INL/EXT-13-29642

Advanced Test Reactor Complex Sewage Lagoon Evaluation

J·U·B ENGINEERS, INC.

WALSH ENGINEERING SERVICES

August 2013

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

Idaho National Laboratory

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J-U-B ENGINEERS, Inc.
275 South 5th Ave, Suite 220
Pocatello, ID 83201

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EXECUTIVE SUMMARY

The Advanced Test Reactor (ATR) Complex located in Butte County, Idaho at the Idaho National Laboratory (INL) has an existing evaporative wastewater system to collect and treat sanitary wastewater from the facility. The existing system includes two cells, Cell #1 has a surface area of 2.9 acres and Cell #2 has a surface area of 13.8 acres. Cell #1 incorporates a soil liner system and Cell #2 includes both a PVC geomembrane and a soil liner. In 2010, both cells were tested in accordance with Idaho Department of Environmental Quality requirements and measured seepage was within acceptable limits.

Under current wastewater flow, the two cell system is oversized for the population currently served and anticipated future populations. As a result, one or both of the cells would typically go dry during the summer if additional supplemental water was not added to the system. Supplemental water is currently added to the system to prevent the clay soil liners from drying out and "cracking", thereby reducing the effectiveness of the soil liner.

It is estimated that an average of 550 workers are present at the complex for 10 hours each day, Monday through Thursday. Friday through Sunday, an average of 100 workers are present for 10 hours. In total, approximately 13,500 worker-days per month, based on a standard 8 hour work-day was estimated. Using data from the influent pump station flowmeter between January 2011 and April 2013, the following flow estimates were made for both sanitary flows and supplemental water added to the system:

- Total flow
  - Average annual = 17,599,720 gallons per year
  - Average monthly = 1,354,445 gallons per month
- Sanitary flow
  - Average annual = 5,649,986 gallons per year
  - Average monthly = 469,280 gallons per month
- Supplemental water
  - Average annual = 11,949,733 gallons per year
  - Average monthly = 2,987,433 gallons per month (when supplementing)
  - Added in 2011 = 9,094,483 gallons (July through September)
  - Added in 2012 = 14,804,983 gallons (July through November)

Based on these flows, a water balance analysis was performed under both "wet" and "dry" conditions using only the sanitary flows and eliminating the addition of supplemental water. The water balance was performed using the assumption that Cell #1 would be kept as full as possible and any overflow would be to Cell #2. The results of this analysis show that Cell #1 is slightly undersized to serve the current population and that under average conditions Cell #1 will overflow into Cell #2 in the early spring. The sensitivity analysis showed that if seepage increased in Cell #1, but still within acceptable limits, Cell #1 would be capable of handling all of the sanitary flows and that seepage at the upper acceptable limit would still require some supplemental water to be added to Cell #1 to prevent it from going dry.

Needs and deficiencies of the existing system were identified based on review of construction documents and discussions with operations personnel. In total, five key elements were identified in the report.

1. Use of Supplemental Water. The current operational reliance on large volumes of supplemental water to maintain the existing soil liners in both cells is the primary deficiency addressed in the evaluation. The reliance of Cell #1 on the soil liner system requires that a water "cap" be maintained in the lagoon to preserve the integrity of the soil liner. However, seepage control in Cell #2 is provided by the PVC geomembrane which requires only a soil cover to protect it from UV degradation and this is provided by the soil liner overlaying the geomembrane. In Cell #2, a water cap is not required to protect the integrity of the soil liner as its function in Cell #2 is only to provide UV protection to the geomembrane. Eliminating the operational requirement to maintain a water cap in Cell #2 is a significant change from existing operations and will likely result in annual water savings of 9 to 15 million gallons.
2. Remaining life of PVC geomembrane in Cell #2. Samples of the existing liner were taken and sent to a specialty testing laboratory for analysis to determine the current condition of the geomembrane, rate of degradation, and anticipated useful life remaining. The test results showed signs of deterioration in the ductility and flexibility of the existing PVC liner consistent with what would be expected for a 15 year old installation. Based on a typical 20 year design life for these types of liner systems, replacement of the liner may be needed as soon as Year 2017. However, provided the lagoon continues to pass the periodic seepage testing and continues to be adequately protected, another 10 to 20 years of remaining life may be available.
3. Pond bottom slope. The existing lagoons were constructed with flat bottoms. With the current liner systems in both Cell #1 and #2, the flat bottom is not problematic. However, if future replacement of the liner systems is contemplated with exposed geomembranes, regrading of the pond bottoms to prevent gas accumulation under the liner is recommended.
4. Fencing and signage. Idaho Department of Environmental Quality does not appear to require that the facility be fenced. However, if livestock or wildlife intrusion or damage to either lagoon surface resulting from these activities is observed, fencing of the lagoons is recommended. If in the future, either lagoon is relined with an exposed geomembrane, the facilities should be fenced as exposed geomembranes are susceptible to extensive damage when animals become trapped by the slick liner.
5. Potential health hazards. Modification of current operations of the facility contemplated will result in the bottom of Cell #2 being dry. The potential for biosolids to be wind-blown and result in potential exposure is considered and potential remedial actions provided. EPA guidance regarding the storage of biosolids should be followed.

A number of alternatives were evaluated and their resolution of the identified needs and deficiencies considered. The "Do Nothing" alternative was not considered feasible because of the current reliance on large volumes of supplemental water to maintain the water "cap" on both cells. Complete replacement of the existing lagoons was also quickly removed from consideration because of the high initial costs and the relatively good condition of the existing facilities that would be replaced.

Additional short and long term alternatives were evaluated and recommended alternatives identified.

For the short term, it is recommended that the practice of adding supplemental water be stopped and the system be operated to hold all wastewater in Cell #1 as practical, and allow Cell #2 to go dry except under those conditions when Cell #1 is full and overflows into Cell #2. Monitoring of operation in this manner will continue to determine if supplemental water is needed to maintain the water "cap" on Cell #1. These recommended changes to current operational practices can be done without requiring the creation and subsequent review and approval of documents by the Idaho Department of Environmental Quality. It is recommended that operation in this manner continue until one of two conditions is encountered:

1. Actual operation demonstrates that supplemental water is still needed to maintain a water "cap" in Cell #1 and the annual quantity required is significant enough to warrant implementation of one of the identified long term alternatives.
2. The condition of the existing liner systems in either Cell #1 or #2 degrades to the point that one or both of the cells fail the seepage test. The test is required every 10 years during operation of the lagoons.

When one of these two conditions is reached, it is recommended that one of two long term alternatives be implemented. The first long term alternative would include abandoning Cell #1 and rehabilitating Cell #2. This rehabilitation would include:

- Remove and dispose of accumulated biosolids in Cell #2.
- Add a new interior dike to divide the Cell #2 and construct a new transfer structure and bypass piping to provide flow control.
- Reshape the bottom of the divided Cell #2.
- Replace the existing PVC geomembrane with an exposed geomembrane.
- Complete closure plan for Cell #1.

The second long term alternative includes the reconstruction of Cell #1 and the continued use of Cell #2 without modification. This would include:

- Remove and dispose of accumulated biosolids in Cell #1.
- Reshape the bottom of Cell #2
- Installation of a geomembrane liner in Cell #1.

The ultimate selection of the preferred long term alternative will be made as the operation under the short term alternative is monitored and the condition of the existing lagoons liner systems is evaluated by subsequent leakage testing. When additional information in these regards is available, a life cycle cost comparison of the two long term alternatives can be completed. It is anticipated that this analysis will be performed as part of future studies that will be performed as part of the implementation program. Implementation of either long term alternative will require a number of submittals to the Idaho Department of Environmental Quality including:

- Facility Planning Document
- Preliminary Engineering Report
- Construction Drawings and Specifications
- Record Drawings and Specifications
- Operations and Maintenance Manual

The recommended alternative outlined and the noted changes in operations of the facility will provide a long term solution to wastewater treatment and disposal and conserve an estimated 9 to 15 million gallons of supplemental water annually compared to current operations.

CONTENTS

EXECUTIVE SUMMARY iii

1. INTRODUCTION 1-1

   1.1 Study Background 1-1

   1.2 System History 1-1

   1.3 Study Objectives 1-3

2. CLIMATIC DATA 2-1

   2.1 Precipitation 2-1

   2.2 Evaporation 2-1

3. SYSTEM EVALUATION 3-1

   3.1 Existing System Drawings 3-1

   3.2 Existing System Description 3-1

   3.3 Service Area Limits and Population 3-3

   3.4 Flows 3-3

   3.5 Water Balance 3-5

   3.6 Needs and Deficiencies 3-8

      3.6.1 Addition of Supplemental Water 3-8
      3.6.2 Remaining Life of Cell #2 Liner 3-9
      3.6.3 Bottom Slope 3-10
      3.6.4 Fencing and Signage 3-10
      3.6.5 Potential Health Hazards 3-11

4. ALTERNATIVES EVALUATION 4-1

   4.1 Screening of Alternatives for Further Evaluation 4-1

      4.1.1 Do Nothing Alternative 4-1
      4.1.2 Replacement of Existing Lagoons 4-1
      4.1.3 Consideration of Short-Term and Long-Term Scenarios 4-1

   4.2 Short-Term Alternative 4-1

   4.3 Long-Term Alternatives 4-2

      4.3.1 Alternative LT-1: Abandon Cell #1 4-2

4.3.2 Alternative LT-2: Reconstruct Cell #1 4-5

4.4 Selection of Preferred Long-Term Alternative 4-6

4.4.1 Engineer's Opinions of Probable Cost 4-6
4.4.2 Comparison of Alternatives 4-6

5. IMPLEMENTATION OF PREFERRED ALTERNATIVE 5-1

5.1 Regulatory Requirements 5-1

5.2 Summary of Implementation Steps 5-1

6. ATTACHMENTS 6-1

Attachment A, Record Drawings for the ATR Sanitary Wastewater Lagoons A-1

Attachment B, 2010 Seepage Testing Results B-1

Attachment C, 2013 PVC Liner Test Results C-1

FIGURES

1-1. Vicinity map 1-2

3-1. Overall site plan (existing system) 3-1

3-2. Photo of existing lagoons 3-2

3-3. Photo of existing Transfer Structure #1 3-2

3-4. Photo of Cell #1 inlet splash pad 3-3

3-5. Influent flow data 3-4

3-6. Water balance – existing conditions (with 4 foot initial Cell #1 depth) 3-5

3-7. Water balance – existing conditions (with 8 foot initial Cell #1 depth) 3-6

3-8. Water balance – existing conditions (25% increase in staffing) 3-7

3-9. Water balance – existing conditions (increased seepage rates in Cell #1) 3-8

4-1. Overall site plan (short-term alternative) 4-2

4-2. Water balance – Alternative LT-1) 4-3

4-3. Overall site plan (Alternative LT-1) 4-4

4-4. Overall site plan (Alternative LT-2) 4-5

TABLES

2-1. Monthly precipitation data...2-1

2-2. Monthly evaporation data 2-2

3-1. ATR existing lagoons 3-2

3-2. Existing liner test results...3-10

Advanced Test Reactor Complex Sewage Lagoon Evaluation

1. INTRODUCTION

1.1 Study Background

The Advanced Test Reactor (ATR) Complex located in Butte County, Idaho at the Idaho National Laboratory (INL) has an existing wastewater system to collect and treat sanitary wastewater from the facility. The INL is concerned that the evaporation sewage lagoons, which are part of the wastewater system, may be oversized for current and known future population. Also, there is concern about the sustainability of the large volumes of supplemental water which are added to the system according to current operational practices. Therefore, this study was initiated to evaluate the system capacity, operational practices, and potential improvement alternatives, as warranted.

The ATR Complex is operated for the United States Department of Energy by Battelle Energy Alliance, LLC (BEA). Walsh Engineering Services, PC is contracted by BEA to provide facility engineering services for ATR. J-U-B ENGINEERS, Inc. has been subcontracted by Walsh Engineering Service, PC to develop this evaluation study.

1.2 System History

Prior to 1995, sanitary wastewater from the ATR Complex was collected and treated at a mechanical wastewater treatment plant and discharged to a subsurface disposal system. Deterioration of this wastewater treatment plant and the need for a lower maintenance system led to its replacement with an evaporation (i.e. total containment) lagoon system.

The new evaporation sewage lagoons were installed in 1995 and consisted of two (2) cells both lined with bentonite clay. After construction, both cells were seepage tested, and Cell #2 failed the test. As a result, Cell #2 only was reconstructed in 1997 by removing the clay liner, installing a PVC geomembrane liner, and then reinstalling the clay material on top for protection of the PVC liner. According to ATR operations staff, this is the current condition of Cell #2, and Cell #1 continues to have the clay liner only. The ATR sewage lift station and lagoons are managed and operated by the Facilities and Site Services (F&SS) organization located at the Central Facilities Area (CFA) which is approximately 4 miles south of the ATR Complex.

Because clay material cracks when it dries out, lagoons that rely on a clay liner to prevent seepage are typically operated to maintain a minimum depth of water at all times. For this reason and because of the presence of the clay material in the ATR lagoons, F&SS staff, with the assistance of ATR Operations, has operated the system to continuously maintain a minimum depth of water in both cells. This has required the addition of large amounts of supplemental water in the summer months when evaporation rates are peaking. The supplemental water is added within the collection system upstream of the influent lift station.

In 2010, BEA conducted a seepage test of the sewage lagoons. Both cells passed the test with seepage rates below the Idaho Department of Environmental Quality (IDEQ) threshold operating criteria of 0.25 inches per day. The observed seepage rate for Cell #1 was the highest, greater than 0.125 inches per day, while the rate for Cell #2 was well below 0.125 inches per day. Cell #2 was tested at a water depth of 4 feet instead of its full depth of 8 feet.

The ATR Complex also generates industrial wastewater divided into “warm” waste and “cold” waste flows, but these flows do not enter the sanitary wastewater collection system and are discharged to other lagoons in the vicinity. Figure 1-1 provides a vicinity map of the ATR Complex.

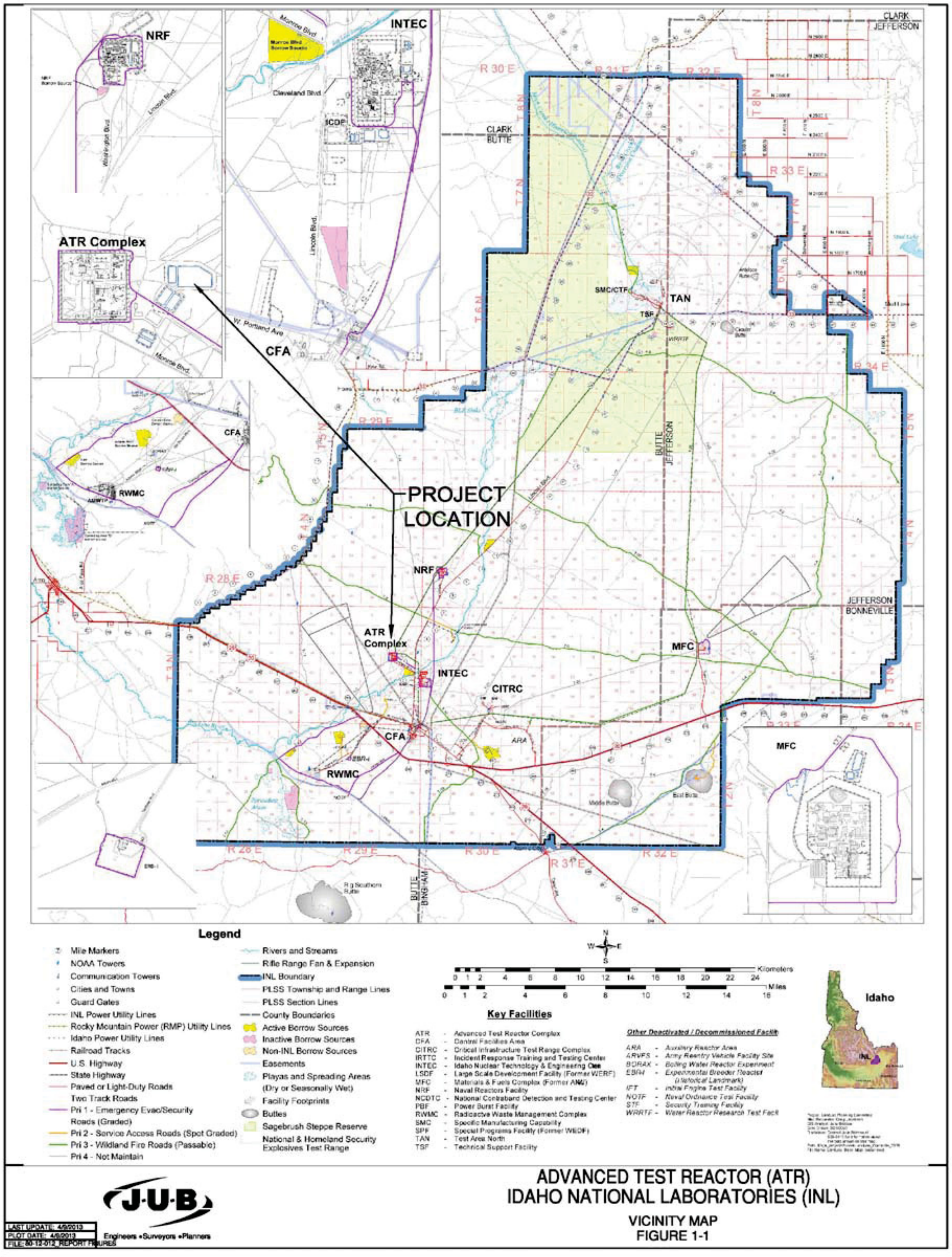


Figure 1-1. Vicinity map.

1.3 Study Objectives

In general, the objectives for this study include the following:

- Describe the climatic conditions relevant to assess the capacity of the evaporation lagoons.
- Calculate flows and a water balance for the system for existing and anticipated future conditions.
- Assess the capacity of the evaporative lagoon system.
- Identify general needs and deficiencies.
- Identify operational changes to reduce the volume of supplemental water added to the system.
- Screen and evaluate alternatives needed to address the needs and deficiencies.
- Describe key issues to consider for implementation of the preferred alternative including an opinion of probable construction cost.

This study is intended to be a cursory assessment and tool to assist with long-term decision-making. If a project is implemented, the preparation of additional documents will be needed including those required to meet IDEQ requirements such as a facilities plan, preliminary engineering report, and detailed plans and specifications for construction.

2. CLIMATIC DATA

2.1 Precipitation

Precipitation data were obtained from the National Oceanic and Atmospheric Administration (NOAA) Field Research Division in Idaho Falls. Approximately 60 years of monthly precipitation data for the Central Facilities Area (CFA) for the period between March 1950 and February 2010 were analyzed to determine the annual precipitation value that corresponded to both the 10-year high and 10-year low precipitation years. CFA is located approximately 4 miles south of ATR.

The 10-year high precipitation value is considered a reasonable value to use in analyzing the capacity of an evaporative lagoon system during a "wet" year whereas the 10-year low value is reasonable for a "dry" year. For example, the 10-year high is the highest amount of annual precipitation that would statistically occur every 10 years. The annual precipitation amount was then allocated to each month proportionally to the average monthly precipitation. The resulting monthly 10-year high and low precipitation values are summarized in Table 2-1.

For comparison, in this 60 year period, the median annual precipitation was 8.54 inches with a high of 14.4 inches and a low of 4.45 inches. In 2009, which was considered a relatively wet year, the annual precipitation was 10.4 inches (the 13th wettest year in the past 60 years).

Table 2-1. Monthly precipitation data.

Month	10-Year High Precipitation (inches)	10-Year Low Precipitation (inches)
January	0.94	0.42
February	0.81	0.37
March	0.82	0.37
April	1.07	0.48
May	1.64	0.74
June	1.62	0.73
July	0.64	0.29
August	0.65	0.30
September	0.86	0.39
October	0.75	0.34
November	0.83	0.37
December	0.97	0.44
Annual	11.6	5.25

Source: Data provided by the NOAA Field Research for the Central Facilities Area for March 1950 to February 2010.

2.2 Evaporation

Evaporation data were obtained from a Web publication titled *Monthly Shallow Pond Evaporation in Idaho* (Molnau, Myron, Kpordze, Kojo, and Craine, Katherine L., ASAE paper PNW 92-111, 1992). Using the guidelines of this publication, it was determined that the annual evaporation for the INL area is 40 inches "pond" evaporation rate, (not "pan" evaporation rate). Although the *Monthly Shallow Pond Evaporation in Idaho* publication indicates no evaporation should generally be assumed in Idaho for December through February, experience for this particular location dictates that the "no evaporation" period should be expanded to November through April when the lagoon could be frozen (or have minimal evaporation), and subsequent calculations were based on this assumption. The resulting monthly evaporation rates are summarized in Table 2-2.

High salt concentrations in wastewater warrant further reducing the evaporation rate with a “salinity correction factor”. No analytical results of the wastewater at ATR were available, but results from wastewater samples taken at the Materials and Fuels Complex indicated a total dissolved solids concentration of 1,133 milligrams per liter (mg/L) in 2005 (average) and 1,100 mg/L on August 16, 2006. These concentrations are not high enough to warrant correction for salinity.

Based on this data, the annual net evaporation for the INL area during a “wet” year is estimated to be approximately 20 inches (31.60 inches evaporation – 11.60 inches precipitation).

Table 2-2. Monthly evaporation data.

Month	Average Evaporation (inches)[1]	Adjusted Average Evaporation (inches)[2]
January	0.4	0
February	0.8	0
March	1.60	0
April	2.80	0
May	4.80	4.80
June	6.00	6.00
July	7.60	7.60
August	6.40	6.40
September	4.40	4.40
October	2.40	2.40
November	1.60	0
December	1.2	0
Annual	**40.0**	**31.60**

[1]Source: *Monthly Shallow Pond Evaporation in Idaho* (Molnau, Myron, Kpordze, Kojo and Craine, Katherine L., 1992. ASAE paper PNW 92-111)

[2]Adjusted values used for evaporative lagoon sizing, assuming no evaporation during the colder months.

3. SYSTEM EVALUATION

3.1 Existing System Drawings

Available drawings of the existing evaporative lagoon system are included in Attachment A. Also, Figure 3-1 shows an overall view of the lagoon system site.

