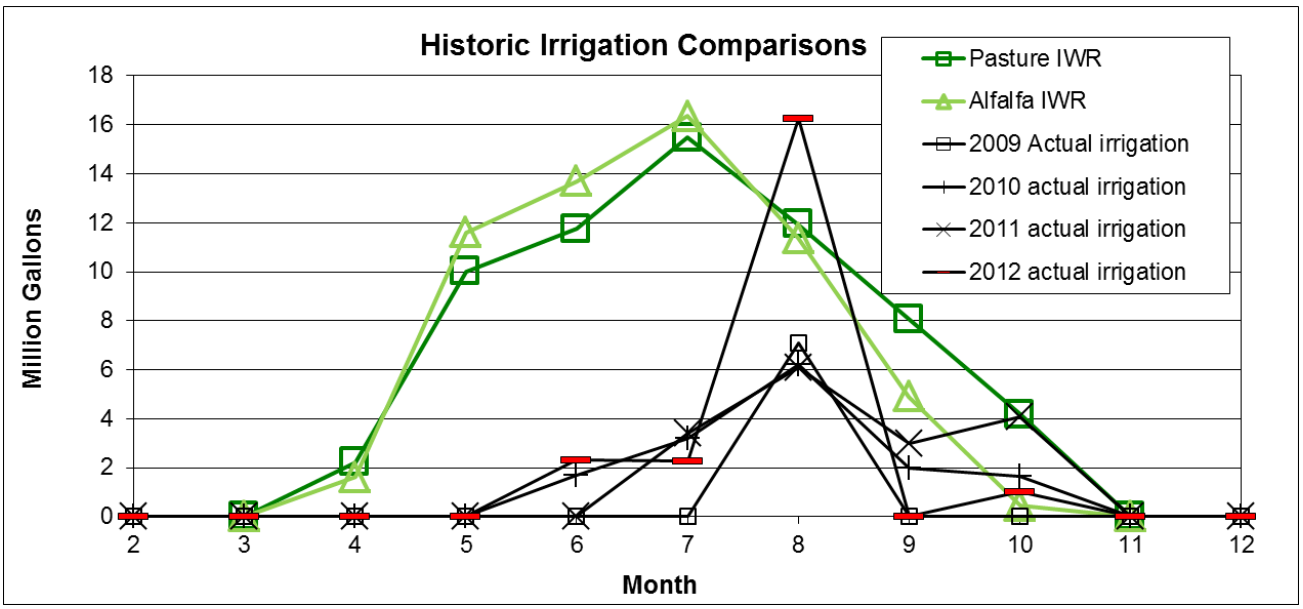
Recycled water is disinfected to Class C effluent at 23 CFUs total coliform per 100 mL, based on a median average of the last 5 results and a maximum limit of 230 CFUs/100 mL on individual samples.

### B. Hydraulic Loading Rates

The historical hydraulic loading rates for the reuse field are shown in Appendix B, Table 4B *Facility Loading Rates*. Actual irrigation (recycled water plus supplemental irrigation water) and theoretical Irrigation Water Requirements (IWR) are charted below.

It is recommended the facility boost supplemental irrigation water to better match the irrigation water requirements.



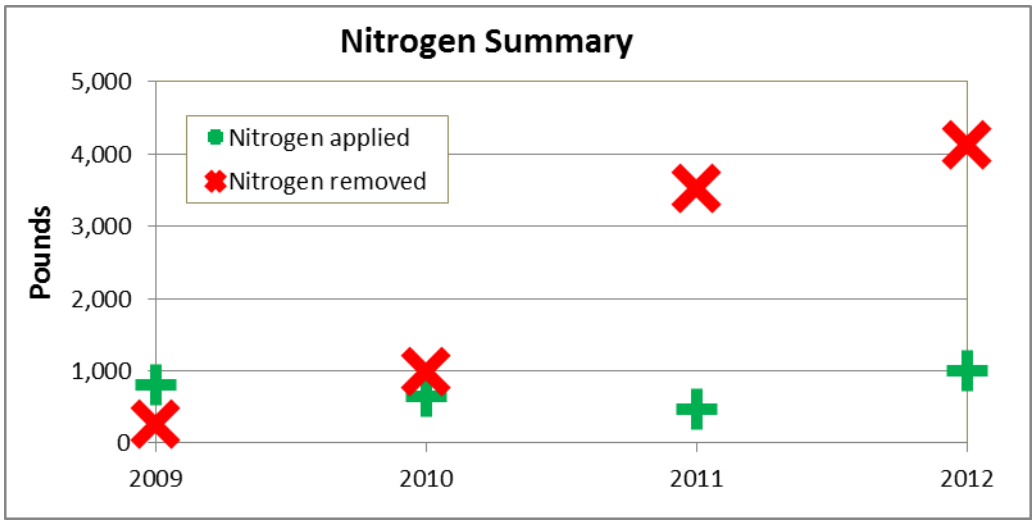



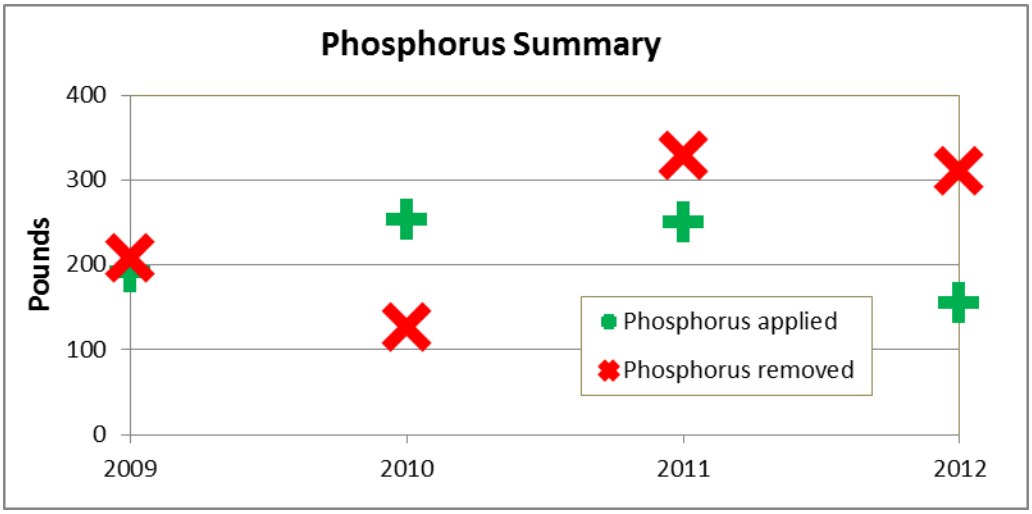

## C. Constituent Loading Rates

Constituent loading rates are located in Appendix B, Table 4B *Facility Loading Rates*.

