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Industrial Park Design Narrative and Details

T&L COMMERCIAL DEVLOPMENT

DEQ DESIGN & ASSOCIATES

Table of Contents

1 Project Description

T & L Commercial Development is proposing to develop a 6.7 acre vacant lot. The lot is located in Small County at 1111 Landry Lane. The project includes the construction of one 20,000 SF office building. Two travel lanes connect two separate parking lots, one on either side of the office building to Landry Lane. An employee picnic area is located at the rear of the office building and connected to the western parking lot. The McMcutcheon Pedestrian plaza and outdoor walkways connect various entrances to the building and parking lots. The parking lots provide a total of 70 parking spaces. The total traffic average daily trips to the site is estimated to be 100.

The office park is intended to meet the needs of a functioning business while also offering places for employees to enjoy the outdoors. Providing the patio area adjacent to an open turf area and meadow allow for a more aesthetically open and natural place for employees to escape the office if only for a few minutes. The site is zoned B-2 and the development is a by-right development with no special provisions or waivers. The adjacent properties to the east, north, and west are all vacant and forested.

2 Existing Site Conditions

The vast majority of the existing site is a grassed, open field, with a small portion along the northern edge of the property that is forested. There is approximately 5.8 acres of fair conditioned open space and 0.9 acres of forest. The site is on moderate slopes, with an average slope of 7% sloping mostly down to Landry Lane, with the eastern and western edges draining to either side. The soils are predominantly Hydrologic Soil Group (HSG) C soils, as indicated by the NRCS Websoil Survey, which indicates moderately well drained soils. Specifically they are classified as Codorus silt loam (43%) and Delanco loam (57%).

There are no known wetlands or streams on-site, however the southern edge of the property along Landry Lane drains through an existing 18” RCP pipe under the road to an existing stream, called

Harper Creek. Harper Creek is an intermittent stream and is in poor condition, with a down cutting channel. No erosion around the culvert was evident during a field visit by Design & Design Associates on June 26th, 2013, but channel erosion and downsutting was taking place immediately downstream.

The site is in the Chesapeake Bay watershed and Harper Creek drains to DD stream, which is impaired for bacteria. A TMDL has not been developed for the impaired waterway.

3 Proposed Site Conditions

The proposed site conditions include 1.95 acres of impervious cover, including two parking areas, the travel lanes, building rooftop, pedestrian pathways, and an employee patio. Approximately 3.50 acres of forest and rehabilitated open space are proposed with another 1.25 acres of managed turf. The total site area is 6.7 acres.

The managed turf areas were minimized to 1.25 acres in order to reduce the amount of future maintenance and mowing and to preserve the existing land cover at the proposed site. Offsite runoff up slope of the proposed site will be treated and consist of undisturbed open space as well.

4 Site Drainage and Hydrology

4.1 Existing Site Hydrology and Drainage

Currently there is one primary drainage area of approximately 5.8 acres draining the site. It begins just north of the northern edge of the property and flows overland to the existing culvert along the southern edge of the property that drains under Landry Lane, which serves as the outlet from the site. The culvert then outfalls to Harper Creek on the other side of the road. The existing culvert is an 18” concrete pipe that is undersized for the site currently. Large storms every few years flood the road. Flows also exit the pipe at high velocities and have caused severe erosion downstream. The time of concentration (Tc) was estimated as 22 minutes and the curve number (CN) equal to 79 based on fair existing site conditions.

The 24 hour precipitation amounts for select storm events are shown in the table below. The region is located in Smalltown, VA, which is in a Type II storm type region.

Table 4-1: Precipitation, 24 hour storm events for select storm events

	1-year storm	2-year storm	10-year storm	100-year storm
24-hour total	2.6 in	3.6 in	5.6 in	9.3 in

The existing peak flows from the site were modeled in HEC-HMS using the TR-55 method and are summarized in Table 4-2 below. Refer to the Existing Conditions sheet for land use breakouts, curve number, time of concentration, and the drainage area delineation.

