



**PRELIMINARY STORMWATER  
MANAGEMENT STUDY**

**MISSION CHATEAU RETIREMENT COMMUNITY –  
85<sup>TH</sup> & MISSION**

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**Prairie Village, Kansas**

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# **Mission Chateau Retirement Community** **Preliminary Stormwater Management Study**

## **EXECUTIVE SUMMARY**

The proposed Mission Chateau Retirement Community is to be constructed on the former Mission Valley Middle School site located on the west side of Mission Road near the intersection with 84<sup>th</sup> Terrace in Mission, Kansas. The approximately 18.4 acre site includes the vacant school buildings and associated school fields, parking, and other ancillary fences, landscaping, and tennis courts. The proposed retirement community will include independent living and assisted living components, with associated parking, landscaping and miscellaneous improvements. This Preliminary Stormwater Management Study analyzes the impact of the redevelopment on peak flow rates from the site, and this Study identifies improvements incorporated into the design to mitigate impacts to design peak flows and water quality in accordance with local design standards.

The results of this Study indicate that the proposed redevelopment with stormwater management controls will meet design requirements for not increasing peak flow rates from the site in the 50% chance, 10% chance and 1% chance storm events, and that the design will meet water quality requirements for mitigating water quality impacts. These measures include minimizing grading in the existing area identified as Zone X – Future Base Flood on the current effective Flood Insurance Rate Map (FIRM).

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FIGURE 1 – Existing Drainage Map

FIGURE 2 – Proposed Drainage Map

## APPENDICES

Appendix A: Johnson County Watershed Study (Tile F28)  
FEMA Flood Map

Appendix B: Stormwater Quality Calculation Worksheets

Appendix C: HEC-HMS Detention Modeling Input and Output

Appendix D: Example Rain Garden Photos

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## **GENERAL INFORMATION**

This Preliminary Stormwater Management Study was prepared to analyze the impacts of the proposed redevelopment on site stormwater management, and it will ensure that the proposed preliminary design meets current design standards, including Section 5600 of the Design Standards and Specification of the Kansas City Metropolitan Chapter of the American Public Works Association (APWA 5600) for peak flow control and mitigation for water quality impacts in accordance with the Manual of Best management Practices for Stormwater Quality, 2012 edition (BMP Manual).

The hydrologic analysis was completed utilizing HEC-HMS v3.5 utilizing an SCS Type-2 24-hr storm event with a 5-minute time step. The SCS Unit Hydrograph method was used in transformation of rainfall to runoff.

### **Project Location and Description**

The proposed site is located Section 28, Township 12 South, Range 25 East, in Prairie Village, Johnson County, Kansas and includes approximately 18.4 acres. The site is planned for redevelopment into a retirement community with parking, landscaping and ancillary improvements. The site is generally bounded by Mission Road to the East, multi-family residential areas to the north and northwest, and single family residential areas to the southwest and south. Dykes Branch is a creek that runs along the north property line of the site and then continues east through culverts under Mission Road.

## **HYDROLOGIC/HYDRAULIC ANALYSIS**

### **Existing Conditions Analysis**

The existing site prior to redevelopment includes the vacant Mission Valley Middle School with associated parking, access, field and miscellaneous improvements. The site sits on a ridgeline, with approximately 5.4 acres draining southerly to the south property line, and the remaining 13.0 acres generally draining to Dykes Branch on the northern property boundary. Runoff to the south is currently collected in grated inlets along the south property line and conveyed through an enclosed sewer to a downstream storm sewer

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system along Mission Road. Overflows run through the rear and side yards of residences south of the property and then to the curb inlets along 86<sup>th</sup> Street. There are grated inlets along the west property boundary that capture stormwater from offsite areas and the western portion of the site and an underground conveyance system conveys flows to Dykes Branch. Overflows from this area run overland north to Dykes Branch. Runoff from the remainder of the site generally runs overland or into inlets and underground conduits which empty into Dykes Branch. There appears to be a small underground detention storage facility on the north side of the school building. It appears to have been installed to mitigate peak flows for a 1,000+- square foot library addition completed between 2006 and 2008. This minor detention did not affect the existing site Curve Number.

The site prior to redevelopment included approximately 3.7 acres of impervious area and 14.7 acres of pervious landscaping and other areas. This results in a weighted Curve Number of 79 for the overall site prior to redevelopment. Impervious areas are assigned a Curve Number of 98, and pervious areas are assigned a Curve Number of 74. For the rational method, this equates to a "C" value of 0.42 with an impervious surface value of 0.90 and pervious surface value of 0.30.

For analysis, the site was broken up into two drainage areas, namely one that is tributary to Dykes Branch (north) and one that is tributary to the southeast corner of the site at Mission Road (south) (see Figure 1). The time of concentration for both areas on the existing site is approximately 10 minutes when calculated in accordance with procedures in APWA 5600.

