

# **CCR RULE COMPLIANCE**

## **ASH FILTER PONDS INFLOW DESIGN FLOOD CONTROL SYSTEM INITIAL PLAN**

Prepared for:



GenOn Northeast Management Company  
Keystone Generating Station  
Shelocta, Pennsylvania

Prepared by:



CB&I Environmental & Infrastructure, Inc.  
Pittsburgh, Pennsylvania 15235

October 2016

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## **1.0 Introduction**

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On December 19, 2014, the Administrator of the United States Environmental Protection Agency signed the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities final rule (the Rule). The Rule was published in the Federal Register on April 17, 2015, became effective on October 19, 2015, and is contained within amended portions of Title 40, Part 257 of the Code of Federal Regulations (CFR). The Rule establishes a comprehensive set of requirements for the disposal/management of CCR in landfills and surface impoundments at coal-fired power plants under Subtitle D of the Resource Conservation and Recovery Act. These requirements include compliance with location restrictions, design criteria, operating criteria, groundwater monitoring and corrective action criteria, and closure and post-closure care aspects.

Included with the operating criteria under 40 CFR §257.82 are requirements to prepare an initial inflow design flood control system plan (Plan) and subsequent periodic Plans for all existing, new, or expanded CCR surface impoundments. Pursuant to the Rule, this Plan is to serve as documentation by a professional engineer that the CCR unit is designed, constructed, operated, and maintained with an inflow design flood control system that will adequately manage flow into and from the CCR unit under the peak discharge conditions of the design flood. The specific design flood under which each CCR unit must be evaluated is based on the hazard potential classification of the impoundment as determined pursuant to §257.73(a)(2). Further details regarding the required content and criteria for the Plan (pursuant to §257.82[c]) are provided in Section 2.0 of this document. The initial Plan must be prepared no later than October 17, 2016, and periodic Plans must be prepared every 5 years thereafter.

The Keystone Generating Station (Station) is a coal-fired power plant operated by GenOn Northeast Management Company (a subsidiary of NRG Energy, Inc. [NRG]) and located in Shelocta, Pennsylvania. The Station has three surface impoundments that are subject to this Rule, specifically identified as Ash Filter Ponds A, B and C. The ponds are utilized as part of the bottom ash management system, and are used for the settling of fine ash particles from sluice water. Sluice water that is pumped through the ash hoppers associated with Units # 1 and #2 flows to four bottom ash dewatering bins known as hydrobins. Overflow and decant water from the hydrobins gravity flows via piping to a distribution box, where it is directed to the ash ponds. Under normal operating conditions, all three ponds are in service; however, adequate capacity is provided by two ponds such that it is possible to periodically remove one pond from service for cleaning and maintenance. Accumulated bottom ash that is removed from the ponds during cleanout activities is transported to the Station's CCR landfill facility (comprised of the East Valley and West Valley Disposal Sites). The locations of the Station and the ponds are shown on Figure 1.

NRG engaged the services of CB&I Environmental & Infrastructure, Inc. (CB&I) to develop an initial Plan for all three Ash Filter Ponds. This Plan development followed the review of available background and design information and a field visit conducted on June 7, 2016. Additionally, development of this Plan occurred following an Initial Hazard Potential Classification completed by CB&I, and documented under separate cover in October 2016.

Beyond this introductory section of the Plan, Section 2.0 outlines the regulatory requirements of §257.82; Section 3.0 describes the hydrologic and hydraulic evaluation performed for the subject impoundments, and Section 4.0 provides conclusions and recommendations regarding the adequacy of the impoundments to manage the specified flood conditions. Section 5.0 contains the professional engineer certification, and Section 6.0 lists the references that were consulted during development of this Plan.

As required, this Plan will be appropriately placed in the facility's operating record pursuant to §257.105(g)(4), noticed to the State Director per §257.106(g)(4), and posted to the publicly accessible internet site pursuant to §257.107(g)(4).

## **2.0 Hydrologic and Hydraulic Capacity Requirements of 40 CFR §257.82**

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The Rule requires owners or operators of any existing CCR surface impoundment to design, construct, operate, and maintain an inflow design flood control system (Federal Register, 2015). The ability of the system to meet these requirements must be demonstrated in the form of an inflow design flood control system Plan.

### **2.1 Demonstration of the Adequacy of the Inflow Design Flood Control System**

Pursuant to §257.82(a)(1)-(2), the design flood control system must:

- *Adequately Manage Flow Into the CCR Unit* – The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood.
- *Adequately Manage Flow From the CCR Unit* – The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

Pursuant to §257.82(a)(3), the inflow design flood that must be managed is based on the type of impoundment (incised or non-incised) and hazard potential classification as determined in accordance with §257.73(a)(2). The impoundment types and classifications and the associated inflow design floods are as follows:

- *Incised CCR Surface Impoundment* – A 25-year design flood applies to an incised CCR surface impoundment.
- *Low Hazard Potential CCR Surface Impoundment* – A 100-year design flood applies to a (non-incised) Low Hazard CCR surface impoundment.
- *Significant Hazard Potential CCR Surface Impoundment* – A 1000-year design flood applies to a (non-incised) Significant Hazard CCR surface impoundment.
- *High Hazard Potential CCR Surface Impoundment* – The probable maximum flood applies to a (non-incised) Significant Hazard CCR surface impoundment.

Since the subject ponds are diked, Low Hazard (refer to Section 3.3) impoundments, the 100-year design flood applies. Pursuant to §257.82(c), discharge from the CCR unit must be handled in accordance with the surface water requirements of §257.3-3 (i.e., the discharge must be authorized under the National Pollutant Discharge Elimination System [NPDES] program). Flow from these ponds is discharged in accordance with the Station’s NPDES permit No. PA0002062 issued by the Pennsylvania Department of Environmental Protection (PADEP).

## **2.2 *Inflow Design Flood Control System Plan***

The Rule requires preparation of an initial Plan and periodic Plans to document the adequacy of the inflow design flood control system. The Plan must be supported by appropriate engineering calculations per §257.82(c)(1) and be certified by a qualified professional engineer in accordance with §257.82(c)(5).

