NEW LONGVIEW MANSION PARKING LOT STORMWATER DRAINAGE STUDY

Prepared for:

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Olsson Project No. 022-06318

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1. INTRODUCTION

This Stormwater Drainage Study has been prepared to evaluate the stormwater hydrology of a proposed parking lot within the New Longview Mansion (NLV Mansion) property. The proposed parking lot will be placed on portions of developed and undeveloped areas.

The site is located northwest of the NLV Mansion building in Lee's Summit, Jackson County, Missouri. Figure 1 shows the general location of the proposed parking lot within the NLV Mansion property.

Stormwater runoff from the project site is tributary to Longview Lake, approximately 1/4 mile downstream of the study area.

This report is intended to serve as the project Stormwater Drainage Study for the NLV Mansion parking lot and has been prepared to evaluate the Existing and Proposed Conditions stormwater hydrology. Refer to Appendix B and C for hydrologic model input data and simulation results for Existing and Proposed Conditions. Refer to Appendix A for maps and exhibits.

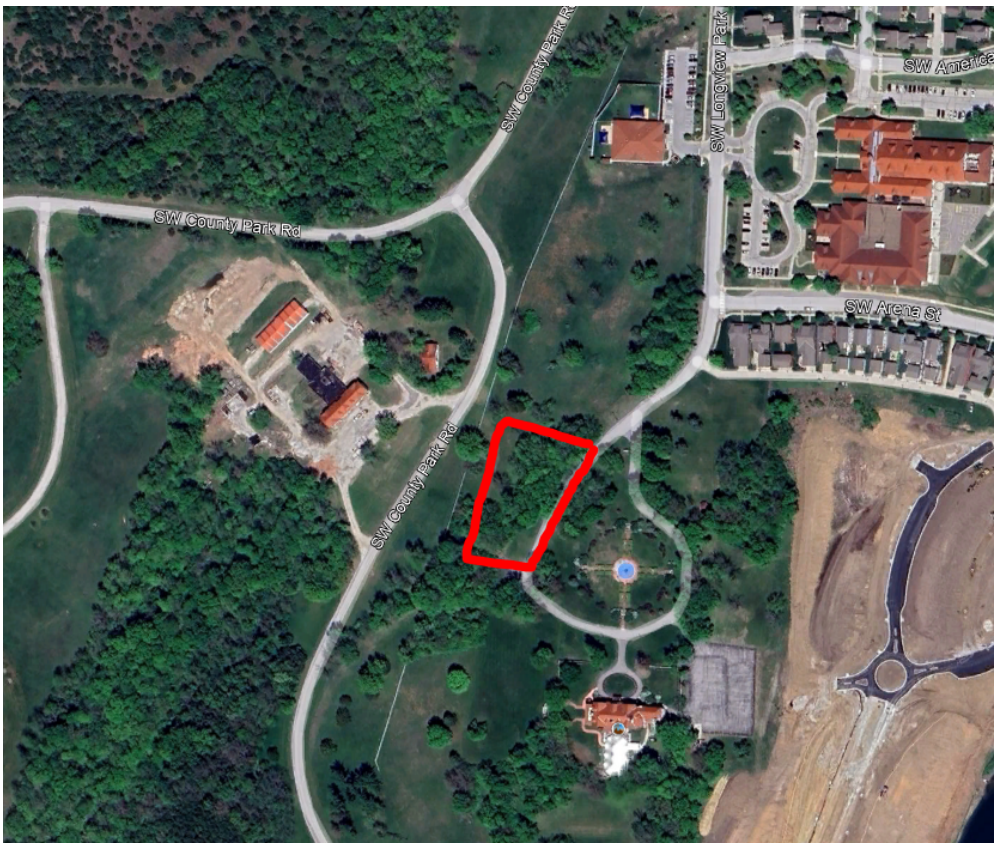


Figure 1. Vicinity Map

1.1. FEMA Floodplain Classification

The FEMA FIRM Panel 29095C0414G (eff. January 20, 2017) depicts the proposed development areas as “Zone X.” This zone is described as “areas determined to be outside the 0.2% annual-chance floodplain.” Refer to the attached FEMA Floodplain Map (Exhibit 8-1.1) for depiction of the established floodplains relative to the project site.