The site was analyzed utilizing the Curve Number method (utilizing hydrologic Soil Group "C" soils) with the Natural Resource Conservation Service (NRCS) Type II 24-hr design storm. Table 1 lists the Pre-redevelopment site parameters and peak flows for the 50% (2-yr), 10% (10-yr) and 1% (100-yr) annual chance storms.

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**Table 1 – Pre-Redevelopment Site Peak Flows**

Outfall	Drainage Area (acres)	Curve Number	Time of Conc. (min)	50% Chance Peak Flow (cfs)	10% Chance Peak Flow (cfs)	1% Chance Peak Flow (cfs)
North	13.0	79	10	28.4	52.6	89.8
South	5.4	79	10	11.7	21.8	37.2

Dykes Branch includes runoff from upstream areas that passes through the creek along the north property line to culverts under Mission Road. In addition, runoff from upstream of the site is passed through the site to Dykes Branch. In particular, approximately 3.3 acres of offsite drainage is passed through the site from the southwest, and approximately 1.3 acres of drainage is conveyed along the west property line directly to Dykes Branch. Table 2 summarizes existing peak flows from the site, including 3.3 acres of offsite drainage that is passed through the site.

**Table 2 – Pre-Redevelopment Site Peak Flows (including offsite pass through flow)**

SubArea/ Outfall	Drainage Area (acres)	Curve Number	Time of Conc. (min)	50% Chance Peak Flow (cfs)	10% Chance Peak Flow (cfs)	1% Chance Peak Flow (cfs)
Offsite 3.3 acres	3.3	82	8.4	8.5	14.9	24.6
North	16.3	--	--	36.6	67.3	114

### **Proposed Conditions Analysis**

The proposed project includes construction of a residential retirement community and other infrastructure improvements. A site plan is shown in Figure 2. Finish Floor Elevations and low entry elevations will be at least one foot above the future 1% chance water surface elevations in accordance with APWA 5600.

The detailed stormwater collection and conveyance system will be designed in accordance with City design criteria as part of the final design. In general, the collection and conveyance system will be designed for a minimum 10% chance design storm peak flows, with overflow paths provided to convey 1% chance peak overflows. Portions of the site

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storm sewer system may be designed to convey 1% chance peak flows in the underground storm system if overflow paths are not feasible, such as in internal courtyard areas. Offsite drainage from the southwest 3.3 acres will be routed through the site storm sewer system, and drainage from the west will be routed in a swale along the west property line directly to Dykes Branch.

The site will be graded to locate low building openings a minimum of one (1) foot above the base future flood elevations along Dykes Branch ranging from 940.96 to 938.00, as shown in the Appendix. In accordance with City guidance, detention will be designed for the development to reduce peak runoff rates to meet APWA criteria for comprehensive control and to meet water quality guidance in the BMP Manual. In accordance with guidance from the City, the northern 1.4 acres of site, in the 1% chance flood limits set-aside area, will not be included as part of the detention calculations for several reasons. It is impractical to route Dykes Branch flows through a detention basin, and this area will remain unpaved with only minimal grading for a trail and at the transition to the site improvements, similar to existing conditions, following construction. Therefore, the existing detention area for analysis tributary to the north, for use in determining allowable peak flow rates, is 11.6 acres, with an allowance for pass-through of flows from the 3.3 acres offsite area. This Study provides information and a preliminary design summary of the required detention. During final design of the site and drainage systems, specific outlet structure configurations and final facility sizes will be incorporated into the design of the site.

The proposed redeveloped site for detention analysis includes approximately 8.6 acres of impervious area and 8.4 acres of pervious area, in addition to the 1.4 acre 1% chance flood limit set-aside area. This results in a weighted Curve Number of 86 for the site post-redevelopment, assuming a Curve Number of 98 for impervious areas and 74 for pervious areas. For the rational method, this equates to a "C" value of 0.61 with impervious surface value at 0.9 and pervious surface at 0.30. The time of concentration for the site was calculated in accordance with procedures outlined in APWA 5600.

The time of concentration for the proposed site is 5 minutes for the south area of 0.8 acres, and 7.5 minutes for the north area of 16.2 acres. For the detention analysis, the proposed

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drainage areas north were further subdivided into a 0.9 acre area that will be released directly to Dykes Branch, and the remaining 15.3 acres that will be routed to the detention basin.

**Table 3 – Post-Redevelopment Site Peak Flows (undetained on-site)**

SubArea/ Outfall	Drainage Area (acres)	Curve Number	Time of Conc. (min)	50% Chance Peak Flow (cfs)	10% Chance Peak Flow (cfs)	1% Chance Peak Flow (cfs)
North	16.2	86	7.5	47.7	79.4	126
South	0.8	86	5	2.7	4.6	7.3

Undetained peak flows on the site are higher than those before the redevelopment, as indicated in Table 3. Site detention has been incorporated into the site design to mitigate peak flow rates leaving the site.

