FINAL REPORT for the

MAUI MEADOWS SUBDIVISION
DRAINAGE MASTER PLAN

JUNE 2019

Prepared For:

County of Maui
Department of Public Works
Engineering Division
200 South High Street, 4th Floor
Wailuku, Maui, HI 96793

R. M. TOWILL CORPORATION
SINCE 1930

2024 North King Street, Suite 200
Honolulu, Hawaii 96819-3494
(808) 842-1133 ● Fax: (808) 842-1937
(RMTC Ref: 1-20258-1-E)

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EXECUTIVE SUMMARY

Purpose and Methodology

Maui Meadows Subdivision is an established residential area developed in the 1960s. Several small gulches pass through the subdivision carrying large quantities of storm water runoff across Piilani Highway toward the ocean. This drainage master plan will be a supplement to the Kihei Drainage Master Plan and provides a guideline for future flood mitigation improvements. The scope of work includes:

- Prepare the drainage maps based on the County's Light Detection and Ranging (LIDAR) data
- Calculate the design runoff through the subdivision by conducting a hydrologic analysis
- Assess the existing infrastructure capacity and incorporate future development, if any, in the analysis
- Recommend possible flood mitigation improvements and provide the conceptual cost

Hydrology

The hydrologic criteria used in this drainage master plan are as follows:

Table ES1 Maui County Design Criteria (Maui Meadows Subdivision)

Component	Area	Design Storm
Drainage Area	≤ 100 acres	10-year, 1-hour [2] 50-year, 1-hour [1, 2]
Drainage Area	> 100 acres	100-year, 24 hour [3]

[1] In sump or tailwater condition and design of roadway culverts and bridges

[2] Peak discharge is calculated by Rational Method.

[3] Peak discharge is calculated by Natural Resource Conservation Service (NRCS) hydrograph method.

Table ES2 HDOT Design Criteria (Piilani Highway)

Recurrence Intervals, Tm (years)			
Functional Classification	Bridge/Culvert Crossing	Roadway (at grade)	Roadway (sump)
Arterial	50 [1,2]	25	50

[1] 100-year interval for sites covered under the Flood Insurance Rate Map (FIRM)

[2] Peak discharge is calculated by Natural Resource Conservation Service (NRCS) hydrograph method.

Hydraulics

Culvert analyses were performed to determine the existing culvert capacities by using HY-8, Hydraflow (AutoCAD extension), and nomographs. For culverts with as-built plans available, the capacity was evaluated based on the inverts and roadway elevation with supplemental information from field reconnaissance.

For the culverts within the Maui Meadows Subdivision, the maximum allowable headwater elevation was set at one foot below the edge of the roadway or H/D =1.0 if the height is less than the one foot. For the culverts at Piilani Highway, the maximum allowable headwater elevation was set to be one foot below the edge of the roadway. Potential diversion ditches and swales were evaluated using Manning's equation for open channel flow.

Recommendations

The three options are briefly summarized below. For detailed descriptions, refer to Section 4 of this report.

Option 1 – Mauka Diversion

This option would construct concreted-lined diversion channels mauka of the Maui Meadows Subdivision to convey the runoff to an open area. Potential upsizing of the existing culverts within the subdivision may still be required to pass the remaining runoff. Due to the potential impacts to the downstream properties by the diverted runoff, future investigation will be required to further evaluate the feasibility.

Option 2 – Culvert Improvements (100-Year, 24-Hour and 50-Year, 1-Hour Storms)

This option would upsize the existing culverts to pass the design storm per the Maui County and HDOT drainage standards.

Option 3 – Culvert Improvements (50-Year, 24-Hour and 50-Year, 1-Hour Storms)

This option would consider upsizing the existing culverts to pass a less severe, but more frequent storm. A 50-year, 24-hour storm was used for culverts with contributing area greater than 100 acres. For culverts with contributing area less than 100 acres, the same 50-year, 1-hour storm would be applied as in Option 2.

Cost Estimate Summary

The conceptual rough order of magnitude cost estimates are summarized in the table below.

	Conceptual Cost
Option 1 (diversion channels only)	$34,084,000
Option 2	$12,471,000
Option 3	$11,324,000

SECTION 1 – INTRODUCTION

1.1 Background

Maui Meadows Subdivision is an established residential area developed in the 1960s. Several small gulches pass through the subdivision carrying large quantities of storm water runoff across Piilani Highway toward the ocean. Rare, but intense, storms cause flash floods in the subdivision due to existing drainage deficiencies. This drainage master plan will be a supplement to the Kihei Drainage Master Plan and provides a guideline for future flood mitigation improvements.

1.2 Purpose and Scope

The purpose of this study is to formulate and develop a drainage master plan to address existing drainage deficiencies. The scope of work includes:

- Prepare the drainage maps based on the County's Light Detection and Ranging (LIDAR) data
- Calculate the design runoff through the subdivision by conducting a hydrologic analysis
- Assess the existing infrastructure capacity and incorporate future development, if any, in the analysis
- Recommend possible flood mitigation improvements and provide the conceptual cost

1.3 Related Studies

The following drainage master plan is used as a reference in preparing this study.

- "Pre-final Report for the Kihei Drainage Master Plan Waiakoa Gulch to Kilohana Drive," R. M. Towill Corporation, November 2016, referred as 2016 Kihei DMP.

  The 2016 Kihei DMP provided the updated analyses of the storm runoff within the Kihei District. The peak discharge calculations were based on the 100-year, 24-hour storm frequency and were used to determine the proposed drainage improvements. Conceptual rough order of magnitude cost estimates were also provided. A portion of the Maui Meadows Subdivision was within one of the studied districts in the 2016 Kihei DMP scope, and hydrologic and hydraulic analyses were performed only for the Piilani Highway culverts. The culvert analyses within the Maui Meadows Subdivision were not included.

SECTION 2 – SITE DESCRIPTION

2.1 Location

The Maui Meadows Subdivision is located along the leeward coast of South Maui and the western slope of Haleakala (Figure 2.1) at the south end of the Kihei District. It is approximately 14 miles southeast of the town of Wailuku. Access to the subdivision is through Piilani Highway, located at the makai side of the subdivision. There are no detailed Federal Emergency Management Agency (FEMA) flood studies within the project area.

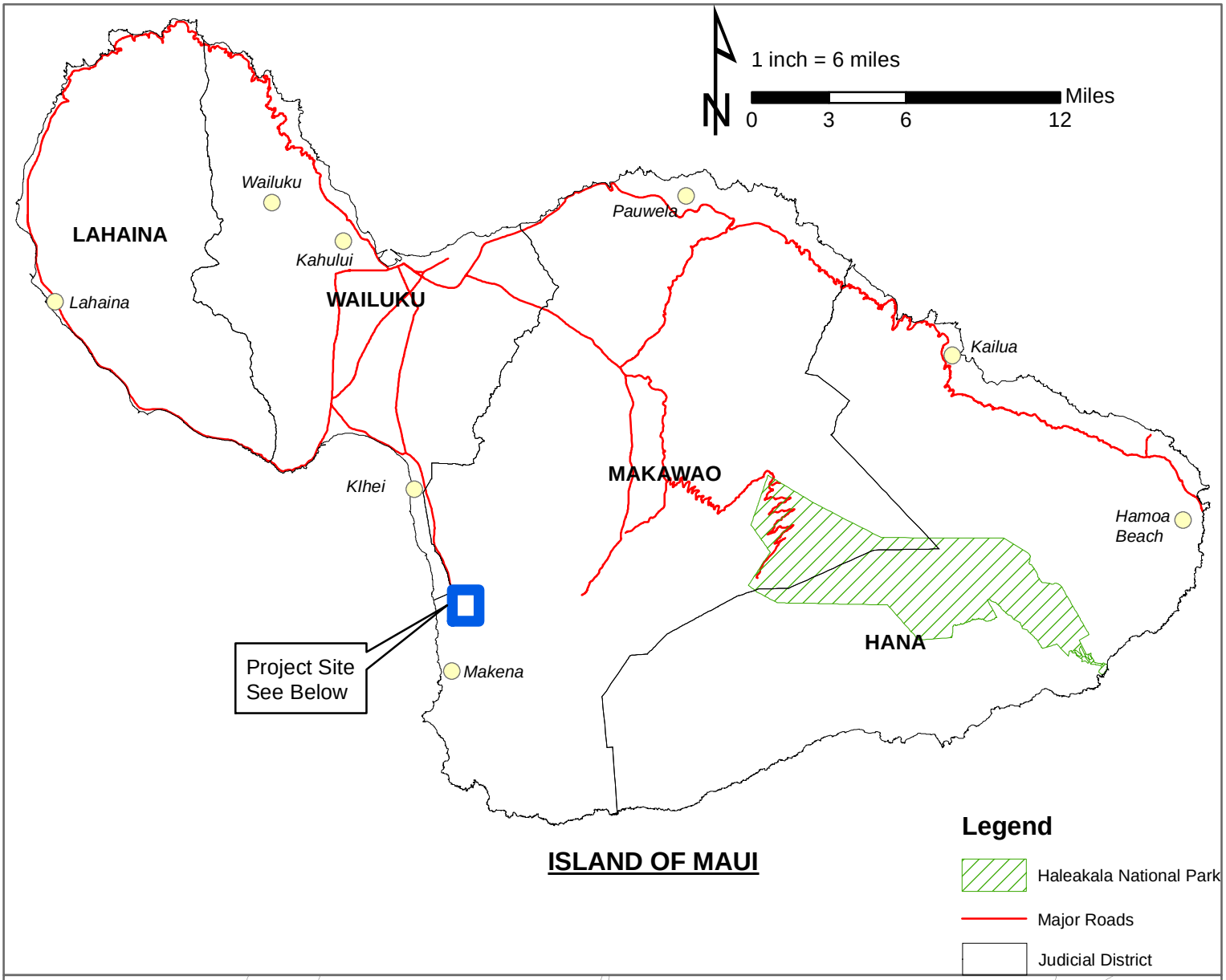
2.2 Topography

The elevation within the Maui Meadows Subdivision ranges from 660 feet mean sea level (msl) at the mauka side of the subdivision to 220 feet msl at the Piilani Highway culverts and the average slope is approximately 12%. The landscape mainly consists of residential areas and roadways. Mauka of the subdivision, the slope becomes steeper (greater than 20%) as it approaches the leeward side of Haleakala and the elevation goes up to 5,500 feet msl.

2.3 Climate

The general climate on the island of Maui is greatly influenced by geographic location, and can be characterized as the wet winter season (October to April) and the dry summer season (May to September). At the windward side of the Haleakala mountain range, the predominant northeasterly trade winds generate heavy rainfall whereas the leeward side of the Haleakala mountain range remains relatively dry. The Kihei District has a mean annual rainfall of approximately 10 inches (Reference 1).

Orographic rainfall and cyclonic storms also contribute to precipitation on the island. The orographic rainfall pattern is restricted to elevations exceeding 2,000 feet where clouds are formed. Moisture in the air from the ocean is uplifted and cooled at upper elevation of the mountain where the highest rainfall is observed. Rainfall decreases gradually toward the coastal areas, as the elevations decrease. Cyclonic storms usually produce distributed rainfall several times a year.



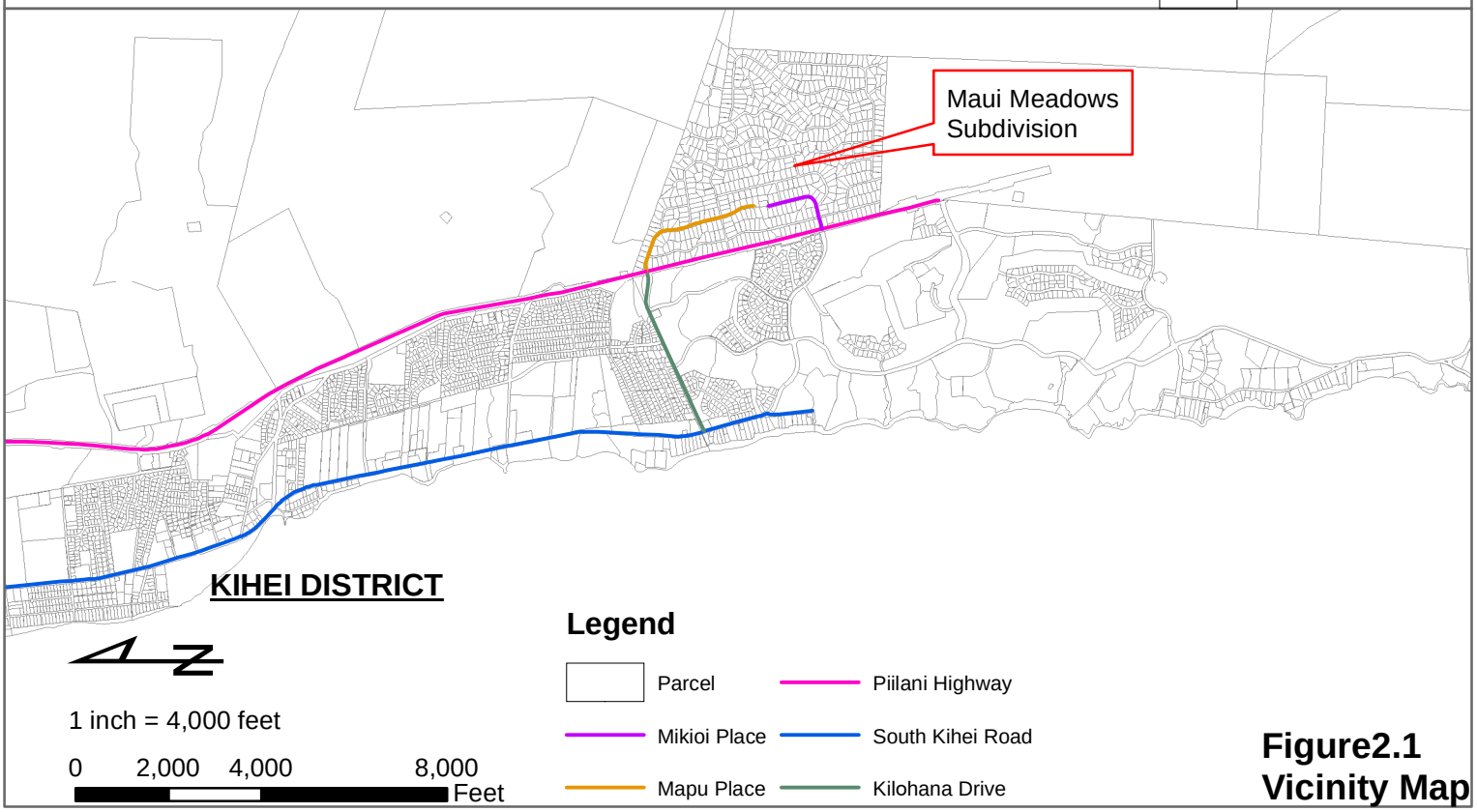


Figure2.1
Vicinity Map

SECTION 3 – METHODOLOGY

3.1 General

The methodology used to prepare this drainage master plan is accordance with the guidelines in the Maui County Drainage Standards (Reference 2, County Standards) and the Design Criteria for Highway Drainage (Reference 3, HDOT Standards) by the Hawaii State Department of Transportation Highway Divisions (HDOT).

For the existing conditions:

- The base maps were prepared based on the detailed LiDAR topography and supplemented with the United States Geological Survey (USGS) quadrangle.

- The existing drainage structures within Maui Meadows Subdivision and along Piilani Highway were identified and the capacities were determined using information obtained from the as-built plans.

- Field reconnaissance was conducted for the existing drainage structures; the reconnaissance was limited to the areas that were accessible and where consent was given by the private property owners. The purpose was to verify the size of the drainage structures and to confirm the drainage flow pattern. The field information was used to refine the capacity calculations.

For the proposed conditions:

- For the existing drainage structures, if determined to have inadequate capacities, options are discussed to provide flood mitigation improvements (see Section 4). Currently, there is no future development planned mauka of the Maui Meadows Subdivision. Therefore, the existing drainage areas and peak discharges from the existing conditions are used for the future condition.

3.2 Base Maps

The LiDAR data, provided by the County of Maui, was used as the primary source to delineate the drainage basins. The topographic data was collected in 2004 and published in 2005. For areas outside of the LiDAR coverage, the USGS quadrangle maps were used to continue delineation. The existing drainage basin map is shown on Figure 3.1.

3.3 Hydrology

3.3.1 Criteria

The hydrologic criteria used in this drainage master plan are as follows:

Table 3.1 Maui County Design Criteria (Maui Meadows Subdivision)

Component	Area	Design Storm
Drainage Area	≤ 100 acres	10-year, 1-hour [2] 50-year, 1-hour [1, 2]
Drainage Area	> 100 acres	100-year, 24 hour [3]

[1] In sump or tailwater condition and design of roadway culverts and bridges
[2] Peak discharge is calculated by Rational Method.
[3] Peak discharge is calculated by Natural Resource Conservation Service (NRCS) hydrograph method.

Table 3.2 HDOT Design Criteria (Piilani Highway)

Recurrence Intervals, Tm (years)			
Functional Classification	Bridge/Culvert Crossing	Roadway (at grade)	Roadway (sump)
Arterial	50 [1,2]	25	50

[1] 100-year interval for sites covered under the Flood Insurance Rate Map (FIRM)
[2] Peak discharge is calculated by Natural Resource Conservation Service (NRCS) hydrograph method.

3.3.1 Rational Method

The Rational Method is represented by the following formula.

$$Q = C\,I\,A$$

where:

Q = peak discharge (cubic feet per second, cfs)
C = runoff coefficient (dimensionless)
I = rainfall intensity for a duration equal to the time of concentration (in/hr)
A = drainage area (acres)

3.3.2 NRCS Hydrograph Method

The Hydrologic Engineering Center–Hydrologic Modeling System (HEC-HMS, Reference 4) from the United States Army Corps of Engineers (USACE) was utilized to determine the 100-year peak discharges and runoff volumes with duration of 24 hours. The HEC-HMS software incorporates the NRCS hydrograph method as one of its tools and is a generalized modeling system capable of representing the watershed surface runoff.

Legend
(Drainage Basin IDs)

26 29 32 Piilani Highway
27 30 33
28 31 34

1 inch = 1,000 feet
0 1,000 2,000 3,000 Feet

Figure 3.1
Maui Meadows Subdivision
Existing Drainage Basin Map

The HEC-HMS model used in this master plan is a precipitation-runoff process model and is built on several parameters described below.

- Curve Number (CN)
  The curve number was selected as the loss method and the NRCS unit hydrograph was selected as the transform method to develop peak discharges and relevant hydrographs. The hydrographs were added to form composite hydrographs where two or more drainage basins contribute to the same point of interest. The resultant peak discharges may not be the summation of all the peak discharges because the time to the peak of each hydrograph varies. Therefore, the peaks may not coincide.

  A composite runoff curve number for each drainage basin was calculated based on the soil types and land cover. The soil types for the island of Maui were obtained from the NRCS website (Soil Survey Geographic Database, SSURGO, Reference 5) and the hydrologic soil group (HSG) classification (A, B, C, and D) was determined. The existing land covers/land uses (LCLU) were obtained from the National Oceanic and Atmospheric Administration (NOAA) Coastal Change Analysis Program (C-CAP) website (imagery collected on 2010, published on 2013, Reference 6).

- Time of Concentration (Tc)
  The Tc is computed based on NRCS Technical Release-55 (TR-55, Reference 7) methodology by adding the travel times of the three flow regions: sheet flow, shallow concentrated flow, and channel flow (if applicable). In addition, Tc can also be expressed as lag time, which can be approximated by taking 60% of the time of concentration according to SCS studies.

  $Tc = Ts + Tsc + Tch$
  where:
  Tc = time of concentration (hr)
  Ts = sheet flow travel time (hr)
  Tsc = shallow concentrated flow travel time (hr)
  Tch = open channel flow travel time (hr)

  Sheet Flow Region:

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

  where:
  Ts = travel time (hr)
  n = Manning's roughness coefficient (TR-55, table 3-1)
  L = flow length (100 feet)
  P_2 = 2-year, 24-hour rainfall (inches) (values were taken from *Appendix C*)
  s = land slope (ft/ft)

  The 2-year, 24-hour rainfall was obtained from the NOAA website and was at the basin centroid location to represent the entire basin.

Shallow Concentrated Flow Region:
After traveling the first 100 feet, sheet flow usually becomes shallow concentrated flow. The travel time is obtained by dividing the flow length by the average velocity. The average velocity is a function of stream slope and channel type (paved or unpaved). The TR-55 manual provides a figure and equations to determine the average velocity.

Open Chanel Flow
The open channel flow travel time is obtained by dividing flow length by the average velocity, which is computed by Manning's equation.

- Reach Routing
  The reach routing was applied in the HEC-HMS model and the lag routing method was selected to represent the time required to travel between drainage basins. The attenuation is small since the stream segment is relatively short and steep, and the velocity is assumed to be consistent throughout the reach.

- Rainfall Distribution
  The meteorologic model is one of the main components in the HEC-HMS model, which specifies the boundary conditions and the precipitation amounts. The SCS unit hydrograph was adopted and typically the SCS Type I storm is used for the Hawaiian Islands. The cumulative precipitation of the SCS Type I unit hydrograph for the duration of 24-hour was input as a time-series table (Reference 8). The total 24-hour rainfall depths of various recurrence intervals were obtained from the NOAA website, Precipitation Frequency Data Server (NOAA Atlas 14 for the Hawaiian Island, Reference 9).

  In order to determine the total rainfall depth of various recurrence intervals for each drainage basin, the centroid of each drainage basin was first determined to represent the rainfall data over the entire contributing area of the drainage basin. Some centroid locations were found to be outside of the drainage basin polygon, but were in the close vicinity, which is assumed to be insignificant in this study.

3.4 Hydraulics

3.4.1 Culverts

Culvert analyses were performed to determine the existing culvert capacities by using HY-8 (Federal Highway Administration, Reference 10), Hydraflow (AutoCAD extension, Reference 11), and nomographs (Reference 12). For culverts with as-built plans available, the capacity was evaluated based on the inverts and roadway elevation with supplemental information from field reconnaissance.

For the culverts within the Maui Meadows Subdivision, the maximum allowable headwater elevation was set at one foot below the edge of the roadway or H/D =1.0 if the height is less than the one foot.

For the culverts at Piilani Highway, the maximum allowable headwater elevation was set to be one foot below the edge of the roadway. The proposed improvements to the drainage structures located at Piilani Highway in this report are subject to HDOT approval,

3.4.2 Diversion Ditches and Swales

Potential diversion ditches and swales were evaluated using Manning's equation for open channel flow.

SECTION 4 – ASSESSMENT

4.1 Existing Culverts and Drainage Areas

The general flow direction at Maui Meadows Subdivision is from mauka to makai with Piilani Highway located at the makai boundary on the west side of the study area. There are 53 existing drainage structures (culverts and drain inlets) identified within the study area from the as-built plans with sizes range from 1-24" to 4-114". The Existing Culverts Map is shown in Figure 4.1.a.

Based on the LiDAR topography, there are 9 major drainage basins at the Maui Meadows Subdivision (DA 26 to 34) as shown in Figure 4.1.b Drainage basins 30, 33, 34 are the three largest drainage basins with contributing areas of 2066.9, 770.6, and 984.2 acres at the Piilani Highway crossings. The existing conditions HEC-HMS diagrams are shown in Figure 4.1.c to 4.1.j. The existing conditions rational method diagrams are shown in Figure 4.1.k to 4.1.n.

Drainage basins 26 to 29 were analyzed in the 2016 Kihei DMP and were refined in this report with supplemental as-built plans showing culverts at the roadway crossings. Therefore, the peak discharges of drainage basins 26 to 29 shown in the 2016 Kihei DMP are superseded by the results presented in this report.

One noticeable difference is that drainage basin 26 is separated into 26A and 26B. Runoff from drainage basin 26B is captured by Culvert 39 (1-36" CMP). After crossing Hoomua Drive, the runoff is conveyed to an underground system and routed to Mapu Place where it outlets to the upstream side of Culvert 31 in drainage basin 27 (1-48" CMP). This underground system (no as-built plan available) is within private property according to the resident. The remaining runoff in drainage basin 26A will flow to the Piilani Highway culverts (3-48"). The comparison of the revised area of drainage basins 26 and 27 at Piilani Highway is summarized in Table 4.1.

Table 4.1 Revised Area Comparison at Piilani Highway for Drainage Basins 26 and 27

	2016 Kihei DMP	Maui Meadows Subdivision DMP
DA 26	93	17.3
DA 27	27	103.6

The existing culvert sizes, capacities, and contributing areas are summarized in Table 4.2.

ID	Size
1	Roadside DI
2	Roadside DI
3	3-6'-0"x3'-8" Pipe Arches
4	1-24" CMP
5	1-24" CMP
6	1-24" CMP
7	1-36" CMP
8	1-24" CMP
9	1-24" CMP
10	1-24" CMP
11	1-36" CMP
12	Roadside DI
13	3-4'-10"x3'-0" CMPA
14	1-60" CMP
15	3-6'-0"x3'-8" CMPA
16	1-24" CMP
17	1-36" CMP
18	3-6'-0"x3'-8" CMPA
19	1-36" CMP
20	3-4'-10"x3'-0" CMPA
21	1-36" CMP
22	1-30" CMP
23	1-24" CMP
24	3-6'-0"x3'-8" CMPA
25	1-36" CMP
26	3-36" CMP
27	1-36" CMP
28	1-24" CMP
29	1-36" CMP
30	1-24" CMP
31	1-48" CMP
32	3-36" CMP
33	1-48" CMP
34	1-24" CMP
35	3-36" CMP
36	3-6'-8"x3'-6" CMPA
37	2-36" CMP
38	1-36" CMP
39	1-36" CMP
40	1-48" CMP
41	1-24" CMP
42	1-42" CMP
43	3-6'-8"x3'-6" CMPA
44	1-36" CMP
45	1-42" CMP
46	4-114"
47	1-120"
48	3-48"
49	2-120"
50	3-48"
51	2-42"
52	1-30"
53	1-84"

Notes:
DI = Drain Inlet
CMPA = Corrugated Metal Pipe Arch
CMP = Corrugated Metal Pipe

Underground Pipe

KAIMANU PL
LANINA PL
LAUNA DR
KAAPUNI PL
LANIHOU PL
KEHA DR
NAHENAHE PL
LANIOLU PL
HOOKIPA PL
LAULI PL
LUANA PL
WAILEIA PL
KALEO PL
MAKAMAE PL
KUAUA PL
MALINA PL
PAWALI ST
KOHALA ST
KUMULANI DR
MILILANI PL
HOOMUA DR
KEHALA DR
KEAHI PL
KUPULAU DR
MAPU PL
MIKIOI PL
HOALA DR
AKALA DR
PIILANI HY
KUALONO PL

Legend

Culverts/Drain Inlets **30** Culverts/DI ID
Major Flow Path

1 inch = 500 feet

0 250 500 1,000 1,500 Feet

Figure 4.1.a
Existing Culverts

Maui Meadows Subdivision

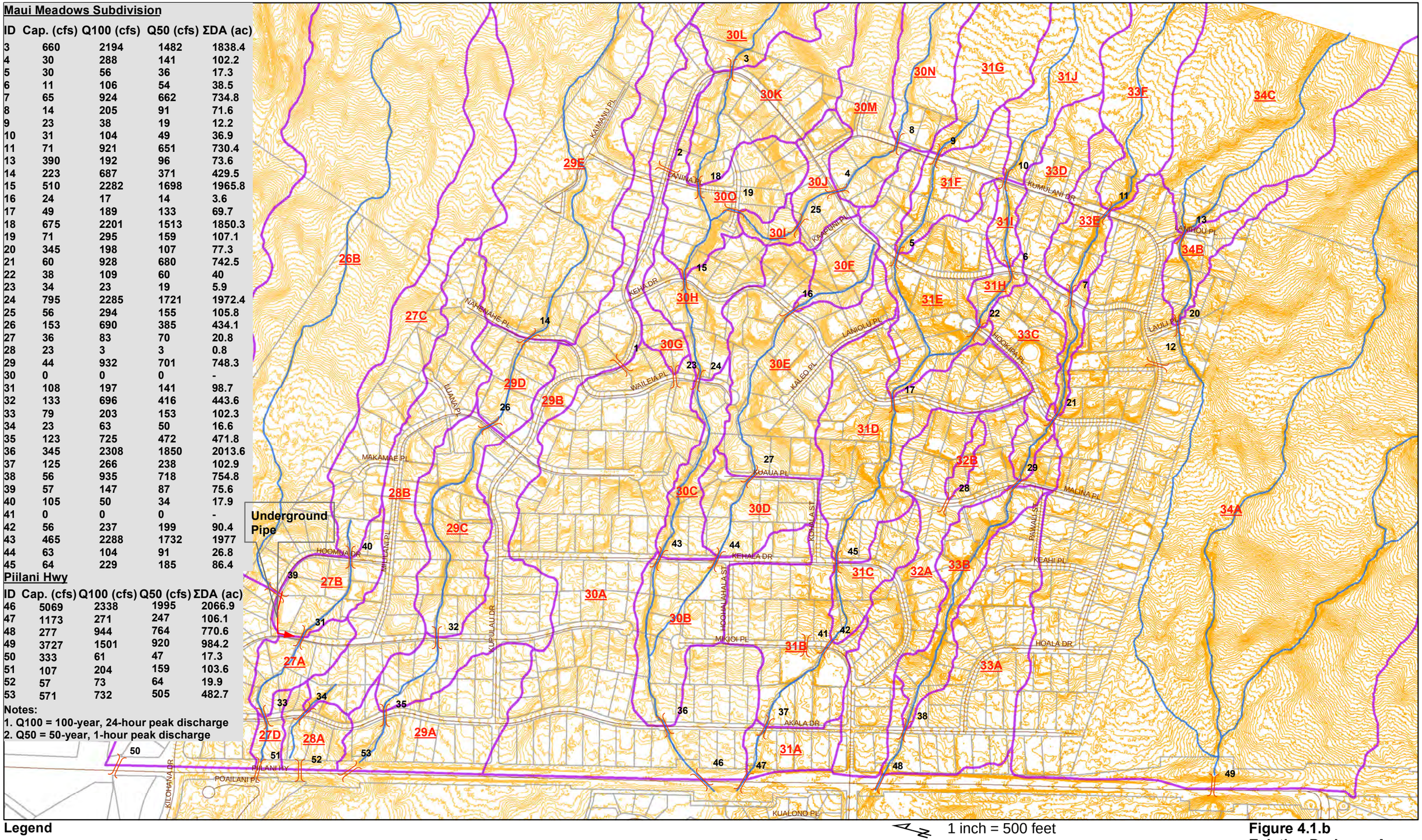
ID	Cap. (cfs)	Q100 (cfs)	Q50 (cfs)	ΣDA (ac)
3	660	2194	1482	1838.4
4	30	288	141	102.2
5	30	56	36	17.3
6	11	106	54	38.5
7	65	924	662	734.8
8	14	205	91	71.6
9	23	38	19	12.2
10	31	104	49	36.9
11	71	921	651	730.4
13	390	192	96	73.6
14	223	687	371	429.5
15	510	2282	1698	1965.8
16	24	17	14	3.6
17	49	189	133	69.7
18	675	2201	1513	1850.3
19	71	295	159	107.1
20	345	198	107	77.3
21	60	928	680	742.5
22	38	109	60	40
23	34	23	19	5.9
24	795	2285	1721	1972.4
25	56	294	155	105.8
26	153	690	385	434.1
27	36	83	70	20.8
28	23	3	3	0.8
29	44	932	701	748.3
30	0	0	0	-
31	108	197	141	98.7
32	133	696	416	443.6
33	79	203	153	102.3
34	23	63	50	16.6
35	123	725	472	471.8
36	345	2308	1850	2013.6
37	125	266	238	102.9
38	56	935	718	754.8
39	57	147	87	75.6
40	105	50	34	17.9
41	0	0	0	-
42	56	237	199	90.4
43	465	2288	1732	1977
44	63	104	91	26.8
45	64	229	185	86.4

