INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

WEC Temporary Ash Disposal Area

Hastings Utilities / City of Hastings, Nebraska and
Public Power Generation Agency

November 2020

Inflow Design Flood Control System Plan, 40 CFR §257.82(c)
WEC Temporary Ash Disposal Area

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1. Introduction and Purpose

On April 17, 2015 the U.S. Environmental Protection Agency (EPA) issued the final rule for the regulation and management of coal combustion residuals (CCR) under Subtitle D of the Resource Conservation and Recovery Act (RCRA) [40 CFR Part 257, Subpart D]. The rule – effective on October 19, 2015 – and as amended, applies to the WEC Ash Disposal Area which is considered an existing CCR surface impoundment.

CCR Rule 40 CFR §257.82 requires that owners or operators of a CCR surface impoundment must design, construct, operate, and maintain an inflow design flood control system per the requirements below:

1. The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood (specified in item 3 below);
2. The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood (specified in item 3 below);
3. The existing WEC Temporary Ash Disposal Area is not fully incised and thereby considered a low hazard potential CCR surface impoundment. Thus, the WEC Temporary Ash Disposal Area and surrounding areas that drain to the impoundment must be modelled using the 100-year, 24-hour storm event instead of the 25-year event previously used in calculations.

The requirements also include preparation of an Inflow Design Flood Control System Plan to evaluate the inflow design flood control system for active CCR surface impoundments. This Inflow Design Flood Control System Plan presented herein addresses the specific requirements of 40 CFR §257.82(c)(1).

2. Facility Description

The Whelan Energy Center located near Hastings, Nebraska, has two coal fired electric generating units. WEC Units 1 and 2 have net capacity ratings of 77 megawatts and 220 megawatts, respectively. Figure 1 provides the location of WEC relative to City of Hastings, Nebraska (see figures in Attachment 1). Hastings Utilities / City of Hastings, NE (Hastings) is the owner and operator of WEC Unit 1 (WEC1) and the operating agent of WEC Unit 2 (WEC2) for Public Power Generation Agency (PPGA). The WEC Temporary Ash Disposal Area, located at WEC, is permitted under the Nebraska Department of Environmental Quality (NDEQ) [now referred to as the Nebraska Department of Environment and Energy (NDEE)] Title 132 – Integrated Solid Waste Management Regulations. Original Title 132 permitting efforts began in 1999 pursuant to NDEQ requirements. The federal CCR rule – effective on October 19, 2015 – and as subsequently amended, applies to the WEC Ash Disposal Area which is considered an existing CCR surface impoundment.

The WEC Temporary Ash Disposal Area is an unlined CCR surface impoundment of approximately 23.2 acres that has historically received CCR in sluiced and dry form for storage prior to removal for beneficial uses. Fossil fuel ash sluicing and disposal at this site began in 1981, the same year that WEC1 began commercial operation. The disposal area was constructed as an ash pond to provide storage for ash, sluice water, and other process waters with option to recycle water back to the WEC. Due to ash pond size and evaporation, recycling water back to the plant did not occur. Over time, other process waters such as cooling tower blowdown was redirected away from the WEC Temporary Ash Disposal Area. With start-up of WEC2, commercial operations on May 1, 2011, scrubber ash was sluiced to the East

Area and fly ash was periodically sluiced to the West Area. Sluicing of scrubber ash ended in 2013 after a pug mill was installed to load trucks with moistened scrubber ash for hauling and placement within the East Area of the WEC Temporary Ash Disposal Area. Figure 2 in Attachment 1 shows the locations of the plant, supporting facilities, WEC Temporary Ash Disposal Area, and groundwater monitoring wells.

2.1. Site Location

The legal description of the Whelan Energy Center site is as follows: "The North Half of Section 14, Township 7 North, Range 9 West in Adams County, Nebraska, containing 320 acres more or less." The Site is approximately 2 miles east of Hastings, Nebraska, on Highway 6.

The site includes the WEC generating station, electric substation, WEC Temporary Ash Disposal Area, farming operations, and a train car repair facility. The current disposal area footprint of the WEC Temporary Ash Disposal Area is approximately 23.2 acres located along the west property boundary.

2.2. Site Description

The regional and site-specific topography is generally level. On the WEC site, moderately sloping elevations vary up to about 15 feet. The WEC Temporary Ash Disposal Area has a base elevation within in-situ lean clay material of Peoria loess with permeability of approximately 10^{-4} to 10^{-8} cm/sec (HDR 2006). Three sides of the WEC Temporary Ash Disposal Area are cut slopes to the CCR. The only embankment that extends above the natural ground is the south embankment.

The south embankment has a top perimeter road design elevation of 1898 feet above mean sea level (MSL) (1927 NGVD), sloping at approximate 4:1 horizontal to vertical to natural ground elevation of 1890 feet MSL. Immediately south is the Leachate Pond and Surge Pond as shown on Figure 2 in Attachment 1.

3. Hydrologic and Hydraulic Analysis

The WEC Temporary Ash Disposal Area has had hydrologic and hydraulic analysis for the ash sluice flows from both WEC1 and WEC2 and sizing of outlet structures for the 25-year, 24-hour storm event as required by the NDEE. These calculations are contained in Appendix M of the Title 132 Permit Renewal Application (HDR 2016). The CCR Rule requires a CCR surface impoundment with low hazard potential to model the potential impacts of stormwater during a 100-year, 24-hour storm event.

This new hydraulic analysis included preparation of a surface water model using Hydraflow for Autodesk Civil 3D to determine whether the existing areas of the WEC Temporary Ash Disposal Area and/or the outfalls are enough to manage inflow from the 100-year, 24-hour storm event. The modeling (Attachment 2) was completed by HDR based on the best available information provided by Hastings and contained within the Title 132 Permit Renewal Application.

3.1. CCR Surface Impoundment Description

The legal description of the Whelan Energy Center site is as follows: "The North Half of Section 14, Township 7 North, Range 9 West in Adams County, Nebraska, containing 320 acres more or less." The Site is approximately 2 miles east of Hastings, Nebraska, on Highway 6. The site includes the

WEC generating station, electric substation, WEC Temporary Ash Disposal Area, farming operations, and a train car repair facility.

The current disposal area footprint of the WEC Temporary Ash Disposal Area is approximately 23.2 acres located along the west property boundary. Sluiced pond ash and dry scrubber ash, along with bottom ash, are separated in the WEC Temporary Ash Disposal Area by an interior management berm created from pond ash. This creates a West Area and East Area, respectively, as shown in Figure 3 (Attachment 1). Although the dry and sluiced CCR wastestreams are separated within the WEC Temporary Ash Disposal Area, the entire area is permitted with the NDEE as a fossil fuel combustion ash disposal area and treated as one CCR unit, surface impoundment. Only the West Area operates as a CCR surface impoundment and area of ponding water is further reduced with the pond ash reclaim activities.

3.2. Existing Inflow/Outflow Design Flood Controls

WEC1 currently sluices its CCR into the West Area of the existing WEC Temporary Ash Disposal Area. The above-ground sluice inlets are located on the north side of the West Area as shown in Figure 3 (Attachment 1). WEC1 CCR flows are approximately 400,000 gallons per day into the West Area of the WEC Temporary Ash Disposal Area, as provided by Hastings. The ash marketer manages the routing of CCR flows and excavation of pond ash within the permitted limits of the disposal area.

In 2007, riser/spillway structures and the Leachate Pond were constructed to transfer water from the WEC Temporary Ash Disposal Area. These structures were required by NDEE in order to maintain the depth of leachate within the disposal area at a depth of approximately 12 to 14 inches or less under normal operations during a 25-year, 24-hour storm event. Ash sluice is directed to flow southward for settlement of ash sediment while the free liquids generally flow along the surface. The free liquids then either drain by gravity to a clear area surrounding the risers or are pumped directly into the Leachate Pond with a portable pump and piping. Spillway invert elevations are shown on Figure 3 in Attachment 1.

With operational changes within the plant and ash management, the riser/spillway structures have not been used for several years.

- East Area risers and spillways – Discontinued use in 2013 when pug mill installed on scrubber ash silo for loading direct into dump trucks, hauled and placed within the East Area of the WEC Temporary Ash Disposal Area.
- West Area riser and spillways – Discontinued use in 2015 when operations began using a pump, float and flexible pipe to pump free liquids to the Leachate Pond.

Subsequently, pumping of water from the West Area into the Leachate Pond has been periodic since 2016 due to significant reductions in water use for WEC1 ash sluice pipe flushing and pond evaporation. Water in the Leachate Pond either evaporates or is used for CCR dust control. Although the Leachate Pond is currently dry, surface water modeling described in Section 3.3 used the normal pool depths.

The inlets and outlets for the West Area of the WEC Temporary Ash Disposal Area are further described below.

3.2.1. Inlets

The West Area of the WEC Temporary Ash Disposal Area can receive ash sluice via two (2) force mains with invert elevations of 1898.0 to 1898.27 feet MSL. WEC1 fly ash and bottom ash sluice daily flow is approximately 400,000 gallons per day or 0.62 cubic feet per second (cfs) when the WEC Unit 1 is operational. WEC2 no longer sluices fly ash.

Some surface water run-on occurs from the north side into the WEC Temporary Ash Disposal Area. The north drainage area is estimated to be approximately 4.7 acres as shown on the drainage map in Attachment 2. During a 100-year storm event the peak runon flow into the West Area is 46.8 cfs.

3.2.2. Outlets

The outlets from the WEC Temporary Ash Disposal Area had been the CMP outlet risers and spillways located on the south end. The outlet risers are slotted from design elevation 1888.67 feet to 1889.00 feet MSL with an overflow rim elevation at 1891.00 feet MSL. Actual bottom elevations of slots are shown on Figure 3. The bottom of each riser is fitted with 36-inch diameter CMP spillway with invert design elevation of 1886.0 feet. Each spillway is about 120 horizontal feet at an installed slope of approximately 4.5 percent. The spillways convey water through the south embankment into the Leachate Pond. Discharge invert elevations range from 1883.00 feet to 1883.52 feet MSL as shown in Figure 3.

3.2.3. Leachate Pond

The Leachate Pond has a riser feeding a pump station located on the east side of the pond. The Leachate Pond was constructed within the native clay soils with a 12" compacted sub-base. It is approximately 5.2 acres, with a storage volume between elevation 1887 feet MSL and base elevation 1880 feet MSL of approximately 41,400 cubic yards. During a 25-year, 24-hour storm event, elevation 1887 was set as the maximum liquid elevation in the leachate retention pond so that liquids do not back up into the WEC Temporary Ash Disposal Area. The top of orifice elevation is set at 1884.40 feet MSL.

3.2.4. Surge Pond

The Surge Pond area is approximately 18 acres for storage of general site stormwater runoff and the runon from the property north of U.S. Highway 6. The existing weir structure at the south boundary of the WEC site has an invert elevation of 1890.4 feet MSL. A protective bermed area and headwall allows stormwater to accumulate to approximate elevation 1892.50 feet MSL before discharging through the existing weir structure. With an average base elevation of 1890.0 feet MSL, the Surge Pond has a capacity up to 72,600 cubic yards or 45 acre-feet.

3.3. Hydrologic and Hydraulic Model and Results

The surface water hydraulic model was prepared using Hydraflow to model the existing runon and containment within the WEC Temporary Ash Disposal Area and the runoff structures. Model's input data is provided below.

3.3.1. Drainage Areas

To accurately model the CCR surface impoundment, the model must include inflow from both ash sluice water entering the system for treatment and stormwater entering the system via direct precipitation and stormwater runon. Table 1 shows the drainage areas contributing to the WEC Temporary Ash Disposal Area during the 100-year, 24-hour storm event which are also shown in on a figure in Attachment 2.

Table 1. Inflow and Drainage Areas

Pond or Drainage Area Name	Source/Area	Peak Flow During 100-year, 24-hour Storm Event
North Run-on Area	4.7 Acres	46.8 CFS
WEC1 Ash Sluice	10-inch Force Main	0.62 CFS
WEC2 Fly Ash Sluice	10-inch Force Main	0 CFS
WEC Temporary Ash Disposal Area		
West Area	11.3 Acres	102.36 CFS
East Area	11.9 Acres	107.8 CFS
East Run-on Area	2.3 Acres	23.44 CFS

Total peak flow into the West Area is 149.78 cfs and includes the North Run-on Area, WEC1 Ash Sluice, WEC2 Fly Ash Sluice and West Area precipitation. During the 100-year 24-hour storm event, the total volume increase is 439,406 cubic feet or 10.1 acre-feet.

3.3.2. Rainfall Data

Rainfall events for Hastings, Nebraska area were available from the National Oceanic and Atmospheric Administration (NOAA) Precipitation Frequency Data Server. Rainfall for the 100-year 24-hour storm event is 6.70 inches.

3.3.3. Weighted Curve Number

The weighted curve number (CN) is determined according to a hydrologic soil group and ground cover for a delineated drainage basin. Most drainage areas were identified as water surfaces with compacted soil surfaces (i.e. impervious coverage), while some north areas contributing to runon are considered vegetated soil. A CN number of 100 was conservatively used for all areas.

3.3.4. Time of Concentration

Time of concentration (Tc) is defined as the time required for run-on or run-off to travel from the most hydrologically distant point of a sub-catchment to the point of collection. It is determined by summing the travel time for consecutive flow segments along the sub-catchment's hydraulic path. For the West Area of the WEC Temporary Ash Disposal Area, the Tc

is 5.0 minutes for the north runon and 7.6 minutes for the West Area itself. Within the East Area of the WEC Temporary Ash Disposal Area, the Tc is estimated at 2.5 minutes for the east runon and 7.1 minutes for the East Area itself.

3.3.5. Model Inputs

The hydraulic evaluation was completed based on the best available information provided by Hastings at the time of this report. North runon areas are due to access road improvements and new culverts along the north side of the WEC Temporary Ash Disposal Area. Existing pond elevations and inlet/outlet structures information were taken from previous design and permit reports. Spillway invert elevations and pipe slopes were obtained from most recent survey from 2016 shown in Figure 3 (Attachment 1). Table 2 summarizes the structure information.

Table 2. Inflow/Outflow Structure Information

Pond	Structure & Type	Elevation (feet) (NGVD27)
WEC Temporary Ash Disposal Area: West Area	Top Embankment	1898.0
	Base of Disposal Area	1888.0
	Assumed Normal Pool Elevation (no outlets)	1892.0
	Assumed Pool Elevation (clear area w/ risers)	1892.5
	Inlets: • 10-inch diameter pipe from WEC1 • North runon (assumed) • Precipitation	 1898.0 1897.0
	Outlets: • Two (2) 48-inch diameter Risers, ○ Orifice Openings ○ Riser Pipe Rim Elevation • Two (2) 36-inch diameter CMP • Evaporation	 1888.59 to 1888.92 1888.66 to 1888.99 1890.97 1891.03 1886.0
WEC Temporary Ash Disposal Area: East Area	Top Embankment	1898.0
	Base of Disposal Area	1888.0
	Assumed Normal Pool Elevation	1888.0*
	Inlets: Precipitation	
	Outlets: • Two (2) 48-inch diameter Risers, ○ Orifice Openings ○ Riser Pipe Rim Elevation • Two (2) 36-inch diameter CMP • Evaporation	 1888.67 to 1889.00 1888.71 to 1889.04 1891.02 1891.00 1886.0

*No ash sluicing into East Area.

Pond	Structure & Type	Elevation (feet) (NGVD27)
Leachate Pond	Top Embankment	1894.0
	Base of Leachate Pond	1880.0
	Normal Pool Elevation	1884.3
	Maximum Pool Elevation	1893.0
	Inlets: • Four (4) 36-inch diameter CMP (from west to east)	 1883.27, 1883.00 1883.30, 1883.52
	Outlets: • One (1) 24-inch diameter CMP • One (1) 36-inch diameter Riser ○ Orifice Openings ○ Riser Pipe Rim Elevation • Evaporation	 1880.63 1884 to 1884.40 1885.29

3.4. Evaluation of Existing Inflow/Outflow Design Controls

Hydraflow for Autodesk Civil 3D was used to evaluate the inflow, outflow and peak elevations observed for the 100-year, 24-hour storm event for the existing CCR surface impoundment. Table 3 summarizes the storage area and peak elevations within the WEC Temporary Ash Disposal Area.

Table 3. Areas and Elevations During 100-year, 24-hour Storm Event

WEC Temporary Ash Disposal Area	Area Required for 4-ft Depth (acres)	Peak Elevation* (ft)	Peak Inflow (cfs)	Remaining Freeboard (ft)
West Area – Pond Ash	2.5	1896.0	149.78	2.0
East Area – Scrubber Ash	1.9	1892.0	131.24	6.0

* Peak elevation above normal pool elevation listed in Table 2.

With excavation, stockpiling and removal of pond ash for beneficial use, the actual area available for peak inflow may be greater than that shown in Table 3. For example, available storage of five acres within the West Area would result in only a two-foot rise or peak elevation of 1894.0 feet MSL.

Based on the modelling results, at no time during a 100-year, 24-hour storm event will water elevations rise above the top of slope/berms of the WEC Temporary Ash Disposal Area. Following the storm event, water will be discharged to the Leachate Pond through surface pumping. Water in the Leachate Pond evaporates or is used for dust control on the WEC Temporary Ash Disposal Area; it is not discharged to the Surge Pond.

