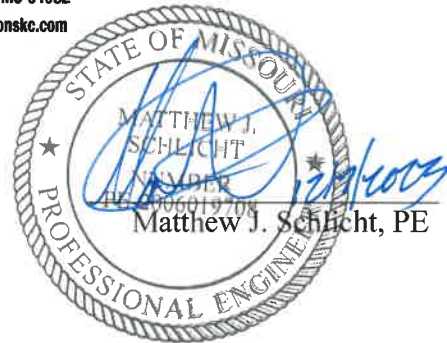


# MICRO STORM WATER DRAINAGE STUDY

**PRO DEO**  
**SITE ACREAGE: 0.90 ACRES**

**Lee's Summit, MO**

***PREPARED BY:***



## Revision

| Date | Comment | By |
|------|---------|----|
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### **3. GENERAL INFORMATION**

A new “boys” home called Pro Deo is being proposed on Lots 9 and 10 of Southview Heights. The property is located at the NW corner of the intersection of SE Douglas Street and SE Blue Parkway. The property contains 0.90 acres. The proposed improvements will consist of a new building, parking lot, drive aisle and associated utility infrastructure. The site generally drains from west to the southeast via sheet and shallow concentrated flow. No storm sewer, BMPs detention facilities nor water bodies currently exist on site. See Exhibit A for an aerial image of the proposed project site along with an aerial image of the surrounding area.

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

The property is located in an Area of Minimal Flood Hazard, Zone X, according to FEMA Firm Map Number 29095C0438G, 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 25, August 22, 2023. The existing site contains one major soil type:

10082            Arisburg-Urban Land Complex, 1 to 5 Percent Slopes  
Hydrologic Soils Group (HSG): Type C

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

### **4. METHODOLOGY**

This Micro Storm Drainage Study has been prepared to evaluate potential hydrologic impacts from the proposed development and recommend improvements to eliminate potential negative downstream impacts. 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 per APWA 5600

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

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 shall release the water quality event over a period of 40-72 hours. Design principles taken from the MARC BMP Manual will be utilized to assist in the design of the detention basin control structure for extended release events.

## 5. EXISTING CONDITIONS ANALYSIS

The existing site is grass covered and generally drains from the West to the Southeast via sheet and shallow concentrated flow. The site contains two drainage sub-basins labeled E and S for the purposes of this report. Sub-basin E contains 0.57 acres and is located in the northeast corner of the site. Sub-area E drains southeasterly via sheet and shallow concentrated flow where it is intercepted by a grate inlet at the intersection of Douglas and Blue Parkway. Sub-basin S contains 0.33 acres and is located generally in the southwest corner of the property. Sub-basin S drains to the south via sheet flow where it is collected by a roadside ditch south of Blue Parkway. See Exhibit D - Existing Drainage Area Map for details of each sub-basin. Table 5-1 below details the hydrologic properties for each sub-basin along with peak discharge rates for the 2, 10 and 100-year storms.

Table 5-1 Existing Conditions Sub-area Data and Peak Discharge Rates

| Sub-Basin | Area (ac.) | Composite CN | Tc (min.) | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|-----------|------------|--------------|-----------|----------|-----------|------------|
| E         | 0.57       | 74           | 10.4      | 1.06     | 2.20      | 4.03       |
| S         | 0.33       | 74           | 10.4      | 0.62     | 1.27      | 2.33       |

Exhibit E contains a complete Hydraflow Hydrograph Report with pre and post development hydrographs for each sub-basin along with proposed detention basin data and routed hydrographs.

### 5.1 ALLOWABLE RELEASE RATES

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 peak discharge release rates were calculated at each Point of Interest, POI.

Allowable Peak Discharge Release Rate Example Calculation:

Sub-basin E (2-Yr):  $0.57 \times 0.5 = \underline{0.29 \text{ cfs}}$

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

| Sub-basin | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|-----------|----------|-----------|------------|
| E         | 0.29     | 1.14      | 1.71       |
| S         | 0.17     | 0.66      | 0.99       |

## 6. PROPOSED CONDITIONS ANALYSIS

The proposed improvements will consist of a new building, parking lot, drive aisle and associated utility infrastructure. The proposed site will consist of three drainage sub-basins referred to as E, E1 and S for the purposes of this report. Sub-basin E1 contains 0.69 acres. Sub-basin E1 contains nearly all of the proposed site improvements. Sub-basin E1 will drain via sheet and shallow concentrated flow to an inlet located in the parking lot where flow will be routed to the proposed earthen detention basin. The building will have a roof drain system installed and routed to the proposed detention basin. Sub-basin E contains 0.11 acres of unimproved land located along the north and east boundaries of the property. Sub-basin E will be combined with detained Sub-basin E1 to determine if proposed peak discharge rates are at or below allowable for Sub-basin E. Sub-basin S contains 0.10 acres with no proposed improvements. Sub-basin S will free release via sheet flow to the south where it will be collected by a roadside ditch along Blue Parkway at POI S.

Exhibit F contains the Proposed Drainage Area Map. Table 6-1 below details the hydrologic properties for each sub-basin along with peak discharge rates for the 2, 10 and 100-year storms.

Table 6-1 Proposed Conditions Sub-basin Data and Peak Discharge Rates

| Sub-Basin | Area (ac.) | Composite CN | Tc (min.) | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|-----------|------------|--------------|-----------|----------|-----------|------------|
| E         | 0.11       | 74           | 5.9       | 0.25     | 0.52      | 0.93       |
| E1        | 0.69       | 87           | 8.1       | 2.48     | 4.15      | 6.60       |
| S         | 0.10       | 74           | 7.4       | 0.21     | 0.42      | 0.77       |

As shown above in Table 6-1 Sub-basin Combined E + E1 will require detention to attenuate proposed peak discharge rates below Allowable Release Rates as shown in Table 5-2 for Sub-basin E.