Piilani Hwy

ID	Cap. (cfs)	Q100 (cfs)	Q50 (cfs)	ΣDA (ac)
46	5069	2338	1995	2066.9
47	1173	271	247	106.1
48	277	944	764	770.6
49	3727	1501	920	984.2
50	333	61	47	17.3
51	107	204	159	103.6
52	57	73	64	19.9
53	571	732	505	482.7

Notes:
1. Q100 = 100-year, 24-hour peak discharge
2. Q50 = 50-year, 1-hour peak discharge

Underground Pipe



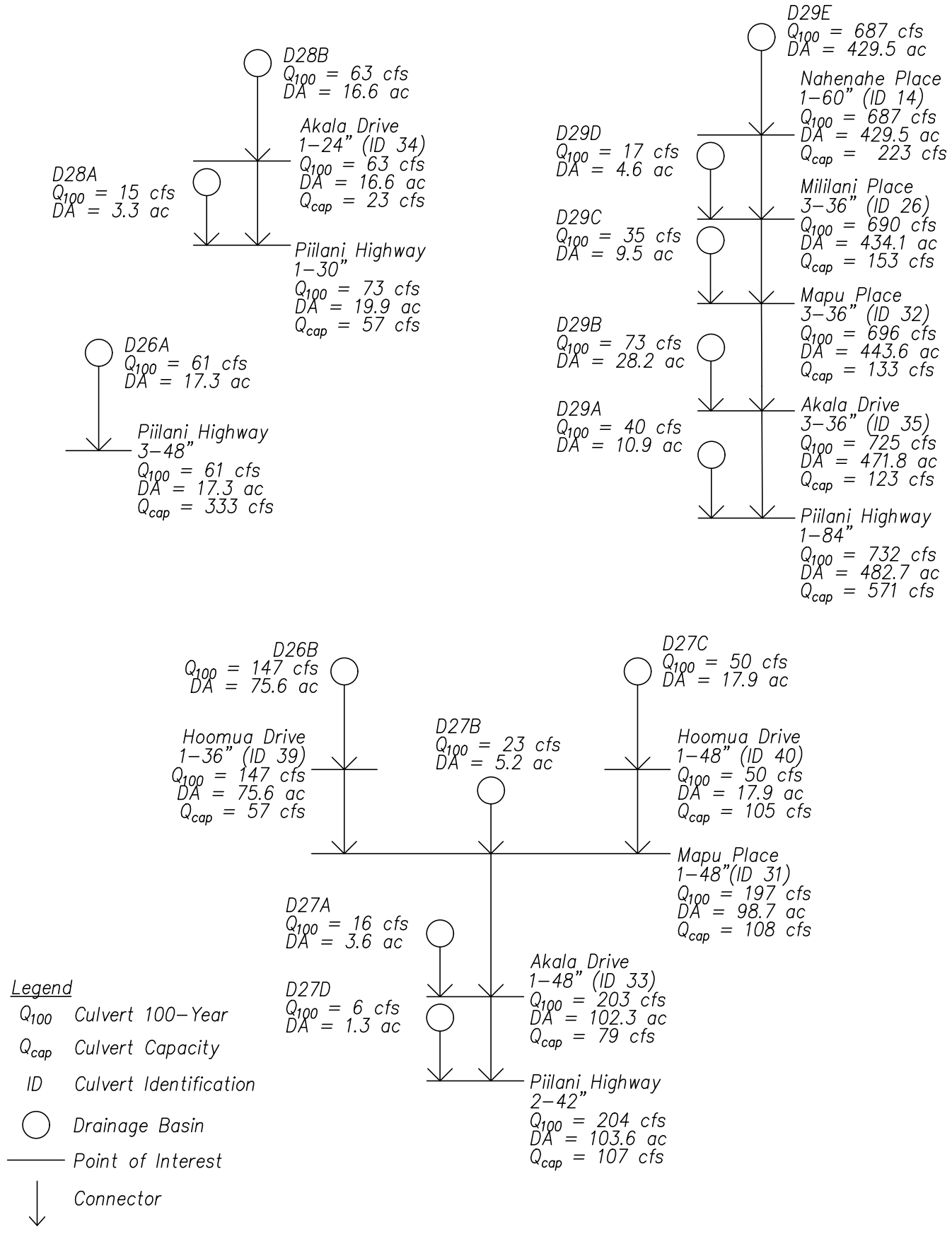
Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 30 Drainage Basin ID
- 30 Culverts/DI ID

1 inch = 500 feet

0 250 500 1,000 1,500 Feet

Figure 4.1.b
Existing Drainage Area - LiDAR



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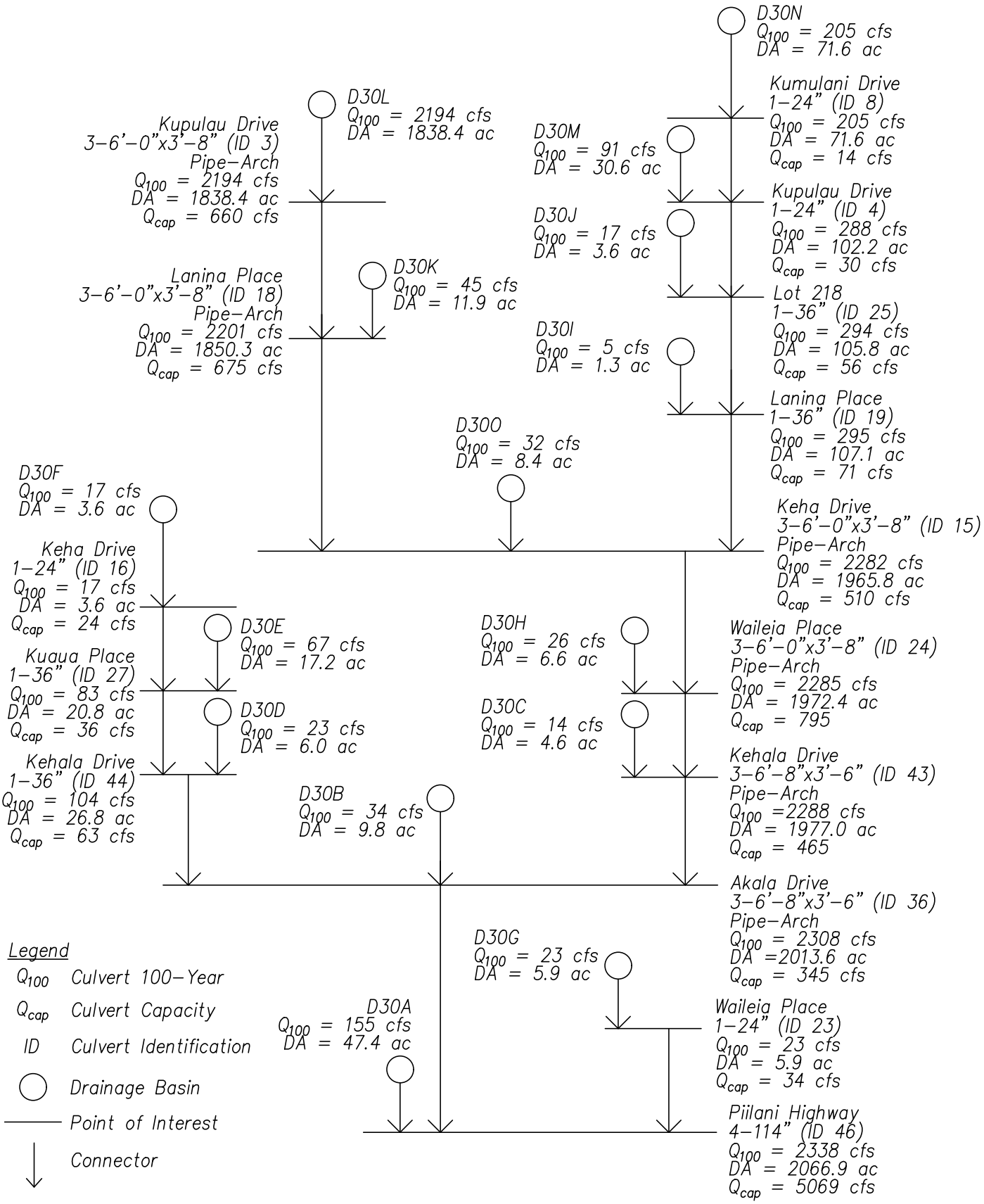
Drainage Areas 26 to 29
Existing Conditions
HEC-HMS Diagram (100-yr, 24-hr)

Figure 4.1.c



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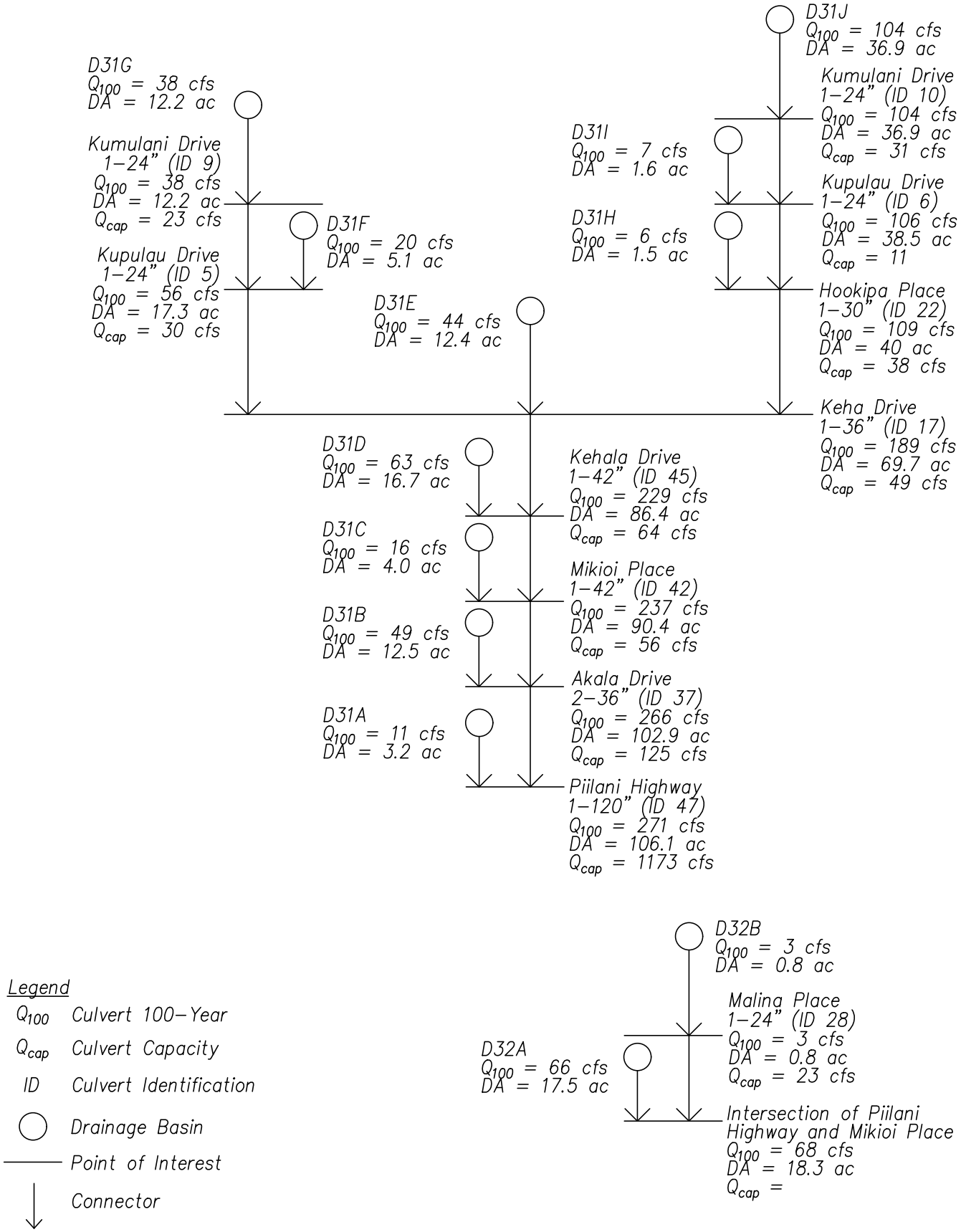
Drainage Area 30
Existing Conditions
HEC-HMS Diagram (100-yr, 24-hr)

Figure 4.1.d



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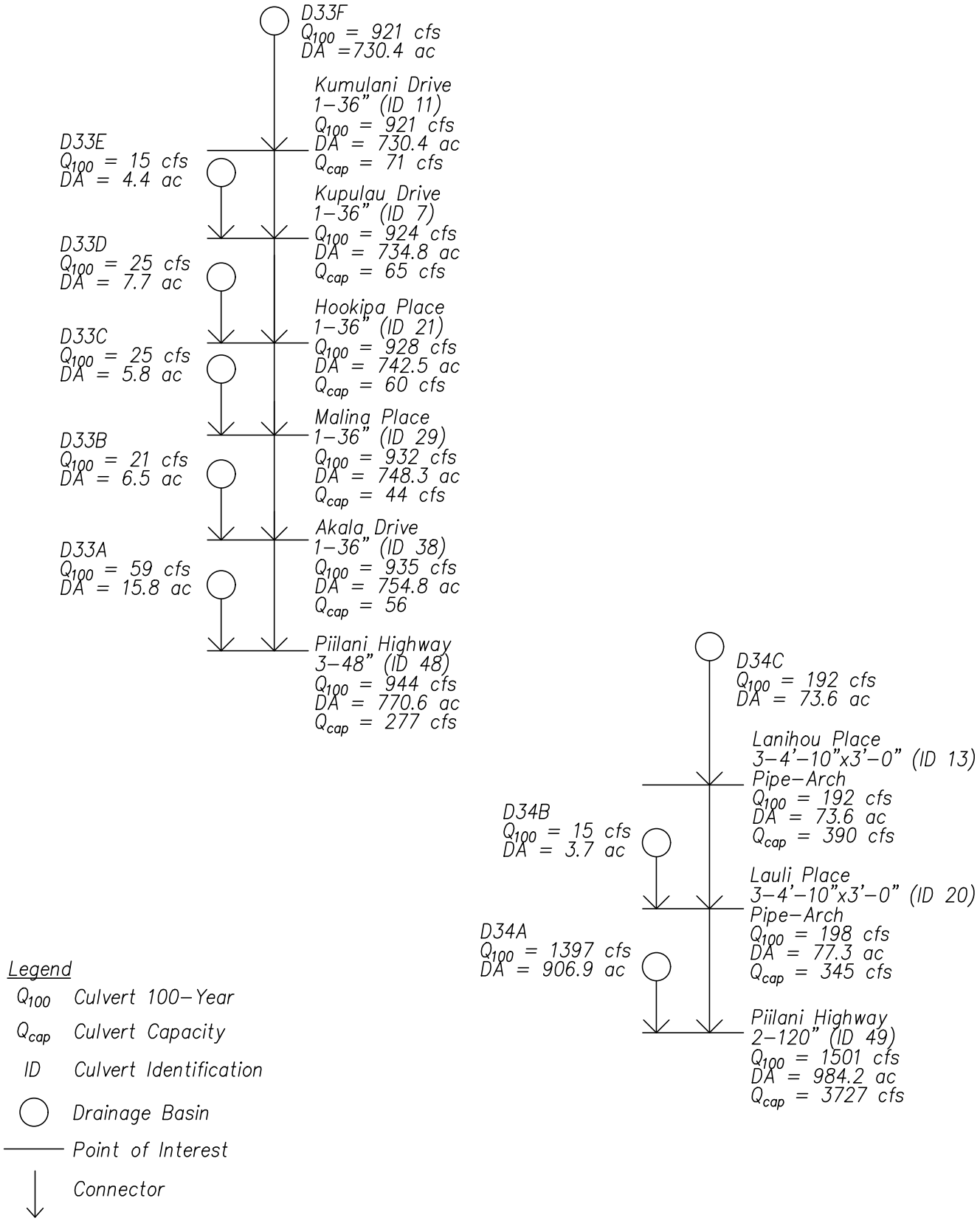
Drainage Areas 31 and 32
Existing Conditions
HEC-HMS Diagram (100-yr, 24-hr)

Figure 4.1.e



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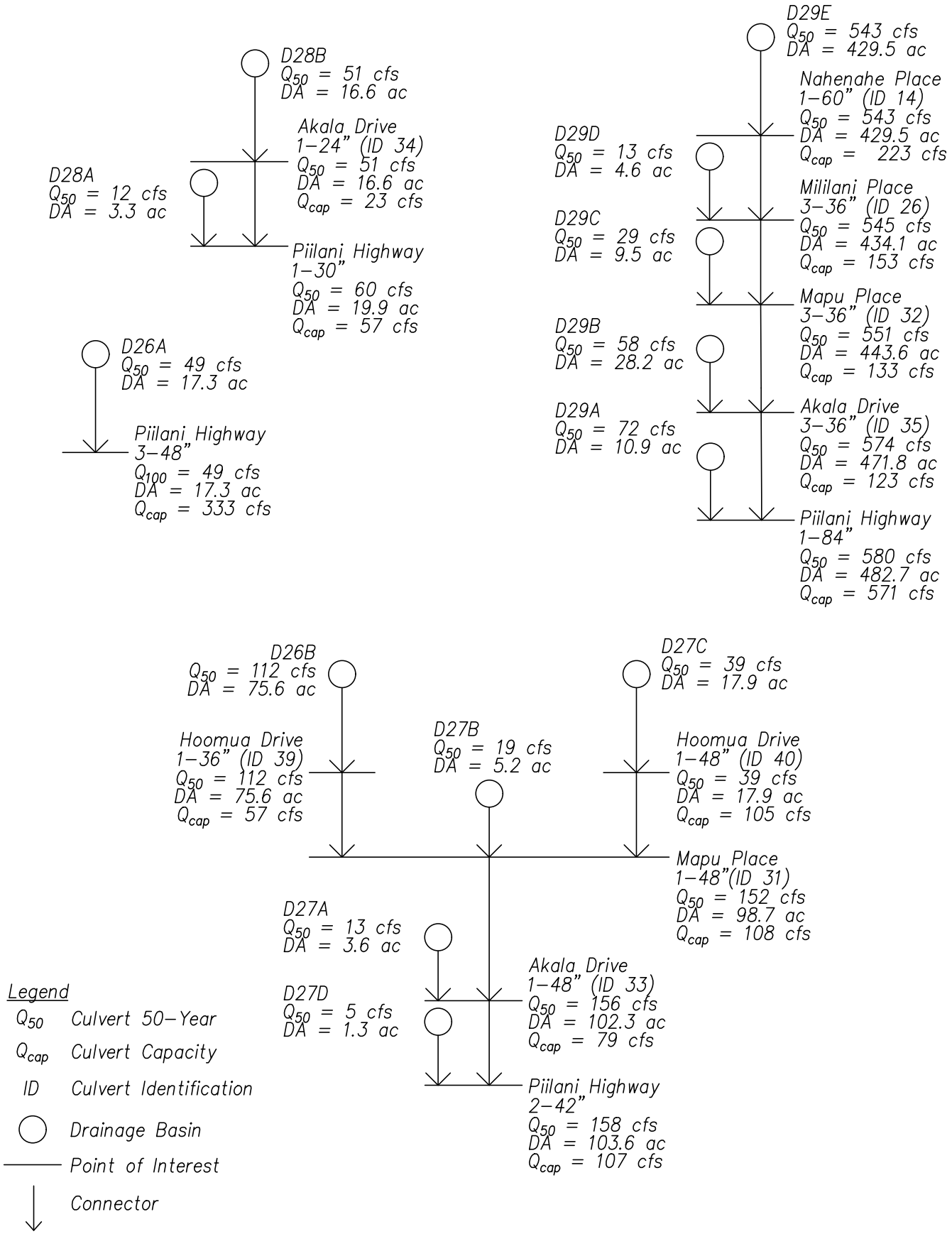
Drainage Area 33 and 34
Existing Conditions
HEC-HMS Diagram (100-yr, 24-hr)

Figure 4.1.f



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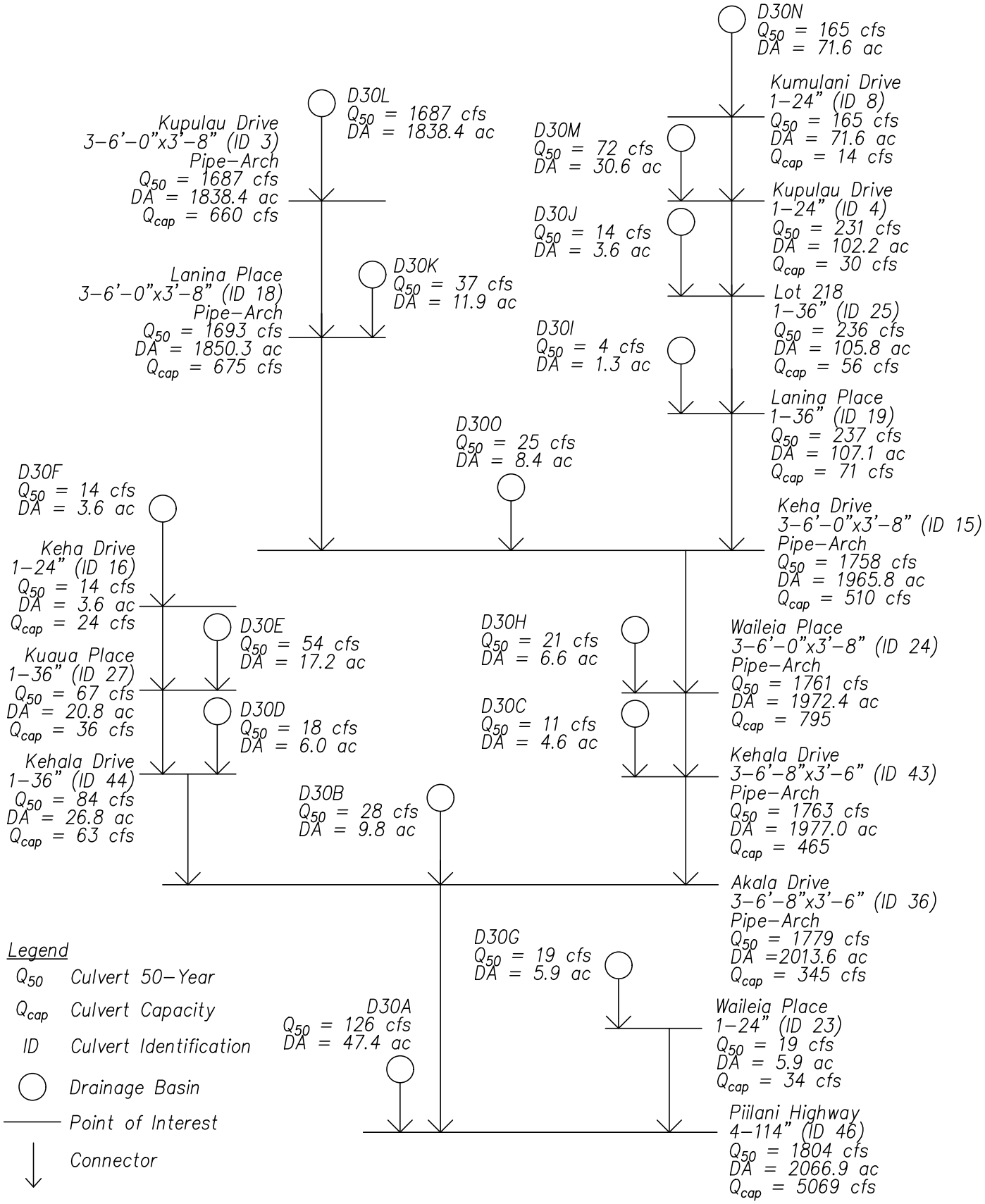
Drainage Areas 26 to 29
Existing Conditions
HEC-HMS Diagram (50 Year)

Figure 4.1.g



MAUI MEADOWS SUBDIVISION DRAINAGE MASTER PLAN

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R. M. TOWILL CORPORATION
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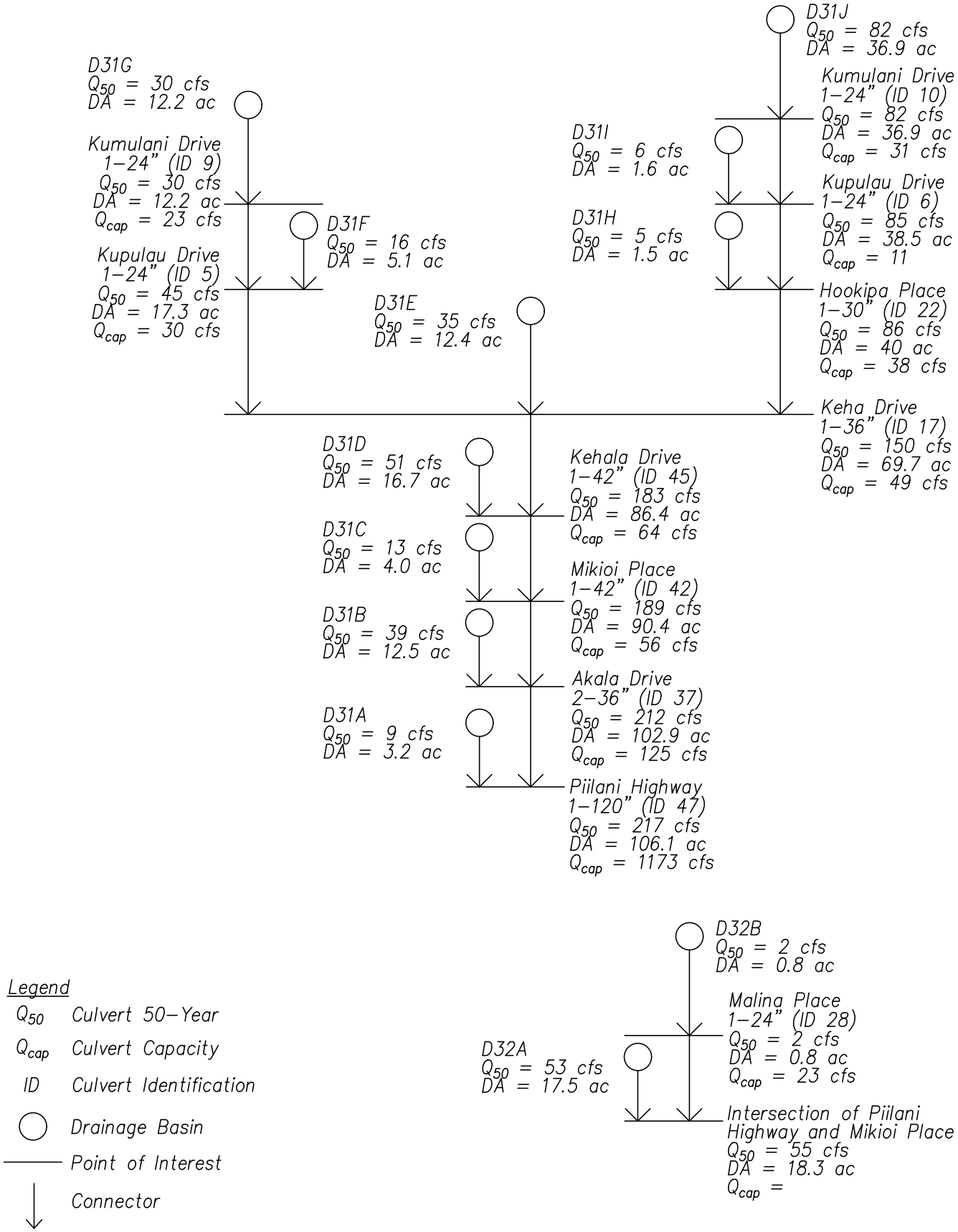
Drainage Area 30
Existing Conditions
HEC-HMS Diagram (50 Year)

Figure 4.1.h



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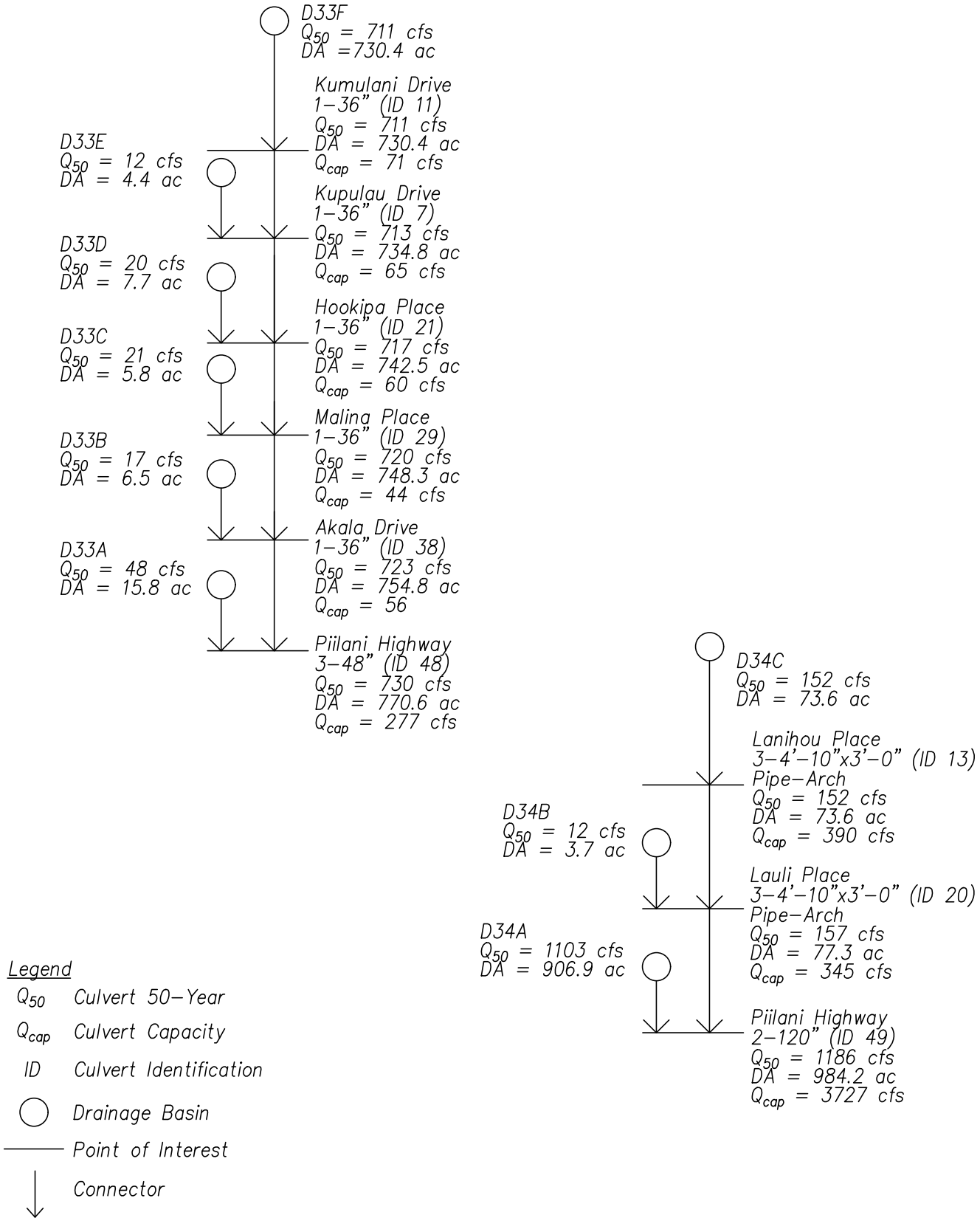
Drainage Areas 31 and 32 Existing Conditions HEC-HMS Diagram (50 Year)

