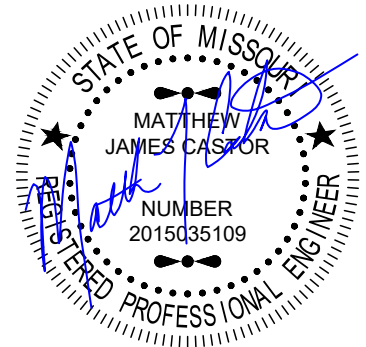


Technical Memorandum (Lakewood Pool Area Parking Lot Expansion)

To: City of Lee's Summit
Attn: _____
From: HG Consult (Matthew Castor)
Date: May 23, 2023
Re: Detention Pond Calculations



Introduction

The purpose of the study was to analyze the hydrology/hydraulics of the Lakewood Pool Area Parking Lot Expansion and determine detention pond sizes in accordance with APWA 5600 (Stormwater Detention and Retention) and City of Lee's Summit requirements.

The subject property is a platted parcel located in the south corner of NE Channel Drive and NE Dick Howser Drive in the Lakewood Development. The parcel is developed and is currently zoned R1 per the city's zoning map. The existing parking lot is unable to accommodate the needs of the association therefore they would like to add 31 additional parking spaces and 11,413.39 SF of pavement. Detention is being proposed via a PavDrain system under the proposed parking lot to capture the runoff from the proposed improvements. A perforated pipe will be installed under the PavDrain system that will discharge approximately 200 feet to the southeast. An SCS curve number of 98 was applied to the proposed parking area. The comprehensive control release rates as shown in APWA 5608.4 were applied to the calculations. The proposed detention does not release the WQ event (1.37" of rainfall) over a 40-hour duration. However, the proposed concrete modular blocks provide a water quality value rating higher than the required level of service. See water quality hydrograph and water quality section for additional information. An SCS 24-hour hydrograph with a Type II distribution was used for all calculations. The analysis was completed with PondPack Connect Edition utilizing SCS Hydrograph methodology. Time of concentration was assumed at 5 minutes for calculations. The subsequent 100-Year event with the primary outlet clogged will be routed overland across the parking lot.

Findings

Table I – Methodology and Rainfall Data

Methods and Rainfall Data	
Pond Routing	Pondpack using SCS Method
Existing CN	74
T _c	5 minutes
Water Quality, type II, 24-hr	1.4 inch
2-yr rainfall, type II, 24-hr	3.5 inch
10-yr rainfall, type II, 24-hr	5.3 inch
100-yr rainfall, type II, 24-hr	7.7 inch

Existing Drainage Areas and CN Values

Area ID	Area (SF)	CN Value (Existing)
Proposed Parking	11,413	74

Proposed Drainage Areas and CN Values

Area ID	Area (SF)	CN Value (Proposed)
Proposed Parking	11,413	98

Allowable Discharge

	2-Year	10-Year	100-Year
Discharge for Parking Lot (as calculated) (cfs)	0.50	1.07	1.91
*Allowable Discharge for Parking Lot (cfs)	0.13	0.52	0.79

*Comprehensive values utilizing 0.5 cfs (2-Year), 2 cfs (10-Year), and 3 cfs (100-Year) per site acre applied

Proposed Flow Values and Pond Results

	2-Year	10-Year	100-Year	100-Year*
P-1 POI (Detention Pond Discharge) (cfs)	0.10	0.11	0.11	2.08
Detention Pond WSE	928.85	929.10	929.46	929.68
Freeboard	2.82	2.55	2.22	N/A

*Assumes zero flow through primary outlet with subsequent 1% storm event

Detention Pond Input Data/Outlet Structure Design

	ELEV
3" Perforated Pipe (Upstream Invert)	927.86
3" Perforated Pipe (Downstream Invert)	925.69
Top of Pond	929.50

*Assumes zero flow through primary outlet with subsequent 1% storm event

Water Quality

Water Quality is being achieved via the pervious pavement (modular concrete blocks). These modular concrete blocks provide an overall Value Rating (VR) of 7.5. The weighted VR for the developed portion of the site is also 7.5 due to the entire area (100% of the proposed parking lot) being treated via the modular concrete blocks. Because of this being a previously developed site, the required level of service (LS) is 6.8. Due to the fact that the VR exceeds the LS no additional water quality BMP's are required. See Chapter 4 of the MARC/APWA BMP Manual for additional information.