### DETENTION

A new single stage earthen detention basin is being proposed in Sub-basin E1 to attenuate proposed peak discharge rates. Following are a list of design parameters for the detention system.

Designation: Detention Basin E1

Type: Earthen Basin

Side Slopes: 3:1 Max.

Bottom Slope: 2% Min., Turf Lined

Basin Bottom Elevation: 1024.60 @ Influent Pipe

Basin Top Berm Elevation: 1031.40

Basin Volume: 10,635 cf @ 1031.00

Control Structure: 6'x5' deep precast concrete box, with interior 6" Baffle wall

Weir Wall Orifices: (8) 1" Diameter on 4" Centers (Extended Detention) FL=1024.20

(1) 3" Dia. Orifice, FL=1027.75

Weir Crest EL=1030.25, Crest Length 5'-0"

Control Structure Top Elevation: 1031.25

Control Structure Emergency Overflow Weir Openings: All Sides, FL=1030.25, 6" Openings

Control Structure Influent Pipe: 15" HDPE, FL (In) = 1024.60, FL (Out) = 1024.40, L=18.51', S=1.08%

Control Structure Effluent Pipe: 15" HDPE, FL (In) = 1024.00, FL (Out) = 1022.45, L=40.95', S=3.79%

Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=1030.25, Crest Length=42'

Control Structure Overflow: Crest Elevation, Crest Length=10.5'

Consecutive 100-YR Q=6.60 cfs Emergency Spillway HGL=1030.38, Water Depth=0.13', Freeboard=1.02'

The emergency overflow shall consist of both the control structure overflow weir and the earthen broad crested weir.

The Detention Basin Plan may be found in Exhibit G. Water quality volume calculations may be found in Exhibit H. Emergency spillway calculations may be found in Exhibit I. See Table 6-2 below for a summary of detention basin data.

Table 6-2 Proposed Detention Basin Data

|          | Peak Q In<br>(cfs) | Tp In<br>(min.) | Peak Q Out<br>(cfs) | Tp Out<br>(min) | Peak<br>W.S.E. | Max. Storage Vol. (cf) |
|----------|--------------------|-----------------|---------------------|-----------------|----------------|------------------------|
| 2-Year   | 2.48               | 718             | 0.30                | 739             | 1027.55        | 2,429                  |
| 10-Year  | 4.15               | 718             | 0.66                | 730             | 1028.56        | 4,155                  |
| 100-Year | 6.60               | 718             | 1.00                | 730             | 1029.73        | 6,836                  |

As shown in the table above all proposed peak flowrates have been attenuated. See Table 6-3 below for a summary of proposed peak discharge rates for combined Sub-basins E and E1. Hydrographs of each sub-basin have been combined to determine subsequent peak discharge rates for the entire area.

Table 6-3 Proposed Conditions Post Detention Peak Discharge Rates

| Sub-Basin       | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|-----------------|----------|-----------|------------|
| Combined E & E1 | 0.47     | 0.97      | 1.71       |

Table 6-4 below provides a comparison of peak discharge rates for Existing, Proposed and Allowable Conditions for Sub-basins E and S.

Table 6-4 Peak Discharge Comparison

| POI | Condition  | Q2 (cfs) | Q10 (cfs) | Q100 (cfs) |
|-----|------------|----------|-----------|------------|
| E   | Proposed   | 0.47     | 0.97      | 1.71       |
|     | Existing   | 1.06     | 2.20      | 4.03       |
|     | Difference | -0.59    | -1.23     | -2.32      |
|     | Allowable  | 0.29     | 1.14      | 1.71       |
|     | Difference | 0.18     | -0.17     | 0.00       |
| S   | Proposed   | 0.21     | 0.42      | 0.77       |
|     | Existing   | 0.62     | 1.27      | 2.33       |
|     | Difference | -0.41    | -0.85     | -1.56      |
|     | Allowable  | 0.17     | 0.66      | 0.99       |
|     | Difference | 0.04     | -0.24     | -0.22      |

As shown in Table 6-4 above peak discharge rates for Sub-basins E and S will be reduced well below existing discharge rates for all regulatory design storms. In addition runoff from the water quality storm event will be detained and released over a minimum 40 hour time period. Proposed peak discharge rates for the more minor 2-year storm at each POI do not quite meet allowable release rates therefore a formal waiver will be requested.

## 7. CONCLUSION & RECOMMENDATIONS

This micro storm water drainage study shows that the development of Pro Deo will not generate any negative downstream hydraulic impacts. A new earthen detention basin located in the southeast corner of the property will provide attenuation for the proposed improvements.

In conclusion, proposed peak discharge rates are all well below existing discharge rates. The water quality storm will be detained and released over a 40 hour time period. The proposed peak discharge rates meet allowable release rates except for the more minor 2-year storm. A waiver will be requested for this exception to

the standard requirements. Except for the proposed waiver this study is in conformance with all applicable City of Lee's Summit standards and criteria therefore Engineering Solutions recommends approval of this micro storm water drainage study.

## **8. EXHIBITS:**

- **Exhibit A – Aerial Images**
- **Exhibit B – FEMA FIRMette**
- **Exhibit C – NRCS Soils Report**
- **Exhibit D – Pre-Development Drainage Area Map**
- **Exhibit E – Hydraflow Hydrograph Calculations (Pre, Post & Detention)**
- **Exhibit F – Post-Development Drainage Area Map**
- **Exhibit G – Detention Basin Plan (Outlet Control Structure)**
- **Exhibit H – Water Quality Volume Calculations**
- **Exhibit I – Emergency Spillway Calculations**