INL/EXT-13-30812

2013 Annual Wastewater Reuse Report for the Idaho National Laboratory Site's Central Facilities Area Sewage Treatment Plant

February 2014

The INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance

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February 2014

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Prepared for the
U.S. Department of Energy
Office of Nuclear Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

ABSTRACT

This report describes conditions, as required by the state of Idaho Wastewater Reuse Permit (#LA-000141-03), for the wastewater land application site at the Idaho National Laboratory Site's Central Facilities Area Sewage Treatment Plant from November 1, 2012, through October 31, 2013. The report contains, as applicable, the following information:

- Site description
- Facility and system description
- Permit required monitoring data and loading rates
- Status of compliance conditions and activities
- Discussion of the facility's environmental impacts.

During the 2013 permit year, no wastewater was land-applied to the irrigation area of the Central Facilities Area Sewage Treatment Plant and therefore, no effluent flow volumes or samples were collected from wastewater sampling point WW-014102. However, soil samples were collected in October from soil monitoring unit SU-014101.

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ACRONYMS

CFA	Central Facilities Area
CWI	CH2M-WG Idaho, LLC
DEQ	Idaho Department of Environmental Quality
INL	Idaho National Laboratory
MG	million gallons
MS	Monitoring Services
STP	Sewage Treatment Plant
SwRI	Southwest Research Institute
WRP	Wastewater Reuse Permit

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1. INTRODUCTION

The Central Facilities Area (CFA) Sewage Treatment Plant (STP) is a wastewater land application facility operated by Battelle Energy Alliance, LLC, under Wastewater Reuse Permit (WRP) LA-000141-03 issued by the State of Idaho, Department of Environmental Quality (DEQ). The permit was re-issued on March 17, 2010 and expires on March 16, 2015 (Neher 2010). This report covers the reporting year of November 1, 2012, through October 31, 2013.

Following a description of the STP site, facility, and system, this report presents, as applicable, the status of monitoring data, special compliance conditions, noncompliances, and environmental impacts that occurred at the CFA STP during the 2013 reporting year.

2. SITE, FACILITY, AND SYSTEM DESCRIPTION

The STP is located approximately five miles north of the Idaho National Laboratory (INL) Site's southern boundary and southeast of the Central Facilities Area (CFA), which is about 50 miles west of Idaho Falls in Butte County, Idaho (Figure 1). The STP is approximately 2,200 ft downgradient of the nearest drinking water well and 4,000 ft north of Highway 26. The wastewater land application area is approximately 2,200 ft from the nearest inhabited building.

As shown in Figure 1, the STP consists of a:

- 1.7-acre partial-mix, aerated lagoon (Lagoon No. 1)
- 10.3-acre facultative lagoon (Lagoon No. 2)
- 0.5-acre polishing pond (Lagoon No. 3)
- 73.5 acre wastewater land application area consisting of desert steppe and crested wheatgrass vegetative communities
- Computerized center-pivot, sprinkler irrigation system.

A 350-gpm (gallon per minute) pump moves wastewater from the lagoons to the center-pivot sprinkler system, which waters the land application area at low pressures (about 30 lbs/in^2) to minimize aerosols and spray drift.

