

Basis of the Request to Deepen the  
Hu Honua Bioenergy, LLC Disposal Wells  
UIC Application No. UH-3051

## Introduction

Based on the Approval to Construct (ATC) dated June 14, 2018 from the State Department of Health (DOH), Hu Honua Bioenergy, LLC (HHB) began construction of its first of three disposal wells. The ATC allowed the wells to be drilled to 400-foot depth (about 320 feet into groundwater) and limited the method of disposal to the available gravity head, meaning a maximum water level build-up in the well of about 80 feet, the distance from the top of the groundwater to ground level.

After Well No. 1 had been drilled to its permit-approved 400-foot depth, a disposal test was run on February 1, 2019 to determine its capacity with a build-up in the well of no more than 80 feet. That capacity was determined to be 2950 gallons per minute (GPM). The HHB plant requires the combined capacity of its three disposal wells be 15,000 GPM (21.6 MGD). At a minimum, each of the wells would have to have a capacity of at least 5,000 GPM. Capacities of 7,500 GPM would be far more preferable so that the 15,000 GPM plant disposal requirement could be met with two wells while the third was off-line for maintenance and/or rehabilitation. Clearly, far greater capacity than can be provided at 400-foot well depths and gravity delivery is required.

## Proposed Well Modifications to Achieve the Required Disposal Capacity

An application to modify the wells to provide the required disposal capacity has been submitted to DOH. The requested well section modifications include the following changes and additions:

- The well depths would be increased from 400 to 800 feet;
- Louvered casing, which was not included in the original well design, would be installed; and
- Water would be delivered into the well with a drop pipe.

Figures 1 and 2 illustrate the revised well sections as proposed. Figure 2A schematically illustrates disposal into the well, down the drop pipe, and into the formation. The increased depth is needed to provide the required capacity. The louvered casing will allow rehabilitation of well disposal capacity by surge blocking as well as by pumping, improving the effectiveness of the rehabilitation. The use of the drop pipe for delivery into the well is to minimize air entrainment which can temporarily reduce disposal capacities dramatically.

## Change of the Discharge Depth with the Proposed Disposal Well Modifications

Figure 3 is a temperature and salinity profile through the water column of UIC Well No. 1. The groundwater gets colder with depth and this trend is expected to continue with increased depth. It is also clear that at its present depth, the bottom of the well penetrates into the top of the transition zone. At the proposed 800-foot depth for the disposal wells, the lowest 300 feet is likely to be saline groundwater of salinity comparable to that of ocean water. Delivery of the plant's cooling water with the proposed well modifications will be at greater depths in the underlying groundwater body and would likely emerge further offshore.

## Monitoring the Potential Impact on the Department of Water Supply's Kulaimano Well

In letters to DOH, the County Department of Water Supply (DWS) has expressed its concern that the plant's pumping and disposal activities may adversely impact its Kulaimano (Pepeekeo) Well, identified as State No. 5006-001. Monitoring during testing and subsequent operation of the HHB wells will be undertaken to specifically address DWS' concerns. The DWS well is located a little over a mile inland from the HHB wells. There are two wells situated almost midway between the HHB wells and the

DWS well. They are identified as Well Nos. 5005-001 and -007 and both are owned by HHB (their locations are shown on Figure 4; note that Well 5005-007 has replaced Well 5005-002 at the same location, as Well 5005-002 has been sealed).