### **3.0 Hydrologic and Hydraulic Evaluation**

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Confirmation of the adequacy of the inflow design flood control system was performed via a hydrologic and hydraulic evaluation conducted by CB&I. The overall effort consisted of four main activities, including: (1) review of background and design information, (2) a site visit, (3) development of a hazard potential classification (provided under separate cover in a report by CB&I dated October 2016, but referenced herein), and (4) preparation of stormwater calculations. These activities are described in the sections below.

#### **3.1 Review of Background and Design Information**

Prior to the field visit, CB&I collected and reviewed available background and design information regarding the impoundments and surrounding area, including mapping, aerial images, and reports and other documents provided by NRG. Mapping and aerial images were utilized to prepare Figures 1 through 3 included with this Plan. Pertinent information identified during development of the figures included ground surface elevations and topography, surface water features, and pond design information (such as geometry, crest elevations, operating water levels, and inflow and outflow features).

The impoundments are situated on the southern reaches of the Station property, just northwest of the primary operations area. The nearest Station property boundary is to the south and southeast, and abuts Crooked Creek, which is approximately 0.4 miles away from the subject ponds. The ponds are located together in a common impoundment area and share an overall perimeter dike. Two interior divider dikes separate the ponds so that the ponds are not hydraulically connected. The impoundment area is bordered by station haul roads to the northeast, northwest, and southwest, and power plant operational areas to the southeast.

Topographic information for the subject area was obtained from LIDAR mapping (PA Department of Conservation and Natural Resources, 2006). The natural ground surface in the vicinity of the impoundment area slopes to the southwest. The embankment top elevation around the perimeter of the ponds varies from approximately 1020.5 feet mean sea level (ft msl) on the northwestern side to about 1022.5 ft msl on the southeastern side. The greatest exterior embankment height occurs on the southwestern side of the ponds, and is approximately 10.5 feet. The embankment height decreases in the northeast direction, and is minimal (approximately 1 foot) along the northeastern pond perimeter. Channels or swales are located along the toe of all four sides of the embankment area. To the northeast, this channel prevents run-on toward the embankment as well as collecting runoff from the embankment itself. Along the remaining sides, the channels collect runoff from the embankment area and convey it toward on-site treatment facilities, including the Coal Pile Runoff (CPRO) ponds located southwest of the Ash Filter Ponds and the on-site Industrial Waste Treatment Facility (IWT).

Google Earth imagery (Google Earth, 2015) was reviewed to confirm select elevations relative to those depicted in the LIDAR mapping. Google Earth indicates typical elevations ranging from approximately 1,020 to 1,022 ft msl around the crests of the impoundments, which is in general agreement with the crest elevations identified in the LIDAR mapping and design plans (Gilbert/Commonwealth, Inc., 1995).

The combined total capacity of all three Ash Filter Ponds is 17.3 acre-feet (ac-ft) (Dewberry, 2014), which equates to a capacity of about 5.8 ac-ft per pond. Under normal operating conditions, all three ponds are in service, although each pond is capable of providing 50 percent of the total required capacity to allow the temporary removal of one pond for cleaning and maintenance. The ponds are operated so as to keep a relatively constant water level for each pond that is in service. The normal water operating level for all three ponds is 1018.5 feet, which is two feet below the design crest elevation of 1020.5 feet msl.

The primary inflow to the Ash Filter Ponds is sluice water from the hydrobins. Overflow and decant water from the hydrobins gravity flows via piping to a distribution box, where it is directed through piping into the southeastern side of each pond. Some water is introduced into the system via precipitation falling directly into and around the ponds, and from additional sources (such as flow from miscellaneous sumps and drains) that are routed to the distribution box, but the majority is represented by sluice water. Suspended ash particles settle out from the water as it moves through the ponds toward the outlet structures.

Clarified water exits on the northwestern side of the ash ponds. Water gravity flows from each pond via an outlet structure consisting of two saw tooth weir troughs connected to a concrete riser box. The riser box also collects underdrain flow. A gate valve controls the underdrain flow, and is opened during pond dewatering procedures. Flow from each pond's riser box is conveyed via gravity through piping to a shared pump station located northwest of the ponds. From the pump station, primary discharge is via pumping to the Thermal Pond, which is located approximately 2000 feet northwest of the Ash Filter Ponds. The Thermal Pond discharges via NPDES-permitted Internal Monitoring Point 503 (IMP-503) to the Final Settling Pond. Overflow from the pump station can also exit through an emergency overflow pipe, which routes the water to the Final Settling Pond via IMP-203. Ultimately, the Final Settling Pond discharges to Crooked Creek via Outfall 003.

### **3.2 Field Visit**

On June 7, 2016, Laurel Lopez (CB&I senior engineer) met with Mark Jacklin (NRG Environmental Specialist) to perform a site walk and visual reconnaissance of the ponds and surrounding area. The visit was conducted to support CB&I's hazard assessment of the impoundments (provided under separate cover) and the hydrologic and hydraulic evaluation performed herein. CB&I walked the perimeter dike crest and the crest of each of the interior dikes,

and confirmed that the components and configuration of the ash water management system (pump station, inlet and outlet structures, distribution box, etc.) appeared to be in general agreement with the previously-reviewed design documents. As part of the hydrologic and hydraulic evaluation, CB&I visually assessed upstream conditions for run-on potential. Due to the diked construction of the impoundment area and the presence of a diversion ditch between the ponds and the small upstream area to the northeast, potential run-on is minimal, limited to precipitation falling directly on and in the immediate vicinity of the ponds.

### **3.3 Hazard Potential Classification**

Based on the review of background information and field observations, CB&I assigned a Low Hazard rating to each of the three subject ponds. A full discussion of the process and rationale for this assignment is provided in a report entitled, “Ash Filter Ponds Hazard Potential Classification Initial Assessment Report” (CB&I, 2016). The Low Hazard rating for each pond is based on the determination that a failure or mis-operation of these impoundments would be unlikely to cause a loss of human life and would cause minor economic or environmental losses principally limited to the surface impoundment owner’s property. In addition, a failure or mis-operation would be unlikely to impact lifeline or critical facilities or cause other significant negative effects.