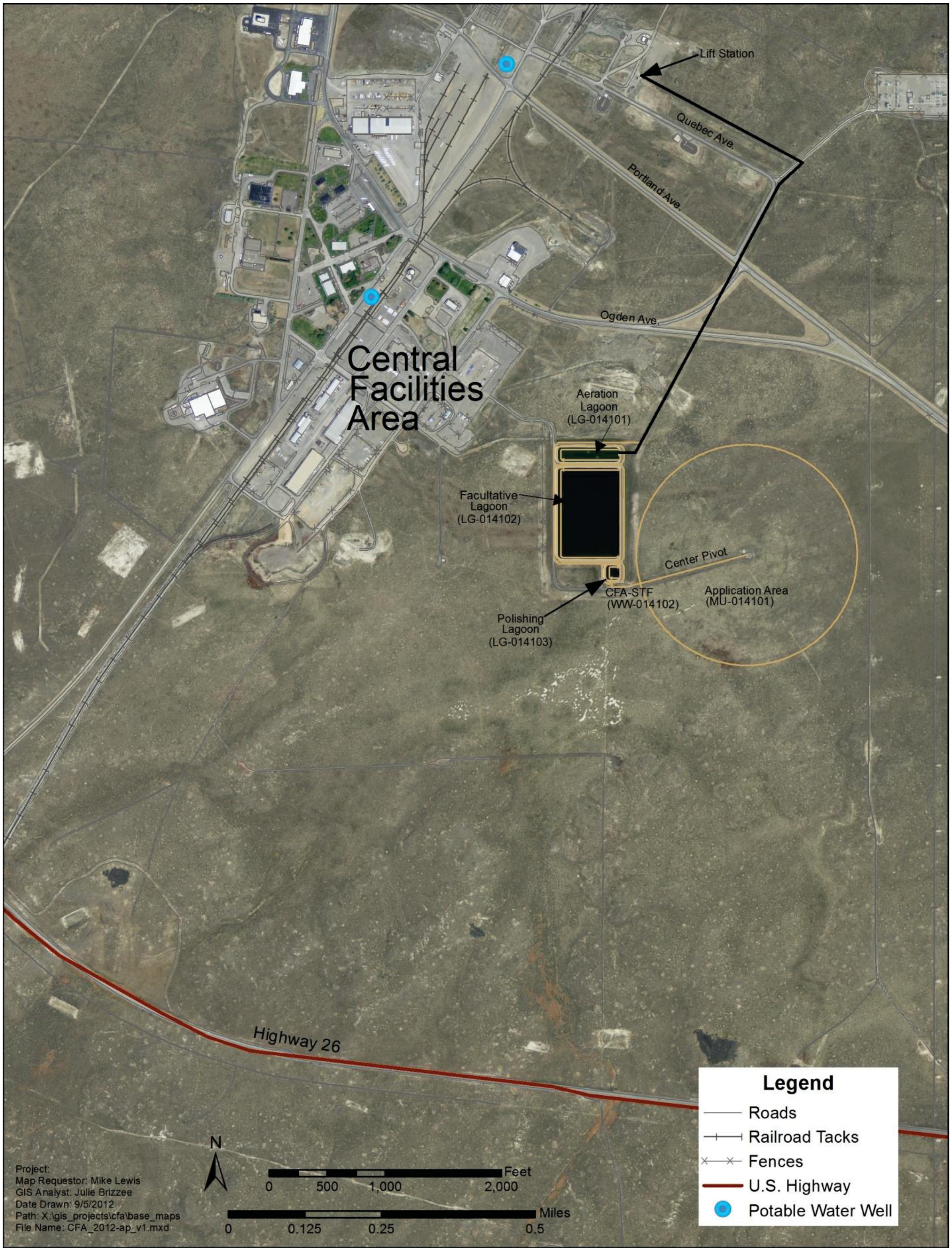

Figure 1. Area map showing the location of the Central Facilities Area Sewage Treatment Plant.

As stipulated in the permit (Section F, Table 4), no grazing of domesticated animals or cultivation of crops for human consumption occurred on the application area during the 2013 permit year.

The STP serves all major CFA facilities. The wastewater is derived from: bus and vehicle maintenance areas; boiler blowdown; heating, ventilation, and air conditioning systems; employee showers and restrooms; laboratories; craft shops; a fire station; and a medical dispensary. Additional wastewater may be transported from other area comfort stations, septic tanks and portable toilets.

3. EFFLUENT MONITORING AND LOADING RATES

This section describes the sampling and analytical methods used in the effluent monitoring program. It provides the effluent monitoring data, the effluent flow data, and a summary of the truck-hauled wastewater that is discharged to the CFA STP. The section also includes the calculated hydraulic and nutrient loading rates as required by the permit.

3.1 Sampling Program and Analytical Methods

During the 2013 permit year, no wastewater was applied to the land application area.

When wastewater is land applied, INL Monitoring Services (MS) monitors effluent discharges at the CFA STP. The MS program involves sampling, analysis, and data interpretation carried out under a quality assurance program in accordance with the permit. Samples are collected from the CFA STP pump pit (WW-014102) prior to discharge to the sprinkler pivot.

CH2M-WG Idaho, LLC (CWI), wastewater operators are subcontracted to perform the monthly effluent total coliform analyses. The CWI, State of Idaho-licensed wastewater operators perform the total coliform analysis using *Standard Methods for Examination of Water and Wastewater*. The pH analysis is performed by MS personnel on a grab sample collected at the effluent location.

