

# MACRO STORM WATER DRAINAGE STUDY

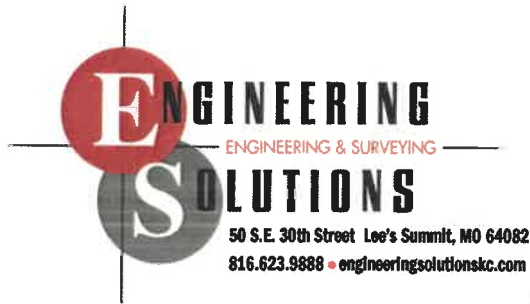
## Oldham Village

SW Quadrant SW Oldham Parkway & MO 291 South

Site Acreage: 49.68 Acres (Future Buildout)

Lee's Summit, MO

**PREPARED BY:**



Prepared On: May 22, 2024



### Revision

Date	Comment	By
6-25-24	Revised Per city Comment	AEP

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### **3. GENERAL INFORMATION**

The macro storm study has been prepared to evaluate potential negative downstream hydraulic impacts and propose potential mitigation measures associated with the redevelopment of the proposed Planned Mixed Use Development, Oldham Village. The proposed redevelopment will consist of three multi-family communities in addition to multiple commercial establishments. The site is located at the southwest corner of SW Oldham Parkway and MO 291 Highway. The proposed master development contains 45.41 acres with future potential up to 49.68 acres. The existing site is developed and contains primarily hard surface. An existing earthen detention basin is located on the southwest corner of the site. The detention basin drains into the upper most reach of Cedar Creek. The site consists of land located in Section 7, Township 47 North, and Range 31 West. See Exhibit A for an aerial view of the site along with a historical aerial of the site and surrounding area. A proposed site plan is also included in Exhibit A.

#### **3.1 FEMA FLOODPLAIN DETERMINATION**

The property is located in an Area of Minimal Flood Hazard, Zone X, according to Flood Emergency Management Agency (FEMA) Firm Map Number 29095C0419G, effective January 20, 2017.

See Exhibit B for a FEMA FIRMette which includes the proposed project area.

#### **3.2 NRCS SOIL CLASSIFICATION**

Soil classifications published by the United States Department of Agriculture/National Resources Conservation Service (USDA/NRCS) website for Jackson County, Missouri, Version 24, August 31, 2022. The existing site contains three major soil types:

- |       |  |
|-------|--|
| 10082 | Arisburg-Urban Land Complex, 1 to 5 Percent Slopes<br>Hydrologic Soils Group (HSG): Type C |
| 10181 | Udarents-Urban Land-Sampsel Complex, 5 to 9 Percent Slopes<br>(HSG): Type C                |
| 99033 | Udarents-Urban Land Complex, 2 to 9 Percent Slopes<br>(HSG): Type C                        |

See Exhibit C for a detailed soils report of the proposed project site.

### **4. METHODOLOGY**

This Macro Storm Drainage Study has been prepared to evaluate potential hydrologic impacts from the proposed redevelopment and recommend improvements to eliminate any potential negative impacts. The study utilized existing contours to create the Existing Drainage Area Map. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Using the above criteria, the proposed site was evaluated using SCS Methods to calculate storm runoff volumes, peak rates of discharge, existing and proposed hydrographs and required storage volumes for detention facilities. The analysis contains results for the 2, 10 and 100-year design storms.

### **5. EXISTING CONDITIONS ANALYSIS**

The site consists of one (1) drainage basin. The basin includes a substantial amount of offsite area to the north, south and east. The basin drains to Point of Interest A located approximately 260 feet west of the sites western property boundary. POI A is the termination point for the FEMA FIS on Cedar Creek. The tributary area to the

POI is 147.45+/- acres. The basin consists of 49.68 acres of proposed master development which includes potential future parcels and 97.77 acres of right-of-way and offsite area. The drainage basin has been essentially built out in the past and therefore currently has both open and enclosed storm sewer systems active throughout the basin. The basin generally drains to Cedar Creek located along the west central portion of the property. The basin is fairly symmetric with nearly equal portions draining from the north, east and south. The existing onsite detention basin area (Tract B) adjacent to Cedar Creek will continue to serve as detention for the proposed redevelopment.

An Existing Drainage Map may be found in Exhibit D. Hydraflow Hydrograph software was utilized to calculate SCS Method peak discharge rates. A complete breakdown of Existing and Proposed hydrographs may be found in Exhibit E. The following tables summarize the results of the Existing Conditions analysis.

