SOUTHWESTERN ELECTRIC POWER COMPANY

WELSH POWER PLANT
ASH LANDFILL

Run-on and Run-off Control System Plan Update & Reissue

September 17, 2021

PREPARED BY:

MTG ENGINEERS & SURVEYORS
5930 Summerhill Road 903.838.8533 telephone
Texarkana, TX 75503 903.832.4700 facsimile
TBPE No. 354

MTG TEXAS FIRM REGISTRATION NUMBER: 354
MTG PROJECT NUMBER: 217001

WELSH POWER PLANT - ASH LANDFILL
Run-on and Run-off Control System Plan

Table of Contents

1.0 Introduction

The Welsh Power Plant has a deed recorded ash landfill (Phase 1 Landfill) that currently receives ash materials from two 528 MW coal fired boilers. The plant annually produces fly ash, bottom ash and economizer ash. Typically, bottom and economizer ash are sluiced to the Primary Ash Pond, which has been periodically dredged and temporarily stored in the Bottom Ash Storage Pond.

Welsh Units 1 and 3 were retrofitted in 2016 to capture mercury in order to comply with EPA Mercury and Air Toxics Standard (MATS) emissions regulations. Activated Carbon Injection (ACI) captures the mercury and is mixed with fly ash to form an ACI byproduct, which is captured in a Pulse Jet Fabric Filter (PJFF).

The Ash Landfill has traditionally been operated in two sections, with a portion of the landfill being primarily composed of dredged bottom ash, economizer ash, and fly ash material sluiced to the ash landfill between approximately 1986 and 2000. The western portion of the Ash Landfill is used to reclaim ash materials for beneficial reuse. Ash sales to the construction industry have helped to extend the Ash Landfill life. A contract ash marketer utilizes the western two-thirds of the Ash Landfill as a temporary storage and processing area for fly ash. The ash marketer is contracted to sell all marketable ash material for beneficial reuse in order to extend the life of the Ash Landfill.

Modifications to the Ash Landfill cap, cover and dewatering systems were incorporated into a landfill site development plan and implemented in 2016 through 2019 (two separate contract efforts). These modifications were submitted to the Texas Commission on Environmental Quality (TCEQ) Industrial Solid Waste Permits Section and each were acknowledged by same. The modifications included provisions for a minimum 3-foot thickness compacted clay cap and a minimum 1.5-foot thickness erosion/vegetative cover, in accordance with TCEQ Technical Guideline No. 3. A project was also conducted in 2017, adding the Low Water Crossing.

30 TAC 352.811 (and by reference 40 CFR 257.81) requires the owner or operator of an existing or new landfill or any lateral expansion of a landfill used for Coal Combustion Residuals (CCR) must comply with the following:

- Design, construct, operate, and maintain:
    - A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
    - A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
- Run-off from the active portion of the CCR unit must be handled in accordance with the associated surface water requirements.

- Prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the following timeframes:
    - For existing CCR landfills, the owner or operator of the CCR unit must have prepared the initial run-on and run-off control system plan no later than October 17, 2016.
    - The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans every five (5) years thereafter.
- Obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.
- Comply with the recordkeeping requirements specified in 30 TAC 352.1301, the notification requirements specified in 30 TAC 352.1311, and the Publicly Accessible Website requirements specified in 30 TAC 352.1321.

This Run-on and Run-off Control System Plan presents the regulatory-required materials as noted above for the Welsh Ash Landfill. Though design of permanent run-on and run-off control measures were prepared for the Welsh Ash Landfill in the previously submitted/approved Design Modification, this Run-on and Run-off Control System Plan addresses a combination of both interim and permanent systems which are hereafter described.

As the Welsh Ash Landfill is subsequently filled and completed, periodic updates to this Run-on and Run-off Control System Plan may be required.

2.0 Run-on Control Systems

Run-on Controls are provided and accomplished for the interim condition of the Welsh Ash Landfill by a combination of perimeter grading conditions and interim/permanent perimeter drainage systems. The design and function of these systems are as follows:

2.1 Perimeter Grading Conditions

As shown in Figure 1 – Fly Ash Storage Area Phase I (WEPX-88), the Welsh Ash Landfill was constructed with a screen dike on the entire west, north and east sides with drainage culverts located on the north and the southeast areas. A berm of minimal length was constructed on the eastern side of the south boundary. The net effect of this original construction is a perimeter grading condition that is an average of fifteen feet above the surrounding area. As a result of this perimeter grading condition and the hydraulic and hydrological conditions demonstrated in perimeter drainage systems hereafter, a run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm has been in place from the outset.

2.2 Interim & Permanent Perimeter Drainage Systems

As shown in Figure 2 – Current TCEQ NOR Site Development Plan, the future condition of the Welsh Ash Landfill provides for a perimeter drainage system consisting of varying depth perimeter drainage systems (ditches). These perimeter drainage systems are designed as both a run-on and run-off control system to prevent flow onto or away from the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm (Design Event).

In the interim condition, as shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 – Existing & Proposed Conditions - Drainage Area Map, interim/permanent perimeter drainage systems have been provided. Currently the Run-on and Run-off Control System includes permanent components of the perimeter drainage systems along a portion of the east and northeast sides of the Welsh Ash Landfill. All other perimeter drainage systems are interim. These perimeter ditches are designed to likewise prevent flow onto the active portion of the landfill during the peak discharge from the Design Event.

2.3 Summary of Design Requirements & Justifications

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system functions to control run-on for the peak discharge from a 24-hour, 25-year storm.

3.0 Run-off Control Systems

Run-off Controls are provided and accomplished for the interim condition of the Welsh Ash Landfill by a combination of perimeter grading conditions and interim/permanent perimeter drainage systems. The design, operation and maintenance of these perimeter drainage systems provide for conveyance of all 24-hour, 25-year storm run-off from within the Welsh Landfill to the Primary Bottom Ash Pond, a management unit designed to accommodate these flows and other process discharges from the Welsh Power Plant. The design and function of these systems are as summarized follows:

3.1 Perimeter Grading Conditions

As previously noted, the original construction resulted in a perimeter grading condition that is an average of fifteen feet above the surrounding area. As a result of this perimeter grading condition and the hydraulic and hydrological conditions demonstrated in perimeter drainage systems hereafter, an uncontrolled run-off control system is in place to prevent flow away from the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.

3.2 Interim Top Slope Diversion Berms and Swales

Due to proximity to interim perimeter drainage systems, Drainage Areas CDA 01, CDA 02, CDA 03, CDA 04, and CDA 05 currently require drainage swales in conjunction with berms, dikes or other top slope diversions to ensure contact runoff is managed within the landfill. As shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 – Existing & Proposed Conditions - Drainage Area Map, these drainage features are configured with the purpose of preventing run-off from the adjacent perimeter drainage areas during a 24-hour, 25-year storm event.

3.3 Permanent Side Slope Terraces and Letdowns

Currently the Run-on and Run-off Control System includes earthen side slope terraces and letdowns along a portion of the east and northeast sides of the Welsh Ash Landfill. The future side slopes of the landfill will extend at a 3H:1V slope to a height of approximately 75-feet above the flowline of the permanent perimeter drainage systems (ditch). These systems or similar will be extended as the landfill continues to fill.

In accordance with Figure 2 – Current TCEQ NOR Site Development Plan and associated design, these terraces and letdowns are designed and implemented as run-off control systems to accommodate runoff from a 24-hour, 25-year storm (Design Event), when needed.

3.4 Interim and Permanent Perimeter Drainage Systems

As shown in Figure 2 – Current TCEQ NOR Site Development Plan, the future condition of the Welsh Ash Landfill provides for a perimeter drainage system consisting of varying depth perimeter drainage systems (ditches). These perimeter ditches are designed as both a run-on and run-off control system to prevent flow onto or away from the active portion of the landfill during the peak discharge from a 24-hour, 25-year storm (Design Event).

In the interim condition, as shown in Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography) and the associated Figure 4 – Existing & Proposed Conditions - Drainage Area Map, some of these perimeter drainage systems (ditches) have been provided. Currently the Run-on and Run-off Control System includes permanent components of the perimeter drainage systems along a portion of the north and east sides of the Welsh Ash Landfill. All other perimeter drainage systems are interim. These perimeter ditches are designed to likewise prevent flow onto the active portion of the landfill during the peak discharge from the Design Event.

3.5 Interim and Permanent Culvert Systems

3.5.1 Interim. Driveway crossings are implemented around the perimeter drainage system on an as-needed basis. These crossings are considered interim; however, are sized for run-on and run-off control for the Design Event.

3.5.2 Permanent Culvert Systems, designed to control run-on and run-off equal to or greater than the 24-hour, 25-year design storm event and conveying same to the Primary Bottom Ash Pond, are currently in place as follows:

- Two HDPE culverts, one 30-inches in diameter and one 36-inches in diameter, in the perimeter ditch at the northeast corner of the Welsh Ash Landfill;
- Two 30-inch diameter HDPE culverts in the perimeter ditch at the northwest corner of the Welsh Ash Landfill; and
- A series of three 30-inch diameter HDPE culverts collecting and discharging stormwater runoff from within the landfill at the original “Culvert Number 2” (shown as 2a, 2b, and 2c) location (future landfill leachate collection sump).

3.6 Permanent Low Water Crossing System

The run-on and run-off designs provide for run-off to be routed south via a low water crossing. This low water crossing is comprised of a textured reinforced concrete trapezoidal broadcrest section, 10-feet wide by 2.76’ deep with 12H:1V side slopes and a -1.1% slope along the flowline. The crossing is sized and configured for in excess of the 24-hour, 25-year storm event for future landfill sideslope, terraces and letdowns.

At present, this low water crossing is blocked by perimeter berms to ensure that contact stormwater is routed to the Culvert Number 2 (shown as 2a, 2b, & 2c) location for discharge.

3.7 Summary of Design Requirements and Justifications

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system function to control run-off for the peak discharge from a 24-hour, 25-year storm.

4.0 Summary of Requirements, Justifications and Conclusions

As previously stated,30 TAC 352.811 (and by reference Federal Regulation Title 40, Part 257.81) requires the owner or operator of an existing or new landfill or any lateral expansion of a landfill used for Coal Combustion Residuals (CCR) to comply with design, construction, operation, maintenance, certification and recordkeeping requirements that are summarized as follows:

- Design, construct, operate, and maintain:
    - A run-on control system to prevent flow onto the active portion of the CCR unit during the peak discharge from a 24-hour, 25-year storm.
    - A run-off control system from the active portion of the CCR unit to collect and control at least the water volume resulting from a 24-hour, 25-year storm.
- Run-off from the active portion of the CCR unit must be handled in accordance with the surface water requirements under 30 TAC 352.2.
- Prepare initial and periodic run-on and run-off control system plans for the CCR unit according to the following timeframes:
    - For existing CCR landfills, the owner or operator of the CCR unit must have prepared the initial run-on and run-off control system plan no later than October 17, 2016.
    - The owner or operator of the CCR unit must prepare periodic run-on and run-off control system plans every five (5) years thereafter.
- Obtain a certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of this section.
- Comply with the recordkeeping requirements specified in 30 TAC 352.1310, the notification requirements specified in 30 TAC 352.1311, and the Publicly Accessible Website requirements specified in 30 TAC 352.1321.

Both Table 1 – Drainage Area Summaries and Table 2 – Q25 Run-on and Run-off Analysis Justifications (and supporting design calculations), as contained in Appendix 2, provide a summary of hydraulic and hydrologic capacity of the interim run-on/run-off control system. These analyses demonstrate that, in all instances, the currently implemented (and maintained) drainage system functions to control both run-off and run-on for the peak discharge from a 24-hour, 25-year storm.

5.0 Plan Review and Changes in Welsh Ash Landfill Configuration

Landfill Owner and/or Operator will review and evaluate this Plan every five (5) years from initial plan preparation and when there are changes in the facility design, construction, operation, or maintenance that materially affect the facility's potential for run-on and run-off control. Amendments to the Plan made to address changes of this nature are referred to as technical or major amendments and must be certified by a Professional Engineer. Non-technical amendments can be performed by the Facility Owner and/or Operator. Non-technical amendments include the following:

Technical and administrative amendments to the Plan will be documented on the Plan Review Log. Owner/Operator will make the necessary revisions to the Plan as soon as possible, but no later than six months after the change occurs. The Plan must be implemented as soon as possible following a technical amendment, but no later than six months from the date of the amendment. The Designated Person is responsible for initiating and coordinating revisions to the Spill Prevention, Control, and Countermeasure (SPCC) Plan.

Scheduled reviews and Plan amendments will be recorded in the Plan Review Log provided in Appendix 3. The log will be completed even if no amendment is made to the Plan as a result of the review.

6.0 Professional Engineer Certification

The original plan and all reviews and amended plans must obtain certification from a qualified professional engineer stating that the initial and periodic run-on and run-off control system plans meet the requirements of TAC 352.811 (and by reference 40 CFR 257.81). This certification in no way relieves the owner or operator of the facility of his/her duty to fully implement this Plan. The Professional Engineer Certification page is provided in Appendix 4.

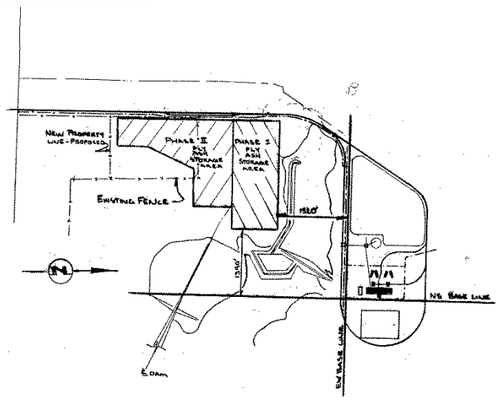
Appendix 1: Figures

Figure 1 – Fly Ash Storage Area Phase I (WEPX-88)

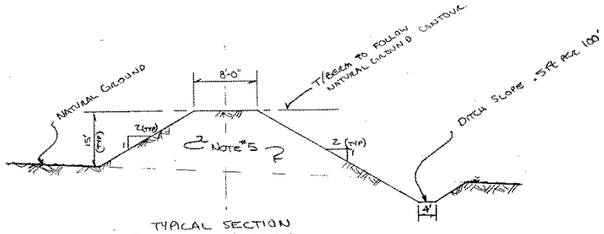
Figure 2 – Current TCEQ NOR Site Development Plan

Figure 3 – Composite Existing Conditions (Merged Field & LiDAR Topography)

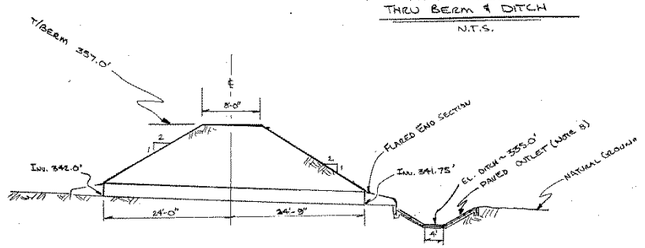
Figure 4 – Existing & Proposed Conditions - Drainage Area Map



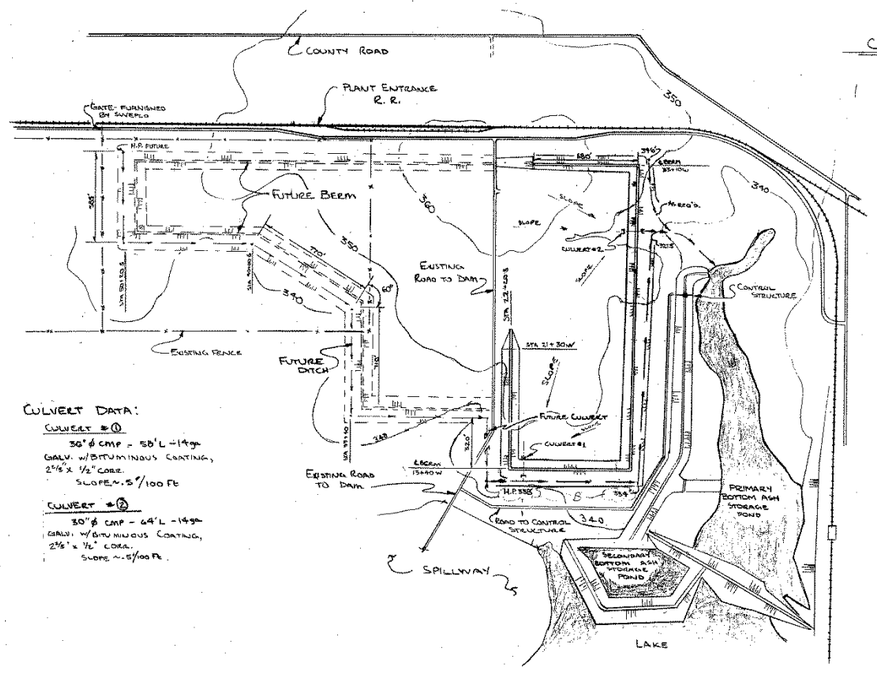
PLAN



TYPICAL SECTION
THRU BERM & DITCH
N.T.S.



