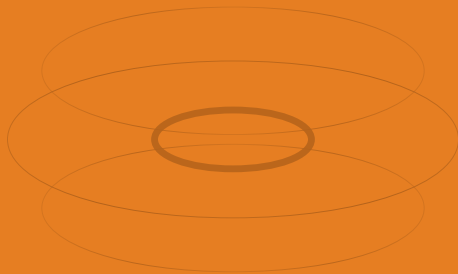


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Calculation

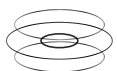


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Project:



TORUS

, County,

ISSUE SUMMARY AND APPROVAL

This page records each issue of CIV-CAL-002. The preparer, reviewer and approver sign for each revision.

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Contributors

Rev.	Discipline	Prepared by	Reviewed by	Approved by
A	Civil			

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A P P E N D I C E S

APPENDIX A. GRADING AND DRAINAGE PLAN 12

1. OBJECTIVE

This calculation sets the design rainfall for the , computes peak runoff from the station pad, the access road and the offsite areas that drain across them, and sizes the perimeter ditches, the access road ditches, entrance culvert CUL-1 and the erosion protection at each outfall. It also fixes the 25-year, 24-hour rainfall used for the T-101 secondary containment in CIV-RPT-003.

2. METHODOLOGY

The site and its contributing areas are small (the largest design point drains 16.9 ac), so TORUS used the rational method, as FHWA HEC-22 recommends for areas of this size. Rainfall comes from NOAA Atlas 14, Volume 8, at , the nearest published station. Intensities between tabulated durations were interpolated log-linearly in depth and duration, which follows the shape of the depth-duration curve better than straight-line interpolation.

Times of concentration follow NRCS TR-55: sheet flow for the first 100 ft, then shallow concentrated flow, then channel flow at an assumed 1.5 ft/s. The ditch results in Section 6.4 show average velocities of 1.7 to 3.0 ft/s, so the assumed channel velocity makes the times slightly long for the faster ditches and slightly short for the slow ones. The effect on peak flow is a few percent either way, well inside the accuracy of the runoff coefficients. The minimum time of concentration is 10 minutes. At each design point the time of concentration is the longest travel path of any contributing area, and the runoff coefficient is the area-weighted composite.

Ditches were checked with Manning's equation for the 25-year flow on established grass, and for the 10-year flow on a bare channel protected by erosion control blanket, which is the condition during vegetation establishment. The bed shear stress was compared with the permissible values in FHWA HEC-15. The entrance culvert was sized with FHWA HDS-5: inlet control from the HDS-5 regression equations and outlet control from the full-flow energy equation, with the larger headwater governing. Outlet protection uses the NRCS rock apron method, cross-checked against FHWA HEC-14.

3. DESIGN INPUTS

The inputs in Table 3-1 govern the calculation. Topography, offsite divides and the county ditch are assumptions until the survey is complete.

Table 3-1: Design Inputs

Input	Value	Source
Rainfall depths	NOAA Atlas 14, Vol. 8, (Table 6-1)	NOAA; TBV at final coordinates (HOLD H-02)

Input	Value	Source
Design storm, ditches and culvert	25-yr design, 10-yr check	County practice (HOLD H-05)
Overtopping check, access road	100-yr	TORUS practice
Runoff coefficient, pasture (HSG D)	0.35	HEC-22 Table 3-1, upper end for clay
Runoff coefficient, aggregate surfacing	0.60	HEC-22 Table 3-1
Runoff coefficient, concrete and roofs	0.90	HEC-22 Table 3-1
Concrete share of the pad	8 %	STR-CAL-002 foundation footprints
Composite pad coefficient	0.62	Area-weighted
Existing ground	Plane, 1.2 % fall east, 0.8 % fall south	Assumed (HOLD H-02)
County road west ditch	2 ft bottom, 4:1 and 3:1 sides, 3 ft deep, 0.8 %	Assumed (HOLD H-05)
Area draining to the county ditch at the entrance	10.0 ac pasture	Assumed (HOLD H-05)
Flood zone	FEMA Zone X	Assumed (HOLD H-09)

4. ASSUMPTIONS

- Existing ground is a plane falling 1.2 % east and 0.8 % south, and the offsite drainage divides lie 190 ft north and 150 ft west of the pad. *Verification required (HOLD H-02).*
- The county road west ditch has the section in Table 3-1 and drains 10.0 ac upstream of the entrance. *Verification required (HOLD H-05).*
- The soils are hydrologic soil group D (Permian red-bed clay). *Verification required (HOLD H-07).*
- The rainfall depths in Table 6-1 are the Atlas 14 point estimates for . *Verification required against NOAA PFDS at the surveyed coordinates.*
- The site is outside the 100-year floodplain. *Verification required (HOLD H-09).*

5. REFERENCES

- NOAA Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 8 (Midwestern States), Version 2.0 (2013).
- USDA NRCS, Technical Release 55, Urban Hydrology for Small Watersheds (1986), Chapter 3.
- FHWA HEC-22, Urban Drainage Design Manual, 3rd Edition (2009, revised 2013).