3.5. Improvements to Existing Inflow/Outflow Design Controls

Based on the available information and model results contained in Attachment 2, the existing inflow design flood control systems in place for the WEC Temporary Ash Disposal Area meet the requirements of 40 CFR §257.82 and will adequately manage and contain the flow into the WEC Temporary Ash Disposal Area during the 100-year, 24-hour storm event without overtopping. At such a time that the disposal area no longer has the storage area required, the existing outlets should be hydraulically reconnected and utilized, and clear areas reshaped.

4. Certification

Based on the information in City of Hastings facility records, topographic survey data and information available in the NDEE Title 132 permit application, and Hastings visual observations and analyses, this Inflow Design Flood Control System Plan was developed in accordance with the requirements of the USEPA 40 CFR Part 257-Criteria for Classification of Solid Waste Disposal Facilities and Practices; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, April 17, 2015 (CCR Rule). I certify to the best of my knowledge, information and belief that this Inflow Design Flood Control System Plan has been prepared in accordance with good engineering practice, including consideration of applicable industry standards and requirements of CCR Rule §257.82. I am a duly licensed Professional Engineer under the laws of the State of Nebraska.

Print Name: Marty Stange

Signature:

Date: 12/08/2020

License #: E-6129

My license renewal date is December 31, 2020.

5. References

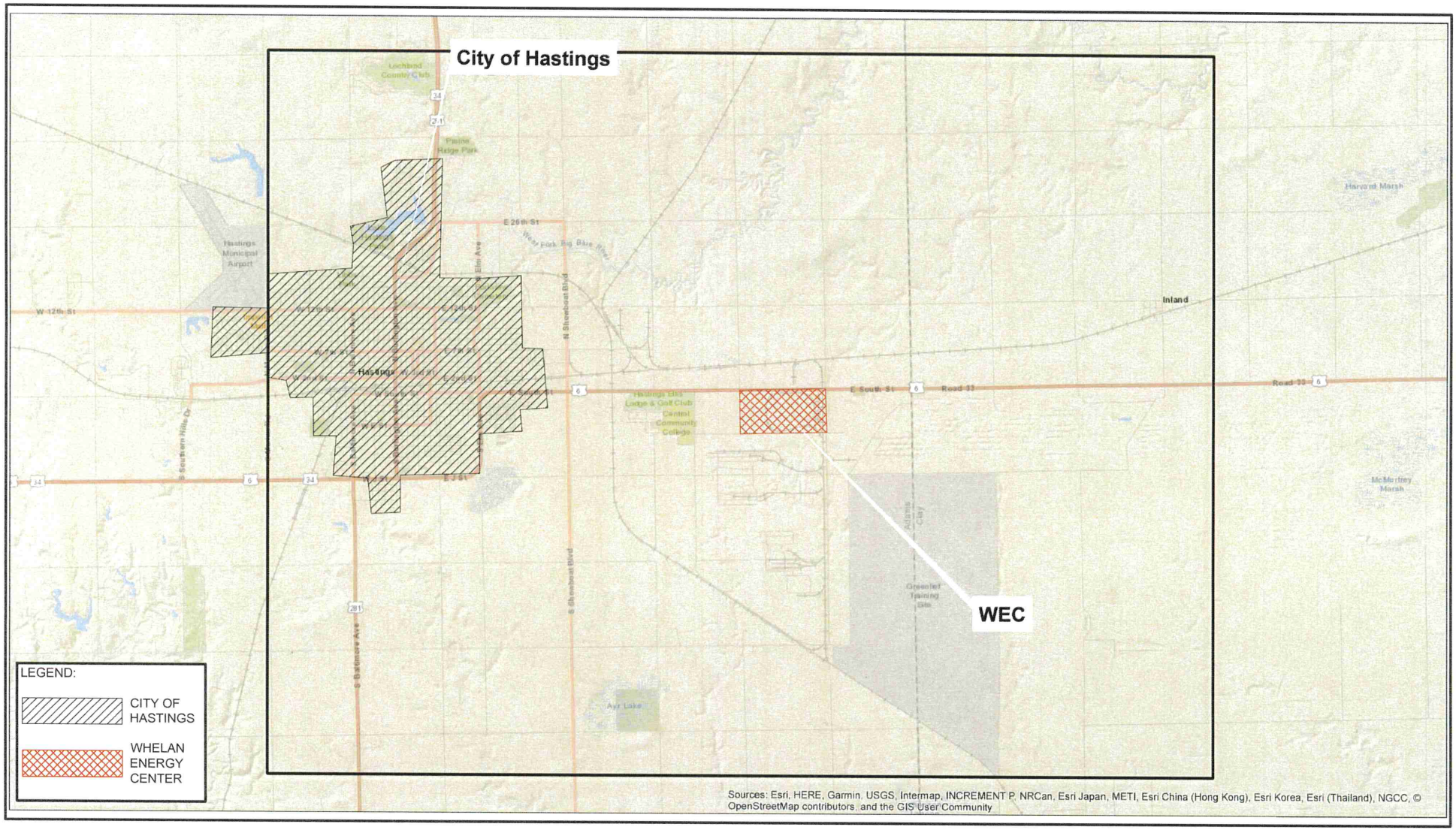
Federal Register, 2015. 40 CFR Parts 257 and 261 Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities. Vol. 80, No. 74, Pages 21302 – 21501. April 17, 2015.

Hastings, 2020. Data on water surface elevations and storage volumes.

HDR, Inc., 2006. Supplemental Hydrogeologic Characterization for Whelan Energy Center Fossil Fuel Combustion Ash Temporary Ash Disposal Area. Prepared for Hastings Utilities. Original December 2001.

HDR, Inc., 2016. Title 132 Permit Renewal Application, WEC Temporary Ash Disposal Area. Whelan Energy Center. Prepared for Public Power Generation Agency and Hastings Utilities. October 6, 2016.

Attachment 1: Figures



public power generation agency

HASTINGS UTILITIES

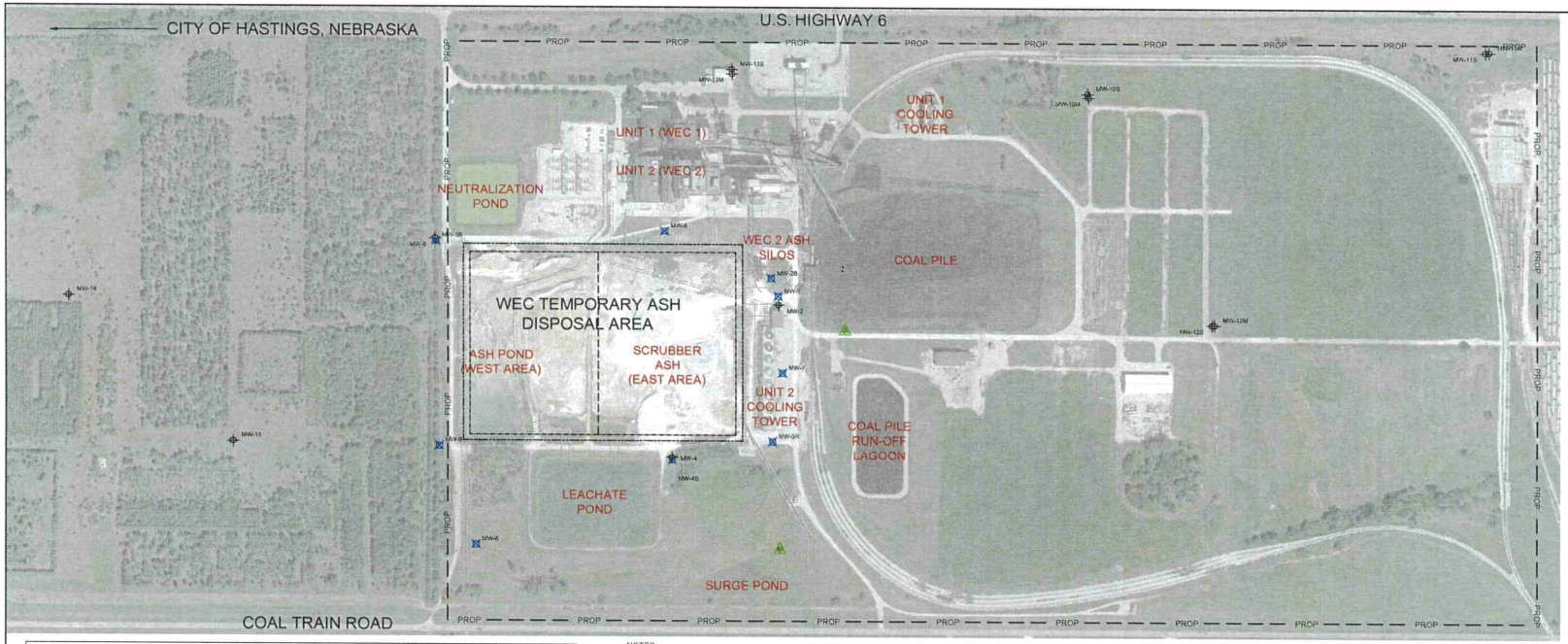
HDR

GERALD T. WHALEN ENERGY CENTER

LOCATION OF WEC AND CITY OF HASTINGS

DATE
NOVEMBER 2020

FIGURE
1



GROUNDWATER MONITORING WELLS

WELL DESIGNATION	NORTHING	EASTING	TOP OF CASING ELEVATION*	GROUND ELEVATION*	COMMENT
MW-1	334585.29	2330340.91	1903.16	1900.66	DETECTION MONITORING WELL
MW-2	334649.00	2330345.01	1903.18	1900.93	DRY
MW-2B	334663.85	2330310.77	1903.43	1900.60**	DETECTION MONITORING WELL
MW-3R	333955.95	2330316.80	1900.76	1897.66	DETECTION MONITORING WELL
MW-4	333888.31	2329891.68	1899.21	1895.19	DRY
MW-4B	333876.00	2329890.22	1897.56	1894.69**	DETECTION MONITORING WELL
MW-5	334830.77	2328882.44	1898.90	1897.60	DRY
MW-5B	334819.84	2328884.33	1899.84	1897.21**	DETECTION MONITORING WELL
MW-6	333507.64	2329055.42	1899.88	1893.54	DETECTION MONITORING WELL
MW-7	334250.89	2330359.26	1901.79	1899.14**	DETECTION MONITORING WELL
MW-8	334864.54	2329857.95	1903.93	1901.05**	DETECTION MONITORING WELL
MW-9	333935.57	2328898.85	1897.11	1894.31**	DETECTION MONITORING WELL
MW-10S	334585.29	2330340.91	1904.86	1904.16	DELINEATION WELL
MW-10M	334649.00	2330345.01	1905.18	1902.16	DELINEATION WELL
MW-11S	334663.85	2330310.77	1899.69	1897.13	DELINEATION WELL
MW-11M	333955.95	2330316.80	1899.66	1897.13	DELINEATION WELL
MW-12S	333888.31	2329891.68	1910.39	1907.3	DELINEATION WELL
MW-12M	333876.00	2329890.22	1910.15	1907.56	DELINEATION WELL
MW-13S	334830.77	2328882.44	1904.89	1902.34	DELINEATION WELL
MW-13M	334819.84	2328884.33	1905.04	1902.40	DELINEATION WELL
MW-14	333507.64	2329055.42	1897.46	1894.74	DELINEATION WELL
MW-15	334250.89	2330359.26	1897.64	1895.32	DELINEATION WELL

* TOP OF CASING AND GROUND ELEVATIONS PROVIDED BY HASTINGS UTILITIES JULY 23, 2019.
** DESIGNATED GROUND ELEVATIONS DEPICT THE ELEVATION OF THE TOP OF THE CONCRETE SLAB NEAREST TO THE CASING ON THE NORTH SIDE.
***NORTHING AND EASTING COORDINATES ARE APPROXIMATIONS AND WILL BE UPDATED ALONG WITH TOC AND GROUND SURFACE ELEVATIONS DURING THE NEXT SITE SURVEY.

NOTES:

1. AERIAL DATED 8/27/2017 OBTAINED FROM GOOGLE EARTH.
2. WEC 2 BOTTOM ASH AND SCRUBBER ASH ARE PLACED DRY IN WEC TEMPORARY ASH DISPOSAL AREA.

CONTROLS	NORTHING	EASTING	ELEVATION	LONG DESCRIPTION
25	334815.14	2328892.86	1896.51	BRASS CAP
26	334879.51	2330467.21	1900.86	BRASS CAP
27	333932.07	2330190.86	1894.46	BRASS CAP

*NOTE: STATE PLANE CONTROL IS BASED ON NEBRASKA SOUTH ZONE NAD 27. VERTICAL CONTROL IS BASED ON NGVD29.

public power generation agency

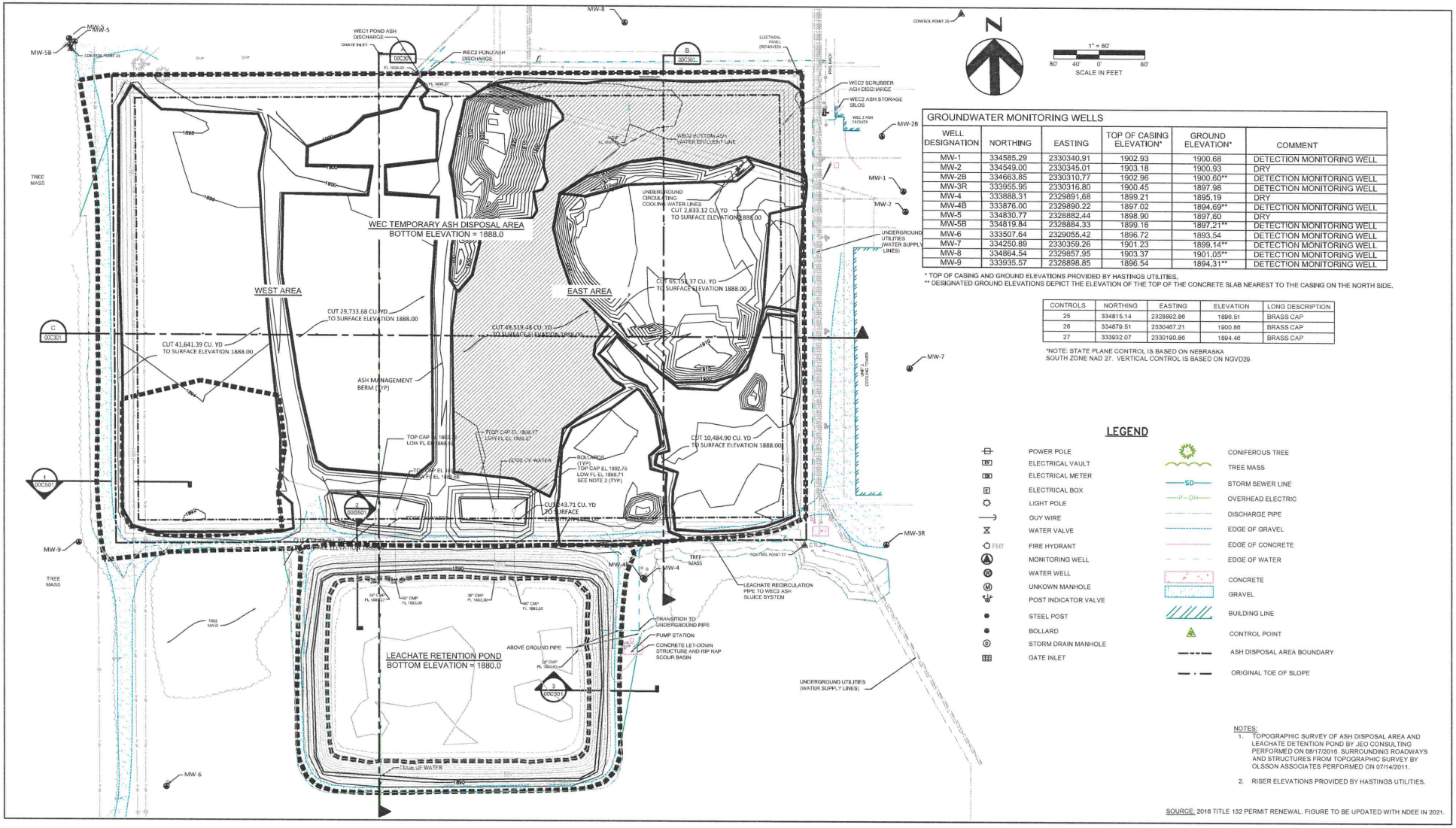
HASTINGS UTILITIES

GERALD T. WHALEN ENERGY CENTER

WEC CCR FACILITIES AND MONITORING WELL LOCATIONS

DATE
NOVEMBER 2020

FIGURE
2



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MW-2B	334663.85	2330310.77	1902.96	1900.60**	DETECTION MONITORING WELL
MW-3R	333955.95	2330316.80	1900.45	1897.98	DETECTION MONITORING WELL
MW-4	333888.31	2329891.68	1899.21	1895.19	DRY
MW-4B	333876.00	2329890.22	1897.02	1894.69**	DETECTION MONITORING WELL
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MW-7	334250.89	2330359.26	1901.23	1899.14**	DETECTION MONITORING WELL
MW-8	334864.54	2329857.95	1903.37	1901.05**	DETECTION MONITORING WELL
MW-9	333935.57	2328898.85	1896.54	1894.31**	DETECTION MONITORING WELL

* TOP OF CASING AND GROUND ELEVATIONS PROVIDED BY HASTINGS UTILITIES.
** DESIGNATED GROUND ELEVATIONS DEPICT THE ELEVATION OF THE TOP OF THE CONCRETE SLAB NEAREST TO THE CASING ON THE NORTH SIDE.