Figure 4.1.i



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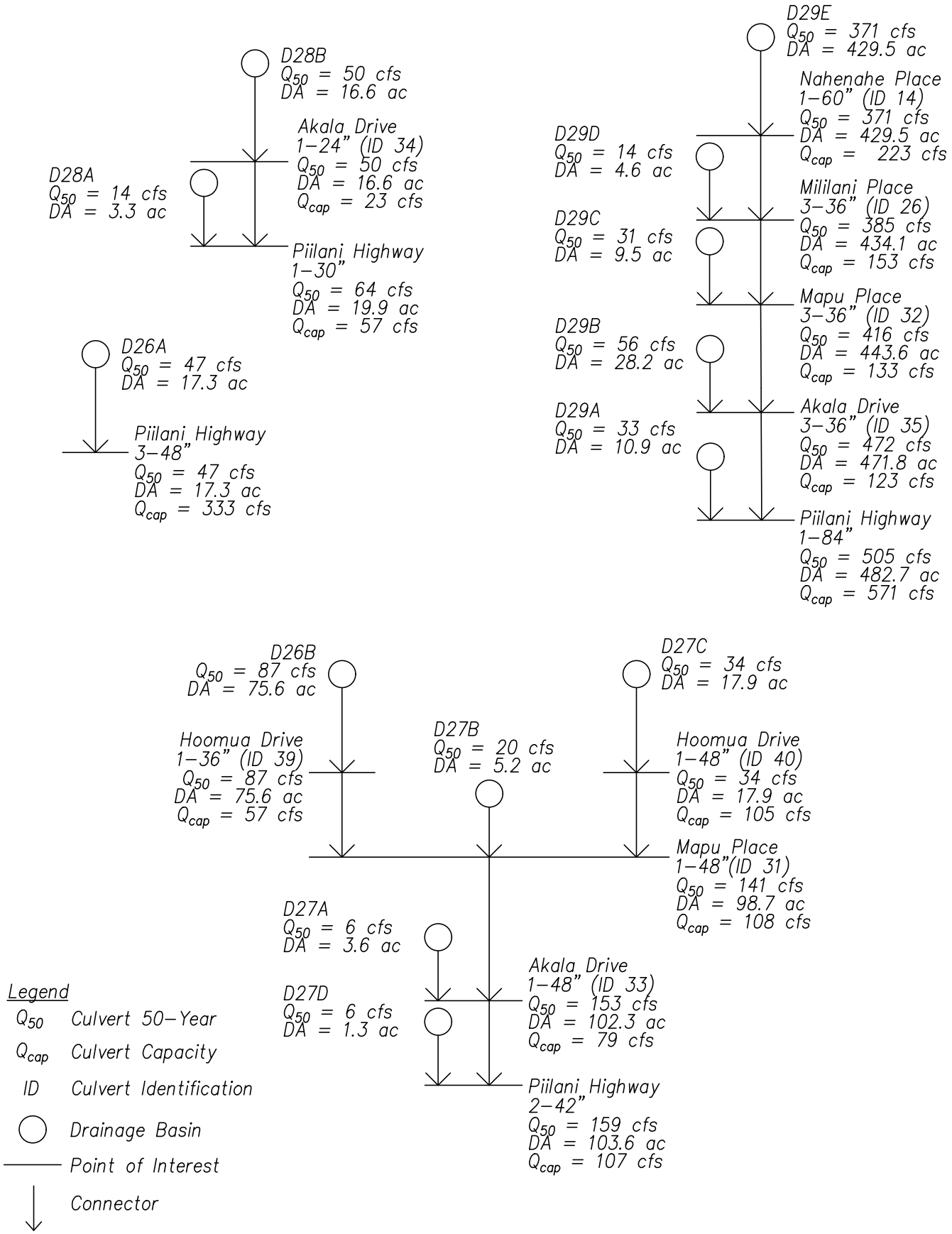
Drainage Area 33 and 34
Existing Conditions
HEC-HMS Diagram (50 Year)

Figure 4.1.j



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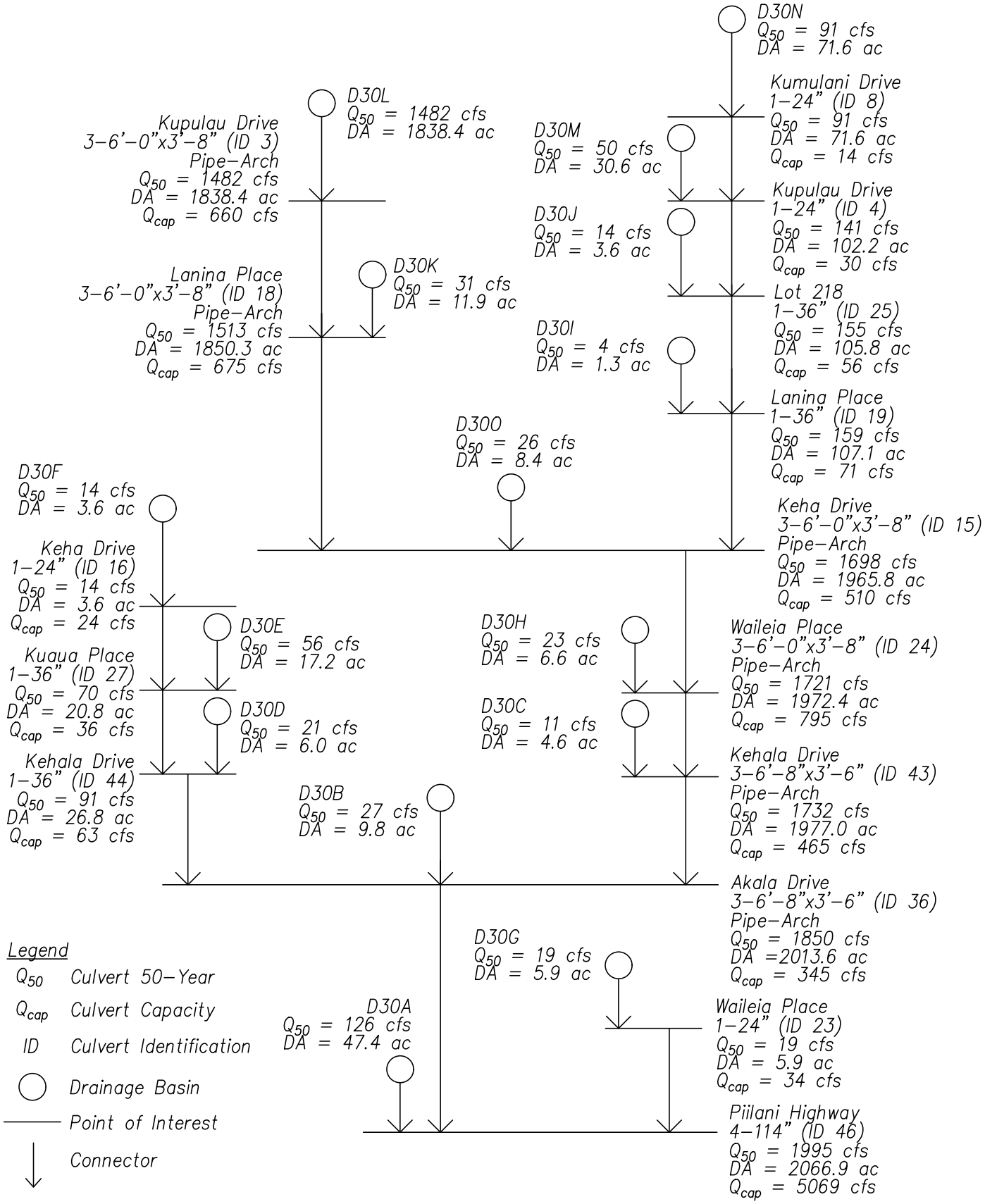
Drainage Areas 26 to 29
Existing Conditions
Rational Method Diagram (50-yr, 1-hr)

Figure 4.1.k



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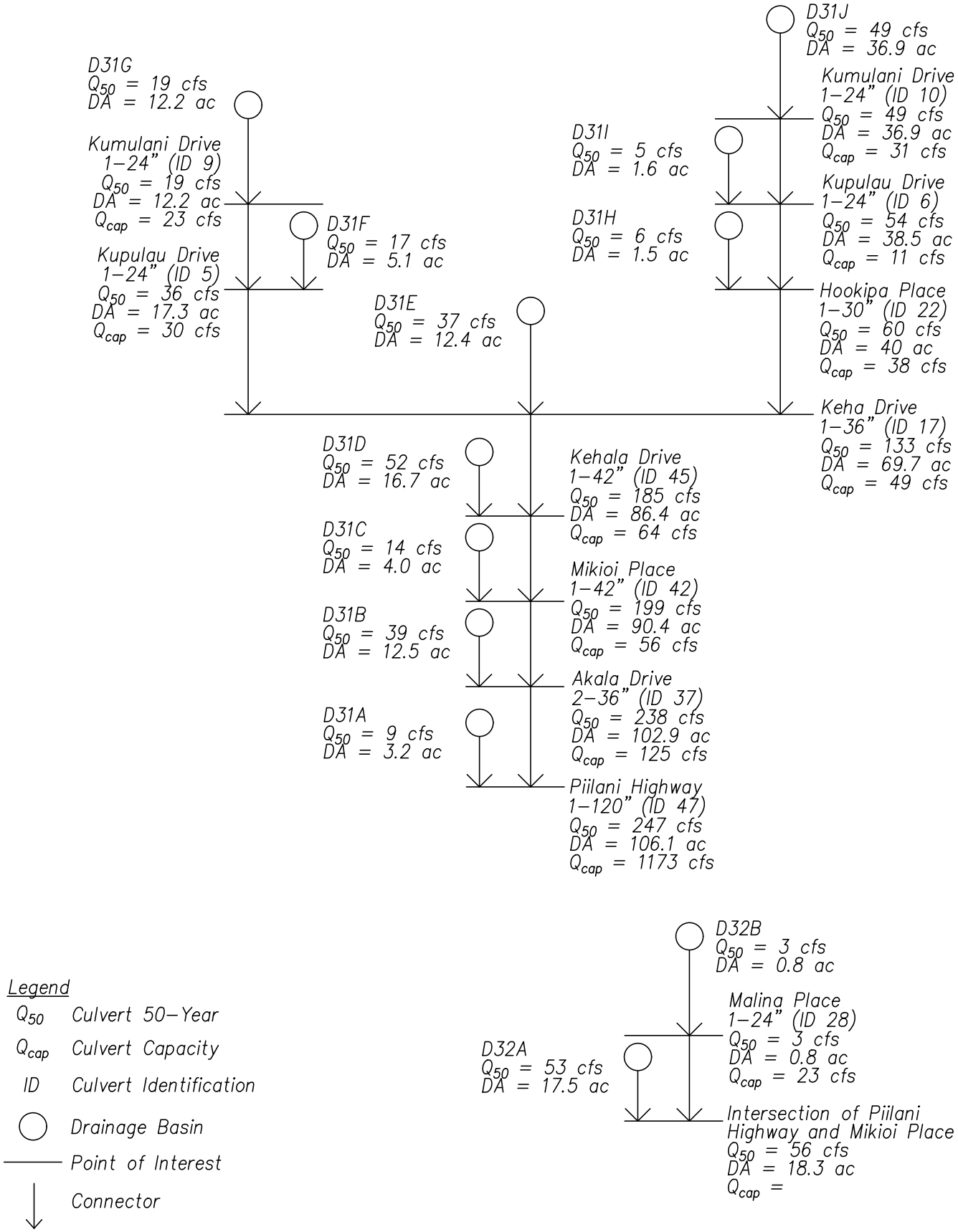
Drainage Area 30
Existing Conditions
Rational Method Diagram (50-yr, 1-hr)

Figure 4.1.I



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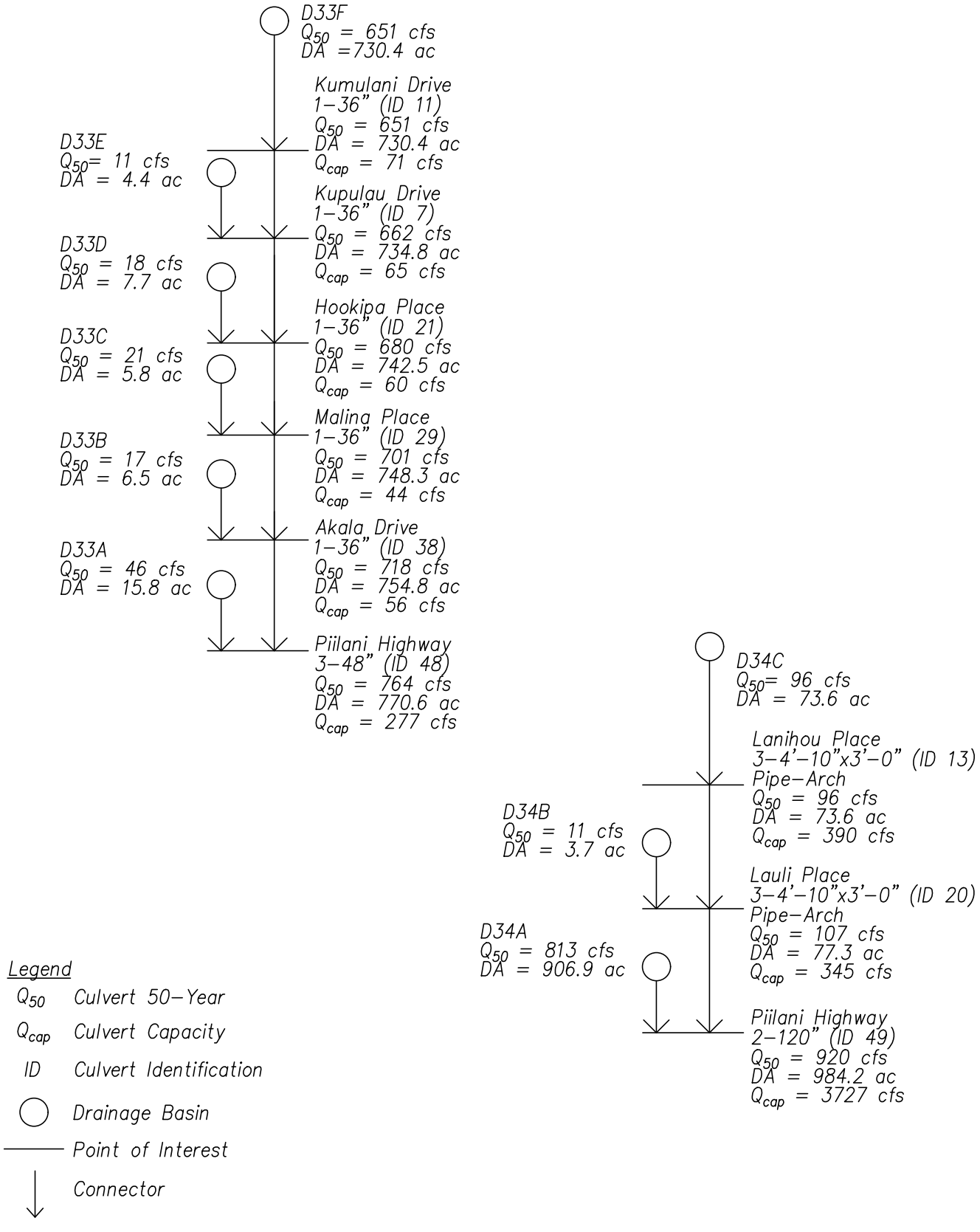
Drainage Areas 31 and 32
Existing Conditions
Rational Method Diagram (50-yr, 1-hr)

Figure 4.1.m



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Drainage Area 33 and 34
Existing Conditions
Rational Method Diagram (50-yr, 1-hr)

Figure 4.1.n

Table 4.2 Existing Culvert Summary

Culvert ID	Size	Contributing Area (acres)	Q100-24[1] (cfs)	Q50-1[3] (cfs)	Capacity[9] (cfs)	Culvert ID	Size	Contributing Area (acres)	Q100-24[1] (cfs)	Q50-24[2] (cfs)	Q50-1[3] (cfs)	Capacity[9] (cfs)
1[7]	1-24” DI	-				31	1-48” CMP	98.7	197		141	108
2[7]	1-24” DI	-				32	3-36” CMP	443.6	696		416	133
3	3-6’-0”x3’-8” Pipe Arches	1,838.4	2,194	1,482	660	33	1-48” CMP	102.3	203		153	79
4	1-24” CMP	102.2	288	141	30	34	1-24” CMP	16.6	63		50	23
5	1-24” CMP	17.3	56	36	30	35	3-36” CMP	471.8	725		472	123
6	1-24” CMP	38.5	106	54	11	36	3-6’-8”x3’-6” CMPA	2,013.6	2,308		1,850	345
7	1-36” CMP	734.8	924	662	65	37	2-36” CMP	102.9	266		238	125
8	1-24” CMP	71.6	205	91	14	38	1-36” CMP	754.8	935		718	56
9	1-24” CMP	12.2	38	19	23	39[8]	1-36” CMP	75.6	147		87	57
10	1-24” CMP	36.9	104	49	31	40	1-48” CMP	17.9	50		34	105
11	1-36” CMP	730.4	921	651	71	41[6]	1-24” CMP	-	-		-	-
12[7]	1-24” DI	-	-	-	-	42	1-42” CMP	90.4	237		199	56
13	3-4’-10”x3’-0” CMPA	73.6	192	96	390	43	3-6’-8”x3’-6” CMPA	1,977	2,288		1,732	465
14	1-60” CMP	429.5	687	371	223	44	1-36” CMP	26.8	104		91	63
15	3-6’-0”x3’-8” CMPA	1,965.8	2,282	1,698	510	45	1-42” CMP	86.4	229		185	64
16	1-24” CMP	3.6	17	14	24	46[4]	4-114”	2,066.9	2,338	1,804	1,995	5,069
17	1-36” CMP	69.7	189	133	49	47[4]	1-120”	106.1	271	217	247	1173
18	3-6’-0”x3’-8” CMPA	1,850.3	2,201	1,513	675	48[4]	3-48”	770.6	944	730	764	277
19	1-36” CMP	107.1	295	159	71	49[4]	2-120”	984.2	1,501	1,186	920	3,727
20	3-4’-10”x3’-0” CMPA	77.3	198	107	345	50[4]	3-48”	17.3	61	49	47	333
21	1-36” CMP	742.5	928	680	60	51[4]	2-42”	103.6	204	158	159	107
22	1-30” CMP	40	109	60	38	52[4]	1-30”	19.9	73	60	64	57
23	1-24” CMP	5.9	23	19	34	53[4]	1-84”	482.7	732	580	505	571
24	3-6’-0”x3’-8” CMPA	1972.4	2,285	1,721	795							
25[8]	1-36” CMP	105.8	294	155	56							
26	3-36” CMP	434.1	690	385	153							
27	1-36” CMP	20.8	83	70	36							
28	1-24” CMP	0.8	3	3	23							
29	1-36” CMP	748.3	2,194	1,482	44							
30[5]	1-24” CMP	-	-	-	-							

[1]Q100-24 = 100-year, 24-hour peak discharge [2]Q50-24 = 50-year, 24-hour peak discharge [3]Q50-1 = 50-year, 1-hour peak discharge [4]Culverts are at Piilani Highway, HDOT drainage standards = 50-year storm

[5]Unable to locate upstream side of culvert and downstream side is totally buried. Culvert appears to be abandoned.

[6]Upstream side is located in walled off private property and downstream side is totally buried. Culvert appears to be abandoned.

[7]Roadside drain inlet. Regular maintenance is required to keep grate opening free of debris. [8]Private property [9]Headwater is 1-foot below the edge of the road

4.2 Existing Flooding Issues

Several locations within the Maui Meadows Subdivision regularly experience flooding problems (Figure 4.2.a). The causes may be attributed to inadequate local and regional drainage systems. This section will discuss these issues and provide short-term recommendations. Potential long-term solutions are provided in Section 4.3.

4.2.1 Flooding Issue 1 - Culvert 8 (1-24" CMP)

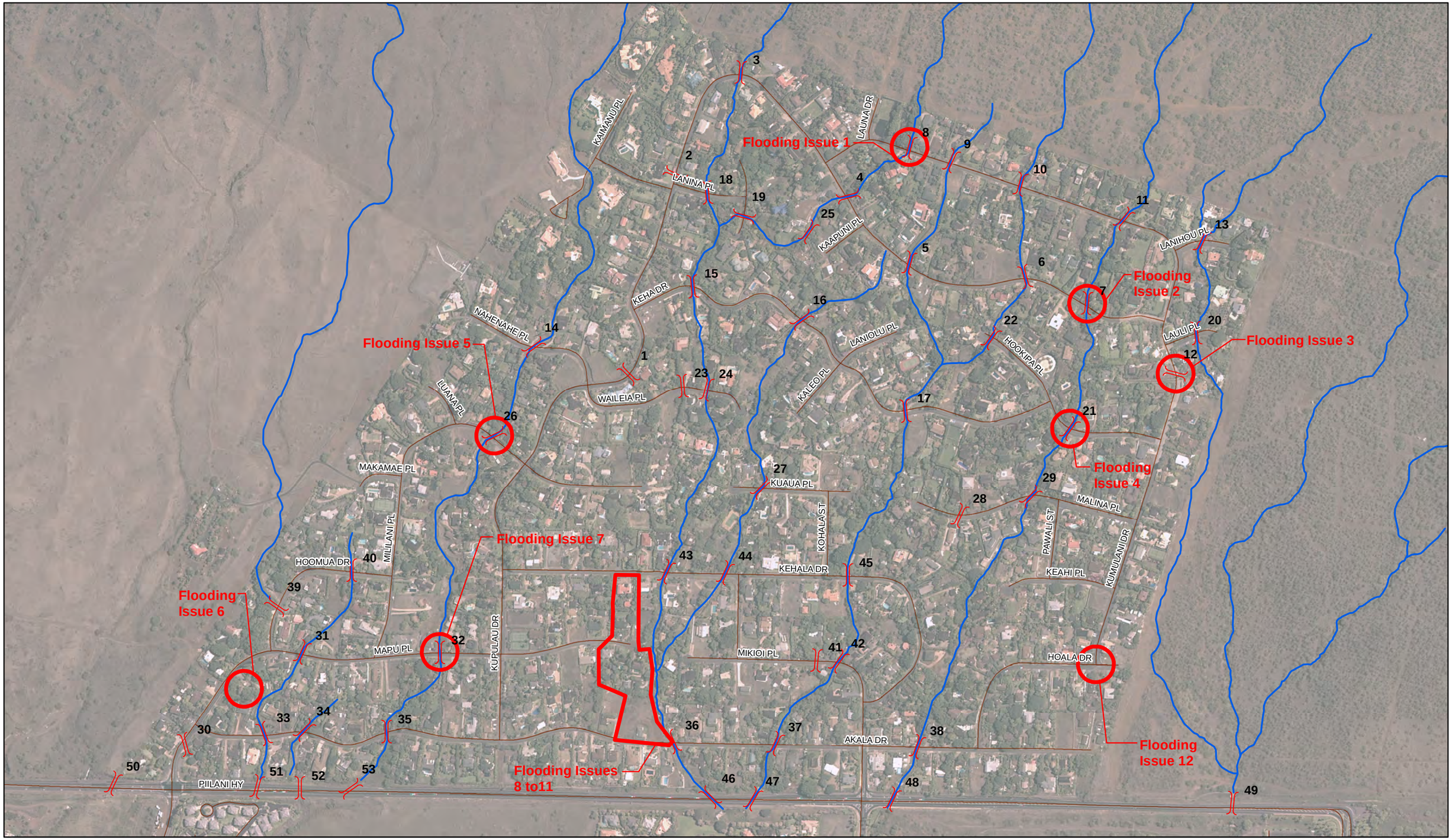
Existing Conditions

The existing Culvert 8 is located at Kumulani Drive, approximately 230 feet south of intersection of Kumulani Drive and Launa Drive (Figure 4.2.b). The contributing drainage area to Culvert 8 is 71.6 acres with a peak discharge of 91 cfs for the 50-year, 1-hour storm. The existing culvert capacity is 14 cfs.

The upstream side of Culvert 8 is within a private property and is not accessible to verify the culvert information. The culvert capacity was determined per the as-built plan. Based on the residents' observation, the flooding was not caused by the flow overtopping Kumulani Drive. Instead, the roadside runoff would sheet flow along the makai side of the road into the private property, TMK: 2-1-019: 062 due to the driveway sloping down toward the house. An existing 12" roadside culvert was installed by the driveway entrance at TMK: 2-1-019: 062 with the intention to convey the roadside runoff to the downstream side of Culvert 8. Field observation showed that debris accumulated at the downstream side of Culvert 8 causing an adverse slope. The field photos are included in Appendix C.

Recommendations

- For a short-term solution, reconstruct the private driveway entrance within the County right-of-way to provide a concrete thru gutter at makai side of Kumulani Drive. This is to convey the roadside runoff to the inlet of the existing 12" roadside culvert.
- Perform regular maintenance to clear the debris at both the upstream and downstream sides of Culvert 8.
- The long-term solution at Culvert 8 will require the culvert to be upsized and is discussed in Section 4.3.



Legend

- Flooding Issue
- Major Flow Path
- Culverts/Drain Inlets
- 30 Culverts/DI ID

1 inch = 500 feet

0 250 500 1,000 1,500 Feet

Figure 4.2.a
Existing Flooding Issues Map

Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 8 Culverts/DI ID
- Proposed Swale
- 30M Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.b
Flooding Issue 1
Existing Conditions and Recommendations

4.2.2 Flooding Issue 2 - Culvert 7 (1-36" CMP)

Existing Conditions

The existing Culvert 7 is located at Kupulani Drive, approximately 480 feet north of intersection of Kupulani Drive and Kumulani Drive (Figure 4.2.c). The contributing drainage area to Culvert 7 is 734.8 acres with a peak discharge of 924 cfs for the 100-year, 24-hour storm. The existing culvert capacity is 65 cfs.

The culvert capacity was determined based on field reconnaissance and is inadequate to pass the design flow. The road crossing is at a relative flat area where the runoff overtops the road and appears to sheet flow to the downstream area. Debris was observed at the upstream side of Culvert 7 impeding flow to the culvert. The downstream side of Culvert 7 appeared to be in good condition during field reconnaissance. The field photos are included in Appendix C.

Recommendations

- Perform regular maintenance to clear the debris at both the upstream and downstream sides of Culvert 7.
- The long-term solution at Culvert 7 will require the culvert to be upsized and is discussed in Section 4.3.

Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 7 Culverts/DI ID
- Exist Flow Pattern
- 33E Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.c
Flooding Issue 2
Existing Conditions and Recommendations

4.2.3 Flooding Issue 3 - Culvert 12 (Roadside Drain Inlet)

Existing Conditions

The existing Culvert 12 a roadside drain inlet located at the north side of Kumulani Drive, approximately 410 feet east of intersection of Kumulani Drive and Hookipa Place (Figure 4.2.d). The contributing drainage area to Culvert 12 is approximately 4.6 acres with a peak discharge of 15 cfs for the 10-year, 1-hour storm. The drain inlet would capture 13 cfs under sump condition.

The contributing drainage area to the drain inlet was estimated from the LiDAR topography. Debris was observed in the field blocking approximately 1/3 of the grate opening. Based on the as-built plans, the roadside drain inlet (in sump condition) is along a 14% segment of Kumulani Drive, where concrete swales are on both sides of the road (4 feet wide and 1.5 inch deep). Due to the steep road slope, the majority of the roadside runoff is anticipated to bypass the drain inlet. In addition, the capacity of the concrete swale in this segment is approximately 0.9 cfs and the drain inlet will capture only a portion of the runoff contained in the concrete swale. The captured runoff is routed to the ditch at the opposite side of Kumulani Drive and eventually discharges to the open area outside of the subdivision. The remaining runoff will continue flowing down Kumulani Drive. The field photos are included in Appendix C.

Recommendations

- Perform regular maintenance to clear the debris at the filter sock to keep the drain inlet grate open.

Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 12 Culverts/DI ID
- Exist Flow Pattern
- 34A Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.d
Flooding Issue 3
Existing Conditions and Recommendations

4.2.4 Flooding Issue 4 - Culvert 21 (1-36" CMP)

Existing Conditions

The existing Culvert 21 is located at Hookipa Place, approximately 190 feet south of intersection of Hookipa Place and Keha Drive (Figure 4.2.e). The contributing drainage area to Culvert 21 is 742.5 acres with a peak discharge of 924 cfs for the 100-year, 24-hour storm. The existing culvert capacity is 60 cfs.

The culvert capacity was determined based on field reconnaissance and is inadequate to pass the design flow. Culvert 21 is downstream of Culvert 7 and experiences similar situation due to inadequate culvert capacity. Per as-built plan, Hookipa Drive is approximately 10% at the culvert crossing and slopes south toward Kumulani Drive. When the road is overtopped, runoff flows to the downstream properties. Heavy vegetation and debris was observed in the field at both the upstream and downstream sides of Culvert 21 impeding flow to the culvert. The field photos are included in Appendix C.

Recommendations

- Perform regular maintenance to clear the debris at both the upstream and downstream sides of Culvert 21.
- The long-term solution at Culvert 21 will require the culvert to be upsized and is discussed in Section 4.3.

Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 21 Culverts/DI ID
- Exist Flow Pattern
- 34A Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.e
Flooding Issue 4
Existing Conditions and Recommendations

4.2.5 Flooding Issue 5 - Culvert 26 (3-36" CMP)

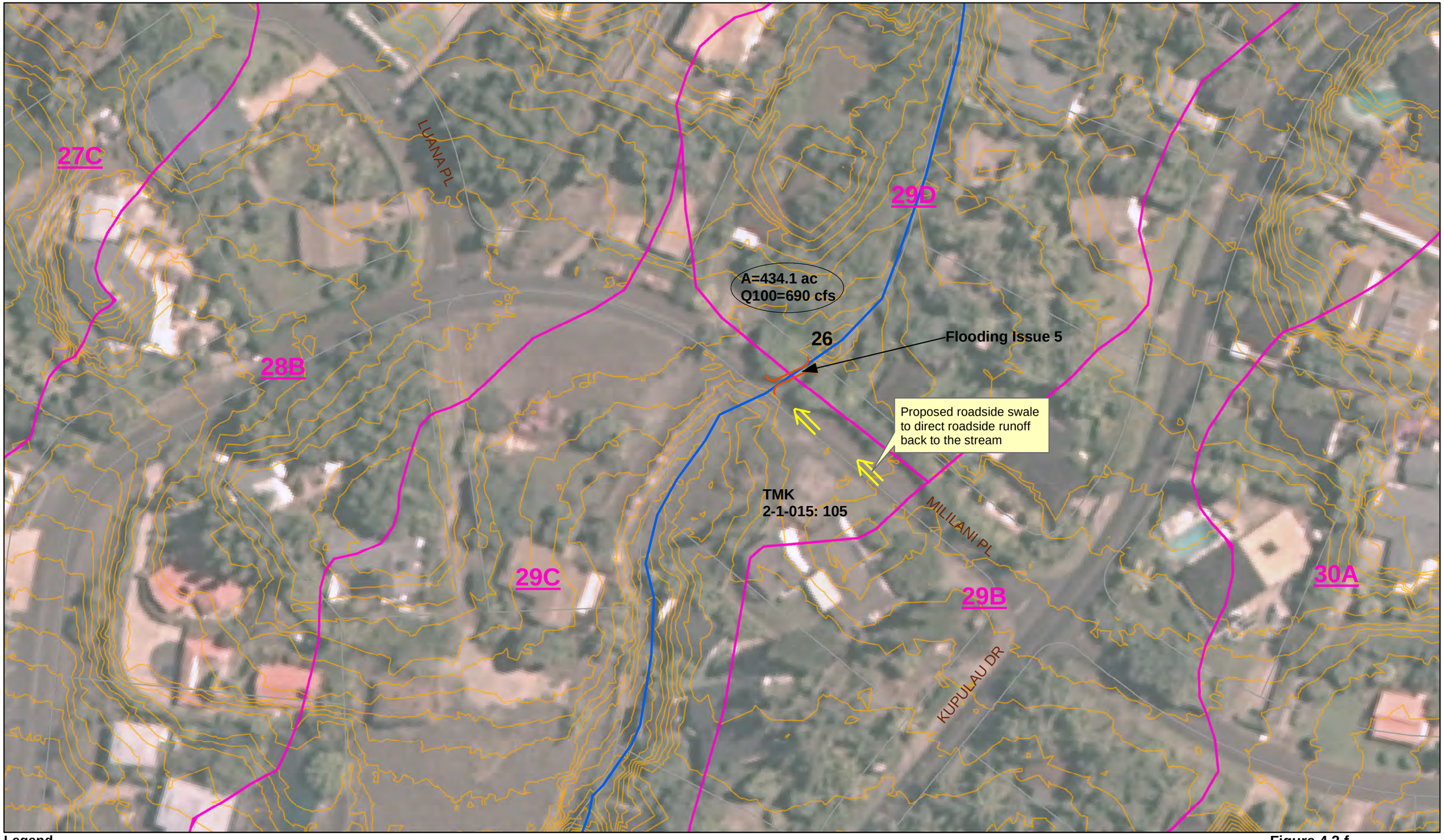
Existing Conditions

The existing Culvert 26 is located at Mililani Place, approximately 240 feet north of intersection of Mililani Place and Kupulau Drive (Figure 4.2.f). The contributing drainage area to Culvert 26 is 434.1 acres with a peak discharge of 690 cfs for the 100-year, 24-hour storm. The existing culvert capacity is 153 cfs.

