

# Drainage Analysis Memo



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To: Bourbon County Joint Planning Commission  
From: Worth Ellis, PE  
Date: July 2019  
Re: Central Motor Wheel of America (CMWA) – A New Facility

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## 1 INTRODUCTION

This report was prepared to document the design, layout, and sizing of stormwater drainage facilities for a proposed development located in Paris, Bourbon County, Kentucky. The proposed development will consist of a building (approximately 265,911 square feet) with associated access drives, loading areas, and parking. The new facility will be situated behind (east of) the existing CMWA facility off Wheat Drive.

The following scope was completed as part of the drainage analysis:

1. Storm Sewer Model;
2. Pre-Construction Drainage Area Model; and
3. Post-Construction Detention Model.

## 2 SOFTWARE AND METHODOLOGY

Bourbon County Joint Planning Commission and the City of Paris have yet to develop a stormwater manual to establish guidelines for storm sewer design. To complete this analysis, Palmer Engineering proposed that they be allowed to utilize the storm events required for detention design and storm sewer design in Winchester, where Palmer's home office resides. The storm events for design will be highlighted below. In an email dated 7/10/19, Palmer received approval to proceed as proposed.

Storm and Sanitary Analysis 2019 (by Autodesk) was used to evaluate the proposed storm sewer as well as the pre and post-development conditions. The methodology used for the design was SCS TR-55 and the storm distributions used for each storm event were SCS TYPE II. The rainfall depths for the proposed storm events were acquired from the NOAA Hydrometeorological Design Center's Precipitation Frequency Data Server.

### 2.1 RAIN EVENTS

The following rainfall depths were acquired from the NOAA Atlas 14 Point Precipitation Frequency Estimates for the site:

- 10-year, 24-hour: **Storm Sewer Design and Detention Modeling**
- 25-year, 24-hour: **Detention Modeling**
- 100-year, 24-hour: **Storm Sewer Check and Detention Modeling**

**Re: CMWA New Facility Drainage Analysis**

## **2.2 RAINFALL DEPTHS**

The following rainfall depths were acquired from the NOAA Atlas 14 Point Precipitation Frequency Estimates for the site:

- 10-year, 24-hour: **4.27 inches**
- 25-year, 24-hour: **5.11 inches**
- 100-year, 24-hour: **6.56 inches**

## **2.3 SUBCATCHMENT PARAMETERS**

Drainage area subcatchments were assigned the following parameters.

1. Subcatchment Geometry: Subcatchments were delineated based on contours developed from the Kentucky Aerial Photography and Elevation Dataset (KYAPED) Digital Elevation Model (DEM). These were further supplemented with site survey information and the proposed contours from the proposed grading and drainage plan. These contours were utilized to delineate the overall watershed, subcatchment areas, slopes, and drainage lengths. The study watershed area is shown in Attachment A.
2. Subcatchment Soils: Soils delineations in the drainage area were referenced from the United States Department of Agriculture Natural Resources Conservation Service Web Soil Survey. A hydraulic soil classification of both "C" and "B" were noted within the analyzed drainage area. A soils map generated by the Web Soil Survey is included in Attachment B.
3. Subcatchment Curve Number: Curve numbers were assigned to sub catchments based on typical land use values found within the Storm and Sanitary Analysis Software. Aerial imagery and the proposed construction plans were used to determined land use areas within each catchment area:
  - > 75% grass cover, Class B Soils, Good: **61**
  - > 75% grass cover, Class C Soils, Good: **74**
  - Paved and Parking Areas: **98**

See Attachment A for drainage area and sub-catchment exhibits. See Attachments D and E for composite Curve Number calculations for individual sub-catchments.

## **3 STORM SEWER DESIGN**

Several different constraints and assumptions were taken into consideration during the design of the storm sewer systems. These constraints and assumptions included:

- A minimum storm sewer pipe size of 15 inches was selected to minimize the potential of the storm sewer pipes clogging.
- All catch basins were analyzed in Storm and Sanitary Analysis (SSA) with a 50% clogging factor to better simulate field conditions.

**Re: CMWA New Facility Drainage Analysis**

- All storm structures and their corresponding pipes were sized for the 10-year 24-hour storm event and checked for the 100-year 24-hour storm event.
- A minimum allowable time of concentration (TOC) of ten (10) minutes was assigned to all sub-catchments.
- All pipes were analyzed with a Manning's friction coefficient of 0.012.

Detailed information on the layout of the storm sewer can be found on the development plans as well as the SSA Reports attached (see Attachments C and D). Refer to these documents for detailed information on pipe sizes, pipe material, and pipe slopes as well as structure information.

#### **4 DETENTION DESIGN**

The goal of the detention design is to ensure that the post-development stormwater runoff for the 10 Year – 24 Hour, 25 Year – 24 Hour, and 100 Year – 24 Hour storm events does not exceed pre-development conditions.

##### **4.1 EXISTING DRAINAGE AREA CONDITIONS**

The existing site is currently a vacant grass and tree covered lot. The existing CMWA and KST detention features release to drainage ditches or swales currently running through the proposed property to be developed. Drainage from the site to be developed sheet flows to either these swales or directly to the nearby tributary of Stoner Creek to the north. For the purpose of this analysis, the KST property, whose drainage releases uphill from the proposed site, was considered to be entirely pervious. The site contains two detention features designed to reduce runoff from their property. Some impervious area, approximately 6 acres, from the existing CMWA facility is released uphill of the proposed site as well. To make the analysis more concise, the drainage area was terminated at the northern property boundary. The overall drainage area delineated includes approximately 45.6 acres with a composite curve number (CN) of 71.95 and a time of concentration (TOC) of 21.54 minutes.