1.2. Soil Classification

Soil Maps published in the Soil Survey for Jackson County, Missouri categorizes soils in the study area as:

Table 1. Soil Classifications

Hydrologic Soil Group	Map Symbol	Type	Slopes
C/D	30080	Greenton silty clay loam	5-9%
D	10128	Sharpsburg-Urban land complex	2-5%
C/D	10117	Sampsel silty clay loam	5-9%
C	99034	Udarents-Urban land complex	9-20%

NRCS Runoff Curve Numbers (CN’s) in this study have been assigned to tributary areas based upon these Hydrologic Soil Groups (HSG’s) and associated existing and proposed land use. Land uses in the study area include open space, streets, and residential lots for twin gallery homes. The CN’s are assigned accordingly. Refer to the Soils Map in Appendix A for distribution of soil types throughout the sub-watersheds.

2. METHODOLOGY

The base data for the models prepared for this report has been obtained from available online maps and aerial imagery. Stormwater management is based upon methods and objectives defined in the Kansas City Metropolitan Chapter of the American Public Works Association's (KC-APWA) 2011 design guidance document called "Section 5600 Storm Drainage Systems & Facilities" (2011).

Runoff rates were analyzed using Autodesk Storm and Sanitary Analysis 2022 (SSA). SSA utilizes the following methods to model Existing and Proposed Conditions for stormwater runoff.

- NRCS TR-55 Unit Hydrograph Method
- 2-, 10-, and 100-year Return Frequency, 24-hour Storm Precipitation Depths (TP-40)
    - ARC Type II Soil Moisture Conditions
    - 24-Hour NRCS Type II Rainfall Distribution
    - Runoff Curve Numbers per NRCS TR-55 (Tables 2-2a – 2-2c) and KCAPWA Section 5602.3
    - NRCS TR-55 Methods for determination of Time of Concentration and Travel Time.
        - Note: SSA models use "Time of Concentration" for computing subarea hydrology.

Stormwater runoff models were created for the 2-, 10-, and 100-year design storm events. The precipitation depths used in the analysis have been interpolated from the "Technical Paper No. 40 Rainfall Frequency Atlas of the United States" (TP-40) isopluvial maps (May 1961). Table 2 below summarizes the rainfall depths used in this analysis:

Table 2. Precipitation Depths.

Return Period	24-Hour Precipitation Depth (inches)
Water Quality Storm* (WQ)	1.37
2-Year (50% Storm)	3.60
10-year (10% Storm)	5.34
100-Year (1% Storm)	7.90

*The "Water Quality Storm" is defined in the MARC & APWA "Manual of Best Management Practices for Stormwater Quality" as a 24-hour 1.37" rainfall depth. This particular storm event is utilized for proposed water quality analysis.

3. EXISTING CONDITIONS ANALYSIS

To quantify the effects of the proposed parking lot, the following area and point of interest have been chosen for existing and proposed conditions analysis. See Exhibit 01 – Existing Conditions Drainage Map in Appendix A for a visual depiction of the drainage area and point of interest.

Drainage Area represents the area north of the NLV Mansion building, which slopes westward toward the existing road, then discharges to an existing pipe running under SW County Park Road. In existing conditions, the drainage area has an area of 10.56 acres.

Point of Interest A is located at a storm pipe that runs under SW County Park Road. This point compares the drainage area for both models.

Tables 3, 4, and 5 below summarize the results of the existing conditions analysis. The proposed conditions data is compared to these results in Section 4 of this report. Refer to Appendix B for output and a schematic for the existing conditions model and detailed calculations for the time of concentration.

Curve numbers were determined for existing and proposed conditions as shown in Table 3.

Table 3. Curve Numbers.

Land Use	Hydrologic Soil Group	Curve Number
Woods & Grass Combination	D	79
Paved Parking & Roofs	D	98

Table 4. Existing Conditions Area Data.

Area Name	Total Area (acres)	T_C (hours)	Weighted Curve Number
A	10.56	0.294	80.47

Table 5. Existing Conditions Point of Interest Peak Flow Rates.

Point of Interest	Q_2 (cfs*)	Q_{10} (cfs)	Q_{100} (cfs)
A	20.52	39.26	65.27

*cfs = cubic feet per second

Per APWA Section 5608.4 and the City of Lee's Summit criteria, the performance criteria for comprehensive control is to provide detention to limit peak flow rates at downstream points of interest to maximum release rates:

- 50 percent storm peak rate less than or equal to 0.5 cubic feet per second (cfs) per site acre
- 10 percent storm peak rate less than or equal to 2.0 cfs per site acre
- 1 percent storm peak rate less than or equal to 3.0 cfs per site acre

Extended detention of the 90 percent mean annual event is also required for comprehensive control per APWA Section 5608.4.

Allowable release rates were calculated for the point of interest. Table 6 below summarizes the amount of area and the allowable discharges for each storm event.

Table 6. Allowable Peak Flow Rates.