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*NOTE: STATE PLANE CONTROL IS BASED ON NEBRASKA SOUTH ZONE NAD 27. VERTICAL CONTROL IS BASED ON NGVD29.

LEGEND

- POWER POLE
- ELECTRICAL VAULT
- ELECTRICAL METER
- ELECTRICAL BOX
- LIGHT POLE
- GUY WIRE
- WATER VALVE
- FIRE HYDRANT
- MONITORING WELL
- WATER WELL
- UNKOWN MANHOLE
- POST INDICATOR VALVE
- STEEL POST
- BOLLARD
- STORM DRAIN MANHOLE
- GATE INLET
- CONIFEROUS TREE
- TREE MASS
- STORM SEWER LINE
- OVERHEAD ELECTRIC
- DISCHARGE PIPE
- EDGE OF GRAVEL
- EDGE OF CONCRETE
- EDGE OF WATER
- CONCRETE
- GRAVEL
- BUILDING LINE
- CONTROL POINT
- ASH DISPOSAL AREA BOUNDARY
- ORIGINAL TOE OF SLOPE

NOTES:
1. TOPOGRAPHIC SURVEY OF ASH DISPOSAL AREA AND LEACHATE DETENTION POND BY JEO CONSULTING PERFORMED ON 08/17/2016. SURROUNDING ROADWAYS AND STRUCTURES FROM TOPOGRAPHIC SURVEY BY OLSSON ASSOCIATES PERFORMED ON 07/14/2011.
2. RISER ELEVATIONS PROVIDED BY HASTINGS UTILITIES.

SOURCE: 2016 TITLE 132 PERMIT RENEWAL. FIGURE TO BE UPDATED WITH NDEE IN 2021.

public power generation agency

HASTINGS UTILITIES

GERALD T. WHALEN ENERGY CENTER

ASH DISPOSAL AREA PLAN

DATE
NOVEMBER 2020

FIGURE
3

Attachment 2: Hydraulic Analyses

Project: WEC
Subject: Stormwater
Task: Hydraulic Calculations

Computed by: K. Kinley Date: 11/19/2020
Checked by: L. Calub Date: 11/23/2020

Objective: Demonstrate disposal areas can manage a 100-yr 24-hr storm event

References: Site data, historic calculations
Hydraflow, Mannings

Assumptions: 25-yr 24 hr storm event is 5.11-inches on site. (NOAA Atlas 14 Vol 8 Version 2)
100-yr 24 hr storm event is 6.70-inches on site. (NOAA Atlas 14 Vol 8 Version 2)

Calculations: *Drainage Areas*

n for smooth surfaces	0.011	0.015			
	Sheet Flow (ft)*	**Channel Flow (ft)***	**Acres**	**Peak flow (cfs)**	**Total Volume (cf in 24-hrs)**
North Runon	50	1500	4.7	46.8	117,881
WEC1 Ash Sluice**	na	na	10-in forcemain	0.62	53,568
WEC2 Fly Ash Sluice	na	na	10-in forcemain	0	0
West Disposal Area	300	600	11.3	102.36	267,957
			Totals for west disposal area	**149.78**	**439,406**
East Runon	100	0	2.3	23.44	52,442
East Disposal Area	300	400	11.9	107.8	282,184
			Totals for east disposal area	**131.24**	**334,626**

*slopes subject to change with operations. Generally low slope. Modeled with 0.5%.
**400,000 GPD

Current Conditions - No discharge

Under current conditions, there is estimated to be no discharge during the 100-yr 24-hr storm event. Operations change over time on site. In order to maintain no discharge for each area, the 100-YR 24-hr volume must be held within the disposal area with 1-ft of freeboard.

Current elevation of ponded water is estimated at elev. 1893 by the site:

	Req. Storage (cf)	Area Req. if 4-ft deep (SF)
West Disposal Area	439,406	109,852
East Disposal Area	334,626	83,657

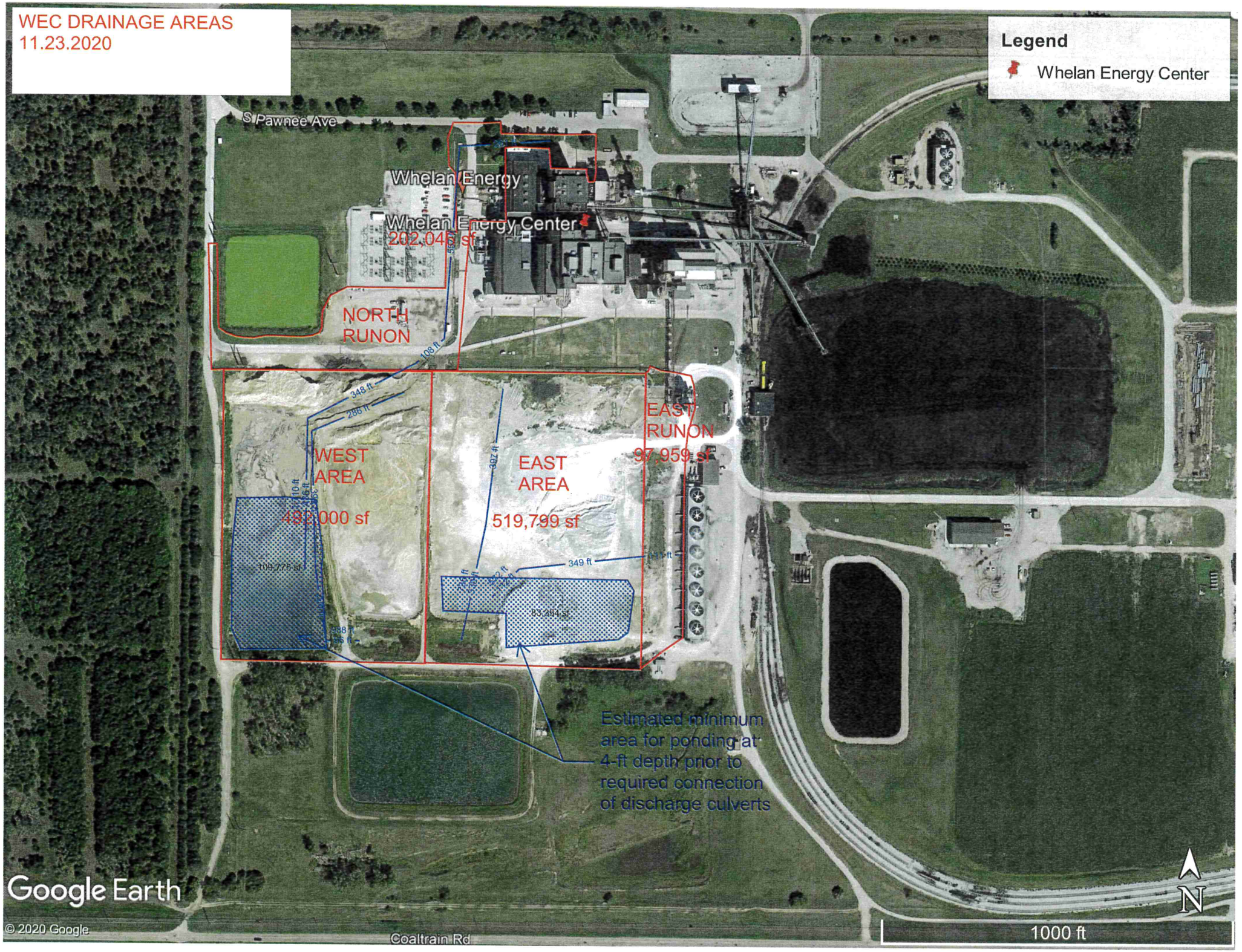
Future Conditions - Discharge to Leachate Pond
In the event the disposal area operations displace stormwater storage volume, the discharge structures will be utilized. Assumptions are as follows:

1. Starting pool elevation is 1892.5 (limited storage before riser discharge)
2. Storage is limited to 5,000-sf, 3:1 side slopes, and maximum elevation is 1898 (approx. inlet clear area)
3. Outflow culverts are modeled as 'dual barrel' to estimate peak storage.

Total flow to the leachate pond= 774,032 cf for 24-hrs
Leachate pond storage*= 1,568,160 cf

*Elevation 1884 to 1893, est. available for storage. Leachate Pond is 5.2 acres.

Conclusion: In the 100-yr storm event, the stormwater is contained within the disposal areas without overtopping. At such time that a disposal area no longer has the storage required, the discharge culverts will be hydraulically connected and utilized, and spillways reshaped. The discharge culverts are estimated to control the design storm without exceeding the berm elevation.


WEC DRAINAGE AREAS
11.23.2020
Legend
Whelan Energy Center
S Pawnee Ave
Whelan Energy
Whelan Energy Center
202,045 sf
NORTH
RUNON
108 ft
348 ft
286 ft
WEST
AREA
432,000 sf
109,775 sf
EAST
AREA
519,799 sf
382 ft
EAST
RUNON
97,959 sf
349 ft
83,354 sf
Estimated minimum
area for ponding at
4-ft depth prior to
required connection
of discharge culverts
Google Earth
© 2020 Google
Coaltrain Rd
N
1000 ft

NOAA Atlas 14, Volume 8, Version 2
Location name: Hastings, Nebraska, USA*
Latitude: 40.5791°, Longitude: -98.314°
Elevation: 1898.24 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.364 (0.290-0.466)	0.431 (0.342-0.551)	0.542 (0.429-0.695)	0.637 (0.501-0.818)	0.771 (0.588-1.01)	0.877 (0.654-1.15)	0.986 (0.711-1.31)	1.10 (0.760-1.48)	1.25 (0.834-1.71)	1.37 (0.890-1.88)
10-min	0.533 (0.424-0.683)	0.631 (0.501-0.807)	0.794 (0.628-1.02)	0.932 (0.734-1.20)	1.13 (0.861-1.48)	1.28 (0.957-1.69)	1.44 (1.04-1.92)	1.61 (1.11-2.17)	1.83 (1.22-2.50)	2.01 (1.30-2.75)
15-min	0.650 (0.517-0.832)	0.769 (0.611-0.985)	0.968 (0.766-1.24)	1.14 (0.895-1.46)	1.38 (1.05-1.80)	1.57 (1.17-2.06)	1.76 (1.27-2.34)	1.96 (1.36-2.64)	2.24 (1.49-3.05)	2.45 (1.59-3.36)
30-min	0.934 (0.743-1.20)	1.11 (0.880-1.42)	1.40 (1.11-1.79)	1.65 (1.30-2.11)	1.99 (1.52-2.60)	2.26 (1.69-2.98)	2.54 (1.83-3.38)	2.83 (1.96-3.81)	3.22 (2.14-4.39)	3.52 (2.28-4.82)
60-min	1.21 (0.958-1.54)	1.43 (1.13-1.83)	1.81 (1.43-2.32)	2.14 (1.68-2.75)	2.63 (2.01-3.45)	3.02 (2.26-3.99)	3.44 (2.48-4.59)	3.87 (2.69-5.24)	4.49 (2.99-6.14)	4.97 (3.23-6.82)
2-hr	1.48 (1.19-1.87)	1.74 (1.40-2.20)	2.21 (1.77-2.80)	2.63 (2.10-3.34)	3.26 (2.53-4.25)	3.78 (2.86-4.94)	4.33 (3.17-5.73)	4.92 (3.46-6.59)	5.75 (3.89-7.81)	6.42 (4.22-8.72)
3-hr	1.62 (1.31-2.04)	1.91 (1.54-2.40)	2.43 (1.96-3.05)	2.91 (2.33-3.66)	3.63 (2.85-4.72)	4.24 (3.24-5.53)	4.90 (3.61-6.46)	5.61 (3.98-7.49)	6.63 (4.52-8.96)	7.46 (4.94-10.1)
6-hr	1.88 (1.54-2.33)	2.21 (1.80-2.73)	2.80 (2.28-3.48)	3.36 (2.72-4.18)	4.21 (3.34-5.43)	4.94 (3.82-6.37)	5.73 (4.28-7.48)	6.59 (4.73-8.72)	7.83 (5.41-10.5)	8.83 (5.92-11.8)
12-hr	2.12 (1.76-2.60)	2.52 (2.08-3.08)	3.21 (2.65-3.94)	3.83 (3.14-4.70)	4.74 (3.79-6.00)	5.50 (4.28-6.97)	6.29 (4.74-8.09)	7.14 (5.18-9.31)	8.34 (5.82-11.0)	9.29 (6.30-12.3)
24-hr	2.45 (2.05-2.96)	2.85 (2.38-3.44)	3.56 (2.96-4.30)	4.18 (3.46-5.07)	5.11 (4.13-6.38)	5.88 (4.64-7.37)	6.70 (5.11-8.50)	7.57 (5.55-9.75)	8.80 (6.22-11.5)	9.78 (6.72-12.8)
2-day	2.80 (2.37-3.33)	3.21 (2.71-3.82)	3.93 (3.31-4.68)	4.57 (3.82-5.46)	5.52 (4.51-6.79)	6.30 (5.02-7.79)	7.13 (5.50-8.94)	8.01 (5.95-10.2)	9.26 (6.63-12.0)	10.3 (7.14-13.3)
3-day	3.02 (2.57-3.56)	3.46 (2.94-4.08)	4.22 (3.57-4.99)	4.89 (4.12-5.80)	5.87 (4.82-7.15)	6.67 (5.35-8.17)	7.51 (5.83-9.34)	8.40 (6.28-10.6)	9.63 (6.95-12.4)	10.6 (7.45-13.7)
4-day	3.21 (2.74-3.77)	3.68 (3.14-4.32)	4.48 (3.82-5.27)	5.18 (4.39-6.11)	6.19 (5.10-7.49)	7.00 (5.64-8.53)	7.85 (6.13-9.70)	8.74 (6.56-11.0)	9.97 (7.22-12.7)	10.9 (7.72-14.1)
7-day	3.78 (3.26-4.38)	4.31 (3.71-5.00)	5.19 (4.46-6.04)	5.95 (5.09-6.94)	7.02 (5.83-8.38)	7.88 (6.40-9.47)	8.75 (6.89-10.7)	9.65 (7.32-12.0)	10.9 (7.96-13.8)	11.8 (8.45-15.1)
10-day	4.31 (3.74-4.97)	4.89 (4.24-5.64)	5.86 (5.06-6.77)	6.67 (5.73-7.73)	7.81 (6.52-9.24)	8.70 (7.11-10.4)	9.61 (7.61-11.7)	10.5 (8.04-13.0)	11.8 (8.69-14.8)	12.8 (9.17-16.2)
20-day	5.87 (5.15-6.66)	6.62 (5.81-7.53)	7.85 (6.86-8.94)	8.86 (7.71-10.1)	10.2 (8.62-11.9)	11.3 (9.32-13.2)	12.3 (9.87-14.7)	13.4 (10.3-16.2)	14.7 (11.0-18.3)	15.7 (11.5-19.8)
30-day	7.17 (6.34-8.08)	8.09 (7.15-9.13)	9.57 (8.43-10.8)	10.8 (9.43-12.2)	12.4 (10.5-14.2)	13.5 (11.2-15.7)	14.7 (11.8-17.4)	15.8 (12.3-19.1)	17.3 (12.9-21.2)	18.3 (13.4-22.9)
45-day	8.82 (7.85-9.86)	9.98 (8.88-11.2)	11.8 (10.5-13.2)	13.2 (11.7-14.9)	15.1 (12.9-17.2)	16.5 (13.8-19.0)	17.8 (14.4-20.8)	19.0 (14.8-22.7)	20.5 (15.5-25.0)	21.5 (16.0-26.7)
60-day	10.2 (9.16-11.4)	11.6 (10.4-12.9)	13.7 (12.2-15.3)	15.4 (13.6-17.2)	17.5 (15.0-19.8)	19.0 (16.0-21.7)	20.4 (16.6-23.7)	21.7 (17.0-25.8)	23.3 (17.6-28.2)	24.3 (18.1-30.0)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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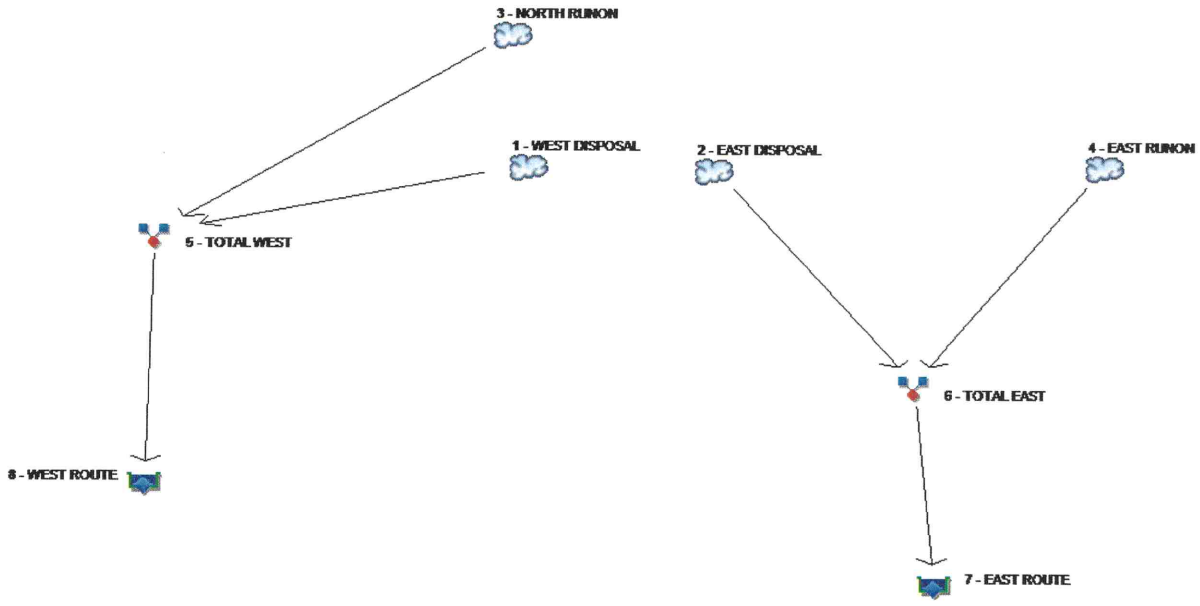
PF graphical