SECTION THRU
CULVERT # 1
N.T.S.

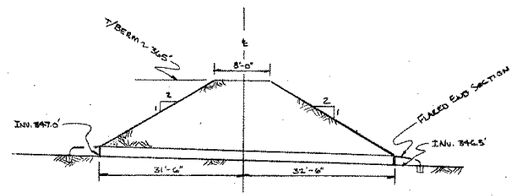


CULVERT DATA:

CULVERT #①
30" ϕ CMP - 58'L - 14ga
GALV. w/BITUMINOUS COATING,
2⅔" x ½" CORR.
SLOPE ~.5'/100 Ft

CULVERT #②
30" ϕ CMP - 64'L - 14ga
GALV. w/BITUMINOUS COATING,
2⅔" x ½" CORR.
SLOPE ~.5'/100 Ft.

ENLARGED PLAN
1" = 400'



SECTION THRU
CULVERT # 2
N.T.S.

NOTES:

1) PHASE I FLY ASH STORAGE AREA CONSTRUCTION WILL INCLUDE CONSTRUCTION OF BERM AND DRAINAGE DITCH AS SHOWN ON THIS DRAWING. NO WORK WILL BE DONE AT THIS TIME ON PHASE II.
2) ENTIRE AREA UNDER BERM SHALL BE STRIPPED, GRUBBED AND ALL UNSUITABLE MATERIAL ENCOUNTERED SHALL BE WASTED IN SECIFIED AREAS.
3) ALL TOPSOIL SHALL BE STOCKPILED AS DIRECTED BY FIELD ENGINEERS.
4) EMBANKMENT SHALL BE CONSTRUCTED FROM SUITABLE MATERIAL EXCAVATED FROM DITCH CONSTRUCTION AND FROM WITHIN STORAGE AREA.
5) EMBANKMENT SHALL BE 90% MODIFIED PROCTOR COMPACTION IN ACCORDANCE W/ S&L STD. 1714.
6) ALL SLOPES SHALL BE TOPSOILED AND SEEDED UPON COMPLETION OF WORK.
7) CULVERTS SHALL BE FURNISHED AND INSTALLED BY EARTHWORK CONTRACTOR. BEDDING AND BACKFILLING SHALL BE IN ACCORDANCE WITH MANUFACTURERS SPECS.
8) OUTLET OF CULVERT #1 SHALL HAVE CONCRETE SLOPE PROTECTION OF 4" SLAB W/6" x 6" #6 MESH. BANKS OF DITCH SHALL BE PAVED FOR 10FT EITHER SIDE OF CULVERT #1.

EXHIBIT A

REV.	DATE	BY	SUBJECT
B	1/8/77	AM	CHAN. EXTENSION, ADD CULVERT #2, REVISE CONTOURS PER ENGINEER.
A	9/1/76	AM	REVISE DITCH WIDTH TO 4'
	8/6/76	AM	FOR CONSTRUCTION

WELSH POWER PLANT - UNIT 1
FLY ASH STORAGE AREA
PHASE I

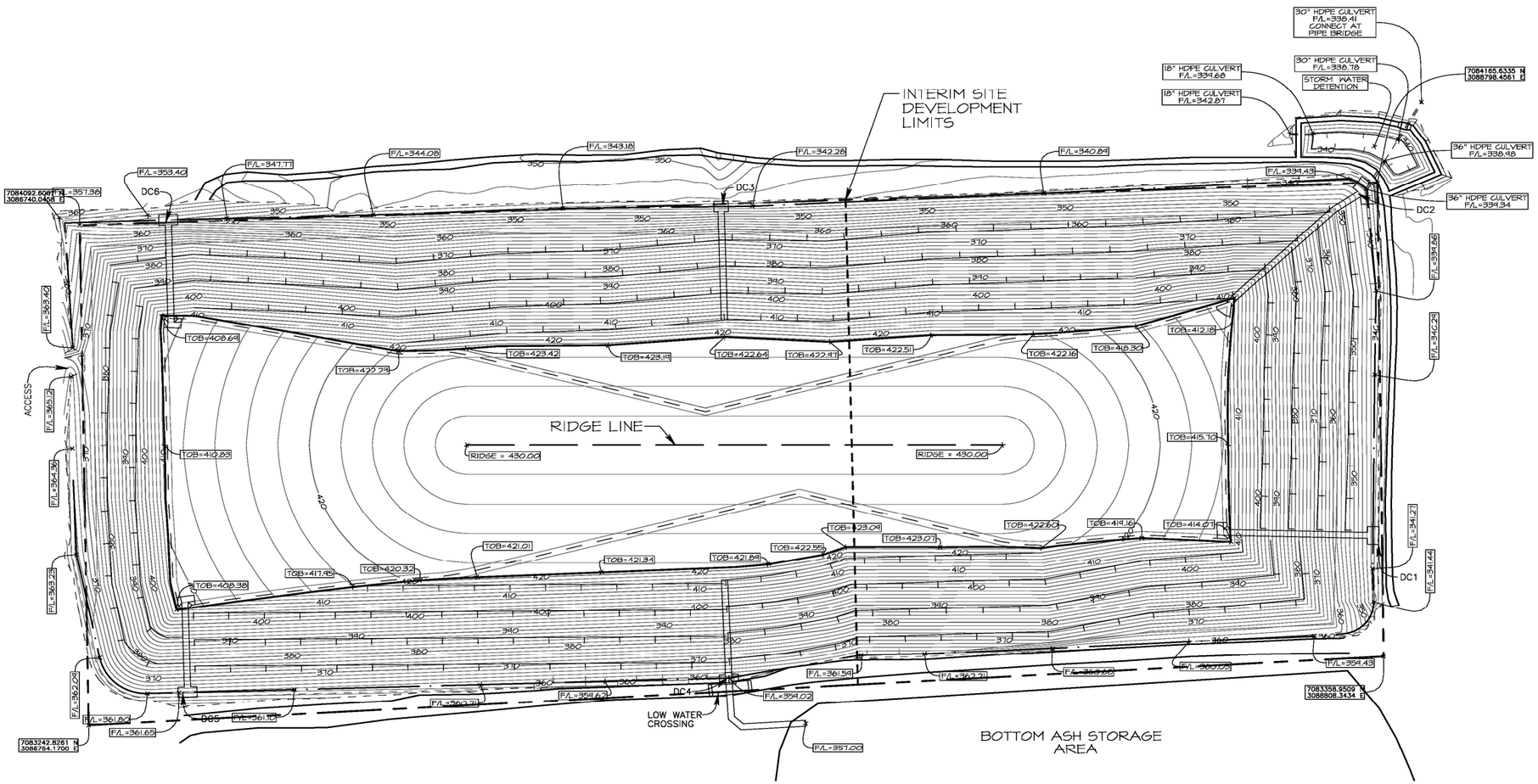
SOUTHWESTERN ELECTRIC POWER CO.
POWER CONSTRUCTION DEPARTMENT
DIVISION

APPROVED ENGR. IN CHARGE
APPROVED DIV. SUPT.
APPROVED CHIEF ENGR.

SHEET
DRWN. BY MELSON
TRAC. BY
DATE: 12-8-76
SCALE: As Noted
WORK ORDER
DRWG NO. WEPX-88

FILE

Figure 1- Fly Ash Storage Area Phase I (WEPX-88)



STATE OF TEXAS
ROBERT H. MURRAY
59111
REGISTERED PROFESSIONAL ENGINEER

THE SEAL APPEARING ON THIS DOCUMENT WAS AUTHORIZED BY ROBERT H. MURRAY, P.E. NO. 59111 ON MARCH 2, 2016

ISSUED FOR REGISTRATION PURPOSES ONLY

MTG engineers & surveyors
5430 SUMMERHILL RD. | P.O. BOX 3786
TEXARKANA, TEXAS 75501
P 903.838.8533 | F 903.832.4700
www.mtgengineers.com
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MTG Project #: MTG File #:

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

SITE DEVELOPMENT PLAN - FINAL

SWEPCO WELSH POWER PLANT DESIGN MODIFICATIONS TO FLY ASH STORAGE AREA

UNIT:	DRAWING NUMBER: 1-30202 REV:
SCALE:	
DR:	AS GRAPHED
CH:	
SUP:	
ENG:	
DATE:	

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

X:\2015 Projects\157003 AEP Ash Landfill Project\05 Engineering Design\Design\157003_EOTA.pro
Tue Sep 6, 2016 2:18PM

Figure 2 - Current TCEQ NOR Site Development Plan

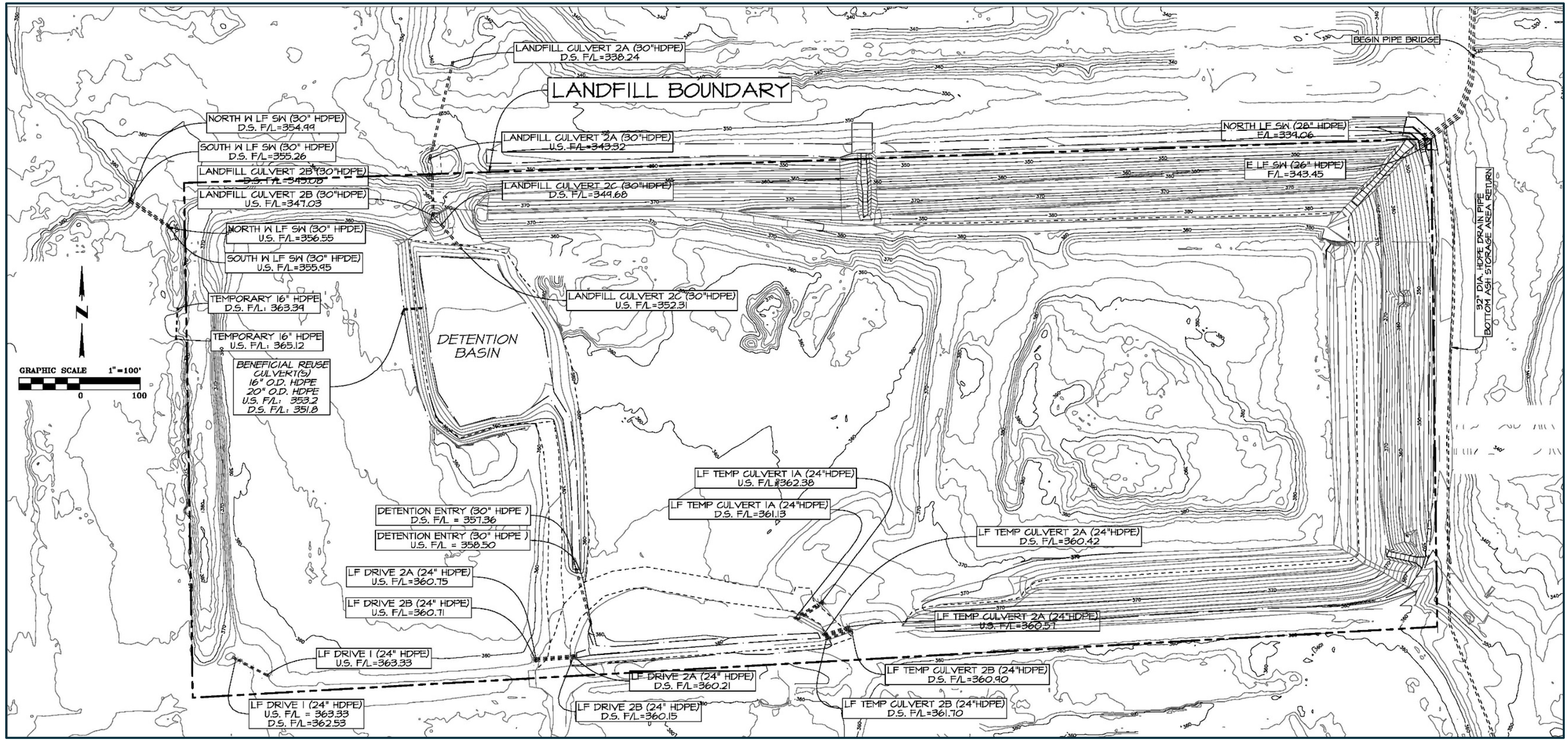

Figure 3 - Composite Existing Conditions (Merged Field & LiDAR Topography)