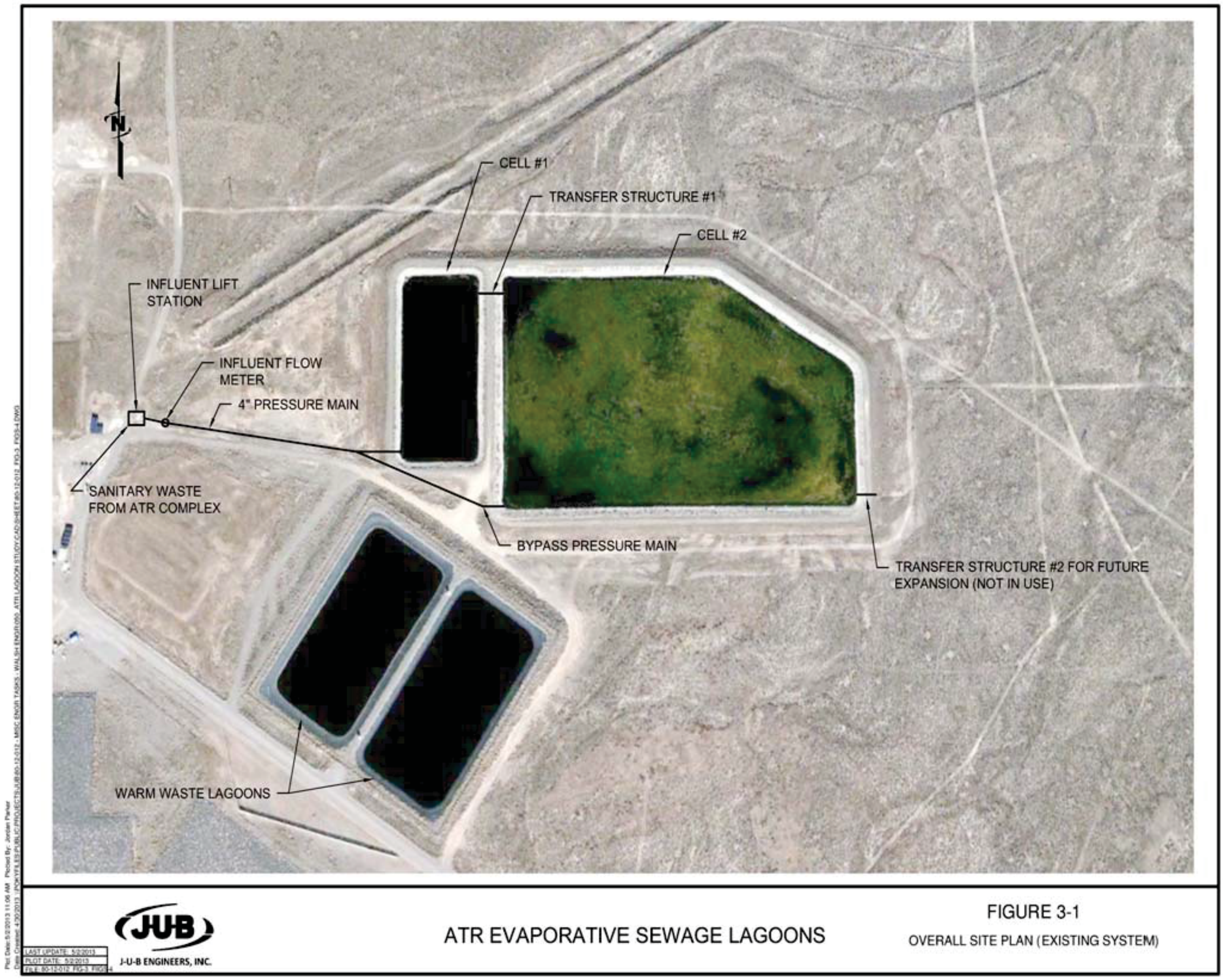


Figure 3-1. Overall site plan (existing system).

3.2 Existing System Description

Sanitary wastewater from the ATR Complex is collected and conveyed through gravity lines to the influent pump station. The duplex pump station then pumps the wastewater through a 4 inch pressure main to the evaporative lagoon system for disposal via evaporation. The discharge of the pump station has an ultrasonic flow meter. Table 3-1 summarizes the details of the two evaporative lagoons.

Table 3-1. ATR existing lagoons.

Lagoon Cell	Year Constructed	Approximate Average Water Surface Area (acres)	Liner	Maximum Water Depth (feet)	Freeboard above Max Water Depth (feet)
#1	1995	2.9	12” of bentonite-treated soil with riprapped sides	8	2
#2	1995[1]	13.8	30 mil PVC overlain by 12” of bentonite-treated soil with riprapped sides	8	2
Total		16.7			

[1] The PVC geomembrane liner was added to Cell #2 in 1997.

Figure 3-2 below is a photo of the lagoons with Cell #1 on the right and Cell #2 on the left.

Figure 3-2. Photo of existing lagoons.

Wastewater from the influent pump station normally enters the southwest corner of Cell #1 and flows out the northeast corner through an in-dike transfer structure into the adjacent Cell #2. This transfer structure consists of an overflow weir and does not allow the water level in Cell 1 to be lowered below 3 feet of water depth. The overflow weir is typically set to maintain an operating depth in Cell #1 of 7 to 7.5 feet, although occasionally it is lowered for operational and maintenance reasons. Figure 3-3 is a photo of Transfer Structure #1.

Figure 3-3. Photo of existing Transfer Structure #1.

Splash pads are provided at the Cell #1 and Cell #2 inlet. A second transfer structure is located in the southeast corner of Cell #2 to facilitate future expansion if needed. A line is provided which allows the flow from the influent pump station to be diverted directly to the southwest corner of Cell #2, thereby bypassing Cell #1. Figure 3-4 is a photo of the Cell #1 inlet splash pad.

Figure 3-4. Photo of Cell #1 inlet splash pad.

The lagoon dikes include a 10 foot wide section of gravel road around the perimeters. The exterior and interior slopes are 3:1 (horizontal : vertical). Both cells appear to have flat bottoms. The lagoon facility is not fenced.

For Cell #2, liner vents are located at 75 foot spacing on-center around the inside top of dike. The liner is anchored in a perimeter trench 2 feet deep x 1 foot wide.

3.3 Service Area Limits and Population

The service area boundary of the evaporative lagoon system is limited to the ATR Complex boundary. The following information regarding existing and future population at the ATR Complex was provided by BEA. According to current plans, no significant future growth is planned for the population served by the lagoon system. Therefore, future growth projections of population were not considered in this evaluation, and subsequent analyses of the system were based only on the existing ATR Complex population estimates. It was assumed that the existing population and flows are also representative of future population and flows.

Currently, BEA estimates that an average of 550 workers are present at the complex for 10 hours each day on Monday through Thursday. On Friday through Sunday, an average of 100 workers are present for 10 hours each day. This represents a total monthly workforce of approximately 13,616 worker-days per month based on a standard 8 hour work-day.

3.4 Flows

Data from the influent pump station flow meter collected between January 2011 and April 2013 were evaluated to estimate the existing flows to the lagoons. Because the flow meter measures both sanitary wastewater flow and supplemental water that is added in the collection system to maintain water in the lagoons, an average flow value was calculated for this time period using only the months when no supplemental water was added. This value was then used to represent the average sanitary monthly flow.

For months when supplemental water was added, the average sanitary monthly flow value was subtracted from the total value measured for that month, and the result was assumed to represent the volume of supplemental water added for that month. The results of this analysis are summarized as follows:

- Total flow
  - Average annual = 17,599,720 gallons per year
  - Average monthly = 1,354,445 gallons per month
- Sanitary flow
  - Average annual = 5,649,986 gallons per year
  - Average monthly = 469,280 gallons per month
- Supplemental water
  - Average annual = 11,949,733 gallons per year
  - Average monthly = 2,987,433 gallons per month (when supplementing)
  - Added in 2011 = 9,094,483 gallons (July through September)
  - Added in 2012 = 14,804,983 gallons (July through November)

These data are graphically presented in Figure 3-5.

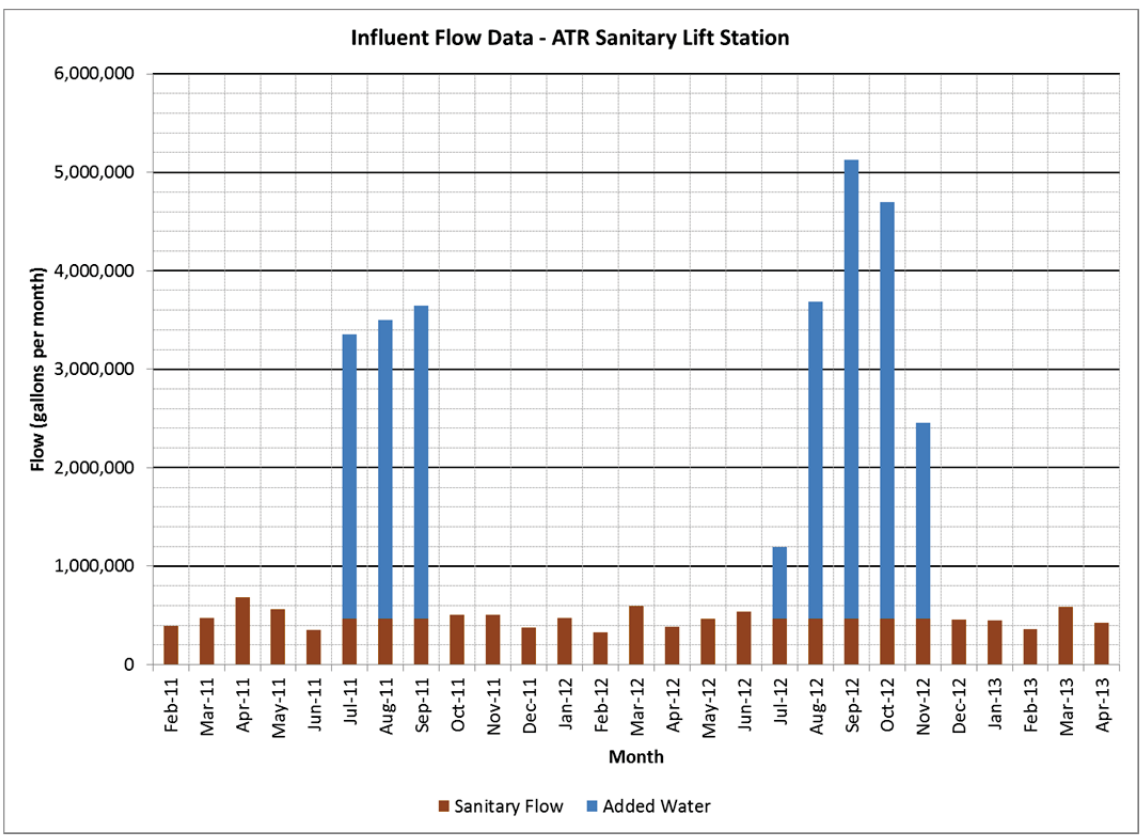


Figure 3-5. Influent flow data.

Based on the sanitary flow and the existing population, the average sanitary flow per worker based on a standard 8 hour workday is 34.5 gallons per worker-day. For comparison, according to Metcalf and Eddy's *Wastewater Engineering*, an "office" facility typically uses about 15 gallons per day per worker. BEA operators speculate that the higher flows at ATR may be a result of more frequent use of showers by the complex staff.

For 13,616 worker-days per month and 34.5 gallons per worker-day, the average daily sanitary flow is approximately 15,400 gallons per day.

3.5 Water Balance

A water balance spreadsheet model of the evaporative sewage lagoons was developed using the influent flow, evaporation, precipitation, and seepage data discussed earlier in this report. Modeling scenarios were developed for both "wet" year and "dry" year conditions using the 10-year high and 10-year low precipitation values, respectively.

The spreadsheet model was prepared assuming that flow will enter Cell #1 and then overflow into Cell #2 once the water level in Cell #1 rises to 8 feet. A two year cycle of the lagoon water levels was evaluated to show the water level fluctuation over the course of two water cycle seasons. For this analysis, a water cycle season was assumed to start on October 1 which is when the system would be at its lowest level in the annual cycle.

The month-to-month water balance for Cell #1 and Cell #2 based on the model for existing "wet" and "dry" year conditions is shown in Figure 3-6 below for the two year water cycle period. In this figure, an initial water depth of 4 feet was assumed for Cell #1 and an empty depth for Cell #2.

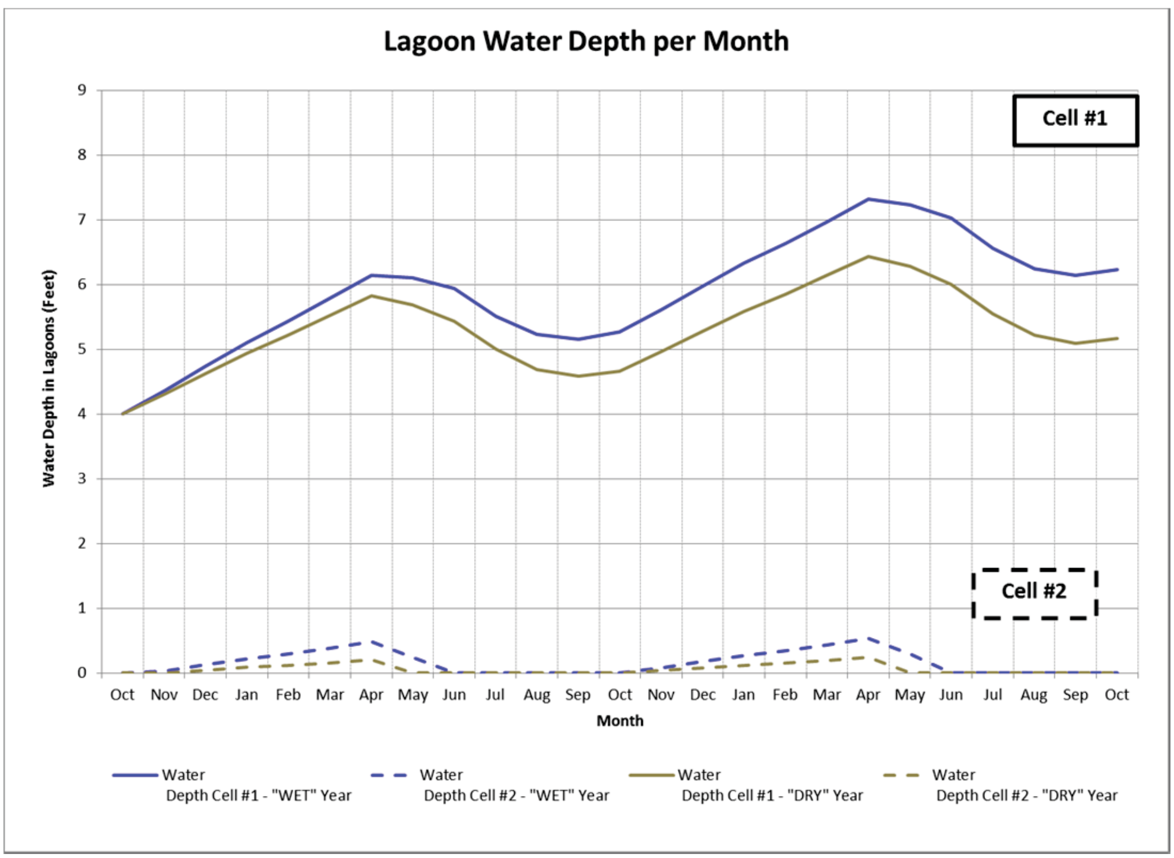


Figure 3-6. Water balance – existing conditions (with 4 foot initial Cell #1 depth).

In the above figure, the trendline of the water depth in Cell #1 is generally upward indicating that with the assumed seepage, evaporation, precipitation, and influent conditions, Cell #1 will fill over the course of multiple years until it overflows into Cell #2 during the spring and summer time periods until sufficient evaporation has occurred. This will occur even in “dry” year conditions.

To show a repeatable trend for a full water cycle year, the initial depth of Cell #1 was changed to the full depth of 8 feet, and the model was rerun. Figure 3-7 below shows the results.

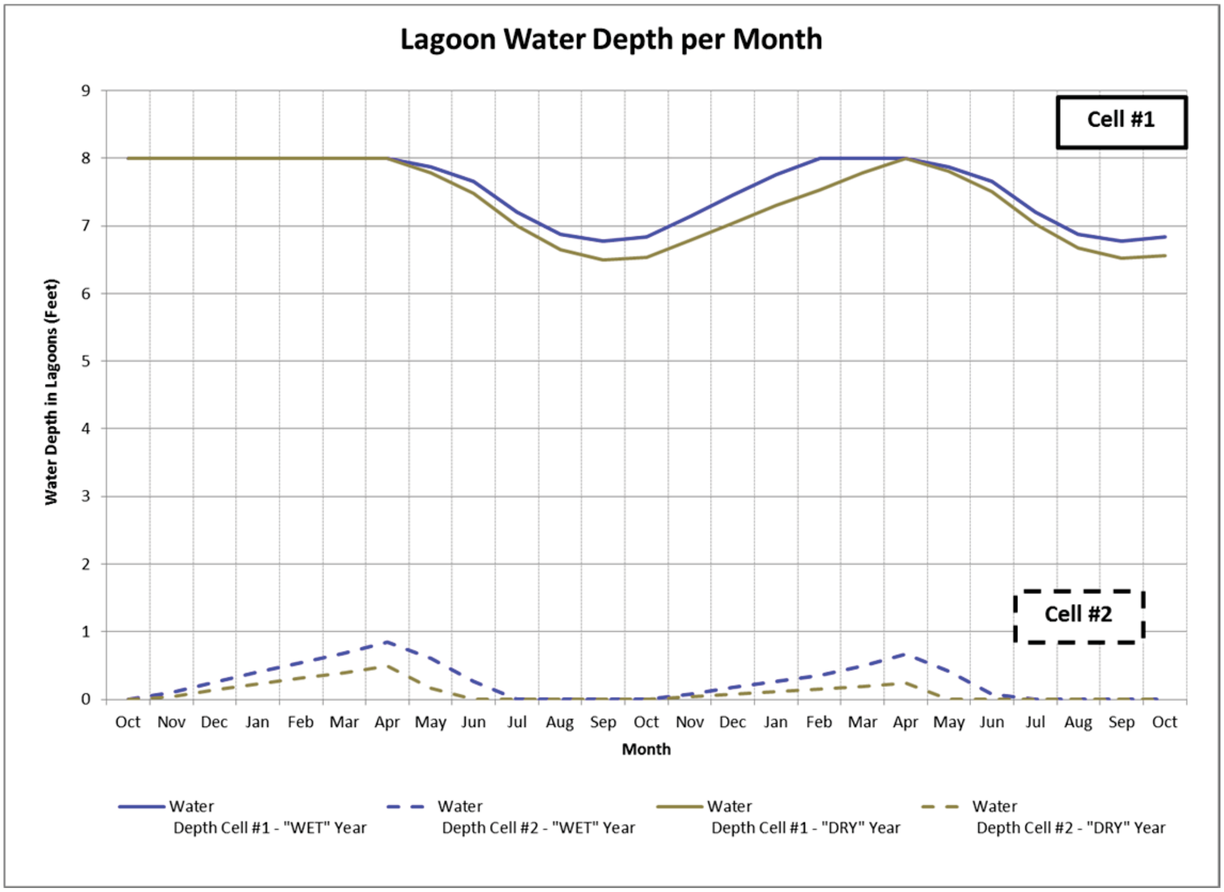


Figure 3-7. Water balance – existing conditions (with 8 foot initial Cell #1 depth).

The above figure shows that for “wet” year conditions, Cell #1 will be full and overflow into Cell #2 during the February to April timeframe. For “dry” year conditions, Cell #1fills in April and briefly overflows a small volume into Cell #2. This indicates that Cell #1 is slightly undersized to be able to accommodate the existing influent flows for the assumed conditions.

A cursory sensitivity analysis was performed to assess the impact of the assumed influent and seepage input values on this conclusion. First, the number of worker-days per month was increased by 25% from 13,616 to 17,020. An initial depth of 8 feet in Cell #1 was used to show a repeatable trend over the course of a full water cycle year. Figure 3-8 below shows the results.

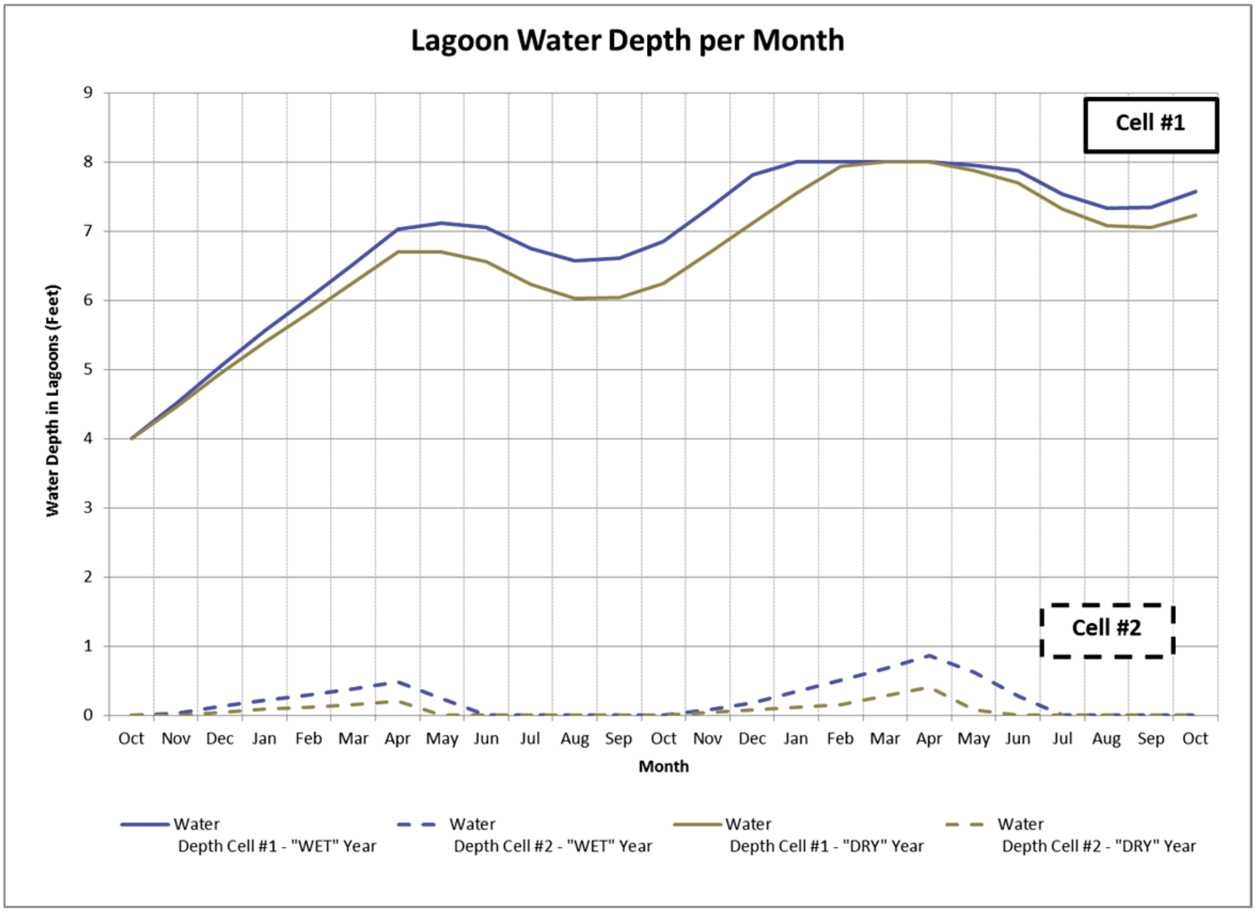


Figure 3-8. Water balance – existing conditions (25% increase in staffing).

The above figure shows that Cell #1 remains full and overflows into Cell #2 over a longer period of time throughout the year. The additional overflow increases the maximum depth in Cell #2 by less than 1 foot.

Next, using the originally assumed staffing level of 13,616 worker-days per month, the assumed Cell #1 seepage rate in the model was increased from the originally assumed value of 0.125 inches per day to determine the value that would balance the system:

- For "wet" year conditions: 0.168 inches per day
- For "dry" year conditions: 0.147 inches per day

This indicates that if the seepage rate in Cell #1 increases above these values, there would eventually be insufficient influent flow to keep water in Cell #1 throughout the entire year, and supplemental water would need to be added. It should be noted that these values are still significantly less than the maximum rate of 0.25 inches per day of seepage that would be required by DEQ to pass a seepage test. Figure 3-9 below shows the results using these assumed seepage rates.

