KPDES

KENTUCKY POLLUTANT DISCHARGE ELIMINATION SYSTEM

FACT SHEET

KPDES No.: KY0002020

AI No.: 3148

Kentucky Utilities Company – E.W. Brown Generating Station

815 Dix Dam Road

Harrodsburg, Mercer County, Kentucky

Date: June 10, 2022

Public Notice Information

Public Notice Start Date: April 21, 2022

Comment Due Date: May 21, 2022

General information concerning the public notice process may be obtained on the Division of Water's Public Notice Webpage at the following address: http://water.ky.gov/Pages/PublicNotices.aspx.

Public Notice Comments

Comments must be received by the Division of Water no later than 4:30 PM on the closing date of the comment period. Comments may be submitted by e-mail at: DOWPublicNotice@ky.gov or written comments may be submitted to the Division of Water at 300 Sower Blvd, Frankfort, Kentucky 40601.

Reference Documents

A copy of this proposed fact sheet, proposed permit, the application, other supporting material and the current status of the application may be obtained from the Department for Environmental Protection's Pending Approvals Search Webpage:
http://dep.gateway.ky.gov/eSearch/Search_Pending_Approvals.aspx?Program=Wastewater&NumDaysDoc=30.

Open Records

Copies of publicly-available documents supporting this fact sheet and proposed permit may also be obtained from the Department for Environmental Protection Central Office. Information regarding these materials may be obtained from the Open Records Coordinator at (502) 782-6849 or by e-mail at EEC.KORA@ky.gov.

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SECTION 1

FACILITY SYNOPSIS

1. FACILITY SYNOPSIS

1.1. Name and Address of Applicant

Kentucky Utilities Company
P.O. Box 32010
Louisville, Kentucky 40232

1.2. Facility Location

Kentucky Utilities – E.W. Brown Generating Station
815 Dix Dam Road
Harrodsburg, Mercer County, Kentucky

1.3. Description of Applicant's Operation

The facility is a fossil fuel fired steam electric power plant for the generation, transmission and distribution of electricity.

Generation of electric power is from fossil fired units with the following nameplate generating capacity: Unit 1(Retired March 1, 2019) – 114 MW, Unit 2(Retired March 1, 2019) – 180 MW, and Unit 3 – 464 MW.

Combustion Turbines, Natural Gas or Fuel Oil Fired: Unit 5 – 123 MW, Units 6-7 – 177 MW/each, and Units 8-11 – 126 MW/each.

Solar Facility: Universal Solar Facility, 44,000 panels, 50 acres – 10 MW

Dix Dam Hydroelectric Facility: 3 Turbines – 33 MW

1.4. Wastewaters Collected and Treatment

The following table lists the flow, wastewater types collected, and treatment type for each outfall:

TABLE 1.

Outfall No.	Average Flow	Wastewater Types Collected	Treatment Type
001	5.14	Stormwater Runoff	Settling Mixing Neutralization Discharge to Surface Water
002	0.264	Stormwater Runoff	Discharge to Surface Water
003	5.63	Non-Contact Cooling Water	Disinfection (Other) Discharge to Surface Water
004	0.00	Process Wastewater	Chemical Precipitation
005	18.50	Raw Water Intake	None
006	Not yet constructed	Process Wastewater Stormwater	Settling Mixing Neutralization Discharge to Surface Water
007	Not yet constructed	Process Wastewater	Chemical Precipitation
008	Not yet constructed	Stormwater	Discharge to Surface Water

The design flow of the facility is 25.92 MGD. The average annual flow is 11.03 MGD.

1.5. Permitting Action

This is a modification of a major KPDES permit for an existing source Steam Electric Generating Station [SIC Code 4911].

This permit modification is in response to the 2020 EPA's revisions to Steam Electric Effluent Limitation Guidelines. The modification modifies the technology-based requirements for FGD and Bottom Ash Transport to comply with the revised guidelines. Outfalls 006 and 007 has been modified to reflect these changes.

SECTION 2

RECEIVING/INTAKE WATERS

2. RECEIVING / INTAKE WATERS

2.1. Receiving Waters

All surface waters of the Commonwealth have been assigned stream use designations consisting of one or more of the following designations: Warmwater Aquatic Habitat (WAH), Primary Contact Recreation (PCR), Secondary Contact Recreation (SCR), Domestic Water Supply (DWS), Coldwater Aquatic Habitat (CAH) or Outstanding State Resource Water (OSRW)[401 KAR 10:026].

All surface waters of the Commonwealth are assigned one of the following antidegradation categories: Outstanding National Resource Water (ONRW), Exceptional Water (EW), Impaired Water (IW) or High Quality Water (HQ)[401 KAR 10:030].

Surface waters categorized as an IW are listed in Kentucky's most recently approved Integrated Report to Congress on the Condition of Water Resources in Kentucky - Volume II. 303(d) List of Surface Waters.

The following table lists the stream use classifications associated with this permit.

TABLE 2.

Receiving Water Name	Use Designation	Antidegradation Category	7Q10 Low Flow (cfs)	Harmonic Mean Flow (cfs)
Herrington Lake (Dix River)	WAH PCS SCR DWS	HQ	N/A (Lake)	N/A (Lake)

2.2. Intake Waters – Nearest Downstream Intake

TABLE 3.

Intake Water Name	Public Water Supply Name	Latitude (N) Decimal Degrees	Longitude (W) Decimal Degrees	Miles Downstream	7Q10 Low Flow (cfs)	Harmonic Mean Flow (cfs)
Kentucky River	Harrodsburg Mun. Water Works	37.817787°	84.721952°	4.8	121	1312

SECTION 3

OUTFALL 001

3. OUTFALL 001

3.1. Outfall Description

The following table lists the outfall type, location, and description:

TABLE 4.				
Outfall Type	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
External	37.784741°	84.715331°	Herrington Lake (Dix River)	Landfill Inactive Areas Perimeter Access & Adjacent Drainage Areas Stormwater Runoff Landfill Liner Underdrain-Monitoring System Future Stormwater Runoff from Closed/Capped Auxiliary Ash Pond

3.2. Reported Values

The following table summarizes the reported values for Outfall 001:

TABLE 5.							
Reported Parameters	**Units**	**EFFLUENT**					
		Loadings (lbs./day)		**Concentrations**			
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**
Effluent Flow	MGD	5.14	6.12	N/A	N/A	N/A	N/A
Total Suspended Solids	mg/l	N/A	N/A	N/A	14.32	18.20	N/A
Oil & Grease	mg/l	N/A	N/A	N/A	0.073	0.092	N/A
pH	SU	N/A	N/A	7.40	N/A	N/A	8.60
Hardness (as mg/l $CaCO_3$)	mg/l	N/A	N/A	N/A	824.3	933.3	N/A
Total Recoverable Metals	mg/l	N/A	N/A	N/A	0.105	0.105	N/A
Acute Toxicity	TU_a	N/A	N/A	N/A	N/A	N/A	<1.00

The above values are based on 5-year Discharge Monitoring Report (DMR) averages from 05/31/2014 to 03/31/2019.

Due to the major facility changes and redirection of flows from this outfall (See Section 3.4.1). This outfalls DMR and application data was used for Outfall 006's Reasonable Potential Analysis.

3.3. Effluent Limitations and Monitoring Requirements

The following table summarizes the effluent limitations and monitoring requirements for Outfall 001:

TABLE 6.

EFFLUENT LIMITATIONS								MONITORING REQUIREMENTS	
Effluent Characteristic	Units	Loadings (lbs./day)		Concentrations				Frequency	Sample Type
		Monthly Average	Daily Maximum	Minimum	Monthly Average	Daily Maximum	Maximum		
Flow	MGD	Report	Report	N/A	N/A	N/A	N/A	1/Quarter	Instantaneous
Total Suspended Solids	mg/l	N/A	N/A	N/A	Report	100	N/A	1/Quarter	Grab
pH	SU	N/A	N/A	6.0	N/A	N/A	9.0	1/Quarter	Grab
Hardness (as mg/l $CaCO_3$)	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Arsenic	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Cadmium	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Chromium	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Copper	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Lead	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Mercury	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Nickel	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Silver	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Zinc	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab

3.4. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

3.4.1. Facility Changes

This outfall used to be for the plants Auxiliary Ash Pond discharges which received plant process wastewaters and treated discharges combined with flow from the Landfill Stormwater Runoff Pond. Stormwater runoff from areas adjacent to the Outfall 001 channel and a landfill liner underdrain system also contribute to the flow monitoring by Outfall 001. Effective with this permit the Plant's process flow will be redirected to the Process Pond configured to discharge to a new external Outfall 006 via a high rate multi-port diffuse. This will facilitate closure of the Auxiliary Ash Pond and may require several months to divert/transfer flows from the Auxiliary pond to the New Process Pond. The Auxiliary Ash Pond will be dewatered, capped vegetative cover established, and uncontaminated stormwater runoff flows will be managed to combine with landfill stormwater runoff flows to the existing Outfall 001. Stormwater runoff from Landfill Stormwater Runoff Pond, non-contaminated plant stormwater runoff, landfill liner underdrain system, and future stormwater runoff from the closed/capped Auxiliary Ash Pond will be discharged through Outfall 001. No wastewater flows from Process Pond, Plant Process Wastewaters, Dewatering flows (directed to 006), coal pile runoff, toe/abutment drain collection system waters, or direct precipitation upon the Auxiliary Ash Pond areas will discharge through this outfall once the permit becomes effective.

3.4.2. Technology-Based Effluent Limitations

Technology-based effluent limitations and standards, based on federally promulgated standards, a case-by-case basis, or a combination of the two, shall be included in all KPDES permits, where applicable.

3.4.2.1. Best Professional Judgement

Total Suspended Solids

This facility utilizes a sedimentation basin to provide for the settling of suspended solids. Sedimentation is a commonly used treatment technology for the removal of total suspended solids from non-contaminated stormwater runoff associated with landfill operations. Sedimentation is both efficient and cost effective. Although several factors may influence the final concentration of total suspended solids in the discharge, it has been the experience of the Division that ponds that retain landfill-related stormwater for six hours or more can achieve a total suspended solids concentration of 100 mg/l as a daily maximum.

3.4.3. Water Quality-Based Effluent Limitations

The following table lists those pollutants and/or pollutant characteristics of concern that DOW has determined exhibit reasonable potential to cause or contribute to an excursion of a water quality-based criterion, and the basis of DOW's determination. These determinations are consistent with the DOW's reasonable potential analysis (RPA) procedures outlined in *Permitting Procedures For Determining "Reasonable Potential"* Kentucky Division of Water May 1, 2000.

TABLE 7.	
Pollutant or Pollutant Characteristic	**Basis**
Total Recoverable: Arsenic, Cadmium, Chromium, Copper,	Since the plants process wastewater has been redirected to Outfall 006 and only stormwater with deminimis CCR-Contact, and future stormwater from the

Lead, Mercury, Nickel, Silver, and Zinc	closed/capped Auxiliary Ash Pond discharge through this outfall, it is the Divisions best professional judgement to monitor for these pollutants. Monitoring will allow us to know the concentrations within the effluent. In the future DOW will analyze the results for the potential to exceed water quality criteria.

3.5. Limitation Calculations

3.5.1. Calculations for Water Quality-Based Effluent Limitations

Since this outfall's previously permitted flows (other than stormwater with deminimis CCR-Contact) will be redirected and discharge through Outfall 006 effective with this permit. The DMR data and Application data for this Outfall was used in the reasonable potential analysis for Outfall 006; Monitoring conditions have been continued on this outfall in order to assess the stormwater discharge that will continue through this outfall. In the future DOW will analyze the results for the potential to exceed water quality criteria.

3.6. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

3.6.1. Flow

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

3.6.2. Total Suspended Solids

The limitations for this parameter are consistent with the requirements of 40 CFR 125.3(c)(2) as incorporated by reference in 401 KAR 5:080, Section 2(3). The limits are representative of the Division of Water's "Best Professional Judgment" (BPJ) determination of the "Best Conventional Pollutant Control Technology" (BCT) requirements for these pollutants.

3.6.3. pH

The limitations for this parameter are consistent Kentucky's Water Quality Standards [401 KAR 10:031, Section 4(1)(b) and Section 7].

3.6.4. Hardness and Total Recoverable: Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, and Zinc

The monitoring requirements for these pollutants are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(i)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

SECTION 4

OUTFALL 002

4. OUTFALL 002

4.1. Outfall Description

The following table lists the outfall type, location, and description:

TABLE 8.				
Outfall Type	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
External	37.786910°	84.712715°	Herrington Lake (Dix River)	Direct precipitation upon the Units 1-2 buildings roofs.

4.2. Reported Values

The following table summarizes the reported values for Outfall 002:

TABLE 9.							
Reported Parameters	**Units**	**EFFLUENT**					
		Loadings (lbs./day)		**Concentrations**			
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**
Flow	MGD	0.264	0.619	N/A	N/A	N/A	N/A
Temperature	°F	N/A	N/A	N/A	74.63	81.44	N/A
Free Available Chlorine	mg/l	N/A	N/A	N/A	NR	NR	N/A
Time of Oxidant Addition	min/day	N/A	N/A	N/A	N/A	5.50	N/A
Total Residual Oxidants	mg/l	N/A	N/A	N/A	0.001	0.004	N/A
pH	SU	N/A	N/A	7.30	N/A	N/A	8.95
Total Recoverable Chromium	mg/l	N/A	N/A	N/A	0.0002	0.0002	N/A
Total Recoverable Zinc	mg/l	N/A	N/A	N/A	0.004	0.004	N/A
Priority Pollutants	mg/l	N/A	N/A	N/A	BDL	BDL	N/A
The abbreviation NR means Not Required. There were no periods of chlorination during the last 5 years of the permit cycle.							
The abbreviation BDL means Below Detection Level.							

The above values are based on 5-year Discharge Monitoring Report (DMR) averages from 05/31/2014 to 03/31/2019.

4.3. Effluent Limitations and Monitoring Requirements

The stormwater runoff from the areas served by Outfall 002 shall be managed using appropriate Best Management Practices (BMPs) to prevent the discharge of pollutants from those areas.

4.4. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

4.4.1. Facility Changes

Outfall 002 discharges previously included the Cooling Tower Blowdown flows from the currently-Retired Units 1-2 as of March 1, 2019. Current operations and into the future will include drainage from the Units 1-2 building rooftop direct precipitation flow which will continue to flow through the oil-water separator prior to discharge.

4.5. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

4.5.1. Best Management Practices (BMPs)

The use of BMPs for the control of drainage from the non-industrial portions of the facility are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(k)].

SECTION 5

OUTFALL 003

5. OUTFALL 003

5.1. Outfall Description

The following table lists the outfall type, location, and description:

TABLE 10.				
Outfall Type	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
External	37.787529°	84.714465°	Herrington Lake (Dix River)	Unit 3 Cooling Tower Blowdown Direct precipitation to cooling towers and unit 3 building roof drains

5.2. Reported Values

The following table summarizes the reported values for Outfall 003:

TABLE 11.							
Reported Parameters	**Units**	**EFFLUENT**					
		Loadings (lbs./day)		**Concentrations**			
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**
Flow	MGD	5.63	8.46	N/A	N/A	N/A	N/A
Temperature	°F	N/A	N/A	N/A	70.65	77.21	N/A
Free Available Chlorine	mg/l	N/A	N/A	N/A	NR	NR	N/A
Time of Oxidant Addition	min/day	N/A	N/A	N/A	N/A	5.34	N/A
Total Residual Oxidants	mg/l	N/A	N/A	N/A	0.0007	0.0007	N/A
pH	SU	N/A	N/A	7.30	N/A	N/A	8.70
Total Recoverable Chromium	mg/l	N/A	N/A	N/A	0.0002	0.0002	N/A
Total Recoverable Zinc	mg/l	N/A	N/A	N/A	0.0018	0.0090	N/A
Priority Pollutants	mg/l	N/A	N/A	N/A	BDL	BDL	N/A
The abbreviation NR means Not Required. There were no periods of chlorination during the last 5 years of the permit cycle.							
The abbreviation BDL means Below Detection Level.							

The above values are based on 5-year Discharge Monitoring Report (DMR) averages from 05/31/2014 to 03/31/2019.

5.3. Effluent Limitations and Monitoring Requirements

The following table summarizes the effluent limitations and monitoring requirements for Outfall 003:

TABLE 12.

EFFLUENT LIMITATIONS								MONITORING REQUIREMENTS	
Effluent Characteristic	Units	Loadings (lbs./day)		Concentrations				Frequency	Sample Type
		Monthly Average	Daily Maximum	Minimum	Monthly Average	Daily Maximum	Maximum		
Flow	MGD	Report	Report	N/A	N/A	N/A	N/A	1/Week	Instantaneous
Temperature	°F	N/A	N/A	N/A	Report	110	N/A	1/Week	Grab
pH	SU	N/A	N/A	6.0	N/A	N/A	9.0	1/Week	Grab
Free Available Chlorine[1]	mg/l	N/A	N/A	N/A	0.2	0.5	N/A	1/Occurrence[2]	Multiple Grab[5]
Total Residual Chlorine[1]	mg/l	N/A	N/A	N/A	Report	0.019	N/A	1/Occurrence[2]	Multiple Grab[5]
Total Residual Oxidants[1,6]	mg/l	N/A	N/A	N/A	Report	0.2	N/A	1/Occurrence[3]	Multiple Grab[5]
Oxidant Discharge Time[1]	Min/unit/day	N/A	N/A	N/A	N/A	120	N/A	1/Occurrence[4]	Log
Total Chromium[1]	mg/l	N/A	N/A	N/A	0.2	0.2	N/A	1/Year	Grab
Total Zinc[1]	mg/l	N/A	N/A	N/A	1.0	1.0	N/A	1/Year	Grab
Priority Pollutants[1,7]	No Detectable Amount							1/Year	Calculated[8]

[1]Sampling of cooling tower blowdown must be taken at the nearest accessible point prior to discharge to or mixing with the receiving waters or wastestreams from other outfalls.

[2] The measurement frequency "Occurrence" means only during periods of chlorination addition to cooling water, but no more frequent than once per week.

[3] The measurement frequency "Occurrence" means only during periods of oxidation addition to cooling water, but no more frequent than once per week.

[4]The measurement frequency "Occurrence" means during periods of chlorination or oxidation addition to cooling water, but no more frequent than once per week.