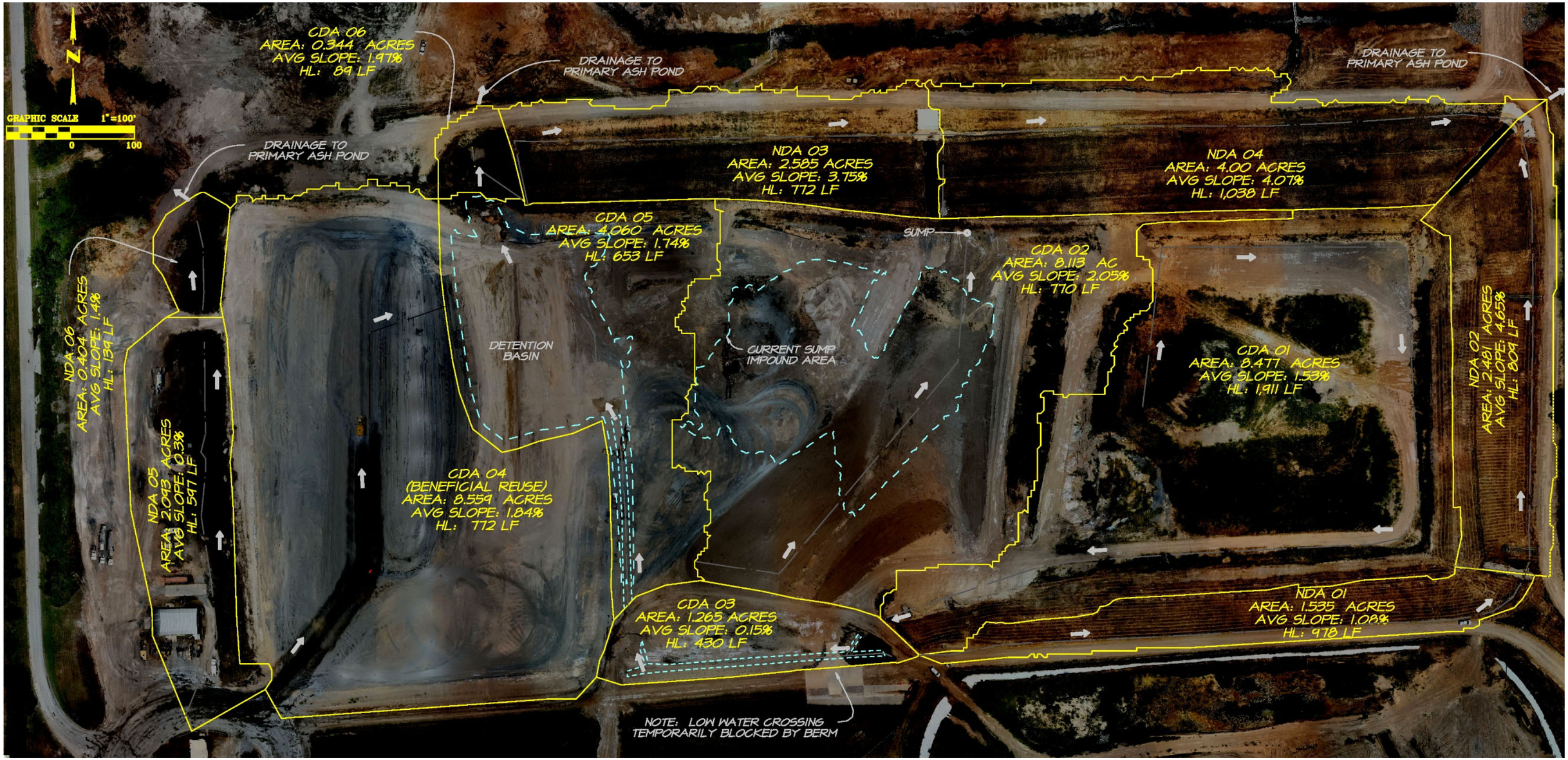

Figure 4 – Existing & Proposed Conditions - Drainage Area Map

Appendix 2: Tables

Table 1 – Drainage Area Summaries

Table 2 – Q25 Run-on and Run-off Analysis Justifications

DRAINAGE AREA SUMMARIES

DRAINAGE AREA ID	DISCHARGE STATUS	DRAINAGE AREA LOCATION	AREA (ACRES)	SLOPE (%)	HYDRAULIC LENGTH (FEET)	RATIONAL C FACTOR	CALCULATED TC (MIN)	USED TC (MIN)
CDA 01	CONTACT	LANDFILL INTERIOR	8.477	1.53%	1911	0.40	13.00	13.00
CDA 02 *	CONTACT	LANDFILL INTERIOR	8.113	2.05%	770	0.50	5.85	10.00
CDA 03	CONTACT	LANDFILL INTERIOR	1.265	0.15%	430	0.50	10.74	11.00
CDA 04	CONTACT	LANDFILL INTERIOR	8.559	1.84%	772	0.50	6.08	10.00
CDA 05 **	CONTACT	LANDFILL INTERIOR	4.060	1.74%	653	0.50	5.76	10.00
CDA 06	CONTACT	LANDFILL INTERIOR	0.344	1.97%	89	0.75	1.12	10.00
NDA 01	NON-CONTACT	LANDFILL PERIMETER DITCH	1.535	1.08%	978	0.50	8.95	10.00
NDA 02	NON-CONTACT	LANDFILL PERIMETER DITCH	2.481	4.65%	809	0.50	4.41	10.00
NDA 03	NON-CONTACT	LANDFILL PERIMETER DITCH	2.585	3.75%	772	0.50	4.32	10.00
NDA 04	NON-CONTACT	LANDFILL PERIMETER DITCH	4.000	4.07%	1038	0.50	5.62	10.00
NDA 05	NON-CONTACT	LANDFILL PERIMETER DITCH	2.093	0.30%	597	0.40	10.02	10.00
NDA 06	NON-CONTACT	LANDFILL PERIMETER DITCH	0.404	1.40%	139	0.40	1.80	10.00

** Q25 DISCHARGE IS BY LEACHATE COLLECTION SUMP PUMP AT 30 GPM (0.08027 CFS)*

*** DISCHARGE FROM CDA 05 IS VIA A TEMPORARY STORMWATER DETENTION BASIN WITH A 30-INCH DIAMETER HDPE OUTLET CULVERT*

Table 1 – Drainage Area Summaries

Q-25 RUN-ON/RUN-OFF ANALYSIS JUSTIFICATIONS

ANALYSIS ID	JUSTIFICATION ANALYSIS DRAINAGE AREAS INCLUDED	DRAINAGE STATUS	ANALYSIS TYPE	ANALYSIS AREA (ACRES)	ANALYSIS SLOPE (%)	BASIN SLOPE (%)	HYDRAULIC LENGTH (FEET)	ANALYSIS C FACTOR	ANALYSIS TC (MIN)	REQUIRED Q25 CAPACITY (CFS)	ANALYSIS JUSTIFICATION CONFIGURATION	AVAILABLE DEPTH (FT)	ANALYSIS DEPTH (FT)
INTERNAL CONTACT DRAINAGE AREAS													
I-01	CDA 01	CONTACT	TWO 24" HDPE CULVERTS	8.477	0.86%	1.53%	1911	0.40	13.00	27.09	TWO 52-FT LONG X 24" DIA HDPE CULVERTS	4.90	4.19
I-02	CDA 02 (LEACHATE COLLECTION AREA)	CONTACT	DRAINAGE CAPTURED & REMOVED BY SUMP PUMP	8.113	2.05%	2.05%	770	0.50	10.00	36.27	AREA RETAINS Q-25 RUNOFF VIA DETENTION PEAK Q = 0.07 CFS	2.38	1.93
I-03	CDA 01 & CDA 03	CONTACT	TRAPEZOIDAL CHANNEL, 3:1 SIDES	9.742	0.15%	1.35%	2341	0.41	23.74	23.32	0.15% 10-FT CHANNEL, 3:1 Sides, 1.5-FT DEEP	1.50	0.54
	CDA 01 & CDA 03	CONTACT	TWO 60'X24" HDPE CULVERTS	9.742	2.33%	1.35%	2341	0.41	23.74	23.32	70-FT LONG X 30" DIA HDPE CULVERT	8.80	2.51
I-04	CDA 04	CONTACT	TWO 32'X16" HDPE CULVERTS	8.559	4.37%	1.84%	772	0.50	10.00	38.26	TWO 32-FT LONG X 16" DIA HDPE CULVERTS *	6.22	6.92
I-05	DETENTION - AREAS CDA 1, 3, 4 & 5	CONTACT	DETENTION BASIN T0 SERIES OF HDPE PIPES	22.361	4.35%	1.26%	2994	0.57	20.00	82.21	SERIES - TWO 30" HDPE CULVERTS - PEAK Q = 34.74 CFS	8.00	3.29
I-06	DETENTION I-05 DISCHARGE	CONTACT	32'X32" HDPE CULVERT	22.705	0.40%	1.26%	3083	0.57	N/A	34.74	USE I-05 DETENTION PEAK DISCHARGE	8.00	3.27
PERIMETER NON-CONTACT DRAINAGE AREAS													
P-01	NDA 01	NON-CONTACT	V-DITCH, 3:1 SIDES	1.535	0.30%	1.97%	978	0.50	10.00	6.9	0.3% V-DITCH, 3:1 SIDES, 1.78-FEET DEPTH	1.80	1.13
P-02	NDA 01 & NDA 02	NON-CONTACT	5' CHANNEL, 3:1 SIDES	4.016	0.30%	3.29%	1787	0.50	10.00	17.97	0.3% - V-DITCH, 3:1 SIDES, 4-FEET DEPTH	4.00	1.63
P-03	NDA 03	NON-CONTACT	20' CHANNEL, 3:1 SIDES	2.585	0.30%	10.05%	772	0.50	10.00	11.56	0.3% - 20' CHANNEL, 3:1 SIDES, 7.5-FEET DEPTH	7.70	0.39
P-04	NDA 03 & NDA 04	NON-CONTACT	15' CHANNEL, 3:1 SIDES	6.585	0.30%	3.94%	1810	0.50	10.00	29.46	0.3% - 15' CHANNEL, 3:1 SIDES, 6.5-FEET DEPTH	6.50	0.80
P-02 & P04	DETENTION - AREAS NDA 01, 02,03 & 04	NON-CONTACT	426'X26" HDPE, U.S. 343.45, D.S. 335.48	10.601	1.87%	3.69%	1810	0.5	10.00	47.38	426'X26' HDPE @ 1.887% (COMBINED MAX Q = 38.49 CFS)	4.05	N/A
		NON-CONTACT	587'X28" HDPE, U.S. 339.06, D.S. 333.87		0.88%						587X28' HDPE @ 0.88%	8.44	2.42
P-05	NDA 05	NON-CONTACT	.3% V-DITCH, 3:1 L & 4:1R SIDES	2.093	3.46%	0.30%	597	0.4	10.00	7.49	.3% V-DITCH, 3:1 L & 4:1R SIDES	4.60	1.10
			50'X16" TEMP HDPE, U.S.365.12, D.S. 363.39								50'X16" TEMP HDPE @ 3.46%	6.72	1.92
P-06	NDA 05 & NDA 06	NON-CONTACT	.3% V-DITCH, 3:1 L & 3:1R SIDES	2.497	1.19%	1.19%	736	0.40	10.00	8.94	.3% V-DITCH, 3:1 L & 3:1R SIDES	1.92	1.73
			TWO 84'X30" HDPE, U.S.356.55, D.S. 355.26	2.497	1.54%	1.19%	736	0.40	10.00	8.94	TWO 84'X30" HDPE, U.S.356.55, D.S. 355.26	8.20	0.99

* ANALYSIS RUN FOR 15-INCH CULVERT OPTION AND AREA IS CONTAINED AND MERELY RUNS OVER THE TOP OF ROCK DETENTION BERM

Table 2 - Q25 Run-on and Run-off Analysis Justifications

ANALYSIS JUSTIFICATION CALCULATIONS
INTERNAL CONTACT DRAINAGE AREAS

Note: "Contact Drainage Areas" refers to storm water runoff from these areas having come in contact with CCR materials.

ANALYSIS JUSTIFICATION - SECTION I-01

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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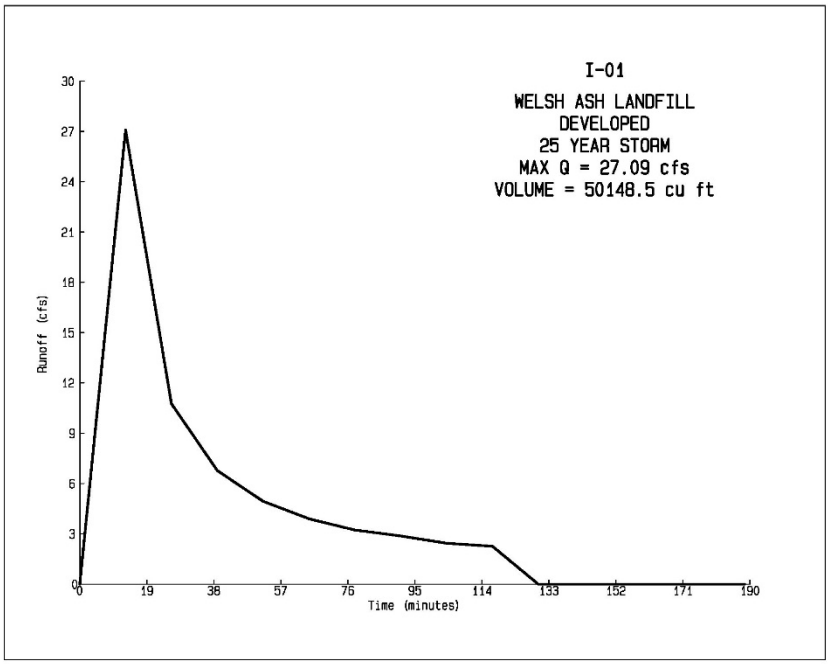
HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A

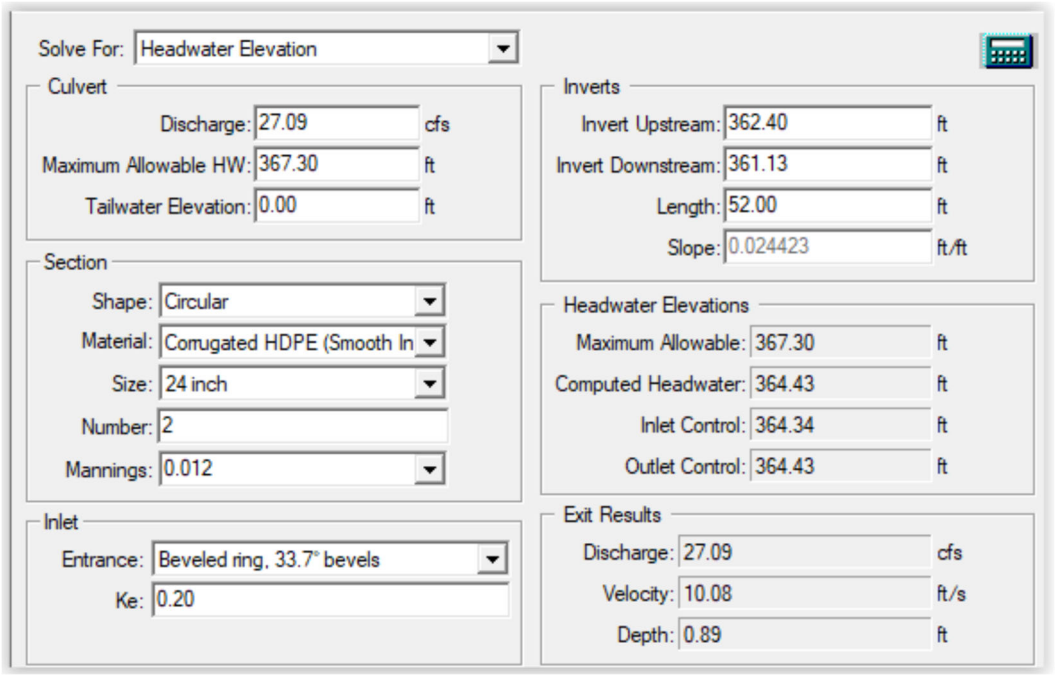
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER SECTION I-01 (CDA 01)
DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 8.48 ACRES
RUNOFF COEFF. = 0.40
RAINFALL INT. = 7.99 IN/HR
TIME OF CONC. = 13.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
6.5	13.5
13.0	27.1
19.5	18.9
26.0	10.8
32.5	8.8
39.0	6.8
45.5	5.9
52.0	4.9
58.5	4.4
65.0	3.9
71.5	3.6
78.0	3.2
84.5	3.1
91.0	2.9
97.5	2.7
104.0	2.4
110.5	2.4
117.0	2.3
123.5	1.1
130.0	0.0
136.5	0.0
143.0	0.0
149.5	0.0
156.0	0.0
162.5	0.0
169.0	0.0
175.5	0.0
182.0	0.0
188.5	0.0



PEAK FLOW = 27.09 CFS
TIME TO PEAK = 13.00 MIN
TOTAL VOLUME = 50148.54 CU FT

I-01 CULVERTS: TWO 52’ X 24" DIA HDPE CULVERTS, 4.9’ MAX HW DEPTH
4.19’ CALCULATED HW DEPTH - MEETS Q-25 REQUIREMENT*



* Bentley CulvertMaster – Culvert Analysis

ANALYSIS JUSTIFICATION - SECTION I-02

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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HYDROLOGIC REPORT

