Construction Dewatering Mitigation Plan

PPL Bell Bend Nuclear Power Plant
Salem Township, Luzerne County, PA

1. Executive Summary

Certain elements of the BBNPP infrastructure are proposed to be constructed in locations which will require dewatering to support completion of construction under dry conditions. The need to dewater prior to and during construction exists in part because the construction of critical safety-related structures will require excavation of soil and weathered rock as well as placement of engineered fill beneath foundations. This section will provide descriptions of dewatering activities, explain the impact that site activities will have on groundwater levels during and post-construction, discuss the environmental impacts that may result from dewatering, and explain proposed monitoring and mitigation measures.

During construction activities, three different site areas will be excavated down to competent bedrock. These three areas include the Power Block (Nuclear Island) area, the Essential Service Water Emergency Makeup System (ESWEMS) Pond area, and the area beneath the Cooling Towers. During excavation, variable amounts of groundwater will be encountered at each of these three areas. Because the excavation, backfilling, and construction activities need to be performed in dry conditions, temporary groundwater controls will be required during construction. The groundwater elevations will be drawn downward to below the deepest portion of each excavation with dewatering wells and/or sumps. Construction dewatering for the Power Block and Cooling Towers is anticipated to be minor and will be accomplished with a series of gravity drains and sump pumps. No adverse impacts to jurisdictional waters are anticipated as a result of construction dewatering in these areas.

Dewatering required for the construction of the ESWEMS pond will be more extensive, and is the subject of this narrative. Based upon computer modeling of groundwater levels in the vicinity of the proposed ESWEMS Pond, absent mitigation a depression of groundwater levels will occur over the multi-year pumping period. This depression would range from near-zero impact to many feet of groundwater elevation depression within wetlands nearby the source of withdrawal.

While a slurry wall will be constructed to aid in containing the aerial extent and depth of groundwater depression, this measure alone will not likely prevent adverse impacts to nearby wetlands and watercourses. Therefore, PPL is proposing to implement appropriate mitigation to maintain suitable hydrologic conditions in affected wetlands during periods of intense groundwater withdrawal.

To effectively determine mitigation needs, baseline monitoring of hydrologic conditions within the zone of influence of pumping is proposed. A series of shallow piezometers and soil moisture monitoring devices will be installed in strategic locations, and data collected during a baseline monitoring period will be used to complement data from existing flow gauges and monitoring wells at BBNPP. This record of information will serve as a benchmark for comparison to determine the mitigation needs during the pumping period.

Mitigation measures will include introduction of water to affected wetlands and/or watercourses, as needed, from one or more subsurface storage reservoirs constructed on the site to store pumped groundwater. Application of stored water will be completed by a temporary irrigation system, and continued monitoring of the wetlands will be completed to allow real-time flow corrections to maintain conditions reflecting the baseline.

Post-construction evaluation of affected wetlands will be completed to determine if any additional restoration activities are required to offset any unintended impacts. The compensatory mitigation program for BBNPP includes mitigation measures provided to offset any loss of function or value of affected wetlands during the period of impact from groundwater withdrawal.

2. Background

Avoidance of groundwater impacts was evaluated with regard to the placement of safety-related structures. Given the location of the main power block and the resulting location of the Bell Bend Switchyard, the Cooling Towers and the ESWEMS Retention Pond were placed in the only obvious locations. They must be located in the protected area, near the power block, and meet NRC design specifications. Within these constraints the facilities were sited to avoid permanently impacting the exceptional value wetlands.

The safety-related ESWEMS Retention Pond provides 27 days of makeup to the cooling tower basins. The total design volume of this pond includes the make-up water

requirements (i.e. evaporation and drift) for the cooling towers, 30 days of seepage through the pond clay liner, and the volume of water lost to an ice cover. To satisfy these design requirements, the resulting pond measures 700 ft. by 400 ft. at grade level, contains at normal operating levels about 76.6 acre-ft of water and has a water depth of 17 feet. During construction the ESWEMS pond excavation is expected to fully penetrate the overburden soils and the upper weathered rock. The excavation will in a worst-case require removal of up to 56 feet of overburden and weathered bedrock.

The location of the ESWEMS Pond and the depth of the associated excavation requires a depression of existing groundwater elevations by over 50 feet to ensure dry conditions. An active dewatering system will be installed to support dewatering activities, which will be maintained continuously for up to 24 months. Analyses of the dewatering system requirements and modeling of predicted impacts to groundwater elevations is described in technical reports completed in 2010 (Ref. 1, 2).