Point of Interest	Allowable 2-Year (cfs)	Allowable 10-Year Q (cfs)	Allowable 100-Year Q (cfs)
A	5.28	21.12	31.68

4. PROPOSED CONDITIONS ANALYSIS

The proposed conditions sections of this analysis assume the parking lot at NLV Mansion is fully constructed. This analysis includes the construction of the pavement, ribbon curb, and BMPs. The difference between the existing conditions model and the proposed conditions model will be evaluated in this section as well as the allowable release rates. Refer to Exhibit 02 – Proposed Conditions Drainage Map in Appendix A for a visual depiction of the drainage areas and points of interest.

During the pre-application meeting for this project, it was agreed upon with City of Lee's Summit officials that detention for this project should be waived due to the proximity of the parking lot and Longview Lake at ¼ mile. To keep the balance of stormwater that drains from the site to Longview Lake close to the current time of concentration, detention of stormwater will not be included for this project. BMPs are still required to meet the MARC manual water quality volume requirements.

4.1. Effects of Development

The proposed conditions analysis assumes completion of the parking lot at NLV Mansion. The modeled point of interest is the same as the existing conditions model. The drainage area also remains the same since the parking lot is surrounded by the drainage area boundary. The following is a summary of the proposed conditions drainage area. See Exhibit 02 – Proposed Conditions Drainage Map in Appendix A. Table 7 summarizes the proposed conditions area data.

Drainage Area represents the same area as described in the existing conditions. Impervious area and curve number have been increased due to the parking lot.

The analysis provided in Section 3 established existing conditions of the parking lot's drainage area.

The following tables summarize the results of the proposed conditions analysis. Tables 7 and 8shows the effects of the parking lot for the drainage area. Refer to Appendix C for output and a schematic of the proposed conditions Storm and Sanitary Analysis 2022 model.

Table 7. Proposed Conditions Area Data.

Area Name	Total Area (acres)	T_C* (hours)	Weighted Curve Number
A	10.56	0.294	81.58

*Tc = Time of Concentration

Table 8. Proposed Conditions Point of Interest Peak Flow Rate.

Point of Interest	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A	21.56	40.49	66.57

Table 8 shows post-development peak discharge values at the points of interest.

Table 9. Proposed Conditions vs. Allowable Release Rates.

Point of Interest	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A	+16.28	+19.37	+34.89

Table 10. Proposed Conditions vs. Existing Conditions.

Point of Interest	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)
A	+1.04	+1.23	+1.30

Tables 9 and 10 show increases of flow from the proposed condition compared to the allowable release rates and existing conditions. Neither conditions can be met without detention. A waiver is requested that the proposed conditions be accepted as is, with the increase of these flows. It should be noted that the increase of the flow to existing conditions is not more than 6% for all storm events.

4.2. Proposed BMP Facilities

Although detention for the proposed parking lot is requested to be waived, water quality volume requirements must be met through BMPs. The treatment area for the BMPs will only include areas of disturbance, and not the entire drainage area. BMP Worksheet 1 in Appendix C shows that the level of service required for the parking lot is a 7, with most of the disturbed area being impervious.

With the requirement of a level of service 7, rain gardens will be used with the high value rating and small footprint required to meet the level of service. Overflow from the rain gardens both drain to the point of interest within the drainage area (see Exhibit-03 in Appendix A). Worksheets for calculations of the rain gardens can be found in Appendix C that show meeting the design criteria for water quality volume.

5. SUMMARY

This stormwater drainage study was prepared to evaluate the hydrologic impact generated by the development of NLV Mansion parking lot and to provide a comprehensive stormwater management plan for the proposed project. Once fully constructed, the area will include 79 parking stalls, pavement, pavement striping, and rain gardens.

Increases in peak flow rates caused by the project are requested to be waived per the proximity to Longview Lake. Water quality volume and level of service will be mitigated by two rain gardens.

6. CONCLUSIONS AND RECOMMENDATIONS

The results of the analysis demonstrate that the proposed stormwater management plan for the project achieves compliance with water quality volume requirements. Once constructed, all flows at the point of interest are above the existing conditions flows and allowable release rates. It is requested that the increase in flow rates be waived to keep flowrates to Longview Lake close to existing conditions and not withhold stormwater for an extended amount of time. We therefore request approval of this NLV Mansion Stormwater Drainage Study.

7. REFERENCES

KC-APWA (Kansas City Metropolitan Chapter of the American Public Works Association). (2011). “Section 5600 Storm Drainage & Facilities.”

