ATTACHMENT F

JPA SECTION 22

ROAD CROSSINGS – HYDRAULIC STUDY

North Anna Culvert Analysis Summary
For Joint Permit Application

I. Objective

A summary of the hydraulic analyses conducted for culverts where proposed roads or embankments cross existing streams or wetland areas is provided. Hydraulic analyses are not provided for internal plant drainage pipes or culverts that do not impact streams or wetlands. Eight culverts are sized to pass the peak discharges from the 25-year, 24-hour storm without over topping the road crossings. None of the culverts are placed within FEMA designated 100-year floodplains.

II. Methodology

The culvert locations are shown on Figure 1. The upstream invert coordinates for each of the culverts are shown in Table 1. The peak discharges for the culverts are determined using NRCS methodologies (Reference 1) and the computer program HEC-HMS, version 3.1.0 (Reference 2). It should be noted that the peak discharge for Culvert #11 also includes the peak discharge from storm water management (SWM) basin #3 and the peak discharge for Culvert B also includes the peak discharge from SWM Basin #2.

III. Hydrologic Data

The hydrologic data required to determine the peak discharges for the 25-year, 24-hour storm using NRCS methodologies include the following and are summarized for each culvert in Table 1.

III.A Drainage Area

Drainage areas for each of the culverts were determined based on the topographic information shown on the finished grading plan drawings.

III.B Rainfall Data:

The 25-year, 24-hour rainfall for the North Anna site is determined from NOAA Atlas 14, 6.14 inches (Reference 3).

III.C Runoff Curve Number:

The composite runoff curve numbers for each culvert drainage area were determined based on soil types and proposed land cover conditions in accordance with Reference 1. The soil types were determined by information presented in the US Department of Agriculture Soil Survey for Louisa, Co. VA. (Reference 4).

III.D Lag Time (Time of Concentration)

The computer program HEC-HMS requires the use of a lag time for each sub-basin when computing peak discharges using the NRCS Unit Hydrograph methodology. The lag time is equivalent to 0.6 multiplied by the time of concentration value determined by NRCS methodologies (Reference 1).

III.E. Detention Storage – Level Pool Hydrologic Routing

The topography upstream of Culvert #7 provides significant storage volume during flooding events. Therefore, this storage volume was considered and a level pool routing methodology was used in the HEC-HMS model upstream of Culvert #7 to determine the peak discharges.

Although storage routing upstream of Culverts #11 and B was not used upstream of the culvert entrances, storage routing was used in determining the peak discharges from SWM basins #2 and #3 which contribute flow to these culverts.

IV. Culvert Hydraulics

The peak upstream water levels (head water elevation) for the 25-year peak discharge is determined for each culvert based on the culver size, geometry, and design flow rate. The headwater elevations are determined using both inlet and outlet control conditions with the higher water level conservatively selected as the design headwater elevation (Reference 5). The top of the road elevation is then compared with the headwater level to determine the adequacy of the selected culvert size for the design storm event.

Culvert diameters, top of road elevations, peak discharges, peak velocities, and headwater and tailwater elevations are summarized in Table 1 for each culvert.

Note that for Culvert B, the configuration of the culvert changes mid way along the culvert path. As the culvert passes under the road (the upstream culvert) it consists of three 24 inch diameter pipes. This is due to clearance requirements with utilities that are passing through the road. Once the culvert clears the road utilities, the configuration changes to one 42 inch diameter pipe for the downstream culvert. The downstream culvert picks up some small additional drainage from the downstream side of the road, thus there is a separate headwater and tailwater elevation calculated for each portion of the culvert. However, the additional drainage area is conservatively applied to both portions of the culvert.

V. Summary

As indicated in Table 1, the culverts as presented adequately pass the peak discharges from the design storm without overtopping the roads. Additionally, all headwater storage during the storms will be of a temporary nature and will be completely contained on Dominion property.

VI. References

1. Technical Release 55, Urban Hydrology for Small Watersheds, U.S. Department of Agriculture, Soil Conservation Service, June 1986.

2. HEC-HMS Hydrologic Modeling System, Version 3.1.0 User's Manual, U.S. Army Corps of Engineers, November 2006

3. National Oceanic and Atmospheric Administration (NOAA), website (http://www.nws.noaa.gov/oh/hdsc/currentpf.htm#N, 04/23/2009)

4. U.S. Department of Agriculture, Natural Resources Conservation Service, Soil Survey of Louisa County, Virginia.(http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx, 04/23/2009)