### **3.4 Hydrologic Calculations**

As noted previously, the ponds are operated so as to maintain constant operating water levels in the ponds that are in service. Under normal operating conditions, this is accomplished by application of pond inflow rates that are below the capacity of the pond outfall structures with very minimal increases in water levels, such that pond outflow equals pond inflow. Accordingly, the water level rises to just slightly (less than a few inches) above the crest of the effluent saw tooth weirs, and discharge occurs until the water level drops and becomes approximately equal to the crest of the effluent weirs. For practical purposes, the normal operating water level for each pond is approximately equal to the crest of the effluent weir structure.

These calculations consider the capacity of each pond to contain stormwater from the inflow design flood. For the modeling of each pond, it is assumed that the pond is filled to its normal water operating level when the design flood occurs. The design flood is assumed to be equivalent to the design storm, since hydrologic analyses are based upon storm events rather than floods. If the available capacity of the pond between the operating water level and the crest is determined to be greater than the design storm inflow volume, the flood control system is deemed adequate to manage the flow into the pond during and following the inflow design storm. Under these conditions, the storm water inflow would temporarily raise the water level of the subject pond above the normal operating level, but would not overtop the basin crest. Conservatively, these calculations consider each pond’s capacity to temporarily hold the entire storm event inflow

volume. In actuality, pond discharge would occur during the storm event and the entire storm inflow volume would not need to be held at once.

Attachment A provides calculations showing the capability of each pond to hold the contents of a 24-hour, 100-year design storm within the volume between its operating water level and crest. The point precipitation associated with the specified storm event is 5.19 inches (NOAA, 2016). Since stormwater inflow into each pond is limited to the precipitation that falls directly on the pond footprint and upon a small area surrounding the pond, a direct computation of inflow volume was performed as the precipitation depth for the inflow design storm times the approximate pond surface water drainage area. The drainage areas were obtained via CAD and are depicted on Figure 3. The available volume between the operating water level and crest elevation for each pond was computed using the areas at each elevation (determined via CAD and shown on Figure 3), freeboard height, and the average end area method. The inflow volume and available volume were computed and compared for each pond. These calculations show the available capacity for stormwater inflow to be adequate for all of the ponds. For the 100-year storm event, it is estimated that only between 32 to 35 percent of the pond volume above the operating water level would be utilized for the ponds.

### **3.5 *Pond Outflow Considerations***

Following the design storm event, the pond water level would gradually return to its normal operating water level via the regular discharge process (gravity drainage to the ash pond pump station and subsequent pumping to the Thermal Pond). As an extra precautionary measure, the ash filter pond pump station has an overflow pipe that can route excess water to the Final Settling Pond. With the routing of both primary and potential overflow to downstream on-site ponds that would further attenuate the flow, and the routing of all discharges through NPDES-permitted outfalls located on Station property, outflow from the design storm event would not result in any adverse downstream impacts. Any such discharges would be temporary and limited. Accordingly, the inflow design flood control system adequately manages flow from each CCR unit that results from the inflow design storm.

## **4.0 Conclusions and Recommendations**

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Based upon observations, review of information, and the hydrologic and hydraulic analyses described herein (and associated calculations contained in Attachment A), the subject ponds have flood control systems that are adequate to manage flow into and from the units under the applicable inflow design flood. Any outflow from the ponds will be via an approved NPDES outfall.

These conclusions are based upon the background information provided to CB&I by NRG and field observations made around the time of the Plan preparation. The applicability of these results is dependent upon the ongoing operation and maintenance of the ponds in accordance with design documents and appropriate operating procedures. Any deviations from the crest elevations or operating conditions presented in this Plan would warrant a re-evaluation of the ponds to ensure adequate available capacity for stormwater inflow. Such a re-evaluation would fall under the provisions of §257.82(c)(2), which stipulate that the Plan must be amended whenever significant changes in CCR unit configuration/operation affect the validity of the Plan that is currently in effect. Once completed, the amended Plan must be appropriately placed into the facility's operating record. As a matter of routine maintenance/inspection, any areas of settlement, depressions, ruts, or similar features along the crest shall be regraded and filled as needed. In addition, the integrity of the grading and diversion channels around the ponds should be periodically inspected to ensure their continued functionality.

## 5.0 Professional Engineer Certification

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I attest to being familiar with the hydrologic and hydraulic capacity requirements of 40 CFR §257.82. I have personally visited and examined the Keystone Generating Station Ash Filter Ponds, and have reviewed available design and operational information for the ponds as provided by NRG. Based my observations, review of information, and analyses, the subject ponds have flood control systems that are adequate to manage flow into and from the units under the applicable inflow design flood. Further, this document serves as the Inflow Design Flood Control System Initial Plan and meets the applicable requirements of §257.82(c). I hereby certify that the information contained in this Plan is true and accurate to the best of my belief.

Name of Professional Engineer: Laurel C. Lopez

Company: CB&I Environmental & Infrastructure, Inc.

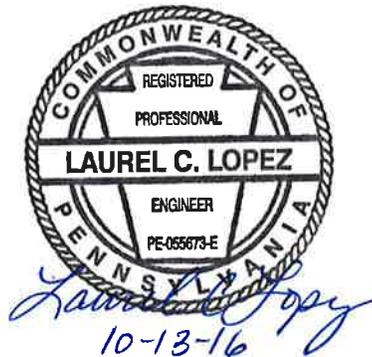
Signature: *Laurel C Lopez*

Date: 10-13-16

PE Registration State: Pennsylvania

PE Registration Number: PE-055673-E

Professional Engineer Seal:



## **6.0 References**

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CB&I. “Ash Filter Ponds Hazard Potential Classification Initial Assessment Report.” October 2016.

Dewberry Consultants, LLC. “Coal Combustion Residue Impoundment Round 12 – Dam Assessment Report, Keystone Generating Station Filter Ash Ponds & Thermal Pond, GenOn Energy Shelocta, PA.” Prepared for the United States Environmental Protection Agency. January 2014.