3. Dewatering Activities

Dewatering will be accomplished through the installation of an active extraction system of wells and collection trenches situated at the interface of the overburden/rock interface. Additional passive dewatering via construction of collection trenches may also be necessary north of the nuclear island in the location of the proposed cooling towers. One or more sedimentation/detention ponds will be used to store extracted groundwater, and provide suitable treatment to ensure it is suitable for beneficial reuse.

A subsurface bentonite slurry flow barrier will be installed around portions of the areas to be excavated and dewatered. A continuous wall with its lowest elevation situated upon bedrock will be installed to contain the area of impact from dewatering.

The predicted volume of groundwater to be extracted would average 350 gallons per minute (gpm), which is equivalent to 0.5 million gallons per day (gpd). The period of dewatering will be concurrent with the period of time required to complete subsurface construction of the facilities in the area of groundwater extraction. This period is approximately two years.

3.1 Potential Impacts from Dewatering

Modeling of steady-state aquifer conditions under various scenarios was completed, using the Schlumberger Water Services Visual MODFLOW software (2009 version). Water flow

budget and drawdown forecasts for dewatering using a flow barrier is the condition germane to the prediction of potential impacts to wetlands and streams, and is used as the basis for the evaluation of impacts presented here.

3.2 Area of Effect

The estimated area of detectable groundwater elevation depression within wetlands is depicted in Figure 1. This Area of Effect, focused to the west of the ESWEMS pond, includes approximately 5.6 acres of Wetlands 11 and 12 and approximately 1400 lineal feet of Tributary 1 to Walker Run and Tributary 2.

3.3 Extent of Impacts

The estimated level of groundwater elevation variation from "normal," or baseline conditions (described in Section 4.9) is expected to range from imperceptible at lower pumping volumes up to several feet of depression during maximum pumping conditions if mitigation measures are not implemented. In an unmitigated condition, this level of variation is likely to have an impact on hydrophyte growth and speciation as well as overall wetland biochemistry, and would affect the functions and values of the affected wetlands over the period of impact (Ref 3).

4. Monitoring Plan

Monitoring of hydrologic conditions and inputs are proposed as part of the dewatering impact evaluation and mitigation program in the pre-dewatering, active dewatering, and post-dewatering periods. The goal of the monitoring programs are to accurately establish baseline conditions, to ensure that mitigation actions mimic the baseline, and to evaluate any adverse impacts to affected wetlands following completion of dewatering activities.

Baseline conditions are herein defined as records of streamflow, shallow soil moisture levels, and groundwater (or perched water) elevations within the area of effect. The baseline will include these data, which PPL proposes to collect for a minimum two year period prior to the initiation of groundwater withdrawal. This data will be evaluated on a monthly, seasonal, and total average basis with applicable statistical analyses. The baseline data set will also include precipitation and temperature over the study period, allowing a generalized normalization of baseline to account for water balance inputs and outputs such as precipitation and evapotranspiration.

4.1 Monitoring (Pre-Construction)

Collection of data for the purpose of defining baseline conditions is proposed to be completed over a time span of at least two years. The determination of whether two full seasons of data is enough to establish pre-construction conditions or if augmentation of the data record is needed is dependent upon the level of variability observed within shallow groundwater and streamflow conditions during the first two seasons of monitoring.

Low variability in the hydrologic measurements collected will be taken as an indication that the data collected is suitable for use as a representative baseline condition that can be employed to guide mitigation measures designed to avoid long- and short-term hydrologic impacts to streams and wetlands within the Area of Effect. Moderate to high variability may dictate collection of additional data to ensure the baseline conditions captures a realistic range of hydrologic conditions.

The methods of data collection, as well as the interpretation and analysis of monitoring results will generally follow the standards set forth in the ACOE publication "Technical Standard for Water Table Monitoring of Potential Wetland Sites," a Wetlands Regulatory Assistance Program report (ERDC TN-WRAP-05-2) published in June, 2005.

Primary parameters to be collected as part of the monitoring program include shallow groundwater (or perched water) elevations, streamflow depths, and soil moisture.

The purpose of monitoring and baseline establishment for all 3 parameters is to support appropriate mitigation, with an operation goal of mimicking baseline conditions through direct addition of water following initiation of dewatering activities.

Figure 2 illustrates the proposed location of shallow wells (piezometers), stream gauges, and soil moisture probes, as well as the locations of existing piezometers and in-stream pressure transducers. The existing instrumentation has been recording data at 10 minute intervals since November 2009, and was installed to support other mitigation efforts.