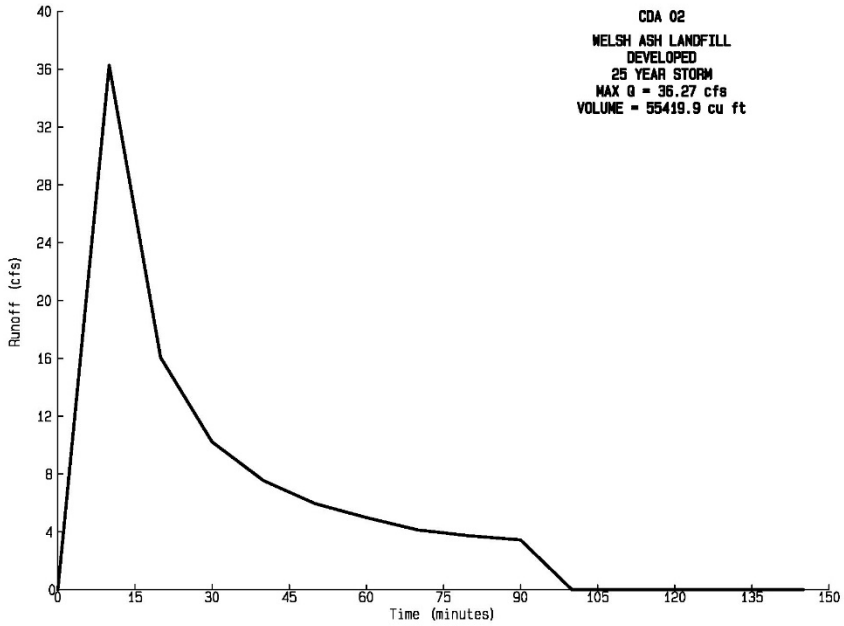
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

BASIN IDENTIFIER CDA 02
DISCHARGES INTO WELSH ASH LANDFILL

BASIN AREA = 8.11 ACRES
RUNOFF COEFF. = 0.50
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	18.1
10.0	36.3
15.0	26.2
20.0	16.1
25.0	13.1
30.0	10.2
35.0	8.9
40.0	7.5
45.0	6.8
50.0	6.0
55.0	5.5
60.0	5.0
65.0	4.6
70.0	4.1
75.0	3.9
80.0	3.7
85.0	3.6
90.0	3.4
95.0	1.7
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0

PEAK FLOW = 36.27 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 55419.90 CU FT



NOTE: Section I-02 is essentially a leachate collection cell which drains to the north side of the landfill where water is collected in a sump and pumped to the Primary Ash Pond return system. As a result, Section I-02 does not discharge to the stormwater run-on & run-off system and is treated as a detention pond with no Q25 impact to landfill drainage systems.

ANALYSIS JUSTIFICATION - SECTION I-02 (CONT)

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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HYDROLOGIC REPORT - STAGE, STORAGE, AND DISCHARGE

Pumped Detention Area - CDA 02

1=USER DEFINED

1)	356.620	Q	0.00
	Through		
7)	359.500	Q	0.07

ELEV	STORAGE (CU.FT.)	OUTFLOW (CFS)	2S/T+O (CFS)
356.62	0.0	0.0	0.0
356.67	0.0	0.0	0.0
356.72	0.0	0.0	0.0
356.76	0.0	0.0	0.0
356.81	0.0	0.0	0.0
356.86	0.0	0.0	0.0
356.91	0.0	0.1	0.1
356.95	0.0	0.1	0.1
357.00	0.0	0.1	0.1
357.06	68.5	0.1	0.5
357.13	137.0	0.1	1.0
357.19	205.5	0.1	1.4
357.25	274.1	0.1	1.9
357.31	342.6	0.1	2.4
357.38	411.1	0.1	2.8
357.44	479.6	0.1	3.3
357.50	548.1	0.1	3.7
357.56	915.3	0.1	6.2
357.63	1282.5	0.1	8.6
357.69	1649.7	0.1	11.1
357.75	2016.9	0.1	13.5
357.81	2384.1	0.1	16.0
357.88	2751.3	0.1	18.4
357.94	3118.5	0.1	20.9
358.00	3485.7	0.1	23.3
358.06	4524.5	0.1	30.2
358.13	5563.4	0.1	37.2
358.19	6602.2	0.1	44.1
358.25	7641.0	0.1	51.0
358.31	8679.8	0.1	57.9
358.38	9718.7	0.1	64.9
358.44	10757.5	0.1	71.8
358.50	11796.3	0.1	78.7
358.56	13968.8	0.1	93.2
358.63	16141.3	0.1	107.7
358.69	18313.8	0.1	122.2
358.75	20486.3	0.1	136.6
358.81	22658.7	0.1	151.1
358.88	24831.2	0.1	165.6
358.94	27003.7	0.1	180.1
359.00	29176.2	0.1	194.6

ANALYSIS JUSTIFICATION - SECTION I-02 (CONT)

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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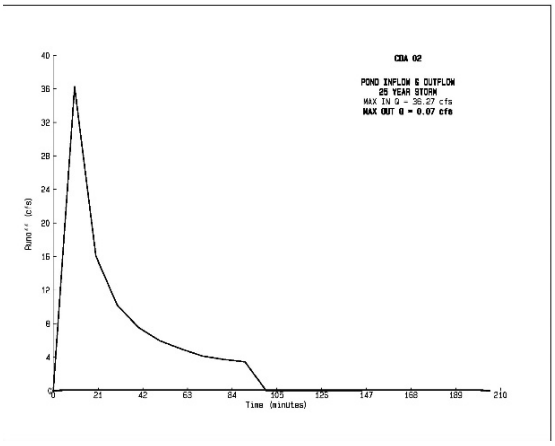
SECTION I-02 HYDROGRAPH ROUTING (Discharges via Forcemain to Primary Ash Pond)
PUMPED DETENTION AREA: CDA 02

T	I1	I2	2S1/T	O1	2S2/T+O2	O2	2S2/T
25 YEAR STORM FREQUENCY							
5.00	0.0	18.1	0.0	0.0	18.1	0.1	18.1
10.00	18.1	36.3	18.1	0.1	72.4	0.1	72.3
15.00	36.3	26.2	72.3	0.1	134.7	0.1	134.6
20.00	26.2	16.1	134.6	0.1	176.8	0.1	176.7
25.00	16.1	13.1	176.7	0.1	205.9	0.1	205.8
30.00	13.1	10.2	205.8	0.1	229.1	0.1	229.0
35.00	10.2	8.9	229.0	0.1	248.1	0.1	248.0
40.00	8.9	7.5	248.0	0.1	264.4	0.1	264.3
45.00	7.5	6.8	264.3	0.1	278.5	0.1	278.5
50.00	6.8	6.0	278.5	0.1	291.1	0.1	291.0
55.00	6.0	5.5	291.0	0.1	302.4	0.1	302.3
60.00	5.5	5.0	302.3	0.1	312.7	0.1	312.7
65.00	5.0	4.6	312.7	0.1	322.2	0.1	322.1
70.00	4.6	4.1	322.1	0.1	330.7	0.1	330.7
75.00	4.1	3.9	330.7	0.1	338.7	0.1	338.6
80.00	3.9	3.7	338.6	0.1	346.2	0.1	346.1
85.00	3.7	3.6	346.1	0.1	353.4	0.1	353.3
90.00	3.6	3.4	353.3	0.1	360.3	0.1	360.2
95.00	3.4	1.7	360.2	0.1	365.3	0.1	365.3
100.00	1.7	0.0	365.3	0.1	366.9	0.1	366.9
105.00	0.0	0.0	366.9	0.1	366.8	0.1	366.7
110.00	0.0	0.0	366.7	0.1	366.7	0.1	366.6
115.00	0.0	0.0	366.6	0.1	366.5	0.1	366.5
120.00	0.0	0.0	366.5	0.1	366.4	0.1	366.3
125.00	0.0	0.0	366.3	0.1	366.2	0.1	366.2
130.00	0.0	0.0	366.2	0.1	366.1	0.1	366.0
135.00	0.0	0.0	366.0	0.1	366.0	0.1	365.9
140.00	0.0	0.0	365.9	0.1	365.8	0.1	365.8
145.00	0.0	0.0	365.8	0.1	365.7	0.1	365.6
150.00	0.0	0.0	365.6	0.1	365.6	0.1	365.5
155.00	0.0	0.0	365.5	0.1	365.4	0.1	365.4
160.00	0.0	0.0	365.4	0.1	365.3	0.1	365.2
165.00	0.0	0.0	365.2	0.1	365.2	0.1	365.1
170.00	0.0	0.0	365.1	0.1	365.0	0.1	365.0
175.00	0.0	0.0	365.0	0.1	364.9	0.1	364.8
180.00	0.0	0.0	364.8	0.1	364.8	0.1	364.7
185.00	0.0	0.0	364.7	0.1	364.6	0.1	364.6
190.00	0.0	0.0	364.6	0.1	364.5	0.1	364.4
195.00	0.0	0.0	364.4	0.1	364.4	0.1	364.3
200.00	0.0	0.0	364.3	0.1	364.2	0.1	364.2

TIME TO PEAK = 0.08 HOURS
MAXIMUM OUTFLOW = 0.07 CFS
MAXIMUM STORAGE = 55028 CU FT
MAXIMUM ELEVATION = 65.41 FT
INFLOW VOLUME = 55420 CU FT
OUTFLOW VOLUME = 804 CU FT

MEETS Q25 REQUIREMENT (empties over time)



ANALYSIS JUSTIFICATION - SECTION I-03

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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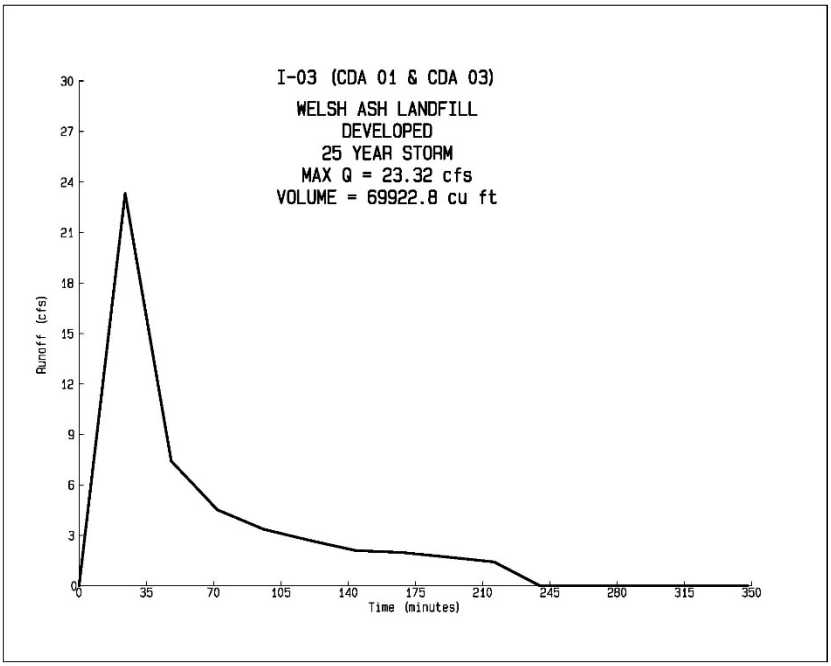
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

BASIN IDENTIFIER I-03 (CDA 01 & CDA 03)

DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 9.74 ACRES
RUNOFF COEFF. = 0.41
RAINFALL INT. = 5.84 IN/HR
TIME OF CONC. = 24.00 MINUTES

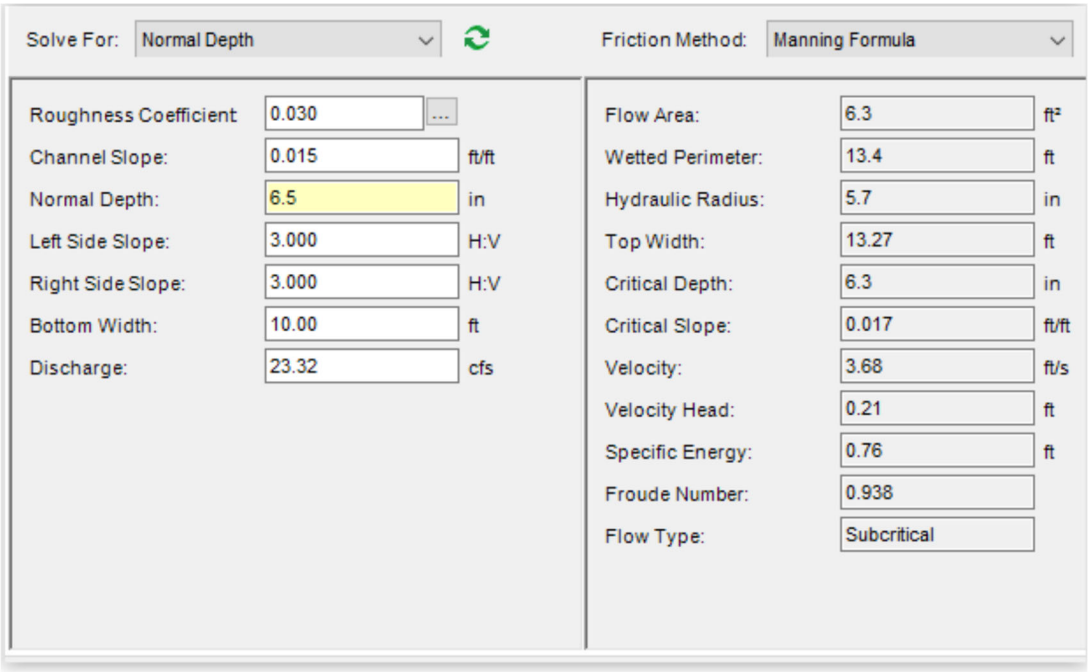
TIME (MIN)	RUNOFF (CFS)
0.0	0.0
12.0	11.7
24.0	23.3
36.0	15.4
48.0	7.4
60.0	6.0
72.0	4.5
84.0	3.9
96.0	3.4
108.0	3.0
120.0	2.7
132.0	2.4
144.0	2.1
156.0	2.0
168.0	2.0
180.0	1.8
192.0	1.7
204.0	1.6
216.0	1.4
228.0	0.7
240.0	0.0
252.0	0.0
264.0	0.0
276.0	0.0
288.0	0.0
300.0	0.0
312.0	0.0
324.0	0.0
336.0	0.0
348.0	0.0