All other effluent samples would be submitted to and analyzed by Southwest Research Institute's Analytical and Environmental Chemistry Department located in San Antonio, Texas.

3.2 Effluent Monitoring Results

The permit year covered in this report is November 1, 2012, through October 31, 2013. No wastewater was land applied during this period and therefore, no samples were collected.

3.3 Flow Volumes and Hydraulic Loading Rates

Daily effluent flow readings are recorded at the pivot control panel when the pivot is operating. The pivot was not operated during the 2013 permit year.

The permit (Section F, Table 4) specifies the following:

- Application season (growing season) is April 1 through October 31. Application to frozen or snow-covered ground is prohibited.
- Application of supplemental (fresh) irrigation water is prohibited.
- Wastewater shall not exceed 37 million gallons (MG) annually or 18.5 in./acre.
- Wastewater may be applied on a maximum of 73.5 acres.

No wastewater was applied during the 2013 permit year. No supplemental irrigation water was applied to the application area.

Figure 2 shows the effluent flow volumes to the CFA STP pivot from permit year 2004 through the current permit year. Volumes decreased significantly from 2004 through 2007, remained relatively stable from 2007 through 2010, and dropped to 1.22 MG in 2011 and 0 MG in 2012 and 2013. Reduction in personnel and operations is expected to have resulted in a reduction in the wastewater flow.

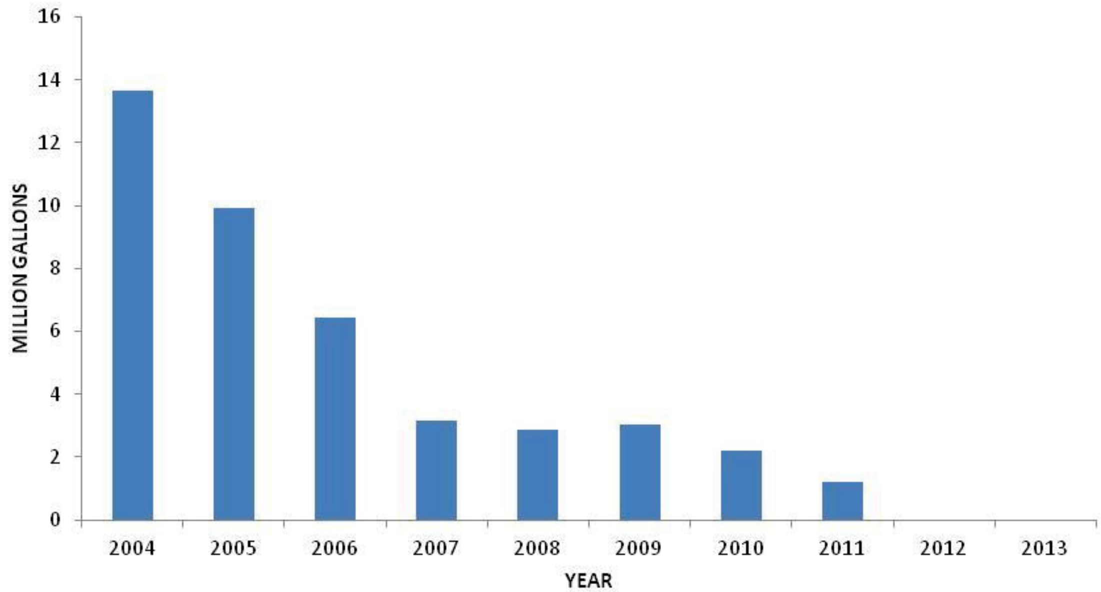

Figure 2. Annual effluent flow to the Central Facilities Area Sewage Treatment Plant pivot.

3.3.1 Truck-hauled Wastewater Discharges

Truck-hauled wastewater consists of wastewater pumped from portable toilets, septic tanks, and comfort stations. These wastewater systems are pumped by septic system pumping companies licensed in the State of Idaho. Prior to discharge, CFA STP personnel are contacted by the pumping company. A form is filled out documenting the date and the estimated volume of wastewater discharged. The wastewater is then discharged into a manhole upstream of the influent flow meter. For the 2013 permit year, approximately 12,100 gallons of truck-hauled wastewater was discharged to the CFA STP.

3.4 Nutrient Loading Rates

The permit requires loading rate calculations for total dissolved solids, total nitrogen, chemical oxygen demand, and total phosphorus. For the 2013 permit year, loading rates were zero since no wastewater was land applied.