Shallow groundwater will be measured through the installation of shallow groundwater wells, or piezometers. Six piezometers are proposed to be installed in the wetlands within the Area of Effect. These six piezometers will be installed along two transects spanning the wetland features located within the area of effect. Data logging pressure transducers will be installed

in the piezometers and record shallow groundwater elevations to 0.01 ft increments at 10-minute intervals.

Two soil moisture probes will be installed on each transect, between the piezometers, for a total of four soil moisture sensors. Average soil moisture in the upper 12" of the soil profile will be measured. These probes will be connected to data loggers that will be set to record at intervals similar to the pressure transducers. These measurements will reveal whether or not shallow soils within the wetlands are between saturation and field capacity, being roughly equivalent to the range of appropriate growing season root zone wetland hydrology. The extent of saturation as well as the number of weeks during the growing season that saturated/moist soil conditions exists will add to the definition of baseline hydrology within the Area of Effect.

Streamflow monitoring at BBNPP has been ongoing in select areas since 2008. Flow depth has been recorded in 10-minute intervals at the locations shown in Figure 2 since November 2009. Flow within the streams located in the Area of Effect will continue to be monitored in four locations, as shown on Figure 2.

4.2 Monitoring (Active Withdrawal)

Following initiation of groundwater withdrawal continued monitoring of streamflow, shallow groundwater elevations, and soil moisture will be maintained. While the measurement and monitoring schedule is proposed to be the same during the pre-withdrawal period as during pumping, data will be downloaded and evaluated daily to determine the need for supplemental irrigation to maintain the baseline hydrologic conditions. Seasonal and diurnal fluctuations, as well as recent rainfall data will be evaluated on a daily basis and compared to baseline conditions for the current season and rainfall history. Deviation of the shallow groundwater depth, soil moisture, and/ or streamflow from the baseline conditions will serve as a trigger to initiate irrigation, as needed, to sustain the baseline hydrology.

4.3 Monitoring (Post-Construction)

Monitoring of identical parameters at the same frequency following completion of groundwater withdrawal activities is proposed to ensure that hydrologic conditions return to a steady-state condition. Post-construction monitoring data will be downloaded daily for the first two weeks following completion of dewatering activities, and weekly for an additional six weeks. After that time, monitoring will continue for at least the remainder of the growing

season with monthly data download and comparison to baseline conditions. If the post construction monitoring results indicate a return to baseline conditions with no supplemental irrigation for the growing season following the completion of dewatering activities, then subsequent monitoring may be suspended.

5. Mitigation

Mitigation of potential negative impacts to wetlands and streams resulting from groundwater withdrawal is proposed via direct provision of makeup water. For the purposes of this project, successful mitigation is proposed to be achieved when observation of shallow groundwater, surface water, and soil moisture indicates that wetland hydrologic conditions within the Area of Effect mimic baseline conditions. Acceptable tolerances for groundwater elevations during pumping are proposed to be less than three inches difference between seasonally observed baseline water surface elevations from the same time period during pre-construction. Acceptable tolerances for stream flow depth are proposed to be less than two inches difference between seasonally observed flow depth during pumping and baseline conditions; however field judgment may need to be exercised during summer months when baseline conditions may indicate little to no flow. Acceptable seasonal ranges for each monitoring location will be established as part of the pre-construction monitoring work.

Makeup water to be used for mitigation will be supplied by the dewatering pumps and routed to an on-site settling basin to remove any entrained sediment. If wetland or streamflow observations indicate a reduction in flow requiring mitigation, water will be directly introduced to the affected stream channel or wetland via a temporary irrigation system. A schematic of the pumping and irrigation system is provided in Figure 3.

5.1 Mitigation Water Supply

Pumped groundwater from the construction dewatering operation will be discharged into the first cell of a two-cell holding pond. Each cell has the capacity to hold twenty-four hours of pumped water at the anticipated pumping rate. The total pond capacity is equal to two days of pumping volume. Overflow from the pond will be conveyed via a temporary swale to the downstream end of Wetland 11, from there it will be conveyed to Tributary 1 of Walker Run via a proposed culvert. The dewatering pumping rate will be approximately 0.7 cfs, so impacts to the existing downstream channels are not anticipated. The pond depth will be six to eight feet, and water will be drawn from the bottom to minimize thermal impacts.