PEAK FLOW = 23.32 CFS
TIME TO PEAK = 24.00 MIN
TOTAL VOLUME = 69922.80 CU FT

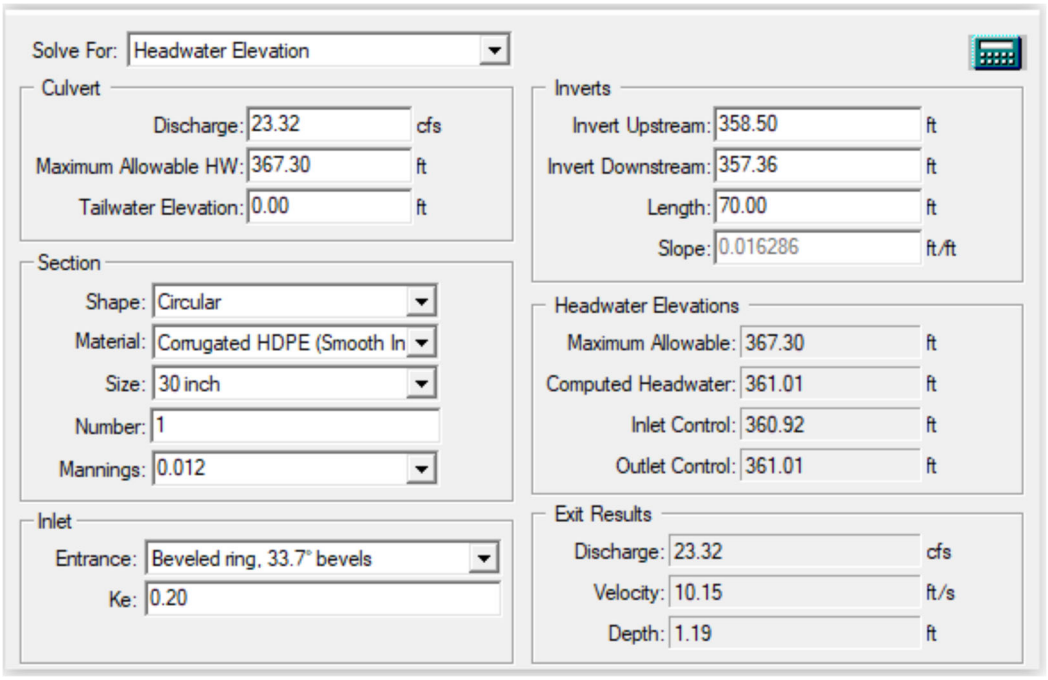
ANALYSIS JUSTIFICATION - SECTION I-03 (CONT)

I-03 CHANNEL: 0.15% V-DITCH, 10-FT TRAPEZOIDAL, 3:1 SIDES, 1.5-FT MIN. DEPTH
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
0.55'CALCULATED DEPTH, MEETS Q-25 REQUIREMENT*



* Bentley FlowMaster V8i – Trapezoidal Channel Analysis

I-03 CULVERT: 70' X 30" DIA HDPE CULVERT, 8.8' MAX HW DEPTH
2.51' CALCULATED HW DEPTH - MEETS Q-25 REQUIREMENT*



* Bentley CulvertMaster – Culvert Analysis

ANALYSIS JUSTIFICATION - SECTION I-05

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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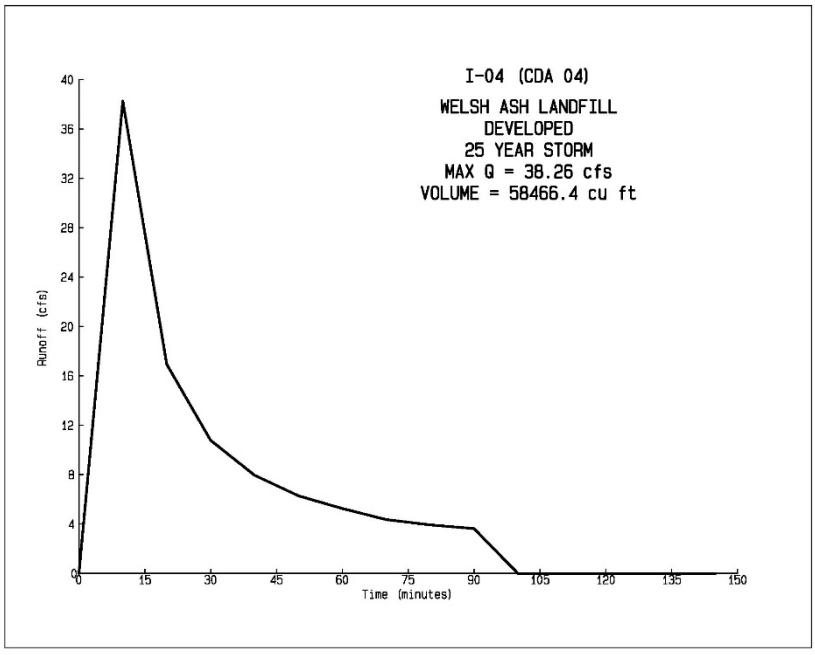
HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

BASIN IDENTIFIER I-04 (CDA 04) - BENEFICIAL REUSE AREA

DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 8.56 ACRES
RUNOFF COEFF. = 0.50
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

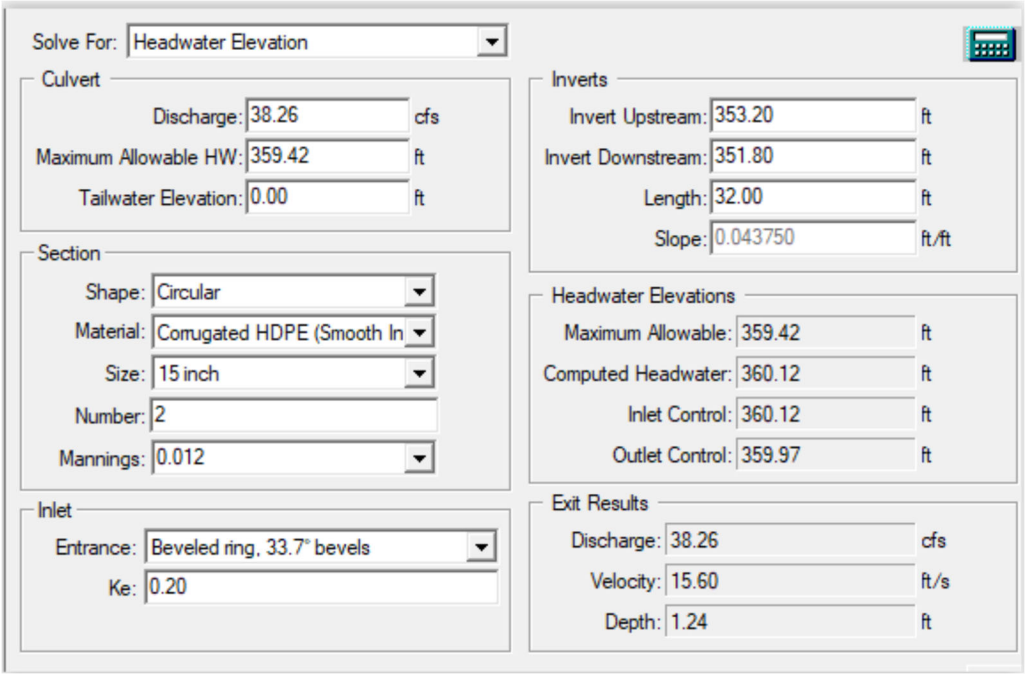
TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	19.1
10.0	38.3
15.0	27.6
20.0	16.9
25.0	13.9
30.0	10.8
35.0	9.4
40.0	8.0
45.0	7.1
50.0	6.3
55.0	5.8
60.0	5.3
65.0	4.8
70.0	4.4
75.0	4.2
80.0	3.9
85.0	3.8
90.0	3.6
95.0	1.8
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0



PEAK FLOW = 38.26 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 58466.40 CU FT

ANALYSIS JUSTIFICATION - SECTION I-04 (CONT)

I-03 TEMPORARY CULVERTS: TWO 32'X16" HDPE CULVERTS, 6.22' MAX HW DEPTH
6.92' HW DEPTH (FOR 15" DIA CULVERTS) EXCEEDS (0.7') TOP OF ROCK BERM OF THE DETENTION BASIN; HOWEVER, FLOWS ARE CONTAINED MEETS Q-25 REQUIREMENT*



* Bentley CulvertMaster – Culvert Analysis - (Calculated W/ 15" Dia Culverts)

ANALYSIS JUSTIFICATION - SECTION I-05
SERIES OF TWO 30-IN DIA HDPE CULVERTS – DETENTION OUTLET

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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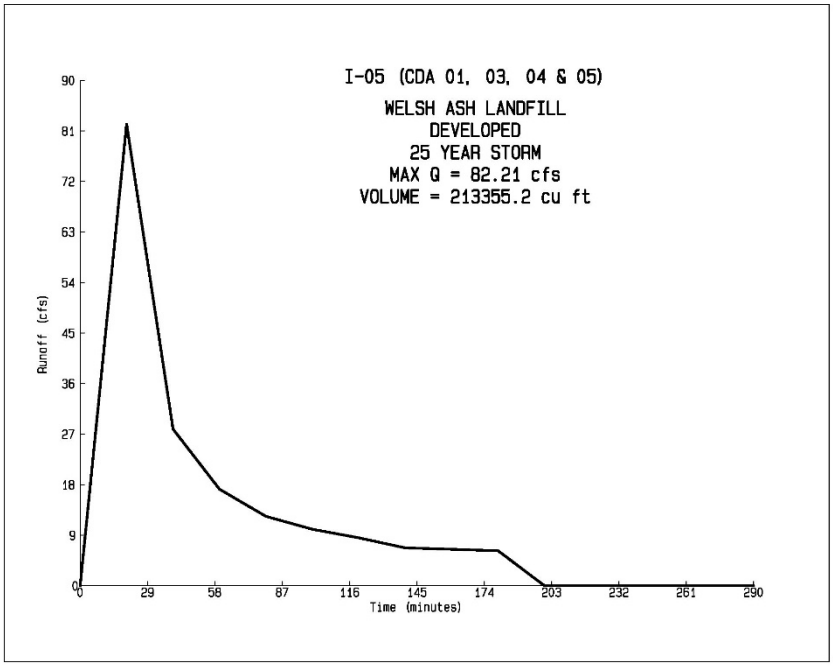
HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER I-05 (DETENTION FOR CDA 01, 03, 04 & 05)
DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 22.36 ACRES
RUNOFF COEFF. = 0.57
RAINFALL INT. = 6.45 IN/HR
TIME OF CONC. = 20.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
10.0	41.1
20.0	82.2
30.0	55.1
40.0	27.9
50.0	22.6
60.0	17.2
70.0	14.8
80.0	12.4
90.0	11.2
100.0	10.1
110.0	9.3
120.0	8.5
130.0	7.6
140.0	6.8
150.0	6.6
160.0	6.5
170.0	6.4
180.0	6.2
190.0	3.1
200.0	0.0
210.0	0.0
220.0	0.0
230.0	0.0
240.0	0.0
250.0	0.0
260.0	0.0
270.0	0.0
280.0	0.0
290.0	0.0



PEAK FLOW = 82.21 CFS
TIME TO PEAK = 20.00 MIN
TOTAL VOLUME = 213355.20 CU FT

ANALYSIS JUSTIFICATION - SECTION I-05 (CONT)
SERIES OF 30-IN DIA HDPE – DETENTION OUTLET

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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HYDROLOGIC REPORT - STAGE, STORAGE, AND DISCHARGE

POND: I-05 (DETENTION FOR CDA 01, 03, 04 & 05)

1=USER DEFINED *

1)	350.500	Q	0.00	10)	353.450	Q	30.00
2)	351.150	Q	2.00	11)	353.990	Q	38.00
3)	351.440	Q	4.00	12)	354.470	Q	44.00
4)	351.660	Q	6.00	13)	355.040	Q	50.00
5)	351.860	Q	8.00	14)	355.910	Q	58.00
6)	352.040	Q	10.00	15)	356.650	Q	64.00
7)	352.500	Q	16.00	16)	357.180	Q	68.00
8)	352.920	Q	22.00	17)	358.040	Q	74.00
9)	353.060	Q	24.00	18)	358.970	Q	80.00

ELEV	STORAGE (CU.FT.)	OUTFLOW (CFS)	2S/T+O (CFS)
350.50	0.0	0.0	0.0
350.75	12.8	0.8	0.8
351.00	25.6	1.5	1.6
351.25	615.8	2.7	4.7
351.50	1205.9	4.5	8.6
351.75	3435.9	6.9	18.4
352.00	5665.9	9.6	28.4
352.25	10391.0	12.7	47.4
352.50	15116.1	16.0	66.4
352.75	22732.0	19.6	95.3
353.00	30347.8	23.1	124.3
353.25	40426.1	26.9	161.7
353.50	50504.3	30.7	199.1
353.75	62132.0	34.4	241.6
354.00	73759.7	38.1	284.0
354.25	86213.7	41.2	328.6
354.50	98667.6	44.3	373.2
354.75	111596.0	46.9	418.9
355.00	124524.3	49.6	464.7
355.25	137942.5	51.9	511.7
355.50	151360.8	54.2	558.8
355.75	165355.4	56.5	607.7
356.00	179350.0	58.7	656.6
356.35	200039.7	61.6	728.4
356.70	220729.4	64.4	800.1
356.75	223797.2	64.8	810.7
356.80	226865.0	65.1	821.3
356.90	233083.1	65.9	842.8
357.00	239301.2	66.6	864.3
357.05	242453.6	67.0	875.2
357.10	245605.9	67.4	886.1
357.15	248789.3	67.8	897.1
357.20	251972.8	68.1	908.0
357.35	261714.3	69.2	941.6
357.50	271455.7	70.2	975.1
357.75	288481.5	72.0	1033.6
358.00	305507.4	73.7	1092.1
357.25	255220.0	68.5	919.2
356.50	208906.7	62.8	759.1
356.75	223797.2	64.8	810.7
357.00	239301.2	66.6	864.3
357.25	255220.0	68.5	919.2
357.50	271455.7	70.2	975.1
357.75	288481.5	72.0	1033.6
358.00	305507.4	73.7	1092.1
358.25	419039.7	75.4	1472.2
358.50	436919.1	77.0	1533.4

Discharge (cfs)	HW Elev. (ft)
0.00	350.50
2.00	351.15
4.00	351.44
6.00	351.66
8.00	351.86
10.00	352.04
12.00	352.20
14.00	352.35
16.00	352.50
18.00	352.65
20.00	352.78
22.00	352.92
24.00	353.06
26.00	353.19
28.00	353.32
30.00	353.45
32.00	353.59
34.00	353.72
36.00	353.85
38.00	353.99
40.00	354.13
42.00	354.30
44.00	354.47
46.00	354.65
48.00	354.84
50.00	355.04
52.00	355.24
54.00	355.46
56.00	355.68
58.00	355.91
60.00	356.15
62.00	356.39
64.00	356.65
66.00	356.91
68.00	357.18
70.00	357.46
72.00	357.74
74.00	358.04
76.00	358.34
78.00	358.65
80.00	358.97
82.00	359.30
84.00	359.63
85.00	359.80

* Discharge Rating Curve by Bentley CulvertMaster – Culvert Analysis

ANALYSIS JUSTIFICATION - SECTION I-05 (CONT)
SERIES OF 30-IN DIA HDPE – DETENTION OUTLET
MEETS Q-25 REQUIREMENT

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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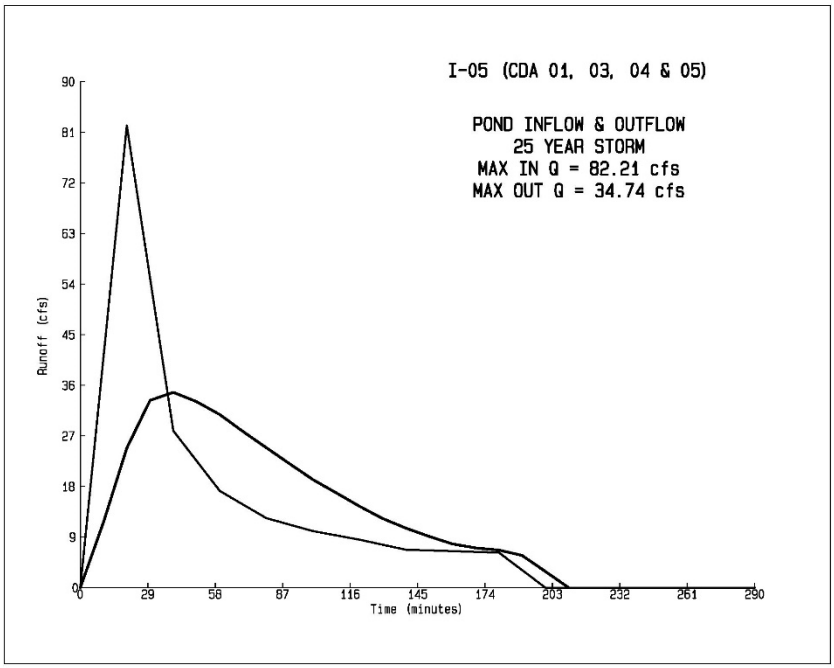
HYDROLOGIC REPORT