Federal Emergency Management Agency (FEMA). “National Flood Hazard Layer.” Armstrong County, Pennsylvania. February 16, 2016.

Federal Register, Vol. 80, No. 74. Section 257.82 (Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundments). April 17, 2015.

Gilbert/Commonwealth, Inc. “Ash Filter Pond Improvements, Drawing No. D-781-071.” Last Revised October 10, 1995.

Google Earth. Imagery for Shelocta, Pennsylvania. Dated October 11, 2015.

NOAA. “Point Precipitation Frequency (PF) Estimates, Shelocta, PA.” NOAA Atlas 14, Vol. 2, Version 3.

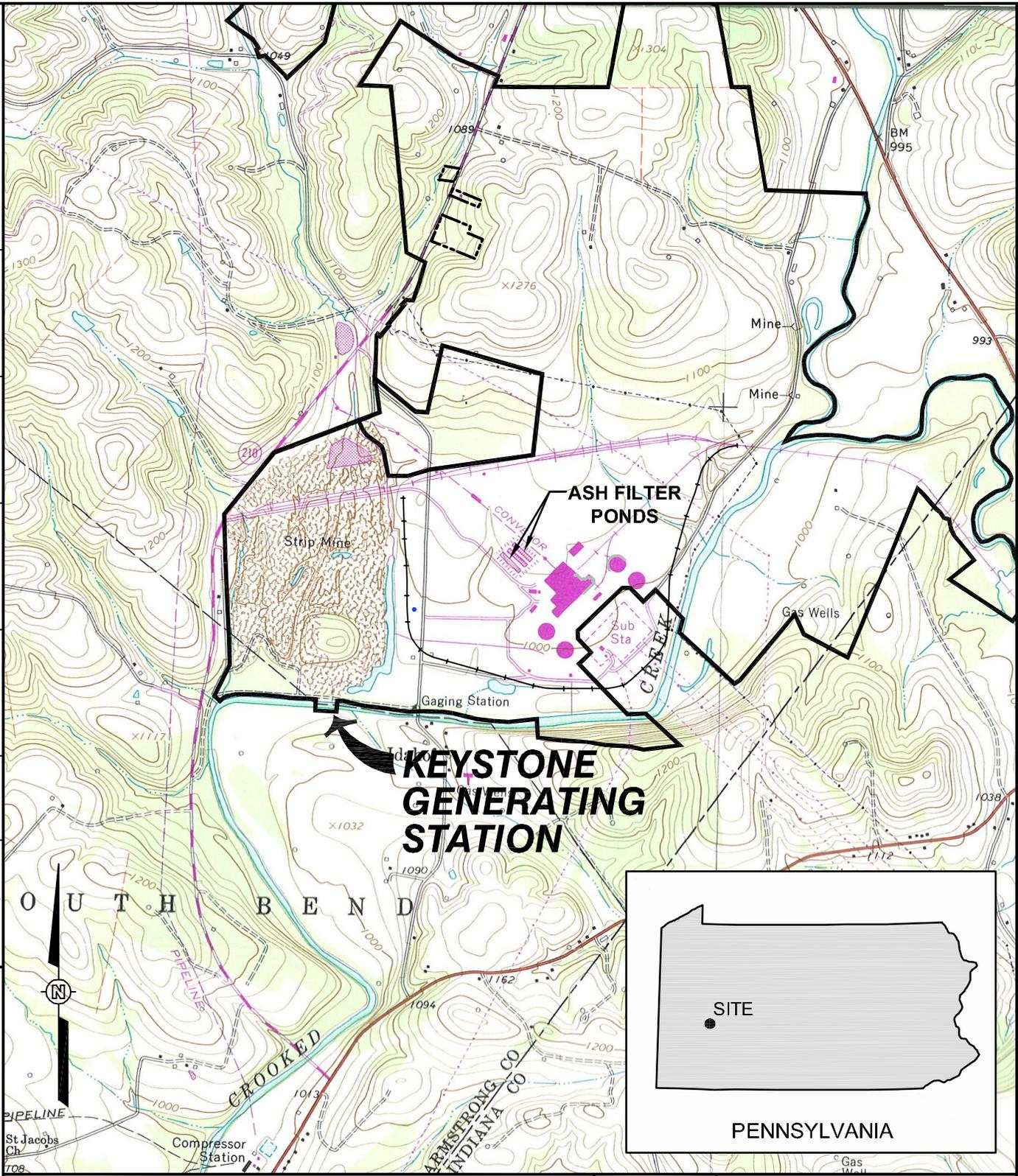
NRG. “SPCC Plan Sketch, General Plot Plan, Drawing No. E-727-1002.” Last Revised January 27, 2016.

Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey. LIDAR Mapping. PA Map Program. April 2006.

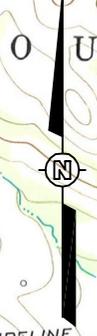
## ***Figures***

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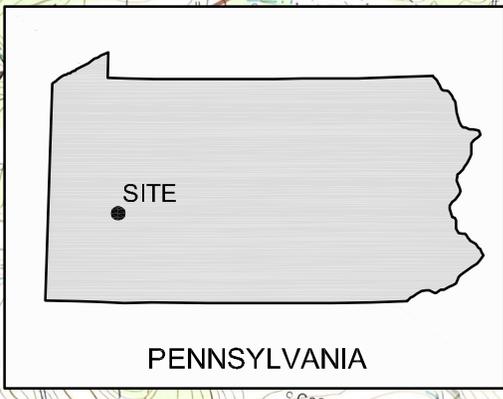
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 Plotted By: Evon.Schlegel



**REFERENCE:**  
 USGS TOPOGRAPHIC MAP, 7.5 MINUTE SERIES  
 ELDERTON, PENNSYLVANIA QUADRANGLE, DATED 1964,  
 PHOTOREVISED 1973, SCALE: 1"=2000'.