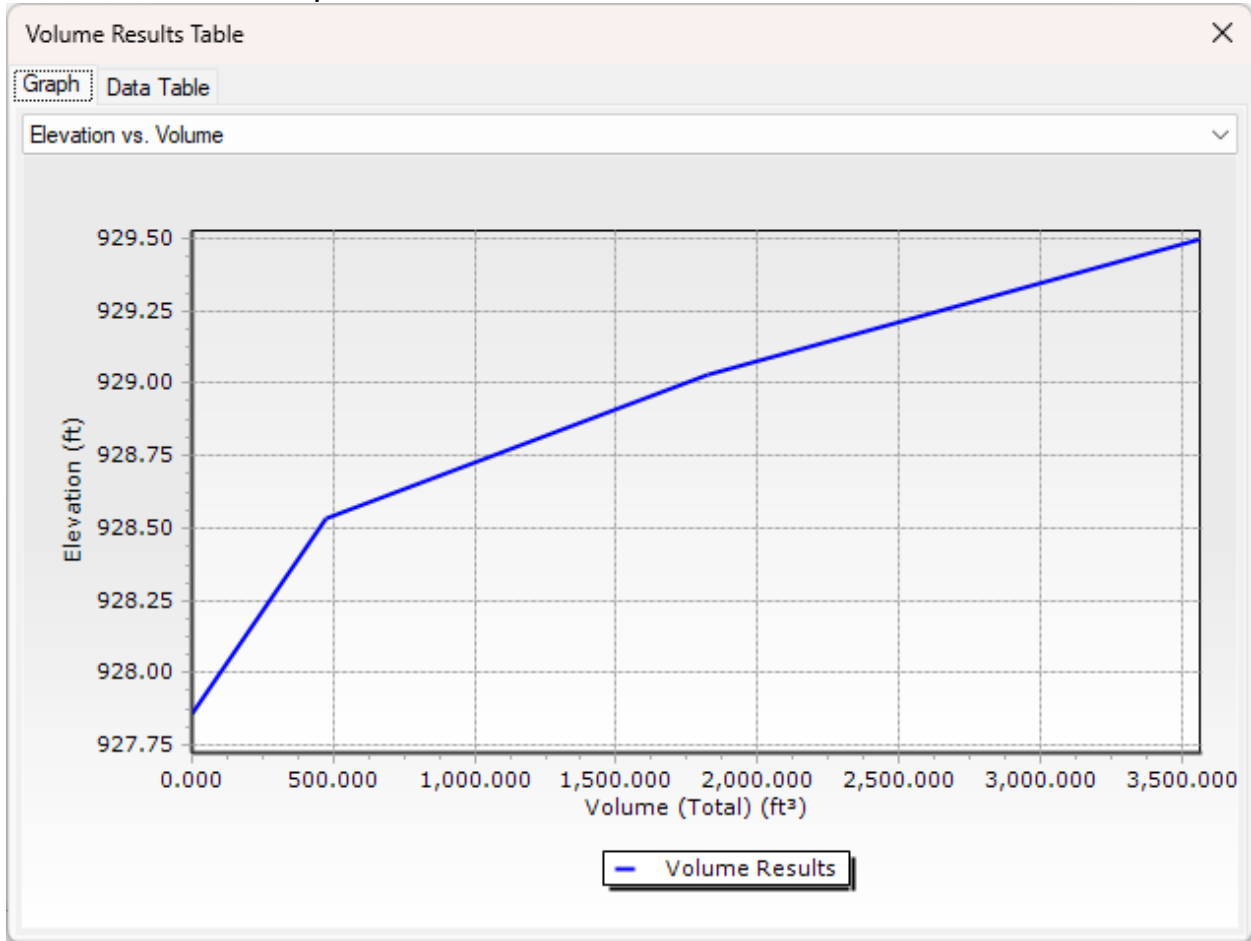
Water Quality Hydrograph



Detention Pond Volume Table

Volume Results Table						
Graph Data Table						
	Elevation (ft)	Planimeter (ft ²)	Area (ft ²)	A1+A2+sqr (A1*A2) (ft ²)	Volume (ft ³)	Volume (Total) (ft ³)
1	927.86	0.0	0.000	0.000	0.000	0.000
2	928.53	0.0	2,121.330	2,121.330	474.000	474.000
3	929.03	0.0	3,314.580	8,087.573	1,348.000	1,822.000
4	929.50	0.0	4,142.810	11,163.018	1,749.000	3,571.000

Detention Pond Volume Graph



Conclusion

The proposed development will provide comprehensive control for all developed areas via a PaveDrain system under the proposed parking area. The PaveDrain system will discharge to the south via 3" perforated schedule 40 PVC. The subsequent 100-Year storm event will flow overland across the top of the parking lot.

As mentioned previously in this report, due to the size and constraints of this site, the proposed system does not release the WQ event over a 40-hour duration however the required level of service is achieved via the modular concrete blocks.

See attached Pondpack calculations for additional information.