4. FHWA HDS-5, Hydraulic Design of Highway Culverts, 3rd Edition (2012).
5. FHWA HEC-15, Design of Roadside Channels with Flexible Linings, 3rd Edition (2005).
6. FHWA HEC-14, Hydraulic Design of Energy Dissipators for Culverts and Channels, 3rd Edition (2006).
7. USDA NRCS, National Engineering Handbook Part 650, rock outlet protection practice.
8. GEN-DB-001, Basis of Design.
9. CIV-CAL-001, Earthwork and Grading; CIV-CAL-003, Access and Internal Roads; CIV-RPT-003, T-101 Containment and SPCC Design Note.
10. CIV-DWG-003, Grading and Drainage Plan (Appendix A); CIV-DWG-004, Civil Sections and Details.

6. CALCULATION

6.1. RAINFALL

Table 6-1 gives the Atlas 14 depths used. The 25-year, 24-hour depth of 6.33 in is also the rainfall allowance for the T-101 containment.

Table 6-1: Precipitation Frequency Depths,

Duration	2-yr (in)	10-yr (in)	25-yr (in)	100-yr (in)
5 min	0.48	0.69	0.82	1.03
10 min	0.70	1.01	1.20	1.51
15 min	0.86	1.24	1.47	1.85
30 min	1.20	1.75	2.10	2.66
60 min	1.56	2.30	2.79	3.59
2 hr	1.93	2.86	3.49	4.54
3 hr	2.12	3.15	3.87	5.07
6 hr	2.54	3.78	4.66	6.15
12 hr	2.99	4.44	5.46	7.19
24 hr	3.52	5.16	6.33	8.28

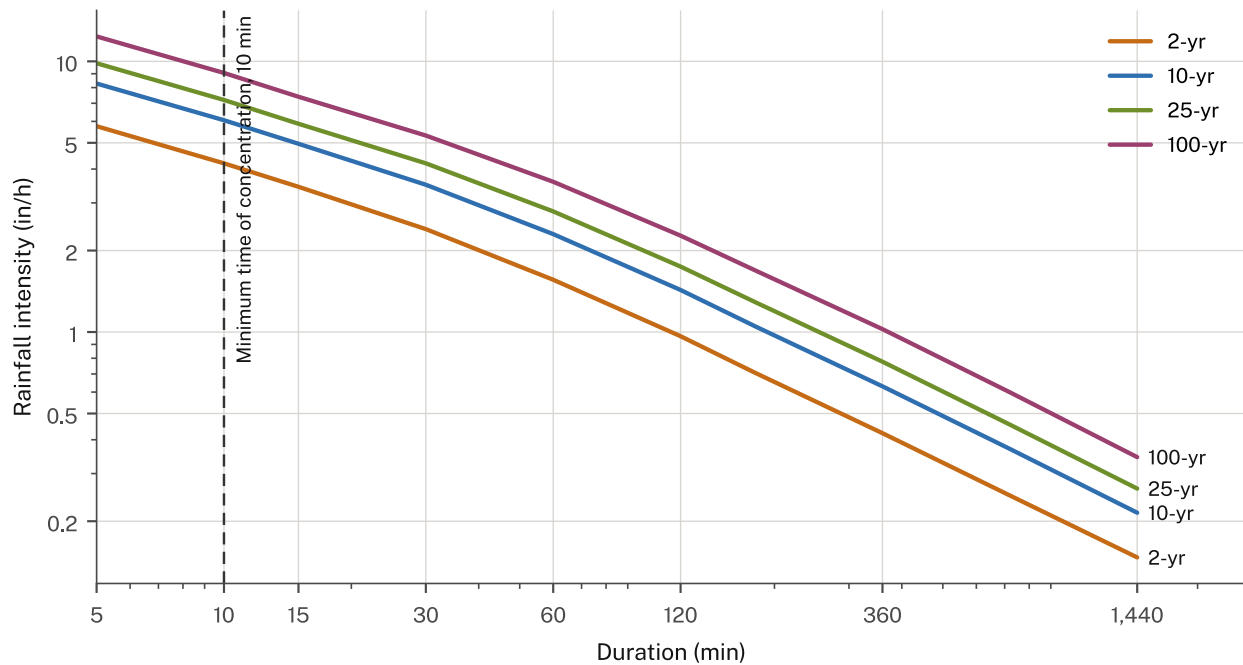
Between tabulated durations the depth is interpolated log-linearly and converted to intensity:

TORUS method

$$\ln P(t) = \ln P_1 + \frac{\ln(t/t_1)}{\ln(t_2/t_1)}(\ln P_2 - \ln P_1), \quad i = \frac{P(t)}{t/60}$$

Figure 6-1 shows the resulting intensity-duration-frequency curves. At the 10 to 30 minute times of concentration that govern this site, the 25-year intensity is 4.2 to 7.2 in/h.

