

STORMWATER REPORT

Firestone Complete Auto Care

3501 SW Market Street
Lee's Summit, MO 64082

Jackson County

Gresham Smith Project # 40831.45

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GENERAL INFORMATION

The proposed Firestone Auto Care store is located on approximately 1.237 acres at 3501 SW Market Street in Lee's Summit, Jackson County, Missouri. The site is currently undeveloped. Existing slopes range from 1 to 5 percent, draining to the northeast (see Appendix A). The proposed development is a one story, 6,262 square foot commercial auto maintenance store with associated parking and utilities. Existing drainage patterns will be preserved in the proposed design, with the addition of a detention pond for stormwater discharge management and quality.

Approximately 49.6% of the proposed site will consist of the building footprint and pavement, and the remaining 50.4% will be grass and landscaped areas. See Figure 1 for a further pre and post development breakdown. The soils onsite consist of 16.6% Arisburg-Urban land complex loam, classified as Hydrologic soil group C and 83.4% Udarents-Urban land-Sampsel complex, classified as Hydrologic soil group C according to the NRCS Web Soil Survey. Runoff coefficients for soil group C were used in the following analysis, see table 1 below. None of the project site is located within a Flood Zone according to FEMA map number 29095C0532G, revised January 20, 2017. The proposed area of disturbance is 1.60 acres.

Table 1: Soil Classification Table (based on NRCS Web Soil Survey)

Soil Classification Name	Slope	Hydrologic Soil Group
Arisburg-Urban land complex (16.6% of site)	1 to 5 percent	C
Udarents-urban land-sampsel complex (83.4% of site)	2 to 5 percent	C

METHODOLOGY:

The general design approach for calculating the storm water runoff at the project location came from the APWA (American Public Works Association) hydrology section 5602 and stormwater detention and retention section 5608. The SCS method was used to calculate the peak flow rates of runoff at two points of interest. The SCS method was also used to develop the baseline unit hydrograph. SCS curve numbers are based on APWA Section 5602.3, as the entirety of the site falls under hydrologic soils C (74 for pervious locations and 98 for impervious areas). Design storm rainfall depths are taken from NOAA's Precipitation Data Server for the 24 hour duration on the 2 year, 10 year and 100 year storm events. There is a water quality element for the detention pond that is designed to store the water and drain it out slowly over a 40 hour period.

EXISTING CONDITIONS ANALYSIS:

The 1.237 acre property and the surrounding locations is currently 100% pervious. From the existing drainage patterns, 2 points of interest can be identified. The first is the storm grate to the North of the site along SW Market Street while the second is where the sheet flow from the site and surrounding location becomes concentrated flow to the east. The following land use areas and curve numbers shown below in figure 1 were developed using the TR-55 data:

Figure 1: Existing Conditions Curve Number Summary Table

Curve Numbers - Soil Group C (POI 1)		
Land Use	Curve Number	Predeveloped Acres
Impervious	98	0.286
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	0.421
	Total Area	0.708
Composite Curve Number		84

Curve Numbers - Soil Group C (POI 2)		
Land Use	Curve Number	Predeveloped Acres
Impervious	98	0.000
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	2.421
	Total Area	2.421
Composite Curve Number		74

The point of interest's locations, flow paths and drainage areas can be found in Appendix A. The flow path for POI 1, using the TR-55 Tc worksheet available in Autocad Civil 3d's Hydraflow software resulted in a time of concentration of 9.6 minutes for existing conditions. The flow path for POI 2, using the TR-55 Tc worksheet available in Autocad Civil 3d's Hydraflow software resulted in a time of concentration of 9.8 minutes for existing conditions. Using the SCS method of calculating storm runoff to each point of interest, the following flow rates were obtained:

FS SITE	24-HOUR RAINFALL	PRE-DEVELOPED RUNOFF FOR POI 1	PRE-DEVELOPED RUNOFF FOR POI 2
RECURRENCE INTERVAL	(IN.)	(C.F.S.)	(C.F.S.)
2-YEAR STORM	3.68	2.343	5.230
10-YEAR STORM	5.61	4.214	10.990
100-YEAR STORM	9.17	7.681	22.65

Detailed calculations for the existing conditions for points of interest 1 and 2 can be found in Appendix B.