Table 4-2: Existing Peak Flows from Site

Event	1 Year	2 Year	10 Year
Flow (cfs)	3.6	7.8	17.5

4.2 SWM Requirements for Proposed Site

The water quality and water quantity requirements for the site are discussed in this section. The site is subject to regulations that will become effective on July 1, 2014.

4.2.1 Hydrology

The post-development drainage area for the property is 5.3 acres, which is slightly smaller than the pre-development drainage area. The composite CN is 79, with an assumed Tc of 5 minutes for all DAs. To the east and west edges of the site portions of runoff totaling less than 0.3 acres have been pushed to other drainage areas through the proposed grading of the site.

4.2.2 Water Quality Requirements

The Virginia Runoff Reduction Method Spreadsheet, Version 2011 was used to estimate total phosphorus (TP) loads from the proposed site. The loads are primarily from the impervious surfaces and managed turf areas. The TP load from the site for the proposed land use is 5.17 lb/yr with a required reduction of 2.42 lb/yr. The proposed nitrogen loading is 37 lb/yr. See Appendix A for detailed calculations.

4.2.3 Water Quantity Requirements

A. Channel Protection Requirement - The site drains concentrated stormwater flow into a natural stormwater conveyance system. Therefore, the energy balance equation must be satisfied for the 1-year storm. The energy balance equation is:

$$Q_{1,post} x\ Vpost \leq Q_{1,pre} x\ Vpre$$

Where **Qpre = 3.6 cfs** and **Vpre = 0.43 Acre-ft**. The Vpost and Qpost shall be less than the product of Qpre and Vpre. $Q_{allowable}$ is 4.1 cfs. See Appendix B for detailed calculations.

B. Flood Protection – The existing outfall is currently experiencing localized flooding, as the culvert is undersized. Therefore, the SWM Plan was designed such that the 10 year, 24 hour post-development peak discharge will be less than the pre-development 10-year, 24 hour storm event.

$$Q_{10,post} \leq Q_{10,pre}$$

The flood protection criteria are satisfied as the pre-development **$Q_{10, post}$ of 15.9 cfs,** is less than the **$Q_{10, pre}$ of 17.5 cfs.**

5 Proposed Stormwater Management Plan

5.1 Methodology

Due to the site's location upstream of an existing stream channel and the future road easement on the property special consideration was taken to design the layout of the proposed development. In order to minimize the need for water quality and quantity control on site, and in order to minimize post-construction landscape maintenance, Environmental Site Design was implemented. This also allowed for an increased area of rehabilitated open space and forest cover on the site. The project site currently receives runoff from upland offsite areas as well. These offsite areas will not be disturbed and will maintain their current land use and land cover type.

As mentioned, the proposed site land use was chosen in order to minimize the necessary water quantity and quality control devices on the project site, however, the proposed impervious and managed turf cover changes the runoff conditions of the site and the will require necessary management. Offsite drainage will also be treated along with the project drainage. The drainage area remains mostly the same, but will be slightly modified due to the grading of the site, with a reduction of 0.4 acres.

A variety of BMPs are also utilized in order to reduce total phosphorous loading and peak flows from the site. These include permeable pavement, a cistern, extended detention, and a dry swale. A stormwater network under the west parking lot will capture offsite, roof, BMP, and parking drainage that will outfall to a BMP at the southern end of the site. At the eastern side of the project and swale adjacent to the proposed parking lot will flow into a different stormwater network that will also outfall to the BMP at the south end of the project. The BMP will then flow to the culvert under Landry Lane to Harper Creek.

Upstream of the project offsite drainage flow onto the project site and is captured by a drop inlet to the north of the project and a dry swale to the east of the project. The variety of stormwater BMPs on the project reduce runoff and nutrients leaving the site. A Bentley Pondpack model was set up to simulate routing and to assess compliance with the water quantity requirements. Adjusted curve numbers were used to account for the proposed runoff reduction methods and a pond was simulated to account for the proposed Extended Detention storage. Appendix C shows the Pondpack Model graphic and Appendix D includes the results of the Pondpack routing results.