Figure 6-1. Rainfall Intensity-Duration-Frequency Curves,



6.2. DRAINAGE AREAS AND PEAK FLOWS

The pad is split at the access road entrance (Y = 62). The north part drains east to swale D-2 and the access road north ditch D-6; the south part drains to swale D-5, the south ditch D-4 and the SE outfall. Interceptor ditches D-1 and D-3 carry offsite run-on from the north and west around the pad, so that no offsite water crosses the equipment area. Table 6-2 lists the areas, and Table 6-3 gives the travel time build-up.

Table 6-2: Drainage Areas

Area	Description	A (ac)	C	Tc (min)	Q10 (cfs)	Q25 (cfs)
DA-1	Offsite run-on north of pad (Y 210 to 400, X -50 to 300) (HOLD H-02)	1.53	0.35	17.7	2.4	3.2
DA-2	Offsite run-on west of pad (X -200 to -50, Y -18 to 400) (HOLD H-02)	1.44	0.35	17.4	2.3	3.0
DA-3	Pad north of access road (Y 62 to 210) plus west apron	0.94	0.62	10.0	3.5	4.6
DA-4	Pad south of access road (Y -10 to 62)	0.45	0.62	10.0	1.7	2.2
DA-5	Access road corridor north half (608 ft x 30 ft)	0.42	0.43	10.0	1.1	1.4
DA-6	Access road corridor south half (608 ft x 30 ft)	0.42	0.43	10.0	1.1	1.4
DA-7	Offsite north of access road (X 300 to 847, Y 80 to 400) (HOLD H-02)	4.02	0.35	17.9	6.4	8.3

Area	Description	A (ac)	C	T _c (min)	Q10 (cfs)	Q25 (cfs)
DA-8	County road west ditch, upstream of entrance (assumed 10 ac) (HOLD H-05)	10.00	0.35	28.1	12.7	16.7

Note 1: T_c is the area's own time of concentration, before travel along the ditches.

Table 6-3: Time of Concentration Segments

Area	Segment	Length (ft)	Slope (%)	Time (min)
DA-1	Sheet, n = 0.15	100	0.8	13.5
DA-1	Shallow concentrated, V = 1.44 ft/s	90	0.8	1.0
DA-1	Channel, D-1, V = 1.5 ft/s	286	1.2	3.2
DA-2	Sheet, n = 0.15	100	1.2	11.5
DA-2	Shallow concentrated, V = 1.61 ft/s	318	1.0	3.3
DA-2	Channel, D-3, V = 1.5 ft/s	236	0.8	2.6
DA-3	Sheet, n = 0.011	100	1.1	1.5
DA-3	Shallow concentrated, V = 1.69 ft/s	170	1.1	1.7
DA-3	Channel, D-2, V = 1.5 ft/s	80	0.8	0.9
DA-4	Sheet, n = 0.011	100	1.1	1.5
DA-4	Shallow concentrated, V = 1.69 ft/s	170	1.1	1.7
DA-4	Channel, D-5, V = 1.5 ft/s	62	0.8	0.7
DA-5	Sheet, n = 0.011	12	3.0	0.2
DA-5	Channel, D-6, V = 1.5 ft/s	608	1.2	6.8
DA-6	Sheet, n = 0.011	12	3.0	0.2
DA-6	Channel, D-7, V = 1.5 ft/s	608	1.2	6.8
DA-7	Sheet, n = 0.15	100	1.0	12.3
DA-7	Shallow concentrated, V = 1.61 ft/s	220	1.0	2.3
DA-7	Channel, D-6, V = 1.5 ft/s	300	1.2	3.3
DA-8	Sheet, n = 0.15	100	0.8	13.5
DA-8	Shallow concentrated, V = 1.44 ft/s	500	0.8	5.8
DA-8	Channel, county ditch, V = 1.5 ft/s	800	0.8	8.9

Sheet flow time follows TR-55 with the 2-year, 24-hour depth $P_2 = 3.52$ in:

NRCS TR-55, Eq. 3-3

$$T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$$



Peak flow at each design point uses the composite coefficient, the longest travel path, and the HEC-22 frequency factor $C_f = 1.0$ for the 10-year and 1.1 for the 25-year storm, with $C_f C \leq 1.0$:

FHWA HEC-22, rational method

$$Q = C_f C i A$$

For the entrance culvert, the contributing areas total 16.90 ac with a composite coefficient of 0.367. The travel paths are DA-1 25.7 min; DA-3 16.5 min; DA-5 10.0 min; DA-7 21.1 min; DA-8 28.1 min. The county ditch area DA-8 governs at 28.1 min, where the 25-year intensity is 4.33 in/h:

FHWA HEC-22, rational method

$$Q_{25} = 1.1 \times 0.367 \times 4.33 \times 16.90 = 29.6 \text{ cfs}$$

Table 6-4 gives the flows at every design point.