POND OUTFLOW HYDROGRAPH

POND IDENTIFIER I-05 (DETENTION FOR CDA 01, 03, 04 & 05)

25 YEAR STORM FREQUENCY

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
10.0	11.7
20.0	24.8
30.0	33.3
40.0	34.7
50.0	33.1
60.0	30.8
70.0	27.8
80.0	24.9
90.0	22.0
100.0	19.2
110.0	16.9
120.0	14.5
130.0	12.3
140.0	10.6
150.0	9.1
160.0	7.8
170.0	7.1
180.0	6.7
190.0	5.7
200.0	2.9
210.0	0.0



PEAK FLOW = 34.74 CFS

TIME TO PEAK = 40.00 MIN

TOTAL VOLUME = 213542.40 CU FT

ANALYSIS JUSTIFICATION - SECTION I-05 (CONT)

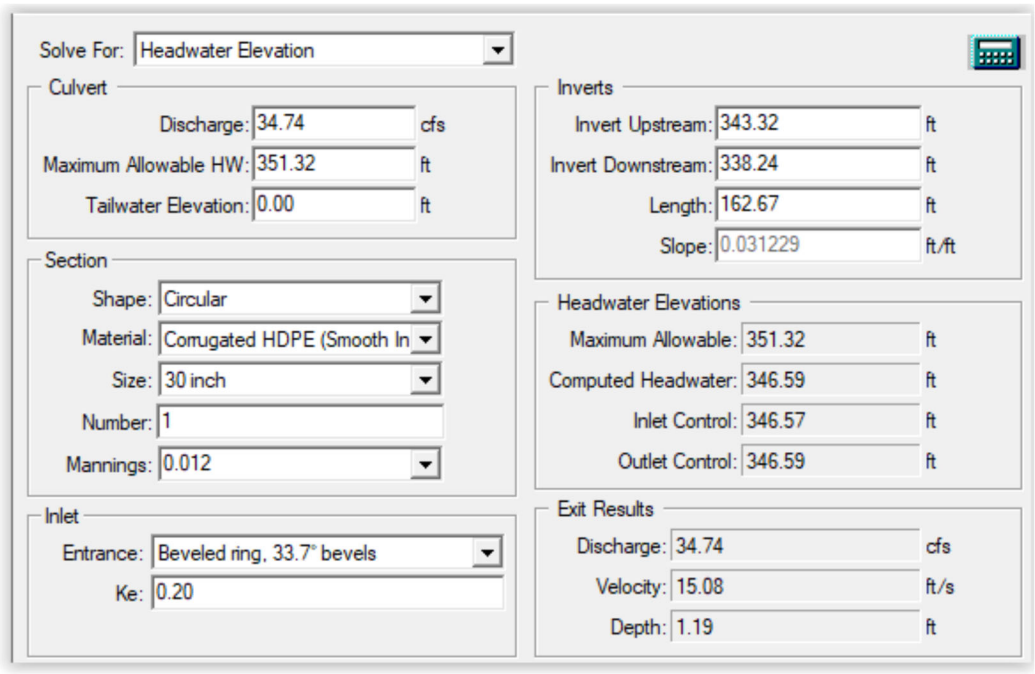
I-05 CULVERT: 32’ X 30" DIA HDPE CULVERT, 8.8’ MAX HW DEPTH

3.27’ CALCULATED HW DEPTH - MEETS Q-25 REQUIREMENT*

USE I-05 DETENTION DISCHARGE HYDROGRAPH

25 YEAR STORM FREQUENCY

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
10.0	11.7
20.0	24.8
30.0	33.3
40.0	34.7
50.0	33.1
60.0	30.8
70.0	27.8
80.0	24.9
90.0	22.0
100.0	19.2
110.0	16.9
120.0	14.5
130.0	12.3
140.0	10.6
150.0	9.1
160.0	7.8
170.0	7.1
180.0	6.7
190.0	5.7
200.0	2.9
210.0	0.0



PEAK FLOW = 34.74 CFS
TIME TO PEAK = 40.00 MIN
TOTAL VOLUME = 213542.40 CU FT

ANALYSIS JUSTIFICATION CALCULATIONS
PERIMETER NON-CONTACT DRAINAGE AREAS

Note: "Perimeter Non-Contact Drainage Areas" refers to storm water runoff from these areas having not come in contact with CCR materials.

ANALYSIS JUSTIFICATION - SECTION P-01 DITCH

0.3% V-DITCH, 3:1 SIDES, 1.8-FT MIN. HW DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER P-01
DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 1.53 ACRES
RUNOFF COEFF. = 0.50
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	3.4
10.0	6.9
15.0	5.0
20.0	3.0
25.0	2.5
30.0	1.9
35.0	1.7
40.0	1.4
45.0	1.3
50.0	1.1
55.0	1.0
60.0	0.9
65.0	0.9
70.0	0.8
75.0	0.7
80.0	0.7
85.0	0.7
90.0	0.7
95.0	0.3
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0

PEAK FLOW = 6.86 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 10485.00 CU FT

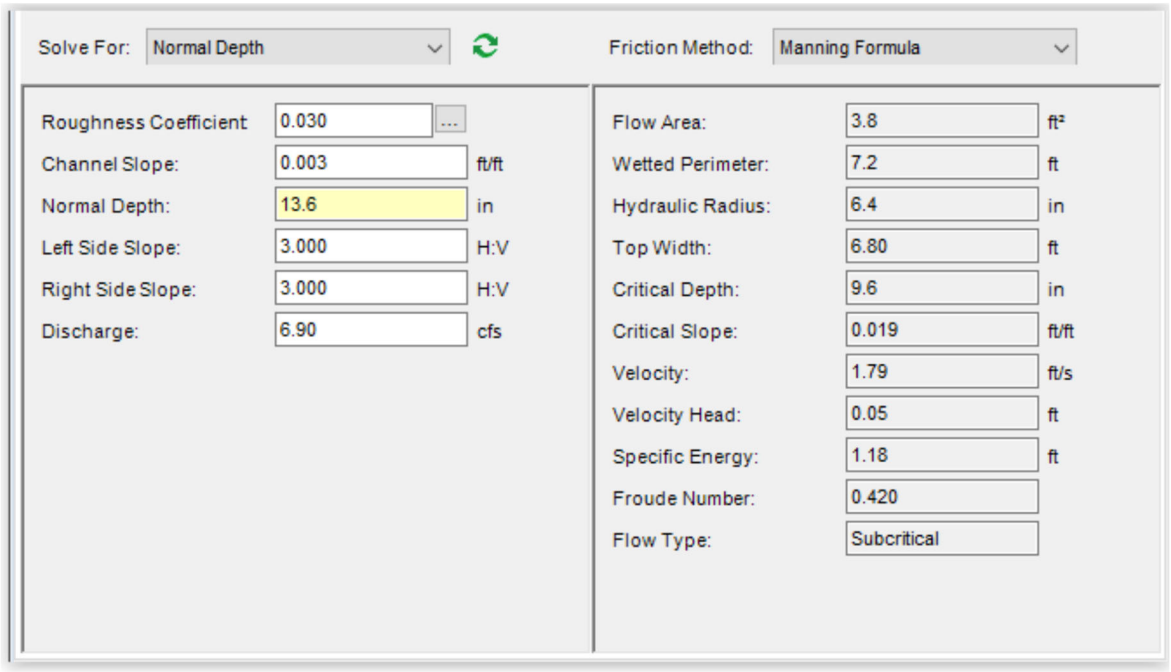
ANALYSIS JUSTIFICATION - SECTION P-01 DITCH (CONT)

0.3% V-DITCH, 3:1 SIDES, 1.5-FEET MIN. DEPTH AVAIL.

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

1.13' CALCULATED HW DEPTH, MEETS Q-25 REQUIREMENT*

*



Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-02

0.3% V-DITCH, 3:1 SIDES, 4.0' MIN. DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