[5]The sample type 'Multiple Grab' means grab samples collected at the approximate beginning of oxidant discharge and once every fifteen (15) minutes thereafter until the end of the oxidant discharge.

[6]The term Total Residual Oxidants (TRO) means the value obtained by using the amperometric titration or DPD methods for Total Residual Chlorine described in 40 CFR Part 136. In the event of addition of an oxidant other than Chlorine, the permittee shall receive prior approval from the DOW permitting staff before the initial use. TRO monitoring and limits only apply if the applicant chooses to utilize an oxidant other than Chlorine.

[7]Priority Pollutants are those contained in chemicals added for cooling tower maintenance and shall be monitored annually by grab sample or by engineering calculations. The results of the analyses/engineering calculations shall be totaled and reported as a single concentration on the DMR. The laboratory bench sheets/engineering or electronic equivalent calculations showing the results for each pollutant shall be attached to the DMR. The term priority pollutants means the 126 priority pollutants listed in 40 CFR Part 423 Appendix A except total chromium and total zinc.

TABLE 12.									
EFFLUENT LIMITATIONS								MONITORING REQUIREMENTS	
Effluent Characteristic	Units	Loadings (lbs./day)		Concentrations				Frequency	Sample Type
		Monthly Average	Daily Maximum	Minimum	Monthly Average	Daily Maximum	Maximum		
[8]Compliance with the limitations, for the 126 priority pollutants, in paragraph (b)(10) of 40 CFR 423.15 may be determined by engineering calculations which demonstrate that the regulated pollutants are not detectable in the final discharge by the analytical methods in 40 CFR part 136.									
Neither free available chlorine nor total residual chlorine or oxidants may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available chlorine or total residual chlorine or oxidants at any one time unless the utility can demonstrate to the DOW that the units in a particular location cannot operate at or below this level of chlorination or oxidant addition.									

5.4. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

5.4.1. Technology-Based Effluent Limitations

Technology-based effluent limitations and standards, based on federally promulgated standards, a case-by-case basis, or a combination of the two, shall be included in all KPDES permits, where applicable.

5.4.1.1. Federal Effluent Limitations Guidelines

EPA has established a minimum level of technology that must be applied to certain industries. Due to the operations at this facility, all applicable sections of 40 CFR 423 shall be applied to this outfall. The following is a list of those requirements:

40 CFR 423.12(b) (1)

The pH of all discharges, except once through cooling water, shall be within the range of 6.0-9.0.

40 CFR 423.12(b) (2)

There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

40 CFR 423.12(b) (7)

The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown sources times the concentration listed in the following table:

TABLE 13.
BPT Effluent Requirements – Cooling Tower Blowdown

Effluent Characteristic	Maximum for any one day	Maximum for monthly average
Free Available Chlorine	0.5 mg/l	0.2 mg/l

40 CFR 423.12(b) (8)

Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the Regional Administrator or sate, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

40 CFR 423.12(b) (12)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b)(3) through (b)(7), and (b)(11), of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.12 (b) (12) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner.

40 CFR 423.13(a)

There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

40 CFR 423.13(d) (1)

The quantity of pollutants discharged in cooling tower blowdown shall not exceed the quantity determined by multiplying the flow of cooling tower blowdown time the concentration listed below:

TABLE 14. BAT Effluent Requirements – Cooling Tower Blowdown		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
Free Available Chlorine	0.5 mg/l	0.2 mg/l
The 126 priority pollutants (appendix A) contained in chemicals added for cooling tower maintenance, except:	([1])	([1])
Chromium, Total	0.2 mg/l	0.2 mg/l
Zinc, Total	1.0 mg/l	1.0 mg/l
[1]No detectable amount		

40 CFR 423.13(d) (2)

Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the utility can demonstrate to the Regional Administrator or state, if the state has NPDES permit issuing authority, that the units in a particular location cannot operate at or below this level of chlorination.

40 CFR 423.13(d) (3)

At the permitting authority's discretion, instead of the monitoring in 40 CFR 122.11(b), compliance with the standards for the 126 priority pollutants in paragraph (d)(1) of this section may be determined by engineering calculations demonstrating that the regulated pollutants are not detectable in the final discharge by the analytical methods in 40 CFR part 136.

40 CFR 423.13(m)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b) through (l) of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.13 (m) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner

5.4.2. Best Professional Judgment "BPJ"

Time of Oxidants Discharge

The Division of Water will impose a limit of 120 minutes/day/unit of chlorination / oxidation discharge time. The limit is representative of the BAT requirements for the discharge of chlorine in cooling tower blowdown as specified in 40 CFR 423.13(d)(2) as incorporated in 401 KAR 5:065, Section 2(6). It is the "Best Professional Judgement" (BPJ) of the Division of Water that this requirement is also applicable to the addition of other oxidants as well as chlorine.

Total Residual Oxidants

The Division of Water will impose a daily maximum limit of 0.20 mg/l for this parameter. The limit is representative of the BAT requirements for total residual chlorine in once through cooling water as specified in 40 CFR 423.13(b)(1) as incorporated in 401 KAR 5:065, Section 2(6). It is the Division of Water's Best Professional Judgment (BPJ) determination to limit the addition of other oxidants as well as chlorine in cooling tower blowdown.

5.4.3. Water Quality-Based Effluent Limitations

The following table lists those pollutants and/or pollutant characteristics of concern that DOW has determined exhibit reasonable potential to cause or contribute to an excursion of a water quality-based criterion, and the basis of DOW's determination. These determinations are consistent with the DOW's reasonable potential analysis (RPA) procedures outlined in *Permitting Procedures For Determining "Reasonable Potential"* Kentucky Division of Water May 1, 2000.

TABLE 15.

Pollutant or Pollutant Characteristic	Basis
Temperature	Thermal pollution or heat loads are typically associated with industrial facilities where large volumes of cooling water are utilized. Therefore, DOW has determined that reasonable potential for this pollutant does exist.
Total Residual Chlorine	The ELG establishes a limit for this pollutant in once through cooling water that is less stringent than Kentucky Water Quality Standard. Therefore, the facility shows reasonable potential to violate WQS when chlorine is being added to the cooling water.

5.4.4. Mixing Zone (MZ)

The Kentucky Water Quality Standards (KYWQS) allow the assignment of a MZ for chronic aquatic life (Chronic) and human health fish consumption (Fish) WQBELs and thermal discharges [401 KAR 10:029, Section 4]. The pollutants and/or the pollutant characteristics for which DOW has granted a MZ are listed as follows:

TABLE 16.

Pollutant or Pollutant Characteristic	Mixing Zone Factor (MZF)	Linear Distance (ft)	Surface Area (sq. ft)	Volume (cfs)
Temperature	0.070	56	2462	36.54

5.5. Limitation Calculations

5.5.1. Calculations for Water Quality-Based Effluent Limitations

These calculations were performed using a Microsoft EXCEL based workbook developed by DOW. The workbook is designed to compare effluent data to the applicable water quality standards while also incorporating the characteristics of the receiving water and any regulatory ZID and/or MZ. The following table summarizes the results of these calculations for this outfall:

Effluent Characteristic	Units	Reported Av	Reported M	Average Limitation	Maximum Limitation	Average Discharge %	Maximum Discharge %	MZF	Data Sou
Antimony	µg/L	1.2	1.2	83.3494849	N/A	1.44	N/A	0	APP
Arsenic	µg/L	1.1		150	340	0.73	0.00	0	APP
Barium	µg/L	31	31	14883.83659	N/A	0.21	N/A	0	APP
Beryllium	µg/L	0	0	59.53534636	N/A	0.00	N/A	0	APP
Cadmium	µg/L	0	0	0.43540447	4.096466086	0.00	0.00	0	APP
Chloride	µg/L	7700	7700	600000	1200000	1.28	0.64	0	APP

Chromium	µg/L	0.2	0.2	1488.383659	N/A	0.01	N/A	0	DMR
Chromium (III)	µg/L	0.32	0.32	145.7820525	3050.048329	0.22	0.01	0	APP
Chromium (VI)	µg/L	0.32	0.32	11	16	2.91	2.00	0	APP
Color	Platinum Cobalt Units	20	20	1116.287744	N/A	1.79	N/A	0	APP
Copper	µg/L	4	4	16.14454255	25.62955251	24.78	15.61	0	APP
Cyanide, Free	µg/L	0	0	5.2	22	0.00	0.00	0	APP
Fluoride	µg/L	0	0	59535.34636	N/A	0.00	N/A	0	APP
Iron	µg/L	66	66	3500	4000	1.89	1.65	0	APP
Lead	µg/L	0	0	7.20274097	184.8346504	0.00	0.00	0	APP
Mercury	µg/L	0	0	0.051	1.4	0.00	0.00	0	APP
Nickel	µg/L	1.4	1.4	89.78180744	807.5317434	1.56	0.17	0	APP
Nitrate (as N)	µg/L	1500	1500	148838.3659	N/A	1.01	N/A	0	APP
Phenol	µg/L	13	13	300	300	4.33	4.33	0	APP
Selenium	µg/L	0	0	5	N/A	0.00	N/A	0	APP
Silver	µg/L	0	0	N/A	11.41446492	N/A	0.00	0	APP
Sulfate	µg/L	27000	27000	3720959.147	N/A	0.73	N/A	0	APP
Thallium	µg/L	0	0	0.47	N/A	0.00	N/A	0	APP
Zinc	µg/L	1.8	1.8	206.3974123	206.3974123	0.87	0.87	0	DMR
Gross total alpha particle activity including radium-226 but exculding radon and uranium	pCi/L	0	0	2273.131439	N/A	0.00	N/A	0	APP
Combined radium-226 and radium-228	pCi/L	1.433	1.433	757.7104796	N/A	0.19	N/A	0	APP
Total gross beta particle activity	pCi/L	1.64	1.64	7577.104796	N/A	0.02	N/A	0	APP
Strontium-90	pCi/L	0.735	0.735	1212.336767	N/A	0.06	N/A	0	APP
Uranium	µg/L	0.453	0.453	4546.262877	N/A	0.01	N/A	0	APP
Total Residual Chlorine	µg/L	0	0	11	19	0.00	0.00	0	APP
Ammonia (as N)	mg/l	0	0	257.0004426	N/A	0.00	N/A	0	APP
Temperature	˚F	70.65	70.65	0	110	64.23	64.23	0.0701221	DMR

5.6. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

5.6.1. Flow

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

5.6.2. pH

The limits for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], representative of the BPT requirements for pH [40 CFR 423.12 (b)(1)], and state water quality standards [401 KAR 10:031, Sections 4(1)(b) and 7].

5.6.3. Free Available Chlorine

The limits for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], and representative of the BPT and BAT requirements for cooling tower blowdown [40 CFR 423.12(b)(7)] and [40 CFR 423.13(d)(1)].

5.6.4. Total Chromium, Total Zinc, and Priority Pollutants

The limits for these parameters are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], representative of the BAT requirements for cooling tower blowdown [40 CFR 423.13(d)(1)].

5.6.5. Time of Oxidants Discharge

The limits for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], representative of the BAT requirements for chlorine addition in [40 CFR 423.13 (d)(1)(2)] and imposing Best Professional Judgement [401 KAR 5:080, Section 2(3) – 40 CFR 125.3].

5.6.6. Total Residual Oxidants

The limits for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing Best Professional Judgement [401 KAR 5:080, Section 2(3) – 40 CFR 125.3].

5.6.7. Total Residual Chlorine

The limitations for this parameter are consistent with Kentucky's Water Quality Standards [401 KAR 10:031, Section 6].

5.6.8. Temperature

The limitations for this parameter are consistent with Kentucky's Water Quality Standards [401 KAR 10:031, Section 4(1)(d)].

SECTION 6

OUTFALL 004

6. OUTFALL 004

6.1. Outfall Description

The following table lists the outfall type, location, and description:

TABLE 17.				
Outfall Type	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
Internal	37.788653°	84.713311°	Outfall 006	Boiler Chemical cleaning Wastewater

6.2. Reported Values

The following table summarizes the reported values for Outfall 004:

TABLE 18.							
Reported Parameters	**Units**	**EFFLUENT**					
		Loadings (lbs./day)		**Concentrations**			
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**
Flow	MGD	ND	ND	N/A	N/A	N/A	N/A
Total Recoverable Copper	mg/l	N/A	N/A	N/A	ND	ND	N/A
Total Recoverable Iron	mg/l	N/A	N/A	N/A	ND	ND	N/A
pH	SU	N/A	ND	N/A	N/A	N/A	ND
The abbreviation ND means No Discharge. The facility has reported No Discharge on their DMR for the last 5 years.							

The above values are based on 5-year Discharge Monitoring Report (DMR) averages from 05/31/2014 to 03/31/2019.

6.3. Effluent Limitations and Monitoring Requirements

The following table summarizes the effluent limitations and monitoring requirements for Outfall 004:

TABLE 19.									
EFFLUENT LIMITATIONS								**MONITORING REQUIREMENTS**	
Effluent Characteristic	**Units**	**Loadings (lbs./day)**		**Concentrations**				**Frequency**	**Sample Type**
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**		
Flow	MGD	Report	Report	N/A	N/A	N/A	N/A	1/Batch[1]	Calculated
Total Recoverable Copper	mg/l	N/A	N/A	N/A	1.0	1.0	N/A	1/Batch[1]	Grab
Total Recoverable Iron	mg/l	N/A	N/A	N/A	1.0	1.0	N/A	1/Batch[1]	Grab

TABLE 19.									
EFFLUENT LIMITATIONS								MONITORING REQUIREMENTS	
Effluent Characteristic	Units	Loadings (lbs./day)		Concentrations				Frequency	Sample Type
		Monthly Average	Daily Maximum	Minimum	Monthly Average	Daily Maximum	Maximum		
[1]Monitoring shall be conducted once per metal cleaning operation.									
Metal cleaning waste shall mean any wastewater resulting from cleaning (with or without chemical cleaning compounds) any metal process equipment including, but not limited to boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning. In accordance with the conditions of the previous permits, the permittee is allowed to discharge Non-Chemical metal cleaning wastewater directly to the ash pond or process pond without limitations or monitoring requirements, pursuant to the Jordan Memorandum. Monitoring is required only when chemical metal cleaning activities are being performed.									

6.4. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

6.4.1. Jordan Memorandum

According to 40 CFR 423.11(c) the term chemical metal cleaning waste means any wastewater resulting from the cleaning of any metal process equipment with chemical compounds, including, but not limited to, boiler tube cleaning. According to 40 CFR 423.11(d) the term metal cleaning waste means any wastewater resulting from cleaning [with or without chemical compounds] any metal process equipment including, but not limited to, boiler tube cleaning, boiler fireside cleaning, and air preheater cleaning.

There are Non-Chemical metal cleaning wastewater that will be discharged to the new Process Pond Outfall 006. These waters are not a result of cleaning with chemical compounds and they do not flow through Outfall 004. In the past these wastewaters were permitted to discharge directly to the auxiliary pond without limitations or monitoring requirements. That permitting action was done pursuant to the Jordan Memorandum. The memorandum is from J. William Jordan, US EPA Permit Assistance and Evaluation Division, to Bruce P. Smith, US EPA Enforcement Division Region III, concerning interpretation of the metal cleaning wastes guidelines in the federal effluent limitation guidelines for steam electric power generating point sources. In the memorandum, Mr. Jordan explains that "All water washing operations are 'low volume' while any discharge from an operation involving chemical cleaning should be included in the metal cleaning category." With that in mind, it makes sense that the limitations for chemical metal cleaning wastes do not apply to the air heater wash waters and boiler fireside wash waters at this facility.

It is the BPJ of the DOW to place low volume waste requirements on these wastewaters. The DOW has developed flow-weighted limitations at Outfall 006 to insure compliance with the federal effluent limitation guidelines for low volume wastes, chemical metal cleaning wastes, and other process wastewaters.

6.4.2. Technology-Based Effluent Limitations

Technology-based effluent limitations and standards, based on federally promulgated standards, a case-by-case basis, or a combination of the two, shall be included in all KPDES permits, where applicable.

6.4.2.1. Federal Effluent Limitations Guidelines

EPA has established a minimum level of technology that must be applied to certain industries. Due to the operations at this facility, all applicable sections of 40 CFR 423 shall be applied to this outfall. The following is a list of those requirements:

40 CFR 423.12(b)(5)

The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

TABLE 20.		
BPT Effluent Requirements – Metal Cleaning Wastes		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l

Copper, Total	1.0 mg/l	1.0 mg/l
Iron, Total	1.0 mg/l	1.0 mg/l

40 CFR 423.12(b) (12)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b)(3) through (b)(7), and (b)(11), of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.12 (b) (12) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner.

40 CFR 423.13(e)

The quantity of pollutants discharged in chemical metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of chemical metal cleaning wastes times the concentration listed in the following table:

TABLE 21.		
BAT Effluent Requirements – Chemical Metal Cleaning Wastes		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
Copper, Total	1.0 mg/l	1.0 mg/l
Iron, Total	1.0 mg/l	1.0 mg/l

40 CFR 423.13(m)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b) through (l) of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.13 (m) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner.

6.4.3. Total Suspended Solids, and Oil and Grease

Since Outfall 004 effluent is directed to the new Outfall 006 Process Pond, the limitations for these pollutants has been applied at Outfall 006 after commingling with other plant process waters. The DOW has developed flow-weighted limitations to insure compliance with the federal effluent limitation guidelines. The Division has determined that application of the requirements for these parameters after commingling will be appropriate due to the same requirements being applied to the other wastestreams of Outfall 006.

6.5. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

6.5.1. Internal Monitoring Point

The monitoring requirements for these parameters are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(iii)], and the requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

6.5.2. Flow

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

6.5.3. Total Copper and Total Iron

The limits for these parameters are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], representative of the BPT and BAT requirements for metal cleaning wastes [40 CFR 423.12(b)(5)] and [40 CFR 423.13(e)].