The post drainage and routing model showed the post development discharge show a decreased 10 year discharge of $\mathbf{Q_{10,\,post} = 15.9}$ **cfs.** A separate analysis was conducted using this reduced peak flow; this analysis showed that this reduction was sufficient to reduce flooding of the site, so that the road is not overtopped. The headwater elevation at the culvert for the 10 year storm went from 517.6 ft to 516.7 ft.

6 Best Management Practice Designs and Treatment

Four different practices were chosen to treat the runoff from the site. All practices were designed in accordance with the VA DEQ BMP Design Specifications (v. 2011), and each design is described in detail below.

6.1 Cistern

The most upstream practice at the site is a cistern located at the north end of the project that will collect 0.2 acres of roof runoff and store the runoff for later use for managing and maintaining the developed site. The cistern was designed using the provided DEQ Cistern Design Spreadsheet.

Assumptions used in determining the cistern size were:

- All managed turf areas (54,450 s.f.) will be irrigated using the water captured by the cistern
- 70 people will be working in the building

In order for the cistern to be 90% efficient a 7,000 gallon tank was chosen. If the cistern overflows it will enter the stormwater system and be treated downstream by other proposed BMPs. The cistern will provide a 0.4 lb/yr phosphorous removal through volume reduction and 621 c.f. of runoff reduction.

Table 7-2: Water Quantity, Channel Protection Compliance Summary

Q_{Pre}, 1year (cfs)	V_{Pre}, 1 year (Ac-ft)	$Q_{Allowable}$, 1 year (cfs)	Q_{Post}, 1 year (cfs)	V_{Post}, 1 year (Ac-ft)
3.62	0.43	4.1	3.56	0.38

The channel protection criteria are met as 3.56 cfs is less than the allowable y-year peak discharge of 4.1 cfs. The flood protection criteria is summarized below

Table 7-3: Water Quantity, Flood Protection Compliance Summary

Pre-development Q, 10 year (cfs)	Post-development, Q, 10 (cfs)
17.5	15.9

The flood protection criteria is met as the post-development 10 year peak flow rate is less than the pre-development peak flow rate. In addition, the flow has been reduced such that the road is not overtopped during a 10 year storm under post-development conditions.

Appendix B: Water Quantity Calculations

Existing Conditions:

Pre: $S = \frac{1000}{CN} - 10 = \frac{1000}{79} - 10 = 2.7in$

$$q_{pre} = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(2.6 - (0.2 \times 2.7))^2}{2.6 + (0.8 \times 2.7)} = 0.90\ in$$

$V_{pre} = q\ x\ A\ x\ \frac{1}{12} = 0.90\ in\ x\ 5.7\ Ac\ x \frac{1\ ft}{12\ in} = \ \mathbf{0.43\ Acre - ft}$

Proposed Conditions:

Post: $S = \frac{1000}{CN} - 10 = \frac{1000}{78} - 10 = 2.8\ in$

$$q_{post} = \frac{(P - 0.2S)^2}{P + 0.8S} = \frac{(2.6 - (0.2 \times 2.8))^2}{2.6 + (0.8 \times 2.8)} = 0.86\ in$$

$V_{post} = q\ x\ A\ x\ \frac{1}{12} = 0.86\ in\ x\ 5.3\ Ac\ x \frac{1\ ft}{12\ in} = \ \mathbf{0.38\ Acre - ft}$

Energy Balance:

$Q_{post} \leq Q_{pre} \left(\frac{V_{pre}}{V_{post}}\right)$

$= 3.6 \times \left(\frac{0.43}{0.38}\right)$

$= 4.1\ cfs$

Allowable Q_1 > Proposed Q_1