Table 6-4: Peak Flows at Design Points

Design point	A (ac)	C	Tc (min)	Q10 (cfs)	Q25 (cfs)	Q100 (cfs)
D-1 outlet, NE pad corner	1.53	0.35	17.7	2.4	3.2	4.6
D-2 outlet, to D-6	2.46	0.45	19.2	4.9	6.4	9.2
D-3 outlet, SW pad corner	1.44	0.35	17.4	2.3	3.0	4.3
D-5 outlet, to D-4	0.45	0.62	10.0	1.7	2.2	3.2
D-4 outlet, SE outfall	1.89	0.41	20.8	3.3	4.3	6.2
D-6 outlet, county ditch	6.90	0.39	25.7	10.2	13.5	19.4
D-7 outlet, county ditch	0.42	0.43	10.0	1.1	1.4	2.1
CUL-1, entrance culvert	16.90	0.37	28.1	22.4	29.6	42.5

6.3. EFFECT OF THE DEVELOPMENT ON PEAK FLOW

Table 6-5 compares the peak flow at the two site outfalls before and after construction. For the pre-development case every area is taken as pasture, and the gravel sheet flow and ditch travel are replaced by short-grass sheet flow and shallow concentrated flow on the existing slope. The increase is small because the 1.4 ac gravel pad is a small part of each contributing area, and most of the flow at the county ditch comes from offsite pasture.

Table 6-5: Pre- and Post-Development Peak Flows

Outfall	Pre Tc (min)	Pre Q10 (cfs)	Post Q10 (cfs)	Pre Q25 (cfs)	Post Q25 (cfs)	Increase Q25 (cfs)
D-4 outlet, SE outfall	20.9	2.8	3.3	3.6	4.3	0.7
D-6 outlet, county ditch	25.2	9.2	10.2	12.1	13.5	1.3

TORUS does not propose detention. The increase at either outfall is at most 1.3 cfs, neither construction stormwater permit that could apply requires post-construction detention for a site of this size, and a detention basin would add disturbed area and a permanent maintenance item for no downstream benefit. County may still require it (HOLD H-05).

6.4. DITCHES

Two standard sections are used. Type A serves the pad interceptors and swales, where flows are small and a shallow, mowable section suits the pad edge. Type B serves the access road, where the ditch must be deep enough to drain the road subgrade and carry the offsite flow from north of the road. Table 6-6 gives the sections.

Table 6-6: Standard Ditch Sections

Type	Use	Bottom width (ft)	Side slopes	Depth (ft)	Top width (ft)
A	Pad interceptor / swale	2	3:1 and 3:1	1.5	11.0
B	Access road ditch	2	4:1 and 3:1	2.0	16.0

Flow depth is found from Manning's equation and the bed shear from the flow depth and slope:

Manning; FHWA HEC-15, Eq. 2.3

$$Q = \frac{1.486}{n} A R^{2/3} S^{1/2}, \quad \tau = \gamma y S$$

For D-6, the most heavily loaded ditch, with $Q_{25} = 13.5$ cfs, $S = 0.012$ and $n = 0.035$ for established grass, the normal depth is 0.87 ft, so:

FHWA HEC-15

$$V = 3.04 \text{ ft/s}, \quad \tau = 62.4 \times 0.87 \times 0.012 = 0.66 \text{ lb/ft}^2$$

Both are within the limits for established Bermuda grass (5.0 ft/s and 1.0 lb/ft²), and the freeboard is 1.13 ft. Table 6-7 and Table 6-8 give the results for all seven ditches.

Table 6-7: Ditch Performance, 25-Year Flow on Established Grass

Ditch	Type	Length (ft)	Slope (%)	Q25 (cfs)	Depth (ft)	Velocity (ft/s)	Shear (lb/ft ²)
D-1, north interceptor	A	286	1.2	3.2	0.45	2.1	0.34
D-2, east swale (north)	A	136	0.8	6.4	0.70	2.2	0.35
D-3, west interceptor	A	236	0.8	3.0	0.48	1.8	0.24
D-4, south ditch	A	308	1.2	4.3	0.52	2.3	0.39
D-5, east swale (south)	A	62	0.8	2.2	0.41	1.7	0.21

Ditch	Type	Length (ft)	Slope (%)	Q25 (cfs)	Depth (ft)	Velocity (ft/s)	Shear (lb/ft ²)
D-6, access road north	B	587	1.2	13.5	0.87	3.0	0.66
D-7, access road south	B	587	1.2	1.4	0.29	1.7	0.22

Table 6-8: Ditch Performance During Establishment, 10-Year Flow with Erosion Control Blanket

Ditch	Q10 (cfs)	Depth (ft)	Velocity (ft/s)	Shear (lb/ft ²)	Freeboard at Q25 (ft)	Lining
D-1, north interceptor	2.4	0.33	2.5	0.24	1.05	Seed and ECB
D-2, east swale (north)	4.9	0.52	2.6	0.26	0.80	Seed and ECB
D-3, west interceptor	2.3	0.35	2.1	0.18	1.02	Seed and ECB
D-4, south ditch	3.3	0.38	2.7	0.29	0.98	Seed and ECB
D-5, east swale (south)	1.7	0.30	2.0	0.15	1.09	Seed and ECB
D-6, access road north	10.2	0.66	3.6	0.49	1.13	Seed and ECB
D-7, access road south	1.1	0.21	1.9	0.16	1.71	Seed and ECB

Note 1: Establishment condition uses $n = 0.025$. Permissible shear for straw or coconut erosion control blanket (ECB) is 1.75 lb/ft².