The charts below compare applied nitrogen and phosphorus to the calculated removal rates of those nutrients as determined by crop tissue analysis. Generally, nutrient removal is greater than nutrient supply.

This facility has not fertilized the 77 acre application site since its development.




## 5. Site Management

### A. Buffer Zones

There are no dwellings, areas of public access, private water sources, or public water sources within a minimum of 1100 feet of the application site.

### B. Runoff

A runoff management plan was submitted August 12, 2008. The DEQ revisited the plan in 2012, verified calculations, and sent an official plan approval on January 31, 2012.

### C. Seepage Rate Testing

Seepage rate history is tabled below.

| Lagoon | Test Date Completion | Date of DEQ approval of test report | Seepage rate, inches/day | Allowable rate, inches/day | Date next seepage rate test is due |
|---|---|---|---|---|---|
| Cell A | July 2009 | August 11, 2009 | 0.156 | 0.25 | August 2019 |

| Lagoon | Test Date Completion | Date of DEQ approval of test report | Seepage rate, inches/day | Allowable rate, inches/day | Date next seepage rate test is due |
|---|---|---|---|---|---|
| Cell B | July 2009 | August 11, 2009 | 0.048 | 0.25 | August 2019 |
| Cell C & Cell D combined tests | July 2009<br>June 2010 | August 11, 2009<br>July 20, 2010 | 0.110<br>0.084 | 0.25 | August 2020 |

Given the 10 year seepage test frequency requirement, all lagoons will have to be retested during this permit term, according to the dates tabled above. Test procedures for completing seepage tests should be submitted at least 42 days prior to the due date shown in the table above.

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

### D. Waste Solids/Biosolids/Sludge/Solid Waste

The facility has not submitted a Waste Solids Plan to date, nor has it removed solids from lagoons. However, this permit renewal includes a compliance activity to develop a biosolids management plan which will track sludge accumulation in the lagoons in order to anticipate any sludge removal requirements.

### E. Nuisance Odors

The Odor Management Plan submitted with the 2010 annual report was approved by the DEQ on January 31, 2012.

### F. Cropping Plan

A cropping plan was submitted on June 5, 2008, as part of the permit renewal application, approved with the 2009 permit issuance. Facility consultation with the NRCS determined that forage crops such as Timothy grass, Latar orchard grass, or alfalfa would best fit the location. Crop rotations would include wheat or barley.

### G. Grazing

Grazing is not allowed at the facility. A DEQ-approved plan is required prior to any grazing activities on a permitted reuse site.

## 6. Monitoring

### A. Recycled water Monitoring

Recycled water quality monitoring results are given in Table 4A *Recycled water Chemistry*, above. COD monitoring was removed in the previous permit renewal due to historically low application rates.

Recycled water monitoring requirements remain unchanged for this permit renewal with the exceptions of pH measurement, which is no longer required, and the addition of Volatile Dissolved Solids (VDS), which were added to help determine the high Total Dissolved Solids concentrations existent in the groundwater. Required recycled water monitoring is:

- Weekly monitoring for total coliform;
- Monthly monitoring for Total Kjeldahl nitrogen, nitrate + nitrite-nitrogen, total phosphorus, TDS, and VDS.

## B. Soil Monitoring

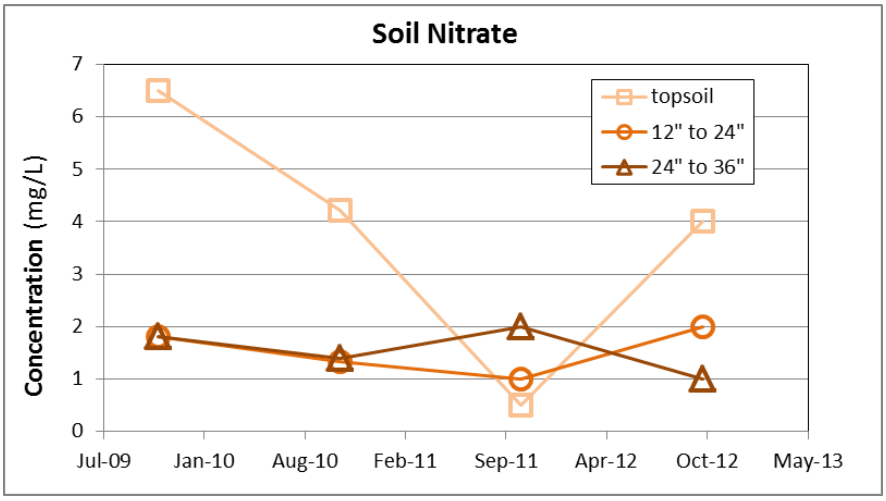
Soil nitrate and phosphorus concentrations are listed in Table 6B *Soil Data*, below. The data is charted below the table for graphic representation. A summary table is provided below the charts.