SECTION 7

OUTFALL 005

7. OUTFALL 005

7.1. Outfall Description

The following table list the outfall type, location, and description:

TABLE 22.				
Outfall Type	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
Plant Intake	37.783567°	84.709256°	Plant Intake from Herrington Lake	Raw Water Intake

7.2. Reported Values

The following table summarizes the reported values for Outfall 005:

TABLE 23.							
Reported Parameters	**Units**	**EFFLUENT**					
		Loadings (lbs./day)		**Concentrations**			
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**
Flow	MGD	18.50	23.48	N/A	N/A	N/A	N/A
Temperature	°F	N/A	N/A	N/A	58.17	59.99	N/A
Total Suspended Solids	mg/l	N/A	N/A	N/A	1.02	1.59	N/A
Hardness (as mg/l $CaCO_3$)	mg/l	N/A	N/A	N/A	155.3	167.5	N/A
Total Recoverable Metals	mg/l	N/A	N/A	N/A	0.043	0.043	N/A
pH	SU	N/A	N/A	7.33	N/A	N/A	8.16

The above values are based on 5-year Discharge Monitoring Report (DMR) averages from 05/31/2014 to 03/31/2019.

7.3. Intake Limitations and Monitoring Requirements

The following table summarizes the Intake limitations and monitoring requirements for Outfall 005:

TABLE 24.									
INTAKE LIMITATIONS								**MONITORING REQUIREMENTS**	
Intake Characteristic	**Units**	**Loadings (lbs./day)**		**Concentrations**				**Frequency**	**Sample Type**
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**		
Flow [1]	MGD	Report	Report	N/A	N/A	N/A	N/A	Daily	Calculated
Temperature[1]	°F	N/A	N/A	N/A	Report	Report	N/A	Daily	Grab

TABLE 24.									
INTAKE LIMITATIONS								**MONITORING REQUIREMENTS**	
Intake Characteristic	**Units**	**Loadings (lbs./day)**		**Concentrations**				**Frequency**	**Sample Type**
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**		
[2]Cooling Water Intake Inspection	Fail=1 Pass=0	N/A	N/A	N/A	N/A	N/A	Report[3]	1/Week	Inspection[4]
[1]Intake from Stream									
[2]Weekly monitoring of the cooling water intake system shall be performed, during the period the cooling water intake structure is in operation, to ensure that the design and construction technology required by §125.94 (i.e., intake flow commensurate with closed cycle cooling) is functioning as designed and is being appropriately maintained and operated.									
[3]If the intake flow through the screen is not commensurate with closed cycle cooling a "1" is to be reported. If intake flow is commensurate with closed cycle cooling "0" is to be reported.									
[4]This inspection may take the form of either visual inspections or the use of remote monitoring devices.									
An annual certification statement signed by the authorized representative shall be submitted to the DOW surface water permits branch no later than January 31st for the previous year. See Section 5.8.3.3. "Reporting Requirements for Cooling Water Intake" for additional details.									

7.4. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

7.4.1. Cooling Water Intake

7.4.1.1. Cooling Water Intake Description

Brown is located near Burgin, Kentucky on Herrington Lake adjacent to the Dix Dam. The facility had three closed-cycle condenser cooled coal-fired units. Units 1 & 2 were retired in March 2019. Unit 3 withdraws all of the Closed-cycle Recirculating System (CCRS) makeup water from Herrington Lake. Brown employs two cooling water intake structures. One structure includes three service water pumps that were originally designed to provide water to Units 1 and 2, and the second structure includes two service water pumps that provide water to Unit 3. While Units 1 and 2 had their own intake that includes use of a CCRS for all cooling water withdrawn from Herrington Lake, that intake and CCRS are no longer used except for redundancy.

Unit 3 withdraws its CCRS makeup water from Herrington Lake. Under normal operation water is withdrawn from Herrington Lake by the two Unit 3 submerged pumps which are supported by steel framed platforms. There is no underwater intake structure or screen house. Each pump has a fixed panel screen attached to the intake opening, approximately 38" long and 28" diameter. Specific screen opening sizes are not available. Pumps are located at elevation 661', compared to the average water level of 734'. The pump intake is typically submerged 55' to 96' depending on the lake level. No backwash of the screens is installed. When a pump is turned off the water in the intake pipe to the pump will reverse course back into the lake. The pumps have a total design intake flow of 25.92 MGD. Based on the last five years of operating data (2014-2019) Brown withdrew an average of 28.6 cfs from Herrington Lake, which is based on all three Units in operation.

Units 1 and 2 each had a single mechanical draft cooling tower while Unit 3 has two parallel mechanical draft cooling towers. Brown Unit 3 has used a re-circulating cooling water system since the unit began operating in 1972. The system utilizes two counter flow, induced draft cooling towers to cool the re-circulating water through evaporation. Service Water Return (make-up water) is used to replenish losses from the system due to drift, evaporation, and blowdown. Blowdown is necessary to maintain the proper level in the cooling towers and to ensure that minerals, such as calcium and magnesium don't become so concentrated that scaling occurs in the condenser and piping. An anti-scalant chemical is added to the system as well, to allow operation at higher cycles of concentration. The use of Service Water Return as the cooling medium, permits safe operation of the circulating water system at 2.5 cycles of concentration or above, thus further reducing blowdown flow. There is no emergency intake at the facility.

As discussed above, the cooling makeup water for the CCRSs is withdrawn from pumps that are typically submerged 55' to 96' depending on lake level. By withdrawing cooling water from the deep water behind the dam it is water with lower densities of entrainable life states. Herrington Lake upstream of the Dam is stratified during portions of the year and hypoxic conditions exist below 10-15 feet during primarily the summer months, but may occur in lake spring and fall. At times, hypoxic levels of oxygen occur throughout the entire water column and near anoxic conditions are common at bottom depths during the summer. Thus it is expected that impingeable sized fish avoid these areas during periods of low dissolved oxygen and entrainable life stages are not likely to survive at lower depths where the intake pipe withdraws cooling water during these periods.

7.4.1.2. Impingement Mortality BTA Determination

The permittee has selected to comply with the impingement mortality standard in 40 CFR 125.94(c)(1) by implementing a closed cycle recirculating system. This intake structure feeds into a cooling system that meets the definition of a closed-cycle recirculating system in 40 CFR 125.92(c), as demonstrated by the following: Brown currently employs use of a closed-cycle cooling system for Unit 3. Additionally, Units 1 & 2 were retired in February 2019. Units 1 and 2 each had a single mechanical draft cooling tower. Unit 3 has two parallel mechanical draft cooling tower. With the use of Service Water Return (make-up water) it is anticipated that cooling tower will operate at 2.5 cycles of concentration or above.

7.4.1.3. Entrainment BTA Determination

The current technology and operations for the cooling water intake structure have been identified by the Division as the best technology available for minimizing entrainment at this intake structure. Since the facility already operates with closed-cycle recirculating system the following additional technologies were also evaluated: (1) fine mesh screens with a mesh size of 2mm or smaller with a safe return mechanism, (2) variable speed pumps, and (3) water reuse or alternate sources of cooling water. Each technology was evaluated using the criteria listed in 40 CFR 125.98(f)(2) and, where relevant, the criteria listed in 40 CFR 125.98(f)(3). See the tables below for analyses:

Cooling Towers	
Numbers and Types of organisms entrained	Optimized cooling towers in freshwater areas can reduce entrainment by 97.25%. Additionally, the 316(b) Rule Preamble makes the following statement: "Closed-cycle cooling is indisputably the most effective technology at reducing entrainment." This in conjunction with the deep water withdrawal provides a significant reduction to entrainment.
Particulate emissions or other pollutants	The facility is currently in compliance with their permit limitations and therefore this is not considered a critical factor.
Land availability	Cooling towers are not feasible if not land is available on or near the facility. The facility currently has a cooling tower on their remaining units. Therefore, this is not considered a critical factor.
Remaining useful plant life	KU retired Units 1 and 2 in 2019. There are no plans to add additional units to the facility in the next five years.
Quantified and qualitative social benefits	The permittee is not required to provide Cost Evaluation Study (40 CFR 122.21(r)(10)) or Benefits Evaluation (40 CFR 122.21(r)(11)) because AIF is less than 125 MGD. The permittee provided no estimate of cost. However, the facility already has cooling towers on all their units.
Conclusion	Division concludes that the closed-cycle recirculating systems already in place at the facility meets BTA requirements for entrainment. In agreement with EPA that closed-cycle cooling is indisputably the most effective technology at reducing entrainment due to the large reduction in flow.

Fine Mesh Screens with a Mesh Size of 2 mm or smaller

Numbers and Types of organisms entrained	The facility does not have historical, relevant entrainment data that can be compared with data for this technology. In order for any entrainment reductions to be seen a screen with a mesh size of <2.0 mm should be used, as nearly 100% of eggs are still pass through a 2.0 mm mesh screen. Through EPA's review of control technologies, the Agency found that the survival of "converts" on fine mesh screen was very poor, and in some extreme cases comparable to the extremely low survival of entrained organisms that are allowed to pass entirely through the facility.
Particulate emissions or other pollutants	None expected other than increase in solids clogging the mesh slot size.
Land availability	The size of the screen face may need to be increased to maintain current flow rates. As EPA noted in the 316(b) existing facilities rule technical development document, in order to equip fine mesh screen and maintain a through-screen velocity of 0.5 fps, as many as 68% of facilities would need to expand their intake screen area by more than five times. Due to the large amount of make-up flow required at this facility the Impingement area of influence would be increased significantly. EPA estimated that 17% of existing intake screens in the U.S. could not be enlarged to accommodate a 2 mm screen.
Remaining useful plant life	KU retired Units 1 and 2 in 2019. There are no plans to add additional units to the facility in the next five years.
Quantified and qualitative social benefits	The permittee is not required to provide Cost Evaluation Study (40 CFR 122.21(r)(10)) or Benefits Evaluation (40 CFR 122.21(r)(11)) because AIF is less than 125 MGD. The permittee provided no estimate of cost. The data that is available for this factor is not of sufficient rigor to allow the Division to preclude this technology.
Conclusion	The use of a fine mesh screen is not required, in part, because the main entrainment reduction expected from the use of fine mesh screens with a mesh size of 2 mm or smaller is early life stage organisms (i.e. nursery areas). Since Brown employs a design intake location that significantly reduces entrainment by withdrawing cooling water from deep water behind the Dix Dam that has low dissolved oxygen or anoxic conditions during portions of the entrainment season. Additionally, the use of fine mesh screens would have the potential to clog more frequently thereby increasing the through screen velocity.

Variable Speed Pumps	
Numbers and Types of organisms entrained	Proper use of variable frequency drives can reduce entrainment mortality by decreasing the volume of water withdrawn. However, using less cooling water increases in-plant and discharge temperatures, lowering the survival rate of entrained. This technology is estimated to provide only minor reductions to entrainment. This is because the facility already operates their pumps as need to meet water demands. Also, opportunities for flow reduction are expected to be greater during cooler months because of ambient water temperatures. To the extent that this is true and entrainment impacts are less probable during conditions with cooler water temperatures, the reductions achieved will be low.

Particulate emissions or other pollutants	There would probably be both trivial increases and trivial decreases in pollution as part of slight energy penalties caused by increased temperature of condensers and slightly decreased pump energy use, respectively. Lower flow rates in cooling tubes may require use of more chemicals or energy to control scaling.
Land availability	Not typically an issue.
Remaining useful plant life	KU retired Units 1 and 2 in 2019. There are no plans to add additional units to the facility in the next five years.
Quantified and qualitative social benefits	The permittee is not required to provide Cost Evaluation Study (40 CFR 122.21(r)(10)) or Benefits Evaluation (40 CFR 122.21(r)(11)) because AIF is less than 125 MGD. The permittee provided no estimate of cost. The data that is available for this factor is not of sufficient rigor to allow the Division to preclude this technology.
Thermal Discharge Impacts	The use of variable speed pumps would not reduce thermal loads but would probably increase temperature and decrease flow so temperature impacts would be variable and probably minimal. But the current thermal impact from the facility is not a concern. This was not considered a significant factor.
Conclusion	Use of variable speed pumps is not required, in part, because each CWIS already uses 2 pumps. The pumps are already operated as needed to supply cooling water needs. This technology is estimated to provide only minor reductions to entrainment due to the location of the water withdrawal pumps.

Water Reuse or Alternate Sources of Cooling Water
This is typically not an option for steam electric power plants due to the high volume of cooling water that is required. Recent cooling water withdraw flows average around 18 MGD.

7.4.2. Intake Structure Standard Requirements

7.4.2.1. Future BTA Determination

This is a Final BTA determination made in accordance with the requirements of the federal regulations in 40 CFR 125.90-98, based upon the materials submitted by the permittee through 40 CFR 122.21(r). Future BTA determinations will be re-confirmed under the same regulations, but the permittee may request that some application materials be waived under 40 CFR 125.95(c) and 40 CFR 125.98(g).

7.4.2.2. Visual or Remote Inspections

The permittee is required to conduct visual or remote inspections of the intake structure at least weekly during periods of operation, pursuant to 40 CFR 125.96(e).

7.4.2.3. Reporting Requirements

The permittee is required to submit an annual certification statement and report, pursuant to 40 CFR 125.97(c).

7.4.2.4. Endangered Species Act

Nothing in this permit authorizes take for the purpose of a facility's compliance with the Endangered Species Act. 40 CFR 125.98(b)(1) requires the inclusion of this provision in all permits subject to 316(b) requirements. Contact the state Natural Heritage Inventory (NHI) staff with inquiries regarding incidental take of state-listed threatened and endangered species and the US Fish and Wildlife Service with inquiries regarding incidental take of federally-listed threatened and endangered species.

7.5. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

7.5.1. Flow

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

7.5.2. Temperature

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(i)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

7.5.3. Cooling Water Intake Inspection

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)], requirements for visual or remote inspections [40 CFR 125.96 (e)], and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

SECTION 8

OUTFALL 006

8. OUTFALL 006

8.1. Outfall Description

The following table lists the outfall type, location, and description:

TABLE 25.					
Outfall Number	**Outfall Type**	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
006	External	37.782714°	84.715321°	Herrington Lake (Dix River)	Discharge to Herrington Lake from new Process Pond that contains flows from the following: FGD Wastewater (Future Outfall 007), Bottom Ash Sluice Water, Landfill Leachate, Low Volume Waste, Coal Pile Runoff, chemical (Outfall 004) and nonchemical metal cleaning wastewater, Abutment and Wick-Drain Sumps, Closed Main Ash Pond Toe Drain Sump, Auxiliary Ash Pond Dewatering Flows, and Stormwater.
006A	External	37.782714°	84.715321°	Herrington Lake (Dix River)	Additional requirements when the facility is dewatering from ATB's

8.2. Effluent Limitations and Monitoring Requirements

8.2.1. Outfall 006

The following table summarizes the effluent limitations and monitoring requirements for Outfall 006:

TABLE 26.									
EFFLUENT LIMITATIONS								**MONITORING REQUIREMENTS**	
Effluent Characteristic	**Units**	**Loadings (lbs./day)**		**Concentrations**				**Frequency**	**Sample Type**
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**		
Effluent Flow	MGD	Report	Report	N/A	N/A	N/A	N/A	2/Month	Instantaneous
Flow, process wastewater[1,3]	GPD	N/A	33,339[2]	N/A	N/A	N/A	N/A	Continuous	Metered
Total Suspended Solids									
Tier 1	mg/l	N/A	N/A	N/A	30.0	83.0	N/A	2/Month	Grab
Tier 2[3]	mg/l	N/A	N/A	N/A	30.0	81.7	N/A	2/Month	Grab
Oil & Grease									
Tier 1	mg/l	N/A	N/A	N/A	12.7	17.2	N/A	2/Month	Grab
Tier 2[3]	mg/l	N/A	N/A	N/A	12.6	17.5	N/A	2/Month	Grab
pH	SU	N/A	N/A	6.0	N/A	N/A	9.0	2/Month	Grab
Total Recoverable Mercury[4]	mg/l	N/A	N/A	N/A	0.000051	0.0014	N/A	1/Month	Grab

TABLE 26.									
EFFLUENT LIMITATIONS								MONITORING REQUIREMENTS	
Effluent Characteristic	Units	Loadings (lbs./day)		Concentrations				Frequency	Sample Type
		Monthly Average	Daily Maximum	Minimum	Monthly Average	Daily Maximum	Maximum		
Total Recoverable Cadmium	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Selenium	mg/l	N/A	N/A	N/A	0.075[5]	Report	N/A	1/Quarter	Grab
Total Recoverable Selenium (Fish Tissue)	mg/kg dry weight	N/A	N/A	N/A	N/A	N/A	8.6	([3])	([3])
Total Recoverable Thallium	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Hardness (as mg/l $CaCO_3$)	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Acute WET[6]	TU_A	N/A	N/A	N/A	N/A	N/A	1.00	1/Quarter	([7])
[1]This represents discharge from the bottom ash transport system									
[2]30 – Consecutive day rolling average									
[3]These limits shall become effective on July 1, 2023 and are representative of the allowed 10% bottom ash purge and the FGD system being converted to a zero discharge.									
[4]These limitations shall apply on the date specified in the compliance schedule for this effluent (see Section 8.3.4) and continue in effect for the remainder of the permit. Until the limitations are effective, the permittee shall report monitored values for both the monthly average requirements and daily maximum requirements.									
[5]Should the monthly average concentration of Total Recoverable Selenium exceed 0.075 mg/l, see permit Section 5.10 for additional requirements.									
[6]WET – Whole Effluent Toxicity									
[7]Two (2) discrete grab samples shall be collected 12 hours apart									
The reported results from Outfall 006A "Additional Requirements during Ash Pond Dewatering" shall be used as compliance results for this outfall as well.									