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**FIGURE 1**  
**SITE LOCATION MAP**  
 KEYSTONE GENERATING STATION  
 ARMSTRONG COUNTY, PENNSYLVANIA

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 Plotted By: Evan.Schlegel

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Pittsburgh, PA	10/10/16	LCL	ELS	DJS	LCL	1009174011-B1



**LEGEND:**

-  EXISTING DRAINAGE CHANNEL OR SWALE
-  APPROXIMATE UNDERGROUND PIPING ALIGNMENT



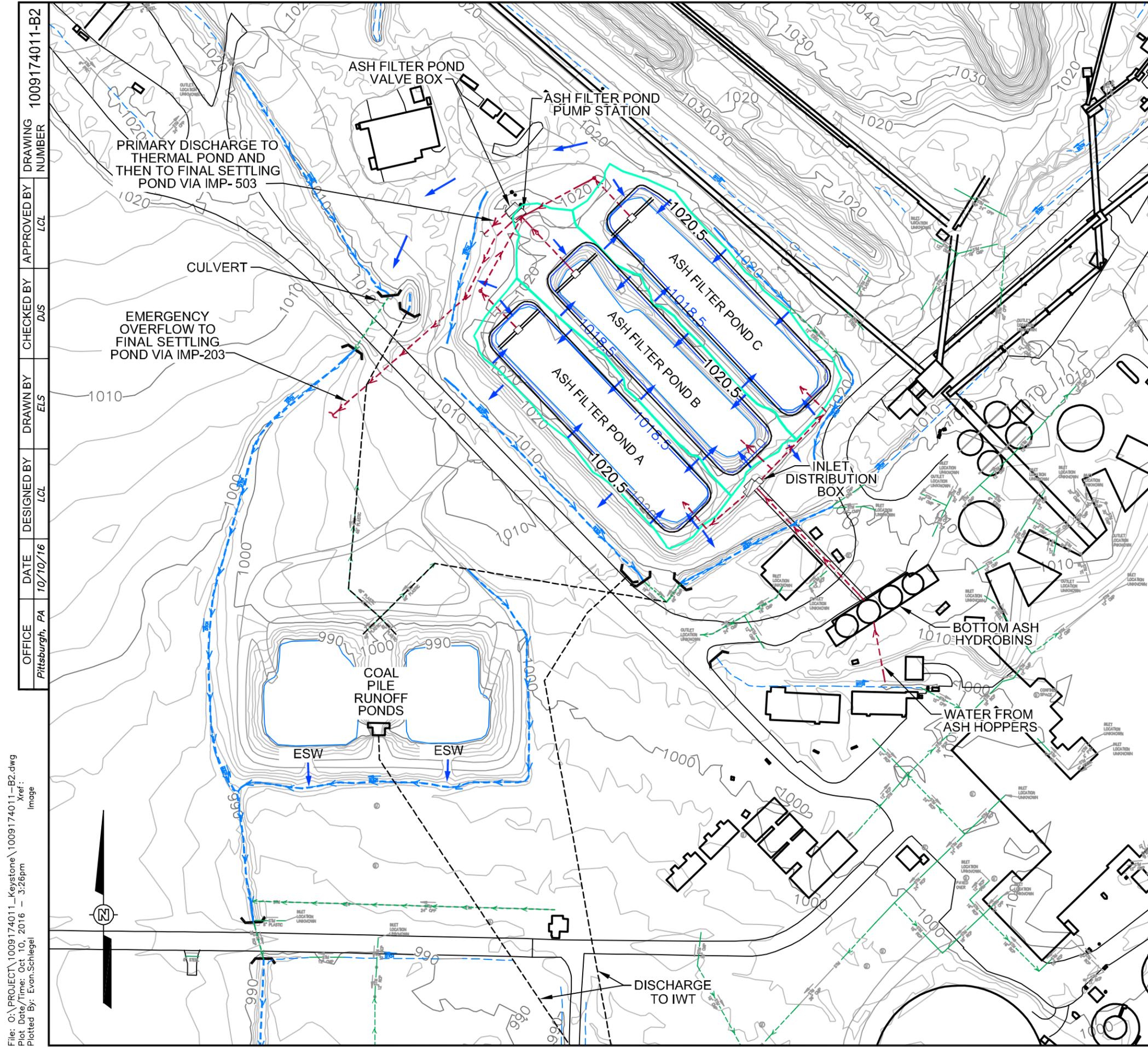
**REFERENCE:**  
 GOOGLE AERIAL PHOTOGRAPH, DATED 10/11/2015.



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**FIGURE 2**  
**PHOTOGRAPHIC MAP**  
 KEYSTONE GENERATING STATION  
 PLUMCREEK TOWNSHIP, ARMSTRONG COUNTY, PA



**LEGEND:**

- 1020— 2-FOOT TOPOGRAPHIC CONTOUR (REFERENCE 1)
- — — — — EXISTING DRAINAGE CHANNEL OR SWALE
- ← — — — — SURFACE WATER FLOW DIRECTION
- EXISTING STRUCTURE
- — — — — STORMWATER DRAINS
- — — — — APPROXIMATE POND SURFACE DRAINAGE AREA LIMITS
- 1020.5— APPROXIMATE POND CREST ELEVATION (REFERENCE 2)
- 1018.5— APPROXIMATE POND NORMAL WATER OPERATING LEVEL ELEVATION (REFERENCE 2)
- - - - - APPROXIMATE UNDERGROUND PIPING ALIGNMENT
- - - - - APPROXIMATE ASH PROCESS WATER FLOW DIRECTION

ASH FILTER POND ID	CREST*		OPERATING WATER LEVEL*		APPROXIMATE POND SURFACE DRAINAGE AREA (SQ. FT.)
	ELEV. (FT.)	AREA (SQ. FT.)	ELEV. (FT.)	AREA (SQ. FT.)	
A	1020.5	38,108	1018.5	34,271	54,171
B	1020.5	39,243	1018.5	35,378	60,688
C	1020.5	38,738	1018.5	34,895	59,145

\* ELEVATIONS AND AREAS WERE OBTAINED FROM REFERENCE 2.