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

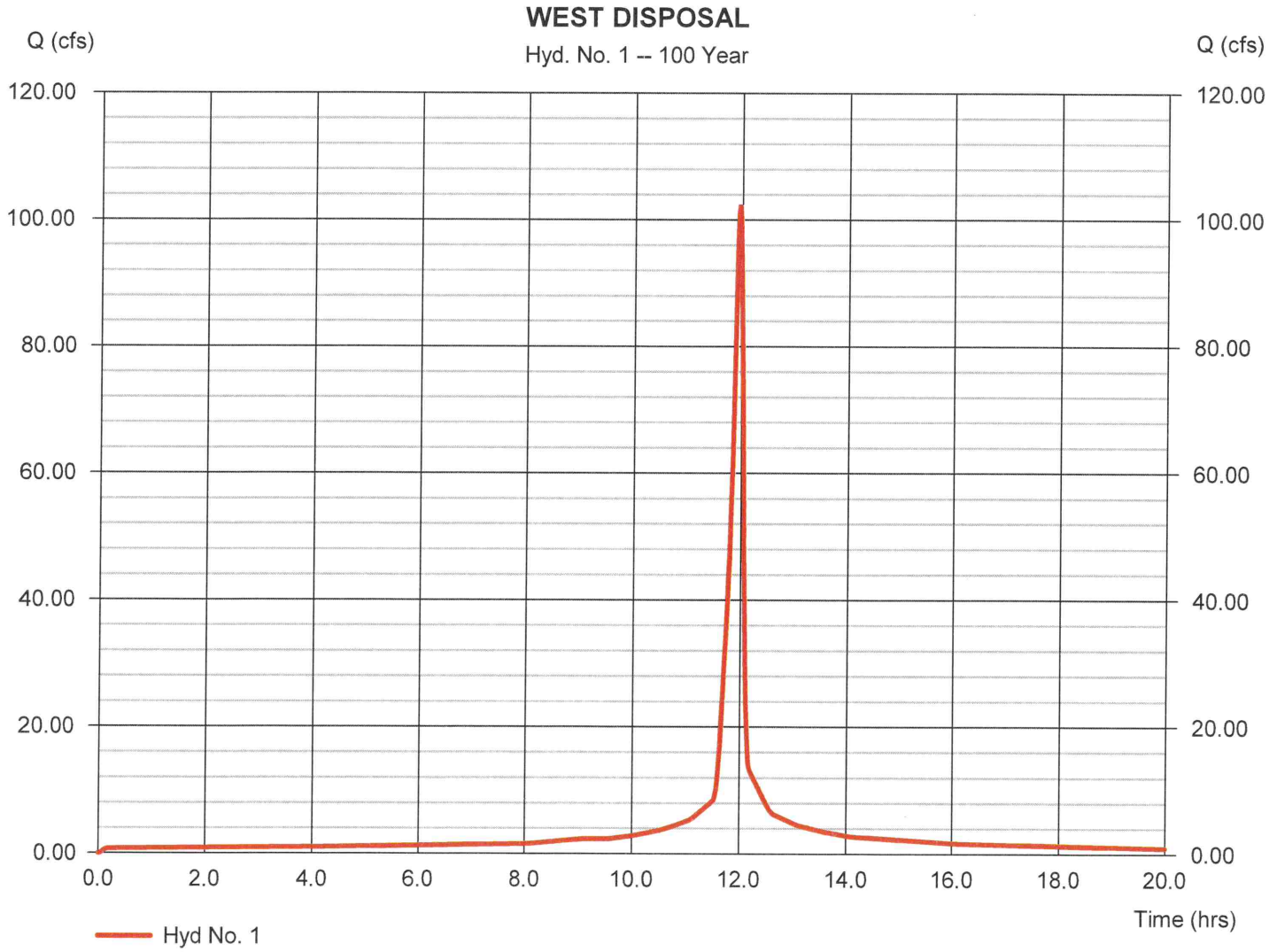
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	102.36	1	718	267,957	------	------	------	WEST DISPOSAL
2	SCS Runoff	107.80	1	718	282,184	------	------	------	EAST DISPOSAL
3	SCS Runoff	46.80	1	717	117,881	------	------	------	NORTH RUNON
4	SCS Runoff	23.44	1	715	52,442	------	------	------	EAST RUNON
5	Combine	148.48	1	718	385,838	1, 3,	------	------	TOTAL WEST
6	Combine	125.92	1	717	334,627	2, 4,	------	------	TOTAL EAST
7	Reservoir	93.54	1	721	320,978	6	1893.85	70,669	EAST ROUTE
8	Reservoir	110.92	1	721	376,722	5	1893.91	74,115	WEST ROUTE

Hydrograph Report

Hyd. No. 1

WEST DISPOSAL

Hydrograph type	= SCS Runoff	Peak discharge	= 102.36 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 1 min	Hyd. volume	= 267,957 cuft
Drainage area	= 11.300 ac	Curve number	= 100
Basin Slope	= 0.5 %	Hydraulic length	= 900 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.60 min
Total precip.	= 6.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

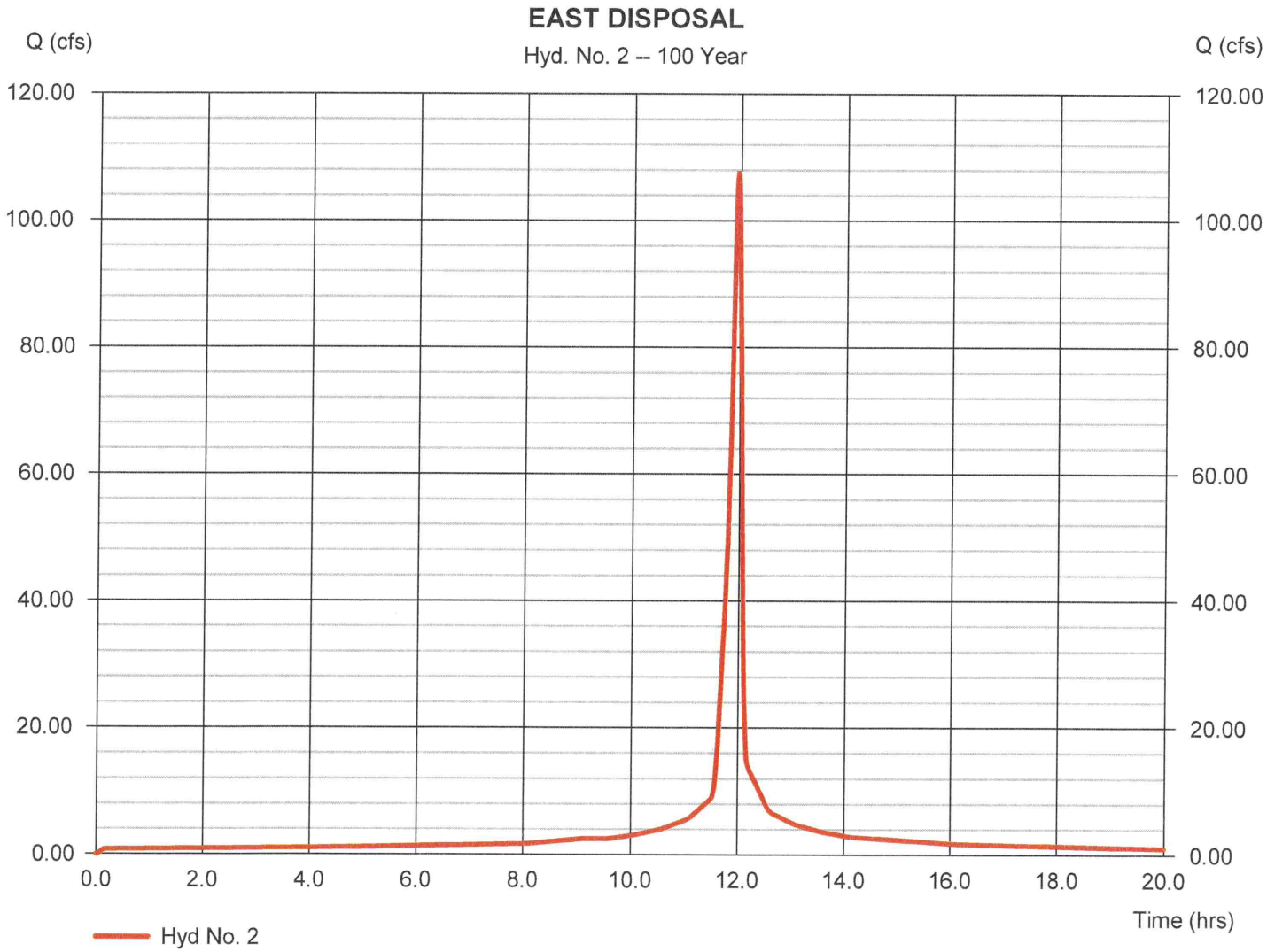


Hydrograph Report

Hyd. No. 2

EAST DISPOSAL

Hydrograph type	= SCS Runoff	Peak discharge	= 107.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 1 min	Hyd. volume	= 282,184 cuft
Drainage area	= 11.900 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 7.10 min
Total precip.	= 6.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

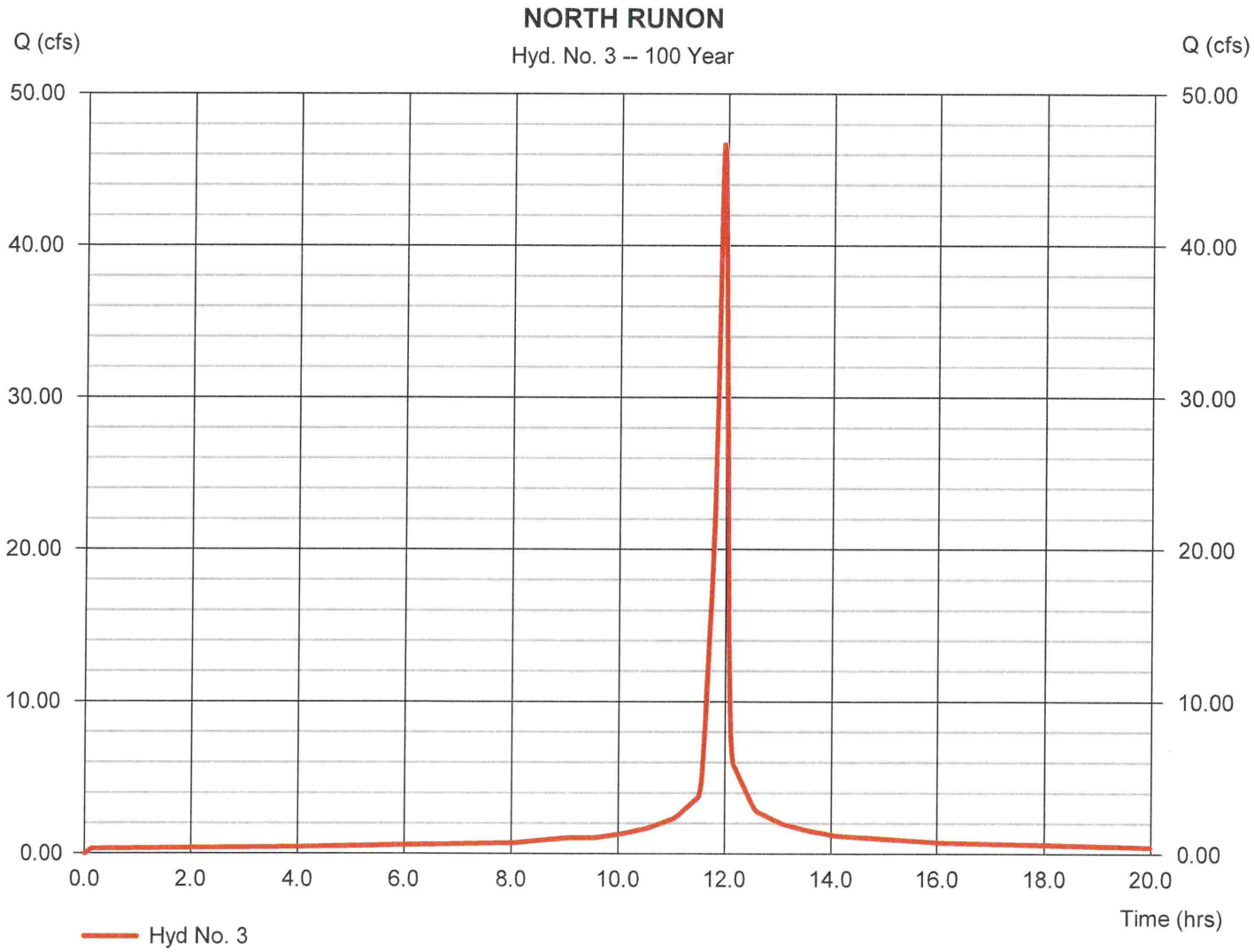


Hydrograph Report

Hyd. No. 3

NORTH RUNON

Hydrograph type	= SCS Runoff	Peak discharge	= 46.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.95 hrs
Time interval	= 1 min	Hyd. volume	= 117,881 cuft
Drainage area	= 4.700 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 5.02 min
Total precip.	= 6.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

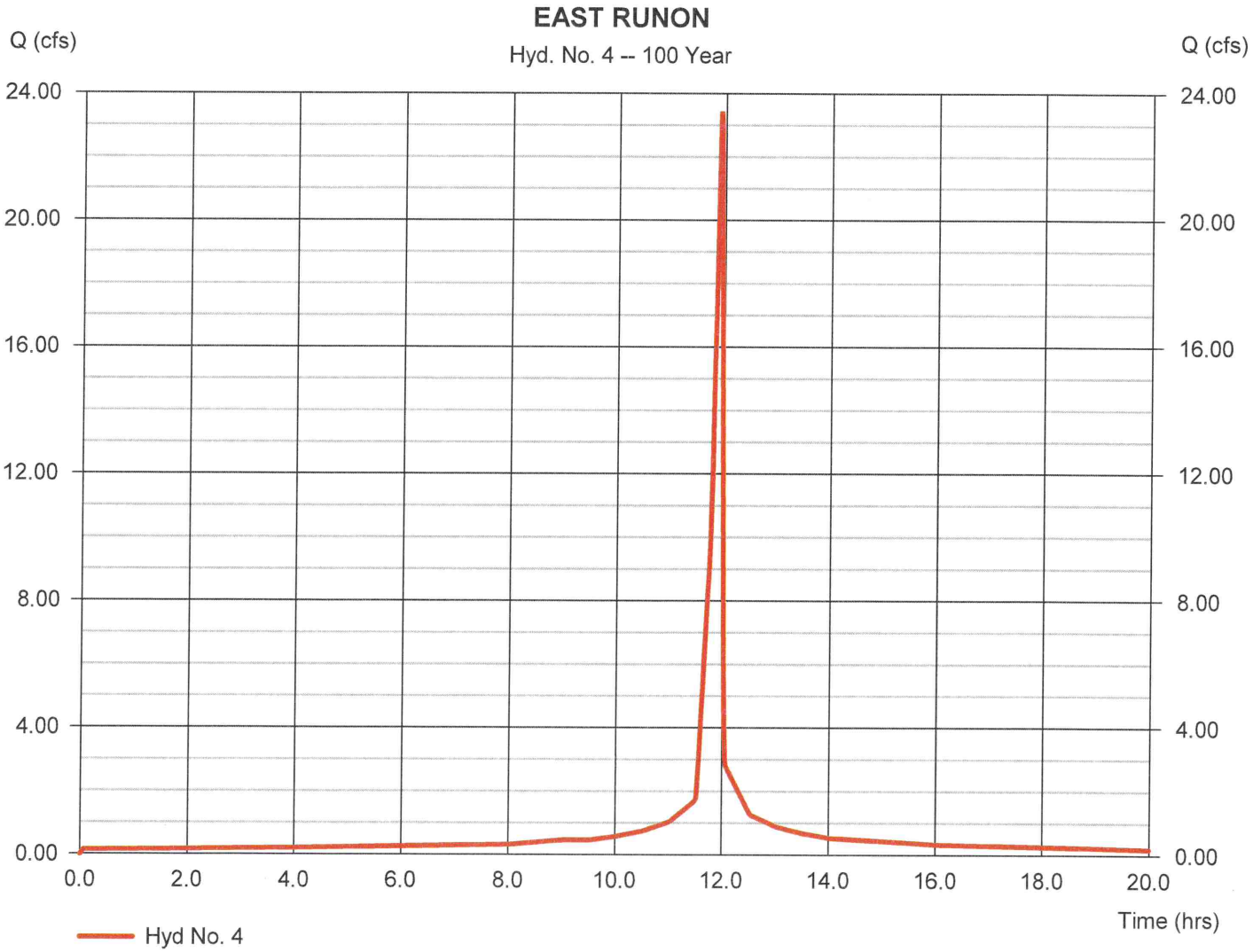


Hydrograph Report

Hyd. No. 4

EAST RUNON

Hydrograph type	= SCS Runoff	Peak discharge	= 23.44 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.92 hrs
Time interval	= 1 min	Hyd. volume	= 52,442 cuft
Drainage area	= 2.300 ac	Curve number	= 100
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 2.50 min
Total precip.	= 6.70 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