5. Hydraulic Engineering Circular 5 (HEC-5**),** Federal Highway Administration, 1965.

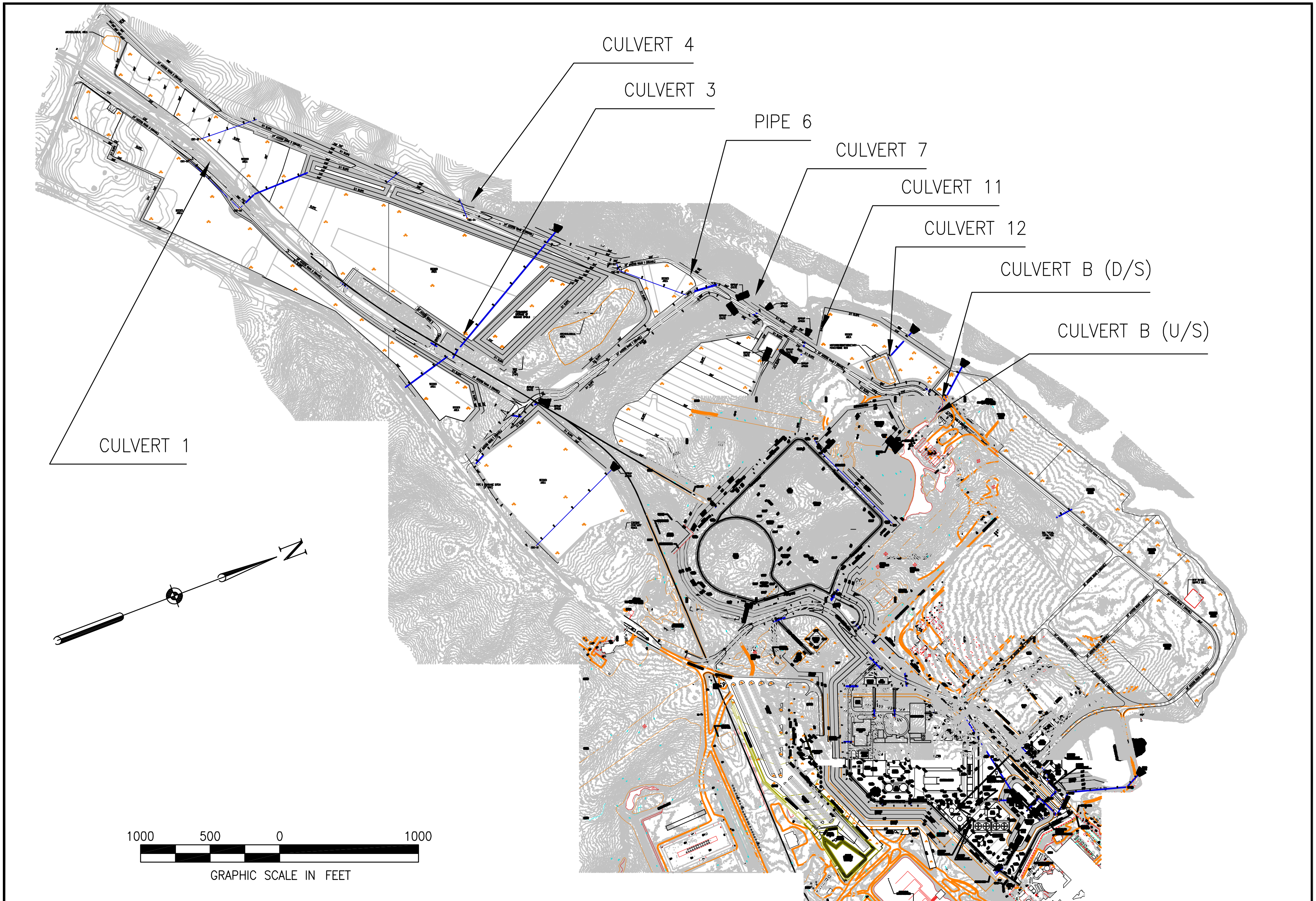
Table 1 – Culvert Analysis Summary

Culvert No.	Upstream Invert Coordinates	Contributing Drainage Basin	Drainage Area (ac)	Composite Runoff CN	Lag Time (hr)	Design Return Period	Peak Discharge (cfs)	Pipe Diameter (ft)	Number of Pipes	Peak Pipe Velocity (fps)	Headwater Elevation (ft) NAVD88	Top of Road Elevation (ft) NAVD88	Tailwater Elevation (ft) NAVD88
Culvert #1	N 5383.56 E 1006.13	PO-01	22.82	62	0.31	25-year	43.2	3 ft (36")	1	6.11	345.68	352.00	339.00
Culvert #3	N 6863.65 E 2103.44	PO-03	27.58	63	0.27	25-year	58.2	3.5 ft (42")	1	6.05	328.00	340.00	295.50
Culvert #4	N 6911.56 E 1178.93	PO-04	19.78	63	0.27	25-year	40.9	2.5 ft (30")	1	8.33	322.09	324.00	316.50
Pipe #6	N 8538.42 E 1706.63	PO-06	14.53	65	0.21	25-year	38.7	2 ft (24")	2	6.16	290.04	292.00	289.00
Culvert #7	N 8907.18 E 1906.16	PO-05 PO-07	30.13 20.04	69 62	0.26 0.18	25-year	38.2(3)	2ft (24")	1	12.16	266.11	286.00	255.00
Culvert #11	N 9316.97 E 2161.22	PO-08 PO-09 PO-11 SWM #3	4.61 1.55 8.88 12.68	61 61 65 62	0.21 0.12 0.29 0.17	25-year	29.6(4)	2.5ft (30")	1	6.03	257.73	290.00	255.50
Culvert B (U/S)	N 10302.69 E 2574.21	B	79.0(1)	68.5(2)	0.18	25-year	91.0(5)	2.0ft (24")	3	9.66	269.27	270.00	266.56
Culvert B (D/S)	N 10339.11 E 2504.94		81.4(1)	68.5(2)	0.18	25-year	98.7(5)	3.5ft (42")	1	10.26	266.56	270.00	257.75
Culvert #12	N 9935.26 E 2197.37	PO-12	4.87	77.6	0.11	25-year	25.6	2.0 ft (24")	1	8.15	272.14	276.00	258.90

Notes:

(1) Includes SWM Basin #2 drainage area
(2) Does not include SWM Basin #2 drainage area CN
(3) Peak discharge includes the effects of detention storage u/s of culvert
(4) Includes SWM Basin #3 discharge
(5) Includes SWM Basin #2 discharge

FILE PATH: (LOVETON) Q:\PROJECTS\1439101\SITE SEPARATION CULVERT B\CULVERT BASEMAP.DWG [LAYOUT1] 8/25/09



NORTH ANNA NUCLEAR POWER PLANT
LAKE ANNA, VIRGINIA
NOVEMBER 2009

FIGURE 1: LOCATION OF CULVERTS