5.2 Irrigation System

A temporary irrigation system will be installed with sprinkler heads on the east side of Wetland 11 and on the north side of Wetland 12. In addition, piping will be in place to supplement stream flow to the Tributary 1 of Walker Run and Tributary 2, as needed. The irrigation system will consist of four zones such that supplemental flow can be added to either wetland or stream independently based on the needs identified by the construction phase monitoring. Daily monitoring results will be compared to established seasonal baseline ranges and the irrigation system will be activated if actual conditions are below the acceptable ranges.

5.3 Maintenance of Baseline Conditions

As discussed in Section 4.1, establishment of baseline hydrologic conditions in on-site streams and wetlands is being completed to provide a reference condition towards which mitigation activities may be targeted. This baseline provides a multi-year, all-seasons reference to guide mitigation actions, including provision of makeup water to the affected areas.

Critical to the effectiveness of preventing adverse impacts to wetlands is ensuring mitigation activities correctly mimic baseline conditions. Continued monitoring of wetlands within the area of effect using the same monitoring points/devices and similar monitoring equipment is proposed to evaluate the success of mitigation actions and to serve as a positive feedback system to dictate changes in the type, extent, and duration of mitigation.

6. References:

- Construction Dewatering Design, Bell Bend Nuclear Power Plant, UniStar Nuclear Energy, Report No. SL-009655, Revision 2. Sargent & Lundy, LLC. November 23, 2010.
- Evaluation of Temporary Construction Dewatering Strategies, Proposed Bell Bend Nuclear Power Plant, Berwick, Pennsylvania. Weaver Boos Consultants North Central, LLC. October 20, 2010.
- *Wetlands, 2nd Ed.* William J. Mitsch and James G. Gosselink, 1993.