4. SOIL MONITORING

The CFA STP permit requires that the soil within the land application area be sampled in October 2010, and then three years later in October 2013. Soil samples for 2013 were collected on October 15.

4.1 Sampling Program and Analytical Methods

The soil samples are collected by MS personnel. The program sampling and data interpretation are carried out under a quality assurance program. For October 2013, ten soil samples were collected from the land application area at three depths and then composited in accordance with INL procedures and as specified in the permit. The samples are analyzed using *Methods of Soil Analysis*.

4.2 Soil Monitoring Results

Cascade Earth Science, Ltd. (CES 1993) characterized soils at the CFA STP prior to construction. Soils in the upper 6 in. are predominantly silty clay loam. Soils from 6 to 52 in. are predominantly silt loam. Soils at CFA were determined to be suitable for slow-rate wastewater application (EG&G 1993).

For the period of 1995 through 2004, the permit required that samples be collected from five sampling locations on the application area at the 0–12 and 12–24 in. depths. Beginning with the October 2005 soil sampling event, samples have been collected at 10 locations (Figure 3) in the land application area as required by the permit. Subsamples are taken from the 0–12, 12–24, and 24–36 in. depths at each location and composited, yielding three composite samples, one from each depth. The 24–36 in. depth interval was a new permit requirement for 2005; soil samples were not collected at this interval prior to 2005.