### **Detention**

The redevelopment of the site will result in higher imperviousness and higher peak flow rates, and detention has been incorporated into the site design to meet APWA 5600 requirements. In order to meet peak flow rate requirements, the drainage area routed south was reduced to reduce peak flow rates, and the remainder of the site and offsite flow was routed to the detention area in the northeast corner of the site. Table 4 summarizes the detention design, volume requirements, and peak rate comparison for both the north and the south outfalls.

In accordance with APWA 5600, the proposed north detention incorporates extended detention of runoff from the 90% mean annual event (1.37" 24-hr storm), for 15.5 acres. An additional 1.5 acres is routed to Rain Gardens on the site to provide extended detention in the 1.37" storm. Pond stage-storage and outlet configuration information is included in Appendix C.

The peak 1% chance water surface elevation on the detention pond is 945.5. An overflow is provided at elevation 946, overtopping the north berm, and outletting into Dykes Branch.



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**Table 4 – Post-Redevelopment Site Peak Flow vs. Allowable**

Outfall	Storm	Drainage Area (acres)	Detention Volume (ac-ft)	Allowable Peak Flow (cfs)	Post-Dev. Peak Flow (cfs)	Diff. (cfs)
North	50%	19.5	1.6	14.3	11.7	-2.6
North	10%	19.5	2.6	38.1	29.9	-8.2
North	1%	19.5	3.9	59.4	59.2	0.2
South	50%	0.8	--	2.7	2.7	0
South	10%	0.8	--	10.8	4.6	-6.2
South	1%	0.8	--	16.2	7.3	-8.9
North Set-aside	50%	1.4	--	3.1	3.1	0
North Set-aside	10%	1.4	--	5.7	5.7	0
North Set-aside	1%	1.4	--	9.7	9.7	0

### **FEMA Flood Classification**

The north portion of the project site is classified as a "Zone X Future Base Flood" Area according to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community Panel Number 20091C0039G dated August 3, 2009. According to the FEMA FIRM, Zone X Future Base Flood indicates potential 1% chance flood extents upon complete development in upstream watershed (see FEMA Firmette in Appendix A). For this project, grading will be minimized in this area.

### **Stormwater Treatment Requirements**

The BMP Manual was utilized to establish stormwater quality mitigation requirements for the site. This project is classified as a redevelopment for purposes of determining a Level of Service for the site. In accordance with City guidance, the considered area includes the 17.0 acres outside the northern set-aside area, with an additional 0.5 acre potentially disturbed during construction. The site requires a Level of Service (LOS) of 5.3 to be

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applied to the required treatment area of 13.8 acres. This results in a required Total Value Rating (VR) of 73.1 for the Mission Chateau site. The preliminary proposed water quality facility plan includes rain gardens, small areas of native vegetation, and extended dry detention. The majority of the site will be treated utilizing the detention basin as an extended detention basin. Smaller portions of the site will be planted with native vegetation incorporated into the landscaping. Three rain gardens will be incorporated into the landscaping areas designated as stormwater areas. Calculations for the preliminary site are included in Appendix B.

### **Downstream Considerations**

Keith Bredehoeft with the City of Prairie Village and David Ley with the City of Leawood provided a brief summary of known downstream flooding problems. Mr. Bredehoeft indicated that Mission Road has flooded as recently as 2010, and residents have reported channel erosion east of Mission Road in recent years. He also indicated that low areas near Corinth Elementary regularly flood. Mr. Ley indicated that, in Leawood, there are properties in the FEMA 1% chance floodplain on Wenonga north of 83<sup>rd</sup> Street and downstream of the 83<sup>rd</sup> Street bridge. The proposed development will decrease peak flows from the site for the storms analyzed, and the proposed improvements should have no adverse impact on peak flows downstream for the storms analyzed. Table 5 summarizes the peak flows from the site following redevelopment compared to existing conditions.

**Table 5 – Post-Redevelopment Site Peak Flow Comparison, vs. Existing**

Outfall	Storm	Drainage Area (acres)	Existing Peak Flow (cfs)	Post-Dev. Peak Flow (cfs)	Difference (cfs)
North	50%	20.9	36.6	12.7	-23.9
North	10%	20.9	67.3	34.2	-33.1
North	1%	20.9	114	66.4	-47.6
South	50%	0.8	11.7	2.7	-9.0
South	10%	0.8	21.8	4.6	-17.2
South	1%	0.8	37.2	7.3	-29.9

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### **CONCLUSIONS AND RECOMMENDATIONS**

As outlined in this Study, the proposed redevelopment, with detention, will increase impervious cover on the site but will not increase peak flows from the site in the 2%, 10% and 1% annual chance storms. Additionally, storm water quality facilities have been incorporated into the design in accordance with the requirements of the BMP Manual. The proposed re-development is consistent with the design assumptions and criteria in APWA 5600 and the City of Prairie Village regulations.