Every ditch passes with at least 0.8 ft of freeboard, and the highest shear, 0.66 lb/ft², is about two-thirds of the grass limit. TORUS therefore specifies seed and ECB for all ditches. A turf reinforcement mat or riprap lining would add cost without need on these slopes.

6.5. ENTRANCE CULVERT CUL-1

The access road meets the county road with a 30 ft throat and 50 ft radius returns (CIV-CAL-003). The county road west ditch passes under the driveway, flowing south, 8 ft inside the county right-of-way. At that line the driveway, including the flared returns, is 62.7 ft wide. With traversable 4:1 end slopes and 12 in of cover over a 36 in pipe, the culvert is 96 ft long.

The culvert must pass the 25-year flow with a headwater no more than 1.2 times the diameter, keep the 25-year headwater within the county ditch, and pass the 100-year flow without overtopping the driveway. Table 6-9 shows the sizes checked. The 24 in and 30 in pipes fail the headwater limit, so a 36 in pipe is selected.

Table 6-9: CUL-1 Size Selection

Diameter	Storm (yr)	Q (cfs)	Tailwater (ft)	Inlet HW (ft)	Outlet HW (ft)	HW/D	Acceptable
24 in	10	22.4	1.21	3.30	5.25	2.63	No
24 in	25	29.6	1.36	4.73	8.37	4.19	No
30 in	10	22.4	1.21	2.46	2.74	1.09	No
30 in	25	29.6	1.36	3.13	3.91	1.56	No
36 in	10	22.4	1.21	2.19	2.10	0.73	Yes
36 in	25	29.6	1.36	2.62	2.66	0.89	Yes
42 in	10	22.4	1.21	2.03	1.97	0.58	Yes
42 in	25	29.6	1.36	2.39	2.30	0.68	Yes

Note 1: Corrugated metal pipe, concrete headwalls, $n = 0.024$, slope 0.8 %. Tailwater is the normal depth in the county ditch downstream.

For the selected pipe at the 25-year flow, $Q = 29.6$ cfs, $D = 3$ ft and $A = 7.07$ ft², the HDS-5 flow parameter is:

FHWA HDS-5, Eq. 3.1

$$X = \frac{K_u Q}{AD^{0.5}} = \frac{29.58}{7.069 \times 1.732} = 2.42$$

Because $X < 3.5$ the inlet is unsubmerged. With the critical depth $d_c = 1.76$ ft and the HDS-5 coefficients for corrugated metal pipe with a headwall ($K = 0.0078$, $M = 2.0$):

FHWA HDS-5, Eq. 3.1, form 1

$$\frac{HW_i}{D} = \frac{H_c}{D} + KX^M - 0.5S \Rightarrow HW_i = 2.62 \text{ ft}$$

For outlet control, with the entrance loss coefficient $k_e = 0.5$ for a square-edged headwall and a tailwater of 1.36 ft:

FHWA HDS-5, Eq. 3.4

$$H = \left[1 + k_e + \frac{29n^2L}{R^{1.33}} \right] \frac{V^2}{2g} = \left[1.5 + \frac{29(0.024)^2(96)}{0.75^{1.33}} \right] \frac{4.18^2}{64.4} = 1.05 \text{ ft}$$