The culvert capacity was determined based on field reconnaissance and is inadequate to pass the design flow. The culvert crossing is at a sag segment of Mililani Place. When the road is overtopped, the runoff most likely flows toward the private property TMK: 2-1-015: 105. The field photos are included in Appendix C.

Recommendations

- For a short-term solution, construct a roadside swale makai of Mililani Place to direct roadside runoff away from the private property TMK: 2-1-15: 105 and back to the stream.
- Perform regular maintenance to clear debris at both the upstream and downstream sides of Culvert 26.
- The long-term solution at Culvert 26 will require the culvert to be upsized and is discussed in Section 4.3.



Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 26 Culverts/DI ID
- Proposed Swale
- 29D Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.f
Flooding Issue 5
Existing Conditions and Recommendations

4.2.6 Flooding Issue 6 – Mapu Place (Sheet Flow)

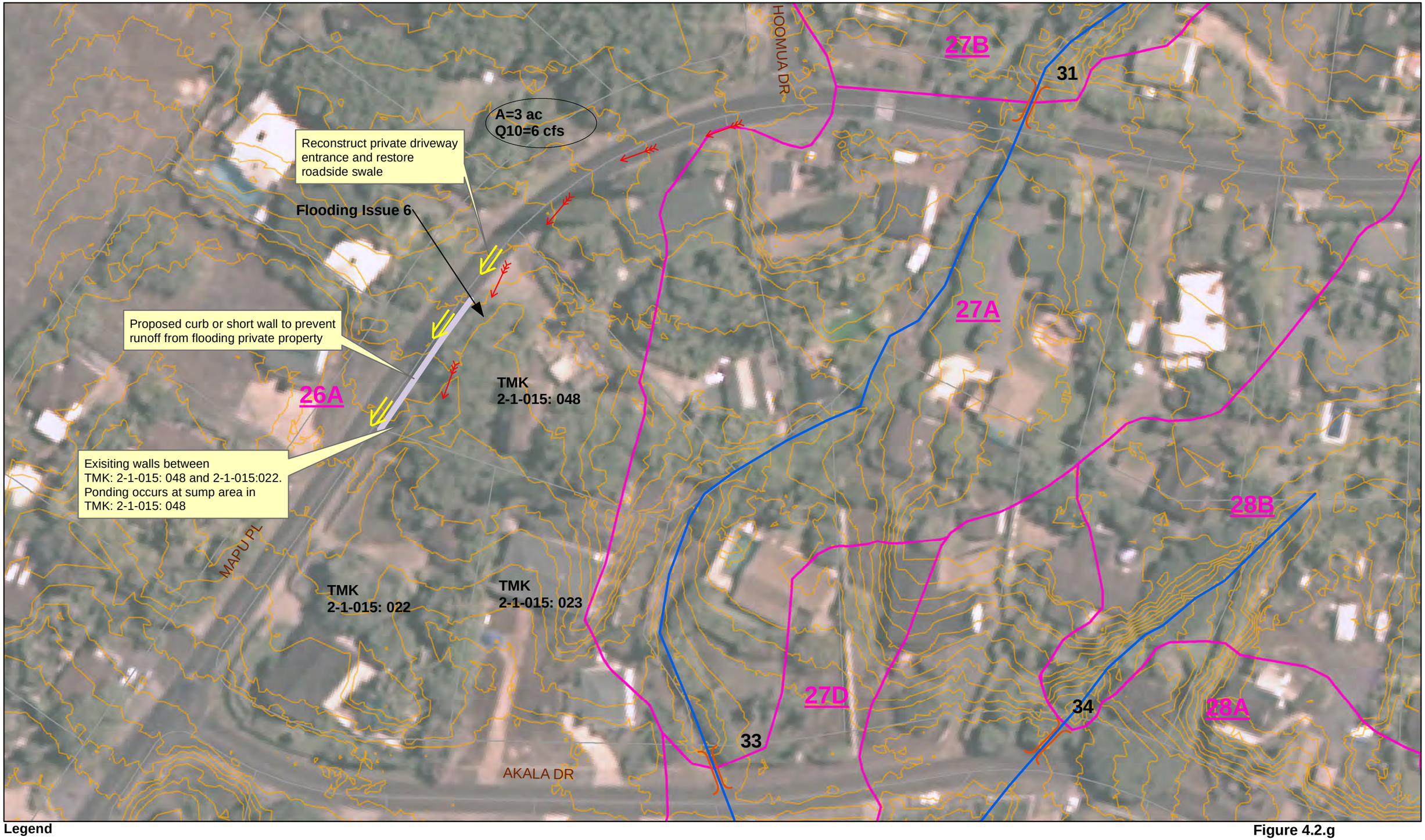
Existing Conditions

The flooding at this location is mainly caused by the Mapu Place roadside runoff sheet flowing to the private property, TMK: 2-1-015: 048 (Figure 4.2.g). Based on field reconnaissance, it was verified that the existing topography in the private property is lower than the road elevation. The contributing drainage area (3 acres) to the private property was estimated from the LiDAR topography and the 10-year, 1-hour peak discharge is 6 cfs.

There is a trace of a faded roadside swale (asphalt) and it disappears gradually as it continues downslope of Mapu Place. It was possible that, over period of time, the roadside swale was covered when the road was repaved. Due to the existing terrain, water accumulates in a sump area in TMK: 2-1-015: 048 bordering the adjacent property and would not flow back to the road. The field photos are included in Appendix C.

Recommendations

- Reconstruct the private driveway entrance within the County right-of-way to provide a concrete thru gutter.
- Restore/reconstruct the roadside swale to direct runoff along Mapu Place.
- Construct a curb or short wall along the right-of-way to prevent the roadside runoff from flowing to the private property. The runoff will then flow downslope toward Piilani Highway.



Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 31 Culverts/DI ID
- Exist Flow Pattern
- Proposed Swale
- Proposed Wall

26A Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.g
Flooding Issue 6
Existing Conditions and Recommendations

4.2.7 Flooding Issue 7 – Culvert 32 (3-36" CMP)

Existing Conditions

The existing Culvert 32 is located at Mapu Place, approximately 350 feet north of intersection of Mapu Place and Kupulau Drive (Figure 4.2.h). The contributing drainage area to Culvert 32 is 443.6 acres with a peak discharge of 696 cfs for the 100-year, 24-hour storm. The existing culvert capacity is 133 cfs.

The culvert capacity was determined based on field reconnaissance and is inadequate to pass the design flow. Based on the residents' observation, the stream segment upstream of Culvert 32 was filled with sediment and debris up to the elevation of the backyard at the private property, TMK: 2-1-015: 061. This was the cause of the 2017 flood at the private property, where runoff flooded through the backyard and flowed down Mapu Place. Erosion at the upstream stream bank (next to the flooded property) of Culvert 32 was observed in the field. Portion of the upstream segment was dredged by the County just days prior to Hurricane Lane's arrival (August 2018). However, the dredged materials were still left at the site as seen during field reconnaissance. The field photos are included in Appendix C.

Recommendations

- Remove the dredged materials left at the upstream side of Culvert 32.
- Stabilize the upstream bank by the private property, TMK: 2-1-015: 061 to prevent erosion.
- Construction of a retaining wall along the private property next to the stream may be considered to prevent runoff from entering the backyard. Coordination with the private owner and a detailed hydraulic analysis will be required to evaluate the feasibility of this option.
- Perform regular maintenance to clear vegetation and debris at both the upstream and downstream sides of Culvert 32.
- The long-term solution at Culvert 32 will require the culvert to be upsized and is discussed in Section 4.3.

Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 32 Culverts/DI ID
- Proposed Wall
- 29C Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.h
Flooding Issue 7
Existing Conditions and Recommendations

4.2.8 Flooding Issues 8 to 11 – Culverts 36 and 43 (3-6'-8"x3'-6" CMPA)

Existing Conditions

The existing Culvert 36 is located at Akala Drive, approximately 960 feet south of intersection of Akala Place and Kupulau Drive (Figure 4.2.i). The contributing drainage area to Culvert 36 is 2,013.6 acres with a peak discharge of 2,308 cfs for the 100-year, 24-hour storm. The existing culvert capacity is 345 cfs.

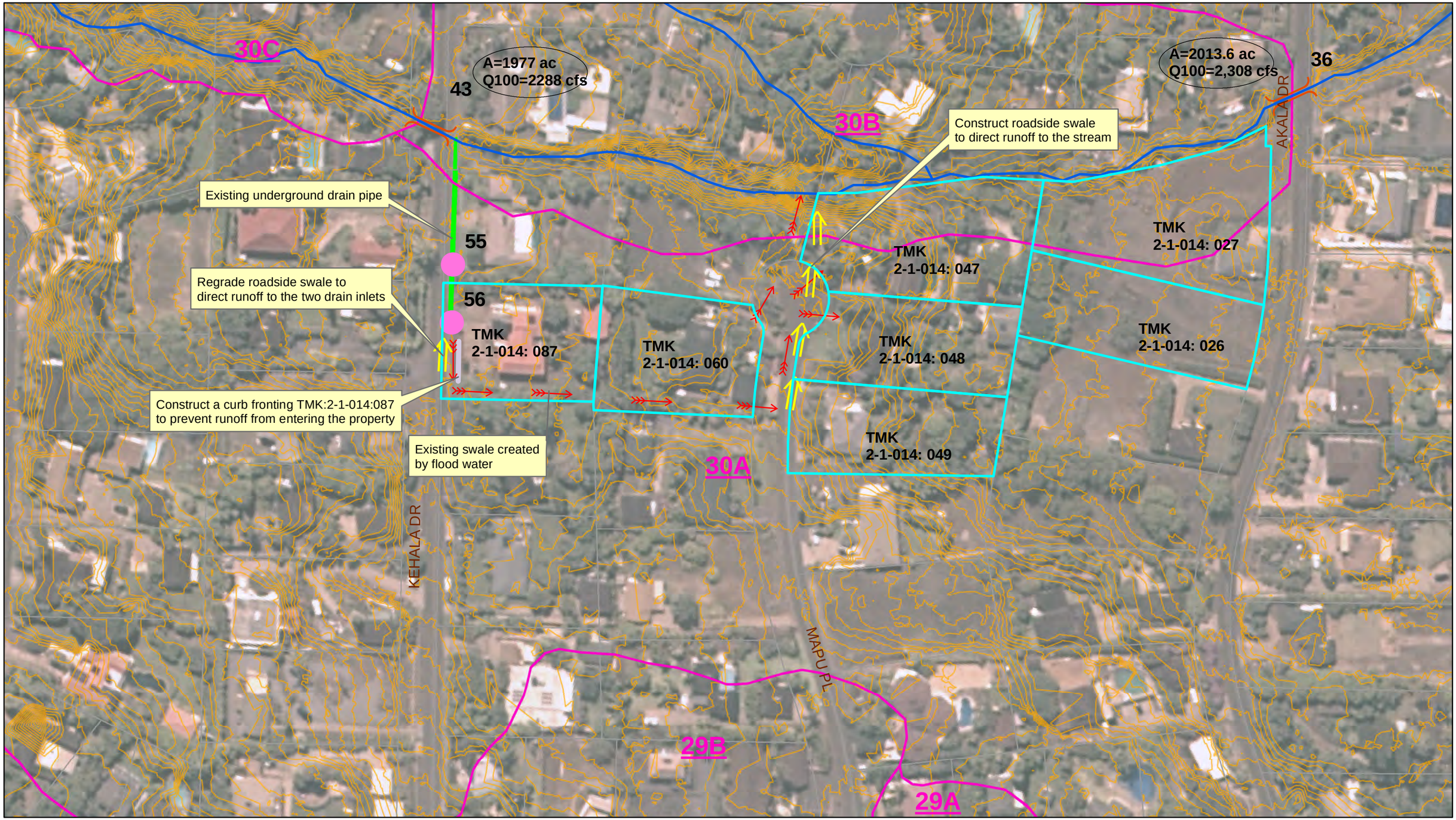
The existing Culvert 43 is located at Kehala Drive, approximately 900 feet south of intersection of Kehala Drive and Kupulau Drive (Figure 4.2.i). The contributing drainage area to Culvert 43 is 1,977 acres with a peak discharge of 2,288 cfs for the 100-year, 24-hour storm. The existing culvert capacity is 465 cfs.

The culvert capacities were determined based on field reconnaissance and are inadequate to pass the design flow. Heavy vegetation was found at both the upstream and downstream sides of Culverts 36 and 43 in the field. When the runoff overtops Kehala Drive, it flows north to the sag segment of Kehala Drive fronting the private property, TMK: 2-1-014: 087. Two roadside drain inlets were found at makai side of Kehala Drive by the aforementioned property. The intent is to capture the roadside runoff and convey it to the downstream area of Culvert 43. However, no as-built plans are available at this time. A swale, which appears to have been created over time by erosion from flood water, was found at the northern property line of TMK: 2-1-014: 087. Based on field reconnaissance, it appears that the swale elevation is lower than the two drain inlets, which causes some flood water flowing toward the downstream property, TMK: 2-1-014: 060.

According to the residents, rapid flood water flowed from Kehala Drive down to the private driveway of TMK 2-1-014: 060 during large storm events. Due to the existing topography, the runoff flooded the downstream properties, TMK: 2-1-014: 026, 027, 047, 048, and 049. The cul-de-sac at the end of Mapu Place is the low point of road with no outlet and ponding up to 1 foot was observed. An earth swale at the end of the cul-de-sac was made by the residents prior to Hurricane Lane's arrival (August 2018) in order to direct runoff to the nearby stream.

Recommendations

- Regrade the roadside swale at makai side of Kehala Drive to direct runoff to the two drain inlets.
- Provide a curb or berm fronting TMK: 2-1-014: 087 to prevent runoff from flowing to the property.
- Construct roadside swale/thru gutter within the County right-of way along the makai side of Mapu Place to direct runoff to the end of the cul-de-sac.
- Construct a swale at the end of the Mapu Place cul-de-sac to direct runoff to the stream. The work may involve grading the whole cul-de-sac.
- Perform regular maintenance to clear vegetation and debris at both the upstream and downstream sides of Culverts 36 and 43.
- The long-term solution at Culverts 36 and 43 will require the culverts to be upsized and is discussed in Section 4.3.



Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- Grated Drain Inlet
- Exist Flow Pattern
- Proposed Swale
- Drain Pipe
- Proposed Wall
- 30C Drainage Basin ID
- 43 Culverts/DI ID

1 inch = 100 feet

0 50 100 200 300 Feet

Figure 4.2.i
Flooding Issues 8 to 11
Existing Conditions and Recommendations

4.2.9 Flooding Issue 12 – Hoala Drive and Kumulani Drive Intersection

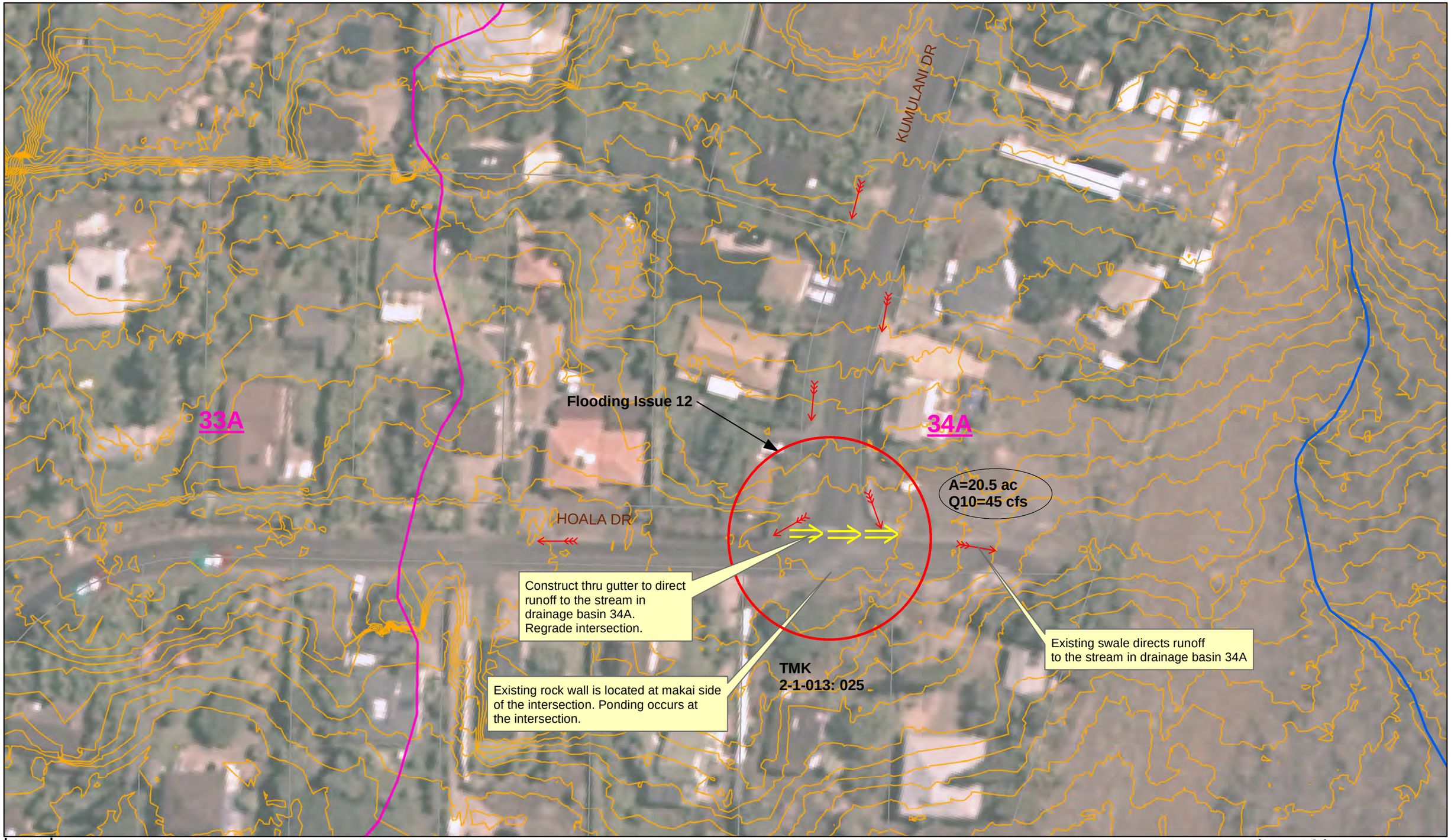
Existing Conditions

The flooding at this location is mainly due to the roadside runoff sheet flows to the intersection and causes ponding. The contributing drainage area (20.5 acres) to the intersection was estimated from the LiDAR topography and the 10-year, 1-hour peak discharge is 45 cfs.

An existing rock wall located along the makai side of Hoala Drive prevents runoff from flowing straight to the private property, TMK: 2-1-013: 0.25. The roadside swales on both sides of Kumulani Drive continue to Hoala Drive and would direct runoff to both north and south of the intersection. However, based on field reconnaissance, it appears that the ponding still occurs at the intersection. Two options were provided below for flood mitigation. The field photos are included in Appendix C.

Recommendations

- Option 1 (Figure 4.2.j) will construct a thru gutter across Kumulani Drive to direct runoff to the stream in drainage basin 34A. Grading would be required at the intersection.
- Option 2 (Figure 4.2.k) will install a drainage system consisting of drain inlets and pipes to convey runoff to the stream in drainage basin 34A. Grading would also be required at the intersection to direct runoff to the drain inlets.
- The aforementioned two options will mitigate ponding issue at the intersection for the 10-year, 1-hour storm. However, during large storm events, Hoala Drive as a whole will function as a channel and convey runoff to drainage basin 34A.



Legend

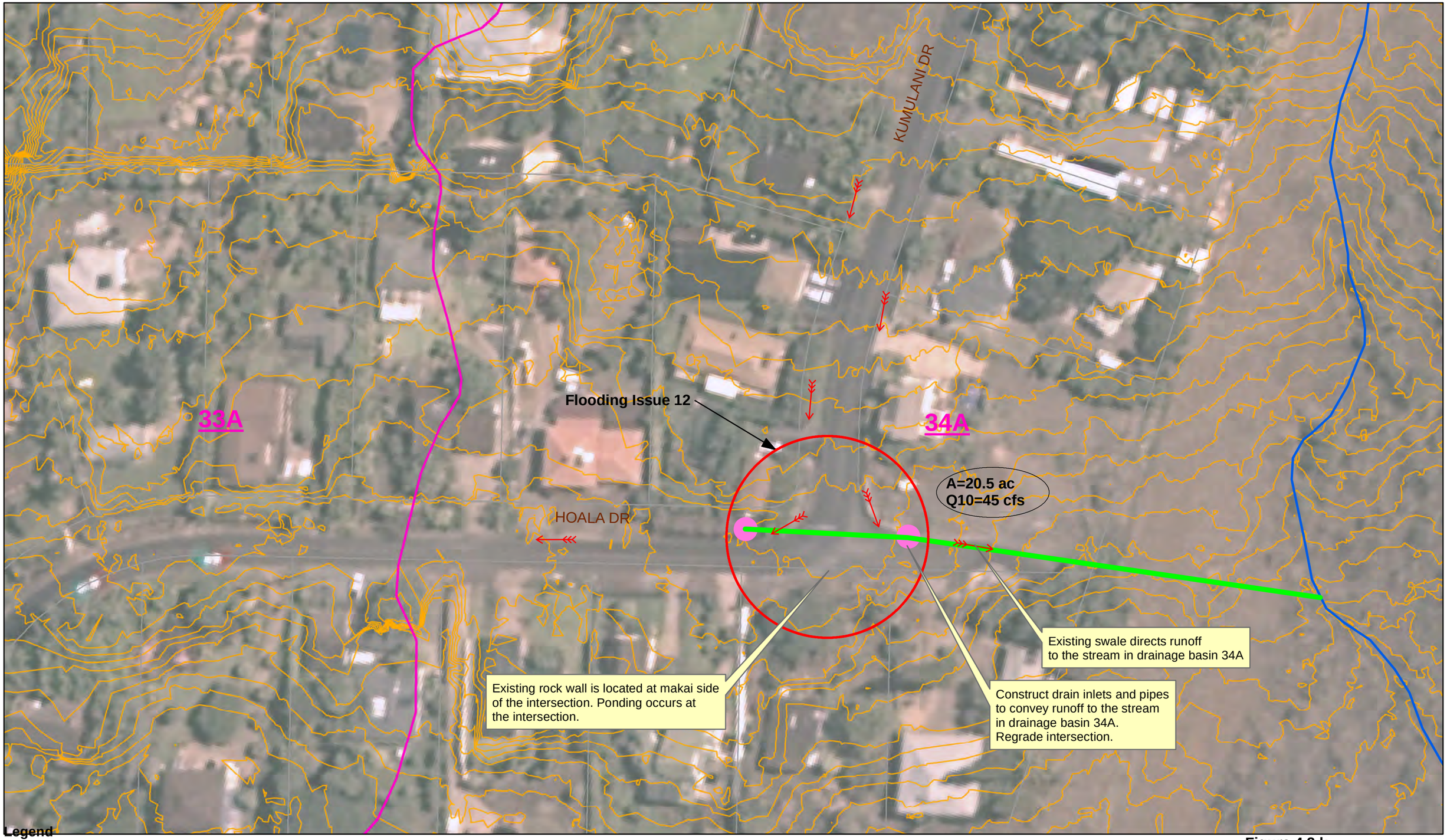
- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts/Drain Inlets
- 32 Culverts/DI ID
- Exist Flow Pattern
- Proposed Swale

34A Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.j
Flooding Issue 12
Existing Conditions and Recommendations Option 1



Legend

- Drainage Basin
- Parcel
- Major Flow Path
- LiDAR 2-ft Contours
- Culverts_MM
- 32 Culverts/DI ID
- Exist Flow Pattern
- Drain pipe
- Proposed Drain Inlet
- 34A Drainage Basin ID

1 inch = 60 feet

0 30 60 120 180 Feet

Figure 4.2.k
Flooding Issue 12
Existing Conditions and Recommendations Option 2

4.3 Regional Drainage Improvements

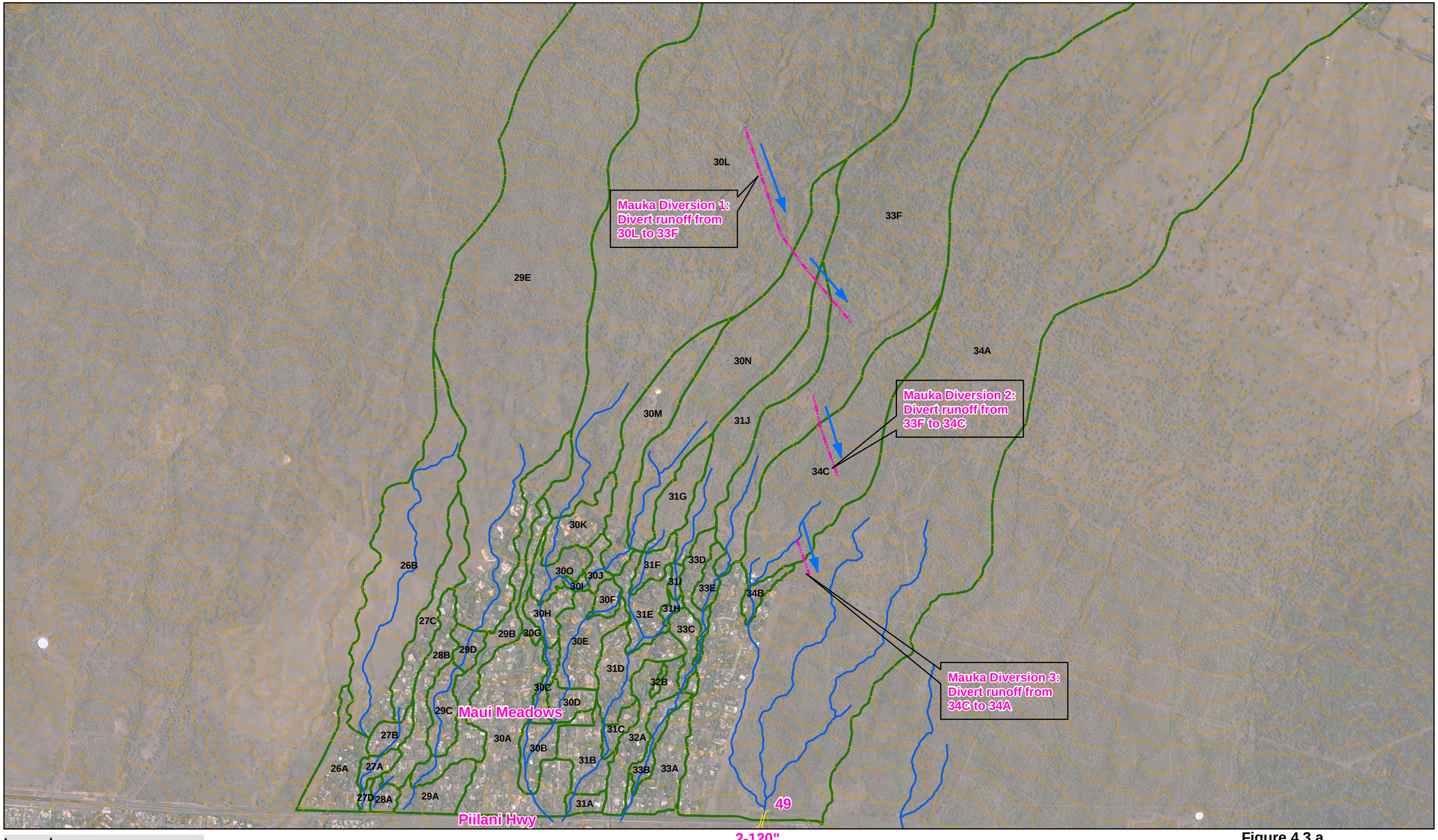
Based on Table 4.2 and the drainage standards of Maui County and HDOT, majority of the existing culverts within the study area do not have adequate capacities to pass the regional design storm. This section will present three options for flood mitigation improvements.

4.3.1 Option 1 – Mauka Diversion

Maui Meadows Subdivision is a well-developed residential community and receives large quantities of offsite runoff from the mauka mountainous areas. Two of the large drainage basins, 30L (1838.4 ac) and 33F (730.4 ac), carry approximately 2,194 cfs and 921 cfs (100-year, 24-hour), respectively, to the mauka side of the subdivision, which poses a challenge to construct a new channel to contain the flow. As such, Option 1 (construction of three mauka diversion channels) is proposed to convey the runoff to an open area in drainage basin 34A (Figure 4.3.a). Runoff from drainage basin 34A crosses Piilani Highway through 2-120" culverts with a capacity of 3,727 cfs. The combined runoff reaching Piilani Highway is approximately 3,500 cfs in Option 1.

The diversion channel will be a concrete-lined trapezoidal channel with a 50-feet bottom width, minimum 6 feet height, and a 2:1 side slope. The conceptual cost for the three mauka diversion channels along is approximately $34.1 million.

The mauka division will alleviate the major impacts to the Maui Meadows Subdivision, but the existing drainage structures are still required to pass the remaining runoff with potential upsizing at various locations (no costs are available at this time). In addition, consideration would need to be given to the properties makai of Piilani Highway which would be impacted by the diverted runoff. Due to lack of data for the area makai of Piilani Highway, discussion with Maui County and future investigation will be required to further evaluate the feasibility of Option 1. Should Option 1 be pursued, the conceptual costs will be refined to include improvements of the existing culverts and makai of Piilani Highway.



Legend

- Drainage Area
- Diversion
- Major Flow Path
- USGS Contour

1 inch = 1,200 feet

0 600 1,200 2,400 3,600 Feet

Figure 4.3.a
Option 1 - Mauka Diversion

4.3.2 Option 2 – Culvert Improvements (100-Year, 24-Hour and 50-Year, 1-Hour Storms)

Option 2 would upsize the existing culverts to pass the design storm per the Maui County and HDOT drainage standards. The existing roadside drain inlets would remain because they were designed only for local drainage. Regular maintenance will be required to keep the drain inlets and stream free of debris.

Due to the existing residential development, in many cases the proposed culverts may require land acquisition and grading in the surrounding areas to accommodate the increased culvert sizes with lower invert elevations. The depth of the invert to be lowered varies and is set at 6 feet maximum in Option 2. The assumption is that the newly lowered invert elevations would be able to daylight back to the existing ground (LiDAR) and relocation of the existing utility may be kept to a minimum. Furthermore, it is assumed that the culverts are under entrance control, for which the higher headwater would increase the culvert capacities. The culvert sizes and inverts may be revised to accommodate the specific site conditions during the design phase.