United States Weather Bureau. “Technical Paper No. 40 Rainfall Frequency Atlas of the United States” (1961). Department of Commerce, Washington, D.C

APPENDIX A

Exhibits

LEGEND

- DRAINAGE AREA
- IMPERVIOUS AREA
- WOODS/GRASS

N

0’ 50’ 100’

SCALE IN FEET

OLSSON - CIVIL ENGINEERING
MISSOURI CERTIFICATE OF AUTHORITY # 001592

DWG: F:\2022\06001-06500\022-06318\40-Design\Reports\GNCV\Stormwater Drainage Study\Calcs\Existing Drainage Areas_02206318.dwg USER: ssaylor
DATE: Oct 26, 2023 12:20am XREFS: C_PBASE_02206318

PROJECT NO: 022-06318 DRAWN BY: SMS DATE: 10/25/2023	NLV MANSION PARKING LOT EXISTING CONDITIONS DRAINAGE MAP	olsson 1301 Burlington Street North Kansas City, MO 64116 TEL 816.361.1177

EXHIBIT

EX-01

LEGEND

- DRAINAGE AREA
- IMPERVIOUS AREA
- WOODS/GRASS

N

0' 50' 100'

SCALE IN FEET

OLSSON - CIVIL ENGINEERING
MISSOURI CERTIFICATE OF AUTHORITY # 001592

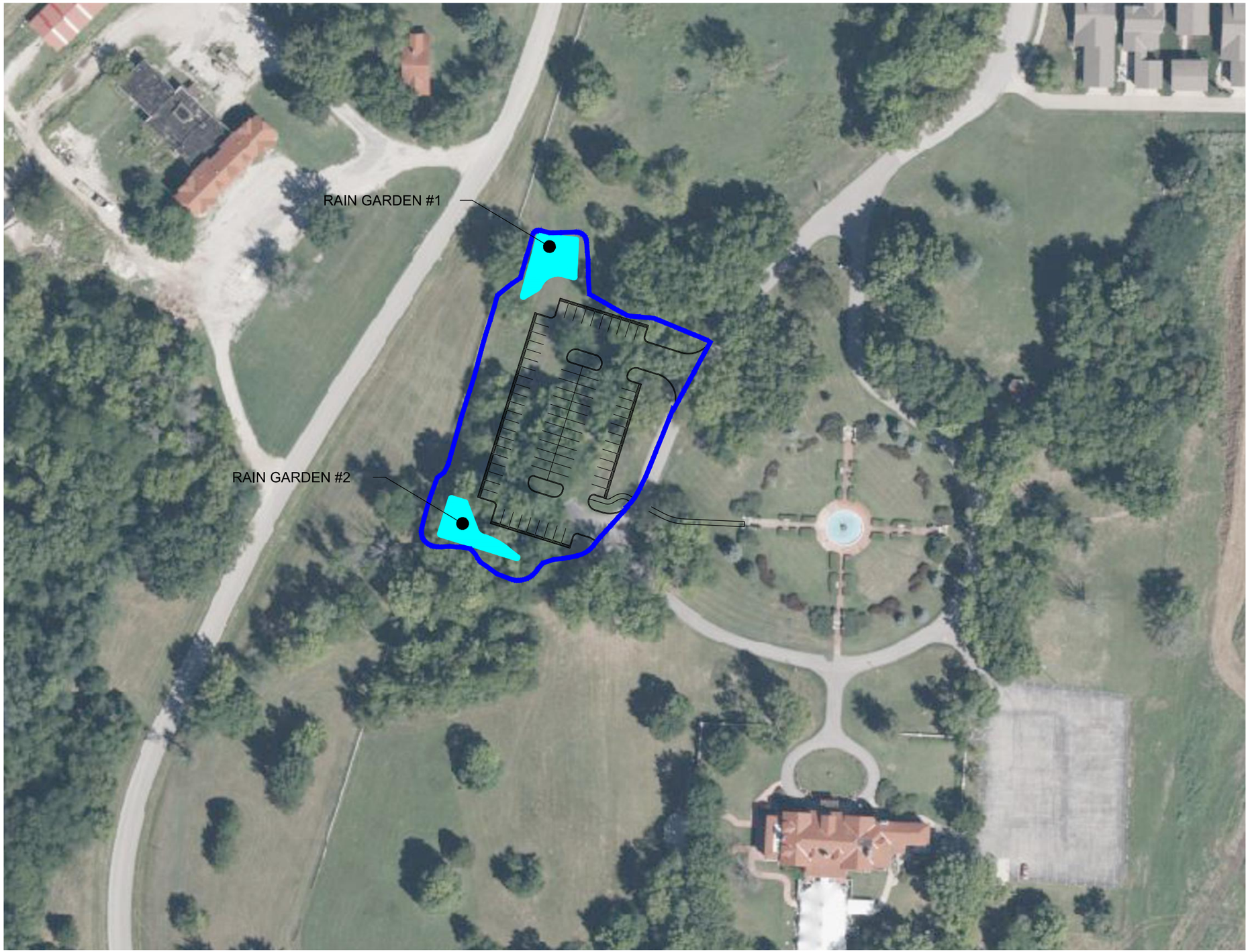
olsson
1301 Burlington Street
North Kansas City, MO 64116
TEL 816.361.1177