Figure 1:
Potential Area of Dewatering Impacts

Land Studies

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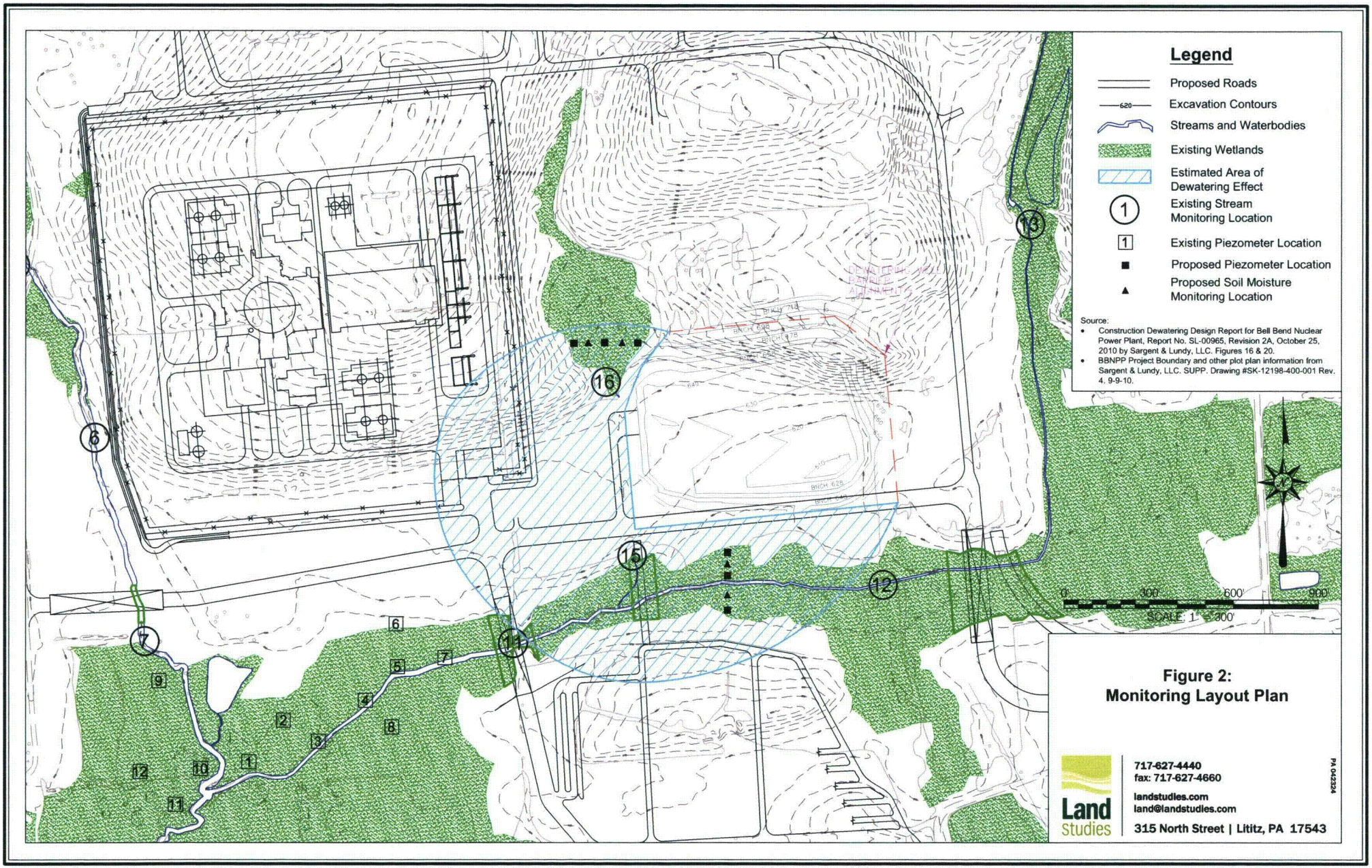
Legend
Proposed Roads
620
Excavation Contours
Streams and Waterbodies
Existing Wetlands
Estimated Area of Dewatering Effect
1
Existing Stream Monitoring Location
1
Existing Piezometer Location
Proposed Piezometer Location
Proposed Soil Moisture Monitoring Location
Source:
• Construction Dewatering Design Report for Bell Bend Nuclear Power Plant, Report No. SL-00965, Revision 2A, October 25, 2010 by Sargent & Lundy, LLC. Figures 16 & 20.
• BBNPP Project Boundary and other plot plan information from Sargent & Lundy, LLC. SUPP. Drawing #SK-12198-400-001 Rev. 4, 9-9-10.
0
300'
600'
900'
SCALE: 1" = 300'
Figure 2:
Monitoring Layout Plan
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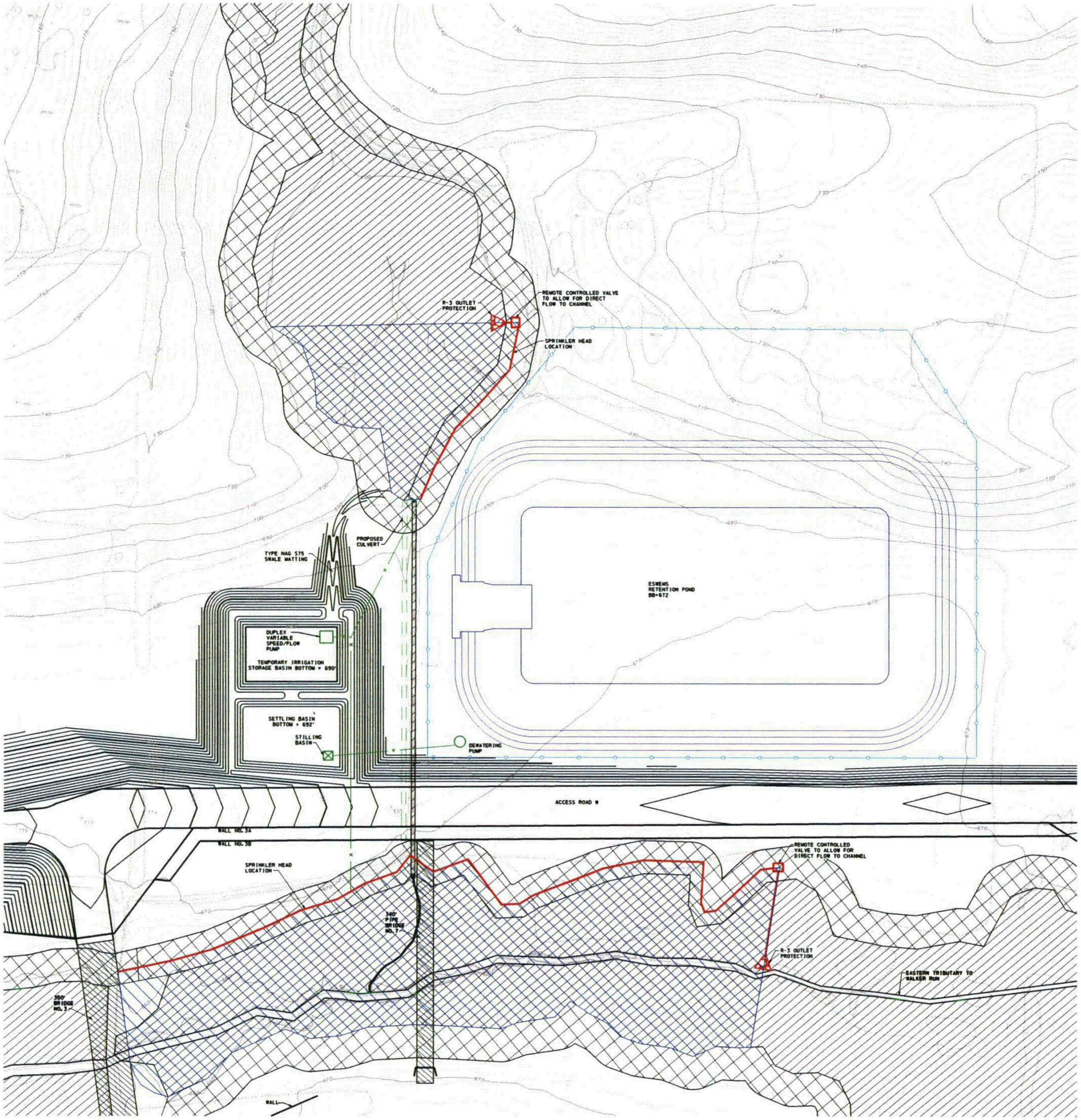