In addition, it should be noted that the majority of the existing streams in the open channel condition, which meanders between the residential lots, may not be able to contain the design flow. The upsized culverts may pass the design flow, but the upstream channel may require widening and stabilization to mitigate flooding issues. To address the flooding issues, all these factors would need to be considered and would involve coordination among various government agencies and the local community.

Currently, there is no future development planned mauka of the Maui Meadows Subdivision. Therefore, the existing drainage areas and peak discharges from the existing conditions have been applied to size the proposed culverts. The proposed culvert sizes for option 2 are summarized in Table 4.3 and shown in Figure 4.3.b. The conceptual cost estimate, excluding land acquisition, is provided in Table 4.4.

ID	Proposed Culvert Size
3	1-19'x7' Box
4	2-48" Conc. Pipe
5	1-30" Conc. Pipe
6	1-36" Conc. Pipe
7	1-13'x6' Box
8	1-48" Conc. Pipe
10	1-36" Conc. Pipe
11	1-12'x6' Box
14	1-10'x5' Box
15	1-23'x7' Box
17	1-54" Conc. Pipe
18	1-23'x7' Box
19	2-54" Conc. Pipe
21	1-13'x6' Box
22	1-36" Conc. Pipe
24	1-23'x7' Box
25	1-7'x5' Box
26	1-10'x5' Box
27	1-42" Conc. Pipe
29	1-13'x6' Box
31	1-54" Conc. Pipe
32	1-10'x5' Box
33	2-48" Conc. Pipe
34	1-36" Conc. Pipe
35	1-10'x5' Box
36	1-23'x7' Box
37	1-5'x5' Box
38	1-13'x6' Box
39	1-42" Conc. Pipe
42	1-5'x4' Box
43	1-23'x7' Box
44	1-42" Conc. Pipe
45	1-60" Conc. Pipe
48	1-12'x5' Box
51	2-48" Conc. Pipe
52	1-36" Conc Pipe
53	1-96" Conc. Pipe

Underground Pipe

KAIMANU PL
LANINA PL
LAUNA DR
KAAPUNI PL
LANIHOU PL
KEHA DR
NAHENAHE PL
LAULI PL
LANIOLU PL
HOOKIPA PL
WAILEIA PL
LUANA PL
KALEO PL
MAKAMAE PL
KUAUA PL
MALINA PL
PAWALI ST
KUMULANI DR
KOHALA ST
MILILANI PL
HOOMUA DR
KEHALA DR
KEAHI PL
KUPULAU DR
MAPU PL
MIKIOI PL
HOALA DR
AKALA DR
PIILANI HY
KUALONO PL

Legend

No Improvements
Culvert Improvements
Major Flow Path
30 Culverts/DI ID

1 inch = 500 feet

0 250 500 1,000 1,500 Feet

Figure 4.3.b
Option 2 - Culvert Improvements

Table 4.3 Option 2 Proposed Culvert Sizes

Culvert ID	Contributing Area (acres)	Designed Storm	Q (cfs)	Existing	Proposed[5]	Culvert ID	Contributing Area (acres)	Designed Storm	Q (cfs)	Existing	Proposed[5]
3	1,838.4	100-year, 24-hour	2,194	3-6’-0”x3’-8” Pipe Arches	1-19’x7’ Box	31	98.7	50-year, 1-hour	141	1-48” CMP	1-54” Conc. Pipe
4	102.2	100-year, 24-hour	288	1-24” CMP	2-48” Conc. Pipe	32	443.6	100-year, 24-hour	696	3-36” CMP	1-10’x5’ Box
5	17.3	50-year, 1-hour	36	1-24” CMP	1-30” Conc. Pipe	33	102.3	100-year, 24-hour	203	1-48” CMP	2-48” Conc. Pipe
6	38.5	50-year, 1-hour	54	1-24” CMP	1-36” Conc. Pipe	34	16.6	50-year, 1-hour	50	1-24” CMP	1-36” Conc. Pipe
7	734.8	100-year, 24-hour	924	1-36” CMP	1-13’x6 Box	35	471.8	100-year, 24-hour	725	3-36” CMP	1-10’x5’ Box
8	71.6	50-year, 1-hour	91	1-24” CMP	1-48” Conc. Pipe	36	2,013.6	100-year, 24-hour	2308	3-6’-8”x3’-6” CMPA	1-23’x7’ Box
9	12.2	50-year, 1-hour	19	1-24” CMP	Not Required	37	102.9	100-year, 24-hour	266	2-36” CMP	1-5’x5’ Box
10	36.9	50-year, 1-hour	49	1-24” CMP	1-36” Conc. Pipe	38	754.8	100-year, 24-hour	935	1-36” CMP	1-13’x6’ Box
11	730.4	100-year, 24-hour	921	1-36” CMP	1-12’x6’ Box	39[4]	75.6	50-year, 1-hour	87	1-36” CMP	1-42” Conc. Pipe
13	73.6	50-year, 1-hour	96	3-4’-10”x3’-0” CMPA	Not Required	40	17.9	50-year, 1-hour	34	1-48” CMP	Not Required
14	429.5	100-year, 24-hour	687	1-60” CMP	1-10’x5’ Box	41[3]	-	-		1-24” CMP	Not Required -
15	1,965.8	100-year, 24-hour	2,282	3-6’-0”x3’-8” CMPA	1-23’x7’ Box	42	90.4	50-year, 1-hour	199	1-42” CMP	1-5’x4’ Box
16	3.6	50-year, 1-hour	14	1-24” CMP	Not Required	43	1,977	100-year, 24-hour	2288	3-6’-8”x3’-6” CMPA	1-23’x7’ Box
17	69.7	50-year, 1-hour	133	1-36” CMP	1-54” Conc. Pipe	44	26.8	50-year, 1-hour	91	1-36” CMP	1-42” Conc. Pipe
18	1,850.3	100-year, 24-hour	2,201	3-6’-0”x3’-8” CMPA	1-23’x7’ Box	45	86.4	50-year, 1-hour	185	1-42” CMP	1-60” Conc Pipe
19	107.1	100-year, 24-hour	295	1-36” CMP	2-54” Conc Pipe	46[1]	2,066.9	50-year, 24-hour	1995	4-114”	Not Required
20	77.3	50-year, 1-hour	107	3-4’-10”x3’-0” CMPA	Not Required	47[1]	106.1	50-year, 24-hour	247	1-120”	Not Required
21	742.5	100-year, 24-hour	928	1-36” CMP	1-13’x6’ Box	48[1]	770.6	50-year, 24-hour	764	3-48”	1-12’x5’ Box
22	40	50-year, 1-hour	60	1-30” CMP	1-36” Conc. Pipe	49[1]	984.2	50-year, 24-hour	920	2-120”	Not Required
23	5.9	50-year, 1-hour	19	1-24” CMP	Not Required	50[1]	17.3	50-year, 24-hour	47	3-48”	Not Required
24	1972.4	100-year, 24-hour	2,285	3-6’-0”x3’-8” CMPA	1-23’x7’ Box	51[1]	103.6	50-year, 24-hour	159	2-42”	2-48” Conc Pipe
25[4]	105.8	100-year, 24-hour	294	1-36” CMP	1-7’x5’ Box	52[1]	19.9	50-year, 24-hour	64	1-30”	1-36” Conc. Pipe
26	434.1	100-year, 24-hour	690	3-36” CMP	1-10’x5’ Box	53[1]	482.7	50-year, 24-hour	505	1-84”	1-96” Conc. Pipe
27	20.8	50-year, 1-hour	70	1-36” CMP	1-42” Conc. Pipe						
28	0.8	50-year, 1-hour	3	1-24” CMP	Not Required						
29	748.3	100-year, 24-hour	932	1-36” CMP	1-13’x6’ Box						
30[2]	-	-		1-24” CMP	Not Required -						

[1]Culverts are at Piilani Highway, HDOT drainage standards = 50-year storm

[2]Unable to locate upstream side of culvert and downstream side is totally buried. Culvert appears to be abandoned.

[3]Upstream side is located in walled off private property and downstream side is totally buried. Culvert appears to be abandoned.

[4]Private property [5]Headwater is 1-foot below the edge of the road

Table 4.4 Option 2 Conceptual Cost Estimate

Maui Meadows Subdivision		Piilani Highway	
Culvert ID	Cost	Culvert ID	Cost
Culvert 3	$470,000	Culvert 48	$816,000
Culvert 4	$216,000	Culvert 51	$610,000
Culvert 5	$90,000	Culvert 52	$490,000
Culvert 6	$112,000	Culvert 53	$783,000
Culvert 7	$402,000		
Culvert 8	$142,000		
Culvert 10	$103,000		
Culvert 11	$405,000		
Culvert 14	$333,000		
Culvert 15	$538,000		
Culvert 17	$154,000		
Culvert 18	$575,000		
Culvert 19	$228,000		
Culvert 21	$400,000		
Culvert 22	$103,000		
Culvert 24	$480,000		
Culvert 25 (private)	$172,000		
Culvert 26	$347,000		
Culvert 27	$112,000		
Culvert 29	$414,000		
Culvert 31	$138,000		
Culvert 32	$331,000		
Culvert 33	$210,000		
Culvert 34	$119,000		
Culvert 35	$342,000		
Culvert 36	$611,000		
Culvert 37	$185,000		
Culvert 38	$405,000		
Culvert 39 (private)	$511,000		
Culvert 42	$218,000		
Culvert 43	$631,000		
Culvert 44	$116,000		
Culvert 45	$159,000		
Subtotal Cost	$9,772,000	Subtotal Cost	$2,700,000
Total Cost	$12,471,000		

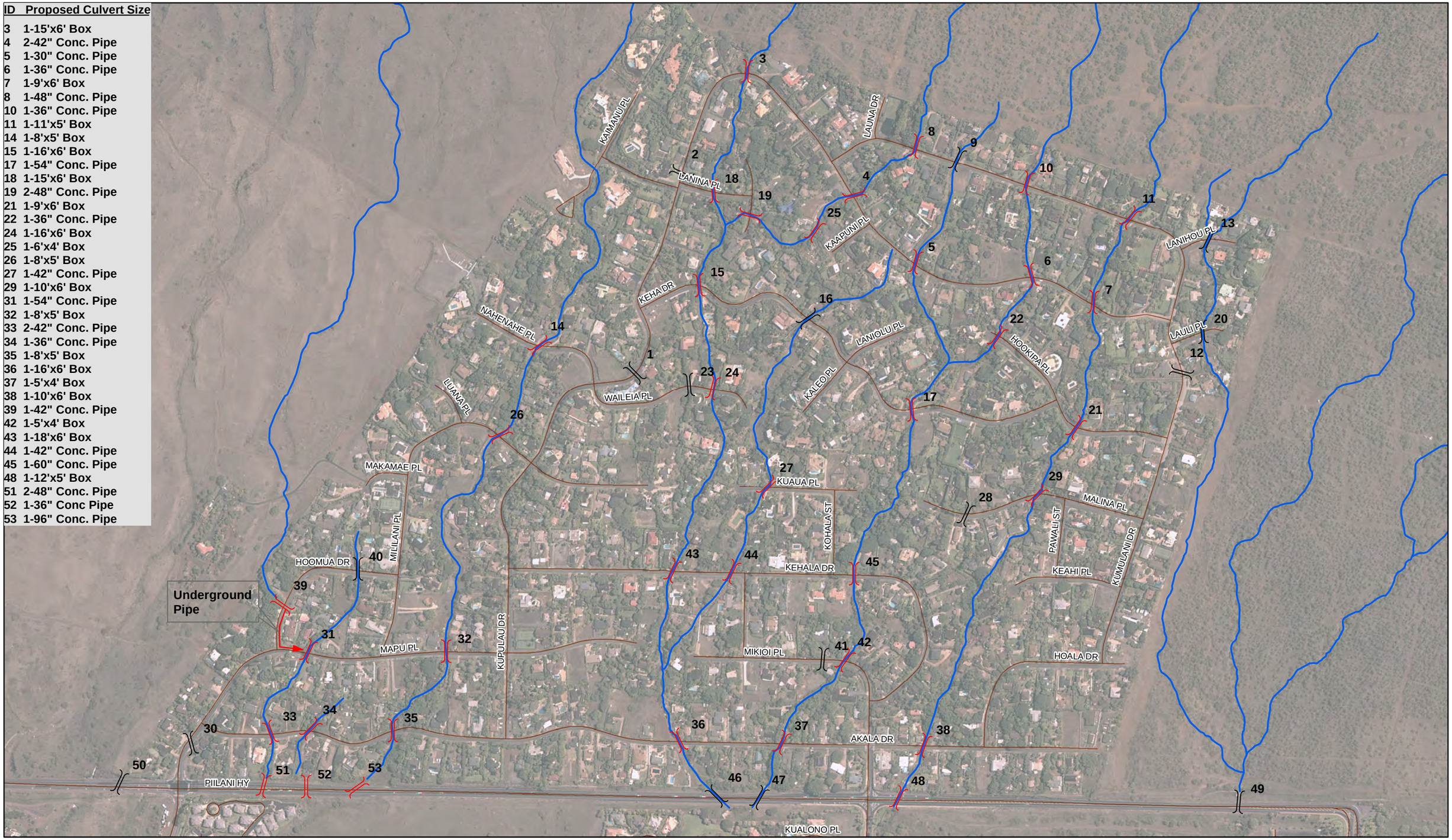
4.3.3 Option 3 – Culvert Improvements (50-Year, 24-Hour and 50-Year, 1-Hour Storms)

As described in the previous section, various factors may limit the drainage improvements to fully comply with the standards, especially for the culverts along the large gulches. As an alternative, culverts which can convey a less severe, but more frequent storm is considered in this option. In Option 3, those culverts whose contributing area is greater than 100 acres would be replaced by larger culverts sized to convey a smaller 50-year, 24-hour storm (Figure 4.3.c) instead of the standard 100-year, 24-hour storm. For those culverts whose contributing area is less than 100 acres, the same 50-year 1-hour design storm would be applied as in Option 2. In those cases where the proposed culvert size is not feasible for the specific site condition due to various physical restrictions, a smaller design storm may be considered provided that the design is reviewed and approved by the County.

The proposed culvert sizes for Option 3 are summarized in Table 4.5 and shown in Figure 4.3.g with the conceptual cost estimate provided in Table 4.6. A comparison of the culvert sizes proposed in Option 2 and Option 3 are provided in Table 4.7.

According to Tables 4.4 and 4.6, the total conceptual costs of Option 2 and Option 3 culvert improvements are approximately $12.5 million and 11.3 million respectively. The relatively small difference of $1.2 million in cost between the two options may be attributed to the fact that the maximum headwater elevation was set at 1 foot below the edge of the road. In order to maintain the same headwater elevation in both Option 2 and Option 3, the proposed culvert inverts will be lowered to accommodate the increased culvert sizes. The reduction in the flow quantity between the 100-year, 24-hour and 50-year, 24-hour storms does not result in a significant reduction of the culvert sizes in general.

ID	Proposed Culvert Size
3	1-15'x6' Box
4	2-42" Conc. Pipe
5	1-30" Conc. Pipe
6	1-36" Conc. Pipe
7	1-9'x6' Box
8	1-48" Conc. Pipe
10	1-36" Conc. Pipe
11	1-11'x5' Box
14	1-8'x5' Box
15	1-16'x6' Box
17	1-54" Conc. Pipe
18	1-15'x6' Box
19	2-48" Conc. Pipe
21	1-9'x6' Box
22	1-36" Conc. Pipe
24	1-16'x6' Box
25	1-6'x4' Box
26	1-8'x5' Box
27	1-42" Conc. Pipe
29	1-10'x6' Box
31	1-54" Conc. Pipe
32	1-8'x5' Box
33	2-42" Conc. Pipe
34	1-36" Conc. Pipe
35	1-8'x5' Box
36	1-16'x6' Box
37	1-5'x4' Box
38	1-10'x6' Box
39	1-42" Conc. Pipe
42	1-5'x4' Box
43	1-18'x6' Box
44	1-42" Conc. Pipe
45	1-60" Conc. Pipe
48	1-12'x5' Box
51	2-48" Conc. Pipe
52	1-36" Conc Pipe
53	1-96" Conc. Pipe



Legend

No Improvements — Major Flow Path

Culvert Improvements — **30** Culverts/DI ID

1 inch = 500 feet

0 250 500 1,000 1,500 Feet

Figure 4.3.g
Option 3 - Culvert Improvements

Table 4.5 Option 3 Proposed Culvert Sizes

Culvert ID	Contributing Area (acres)	Designed Storm	Q (cfs)	Existing	Proposed[5]	Culvert ID	Contributing Area (acres)	Designed Storm	Q (cfs)	Existing	Proposed[5]
3	1,838.4	50-year, 24-hour	1,687	3-6’-0”x3’-8” Pipe Arches	1-15’x6’ Box	31	98.7	50-year, 1-hour	141	1-48” CMP	1-54” Conc. Pipe
4	102.2	50-year, 24-hour	231	1-24” CMP	2-42” Conc. Pipe	32	443.6	50-year, 24-hour	551	3-36” CMP	1-8’x5’ Box
5	17.3	50-year, 1-hour	36	1-24” CMP	1-30” Conc. Pipe	33	102.3	50-year, 24-hour	156	1-48” CMP	2-42” Conc. Pipe
6	38.5	50-year, 1-hour	54	1-24” CMP	1-36” Conc. Pipe	34	16.6	50-year, 1-hour	50	1-24” CMP	1-36” Conc. Pipe
7	734.8	50-year, 24-hour	713	1-36” CMP	1-9’x6’ Box	35	471.8	50-year, 24-hour	574	3-36” CMP	1-8’x5’ Box
8	71.6	50-year, 1-hour	91	1-24” CMP	1-48” Conc. Pipe	36	2,013.6	50-year, 24-hour	1,779	3-6’-8”x3’-6” CMPA	1-19’x6’ Box
9	12.2	50-year, 1-hour	19	1-24” CMP	Not Required	37	102.9	50-year, 24-hour	212	2-36” CMP	1-5’x4’ Box
10	36.9	50-year, 1-hour	49	1-24” CMP	1-36” Conc. Pipe	38	754.8	50-year, 24-hour	723	1-36” CMP	1-10’x6’ Box
11	730.4	50-year, 24-hour	711	1-36” CMP	1-11’x5’ Box	39[4]	75.6	50-year, 1-hour	87	1-36” CMP	1-42” Conc. Pipe
13	73.6	50-year, 1-hour	96	3-4’-10”x3’-0” CMPA	Not Required	40	17.9	50-year, 1-hour	34	1-48” CMP	Not Required
14	429.5	50-year, 24-hour	543	1-60” CMP	1-8’x5’ Box	41[3]	-	-		1-24” CMP	Not Required -
15	1,965.8	50-year, 24-hour	1,758	3-6’-0”x3’-8” CMPA	1-16’x6’ Box	42	90.4	50-year, 1-hour	199	1-42” CMP	1-5’x4’ Box
16	3.6	50-year, 1-hour	14	1-24” CMP	Not Required	43	1,977	50-year, 24-hour	1,763	3-6’-8”x3’-6” CMPA	1-18’x6’ Box
17	69.7	50-year, 1-hour	133	1-36” CMP	1-54” Conc. Pipe	44	26.8	50-year, 1-hour	91	1-36” CMP	1-42” Conc. Pipe
18	1,850.3	50-year, 24-hour	1,693	3-6’-0”x3’-8” CMPA	1-15’x6’ Box	45	86.4	50-year, 1-hour	185	1-42” CMP	1-60” Conc Pipe
19	107.1	50-year, 24-hour	237	1-36” CMP	2-48” Conc Pipe	46[1]	2,066.9	50-year, 24-hour	1,804	4-114”	Not Required
20	77.3	50-year, 1-hour	107	3-4’-10”x3’-0” CMPA	Not Required	47[1]	106.1	50-year, 24-hour	217	1-120”	Not Required
21	742.5	50-year, 24-hour	717	1-36” CMP	1-9’x6’ Box	48[1]	770.6	50-year, 24-hour	730	3-48”	1-12’x5’ Box
22	40	50-year, 1-hour	60	1-30” CMP	1-36” Conc. Pipe	49[1]	984.2	50-year, 24-hour	1,186	2-120”	Not Required
23	5.9	50-year, 1-hour	19	1-24” CMP	Not Required	50[1]	17.3	50-year, 24-hour	49	3-48”	Not Required
24	1972.4	50-year, 24-hour	1,761	3-6’-0”x3’-8” CMPA	1-16’x6’ Box	51[1]	103.6	50-year, 24-hour	158	2-42”	2-48” Conc Pipe
25[4]	105.8	50-year, 24-hour	236	1-36” CMP	1-6’x4’ Box	52[1]	19.9	50-year, 24-hour	60	1-30”	1-36” Conc. Pipe
26	434.1	50-year, 24-hour	545	3-36” CMP	1-8’x5’ Box	53[1]	482.7	50-year, 24-hour	580	1-84”	1-96” Conc. Pipe
27	20.8	50-year, 1-hour	70	1-36” CMP	1-42” Conc. Pipe						
28	0.8	50-year, 1-hour	3	1-24” CMP	Not Required						
29	748.3	50-year, 24-hour	701	1-36” CMP	1-10’x6’ Box						
30	-	-		1-24” CMP	Not Required -						

[1]Culverts are at Piilani Highway, HDOT drainage standards = 50-year storm

[2]Unable to locate upstream side of culvert and downstream side is totally buried. Culvert appears to be abandoned.

[3]Upstream side is located in walled off private property and downstream side is totally buried. Culvert appears to be abandoned.

[4]Private property [5]Headwater is 1-foot below the edge of the road

Table 4.6 Option 3 Conceptual Cost Estimate

Maui Meadows Subdivision		Piilani Highway	
Culvert ID	Cost	Culvert ID	Cost
Culvert 3	$410,000	Culvert 48	$817,000
Culvert 4	$196,000	Culvert 51	$610,000
Culvert 5	$90,000	Culvert 52	$490,000
Culvert 6	$112,000	Culvert 53	$783,000
Culvert 7	$327,000		
Culvert 8	$142,000		
Culvert 10	$103,000		
Culvert 11	$369,000		
Culvert 14	$278,000		
Culvert 15	$412,000		
Culvert 17	$154,000		
Culvert 18	$460,000		
Culvert 19	$200,000		
Culvert 21	$326,000		
Culvert 22	$103,000		
Culvert 24	$383,000		
Culvert 25 (private)	$144,000		
Culvert 26	$300,000		
Culvert 27	$112,000		
Culvert 29	$370,000		
Culvert 31	$138,000		
Culvert 32	$287,000		
Culvert 33	$190,000		
Culvert 34	$119,000		
Culvert 35	$293,000		
Culvert 36	$539,000		
Culvert 37	$162,000		
Culvert 38	$361,000		
Culvert 39 (private)	$511,000		
Culvert 42	$218,000		
Culvert 43	$540,000		
Culvert 44	$116,000		
Culvert 45	$159,000		
Subtotal Cost	$8,624,000	Subtotal Cost	$2,700,000
Total Cost	$11,324,000		

Table 4.7 Comparisons of Option 2 and 3 Proposed Culvert Sizes

Culvert ID	Existing	Option 2	Option 3	Culvert ID	Existing	Option 2	Option 3
3	3-6’-0”x3’-8” Pipe Arches	1-19’x7’ Box	1-15’x6’ Box	31	1-48” CMP	1-54” Conc. Pipe	1-54” Conc. Pipe
4	1-24” CMP	2-48” Conc. Pipe	2-42” Conc. Pipe	32	3-36” CMP	1-10’x5’ Box	1-8’x5’ Box
5	1-24” CMP	1-30” Conc. Pipe	1-30” Conc. Pipe	33	1-48” CMP	2-48” Conc. Pipe	2-42” Conc. Pipe
6	1-24” CMP	1-36” Conc. Pipe	1-36” Conc. Pipe	34	1-24” CMP	1-36” Conc. Pipe	1-36” Conc. Pipe
7	1-36” CMP	1-13’x6’ Box	1-9’x6’ Box	35	3-36” CMP	1-10’x5’ Box	1-8’x5’ Box
8	1-24” CMP	1-48” Conc. Pipe	1-48” Conc. Pipe	36	3-6’-8”x3’-6” CMPA	1-23’x7’ Box	1-19’x6’ Box
9	1-24” CMP	Not Required	Not Required	37	2-36” CMP	1-5’x5’ Box	1-5’x4’ Box
10	1-24” CMP	1-36” Conc. Pipe	1-36” Conc. Pipe	38	1-36” CMP	1-13’x6’ Box	1-10’x6’ Box
11	1-36” CMP	1-12’x6’ Box	1-11’x5’ Box	39[1]	1-36” CMP	1-42” Conc. Pipe	1-42” Conc. Pipe
13	3-4’-10”x3’-0” CMPA	Not Required	Not Required	40	1-48” CMP	Not Required	Not Required
14	1-60” CMP	1-10’x5’ Box	1-8’x5’ Box	41	1-24” CMP	Not Required -	Not Required
15	3-6’-0”x3’-8” CMPA	1-23’x7’ Box	1-16’x6’ Box	42	1-42” CMP	1-5’x4’ Box	1-5’x4’ Box
16	1-24” CMP	Not Required	Not Required	43	3-6’-8”x3’-6” CMPA	1-23’x7’ Box	1-18’x6’ Box
17	1-36” CMP	1-54” Conc. Pipe	1-54” Conc. Pipe	44	1-36” CMP	1-42” Conc. Pipe	1-42” Conc. Pipe
18	3-6’-0”x3’-8” CMPA	1-23’x7’ Box	1-15’x6’ Box	45	1-42” CMP	1-60” Conc Pipe	1-60” Conc Pipe
19	1-36” CMP	2-54” Conc Pipe	2-48” Conc Pipe	46	4-114”	Not Required	Not Required
20	3-4’-10”x3’-0” CMPA	Not Required	Not Required	47	1-120”	Not Required	Not Required
21	1-36” CMP	1-13’x6’ Box	1-9’x6’ Box	48	3-48”	1-12’x5’ Box	1-12’x5’ Box
22	1-30” CMP	1-36” Conc. Pipe	1-36” Conc. Pipe	49	2-120”	Not Required	Not Required
23	1-24” CMP	Not Required	Not Required	50	3-48”	Not Required	Not Required
24	3-6’-0”x3’-8” CMPA	1-23’x7’ Box	1-16’x6’ Box	51	2-42”	2-48” Conc Pipe	2-48” Conc Pipe
25[1]	1-36” CMP	1-7’x5’ Box	1-6’x4’ Box	52	1-30”	1-36” Conc. Pipe	1-36” Conc. Pipe
26	3-36” CMP	1-10’x5’ Box	1-8’x5’ Box	53	1-84”	1-96” Conc. Pipe	1-96” Conc. Pipe
27	1-36” CMP	1-42” Conc. Pipe	1-42” Conc. Pipe				
28	1-24” CMP	Not Required	Not Required				
29	1-36” CMP	1-13’x6’ Box	1-10’x6’ Box				
30	1-24” CMP	Not Required -	Not Required -				

[1]Private property

SECTION 5 – IMPLEMENTATION

5.1 Permits and Approvals

The following permits are anticipated to be required for the proposed channels, culverts, and storage basins:

- Clean Water Act, Section 404, COE; and Section 10, Rivers and Harbors Appropriation Act, COE
  - Section 7, Endangered Species Act Consultation with U.S. Fish and Wildlife Service (USFWS)
  - Consultation with National Marine Fisheries Service (NMFS) – Required only if work extends beyond the certified shoreline into the ocean
  - Section 106, National Historic Preservation Act Consultation with Native Hawaiian Organizations (NHOs) and State Historic Preservation Office (SHPO)
- Clean Water Act, Section 401, Clean Water Certification, State Department of Health (DOH)
- Stream Channel Alteration Permit (SCAP), DLNR
- National Pollutant Discharge Elimination System (NPDES) Permits (Construction Stormwater and Dewatering), DOH
- Environmental Assessment (EA) or Environmental Impact Statement (EIS), State Office of Environmental Quality Control

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3. "Design Criteria for Highway Drainage," State of Hawaii Department of Transportation Highways Division, October 1, 2010

4. "Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS), version 4.2.1," United States Army Corps of Engineers, March 1, 2017

5. "Natural Resources Conservation Service, Soil Survey Geographic Database website, https://www.nrcs.usda.gov/wps/portal/nrcs/surveylist/soils/survey/state/?stateId=HI," Natural Resources Conservation Service, United States Department of Agriculture, December 2006

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9. "NOAA Atlas 14 Volume 4 Version 3", Precipitation Frequency Data Server website, https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_hi.html

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11. "Hydraflow Express Extension Version 11," Autodesk, Inc., 2016

12. "Hydraulic Design Series Number 5 – Hydraulic Design of Highway Culverts," Federal Highway Administration, United States Department of Transportation, May 2005

13. "Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii," Soil Conservation Service, United States Department of Agriculture, August 1972

14. "Erosion and Sediment Control Guide for Hawaii," Soil Conservation Service, United States Department of Agriculture, March 1981

APPENDIX A

HYDROLOGIC CALCULATIONS

Road Name	Culvert ID	Culvert Size	DA (ac)	Q100-24 (cfs)	Q50-1 (cfs)	Capacity (Top Elev -1') (cfs)
Kupulau Drive	1	24"	Roadside Drain Inlet			
	2	24"	Roadside Drain Inlet			
	3	6'-0"x3'-8" (3)	1838.4	2194	1482	660
	4	24"	102.2	288	141	30
	5	24"	17.3	56	36	30
	6	24"	38.5	106	54	11
	7	36"	734.8	924	662	65
Kumulani Drive	8	24"	71.6	205	91	14
	9	24"	12.2	38	19	23
	10	24"	36.9	104	49	31
	11	36"	730.4	921	651	71
	12	24"	Roadside Drain Inlet			
Lanihou Place	13	4'-10"x3'-0" (3)	73.6	192	96	390
Nahenahe Place	14	60"	429.5	687	371	223
Keha Drive	15	6'-0"x3'-8" (3)	1965.8	2282	1698	510
	16	24"	3.6	17	14	24
	17	36"	69.7	189	133	49
Lanina Place	18	6'-0"x3'-8" (3)	1850.3	2201	1513	675
	19	36"	107.1	295	159	71
Lauli Place	20	4'-10"x3'-0" (3)	77.3	198	107	345
Hookipa Place	21	36"	742.5	928	680	60
	22	30"	40	109	60	38
Waileia Place	23	24"	5.9	23	19	34
	24	6'-0"x3'-8" (3)	1972.4	2285	1721	795
Kaapuni Place (Lot 218)	25	36"	105.8	294	155	56
Mililani Place	26	36" (3)	434.1	690	385	153
Kuaua Place	27	36"	20.8	83	70	36
Malina Place	28	24"	0.8	3	3	23
	29	36"	748.3	932	701	44
Mapu Place	30	24"				0
	31	48"	98.7	197	141	108
	32	36" (3)	443.6	696	416	133
Akala Drive	33	48"	102.3	203	153	79
	34	24"	16.6	63	50	23
	35	36" (3)	471.8	725	472	123
	36	6'-8"x3'-6" (3)	2013.6	2308	1850	345
	37	36" (2)	102.9	266	238	125
	38	36"	754.8	935	718	56
Hoomua Drive	39	36"	75.6	147	87	57
	40	48"	17.9	50	34	105

Road Name	Culvert ID	Culvert Size	DA (ac)	Q100-24 (cfs)	Q50-1 (cfs)	Capacity (Top Elev -1') (cfs)
Mikioi Place	41	24"				0
	42	42"	90.4	237	199	56
Kehala Drive	43	6'-8"x3'-6" (3)	1977	2288	1732	465
	44	36"	26.8	104	91	63
	45	42"	86.4	229	185	64
Piilani Hwy	46	114" (4)	2066.9	2338	1995	5069
	47	120"	106.1	271	247	1173
	48	48" (3)	770.6	944	764	277
	49	120" (2)	984.2	1501	920	3727
	50	48" (3)	17.3	61	47	333
	51	42" (2)	103.6	204	159	107
	52	30"	19.9	73	64	57
	53	84"	482.7	732	505	571

Notes:

1 Q100-24 = 100-year, 24-hour peak discharge

2 Q50-1 = 50-year, 1-hour peak discharge

NRCS 24-Hour Storm

DA	Area (ac)	Area (sq mi)	Q100 [1] (cfs)	Q100/A (cfs/ac)	Q50 [1] (cfs)	Note
26A	17.3	0.027	61	3.53	49	at Piilani Hwy
27A	3.6	0.006	16	4.44	13	
27B	5.2	0.008	23	4.42	19	
27C	17.9	0.028	50	2.79	39	
27D	1.3	0.002	6	4.62	5	
26B	75.6	0.118	147	1.94	112	
Total	103.6		204	1.97	158	at Piilani Hwy
28A	3.3	0.005	15	4.55	12	
28B	16.6	0.026	63	3.80	51	
Total	19.9		73	3.67	60	at Piilani Hwy
29A	10.9	0.017	40	3.67	32	
29B	28.2	0.044	73	2.59	58	
29C	9.5	0.015	35	3.68	29	
29D	4.6	0.007	17	3.70	13	
29E	429.5	0.671	687	1.60	543	
Total	482.7		732	1.52	580	at Piilani Hwy
30A	47.4	0.074	155	3.27	126	
30B	9.8	0.015	34	3.47	28	
30C	4.6	0.007	14	3.04	11	
30D	6.0	0.009	23	3.83	18	
30E	17.2	0.027	67	3.90	54	
30F	3.6	0.006	17	4.72	14	
30G	5.9	0.009	23	3.90	19	
30H	6.6	0.010	26	3.94	21	
30I	1.3	0.002	5	3.85	4	
30J	3.6	0.006	17	4.72	14	
30K	11.9	0.019	45	3.78	37	
30L	1838.4	2.872	2194	1.19	1687	
30M	30.6	0.048	91	2.97	72	
30N	71.6	0.112	205	2.86	165	
30O	8.4	0.013	32	3.81	25	
Total	2066.9		2338	1.13	1804	at Piilani Hwy

[1] The peak flows are obtained from the HEC-HMS hydrographs.