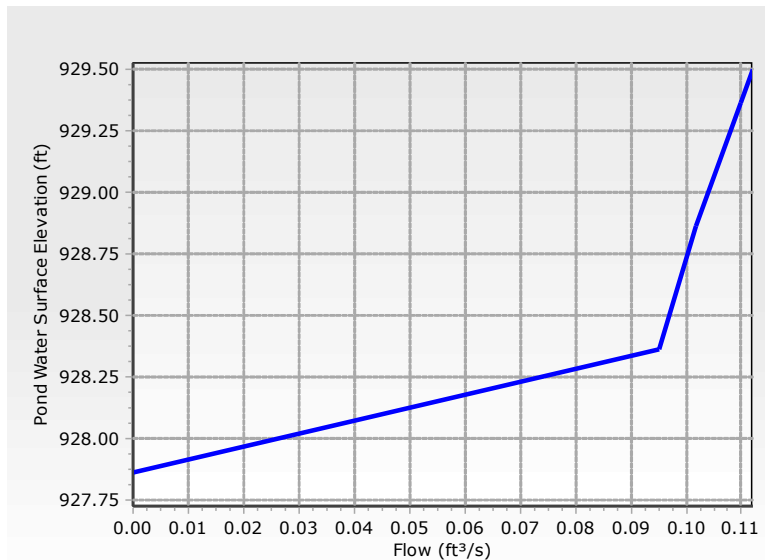
Composite Outlet Structure Detailed Report: Composite Outlet Structure

Element Details			
Label	Composite Outlet Structure	Notes	
Headwater Range			
Headwater Type	Use Pond for Headwater Range	Maximum (Headwater)	929.50 ft
Pond Minimum (Headwater)	PaveDrain 927.86 ft	Increment (Headwater)	0.50 ft
SpotElevation (ft)			
Tailwater Setup			
Tailwater Type	Free Outfall		
Tailwater Tolerances			
Maximum Iterations	30	Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft	Flow Tolerance (Minimum)	0.001 ft ³ /s
Headwater Tolerance (Maximum)	0.50 ft	Flow Tolerance (Maximum)	10.000 ft ³ /s
Tailwater Tolerance (Minimum)	0.01 ft		
Outlet Structure			
Outlet Structure Type	Culvert	Culvert Type	Circular
Outlet Structure (IDs and Direction)			
Outlet ID	Culvert	Downstream ID	Tailwater
Flow Direction	Forward Flow Only	Notes	
Outlet Structure (Advanced)			
Elevation (On)	0.00 ft	Elevation (Off)	0.00 ft
Culvert Data			
Number of Barrels	1	Downstream Invert	925.69 ft
Length	217.00 ft	Diameter	3.0 in
Upstream Invert	927.86 ft		
Unsubmerged->Submerged			
Specify Transitions	False	Compute Inlet Control Only	False

Composite Outlet Structure Detailed Report: Composite Outlet Structure

Culvert Coefficients			
Inlet Description	Concrete - Groove end projecting	C	0.0317
Chart	Chart 1	Y	0.6900
Nomograph	Nomograph 3	Manning's n	0.013
Equation Form	Form 1	Ke	0.200
K	0.0045	Kr	0.000
M	2.0000	Slope Correction Factor	-0.500

Culvert (Advanced)			
Convergence Tolerance	0.00 ft	Specify Number of Backwater Sections	False



RATING TABLE FOR ONE OUTLET TYPE
 Structure ID = Culvert (Culvert-Circular)

 Mannings open channel maximum capacity: 0.10 ft³/s
 Upstream ID = (Pond Water Surface)
 Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)

Composite Outlet Structure Detailed Report: Composite Outlet Structure

RATING TABLE FOR ONE OUTLET TYPE
 Structure ID = Culvert (Culvert-Circular)

 Mannings open channel maximum capacity: 0.10 ft³/s
 Upstream ID = (Pond Water Surface)
 Downstream ID = Tailwater (Pond Outfall)

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
927.86	0.00	(N/A)	0.00
928.36	0.10	(N/A)	0.00
928.86	0.10	(N/A)	0.00
929.36	0.11	(N/A)	0.00
929.50	0.11	(N/A)	0.00

Computation Messages

Upstream HW & DNstream TW < Inv.El FULL FLOW...Lfull=104.32ft Vh=.059ft HL=1.283ft Hev= .00ft FULL FLOW...Lfull=202.94ft Vh=.067ft HL=2.780ft Hev= .00ft FULL FLOW...Lfull=211.26ft Vh=.078ft HL=3.363ft Hev= .00ft FULL FLOW...Lfull=212.26ft Vh=.081ft HL=3.513ft Hev= .00ft