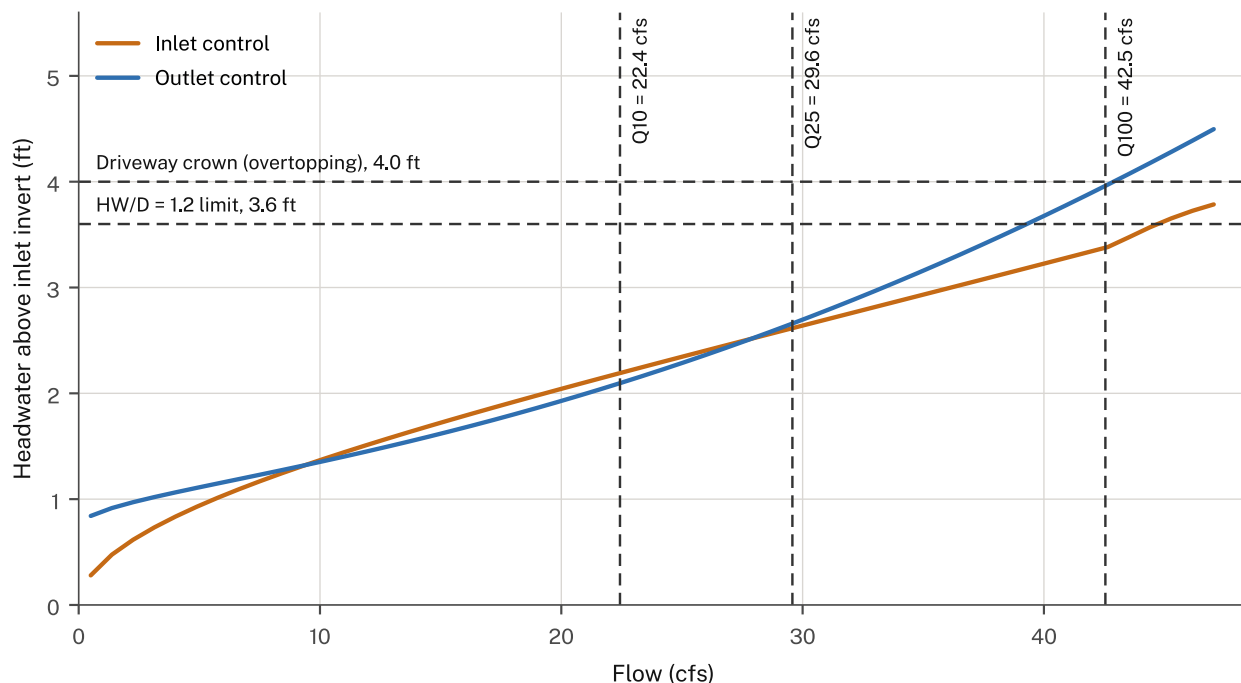
FHWA HDS-5, Eq. 3.5

$$HW_o = h_o + H - SL = 2.38 + 1.05 - 0.008(96) = 2.66 \text{ ft}$$

where h_o is the larger of the tailwater and $(d_c + D)/2$. Outlet control governs at the 25-year flow, and inlet control at the 10-year flow. Figure 6-2 shows both control curves across the full flow range.

CUL-1 is a 36 in corrugated metal pipe, 96 ft long, with concrete headwalls. The 25-year headwater is 2.66 ft ($HW/D = 0.89$) and the 10-year headwater is 2.19 ft.

Figure 6-2. CUL-1 Headwater Against Flow



The 100-year headwater is 3.96 ft, 0.04 ft below the driveway crown at the culvert. The driveway does not overtop, but the margin is small. If the survey shows a larger contributing area than assumed, the driveway crown at the crossing should be raised, or the pipe increased to 42 in, before issue for construction. A projecting inlet was also checked: it gives a 25-year inlet headwater of 2.86 ft. Headwalls are retained because they protect the pipe ends from mowing and traffic and hold the fill slopes at the ditch. County may require safety end sections instead of headwalls within the clear zone (HOLD H-05).

The outlet velocity at normal depth in the pipe is 5.2 ft/s at the 25-year flow, which sets the outlet protection below.

6.6. OUTFALL PROTECTION

At the culvert outlet the tailwater is below half the pipe diameter, so the NRCS apron equations for minimum tailwater apply:

NRCS rock outlet protection

$$L_a = 1.8 \frac{Q}{D_o^{1.5}} + 7D_o, \quad d_{50} = \frac{0.02 Q^{4/3}}{TW D_o}$$

These give a 32 ft apron, 9 ft wide at the pipe and 41 ft wide at the end, and a computed stone size of 5.3 in. The HEC-14 method gives 3.7 in. TORUS specifies 6 in median stone as the practical minimum for riprap that resists displacement, placed 12 in thick on nonwoven geotextile.

At the SE outfall, ditch D-4 discharges onto natural pasture at 2.3 ft/s. The Isbash relation gives a stone size of 0.8 in, so the same 6 in stone is used in a 10 ft by 11 ft apron. A 35 ft level spreader (10 ft per cfs of the 10-year flow) then returns the flow to sheet flow at the location where it left the site before development. Table 6-10 summarizes the riprap.

Table 6-10: Riprap Aprons

Location	Length (ft)	Width (ft)	Median stone (in)	Thickness (in)	Volume (CY)	Weight (tons)
CUL-1 outlet apron	32	9 to 41	6	12	29.6	43
CUL-1 inlet toe apron	5	6	6	12	1.1	2
SE outfall apron	10	11	6	12	4.1	6
Total					34.8	50

Note 1: Type I plain riprap or graded stone, placed on 8 oz/yd² nonwoven geotextile, at 1.45 tons per cubic yard.