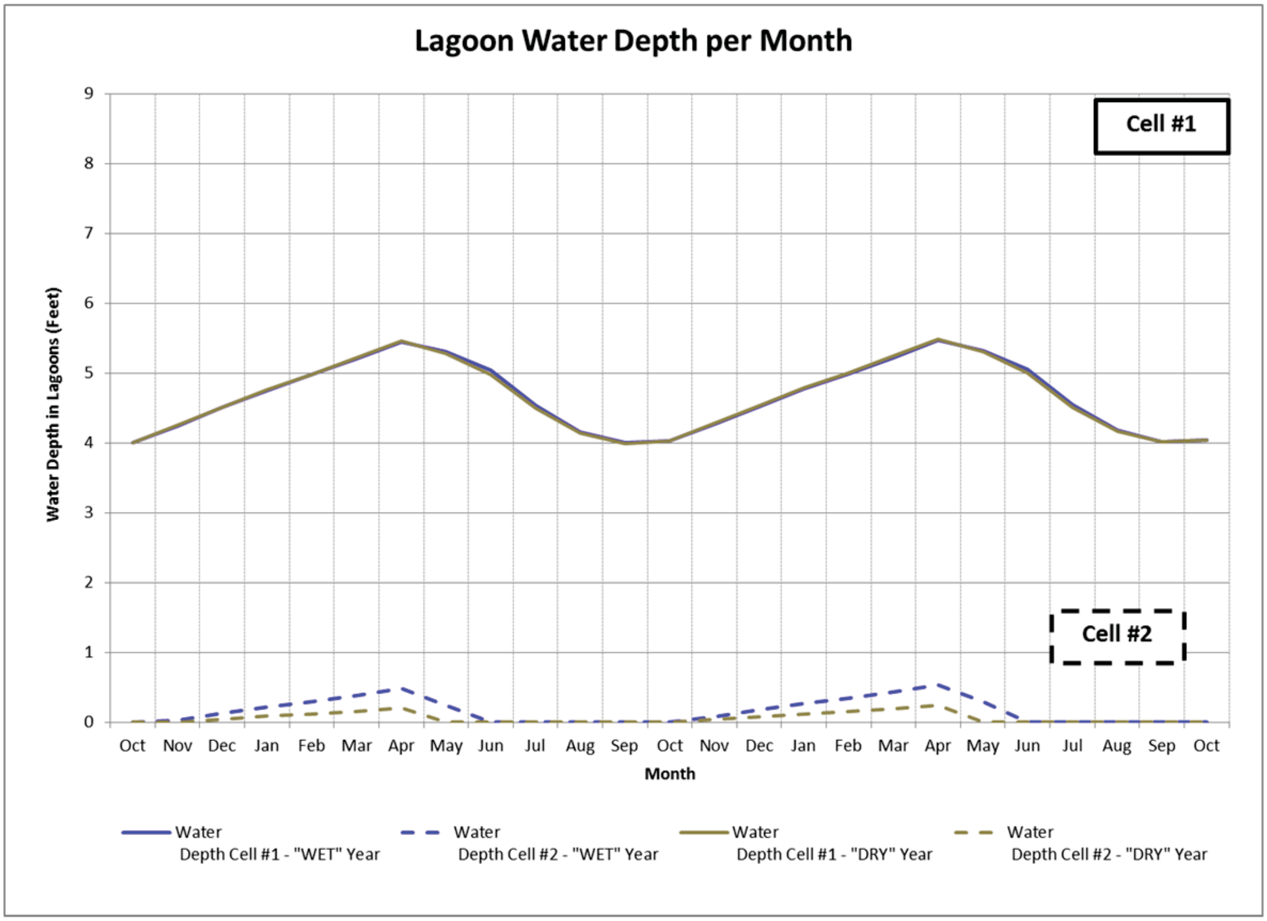


Figure 3-9. Water balance – existing conditions (increased seepage rates in Cell #1).

3.6 Needs and Deficiencies

The identified needs and deficiencies of the evaporative lagoon system are summarized below:

3.6.1 Addition of Supplemental Water

One of the primary concerns is the large volume of supplemental water that is added to the lagoon system each summer to maintain a minimum water level in both Cell #1 and Cell #2. Providing this volume of supplemental water requires significant infrastructure and energy resources and is conflict with the site's sustainability goals and objectives.

The existing clay liner in Cell #1 appears to be in acceptable condition based on the results of the 2010 seepage test. However, since the control of seepage relies on the integrity of its clay liner, a water cap must be maintained in the lagoon to keep it from drying out and cracking.

However, the control of seepage in Cell #2 relies on its PVC liner, which is not susceptible to drying out. Nevertheless, because the PVC liner material is not resistant to ultraviolet degradation, an earthen cover must be maintained over it. For this reason, 12 inches of clay soil material was originally installed over the liner. The integrity of this soil should be monitored for erosion or damage which could expose the underlying PVC liner. However, it should be noted that maintaining a permanent water cap in the lagoon is not needed as minor cracking of the clay material should not compromise its ability to adequately protect the underlying PVC liner from potential ultraviolet radiation damage.

3.6.2 Remaining Life of Cell #2 Liner

The existing buried PVC liner in Cell #2 also appears to be in acceptable condition based on the results of the 2010 seepage test. However, because it was installed approximately 15 years ago and the typical life of these types of liners is 20 to 30 years in a properly constructed, covered condition, sampling and testing of the liner was performed to help estimate the liner's condition and remaining life. This information will be important in making long-term decisions about the lagoon system and the timeframe and implementation of potential alternatives.

The sampling and testing completed are outlined below:

- Sampling was completed by BEA staff.
- Sample locations – At the two following locations, the soil cover over the PVC liner was removed above the maximum water level, and a sample was cut out and removed:
  - The northeast side of Cell #2
  - The southwest side of Cell #2
- Sample size – At each sampling location a small, less than 3 square foot sample was taken.
- Tests performed – The following tests were performed. For destructive tests, one test was performed in each perpendicular direction. For each sample location, 5 replicate tests were performed:
  - Thickness (ASTM D5199)
  - Tensile Properties (ASTM D882, 20 ppm ipm strain rate)
  - Tear Resistance (ASTM D1004)
  - Low Temperature Brittleness (ASTM D1790, -29°C)
  - Percent Plasticizer (ASTM D2124)
- Testing laboratory – The testing was completed by:
  - TRI Environmental, Inc., 9063 Bee Caves Rd., Austin , Texas 78733; (512) 263-2101

The summary test results are shown in Table 3-2 and the detailed test results are provided in Attachment C. In summary, although the original specification for the PVC liner was not available for review, the testing showed deterioration of the PVC liner compared to typical, as-manufactured values. For example, the tensile elongation testing showed a 30 to 60% reduction. This indicates a significant loss of ductility and flexibility and an increase in brittleness making the liner more susceptible to breakage from impacts or movement, particularly as may occur during freeze/thaw action during the winter. Also, the plasticizer content showed a reduction of approximately 40% which confirms aging of the PVC material.

In terms of remaining useful life, the test results are consistent with the expected degradation of a 15 year old, 30 mil PVC liner installed in a covered condition. The typical design life for these types of liner systems if properly constructed is 20 years, although some installations have seen a 30 year service life. For Cell #2, an increasing risk of liner failure should be expected if the system is operated beyond a 20 year life; therefore, replacement of the liner may be needed as soon as Year 2017. However, provided the lagoon continues to pass the periodic seepage testing and the liner continues to be adequately protected, another 10 to 20 years of remaining life may be availalbe.

Table 3-2. Existing liner test results.

Parameter	Avg. Test Result for Sample #1	Avg. Test Result for Sample #2	Typ. Value for New 30-mil PVC Liner
Thickness	25 mils	26 mils	28.5–31.5 mils
Strength at 100% Strain (Direction A)	81.0 ppi	81.5 ppi	32 ppi
Strength at 100% Strain (Direction B)	85.5 ppi	79.4 ppi	32 ppi
Break Strength (Direction A)	79.3 ppi	82.5 ppi	73 ppi
Break Strength (Direction B)	84.1 ppi	80.2 ppi	73 ppi
Break Elongation (Direction A)	137%	199%	380%
Break Elongation (Direction B)	154%	201%	380%
Tear Strength (Direction A)	21 lb	17 lb	8 lb
Tear Strength (Direction B)	20 lb	17 lb	8 lb
Low Temperature Brittleness (Direction A)	Fail	Fail	Pass
Low Temperature Brittleness (Direction B)	Fail	Fail	Pass
Percent Plasticizer	17.8%	19.2%	30–35%

3.6.3 Bottom Slope

The existing lagoons were constructed with flat bottoms. Typical standard of practice is to construct wastewater lagoons lined with an exposed geomembrane liner with a sloped bottom of approximately 2% and the low point at the middle of the lagoon. This will allow any gas that is trapped under the liner to migrate to the lagoon perimeter where it can escape without building up under the liner and damaging it. Gas can be generated by decomposing organic matter present in the native soils or from wastewater collecting under the liner from leaks.

When the lagoon liners are replaced in the future, reconstruction of the lagoon bottoms is recommended to provide the desired slope if the replacement liner system does not include a soil cover.

3.6.4 Fencing and Signage

The existing lagoons are not fenced or signed. The DEQ requirements for wastewater lagoons state:

> *Fencing. The pond area shall be enclosed with an adequate fence to prevent entering of livestock and discourage trespassing. This requirement does not apply to pond areas which store or impound Class A municipal reclaimed effluent. IDAPA 58.01.16.493.09.c.i*

> *Warning Signs. Appropriate permanent signs shall be provided along the fence around the pond to designate the nature of the facility and advise against trespassing. At least one (1) sign shall be provided on each side of the site and one (1) for every five hundred (500) feet of its perimeter. IDAPA 58.01.16.493.09.c.iii*

However, the IDAPA regulations also state the following:

> *These rules pertain to all new and existing municipal wastewater lagoons, including discharging or non-discharging lagoons, municipal wastewater treatment lagoons, municipal wastewater storage lagoons, and any other municipal wastewater lagoons that, if leaking, have the potential to degrade waters of the state. Lagoons are also sometimes referred to as ponds. Section 493*

> *does not apply to industrial lagoons or mining tailings ponds, single-family dwellings utilizing a single lagoon, two (2) cell infiltrative system, those animal waste lagoons excluded from review under Section 39-118, Idaho Code, or storm water ponds. IDAPA 58.01.16.493.01.a.*
>
> *Lagoons utilized for equalization, percolation, evaporation, and sludge storage do not have to meet the requirements set forth in Subsections 493.05 through 493.10, but must comply with all other applicable sub sections. IDAPA 58.01.16.493.01.b.*

Because the lagoons in this report are described as evaporative lagoons, IDAPA 58.01.16.493.09.c.i or iii should not be applicable. Also, the existing riprap around the lagoon perimeter should help minimize livestock or wildlife intrusion.

Nevertheless, if livestock or wildlife intrusion in the lagoons is regularly observed, the construction of a fence around the lagoon is recommended to help protect the integrity of the lagoon liners, especially as Cell #2 is often in an empty condition making it susceptible to damage from wildlife. In this case, the fence installation should also include warning signs per DEQ requirements.

3.6.5 Potential Health Hazards

One potential health hazard concern is blowing biosolids dust that could occur in windy conditions if a lagoon is left in an empty condition for an extended period time during hot, dry, summer weather. EPA provides guidance regarding the storage of biosolids which can be reviewed at the following link (see Chapter 5, Part III, in particular).

http://water.epa.gov/scitech/wastetech/biosolids/guide.cfm

Liquid biosolids typically form a crust as they dry which is resistant to wind erosion. Also, the remoteness of the lagoon site and the buffer that already exists between the lagoons and public access will further reduce the potential health risk from wind-blown, dried biosolids. During the initial period of operation in an empty condition, operators should check the lagoon for wind-blown dust during high wind events. If a problem regularly occurs, a tackifier can be sprayed on the surface, similar to what is used for dust control on large ground disturbing construction projects. Reapplication of the tackifier may be necessary each spring or if water is reintroduced to the lagoon.

4. ALTERNATIVES EVALUATION

4.1 Screening of Alternatives for Further Evaluation

To address the identified needs and deficiencies, a number of potential alternatives were developed for consideration and screening.

4.1.1 Do Nothing Alternative

Because of the addition of large volumes of supplemental water to both lagoon cells and conflict of this practice with the site's sustainability goals, the strict "Do Nothing" alternative of maintaining the status quo and current operational practices is not considered feasible, and this alternative was dropped from further consideration.

4.1.2 Replacement of Existing Lagoons

Because the existing lagoons still have significant life left in them and abandonment of the existing lagoons and construction of an entirely new lagoon system would be very costly, complete replacement of the existing lagoons is not consider feasible, and this alternatives was also dropped from further consideration.

4.1.3 Consideration of Short-Term and Long-Term Scenarios

The sensitivity of the water balance to the actual seepage rate in Cell #1 and the ongoing need to maintain a water cap in Cell #1 to protect the clay liner were noted and discussed earlier in this report. If the seepage rate in this cell increases above 0.147 inches per day, there will likely be years when supplemental water must be added to maintain the Cell #1 water cap in the late summer. However, until that happens, Cell #1 appears to be sized such that the addition of supplemental water should not be required most years.

For this reason, the recommended alternative for the short-term is to continue the use of the existing lagoons but stop the addition of supplemental water to maintain a water cap in Cell #2, which is not necessary due to the PVC liner. This alternative is further discussed in Section 4.2.

For the long-term, when supplemental water addition becomes necessary to maintain a water cap in Cell #1, reconstruction or reconfiguration of the existing lagoons should be considered. These alternatives are further discussed in Section 4.3.

4.2 Short-Term Alternative

As discussed earlier, the water balance model indicates that until the seepage rate in Cell #1 increases above 0.147 inches per day, the regular addition of supplemental water to maintain a water cap in this cell should not be necessary. During "wet" years or when influent flows are higher than normal, the water level in Cell #1 will increase until it overflows into Cell #2 which more than adequate capacity for accommodating anticipated flows.

When the seepage rate and/or influent flow decreases and it becomes apparent that the regular addition of supplemental water will be necessary, the implementation of one of the long-term alternatives discussed in Section 4.3 should be considered.

As part of implementing this short-term alternative, fencing and signage of the entire lagoon site should be addressed. Figure 4-1 below shows the overall site plan for the short-term alternative.

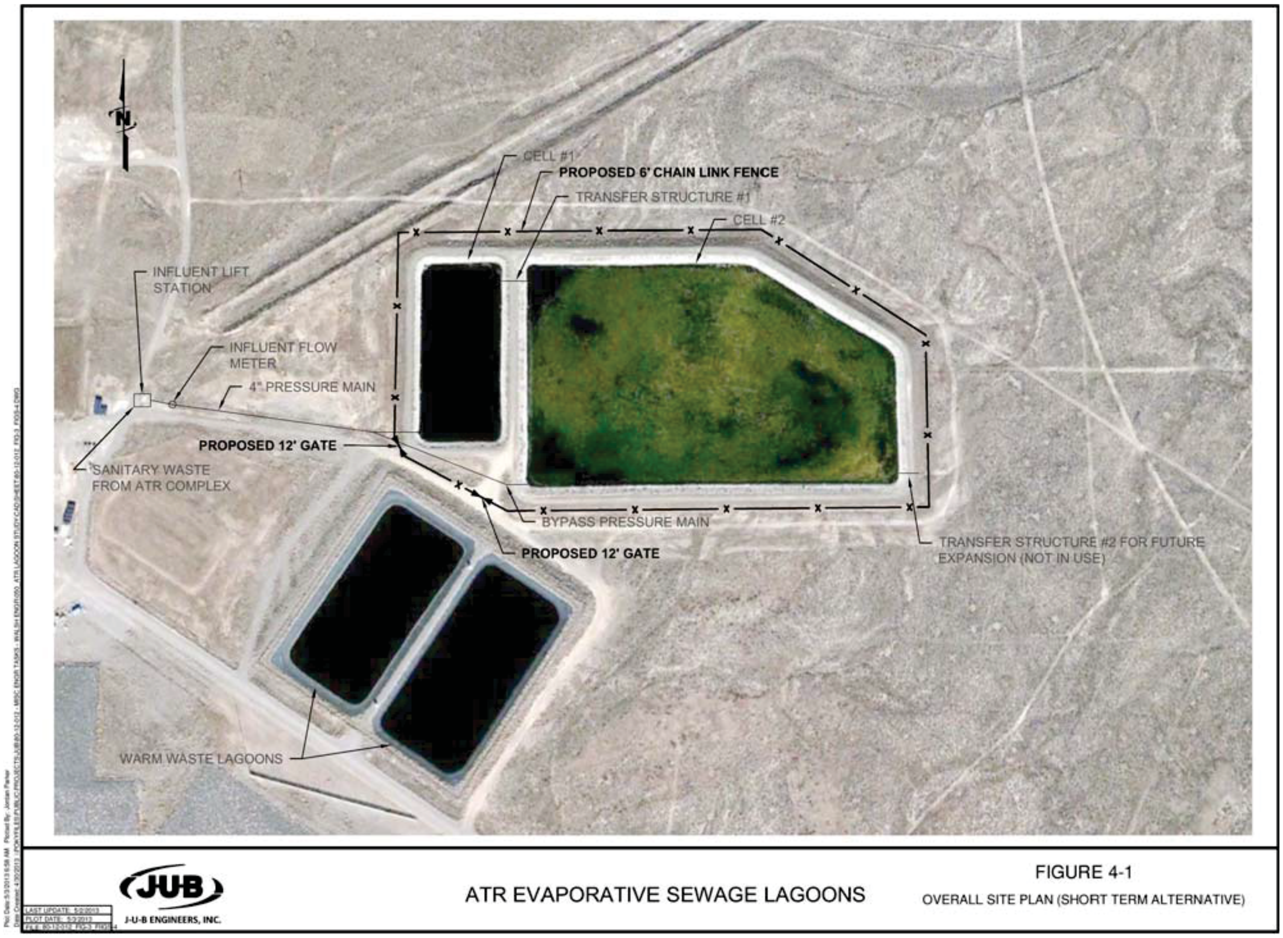


Figure 4-1. Overall site plan (short-term alternative).

4.3 Long-Term Alternatives

For the long-term when increasing seepage in Cell #1 triggers the need for regular addition of supplemental water or the Cell #2 liner has exceeded its life expectancy based on laboratory testing of the liner or either lagoon fails a seepage test, the two general alternatives available for consideration are either to abandon Cell #1 or to reconstruct Cell #1. There are other variations or combinations of these alternatives that could be considered at the time of project implementation, but these alternatives generally represent the two different approaches to addressing the situation. These alternatives, designated as LT-1 and LT-2, respectively, are further discussed in the following sections.

4.3.1 Alternative LT-1: Abandon Cell #1

If Cell #1 is abandoned, all of the influent flow will be diverted to Cell #2. The water balance model was used to verify that Cell #2 by itself is adequately sized for the anticipated flows as shown in Figure 4-2 below. A zero seepage rate was assumed to show the worst-case scenario.

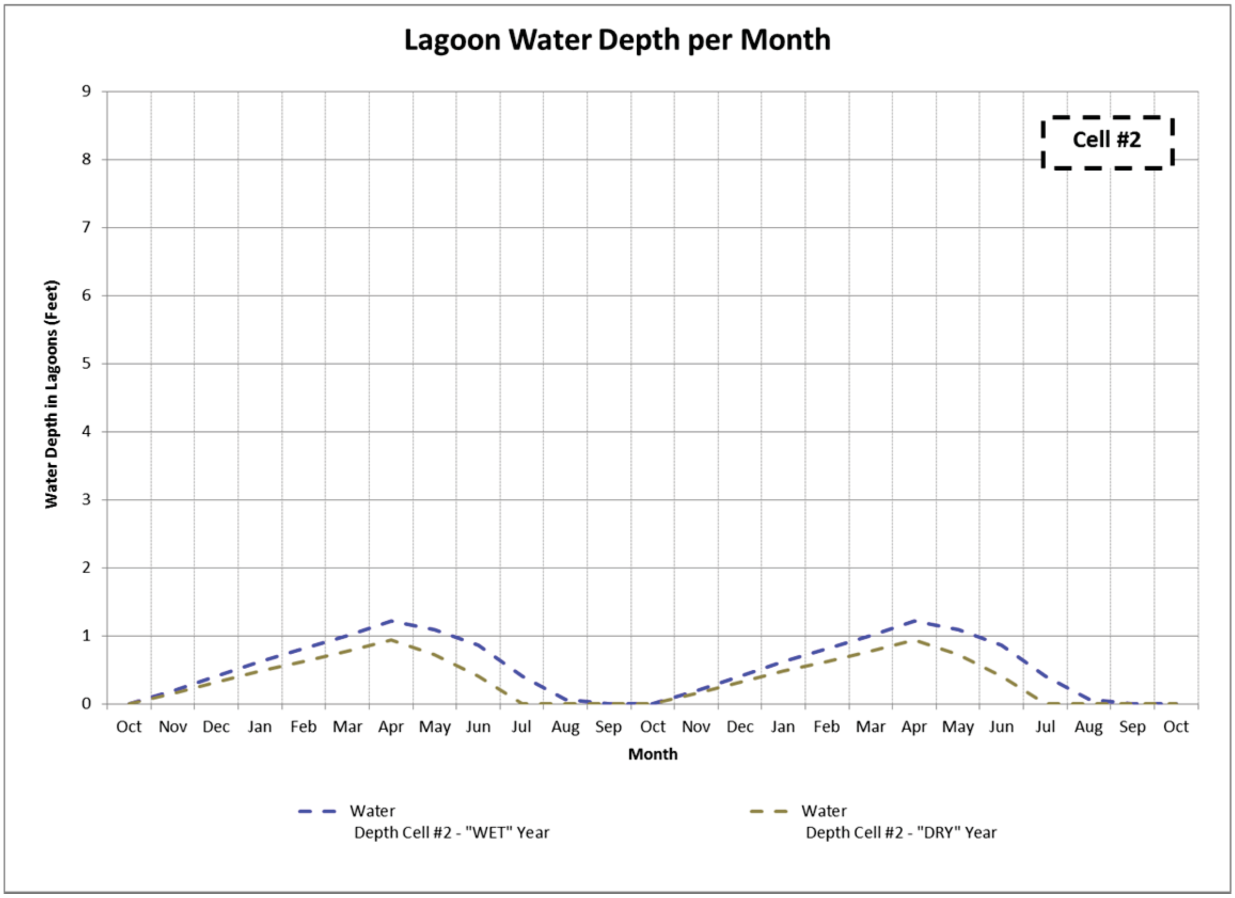


Figure 4-2. Water balance – Alternative LT-1).

As the figure shows, the water level in Cell #2 does not increase above approximately 1.5 feet indicating that the capacity in this cell is more than adequate for the anticipated flows. The figure shows that the lagoon will empty in the late summer or early fall timeframe depending on weather conditions.

DEQ requires at least two cells in operation (see IDAPA 58.01.16.493.08.a) for a wastewater lagoon system treating less than 50,000 gallons per day. This will allow one cell to be isolated for maintenance or seepage testing as necessary. It will also provide redundancy should failure of one cell occur. Therefore, if Cell #1 is abandoned, the following improvements to Cell #2 should be made:

- Remove and dispose of accumulated biosolids in accordance with a sludge management plan approved by the state and following EPA 40 CFR 503 rules. A CERCLA evaluation will likely be needed to assess whether disposal or land application can be used.
- Add a new interior dike to divide the lagoon into two cells, Cell #2A and Cell #2B.
- Construct a transfer structure in the new interior dike with a downward-opening weir to allow the transfer of flow between the two cells.
- Add piping to allow bypass of the new Cell #2A if necessary.
- Replace the liner system. Because of the age of the existing PVC liner and the impacts to the existing liner that the addition of a new interior dike will create, it is recommended that the entire liner system be replaced at that time.

- Reconfigure the lagoon bottom to provide a bottom slope. Replacing the entire liner system will require removal of settled solids and reconstruction of the lagoon bottom to provide a suitable base for the new liner. While these disturbances are occurring, it is recommended to reconfigure the bottom of the cells to provide adequate sloping to correct the deficiency discussed earlier.

For the purposes of this report, it was assumed that the new interior dike would be located to divide the lagoon in half. It was also assumed that the lagoon would be lined with a new high-density polyethylene (HDPE) liner system. Clay liner systems are still available, but meeting DEQ's requirements for a maximum design seepage rate of 500 gallons per day per acre is very difficult. (This is 8 times more stringent than DEQ's maximum operating design seepage rate of 3,400 gallons per day per acre (0.125 inches per day)). However, further evaluation at the time of project implementation is recommended to verify the most feasible and cost-effective configuration of the improvements.