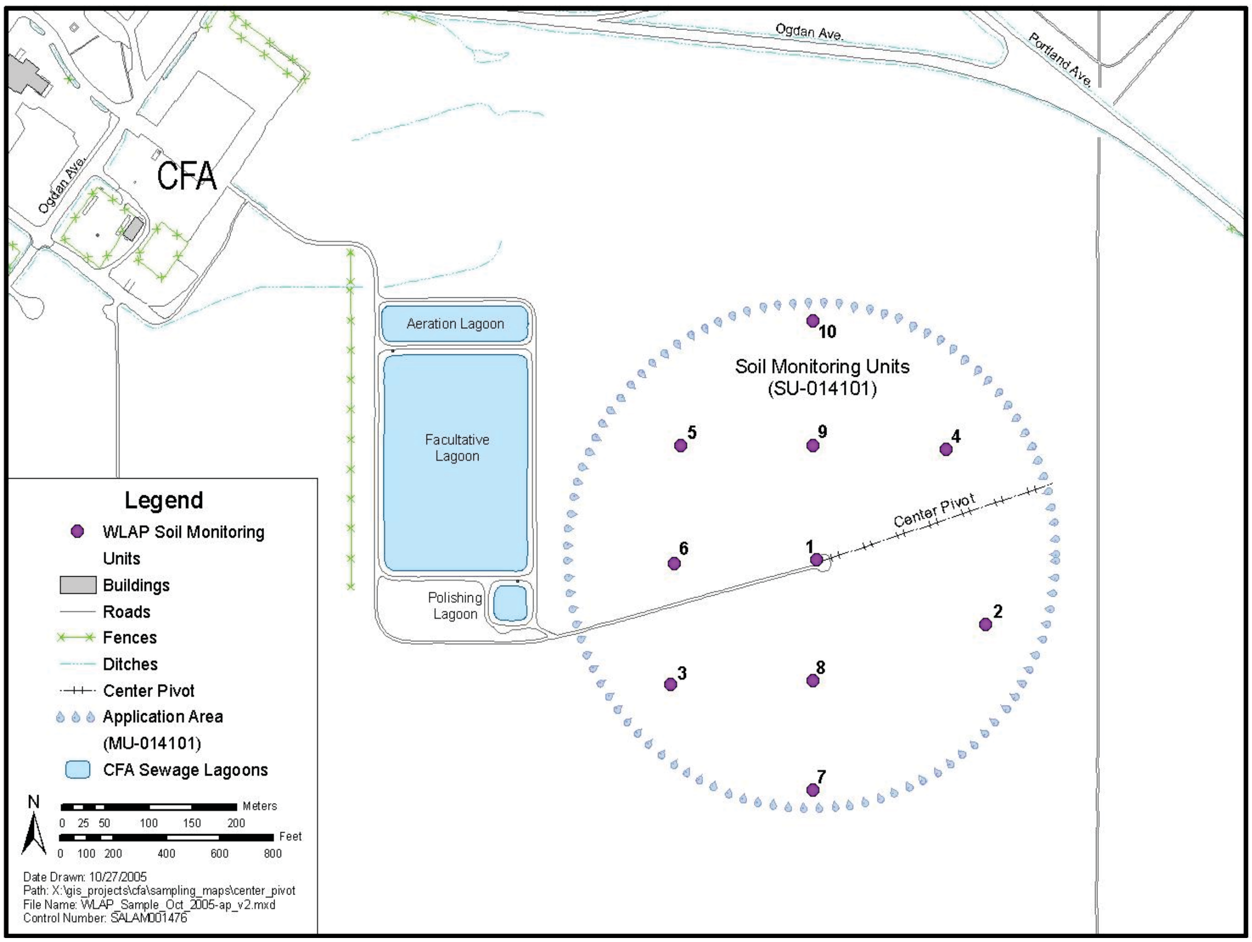

Figure 3. Central Facilities Area Sewage Treatment Plant Wastewater Reuse Permit soil monitoring locations.

Table 1. Central Facilities Area Sewage Treatment Plant application area soil monitoring results.

Parameter	Depth (in.)	2005	2006	2007	2008	2009[a]	2010[b]	2013[c]
pH	0–12	8.02	8.29	8.05	8.21	8.26	7.97	8.05
	12–24	7.94	8.05	8.00	7.88	7.95	7.85	8.07
	24–36	8.03	8.15	8.09	8.00	8.05	7.85	8.05
Electrical Conductivity (mmhos/cm)	0–12	1.93	0.86	1.221	0.722	0.675	1.091	0.356
	12–24	2.86	3.20	2.03	2.66	2.490	2.660	1.281
	24–36	2.10	3.54	1.95	2.20	1.937	2.590	1.516
Organic Matter (%)	0–12	1.49	1.76	1.33	1.49	1.51	1.72	1.43
	12–24	0.79	0.933	0.774	0.874	0.655	0.828	0.814
	24–36	0.46	0.562	0.483	0.867	0.424	0.603	0.521
Nitrate as Nitrogen (ppm)	0–12	5.44	3.07	3.18	1.16	1.62	1.41	3.17
	12–24	1.66	1.003 U[d]	0.977 U	0.996 U	0.998 U	1.02 U	0.980 U
	24–36	1.73	0.998 U	1.00 U	0.986 U	0.996 U	1.01 U	0.958 U
Ammonium Nitrogen (ppm)	0–12	0.49 U	1.99	0.516	1.46	0.818	0.512 U	1.08
	12–24	0.48U	0.501 U	0.489 U	0.498 U	0.499 U	0.508 U	0.517 U
	24–36	0.49 U	0.501 U	0.500 U	0.493 U	0.498 U	0.507 U	0.516 U
Extractable Phosphorus (ppm)	0–12	13.10	10.60	9.05	11.2	7.77	15.4	8.88
	12–24	3.26	1.94	1.77	3.98	1.72	3.64	3.17
	24–36	1.72	0.99 U	1.19	2.84	1.28	4.34	1.66
Sodium Adsorption Ratio	0–12	5.64	9.68	3.79	4.06	3.83	4.32	2.44
	12–24	3.94	7.45	4.00	4.73	4.19	5.10	3.97
	24–36	3.12	10.00	3.69	3.48	2.5	4.62	3.07

a. During the 2009 sampling event, refusal was met at the 23 in. depth at location #1. The auger was moved allowing for the 24–36 in. depth sample to be collected. At sampling location #4, refusal was met at the 30 in. depth.

b. During the 2010 sampling event, refusal was met at 18 in. at location #4. The location was moved and additional sample was collected from 18–24 in., completing the 12–24 in. depth sample. Refusal was again encountered at the 30 in. depth at location #4, resulting in the sample being collected at a depth of 24–30 inches.

c. During the 2013 sampling event, refusal was met at 28 in. at location #4. Therefore, the sample was collected at the 24-28 in. depth at location #4.

d. U flag indicates that the result was reported as below the detection limit.

Soil sample results from 2005 through 2010 and then for 2013 are shown in Table 1. The WRP required samples to be collected in 2010 and then again in 2013. All soil samples are collected in October of each year.