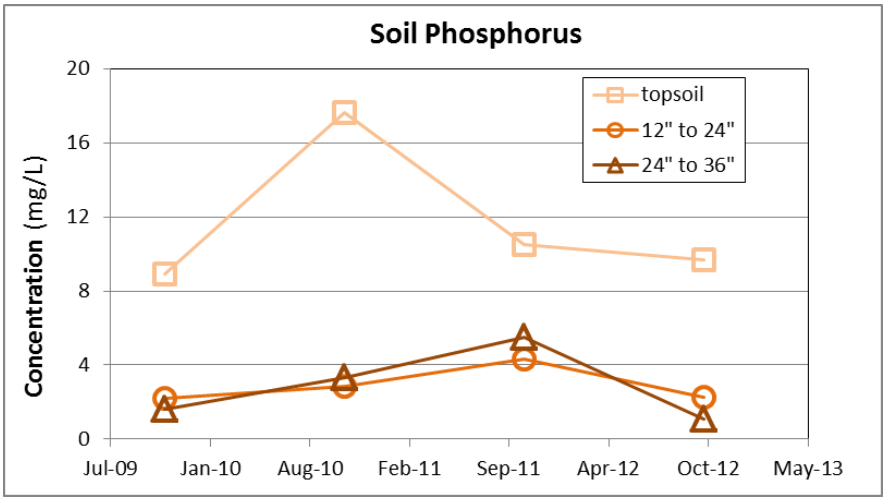
The variability in soil pH may affect phosphorus analysis if the lab conducting the analysis does not follow the NRCS 590 guidelines determining whether the Olsen method or the Bray method is used (http://www.agri.idaho.gov/Categories/Animals/Documents/nutrient_Management_code_590.PDF). Specifically, if the soil pH is greater than 6.5, the Olsen method is generally used. If the soil pH is less than 6.5, the Bray method is used.

TDS concentrations appear to show impact from recycled water applications. Therefore, a well altitude survey compliance activity was added to this permit renewal to establish hydraulic gradient and verify upgradient and downgradient wells. Also, recycled water Volatile Dissolved Solids monitoring has been added to assess recycled water potential contributions to groundwater Total Dissolved Solids.

**Table 6B: Soil Data**

| | 09/08/09 | | | 10/22/09 | | | 10/18/10 | | | 10/14/11 | | | 10/10/12 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 - 12" | 12-24" | 24-36" | 0 - 12" | 12-24" | 24-36" | 0 - 12" | 12-24" | 24-36" | 0 - 12" | 12-24" | 24-36" | 0 - 12" | 12-24" | 24-36" |
| Electr. Cond | | | | | | | | | | | | | 169 | 149 | 212 |
| N, ammonium | | | | 0.25 | 0.25 | 0.25 | 1.15 | 0.015 | 0.07 | 1.89 | 1.43 | 0.75 | 2.45 | 0.3 | 0.18 |
| N, Nitrate | | | | 6.5 | 1.8 | 1.8 | 4.22 | 1.34 | 1.39 | 0.5 | 1 | 2 | 4 | 2 | 1 |
| pH | | | | 6.2 | 7.9 | 8.2 | 5.7 | 6.9 | 7.9 | 6.5 | 7 | 7.3 | 5.9 | 6.2 | 7.1 |
| P | | | | 8.9 | 2.2 | 1.6 | 17.63 | 2.85 | 3.31 | 10.49 | 4.35 | 5.5 | 9.67 | 2.26 | 1.1 |
| SAR | 0.52 | 0.46 | 0.47 | 8.25 | 3.68 | 3.97 | | | | | | | | | |
| Fe, DTPA | 91.59 | 50.06 | 30.47 | 83 | 27 | 30 | | | | | | | | | |
| Mn, DTPA | 31.68 | 9.97 | 7.16 | 38 | 5 | 4 | | | | | | | | | |