**Table 5.1 Existing Conditions Subarea**

Subarea	Area (ac.)	Curve Number	Tc (min)
A	147.45	88	28.8

**Table 5.2 Existing Conditions Runoff Data: Peak Discharge Rates**

Subarea	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	303.47	508.68	809.50

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

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

The allowable offsite contribution was determined by the area ratio method. The allowable offsite peak discharge is the product of the ratio of offsite area to onsite area multiplied by a given storm's existing peak discharge rate. The allowable peak discharge rate is the sum of the offsite allowable plus the onsite allowable per APWA Section 5608.4. See allowable 100-year peak discharge rate calculation below.

$$\text{Example (100-YR): } [(97.77 / 147.45 \times 809.50) + (49.68 \times 3.0)] = 685.80 \text{ cfs}$$

**Table 5.3 Existing Conditions APWA Allowable Peak Discharge Release Rates**

POI	Onsite Area (ac.)	Offsite Area (ac.)	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	49.68	97.77	226.06	436.65	685.80

There are a few very minor subareas that are peripheral (free release) areas on the site consisting primarily of turf with no hard infrastructure improvements. These areas are not being negatively impacted by the proposed improvements. Subarea A will be the focus of this report.

## 6. PROPOSED CONDITIONS ANALYSIS

The proposed conditions analysis will include potential future Oldham Village lots located along MO 291 Highway south of SW Oldham Parkway. The proposed onsite area including potential future lots is 49.68 acres. Tributary runoff will be conveyed via both open and enclosed storm sewer systems to POI "A". A new retention system shall be constructed to attenuate post development runoff from Subarea A1 which includes a large

percentage of right-of-way and offsite area. Detained peak discharge rates from Subarea A1 will be combined with peak discharge rates from Subarea A to determine the overall peak discharge rates at POI “A”. The proposed peak discharge rates will be compared to allowable discharge rates to determine if they meet or exceed the City’s Comprehensive Control Storm Water Management criteria. The Proposed Drainage Map may be found in Exhibit F.

**Proposed Flow Rates**

Existing Subarea A has been divided into two subareas to account for proposed attenuation. Subarea A1 is located generally in the north and accounts for all proposed and potential future improvements for Oldham Marketplace. Subarea 1 will drain via open and enclosed storm sewer systems to a new earthen detention basin located adjacent to Cedar Creek on a parcel of property labeled Tract B. The remainder of the property which will not be detained is generally located in the southern portion of the basin and will be referred to as Subarea B. The composite curve numbers utilized for Subareas A and B consist of the following classifications and land usage specific curve numbers; right-of-way and single family residential 82, multi-family residential 88 and commercial 94.

**Table 6.1 Proposed Conditions Subarea Data**

Subarea	Area (ac.)	Composite CN	Tc (min)
A1	128.42	88	28.8
A	19.02	82	15.7

**Table 6.2 Proposed Conditions Runoff Data: Subarea Peak Discharge Rates**

Subarea	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A1	264.31	443.03	705.02
A	43.70	79.44	133.37
Combined (A1 + A)	294.69	498.80	799.42

As shown in Table 6.2 above Subarea A1 will require detention to attenuate storm runoff peak discharge rates at or below regulatory levels at POI A.

**6.1. DETENTION**

A new single stage earthen Detention basin A1 is being proposed in Subarea A1 to attenuate proposed peak discharge rates. Following are a list of design parameters for the attenuation system.

- Designation: Detention Basin A1
- Type: Earthen Basin
- Side Slopes: 3:1 Max.
- Bottom Slope: 0% (Water Quality)
- Basin Bottom Elevation: 994.00
- Basin Top Berm Elevation: 1004.00
- Basin Volume: 1,303,203 cf @ 1004.00
- Control Structure: (3) 8’x6’ Precast Concrete Box with Interior 6” Baffle/Weir Wall
- Baffle Wall Orifices: (1) 5.80”x5.80” Rectangular Orifice (WQv Orifice)
- Weir Wall Crest Elevation: 995.50
- Control Structure Top Elevation: 1002.00
- Control Structure Overflow Weir Openings: N/A – NO Field Inlet Openings
- Control Structure Influent Pipe: 60” HDPE, FL (In) = 994.00, FL (Out) = 993.90, L=20.5’, S= 0.49%

Control Structure Effluent Pipe: 60" HDPE, FL (In) = 993.70, FL (Out) = 993.50, L=50.0', S=0.40%  
 Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1001.50, Crest Length=240'  
 Consecutive 100-YR Q=705.02 cfs, Emergency Spillway HGL=1002.58, Freeboard=1.42'

The Detention Basin Plan for the Development may be found in Exhibit G. Basin A1 emergency spillway calculations may be found in Exhibit H. See Table 6.3 for a summary of detention basin data.