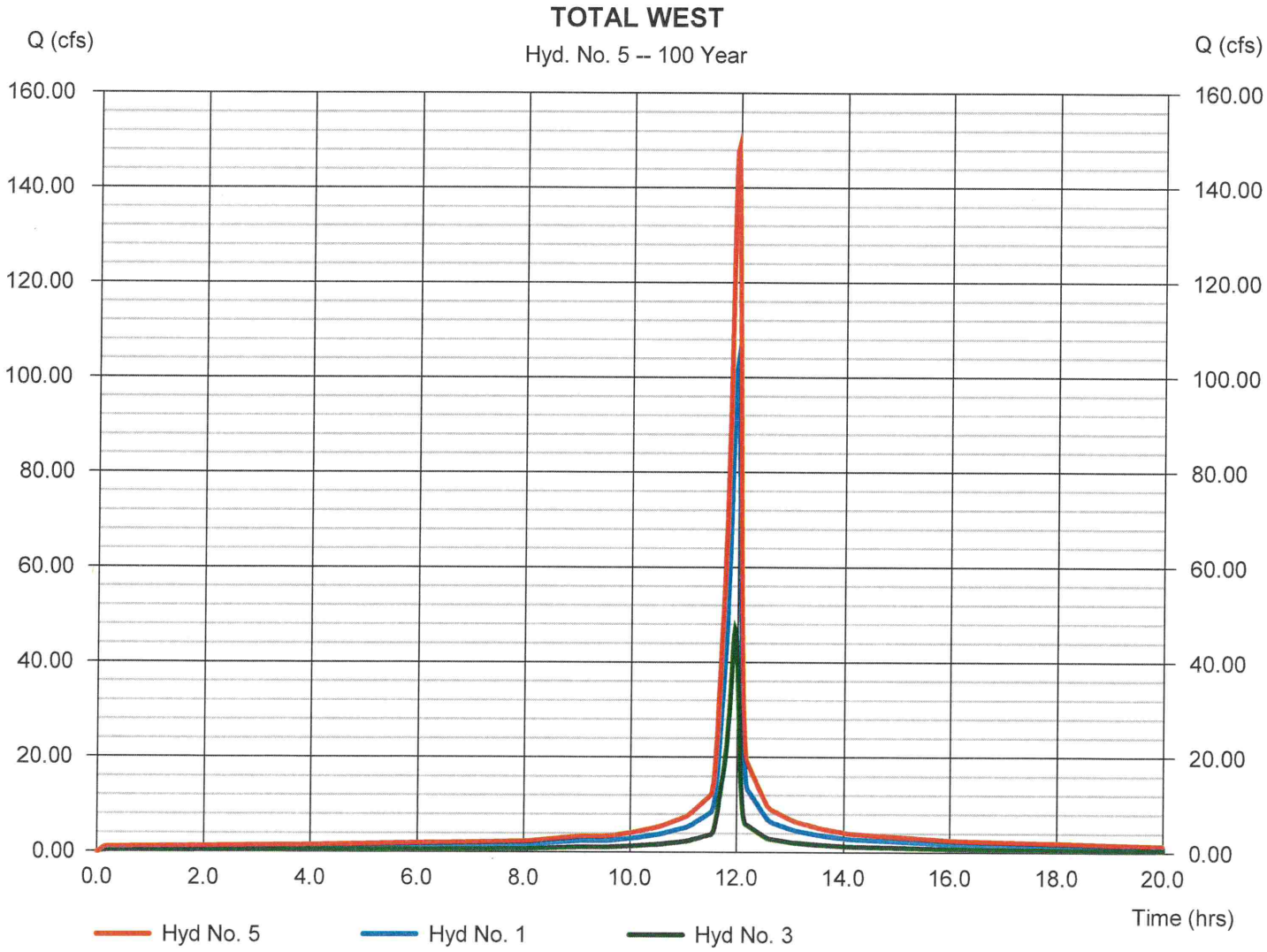
Hydrograph Report

Hyd. No. 5

TOTAL WEST

Hydrograph type	= Combine	Peak discharge	= 148.48 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.97 hrs
Time interval	= 1 min	Hyd. volume	= 385,838 cuft
Inflow hyds.	= 1, 3	Contrib. drain. area	= 16.000 ac

+0.62-CFS BASE FLOW (WEC1 Ash Sluice) = 149.1-CFS

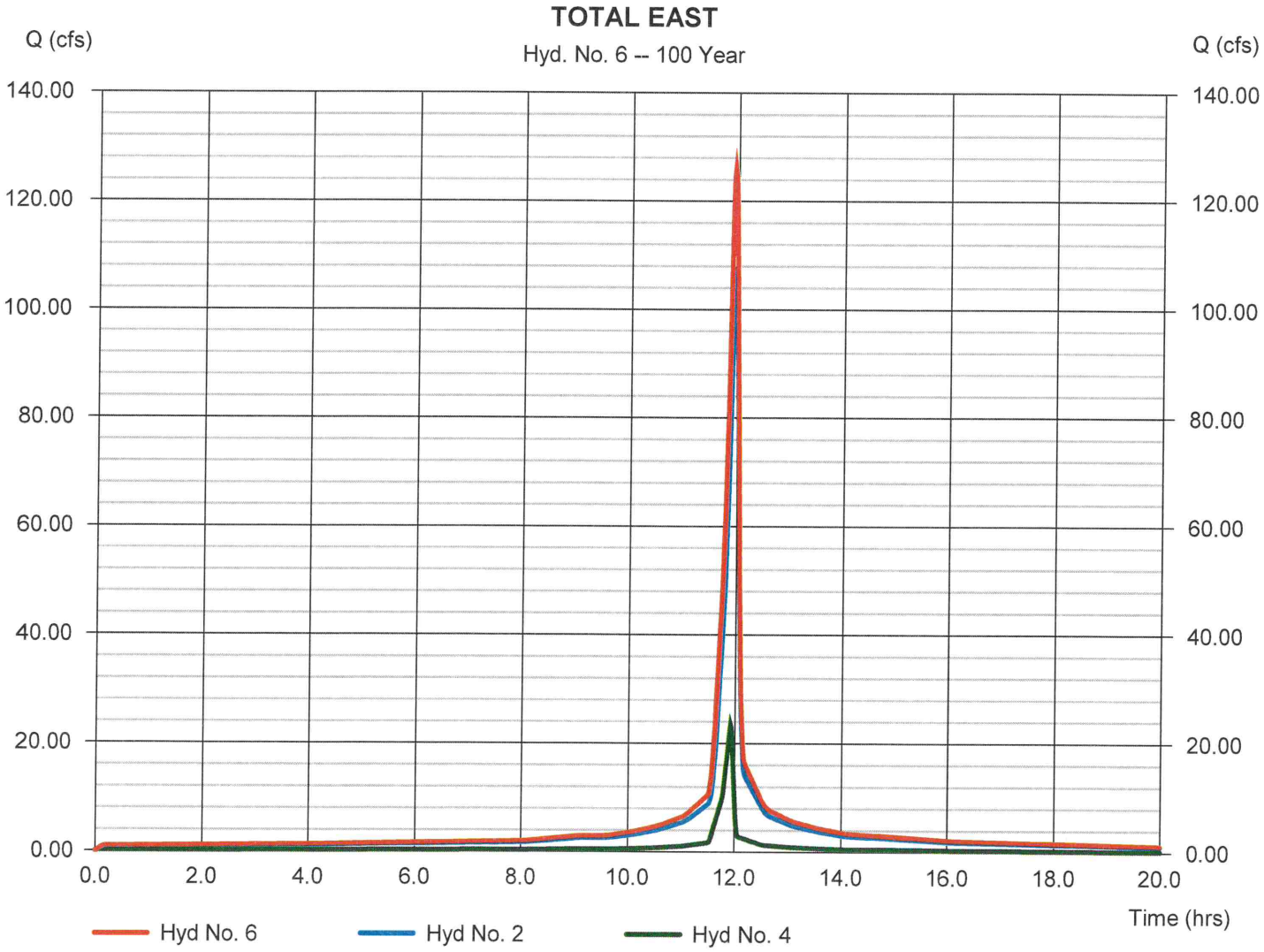


Hydrograph Report

Hyd. No. 6

TOTAL EAST

Hydrograph type	= Combine	Peak discharge	= 125.92 cfs
Storm frequency	= 100 yrs	Time to peak	= 11.95 hrs
Time interval	= 1 min	Hyd. volume	= 334,627 cuft
Inflow hyds.	= 2, 4	Contrib. drain. area	= 14.200 ac



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020 — Friday, 11 / 20 / 2020

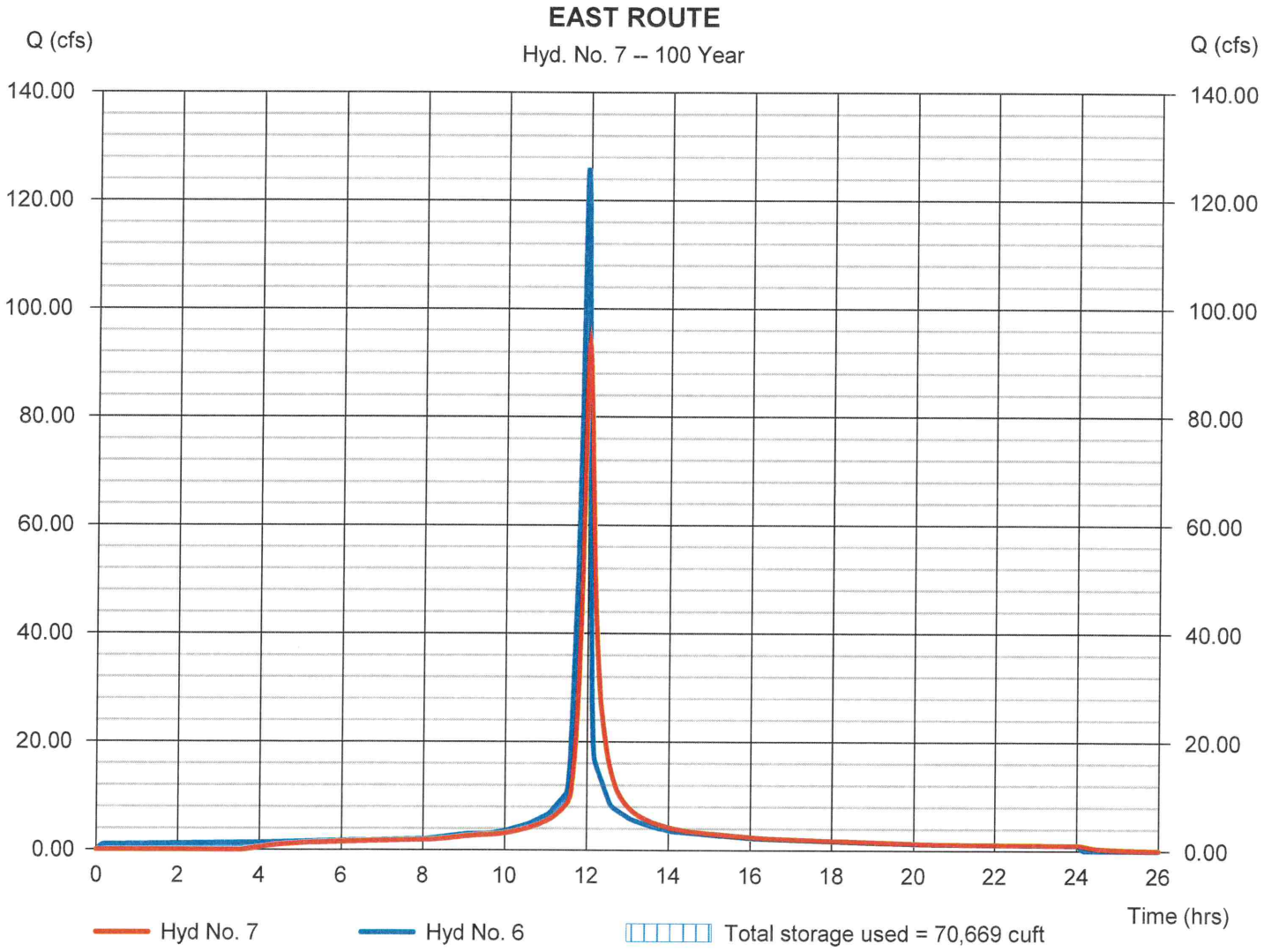
2X36" OUTLETS WITH 48" RISERS

Hyd. No. 7

EAST ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 93.54 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.02 hrs
Time interval	= 1 min	Hyd. volume	= 320,978 cuft
Inflow hyd. No.	= 6 - TOTAL EAST	Max. Elevation	= 1893.85 ft
Reservoir name	= EAST OUTLET	Max. Storage	= 70,669 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020 — Friday, 11 / 20 / 2020

Pond No. 1 - EAST OUTLET

2X36" OUTLETS WITH 48" RISERS

Pond Data

Trapezoid -Bottom L x W = 100.0 x 50.0 ft, Side slope = 3.00:1, Bottom elev. = 1892.50 ft, Depth = 5.50 ft

Stage / Storage Table

CLEAR AREA ONLY

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1892.50	5,000	0	0
0.55	1893.05	5,506	2,888	2,888
1.10	1893.60	6,034	3,172	6,060
1.65	1894.15	6,583	3,469	9,529
2.20	1894.70	7,154	3,777	13,306
2.75	1895.25	7,747	4,097	17,403
3.30	1895.80	8,362	4,429	21,832
3.85	1896.35	8,999	4,773	26,605
4.40	1896.90	9,657	5,129	31,734
4.95	1897.45	10,337	5,497	37,232
5.50	1898.00	11,039	5,877	43,109

INPUT APPROX. INVERT ELEV. AND LENGTHS TO MODEL DUAL CULVERT OUTFLOW

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	0.00	0.00	0.00
Span (in)	= 36.00	0.00	0.00	0.00
No. Barrels	= 2	0	0	0
Invert El. (ft)	= 1888.67	0.00	0.00	0.00
Length (ft)	= 125.00	0.00	0.00	0.00
Slope (%)	= 4.20	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

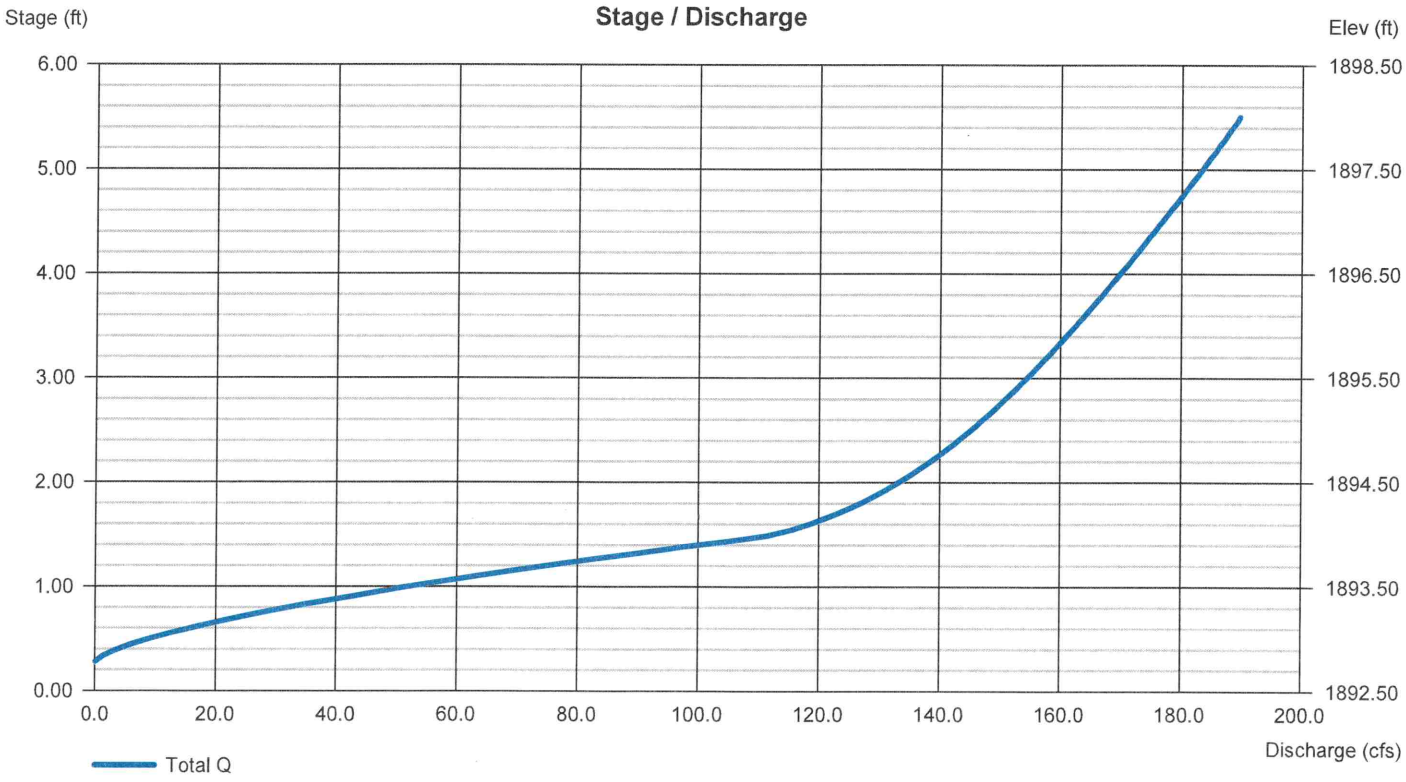
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 25.14	0.00	0.00	0.00
Crest El. (ft)	= 1892.77	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