8.2.2. Outfall 006A (Additional Requirements during Ash Pond Dewatering)

This outfall is for the additional monitoring requirements if any Auxiliary Pond dewatering takes place during the month. The facility shall give the DOW regional office notice prior to commencement of any dewatering activity. If the facility does not dewater during the month, they can report NODI Code 9 "Conditional Monitoring-Not Required This Period" on that month's DMR for this outfall. The following table summarizes the effluent limitations and monitoring requirements for Outfall 006A:

TABLE 27.									
EFFLUENT LIMITATIONS								MONITORING REQUIREMENTS	
Effluent Characteristic	Units	Loadings (lbs./day)		Concentrations				Frequency	Sample Type
		Monthly Average	Daily Maximum	Minimum	Monthly Average	Daily Maximum	Maximum		
Hardness (as mg/l $CaCO_3$)	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Month	Grab
Total Recoverable Antimony[1]	mg/l	N/A	N/A	N/A	0.195	Report	N/A	1/Month	Grab
Total Recoverable Arsenic[1]	mg/l	N/A	N/A	N/A	1.03	1.03	N/A	1/Month	Grab
Total Recoverable Beryllium[1]	mg/l	N/A	N/A	N/A	0.140	Report	N/A	1/Month	Grab
Total Recoverable Cadmium[1]	mg/l	N/A	N/A	N/A	0.0051	0.023	N/A	1/Month	Grab
Total Recoverable Chromium[1]	mg/l	N/A	N/A	N/A	3.49	Report	N/A	1/Month	Grab
Total Recoverable Copper[1]	mg/l	N/A	N/A	N/A	0.131	0.131	N/A	1/Month	Grab
Total Recoverable Iron[1]	mg/l	N/A	N/A	N/A	10.5	12.2	N/A	1/Month	Grab
Total Recoverable Lead[1]	mg/l	N/A	N/A	N/A	0.106	1.20	N/A	1/Month	Grab
Total Recoverable Nickel[1]	mg/l	N/A	N/A	N/A	1.35	4.08	N/A	1/Month	Grab
Total Recoverable Selenium	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Month	Grab
Total Recoverable Silver[1]	mg/l	N/A	N/A	N/A	Report	0.079	N/A	1/Month	Grab
Total Recoverable Thallium[1]	mg/l	N/A	N/A	N/A	0.007	Report	N/A	1/Month	Grab
Total Recoverable Zinc[1]	mg/l	N/A	N/A	N/A	1.03	1.03	N/A	1/Month	Grab
Acute WET[2]	TU_A	N/A	N/A	N/A	N/A	N/A	Report	1/Month	([3])
[1]The Monthly Average and Daily Maximum concentrations for these pollutants are not effluent limitations, but water quality triggers that, if exceeded for two (2) consecutive dewatering months (this includes even if the facility stops dewatering in-between the two months), require permittee action. See the Best Management Practices Plan Section - Additional BMP Conditions Subsection for additional requirements related to these triggers.									
[2]WET – Whole Effluent Toxicity									
[3]Two (2) discrete grab samples shall be collected 12 hours apart									

8.3. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

8.3.1. Facility Changes and Tiered Limits

This facility will continue to operate a coal fired steam electric power generation and transmission unit. The facility will undergo major changes in response to the recently updated federal regulations concerning Coal Combustion Residuals (CCR) and Steam Electric Power Generating Effluent Limitation Guidelines (ELG). New treatment equipment, redirection of BATW flows, cessation of FGD wastewater, and impoundment construction will significantly change this site. A comprehensive discussion of all the facility changes can be found in the Cover Letters and in the KU's Brown Generating Station KPDES application submitted.

The facility is in the process of closing out their Auxiliary Ash Pond. In order to do this the facility must redirect flows that are currently discharging to the Auxiliary Ash Pond to the new Process Pond. In addition to the planned pond closures the facility is constructing a Zero discharge FGD process water treatment system, and modification to the existing BATW system to maintain a 10% purge rate. In order to capture these changes would affect the facilities TSS and Oil & Grease limits it would be necessary to tier the permit for them. Section 8.4.1 reflects the current conditions at the effective date of the permit (Tier 1) and the future operation conditions once these changes are complete (Tier 2).

8.3.2. Legacy Wastewater

Once the facility converts to sending some of the waste streams that were contributing to the Auxiliary Ash Pond to the new Process Pond, these sources will no longer be contributing to the Auxiliary Ash Pond surface impoundments. The wastewater that these operations were contributing to will still be in the impoundment until it has been closed. The overall volumes of legacy wastewater will continue to decrease dramatically over time as the facility closes out the pond, and the water redirected to Process Pond and legacy wastewater from the Auxiliary Ash Pond will be combined and discharged through outfall 006. Therefore, the Division will continue to apply the same limitations for TSS and Oil & Grease that applied before to outfall 006, since there is no change to the contributing operations to this outfall.

8.3.3. Dewatering of Ash Ponds

In order for the Auxiliary Ash Pond to be closed, it must be decanted and dewatered. During dewatering, mechanical equipment may be required to remove interstitial water from the ash in the Ash Pond. While dewatering occurs, the facility will be required to monitor for the metals listed in Outfall 006A at a frequency of once per month and toxicity testing at a frequency of once per month. All dewatering flows from the Auxiliary Ash Pond will be combined with other process wastewater and directed to the new process pond, prior to discharge to Herrington Lake via a new multi-port, high-rate diffuser. For these reasons, monthly toxicity testing and monitoring of metals, with baseline water quality triggers during dewatering, will be required in place of metals limitations.

8.3.4. Schedule of Compliance

The permittee shall comply with all Outfall 006 effluent limitations by the effective date of the permit except as noted below. At the permittee's request, the DOW has developed a compliance schedule consistent with 40 CFR 122.47 (as incorporated in 401 KAR 5:050, Section 3), for meeting the monthly average requirements for Total Recoverable Mercury at Outfall 006. Outfall 006 consists of existing

Auxiliary Ash Pond legacy wastewater including ash sluice flows and FGD dewatering flows. While the new process wastewater treatment system-FGD wastewater treatment system will operate by late 2019 to reduce mercury concentrations below the required limit for new flows, the large volume of legacy wastewater will require a significant amount of time to manage. The Auxiliary Ash Pond water that needs to be dewatered through the new Process Pond discharge structure is estimated to be 5-10 million gallons and may require 6+ months to gradually comingle these legacy flows with treated wastewaters, while remaining in compliance with the limits for the blended flows. The compliance schedule request is contained within the information submitted by the permittee on May 24, 2019. The milestones and compliance dates in the following schedule of compliance are based on the request and timelines provided therein. The following table outlines each of the compliance schedule's milestones and the corresponding compliance duration:

TABLE 28.

Milestone	Compliance Date
The permittee shall achieve compliance with the Total Recoverable Mercury limitation.	As soon as possible, but not later than August 1, 2020

8.3.5. Fly Ash Transport Water Compliance

The Brown Station has completely converted to dry fly ash handling; therefore, the ELG regulatory prohibition of the discharge of fly ash transport wasters conditionally beginning November 1, 2018 will not affect existing or planned operations at the station.

8.3.6. Bottom Ash Transport Water Compliance

The E.W. Brown Stations Unit 3 coal-fired steam generating plant will comply with the Final ELG Rule for BATW by operating a high recycle rate management system including a purge rate of 10% to maintain the BATW management system equipment reliability and performance. The BATW management system includes two remote submerged flight conveyors to manage bottom ash, coal mill rejects/pyrites, and potentially, the boiler air-heater wash water flows. The existing system must be further modified to accommodate the high recycle rate and up to 10% purge flow consistent with the Final ELG Rule requirements. Generally, this requires installing new tanks/pumps/piping/controls to manage transport water flows to/from the remote mechanical drag system conveyors. Some conversion of existing bottom ash hoppers and related piping for sluice/wash/seal water flows system may also be required to properly manage associated flows.

40 CFR 423.13(k)(1) requires that except for those discharges to which 40 CFR 423.13(k)(2) applies, or when bottom ash transport water is used in the FGD scrubber, there be no discharge of pollutants in bottom ash transport waters. The permittee must meet this requirement by a date determined by the permitting authority. For bottom ash transport water, the date has to be as soon as possible beginning October 13, 2021 but no later than December 31, 2025. The definition for the phrase "as soon as possible" can be found in 40 CFR 423.11(t). The permittee provided the Division of Water information to determine as soon as possible ELG compliance applicability dates.

KU awarded the contract for the project scope, design developed and detailed engineering in April 2021. KU will procure the equipment and materials required. KU will contract for the installation which includes multiple overlapping phases that are not specifically sequential but highly interdepended so that delays of any step will lead to delays of completing the entire project. These phases and general expected durations include:

- Detailed engineering: beginning June 2021

- Procurement: beginning Q3 2021
- Construction – multi – discipline and multi – trades: beginning Q2 2022
- Mechanical startup, troubleshooting and testing; beginning Q3 2022
- Commercial Completion and performance test: beginning Q4 2022
- Plant testing and optimization: beginning Q1-Q2 2023

The DOW grants KU's requested compliance date of July 1, 2023 to comply with the discharge BAT requirements for BATW by operating a high recycle rate management system with a purge rate not to exceed 10% a 30-day rolling average.

8.3.7. Technology-Based Effluent Limitations

Technology-based effluent limitations and standards, based on federally promulgated standards, a case-by-case basis, or a combination of the two, shall be included in all KPDES permits, where applicable.

8.3.7.1. Federal Effluent Limitations Guidelines

EPA has established a minimum level of technology that must be applied to certain industries. Due to the operations at this facility, all applicable sections of 40 CFR 423 shall be applied to this outfall. The following is a list of those requirements:

40 CFR 423.12(b) (1)

The pH of all discharges, except once through cooling water, shall be within the range of 6.0-9.0.

40 CFR 423.12(b) (2)

There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

40 CFR 423.12(b) (3)

The quantity of pollutants discharged from low volume waste sources shall not exceed the quantity determined by multiplying the flow of low volume waste sources times the concentration listed in the following table:

TABLE 29.		
BPT Effluent Requirements – Low Volume Waste		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l

40 CFR 423.12(b) (4)

The quantity of pollutants discharged in fly ash and bottom ash transport water shall not exceed the quantity determined by multiplying the flow of fly ash and bottom ash transport water times the concentration listed in the following table:

TABLE 30.		
BPT Effluent Requirements – Fly and Bottom Ash Transport Water		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l

40 CFR 423.12(b)(5)

The quantity of pollutants discharged in metal cleaning wastes shall not exceed the quantity determined by multiplying the flow of metal cleaning wastes times the concentration listed in the following table:

TABLE 31.		
BPT Effluent Requirements – Metal Cleaning Wastes		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l
Copper, Total	1.0 mg/l	1.0 mg/l
Iron, Total	1.0 mg/l	1.0 mg/l

40 CFR 423.12(b) (9)

Subject to the provisions of paragraph (b)(10) of this section, the following effluent limitations shall apply to the point source discharges of coal pile runoff:

TABLE 32.		
BPT Effluent Requirements – Coal Pile Runoff		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	50 mg/l	-

40 CFR 423.12(b) (10)

Any untreated overflow from facilities designed, constructed, and operated to treat the volume of coal pile runoff which is associated with a 10 year, 24 hour rainfall event shall not be subject to the limitations in paragraph (b)(9) of this section

40 CFR 423.12(b) (11)

The quantity of pollutants discharged in FGD wastewater, flue gas mercury control wastewater, combustion residual leachate, or gasification wastewater shall not exceed the quantity determined by multiplying the flow of the applicable wastewater times the concentration listed in the following table:

TABLE 33.		
BPT Effluent Requirements – combustion residual leachate		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l

40 CFR 423.12(b) (12)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b)(3) through (b)(7), and (b)(11), of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.12 (b) (12) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner.

40 CFR 423.12(b)(13)

In the event that waste streams from various sources are combined for treatment to be discharge, the quantity of each pollutant or pollutant property controlled in paragraphs (b)(1) through (b)(12) of this section attributable to each controlled waste source shall not exceed the specified limitations for that waste source.

40 CFR 423.13(a)

There shall be no discharge of polychlorinated biphenyl compounds such as those commonly used for transformer fluid.

40 CFR 423.13(g)(ii)

For FGD wastewater generated before the date determined by the permitting authority, as specified in paragraph (g)(1)(i), the quantity of pollutants discharged in FGD wastewater shall not exceed the quantity determined by multiplying the flow of FGD wastewater times the concertation listed for TSS in 423.12(b)(11).

40 CFR 423.13(k)(1)(i)

Except for those discharges to which paragraph (k)(2) of this section applies, or when the bottom ash transport water is used in the FGD scrubber, there shall be no discharge of pollutants in bottom ash transport water. Dischargers must meet the discharge limitation in this paragraph by a date determined by the permitting authority that is as soon as possible beginning October 13, 2021, but no later than December 31, 2025. This limitation applies to the discharge of bottom ash transport water generated on and after the date determined by the permitting authority for meeting the discharge limitation, as specified in this paragraph. Except for those discharges to which paragraph (k)(2) of this section applies, whenever bottom ash transport water is used in any other plant process or is sent to a treatment system at the plant (except when it is used in the FGD scrubber), the resulting effluent must comply with the discharge limitation in this paragraph. When the bottom ash transport water is used in the FGD scrubber, it ceases to be bottom ash transport water, and instead is FGD wastewater, which must meet the requirements in paragraph (g) of this section.

40 CFR 423.13(k)(1)(ii)

For discharges of bottom ash transport water generated before the date determined by the permitting authority, as specified in paragraph (k)(1)(i) of this section, the quantity of pollutants discharged in bottom ash transport water shall not exceed the quantity determined by multiplying the flow of bottom ash transport water times the concentration listed for TSS in 423.12(b)(4).

40 CFR 423.13(k)(2)(i)

(A) The discharge of pollutants in bottom ash transport water from a properly installed, operated, and maintained bottom ash system is authorized under the following conditions:

(*1*) To maintain system water balance when precipitation-related inflows are generated from storm events exceeding a 10-year storm event of 24-hour or longer duration (e.g., 30-day storm event) and cannot be managed by installed spares, redundancies, maintenance tanks, and other secondary bottom ash system equipment; or

(*2*) To maintain system water balance when regular inflows from wastestreams other than bottom ash transport water exceed the ability of the bottom ash system to accept recycled water and segregating these other wastestreams is not feasible; or

(*3*) To maintain system water chemistry where installed equipment at the facility is unable to manage pH, corrosive substances, substances or conditions causing scaling, or fine particulates to below levels which impact system operation or maintenance; or

(*4*) To conduct maintenance not otherwise included in paragraphs (k)(2)(i)(A) (*1*), (*2*), or (*3*) of this section and not exempted from the definition of transport water in § 423.11(p), and when water volumes cannot be managed by installed spares, redundancies, maintenance tanks, and other secondary bottom ash system equipment.

(B) The total volume that may be discharged for the above activities shall be reduced or eliminated to the extent achievable using control measures (including best management practices) that are technologically

available and economically achievable in light of best industry practice. The total volume of the discharge authorized in this subsection shall be determined on a case-by-case basis by the permitting authority and in no event shall such discharge exceed a 30-day rolling average of ten percent of the primary active wetted bottom ash system volume. The volume of daily discharges used to calculate the 30-day rolling average shall be calculated using measurements from flow monitors.

40 CFR 423.13(l)

Combustion residual leachate. The quantity of pollutants discharged in combustion residual leachate shall not exceed the quantity determined by multiplying the flow of combustion residual leachate times the concentration for TSS listed in 423.12(b)(11)

40 CFR 423.13(m)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b) through (l) of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.13 (m) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner

40 CFR 423.13(n)

In the event that wastestreams from various sources are combined for treatment or discharged, the quantity of each pollutant or pollutant property controlled in paragraphs (a) through (m) of this section attributable to each controlled waste source shall not exceed the specified limitation for that waste source.

8.3.7.2. Best Professional Judgment (BPJ)

Coal Pile Runoff

In accordance with 401 KAR 5:080, Section 2(3) – 40 CFR 125.3 in the absence of promulgated technology based standards, the cabinet may develop appropriate technology based standards utilizing its 'Best Professional Judgment" (BPJ). The previous permit established the following BPJ limits for coal pile runoff.

TABLE 34.		
BPJ Effluent Requirements – Coal Pile Runoff		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	N/A	30.0 mg/l
Oil and Grease	5.0 mg/l	5.0 mg/l

These limits have not been changed for this permit renewal in accordance with anti-backsliding [40 CFR 122.44(l)].

Stormwater - Total Suspended Solids

The facility treats its storm water for this parameter before discharge in a holding pond. Sedimentation is a commonly used treatment technology for the removal of total suspended solids that is both efficient and cost effective. Although several factors may influence the final concentration of total suspended solids in the discharge, it has been the experience of the Division that ponds that retain wastewater for 6 hours or more can achieve a total suspended solids concentration of 30 mg/l as a monthly average and 60 mg/l as a daily maximum.

Stormwater -Oil & Grease

The facility does not treat its stormwater for this parameter before discharge. If treatment were to be necessary, an adequately sized oil /water separator with ample retention time would provide appropriate treatment. Flotation or gravity separation of lighter petroleum based products from water is a common and cost effective method for the removal of oil & grease. It has been the experience of the Division that this treatment method can achieve an oil & grease concentration of 10 mg/l as a monthly average and 15 mg/l as a daily maximum.

8.3.8. Water Quality-Based Effluent Limitations

The following table lists those pollutants and/or pollutant characteristics of concern that DOW has determined exhibit reasonable potential to cause or contribute to an excursion of a water quality-based criterion, and the basis of DOW's determination. These determinations are consistent with the DOW's reasonable potential analysis (RPA) procedures outlined in *Permitting Procedures For Determining "Reasonable Potential"* Kentucky Division of Water May 1, 2000.

TABLE 35.	
Pollutant or Pollutant Characteristic	**Basis**
Whole Effluent Toxicity	The facility is rated as a "major discharger". The facility's discharge is a complex wastewater.
Total Recoverable Mercury	While the facility current does not show reasonable potential for the pollutant it is suspected that with the facility dewatering and redirecting FGD and other process wastewaters the concentration could become elevated. Therefore, with all these facility changes it is Division of Waters Best Professional Judgement to limit this pollutant.
Total Recoverable Cadmium Total Recoverable Selenium Total Recoverable Thallium	A Mixing Zone has granted for these parameters. Because a Mixing Zone has been granted there is no reasonable potential for this parameter to violate the State Water Quality Standard. However, since the facility would show reasonable potential if not for the Mixing Zone it's the Division of Waters Best Professional Judgement to continue monitoring for these parameters.
Total Recoverable: Antimony, Arsenic, Beryllium, Chromium, Copper, Lead, Nickel, Silver, and Zinc	While the facility did not show reasonable potential to violate the State Water Quality Standards for these pollutants at this outfall, the facility is undergoing major changes during this permit cycle. The facility will be dewatering the ash pond through this outfall. Therefore, it is the Division of Waters Best Professional Judgement to continue monitoring for these parameters during dewatering.