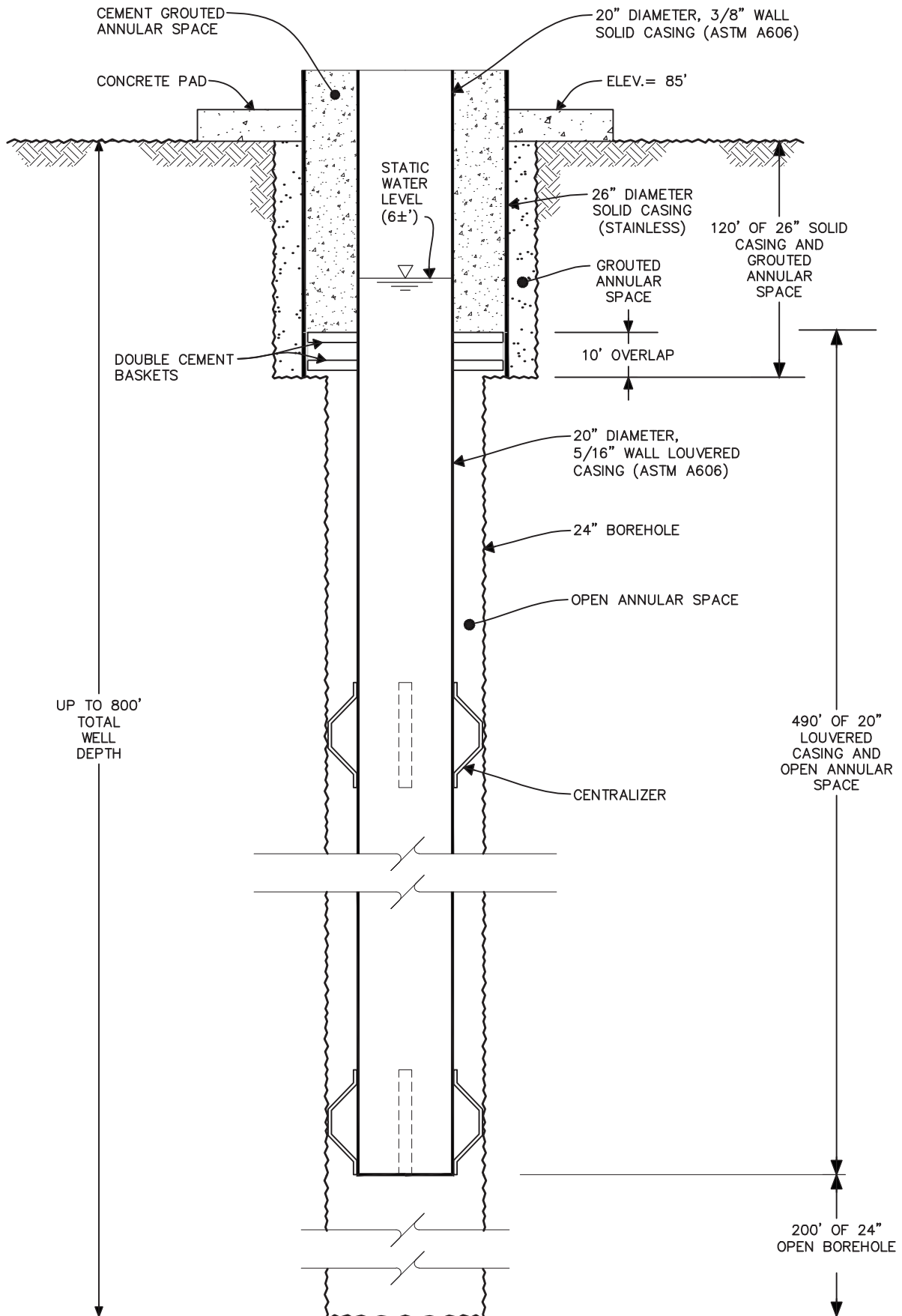
Testing of each of the three disposal wells after deepening to 800-foot depth will be done according to the permit requirements which will include a 12-hour constant rate test at 5000 GPM or possibly greater rate, depending on individual well capacity. The source of water for these disposal tests will be one (or possibly more than one) of the three existing supply wells. At least 24 hours in advance of each of these tests, water level recorders will be installed in both of the intervening HHB wells. The recorders will be retrieved 24 or more hours after the end of each test. The water level records will then be analyzed for any response to the testing activity. Within seven (7) calendar days or less from the end of the test, results of the monitoring will be submitted to DOH-UIC. All results will also be incorporated into the permit-required final report.

These DOH-UIC permit-required tests will be for one disposal well at a time. When the plant is in operation, there will be two or three disposal wells and three of the supply wells operating. Total pumping and disposal will be at 15,000 GPM. Also, the water being disposed will be up to 17°F warmer than produced by the supply wells, allowing temperature as well as water level to be monitored at both intervening HHB wells. Extended monitoring of both water level and temperature in the two HHB intervening wells will be conducted to determine if the supply and disposal activities at the HHB plant will have a detectable impact at either of the two intervening wells. During the plant's first year of operation, reports of this ongoing monitoring would be submitted to DOH-UIC on a monthly basis.