Hydrograph Report

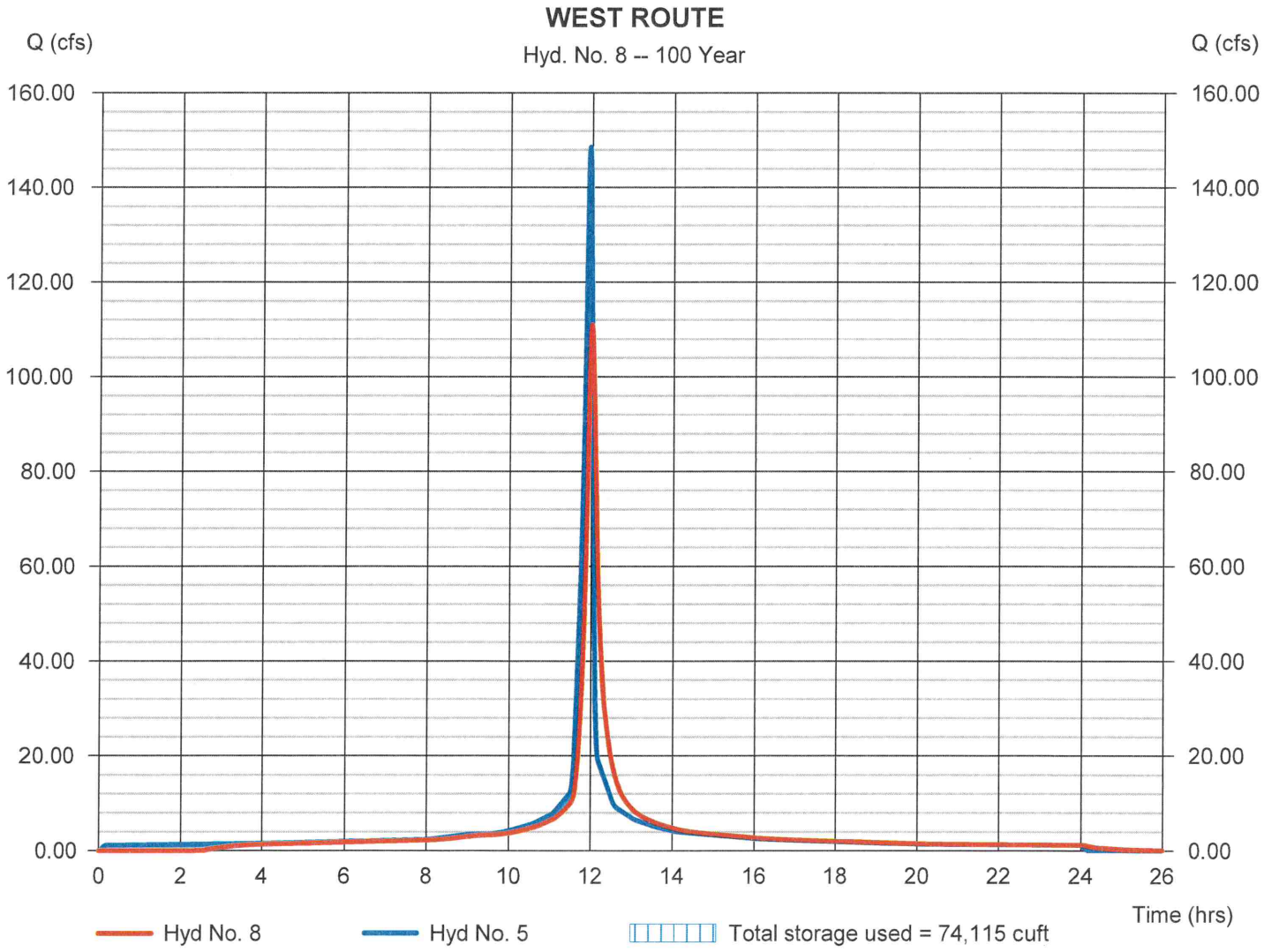
2X36" OUTLETS WITH 48" RISERS

Hyd. No. 8

WEST ROUTE

Hydrograph type	= Reservoir	Peak discharge	= 110.92 cfs
Storm frequency	= 100 yrs	Time to peak	= 12.02 hrs
Time interval	= 1 min	Hyd. volume	= 376,722 cuft
Inflow hyd. No.	= 5 - TOTAL WEST	Max. Elevation	= 1893.91 ft
Reservoir name	= WEST OUTLET	Max. Storage	= 74,115 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Friday, 11 / 20 / 2020

Pond No. 2 - WEST OUTLET

2X36" OUTLETS WITH 48" RISERS

Pond Data

Trapezoid -Bottom L x W = 100.0 x 50.0 ft, Side slope = 3.00:1, Bottom elev. = 1892.50 ft, Depth = 5.50 ft

Stage / Storage Table

CLEAR AREA ONLY

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1892.50	5,000	0	0
0.55	1893.05	5,506	2,888	2,888
1.10	1893.60	6,034	3,172	6,060
1.65	1894.15	6,583	3,469	9,529
2.20	1894.70	7,154	3,777	13,306
2.75	1895.25	7,747	4,097	17,403
3.30	1895.80	8,362	4,429	21,832
3.85	1896.35	8,999	4,773	26,605
4.40	1896.90	9,657	5,129	31,734
4.95	1897.45	10,337	5,497	37,232
5.50	1898.00	11,039	5,877	43,109

INPUT APPROX. INVERT ELEV. AND LENGTHS TO MODEL DUAL CULVERT OUTFLOW

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 36.00	Inactive	0.00	0.00
Span (in)	= 36.00	36.00	0.00	0.00
No. Barrels	= 2	1	0	0
Invert El. (ft)	= 1888.60	1888.60	0.00	0.00
Length (ft)	= 125.00	125.00	0.00	0.00
Slope (%)	= 4.48	4.48	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

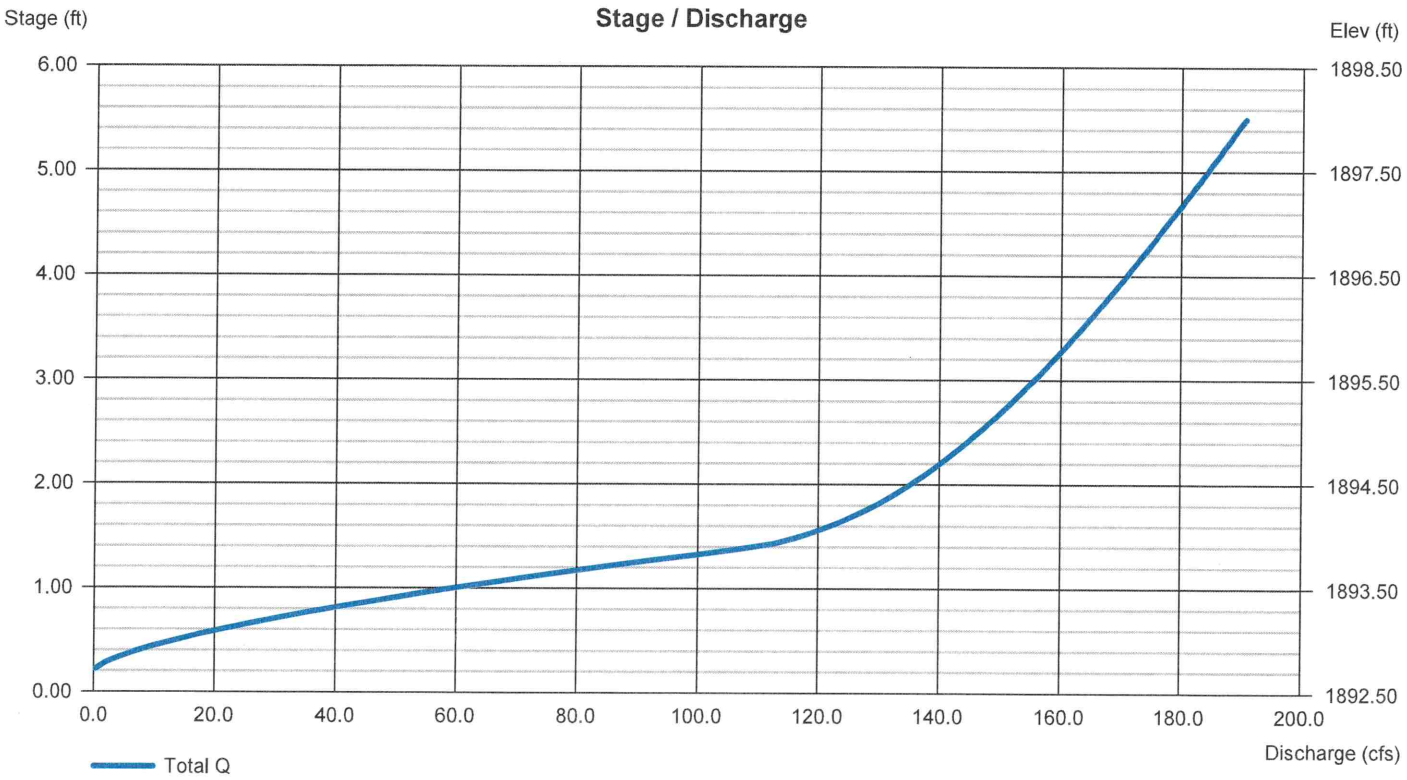
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 25.14	0.00	0.00	0.00
Crest El. (ft)	= 1892.70	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

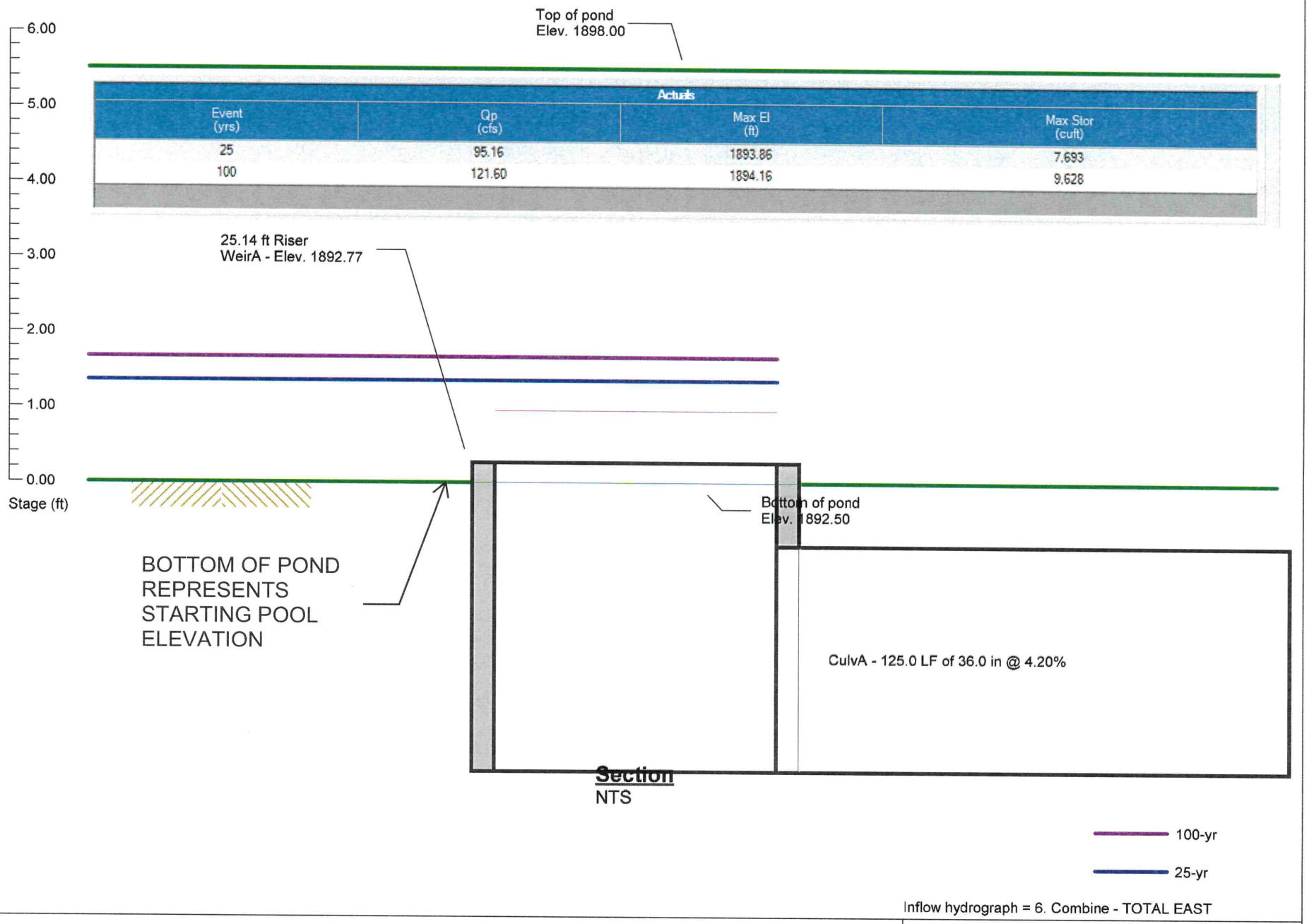
Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

Note: Culvert/Orifice outflows are analyzed under inlet (ic) and outlet (oc) control. Weir risers checked for orifice conditions (ic) and submergence (s).