- REFERENCES:**
- GROUND SURFACE CONTOURS WERE OBTAINED FROM PA MAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY, LIDAR MAPPING, COLLECTED 4/2006.
  - APPROXIMATE CREST AND NORMAL WATER OPERATING LEVEL ELEVATIONS AND AREAS WERE OBTAINED FROM "ASH FILTER POND IMPROVEMENTS, DRAWING NO. D-781-071", BY GILBERT ASSOCIATES, INC., LAST REVISED 10/10/1995.
  - APPROXIMATE CULVERT AND UNDERGROUND PIPING LOCATIONS WERE DERIVED FROM NRG DRAWING NO. E-727-1002, "SPCC PLAN SKETCH, GENERAL PLOT PLAN" LAST REVISED 1/27/2016.
  - APPROXIMATE NPDES DISCHARGE LOCATIONS WERE OBTAINED FROM CB&I DRAWING NO. 1009174004-E2, "PLANT PROPER STORM WATER DRAINAGE AREAS", DATED 2/23/2016.



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**FIGURE 3**  
**HYDROLOGIC MAP**  
 KEYSTONE GENERATING STATION  
 PLUMCREEK TOWNSHIP, ARMSTRONG COUNTY, PA

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 CHECKED BY: DJS  
 APPROVED BY: LCL  
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***Attachment A***

***Hydrologic Calculations***

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I. Purpose

To evaluate the stormwater inflow volume that will result from the design flood (storm) as specified by 40 CFR §257.82(a)(3), and to compare this volume with the available storage capacity for each subject pond.

II. Given

Three CCR impoundments located in Shelocta, PA, each having a Low Hazard Rating and the following design information (From Fig. 3 by CB&I, 2016):

Ash Filter Pond A

Crest Elevation, $E_c$ :	1020.5 ft msl
Pond Area at Crest, $A_c$ :	38,108 sq ft
Operating Water Level, $E_w$ :	1018.5 ft msl
Area at Operating Water Level, $A_w$ :	34,271 sq ft
Approximate Inflow Area, $A_{IN}$ :	54,171 sq ft
Freeboard, $FB = E_c - E_w =$	2.0 ft

Ash Filter Pond B

Crest Elevation, $E_c$ :	1020.5 ft msl
Pond Area at Crest, $A_c$ :	39,243 sq ft
Operating Water Level, $E_w$ :	1018.5 ft msl
Area at Operating Water Level, $A_w$ :	35,378 sq ft
Approximate Inflow Area, $A_{IN}$ :	60,688 sq ft
Freeboard, $FB = E_c - E_w =$	2.0 ft

Ash Filter Pond C

Crest Elevation, $E_c$ :	1020.5 ft msl
Pond Area at Crest, $A_c$ :	38,738 sq ft
Operating Water Level, $E_w$ :	1018.5 ft msl
Area at Operating Water Level, $A_w$ :	34,895 sq ft
Approximate Inflow Area, $A_{IN}$ :	59,145 sq ft
Freeboard, $FB = E_c - E_w =$	2.0 ft

III. Methodology

Step 1: Determine the appropriate Rainfall Depth ( $D_R$ ) for the stormwater inflow calculations.

From 40 CFR §257.82(a)(3), the CCR units must adequately manage flow resulting from the following design floods:

- \* For an incised impoundment, the 25-year flood
- \* For a non-incised, Low Hazard impoundment, a 100-year design flood
- \* For a non-incised, Significant Hazard impoundment, a 1000-year design flood
- \* For a non-incised, High Hazard impoundment, the probable maximum flood

Step 2: Determine the Inflow Volume ( $V_{IN}$ ). For a pond with a limited inflow area (i.e., with inflow limited to rainfall directly on top of the pond footprint and on berm areas right around the pond perimeter), compute the volume directly as the Rainfall Depth ( $D_R$ ) times the Inflow Area ( $A_{IN}$ ). For ponds with run-on from additional upstream areas, compute  $V_{IN}$  using HydroCAD.

Step 3: Compute the Available Capacity ( $V_{AVAIL}$ ) of each pond to contain stormwater runoff as the volume between the pond operating water level and the pond crest elevation. Use the Average End Area method.

Step 4: Compare the volume of inflow ( $V_{IN}$ ) for the specified design flood (storm) to the pond's available capacity ( $V_{AVAIL}$ ) for stormwater runoff to determine if the pond will manage the specified stormwater inflow without overtopping.



#### IV. Calculations

Step 1: Determine the appropriate Rainfall Depth ( $D_R$ ).

None of the ponds are completely incised, and all are assigned Low Hazard classifications. Pursuant to 40 CFR §257.82(a)(3), the ponds must manage flow from the 100-year flood (storm). From NOAA (NOAA, 2016), the rainfall depth ( $D_R$ ) associated with the 24-hour, 100-year storm is:

$$D_R = 5.19 \text{ " } = 0.4325 \text{ ft}$$

Step 2: Determine the Inflow Volume ( $V_{IN}$ ).

Inflow is limited to rainfall directly on top of each pond footprint and upon a limited area around each pond. Therefore, directly compute  $V_{IN}$  as follows:

Inflow,  $V_{IN}$  (cu ft) = Rainfall depth,  $D_R$  (ft) x Inflow Area,  $A_{IN}$  (sq ft)

For Ash Filter Pond A:

$$\begin{aligned} V_{IN} &= 0.4325 \text{ ft} \times 54,171 \text{ sq ft} \\ &= 23,429 \text{ cu ft} \end{aligned}$$

For Ash Filter Pond B:

$$\begin{aligned} V_{IN} &= 0.4325 \text{ ft} \times 60,688 \text{ sq ft} \\ &= 26,248 \text{ cu ft} \end{aligned}$$

For Ash Filter Pond C:

$$\begin{aligned} V_{IN} &= 0.4325 \text{ ft} \times 59,145 \text{ sq ft} \\ &= 25,580 \text{ cu ft} \end{aligned}$$

Step 3: Compute the Available Capacity ( $V_{AVAIL}$ ) of each pond to contain stormwater runoff as the volume between the pond operating water level and the pond crest elevation. Use the Average End Area method.