PROPOSED CONDITIONS ANALYSIS:

The proposed site grading reduces the storm peak discharge and volume of runoff from the site through the use of a detention pond and outlet control structure. The pond is located to the east of the proposed building. The pond's exact location and outfall may be seen on Drawing C3.1. The detention pond is 5.60 feet from the lowest pond bottom elevation to the top of berm.

The point of interests storm flows were determined using the method presented in Section 5602.6 of the APWA 5600 Manual. Post-developed conditions from the detention pond are not to exceed 3 cfs per acre for the 100 year storm event, 2 cfs per acre for the 10 year storm event or 0.5 cfs per acre for the 2 year storm event. The remainder of the peripheral drainage elements near the right of way will require a waiver, but have calculated such that the pre-developed versus post-developed conditions have improved. The comprehensive control strategy also includes a water quality element for the detention pond which specifies that a 40 hour extended detention be provided for the 1.37 inch 90% mean annual storm event. For this project, a detention basin is incorporated to achieve the water quality and storm water management requirements. Refer to the Hydraflow calculations provided in Appendix B for detailed stage-storage volumes for the pond.

The water surface elevation needed to achieve the required Water Quality Volume was calculated as 1012.69 from the Hydraflow pond stage-storage graph provided in Appendix D. An elevation of 1014.65 was taken as the bottom of the rectangular weir in the Hydraflow model used for detention calculations to ensure that the water quality volume and release rates are met.

The outlet of the detention pond will be a precast concrete control structure with a rectangular weir set above the water quality volume storage elevation calculated. See sheet C903 for details of the outlet structure and underdrain connection.

The detention pond's emergency spillway was designed such that the 1% storm WSE maintains and 0.5 foot freeboard from the bottom of the spillway elevation to the top of the 100 year water storage elevation under normal conditions. This is achieved by setting the top of the pond berm to an elevation of 1016.45 and the bottom of the emergency spillway to an elevation of 1015.90. The 1% WSE of 1015.38 (0.52 feet below the bottom elevation of the emergency spillway). The detailed calculations can be found in Appendix B, while a detail of the detention overflow spillway can be found on sheet C903. A 100' wide emergency overflow spillway was designed to achieve the requirements stated above. The emergency spillway was designed to pass the 1% storm event with greater than a 0.5 foot of freeboard from the design stage to the top of the dam. A waiver will be needed in lieu of reaching the required 1 foot of freeboard for the zero available storage in the basin and zero flow through the primary outlet of the structure during a 100 year storm event.

Figure 2 shows the detailed breakdown of land use types used in calculating the curve numbers, using a Hydrologic Soil Group C.

Figure 1: Proposed Condition Curve Number Summary Table

Curve Numbers - Soil Group C (POI 1)		
Land Use	Curve Number	Post Developed Acres
Impervious	98	0.353
Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	0.176
	Total Area	0.529
Composite Curve Number		90

Curve Numbers - Soil Group C (POI 2)			Curve Numbers - Soil Group C (POI 2)		
Land Use	Curve Number	To Pond Acres	Land Use	Curve Number	Remainder of Post Developed Acres
Impervious	98	0.581	Impervious	98	0.439
Semi-Pervious (Gravel)	88	0.000	Semi-Pervious (Gravel)	88	0.000
Pervious (Open Space)	74	0.439	Pervious (Open Space)	74	2.221
	Total Area	1.020		Total Area	2.660
Composite Curve Number		88	Composite Curve Number		78

Figure 3: Stormwater Discharge Summary Table

FS SITE	24-HOUR RAINFALL	POST-DEVELOPED RUNOFF FOR POI 1	POST-DEVELOPED RUNOFF FOR POI 2	SITE DRAINAGE THRU DETENTION POND	POND WATER SURFACE ELEVATION	POND STORAGE VOLUME	FREE BOARD
RECURRENCE INTERVAL	(IN.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(FT.)	(CU. FT.)	(FT.)
2-YEAR STORM	3.68	2.248	3.581	0.043	1013.41	5,573	2.94
10-YEAR STORM	5.61	3.714	7.487	0.060	1014.62	10,492	1.73
100-YEAR STORM	9.17	6.376	16.55	3.021	1015.38	14,287	0.97