Composite Outlet Structure Detailed Report: Composite Outlet Structure

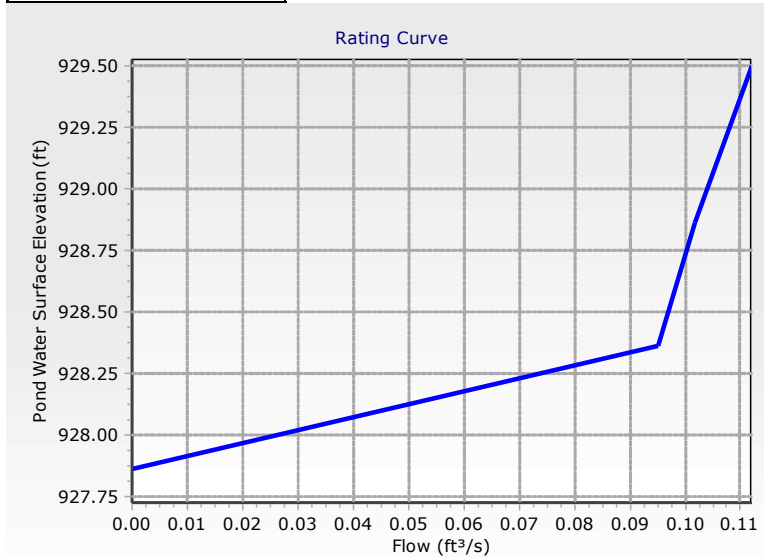
Composite Rating Table

Tailwater Elevation = Free Outfall (Composite Outlet Structure)

Water Surface Elevation (ft)	Flow (ft ³ /s)	Tailwater Elevation (ft)	Convergence Error (ft)
927.86	0.00	(N/A)	0.00
928.36	0.10	(N/A)	0.00
928.86	0.10	(N/A)	0.00
929.36	0.11	(N/A)	0.00
929.50	0.11	(N/A)	0.00

Contributing Structures

None Contributing
Culvert
Culvert
Culvert
Culvert



Lakewood Pool Area Parking Lot Expansion

Project Summary

Title	Lakewood Pool Area Parking Lot Expansion (2, 10, & 100-Yr)
Engineer	Matthew Castor
Company	Hg Consult, Inc
Date	5/2/2023

Notes

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Master Network Summary

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Lakewood Pool Area Parking Lot Expansion

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Parking Lot	Post-Development 2 year	2	3,107.000	11.920	1.19
Parking Lot	Post-Development 10 year	10	4,815.000	11.920	1.81
Parking Lot	Post-Development 100 year	100	7,095.000	11.920	2.63

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Outfall	Post-Development 2 year	2	3,107.000	12.460	0.10
Outfall	Post-Development 10 year	10	4,815.000	12.780	0.11
Outfall	Post-Development 100 year	100	7,095.000	13.280	0.11

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft ³)
PaveDrain (IN)	Post-Development 2 year	2	3,107.000	11.920	1.19	(N/A)	(N/A)
PaveDrain (OUT)	Post-Development 2 year	2	3,107.000	12.460	0.10	928.85	1,276.000
PaveDrain (IN)	Post-Development 10 year	10	4,815.000	11.920	1.81	(N/A)	(N/A)
PaveDrain (OUT)	Post-Development 10 year	10	4,815.000	12.780	0.11	929.10	2,074.000
PaveDrain (IN)	Post-Development 100 year	100	7,095.000	11.920	2.63	(N/A)	(N/A)
PaveDrain (OUT)	Post-Development 100 year	100	7,095.000	13.280	0.11	929.46	3,394.000

Lakewood Pool Area Parking Lot Expansion

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Master Network Summary...2

Lakewood Pool Area Parking Lot Expansion - Primary Outlet Clogged

Project Summary

Title	Lakewood Pool Area Parking Lot Expansion - Primary Outlet Clogged
Engineer	Matthew Castor
Company	Hg Consult, Inc
Date	5/2/2023

Notes

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Master Network Summary

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Lakewood Pool Area Parking Lot Expansion - Primary Outlet Clogged

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Parking Lot	Post-Development 100 year	100	7,095.000	11.920	2.63

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)
Outfall	Post-Development 100 year	100	7,095.000	11.990	2.08

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ft ³)	Time to Peak (hours)	Peak Flow (ft ³ /s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ft ³)
PaveDrain (IN)	Post-Development 100 year	100	7,095.000	11.920	2.63	(N/A)	(N/A)
PaveDrain (OUT)	Post-Development 100 year	100	7,095.000	11.990	2.08	929.68	4,336.000

Lakewood Pool Area Parking Lot Expansion - Primary Outlet Clogged

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Master Network Summary...2