8.3.9. Mixing Zone (MZ)

The Kentucky Water Quality Standards (KYWQS) allow the assignment of a MZ for chronic aquatic life (Chronic) and human health fish consumption (Fish) WQBELs and thermal discharges [401 KAR 10:029, Section 4]. The pollutants and/or the pollutant characteristics for which DOW has granted a MZ are listed as follows:

TABLE 36.				
Pollutant or Pollutant Characteristic	**Mixing Zone Factor (MZF)**	**Linear Distance (ft)**	**Surface Area (sq. ft)**	**Volume (cfs)**
Whole Effluent Toxicity	0.055	44	1520	28.7
Total Recoverable Cadmium	0.100	80	5026	52.2
Total Recoverable Selenium	0.100	80	5026	52.2
Total Recoverable Thallium	0.100	80	5026	52.2

8.4. Limitation Calculations

8.4.1. Calculations for Technology-Based Effluent Limitations

The following table represents the current operations at the facility at the time of the effective date of this permit:

Current Operations	Flow	TSS		TSS Cal		Oil & Grease		Oil & Grease Cal	
		Avg	MAX	Avg	MAX	Avg	Max	Avg	Max
Landfill-Leachate	119300	30	100	3579000	11930000	15	20	1789500	2386000
Landfill-Dam Toe Drain Sump	520500	30	60	15615000	31230000	10	15	5205000	7807500
U1 cooling tower drain area SW	1200	30	60	36000	72000	10	15	12000	18000
Water Treatment Building Sump	141300	30	100	4239000	14130000	15	20	2119500	2826000
Curusher House Dust Collector	27800	30	100	834000	2780000	15	20	417000	556000
Cooling tower Comressor Cleaning wash water	200	30	100	6000	20000	15	20	3000	4000
Coal storage and handling	20700	30	50	621000	1035000	5	5	103500	103500
Coal Pile Runoff Pond	16700	30	50	501000	835000	5	5	83500	83500
FGD wastewater	86000	30	100	2580000	8600000	15	20	1290000	1720000
U2 CT Drain area SW	1100	30	60	33000	66000	10	15	11000	16500
Stacks, 15K Fuel Tanks, ID Fans, Parking Lot, GSU-Aux Transformers area SW	10600	30	60	318000	636000	10	15	106000	159000
Units 1-2 Misc. Equpt Floor Drains	2600	30	100	78000	260000	15	20	39000	52000
U2 SW BkWsh	200	30	100	6000	20000	15	20	3000	4000
CT Air Chillers Condensate	34900	30	100	1047000	3490000	15	20	523500	698000
CT Fuel Oil Truck Unloading Area SW	1500	30	60	45000	90000	10	15	15000	22500
CT Air Chiller Plant Floor Drains	100	30	100	3000	10000	15	20	1500	2000
CT Plant Floor Drains	8000	30	100	240000	800000	15	20	120000	160000
CT Auxilliary Electrical Eqpt area SW	400	30	60	12000	24000	10	15	4000	6000
CT Fuel Oil Storage Tanks area SW	3900	30	60	117000	234000	10	15	39000	58500
CT Fuel Handling Eqpt area SW	200	30	60	6000	12000	10	15	2000	3000
Unit 1-2 Sumps	200	30	100	6000	20000	15	20	3000	4000
Unit 3 boiler chemical cleans	3800	30	100	114000	380000	15	20	57000	76000
Unit 3 boiler blowdown tank	11100	30	100	333000	1110000	15	20	166500	222000
BA Sluice 10% blowdown	120600	30	100	3618000	12060000	15	20	1809000	2412000
Unit 3 air heater washes	3800	30	100	114000	380000	15	20	57000	76000
Unit 3 boiler hopper seal-trough flows	390100	30	100	11703000	39010000	15	20	5851500	7802000
U3 SW bkWsh	3600	30	100	108000	360000	15	20	54000	72000
Unit 3 Misc. Equipment Floor Drains	2600	30	100	78000	260000	15	20	39000	52000
Unit 3 Boiler Drains	1600	30	100	48000	160000	15	20	24000	32000
500K Fuel Tank, Stacks-FGD, IF Fans, GSU-Aux Transformers area SW	17600	30	60	528000	1056000	10	15	176000	264000
Limestone Storage Pile Sump SW	3100	30	60	93000	186000	10	15	31000	46500
FGD mist eliminator system overflow	76600	30	100	2298000	7660000	15	20	1149000	1532000
Wick Drains + Abutment Drains Sumps	104400	30	60	3132000	6264000	10	15	1044000	1566000
North Process Pond, Inner Slopes, & Roads SW	4000	30	60	120000	240000	10	15	40000	60000
South Process Pond, Inner Slopes, & Roads SW	4200	30	60	126000	252000	10	15	42000	63000
Dewatering (Old Permit)	325000	30	80	9750000	26000000	12	14	3900000	4550000
Total	2069500			62085000	171672000			26330000	35515500
	Limits	30	82.95337			12.72288	17.16139		

The following table represents the future operations at the facility once Auxiliary Ash Pond dewatering has been completed and the FGD waste stream has been converted to a zero discharge.

Current Operations	Flow	TSS		TSS Cal		Oil & Grease		Oil & Grease Cal	
		Avg	MAX	Avg	MAX	Avg	Max	Avg	Max
Landfill-Leachate	119300	30	100	3579000	11930000	15	20	1789500	2386000
Landfill-Dam Toe Drain Sump	520500	30	60	15615000	31230000	10	15	5205000	7807500
U1 cooling tower drain area SW	1200	30	60	36000	72000	10	15	12000	18000
Water Treatment Building Sump	141300	30	100	4239000	14130000	15	20	2119500	2826000
Curusher House Dust Collector	27800	30	100	834000	2780000	15	20	417000	556000
Cooling tower Comressor Cleaning wash water	200	30	100	6000	20000	15	20	3000	4000
Coal storage and handling	20700	30	50	621000	1035000	5	5	103500	103500
Coal Pile Runoff Pond	16700	30	50	501000	835000	5	5	83500	83500
FGD wastewater	0	30	100	0	0	15	20	0	0
U2 CT Drain area SW	1100	30	60	33000	66000	10	15	11000	16500
Stacks, 15K Fuel Tanks, ID Fans, Parking Lot, GSU-Aux Transformers area SW	10600	30	60	318000	636000	10	15	106000	159000
Units 1-2 Misc. Equpt Floor Drains	2600	30	100	78000	260000	15	20	39000	52000
U2 SW BkWsh	200	30	100	6000	20000	15	20	3000	4000
CT Air Chillers Condensate	34900	30	100	1047000	3490000	15	20	523500	698000
CT Fuel Oil Truck Unloading Area SW	1500	30	60	45000	90000	10	15	15000	22500
CT Air Chiller Plant Floor Drains	100	30	100	3000	10000	15	20	1500	2000
CT Plant Floor Drains	8000	30	100	240000	800000	15	20	120000	160000
CT Auxilliary Electrical Eqpt area SW	400	30	60	12000	24000	10	15	4000	6000
CT Fuel Oil Storage Tanks area SW	3900	30	60	117000	234000	10	15	39000	58500
CT Fuel Handling Eqpt area SW	200	30	60	6000	12000	10	15	2000	3000
Unit 1-2 Sumps	200	30	100	6000	20000	15	20	3000	4000
Unit 3 boiler chemical cleans	3800	30	100	114000	380000	15	20	57000	76000
Unit 3 boiler blowdown tank	11100	30	100	333000	1110000	15	20	166500	222000
BA Sluice 10% blowdown	33339	30	100	1000170	3333900	15	20	500085	666780
Unit 3 air heater washes	3800	30	100	114000	380000	15	20	57000	76000
Unit 3 boiler hopper seal-trough flows	390100	30	100	11703000	39010000	15	20	5851500	7802000
U3 SW bkWsh	3600	30	100	108000	360000	15	20	54000	72000
Unit 3 Misc. Equipment Floor Drains	2600	30	100	78000	260000	15	20	39000	52000
Unit 3 Boiler Drains	1600	30	100	48000	160000	15	20	24000	32000
500K Fuel Tank, Stacks-FGD, IF Fans, GSU-Aux Transformers area SW	17600	30	60	528000	1056000	10	15	176000	264000
Limestone Storage Pile Sump SW	3100	30	60	93000	186000	10	15	31000	46500
FGD mist eliminator system overflow	76600	30	100	2298000	7660000	15	20	1149000	1532000
Wick Drains + Abutment Drains Sumps	104400	30	60	3132000	6264000	10	15	1044000	1566000
North Process Pond, Inner Slopes, & Roads SW	4000	30	60	120000	240000	10	15	40000	60000
South Process Pond, Inner Slopes, & Roads SW	4200	30	60	126000	252000	10	15	42000	63000
Dewatering (Old Permit)	0	30	80	0	0	12	14	0	0
Total	1571239			47137170.00	128345900.00			19831085.00	27500280.00
	Limits	30	81.68452			12.6213	17.5023		

Bottom Ash Transport Water Volume

For BA transport water, the final rule establishes Best Available Technology Economically Achievable (BAT) as a high recycle rate system with a site-specific volumetric purge (defined in the final rule as BA purge water) which cannot exceed a 30-day rolling average of 10 percent of the BA transport water system's primary active wetted volume. The purge volume and associated effluent limitations are to be established by the permitting authority. EPA selected a 95th percentile of total system volume as representative of a 30-day rolling average, which results in a limitation of 10 percent of total system volume and requires the NPDES permitting authority to develop a site-specific purge percentage that is capped at 10 percent. EPA recognizes that some plants may need to improve their equipment, process controls, and/or operations to consistently meet the limitations included in this final rule; however, this is consistent with the Clean Water Act, which requires that BAT discharge limitations and standards reflect the best available technology economically achievable.

Of the three original coal-fired units, only the 464 MW Unit 3, which went online in 1971, operates today. Brown's existing BAT high recycle system utilizes wet sluicing to transport bottom ash from the operating unit to a remote dewatering conveyor system to dewater the bottom ash. The system can be operated as a closed loop (without a purge stream) or as a high recycle rate system (with a purge). KU is requesting to purge up to 10 percent of the total system volume (up to 33,339 gallons per day) to maintain system water chemistry. Summary of the primary active wetted volume and summary of authorized discharges of pollutants in bottom ash transport water are shown below.

TABLE 37.		
Brown's Primary Active Wetted Volume Summary		
Description	**Total Component Volume (Gal)**	**Cumulative System Volume (Gal)**
Unit 3 Bottom Ash Hopper	23,250	23,250
Unit 3 Hopper Overflow Tank	2,200	25,450
Dewatering Conveyors	252,000	277,450
Dewatering Building Sump	34,475	311,925
Recirculation Piping	21,465	333,390
	Total Nominal Volume	**333,390**
	10% gallons/day	**33,339**

TABLE 38.			
Brown's Purge Discharges			
Discharge Stream	**Flow/Volume**	**Description**	**Frequency**
(A)(1) Stormwater	N/A	To maintain system water balance when precipitation-related inflows are generated from storm events exceeding a 10-year storm event of 24-hour or longer duration (e.g., 30-day storm event) and cannot be managed by installed spares, redundancies, maintenance tanks, and other secondary bottom ash system equipment	Most of the equipment within the BA system is located indoors. The equipment that is located outdoors is covered such that significant storm events do not have an impact to the overall water balance.
(A)(2) Process Waste Streams	N/A	To maintain system water balance when regular inflows from wastestreams other than bottom ash transport water exceed the ability of the bottom ash system to accept recycled water and segregating these other wastestreams is not feasible	Additional waste streams are not comingled with the bottom ash system at Brown and, therefore, will not require discharge.
(A)(3) Water Chemistry Purge	23 gpm	To maintain system water chemistry where installed equipment at the facility is unable to manage pH, corrosive substances, substances or conditions causing scaling, or fine particulates to below levels which impact system operation or maintenance	Water within the bottom ash system has moderate to high scaling tendencies. Additional pH adjustment, by way of acid addition, is required to minimize and/or prevent scaling within the system by lowering system pH. However, pH adjustment chemicals can further perpetuate scaling issues and as such a 10% purge is needed along with planned pH adjustment to help address scaling issues during intermittent operating periods.
(A)(4) Maintenance Flows	Up to 31,600 gallons	To conduct maintenance not otherwise included in paragraphs (k)(2)(i)(A) (*1*), (*2*), or (*3*) of this section and not exempted from the definition of transport water in § 423.11(p), and when water volumes cannot be managed by installed spares, redundancies, maintenance tanks, and other secondary bottom ash system equipment.	Upon Unit Outage: As Brown is a unit that cycles routinely, primarily operating during peak seasons, and has frequent outages a maintenance purge up to the water contained within the system is requested to prevent stagnant water and associated decay within the BA system. Water will be purged in accordance with the 10% discharge restriction. Upon catastrophic piping failure between Unit 3 boiler area and remote dewatering conveyor, volume contained within the bottom ash hopper and transport piping (up to 31,600 gallons) would need to be discharged.

The DOW grants KU's requested total volume discharge of ten percent of the primary active wetted bottom ash system volume as 30-day rolling average. Purge flow form the BATW management system will continue to be directed to the plant's existing process pond, then to Outfall 006 and ultimately discharged via the existing high-rate multiport diffuser.

Bottom Ash Transport Water BPJ

The Division has determined that no additional BPJ requirements are needed with this permit modification. This is largely due to the low amount of Bottom Ash Transport purge that will be discharged since the facility will now only have one coal fired unit. Brown Unit 3 routinely cycles with the bulk of annual generation occurring during peak seasons. Since 2015 Unit 3 has averaged an annual capacity factor of just over 30%. Purge flow form the BATW management system will continue to be directed to the plant's existing process pond, then to Outfall 006 and ultimately discharged via the existing high-rate multiport diffuser. The facilities FGD water Treatment System would be unable to handle this purge since the purge flow equates to 39% of the FGD systems design capacity. Additionally, EPA plans to re-evaluate the ELG's for several waste streams from steam electric power plants. EPA is considering whether revisions to the 2020 Rule's requirements applicable to bottom ash transport water and the three subcategories, which are afforded less stringent limits than those otherwise applicable under the Rule, may be warranted. EPA will determine whether more stringent limitations than those in the 2020 Rule appropriately reflect ''best available technology economically achievable.'' EPA intends to sign the notice of proposed rulemaking for public comment in the Fall of 2022. The facility has been granted till July 1, 2023, to comply with the discharge BAT requirements for BATW by operating a high recycle rate management system with a purge rate not to exceed 10% expressed as a 30-day rolling average. Which is around the same time that the permit would be required to apply for renewal, at which point the facility will redetermine the BPJ requirements. This would allow more time to better understand the characteristics of the wastewater that will be purged, as well as provide time to gain insight on EPA's intent for this waste stream.

8.4.2. Calculations for Water Quality-Based Effluent Limitations

Since this outfall will be the new monitoring point for the flows (other than stormwater with deminimis CCR-Contact) that had contributed to Outfall 001 in the past permit cycle. The reasonable potential analysis was done using the DMR and Application data from Outfall 001, in order to have an accurate representation of the discharge through this new outfall.

These calculations were performed using a Microsoft EXCEL based workbook developed by DOW. The workbook is designed to compare effluent data to the applicable water quality standards while also incorporating the characteristics of the receiving water and any regulatory ZID and/or MZ. The following table summarizes the results of these calculations for this outfall:

Hardness Dependent Metals Calculations	Units	Effluent Hardness	Stream Hardness	Mixing Zone Granted	MZF	Mixing Zone Mixed Hardne	ZID Granted	ZID Dilution	Acute Mixed Hardnes
Cadmium	mg/l	824.3	144	YES	0.1	183	NO	N/A	400
Chromium III	mg/l	824.3	144	NO	0	400	NO	N/A	400
Copper	mg/l	824.3	144	NO	0	400	NO	N/A	400
Lead	mg/l	824.3	144	NO	0	400	NO	N/A	400
Nickel	mg/l	824.3	144	NO	0	400	NO	N/A	400
Silver	mg/l	824.3	144	N/A	N/A	N/A	NO	N/A	400
Zinc	mg/l	824.3	144	NO	0	400	NO	N/A	400
Hardness	mg/l	824.3	144	N/A	N/A	N/A	N/A	N/A	N/A

Effluent Characteristic	Units	Reported Av	Reported M	Average Limitation	Maximum Limitation	Average Discharge	Maximum Discharge	MZF	Data Sou
Antimony	µg/L	11.28	11.28	217.0635749	N/A	5.20	N/A	0	DMR
Arsenic	µg/L	24.9	24.9	150	337.5	16.60	7.38	0	DMR
Barium	µg/L	43	43	38761.35266	N/A	0.11	N/A	0	APP
Beryllium	µg/L	1.98	1.98	155.0454106	N/A	1.28	N/A	0	DMR
Cadmium	µg/L	1.85	1.85	5.703034999	8.631374985	32.44	21.43	0.1	DMR
Chloride	µg/L	79000	79000	600000	1200000	13.17	6.58	0	APP
Chromium	µg/L	2.6	2.6	3876.135266	N/A	0.07	N/A	0	DMR
Color	Platinum Cobalt Units	20	20	2907.101449	N/A	0.69	N/A	0	APP
Copper	µg/L	9.64	9.64	30.49938305	49.68449826	31.61	19.40	0	DMR
Cyanide, Free	µg/L	0	0	5.2	22	0.00	0.00	0	APP
Fluoride	µg/L	2300	2300	155045.4106	N/A	1.48	N/A	0	APP
Iron	µg/L	700	700	3500	4000	20.00	17.50	0	APP
Lead	µg/L	2.04	2.04	18.58090366	476.7477624	10.98	0.43	0	DMR
Mercury	µg/L	0.0026	0.0026	0.051	1.4	5.10	0.19	0	DMR
Nickel	µg/L	26	26	168.5409938	1515.871838	15.43	1.72	0	DMR
Nitrate (as N)	µg/L	2000	2000	387613.5266	N/A	0.52	N/A	0	APP
Phenol	µg/L	0	0	300	300	0.00	0.00	0	APP
Selenium	µg/L	26.3	26.3	75.04886957	N/A	35.04	N/A	0.1	DMR
Silver	µg/L	10.3	10.3	N/A	35.13168773	N/A	29.32	0	DMR
Thallium	µg/L	1.19	1.19	7.24682087	N/A	16.42	N/A	0.1	DMR
Zinc	µg/L	8.82	8.82	383.8303147	383.8303147	2.30	2.30	0	DMR
Gross total alpha particle activity including radium-226 but exculding radon and uranium	pCi/L	2.64	2.64	6156.681159	N/A	0.04	N/A	0	APP
Combined radium-226 and radium-228	pCi/L	0.706	0.706	2052.227053	N/A	0.03	N/A	0	APP
Total gross beta particle activity	pCi/L	7.87	7.87	20522.27053	N/A	0.04	N/A	0	APP
Strontium-90	pCi/L	0.772	0.772	3283.563285	N/A	0.02	N/A	0	APP
Uranium	µg/L	3.67	3.67	12313.36232	N/A	0.03	N/A	0	APP
Total Residual Chlorine	µg/L	0	0	11	19	0.00	0.00	0	APP
Ammonia (as N)	mg/l	0	0	691.7333593	N/A	0.00	N/A	0	APP

Effluent Characteristic	Reported Units	Reported Avg	Reported Max	Toxicity Type	Toxicity Units	Maximum Limitation	%Effluent	MZF	Data Source
Toxicity	TUa	0.00	0.00	AcuteWET	TUa	1.00	100.00	0.0473547	DMR

8.5. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

8.5.1. Flow

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

8.5.2. Process Wastewater Flow

The limits for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1)

and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], and representative of the BAT requirements for Bottom Ash Transport Water [40 CFR 423.13(K)(2)(i)].