Improvements to Cell #2 should be made before Cell #1 is abandoned and timed to occur when Cell #1 is at its lowest level. If Cell #1 becomes full during construction, provisions should be in place to be pumping and transferring excess wastewater to the CFA wastewater facility for disposal.

If Cell #1 is abandoned and the lagoon is considered to be subject to all the requirements of IDAPA 58.01.16.493, a closure plan will be required. However, as noted in Section 3.6.4 of this report, this regulation will likely not apply to these "evaporative" lagoons. Figure 4-3 below shows the overall site plan for Alternative LT-1.

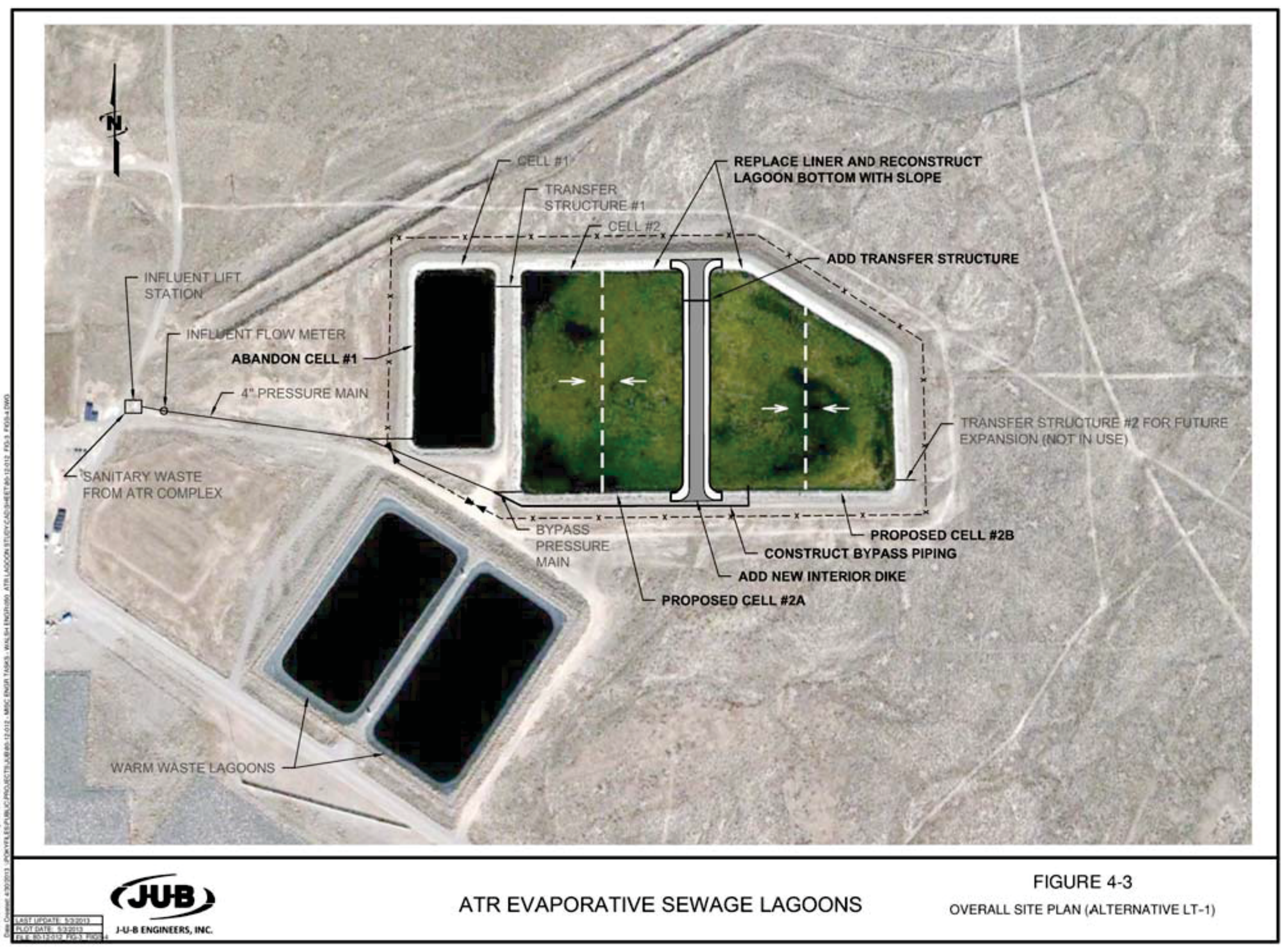


Figure 4-3. Overall site plan (Alternative LT-1).

4.3.2 Alternative LT-2: Reconstruct Cell #1

For this alternative, Cell #1 would be reconstructed, and Cell #2 would continue to be used in its current condition. The capacity of the system would remain unchanged which was confirmed to be adequate by the water balance model presented earlier for the existing conditions. For this alternative, the following improvements to Cell #1 should be made:

- Remove and dispose of accumulated biosolids in accordance with a sludge management plan approved by the state and following EPA 40 CFR 503 rules. A CERCLA evaluation will likely be needed to assess whether disposal or land application can be used.
- Replace the liner system.
- Reconfigure the lagoon bottom to provide a bottom slope. Replacing the entire liner system will require removal of settled solids and reconstruction of the lagoon bottom to provide a suitable base for the new liner. While these disturbances are occurring, it is recommended to reconfigure the bottom of the cells to provide adequate sloping to correct the deficiency discussed earlier.

For the purposes of this report, it was assumed that the lagoon would be lined with a new high-density polyethylene (HDPE) liner system. However, further evaluation at the time of project implementation is recommended to verify the most feasible and cost-effective configuration of the improvements. Figure 4-4 below shows the overall site plan for Alternative LT-2.

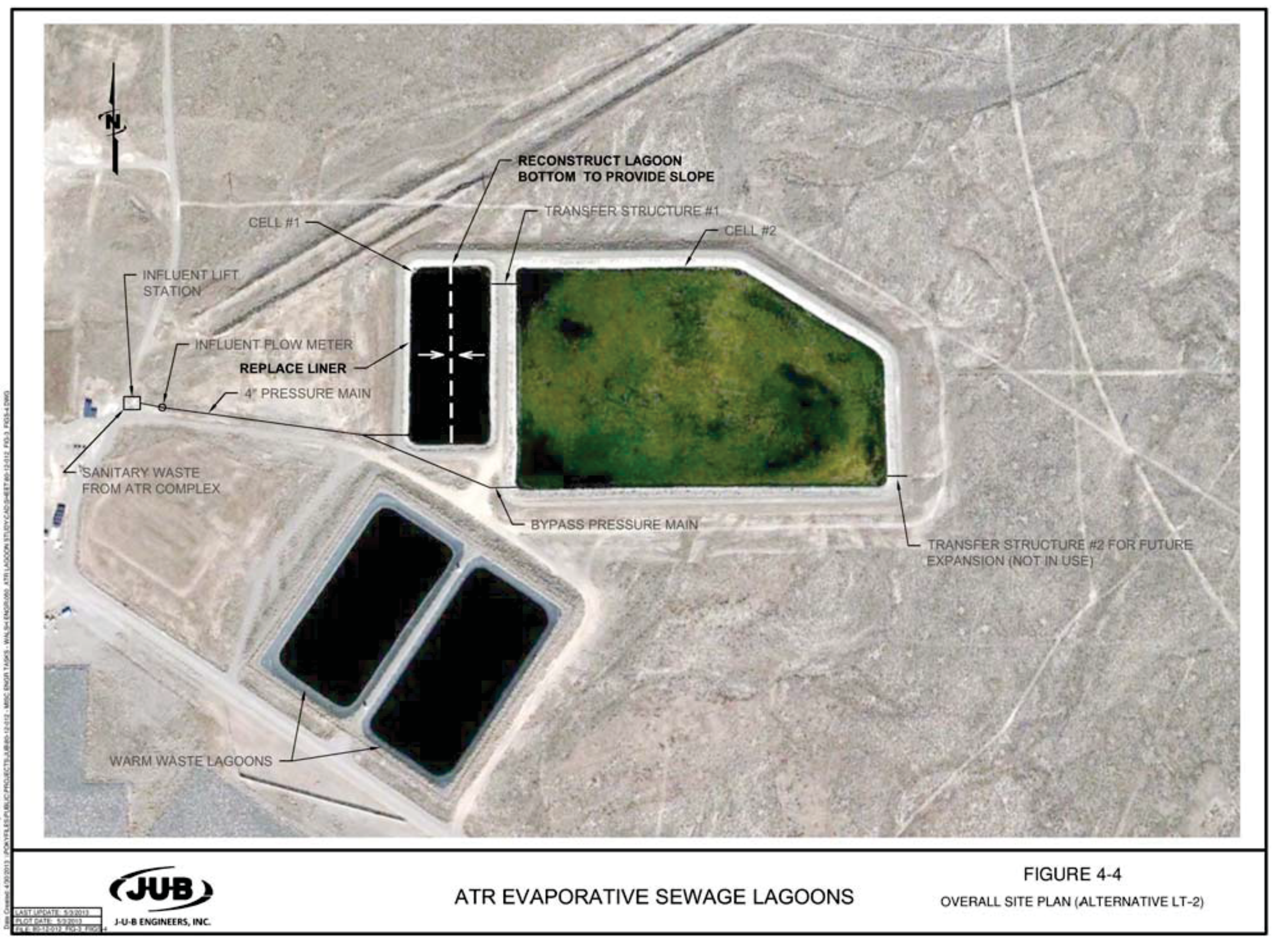


Figure 4-4. Overall site plan (Alternative LT-2).

4.4 Selection of Preferred Long-Term Alternative

4.4.1 Engineer's Opinions of Probable Cost

Cost is an important consideration in the comparison of alternatives and selection of a preferred alternative for implementation. When implementation of a long-term alternative is required, engineer's opinions of probable cost will be prepared for comparison.

4.4.2 Comparison of Alternatives

When implementation of a long-term alternative is required, a detailed comparison of the two alternatives should be undertaken. The comparison should consider the fact that that with Alternative LT-2, the use of Cell #2 will continue in its current condition. At some point, the existing PVC liner will reach the end of its life and require replacement. This future cost should be considered in a life cycle cost comparison.

Other criteria such as regulatory requirements, schedule, implementability, operation and maintenance requirements, and day-to-day reliability should also be considered to select the preferred alternative.

5. IMPLEMENTATION OF PREFERRED ALTERNATIVE

5.1 Regulatory Requirements

To implement the short-term alternative, there are no known additional DEQ regulatory requirements as the construction of a fence and/or signage would not be considered a "material modification" as defined below:

> *Material modifications are those that are intended to increase system capacity or to alter the methods or processes employed. Any project that increases the pumping capacity of a system, increases the potential population served by the system or the number of service connections within the system, adds new or alters existing wastewater system components, or affects the wastewater flow of the system is considered to be increasing system capacity or altering the methods or processes employed. Maintenance and repair performed on the system and the replacement valves, pumps, or other similar items with new items of the same size and type are not considered a material modification.* IDAPA 58.01.16.010

The implementation of the long-term alternative will constitute a "material modification" to the facility and trigger a number of required submittals to DEQ for review and approval (see IDAPA 58.01.16.410 through 425):

- A facility planning study.
- A preliminary engineering report (with prior DEQ concurrence, this report may be incorporated into the facility planning study to satisfy this requirement).
- Construction drawings and specifications.
- Record drawings and specifications
- Operation and maintenance manual

Ongoing regulatory EPA/DEQ requirements will be similar to those required for the existing facility. The facility will continue to operate as a "total containment" system with no discharge; thus, a National Pollutant Discharge Elimination System permit for discharge to surface water or a wastewater reuse permit for discharge to land application will not be required.

Windblown dirt and settled solids from the wastewater will accumulate in the bottom of the lagoons. If solids accumulate in the lagoons to the point where they are using up excessive volume, they should be removed. The removed solids can be land applied with permitting through DEQ.

Periodic seepage testing will continue to be needed in accordance with DEQ requirements as required by IDAPA 58.01.16.493.02. Every 10 years, the seepage testing must be repeated.

If an existing lagoon is abandoned, it must be abandoned in accordance with a DEQ approved closure plan meeting the requirements of IDAPA 58.01.16.493.10. Abandonment would include removal and proper disposal of accumulated solids, the embankment liner, piping, and structures and smooth grading of the site.

5.2 Summary of Implementation Steps

Implementation of the preferred alternative should include the following general steps:

1. Continue seepage rate testing of Cells #1 and #2 to comply with DEQ requirements. Note any trends that show an increasing seepage rate that may indicate a failing liner.

2. Continue monitoring and tracking flows at the influent pump station flow meter. Note any trends that show increasing sanitary wastewater flow that may require additional capacity in the evaporative lagoon system.
3. Continue monitoring and tracking the addition of any supplemental water required to maintain a water cap in Cell #1. Note any trends that show an increasing seepage rate that may indicate a failing liner.
4. Continue monitoring and tracking water level fluctuations throughout the year in Cells #1 and #2. Note any trends that show an increasing seepage rate that may indicate a failing liner or increasing sanitary wastewater flow that may require additional capacity in the evaporative lagoon system.
5. When conditions are apparent that show that regular addition of supplemental water will be required in the near future, secure funding to implement the preferred long-term alternative.
6. Initiate engineering tasks to prepare the documentation discussed in Section 5.1 to satisfy DEQ requirements and to enable procurement of a contractor for construction of the necessary improvements.
7. Construct the necessary improvements.
8. Prepare record drawings and update the operation and maintenance manual.
9. Close-out the project.

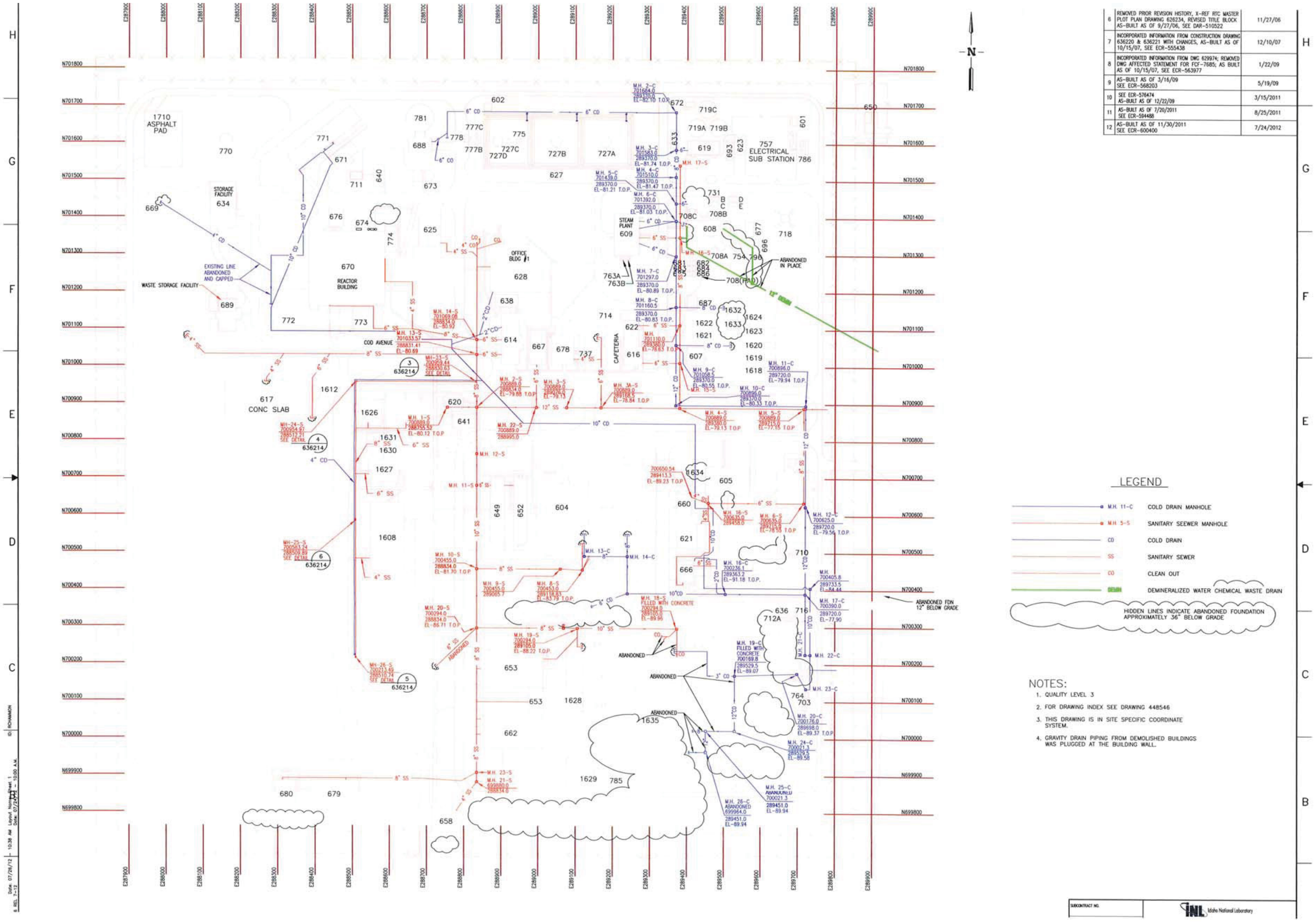
6. ATTACHMENTS

The following items are attached to this report:

- Attachment A, Record Drawings for the ATR Sanitary Wastewater Lagoons
- Attachment B, 2010 Seepage Test Results
- Attachment C, 2013 PVC Liner Test Results

Attachment A

Record Drawings for the ATR Sanitary Wastewater Lagoons

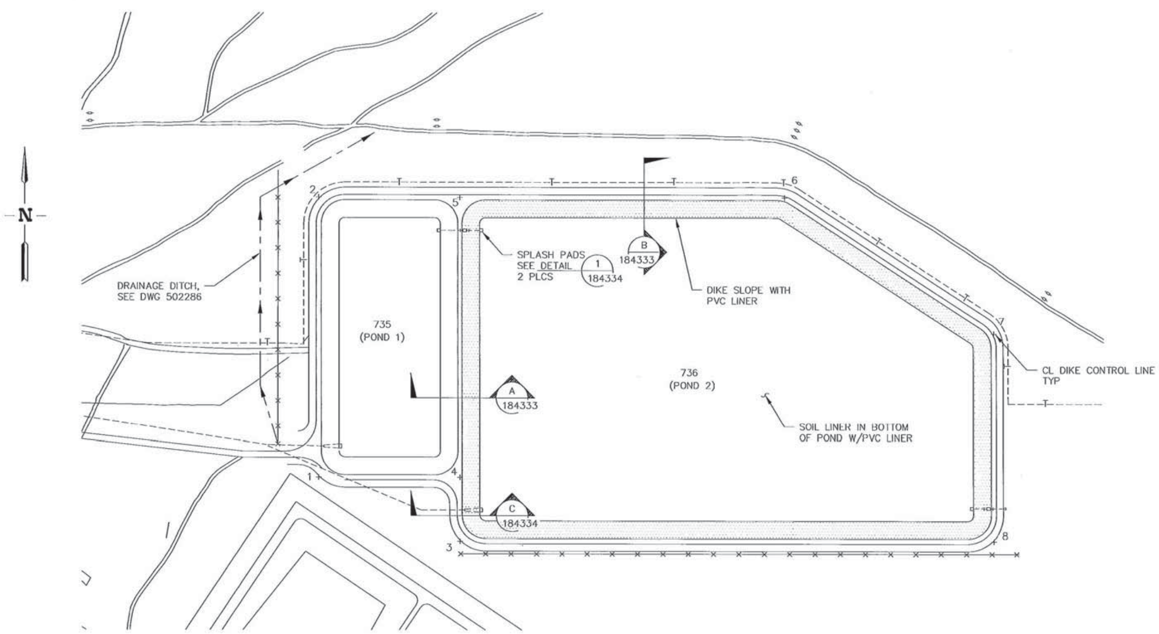


6 REMOVED PRIOR REVISION HISTORY, X-REF RTC MASTER PLOT PLAN DRAWING 626234, REVISED TITLE BLOCK AS-BUILT AS OF 9/27/06, SEE DAR-510522 11/27/06
7 INCORPORATED INFORMATION FROM CONSTRUCTION DRAWING 636220 & 636221 WITH CHANGES, AS-BUILT AS OF 10/15/07, SEE ECR-555438 12/10/07
8 INCORPORATED INFORMATION FROM DWG 629974; REMOVED DWG AFFECTED STATEMENT FOR FCF-7685, AS BUILT AS OF 10/15/07, SEE ECR-563977 1/22/09
9 AS-BUILT AS OF 3/16/09 SEE ECR-568203 5/19/09
10 SEE ECR-578474 AS-BUILT AS OF 12/22/09 3/15/2011
11 AS-BUILT AS OF 7/20/2011 SEE ECR-594488 8/25/2011
12 AS-BUILT AS OF 11/30/2011 SEE ECR-600400 7/24/2012
LEGEND
M.H. 11-C COLD DRAIN MANHOLE
M.H. 5-S SANITARY SEEWER MANHOLE
CD COLD DRAIN
SS SANITARY SEWER
CO CLEAN OUT
DEMINERALIZED WATER CHEMICAL WASTE DRAIN
HIDDEN LINES INDICATE ABANDONED FOUNDATION APPROXIMATELY 36" BELOW GRADE
NOTES:
1. QUALITY LEVEL 3
2. FOR DRAWING INDEX SEE DRAWING 448546
3. THIS DRAWING IS IN SITE SPECIFIC COORDINATE SYSTEM.
4. GRAVITY DRAIN PIPING FROM DEMOLISHED BUILDINGS WAS PLUGGED AT THE BUILDING WALL.
ABANDONED FDN 12" BELOW GRADE
1710 ASPHALT PAD
757 ELECTRICAL SUB STATION 786
STORAGE FACILITY 634
REACTOR BUILDING
STEAM PLANT
OFFICE BLDG #1
CAFETERIA
COD AVENUE
617 CONC SLAB
WASTE STORAGE FACILITY
EXISTING LINE ABANDONED AND CAPPED
ABANDONED IN PLACE
SUBCONTRACT NO.
INL Idaho National Laboratory

NOTE

1. THIS DWG TO BE WORKED WITH DWG 178535, 178536, 178537, & 178542.

REVISIONS		
REV	DESCRIPTION	EFFECTIVE DATE:
1	AS-BUILT, SEE DAR #11101	11-10-97
2	ADDED NOTE 1. AS-BUILT AS OF 8/23/01. SEE DAR 85273.	10/2/01



COORDINATE TABLE		
NO.	NORTHING	EASTING
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3	700,714.50	291,255.50
4	700,839.50	291,255.50
5	701,389.50	291,255.50
6	701,389.50	291,896.30
7	701,122.51	292,309.50
8	700,714.50	292,309.50

PARTIAL AREA PLAN

REVISION 0 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY ROBERT SCHATTIN, PROFESSIONAL ENGINEER NO. 7996, ON 6/16/97 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.

REVISION 0 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY CLINTON O. KINGSFORD, PROFESSIONAL ENGINEER NO. 2104, ON 6/13/97 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.

SUBCONTRACT NO. S97-020855
REQUESTOR: ML RUCKER
DESIGN: CO KINGSFORD
DRAWN: Gene K Mace
PROJECT NO. 020855
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. 7387
EFFECTIVE DATE: 6/18/97

LOCKHEED MARTIN

TRA
TRA STP LINER REPAIR
PARTIAL AREA PLAN

SIZE D | CAGE CODE 01MF3 | INDEX CODE NUMBER: AREA 530, TYPE 0736, CL 02, ORIG 530 | DWG-184332 | REV 2
SCALE: 1"=100.0' | SHEET 1 OF 1

ADOCS NO.