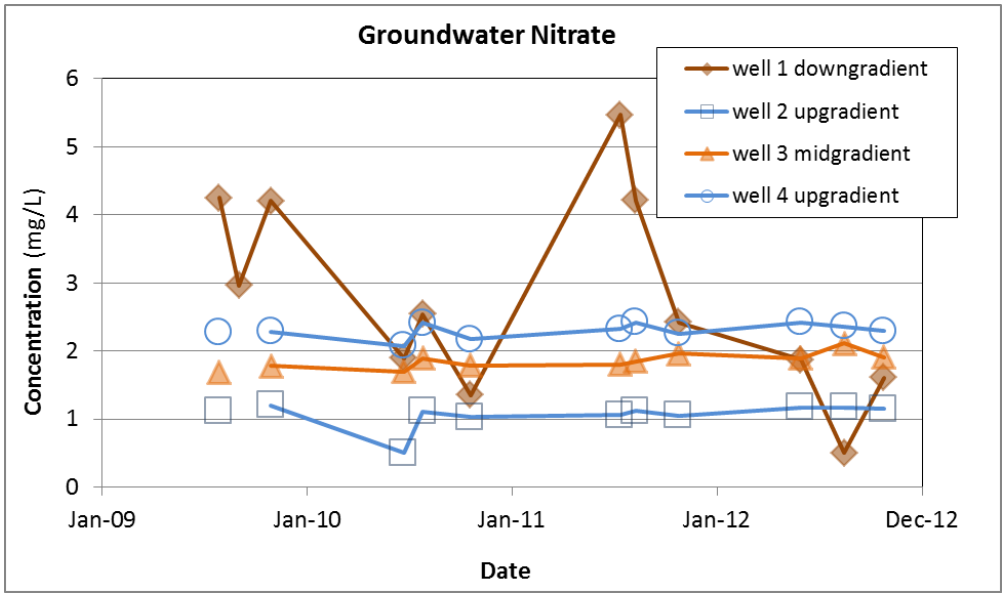


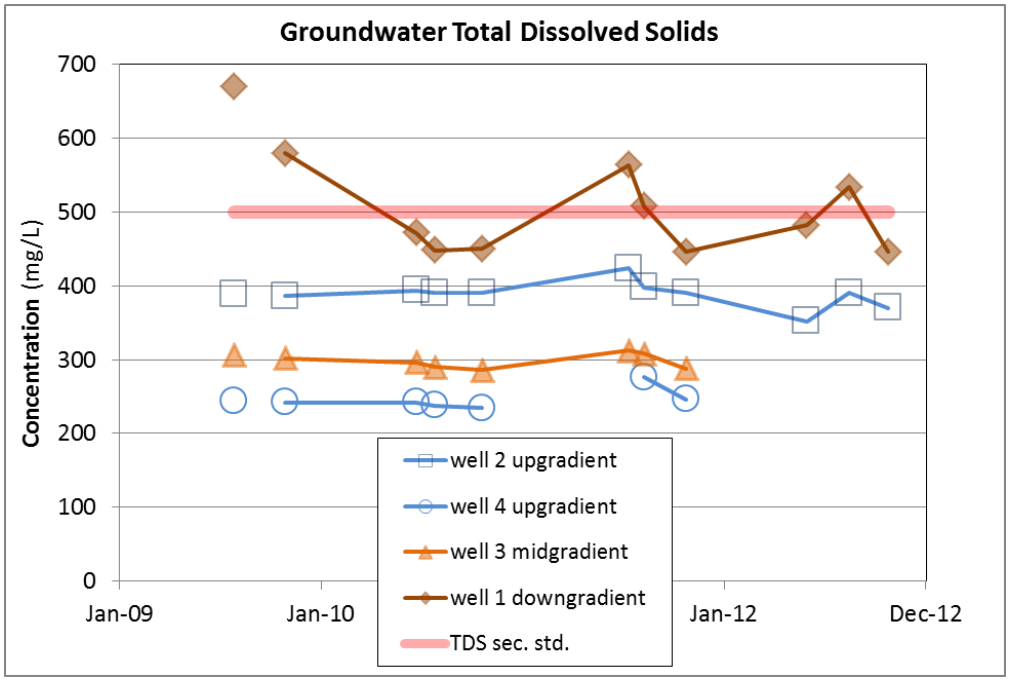

The following soil monitoring requirements were changed with this permit renewal:

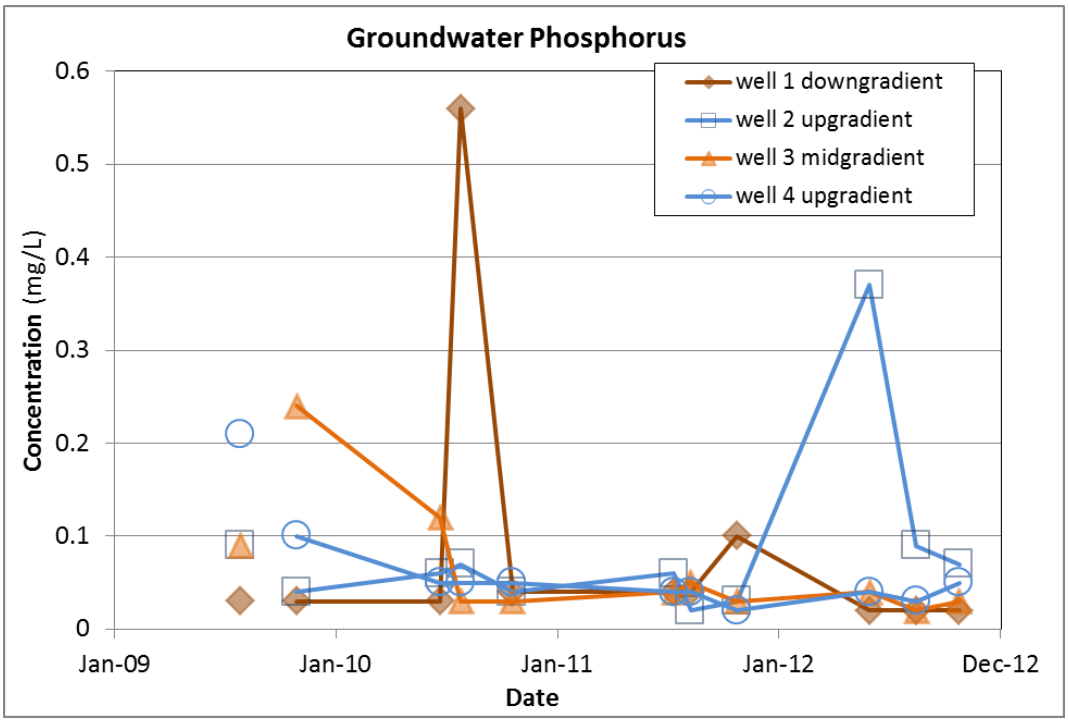
- The first year (of the permit) SAR, DTPA iron and DTPA manganese were removed as monitoring requirements due to the low hydraulic loading at this facility.

## C. Ground Water Monitoring

Ground water monitoring results for nitrate, TDS, and phosphorus are charted below, followed by a well location map. Complete monitoring results are located in Appendix 2 Table 6C *Ground Water Monitoring*.




Groundwater Total Dissolved Solids
Concentration (mg/L)
700
600
500
400
300
200
100
0
Jan-09
Jan-10
Jan-12
Dec-12
well 2 upgradient
well 4 upgradient
well 3 midgradient
well 1 downgradient
TDS sec. std.


Groundwater Phosphorus
Concentration (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
Jan-09
Jan-10
Jan-11
Jan-12
Dec-12
Date
well 1 downgradient
well 2 upgradient
well 3 midgradient
well 4 upgradient

**Background**

Ground water flow direction has never been verified at the facility, so it is difficult to verify features potentially impacting the monitoring wells. Therefore, a compliance activity to survey the monitoring wells and provide potentiometric mapping to verify ground water flow direction has been added to this permit renewal.

**Total Coliform**

Total coliform in all four wells was addressed in 2012 when the operator installed gaskets between the well casing and the casing cap. The gaskets appear to have corrected the problem, save two total coliform exceedances (post fix) in October of 2012; the wells were retested and passed; the exceedances were attributed to one specific lab which had total coliform analyses results inconsistent with normal coliform results for several facilities in the area during that time period.

**Nitrate**

Well 1 shows the highest nitrate concentrations at the site. Although the Ashton area has historic ground water nitrate problems, it is difficult to draw any definite conclusions until ground water flow direction is established. The well may be impacted by recycled water application, by Sewer Creek, or may it be impacted by the irrigation canal over 50 feet distant.

**Total Dissolved Solids**

TDS shows highest concentrations in Well 1 - the suspected downgradient well – evidence of groundwater impact at the facility. The well survey compliance activity will help determine if the well is revealing recycled water application TDS, or impact from the nearby irrigation canal.

**Recommendations**

To better evaluate groundwater impacts at the facility, this permit renewal include the following changes:

- Ground water sampling frequency is changed from three to two events annually;

- The initial sampling event will occur prior to irrigation season; specifically, canal filling.
- The second sampling event will occur at the end of the irrigation season, prior to canal draining.