8.5.3. Total Suspended Solids and Oil & Grease

The limits for these parameters are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], representative of the BPT requirements for low volume waste [40 CFR 423.12(b)(3)], representative of BPT and BAT requirements for bottom ash transport water [40 CFR 423.12(b)(4)] and [40 CFR 423.13(k)], representative of BPT requirements for coal pile runoff [40 CFR 423.12(b)(9)], representative of BPT and BAT requirements for FGD wastewater [40 CFR 423.12(b)(11)] and [40 CFR 423.13(g)], representative of BPT requirements for metal cleaning waste [40 CFR 423.12(b)(5)], representative of BAT requirements for combustion residual leachate [40 CFR 423.13(l)], and imposing Best Professional Judgement [401 KAR 5:080, Section 2(3) – 40 CFR 125.3].

8.5.4. pH

The limit for this parameter is consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], representative of the BPT requirements for pH [40 CFR 423.12 (b)(1)], and state water quality standards [401 KAR 10:031, Sections 4(1)(b) and 7].

8.5.5. Total Recoverable Mercury

The limitations for these parameters are consistent with Kentucky's Water Quality Standards [401 KAR 10:031, Section 6]. The schedule of compliance is consistent with the regulatory provisions for establishing a schedule of compliance [401 KAR 5:050, Section 3 and 40 CFR 122.47].

8.5.6. Total Recoverable Cadmium and Total Recoverable Thallium

The monitoring requirements for these pollutants are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(i)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48]. A mixing zone has been granted, in accordance with 401 KAR 10:029 Section 4, for these parameters.

8.5.7. Total Recoverable Selenium

A mixing zone has been granted for this pollutant that allows the chronic aquatic life criterion to be met at the edge of the mixing zone. The monthly average effluent limitation for this parameter is consistent with the requirements of 401 KAR 5:065, Section 2(4) [40 CFR 122.44(d)] and 401 KAR 10:031, Section 4. The monthly average concentration of 0.075 mg/l serves both as a trigger for the collection of adequate number of fish to conduct selenium residue in fish tissue testing and as a limitation in the event the permittee is unable to collect the required number of fish. These limitations are consistent with Kentucky's water quality standards for total recoverable selenium. The incorporation of Appendix A on the collection and handling requirements established in "Methods for Collection of Selenium Residue in Fish Tissue Used to Determine KPDES Permit Compliance" is consistent with the requirements of 401 KAR 5:050, Section 4 [40 CFR 122.48(a)].

8.5.8. Hardness and Total Recoverable: Antimony, Arsenic, Beryllium, Chromium, Copper, Lead, Nickel, Silver, and Zinc

The monitoring requirements for these pollutants are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(i)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

8.5.9. BMP Triggers

Permits shall include BMPs to control or abate the discharge of pollutants when numeric effluent limitations are infeasible and/or when the practices are reasonably necessary to achieve effluent limitations and standards to carry out the purposes and intent of the Clean Water Act (CWA). To determine the effectiveness of the BMPs during dewatering triggers have been established that if exceeded require the permittee to evaluate the currently employed BMPs and make necessary modifications.

8.5.10. Whole Effluent Toxicity

The limitations for this parameter are consistent with Kentucky's Water Quality Standards [401 KAR 10:031, Sections 4(1)(j)]. A mixing zone has been granted, in accordance with 401 KAR 10:029 Section 4, for this parameter.

SECTION 9

OUTFALL 007

9. OUTFALL 007

9.1. Outfall Description

The following table lists the outfall type, location, and description:

TABLE 39.				
Outfall Type	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
Internal	37.787328°	84.716126°	Outfall 006	Treated FGD Wastewater

9.2. Effluent Limitations and Monitoring Requirements

The following table summarizes the effluent limitations and monitoring requirements for Outfall 007:

TABLE 40.									
EFFLUENT LIMITATIONS								**MONITORING REQUIREMENTS**	
Effluent Characteristic	**Units**	**Loadings (lbs./day)**		**Concentrations**				**Frequency**	**Sample Type**
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**		
Flow [1]	MGD	Report	Report	N/A	N/A	N/A	N/A	1/Month	Instantaneous
Total Recoverable Arsenic[1]	µg/l	N/A	N/A	N/A	8	18	N/A	1/Month	Grab
Total Recoverable Mercury[1]	ng/l	N/A	N/A	N/A	34	103	N/A	1/Month	Grab
Total Recoverable Selenium[1]	µg/l	N/A	N/A	N/A	29	70	N/A	1/Month	Grab
Nitrate/nitrite as N[1]	mg/l	N/A	N/A	N/A	3	4	N/A	1/Month	Grab
[1]These limits and monitoring requirements do not become effective till July 1st, 2023									

9.3. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

9.3.1. FGD Wastewater Compliance

The E.W. Brown Station existing FGDWW treatment system will be modified to recirculate a greater flow of gypsum vacuum filtrate waters back to the FGD tower for evaporation and concentration. Installation of piping, pumps and controls to/from the gypsum filtration building and the FGD tower is required to recirculate and redirect surplus filtrate (unevaporated) waters to the FGD maintenance drainage tank. Installation of cross-connection piping to the existing truck filling station to fill landfill dust-control watering trucks will allow use of these waters and avoid their discharge to surface waters.

40 CFR 423.13(g)(1)(i) require that the quantity of pollutants in FGD wastewater shall not exceed the quantity determined by 40 CFR 423.13(g)(1)(i). The permittee must meet this requirement by a date determined by the permitting authority. For FGD wastewater, the date must be as soon as possible beginning October 13, 2021, but no later than December 31, 2025. The definition for the phrase "as soon as possible" can be found in 40 CFR 423.11(t). The permittee provided the Division of Water information to determine "as soon as possible" ELG compliance applicability dates.

KU awarded the Engineering, Procurement, and Construction agreement in April 2021. The selected engineering firm, working with company staff, will help manage construction and installation of the FGE wastewater equipment required to operate as a Zero Liquid Discharge. For the BATW – FGD wastewater projects, discreet steps of the engineering-procurement-installation contract include multiple overlapping phases which are not specifically sequential but highly interdependent. Delays of any step are likely to delay completing the entire project. For the FGD wastewater specific activities, these phases and general expected durations include:

- Detailed engineering: beginning June 2021
- Procurement: beginning Q3 2021
- Construction – multi – discipline and multi – trades: beginning Q2 2022
- Mechanical startup, troubleshooting and testing; beginning Q3 2022
- Commercial Completion and performance test: beginning Q4 2022
- Plant testing and optimization: beginning Q1-Q2 2023

The DOW grants KU's requested compliance date of July 1, 2023, to comply with the discharge requirements for BAT FGD wastewater by operating as a Zero Liquid Discharge. FGD wastewater generated prior to this date will discharge to Outfall 006 and the TSS and Oil & Grease limitations have been applied accordingly.

9.3.2. Technology-Based Effluent Limitations

Technology-based effluent limitations and standards, based on federally promulgated standards, a case-by-case basis, or a combination of the two, shall be included in all KPDES permits, where applicable.

9.3.2.1. Federal Effluent Limitations Guidelines

EPA has established a minimum level of technology that must be applied to certain industries. Due to the operations at this facility, all applicable sections of 40 CFR 423 shall be applied to this outfall. The following is a list of those requirements:

40 CFR 423.12(b) (11)

The quantity of pollutants discharged in FGD wastewater, flue gas mercury control wastewater, combustion residual leachate, or gasification wastewater shall not exceed the quantity determined by multiplying the flow of the applicable wastewater times the concentration listed in the following table:

TABLE 41.		
BPT Effluent Requirements – FGD wastewater		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
TSS	100.0 mg/l	30.0 mg/l
Oil and Grease	20.0 mg/l	15.0 mg/l

40 CFR 423.12(b) (12)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b)(3) through (b)(7), and (b)(11), of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.12 (b) (12) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner.

40 CFR 423.13(g) (1)(i)

Except for those discharges to which paragraph (g)(2) or (g)(3) of this section applies, the quantity of pollutants in FGD wastewater shall not exceed the quantity determined by multiplying the flow of FGD wastewater times the concentration listed in the table 1 following this paragraph (g)(1)(i). Dischargers must meet the effluent limitations for FGD wastewater in this paragraph by a date determined by the permitting authority that is as soon as possible beginning October 13, 2021, but no later than December 31, 2025. These effluent limitations apply to the discharge of FGD wastewater generated on and after the date determined by the permitting authority for meeting the effluent limitations, as specified in this paragraph.

TABLE 42.		
BAT Effluent Requirements – FGD wastewater		
Effluent Characteristic	**Maximum for any one day**	**Maximum for monthly average**
Arsenic, total	18 µg/l	8 µg/l
Mercury, total	103 ng/l	34 ng/l
Selenium, total	70 µg/l	29 µg/l
Nitrate/nitrite as N	4 mg/l	3 mg/l

40 CFR 423.13(g) (1)(ii)

For FGD wastewater generated before the date determined by the permitting authority, as specified in paragraph (g)(1)(i), the quantity of pollutants discharged in FGD wastewater shall not exceed the quantity determined by multiplying the flow of FGD wastewater times the concentration listed for TSS in 423.12(b)(11).

40 CFR 423.13(m)

At the permitting authority's discretion, the quantity of pollutant allowed to be discharged may be expressed as concentration limitations instead of the mass-based limitations specified in paragraphs (b) through (l) of this section concentration limitations shall be those concentrations specified in this section.

In accordance with Sections 423.13 (m) the permitting authority may allow the quantity of pollutant discharge to be expressed as a concentration limitation instead of a mass based limitation. The DOW has determined to apply the requirements of 40 CFR Part 423 in this manner.

9.3.3. Total Suspended Solids, and Oil and Grease

Since Outfall 007 effluent is directed to the new Outfall 006 Process Pond the limitations for these pollutants has been applied at Outfall 006 after commingling with other plant process waters. The DOW has developed flow-weighted limitations to insure compliance with the federal effluent limitation guidelines.

9.4. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

9.4.1. Internal Monitoring Point

The monitoring requirements for these parameters are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(iii)], and the requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

9.4.2. Flow

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

9.4.3. Total Arsenic, Total Mercury, Total Selenium, and Nitrate/nitrite

The limits for these parameters are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)(1) and 122.44(i)(1)], the criteria and standards for imposing TBELs [401 KAR 5:065, Section 2(6) – 40 CFR 122 Appendix A], and representative of the BAT requirements for FGD wastewater [40 CFR 423.13(g)(1)(i)].

SECTION 10

OUTFALL 008

10. OUTFALL 008

10.1. Outfall Description

The following table lists the outfall type, location, and description:

TABLE 43.				
Outfall Type	**Latitude (N)**	**Longitude (W)**	**Receiving Water**	**Description of Outfall**
External	37.787492°	84.714583°	Herrington Lake (Dix River)	High Rain Overflow of Railway Stormwater/Wick-Drain

10.2. Effluent Limitations and Monitoring Requirements

The following table summarizes the effluent limitations and monitoring requirements for Outfall 008:

TABLE 44.									
EFFLUENT LIMITATIONS								**MONITORING REQUIREMENTS**	
Effluent Characteristic	**Units**	**Loadings (lbs./day)**		**Concentrations**				**Frequency**	**Sample Type**
		Monthly Average	**Daily Maximum**	**Minimum**	**Monthly Average**	**Daily Maximum**	**Maximum**		
Flow	MGD	Report	Report	N/A	N/A	N/A	N/A	1/Quarter	Instantaneous
Total Suspended Solids	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
pH	SU	N/A	N/A	Report	N/A	N/A	Report	1/Quarter	Grab
Hardness (as mg/l $CaCO_3$)	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Arsenic	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Cadmium	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Chromium	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Copper	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Lead	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Mercury	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Nickel	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Silver	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Total Recoverable Zinc	mg/l	N/A	N/A	N/A	Report	Report	N/A	1/Quarter	Grab
Until this outfall is constructed and the high rain overflow wastewater starts discharging through this outfall NODI Code 9 “Conditional Monitoring-Not Required This Period” can be used for the monitoring requirements for this outfall.									

10.3. Pertinent Factors

The effluent limitations for this outfall were developed in accordance with DOW's General Procedures for Limitations Development located on DOW's webpage at:

http://dep.ky.gov/formslibrary/Documents/General%20Procedures%20for%20Limitations%20Development.pdf

10.3.1. Water Quality-Based Effluent Limitations

The following table lists those pollutants and/or pollutant characteristics of concern that DOW has determined exhibit reasonable potential to cause or contribute to an excursion of a water quality-based criterion, and the basis of DOW's determination. These determinations are consistent with the DOW's reasonable potential analysis (RPA) procedures outlined in *Permitting Procedures For Determining "Reasonable Potential"* Kentucky Division of Water May 1, 2000.

TABLE 45.	
Pollutant or Pollutant Characteristic	**Basis**
Total Suspended solids, Hardness, pH and Total Recoverable: Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, and Zinc	Since there is no data for the high rain event overflow, in order to insure there is no issues with the discharge it is the Divisions best professional judgement to monitor for these pollutants. Monitoring will allow us to know the concentrations within the effluent. In the future DOW will analyze the results for the potential to exceed water quality criteria.

10.4. Justification of Requirements

Chapters 5 and 10 of Title 401 of the Kentucky Administrative Regulations (KARs), cited in the following, have been duly promulgated pursuant to the requirements of Chapter 224 of the Kentucky Revised Statutes.

At a minimum, all permits shall contain technology-based effluent limitations (TBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(a)]. When necessary to achieve water quality standards, all permits shall contain water quality-based effluent limitations (WQBELs) [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(d)]. Any WQBELs included in this permit are based upon the Kentucky Water Quality Standards (KYWQS) [401 KAR 10:031].

10.4.1. Flow

The monitoring requirements for this parameter are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(ii)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

10.4.2. Total Suspended Solids, Hardness, pH, and Total Recoverable: Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, and Zinc

The monitoring requirements for these pollutants are consistent with the KPDES permit program requirements for establishing effluent limitations, standards, and permit conditions [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)(1)(i)] and requirements for recording and reporting of monitoring results [401 KAR 5:050, Section 4 – 40 CFR 122.48].

SECTION 11

OTHER CONDITIONS

11. OTHER CONDITIONS

11.1. Schedule of Compliance

The permittee is required to comply with all effluent limitations by the effective date of the permit unless a compliance schedule is included with the permit. The schedule of compliance is consistent with the regulatory provisions for establishing a schedule of compliance [401 KAR 5:050, Section 3 and 40 CFR 122.47].

11.2. Antidegradation

The conditions of Kentucky's Antidegradation Policy have been satisfied [401 KAR 10:029, Section 1]. This permitting action is a reissuance of a KPDES permit that does not authorize an expanded discharge.

11.3. Standard Conditions

The conditions listed in the Standard Conditions Section of the permit are consistent with the conditions applicable to all permits [401 KAR 5:065, Section 2(1) – 40 CFR 122.41].

11.4. Sufficiently Sensitive Analytical Methods

Analytical methods utilized to demonstrate compliance with the effluent limitations established in this permit shall be sufficiently sensitive to detect pollutant levels at or below the required effluent limit [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(i)].

11.5. Certified Laboratory

All environmental analysis to be performed by a certified laboratory is consistent with the certified wastewater laboratory requirements [401 KAR 5:320, Section 2].

11.6. BMP Plan

Permits are to include BMPs to control or abate the discharge of pollutants when: 1) authorized under section 304(e) of the CWA for the control of toxic pollutants and hazardous substances from ancillary industrial activities; 2) authorized under Section 402(p) of the CWA for the control of stormwater discharges; 3) numeric effluent limitations are infeasible; or 4) the practices are reasonably necessary to achieve effluent limitations and standards or to carry out the purposes and intent of the CWA [401 KAR 5:065, Section 2(4) – 40 CFR 122.44(k)]

11.7. Cooling Water Additives, FIFRA, and Mollusk Control

The discharge of any product registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) in cooling water which ultimately may be released to the waters of the Commonwealth is prohibited, except Herbicides, unless specifically identified and authorized by the KPDES permit. In the event the permittee needs to use a biocide or chemical not previously reported for mollusk control or other purpose, the permittee shall submit sufficient information, a minimum of thirty (30) days prior to the commencement of use of said biocides or chemicals to the Division of Water for review and establishment of appropriate control parameters.

11.8. Polychlorinated Biphenyls

Pursuant to the requirements of 40 CFR Part 423.12(b) (2), there shall be no discharge, from any point source, of Polychlorinated Biphenyl compounds such as those commonly used in transformer fluids. The permittee shall implement this requirement as a specific section of the BMP plan developed for this section.