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PROJECT:  Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro
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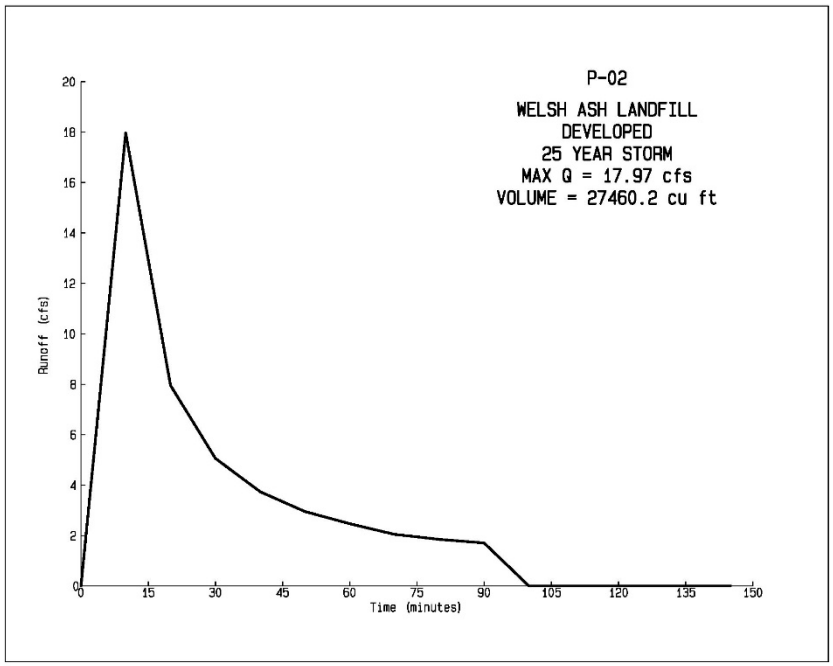
HYDROLOGIC REPORT
------------------------------------------------------------------------
DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY
BASIN IDENTIFIER   P-02 (NDA 01 & NDA 02)
DISCHARGES INTO    WELSH ASH LANDFILL
BASIN AREA     =      4.02  ACRES
RUNOFF COEFF. =       0.50
RAINFALL INT. =       8.94  IN/HR
TIME OF CONC. =      10.00  MINUTES
      TIME      RUNOFF
     (MIN)       (CFS)
    -------   ------------
       0.0         0.0
       5.0         9.0
      10.0        18.0
      15.0        13.0
      20.0         8.0
      25.0         6.5
      30.0         5.1
      35.0         4.4
      40.0         3.7
      45.0         3.3
      50.0         3.0
      55.0         2.7
      60.0         2.5
      65.0         2.3
      70.0         2.0
      75.0         2.0
      80.0         1.8
      85.0         1.8
      90.0         1.7
      95.0         0.9
     100.0         0.0
     105.0         0.0
     110.0         0.0
     115.0         0.0
     120.0         0.0
     125.0         0.0
     130.0         0.0
     135.0         0.0
     140.0         0.0
     145.0         0.0
    PEAK FLOW =        17.97  CFS
  TIME TO PEAK =       10.00  MIN
  TOTAL VOLUME =    27460.20  CU FT
```

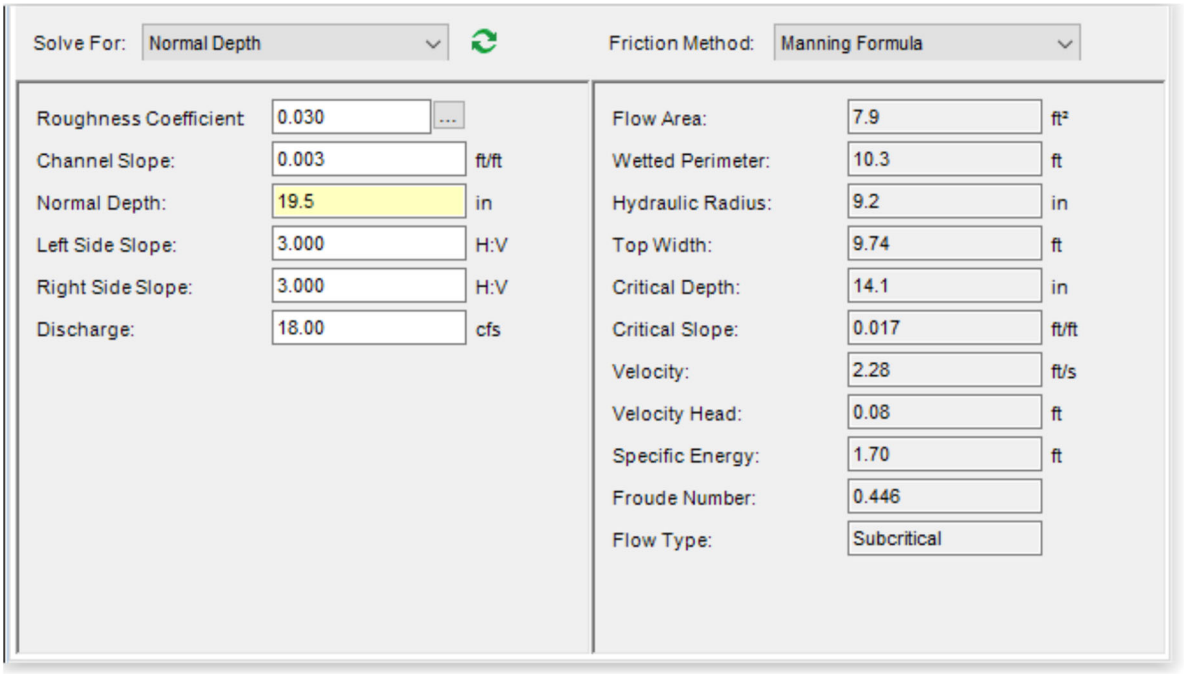


ANALYSIS JUSTIFICATION - SECTION P-02 (CONT)

1.1%,11.8L/12.6R:1, 10' CHANNEL, AVAIL. 4.0' MIN. HW DEPTH

MANNING N VALUE: 0.02 (ROUGHENED CONCRETE)

1.63' CALCULATED HW DEPTH -- MEETS Q-25 REQUIREMENT*



* Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-03

20-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 7.7-FT MIN. DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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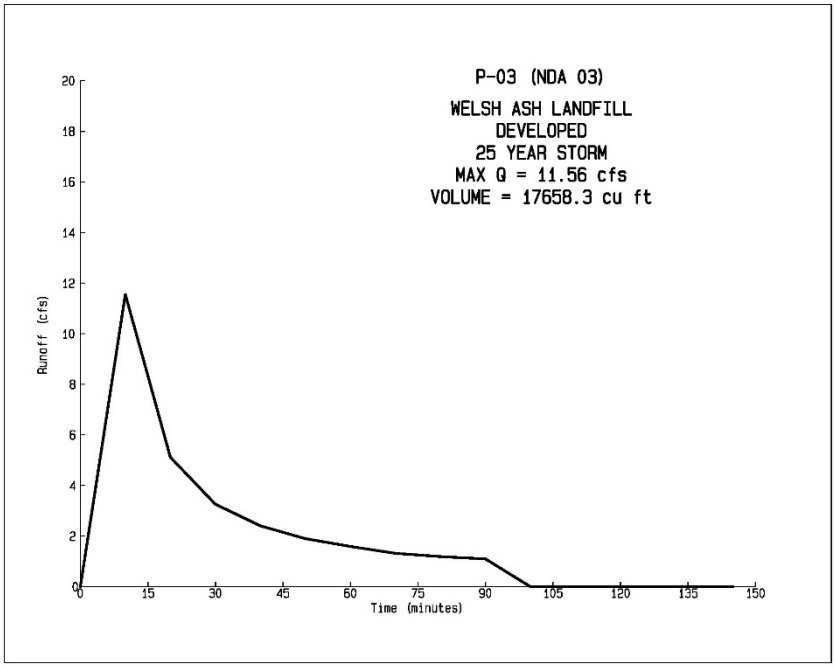
HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

BASIN IDENTIFIER P-03 (NDA 03)
DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 2.59 ACRES
RUNOFF COEFF. = 0.50
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	5.8
10.0	11.6
15.0	8.3
20.0	5.1
25.0	4.2
30.0	3.3
35.0	2.8
40.0	2.4
45.0	2.2
50.0	1.9
55.0	1.7
60.0	1.6
65.0	1.5
70.0	1.3
75.0	1.3
80.0	1.2
85.0	1.1
90.0	1.1
95.0	0.5
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0

PEAK FLOW = 11.56 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 17658.30 CU FT

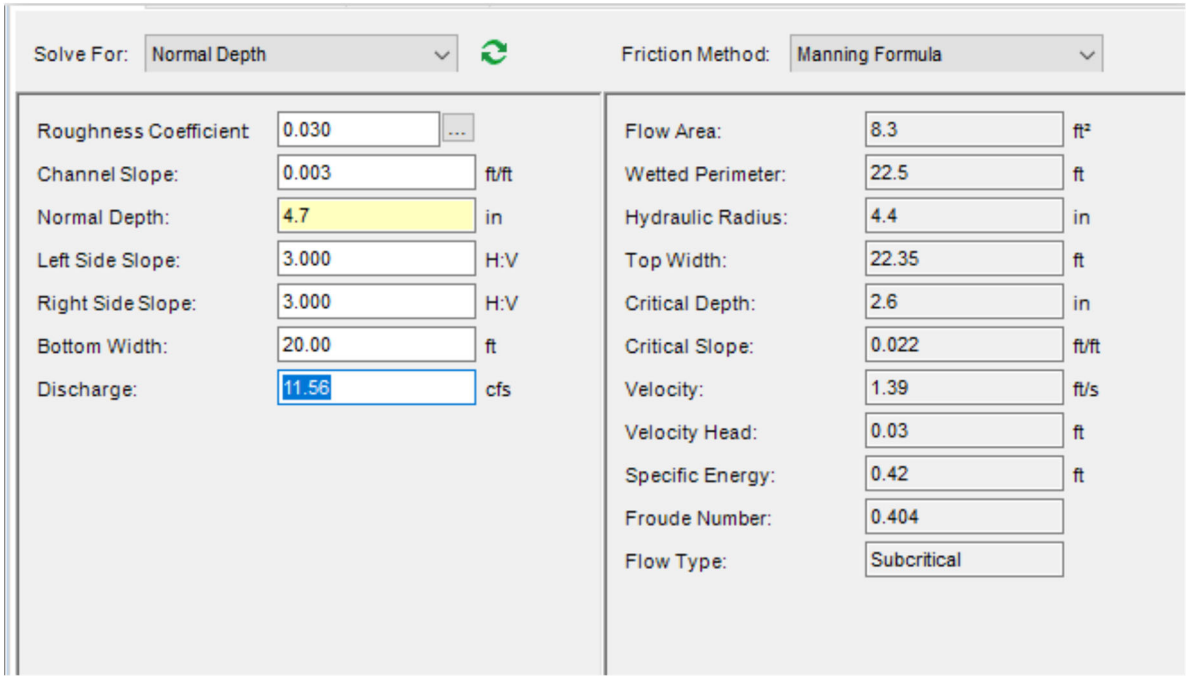


ANALYSIS JUSTIFICATION - SECTION P-03 (CONT)

20-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 7.7' MIN. HW DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

0.39' CALCULATED HW DEPTH, MEETS Q-25 REQUIREMENT*



* Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-04

15-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 6.5-FT MIN. DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

BASIN IDENTIFIER P-04 (NDA 03 & NDA 04)

DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 6.59 ACRES
RUNOFF COEFF. = 0.50
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	14.7
10.0	29.5
15.0	21.3
20.0	13.0
25.0	10.7
30.0	8.3
35.0	7.2
40.0	6.1
45.0	5.5
50.0	4.8
55.0	4.4
60.0	4.1
65.0	3.7
70.0	3.4
75.0	3.2
80.0	3.0
85.0	2.9
90.0	2.8
95.0	1.4
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0

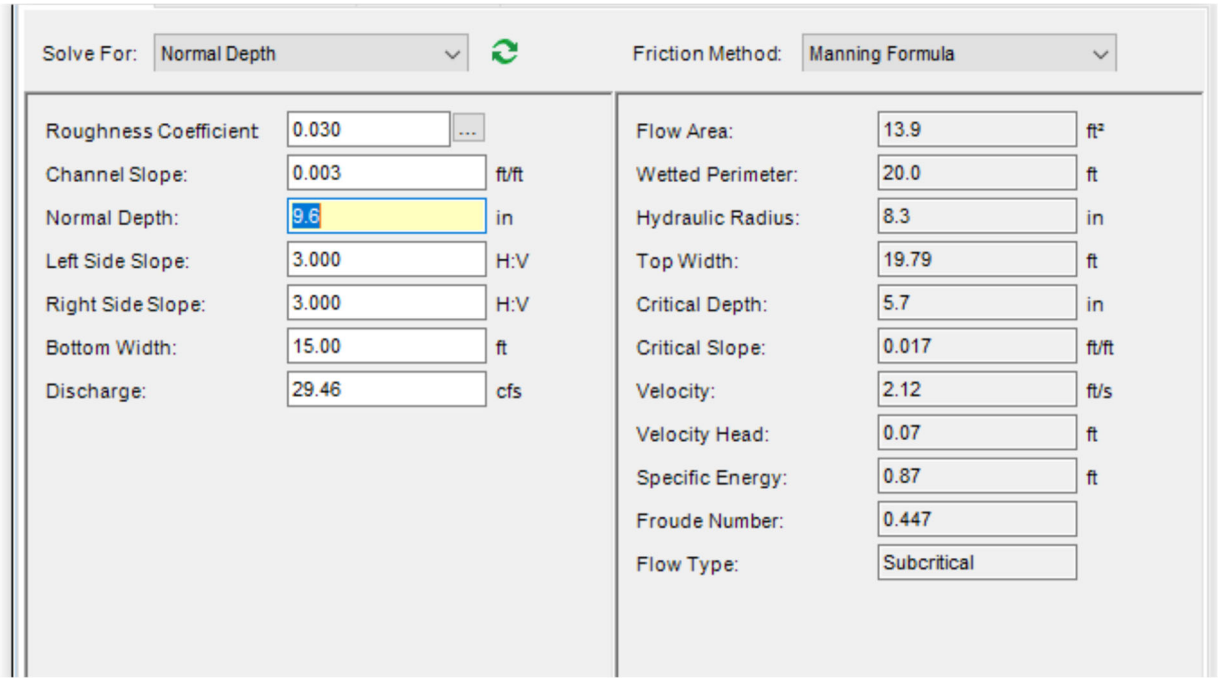
PEAK FLOW = 29.46 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 45016.20 CU FT

ANALYSIS JUSTIFICATION - SECTION P-04 (CONT)

15-FT WIDE, 0.3% CHANNEL, 3:1 SIDES, 6.5-FT MIN. HW DEPTH

MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

0.80' CALCULATED HW DEPTH, MEETS Q-25 REQUIREMENT*



* Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-02 & P-04

P-04 & 02 CULVERTS: 28" & 26" DIA HDPE CULVERTS
SOLVE AS DETENTION

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

BASIN IDENTIFIER P-04 & P-02 COMBINED AT CULVERT - CHANNEL DETENTION

DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 10.60 ACRES
RUNOFF COEFF. = 0.50
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	23.7
10.0	47.4
15.0	34.2
20.0	21.0
25.0	17.2
30.0	13.4
35.0	11.6
40.0	9.9
45.0	8.8
50.0	7.8
55.0	7.2
60.0	6.5
65.0	6.0
70.0	5.4
75.0	5.1
80.0	4.9
85.0	4.7
90.0	4.5
95.0	2.3
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0

PEAK FLOW = 47.38 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 72408.60 CU FT

ANALYSIS JUSTIFICATION - SECTION P-02 & P-04

P-04 & 02 CULVERTS: 28" & 26" DIA HDPE CULVERTS

2.42' CALCULATED HW DEPTH AT 28" CULVERT - MEETS Q-25 REQUIREMENT*

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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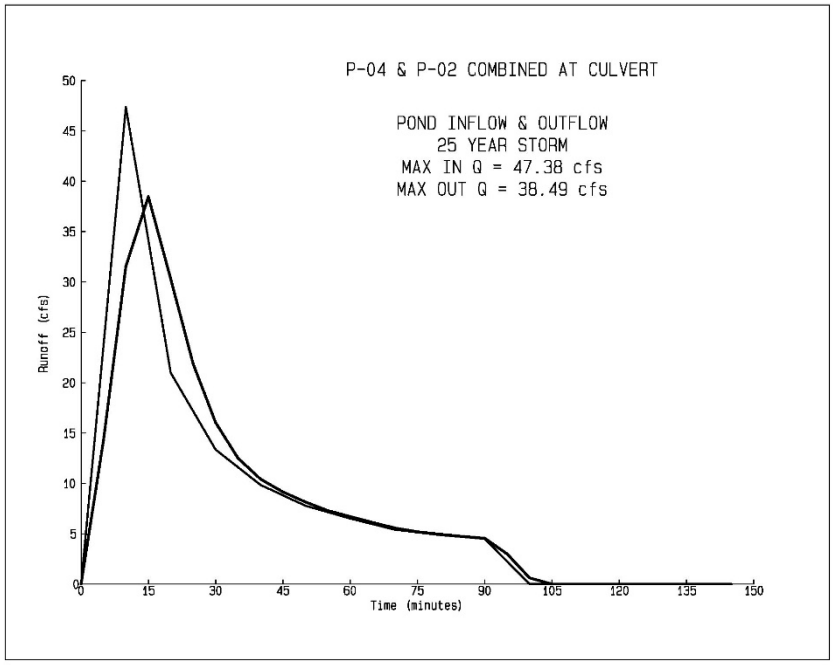
HYDROGRAPH RESERVOIR ROUTING
POND: P-04 & P-02 COMBINED AT CULVERT

T	I1	I2	2S1/T	O1	2S2/T+O2	O2	2S2/T
25 YEAR STORM FREQUENCY							
5.00	0.0	23.7	0.0	0.0	23.7	14.3	9.4
10.00	23.7	47.4	9.4	14.3	66.2	31.6	34.6
15.00	47.4	34.2	34.6	31.6	84.6	38.5	46.1
20.00	34.2	21.0	46.1	38.5	62.8	30.3	32.5