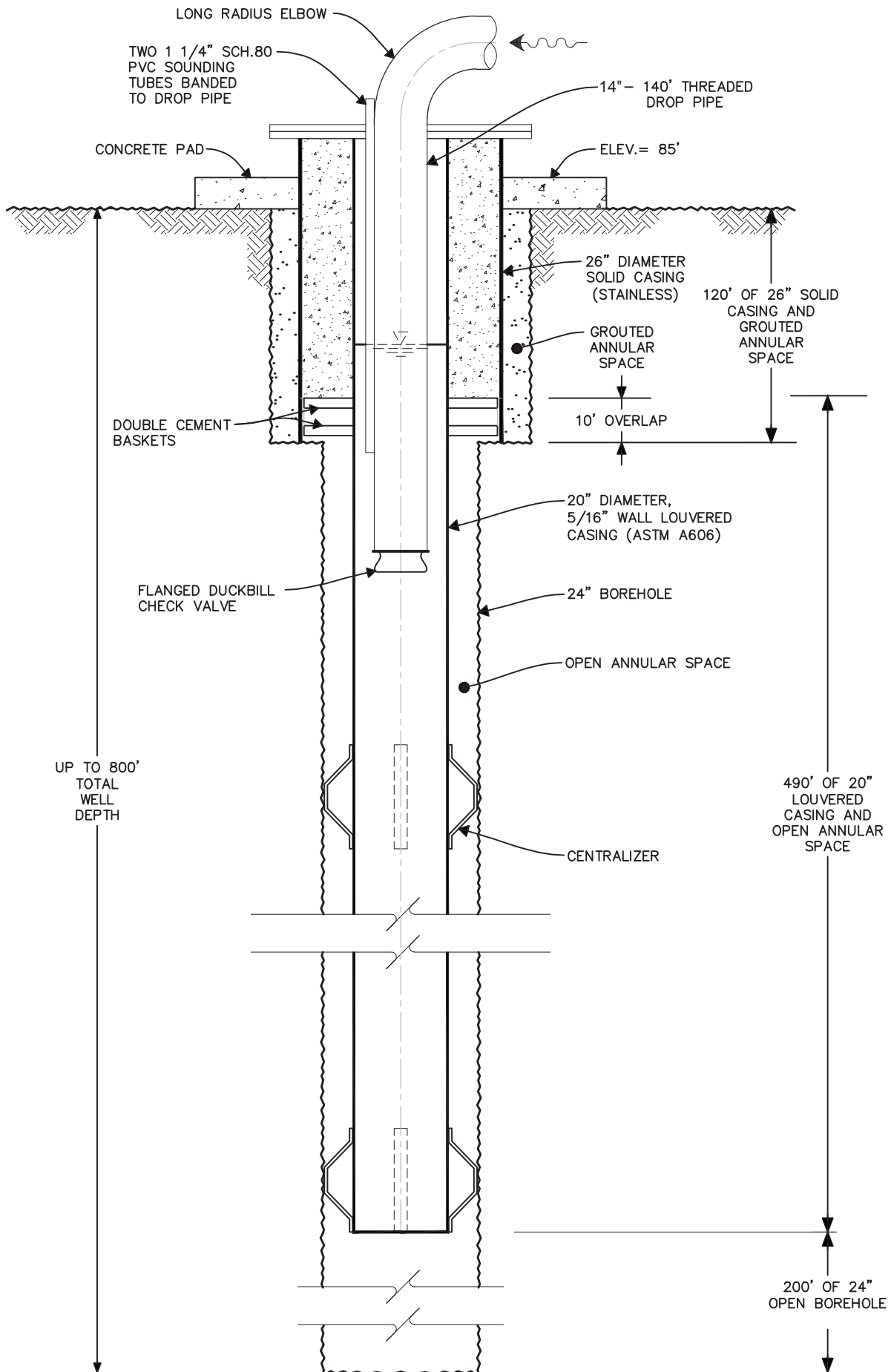
### **Groundwater Modeling of Potential Thermal Impacts**