NOTES:

1. EACH BRANCH OF THE IRRIGATION SYSTEM WILL BE CAPABLE OF MITIGATING 350 GPM FROM THE DEWATERING OPERATION BY MEANS OF DIRECT DISCHARGE TO THE STREAM CHANNEL OR SPRAY IRRIGATION OF THE WETLANDS.
2. SPRINKER HEADS WILL BE SPACED 20' APART.
TEAR DROP WETLAND SPRINKLER HEADS WILL BE CAPABLE OF SPRAYING NO LESS THAN 22 GPM.
3. THE EASTERN TRIBUTARY TO WALKER RUN SPRINKLER HEADS WILL BE CAPABLE OF SPRAYING NO LESS THAN 6 GPM.
4. EACH SPRINKLER HEAD WILL HAVE AN OPERATIONAL PRESSURE OF 30-40LBS/SQ-IN.
5. THE DUPLEX VARIABLE SPEED/FLOW PUMP WILL BE CAPABLE OF PUMPED NO LESS THAN 350GPM.

6. THE DEWATERING POND WILL HAVE TWO DAYS OF STORAGE.
7. THE FIRST BAY WILL HAVE THE CAPACITY TO ALLOW THE PUMPED WATER TO SETTLE FOR 24HRS.
8. THE SECOND BAY HAVE THE CAPACITY TO ALL IRRIGATION FOR 24HRS.
9. THE POND HAS AN EMERGENCY SPILL WAY THAT WILL ALLOW UNNECCESSARY WATER TO PASS TO THE STREAM CHANNEL.

LEGEND

- REMOTE CONTROLLED VALVE TO ALLOW FOR DIRECT FLOW TO CHANNEL
- DUPLEX VARIABLE SPEED/FLOW PUMP
- STILLING BASIN
- DEWATERING PUMP
- SPRINKLER SPRAY ZONE
- 50' EXCEPTIONAL VALUE (EV) WETLAND BUFFER
- WETLANDS
- SPRINKLER HEAD LOCATION
- WATER LINE
- FLOW BARRIER
- R-3 OUTLET PROTECTION Do = 1, W = 5, Lo = 4, 18" THICK

ROCK SIZE DISTRIBUTION TABLE			
	GRADED ROCK SIZE (IN)		
NSA NO.	MAX.	D50	MIN.
R-3	6	3	2

1 inch = 60 ft.

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DATE	NO.	REVISIONS	BY
XXXXXXXX	0	XXXXXXXX XXXXXXXXXX	XXX

ALL DIMENSIONS MUST BE VERIFIED BY CONTRACTOR AND OWNER MUST BE NOTIFIED OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK

BELL BEND NUCLEAR POWER PLANT
SALEM TOWNSHIP, PENNSYLVANIA

DEWATERING / TEMPORARY SPRAY IRRIGATION PLAN

PPL BELL BEND, LLC
38 BOMBOY LANE
SUITE 2
BERWICK, PA 18603

PPLB0802
SHEET 1 OF 1

SCALE	1"=60'
DRAWN BY	WCK
DATE	04/08/11
APPROVED	JFM
DRAWING NO.	DE-WATER