

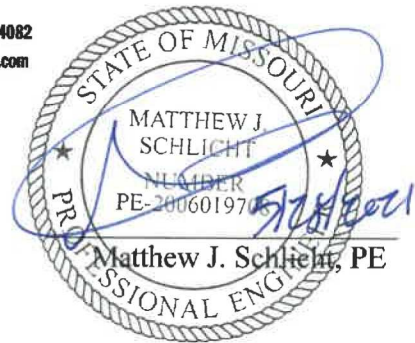
MACRO STORM WATER DRAINAGE STUDY

RANSON LANDING

Site Acreage: 25.7 Acres

SE Corner SE Ranson Road & SE Oldham Parkway
Lee's Summit, MO

PREPARED BY:



Revision

Date	Comment	By

MACRO STORM WATER DRAINAGE STUDY

RANSON LANDING

Site Acreage: 25.7 Acres

SE Corner SE Ranson Road & SE Oldham Parkway
Lee's Summit, MO

PREPARED BY:



Revision

Date	Comment	By

Matthew J. Schlicht, PE

TABLE OF CONTENTS

- 1. REPORT COVER SHEET**
- 2. TABLE OF CONTENTS**
- 3. GENERAL INFORMATION**
 - 3.1 FEMA FLOODPLAIN DETERMINATION**
 - 3.2 NRCS SOIL CLASSIFICATION**
- 4. METHODOLOGY**
- 5. EXISTING CONDITIONS ANALYSIS**
- 6. PROPOSED CONDITIONS ANALYSIS**
 - 6.1 DETENTION**
- 7. 40 HOUR EXTENDED DETENTION/INFILTRATION BMP**
- 8. CONCLUSIONS & RECOMMENDATIONS**
- 9. EXHIBITS**

3. GENERAL INFORMATION

This storm study has been prepared to evaluate potential hydrologic and hydraulic impacts related to the proposed development and recommend improvements designed to mitigate any anticipated negative impacts. The proposed mixed use development contains 25.7 acres and is to consist of 7 lots and a regional detention tract. Lot 1 plan use is a gas station. Lot 2 plan use is a drive thru. Lot 3 and 4 plan use is commercial. Lot 5 plan use is hotel/commercial. Lot 6 plan use is public storage and office/warehouse. Lot 7 plan use is townhomes 100 units. Ranson Landing the Development is bounded by SE Ranson Road on the west, SE Oldham Parkway to the north, newly constructed senior housing to the east and Princeton Heights single family residential subdivision to the south. The regional detention tract will be developed in the initial phase of construction and provide adequate capacity to serve the entire Development plus bypass storm runoff from Princeton Heights. See Exhibit A for an aerial image of the proposed project site along with an aerial image of the surrounding area. The existing site does not contain any storm sewer, water bodies, wetlands nor BMPs. The site is located in the SW 1/4 of Section 10, Township 47N, Range 31W, Lee's Summit, Jackson County, Missouri.

3.1 FEMA FLOODPLAIN DETERMINATION

The property is located in an Area of Minimal Flood Hazard, Zone X, according to FEMA Firm Map Number 29095C0439G, dated January 20, 2017.

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

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 22, May 29, 2020. The existing site contains three major soil types:

- | | |
|-------|---|
| 10000 | Arisburg Silt Loam, 1 to 5 Percent Slopes
Hydrologic Soils Group (HSG): Type C |
| 10082 | Arisburg-Urban Land Complex, 1 to 5 Percent Slopes
HSG: Type C |
| 10180 | Udarents-Urban Land – Sampsel Complex, 2 to 5 Percent Slopes
HSG: Type C |

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

4. METHODOLOGY

The study utilized existing city contours to create the Pre-Development 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 the Soil Conservation Service, SCS TR-55 method to calculate storm runoff volumes, peak rates of discharge, pre and post developed hydrographs and required storage volumes for detention facilities. TR-55 was first introduced in 1975 by the SCS particularly for small urbanizing watersheds. The analysis contains results for the 2, 10 and 100-year design storms.

Hydraflow Hydrographs Extension for AutoCAD Civil 3D was utilized to model the various SCS TR-55 stormwater rainfall runoff events. The following SCS TR-55 Unit Hydrograph variables were utilized;

- AMC II Soil Moisture Conditions
- 24-Hour SCS Type II Rainfall Distribution (Shape Factor 484)
- SCS Runoff Curve Numbers per SCS TR-55 (Tables 2-2a to 2-2c)

Time of Concentration has been calculated using the following formulas:

- Sheet Flow (Max. 100 LF): APWA 5602.5 Time Inlet, $T_1 = 1.8 * (1.1-C) * L^{1/2} / S^{1/3}$
- Shallow Concentrated Flow: SCS TR-55 Appendix F:

Unpaved	$V=16.1345(S)^{0.5}$
Paved	$V=20.3282(S)^{0.5}$

Shallow Concentrated Travel Time (min): SCS TR-55 Eq-3-1, $T_1 = L / V * 60$

- Channel Flow Improved: Manning’s Equation (Full Flow)
- Channel Flow Unimproved: APWA 5602.7.A. Travel Time, Table 5602-6

<u>Avg. Channel Slope (%)</u>	<u>Velocity (fps)</u>
< 2	7
2 to 5	10
>5	15

5. EXISTING CONDITIONS ANALYSIS

The existing site consists mainly of row-cropped farmland with some treed areas lining existing drainage ditches. The site generally drains from south to north via sheet, shallow concentrated and channel flow. The site contains one sub-basins referred to as Sub-basin A for the purposes of this report. The Sub-basin drains to Point of Interest (POI) A which corresponds to its given sub-basin drainage area. POI A consists of an RCB Culvert located under SE Oldham Parkway. Princeton Heights Subdivision upstream has a significant portion of property, 32.49 acres, which drains through the site via a drainage ditch. The senior housing located to the east of the property will drain to the roadside ditch along Oldham for further conveyance to POI A. The Existing Drainage Area Map is located in Exhibit D. Following is a brief description of each sub-basin.