##### **4.2 PROPOSED DRAINAGE AREA CONDITIONS**

A new industrial facility is planned within the existing drainage area noted above. The new facility will add a significant amount of impervious area to the watershed. To reduce post-construction runoff to pre-construction conditions, two separate detention basins will be installed. The primary basin, Basin - 02 (Stor-02 in the SSA reports) will be located in the southeast corner of the property and will take on a majority of the impervious area to be detained. The second basin, Basin-01, will simply convert the sediment basin to be constructed in Phase – 1 of the erosion control into a detention pond. Based on the model, the temporary riser of the sediment basin can simply be removed and replaced with a headwall. Basin-01 (Stor-01) will remain in place to aid Basin-02 in runoff reduction until the future expansion occurs. At that time, it can be resized and/or relocated as necessary. The two detention basins separate the delineated drainage area into three sub-watersheds: an area draining to Basin-01 (Sub-01), and area drainage to Basin-02 (Sub-03), and an area bypassing the detention downstream of Basin-02 (Sub-02). See the exhibits in Attachment A for the delineation of these areas.

**Re: CMWA New Facility Drainage Analysis**

A summary of the three areas is as follow:

- SUB-01 – 21.12 acres with a composite CN of 81.55 and a time of concentration (TOC) of 14.55;
- SUB-02 – 6.78 acres with a composite CN of 72.72 and a TOC of 19.15; and
- SUB-03 – 17.7 acres with a composite CN of 82.82 and a TOC of 12.04.

It should be noted that the pavement to the north of the proposed building was not routed back to Basin-02 to prevent the need for removal prior to the future expansion. The impervious area from the future expansion to the south was included in the detention design, but the impervious area for the future expansion to the north was not.

**4.3 PROPOSED DETENTION SUMMARY**

The top of bank for Basin-01 is at elevation 828.00 and is 12' wide with 3H:1V side slopes. The top of bank for Basin-02 is at elevation 850.00 and is 12' wide with 3H:1V side slopes. Each basin has an emergency spillway (10 – 12 feet wide by 2-feet with 3:1 side slopes) that is designed to discharge the 100 Year – 24 Hour storm event if the primary outlet structure is clogged. Refer to Attachment E for the stage-storage table for each detention feature.

The point of analysis for both pre and post-development was set as the northern property boundary (Out-01 is SSA). The flows under each condition at the point of analysis are shown in the following table.

STAGE OF DEVELOPMENT	10 Year - 24 Hour (CFS)	25 Year - 24 Hour (CFS)	100 Year - 24 Hour (CFS)
Pre	77.90	109.22	167.04
Post	66.10	87.17	132.50

During these storm events, the pre and post-development stage and freeboard values are as shown in the following tables.

**Basin-01 (Stor-01)**

STORM EVENT	POST-DEV DEPTH (FEET)	POST-DEV MAX ELEV (FEET)	POST-DEV FREEBOARD (FEET)	DETENTION INFLOW (CFS)	DETENTION OUTFLOW (FEET)
10 Year -24 Hour	3.30	824.30	3.70	61.04	34.65
25 Year -24 Hour	4.03	825.03	2.97	79.94	40.36
100 Year -24 Hour	5.19	826.19	1.81	113.13	47.98

**Re: CMWA New Facility Drainage Analysis**

**Basin-02 (Stor-02)**

<b>POST-DEV. DEPTH (FEET)</b>	<b>POST-DEV DEPTH (FEET)</b>	<b>POST-DEV MAX ELEV (FEET)</b>	<b>POST-DEV FREEBOARD (FEET)</b>	<b>DETENTION INFLOW (CFS)</b>	<b>DETENTION OUTFLOW (FEET)</b>
10 Year -24 Hour	6.11	846.11	3.89	58.51	20.57
25 Year -24 Hour	6.93	846.93	3.07	75.61	32.02
100 Year -24 Hour	7.80	847.80	2.20	105.52	59.99

**5 CLOSURE**

The intent of this analysis was to first ensure that the proposed storm sewer had adequate pipe sizes to convey the future flow from the proposed development. Conveying both the 10 Year – 24 Hour and 100 Year – 24 Hour storm events, the model shows the proposed storm sewer meets this requirement. Secondly, the purpose of this analysis was to ensure that the post-development flows leaving the site do not exceed the pre-development flows. The models shows that, during all required storm events, the flow leaving the site is reduced.

If you have any questions, please contact us.

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**Re: CMWA New Facility Drainage Analysis**

**List of Attachments:**

- Attachment A: Drainage Area Maps
- Attachment B: Web Soil Survey and Precipitation Data
- Attachment C: Project Drawings
- Attachment D: Storm and Sanitary Analysis Reports – Storm Sewer
  - 10 Year – 24 Hour Storm (Complete)
  - 100 Year – 24 Hour Storm (Inputs Removed)
- Attachment E: Storm and Sanitary Analysis Reports – Detention
  - 10 Year – 24 Hour Storm (Complete) – Pre and Post
  - 25 Year – 24 Hour Storm (Inputs Removed) – Pre and Post
  - 100 Year – 24 Hour Storm (Inputs Removed) – Pre and Post

**List of References:**

- National Oceanographic and Atmospheric Administration (2006). Precipitation-Frequency Atlas of the United States. Volume 2. Retrieved from [https://hdsc.nws.noaa.gov/hdsc/pfds/pfds\\_map\\_cont.html](https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html)
- United States Department of Agriculture Natural Resources Conservation Service (2005). Web Soil Survey. Retrieved from <https://websoilsurvey.nrcs.usda.gov/>
- United States Department of Agriculture Natural Resources Conservation Service (1985). Technical Release 55: Urban Hydrology for Small Watersheds. Retrieved from <https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/other/TR55documentation.pdf>