During the 2013 sampling event, refusal was met at the 28 in. depth at location #4 (Figure 3). Therefore, the third sample depth for location #4 was 24-28 inches.

The 2013 pH levels ranged from 8.05 to 8.09 at the three depths (Table 1). These pH levels were within the 2005 to 2010 pH ranges of 7.85 and 8.29. A pH between 5.5 and 8.4 is suitable for most crops (DEQ 2007).

Organic matter serves many important functions in soil/plant treatment systems. In mineral soils it is usually less than 5%. As expected, organic matter in the 2013 samples (Table 1) was highest in the 0–12 in. range (1.43%) and lowest in the 24–36 in. range (0.521%).

Excessive salts can adversely affect soil and plant health. Conversely, low to moderate salinity, indirectly measured as electrical conductivity, may actually improve the physical conditions of some soils. Soil conductivity levels of 0–2 millimhos per centimeter (mmhos/cm) are generally accepted to have negligible effects on plant growth. Soils with a conductivity of 2–4 millimhos are considered to have a moderately high soil salinity (DEQ 2007) and may restrict growth in very salt-sensitive crops. The soil conductivity levels found in all three depths sampled in 2013, were below the 2 mmhos/cm level (Table 1).

Poor drainage is the most common cause of salt buildup in soils (Blaylock 1994). This can be expected due to the low volume of water applied to the CFA STP pivot application area. Currently, the soil conductivity in the application area is below the 6 mmhos/cm level expected to result in a decrease in relative growth of crested wheat grass (Blaylock 1994) and sagebrush (Swift 1997).

Soils with sodium adsorption ratios (SARs) below 15 and electrical conductivity levels below 2 mmhos/cm are generally classified as not having sodium or salinity problems (Bohn, McNeal, and O'Connor 1985). The SAR indicates the exchangeable sodium levels in the soil. Soils with high exchangeable sodium levels tend to crust badly or disperse, which greatly decreases soil hydraulic conductivity. DEQ guidance (DEQ 2007) states that "SAR values above fifteen (15) classify soils as sodic or alkali, have sodium as the dominant cation, and may possibly experience infiltration problems due to deflocculation of soil colloids." The SARs for 2013 were all less than 4 (Table 1).

The nitrogen data in Table 1 suggest negligible nitrogen accumulation from previous wastewater application. Nitrate as nitrogen (NO_3-N) and ammonium nitrogen (NH_4-N) were detected above the laboratory instrument detection threshold in the upper soil layer (0–12 in.) at a concentration of 3.17 ppm and 1.08 ppm, respectively. All other samples collected for NO_3-N and NH_4-N were below the laboratory instruments detection level. The low soil-available nitrogen (NH_4-N and NO_3-N) concentrations suggest that the sagebrush and grass vegetation use most of the plant-available nitrogen and that the total nitrogen application in the past has been low. The NH_4-N and NO_3-N concentrations are comparable to those of non-fertilized agricultural soils.

Extractable (plant available) phosphorus concentrations at the 0–12 in., 12–24 in., and 24–36 in. depths for samples collected in 2013 were 8.88 ppm, 3.17 ppm, and 1.66 ppm, respectively (Table 1). DEQ guidance (DEQ 2007) recommends that to ensure there are no ground water contamination concerns, the phosphorus should be less than 30 ppm (Olsen method used in these analyses) in the 24–36 in. soil depth. As shown above, the phosphorus concentration at the 24–36 in. depth for 2013 was 1.66 ppm, and well below the level of concern.

5. PERMIT YEAR ACTIVITIES AND ISSUES

This section provides information and status associated with applicable activities and issues during the permit year.

5.1 Status of Permit Required Compliance Activities

Section H, Paragraph 5, of the permit requires that DEQ be notified within 30 days of completing any work described in Section E, and that the annual report shall provide the status of compliance activities still in progress at the end of the permit year.

Compliance Activity CA-141-01(within 12 months of permit issuance): A final Plan of Operation (O&M Manual) for the wastewater reuse facility, incorporating the requirements of this permit shall be submitted to the Department for review and approval.

The permit was issued on March 17, 2010, and therefore, the Plan of Operation was required to be submitted to the DEQ by March 17, 2011, for review and approval. The Plan of Operation was submitted to the DEQ on February 28, 2011 (Stenzel 2011), and approved on June 23, 2011 (Rackow 2011). This compliance activity is completed.