Available Capacity,  $V_{AVAIL}$  (cu ft) =  $[(A_c + A_w)/2] \times FB$

For Ash Filter Pond A:

$$\begin{aligned} V_{AVAIL} &= [(38,108 + 34,271) / 2] \times 2.0 \\ &= (72,379 / 2) \times 2.0 \\ &= 72,379 \text{ cu ft} \end{aligned}$$

For Ash Filter Pond B:

$$\begin{aligned} V_{AVAIL} &= [(39,243 + 35,378) / 2] \times 2.0 \\ &= (74,621 / 2) \times 2.0 \\ &= 74,621 \text{ cu ft} \end{aligned}$$



For Ash Filter Pond C:

$$\begin{aligned} V_{AVAIL} &= [( 38,738 + 34,895 ) / 2 ] \times 2.0 \\ &= ( 73,633 / 2 ) \times 2.0 \\ &= 73,633 \text{ cu ft} \end{aligned}$$

V. Results

Step 4: For each pond, compare the Inflow Volume ( $V_{IN}$ ) for the specified design flood (storm) to the Available Capacity ( $V_{AVAIL}$ ) for stormwater runoff to determine if it will manage the specified inflow without overtopping.

$$\text{Percent of Freeboard Capacity Utilized, \%V}_{FB} = \frac{V_{IN}}{V_{AVAIL}}$$

For Ash Filter Pond A:

$$\begin{aligned} \%V_{FB} &= 23,429 / 72,379 \\ &= 32\% \end{aligned}$$

For Ash Filter Pond B:

$$\begin{aligned} \%V_{FB} &= 26,248 / 74,621 \\ &= 35\% \end{aligned}$$

For Ash Filter Pond C:

$$\begin{aligned} \%V_{FB} &= 25,580 / 73,633 \\ &= 35\% \end{aligned}$$

VI. Conclusions

All three ash filter ponds have adequate capacity to meet the temporary storage requirements for a 100-year design flood (storm).

VII. References

CB&I. "Figure 3 Hydrologic Map, Keystone Generating Station." Drawing No. 1009174011-B2. Dated October 10, 2016.

NOAA. "Point Precipitation Frequency (PF) Estimates, Shelocta, PA." NOAA Atlas 14, Vol. 2, Version 3. Accessed July 26, 2016.

***Attachment A-1***

***NOAA Point Precipitation Frequency (PF) Estimates***

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**NOAA Atlas 14, Volume 2, Version 3**  
**Location name: Shelocta, Pennsylvania, US\***  
**Latitude: 40.6608°, Longitude: -79.3434°**  
**Elevation: 1011 ft\***  
\* source: Google Maps



**POINT PRECIPITATION FREQUENCY ESTIMATES**

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M. Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