PROJECT NO:	022-06318
DRAWN BY:	SMS
DATE:	10/25/2023

NLV MANSION PARKING LOT
PROPOSED CONDITIONS DRAINAGE MAP

EXHIBIT
EX-02

DWG: F:\2022\06001-06500\022-06318\40-Design\Reports\GNCV\Stormwater Drainage Study\Calcs\Proposed Drainage Areas_02206318.dwg USER: ssaylor
DATE: Oct 26, 2023 12:20am XREFS: C_PBASE_02206318



LEGEND

TREATMENT AREA

RAIN GARDEN

N

0’ 50’ 100’

SCALE IN FEET

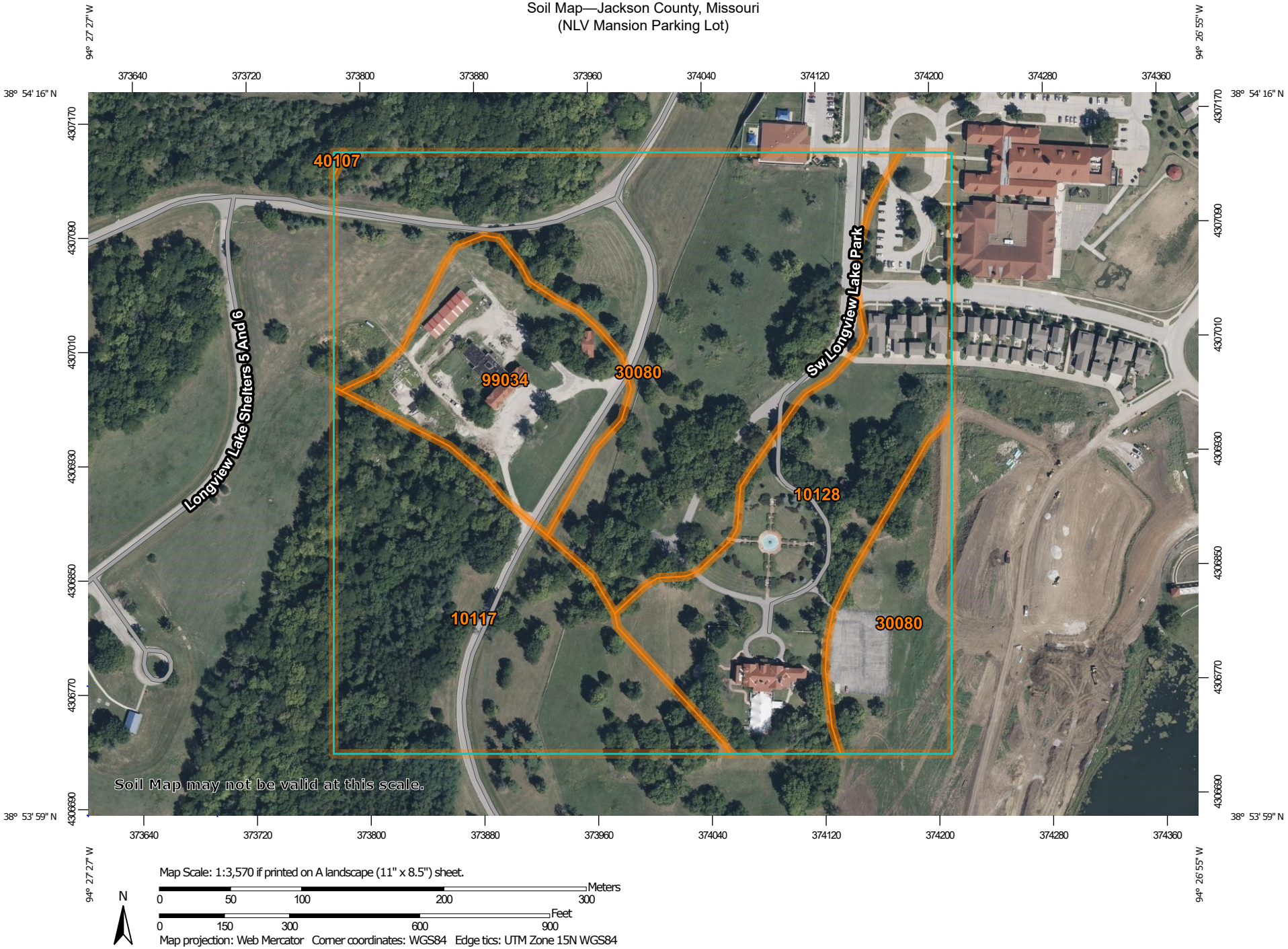
OLSSON - CIVIL ENGINEERING
MISSOURI CERTIFICATE OF AUTHORITY # 001592

DWG: F:\2022\06001-06500\022-06318\40-Design\Reports\GNCV\Stormwater Drainage Study\Calcs\Proposed BMP Exhibit_02300941.dwg USER: ssaylor
DATE: Oct 26, 2023 12:44am XREFS: C_PBASE_02206318

PROJECT NO: 022-06318	NLV MANSION PARKING LOT BMP MAP	EXHIBIT
DRAWN BY: SMS		EX-03
DATE: 10/27/2023		

olsson
1301 Burlington Street
North Kansas City, MO 64116
TEL 816.361.1177

Soil Map—Jackson County, Missouri
(NLV Mansion Parking Lot)



Map Scale: 1:3,570 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 25, Aug 22, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 30, 2022—Sep 8, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10117	Sampsel silty clay loam, 5 to 9 percent slopes	10.4	22.9%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	9.8	21.5%
30080	Greenton silty clay loam, 5 to 9 percent slopes	20.0	44.0%
40107	Snead-Rock outcrop complex, warm, 5 to 14 percent slopes	0.0	0.0%
99034	Udarents-Urban land complex, 9 to 20 percent slopes	5.3	11.6%
Totals for Area of Interest		**45.4**	**100.0%**

National Flood Hazard Layer FIRMette

94°27'29"W 38°54'21"N

94°26'52"W 38°53'53"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/25/2023 at 4:41 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

APPENDIX B

Existing Conditions Model Input and Results

50% Chance Storm

Project Description

File Name	Existing.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	002-YEAR	Cumulative	inches	Missouri	Jackson	2.00	3.50	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	10.56	484.00	80.47	3.50	1.67	17.63	20.52	0 00:17:38

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 10.56
Peak Rate Factor 484
Weighted Curve Number 80.47
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Good	9.74	D	79
Paved parking & roofs	0.82	D	98
Composite Area & Weighted CN	10.56		80.47