25.00	21.0	17.2	32.5	30.3	40.3	21.9	18.5
30.00	17.2	13.4	18.5	21.9	27.2	16.0	11.1
35.00	13.4	11.6	11.1	16.0	20.0	12.5	7.5
40.00	11.6	9.9	7.5	12.5	16.5	10.4	6.1
45.00	9.9	8.8	6.1	10.4	14.3	9.2	5.2
50.00	8.8	7.8	5.2	9.2	12.6	8.2	4.5
55.00	7.8	7.2	4.5	8.2	11.2	7.3	3.9
60.00	7.2	6.5	3.9	7.3	10.3	6.7	3.6
65.00	6.5	6.0	3.6	6.7	9.4	6.1	3.2
70.00	6.0	5.4	3.2	6.1	8.5	5.6	2.9
75.00	5.4	5.1	2.9	5.6	7.9	5.2	2.7
80.00	5.1	4.9	2.7	5.2	7.5	5.0	2.5
85.00	4.9	4.7	2.5	5.0	7.1	4.7	2.4
90.00	4.7	4.5	2.4	4.7	6.9	4.6	2.3
95.00	4.5	2.3	2.3	4.6	4.5	3.0	1.5

TIME TO PEAK = 0.25 HOURS
MAXIMUM OUTFLOW = 38.49 CFS
MAXIMUM STORAGE = 6920 CU FT
MAXIMUM ELEVATION = 341.48 FT
INFLOW VOLUME = 72409 CU FT
OUTFLOW VOLUME = 72482 CU FT


P-04 & P-02 COMBINED AT CULVERT
POND INFLOW & OUTFLOW
25 YEAR STORM
MAX IN Q = 47.38 cfs
MAX OUT Q = 38.49 cfs
Runoff (cfs)
Time (minutes)
0
5
10
15
20
25
30
35
40
45
50
0
15
30
45
60
75
90
105
120
135
150

ANALYSIS JUSTIFICATION - SECTION P-05
0.3% V-DITCH, 3:1 SIDES & 50'X16" DIA HDPE,
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
50'X16" DIA HDPE CULVERT, 8.8' MAX HW DEPTH

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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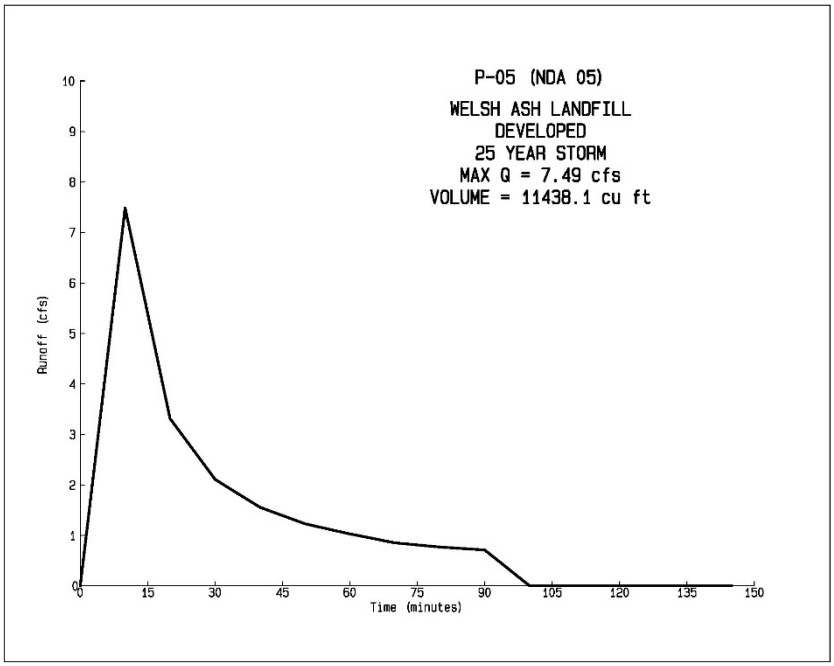
HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

BASIN IDENTIFIER P-05 (NDA 05)

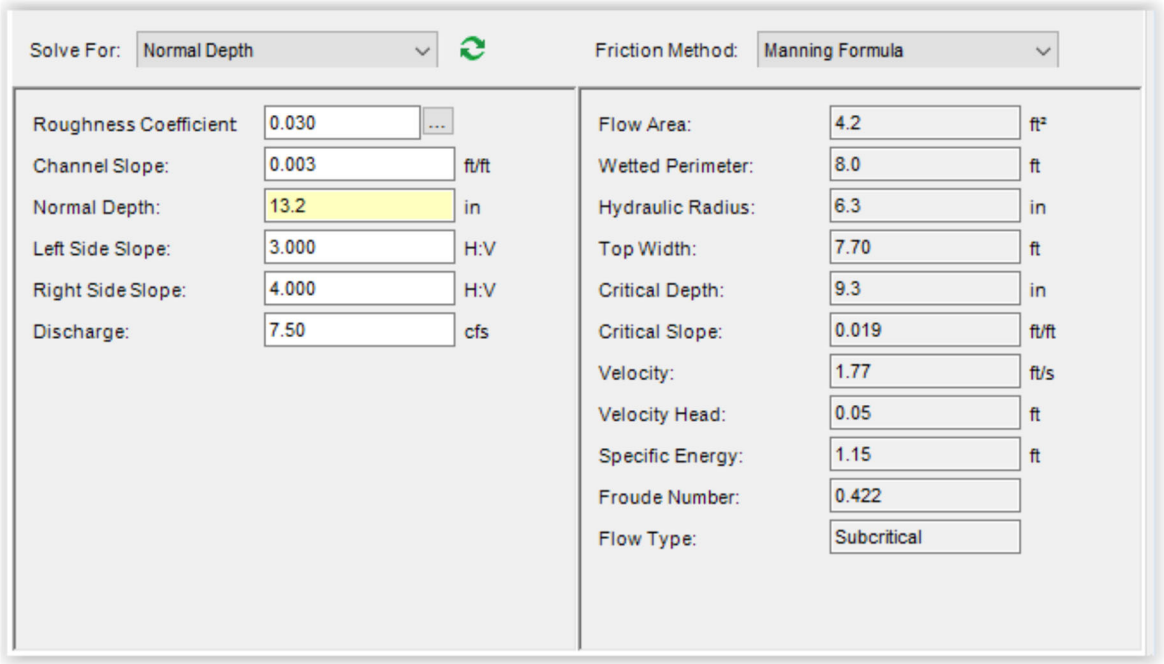
DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 2.09 ACRES
RUNOFF COEFF. = 0.40
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	3.7
10.0	7.5
15.0	5.4
20.0	3.3
25.0	2.7
30.0	2.1
35.0	1.8
40.0	1.6
45.0	1.4
50.0	1.2
55.0	1.1
60.0	1.0
65.0	0.9
70.0	0.9
75.0	0.8
80.0	0.8
85.0	0.7
90.0	0.7
95.0	0.4
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0



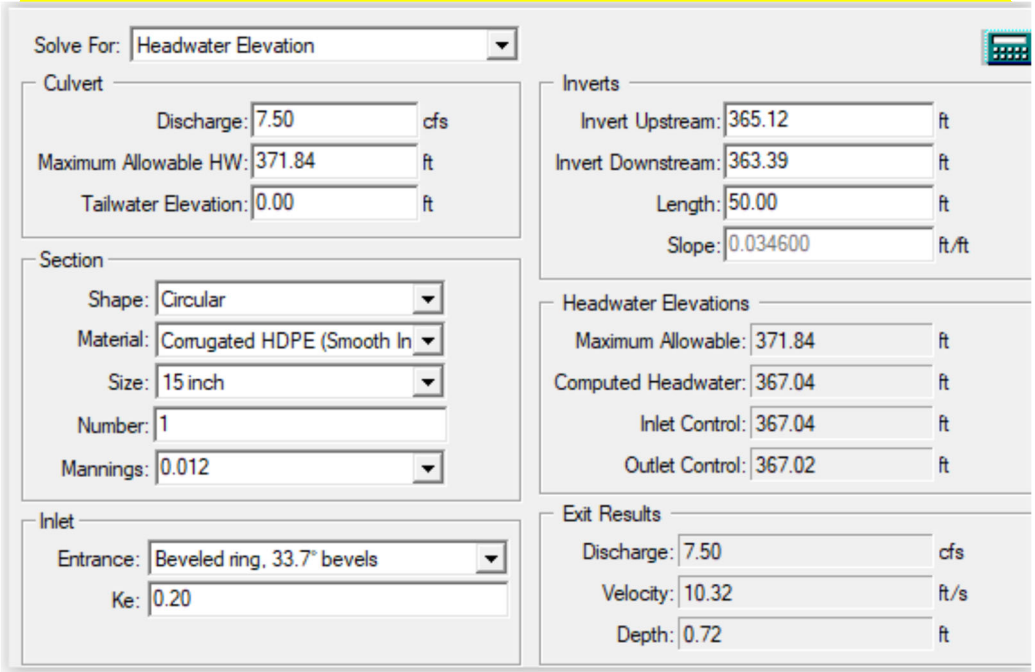
PEAK FLOW = 7.49 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 11438.10 CU FT

ANALYSIS JUSTIFICATION - SECTION P-05
0.3% V-DITCH, 3:1L X 4:1R SIDES, 6.72' MIN. HW DEPTH
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
1.10' CALCULATED HW DEPTH -- MEETS Q-25 REQUIREMENT*



* Bentley FlowMaster V8i – Trapezoidal Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-05
50'X16" DIA HDPE, 6.72 MIN. HW DEPTH
1.92-FT CALCULATED HW DEPTH – MEETS Q-25 REQUIREMENT



* Bentley CulvertMaster – Culvert Analysis (Used 15" DIA HDPE, Conservative)

ANALYSIS JUSTIFICATION - SECTION P-06
0.3% V-DITCH, 3:1 SIDES & TWO 30-IN DIA HDPE
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)

PROJECT: Welsh Run-On & Run-Off Protection Plan\2021 DA Map with H&H Calcs.pro

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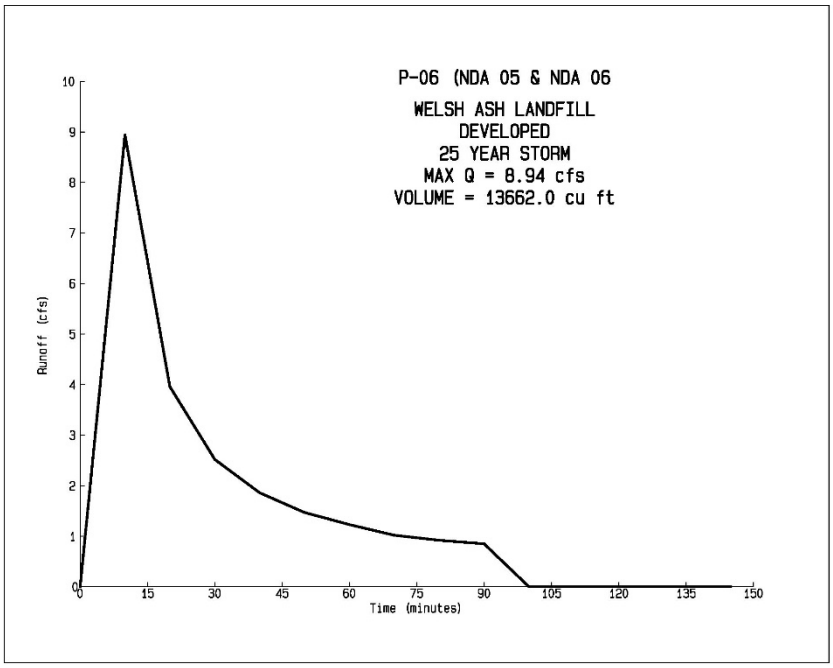
HYDROLOGIC REPORT

DEVELOPED UNIVERSAL RATIONAL HYDROGRAPH
Q(PEAK) = C*I*A
25 YEAR STORM FREQUENCY

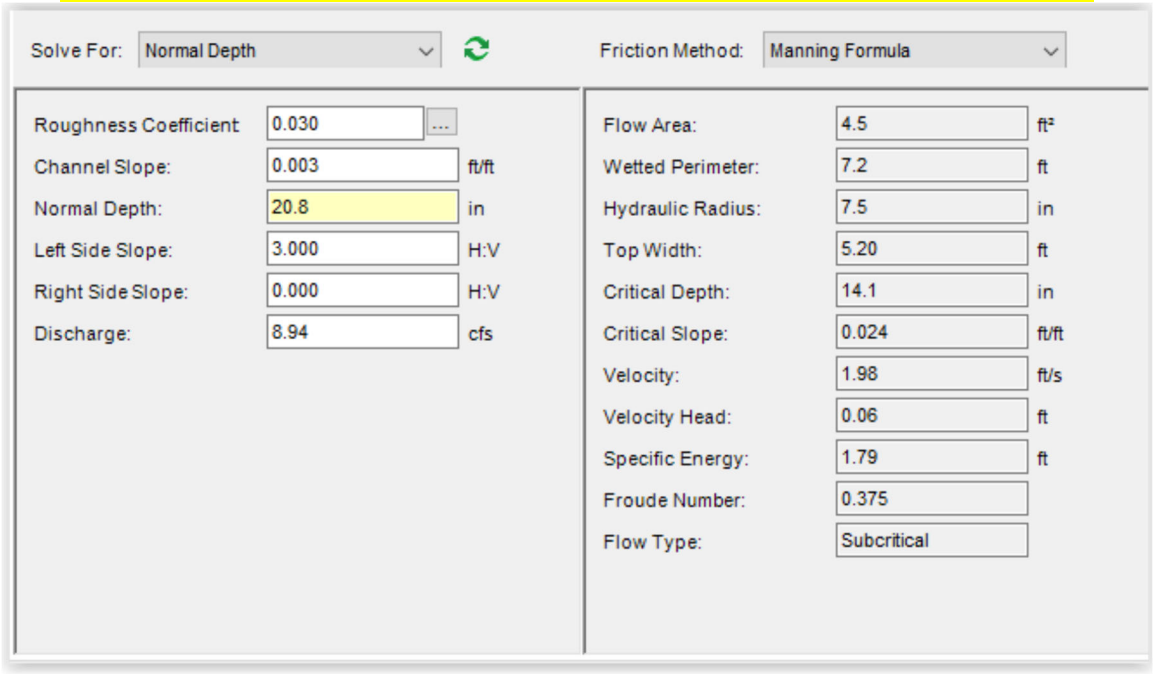
BASIN IDENTIFIER P-06 (NDA 05 & NDA 06
DISCHARGES INTO WELSH ASH LANDFILL
BASIN AREA = 2.50 ACRES
RUNOFF COEFF. = 0.40
RAINFALL INT. = 8.94 IN/HR
TIME OF CONC. = 10.00 MINUTES

TIME (MIN)	RUNOFF (CFS)
0.0	0.0
5.0	4.5
10.0	8.9
15.0	6.5
20.0	4.0
25.0	3.2
30.0	2.5
35.0	2.2
40.0	1.9
45.0	1.7
50.0	1.5
55.0	1.4
60.0	1.2
65.0	1.1
70.0	1.0
75.0	1.0
80.0	0.9
85.0	0.9
90.0	0.8
95.0	0.4
100.0	0.0
105.0	0.0
110.0	0.0
115.0	0.0
120.0	0.0
125.0	0.0
130.0	0.0
135.0	0.0
140.0	0.0
145.0	0.0



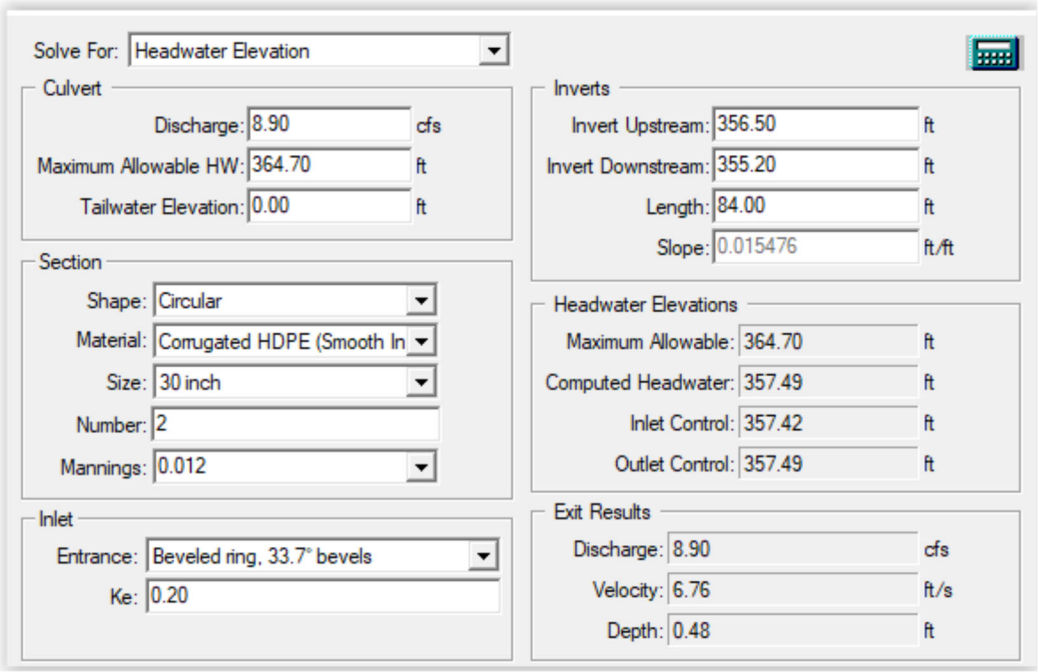
PEAK FLOW = 8.94 CFS
TIME TO PEAK = 10.00 MIN
TOTAL VOLUME = 13662.00 CU FT

ANALYSIS JUSTIFICATION - SECTION P-06 (CONT)
0.3% V-DITCH, 3:1 SIDES & MIN 1.92' HW DEPTH
MANNING N VALUE: 0.03 (GRASSED – CONSERVATIVE)
1.73-FEET CALCULATED HW DEPTH – MEETS Q-25 REQUIREMENT



* Bentley FlowMaster V8i – Triangular Channel Analysis

ANALYSIS JUSTIFICATION - SECTION P-06 (CONT)
TWO 84'X30" DIA HDPE, 8.2 MIN. HW DEPTH
0.99' CALCULATED HW DEPTH – MEETS Q-25 REQUIREMENT



* Bentley CulvertMaster – Culvert Analysis

Appendix 3: Plan Review Log

Plan Review and Changes in Facility Configuration

Scheduled reviews and Plan amendments shall be recorded in the Plan Review Log below. This log must be completed even if no amendment is made to the Plan as a result of the review.

By	Date	Amendment Description	P.E. Certification Required?	P.E. Name	Licensing State Registration No.
RHM	9/13/2021	Complete Reissue *	Yes	Robert H. Murray	Texas 59111

** Significant drainage modifications resulted in major differences require a complete reissue of the Plan*

Appendix 4: Professional Engineer Certification

Professional Engineer Certification Page

The undersigned licensed Professional Engineer (P.E.) attests that this Run-on and Run-off Control Plan has been prepared, reviewed, and/or revised in accordance with good engineering practice, including consideration of applicable industry standards and the requirements of 40 CFR 257. This certification in no way relieves the Owner or Operator of the facility of his/her duty to fully implement this Plan.

Engineer: _____
Robert H. Murray, P.E.

Registration Number: 59111

State: Texas

Date: _____

P.E. certification is required for the Original Plan and Plan Reviews and Amendments.