NRCS 24-Hour Storm

DA	Area (ac)	Area (sq mi)	Q100 [1] (cfs)	Q100/A (cfs/ac)	Q50 [1] (cfs)	Note
31A	3.2	0.005	11	3.44	9	
31B	12.5	0.020	49	3.92	39	
31C	4.0	0.006	16	4.00	13	
31D	16.7	0.026	63	3.77	51	
31E	12.4	0.019	44	3.55	35	
31F	5.1	0.008	20	3.92	16	
31G	12.2	0.019	38	3.11	30	
31H	1.5	0.002	6	4.00	5	
31I	1.6	0.003	7	4.38	6	
31J	36.9	0.058	104	2.82	82	
Total	106.1		271	2.55	217	at Piilani Hwy
32A	17.5	0.027	66	3.77	53	
32B	0.8	0.001	3	3.75	2	
Total	18.3		68	3.72	55	at Piilani Hwy
33A	15.8	0.025	59	3.73	48	
33B	6.5	0.010	21	3.23	17	
33C	5.8	0.009	25	4.31	21	
33D	7.7	0.012	25	3.25	20	
33E	4.4	0.007	15	3.41	12	
33F	730.4	1.141	921	1.26	711	
Total	770.6		944	1.23	730	at Piilani Hwy
34A	906.9	1.417	1397	1.54	1103	
34B	3.7	0.006	15	4.05	12	
34C	73.6	0.115	192	2.61	152	
Total	984.2		1501	1.53	1186	at Piilani Hwy

[1] The peak flows are obtained from the HEC-HMS hydrographs.

Rational 1-Hour Storm

DA	Area	Tc	i50	Adjusted i50	C	Q50	Q50/A
	(ac)	(min)	(in)	(in/hr)		(cfs)	(cfs/ac)
26A	17.3	11.1	2.44	4.9	0.55	47	2.72
27A	3.6	9.2	2.44	5.2	0.62	12	3.33
27B	5.2	7.7	2.48	5.4	0.7	20	3.85
27C	17.9	17.7	2.52	4.3	0.44	34	1.90
27D	1.3	5.3	2.44	6.1	0.71	6	4.62
26B	75.6	28	2.52	3.6	0.32	87	1.15
	103.6					159	1.53
28A	3.3	5.6	2.44	6.05	0.72	14	4.24
28B	16.6	15.1	2.48	4.45	0.68	50	3.01
	19.9					64	3.22
29A	10.9	11.6	2.47	4.9	0.61	33	3.03
29B	28.2	29.4	2.56	3.6	0.55	56	1.99
29C	9.5	12.2	2.48	4.8	0.67	31	3.26
29D	4.6	6.7	2.52	5.9	0.52	14	3.04
29E	429.5	61.3	2.75	2.7	0.32	371	0.86
	482.7					505	1.05
30A	47.4	18.6	2.51	4.3	0.62	126	2.66
30B	9.8	12.7	2.51	4.75	0.58	27	2.76
30C	4.6	12.8	2.51	4.7	0.49	11	2.39
30D	6.0	8	2.51	5.6	0.62	21	3.50
30E	17.2	9.8	2.56	5.3	0.61	56	3.26
30F	3.6	7.3	2.59	6	0.66	14	3.89
30G	5.9	11.9	2.56	5.1	0.62	19	3.22
30H	6.6	8.1	2.56	5.7	0.6	23	3.48
30I	1.3	5.8	2.56	6.15	0.52	4	3.08
30J	3.6	7.2	2.61	6	0.65	14	3.89
30K	11.9	11.1	2.61	5.1	0.51	31	2.61
30L	1838.4	88.3	3.01	2.6	0.31	1482	0.81
30M	30.6	18.8	2.71	4.55	0.36	50	1.63
30N	71.6	26.2	2.76	4.1	0.31	91	1.27
30O	8.4	7.8	2.56	5.75	0.53	26	3.10
	2066.9					1995	0.97

Rational 1-Hour Storm

DA	Area	Tc	i50	Adjusted i50	C	Q50	Q50/A
	(ac)	(min)	(in)	(in/hr)		(cfs)	(cfs/ac)
31A	3.2	7.9	2.5	5.6	0.53	9	2.81
31B	12.5	9.8	2.54	5.2	0.6	39	3.12
31C	4.0	7.5	2.54	5.8	0.62	14	3.50
31D	16.7	11	2.59	5.15	0.61	52	3.11
31E	12.4	11.6	2.59	5.1	0.59	37	2.98
31F	5.1	10.9	2.65	5.25	0.62	17	3.33
31G	12.2	13.4	2.65	4.95	0.32	19	1.56
31H	1.5	7.1	2.59	6.05	0.61	6	4.00
31I	1.6	7.4	2.65	6	0.49	5	3.13
31J	36.9	21.9	2.71	4.3	0.31	49	1.33
	106.1					247	2.33
32A	17.5	12.5	2.54	4.85	0.62	53	3.03
32B	0.8	4.9	2.59	6.7	0.58	3	3.75
	18.3					56	3.06
33A	15.8	12.2	2.54	4.9	0.59	46	2.91
33B	6.5	11.7	2.54	5.1	0.5	17	2.62
33C	5.8	8.9	2.59	5.5	0.65	21	3.62
33D	7.7	16.2	2.65	4.7	0.49	18	2.34
33E	4.4	9.4	2.65	5.4	0.47	11	2.50
33F	730.4	80.1	3.09	2.7	0.33	651	0.89
	770.6					764	0.99
34A	906.9	69.1	3.02	2.8	0.32	813	0.90
34B	3.7	8.2	2.69	5.9	0.49	11	2.97
34C	73.6	24	2.75	4.2	0.31	96	1.30
	984.2					920	0.93

	1 hour				24 hour			
Basin_ID	2 year	10 year	50 year	100 year	2 year	10 year	50 year	100 year
26A	1.10	1.75	2.44	2.75	2.98	5.11	7.53	8.67
26B	1.15	1.82	2.52	2.84	3.09	5.25	7.69	8.83
27A	1.10	1.75	2.44	2.75	2.98	5.11	7.53	8.67
27B	1.12	1.78	2.48	2.79	3.03	5.17	7.61	8.74
27C	1.15	1.82	2.52	2.84	3.09	5.25	7.69	8.83
27D	1.10	1.75	2.44	2.75	2.98	5.11	7.53	8.67
28A	1.10	1.75	2.44	2.75	2.98	5.11	7.53	8.67
28B	1.12	1.78	2.48	2.79	3.03	5.17	7.61	8.74
29A	1.11	1.77	2.47	2.78	2.99	5.12	7.55	8.69
29B	1.16	1.84	2.56	2.87	3.11	5.27	7.72	8.86
29C	1.12	1.78	2.48	2.79	3.03	5.17	7.61	8.74
29D	1.15	1.82	2.52	2.84	3.09	5.25	7.69	8.83
29E	1.27	1.99	2.75	3.09	3.40	5.69	8.25	9.43
30A	1.14	1.80	2.51	2.82	3.04	5.19	7.63	8.77
30B	1.14	1.80	2.51	2.82	3.04	5.19	7.63	8.77
30C	1.14	1.80	2.51	2.82	3.04	5.19	7.63	8.77
30D	1.14	1.80	2.51	2.82	3.04	5.19	7.63	8.77
30E	1.16	1.84	2.56	2.87	3.11	5.27	7.72	8.86
30F	1.18	1.87	2.59	2.91	3.12	5.29	7.75	8.90
30G	1.16	1.84	2.56	2.87	3.11	5.27	7.72	8.86
30H	1.16	1.84	2.56	2.87	3.11	5.27	7.72	8.86
30I	1.16	1.84	2.56	2.87	3.11	5.27	7.72	8.86
30J	1.20	1.88	2.61	2.93	3.17	5.36	7.83	8.98
30K	1.20	1.88	2.61	2.93	3.17	5.36	7.83	8.98
30L	1.44	2.20	3.01	3.37	3.90	6.38	9.10	10.40
30M	1.25	1.96	2.71	3.04	3.26	5.49	8.01	9.18
30N	1.28	2.00	2.76	3.11	3.34	5.60	8.14	9.33
30O	1.16	1.84	2.56	2.87	3.11	5.27	7.72	8.86
31A	1.13	1.79	2.50	2.81	3.00	5.13	7.56	8.70
31B	1.15	1.83	2.54	2.85	3.05	5.20	7.65	8.79
31C	1.15	1.83	2.54	2.85	3.05	5.20	7.65	8.79
31D	1.18	1.87	2.59	2.91	3.12	5.29	7.75	8.90
31E	1.18	1.87	2.59	2.91	3.12	5.29	7.75	8.90
31F	1.22	1.91	2.65	2.98	3.19	5.39	7.87	9.03
31G	1.22	1.91	2.65	2.98	3.19	5.39	7.87	9.03
31H	1.18	1.87	2.59	2.91	3.12	5.29	7.75	8.90
31I	1.22	1.91	2.65	2.98	3.19	5.39	7.87	9.03
31J	1.25	1.96	2.71	3.04	3.26	5.49	8.01	9.18
32A	1.15	1.83	2.54	2.85	3.05	5.20	7.65	8.79
32B	1.18	1.87	2.59	2.91	3.12	5.29	7.75	8.90
33A	1.15	1.83	2.54	2.85	3.05	5.20	7.65	8.79
33B	1.15	1.83	2.54	2.85	3.05	5.20	7.65	8.79
33C	1.18	1.87	2.59	2.91	3.12	5.29	7.75	8.90
33D	1.22	1.91	2.65	2.98	3.19	5.39	7.87	9.03

	1 hour				24 hour			
Basin_ID	2 year	10 year	50 year	100 year	2 year	10 year	50 year	100 year
33E	1.22	1.91	2.65	2.98	3.19	5.39	7.87	9.03
33F	1.48	2.26	3.09	3.46	3.90	6.39	9.12	10.40
34A	1.43	2.20	3.02	3.39	3.62	6.00	8.65	9.88
34B	1.24	1.94	2.69	3.02	3.21	5.42	7.92	9.09
34C	1.27	1.99	2.75	3.09	3.29	5.53	8.07	9.24

MAUI MEADOWS SUBDIVISION DRAINAGE MASTER PLAN

ITEM: Time of Concentration, Tc

LOCATION: KIHEI, MAUI, HAWAII
PREPARED BY: TL
DATE: May 2019

REF: 1-20258-1E
CHECKED BY:
DATE:

1. INTRODUCTION
   This is to determine the time of concentration (Tc) for the drainage area. The method described in SCS TR-55, Section 3 is used.

2. REFERENCES
   2.1 "Urban Hydrology for Small Watersheds, TR-55, 2nd Edition", Soil Conservation Service, U. S. Dept. of Agriculture, June 1986.

   2.3 Erosion and Sediment Control Guide for Hawaii," Soil and Water Conservation Service, U. S. Dept. of Agriculture, March 1981 w/ Addendum July 1983.
   2.4 NOAA Atlas 14 for Hawaian Islands

3. COMPUTATIONS
   The travel time computation for sheet flow is from TR-55 kinematic equation.
   Velocity computation for shallow concentrated flow (based on TR-55, Figure 3-1).

   SF = Sheetflow
   SCF = Shallow Concentrated Flow
   OCF = Open channel flow, where blue line is shown on USGS quadrangle map

Subarea	Reach Description	Hyd. Length (ft)	Elev1 (ft)	Elev2 (ft)	Approx. Slope (ft/ft)	Est. Vel. (fps)	Kinematic P2-24 (in)	Eqn. n	Travel Time (hr)	Lag Time (min)
26A	SF	100	382	374	0.080		2.98	0.13	0.087	
	SCF, unpaved	1000	374	268	0.106	5.3			0.053	
	SCF, unpaved	500	268	238	0.060	4.0			0.035	
	SCF, paved	210	238	220	0.086	6.0			0.010	
	Total	1810							0.185	6.660
26B	SF	100	753	748	0.050		3.09	0.13	0.103	
	SCF, unpaved	1150	748	672	0.066	4.1			0.077	
	SCF, unpaved	3400	672	384	0.085	4.7			0.201	
	SCF, unpaved	650	384	356	0.043	3.3			0.054	
	SCF, unpaved	600	356	290	0.110	5.4			0.031	
	Total	5900						41	0.466	16.776
27A	SF	100	304	298	0.060		2.98	0.13	0.097	
	SCF, paved	270	298	284	0.052	4.6			0.016	
	SCF, unpaved	130	284	274	0.077	4.5			0.008	
	SCF, unpaved	420	274	252	0.052	3.7			0.032	
	Total	920							0.153	5.508
27B	SF	100	362	352	0.100		3.03	0.13	0.079	
	SCF, unpaved	450	352	309	0.096	5.0			0.025	
	SCF, unpaved	390	309	280	0.074	4.4			0.025	
	Total	940							0.128	4.608
27C	SF	100	614	609	0.050		3.09	0.13	0.103	
	SCF, unpaved	1300	609	486	0.095	5.0			0.073	
	SCF, unpaved	1400	486	378	0.077	4.5			0.087	
	SCF, unpaved	580	378	326	0.090	4.8			0.033	
	Total	3380							0.296	10.656

Subarea	Reach Description	Hyd. Length (ft)	Elev1 (ft)	Elev2 (ft)	Approx. Slope (ft/ft)	Est. Vel. (fps)	Kinematic P2-24 (in)	Eqn. n	Travel Time (hr)	Lag Time (min)
27D	SF	100	280	262	0.180		2.98	0.13	0.063	
	SCF, unpaved	400	262	232.26	0.074	4.4			0.025	
	Total	500							0.088	3.168
28A	SF	100	288	273	0.150		2.98	0.13	0.067	
	SCF, paved	240	273	254	0.079	5.7			0.012	
	SCF, unpaved	240	254	235.48	0.077	4.5			0.015	
	Total	580							0.094	3.384
28B	SF	100	492	486	0.060		3.03	0.13	0.096	
	SCF, unpaved	950	486	398	0.093	4.9			0.054	
	SCF, paved	1280	398	298	0.078	5.7			0.063	
	SCF, unpaved	610	298	254	0.072	4.3			0.039	
	Total	2940							0.252	9.072
29A	SF	100	327	322	0.050		2.99	0.13	0.104	
	SCF, unpaved	250	322	312	0.040	3.2			0.022	
	SCF, paved	730	312	282	0.041	4.1			0.049	
	SCF, unpaved	360	282	242	0.111	5.4			0.019	
	Total	1440							0.194	6.984
29B	SF	100	698	695	0.030		3.11	0.13	0.126	
	SCF, unpaved	170	695	690	0.029	2.8			0.017	
	SCF, unpaved	630	690	616	0.117	5.5			0.032	
	SCF, unpaved	620	616	588	0.045	3.4			0.050	
	SCF, unpaved	660	588	524	0.097	5.0			0.036	
	SCF, unpaved	520	524	500	0.046	3.5			0.042	
	SCF, paved	2800	500	310	0.068	5.3			0.147	
	SCF, unpaved	570	310	276	0.060	3.9			0.040	
	Total	6070							0.490	17.640
29C	SF	100	415	411	0.040		3.03	0.13	0.113	
	SCF, unpaved	100	411	400	0.110	5.4			0.005	
	SCF, unpaved	1320	400	306	0.071	4.3			0.085	
	Total	1520							0.204	7.344
29D	SF	100	461	450	0.110		3.09	0.13	0.075	
	SCF, unpaved	320	450	416	0.106	5.3			0.017	
	SCF, unpaved	270	416	402	0.052	3.7			0.020	
	Total	690							0.112	4.032
29E	SF	100	2070	2055	0.150		3.4	0.4	0.155	
	SCF, unpaved	12800	2055	686	0.107	5.3			0.674	
	SCF, unpaved	1950	686	522	0.084	4.7			0.116	
	SCF, unpaved	1180	522	440	0.069	4.3			0.077	
	Total	16030							1.022	36.792
30A	SF	100	481	466	0.150		3.04	0.13	0.067	
	SCF, unpaved	1050	466	350	0.110	5.4			0.054	
	SCF, paved	1170	350	288	0.053	3.7			0.088	
	SCF, unpaved	990	288	260	0.028	2.7			0.101	
	Total	3310							0.310	11.160
30G	SF	100	607	599	0.080		3.11	0.13	0.085	
	SCF, unpaved	220	599	584	0.068	4.2			0.015	
	SCF, paved	1390	584	495	0.064	5.1			0.075	
	SCF, unpaved	490	495	434	0.124	5.7			0.024	
	Total	2200							0.198	7.128

Subarea	Reach Description	Hyd. Length (ft)	Elev1 (ft)	Elev2 (ft)	Approx. Slope (ft/ft)	Est. Vel. (fps)	Kinematic P2-24 (in)	Eqn. n	Travel Time (hr)	Lag Time (min)
30B	SF	100	384	379	0.050		3.04	0.13	0.104	
	SCF, unpaved	170	379	366	0.076	4.5			0.011	
	SCF, paved	420	366	348	0.043	4.2			0.028	
	SCF, unpaved	670	348	290	0.087	4.7			0.039	
	SCF, unpaved	370	290	274	0.043	3.4			0.031	
	Total	1730							0.212	7.632
30D	SF	100	406	399	0.070		3.04	0.13	0.091	
	SCF, unpaved	690	399	344	0.080	4.6			0.042	
	Total	790							0.133	4.788
30E	SF	100	586	575	0.110		3.11	0.13	0.075	
	SCF, unpaved	290	575	538	0.128	5.8			0.014	
	SCF, paved	810	538	476	0.077	5.6			0.040	
	SCF, unpaved	400	476	406	0.175	6.7			0.016	
	SCF, paved	290	406	392	0.048	4.5			0.018	
	Total	1890							0.163	5.868
30F	SF	100	598	590	0.080		3.12	0.13	0.085	
	SCF, unpaved	360	590	556	0.094	5.0			0.020	
	SCF, unpaved	370	556	506	0.135	5.9			0.017	
	Total	830							0.122	4.392
30C	SF	100	452	450	0.020		3.04	0.13	0.149	
	SCF, unpaved	250	450	426	0.096	5.0			0.014	
	SCF, unpaved	920	426	334	0.100	5.1			0.050	
	Total	1270							0.213	7.668
30H	SF	100	561	550	0.110		3.11	0.13	0.075	
	SCF, unpaved	250	550	510	0.160	6.5			0.011	
	SCF, paved	340	510	492	0.053	4.7			0.020	
	SCF, unpaved	550	492	434	0.105	5.2			0.029	
	Total	1240							0.135	4.860
30O	SF	100	612	601	0.110		3.11	0.13	0.075	
	SCF, unpaved	390	601	539	0.159	6.4			0.017	
	SCF, paved	150	539	530	0.060	5.0			0.008	
	SCF, unpaved	140	530	506	0.171	6.7			0.006	
	SCF, unpaved	350	506	484	0.063	4.0			0.024	
	Total	1130							0.130	4.680
30K	SF	100	708	695	0.130		3.17	0.13	0.069	
	SCF, unpaved	930	695	594	0.109	5.3			0.049	
	SCF, paved	390	594	582	0.031	3.6			0.030	
	SCF, unpaved	10	582	572	1.000	16.1			0.000	
	SCF, unpaved	640	572	512	0.094	4.9			0.036	
	Total	2070							0.184	6.624
30L	SF	100	5460	5420	0.400		3.9	0.4	0.098	
	SCF, unpaved	30200	5420	684	0.157	6.4			1.313	
	SCF, unpaved	1120	684	574	0.098	5.1			0.062	
	Total	31420							1.472	52.992
30I	SF	100	590	578	0.120		3.11	0.13	0.072	
	SCF, unpaved	140	578	560	0.129	5.8			0.007	
	SCF, unpaved	320	560	530	0.094	4.9			0.018	
	Total	560							0.097	3.492

Subarea	Reach Description	Hyd. Length (ft)	Elev1 (ft)	Elev2 (ft)	Approx. Slope (ft/ft)	Est. Vel. (fps)	Kinematic P2-24 (in)	Eqn. n	Travel Time (hr)	Lag Time (min)
30J	SF	100	644	636	0.080		3.17	0.13	0.084	
	SCF, unpaved	100	636	620	0.160	6.5			0.004	
	SCF, paved	290	620	591	0.100	6.4			0.013	
	SCF, unpaved	70	591	580	0.157	6.4			0.003	
	SCF, unpaved	230	580	566	0.061	4.0			0.016	
	Total	790							0.120	4.320
30M	SF	100	900	890	0.100		3.26	0.13	0.076	
	SCF, unpaved	2200	890	710	0.082	4.6			0.132	
	SCF, unpaved	1140	710	634	0.067	4.2			0.076	
	SCF, paved	260	634	616	0.069	5.3			0.014	
	SCF, unpaved	300	616	586	0.100	5.1			0.016	
	Total	4000							0.314	11.304
30N	SF	100	1240	1230	0.100		3.34	0.13	0.075	
	SCF, unpaved	4780	1230	698	0.111	5.4			0.247	
	SCF, unpaved	300	698	685	0.043	3.4			0.025	
	SCF, unpaved	1130	685	632	0.047	3.5			0.090	
	Total	6310							0.436	15.696
31A	SF	100	310	303	0.070		3	0.13	0.091	
	SCF, unpaved	190	303	294	0.047	3.5			0.015	
	SCF, unpaved	410	294	264	0.073	4.4			0.026	
	Total	700							0.132	4.752
31B	SF	100	400	391	0.090		3.05	0.13	0.082	
	SCF, unpaved	960	391	302	0.093	4.9			0.054	
	SCF, unpaved	370	302	282	0.054	3.8			0.027	
	Total	1430							0.163	5.868
31C	SF	100	430	420	0.100		3.05	0.13	0.078	
	SCF, unpaved	770	420	330	0.117	5.5			0.039	
	SCF, unpaved	120	330	322	0.067	4.2			0.008	
	Total	990							0.125	4.500
31D	SF	100	567	557	0.100		3.12	0.13	0.077	
	SCF, unpaved	270	557	516	0.152	6.3			0.012	
	SCF, paved	700	516	484	0.046	4.3			0.045	
	SCF, unpaved	980	484	370	0.116	5.5			0.049	
	Total	2050							0.184	6.624
31E	SF	100	636	630	0.060		3.12	0.13	0.095	
	SCF, unpaved	520	630	591	0.075	4.4			0.033	
	SCF, paved	350	591	576	0.043	4.2			0.023	
	SCF, unpaved	220	576	536	0.182	6.9			0.009	
	SCF, unpaved	570	536	486	0.088	4.8			0.033	
	Total	1760							0.193	6.948
31F	SF	100	666	660	0.060		3.19	0.13	0.094	
	SCF, unpaved	300	660	640	0.067	4.2			0.020	
	SCF, paved	340	640	634	0.018	2.7			0.035	
	SCF, unpaved	570	634	582	0.091	4.9			0.032	
	Total	1310							0.181	6.516
31G	SF	100	730	722	0.080		3.19	0.13	0.084	
	SCF, unpaved	400	722	702	0.050	3.6			0.031	
	SCF, unpaved	1400	702	634	0.049	3.6			0.109	
	Total	1900							0.224	8.064

Subarea	Reach Description	Hyd. Length (ft)	Elev1 (ft)	Elev2 (ft)	Approx. Slope (ft/ft)	Est. Vel. (fps)	Kinematic P2-24 (in)	Eqn. n	Travel Time (hr)	Lag Time (min)
31H	SF	100	624	618	0.060		3.12	0.13	0.095	
	SCF, unpaved	220	618	592	0.118	5.5			0.011	
	SCF, unpaved	250	592	564	0.112	5.4			0.013	
	Total	570							0.119	4.284
31I	SF	100	640	634	0.060		3.19	0.13	0.094	
	SCF, unpaved	30	634	626	0.267	8.3			0.001	
	SCF, unpaved	360	626	608	0.050	3.6			0.028	
	Total	490							0.123	4.428
31J	SF	100	1040	1030	0.100		3.26	0.13	0.076	
	SCF, unpaved	3260	1030	702	0.101	5.1			0.177	
	SCF, unpaved	940	702	664	0.040	3.2			0.080	
	SCF, unpaved	460	664	636	0.061	4.0			0.032	
	Total	4760							0.365	13.140
32A	SF	100	520	506	0.140		3.05	0.13	0.068	
	SCF, unpaved	450	506	442	0.142	6.1			0.021	
	SCF, paved	330	442	428	0.042	4.2			0.022	
	SCF, unpaved	1150	428	320	0.094	4.9			0.065	
	SCF, paved	600	320	282	0.063	5.1			0.033	
	Total	2630							0.208	7.488
32B	SF	100	507	490	0.170		3.12	0.13	0.063	
	SCF, unpaved	420	490	430	0.143	6.1			0.019	
	Total	520							0.082	2.952
33A	SF	100	450	438	0.120		3.05	0.13	0.073	
	SCF, unpaved	260	438	412	0.100	5.1			0.014	
	SCF, paved	260	412	404	0.031	3.6			0.020	
	SCF, unpaved	920	404	326	0.085	4.7			0.054	
	SCF, paved	470	326	304	0.047	4.4			0.030	
	SCF, unpaved	220	304	280	0.109	5.3			0.011	
	Total	2230							0.203	7.308
33B	SF	100	456	451	0.050		3.05	0.13	0.103	
	SCF, unpaved	210	451	424	0.129	5.8			0.010	
	SCF, unpaved	1390	424	304	0.086	4.7			0.081	
	Total	1700							0.195	7.020
33C	SF	100	616	610	0.060		3.12	0.13	0.095	
	SCF, unpaved	380	610	556	0.142	6.1			0.017	
	SCF, paved	440	556	520	0.082	5.8			0.021	
	SCF, unpaved	100	520	496	0.240	7.9			0.004	
	SCF, unpaved	280	496	448	0.171	6.7			0.012	
	Total	1300							0.149	5.364
33D	SF	100	681	679	0.020		3.19	0.13	0.146	
	SCF, unpaved	1090	679	612	0.061	4.0			0.076	
	SCF, paved	310	612	592	0.065	5.2			0.017	
	SCF, unpaved	650	592	514	0.120	5.6			0.032	
	Total	2150							0.271	9.756
33E	SF	100	677	670	0.070		3.19	0.13	0.088	
	SCF, unpaved	560	670	634	0.064	4.1			0.038	
	SCF, unpaved	10	634	624	1.000	16.1			0.000	
	SCF, unpaved	430	624	598	0.060	4.0			0.030	
	Total	1100							0.157	5.652

Subarea	Reach Description	Hyd. Length (ft)	Elev1 (ft)	Elev2 (ft)	Approx. Slope (ft/ft)	Est. Vel. (fps)	Kinematic P2-24 (in)	Eqn. n	Travel Time (hr)	Lag Time (min)
33F	SF	100	4125	4090	0.350		3.9	0.4	0.103	
	SCF, unpaved	23360	4090	698	0.145	6.1			1.055	
	SCF, unpaved	1540	698	656	0.027	2.7			0.161	
	SCF, unpaved	280	656	632	0.086	4.7			0.016	
	Total	25280							1.336	48.096
34A	SF	100	3130	3125	0.050		3.62	0.13	0.095	
	SCF, unpaved	17240	3125	752	0.138	6.0			0.800	
	SCF, unpaved	1530	752	597	0.101	5.1			0.083	
	SCF, unpaved	1290	597	478	0.092	4.9			0.073	
	SCF, unpaved	285	478	443	0.123	5.7			0.014	
	SCF, unpaved	1600	443	282	0.101	5.1			0.087	
	Total	22045							1.152	41.472
34B	SF	100	671	659	0.120		3.21	0.13	0.071	
	SCF, unpaved	360	659	632	0.075	4.4			0.023	
	SCF, unpaved	80	632	618	0.175	6.7			0.003	
	SCF, paved	190	618	610	0.042	4.2			0.013	
	SCF, unpaved	520	610	550	0.115	5.5			0.026	
	Total	1250							0.136	4.896
34C	SF	100	1095	1090	0.050		3.29	0.13	0.100	
	SCF, unpaved	3570	1090	724	0.103	5.2			0.192	
	SCF, unpaved	1140	724	668	0.049	3.6			0.089	
	SCF, unpaved	120	668	642	0.217	7.5			0.004	
	SCF, unpaved	150	642	629	0.087	4.7			0.009	
	SCF, unpaved	160	629	606	0.144	6.1			0.007	
	Total	5240							0.401	14.436

Maui Meadows Subdivision Drainage Master Plan
Existing Condition - Weighted CN

REF: 1-20258-0E
PREPARED BY: IL
DATE: 8/8/2018

Basin ID: 26A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	156138.93498800000	3.58445672608	55	197.1451
B	Grassland	203018.52861000000	4.66066410950	61	284.3005
B	Impervious Surface	249121.24346100000	5.71903681040	95	543.3085
B	Open Space Developed	119171.59109200000	2.73580328494	61	166.884
B	Scrub Shrub	28076.84457930000	0.64455566068	66	42.54067
Sum			17.34451659160		1234.179

Weighted CN 71.2

Basin ID: 26B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	74755.52880860000	1.71615766372	55	94.38867
B	Grassland	3036596.39970000000	69.71093999350	61	4252.367
B	Impervious Surface	73091.63564840000	1.67795977998	95	159.4062
B	Open Space Developed	38761.46451660000	0.88984434258	61	54.2805
B	Scrub Shrub	70559.21037370000	1.61982306270	66	106.9083
Sum			75.61472484248		4667.351

Weighted CN 61.7

Basin ID: 27A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	24875.48391900000	0.57106500000	55	31.40858
B	Impervious Surface	67979.61332800000	1.56060300000	95	148.2573
B	Open Space Developed	28251.89162900000	0.64857700000	61	39.5632
B	Scrub Shrub	37492.84818300000	0.86072100000	66	56.80759
Sum			3.64096600000		276.0366