**PF tabular**

<b>PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)<sup>1</sup></b>										
<b>Duration</b>	<b>Average recurrence interval (years)</b>									
	<b>1</b>	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>	<b>200</b>	<b>500</b>	<b>1000</b>
<b>5-min</b>	<b>0.318</b> (0.288-0.350)	<b>0.380</b> (0.345-0.419)	<b>0.459</b> (0.416-0.506)	<b>0.520</b> (0.471-0.573)	<b>0.599</b> (0.540-0.659)	<b>0.659</b> (0.592-0.724)	<b>0.718</b> (0.642-0.787)	<b>0.778</b> (0.693-0.853)	<b>0.858</b> (0.760-0.939)	<b>0.917</b> (0.809-1.00)
<b>10-min</b>	<b>0.494</b> (0.447-0.544)	<b>0.593</b> (0.538-0.654)	<b>0.713</b> (0.646-0.786)	<b>0.803</b> (0.726-0.885)	<b>0.916</b> (0.826-1.01)	<b>0.999</b> (0.897-1.10)	<b>1.08</b> (0.967-1.19)	<b>1.16</b> (1.04-1.27)	<b>1.26</b> (1.12-1.38)	<b>1.34</b> (1.18-1.46)
<b>15-min</b>	<b>0.605</b> (0.548-0.667)	<b>0.725</b> (0.658-0.800)	<b>0.875</b> (0.793-0.966)	<b>0.988</b> (0.894-1.09)	<b>1.13</b> (1.02-1.25)	<b>1.24</b> (1.11-1.36)	<b>1.34</b> (1.20-1.47)	<b>1.45</b> (1.29-1.58)	<b>1.57</b> (1.39-1.72)	<b>1.67</b> (1.47-1.83)
<b>30-min</b>	<b>0.801</b> (0.725-0.882)	<b>0.970</b> (0.880-1.07)	<b>1.20</b> (1.09-1.32)	<b>1.37</b> (1.24-1.51)	<b>1.60</b> (1.44-1.76)	<b>1.77</b> (1.59-1.94)	<b>1.94</b> (1.74-2.13)	<b>2.11</b> (1.88-2.31)	<b>2.33</b> (2.07-2.55)	<b>2.50</b> (2.21-2.74)
<b>60-min</b>	<b>0.978</b> (0.885-1.08)	<b>1.19</b> (1.08-1.31)	<b>1.50</b> (1.36-1.66)	<b>1.75</b> (1.58-1.92)	<b>2.07</b> (1.87-2.28)	<b>2.33</b> (2.09-2.56)	<b>2.59</b> (2.32-2.84)	<b>2.86</b> (2.55-3.14)	<b>3.23</b> (2.86-3.53)	<b>3.52</b> (3.10-3.84)
<b>2-hr</b>	<b>1.13</b> (1.03-1.24)	<b>1.37</b> (1.24-1.50)	<b>1.72</b> (1.57-1.90)	<b>2.00</b> (1.82-2.20)	<b>2.39</b> (2.16-2.62)	<b>2.70</b> (2.43-2.95)	<b>3.02</b> (2.70-3.29)	<b>3.35</b> (2.99-3.65)	<b>3.81</b> (3.37-4.14)	<b>4.17</b> (3.67-4.52)
<b>3-hr</b>	<b>1.20</b> (1.10-1.33)	<b>1.46</b> (1.33-1.61)	<b>1.83</b> (1.67-2.01)	<b>2.13</b> (1.93-2.34)	<b>2.55</b> (2.30-2.79)	<b>2.88</b> (2.60-3.15)	<b>3.23</b> (2.90-3.52)	<b>3.60</b> (3.21-3.92)	<b>4.11</b> (3.63-4.46)	<b>4.52</b> (3.96-4.90)
<b>6-hr</b>	<b>1.44</b> (1.32-1.59)	<b>1.73</b> (1.59-1.92)	<b>2.16</b> (1.97-2.38)	<b>2.51</b> (2.28-2.76)	<b>3.00</b> (2.72-3.29)	<b>3.41</b> (3.08-3.73)	<b>3.83</b> (3.44-4.18)	<b>4.29</b> (3.82-4.66)	<b>4.92</b> (4.34-5.35)	<b>5.43</b> (4.76-5.89)
<b>12-hr</b>	<b>1.74</b> (1.60-1.91)	<b>2.08</b> (1.91-2.29)	<b>2.57</b> (2.35-2.82)	<b>2.97</b> (2.72-3.26)	<b>3.56</b> (3.23-3.89)	<b>4.04</b> (3.65-4.40)	<b>4.55</b> (4.09-4.94)	<b>5.10</b> (4.55-5.51)	<b>5.88</b> (5.19-6.35)	<b>6.51</b> (5.71-7.01)
<b>24-hr</b>	<b>2.08</b> (1.92-2.25)	<b>2.47</b> (2.30-2.68)	<b>3.02</b> (2.81-3.27)	<b>3.47</b> (3.22-3.75)	<b>4.11</b> (3.80-4.43)	<b>4.64</b> (4.27-4.98)	<b>5.19</b> (4.76-5.57)	<b>5.76</b> (5.26-6.17)	<b>6.57</b> (5.96-7.01)	<b>7.21</b> (6.51-7.69)
<b>2-day</b>	<b>2.41</b> (2.25-2.60)	<b>2.87</b> (2.68-3.10)	<b>3.48</b> (3.24-3.75)	<b>3.98</b> (3.70-4.28)	<b>4.67</b> (4.33-5.01)	<b>5.22</b> (4.83-5.60)	<b>5.80</b> (5.35-6.21)	<b>6.39</b> (5.88-6.83)	<b>7.21</b> (6.59-7.70)	<b>7.86</b> (7.14-8.38)
<b>3-day</b>	<b>2.59</b> (2.42-2.79)	<b>3.08</b> (2.88-3.32)	<b>3.70</b> (3.46-3.99)	<b>4.21</b> (3.92-4.53)	<b>4.92</b> (4.57-5.28)	<b>5.48</b> (5.08-5.87)	<b>6.07</b> (5.60-6.50)	<b>6.67</b> (6.13-7.13)	<b>7.49</b> (6.85-8.00)	<b>8.14</b> (7.41-8.69)
<b>4-day</b>	<b>2.77</b> (2.59-2.98)	<b>3.29</b> (3.07-3.53)	<b>3.93</b> (3.67-4.22)	<b>4.45</b> (4.15-4.77)	<b>5.17</b> (4.81-5.54)	<b>5.75</b> (5.32-6.15)	<b>6.34</b> (5.86-6.79)	<b>6.95</b> (6.39-7.43)	<b>7.78</b> (7.12-8.31)	<b>8.43</b> (7.68-9.00)
<b>7-day</b>	<b>3.33</b> (3.13-3.56)	<b>3.93</b> (3.69-4.21)	<b>4.64</b> (4.35-4.96)	<b>5.21</b> (4.87-5.56)	<b>5.98</b> (5.58-6.37)	<b>6.58</b> (6.13-7.01)	<b>7.19</b> (6.68-7.65)	<b>7.80</b> (7.22-8.29)	<b>8.61</b> (7.94-9.15)	<b>9.22</b> (8.48-9.80)
<b>10-day</b>	<b>3.86</b> (3.65-4.10)	<b>4.55</b> (4.29-4.82)	<b>5.31</b> (5.01-5.63)	<b>5.92</b> (5.58-6.28)	<b>6.74</b> (6.33-7.13)	<b>7.37</b> (6.92-7.80)	<b>8.00</b> (7.49-8.45)	<b>8.62</b> (8.06-9.11)	<b>9.44</b> (8.78-9.97)	<b>10.1</b> (9.32-10.6)
<b>20-day</b>	<b>5.43</b> (5.14-5.73)	<b>6.36</b> (6.03-6.72)	<b>7.33</b> (6.94-7.74)	<b>8.09</b> (7.66-8.55)	<b>9.10</b> (8.59-9.60)	<b>9.86</b> (9.31-10.4)	<b>10.6</b> (10.0-11.2)	<b>11.3</b> (10.7-11.9)	<b>12.3</b> (11.5-12.9)	<b>13.0</b> (12.1-13.7)
<b>30-day</b>	<b>6.85</b> (6.52-7.22)	<b>8.01</b> (7.62-8.44)	<b>9.14</b> (8.69-9.64)	<b>10.0</b> (9.53-10.6)	<b>11.2</b> (10.6-11.8)	<b>12.1</b> (11.4-12.7)	<b>12.9</b> (12.2-13.6)	<b>13.7</b> (13.0-14.4)	<b>14.8</b> (13.9-15.5)	<b>15.5</b> (14.6-16.3)
<b>45-day</b>	<b>8.79</b> (8.36-9.25)	<b>10.2</b> (9.74-10.8)	<b>11.6</b> (11.0-12.2)	<b>12.6</b> (12.0-13.2)	<b>13.9</b> (13.2-14.6)	<b>14.8</b> (14.1-15.6)	<b>15.7</b> (14.9-16.5)	<b>16.6</b> (15.7-17.4)	<b>17.6</b> (16.6-18.5)	<b>18.3</b> (17.3-19.3)
<b>60-day</b>	<b>10.6</b> (10.1-11.2)	<b>12.3</b> (11.8-13.0)	<b>13.8</b> (13.2-14.5)	<b>15.0</b> (14.2-15.7)	<b>16.4</b> (15.6-17.2)	<b>17.4</b> (16.5-18.3)	<b>18.3</b> (17.4-19.3)	<b>19.2</b> (18.2-20.2)	<b>20.3</b> (19.2-21.3)	<b>21.0</b> (19.9-22.0)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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**PF graphical**