Sub-basin A contains 79.2 acres. The Sub-basin consists of four major land usage groups; crop land, multi-family, single family housing and right-of-way. Following is a breakdown of the four land usage groups.

Crop Land	25.7 acres	CN = 74
Single Family	32.49 acres	CN = 82
Multi-Family	15.03 acres	CN = 88
<u>Right-of-Way</u>	<u>5.97 acres</u>	<u>CN = 82</u>
Composite CN	79.19 acres	CCN = 81

Princeton Heights the single family residential subdivision to the south contains the most hydraulically distant point to POI A and will therefore be utilized to calculate the time of concentration for Sub-basin A.

The following tables summarize the results of the Existing Conditions analysis. Composite curve number calculations by sub-basin may be found in Exhibit E. Time of concentration calculations by sub-basin may be found in Exhibit F. A complete breakdown of TR-55 unit hydrographs may be found in Exhibit G.

Table 5-1 Existing Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
A	79.19	81	20.9

Table 5-2 Existing Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	150.33	279.04	475.11

Per APWA 5608.4 and City of Lee’s Summit criteria, post development peak discharge rates from the site shall not exceed those indicated below:

- 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

Allowable release rates were calculated at POI A per the area ratio method. The proposed Development (25.7 acres) runoff shall not be more than the peak discharge rates stated above.

Allowable Release Example Calculations:

$$\text{Sub-basin A (2-Yr): } ((25.7 \times 0.5) + (79.19 - 25.7 / 79.19 \times 150.33)) = \underline{0.55 \text{ cfs}}$$

Table 5-3 Existing Conditions Sub-basin/Point of Interest Allowable Peak Discharge Release Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	114.39	239.88	398.02

6. PROPOSED CONDITIONS ANALYSIS

The Development will contain mixed uses as described in the general information section. A conceptual layout for the proposed Development may be found in Exhibit I which includes the proposed location of the earthen detention basin just upstream of the SE Oldham Parkway Box Culvert. As stated a single stage earthen detention basin will be utilized to attenuate runoff in the Sub-basin below allowable peak discharge rates as shown in Table 5-3. Runoff from Princeton Heights will continue to drain through the development and will be bypassed through the proposed detention system. The Proposed Drainage Area Map is located in Exhibit H.

Table 6-1 Proposed Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite CN	Tc (min.)
A	21.78	86	19.7
A1	57.41	87	19.7

Table 6-2 Proposed Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	53.04	91.05	2.13
A1	145.12	245.59	147.15
Combined A + A1	198.16	336.63	540.52

As shown above in Table 6-2 Sub-basin Combined A + A1 will require detention to attenuate peak discharge rates below Allowable Release Rates as shown in Table 5-3 for Sub-basin/POI A.

6.1 DETENTION

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

Designation: Detention Basin A1

Type: Earthen Basin

Side Slopes: 3:1 Max.

Bottom Slope: 2% Min., Turf Lined

Basin Bottom Elevation: 1004.00 @ Influent Pipe

Basin Top Berm Elevation: 1014.00

Basin Volume: 299,437 cf @ 1014.00

Control Structure: 60" RCP @ 1.00%

Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1013.00, Crest Length=100'

See Table 6-4 for a summary of detention basin data.

Table 6-4 Proposed Conditions Detention Basin Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
Basin C1						
2-Year	145.12	725	76.74	737	1009.12	115,367
10-Year	245.59	725	173.24	733	1010.63	166,617
100-Year	393.36	724	245.72	734	1013.26	267,989

As shown in the table above all proposed peak flowrates have been attenuated. See Table 6-5 below for a summary of proposed peak discharge rates at point of interest A. Hydrographs tributary to each point of interest have been combined to determine subsequent peak discharge rates.

Table 6-5 Proposed Conditions Post Detention Point of Interest Peak Discharge Rates

Point of Interest	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
A	109.51	246.78	372.35

As can be seen in the above table all peak discharge rates attributable to the proposed development have been attenuated below allowable release rates outlined in Table 5-3.

Table 6-6 below provides a comparison of runoff data between Proposed and Existing Conditions in addition to Proposed Conditions and Allowable Release Rates at each Point of Interest.

Table 6-6 Point of Interest Discharge Comparison

		Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
Point A	Proposed	109.51	246.78	372.35
	Existing	150.33	279.04	475.11
	Difference	-40.82	-32.26	-5.81
	Allowable	114.39	239.88	398.02
	Difference	-4.88	-6.9	-25.67

Peak discharge rates at Point A will be reduced below allowable for all design storms.

7. 40 HOUR EXTENDED DETENTION/INFILTRATION BMP

The large quantity of runoff contributing from Princeton Heights makes 40 hour extended detention unfeasible for the proposed development due to the existing geography and surrounding storm sewer systems. An infiltration type BMP is being proposed as an alternative to extended detention. The BMP will consist of 2.5' thick amended soil placed in the detention basin from the inlet to a given contour. See the detention basin plan for proposed amended soil placement and details.

8. CONCLUSIONS & RECOMMENDATIONS

This macro storm water drainage study shows that the proposed development will not generate any negative downstream hydraulic impacts. A new earthen detention basin will be required to provide detention for the proposed development.

In conclusion, proposed peak discharge rates for POI A are below allowable release rates. The study is in conformance with all applicable City of Lee's Summit standards and criteria therefore Engineering Solutions recommends approval of this macro storm water drainage study.