Weighted CN 75.8

Basin ID: 27B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	43599.62689980000	1.00091371209	55	55.05025
B	Impervious Surface	111647.23247500000	2.56307803179	95	243.4924
B	Open Space Developed	70697.69427900000	1.62300222844	61	99.00314
B	Scrub Shrub	67.39992217610	0.00154729550	66	0.102122
Sum			5.18854126782		397.6479

Weighted CN 76.6

Basin ID: 27C

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	109378.12531200000	2.51098629076	55	138.1042
B	Grassland	422561.09580700000	9.70070675060	61	591.7431
B	Impervious Surface	139250.67611000000	3.19676843696	95	303.693
B	Open Space Developed	80603.08484350000	1.85039961563	61	112.8744
B	Scrub Shrub	28663.06803580000	0.65801613151	66	43.42906
Sum			17.91687722546		1189.844

Weighted CN 66.4

Basin ID: 27D

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	24973.41825750000	0.00224800000	55	0.12364
B	Impervious Surface	94993.82555520000	0.62016300000	95	58.91549
B	Open Space Developed	55551.35660570000	0.62671200000	61	38.22943
B	Scrub Shrub	41857.35986060000	0.10019600000	66	6.612936
Sum			1.34931900000		103.8815

Weighted CN 77.0

Basin ID: 28A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	16290.97162950000	0.37399074365	55	20.56949
B	Impervious Surface	72852.97263030000	1.67248080907	95	158.8857
B	Open Space Developed	49676.77418870000	1.14042637503	61	69.56601
B	Scrub Shrub	4192.66037599000	0.09625062320	66	6.352541
Sum			3.28314855096		255.3737

Weighted CN 77.8

Basin ID: 28B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	183677.78625100000	4.21667862636	55	231.9173
B	Grassland	6755.32277001000	0.15508149200	61	9.459971
B	Impervious Surface	359791.55762100000	8.25971067014	95	784.6725
B	Open Space Developed	155855.68591800000	3.57796853404	61	218.2561
B	Scrub Shrub	15188.38866110000	0.34867882036	66	23.0128
Sum			16.55811814290		1267.319

Weighted CN 76.5

Basin ID: 29A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Bare Land	3840.07487728000	0.08815634154	86	7.581445
B	Evergreen	104664.47163200000	2.40277525922	55	132.1526
B	Impervious Surface	175305.12880000000	4.02446809052	95	382.3245
B	Open Space Developed	132666.45833100000	3.04561499079	61	185.7825
B	Scrub Shrub	56201.00631340000	1.29020273458	66	85.15338
Sum			10.85121741665		792.9944
Weighted CN					73.1

Basin ID: 29B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Bare Land	15726.59897610000	0.36103447848	86	31.04897
B	Evergreen	296540.37086300000	6.80765741571	55	374.4212
B	Grassland	112219.48413100000	2.57621517471	61	157.1491
B	Impervious Surface	378563.61391000000	8.69065950801	95	825.6127
B	Open Space Developed	226099.37941000000	5.19054829685	61	316.6234
B	Scrub Shrub	200748.06333400000	4.60855983308	66	304.1649
Sum			28.23467470684		2009.02
Weighted CN					71.2

Basin ID: 29C

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	25321.87489790000	0.58131258461	55	31.97219
B	Impervious Surface	149410.44321500000	3.43000552936	95	325.8505
B	Open Space Developed	215336.62224200000	4.94346840199	61	301.5516
B	Scrub Shrub	22921.04853440000	0.52619697472	66	34.729
Sum			9.48098349068		694.1033
Weighted CN					73.2

Basin ID: 29D

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	113097.72075900000	2.59637679411	55	142.8007
B	Impervious Surface	60188.15950240000	1.38173554306	95	131.2649
B	Open Space Developed	16464.85678450000	0.37798261350	61	23.05694
B	Scrub Shrub	10537.94968780000	0.24191900459	66	15.96665
Sum			4.59801395526		313.0892
Weighted CN					68.1

Basin ID: 29E

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Bare Land	1305.75470438000	0.02997612322	86	2.577947
B	Evergreen	369752.08174400000	8.48837375475	55	466.8606
B	Grassland	3663037.55178000000	84.09210752920	61	5129.619
B	Impervious Surface	314957.88475700000	7.23046704757	95	686.8944
B	Open Space Developed	358217.87086000000	8.22358364866	61	501.6386
B	Scrub Shrub	13999585.5445000000	321.38754690000	66	21211.58
Sum			429.45205500340		27999.17

Weighted CN 65.2

Basin ID: 30A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	462026.18702700000	10.60670420430	55	583.3687
B	Impervious Surface	808361.61036600000	18.55750330170	95	1762.963
B	Open Space Developed	557823.90189600000	12.80592592280	61	781.1615
B	Scrub Shrub	237640.75054100000	5.45550278024	66	360.0632
Sum			47.42563620904		3487.556

Weighted CN 73.5

Basin ID: 30B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	130442.25892600000	2.99455419415	55	164.7005
B	Impervious Surface	155397.02432000000	3.56743907048	95	338.9067
B	Open Space Developed	76394.91960560000	1.75379304835	61	106.9814
B	Scrub Shrub	63454.95779770000	1.45673121254	66	96.14426
Sum			9.77251752552		706.7328

Weighted CN 72.3

Basin ID: 30C

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	106704.88065400000	2.44961679234	55	134.7289
B	Impervious Surface	46365.93420680000	1.06441964351	95	101.1199
B	Open Space Developed	32066.72166610000	0.73615357974	61	44.90537
B	Scrub Shrub	15652.44454360000	0.35933212015	66	23.71592
Sum			4.60952213573		304.4701

Weighted CN 66.1

Basin ID: 30D

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	73312.59724950000	1.68303238064	55	92.56678
B	Impervious Surface	96344.63917680000	2.21177742324	95	210.1189
B	Open Space Developed	77086.91501520000	1.76967914058	61	107.9504
B	Scrub Shrub	12927.68210510000	0.29677993150	66	19.58748
Sum			5.96126887596		430.2235

Weighted CN 72.2

Basin ID: 30E

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	201850.62024800000	4.63387115823	55	254.8629
B	Impervious Surface	275122.62581400000	6.31597167832	95	600.0173
B	Open Space Developed	209485.29666900000	4.80913991305	61	293.3575
B	Scrub Shrub	62979.11644860000	1.44580735459	66	95.42329
Sum			17.20479010419		1243.661

Weighted CN 72.3

Basin ID: 30F

HSG	Class_name	Area_ac	Area_ac	CN	AreaxCN
B	Evergreen	0.86402368462	0.86402022853	55	47.52111
B	Impervious Surface	1.56250787610	1.56250162607	95	148.4377
B	Open Space Developed	1.14919348671	1.14918888994	61	70.10052
B	Scrub Shrub	0.03623623598	0.03623609104	66	2.391582
Sum			3.61194683557		268.4509

Weighted CN 74.3

Basin ID: 30G

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	67357.79656110000	1.54632842041	55	85.04806
B	Impervious Surface	110379.48154100000	2.53397435859	95	240.7276
B	Open Space Developed	37841.56155690000	0.86872619200	61	52.9923
B	Scrub Shrub	40881.02815940000	0.93850302305	66	61.9412
Sum			5.88753199405		440.7091

Weighted CN 74.9

Basin ID: 30H

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	78707.84557010000	1.80689073467	55	99.37899
B	Impervious Surface	105296.56320300000	2.41728614303	95	229.6422
B	Open Space Developed	69172.25138570000	1.58798273819	61	96.86695
B	Scrub Shrub	36052.77219370000	0.82766107450	66	54.62563
Sum			6.63982069039		480.5138

Weighted CN 72.4

Basin ID: 30I

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	17620.84833900000	0.40452100000	55	22.24866
B	Impervious Surface	16976.65322600000	0.38973200000	95	37.02454
B	Open Space Developed	3407.72424400000	0.07823100000	61	4.772091
B	Scrub Shrub	16765.60650900000	0.38488700000	66	25.40254
Sum			1.25737100000		89.44783

Weighted CN 71.1

Basin ID: 30J

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	40469.39800830000	0.92905325726	55	51.09793
B	Impervious Surface	64738.48554710000	1.48619707304	95	141.1887
B	Open Space Developed	48735.63989740000	1.11882081820	61	68.24807
B	Scrub Shrub	1136.10959564000	0.02608159183	66	1.721385
Sum			3.56015274033		262.2561

Weighted CN 73.7

Basin ID: 30K

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Bare Land	1300.65310268000	0.02985900609	86	2.567875
B	Evergreen	119738.00874800000	2.74881744035	55	151.185
B	Grassland	48175.14976840000	1.10595368387	61	67.46317
B	Impervious Surface	154151.86181700000	3.53885395836	95	336.1911
B	Open Space Developed	44160.27145430000	1.01378439155	61	61.84085
B	Scrub Shrub	151294.14349000000	3.47324951029	66	229.2345
Sum			11.91051799051		848.4825

Weighted CN 71.2

Basin ID: 30L

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
A	Bare Land	1874.45371899000	0.04303170838	77	3.313442
A	Evergreen	2049422.23209000000	47.04844880170	25	1176.211
A	Grassland	2259686.87445000000	51.87548010150	36	1867.517
A	Impervious Surface	195385.33270200000	4.48544798544	95	426.1176
A	Open Space Developed	250979.04491400000	5.76170911003	39	224.7067
A	Pasture/Hay	10978861.54650000000	252.04098856900	39	9829.599
A	Scrub Shrub	3078872.82990000000	70.68147716790	45	3180.666
B	Bare Land	55968.48187460000	1.28486468662	86	110.4984
B	Cultivated Land	48801.94524980000	1.12034298573	71	79.54435
B	Evergreen	3638373.85447000000	83.52590468340	55	4593.925
B	Grassland	7265025.68451000000	166.78270763800	61	10173.75
B	Impervious Surface	878482.96798700000	20.16727460810	95	1915.891
B	Open Space Developed	1366217.53750000000	31.36416442580	61	1913.214
B	Pasture/Hay	27229386.22550000000	625.10319429300	61	38131.29
B	Scrub Shrub	16175418.42420000000	371.33799646700	66	24508.31
C	Evergreen	102474.63005300000	2.35250321287	70	164.6752
C	Grassland	201942.73899200000	4.63598592206	74	343.063
C	Scrub Shrub	3360706.16118000000	77.15150606170	77	5940.666
D	Evergreen	53513.58761190000	1.22850784359	77	94.5951
D	Pasture/Hay	886262.19897400000	20.34586189240	80	1627.669
D	Scrub Shrub	2105.66851448000	0.04833969094	83	4.012194
Sum			1838.38573785515		106309.2
Weighted CN					57.8

Basin ID: 30M

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	89689.38569900000	2.05899321528	55	113.2446
B	Grassland	99579.80106640000	2.28604681788	61	139.4489
B	Impervious Surface	105885.25997300000	2.43080081532	95	230.9261
B	Open Space Developed	33607.78808780000	0.77153173828	61	47.06344
B	Scrub Shrub	1005985.91898000000	23.09435130700	66	1524.227
Sum			30.64172389376		2054.91
Weighted CN					67.1

Basin ID: 30N

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	40291.12246930000	0.92496059766	55	50.87283
B	Grassland	78995.21404240000	1.81348783343	61	110.6228
B	Impervious Surface	29462.84471520000	0.67637655112	95	64.25577
B	Open Space Developed	7773.25135356000	0.17845001025	61	10.88545
B	Scrub Shrub	1831826.80556000000	42.05312518100	66	2775.506
C	Scrub Shrub	1131592.34364000000	25.97788957820	77	2000.297
Sum			71.62428975167		5012.441
Weighted CN					70.0

Basin ID: 30O

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	4.19943164939	4.19943164939	55	230.9687
B	Impervious Surface	2.85335316779	2.85335316779	95	271.0686
B	Open Space Developed	0.36187343368	0.36187343368	61	22.07428
B	Scrub Shrub	0.99291198524	0.99291198524	66	65.53219
Sum			8.40757023610		589.6438
Weighted CN					70.1

Basin ID: 31A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	83411.21181900000	1.91486559837	55	105.3176
B	Impervious Surface	44893.60460650000	1.03061947157	95	97.90885
B	Open Space Developed	9539.64742568000	0.21900104647	61	13.35906
B	Scrub Shrub	1672.28919121000	0.03839063086	66	2.533782
Sum			3.20287674728		219.1193
Weighted CN					68.4

Basin ID: 31B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	173623.37247500000	3.98586012329	55	219.2223
B	Impervious Surface	205075.04474500000	4.70789405527	95	447.2499
B	Open Space Developed	121167.04521100000	2.78162373464	61	169.679
B	Scrub Shrub	46491.71833670000	1.06730726134	66	70.44228
Sum			12.54268517454		906.5936

Weighted CN 72.3

Basin ID: 31C

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	53818.91983910000	1.23551733507	55	67.95345
B	Impervious Surface	71251.44273350000	1.63571459459	95	155.3929
B	Open Space Developed	39142.03590740000	0.89858109449	61	54.81345
B	Scrub Shrub	9585.84687955000	0.22006164424	66	14.52407
Sum			3.98987466839		292.6839

Weighted CN 73.4

Basin ID: 31D

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	226151.13515500000	5.19173645001	55	285.5455
B	Impervious Surface	275267.92816700000	6.31930737470	95	600.3342
B	Open Space Developed	186403.34669000000	4.27924913466	61	261.0342
B	Scrub Shrub	39584.86644150000	0.90874712538	66	59.97731
Sum			16.69904008475		1206.891

Weighted CN 72.3

Basin ID: 31E

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	167885.91152900000	3.85414561696	55	211.978
B	Impervious Surface	176688.87409800000	4.05623463856	95	385.3423
B	Open Space Developed	160398.76501100000	3.68226369623	61	224.6181
B	Scrub Shrub	34055.36368140000	0.78180670118	66	51.59924
Sum			12.37445065293		873.5376

Weighted CN 70.6

Basin ID: 31F

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	61828.67288840000	1.41939669889	55	78.06682
B	Grassland	7872.03038347000	0.18071767382	61	11.02378
B	Impervious Surface	81523.96758490000	1.87154025899	95	177.7963
B	Open Space Developed	70849.16825630000	1.62647960638	61	99.21526
B	Scrub Shrub	588.66977977800	0.01351405267	66	0.891927
Sum			5.11164829076		366.9941

Weighted CN 71.8

Basin ID: 31G

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	21871.81716790000	0.50210984058	55	27.61604
B	Grassland	2015.19896224000	0.04626278749	61	2.82203
B	Impervious Surface	14034.25675170000	0.32218349148	95	30.60743
B	Open Space Developed	14853.00627100000	0.34097946931	61	20.79975
B	Scrub Shrub	479626.64013200000	11.01075662640	66	726.7099
Sum			12.22229221526		808.5552

Weighted CN 66.2

Basin ID: 31H

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	2040.49351844000	0.04684347292	55	2.576391
B	Impervious Surface	28026.03533820000	0.64339181457	95	61.12222
B	Open Space Developed	8150.71834822000	0.18711549475	61	11.41405
B	Scrub Shrub	26870.89971060000	0.61687344340	66	40.71365
Sum			1.49422422564		115.8263

Weighted CN 77.5

Basin ID: 31I

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	38386.73816850000	0.88124177493	55	48.4683
B	Impervious Surface	18766.81683140000	0.43082855599	95	40.92871
B	Open Space Developed	4278.44400164000	0.09821995215	61	5.991417
B	Scrub Shrub	8498.61464503000	0.19510212671	66	12.87674
Sum			1.60539240977		108.2652

Weighted CN 67.4

Basin ID: 31J

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	3823.11176407000	0.08776692049	55	4.827181
B	Grassland	142344.49716800000	3.26779307960	61	199.3354
B	Impervious Surface	26736.37186450000	0.61378509666	95	58.30958
B	Open Space Developed	19799.23105870000	0.45452962020	61	27.72631
B	Scrub Shrub	1227928.51488000000	28.18947260360	66	1860.505
C	Scrub Shrub	186995.96582100000	4.29285385232	77	330.5497
Sum			36.90620117287		2481.253

Weighted CN 67.2

Basin ID: 32A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	228136.66392900000	5.23731810097	55	288.0525
B	Impervious Surface	325380.29946200000	7.46973372330	95	709.6247
B	Open Space Developed	118518.88469700000	2.72083009124	61	165.9706
B	Scrub Shrub	90701.30966300000	2.08222388589	66	137.4268
Sum			17.51010580140		1301.075

Weighted CN 74.3

Basin ID: 32B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	8568.58277538000	0.19670838039	55	10.81896
B	Impervious Surface	8370.69366336000	0.19216545331	95	18.25572
B	Open Space Developed	17906.19657990000	0.41107135457	61	25.07535
B	Scrub Shrub	478.73114354500	0.01099019877	66	0.725353
Sum			0.81093538704		54.87538

Weighted CN 67.7

Basin ID: 33A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	232307.99712800000	5.33307911761	55	293.3194
B	Impervious Surface	268128.49403800000	6.15540786397	95	584.7637
B	Open Space Developed	113462.53221000000	2.60475174614	61	158.8899
B	Scrub Shrub	74500.30890260000	1.71029859745	66	112.8797
Sum			15.80353732517		1149.853

Weighted CN 72.8

Basin ID: 33B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	123457.54444500000	2.83420657200	55	155.8814
B	Impervious Surface	77385.30428340000	1.77652924301	95	168.7703
B	Open Space Developed	26456.63732040000	0.60736324948	61	37.04916
B	Scrub Shrub	55129.71261690000	1.26560911700	66	83.5302
Sum			6.48370818149		445.231

Weighted CN 68.7

Basin ID: 33C

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	86368.86777220000	1.98276430782	55	109.052
B	Impervious Surface	131821.43624500000	3.02621587539	95	287.4905
B	Open Space Developed	11938.91382630000	0.27408084440	61	16.71893
B	Scrub Shrub	22879.71435780000	0.52524806880	66	34.66637
Sum			5.80830909641		447.9278

Weighted CN 77.1

Basin ID: 33D

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	61373.90824990000	1.40895669757	55	77.49262
B	Grassland	41877.51252830000	0.96137924791	61	58.64413
B	Impervious Surface	81933.62253920000	1.88094468032	95	178.6897
B	Open Space Developed	38062.09964690000	0.87378907015	61	53.30113
B	Scrub Shrub	110757.18800300000	2.54264534053	66	167.8146
Sum			7.66771503648		535.9422
Weighted CN					69.9

Basin ID: 33E

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	80326.85281970000	1.84405817558	55	101.4232
B	Grassland	12704.68338729990	0.29166056488	61	17.79129
B	Impervious Surface	40940.47843090000	0.93986781895	95	89.28744
B	Open Space Developed	22582.96572580000	0.51843563035	61	31.62457
B	Scrub Shrub	33496.73040240000	0.76898219444	66	50.75282
Sum			4.36300438419		290.8793
Weighted CN					66.7

Basin ID: 33F

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
A	Evergreen	950477.02236800000	21.82003728850	25	545.5009
A	Grassland	1449435.47701000000	33.27459308480	39	1297.709
A	Impervious Surface	21154.17516990000	0.48563498133	95	46.13532
A	Pasture/Hay	3376940.57950000000	77.52419851470	39	3023.444
A	Scrub Shrub	2255044.41605000000	51.76890349520	45	2329.601
B	Evergreen	514301.75595500000	11.80679093590	55	649.3735
B	Grassland	4820326.59154000000	110.65991443800	61	6750.255
B	Impervious Surface	94936.25999210000	2.17944535671	95	207.0473
B	Open Space Developed	26711.58192010000	0.61321599556	61	37.40618
B	Pasture/Hay	11116718.4886000000	255.20576114800	61	15567.55
B	Scrub Shrub	4099273.92385000000	94.10675668040	66	6211.046
C	Evergreen	13182.26120490000	0.30262428683	70	21.1837
C	Grassland	72738.37973730000	1.66985010771	74	123.5689
C	Scrub Shrub	3003905.35119000000	68.96045378430	77	5309.955
Sum			730.37818009794		42119.78
Weighted CN					57.7

Basin ID: 34A

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Bare Land	14059.47167370000	0.32276234876	86	27.75756
B	Evergreen	1092809.37381000000	25.08755153940	55	1379.815
B	Grassland	12202127.3078000000	280.12341865200	61	17087.53
B	Impervious Surface	884378.42827400000	20.30261629470	95	1928.749
B	Open Space Developed	526747.81362900000	12.09251424760	61	737.6434
B	Pasture/Hay	7882406.53364000000	180.95587840600	61	11038.31
B	Scrub Shrub	16902972.1299000000	388.04039811700	66	25610.67
Sum			906.92513960546		57810.47

Weighted CN 63.7

Basin ID: 34B

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	53789.77024660000	1.23484814982	55	67.91665
B	Grassland	16667.79844720000	0.38264153165	61	23.34113
B	Impervious Surface	44825.03053160000	1.02904522113	95	97.7593
B	Open Space Developed	7692.68671161000	0.17660049317	61	10.77263
B	Scrub Shrub	37972.81677220000	0.87173940918	66	57.5348
Sum			3.69487480495		257.3245

Weighted CN 69.6

Basin ID: 34C

HSG	Class_name	Area_ft2	Area_ac	CN	AreaxCN
B	Evergreen	10384.43461100000	0.23839476926	55	13.11171
B	Grassland	192179.13577200000	4.41184353743	61	269.1225
B	Impervious Surface	31394.73146150000	0.72072674566	95	68.46904
B	Open Space Developed	21312.10915540000	0.48926066125	61	29.8449
B	Scrub Shrub	2951819.07980000000	67.76471274360	66	4472.471
Sum			73.62493845719		4853.019

Weighted CN 65.9

Maui Meadows Subdivision Drainage Master Plan
Existing Condition - Weighted C

REF: 1-20258-0E
PREPARED BY: IL
DATE: 8/21/2018

Basin ID: 26A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	156138.93498800000	3.58445672608	0.3	1.075337
B	Grassland	203018.52861000000	4.66066410950	0.3	1.398199
B	Impervious Surface	249121.24346100000	5.71903681040	0.95	5.433085
B	Open Space Developed	119171.59109200000	2.73580328494	0.55	1.504692
B	Scrub Shrub	28076.84457930000	0.64455566068	0.3	0.193367
Sum			17.34451659160		9.60468

Weighted C 0.55

Basin ID: 26B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	74755.52880860000	1.71615766372	0.3	0.514847
B	Grassland	3036596.39970000000	69.71093999350	0.3	20.91328
B	Impervious Surface	73091.63564840000	1.67795977998	0.95	1.594062
B	Open Space Developed	38761.46451660000	0.88984434258	0.55	0.489414
B	Scrub Shrub	70559.21037370000	1.61982306270	0.3	0.485947
Sum			75.61472484248		23.99755

Weighted C 0.32

Basin ID: 27A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	24875.48391900000	0.57106500000	0.3	0.17132
B	Impervious Surface	67979.61332800000	1.56060300000	0.95	1.482573
B	Open Space Developed	28251.89162900000	0.64857700000	0.55	0.356717
B	Scrub Shrub	37492.84818300000	0.86072100000	0.3	0.258216
Sum			3.64096600000		2.268826

Weighted C 0.62

Basin ID: 27B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	43599.62689980000	1.00091371209	0.3	0.300274
B	Impervious Surface	111647.23247500000	2.56307803179	0.95	2.434924
B	Open Space Developed	70697.69427900000	1.62300222844	0.55	0.892651
B	Scrub Shrub	67.39992217610	0.00154729550	0.3	0.000464
Sum			5.18854126782		3.628314

Weighted C 0.70

Basin ID: 27C

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	109378.12531200000	2.51098629076	0.3	0.753296
B	Grassland	422561.09580700000	9.70070675060	0.3	2.910212
B	Impervious Surface	139250.67611000000	3.19676843696	0.95	3.03693
B	Open Space Developed	80603.08484350000	1.85039961563	0.55	1.01772
B	Scrub Shrub	28663.06803580000	0.65801613151	0.3	0.197405
Sum			17.91687722546		7.915563

Weighted C 0.44

Basin ID: 27D

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	24973.41825750000	0.00224800000	0.3	0.000674
B	Impervious Surface	94993.82555520000	0.62016300000	0.95	0.589155
B	Open Space Developed	55551.35660570000	0.62671200000	0.55	0.344692
B	Scrub Shrub	41857.35986060000	0.10019600000	0.3	0.030059
Sum			1.34931900000		0.96458

Weighted C 0.71

Basin ID: 28A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	16290.97162950000	0.37399074365	0.3	0.112197
B	Impervious Surface	72852.97263030000	1.67248080907	0.95	1.588857
B	Open Space Developed	49676.77418870000	1.14042637503	0.55	0.627235
B	Scrub Shrub	4192.66037599000	0.09625062320	0.3	0.028875
Sum			3.28314855096		2.357164

Weighted C 0.72

Basin ID: 28B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	183677.78625100000	4.21667862636	0.3	1.265004
B	Grassland	6755.32277001000	0.15508149200	0.3	0.046524
B	Impervious Surface	359791.55762100000	8.25971067014	0.95	7.846725
B	Open Space Developed	155855.68591800000	3.57796853404	0.55	1.967883
B	Scrub Shrub	15188.38866110000	0.34867882036	0.3	0.104604
Sum			16.55811814290		11.23074

Weighted C 0.68

Basin ID: 29A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Bare Land	3840.07487728000	0.08815634154	0.3	0.026447
B	Evergreen	104664.47163200000	2.40277525922	0.3	0.720833
B	Impervious Surface	175305.12880000000	4.02446809052	0.95	3.823245
B	Open Space Developed	132666.45833100000	3.04561499079	0.55	1.675088
B	Scrub Shrub	56201.00631340000	1.29020273458	0.3	0.387061
Sum			10.85121741665		6.632673
Weighted C					0.61

Basin ID: 29B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Bare Land	15726.59897610000	0.36103447848	0.3	0.10831
B	Evergreen	296540.37086300000	6.80765741571	0.3	2.042297
B	Grassland	112219.48413100000	2.57621517471	0.3	0.772865
B	Impervious Surface	378563.61391000000	8.69065950801	0.95	8.256127
B	Open Space Developed	226099.37941000000	5.19054829685	0.55	2.854802
B	Scrub Shrub	200748.06333400000	4.60855983308	0.3	1.382568
Sum			28.23467470684		15.41697
Weighted C					0.55

Basin ID: 29C

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	25321.87489790000	0.58131258461	0.3	0.174394
B	Impervious Surface	149410.44321500000	3.43000552936	0.95	3.258505
B	Open Space Developed	215336.62224200000	4.94346840199	0.55	2.718908
B	Scrub Shrub	22921.04853440000	0.52619697472	0.3	0.157859
Sum			9.48098349068		6.309666
Weighted C					0.67

Basin ID: 29D

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	113097.72075900000	2.59637679411	0.3	0.778913
B	Impervious Surface	60188.15950240000	1.38173554306	0.95	1.312649
B	Open Space Developed	16464.85678450000	0.37798261350	0.55	0.20789
B	Scrub Shrub	10537.94968780000	0.24191900459	0.3	0.072576
Sum			4.59801395526		2.372028
Weighted C					0.52

Basin ID: 29E

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Bare Land	1305.75470438000	0.02997612322	0.3	0.008993
B	Evergreen	369752.08174400000	8.48837375475	0.3	2.546512
B	Grassland	3663037.55178000000	84.09210752920	0.3	25.22763
B	Impervious Surface	314957.88475700000	7.23046704757	0.95	6.868944
B	Open Space Developed	358217.87086000000	8.22358364866	0.55	4.522971
B	Scrub Shrub	13999585.5445000000	321.38754690000	0.3	96.41626
Sum			429.45205500340		135.5913

Weighted C 0.32

Basin ID: 30A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	462026.18702700000	10.60670420430	0.3	3.182011
B	Impervious Surface	808361.61036600000	18.55750330170	0.95	17.62963
B	Open Space Developed	557823.90189600000	12.80592592280	0.55	7.043259
B	Scrub Shrub	237640.75054100000	5.45550278024	0.3	1.636651
Sum			47.42563620904		29.49155

Weighted C 0.62

Basin ID: 30B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	130442.25892600000	2.99455419415	0.3	0.898366
B	Impervious Surface	155397.02432000000	3.56743907048	0.95	3.389067
B	Open Space Developed	76394.91960560000	1.75379304835	0.55	0.964586
B	Scrub Shrub	63454.95779770000	1.45673121254	0.3	0.437019
Sum			9.77251752552		5.689039

Weighted C 0.58

Basin ID: 30C

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	106704.88065400000	2.44961679234	0.3	0.734885
B	Impervious Surface	46365.93420680000	1.06441964351	0.95	1.011199
B	Open Space Developed	32066.72166610000	0.73615357974	0.55	0.404884
B	Scrub Shrub	15652.44454360000	0.35933212015	0.3	0.1078
Sum			4.60952213573		2.258768

Weighted C 0.49

Basin ID: 30D

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	73312.59724950000	1.68303238064	0.3	0.50491
B	Impervious Surface	96344.63917680000	2.21177742324	0.95	2.101189
B	Open Space Developed	77086.91501520000	1.76967914058	0.55	0.973324
B	Scrub Shrub	12927.68210510000	0.29677993150	0.3	0.089034
Sum			5.96126887596		3.668456

Weighted C 0.62

Basin ID: 30E

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	201850.62024800000	4.63387115823	0.3	1.390161
B	Impervious Surface	275122.62581400000	6.31597167832	0.95	6.000173
B	Open Space Developed	209485.29666900000	4.80913991305	0.55	2.645027
B	Scrub Shrub	62979.11644860000	1.44580735459	0.3	0.433742
Sum			17.20479010419		10.4691

Weighted C 0.61

Basin ID: 30F

HSG	Class_name	Area_ac	Area_ac	C	AreaxC
B	Evergreen	0.86402368462	0.86402022853	0.3	0.259206
B	Impervious Surface	1.56250787610	1.56250162607	0.95	1.484377
B	Open Space Developed	1.14919348671	1.14918888994	0.55	0.632054
B	Scrub Shrub	0.03623623598	0.03623609104	0.3	0.010871
Sum			3.61194683557		2.386507

Weighted C 0.66

Basin ID: 30G

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	67357.79656110000	1.54632842041	0.3	0.463899
B	Impervious Surface	110379.48154100000	2.53397435859	0.95	2.407276
B	Open Space Developed	37841.56155690000	0.86872619200	0.55	0.477799
B	Scrub Shrub	40881.02815940000	0.93850302305	0.3	0.281551
Sum			5.88753199405		3.630524

Weighted C 0.62

Basin ID: 30H

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	78707.84557010000	1.80689073467	0.3	0.542067
B	Impervious Surface	105296.56320300000	2.41728614303	0.95	2.296422
B	Open Space Developed	69172.25138570000	1.58798273819	0.55	0.873391
B	Scrub Shrub	36052.77219370000	0.82766107450	0.3	0.248298
Sum			6.63982069039		3.960178

Weighted C 0.60

Basin ID: 30I

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	17620.84833900000	0.40452100000	0.3	0.121356
B	Impervious Surface	16976.65322600000	0.38973200000	0.95	0.370245
B	Open Space Developed	3407.72424400000	0.07823100000	0.55	0.043027
B	Scrub Shrub	16765.60650900000	0.38488700000	0.3	0.115466
Sum			1.25737100000		0.650095

Weighted C 0.52

Basin ID: 30J

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	40469.39800830000	0.92905325726	0.3	0.278716
B	Impervious Surface	64738.48554710000	1.48619707304	0.95	1.411887
B	Open Space Developed	48735.63989740000	1.11882081820	0.55	0.615351
B	Scrub Shrub	1136.10959564000	0.02608159183	0.3	0.007824
Sum			3.56015274033		2.313779