The change in frequency and timing will assist in determining canal water impact on ground water.

- As stated above, a compliance activity was added to survey monitoring wells and establish ground water flow direction.

**Monitoring**

Changes to monitoring requirements with this permit renewal are:

- First and last year sampling requirements (Ca, bicarbonate, carbonate, K, Mg, and Na) were removed because a baseline has been established and the sampling no longer proves meaningful.
- Dissolved iron and manganese were removed as hydraulic overloading is not an issue. Secondary ground water quality exceedances are attributed to the usual levels found in local soils.

Monitoring required with this permit renewal is shown below.

| Monitoring Point Serial Number | Sample Type and Frequency | Constituents (units in mg/L unless otherwise specified) |
|---|---|---|
| GW-047-01 through GW-047-04 | Unfiltered grab sample/ twice annually: prior to irrigation season (canal filling), and after irrigation season (but prior to canal draining). | - Water table elevation (feet)<br>- Water table depth (feet)<br>- Nitrate-nitrogen, as N<br>- Total phosphorus , as P<br>- pH (Standard Units)<br>- Total coliform<br>- TDS |

## D. Supplemental Irrigation Water Monitoring

This facility utilizes supplemental irrigation water from the canal bordering the west side of the facility. This permit renewal seeks to reduce the frequency of supplemental irrigation water sampling from annually to every other year. Monitoring requirements are:

- Grab sample every two years for Total Kjeldahl nitrogen, nitrate + nitrite as nitrogen, Total Dissolved Solids, and Volatile Dissolved Solids.
  - Note that pH sampling has been removed as a requirement.

## E. Crop Yield and Tissue Monitoring

The facility is required to report crop yield and tissue analysis in the annual report. Tissue analysis is used to assess nutrient removal (nitrogen and phosphorus) from the site.

## F. Calculation Methodologies

The following methods of calculation are used to determine permit compliance.

a) Hydraulic volumes

- Influent volumes are measured by flow meter;

- Effluent and supplemental irrigation volumes to reuse are measured by flow meter;
- Inches of irrigation are calculated by dividing the total flow by the acreage according to the annual report worksheet.

b) Constituent loading rates

Constituent loading rates are determined by applying analyzed concentrations to recycled water volumes and irrigated acreage.

### G. Quality Assurance Project Plan

The facility is in the process of developing a Quality Assurance Project Plan (QAPP). Development of a QAPP is a compliance activity in this permit renewal in case the permit is issued prior to plan submittal and approval.

## 7. Site Operation and Maintenance

System Classification: Wastewater Collection Class I, Treatment Class I. Operators are required to have Class I collection, Class I treatment, and Land Application licensure.

City employee Del Jensen supervises the wastewater collection, treatment, and reuse site. Mr. Jensen is proper licensed for Class I Treatment, Class I Collection, and Land Application. Todd Martindale is the substitute operator, and is also licensed for Class I Treatment, Class I Collection, and Land Application.

## 8. Compliance Activities

### A. Status of Compliance Activities in Current Permit

| Compliance Activity | Description | Status |
|---|---|---|
| CA-047-01 | Irrigation schedules for the slow rate application shall be developed by a qualified professional. | Complete |
| CA-047-02 | Submit a Runoff Management Plan to the DEQ for review and approval. | Complete |
| CA-047-03 | Update the Plan of Operation (including a QAPP). | Incomplete |
| CA-047-04 | Submit an Odor Management Plan to DEQ for review and approval. | Complete |
| CA-047-05 Prior to June 22, 2019 | Perform a seepage test on each lagoon in accordance with a seepage testing plan submitted to and approved by DEQ. | Not due. |

As stated above, the Plan of Operation update is awaiting the QAPP, currently under development.

### B. Compliance Activities Required in New Permit

| Compliance Activity | Description |
|---|---|
| CA-047-01 | Update the Plan of Operation (including a Sludge Management Plan). |
| CA-047-02 | Submit a QAPP. |
| CA-047-03 | Seepage testing on all lagoons. |
| CA-047-04 | Submit a Well Locations Survey Report. |
| CA-047-05 | Pre-Application Workshop |
| CA-047-06 | Permit Renewal Application |

## 9. Recommendation

Staff recommends the draft recycled water 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.