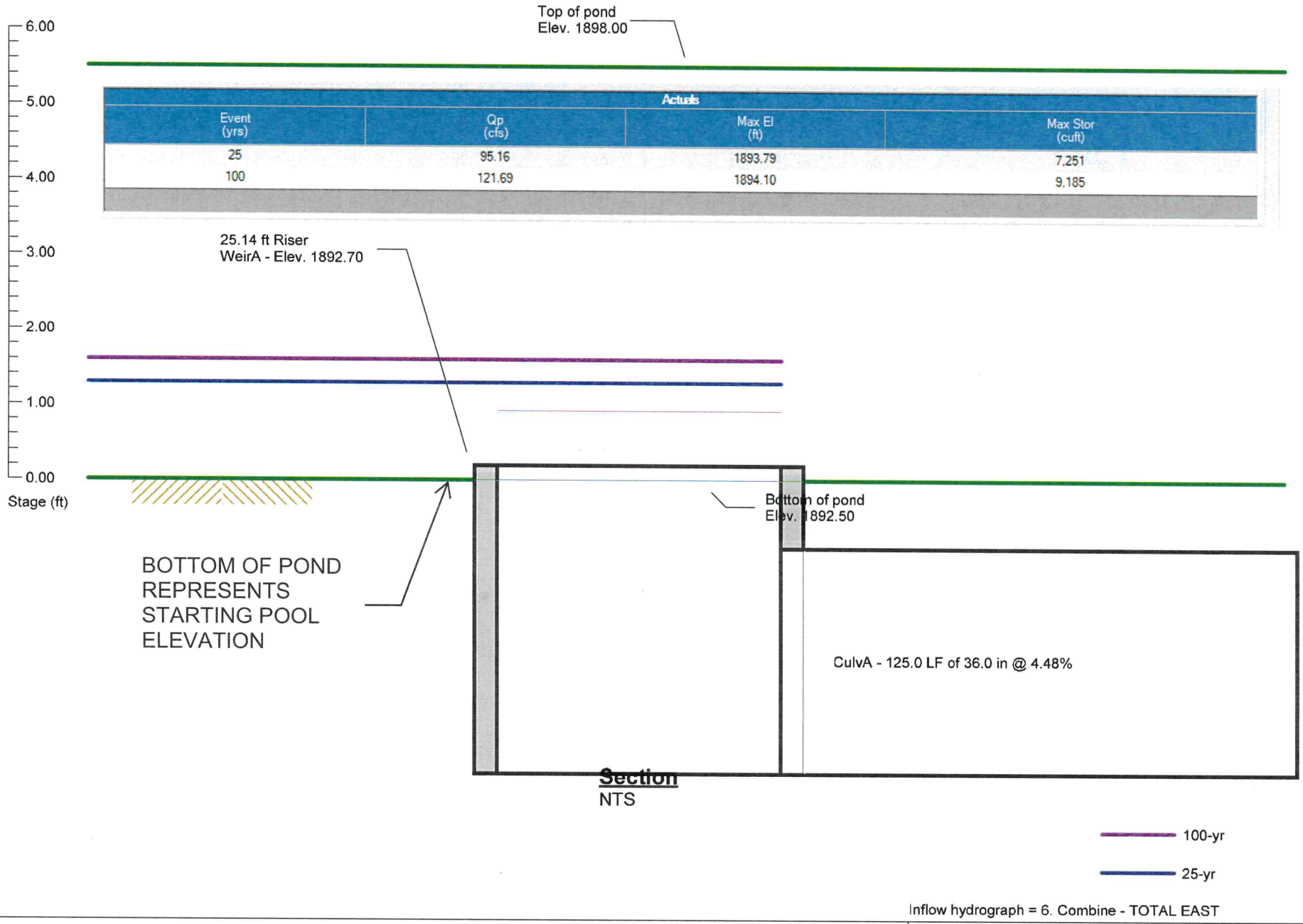
Pond No. 1 - EAST OUTLET



Actuals			
Event (yrs)	Qp (cfs)	Max El (ft)	Max Stor (cuft)
25	95.16	1893.86	7.693
100	121.60	1894.16	9.628

Inflow hydrograph = 6. Combine - TOTAL EAST

Pond No. 2 - WEST OUTLET



Actuals			
Event (yrs)	Qp (cfs)	Max El (ft)	Max Stor (cuft)
25	95.16	1893.79	7,251
100	121.69	1894.10	9,185

Inflow hydrograph = 6. Combine - TOTAL EAST

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Nov 20 2020

Circular Culvert

Invert Elev Dn (ft)	= 1883.00
Pipe Length (ft)	= 125.00
Slope (%)	= 4.00
Invert Elev Up (ft)	= 1888.00
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.019
Culvert Type	= Circular Corrugate Metal Pipe
Culvert Entrance	= Headwall
Coeff. K,M,c,Y,k	= 0.0078, 2, 0.0379, 0.69, 0.5

Max. flow for 1-culvert = 90-cfs. Max. flow for system is ~150-cfs. 2 culverts are required.

Embankment

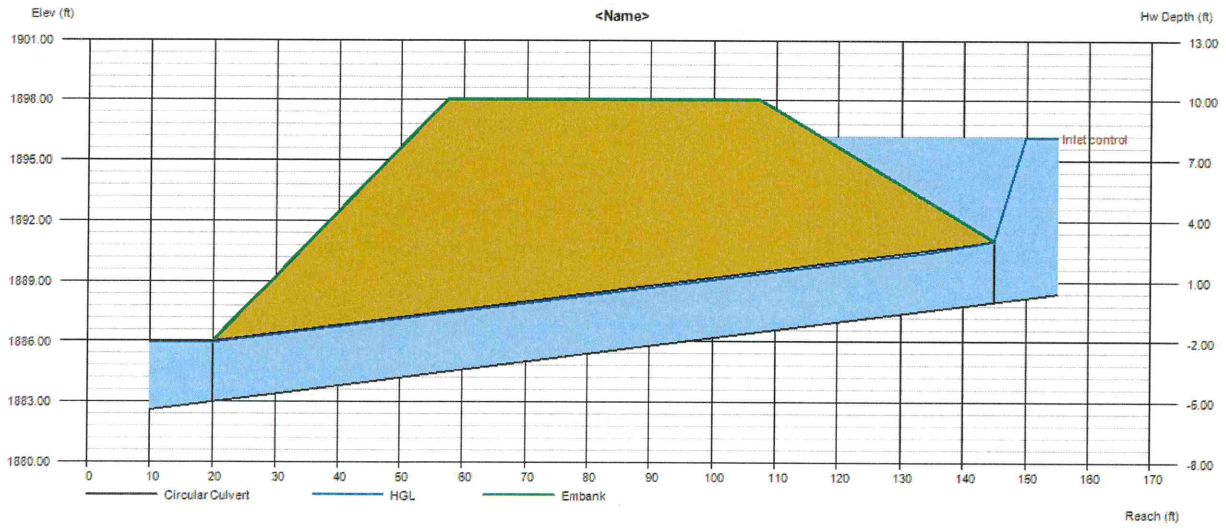
Top Elevation (ft)	= 1898.00
Top Width (ft)	= 50.00
Crest Width (ft)	= 50.00

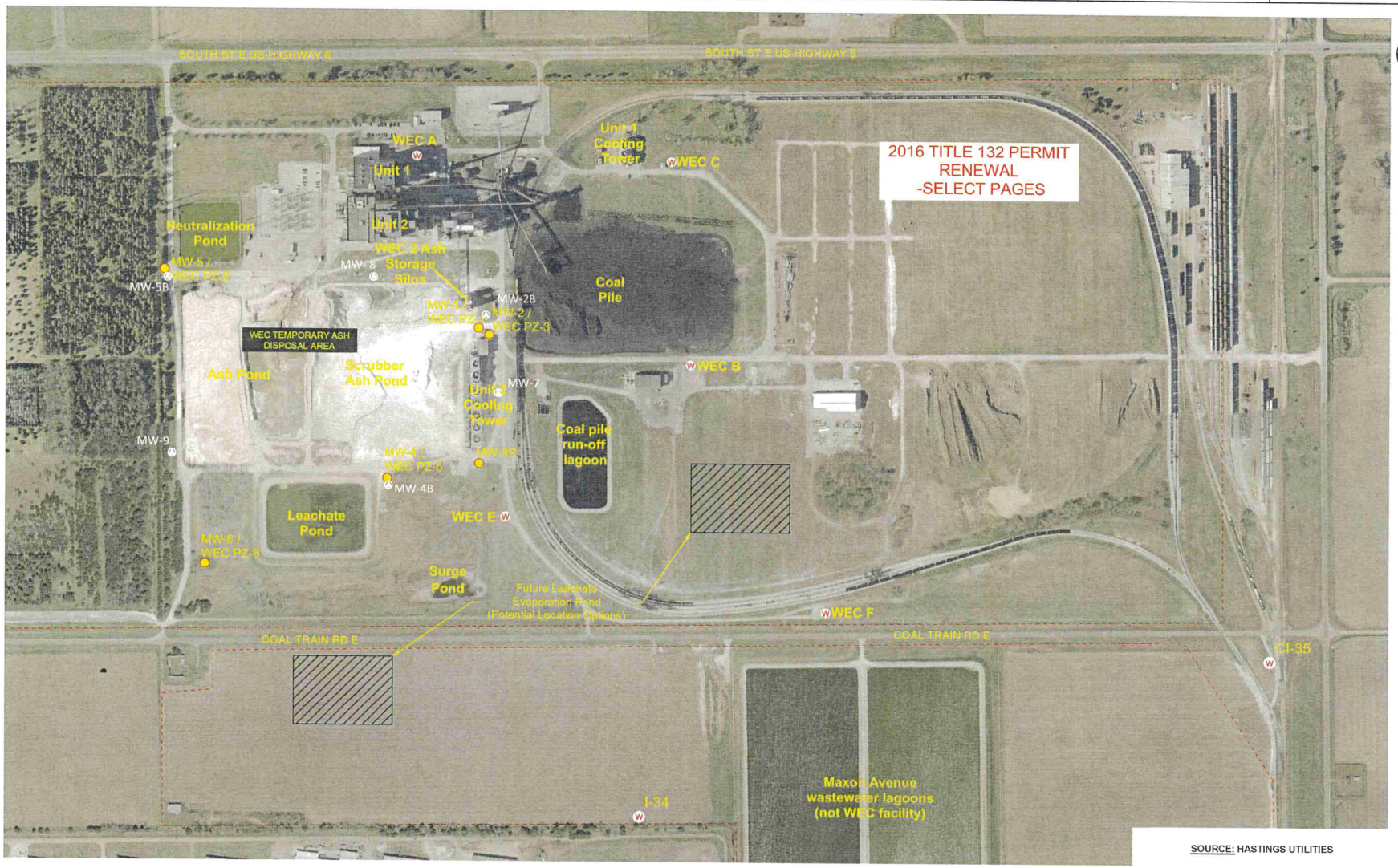
Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 110.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 90.00
Qpipe (cfs)	= 90.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 12.82
Veloc Up (ft/s)	= 12.99
HGL Dn (ft)	= 1885.92
HGL Up (ft)	= 1890.85
Hw Elev (ft)	= 1896.15
Hw/D (ft)	= 2.72
Flow Regime	= Inlet Control





SOURCE: HASTINGS UTILITIES

ISSUE	DATE	DESCRIPTION
0	10/6/2016	NDEQ TITLE 132 PERMIT RENEWAL

PROJECT MANAGER L. CALUB

PROJECT NUMBER 000000010040278

PROFESSIONAL MECHANICAL ENGINEER
LORI J. CALUB
E-9681
STATE OF NEBRASKA

PPGA public power generation agency

HASTINGS UTILITIES

GERALD T. WHELAN ENERGY CENTER
WEC TEMPORARY ASH DISPOSAL AREA

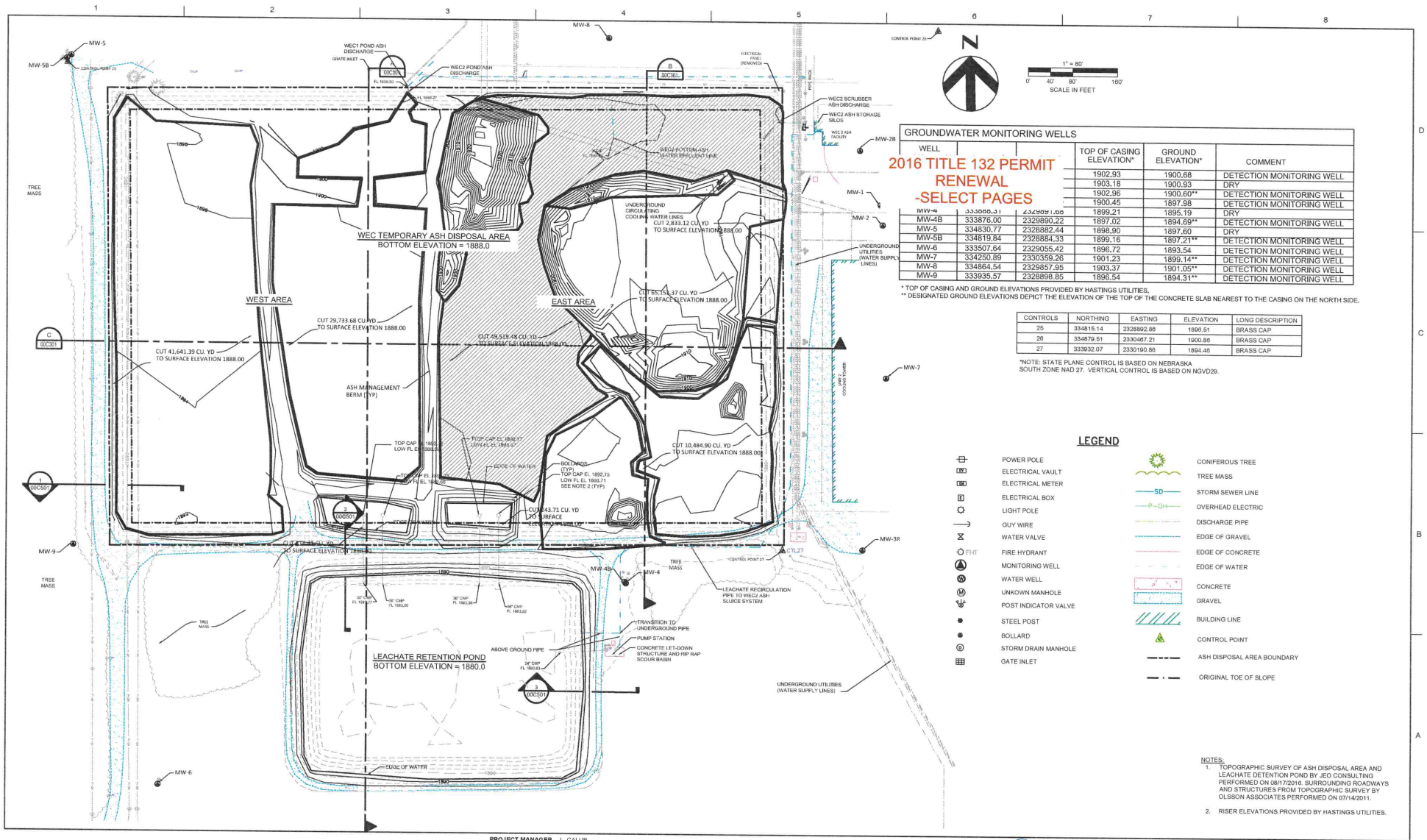
SITE PLAN

0 1" 2"

FILENAME 00C101.DWG

SCALE -

SHEET 00C101



GROUNDWATER MONITORING WELLS

2016 TITLE 132 PERMIT RENEWAL -SELECT PAGES

WELL			TOP OF CASING ELEVATION*	GROUND ELEVATION*	COMMENT
			1902.93	1900.68	DETECTION MONITORING WELL
			1903.18	1900.93	DRY
			1902.96	1900.60**	DETECTION MONITORING WELL
			1900.45	1897.98	DETECTION MONITORING WELL
MW-4	333888.31	2329891.86	1899.21	1895.19	DRY
MW-4B	333876.00	2329890.22	1897.02	1894.69**	DETECTION MONITORING WELL
MW-5	334830.77	2328882.44	1898.90	1897.60	DRY
MW-5B	334819.84	2328884.33	1899.16	1897.21**	DETECTION MONITORING WELL
MW-6	333507.64	2329055.42	1896.72	1893.54	DETECTION MONITORING WELL
MW-7	334250.89	2330359.26	1901.23	1899.14**	DETECTION MONITORING WELL
MW-8	334864.54	2329857.95	1903.37	1901.05**	DETECTION MONITORING WELL
MW-9	333935.57	2328898.85	1896.54	1894.31**	DETECTION MONITORING WELL

* TOP OF CASING AND GROUND ELEVATIONS PROVIDED BY HASTINGS UTILITIES.
** DESIGNATED GROUND ELEVATIONS DEPICT THE ELEVATION OF THE TOP OF THE CONCRETE SLAB NEAREST TO THE CASING ON THE NORTH SIDE.

CONTROLS	NORTHING	EASTING	ELEVATION	LONG DESCRIPTION
25	334815.14	2328892.86	1896.51	BRASS CAP
26	334879.51	2330467.21	1900.86	BRASS CAP
27	333932.07	2330190.86	1894.46	BRASS CAP

*NOTE: STATE PLANE CONTROL IS BASED ON NEBRASKA SOUTH ZONE NAD 27. VERTICAL CONTROL IS BASED ON NGVD29.

LEGEND

- POWER POLE
- ELECTRICAL VAULT
- ELECTRICAL METER
- ELECTRICAL BOX
- LIGHT POLE
- GUY WIRE
- WATER VALVE
- FIRE HYDRANT
- MONITORING WELL
- WATER WELL
- UNKOWN MANHOLE
- POST INDICATOR VALVE
- STEEL POST
- BOLLARD
- STORM DRAIN MANHOLE
- GATE INLET
- CONIFEROUS TREE
- TREE MASS
- STORM SEWER LINE
- OVERHEAD ELECTRIC
- DISCHARGE PIPE
- EDGE OF GRAVEL
- EDGE OF CONCRETE
- EDGE OF WATER
- CONCRETE
- GRAVEL
- BUILDING LINE
- CONTROL POINT
- ASH DISPOSAL AREA BOUNDARY
- ORIGINAL TOE OF SLOPE

NOTES:
1. TOPOGRAPHIC SURVEY OF ASH DISPOSAL AREA AND LEACHATE DETENTION POND BY JEO CONSULTING PERFORMED ON 08/17/2016. SURROUNDING ROADWAYS AND STRUCTURES FROM TOPOGRAPHIC SURVEY BY OLSSON ASSOCIATES PERFORMED ON 07/14/2011.
2. RISER ELEVATIONS PROVIDED BY HASTINGS UTILITIES.