11.9. Point Source Discharge of Combustion Residual Leachate

Pursuant to 40 CFR 423.11(r), the term combustion residual leachate ("leachate") means "leachate from landfills or surface impoundments containing combustion residuals. Leachate is composed of liquid,

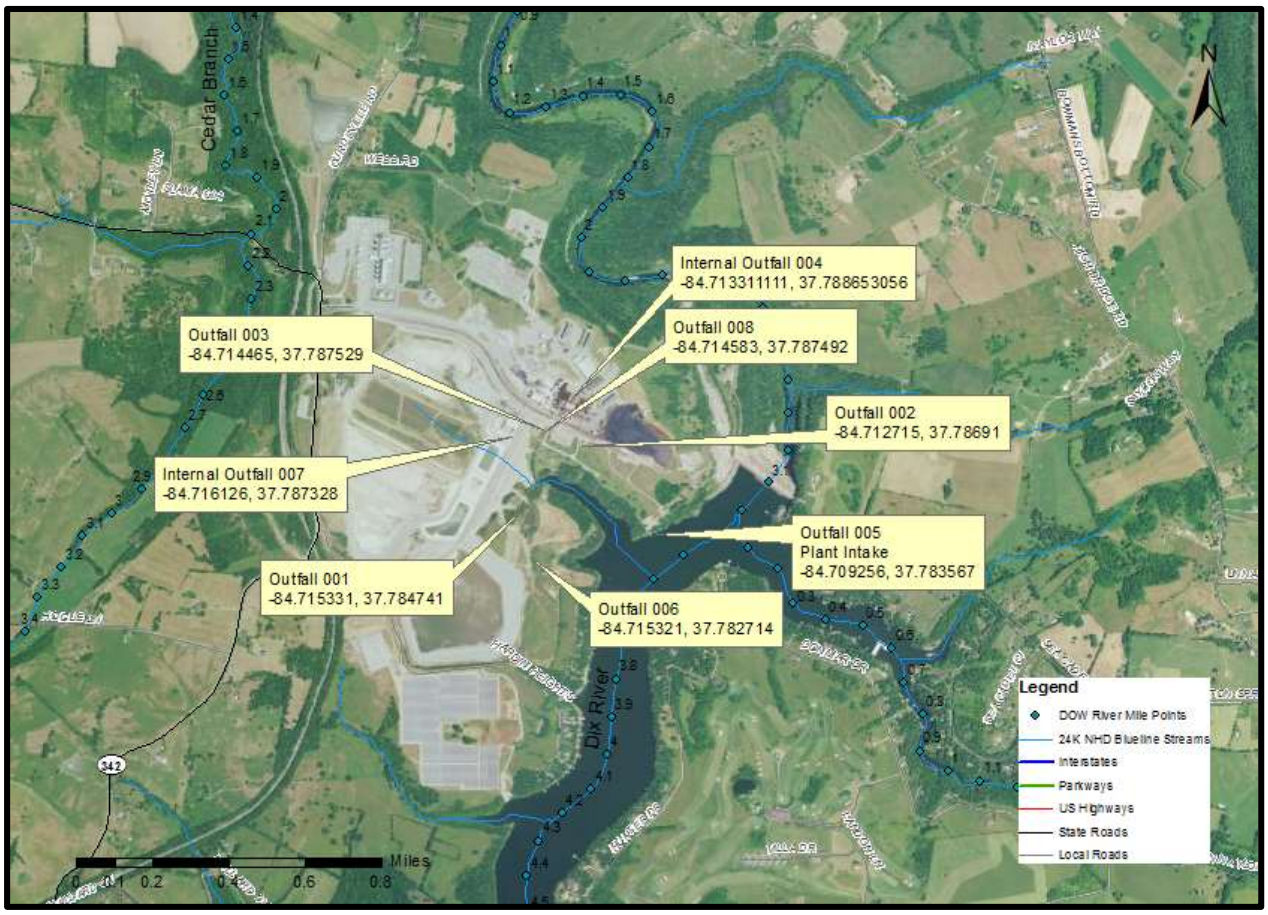
including any suspended or dissolved constituents in the liquid, that has percolated through waste or other materials emplaced in a landfill, or that passes through the surface impoundment's containment structure (*e.g.,* bottom, dikes, berms). Combustion residual leachate includes seepage and/or leakage from a combustion residual landfill or impoundment unit to the surface. Combustion residual leachate includes wastewater from landfills and surface impoundments located on non-adjoining property when under the operational control of the permitted facility."

This permit authorizes the discharge of leachate from outfall 006. For newly discovered leachate seeps from a CCR surface impoundment or a CCR landfill, as defined at 40 CFR 257.53, to the surface that discharge or have a potential to discharge from a point source to a water of the commonwealth other than through outfall 006, the permittee shall develop and implement a plan to address such surface seeps. The plan shall be included as part of the on-site BMP Plan and shall address, at a minimum, (1) scheduled inspections for identifying surface leachate seeps, (2) maintenance of CCR landfills and/or impoundments to minimize the potential for surface leachate seeps, and (3) corrective measures that will be implemented upon the discovery of a surface leachate seep that is not being controlled by a permitted outfall authorized for discharge of leachate. The permittee shall notify the DOW Surface Water Permits Branch and the appropriate DOW Field Office of planned corrective measures for any identified surface seeps of leachate as soon as feasible after discovery of such a leachate seep, but no later than ten (10) days after the discovery. Such corrective measures may include: (1) plans to reduce or eliminate the leachate seep to the surface; (2) actions to route the surface leachate seep (via a conveyance designed to contain the flow or eliminate the possibility of infiltration) to an outfall permitted to discharge leachate; and (3) combinations of actions to eliminate or, if elimination is not feasible, reduce and control a surface leachate seep and ensure any discharge to a receiving stream is authorized by the permit. Please note that this does not exempt the permittee from 24-hour reporting Section 2.12 of the permit.

11.10. Bottom Ash and FGD ELG Compliance Schedule

Uncertainties on how EPA's reconsideration of Bottom Ash Transport wastewater and FGD wastewater could effected the current ELG compliance schedule granted to the facility. Given that uncertainty, Kentucky Division of Water is requiring Kentucky Utilities to provide an updated evaluation of the appropriate compliance date for FGD and Bottom Ash Transport wastewater within 6 months of EPA finalizing their reconsideration. This will allow the Division to re-evaluate and update the ELG compliance schedule if any significant changes are made as a result of this reconsideration.

11.11. Location Map



11.12. CORMIX Session Report

CORMIX SESSION REPORT:
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
CORMIX MIXING ZONE EXPERT SYSTEM
CORMIX Version 11.0GTD
HYDRO2:Version-11.0.0.0 April,2018
SITE NAME/LABEL:
DESIGN CASE: EW Brown
FILE NAME: C:\Users\Andrew.Parrish\Desktop\Cormix\KU Brown\EW Brown.prd
Using subsystem CORMIX2: Multiport Diffuser Discharges
Start of session: 06/14/2019--14:43:03
****
SUMMARY OF INPUT DATA:

AMBIENT PARAMETERS:
Cross-section = bounded
Width BS = 244 m
Channel regularity ICHREG = 1
Ambient flowrate QA = 13.39 m^3/s
Average depth HA = 18 m
Depth at discharge HD = 15 m
Ambient velocity UA = 0.0030 m/s
Darcy-Weisbach friction factor F = 0.0067
Calculated from Manning's n = 0.015
Wind velocity UW = 1.34 m/s
Stratification Type STRCND = A
Surface temperature = 29 degC
Bottom temperature = 22 degC
Calculated FRESH-WATER DENSITY values:
Surface density RHOAS = 995.9449 kg/m^3
Bottom density RHOAB = 997.7714 kg/m^3

DISCHARGE PARAMETERS: Submerged Multiport Diffuser Discharge
Diffuser type DITYPE = unidirectional parallel
Diffuser length LD = 15.24 m
Nearest bank = left
Diffuser endpoints YB1 = 7 m; YB2 = 7 m
Number of openings NOPEN = 3
Number of Risers NRISER = 3
Ports/Nozzles per Riser NPPERR = 1
Spacing between risers/openings SPAC = 7.62 m
Port/Nozzle diameter D0 = 0.133 m
with contraction ratio = 1
Equivalent slot width B0 = 0.001823 m
Total area of openings TA0 = 0.0417 m^2
Discharge velocity U0 = 2.17 m/s
Total discharge flowrate Q0 = 0.090614 m^3/s
Discharge port height H0 = 10 m
Nozzle arrangement BETYPE = unidirectional with fanning

Diffuser alignment angle GAMMA = 0 deg
Vertical discharge angle THETA = -15 deg
Actual Vertical discharge angle THEAC = -15 deg
Horizontal discharge angle SIGMA = 270 deg
Relative orientation angle BETA = 90 deg
Discharge temperature (freshwater) = 25 degC
Corresponding density RHO0 = 997.0456 kg/m^3
Density difference DRHO = -0.4919 kg/m^3
Buoyant acceleration GP0 = -0.0048 m/s^2
Discharge concentration C0 = 75 ppb
Surface heat exchange coeff. KS = 0 m/s
Coefficient of decay KD = 0 /s

FLUX VARIABLES PER UNIT DIFFUSER LENGTH:
Discharge (volume flux) q0 = 0.005946 m^2/s
Momentum flux
(based on slot width B0) m0 =U0^2*B0 = 0.008618 m^3/s^2
(based on volume flux q0) m0 =U0*q0 = 0.012927 m^3/s^2
Buoyancy flux
(based on slot width B0) j0 =U0*GP0*B0 = -0.000019 m^3/s^3
(based on volume flux q0) j0 =q0*GP0 = -0.000029 m^3/s^3

DISCHARGE/ENVIRONMENT LENGTH SCALES:
LQ = 0.00 m Lm = 1391.43 m LM = 11.99 m
lm' = 2.21 m Lb' = 0.89 m La = 0.09 m
(These refer to the actual discharge/environment length scales.)

NON-DIMENSIONAL PARAMETERS:
Slot Froude number FR0 = 731.86
Port/nozzle Froude number FRD0 = 85.69
Velocity ratio R = 713.29

MIXING ZONE / TOXIC DILUTION ZONE / AREA OF INTEREST PARAMETERS:
Toxic discharge = no
Water quality standard specified = yes
Water quality standard CSTD = 4.3 ppb
Regulatory mixing zone = yes
Regulatory mixing zone specification = width
Regulatory mixing zone value = 24.40 m (m^2 if area)
Region of interest = 50000 m
****
HYDRODYNAMIC CLASSIFICATION:

| FLOW CLASS = IMS4 |

This flow configuration applies to a layer corresponding to the linearly stratified density layer at the discharge site.
Applicable layer depth = water depth = 15 m
Limiting Dilution S = (QA/Q0)+ 1.0 = 148.7
****

MIXING ZONE EVALUATION (hydrodynamic and regulatory summary):

X-Y-Z Coordinate system:
Origin is located at the BOTTOM below the port/diffuser center:
7 m from the left bank/shore.
Number of display steps NSTEP = 100 per module.

NEAR-FIELD REGION (NFR) CONDITIONS:
Note: The NFR is the zone of strong initial mixing. It has no regulatory implication. However, this information may be useful for the discharge designer because the mixing in the NFR is usually sensitive to the discharge design conditions.
Pollutant concentration at NFR edge c = 0.4791 ppb
Dilution at edge of NFR s = 156.5
NFR Location: x = 1698.61 m
(centerline coordinates) y = -12.57 m
z = 8.48 m
NFR plume dimensions: half-width (bh) = 3396.56 m
thickness (bv) = 0.69 m
Cumulative travel time: 557224.0625 sec.
WARNING:
The LIMITING DILUTION (given by ambient flow/discharge ratio) is = 148.73
This value is below the computed dilution of 156.54 at the end of the
Near Field Region (NFR). Mixing for this discharge configuration is constrained by the ambient flow.
Please carefully review the prediction file for additional warnings and information.

Buoyancy assessment:
The effluent density is greater than the surrounding ambient water density at the discharge level.
Therefore, the effluent is NEGATIVELY BUOYANT and will tend to sink towards the bottom.
IMPORTANT NOTE:
Since the effluent is NEGATIVELY BUOYANT, it is recommended that you consider using the Brine or Sediment options for Effluent specification for a more detailed analysis, particularly for coastal discharges over a sloping bottom where density currents are important.
CORMIX will however continue with the current simulation.

Stratification assessment:
The specified ambient density stratification is dynamically important.
The discharge near field flow is trapped within the linearly stratified ambient density layer.

UPSTREAM INTRUSION SUMMARY:
Plume exhibits upstream intrusion due to low ambient velocity or strong discharge buoyancy.
Intrusion length = 1440.67 m
Intrusion stagnation point = -1440.35 m
Intrusion thickness = 0.21 m
Intrusion half width at impingement = 3396.56 m
Intrusion half thickness at impingement = 0.69 m
In this case, the UPSTREAM INTRUSION IS VERY LARGE, exceeding ten (10) times the local water depth.
This may be caused by the small ambient velocity, perhaps in combination with the strong buoyancy of the effluent, or alternatively, a strong ambient stratification.
If the ambient conditions are quite unsteady (e.g. tidal), then the

CORMIX steady-state predictions of the upstream intrusion are probably unrealistic. The plume predictions in the immediate near-field, prior to the intrusion layer formation, are acceptable, however.

PLUME BANK CONTACT SUMMARY:
Plume in bounded section does not contact bank.
********** TOXIC DILUTION ZONE SUMMARY **********
No TDZ was specified for this simulation.
********** REGULATORY MIXING ZONE SUMMARY **********
The plume conditions at the boundary of the specified RMZ are as follows:
Pollutant concentration c = 4.212714 ppb
Corresponding dilution s = 17.8
Plume location: x = 0.56 m
(centerline coordinates) y = -12.57 m
z = 8.48 m
Plume dimensions: half-width (bh) = 12.20 m
thickness (bv) = 1.41 m
Cumulative travel time: 121.8103 sec. (RMZ is within NFR)
Note:
Plume concentration c and dilution s values are reported based on prediction file values - assuming linear interpolation between predicted points just before and just after the RMZ boundary has been detected.
Please ensure a small step size is used in the prediction file to account for this linear interpolation. Step size can be controlled by increasing (reduces the prediction step size) or decreasing (increases the prediction step size) the - Output Steps per Module - in CORMIX input.
At this position, the plume is NOT IN CONTACT with any bank.
Furthermore, the specified water quality standard has indeed been met within the RMZ. In particular:
The ambient water quality standard was encountered at the following plume position:
Water quality standard = 4.3 ppb
Corresponding dilution s = 17.4
Plume location: x = 0.31 m
(centerline coordinates) y = -12.33 m
z = 8.41 m
Plume dimensions: half-width (bh) = 1.39 m
thickness (bv) = 1.39 m

Regulatory Mixing Zone Analysis:
The specified RMZ occurs within the near-field region (NFR). This RMZ specification may be highly restrictive.
The specified RMZ is less than the port spacing SPAC. The user is advised to perform CORMIX1 (single port discharge) analysis for an individual port.
This may give more realistic predictions at the RMZ.
********** FINAL DESIGN ADVICE AND COMMENTS **********
CORMIX2 uses the TWO-DIMENSIONAL SLOT DIFFUSER CONCEPT to represent the actual three-dimensional diffuser geometry. Thus, it approximates the details of the merging process of the individual jets from each port/nozzle.
In the present design, the spacing between adjacent ports/nozzles (or riser assemblies) is of the order of, or less than, the local water depth so that the slot diffuser approximation holds well.
Nevertheless, if this is a final design, the user is advised to use a final CORMIX1 (single port discharge) analysis, with discharge data for an individual diffuser jet/plume, in order to compare to the present near-field prediction.

REMINDER: The user must take note that HYDRODYNAMIC MODELING by any known technique is NOT AN EXACT SCIENCE.
Extensive comparison with field and laboratory data has shown that the
CORMIX predictions on dilutions and concentrations (with associated plume geometries) are reliable for the majority of cases and are accurate to within about +-50% (standard deviation).
As a further safeguard, CORMIX will not give predictions whenever it judges the design configuration as highly complex and uncertain for prediction.

11.13. CORMIX Prediction File

CORMIX2 PREDICTION FILE:
2222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222222
CORMIX MIXING ZONE EXPERT SYSTEM
Subsystem CORMIX2: Multiport Diffuser Discharges
CORMIX Version 11.0GTD
HYDRO2 Version 11.0.0.0 April 2018

CASE DESCRIPTION
Site name/label:
Design case: EW Brown
FILE NAME: C:\...drew.Parrish\Desktop\Cormix\KU Brown\EW Brown.prd
Time stamp: 06/14/2019--14:43:03
ENVIRONMENT PARAMETERS (metric units)
Bounded section
BS = 244.00 AS = 4392.00 QA = 13.39 ICHREG= 1
HA = 18.00 HD = 15.00
UA = 0.003 F = 0.007 USTAR =0.8848E-04
UW = 1.340 UWSTAR=0.1448E-02
Density stratified environment
STRCND= A RHOAM = 996.8582
RHOAS = 995.9449 RHOAB = 997.7714 RHOAH0= 996.5537 E =0.1197E-02
DIFFUSER DISCHARGE PARAMETERS (metric units)
Diffuser type: DITYPE= unidirectional_parallel
BANK = LEFT DISTB = 7.00 YB1 = 7.00 YB2 = 7.00
LD = 15.24 NOPEN = 3 NRISER= 3 SPAC = 7.62 NPPERR = 1
D0 = 0.133 A0 = 0.014 H0 = 10.00 SUB0 = 5.00
D0INP = 0.133 CR0 = 1.000 B0 =0.1823E-02
Nozzle/port arrangement: unidirectional_with_fanning
GAMMA = 0.00 THETA = -15.00 SIGMA = 270.00 BETA = 90.00
U0 = 2.174 Q0 = 0.091 Q0A =0.9061E-01
RHO0 = 997.0456 DRHO0 =-.4919E+00 GP0 =-.4840E-02
C0 =0.7500E+02 CUNITS= ppb
IPOLL = 1 KS =0.0000E+00 KD =0.0000E+00
FLUX VARIABLES - PER UNIT DIFFUSER LENGTH (metric units)
q0 =0.5946E-02 SIGNJ0= -1.0
m0 =U0^2*B0 =0.8618E-02 j0 =U0*GP0*B0 =-.1919E-04 (based on slot width B0)
m0 =U0*q0 =0.1293E-01 j0 =q0*GP0 =-.2878E-04 (based on volume flux q0)
Associated 2-d length scales (meters)
lQ=B = 0.003 lM = 11.99 lm = 1391.43
lmp = 2.21 lbp = 0.89 la = 0.09
FLUX VARIABLES - ENTIRE DIFFUSER (metric units)
Q0 =0.9061E-01 M0 =0.1313E+00 J0 =-.2924E-03
Associated 3-d length scales (meters)
LQ = 0.12 LM = 12.76 Lm = 145.62 Lb = 15488.88
Lmp = 3.58 Lbp = 1.80
NON-DIMENSIONAL PARAMETERS
FR0 = 731.86 FRD0 = 85.69 R = 713.29 PL = 56.84