**Table 6.3 Proposed Conditions Detention Basin A1 Data**

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
Basin A1						
2-Year	264.31	731	132.01	749	997.63	403,738
10-Year	443.03	731	270.05	746	999.35	623,078
100-Year	705.02	731	485.33	743	1000.79	820,283

As shown in the table above all proposed peak discharge rates from Subarea A1 have been attenuated. See Table 6.4 below for a summary of proposed peak discharge rates at POI "A" which consists of combined subareas post detained A1 and A.

**Table 6.4 Proposed Conditions Post Detention Point of Interest Peak Discharge Rates**

Point of Interest	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	138.75	282.74	509.32

As shown in the above table all peak discharge rates attributable to Proposed POI "A" have been attenuated below both Existing and Allowable Peak Discharge rates as outlined in Tables 5.2 and 5.3, respectively.

Table 6.5 below provides a comparison of runoff data between Proposed, Existing and Allowable Conditions for the Proposed Development.

**Table 6.5 Point of Interest Discharge Comparison**

POI	Condition	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	Proposed	138.75	282.74	509.32
	Existing	303.47	508.68	809.50
	Difference	-164.72	-225.94	-300.18
	Allowable	226.06	436.65	685.80
	Difference	-87.31	-153.91	-176.48

All proposed peak discharge rates as shown in Table 6.5 will be significantly below allowable.

## 7. 40 HOUR EXTENDED DETENTION

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37"/24-hour rainfall). The proposed detention facility will release the water quality event over a period of 40-72 hours. See Exhibit I for 40 hour extended detention calculations for the basin.

## 8. DOWNSTREAM PEAK DISCHARGE EVALUATION

City personnel have requested the evaluation of peak discharge rates, downstream at the next major point of interest, to determine if attenuation on the subject project is efficacious for the watershed. FEMA completed a revised Flood Insurance Study (FIS) for Cedar Creek on January 20, 2017. As stated earlier in the report our

drainage boundary for the project stormwater management analysis started at the termination of the recently revised FEMA FIS. To accommodate the City’s request and to provide weight to our downstream analysis we consulted the FEMA FIS to select a downstream POI that could be corroborated. The first downstream POI in which peak discharge rates had been quantified in the FIS occurred approximately 580 feet downstream of Southwest Lakeview Boulevard. We selected said point, referred to as POI B for the purposes of this report, to determine and evaluate downstream peak discharge rates. See Exhibit J for FEMA FIS data and a Downstream Drainage Area Map.

The additional area (Subarea B) tributary to POI B downstream of POI A is 87.50 acres. Subarea B consists of park land, single family residential and a portion of Pleasant Lee Middle School Campus. The composite runoff coefficient for Subarea B equates to 0.51 or a curve number of 82. Composite curve number calculations may be found in Exhibit J along with time of concentration calculations. Hydraflow was used to generate existing and proposed peak discharge rates at POI B using SCS Methodology. Hydrographs pertaining to the downstream peak discharge evaluation may be found in Exhibit E.

Data for Subarea B was combined with data from Existing Subarea A. The combined data was used to generate hydrograph “POI B – NO DETENTION” to determine if our data was generating results commensurate with the FEMA FIS. FEMA does not provide peak discharge rates for the 2-year storm event. The 10 and 100-year FEMA FIS peak discharge rates at POI B are 536 cfs and 869 cfs, respectively. The “POI B – NO DETENTION” hydrograph generated peak discharge rates for the 10 and 100-year storm events of 548 cfs and 892 cfs, respectively. The 10 and 100-year peak discharge rates are within 2.24% and 2.65%, respectively. Based on the aforementioned results obtained from the independently derived data both the data and the methodology utilized were determined to be accurate for planning and design.

Table 8.1 below provides a Point of Interest peak discharge rate comparison between FEMA, Existing and Proposed conditions at POI B.

**Table 8.1 Point of Interest Discharge Comparison**

POI	Condition		Q10 (cfs)	Q100 (cfs)
B	Proposed		491.60	827.38
	Existing		548.30	892.27
	Difference		-56.70	-64.89

The proposed condition in Table 8.1 above represents 49.68 acres of Subarea A1 being attenuated based on a comprehensive control strategy as outlined in Section 6.1. The data compiled in Table 8.1 confirms that attenuation as outlined earlier in the report reduces peak discharge rates at both Points of Interest therefore reducing the likelihood of any potential flooding in the watershed.

**9. CONCLUSIONS & RECOMMENDATIONS**

Runoff from the Development will be reduced below both existing and allowable for the Subarea. A detention basin is being proposed in Subarea A1 to attenuate peak discharge rates. Detention Basin A1 will attenuate all proposed peak discharge rates below both Existing and Allowable. Attenuation as outlined will reduce peak discharge rates downstream. It is the opinion of the Professional Engineer that the proposed storm water management improvements outlined in the report will mitigate any negative hydraulic impacts onsite and downstream and therefore recommends approval of said improvements and the storm study.