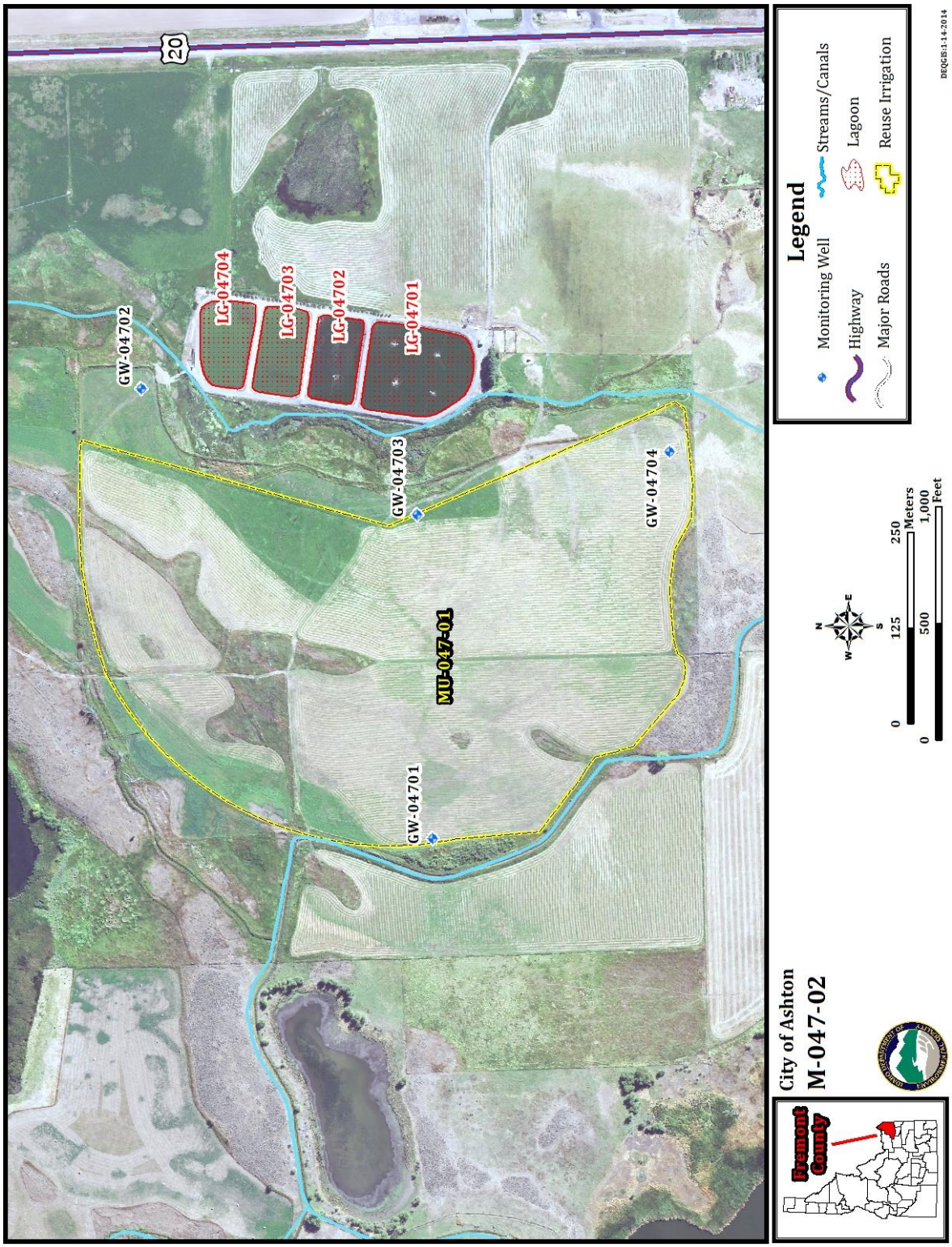
## References

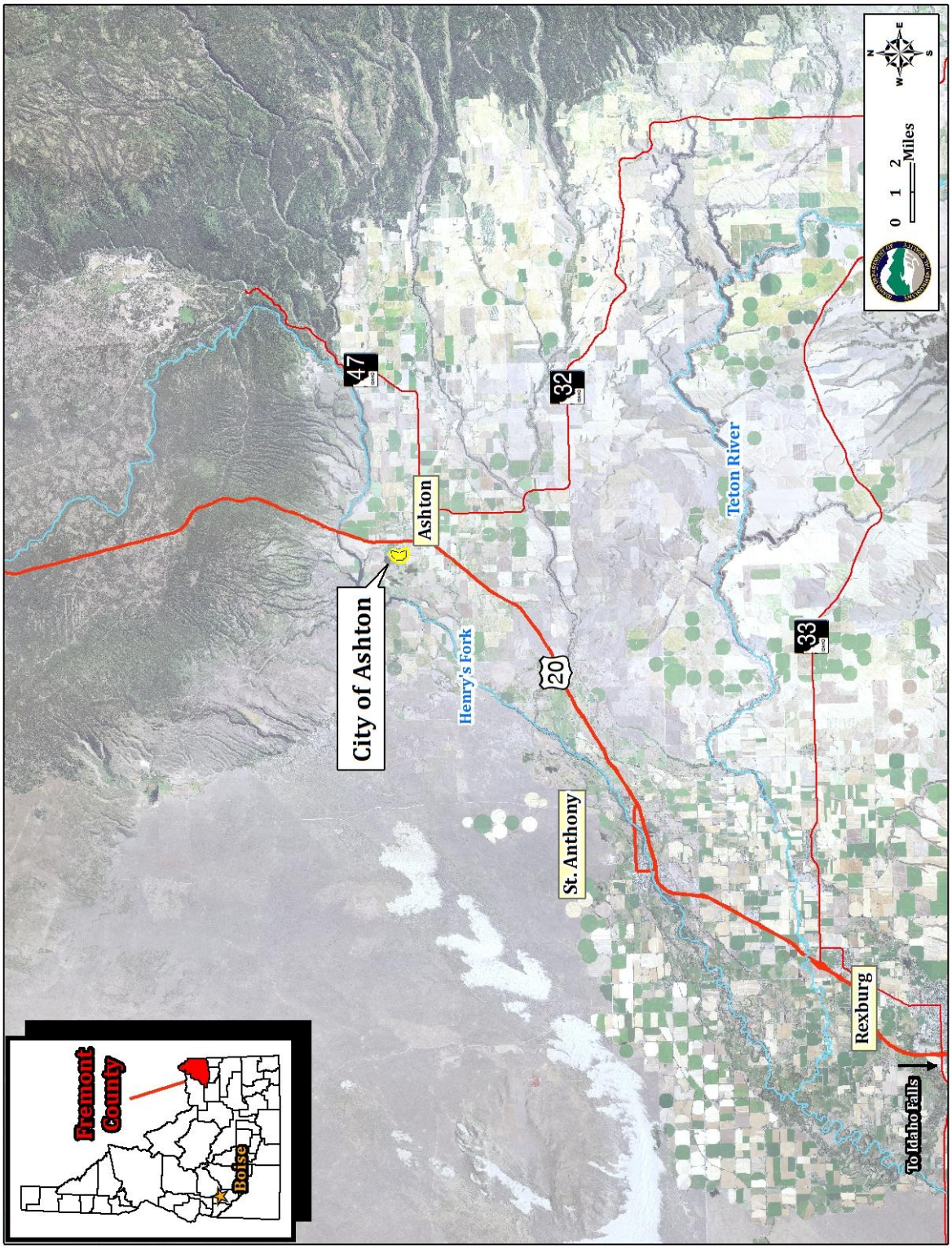

DEQ, 2009, *Permit Renewal Staff Analysis: City of Ashton Wastewater Treatment and Reuse Facility*; LA-000047-02, June 22, 2009.

DEQ, 2009, *Municipal Wastewater Reuse Permit LA-000047-02*, June 22, 2009.

Dyer Group, 2008, *City of Aston Application Package for Wastewater Reuse Permit*, May 2008.