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2.49	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.11	0	0
Computed Flow Time (min) :	14.94	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	488	0	0
Slope (%) :	6.457	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.1	0	0
Computed Flow Time (min) :	1.98	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.03	0	0
Flow Length (ft) :	389	0	0
Channel Slope (%) :	2.57	0	0
Cross Section Area (ft²) :	28	0	0
Wetted Perimeter (ft) :	23	0	0
Velocity (ft/sec) :	9.08	0	0
Computed Flow Time (min) :	0.71	0	0

Total TOC (min) 17.64

Subbasin Runoff Results

Total Rainfall (in)	3.5
Total Runoff (in)	1.67
Peak Runoff (cfs)	20.52
Weighted Curve Number	80.47
Time of Concentration (days hh:mm:ss)	0 00:17:38

10% Chance Storm

Project Description

File Name	Existing.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	010-YEAR	Cumulative	inches	Missouri	Jackson	10.00	5.30	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	10.56	484.00	80.47	5.30	3.20	33.79	39.26	0 00:17:38

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 10.56
Peak Rate Factor 484
Weighted Curve Number 80.47
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Good	9.74	D	79
Paved parking & roofs	0.82	D	98
Composite Area & Weighted CN	10.56		80.47

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2.49	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.11	0	0
Computed Flow Time (min) :	14.94	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	488	0	0
Slope (%) :	6.457	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.1	0	0
Computed Flow Time (min) :	1.98	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.03	0	0
Flow Length (ft) :	389	0	0
Channel Slope (%) :	2.57	0	0
Cross Section Area (ft²) :	28	0	0
Wetted Perimeter (ft) :	23	0	0
Velocity (ft/sec) :	9.08	0	0
Computed Flow Time (min) :	0.71	0	0

Total TOC (min) 17.64

Subbasin Runoff Results

Total Rainfall (in)	5.3
Total Runoff (in)	3.2
Peak Runoff (cfs)	39.26
Weighted Curve Number	80.47
Time of Concentration (days hh:mm:ss)	0 00:17:38

1% Chance Storm

Project Description

File Name	Existing.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	100-YEAR	Cumulative	inches	Missouri	Jackson	100.00	7.70	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	10.56	484.00	80.47	7.70	5.40	56.99	65.27	0 00:17:38