7. RESULTS AND CONCLUSIONS

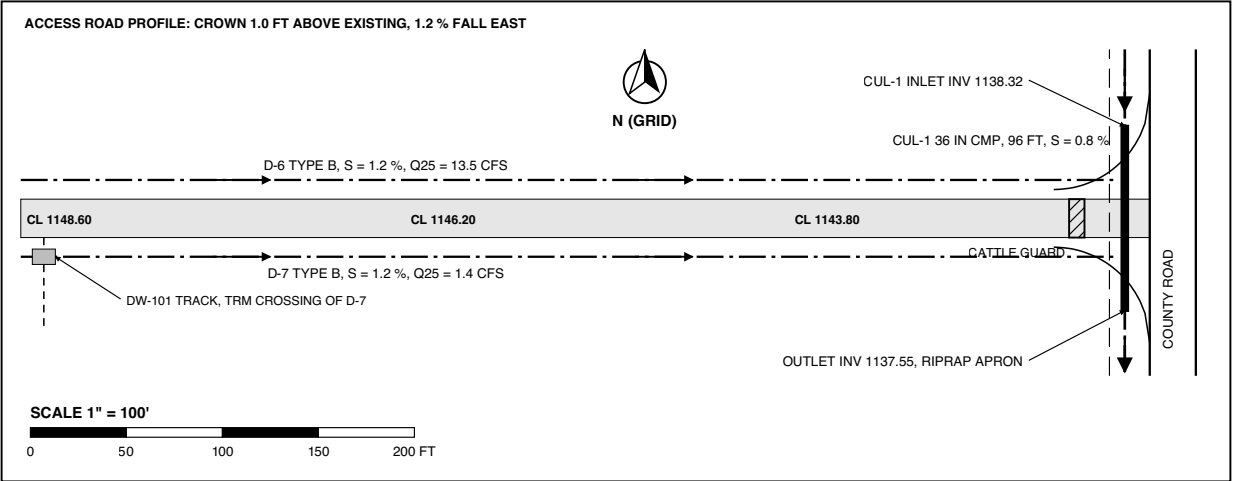
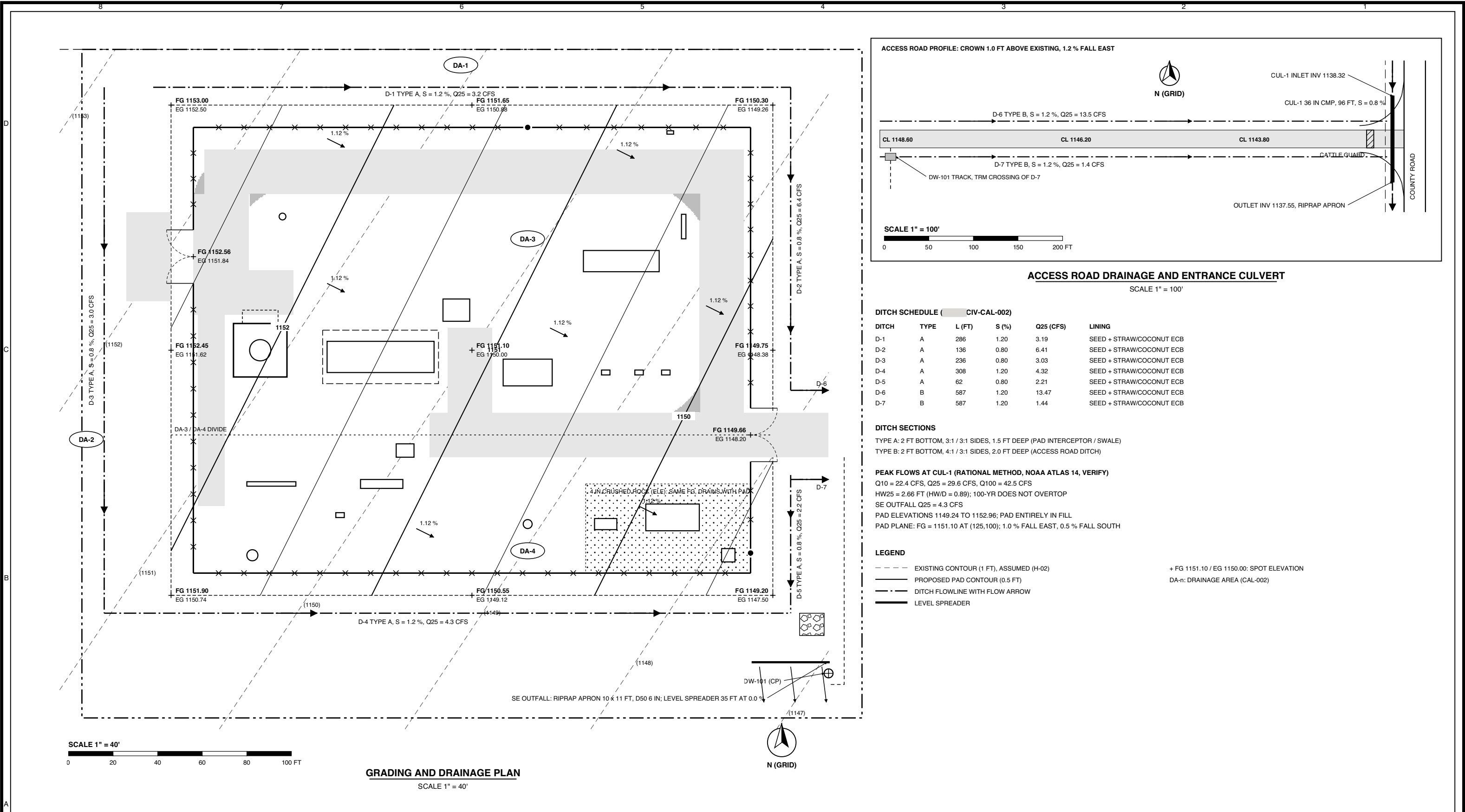
TORUS draws the following conclusions:

1. The 25-year peak flow at the entrance culvert is 30 cfs, most of it from offsite pasture. The 10-year and 100-year flows are 22 cfs and 43 cfs.
2. CUL-1 is a 36 in corrugated metal pipe, 96 ft long, with concrete headwalls. It passes the 25-year flow at $HW/D = 0.89$ under outlet control, and the 100-year flow does not overtop the driveway.
3. All seven ditches carry the 25-year flow on the standard Type A and Type B sections, and are lined with seed and erosion control blanket.
4. Riprap aprons at the culvert and the SE outfall total 50 tons, with a 35 ft level spreader at the SE outfall.
5. Development raises the 25-year peak by at most 1.3 cfs at either outfall, and no detention is proposed.
6. The 25-year, 24-hour rainfall for the T-101 containment is 6.33 in.