**Appendix 1**
**Site Maps**




Fremont County
Boise
City of Ashton
Ashton
47
32
Henry's Fork
20
St. Anthony
Teton River
33
Rexburg
To Idaho Falls
0 1 2
Miles
N
W
E
S

# Appendix 2
# Facility Data

## Table 4B: Facility Loading Rates

| Process | 2010 | 2011 | 2012 |
|---|---|---|---|
| **HMU-4701** | | | |
| Acres | 77 | 77 | 77 |
| Days per year | 214 | 214 | 214 |
| **Fertilizer** | | | |
| Nitrogen: | | | |
| lb/yr | 0 | 0 | 0 |
| lb/ac*yr | | | |
| Phosphorous: | | | |
| lb/yr | 0 | 0 | 0 |
| lb/ac*yr | | | |
| Potassium (K) | | | |
| lb/yr | 0 | 0 | 0 |
| lb/ac*yr | | | |
| **Supplemental water** | | | |
| MG | 3.65 | 5.45 | 10.73 |
| ac*in. | 134 | 201 | 395 |
| ac*in/ac | 2 | 3 | 5 |
| Nitrogen: | | | |
| NTKN + NNO3 ppm | 0.8 | 0.4 | 1.2 |
| lb/yr | 24 | 18 | 104 |
| lb/ac*yr | 0 | 0 | 1 |
| Phosphorus: | | | |
| ppm | 0.040 | 0.005 | 0.002 |
| lb/yr | 1 | 0 | 0 |
| lb/ac*yr | 0 | 0 | 0 |
| TDS: | | | |
| ppm | 118.0 | 96.0 | 133.0 |
| lb/yr | 3,586 | 4,357 | 11,881 |
| lb/ac*yr | 47 | 57 | 154 |
| **Wastewater** | | | |
| MG | 11.10 | 11.10 | 11.14 |
| ac*in. | 409 | 409 | 410 |
| ac*in/ac | 5 | 5 | 5 |
| Nitrogen: | | | |
| NTKN + NNO3 ppm | 6.8 | 4.9 | 9.6 |
| lb/yr | 624 | 448 | 893 |
| lb/ac*yr | 8 | 6 | 12 |
| Phosphorus: | | | |
| ppm | 2.7 | 2.7 | 1.7 |
| lb/yr | 252 | 250 | 155 |
| lb/ac*yr | 3 | 3 | 2 |
| TDS: | | | |
| ppm | 587.3 | 340.3 | 287.2 |
| lb/yr | 54,287 | 31,451 | 26,648 |
| lb/ac*yr | 705 | 408 | 346 |
| **HMU Totals** | | | |
| Total water applied: | | | |
| MG | 14.75 | 16.55 | 21.87 |
| ac*in. | 543 | 609 | 805 |
| ac*in/ac | 7 | 8 | 10 |
| Total nitrogen applied: | | | |
| lb/yr | 648 | 466 | 997 |
| lb/ac*yr | 8 | 6 | 13 |
| Total phosphorous applied: | | | |
| lb/yr | 254 | 250 | 155 |
| lb/ac*yr | 3 | 3 | 2 |
| | | | |
| Total TDS applied: | | | |
| lb/yr | 57,873 | 35,808 | 38,529 |
| lb/ac*yr | 752 | 465 | 500 |
| | **2010** | **2011** | **2012** |

| | 2010 | 2011 | 2012 |
|---|---|---|---|
| **Facility Total Removal** | | | |
| Total nitrogen removed: | | | |
| lb/yr | 980 | 3,509 | 4,113 |
| avg lb/ac*yr | 82 | 292 | 343 |
| Total phosphorous removed: | | | |
| lb/yr | 126 | 328 | 310 |
| avg lb/ac*yr | 2 | 4 | 4 |
| Total TDS removed: | | | |
| lb/yr | 6,031 | 12,908 | 1,637 |
| avg lb/ac*yr | 78 | 168 | 21 |
| **Facility Balance** (loading minus removal) | | | |
| Nitrogen: | | | |
| lb/yr | -332 | -3,043 | -3,116 |
| avg lb/ac*yr | -4 | -40 | -40 |
| Phosphorous: | | | |
| lb/yr | 128 | -78 | -155 |
| avg lb/ac*yr | 2 | -1 | -2 |
| TDS: | | | |
| lb/yr | 51,842 | 22,900 | 36,892 |
| avg lb/ac*yr | 673 | 297 | 479 |
| | **2010** | **2011** | **2012** |

## Table 6C: Ground Water Monitoring

| Well 1 | 2009 | | | 2010 | | | 2011 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28-Jul | 2-Sep | 28-Oct | 22-Jun | 26-Jul | 19-Oct | 12-Jul | 9-Aug | 24-Oct | 29-May | 14-Aug | 24-Oct |
| Coliform, total | 488.4 | 2419 | 19.7 | 23.8 | 31.4 | 27.8 | 8.6 | <2419 | 6.3 | 0.5 | 8.6 | 0.5 |
| Fe, dissolved | 0.005 | | 0.005 | 0.01 | 0.07 | 0.36 | 0.22 | 0.46 | 0.03 | 0.03 | 0.04 | 0.005 |
| Mn, dissolved | 0.08 | | 0.136 | 0.003 | 0.004 | 0.035 | 0.035 | 0.041 | 0.001 | 0.002 | 0.001 | 0.0005 |
| N, nitrate | 4.25 | 2.96 | 4.2 | 1.89 | 2.54 | 1.35 | 5.47 | 4.21 | 2.42 | 1.87 | 0.5 | 1.61 |
| N, nitrite | 0.05 | 0.05 | 0.1 | 0.05 | 0.5 | 0.5 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| P | 0.03 | | 0.03 | 0.03 | 0.56 | 0.04 | 0.04 | 0.04 | 0.1 | 0.02 | 0.02 | 0.02 |
| pH | 7.7 | 7.6 | 7.6 | 7.4 | 7.3 | 7 | 7.2 | 7.3 | 7 | 6.9 | 6.7 | 7.3 |
| TDS | 670 | | 580 | 472 | 448 | 450 | 564 | 508 | 446 | 482 | 534 | 446 |
| | | | | | | | | | | | | |
| Ca | | 66.67 | | | | | | | | | | |
| Bicarbonate | | 480 | | | | | | | | | | |
| Carbonate | | 2.5 | | | | | | | | | | |
| K | | | | | | | | | | | | |
| Mg | | 33.43 | | | | | | | | | | |
| Na | | | | | | | | | | | | |