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Date: 09/10/01 - 5:08 P.M. | ID: OLDHINS
184332-2.dwg
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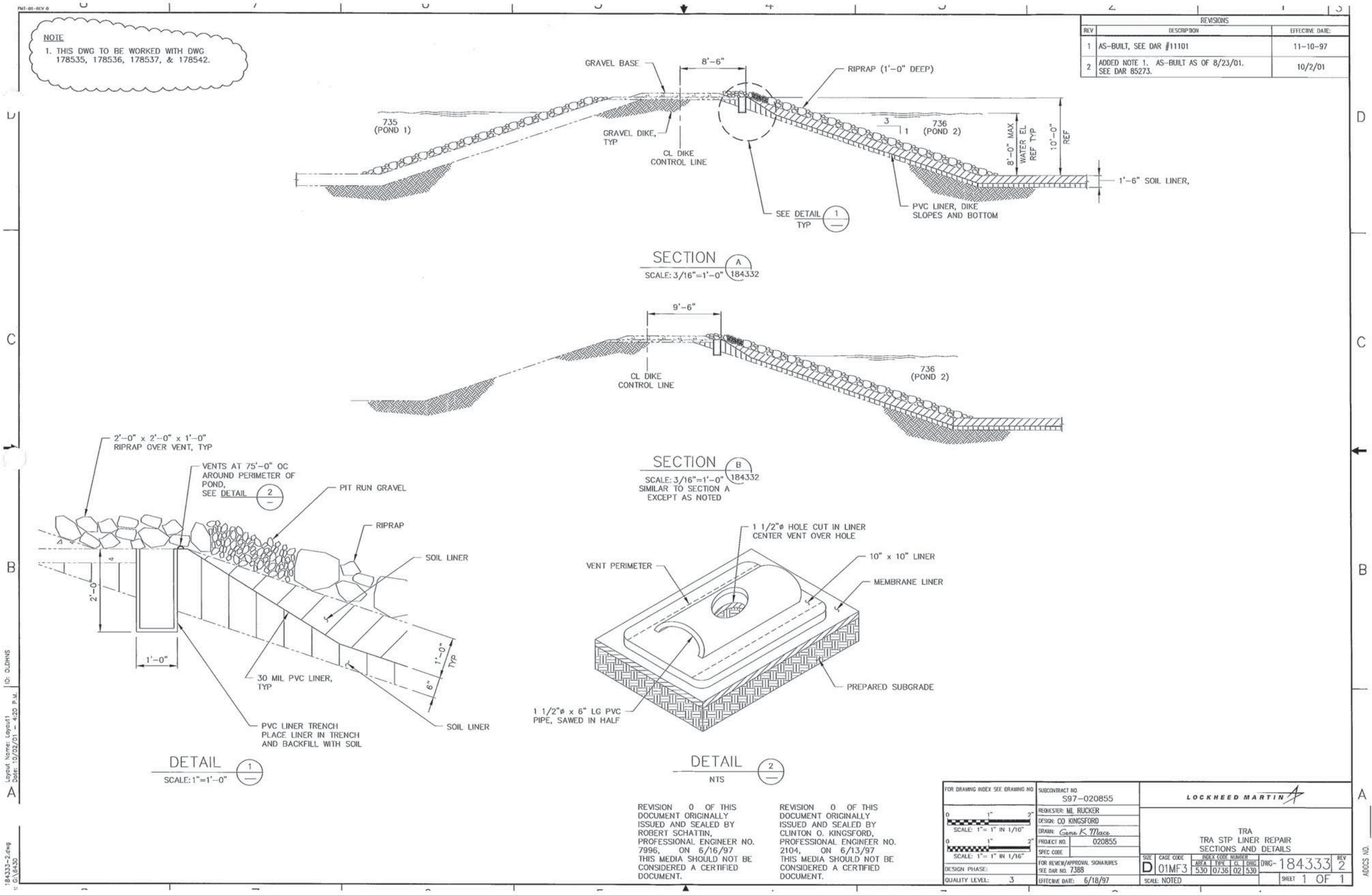
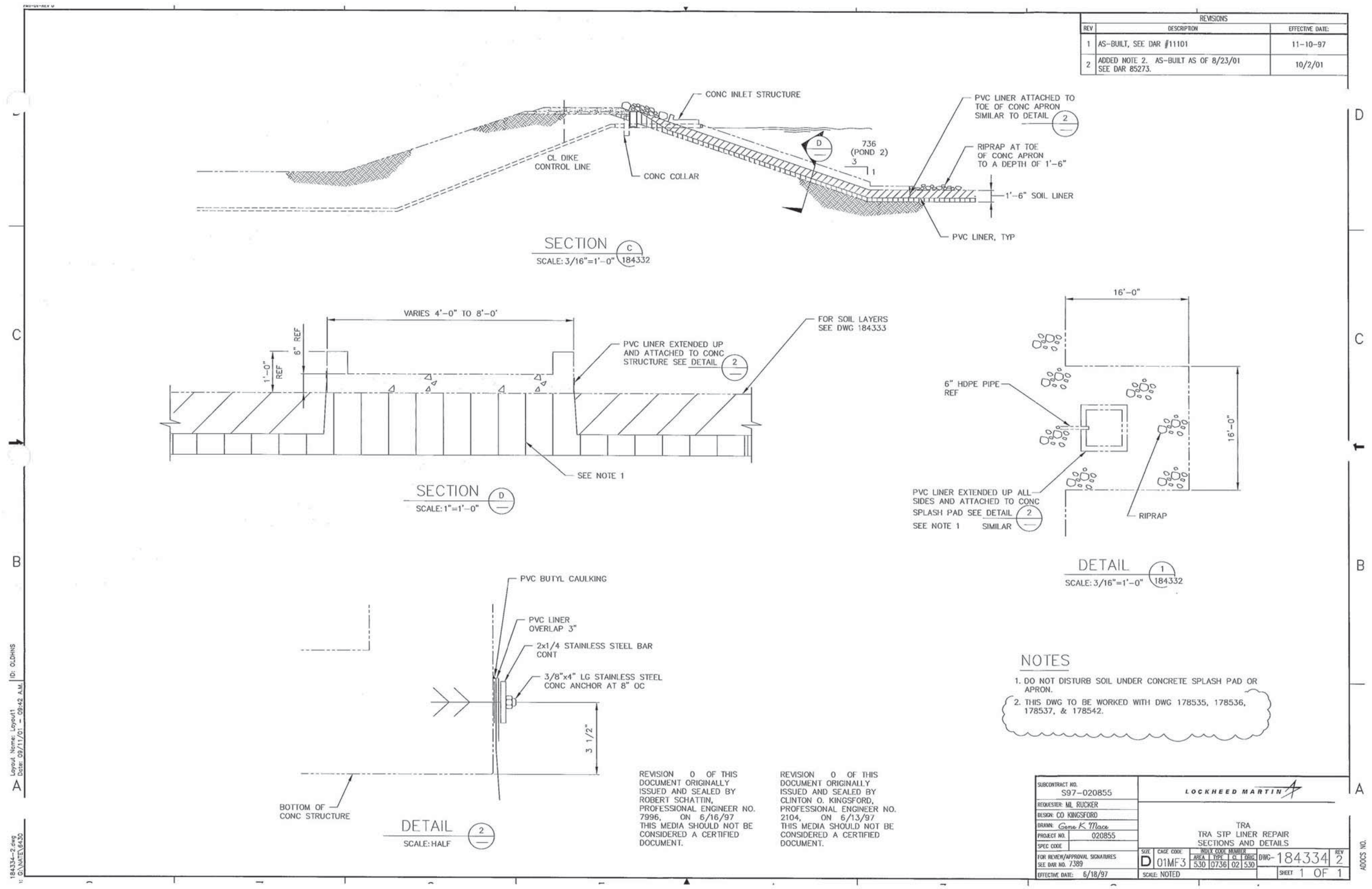
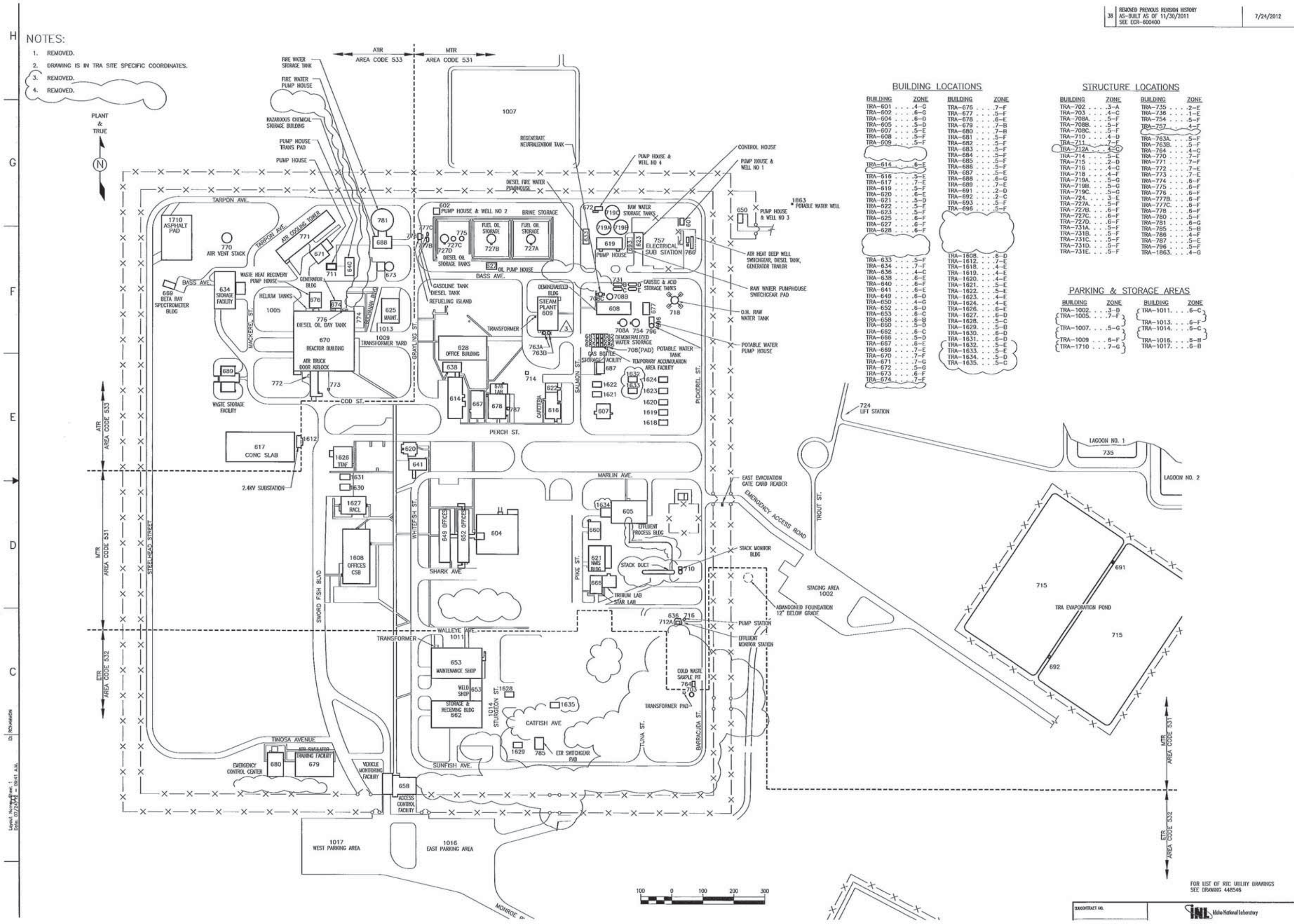
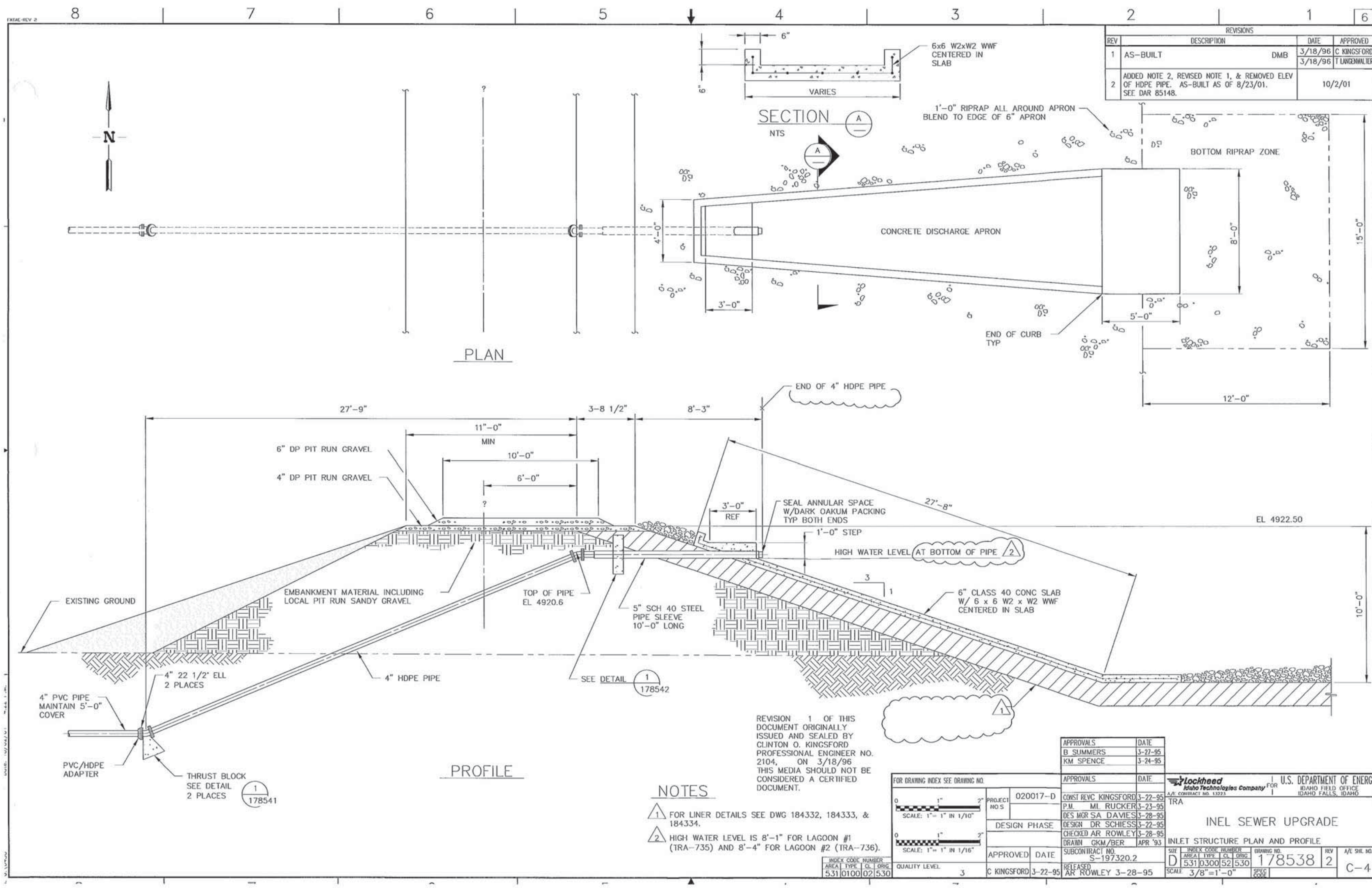
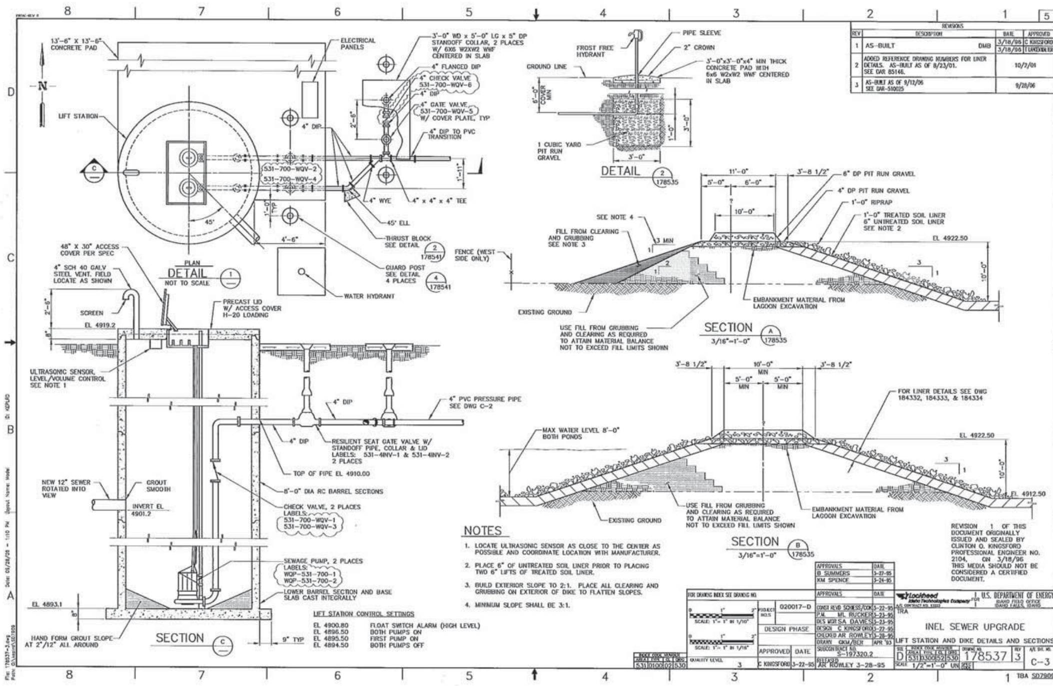

NOTE
1. THIS DWG TO BE WORKED WITH DWG 178535, 178536, 178537, & 178542.
REVISIONS
REV | DESCRIPTION | EFFECTIVE DATE
1 AS-BUILT, SEE DAR #11101 11-10-97
2 ADDED NOTE 1. AS-BUILT AS OF 8/23/01. SEE DAR 85273. 10/2/01
GRAVEL BASE
8'-6"
RIPRAP (1'-0" DEEP)
735 (POND 1)
GRAVEL DIKE, TYP
CL DIKE CONTROL LINE
736 (POND 2)
8'-0" MAX
WATER EL REF TYP
10'-0" REF
1'-6" SOIL LINER,
SEE DETAIL 1 TYP
PVC LINER, DIKE SLOPES AND BOTTOM
SECTION A 184332
SCALE: 3/16"=1'-0"
9'-6"
CL DIKE CONTROL LINE
736 (POND 2)
SECTION B 184332
SCALE: 3/16"=1'-0"
SIMILAR TO SECTION A EXCEPT AS NOTED
2'-0" x 2'-0" x 1'-0" RIPRAP OVER VENT, TYP
VENTS AT 75'-0" OC AROUND PERIMETER OF POND, SEE DETAIL 2
PIT RUN GRAVEL
RIPRAP
SOIL LINER
2'-0"
1'-0"
30 MIL PVC LINER, TYP
1'-0" TYP
8"
SOIL LINER
PVC LINER TRENCH PLACE LINER IN TRENCH AND BACKFILL WITH SOIL
DETAIL 1
SCALE: 1"=1'-0"
1 1/2"ø HOLE CUT IN LINER CENTER VENT OVER HOLE
VENT PERIMETER
10" x 10" LINER
MEMBRANE LINER
PREPARED SUBGRADE
1 1/2"ø x 6" LG PVC PIPE, SAWED IN HALF
DETAIL 2
NTS
REVISION 0 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY ROBERT SCHATTIN, PROFESSIONAL ENGINEER NO. 7996, ON 6/16/97 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
REVISION 0 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY CLINTON O. KINGSFORD, PROFESSIONAL ENGINEER NO. 2104, ON 6/13/97 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
SUBCONTRACT NO S97-020855
REQUESTER: ML RUCKER
DESIGN: CO KINGSFORD
DRAWN: Gene K Mace
PROJECT NO. 020855
SCALE: 1"= 1" IN 1/10"
SCALE: 1"= 1" IN 1/16"
DESIGN PHASE:
QUALITY LEVEL: 3
SEE DAR NO. 7388
EFFECTIVE DATE: 6/18/97
LOCKHEED MARTIN
TRA
TRA STP LINER REPAIR
SECTIONS AND DETAILS
SIZE D
CAGE CODE 01MF3
INDEX CODE NUMBER 530 07.36 02 530
DWG- 184333
REV 2
SCALE NOTED
SHEET 1 OF 1
ADDCS NO.
Layout Name: Layout1
Date: 10/02/01 - 4:20 P.M.
ID: DLDHNS
184333-2.dwg