Compliance Activity CA-141-02 (May 31, 2014): Submit a Seepage Testing Procedure to DEQ for review and approval for the three wastewater treatment lagoons. The Procedure shall describe the testing procedures, equipment, measurement methods, and calculation methodology conclusions for DEQ review and approval.

This procedure will be completed by May 31, 2014.

Compliance Activity CA-141-03 (August 31, 2014): Upon DEQ approval of the Seepage Testing Procedure (CA-141-02, above), the permittee shall complete seepage testing of CFA STP lagoons 1 through 3 and submit a Seepage Test Results Report to DEQ no later than August 31, 2014, for review and approval.

The seepage test will be completed by August 31, 2014.

NOTE: The Compliance Activity Description in Section E, Table 3, of the permit, states that this test is to be completed "no later than August 31, 2015," which contradicts the date of August 31, 2014, given in the Compliance Activity Number Completion Date column in the same section and table. In order to allow the DEQ time to review the seepage test results prior to issuing a new permit, the correct date is clarified as August 31, 2014.

5.2 Noncompliance Issues

There were no noncompliance issues identified during the 2013 permit year.

5.3 Aquatic Weed Control

During permit year 2007, prolific aquatic vegetative growth in Lagoons No.'s 2 and 3 became a potential operational concern. Concerns included the potential for short circuiting, insect breeding, and plugging of the pivot irrigation system pump and spray nozzles. Several vegetative control methods were considered. After discussion with the DEQ (Stanley 2008), it was decided that the INL would purchase grass carp (Ctenopharyngodon idella) and stock them in the two lagoons.

Grass carp can be an economical and effective method for controlling aquatic vegetation. On a daily basis, small grass carp (<16 inches in length) can consume up to two times their body weight under optimal conditions. This rate decreases to 80% of their body weight as the fish grow. Grass carp may live up to 10 or more years under the right conditions.

Approximately 250 triploid (sterile) 6-in. grass carp were released into the CFA STP lagoons during the summer of 2008. Approximately 240 were released into Lagoon No. 2, and 10 were released into Lagoon No. 3. In May, 2010, 190 grass carp were released into Lagoon No. 2, and 10 more were released into Lagoon No. 3. The carp were approximately 6 inches in length. The grass carp suffered significant mortality in both 2008 and 2010. Few if any were believed to have survived over the winters.

However, it did appear that the grass carp reduced the weed growth in Lagoons No. 2 and 3. Aquatic weeds were not an operational issue during the 2011, 2012, and 2013 permit years. Therefore, no carp were planted in any of those three years. If aquatic weed growth becomes an operational issue in the future, purchasing and releasing grass carp will be considered.

5.4 CFA-1718 Lift Station Pump Replacement

One of the two dedicated CFA-1718 lift station pumps failed and was taken out of service in 2011. This pump was replaced with a similar pump in March 2012. In June 2012, the other dedicated pump failed. This pump was repaired and placed back into service in mid November 2012.

5.5 Supplemental Water Added to the Lagoons

Beginning in June 2013, supplemental water was added to the lagoons to maintain the water level and the integrity of the clay liners. The supplemental water is added to the system by the production/potable water wells. Supplemental water flows to the influent lift station along with the other wastewater. From there, the wastewater discharge from the lift station is monitored with an ultrasonic flow meter. In early September, the addition of supplemental water was discontinued.

Having to add supplemental water raised the concern that the CFA STP may be oversized for the current and expected future population. From a sustainability perspective, it is not desirable to add clean water to a wastewater system to maintain the liners. Therefore, the INL has contracted with J-U-B Engineers, Inc. to perform a study to evaluate the CFA STP system capacity, operational practices, and potential improvement alternatives. The evaluation will be completed in permit year 2014.

6. ENVIRONMENTAL IMPACTS

Wastewater has not been discharged to the land application area since permit year 2011.

No waste solids were removed from the lagoons during the permit year. Therefore, there were no waste solids disposal concerns.

The 2013 soil samples show continued low concentrations of phosphorus, ammonium and nitrate nitrogen. Electrical conductivity and sodium adsorption ratio provide indicators there are no soil salinity issues at the application area.

With the historically low hydraulic and nutrient loading rates, combined with no discharge during the 2012 and 2013 permit years and the depth to groundwater (approximately 600 feet below land surface), there are no negative impacts expected to the groundwater resource.

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