(slot) (port/nozzle)
RECOMPUTED SOURCE CONDITIONS FOR RISER GROUPS:
Properties of riser group with 1 ports/nozzles each:
U0 = 2.174 D0 = 0.133 A0 = 0.014 THETA = -15.00
FR0 = 731.86 FRD0 = 85.69 R = 713.29
(slot) (riser group)
FLOW CLASSIFICATION
22222222222222222222222222222222222222
2 Flow class (CORMIX2) = IMS4 2
2 Applicable layer depth HS = 15.00 2
2 Limiting Dilution S =QA/Q0= 148.73 2
22222222222222222222222222222222222222
MIXING ZONE / TOXIC DILUTION / REGION OF INTEREST PARAMETERS
C0 =0.7500E+02 CUNITS= ppb
NTOX = 0
NSTD = 1 CSTD =0.4300E+01
REGMZ = 1
REGSPC= 2 XREG = 0.00 WREG = 24.40 AREG = 0.00
XINT = 50000.00 XMAX = 50000.00
X-Y-Z COORDINATE SYSTEM:
ORIGIN is located at the bottom and the diffuser mid-point:
7.00 m from the LEFT bank/shore.
X-axis points downstream, Y-axis points to left, Z-axis points upward.
NSTEP = 100 display intervals per module

BEGIN MOD101: DISCHARGE MODULE (SINGLE PORT AT DIFFUSER CENTER)
X Y Z S C BV BH Uc TT
0.00 0.00 10.00 1.0 0.750E+02 0.07 0.07 2.174 .00000E+00
END OF MOD101: DISCHARGE MODULE (SINGLE PORT AT DIFFUSER CENTER)

BEGIN CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION
Jet-like motion in linear stratification with weak crossflow.
Zone of flow establishment: THETAE= -15.00 SIGMAE= 270.03
LE = 0.66 XE = 0.00 YE = -0.64 ZE = 9.83
Profile definitions:
BV = Gaussian 1/e (37%) half-width, in vertical plane normal to trajectory
BH = before merging: Gaussian 1/e (37%) half-width in horizontal plane normal to trajectory after merging: top-hat half-width in horizontal plane parallel to diffuser line
S = hydrodynamic centerline dilution
C = centerline concentration (includes reaction effects, if any)
Uc = Local centerline excess velocity (above ambient)
TT = Cumulative travel time
X Y Z S C BV BH Uc TT
Individual jet/plumes before merging:
0.00 -0.64 9.83 1.0 0.750E+02 0.07 0.07 2.174 .00000E+00
0.00 -0.64 9.83 1.0 0.750E+02 0.07 0.07 2.174 .89350E-03
0.00 -0.76 9.80 1.0 0.747E+02 0.08 0.08 2.174 .44190E-01
0.00 -0.87 9.77 1.2 0.639E+02 0.09 0.09 2.174 .96527E-01

0.00 -0.99 9.73 1.3 0.558E+02 0.11 0.11 1.909 .15701E+00
0.00 -1.11 9.70 1.5 0.496E+02 0.12 0.12 1.699 .22402E+00
0.00 -1.23 9.67 1.7 0.446E+02 0.13 0.13 1.527 .30061E+00
0.00 -1.35 9.64 1.9 0.405E+02 0.15 0.15 1.387 .38534E+00
0.00 -1.47 9.61 2.0 0.371E+02 0.16 0.16 1.271 .47821E+00
0.00 -1.58 9.57 2.2 0.343E+02 0.17 0.17 1.174 .57689E+00
0.00 -1.70 9.54 2.4 0.318E+02 0.19 0.19 1.090 .68585E+00
0.00 -1.82 9.51 2.5 0.297E+02 0.20 0.20 1.016 .80296E+00
0.00 -1.94 9.48 2.7 0.278E+02 0.21 0.21 0.952 .92820E+00
0.00 -2.05 9.45 2.9 0.262E+02 0.23 0.23 0.897 .10585E+01
0.01 -2.17 9.41 3.0 0.247E+02 0.24 0.24 0.847 .11998E+01
0.01 -2.29 9.38 3.2 0.234E+02 0.26 0.26 0.802 .13493E+01
0.01 -2.41 9.35 3.4 0.222E+02 0.27 0.27 0.762 .15069E+01
0.01 -2.53 9.32 3.5 0.212E+02 0.28 0.28 0.726 .16688E+01
0.01 -2.65 9.28 3.7 0.202E+02 0.30 0.30 0.693 .18425E+01
0.01 -2.76 9.25 3.9 0.193E+02 0.31 0.31 0.662 .20243E+01
0.01 -2.88 9.22 4.1 0.185E+02 0.32 0.32 0.635 .22143E+01
0.01 -3.00 9.19 4.2 0.178E+02 0.34 0.34 0.610 .24078E+01
0.01 -3.12 9.15 4.4 0.171E+02 0.35 0.35 0.586 .26138E+01
0.01 -3.24 9.12 4.6 0.164E+02 0.36 0.36 0.564 .28280E+01
0.02 -3.35 9.09 4.7 0.159E+02 0.38 0.38 0.544 .30503E+01
0.02 -3.47 9.06 4.9 0.153E+02 0.39 0.39 0.525 .32755E+01
0.02 -3.59 9.02 5.1 0.148E+02 0.40 0.40 0.508 .35138E+01
Level of buoyancy reversal in stratified ambient.
0.02 -3.71 8.99 5.2 0.143E+02 0.42 0.42 0.491 .37604E+01
0.02 -3.83 8.96 5.4 0.139E+02 0.43 0.43 0.476 .40150E+01
0.02 -3.94 8.92 5.6 0.135E+02 0.44 0.44 0.462 .42719E+01
0.02 -4.06 8.89 5.7 0.131E+02 0.46 0.46 0.448 .45427E+01
0.03 -4.18 8.86 5.9 0.127E+02 0.47 0.47 0.435 .48217E+01
0.03 -4.30 8.83 6.1 0.123E+02 0.48 0.48 0.423 .51023E+01
0.03 -4.41 8.79 6.2 0.120E+02 0.50 0.50 0.411 .53974E+01
0.03 -4.53 8.76 6.4 0.117E+02 0.51 0.51 0.400 .57008E+01
0.03 -4.65 8.73 6.6 0.114E+02 0.52 0.52 0.390 .60123E+01
0.03 -4.77 8.70 6.8 0.111E+02 0.54 0.54 0.380 .63248E+01
0.04 -4.89 8.67 6.9 0.108E+02 0.55 0.55 0.371 .66526E+01
0.04 -5.00 8.63 7.1 0.106E+02 0.56 0.56 0.362 .69886E+01
0.04 -5.12 8.60 7.3 0.103E+02 0.58 0.58 0.353 .73329E+01
0.04 -5.24 8.57 7.4 0.101E+02 0.59 0.59 0.345 .76775E+01
0.04 -5.36 8.54 7.6 0.988E+01 0.61 0.61 0.337 .80381E+01
0.05 -5.48 8.51 7.8 0.966E+01 0.62 0.62 0.330 .84070E+01
0.05 -5.60 8.48 7.9 0.946E+01 0.63 0.63 0.323 .87843E+01
0.05 -5.71 8.45 8.1 0.927E+01 0.65 0.65 0.316 .91612E+01
0.05 -5.83 8.42 8.3 0.908E+01 0.66 0.66 0.309 .95550E+01
0.06 -5.95 8.39 8.4 0.890E+01 0.67 0.67 0.303 .99572E+01
0.06 -6.07 8.36 8.6 0.873E+01 0.69 0.69 0.297 .10368E+02
0.06 -6.19 8.33 8.8 0.857E+01 0.70 0.70 0.291 .10777E+02
0.07 -6.31 8.30 8.9 0.841E+01 0.71 0.71 0.285 .11205E+02
0.07 -6.43 8.28 9.1 0.826E+01 0.73 0.73 0.280 .11640E+02
0.07 -6.55 8.25 9.2 0.811E+01 0.74 0.74 0.274 .12085E+02
0.07 -6.67 8.22 9.4 0.797E+01 0.75 0.75 0.269 .12527E+02

0.08 -6.79 8.20 9.6 0.783E+01 0.77 0.77 0.264 .12988E+02
0.08 -6.91 8.17 9.7 0.770E+01 0.78 0.78 0.260 .13458E+02
0.08 -7.03 8.15 9.9 0.757E+01 0.80 0.80 0.255 .13937E+02
0.09 -7.15 8.13 10.1 0.745E+01 0.81 0.81 0.251 .14413E+02
0.09 -7.27 8.11 10.2 0.734E+01 0.82 0.82 0.246 .14908E+02
0.09 -7.39 8.08 10.4 0.722E+01 0.84 0.84 0.242 .15412E+02
0.10 -7.51 8.06 10.6 0.711E+01 0.85 0.85 0.238 .15925E+02
0.10 -7.63 8.05 10.7 0.700E+01 0.86 0.86 0.234 .16435E+02
0.10 -7.75 8.03 10.9 0.690E+01 0.88 0.88 0.230 .16965E+02
0.11 -7.87 8.01 11.0 0.680E+01 0.89 0.89 0.227 .17503E+02
0.11 -7.99 7.99 11.2 0.670E+01 0.90 0.90 0.223 .18051E+02
0.12 -8.11 7.98 11.4 0.661E+01 0.92 0.92 0.220 .18594E+02
0.12 -8.24 7.97 11.5 0.651E+01 0.93 0.93 0.216 .19159E+02
0.12 -8.36 7.96 11.7 0.642E+01 0.94 0.94 0.213 .19732E+02
0.13 -8.48 7.95 11.8 0.633E+01 0.96 0.96 0.210 .20301E+02
0.13 -8.60 7.94 12.0 0.625E+01 0.97 0.97 0.207 .20891E+02
0.14 -8.72 7.93 12.2 0.616E+01 0.99 0.99 0.204 .21490E+02
0.14 -8.85 7.92 12.3 0.608E+01 1.00 1.00 0.201 .22098E+02
0.15 -8.97 7.92 12.5 0.600E+01 1.01 1.01 0.198 .22700E+02
0.15 -9.09 7.92 12.7 0.592E+01 1.03 1.03 0.196 .23324E+02
0.16 -9.21 7.91 12.8 0.585E+01 1.04 1.04 0.193 .23957E+02
Minimum jet height has been reached.
0.16 -9.34 7.92 13.0 0.577E+01 1.05 1.05 0.191 .24598E+02
0.17 -9.46 7.92 13.2 0.570E+01 1.07 1.07 0.188 .25233E+02
0.17 -9.58 7.92 13.3 0.563E+01 1.08 1.08 0.186 .25890E+02
0.18 -9.70 7.93 13.5 0.555E+01 1.09 1.09 0.184 .26556E+02
0.18 -9.82 7.93 13.7 0.548E+01 1.11 1.11 0.182 .27229E+02
0.19 -9.94 7.94 13.8 0.542E+01 1.12 1.12 0.179 .27896E+02
0.19 -10.07 7.95 14.0 0.535E+01 1.13 1.13 0.177 .28585E+02
0.20 -10.19 7.97 14.2 0.528E+01 1.15 1.15 0.175 .29282E+02
0.20 -10.31 7.98 14.4 0.522E+01 1.16 1.16 0.174 .29987E+02
0.21 -10.43 7.99 14.6 0.515E+01 1.17 1.17 0.172 .30683E+02
0.21 -10.55 8.01 14.7 0.509E+01 1.19 1.19 0.170 .31403E+02
0.22 -10.67 8.03 14.9 0.503E+01 1.20 1.20 0.168 .32131E+02
0.23 -10.79 8.05 15.1 0.497E+01 1.21 1.21 0.167 .32849E+02
0.23 -10.91 8.07 15.3 0.491E+01 1.23 1.23 0.165 .33591E+02
0.24 -11.03 8.09 15.5 0.485E+01 1.24 1.24 0.163 .34340E+02
0.24 -11.15 8.12 15.6 0.479E+01 1.25 1.25 0.162 .35097E+02
0.25 -11.27 8.14 15.8 0.474E+01 1.27 1.27 0.160 .35844E+02
0.26 -11.39 8.17 16.0 0.468E+01 1.28 1.28 0.159 .36616E+02
0.26 -11.51 8.20 16.2 0.463E+01 1.29 1.29 0.157 .37394E+02
0.27 -11.63 8.23 16.4 0.458E+01 1.31 1.31 0.156 .38180E+02
0.28 -11.75 8.26 16.6 0.453E+01 1.32 1.32 0.154 .38956E+02
0.28 -11.87 8.29 16.7 0.448E+01 1.33 1.33 0.153 .39757E+02
0.29 -11.99 8.32 16.9 0.443E+01 1.35 1.35 0.151 .40565E+02
0.30 -12.10 8.35 17.1 0.439E+01 1.36 1.36 0.150 .41381E+02
0.30 -12.22 8.38 17.3 0.434E+01 1.37 1.37 0.149 .42186E+02
** WATER QUALITY STANDARD OR CCC HAS BEEN FOUND **
The pollutant concentration in the plume falls below water quality standard or CCC value of 0.430E+01 in the current prediction interval.

This is the spatial extent of concentrations exceeding the water quality standard or CCC value.
0.31 -12.34 8.41 17.5 0.430E+01 1.39 1.39 0.147 .43017E+02
0.32 -12.46 8.45 17.6 0.425E+01 1.40 1.40 0.146 .43856E+02
0.32 -12.57 8.48 17.8 0.421E+01 1.41 1.41 0.144 .44685E+02
Terminal level in stratified ambient has been reached.
Cumulative travel time = 44.6848 sec (0.01 hrs)
Merging of individual jet/plumes not found in this module, but interaction will occur in following module. Overall jet/plume interaction dimensions:
0.32 -12.57 8.48 17.8 0.421E+01 1.41 7.69 0.144 .44685E+02
END OF CORJET (MOD110): JET/PLUME NEAR-FIELD MIXING REGION

BEGIN MOD237: TERMINAL LAYER INJECTION/UPSTREAM SPREADING
UPSTREAM INTRUSION PROPERTIES:
Maximum elevation of jet/plume rise = 11.52 m
Layer thickness in impingement region = 0.21 m
Upstream intrusion length = 1440.67 m
X-position of upstream stagnation point = -1440.35 m
Thickness in intrusion region = 0.21 m
Half-width at downstream end = 3396.56 m
Thickness at downstream end = 0.69 m
In this case, the upstream INTRUSION IS VERY LARGE, exceeding 10 times the local water depth.
This may be caused by a very small ambient velocity, perhaps in combination with large discharge buoyancy.
If the ambient conditions are strongly transient (e.g. tidal), then the
CORMIX steady-state predictions of upstream intrusion are probably unrealistic.
The plume predictions prior to boundary impingement and wedge formation will be acceptable, however.
Control volume inflow:
X Y Z S C BV BH TT
0.32 -12.57 8.48 17.8 0.421E+01 1.41 7.69 .44685E+02
Profile definitions:
BV = top-hat thickness, measured vertically
BH = top-hat half-width, measured horizontally in y-direction
ZU = upper plume boundary (Z-coordinate)
ZL = lower plume boundary (Z-coordinate)
S = hydrodynamic average (bulk) dilution
C = average (bulk) concentration (includes reaction effects, if any)
TT = Cumulative travel time
X Y Z S C BV BH ZU ZL TT
-1440.35 -12.57 8.48 9999.9 0.000E+00 0.00 0.00 8.48 8.48 .47271E+06
-1377.57 -12.57 8.48 68.1 0.110E+01 0.06 480.35 8.51 8.45 .45211E+06
-1069.95 -12.57 8.48 28.4 0.264E+01 0.13 1166.76 8.54 8.41 .35119E+06
-762.33 -12.57 8.48 21.7 0.346E+01 0.17 1578.58 8.56 8.39 .25026E+06
-454.72 -12.57 8.48 19.0 0.395E+01 0.20 1903.29 8.58 8.38 .14934E+06
-147.10 -12.57 8.48 17.9 0.419E+01 0.21 2180.16 8.58 8.37 .48412E+05
** REGULATORY MIXING ZONE BOUNDARY is within the Near-Field Region **
In this prediction interval the TOTAL plume width meets or exceeds the regulatory value = 24.40 m.
This is the extent of the REGULATORY MIXING ZONE.
160.52 -12.57 8.48 22.6 0.331E+01 0.23 3083.41 8.59 8.36 .52602E+05

468.14 -12.57 8.48 54.1 0.139E+01 0.34 3155.28 8.65 8.31 .15353E+06
775.75 -12.57 8.48 96.3 0.779E+00 0.48 3221.55 8.72 8.24 .25445E+06
1083.37 -12.57 8.48 129.3 0.580E+00 0.59 3283.36 8.77 8.18 .35538E+06
1390.99 -12.57 8.48 147.0 0.510E+00 0.65 3341.50 8.80 8.15 .45630E+06
1698.61 -12.57 8.48 156.5 0.479E+00 0.69 3396.56 8.82 8.14 .55722E+06
Cumulative travel time = 557224.0000 sec (154.78 hrs)
Note:
CORMIX is a steady state model and assumes discharge and ambient conditions do not vary over time. The predicted plume cumulative travel time exceeds 48 hours at this trajectory distance. Keep in mind that ambient and discharge conditions are likely to vary over large space and time scales. Predictions at such large space and time scales may be inconsistent with CORMIX modeling assumptions.
Please carefully evaluate your simulation results and limit model interpretation to space and time scales consistent with steady state assumptions and ambient schematization.
END OF MOD237: TERMINAL LAYER INJECTION/UPSTREAM SPREADING

** End of NEAR-FIELD REGION (NFR) **
The LIMITING DILUTION (given by ambient flow/discharge ratio) is: 148.7
This value is LESS than the predicted dilution of 156.5 at the end of the NFR.
Mixing for this discharge configuration is constrained by the ambient flow.
All previous predictions are UNRELIABLE unless the discharge is located in a channel connected with a nearby downstream reservoir which may supply ample entrainment water for mixing.
No predictive techniques available for this situation; SIMULATION ENDS.

CORMIX2: Multiport Diffuser Discharges End of Prediction File

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