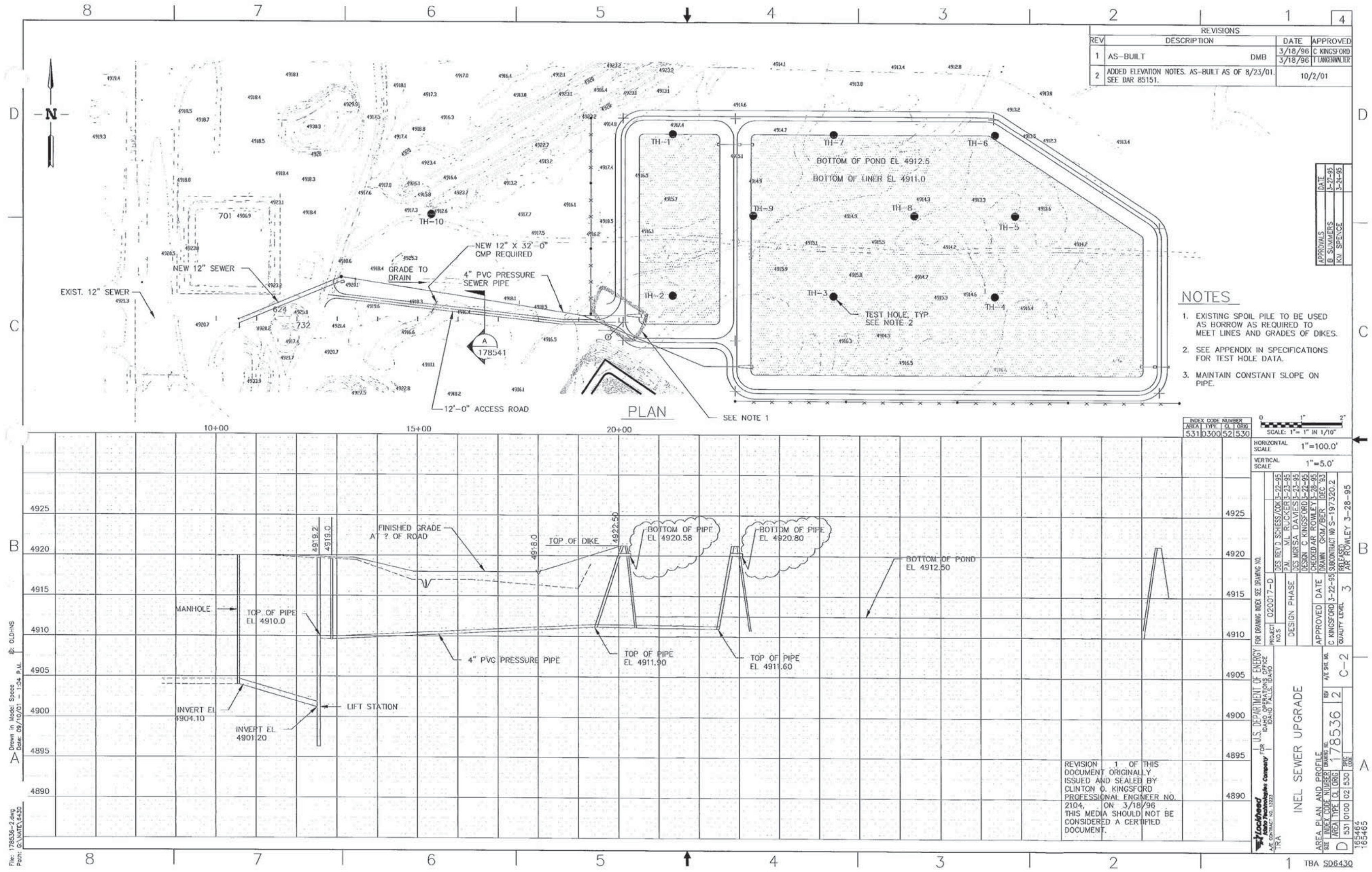

REVISIONS
REV | DESCRIPTION | EFFECTIVE DATE
1 | AS-BUILT, SEE DAR #11101 | 11-10-97
2 | ADDED NOTE 2. AS-BUILT AS OF 8/23/01 SEE DAR 85273. | 10/2/01
CONC INLET STRUCTURE
PVC LINER ATTACHED TO TOE OF CONC APRON SIMILAR TO DETAIL 2
RIPRAP AT TOE OF CONC APRON TO A DEPTH OF 1'-6"
736 (POND 2)
CL DIKE CONTROL LINE
CONC COLLAR
1'-6" SOIL LINER
PVC LINER, TYP
SECTION C 184332
SCALE: 3/16"=1'-0"
VARIES 4'-0" TO 8'-0"
1'-0" REF
6" REF
PVC LINER EXTENDED UP AND ATTACHED TO CONC STRUCTURE SEE DETAIL 2
FOR SOIL LAYERS SEE DWG 184333
SEE NOTE 1
SECTION D
SCALE: 1"=1'-0"
16'-0"
6" HDPE PIPE REF
PVC LINER EXTENDED UP ALL SIDES AND ATTACHED TO CONC SPLASH PAD SEE DETAIL 2 SIMILAR
SEE NOTE 1
RIPRAP
DETAIL 1 184332
SCALE: 3/16"=1'-0"
PVC BUTYL CAULKING
PVC LINER OVERLAP 3"
2x1/4 STAINLESS STEEL BAR CONT
3/8"x4" LG STAINLESS STEEL CONC ANCHOR AT 8" OC
3 1/2"
BOTTOM OF CONC STRUCTURE
DETAIL 2
SCALE: HALF
REVISION 0 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY ROBERT SCHATTIN, PROFESSIONAL ENGINEER NO. 7996, ON 6/16/97 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
REVISION 0 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY CLINTON O. KINGSFORD, PROFESSIONAL ENGINEER NO. 2104, ON 6/13/97 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
NOTES
1. DO NOT DISTURB SOIL UNDER CONCRETE SPLASH PAD OR APRON.
2. THIS DWG TO BE WORKED WITH DWG 178535, 178536, 178537, & 178542.
SUBCONTRACT NO. S97-020855
REQUESTER: ML RUCKER
DESIGN: CO KINGSFORD
DRAWN: Gene K Mace
PROJECT NO. 020855
SPEC CODE
FOR REVIEW/APPROVAL SIGNATURES SEE DAR NO. 7389
EFFECTIVE DATE: 6/18/97
LOCKHEED MARTIN
TRA
TRA STP LINER REPAIR
SECTIONS AND DETAILS
SIZE D
CAGE CODE 01MF3
AREA 530 TYPE 0736 CL 02 ORIG 530
DWG- 184334
REV 2
SCALE: NOTED
SHEET 1 OF 1
ADOCS NO.
Layout Name: Layout1
Date: 09/11/01 - 09:42 A.M.
ID: OLDHHS
184334-2.dwg
G:\NATE\6430


NOTES:
1. REMOVED.
2. DRAWING IS IN TRA SITE SPECIFIC COORDINATES.
3. REMOVED.
4. REMOVED.
PLANT & TRUE
BUILDING LOCATIONS
STRUCTURE LOCATIONS
PARKING & STORAGE AREAS
ATR AREA CODE 533
MTR AREA CODE 531
ETR AREA CODE 532
TRA EVAPORATION POND
EMERGENCY ACCESS ROAD
TROUT ST.
FOR LIST OF RTC UTILITY DRAWINGS SEE DRAWING 448546
REMOVED PREVIOUS REVISION HISTORY AS-BUILT AS OF 11/30/2011 SEE ECR-600400
7/24/2012
Idaho National Laboratory


REVISIONS
REV | DESCRIPTION | DATE | APPROVED
1 | AS-BUILT DMB | 3/18/96 | C KINGSFORD
3/18/96 T LANGENWALTER
2 | ADDED NOTE 2, REVISED NOTE 1, & REMOVED ELEV OF HDPE PIPE. AS-BUILT AS OF 8/23/01. SEE DAR 85148. | 10/2/01
6x6 W2xW2 WWF CENTERED IN SLAB
6"
VARIES
SECTION A
NTS
1'-0" RIPRAP ALL AROUND APRON BLEND TO EDGE OF 6" APRON
BOTTOM RIPRAP ZONE
CONCRETE DISCHARGE APRON
END OF CURB TYP
4'-0"
3'-0"
5'-0"
8'-0"
15'-0"
12'-0"
N
PLAN
END OF 4" HDPE PIPE
27'-9"
3-8 1/2"
8'-3"
11"-0" MIN
10'-0"
6'-0"
6" DP PIT RUN GRAVEL
4" DP PIT RUN GRAVEL
SEAL ANNULAR SPACE W/DARK OAKUM PACKING TYP BOTH ENDS
3'-0" REF
27'-8"
1'-0" STEP
HIGH WATER LEVEL AT BOTTOM OF PIPE 2
EL 4922.50
EXISTING GROUND
EMBANKMENT MATERIAL INCLUDING LOCAL PIT RUN SANDY GRAVEL
TOP OF PIPE EL 4920.6
5" SCH 40 STEEL PIPE SLEEVE 10'-0" LONG
6" CLASS 40 CONC SLAB W/ 6 x 6 W2 x W2 WWF CENTERED IN SLAB
10'-0"
4" 22 1/2' ELL 2 PLACES
4" HDPE PIPE
SEE DETAIL 1 178542
4" PVC PIPE MAINTAIN 5'-0" COVER
PVC/HDPE ADAPTER
THRUST BLOCK SEE DETAIL 2 PLACES 1 178541
PROFILE
REVISION 1 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY CLINTON O. KINGSFORD PROFESSIONAL ENGINEER NO. 2104, ON 3/18/96 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
NOTES
1 FOR LINER DETAILS SEE DWG 184332, 184333, & 184334.
2 HIGH WATER LEVEL IS 8'-1" FOR LAGOON #1 (TRA-735) AND 8'-4" FOR LAGOON #2 (TRA-736).
APPROVALS | DATE
B SUMMERS | 3-27-95
KM SPENCE | 3-24-95
CONST RLVC KINGSFORD 3-22-95
P.M. MI. RUCKER 3-23-95
DES MGR SA DAVIES 3-28-95
DESIGN DR SCHIESS 3-22-95
CHECKED AR ROWLEY 3-28-95
DRAWN GKM/BER APR '93
SUBCONTRACT NO. S-197320.2
RELEASED AR ROWLEY 3-28-95
PROJECT NO S 020017-D
DESIGN PHASE
APPROVED DATE C KINGSFORD 3-22-95
QUALITY LEVEL 3
INDEX CODE NUMBER 531 0100 02 530
Lockheed Idaho Technologies Company
FOR U.S. DEPARTMENT OF ENERGY IDAHO FIELD OFFICE IDAHO FALLS, IDAHO
TRA
INEL SEWER UPGRADE
INLET STRUCTURE PLAN AND PROFILE
SIZE D 531 0300 52 530
DRAWING NO. 178538 REV 2
A/E SHT. NO. C-4
SCALE 3/8"=1'-0"



NOTES
1. LOCATE ULTRASONIC SENSOR AS CLOSE TO THE CENTER AS POSSIBLE AND COORDINATE LOCATION WITH MANUFACTURER.
2. PLACE 6" OF UNTREATED SOIL LINER PRIOR TO PLACING TWO 6" LIFTS OF TREATED SOIL LINER.
3. BUILD EXTERIOR SLOPE TO 2:1. PLACE ALL CLEARING AND GRUBBING ON EXTERIOR OF DIKE TO FLATTEN SLOPES.
4. MINIMUM SLOPE SHALL BE 3:1.
LIFT STATION CONTROL SETTINGS
EL 4900.80 FLOAT SWITCH ALARM (HIGH LEVEL)
EL 4896.50 BOTH PUMPS ON
EL 4895.50 FIRST PUMP ON
EL 4894.50 BOTH PUMPS OFF
PLAN DETAIL 1 NOT TO SCALE
SECTION C
DETAIL 2 178535
SECTION A 3/16"=1'-0" 178535
SECTION B 3/16"=1'-0" 178535
REVISION 1 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY CLINTON G. KINGSFORD PROFESSIONAL ENGINEER NO. 2104, ON 3/18/96 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
U.S. DEPARTMENT OF ENERGY
INEL SEWER UPGRADE
LIFT STATION AND DIKE DETAILS AND SECTIONS
178537
C-3


REVISIONS
REV | DESCRIPTION | DATE | APPROVED
1 AS-BUILT DMB 3/18/96 C KINGSFORD 3/18/96
2 ADDED ELEVATION NOTES. AS-BUILT AS OF 8/23/01. SEE DAR 85151. 10/2/01
APPROVALS DATE
B SUMMERS 3-22-95
KV SPENCE 3-24-95
NOTES
1. EXISTING SPOIL PILE TO BE USED AS BORROW AS REQUIRED TO MEET LINES AND GRADES OF DIKES.
2. SEE APPENDIX IN SPECIFICATIONS FOR TEST HOLE DATA.
3. MAINTAIN CONSTANT SLOPE ON PIPE.
BOTTOM OF POND EL 4912.5
BOTTOM OF LINER EL 4911.0
TEST HOLE, TYP SEE NOTE 2
TH-1
TH-2
TH-3
TH-4
TH-5
TH-6
TH-7
TH-8
TH-9
TH-10
NEW 12" X 32'-0" CMP REQUIRED
4" PVC PRESSURE SEWER PIPE
GRADE TO DRAIN
NEW 12" SEWER
EXIST. 12" SEWER
12'-0" ACCESS ROAD
SEE NOTE 1
PLAN
701
178541
10+00
15+00
20+00
FINISHED GRADE A/ ? OF ROAD
TOP OF DIKE
BOTTOM OF PIPE EL 4920.58
BOTTOM OF PIPE EL 4920.80
BOTTOM OF POND EL 4912.50
MANHOLE
TOP OF PIPE EL 4910.0
4" PVC PRESSURE PIPE
TOP OF PIPE EL 4911.90
TOP OF PIPE EL 4911.60
INVERT EL 4904.10
INVERT EL 4901.20
LIFT STATION
REVISION 1 OF THIS DOCUMENT ORIGINALLY ISSUED AND SEALED BY CLINTON O. KINGSFORD PROFESSIONAL ENGINEER NO. 2104, ON 3/18/96 THIS MEDIA SHOULD NOT BE CONSIDERED A CERTIFIED DOCUMENT.
HORIZONTAL SCALE 1"=100.0'
VERTICAL SCALE 1"=5.0'
INDEX CODE NUMBER AREA TYPE QL ORIG 531 0300 52 530
U.S. DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE IDAHO FALLS, IDAHO
Lockheed Idaho Technologies Company
PROJECT NO.S 020017-D
DESIGN PHASE
APPROVED DATE
C KINGSFORD 3-22-95
QUALITY LEVEL 3
RELEASED AR ROWLEY 3-28-95
SUBCONTRACT NO S-197320.2
INEL SEWER UPGRADE
AREA PLAN AND PROFILE
178536
C-2
TRA
TBA SD6430
165464
165465
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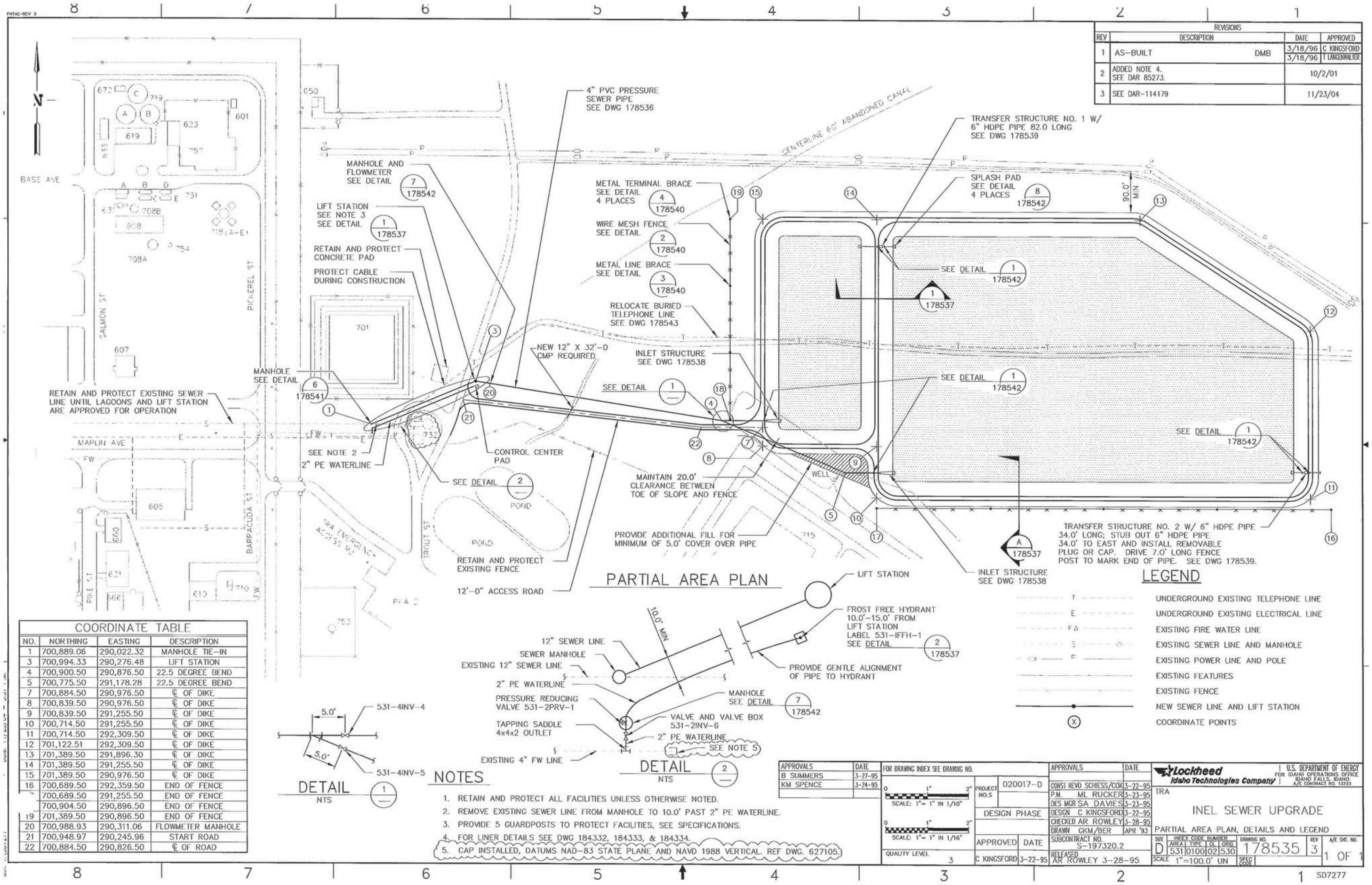
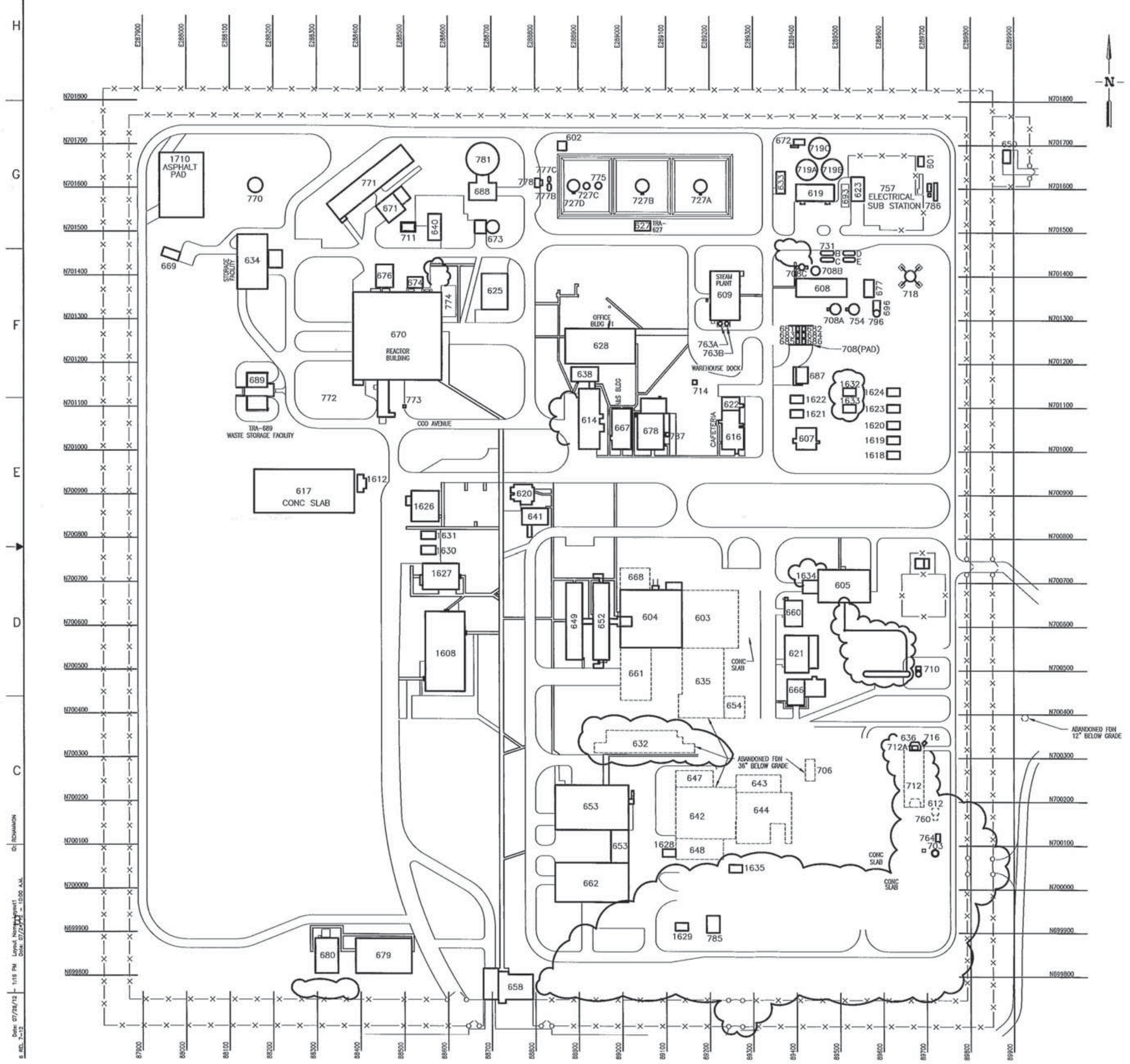
Path: O:\NATE\6430



NOTES

1. RETAIN AND PROTECT ALL FACILITIES UNLESS OTHERWISE NOTED.
2. REMOVE EXISTING SEWER LINE FROM MANHOLE TO 10.0' PAST 2" PE WATERLINE.
3. PROVIDE 5 GUARDPOSTS TO PROTECT FACILITIES, SEE SPECIFICATIONS.
4. FOR LINER DETAILS SEE DWG 184332, 184333, & 184334.
5. CAP INSTALLED, DATUMS NAD-83 STATE PLANE AND NAVD 1988 VERTICAL. REF DWG. 627105.

COORDINATE TABLE			
NO.	NORTHING	EASTING	DESCRIPTION
1	700,889.06	290,022.32	MANHOLE TIE-IN
3	700,994.33	290,276.48	LIFT STATION
4	700,900.50	290,876.50	22.5 DEGREE BEND
5	700,775.50	291,178.28	22.5 DEGREE BEND
7	700,884.50	290,976.50	℄ OF DIKE
8	700,839.50	290,976.50	℄ OF DIKE
9	700,839.50	291,255.50	℄ OF DIKE
10	700,714.50	291,255.50	℄ OF DIKE
11	700,714.50	292,309.50	℄ OF DIKE
12	701,122.51	292,309.50	℄ OF DIKE
13	701,389.50	291,896.30	℄ OF DIKE
14	701,389.50	291,255.50	℄ OF DIKE
15	701,389.50	290,976.50	℄ OF DIKE
16	700,689.50	292,359.50	END OF FENCE
[illegible]	700,689.50	291,255.50	END OF FENCE
[illegible]	700,904.50	290,896.50	END OF FENCE
19	701,389.50	290,896.50	END OF FENCE
20	700,988.93	290,311.06	FLOWMETER MANHOLE
21	700,948.97	290,245.96	START ROAD
22	700,884.50	290,826.50	℄ OF ROAD



4	REMOVED PRIOR REVISION HISTORY, X-REF RTC MASTER PLOT PLAN 626234, REVISED TITLE BLOCK & INDEX CODE AS-BUILT AS OF 9/27/06, SEE DAR-510522	11/27/06
5	SEE ECR-555438	12/10/07
6	AS-BUILT AS OF 9/15/08 SEE ECR-563977	1/22/09
7	AS-BUILT AS OF 3/16/09 SEE ECR-568203	5/19/09
8	SEE ECR-576474 AS-BUILT AS OF 12/22/09, REVISED TITLE	3/15/2011
9	AS-BUILT AS OF 7/20/2011 SEE ECR-594488	8/25/2011
10	AS-BUILT AS OF 11/30/2011 SEE ECR-600400	7/24/2012

REFERENCE DRAWINGS:

ATR COMPLEX UNDERGROUND UTILITY DRAWINGS–

ATR COMPLEX UNDERGROUND PIPING PROJECT–
448546 SHEET 1– AREA MAP AND DRAWING INDEX
448547 SHEET 2– SANITARY SEWER AND COLD WASTE
448548 SHEET 3– STEAM AND CONDENSATE LINES
448549 SHEET 4– MISCELLANEOUS FUEL, ACIDS AND AIR LINES
448550 SHEET 5– WARM WASTE, HOT WASTE AND ESHAUST
448551 SHEET 6– PLANT AIR AND INSTRUMENT AIR
448552 SHEET 7– UNDERGROUND WATER LINES
448553 SHEET 8– WASTE HEAT RECOVERY LINES

ATR UNDERGROUND PIPING–
120009 – YARD PIPING PLANS AND DETAILS SHEET 1
120010 – YARD PIPING PLANS AND DETAILS SHEET 2
120011 – YARD PIPING THRUST BLOCK DETAILS
120012 – PIPE SUPPORTS PLAN SECTIONS AND DETAILS SHEET 1
120013 – PIPE SUPPORTS PLAN SECTIONS AND DETAILS SHEET 2
120015
177229
635002
630315
502611
502612
503773
503774

MTR/ETR UNDERGROUND PIPING–
008845
008851
008855
009221
010581
010585
410219
101923 (HOT CELL)
101956 (HOT CELL)
166421
150502
180929
452225
628113 THRU 628117

PLANT AND INSTRUMENT AIR–
171087 THRU 171120
445771 THRU 445772

BURIED WASTE LINES–
154959 THRU 154965
169647
518411
518412
518416
518419

ABANDONED SYSTEMS–
171229 THRU 171243 TRA WASTE HEAT RECOVERY SYSTEM
156286 THRU 156323 TRA FIREWATER MAIN REPLACEMENT PROJECT
156324 THRU 156328 TAMPER SWITCHES (DIRECT BURIED ROMEX)

UNDERGROUND ELECTRICAL DISTRIBUTION–
421002 – RTC ATR ETR MTR UNDERGROUND POWER DISTRIBUTION
421805 ATR–MTR–ETR MANHOLES AND ELECTRICAL DETAILS UNDERGROUND DISTRIBUTION
107952 – SUBSTATION UNDERGROUND CONDUITS AND GROUNDING PLAND AND DETAILS
430730 – SUBSTATION 3 UNDERGROUND CONDUIT AND GROUNDING PLAN AND DETAILS

FIRE ALARM SYSTEM–
453512 – ATR COMPLEX FIRE ALARM SYSTEM FIRE ALARM PANEL LOCATIONS MAP
453513 – ATR COMPLEX FIRE ALARM SYSTEM PIV LOCATION MAP
453515 – ATR COMPLEX FIRE ALARM SYSTEM NETWORK PLAN AND BLOCK DIAGRAM
166097 – INEL FIRE SAFETY AND PROTECTION IMPROVEMENTS(ALARM SYSTEM)AREA PLAN
520518
181042 THRU 181051
181055

CATHODIC PROTECTION SYSTEM–
156334 THRU 156349
120026 AND 120027
150508 AND 150509
177255 AND 177256
181128 AND 181130

TRA TELEPHONE SYSTEM–
625840 THRU 625852

SECURITY–
167751
167293

TRA LANDSCAPE IMPROVEMENTS–
172661 THRU 172665

TRA SEWAGE PONDS–
178535 THRU 178538

LAWN SPRINKLERS–
008616 (SUPERSEDED)
110907
153087 (SUPERSEDED BY 410219)

414487 – PLOT PLAN OF ATR COMPLEX IDAHO NATIONAL LABORATORY.