| Well 2 | 2009 | | | 2010 | | | 2011 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28-Jul | 2-Sep | 28-Oct | 22-Jun | 26-Jul | 19-Oct | 12-Jul | 9-Aug | 24-Oct | 29-May | 14-Aug | 24-Oct |
| Coliform, total | 5.2 | 3 | 0.5 | 25.9 | 5.2 | 0.5 | 1 | 13.2 | 9.8 | 0.05 | 0.05 | 50.4 |
| Fe, dissolved | 0.01 | | 0.01 | 0.02 | 0.1 | 0.08 | 0.22 | 0.16 | 0.03 | 0.06 | 0.06 | 0.005 |
| Mn, dissolved | 0.0005 | | 0.011 | 0.006 | 0.011 | 0.015 | 0.022 | 0.017 | 0.008 | 0.004 | 0.01 | 0.009 |
| N, nitrate | 1.11 | | 1.2 | 0.5 | 1.11 | 1.03 | 1.06 | 1.12 | 1.05 | 1.17 | 1.17 | 1.15 |
| N, nitrite | 0.05 | | 0.05 | 0.5 | 0.5 | 0.5 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| P | 0.09 | | 0.04 | 0.06 | 0.07 | 0.04 | 0.06 | 0.02 | 0.03 | 0.37 | 0.09 | 0.07 |
| pH | 7.4 | | 7.4 | 7.1 | 7 | 7 | 7.2 | 6.8 | 6.9 | 6.6 | 6.7 | 6.9 |
| TDS | 388 | | 386 | 394 | 390 | 390 | 424 | 398 | 390 | 352 | 390 | 370 |
| | | | | | | | | | | | | |
| Ca | | 46.84 | | | | | | | | | | |
| Bicarbonate | | 300 | | | | | | | | | | |
| Carbonate | | 2.5 | | | | | | | | | | |
| K | | 2.16 | | | | | | | | | | |
| Mg | | 15.17 | | | | | | | | | | |
| Na | | 32.63 | | | | | | | | | | |

| Well 3 | 2009 | | | 2010 | | | 2011 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28-Jul | 2-Sep | 28-Oct | 22-Jun | 26-Jul | 19-Oct | 12-Jul | 9-Aug | 24-Oct | 29-May | 14-Aug | 24-Oct |
| Coliform, total | 1 | 3.1 | 344.8 | 0.5 | 13.5 | 0.5 | 0.5 | 0.5 | 3.1 | 0.05 | 0.05 | 36.8 |
| Fe, dissolved | 0.07 | | 0.18 | 0.06 | 0.08 | 0.45 | 0.11 | 0.55 | 0.02 | 0.18 | 0.32 | 0.005 |
| Mn, dissolved | 0.001 | | 0.017 | 0.016 | 0.006 | 0.02 | 0.013 | 0.025 | 0.005 | 0.012 | 0.01 | 0.002 |
| N, nitrate | 1.69 | | 1.78 | 1.7 | 1.89 | 1.79 | 1.8 | 1.85 | 1.96 | 1.89 | 2.11 | 1.91 |
| N, nitrite | 0.05 | | 0.05 | 0.5 | 0.5 | 0.5 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| P | 0.09 | | 0.24 | 0.12 | 0.03 | 0.03 | 0.04 | 0.05 | 0.03 | 0.04 | 0.02 | 0.03 |
| pH | 7.8 | | 7.9 | 7.7 | 7.7 | 7.4 | 7.2 | 7.2 | 7.1 | 7 | 7.1 | 7.1 |
| TDS | 306 | | 302 | 296 | 290 | 286 | 312 | 308 | 288 | | | |
| | | | | | | | | | | | | |
| Ca | | 12 | | | | | | | | | | |
| Bicarbonate | | 190 | | | | | | | | | | |
| Carbonate | | 2.5 | | | | | | | | | | |
| K | | 2.53 | | | | | | | | | | |
| Mg | | 2.49 | | | | | | | | | | |
| Na | | 48.1 | | | | | | | | | | |

| Well 4 | 2009 | | | 2010 | | | 2011 | | | 2012 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 28-Jul | 2-Sep | 28-Oct | 22-Jun | 26-Jul | 19-Oct | 12-Jul | 9-Aug | 24-Oct | 29-May | 14-Aug | 24-Oct |
| Coliform, total | 2 | 1 | 0.5 | 0.5 | 11.9 | 9.7 | 0.5 | 9.7 | 101.2 | 0.5 | 1 | 0.5 |
| Fe, dissolved | 0.03 | | 0.03 | 0.04 | 0.02 | 0.07 | 0.15 | 0.44 | 0.01 | 0.005 | 0.005 | 0.005 |
| Mn, dissolved | 0.0005 | | 0.002 | 0.004 | 0.0005 | 0.003 | 0.007 | 0.017 | 0.001 | 0.0005 | 0.0005 | 0.0005 |
| N, nitrate | 2.27 | | 2.28 | 2.07 | 2.41 | 2.17 | 2.32 | 2.42 | 2.25 | 2.42 | 2.36 | 2.29 |
| N, nitrite | 0.05 | | 0.05 | 0.5 | 0.5 | 0.5 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| P | 0.21 | | 0.1 | 0.05 | 0.05 | 0.05 | 0.04 | 0.04 | 0.02 | 0.04 | 0.03 | 0.05 |
| pH | 7.5 | | 7.6 | 7.5 | 7.2 | 7.1 | 7 | 7 | 6.8 | 6.7 | 6.9 | 6.9 |
| TDS | 244 | | 242 | 242 | 238 | 234 | | 276 | 246 | | | |
| | | | | | | | | | | | | |
| Ca | | 25.85 | | | | | | | | | | |
| Bicarbonate | | 190 | | | | | | | | | | |
| Carbonate | | 2.5 | | | | | | | | | | |
| K | | 2.21 | | | | | | | | | | |
| Mg | | 12.82 | | | | | | | | | | |
| Na | | 15.81 | | | | | | | | | | |