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 10.56
Peak Rate Factor 484
Weighted Curve Number 80.47
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32

Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Good	9.74	D	79
Paved parking & roofs	0.82	D	98
Composite Area & Weighted CN	10.56		80.47

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2.49	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.11	0	0
Computed Flow Time (min) :	14.94	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	488	0	0
Slope (%) :	6.457	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.1	0	0
Computed Flow Time (min) :	1.98	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.03	0	0
Flow Length (ft) :	389	0	0
Channel Slope (%) :	2.57	0	0
Cross Section Area (ft²) :	28	0	0
Wetted Perimeter (ft) :	23	0	0
Velocity (ft/sec) :	9.08	0	0
Computed Flow Time (min) :	0.71	0	0

Total TOC (min) 17.64

Subbasin Runoff Results

Total Rainfall (in)	7.7
Total Runoff (in)	5.4
Peak Runoff (cfs)	65.27
Weighted Curve Number	80.47
Time of Concentration (days hh:mm:ss)	0 00:17:38

APPENDIX C

Proposed Conditions Model Input and Results

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10/26/2023

WORKSHEET 1: REQUIRED LEVEL OF SERVICE - UNDEVELOPED SITE

Project :	NLV Mansion Parking Lot		
Location:	Lee's Summit, MO		
By:	SMS	Date:	10/25/2023
Checked:		Date:	

1. Runoff Curve Number

A. Predevelopment CN

Cover Description	Soil HSG	CN	Area (ac.)	Product of CN x Area
Woods-grass (Good)	D	79	1.23	97.17
		Totals:	1.23	97.17

Area-Weighted CN = total product/total area = 79 | 79

B. Postdevelopment CN

Cover Description	Soil HSG	CN	Area (ac.)	Product of CN x Area
Woods-grass (Good)	D	79	0.58	45.82
Paved Parking and Roofs	D	98	0.65	63.70
		Totals:	1.23	110

Area-Weighted CN = total product/total area = 89.04065 | 89

C. Level of Service (LS) Calculation

Predevelopment CN:	79
Postdevelopment CN:	89
Difference:	10
LS Required:	7

Change in CN	LS
17+	8
7 to 16	7
4 to 6	6
1 to 3	5
0	4
-7 to -1	3
-8 to -17	2
-18 to -21	1
-22 -	0

10/26/2023

olsson

WORKSHEET 2: DEVELOP MITIGATION PACKAGE(S) THAT MEET THE REQUIRED LS

Project : NLV Mansion Parking Lot
Location: Lee's Summit, MO
By: SMS
Checked:

Date: 10/25/2023
Date:

1. Required LS (from Table 1 or 1A or Worksheet 1 or 1A, as appropriate): 7

2. Proposed BMP Option Package No. 1

Plan ID	BMP #	Cover/BMP Description	Treatment Area	VR from Table 4.4 or 4.6	Product of VR x Area
	1	Rain Garden	1.14	9.00	10.26
	2		0.00	0.00	0.00
	3		0.00	0.00	0.00
	4		0.00	0.00	0.00
	5		0.00	0.00	0.00
	6		0.00	0.00	0.00
	7		0.00	0.00	0.00
	8		0.00	0.00	0.00
	-	Untreated Area	0.09	-	-
		Total:	**1.23**	**Total:**	**10.26**
			Weighted VR		**8.34**

Meets required LS (Yes/No)? YES (if No, or if additional options are being tested, proceed below)

3. Proposed BMP Option Package No. 2

Plan ID	BMP #	Cover/BMP Description	Treatment Area	VR from Table 4.4 or 4.6	Product of VR x Area
	1		0.00	0.00	0
	2		0.00	0.00	0
	3		0.00	0.00	0
	4		0.00	0.00	0
	5		0.00	0.00	0
	6		0.00	0.00	0
	7		0.00	0.00	0
	8		0.00	0.00	0
	-	Untreated Area	1.23	-	-
		Total:	**1.23**	**Total:**	**0**
			Weighted VR		

Meets required LS (Yes/No)? (if No, or if additional options are being tested, proceed below)

50% Chance Storm

Project Description

File Name	Proposed.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	002-YEAR	Cumulative	inches	Missouri	Jackson	2.00	3.50	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	10.56	484.00	81.58	3.50	1.75	18.49	21.56	0 00:17:38

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 10.56
Peak Rate Factor 484
Weighted Curve Number 81.58
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Good	9.12	D	79
Paved parking & roofs	1.44	D	98
Composite Area & Weighted CN	10.56		81.58