ISSUE	DATE	DESCRIPTION
1	11/3/2016	RESPONSE TO NDEQ COMMENTS
0	10/6/2016	NDEQ TITLE 132 PERMIT RENEWAL

PROJECT MANAGER L. CALUB
PROJECT NUMBER 0000000100040278

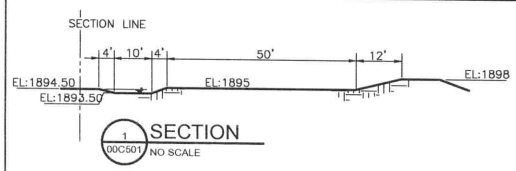
LORI J. CALUB E-9881 PROFESSIONAL MECHANICAL ENGINEER STATE OF NEBRASKA

PPGA public power generation agency
HASTINGS UTILITIES

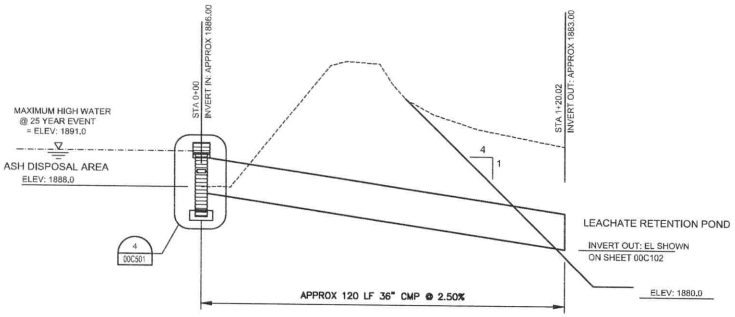
GERALD T. WHELAN ENERGY CENTER
WEC TEMPORARY ASH DISPOSAL AREA

ASH DISPOSAL AREA PLAN

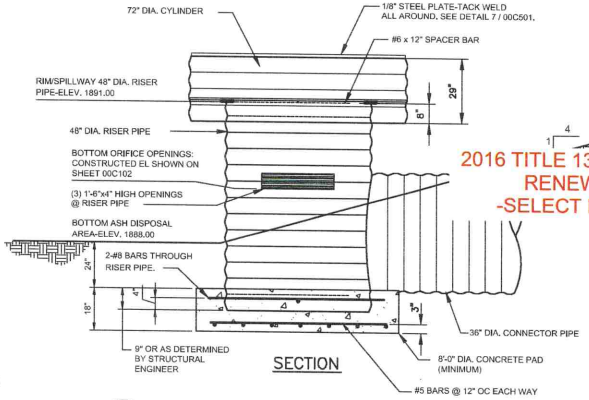
0 1" 2"
FILENAME 00C102.DWG
SCALE -
SHEET 00C102



1 00C501 SECTION
NO SCALE

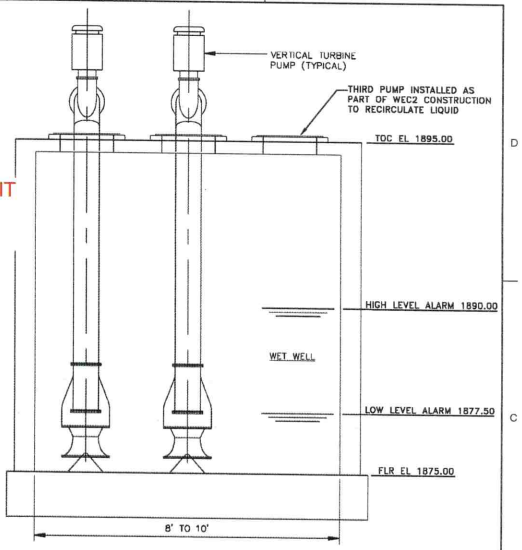


2 00C501 PIPE PROFILE @ ASH DISPOSAL AREA
HORIZONTAL SCALE: 1" = 20'
VERTICAL SCALE: 1" = 5'

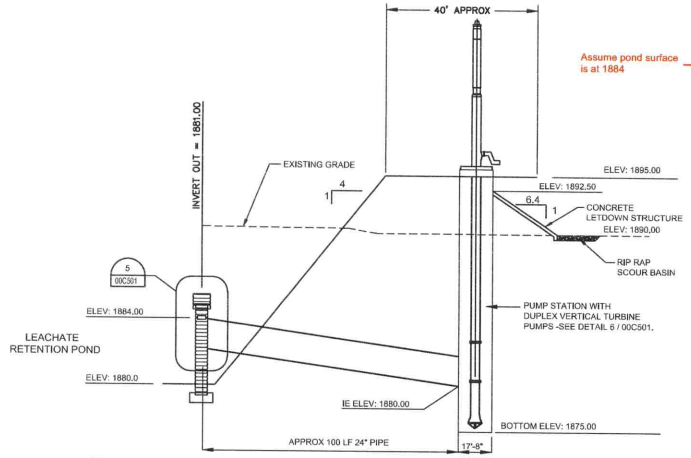


4 00C501 RISER INLET @ ASH DISPOSAL AREA
NO SCALE

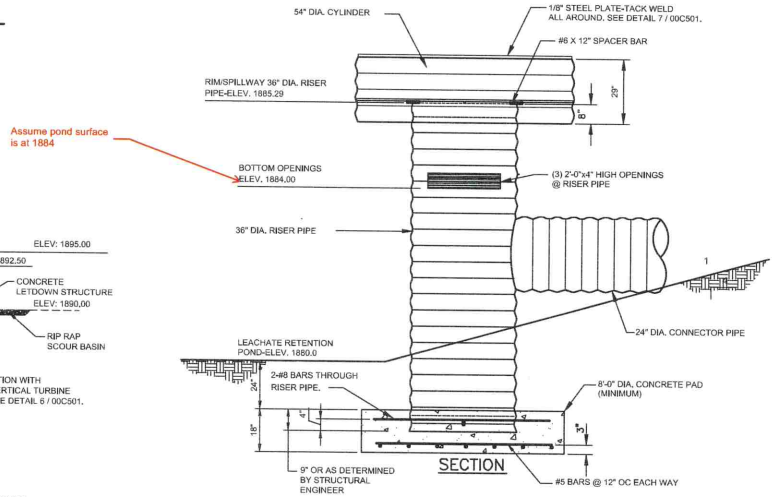
2016 TITLE 132 PERMIT
RENEWAL
-SELECT PAGES



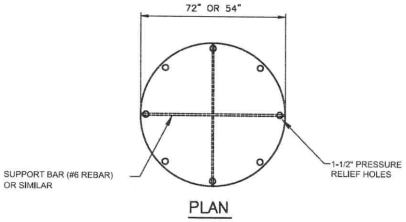
6 00C501 PUMP STATION DETAIL
NO SCALE



3 00C501 PIPE PROFILE @ LEACHATE RETENTION POND
NO SCALE



5 00C501 RISER DETAIL @ LEACHATE RETENTION PUMP
NO SCALE



7 00C501 RISER BAFFLE DETAIL
NO SCALE

HDR

ISSUE	DATE	DESCRIPTION
1	11/3/2016	RESPONSE TO NDEQ COMMENTS
0	10/6/2016	NDEQ TITLE 132 PERMIT RENEWAL

PROJECT MANAGER L. CALUB
PROJECT NUMBER 000000010040278

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STATE OF NEBRASKA

PPGA public power generation agency
HASTINGS UTILITIES

GERALD T. WHELAN ENERGY CENTER
WEC TEMPORARY ASH DISPOSAL AREA

LEACHATE MANAGEMENT DETAILS

0 1" 2"
FILENAME 00C501.DWG
SCALE AS SHOWN
SHEET 00C501

HISTORIC -SELECT PAGES

APPENDIX M
SITE DRAINAGE CALCULATIONS

A. SIZE LEACHATE RETENTION POND

1) Total Volume Quantities (process flows peak day flow on 24 hrs basis and include safety factor of 1.5)

Daily Durations (t)=	24 hrs	or	1440 min
No. Discharge Days =	1 day	or	1440 min
Factor of Safety (FS)=	1.5		
1cf =	7.48 gallons		
1 acre =	43,560 sf		
V =	FS*Q*t ac-ft		

a) Ash Sluice Water - Unit 1	Qsw =	600	gpm	Vsw=	3.98 ac-ft/day
a) Ash Sluice Water - Unit 2	Qfa =	831	gpm	Vfa=	5.51 ac-ft/day
c) Cooling Tower (1&2)	Qct =	0	gpm	Vct=	0.00 ac-ft/day
d) Scrubber Ash Sluicing - Unit 2	Qb =	534	gpm	Vb=	3.54 ac-ft/day
	Vt =	1965	gpm	Vt =	13.03 ac-ft/day

2) Size Leachate Retention Pond to completely retain 25yr, 24 hr rainfall and process flows

Total Rainfall =	4.9 in	NOAA
Evaporation =	0.15 in/day	Regional evaporation for Hastings (56 in/yr)
Vap =	10 ac-ft	Ash pond runoff = (total rainfall-evaporation)*(area of East & West Ash Ponds)
Vlr =	1.7 ac-ft	Leachate retention pond runoff =
Side Slopes	4H:1V	(total rainfall-evaporation)*(Top of Berm Area of Water Depth with +)

Leachate Retention Pond Design

		Floor			Top of Berm					
	Water Depth ft	W1 ft	L1 ft	A1 sf	W2 ft	L2 ft	A2 sf	Vrequired ac-ft	Vavailable ac-ft	Vavailable CF
	4	300	425	127,500	332	457	151,724	24.41	12.82	558,448
x	4.4	300	425	127,500	335	460	154,259	24.43	14.23	619,870
	5	300	425	127,500	364	489	177,996	24.65	17.53	763,740
	6	300	425	127,500	372	497	184,884	24.71	21.51	937,152
xx	7	300	425	127,500	380	505	191,900	24.77	25.66	1,117,900
	8	300	425	127,500	388	513	199,044	24.84	29.99	1,306,176
	9	300	425	127,500	396	521	206,316	24.90	34.49	1,502,172

1-indicates pond bottom dimensions and areas
2-indicates top of berm dimensions and areas
Vrequired = Vt + Vap + Vlr
x = pond dimensions to hold process water only.
xx = pond dimensions to hold process water and storm water.

Estimates are similar for leachate pond storage available

B. SIZE CONNECTOR PIPES (25-YEAR STORM): ASH PONDS

Rational Method; Q = CiA

1) C = Runoff Coefficient = 1.00

Q is higher for 100-yr storm

2) Tc = Time of Concentration
Since Tc ~ 0 for runoff at each Ash Pond, use Tc = 5 min.

3) Rainfall Intensity: i = 8.2 in/hour for 25 year storm event, Tc= 5 min Reference 1

4) Ash Pond (east) W=640ft H=860 ft Ae= 550,400 SF 12.64 acres
Ash Pond (west) W=640ft H=860 ft Aw= 550,400 SF 12.64 acres

5) Calculate Runoff for Tc = 5 min

	Q (cfs)	C	i(in/hr)	A (acres)
Ae	104	1	8.2	12.64
Aw	104	1	8.2	12.64

6) Maximum Daily Flows during normal operating conditions

a) Ash Sluice Water - Unit 1	Qsw =	600 gpm	1.3 cfs
b) Ash Sluice Water - Unit 2	Qfa =	831 gpm	1.9 cfs
c) Cooling Tower (1&2)	Qct =	0 gpm	0.0 cfs
d) Scrubber Ash Sluicing - Unit 2	Qb =	534 gpm	1.2 cfs
	Qt =	1965 gpm	4.4 cfs

Revised estimate is 400k GPD, 0.62-cfs

7) Determine Number of Connector Pipes to Each Pond Considering 5-minute Duration Storm

Max Q (from west pond) = Qw + Qsw + Qfa = 107 cfs
Assume number of pipes, n = 2
Qn = Q/n = 53.40 cfs
Verify Qn Provided Qn = 1.48*A*R^.67*S^.5/n A = Pipe Area
slope(S) = 0.025
mannings n = 0.024
diameter = 36 in
Qn provided = 57.28 cfs OK

Installed slope is higher

8) Size Ash Pond Spillway

Spillway to be reshaped with culvert connection

Head on Pipe Spillway (H)= Spillway crest elevation - design high water level of leachate retention pond
Spillway crest elevation = 1891.00 feet, from drawings
Design high water level of leachate retention pond = 1885.29 feet, from drawings
H = 5.71 feet

Table 2-8, ref. 4
For H = 5.71 Spillway capacity = 68.80 cfs > 53.40 cfs, OK

9) Spillway Capacity Considering Pipe length
Pipe length = 120 lf
Pipe diameter = 36 in

Table 2-8, ref. 4 Correct flow for Length of 120 lf
Correction factor from table = 0.86
So, corrected discharge capacity = 68.80 x 0.86 = 59.17 cfs
59.17 cfs > 53.40 cfs, OK

10) Determine Riser Size

Required Q = 53.40 cfs
Riser size = 48 in
From Figure 2-13, ref. 4: Max. head above the orifice crest when passing required Q = 1.2 ft
Elevation of orifice crest = 1888.67 ft, from drawings
Elevation of spillway crest = 1891.00 ft, from drawings
2.33 ft > 1.2 ft, OK

1.6-ft - OK

11) Area of Orifices Required

Asssume height (h) above crest of orifice = 2 inches = 0.17 ft

Qorifice = Cd*A*(2gh)^.5
Q= Discharge = 1/2*Qt*FS/n = 1.64 cfs per outlet pipe
Cd= Orifice Coefficient = 0.70
h = Height = 0.17 ft
g = Gravity = 32.20 ft/sec^2
A = Orifice Area = 0.72 sf
Assume 3 openings, A = 0.24 sf

Meets base flow from sluice

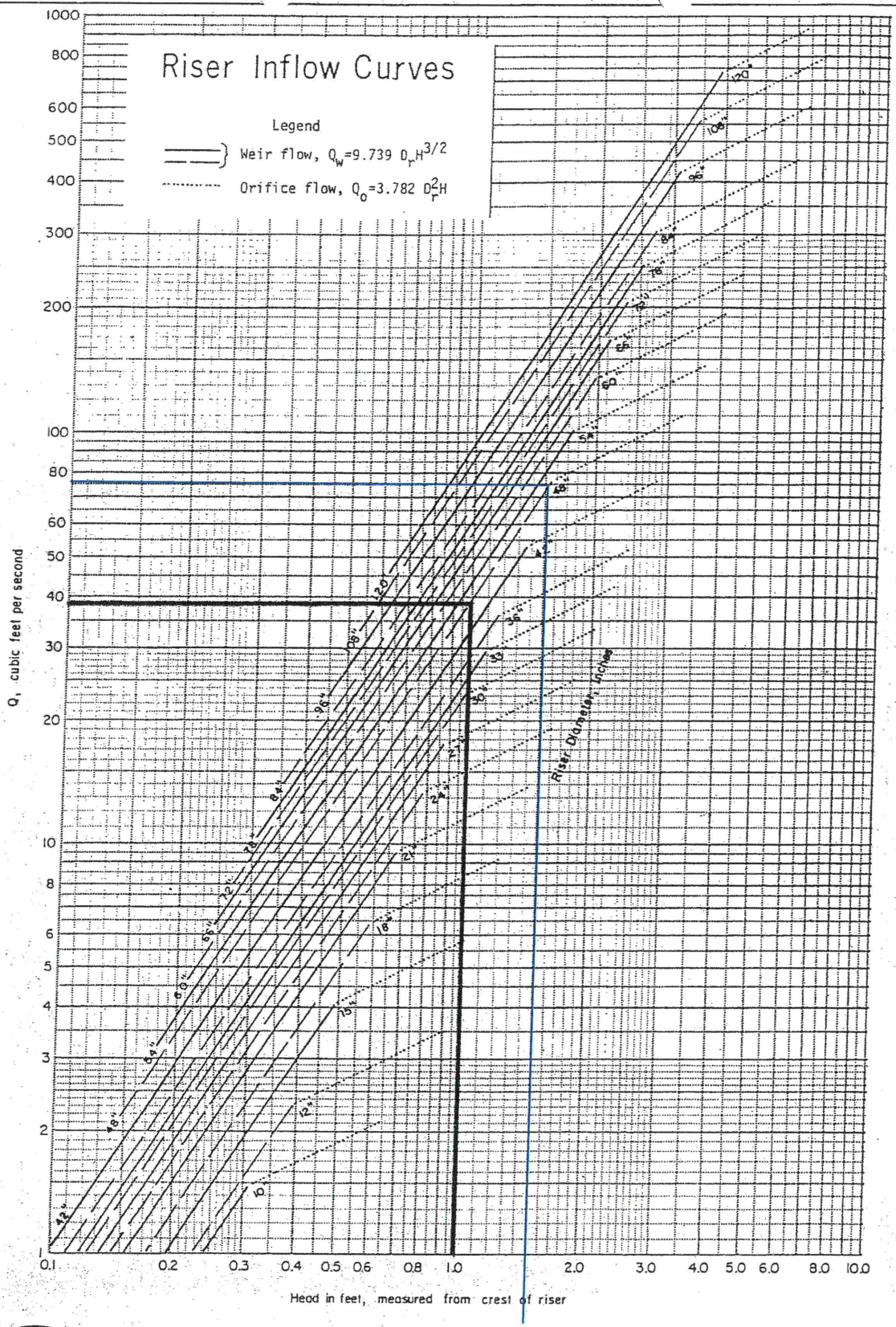
Assume orifice height = 4 inches = 0.33 ft
Orifice length = 0.72 ft

Use 3 openings 4 inch high by 1.50 ft long

12) Rise of Water in Ash Pond From 25-year 24-hour storm
From sheet 2, total rainfall from a 25-year 24-hour storm event = 4.9 in = 0.41 ft

See hydraflow output for clear areas.

Ref. 4



Source: Soil Conservation Service

Riser Inflow Curves
Sediment Basin

Date: JAN 1993

Figure: 2-13

CITY OF OMAHA

Soil Erosion and Sediment Control