Before issue for construction the following must be closed: the topographic survey and offsite divides (HOLD H-02), the county ditch section, the county's culvert size and end treatment requirements and its position on detention (HOLD H-05), the soil group (HOLD H-07) and the flood zone (HOLD H-09). The drainage areas, times of concentration and culvert size shall then be recomputed.

APPENDIX A. GRADING AND DRAINAGE PLAN





ACCESS ROAD DRAINAGE AND ENTRANCE CULVERT
SCALE 1" = 100'

DITCH SCHEDULE (CIV-CAL-002)

DITCH	TYPE	L (FT)	S (%)	Q25 (CFS)	LINING
D-1	A	286	1.20	3.19	SEED + STRAW/COCONUT ECB
D-2	A	136	0.80	6.41	SEED + STRAW/COCONUT ECB
D-3	A	236	0.80	3.03	SEED + STRAW/COCONUT ECB
D-4	A	308	1.20	4.32	SEED + STRAW/COCONUT ECB
D-5	A	62	0.80	2.21	SEED + STRAW/COCONUT ECB
D-6	B	587	1.20	13.47	SEED + STRAW/COCONUT ECB
D-7	B	587	1.20	1.44	SEED + STRAW/COCONUT ECB

DITCH SECTIONS

TYPE A: 2 FT BOTTOM, 3:1 / 3:1 SIDES, 1.5 FT DEEP (PAD INTERCEPTOR / SWALE)
TYPE B: 2 FT BOTTOM, 4:1 / 3:1 SIDES, 2.0 FT DEEP (ACCESS ROAD DITCH)

PEAK FLOWS AT CUL-1 (RATIONAL METHOD, NOAA ATLAS 14, VERIFY)

Q10 = 22.4 CFS, Q25 = 29.6 CFS, Q100 = 42.5 CFS
HW25 = 2.66 FT (HW/D = 0.89); 100-YR DOES NOT OVERTOP
SE OUTFALL Q25 = 4.3 CFS
PAD ELEVATIONS 1149.24 TO 1152.96; PAD ENTIRELY IN FILL
PAD PLANE: FG = 1151.10 AT (125,100); 1.0 % FALL EAST, 0.5 % FALL SOUTH

LEGEND

- EXISTING CONTOUR (1 FT), ASSUMED (H-02)
- PROPOSED PAD CONTOUR (0.5 FT)
- DITCH FLOWLINE WITH FLOW ARROW
- LEVEL SPREADER

+ FG 1151.10 / EG 1150.00: SPOT ELEVATION
DA-n: DRAINAGE AREA (CAL-002)

NOTES / REFERENCES

- EXISTING GROUND IS AN ASSUMED PLANE (HOLD H-02). REGRADE FROM THE TOPOGRAPHIC SURVEY BEFORE IFC.
- ELEVATIONS FT NAVD88. FG = TOP OF AGGREGATE. PAD MIN 0.5 FT ABOVE EXISTING AT EVERY EDGE.
- FILL SLOPES 4H:1V FROM PAD EDGE TO EXISTING GROUND; DITCH SIDES 3:1 (TYPE A), 4:1 / 3:1 (TYPE B).
- ALL DITCHES SEED WITH STRAW/COCONUT ECB. CHECK DAMS AND SILT FENCE: CIV-DWG-005.
- CUL-1 INVERTS FROM ASSUMED COUNTY DITCH DEPTH 3.0 FT; CONFIRM BY SURVEY AND COUNTY PERMIT (H-05).
- LAYOUT AND ROADS PER MEC-DWG-001. DW-101 TRACK CROSSES D-7 ON TRM. DETAILS: DWG-004.

REF: CIV-CAL-001
REF: CIV-CAL-002

REVISIONS			
REV DATE	DESCRIPTION	BY	CHK APP
A	2026-09-29 ISSUED FOR REVIEW (IFR)		
PRELIMINARY - ISSUED FOR REVIEW - NOT FOR CONSTRUCTION			

ENGINEER OF RECORD SEAL

NOT SEALED
PRELIMINARY

PE NO. _____

PROJECT

120 MMSCFD RECEIPT INTO _____
COUNTY, _____
DISCIPLINE: CIVIL
SCALE: AS SHOWN

GRADING AND DRAINAGE PLAN

PAD, DITCHES, ENTRANCE CULVERT
DRAWN: _____ CHECKED: _____ APPROVED: _____
DWG NO. CIV-DWG-003
SHEET 1 OF 1 REV A