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2.49	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.11	0	0
Computed Flow Time (min) :	14.94	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	488	0	0
Slope (%) :	6.457	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.1	0	0
Computed Flow Time (min) :	1.98	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.03	0	0
Flow Length (ft) :	389	0	0
Channel Slope (%) :	2.57	0	0
Cross Section Area (ft²) :	28	0	0
Wetted Perimeter (ft) :	23	0	0
Velocity (ft/sec) :	9.08	0	0
Computed Flow Time (min) :	0.71	0	0

Total TOC (min) 17.64

Subbasin Runoff Results

Total Rainfall (in)	3.5
Total Runoff (in)	1.75
Peak Runoff (cfs)	21.56
Weighted Curve Number	81.58
Time of Concentration (days hh:mm:ss)	0 00:17:38

10% Chance Storm

Project Description

File Name	Proposed.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	010-YEAR	Cumulative	inches	Missouri	Jackson	10.00	5.30	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	10.56	484.00	81.58	5.30	3.31	34.92	40.49	0 00:17:38

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 10.56
Peak Rate Factor 484
Weighted Curve Number 81.58
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Good	9.12	D	79
Paved parking & roofs	1.44	D	98
Composite Area & Weighted CN	10.56		81.58

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2.49	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.11	0	0
Computed Flow Time (min) :	14.94	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	488	0	0
Slope (%) :	6.457	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.1	0	0
Computed Flow Time (min) :	1.98	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.03	0	0
Flow Length (ft) :	389	0	0
Channel Slope (%) :	2.57	0	0
Cross Section Area (ft²) :	28	0	0
Wetted Perimeter (ft) :	23	0	0
Velocity (ft/sec) :	9.08	0	0
Computed Flow Time (min) :	0.71	0	0

Total TOC (min) 17.64

Subbasin Runoff Results

Total Rainfall (in)	5.3
Total Runoff (in)	3.31
Peak Runoff (cfs)	40.49
Weighted Curve Number	81.58
Time of Concentration (days hh:mm:ss)	0 00:17:38

1% Chance Storm

Project Description

File Name	Proposed.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	SCS TR-55
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	00:00:00	0:00:00
End Analysis On	00:00:00	0:00:00
Start Reporting On	00:00:00	0:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	1
Subbasins	1
Nodes	1
Junctions	0
Outfalls	1
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

SN	Rain Gage ID	Data Source	Data Source ID	Rainfall Type	Rain Units	State	County	Return Period (years)	Rainfall Depth (inches)	Rainfall Distribution
49		Time Series	100-YEAR	Cumulative	inches	Missouri	Jackson	100.00	7.70	SCS Type II 24-hr

Subbasin Summary

SN	Subbasin ID	Area (ac)	Peak Rate Factor	Weighted Curve Number	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	Sub-01	10.56	484.00	81.58	7.70	5.53	58.35	66.57	0 00:17:38

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Out-01	Outfall	0.00					0.00	0.00					

Subbasin Hydrology

Subbasin : Sub-01

Input Data

Area (ac) 10.56
Peak Rate Factor 484
Weighted Curve Number 81.58
Rain Gage ID ..... Rain Gage-01

Composite Curve Number

32 Soil/Surface Description	Area (acres)	Soil Group	Curve Number
Woods & grass combination, Good	9.12	D	79
Paved parking & roofs	1.44	D	98
Composite Area & Weighted CN	10.56		81.58

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft^2)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.3	0	0
Flow Length (ft) :	100	0	0
Slope (%) :	2.49	0	0
2 yr, 24 hr Rainfall (in) :	3.5	0	0
Velocity (ft/sec) :	0.11	0	0
Computed Flow Time (min) :	14.94	0	0

Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	488	0	0
Slope (%) :	6.457	0	0
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	4.1	0	0
Computed Flow Time (min) :	1.98	0	0

Channel Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	0.03	0	0
Flow Length (ft) :	389	0	0
Channel Slope (%) :	2.57	0	0
Cross Section Area (ft²) :	28	0	0
Wetted Perimeter (ft) :	23	0	0
Velocity (ft/sec) :	9.08	0	0
Computed Flow Time (min) :	0.71	0	0

Total TOC (min) 17.64

Subbasin Runoff Results

Total Rainfall (in)	7.7
Total Runoff (in)	5.53
Peak Runoff (cfs)	66.57
Weighted Curve Number	81.58
Time of Concentration (days hh:mm:ss)	0 00:17:38

NEW LONGVIEW MANSION PARKING LOT STORMWATER REPORT

Lee's Summit, MO

October 2023

Olsson Project No. 022-06318