HIDDEN LINES INDICATE ABANDONED FOUNDATION APPROXIMATELY 36" BELOW GRADE

SUBCONTRACT NO.

INL Idaho National Laboratory

Attachment B

2010 Seepage Testing Results

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

CCN 223111

900 North Skyline Drive, Suite B • Idaho Falls, Idaho 83402 • (208) 528-2650

C.L. "Butch" Otter, Governor
Toni Hardesty, Director

January 4, 2011

Jo Anna Stenzel, Director
Environmental Support & Services
Battelle Energy Alliance, LLC
P.O. Box 1625
Idaho Falls, ID 83415

RE: INL Advanced Test Reactor Complex, Sewage Treatment Lagoons Seepage Test Results. DEQ Plan & Spec # 10-01-12.

Dear Ms. Stenzel:

The Department of Environmental Quality (DEQ) has completed review of the above referenced seepage rate tests conducted by Battelle energy Alliance (BEA). DEQ has determined that the test procedure utilized is consistent with the testing procedure approved by DEQ on April 23, 2010.

The maximum allowable seepage rate for each lagoon is 0.25 inches per day, as specified in the Wastewater Rules, IDAPA 58.01.16. The test results provided by BEA indicate seepage rates for both lagoons that are less than the maximum allowable seepage rate. Therefore, the lagoons have satisfactorily met the requirement of IDAPA 58.01.16.493.02.

Please note that Lagoon #2 was tested at the recent maximum operating depth of 4 feet, as approved by DEQ, rather than the design operating depth of 8 feet. Therefore, the seepage test results for Lagoon #2 are only valid for hydraulic depths less than 4 feet. Another seepage test on Lagoon #2 will be required at the maximum design operating depth of 8 feet if and when hydraulic depths begin – or are expected – to exceed the current 4 foot depth.

Lagoons are required to be seepage tested every 10 years or if there is a change of condition to the liner that may affect its permeability, including, but not limited to, liner repair below the high water line, liner replacement, lagoon dewatering of soil-lined lagoons which results in desiccation of the soil liner, seal installation, or earthwork affecting liner integrity. Solids removal from the lagoon may also require a seepage test. Please contact DEQ in writing prior to performing activities that may affect liner permeability to determine if a seepage test will be required prior to returning the lagoon to service.

If you have any questions, please call me at 528-2650.

Sincerely,

Tom Rackow

Tom Rackow, PE
Idaho Falls Regional Office

C: Larry Duncan, BEA
Norm Stanley, BEA
Vanica Dugger, DOE-ID
Greg Eager, DEQ-IFRO
Engineering Source File 10-01-12

2011AGD18

Idaho National Laboratory INL

December 21, 2010

CCN 222903

Mr. Greg Eager, P.E.
Department of Environmental Quality
Idaho Falls Regional Office
900 North Skyline Drive, Suite B
Idaho Falls, ID 83402

SUBJECT: Submittal of the Seepage Test Report for the Advanced Test Reactor Complex Sewage Treatment Lagoons

Dear Mr. Eager:

Enclosed is the seepage test report for the Advanced Test Reactor Complex Sewage Treatment Lagoons located at the Idaho National Laboratory. This seepage test report is being submitted for your review and approval and in accordance with IDAPA 58.01.16.493 requirements. The seepage test procedure was submitted and approved by DEQ under DEQ# 10-01-12. Please review and reply at your earliest convenience. If you need any additional information or have any questions, please call Brad Griffith at (208) 533-4530 or Norm Stanley at (208) 526-5901.

Sincerely,

for Bruce M. Angle
Jo Anna Stenzel, Director
Environmental Support & Services

NS: LE

Enclosure

cc: J. Alvarez, INL, MS 3695
V. Dugger, DOE-ID, MS 1216
J. J. Grossenbacher, INL, MS 3695
R. M. Kauffman, DOE-ID, MS 1216
A. J. Kraupp, DOE-ID, MS 1226
D. C. Long, DOE-ID, MS 1240
C. S. Mascareñas, INL, MS 3405
S. A. McBride, INL, MS 3406
S. M. Olson, DOE-ID, MS 1240
T. Rackow, DEQ, Idaho Falls, ID
D. M. Storms, INL, MS 3888

P.O. Box 1625 • 2525 North Fremont Ave. • Idaho Falls, Idaho 83415 • 208-526-0111 • www.inl.gov
Battelle Energy Alliance, LLC

bcc: D. G. Blatter, MS 4131
T. L. Carlson, MS 3405 TLC
L. W. Duncan, MS 6172
B. K. Griffith, MS 7113
J. D. Harris, MS 4131
D. L. Layton, MS 3405
S. D. Lee, MS 3405
M. G. Lewis, MS 3405
T. A. Miller, MS 3428
N. E. Stanley, MS 4131
D. W. Wagoner, MS 3405
INL Correspondence Control, MS 3106, email BEACC@inl.gov
Environmental Correspondence, MS 3428, email ENVAFF@inl.gov
J. A. Stenzel Letter File (JAS-39-10)

Uniform File Code: 6108
Disposition Authority: ENV3-a-2
Retention Schedule: Destroy 5 years after permit expires.

NOTE: Original disposition authority, retention schedule and Uniform Filing Code applied by the sender may not be appropriate for all recipients. Make adjustments as needed.

Statement of Document Quality
Idaho National Laboratory
ATR Complex Sewage Treatment Lagoons Seepage Test Report
INL/EXT-10-20337

I have prepared this document in accordance with applicable requirements and regulatory agency guidance, and I verify that it is true, accurate, and complete to the best of my knowledge. I understand that senior management of INL and/or DOE-ID, under penalty of law, must certify the report (or permit) as true, accurate, and complete. These individuals will be relying on the project/operational/ programmatic/project–specific managers' representation that the information in this report (or permit) is true, accurate, and complete.

Document preparer: (B.K. Griffith) Date: 12/20/10

I have reviewed this document for technical accuracy and content in accordance with applicable requirements and regulatory agency guidance, including validation of calculations, where applicable, and I validate that it is true, accurate, and complete to the best of my knowledge. I understand that senior management of INL and/or DOE-ID, under penalty of law, must certify the report (or permit) as true, accurate, and complete. These individuals will be relying on the project/operational/ programmatic/project–specific managers' representation that the information in this report (or permit) is true, accurate, and complete.

Technical validation reviewer: (N.E. Stanley) Date: 12/20/10

INL/EXT-10-20337

Advanced Test Reactor Complex Sewage Treatment Lagoons Seepage Rate Test Report

December 2010

INL/EXT-10-20337

Advanced Test Reactor Complex Sewage Treatment Lagoons Seepage Rate Test Report

Brad Griffith and Larry Duncan

December 2010

Idaho National Laboratory
Environmental Compliance
Idaho Falls, Idaho 83415

Advanced Test Reactor Complex Sewage Treatment Lagoons Seepage Rate Test Report

INL/EXT-10-20337

December 2010

Approved by:

Don G. Blatter   12-20-10
Manager, Sitewide Management Services   Date

Larry W. Duncan, P.E.   12-20-10
Date

PROFESSIONAL ENGINEER
REGISTERED
5584
STATE OF IDAHO
LARRY W. DUNCAN

12-20-2010

CONTENT

1. PURPOSE 1

2. INTRODUCTION 1

3. PROCEDURE 3

4. LAGOON SEEPAGE RATES 7

5. SUMMARY AND CONCLUSIONS 14

FIGURES

Figure 1. Aerial view of the ATR Complex sewage treatment lagoons. 2

Figure 2. Evaporation Pan. 4

Figure 3. Precipitation Gauge 5

Figure 4. Temperature Logger 5

Figure 5. Hook Gauge. 6

TABLES

Table 1. ATR Complex Sewage Lagoon 1 Seepage Test, DEQ Seepage Calculation Spreadsheet. 8

Table 2. ATR Complex Sewage Lagoon 2 Seepage Test, DEQ Seepage Calculation Spreadsheet. 11

APPENDIXES

APPENDIX A. ATR Complex Sewage Lagoons Seepage Rate Test Report 15

Advanced Test Reactor Complex Sewage Treatment Lagoons Seepage Rate Test Report

1. PURPOSE

The Advanced Test Reactor Complex (ATR Complex) Sewage Treatment Lagoons, operated by Battelle Energy Alliance (BEA) LLC, at the Idaho National Laboratory's (INL) ATR Complex are required to meet the seepage testing regulatory requirements identified in IDAPA 58.01.16.493.02. All existing lagoons must be seepage tested by April 15, 2012 by an Idaho licensed professional engineer, an Idaho licensed professional geologist, or by individuals under their supervision.
IDAPA 58.01.16.493.02.e. requires that the procedure for performing a seepage test be submitted and approved by the Idaho Department of Environmental Quality (DEQ) prior to testing. The Seepage Test Procedure for the ATR Complex Sewage Lagoons was submitted to the DEQ on April 13, 2010 and was approved on April 23, 2010 (DEQ # 10-01-12). This report presents the results of seepage testing performed on ATR Complex Sewage Lagoons 1 and 2 during June and July 2010.

2. INTRODUCTION

The ATR Complex Sewage Treatment Lagoons receive sanitary wastewater from approximately forty buildings inside the ATR Complex. The lagoons are evaporative, non-discharging lagoons and have the following characteristics:

- A gravity flow collection system
- A wet well/lift station that pumps wastewater to the treatment lagoons
- Lagoon 1 is 2.9 acres at an 8 ft depth
- Lagoon 2 is 13.8 acres at an 8 ft depth
- Lagoon 1 is bentonite lined
- Lagoon 2 is bentonite and PVC lined
- Two transfer structures.

The lagoons were designed to treat up to 60,000 gallons per day (gpd) with current flows averaging around 28,000 gpd. Wastewater flows by gravity from Lagoon 1 to Lagoon 2 through a transfer structure located on the north end of the berm between the lagoons. A second transfer structure, which was constructed for possible future expansion, is located on the east berm of Lagoon 2. See Figure 1 for an aerial view of the lagoons.

Lagoon 1 seepage testing was performed June 17 – July 2, 2010, and Lagoon 2 seepage testing was performed July 14 – July 29, 2010.

Figure 1. Aerial view of the ATR Complex sewage treatment lagoons.

2

3. PROCEDURE

The seepage tests were performed using the methods described in the Seepage Test Procedure for the Advanced Test Reactor Complex Sewage Lagoons that was submitted to DEQ on April 13, 2010, and was approved on April 23, 2010 (Appendix A), and the DEQ Guide for Evaluating Wastewater Treatment Lagoon Seepage Rates. Wastewater discharges were diverted directly into Lagoon 2 while seepage testing was performed on Lagoon 1. The wastewater was then routed back into Lagoon 1 while seepage tests were performed on Lagoon 2. Each of the lagoons were isolated during seepage testing by positioning valves and slide gates. Visual verification of isolation was performed at the discharge pipe and with a red dye at the transfer structure slide gate. The water depth during the Lagoon 1 seepage test started at approximately 7 ft 9 in., and Lagoon 2 water depth started at approximately 4 ft.

An evaporation station was set up on the berm between Lagoon 1 and Lagoon 2 near the transfer station stilling well. The evaporation station consisted of a Class-A stainless steel evaporation pan, with a stilling well and a hook gauge. The pan was positioned on a pallet and leveled using a mineral spirits level. Fencing panels were installed around the pan to prevent deer and antelope from drinking during the testing periods (See Figure 2).

A rain gauge and temperature data logger were installed on one of the transfer structure sign posts located on the berm between Lagoons 1 and 2. Precipitation was monitored using a Productive Alternatives All-Weather Rain Gauge. The gauge was a standard 4-in. orifice, funnel-type unit that was installed about 5 ft above the ground with the top orifice being several inches above the mounting post (See Figure 3). The gauge measuring tube had a 1.00 in. capacity with readout increments of 0.01 in. The gauge was read, recorded, and emptied (if precipitation was collected) at approximately 9:00 a.m. daily during the testing periods. Temperature data was collected using a HOBO® H8 Pro Series logger (See Figure 4). The temperature was recorded to the nearest 0.01°F at 1-hour intervals. Seventy-two-hour means were calculated for each water measurement period during the 15-day testing cycles.

Hook gauges (See Figure 5) were used to measure water surface levels at approximately 9:00 a.m. on days 0, 3, 6, 9, 12, and 15 of each seepage test. Seven hook gauge measurements were taken and recorded at the evaporation pan and the lagoon(s) during each measurement cycle. Hook gauge readings were taken to the nearest 0.001 in. Baseline and corrected measurements were taken when water was added to the evaporation pan or when hook gauge extensions were added to reach the lagoon surface.

Seepage tests performed at the ATR Complex Sewage Lagoons deviated from the DEQ Guidance for Evaluating Wastewater Lagoon Seepage Rates in the following areas:

- The guidance specifies that stilling wells should be installed as near to the center of the cell as possible. A request was made in a telephone conversation with Thomas Rackow of the Idaho DEQ (CCN 220351, 3/16/2010) to use the concrete transfer structure located in the lagoon berm between Lagoons 1 and 2 as the stilling well for the water level measurements. Verbal approval was given at that time.

- The guidance suggests lagoons should be tested at the maximum design operational depth. To reach the design maximum depth for Lagoon 2 (13.8 acres), it would require a large volume of clean well water be pumped to the lagoon over a long period of time. It was suggested in a permit hand-off meeting on 4/01/10 with Thomas Rackow of the Idaho DEQ (CCN 220510, 4/05/10) that we test Lagoon 2 near the recent maximum operating depth. Verbal approval was given at that time.

Both of these deviations were included in the Seepage Test Procedure for the Advanced Test Reactor Complex Sewage Lagoons that was submitted to the DEQ on April 13, 2010, and approved on April 23, 2010 (DEQ # 10-01-12).

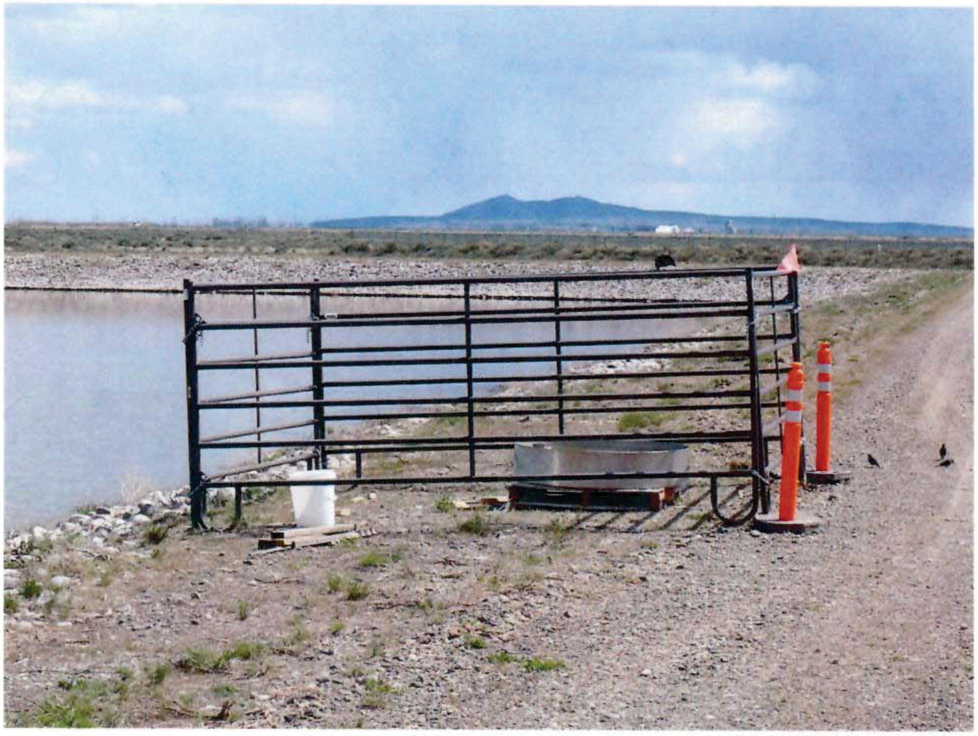


Figure 2. Evaporation Pan.

Figure 3. Precipitation Gauge.

Figure 4. Temperature Logger.

Lagoon water elevation measurements were taken from reference points on the transfer box cover grates using an extended hook gauge. Hook gauge extensions were added to the hook gauge as needed to keep the water surface elevation within the travel distance of the hook gauge. The distance between the reference point and the water surface was re-baselined each time an extension or spacer was added or removed.

One individual made all hook gauge measurements associated with the sewage lagoons and evaporation pan. Verification hook gauge measurements were performed by additional individuals. Daily rain gauge measurements were taken by CFA utility personnel and recorded on the daily log sheets.

Figure 5. Hook Gauge.

4. LAGOON SEEPAGE RATES

All calculations utilized the DEQ Seepage Calculation Spreadsheet found at http://www.deq.state.id.us/water/assist_business/engineers/guidance.cfm

Fifteen-day average seepage rates for the two ATR Complex sewage lagoons are summarized in Tables 1 and 2. These tables are the final DEQ Seepage Calculation Spreadsheets for each lagoon. Field-collected information is found on these spreadsheets.

Table 1. ATR Complex Sewage Lagoon 1 Seepage Test, DEQ Seepage Calculation Spreadsheet.

Lagoon Seepage Rate Test for 15 days of data collected at 3 day intervals

Owner/Facility/HOA/Permittee:	Idaho National Laboratory/Advanced Test Reactor Complex				
Responsible P.E. or P. G. :	Larry Duncan				
Phone Number:	208-533-7792				
Name of Lagoon:	ATR Complex Sewage Treatment Lagoon #1				
Test Start Date:	6/17/10				
Test Start Time:	9:20 AM				
Equipment used for lagoon:	Hook Gauge				
Equipment Accuracy:	0.1	%FS	1	Range (ft)	0.012 Inches
Equipment used for pan:					
Equipment Accuracy:	0.1	%FS	1	Range (ft)	0.012 Inches

Instructions:

1. Enter information in **all** yellow fields.
2. Provide all additional calculations and comments pertaining to testing.
3. If you are using a hook guage, enter additional information (see line 46).
4. Precipitation events more than 4 hours duration require additional calculations (See Precipitation Worksheet).

Precipitation Event (C: Correction Factor)

Precipitation events greater that four hours require a correction factor.

(See worksheet:Precipitation Event, and column U in this sheet.)

Leave C at 1 if there is no need to correct for an event in a test time interval.

5. Air Temperature is rounded to nearest degree F.

Definitions: (Refer to guidance for additional information)

E_{S0} : lagoon surface elevation at start of test for new time increment (units: inches)

E_{SN}: lagoon surface elevation at day n (units:inches)

ES: lagoon surface elevation change (units:inches) ES = Es0-Esn

P: see pan coefficient worksheet for table and temperature range

$E_{pan\ 0}$ evap pan surface elevation start of test for new time increment (units:inches)

$E_{pan\ n}$ evap pan surface elevation day n (units:inches)

n: time in days

S_{r1}: seepage rate (units: inches/day)

S_{R1}= (ES-I_L-Q+precipitation)/n = inches/day

I_L: net lagoon evaporation (units:inches)

I_L=P*(precipitation+$E_{PAN\ 0}$-$E_{PAN\ n}$)*C

Air Temperature: ***median*** over test interval

Note that error calculations are based on the Propagation of Uncertainty.

Sampling Error: the standard error of the sample standard deviation

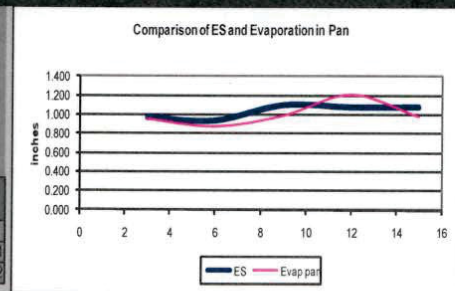
Sampling Error = (standard deviation)/($n^{1/2}$)

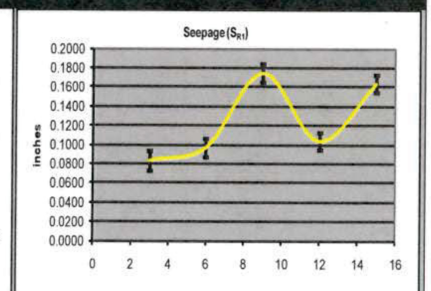
Equipment Error: Equip. Error = (%FS/100* Range) *12inches/ft

Q= ((effluent flow-influent flow (gallons))*ft3*12in) / (lagoon surface area ft2 *7.48 gal.*ft)

Date	E_{S0}	E_{SN}	ES	ES Error	I_L	$I_{L\,Error}$	n	Testing time	Air Temp.	P	$E_{pan\,0}$	$E_{pan\,n}$	Evap pan	Epan error	Precipitation	Q	Effluent Q	Influent Q	Lagoon SA	C: precip factor
	inches	inches	inches	+/- inches	inches	+/- in	days		F	coefficent	inches	inches	inches	+/- in	inches	inches	gallons	gallons	ft2	see note
17-Jun	1.939						0	9:20 AM			3.442									
20-Jun	1.939	0.970	0.970	0.017	0.720	0.013	3	9:05 AM	57	0.749	3.442	2.480	0.962	0.017	0.00	0.000	0	0	1	1.00
23-Jun	3.537	2.603	0.934	0.017	0.643	0.012	3	9:05 AM	59	0.730	3.279	2.398	0.881	0.017	0.00	0.000	0	0	1	1.00
26-Jun	2.603	1.501	1.102	0.017	0.758	0.011	3	9:02 AM	68	0.646	2.398	1.405	0.993	0.017	0.18	0.000	0	0	1	1.00
29-Jun	2.506	1.426	1.080	0.017	0.770	0.011	3	9:15 AM	69	0.637	3.188	1.980	1.208	0.017	0.00	0.000	0	0	1	1.00
2-Jul	3.882	2.800	1.082	0.017	0.612	0.010	3	9:05 AM	72	0.609	1.980	0.995	0.985	0.017	0.02	0.000	0	0	1	1.00
			5.169		3.380		15		68	0.646			5.030		0.200	0.000				1.00

Date	Testing Day	S_{r1}	S_{r1} Equipment Error	S_{r1} Sampling Error		
		in/day	+/- in/day	+/- in/day		
17-Jun	0			0.002860712		
20-Jun	3	0.0831	0.0099	0.000852073		
23-Jun	6	0.0969	0.0098	0.002933435		
26-Jun	9	0.1747	0.0093	0.001267164		
29-Jun	12	0.1035	0.0093	0.002255197	Worst	Best
2-Jul	15	0.1633	0.0091	0.00123151	Case	Case
					in/day	in/day
Total Day 15	15	0.1325	0.0095		0.1420	0.1231
Average	15	0.1243	0.0095	0.0186	0.1524	0.0962





The leakage rate for lagoons constructed after April 15, 2007 shall be no more (0.125) inches (1/8 inch) per day and for existing lagoons constructed prior to April 15, 2007 shall be no more than (0.25) inches (1/4 inch) per day.