Stormwater quality is achieved through the use of an extended dry detention pond. The detention pond will provide temporary storage of stormwater runoff allowing settlement of suspended solids over a period of 40 hours. The reduction in flow from the pre-developed to post-developed conditions will correlate to a water quality improvement for the site and allow for TSS removal. Water Quality Volume required by the city of Lee's Summit is found by the equation below, given in Section 5600 of the Comprehensive Control Strategy Design and Construction Manual.

$$WQv = 1.37 * 0.05 + 0.009(\text{Percent site imperviousness})$$

The percent site imperviousness will be 56.4%, yielding a required Water Quality Volume of 2,828 cubic feet. Adding in an additional 20%, a water quality volume of 3,394.15 cubic feet was used for design of this site.

An Extended Dry Detention Basin will be used to achieve the water quality requirement. A 4" perforated PVC riser will connect to the structure. The end of the PVC riser will be capped and a 1" water quality orifice drilled in the end cap and will dewater the pond in approximately 40 hours. The depth of water quality volume was found to be 1.94' (required water quality volume = 1012.69 – water quality orifice elevation = 1010.75) using the stage-storage table from Hydraflow as shown in Appendix D. A water quality elevation of 1014.65 was used in design of this site.

CONCLUSIONS AND RECOMMENDATIONS:

The flate release rates for the 2, 10 and 100 year storm events are achieved through the use of an extended dry detention basin, while the post development drainage patterns will match the existing conditions drainage pattern in the peripheral drainage areas flowing to tow (2) separate points of interest. The development of a Firestone Complete Auto Care store is proposed on an existing tract on 100% pervious land. This proposed site will consist of 56.4% impervious area. The majority of the 1.237 acre site (approximately 1.02 acres) will be routed through an extended dry detention pond utilizing a water quality and flow release element, as specified in Lee's Summit Design and Construction Manual (DCM). Two (2) points of interests were used in analysis of comparing existing conditions versus post-construction conditions for the peripheral drainage areas. Detailed drainage areas and calculations can be found in Appendix A and B, respectively. The following table summarizes the runoff conditions for this development:

FS SITE	24-HOUR RAINFALL	Peripheral Drainage		Peripheral Drainage		Flat release rate			
		PRE-DEVELOPED RUNOFF FOR POI 1	POST-DEVELOPED RUNOFF FOR POI 1	PRE-DEVELOPED RUNOFF FOR POI 2	POST-DEVELOPED RUNOFF FOR POI 2	SITE DRAINAGE THRU DETENTION POND	POND WATER SURFACE ELEVATION	POND STORAGE VOLUME	FREE BOARD
RECURRENCE INTERVAL	(IN.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(C.F.S.)	(FT.)	(CU. FT.)	(FT.)
2-YEAR STORM	3.68	2.34	2.248	5.23	3.581	0.043	1013.41	5,573	3.04
10-YEAR STORM	5.61	4.21	3.714	10.99	7.487	0.060	1014.62	10,492	1.83
100-YEAR STORM	9.17	7.68	6.376	22.65	16.55	3.021	1015.38	14,287	1.07
	Top of berm		1016.45						

In accordance with the Lee's Summit Design and Construction Manual (DCM) Section 1002.A, the proposed Firestone site will apply for a modification to the following specification:

Perimeter drainage issue which will include specific citations of the Design and Construction Manual related to the peak discharge requirements, as well as supporting documentation, in particular a comparison between pre-development versus post-development peak flow rates for the peripheral areas. The emergency spillway was designed to pass the 1% storm event with greater than a 0.5 foot of freeboard from the design stage to the top of the dam. A waiver will be needed in lieu of reaching the required 1 foot of freeboard for the zero available storage in the basin and zero flow through the primary outlet of the structure during a 100 year storm event.