As described in the May 16, 2019, "Thermal Analysis of Future Cooling Water Discharge, Refined Groundwater Modeling" by Integral Consulting Inc., a groundwater model using the USGS Seawat program has been developed and is currently being refined. This refinement will enable potential impacts on groundwater to be predicted over an area large enough to include DWS' Kulaimano Well and to better predict where in the marine environment the spent cooling water will emerge. Notably, data from the deepened disposal wells, including salinity and temperature profiling, will become available for further refinement of the groundwater model. Based on the data available to date, preliminary model simulations of the 800 feet deep disposal wells indicate that the effect of HHB operations on groundwater will not extend as far inland as the closest of the two HHB intervening wells, much less the DWS well further inland. This is illustrated on Figure 4. The gray area in the plan view at the top of Figure 4 identifies areas inland and offshore of the HHB supply and disposal wells where increases in groundwater temperatures are simulated to be increased by more than 0.5°F. The inland extent does not reach either of the two HHB intervening wells. The lower cross section drawing on Figure 4 is aligned and at the same horizontal scale as the modeled area depicted on the plan view above. These simulation results are to be verified with monitoring of the intervening wells during testing and subsequently after the plant is put into operation as described above.

Attachments



**Figure 1**  
**Well Section of Proposed Deepened Disposal Wells**



**Figure 2**  
**Proposed Drop Pipe for Delivery into the Disposal Wells**

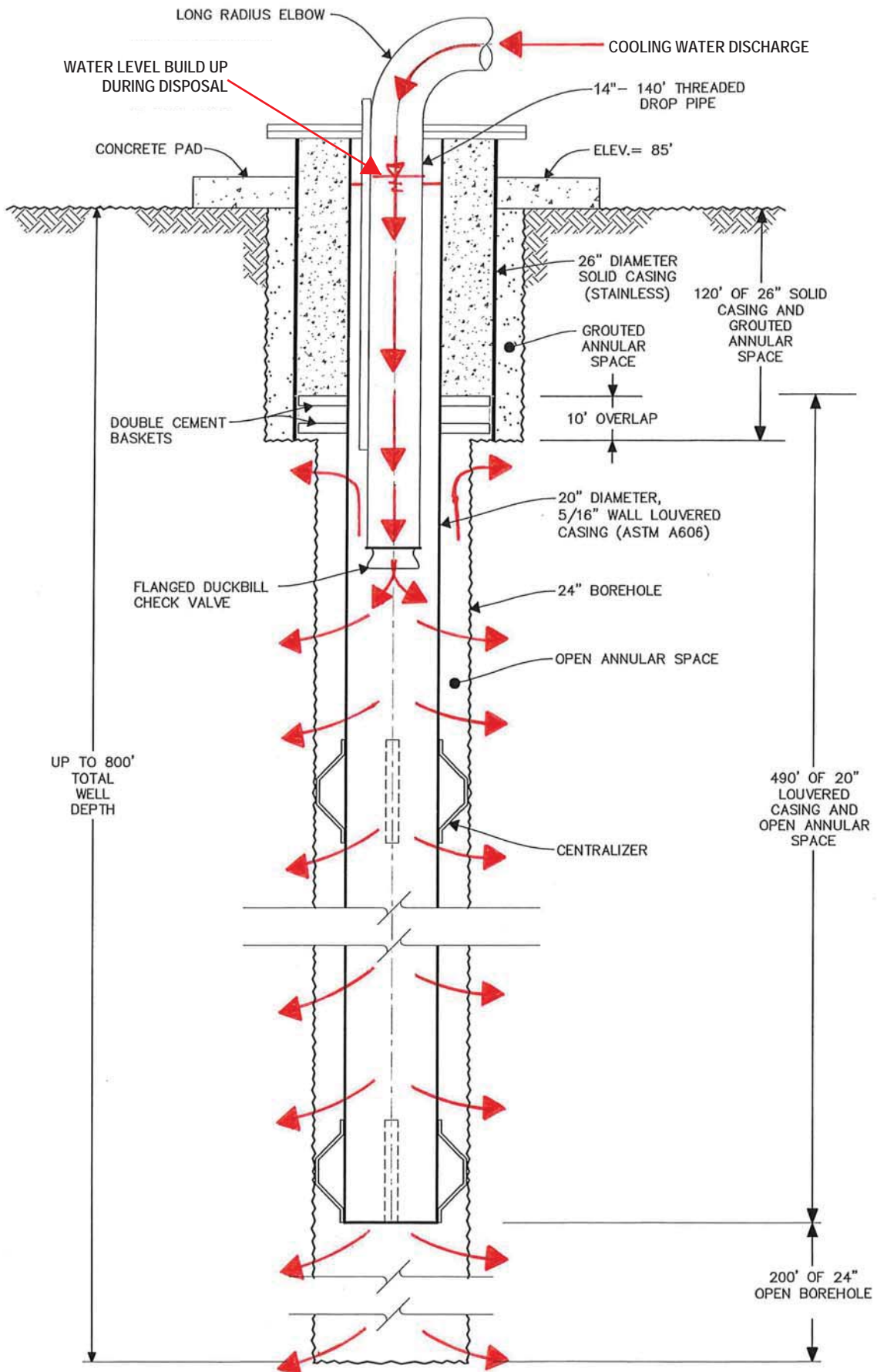
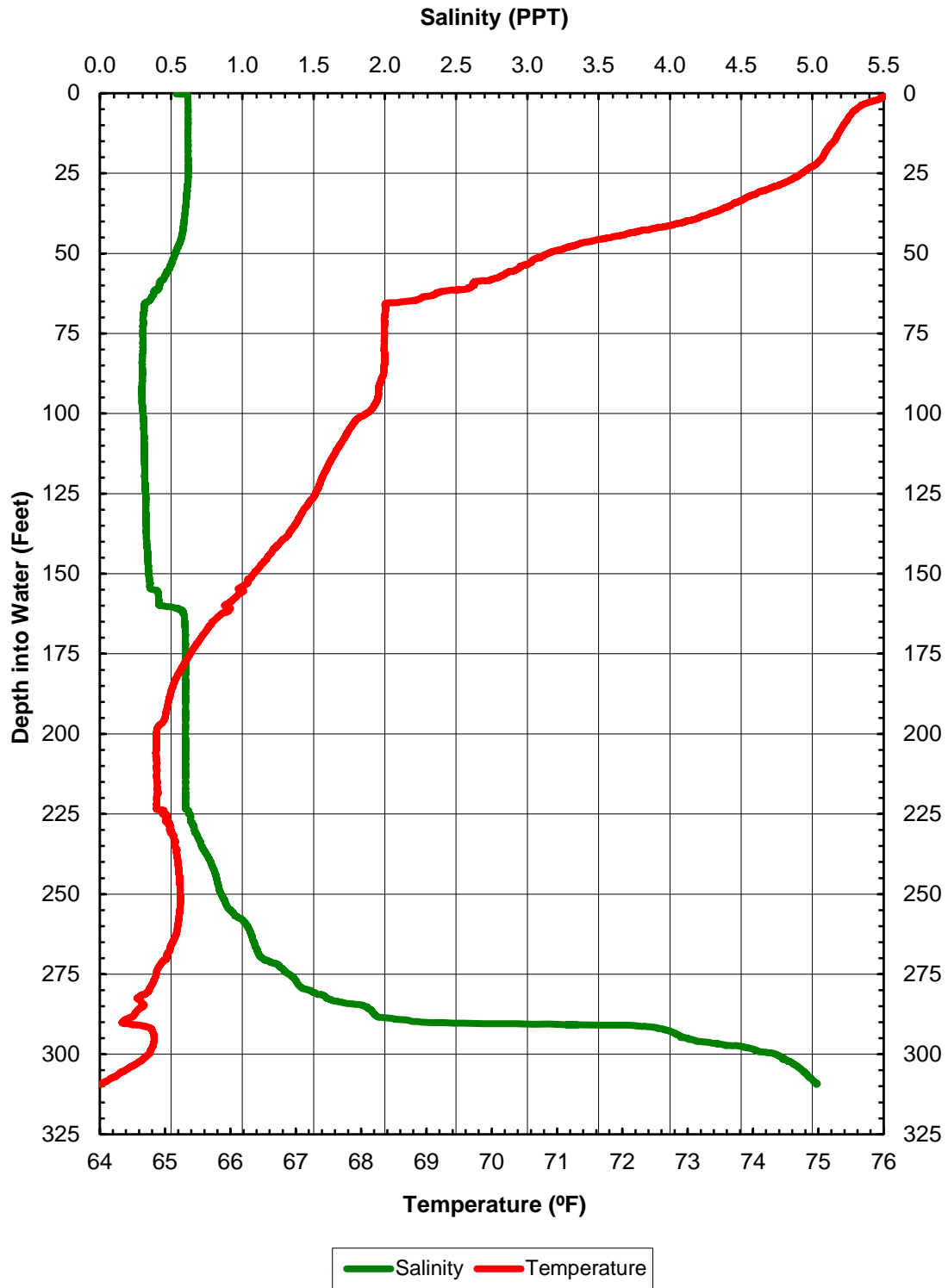
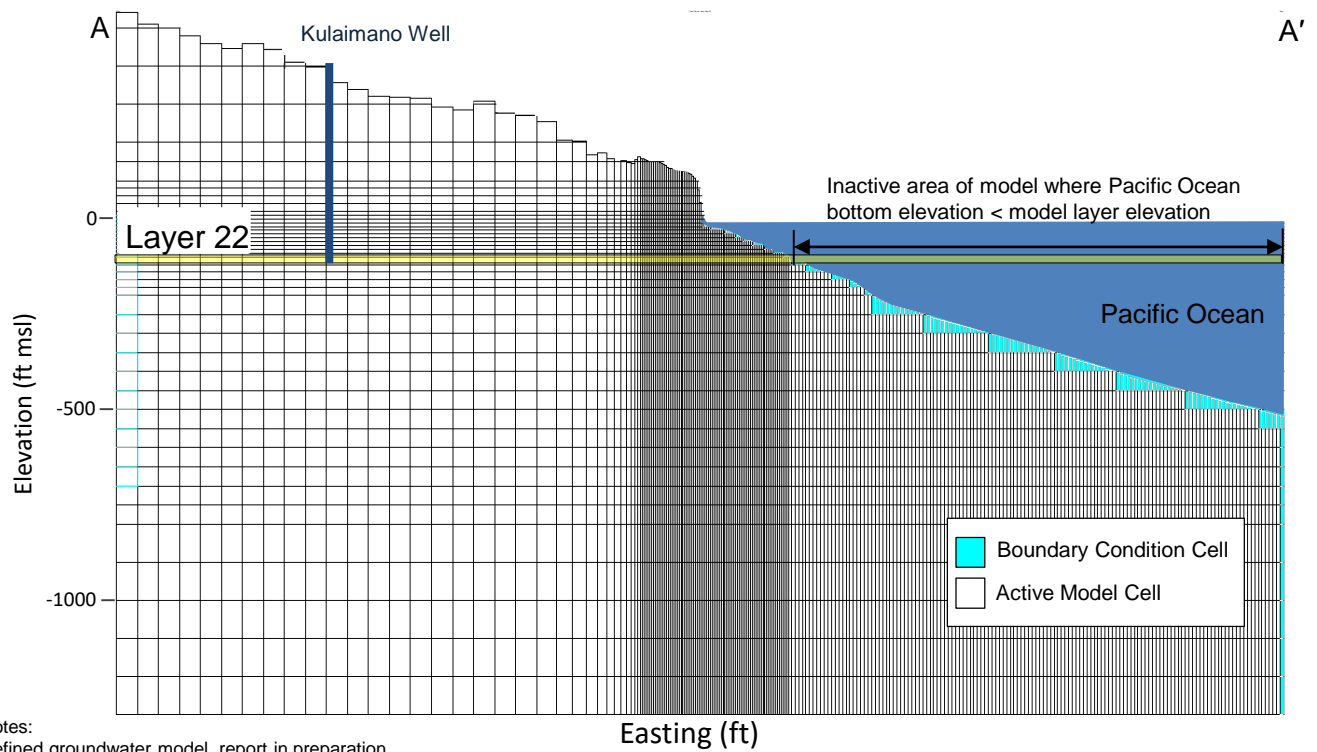
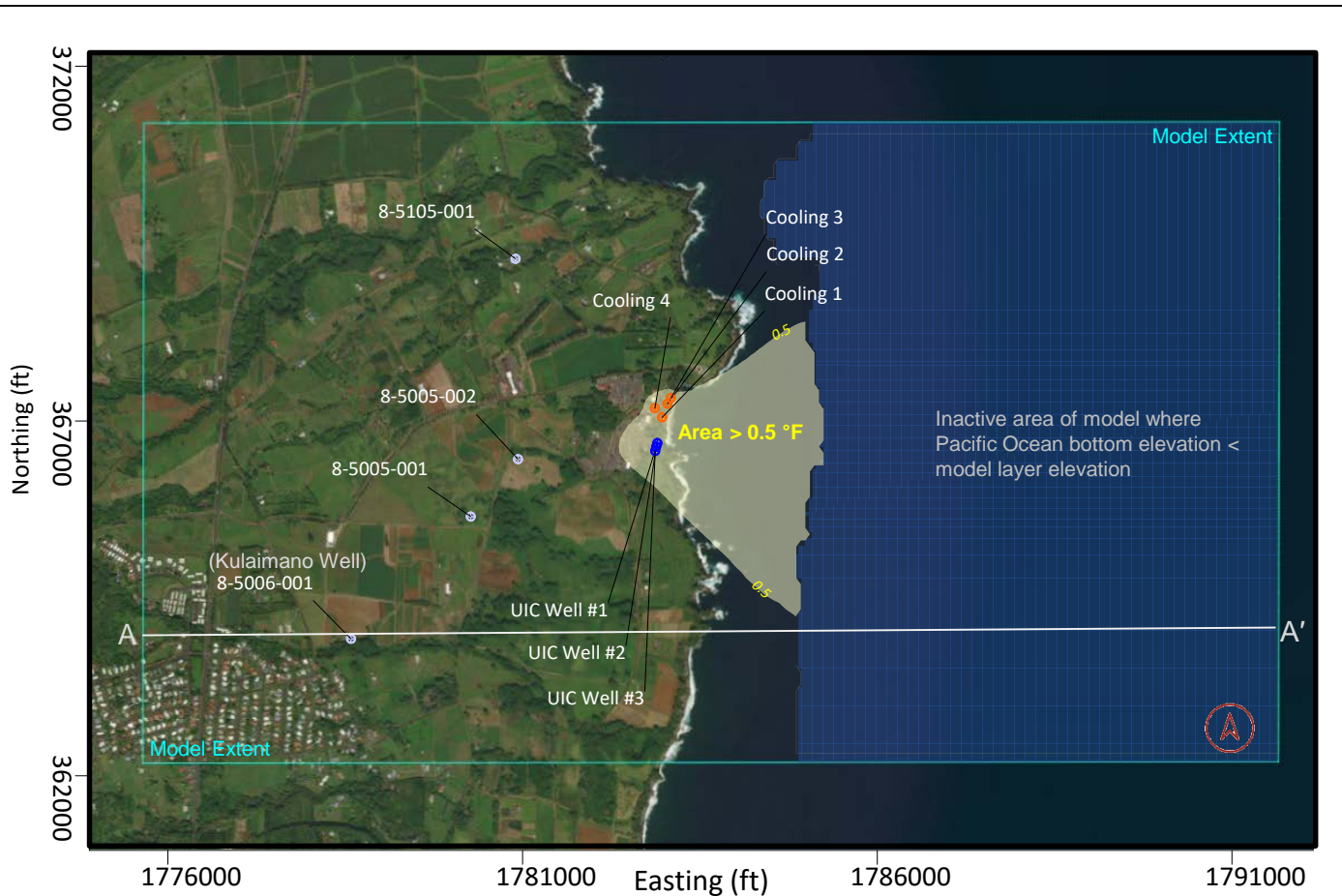


Figure 2A  
 Delivery of Cooling Water Discharged  
 into the Disposal Wells

Figure 3  
Salinity and Temperature Profile through the Water Column  
of Hu Honua UIC Well No. 1 on January 7, 2019





Notes:  
 Refined groundwater model, report in preparation.  
 Change in temperature between anticipated operating scenario and no HHB operations (base case) after 50 years of operations.  
 Temperatures shown in model layer 22 (-100 to -110 ft msl, bottom of Kulaimano well at -114 msl).  
 Coordinate System: NAD83/Hawaii US ft.

**Figure 4.**  
 Model Cross Section and Area where Model-Simulated change in Groundwater Temperature Exceeds 0.5 °F in Model Layer 22 (-100 to -110 ft msl), Anticipated Operating Scenario