Hook Gauge Reading — Hook gauge readings shall be repeated a minimum of seven (7) times and numerically averaged.

Date	one	two	three	four	five	six	seven	average	sampling error	
17-Jun	1.9450	1.9390	1.9300	1.9340	1.9340	1.9420	1.9520	1.9394	0.002861	**Stilling Well**
20-Jun	0.9710	0.9700	0.9690	0.9660	0.9720	0.9720	0.9690	0.9699	0.0008	
23-Jun	2.6100	2.5970	2.6080	2.5920	2.5980	2.6010	2.6120	2.6026	0.002844	Note that empty cells are not counted,
26-Jun	1.5070	1.4980	1.5010	1.5020	1.4990	1.4980	1.4990	1.5006	0.001212	cells with zero are included in
29-Jun	1.4260	1.4320	1.4160	1.4300	1.4250	1.4260	1.4240	1.4256	0.001925	the average.
2-Jul	2.7990	2.7970	2.7960	2.8020	2.8020	2.8040	2.7980	2.7997	0.001128	

Hook Gauge Reading

Date	one	two	three	four	five	six	seven	average	sampling error	
17-Jun	3.4480	3.4390	3.4440	3.4420	3.4370	3.4420	3.4410	3.4419	0.001335	**Evaporative Pan**
20-Jun	2.4800	2.4790	2.4810	2.4790	2.4810	2.4800	2.4790	2.4799	0.00034	
23-Jun	2.4000	2.3950	2.3960	2.4010	2.3980	2.3990	2.4000	2.3984	0.000841	Note that empty cells are not counted,
26-Jun	1.4070	1.4040	1.4060	1.4040	1.4040	1.4050	1.4040	1.4049	0.000459	cells with zero are included in
29-Jun	1.9810	1.9880	1.9780	1.9780	1.9770	1.9770	1.9800	1.9799	0.001471	the average.
2-Jul	0.9960	0.9940	0.9930	0.9940	0.9950	0.9940	0.9980	0.9949	0.000634	

Additional Gauge Reading

Date	one	two	three	four	five	six	seven	average	sampling error	
17-Jun	3.5380	3.5340	3.5360	3.5380	3.5390	3.5350	3.5360	3.5366	0.000685	**Location of Gauge:**
20-Jun	3.2820	3.2790	3.2800	3.2780	3.2770	3.2800	3.2790	3.2793	0.000606	
23-Jun	2.5060	2.5090	2.5080	2.5120	2.5040	2.5020	2.5010	2.5060	0.001496	Note that empty cells are not counted,
26-Jun	3.1880	3.1870	3.1890	3.1860	3.1900	3.1900	3.1890	3.1884	0.000571	cells with zero are included in
29-Jun	3.8540	3.8920	3.8790	3.8830	3.8830	3.8900	3.8920	3.8819	0.005021	the average.
2-Jul								#DIV/0!	#DIV/0!	

The DEQ Seepage Calculation Spreadsheet is password protected and does not allow changes. The additional gauge reading category is populated with dates entered above and does not allow for additional rows to be added. On certain days during the test, new baseline readings were required for both the sewage lagoon and the evaporation pan. These readings were entered into the next row of the additional gauge reading category and were not necessarily on the date identified. The following dates represent when these readings were taken. These averages were entered into the seepage calculation portion of this spreadsheet.

- 17-Jun – average of 3.5366 was a new baseline reading (extensions added) for the lagoon hook gauge taken on 6/20/10. 23-Jun (E_{SO}) show this new baseline.
- 20-Jun – average of 3.2793 was a new baseline reading (water added) for the evaporation pan hook gauge taken on 6/20/10. 23-Jun ($E_{pan\ o}$) show this new baseline.
- 23-Jun – average of 2.5060 was a new baseline reading (extensions added) for the lagoon hook gauge taken on 6/26/10. 29-Jun (E_{SO}) show this new baseline.
- 26-Jun – average of 3.1884 was a new baseline reading (water added) for the evaporation pan hook gauge taken on 6/26/10. 29-Jun ($E_{pan\ o}$) show this new baseline.
- 29-Jun – average of 3.8819 was a new baseline reading (extensions added) for the lagoon hook gauge taken on 6/29/10. 2-Jul (E_{SO}) show this new baseline.

Table 2. ATR Complex Sewage Lagoon 2 Seepage Test, DEQ Seepage Calculation Spreadsheet.

Lagoon Seepage Rate Test for 15 days of data collected at 3 day intervals

Owner/Facility/HOA/Permittee:	Idaho National Laboratory/Advanced Test Reactor Complex				
Responsible P.E. or P. G. :	Larry Duncan				
Phone Number:	208-533-7792				
Name of Lagoon:	ATR Complex Sewage Treatment Lagoon #2				
Test Start Date:	7/14/10				
Test Start Time:	9:07 AM				
Equipment used for lagoon:	Hook Gauge				
Equipment Accuracy:	0.1	%FS	1	Range (ft)	0.012 Inches
Equipment used for pan:	Hook Gauge				
Equipment Accuracy:	0.1	%FS	1	Range (ft)	0.012 Inches

Instructions:

1. Enter information in **all** yellow fields.
2. Provide all additional calculations and comments pertaining to testing.
3. If you are using a hook guage, enter additional information (see line 46).
4. Precipitation events more than 4 hours duration require additional calculations (See Precipitation Worksheet).

Precipitation Event (C: Correction Factor)
Precipitation events greater that four hours require a correction factor.
(See worksheet:Precipitation Event, and column U in this sheet.)
Leave C at 1 if there is no need to correct for an event in a test time interval.

5. Air Temperature is rounded to nearest degree F.

Definitions: (Refer to guidance for additional information)

E_{S0} : lagoon surface elevation at start of test for new time increment (units: inches)
E_{SN}: lagoon surface elevation at day n (units:inches)
ES: lagoon surface elevation change (units:inches) ES = Es0-Esn
P: see pan coefficient worksheet for table and temperature range
$E_{pan\ 0}$: evap pan surface elevation start of test for new time increment (units:inches)
$E_{pan\ n}$: evap pan surface elevation day n (units:inches)
n: time in days

S_{r1}: seepage rate (units: inches/day)

S_{R1} = (ES-I_L-Q+precipitation)/n = Inches day

I_L: net lagoon evaporation (units:inches)

I_L=P*(precipitation+E_{PAN0}-E_{PANn})*C

Air Temperature: ***median*** over test interval

Note that error calculations are based on the Propagation of Uncertainty.

Sampling Error: the standard error of the sample standard deviation

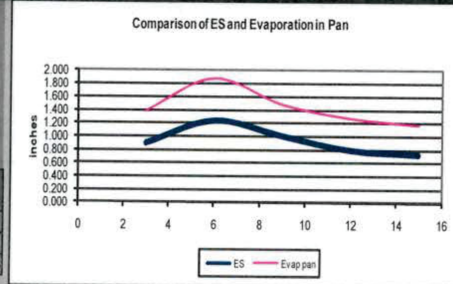
Sampling Error = (standard deviation)/($n^{1/2}$)

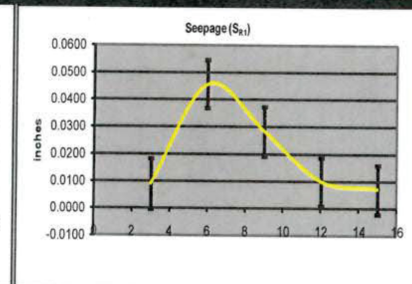
Equipment Error: Equip. Error = (%FS/100* Range) *12inches/ft

Q= ((effluent flow-influent flow (gallons))*ft3*12in) / (lagoon surface area ft2 *7.48 gal.*ft)

Date	E_{SS}	E_{SN}	ES	ES Error	I_L	$I_{L\ Error}$	n	Testing time	Air Temp.	P	$E_{pan\ 0}$	$E_{pan\ n}$	Evap pan	Epan error	Precipitation	Q	Effluent Q	Influent Q	Lagoon SA	C: precip factor
	inches	inches	inches	+/- inches	inches	+/- in	days		F	coefficent	inches	inches	inches	+/- in	inches	inches	gallons	gallons	ft2	see note
14-Jul	2.500						0	9:07 AM			3.164									
17-Jul	2.500	1.607	0.894	0.017	0.867	0.011	3	9:02 AM	70	0.628	3.164	1.783	1.381	0.017	0.00	0.000	0	0	1	1.00
20-Jul	4.189	2.963	1.226	0.017	1.090	0.010	3	9:00 AM	75	0.581	3.145	1.270	1.875	0.017	0.00	0.000	0	0	1	1.00
23-Jul	2.963	1.961	1.002	0.017	0.917	0.010	3	8:55 AM	71	0.619	3.597	2.115	1.482	0.017	0.00	0.000	0	0	1	1.00
26-Jul	2.803	2.010	0.793	0.017	0.764	0.010	3	9:02 AM	73	0.600	3.698	2.424	1.274	0.017	0.00	0.000	0	0	1	1.00
29-Jul	2.010	1.281	0.729	0.017	0.719	0.010	3	9:05 AM	72	0.609	3.072	1.902	1.170	0.017	0.01	0.000	0	0	1	1.00
			4.645		4.381		15		72	0.609			7.182		0.010	0.000				1.00

Date	Testing Day	S_{r1}	S_{r1} Equipment Error	S_{r1} Sampling Error		
		in/day	+/- in/day	+/- in/day		
14-Jul	0			0.000778102		
17-Jul	3	0.0088	0.0092	0.001028492		
20-Jul	6	0.0456	0.0089	0.002768798		
23-Jul	9	0.0283	0.0092	0.001623412		
26-Jul	12	0.0098	0.0090	0.000824778	Worst	Best
29-Jul	15	0.0069	0.0091	0.000889026	Case	Case
					in/day	in/day
Total Day 15	15	0.0182	0.0091		0.0273	0.0091
Average	15	0.0199	0.0091	0.0075	0.0365	0.0033





The leakage rate for lagoons constructed after April 15, 2007 shall be no more (0.125) inches (1/8 inch) per day and for existing lagoons constructed prior to April 15, 2007 shall be no more than (0.25) inches (1/4 inch) per day.

12

Hook Gauge Reading — Hook gauge readings shall be repeated a minimum of seven (7) times and numerically averaged.

Date	one	two	three	four	five	six	seven	average	sampling error
14-Jul	2.4980	2.5020	2.5000	2.4980	2.5020	2.5030	2.4990	2.5003	0.000778
17-Jul	1.6030	1.6050	1.6060	1.6060	1.6080	1.6090	1.6090	1.6066	0.000841
20-Jul	2.9670	2.9710	2.9500	2.9640	2.9590	2.9590	2.9680	2.9626	0.002698
23-Jul	1.9620	1.9660	1.9600	1.9540	1.9630	1.9570	1.9640	1.9609	0.00158
26-Jul	2.0060	2.0090	2.0120	2.0110	2.0100	2.0090	2.0120	2.0099	0.0008
29-Jul	1.2820	1.2790	1.2810	1.2770	1.2840	1.2800	1.2810	1.2806	0.000841

Stilling Well

Note that empty cells are not counted, cells with zero are included in the average.

Hook Gauge Reading

Date	one	two	three	four	five	six	seven	average	sampling error
14-Jul	3.1640	3.1650	3.1640	3.1650	3.1630	3.1650	3.1640	3.1643	0.000286
17-Jul	1.7860	1.7820	1.7810	1.7810	1.7840	1.7840	1.7850	1.7833	0.000747
20-Jul	1.2710	1.2700	1.2680	1.2670	1.2690	1.2720	1.2730	1.2700	0.000816
23-Jul	2.1160	2.1140	2.1160	2.1140	2.1130	2.1160	2.1140	2.1147	0.000474
26-Jul	2.4240	2.4230	2.4240	2.4250	2.4240	2.4250	2.4240	2.4241	0.000261
29-Jul	1.9020	1.9040	1.9020	1.9030	1.9030	1.9010	1.9020	1.9024	0.000369

Evaporative Pan

Note that empty cells are not counted, cells with zero are included in the average.

Additional Gauge Reading

Date	one	two	three	four	five	six	seven	average	sampling error
14-Jul	4.1860	4.1910	4.1900	4.1870	4.1900	4.1910	4.1880	4.1890	0.000756
17-Jul	3.1510	3.1460	3.1430	3.1460	3.1440	3.1450	3.1430	3.1454	0.001043
20-Jul	3.5980	3.5960	3.5970	3.5980	3.5960	3.5970	3.5960	3.5969	0.00034
23-Jul	2.8000	2.8120	2.8100	2.8010	2.8020	2.8000	2.7980	2.8033	0.002055
26-Jul	3.6980	3.6980	3.6980	3.6990	3.6980	3.6950	3.6990	3.6979	0.000508
29-Jul	3.0720	3.0720	3.0710	3.0720	3.0730	3.0720	3.0710	3.0719	0.000261

Location of Gauge:

Note that empty cells are not counted, cells with zero are included in the average.

The DEQ Seepage Calculation Spreadsheet is password protected and does not allow changes. The additional gauge reading category is populated with dates entered above and does not allow for additional rows to be added. On certain days during the test, new baseline readings were required for both the sewage lagoon and the evaporation pan. These readings were entered into the next row of the additional gauge reading category and were not necessarily on the date identified. The following dates represent when these readings were taken. These averages were entered into the seepage calculation portion of this spreadsheet.

- 14-Jul –average of 4.1890 was a new baseline reading (extensions added) for the lagoon hook gauge taken on 7/17/10. 20-Jul (E_{SO}) show this new baseline.
- 17-Jul- average of 3.1454 was a new baseline reading (water added) for the evaporation pan hook gauge taken on 7/17/10. 20-Jul ($E_{pan\ o}$) show this new baseline.
- 20-Jul- average of 3.5969 was a new baseline reading (water added) for the evaporation pan hook gauge taken on 7/20/10. 23-Jul ($E_{pan\ o}$) show this new baseline.
- 23-Jul-average of 2.8033 was a new baseline reading (extensions added) for the lagoon hook gauge taken on 7/23/10. 26-Jul (E_{SO}) show this new baseline.
- 26-Jul-average of 3.6979 was a new baseline reading (water added) for the evaporation pan hook gauge taken on 7/23/10. 26-Jul ($E_{pan\ o}$) show this new baseline.
- 29-Jul-average of 3.0719 was a new baseline reading (water added) for the evaporation pan hook gauge taken on 7/26/10. 29-Jul ($E_{pan\ o}$) show this new baseline.

5. SUMMARY AND CONCLUSIONS

Lagoon seepage tests were performed at the ATR Complex Sewage Lagoons during June and July of 2010. The water level in Lagoon 1 was near design capacity and Lagoon 2 was near operations capacity. Each lagoon was isolated during the testing periods. Monitoring equipment and measurements were applied in compliance with DEQ guidance and the approved Seepage Test Procedure for the Advanced Test Reactor Complex Sewage Lagoons. The calculated seepage rate for each of the lagoons was less than the allowable 0.25 in./day for lagoons constructed prior to April 15, 2007.

- The 15-day average seepage rate for Lagoon #1 was 0.1243 inches/day.
- The 15-day average seepage rate for Lagoon #2 was 0.0199 inches/day.

APPENDIX A

ATR Complex Sewage Lagoons Seepage Rate Test Report

Idaho Department of Environmental Quality
Approval for ATR Complex Sewage Lagoons Seepage Test Procedure

STATE OF IDAHO
DEPARTMENT OF
ENVIRONMENTAL QUALITY

CCN 220844

900 North Skyline Drive, Suite B • Idaho Falls, Idaho 83402 • (208) 528-2650

C.L. "Butch" Otter, Governor
Toni Hardesty, Director

April 23, 2010

Tim Carlson, Acting Director
Environmental Support & Services
Battelle Energy Alliance, LLC
P.O. Box 1625
Idaho Falls, ID 83415

RE: 10-01-12 INL ATR Municipal Sewage Lagoons, Seepage Test Procedure, Approval.

Dear Mr. Carlson:

The Department has reviewed the April 13, 2010 Seepage test procedure for the Advanced Test Reactor (ATR) Complex Sewage Treatment Lagoons (formerly known as the Reactor Technology Complex [RTC] or the Test Reactor Area [TRA]). The total-containment Sewage Treatment Lagoons are being seepage tested to comply with IDAPA 58.01.16.493.02 which requires seepage testing of all municipal wastewater lagoons by April 15, 2012.

The April 13, 2010 seepage test procedure appears to meet state standards and is approved. Because of the desire to perform this test in early spring (April/May), please be cognizant of weather conditions when you schedule the test to ensure freezing conditions won't be likely during the 15-day test period. Of particular concern is ice in the Class A evaporation pan.

Upon completion of the test, please submit the Seepage Test Results Report to me for review and approval. Please reference DEQ # 10-01-12 in all future correspondence related to this project.

If you have any questions, please contact me at 208-528-2650.

Sincerely,

Tom Rackow

Tom Rackow, PE
Idaho Falls Regional Office

C: Norm Stanley, BEA
Vanica Dugger, DOE-ID
Greg Eager, DEQ-IFRO
Engineering Source File 10-01-12

2010AGD1562

Attachment C

2013 PVC Liner Test Results

July 12, 2013
July 17, 2013 Updated with Plasticizer Content / Assessment

Mail To: **Bill To:**

J. Matt Uranga
J-U-B Engineers, Inc.
250 S. Beechwood Ave.
Suite 201
Boise, ID 83709
(voice) 208. 376. 7330
email: muranga@jub.com

<= Same

Dear Mr. Uranga

Thank you for consulting TRI/Environmental, Inc. (TRI) for your geosynthetics testing needs. TRI is pleased to submit this final report for laboratory testing.

Project:	**Sanitary Waste Water Lagoon**
TRI Job Reference Number:	E2379-80-06
Material(s) Tested:	Two,Exposed PVC(s)
Test(s) Requested:	Thickness (ASTM D 5199) Tensile (ASTM D 882) Tear Resistance (ASTM D 1004) Low Temperature Brittleness (ASTM D 1790)
Updating==>	Percent Plasticizer (ASTM D 2124)

If you have any questions or require any additional information, please call us at 1-800-880-8378.

Sincerely,

Sam R. Allen

Sam Allen
Vice President
Geosynthetic Services Division
www.GeosyntheticTesting.com

GEOMEMBRANE TEST RESULTS

TRI Client: J-U-B Engineers, Inc.
Project: Sanitary Waste Water Lagoon

Material: Aged PVC
Sample Identification: NE Side ATR Complex Int'l
TRI Log #: E2379-80-06

PARAMETER	TEST REPLICATE NUMBER 1	2	3	4	5	6	7	8	9	10	MEAN	STD. DEV.
Thickness (ASTM D 5199)												
Thickness (mils)	25	25	25	25	25	23	24	24	23	25	25	1
											23	<< min
Tensile Properties (ASTM D 882, 20 ipm strain rate)												
A Strength @ 100% Strain (ppi)	82.4	78.3	82.7	81.9	79.5						81.0	2.0
B Strength @ 100% Strain (ppi)	86.4	84.6	84.0	85.3	87.3						85.5	1.3
A Break Strength (ppi)	81.0	77.2	80.7	79.6	78.1						79.3	1.6
B Break Strength (ppi)	85.0	83.0	82.7	84.8	85.3						84.1	1.2
A Break Elongation (%)	130	120	177	150	108						137	27
B Break Elongation (%)	188	123	180	107	173						154	37
Tear Resistance (ASTM D 1004)												
A Tear Strength (lbs)	23	21	22	22	24	21	21	20	19	19	21	2
B Tear Strength (lbs)	19	20	21	19	19	21	20	20	20	21	20	1
Low Temperature Brittleness (ASTM D 1790, -29C)											% passing	
A (Pass/Fail)	Fail	*	*	*	*						0	
B (Pass/Fail)	Fail	*	*	*	*						0	
* Insufficient material to complete the required number of replicates												
Percent Plasticizer (ASTM D 2124)												
Plasticizers:				17.8							17.8	

A and B direction assigned by laboratory perpendiculer to each other in absence of marked direction by client

GEOMEMBRANE TEST RESULTS

TRI Client: J-U-B Engineers, Inc.
Project: Sanitary Waste Water Lagoon

Material: Aged PVC
Sample Identification: SW Side ATR Complex Int'l
TRI Log #: E2379-80-06

PARAMETER	TEST REPLICATE NUMBER 1	2	3	4	5	6	7	8	9	10	MEAN	STD. DEV.
Thickness (ASTM D 5199)												
Thickness (mils)	27	28	26	26	26	26	27	26	26	26	26	1
											26	<< min
Tensile Properties (ASTM D 882, 20 ipm strain rate)												
A Strength @ 100% Strain (ppi)	83.2	78.5	81.0	81.3	83.7						81.5	2.1
B Strength @ 100% Strain (ppi)	81.4	75.7	80.6	78.9	80.5						79.4	2.3
A Break Strength (ppi)	83.8	84.3	85.3	75.7	83.7						82.5	3.9
B Break Strength (ppi)	80.5	79.8	79.4	80.9	80.4						80.2	0.6
A Break Elongation (%)	208	248	262	130	145						199	59
B Break Elongation (%)	185	201	170	209	239						201	26
Tear Resistance (ASTM D 1004)												
A Tear Strength (lbs)	17	19	16	16	17	17	17	16	18	18	17	1
B Tear Strength (lbs)	18	17	18	16	17	17	16	15	17	15	17	1
Low Temperature Brittleness (ASTM D 1790, -29C)											% passing	
A (Pass/Fail)	Fail	Fail	*	*	*						0	
B (Pass/Fail)	Fail	Fail	*	*	*						0	
* Insufficient material to complete the required number of replicates												
Percent Plasticizer (ASTM D 2124)												
Plasticizers:				19.2							19.2	

A and B direction assigned by laboratory perpendiculer to each other in absence of marked direction by client

The testing is based upon accepted industry practice as well as the test method listed. Test results reported herein do not apply to samples other than those tested. TRI neither accepts responsibility for nor makes claim as to the final use and purpose of the material. TRI observes and maintains client confidentiality. TRI limits reproduction of this report, except in full, without prior approval of TRI.

Assessment

TRI received two exposed samples with no baseline or unexposed representative sample material for comparison purposes. Thus, this material assessment is provided based on an understanding of present day specifications for buried flexible PVC geomembranes.

The exposed PVC geomembranes received for evaluation demonstrated a loss in ductility. Unexposed PVC geomembranes typically have an tensile elongation at break of 380% and those tested showed an approximate 30 to 60% loss in this value. This loss of ductility was also demonstrated in failure to pass the low temperature brittleness test which requires material flexibility to pass.

Finally, this loss of flexibility is seen in the plasticizer content measurement. Typical as-manufactured PVC geomembranes have a plasticizer content by weight of approximately 30 percent. The samples received and tested showed less than 20% plasticizer present.

In conclusion, these PVC geomembranes show signs of aging via plasticizer loss and the associated loss in ductility/flexibility.

Sam Allen

GeosyntheticTesting.com
9063 Bee Caves Road / Austin, TX 78733 / 512 263 2101 / fax: 512 263 2558