Weighted C 0.65

Basin ID: 30K

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Bare Land	1300.65310268000	0.02985900609	0.3	0.008958
B	Evergreen	119738.00874800000	2.74881744035	0.3	0.824645
B	Grassland	48175.14976840000	1.10595368387	0.3	0.331786
B	Impervious Surface	154151.86181700000	3.53885395836	0.95	3.361911
B	Open Space Developed	44160.27145430000	1.01378439155	0.55	0.557581
B	Scrub Shrub	151294.14349000000	3.47324951029	0.3	1.041975
Sum			11.91051799051		6.126857

Weighted C 0.51

Basin ID: 30L

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
A	Bare Land	1874.45371899000	0.04303170838	0.3	0.01291
A	Evergreen	2049422.23209000000	47.04844880170	0.3	14.11453
A	Grassland	2259686.87445000000	51.87548010150	0.3	15.56264
A	Impervious Surface	195385.33270200000	4.48544798544	0.95	4.261176
A	Open Space Developed	250979.04491400000	5.76170911003	0.55	3.16894
A	Pasture/Hay	10978861.54650000000	252.04098856900	0.3	75.6123
A	Scrub Shrub	3078872.82990000000	70.68147716790	0.3	21.20444
B	Bare Land	55968.48187460000	1.28486468662	0.3	0.385459
B	Cultivated Land	48801.94524980000	1.12034298573	0.3	0.336103
B	Evergreen	3638373.85447000000	83.52590468340	0.3	25.05777
B	Grassland	7265025.68451000000	166.78270763800	0.3	50.03481
B	Impervious Surface	878482.96798700000	20.16727460810	0.95	19.15891
B	Open Space Developed	1366217.53750000000	31.36416442580	0.55	17.25029
B	Pasture/Hay	27229386.22550000000	625.10319429300	0.3	187.531
B	Scrub Shrub	16175418.42420000000	371.33799646700	0.3	111.4014
C	Evergreen	102474.63005300000	2.35250321287	0.3	0.705751
C	Grassland	201942.73899200000	4.63598592206	0.3	1.390796
C	Scrub Shrub	3360706.16118000000	77.15150606170	0.3	23.14545
D	Evergreen	53513.58761190000	1.22850784359	0.3	0.368552
D	Pasture/Hay	886262.19897400000	20.34586189240	0.3	6.103759
D	Scrub Shrub	2105.66851448000	0.04833969094	0.3	0.014502
Sum			1838.38573785515		576.8215
Weighted C					0.31

Basin ID: 30M

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	89689.38569900000	2.05899321528	0.3	0.617698
B	Grassland	99579.80106640000	2.28604681788	0.3	0.685814
B	Impervious Surface	105885.25997300000	2.43080081532	0.95	2.309261
B	Open Space Developed	33607.78808780000	0.77153173828	0.55	0.424342
B	Scrub Shrub	1005985.91898000000	23.09435130700	0.3	6.928305
Sum			30.64172389376		10.96542
Weighted C					0.36

Basin ID: 30N

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	40291.12246930000	0.92496059766	0.3	0.277488
B	Grassland	78995.21404240000	1.81348783343	0.3	0.544046
B	Impervious Surface	29462.84471520000	0.67637655112	0.95	0.642558
B	Open Space Developed	7773.25135356000	0.17845001025	0.55	0.098148
B	Scrub Shrub	1831826.80556000000	42.05312518100	0.3	12.61594
C	Scrub Shrub	1131592.34364000000	25.97788957820	0.3	7.793367
Sum			71.62428975167		21.97154

Weighted C 0.31

Basin ID: 30O

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	4.19943164939	4.19943164939	0.3	1.259829
B	Impervious Surface	2.85335316779	2.85335316779	0.95	2.710686
B	Open Space Developed	0.36187343368	0.36187343368	0.55	0.19903
B	Scrub Shrub	0.99291198524	0.99291198524	0.3	0.297874
Sum			8.40757023610		4.467419

Weighted C 0.53

Basin ID: 31A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	83411.21181900000	1.91486559837	0.3	0.57446
B	Impervious Surface	44893.60460650000	1.03061947157	0.95	0.979088
B	Open Space Developed	9539.64742568000	0.21900104647	0.55	0.120451
B	Scrub Shrub	1672.28919121000	0.03839063086	0.3	0.011517
Sum			3.20287674728		1.685516

Weighted C 0.53

Basin ID: 31B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	173623.37247500000	3.98586012329	0.3	1.195758
B	Impervious Surface	205075.04474500000	4.70789405527	0.95	4.472499
B	Open Space Developed	121167.04521100000	2.78162373464	0.55	1.529893
B	Scrub Shrub	46491.71833670000	1.06730726134	0.3	0.320192
Sum			12.54268517454		7.518343

Weighted C 0.60

Basin ID: 31C

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	53818.91983910000	1.23551733507	0.3	0.370655
B	Impervious Surface	71251.44273350000	1.63571459459	0.95	1.553929
B	Open Space Developed	39142.03590740000	0.89858109449	0.55	0.49422
B	Scrub Shrub	9585.84687955000	0.22006164424	0.3	0.066018
Sum			3.98987466839		2.484822

Weighted C 0.62

Basin ID: 31D

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	226151.13515500000	5.19173645001	0.3	1.557521
B	Impervious Surface	275267.92816700000	6.31930737470	0.95	6.003342
B	Open Space Developed	186403.34669000000	4.27924913466	0.55	2.353587
B	Scrub Shrub	39584.86644150000	0.90874712538	0.3	0.272624
Sum			16.69904008475		10.18707

Weighted C 0.61

Basin ID: 31E

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	167885.91152900000	3.85414561696	0.3	1.156244
B	Impervious Surface	176688.87409800000	4.05623463856	0.95	3.853423
B	Open Space Developed	160398.76501100000	3.68226369623	0.55	2.025245
B	Scrub Shrub	34055.36368140000	0.78180670118	0.3	0.234542
Sum			12.37445065293		7.269454

Weighted C 0.59

Basin ID: 31F

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	61828.67288840000	1.41939669889	0.3	0.425819
B	Grassland	7872.03038347000	0.18071767382	0.3	0.054215
B	Impervious Surface	81523.96758490000	1.87154025899	0.95	1.777963
B	Open Space Developed	70849.16825630000	1.62647960638	0.55	0.894564
B	Scrub Shrub	588.66977977800	0.01351405267	0.3	0.004054
Sum			5.11164829076		3.156616

Weighted C 0.62

Basin ID: 31G

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	21871.81716790000	0.50210984058	0.3	0.150633
B	Grassland	2015.19896224000	0.04626278749	0.3	0.013879
B	Impervious Surface	14034.25675170000	0.32218349148	0.95	0.306074
B	Open Space Developed	14853.00627100000	0.34097946931	0.55	0.187539
B	Scrub Shrub	479626.64013200000	11.01075662640	0.3	3.303227
Sum			12.22229221526		3.961352

Weighted C 0.32

Basin ID: 31H

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	2040.49351844000	0.04684347292	0.3	0.014053
B	Impervious Surface	28026.03533820000	0.64339181457	0.95	0.611222
B	Open Space Developed	8150.71834822000	0.18711549475	0.55	0.102914
B	Scrub Shrub	26870.89971060000	0.61687344340	0.3	0.185062
Sum			1.49422422564		0.913251

Weighted C 0.61

Basin ID: 31I

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	38386.73816850000	0.88124177493	0.3	0.264373
B	Impervious Surface	18766.81683140000	0.43082855599	0.95	0.409287
B	Open Space Developed	4278.44400164000	0.09821995215	0.55	0.054021
B	Scrub Shrub	8498.61464503000	0.19510212671	0.3	0.058531
Sum			1.60539240977		0.786211

Weighted C 0.49

Basin ID: 31J

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	3823.11176407000	0.08776692049	0.3	0.02633
B	Grassland	142344.49716800000	3.26779307960	0.3	0.980338
B	Impervious Surface	26736.37186450000	0.61378509666	0.95	0.583096
B	Open Space Developed	19799.23105870000	0.45452962020	0.55	0.249991
B	Scrub Shrub	1227928.51488000000	28.18947260360	0.3	8.456842
C	Scrub Shrub	186995.96582100000	4.29285385232	0.3	1.287856
Sum			36.90620117287		11.58445

Weighted C 0.31

Basin ID: 32A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	228136.66392900000	5.23731810097	0.3	1.571195
B	Impervious Surface	325380.29946200000	7.46973372330	0.95	7.096247
B	Open Space Developed	118518.88469700000	2.72083009124	0.55	1.496457
B	Scrub Shrub	90701.30966300000	2.08222388589	0.3	0.624667
Sum			17.51010580140		10.78857

Weighted C 0.62

Basin ID: 32B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	8568.58277538000	0.19670838039	0.3	0.059013
B	Impervious Surface	8370.69366336000	0.19216545331	0.95	0.182557
B	Open Space Developed	17906.19657990000	0.41107135457	0.55	0.226089
B	Scrub Shrub	478.73114354500	0.01099019877	0.3	0.003297
Sum			0.81093538704		0.470956

Weighted C 0.58

Basin ID: 33A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	232307.99712800000	5.33307911761	0.3	1.599924
B	Impervious Surface	268128.49403800000	6.15540786397	0.95	5.847637
B	Open Space Developed	113462.53221000000	2.60475174614	0.55	1.432613
B	Scrub Shrub	74500.30890260000	1.71029859745	0.3	0.51309
Sum			15.80353732517		9.393264

Weighted C 0.59

Basin ID: 33B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	123457.54444500000	2.83420657200	0.3	0.850262
B	Impervious Surface	77385.30428340000	1.77652924301	0.95	1.687703
B	Open Space Developed	26456.63732040000	0.60736324948	0.55	0.33405
B	Scrub Shrub	55129.71261690000	1.26560911700	0.3	0.379683
Sum			6.48370818149		3.251697

Weighted C 0.50

Basin ID: 33C

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	86368.86777220000	1.98276430782	0.3	0.594829
B	Impervious Surface	131821.43624500000	3.02621587539	0.95	2.874905
B	Open Space Developed	11938.91382630000	0.27408084440	0.55	0.150744
B	Scrub Shrub	22879.71435780000	0.52524806880	0.3	0.157574
Sum			5.80830909641		3.778053

Weighted C 0.65

Basin ID: 33D

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	61373.90824990000	1.40895669757	0.3	0.422687
B	Grassland	41877.51252830000	0.96137924791	0.3	0.288414
B	Impervious Surface	81933.62253920000	1.88094468032	0.95	1.786897
B	Open Space Developed	38062.09964690000	0.87378907015	0.55	0.480584
B	Scrub Shrub	110757.18800300000	2.54264534053	0.3	0.762794
Sum			7.66771503648		3.741376

Weighted C 0.49

Basin ID: 33E

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	80326.85281970000	1.84405817558	0.3	0.553217
B	Grassland	12704.68338729990	0.29166056488	0.3	0.087498
B	Impervious Surface	40940.47843090000	0.93986781895	0.95	0.892874
B	Open Space Developed	22582.96572580000	0.51843563035	0.55	0.28514
B	Scrub Shrub	33496.73040240000	0.76898219444	0.3	0.230695
Sum			4.36300438419		2.049424

Weighted C 0.47

Basin ID: 33F

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
A	Evergreen	950477.02236800000	21.82003728850	0.3	6.546011
A	Grassland	1449435.47701000000	33.27459308480	0.3	9.982378
A	Impervious Surface	21154.17516990000	0.48563498133	0.95	0.461353
A	Pasture/Hay	3376940.57950000000	77.52419851470	0.55	42.63831
A	Scrub Shrub	2255044.41605000000	51.76890349520	0.3	15.53067
B	Evergreen	514301.75595500000	11.80679093590	0.3	3.542037
B	Grassland	4820326.59154000000	110.65991443800	0.3	33.19797
B	Impervious Surface	94936.25999210000	2.17944535671	0.95	2.070473
B	Open Space Developed	26711.58192010000	0.61321599556	0.55	0.337269
B	Pasture/Hay	11116718.4886000000	255.20576114800	0.3	76.56173
B	Scrub Shrub	4099273.92385000000	94.10675668040	0.3	28.23203
C	Evergreen	13182.26120490000	0.30262428683	0.3	0.090787
C	Grassland	72738.37973730000	1.66985010771	0.3	0.500955
C	Scrub Shrub	3003905.35119000000	68.96045378430	0.3	20.68814
Sum			730.37818009794		240.3801

Weighted C 0.33

Basin ID: 34A

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Bare Land	14059.47167370000	0.32276234876	0.3	0.096829
B	Evergreen	1092809.37381000000	25.08755153940	0.3	7.526265
B	Grassland	12202127.3078000000	280.12341865200	0.3	84.03703
B	Impervious Surface	884378.42827400000	20.30261629470	0.95	19.28749
B	Open Space Developed	526747.81362900000	12.09251424760	0.55	6.650883
B	Pasture/Hay	7882406.53364000000	180.95587840600	0.3	54.28676
B	Scrub Shrub	16902972.1299000000	388.04039811700	0.3	116.4121
Sum			906.92513960546		288.2974
Weighted C					0.32

Basin ID: 34B

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	53789.77024660000	1.23484814982	0.3	0.370454
B	Grassland	16667.79844720000	0.38264153165	0.3	0.114792
B	Impervious Surface	44825.03053160000	1.02904522113	0.95	0.977593
B	Open Space Developed	7692.68671161000	0.17660049317	0.55	0.09713
B	Scrub Shrub	37972.81677220000	0.87173940918	0.3	0.261522
Sum			3.69487480495		1.821492
Weighted C					0.49

Basin ID: 34C

HSG	Class_name	Area_ft2	Area_ac	C	AreaxC
B	Evergreen	10384.43461100000	0.23839476926	0.3	0.071518
B	Grassland	192179.13577200000	4.41184353743	0.3	1.323553
B	Impervious Surface	31394.73146150000	0.72072674566	0.95	0.68469
B	Open Space Developed	21312.10915540000	0.48926066125	0.55	0.269093
B	Scrub Shrub	2951819.07980000000	67.76471274360	0.3	20.32941
Sum			73.62493845719		22.67827
Weighted C					0.31

APPENDIX B

HYDRAULIC CALCULATIONS

EXISTING CULVERT CAPACITY

Culvert Report

10-Kumulani Dr 11+41 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	649.70
Pipe Length (ft)	=	56.00
Slope (%)	=	4.11
Invert Elev Up (ft)	=	652.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

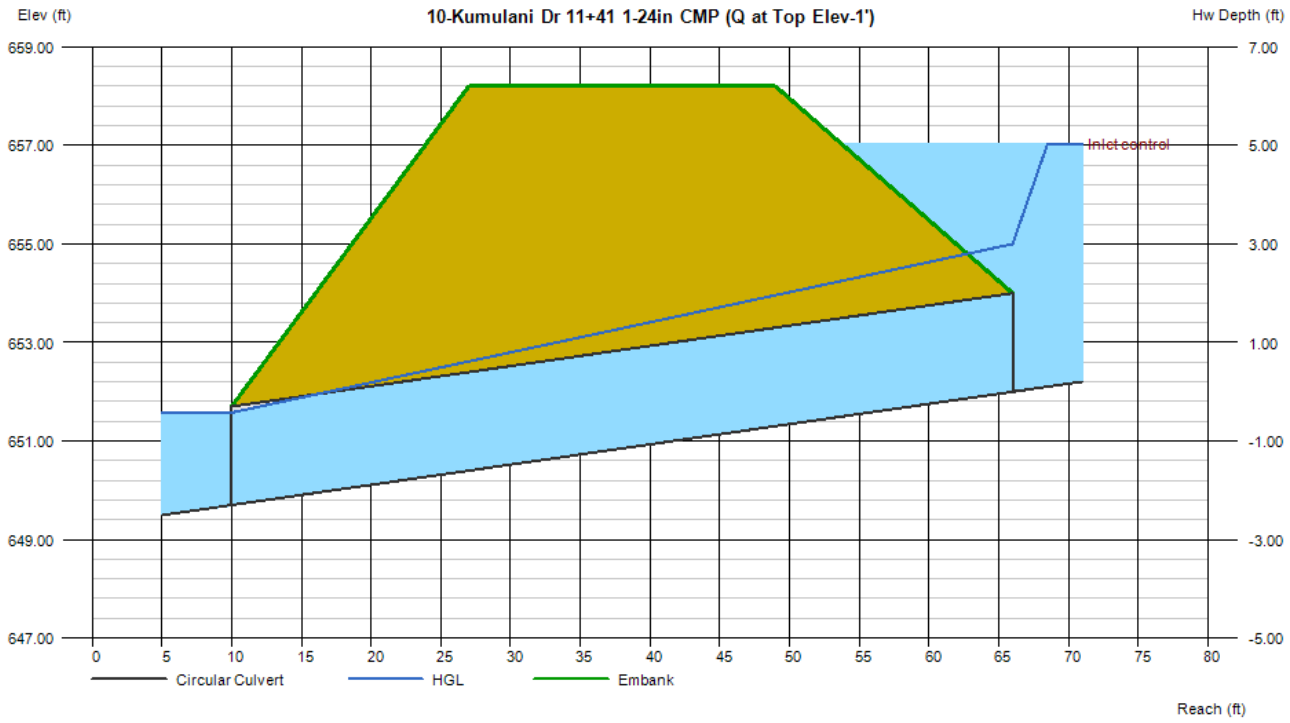
Top Elevation (ft)	=	658.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	31.00
Qmax (cfs)	=	31.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	31.00
Qpipe (cfs)	=	31.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.13
Veloc Up (ft/s)	=	9.87
HGL Dn (ft)	=	651.58
HGL Up (ft)	=	655.00
Hw Elev (ft)	=	657.03
Hw/D (ft)	=	2.51
Flow Regime	=	Inlet Control



Culvert Report

11-Kumulani Dr 17+46 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	640.00
Pipe Length (ft)	=	76.00
Slope (%)	=	6.84
Invert Elev Up (ft)	=	645.20
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

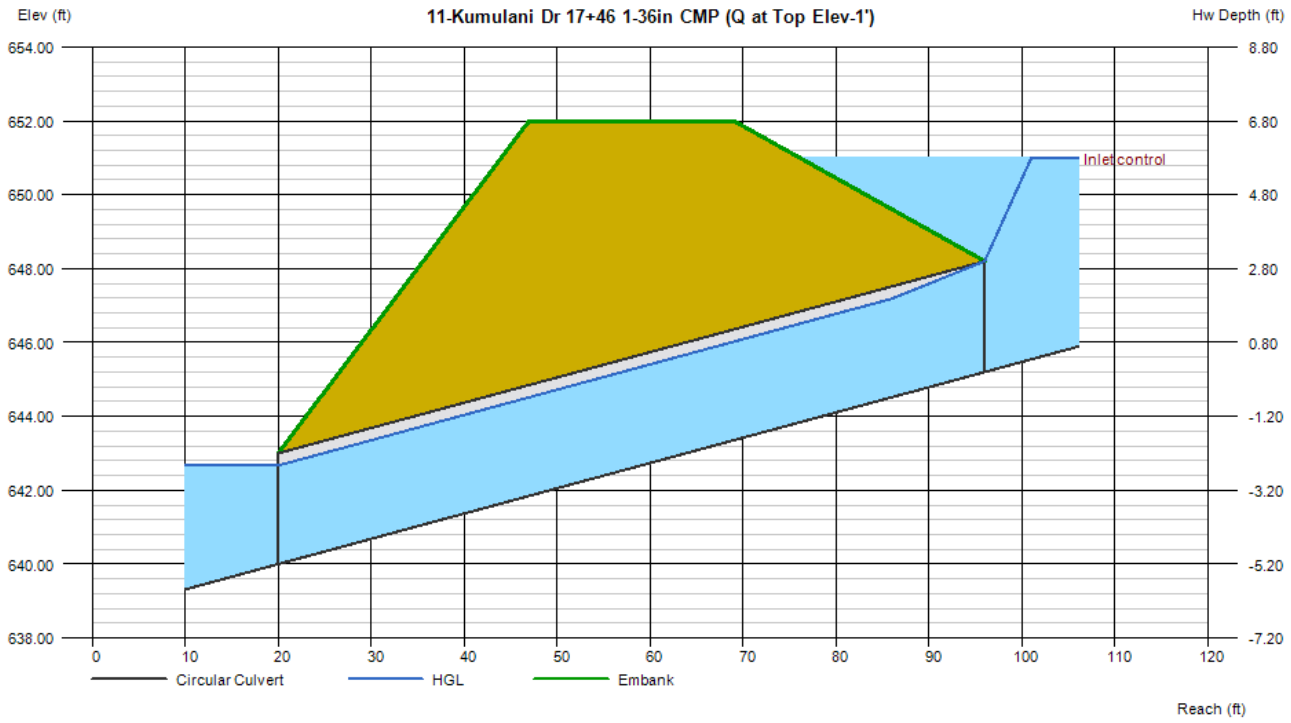
Top Elevation (ft)	=	652.00
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	71.00
Qmax (cfs)	=	71.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	71.00
Qpipe (cfs)	=	71.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.69
Veloc Up (ft/s)	=	10.69
HGL Dn (ft)	=	642.67
HGL Up (ft)	=	647.87
Hw Elev (ft)	=	650.99
Hw/D (ft)	=	1.93
Flow Regime	=	Inlet Control



Culvert Report

14-Nahenahe Pl 4+42 1-60in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	445.80
Pipe Length (ft)	=	75.00
Slope (%)	=	13.87
Invert Elev Up (ft)	=	456.20
Rise (in)	=	60.0
Shape	=	Circular
Span (in)	=	60.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

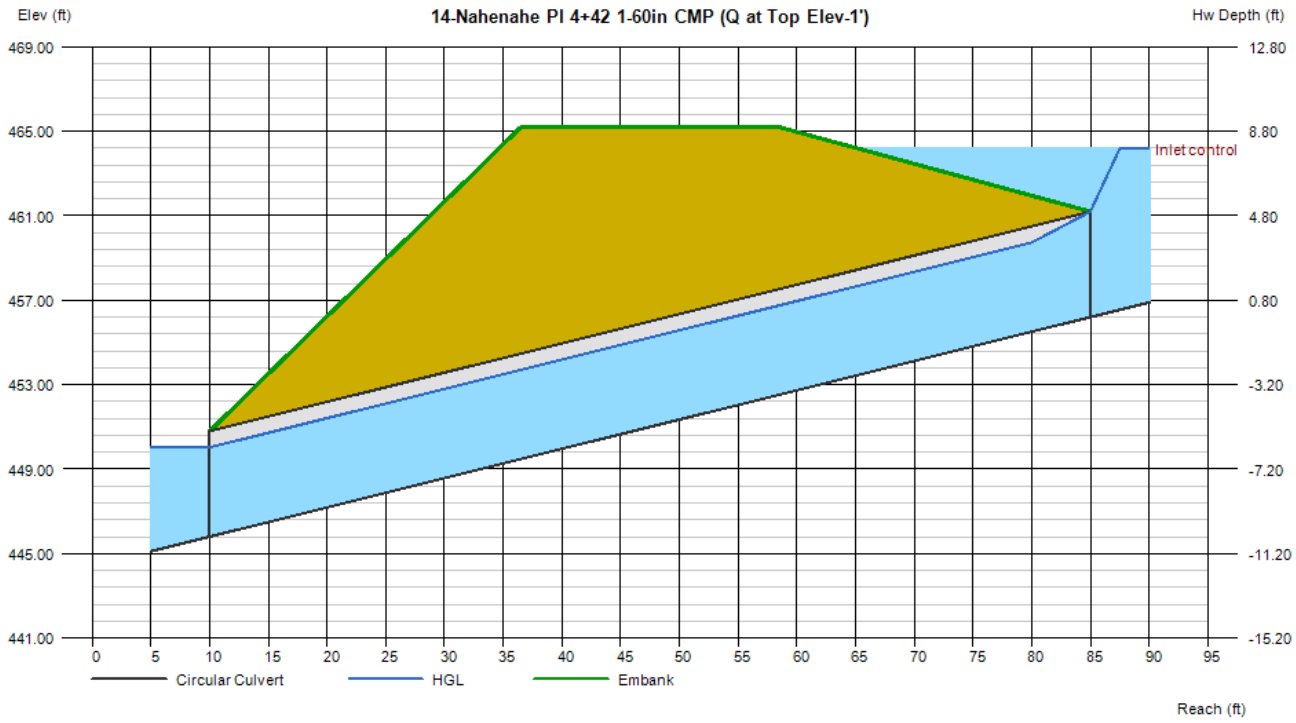
Top Elevation (ft)	=	465.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	223.00
Qmax (cfs)	=	223.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	223.00
Qpipe (cfs)	=	223.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	12.59
Veloc Up (ft/s)	=	12.59
HGL Dn (ft)	=	450.03
HGL Up (ft)	=	460.43
Hw Elev (ft)	=	464.19
Hw/D (ft)	=	1.60
Flow Regime	=	Inlet Control



Culvert Report

16-Keha Dr 10+62 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	511.60
Pipe Length (ft)	=	70.00
Slope (%)	=	8.29
Invert Elev Up (ft)	=	517.40
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

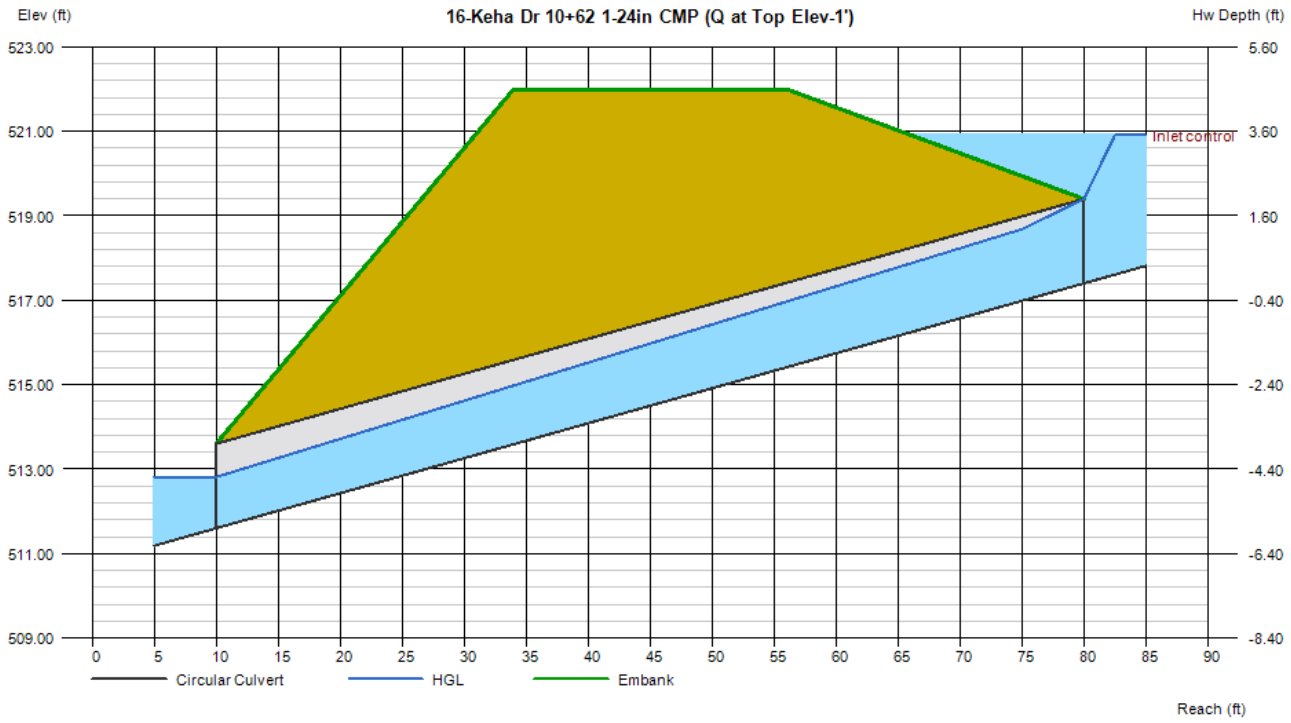
Top Elevation (ft)	=	522.00
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	24.00
Qmax (cfs)	=	24.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	24.00
Qpipe (cfs)	=	24.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	12.04
Veloc Up (ft/s)	=	8.29
HGL Dn (ft)	=	512.81
HGL Up (ft)	=	519.13
Hw Elev (ft)	=	520.91
Hw/D (ft)	=	1.75
Flow Regime	=	Inlet Control



Culvert Report

17-Keha Dr 18+84 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	487.10
Pipe Length (ft)	=	68.00
Slope (%)	=	16.76
Invert Elev Up (ft)	=	498.50
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

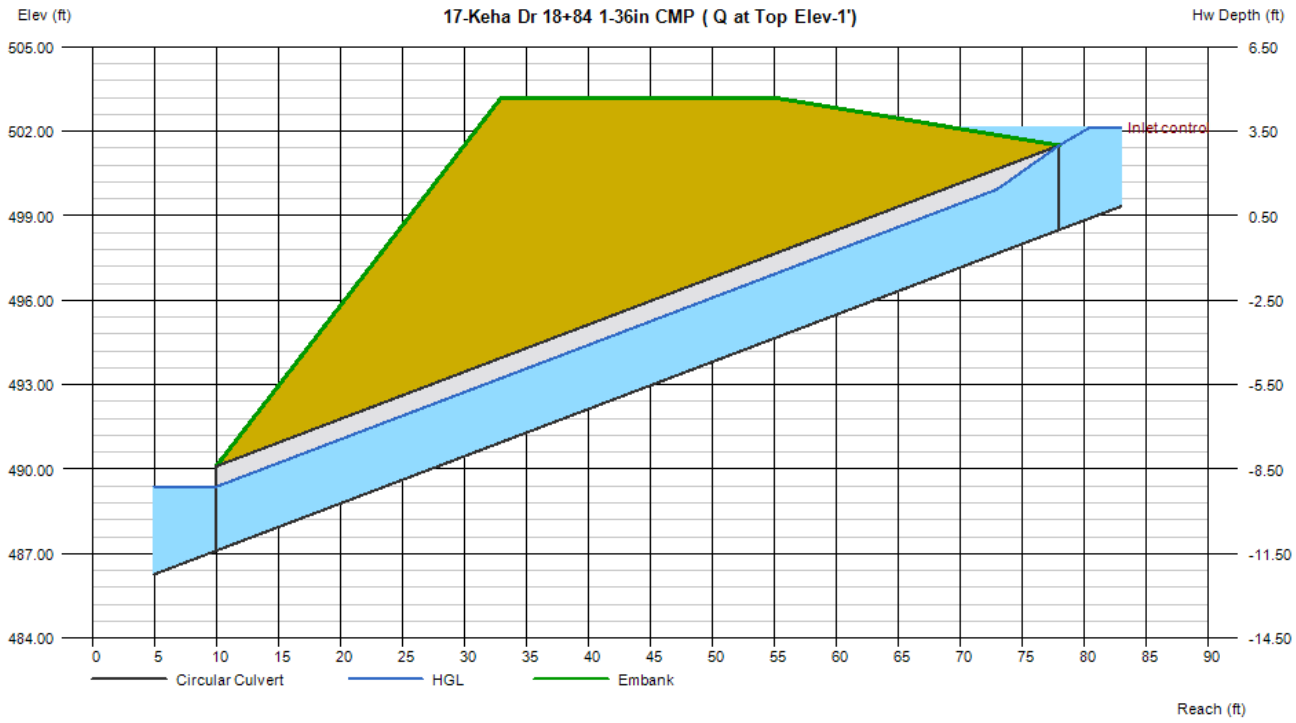
Top Elevation (ft)	=	503.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	49.00
Qmax (cfs)	=	49.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	49.00
Qpipe (cfs)	=	49.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.51
Veloc Up (ft/s)	=	8.51
HGL Dn (ft)	=	489.38
HGL Up (ft)	=	500.78
Hw Elev (ft)	=	502.14
Hw/D (ft)	=	1.21
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jan 29 2019

19-Lanina Place 5+28W 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	539.40
Pipe Length (ft)	=	54.00
Slope (%)	=	5.00
Invert Elev Up (ft)	=	542.10
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

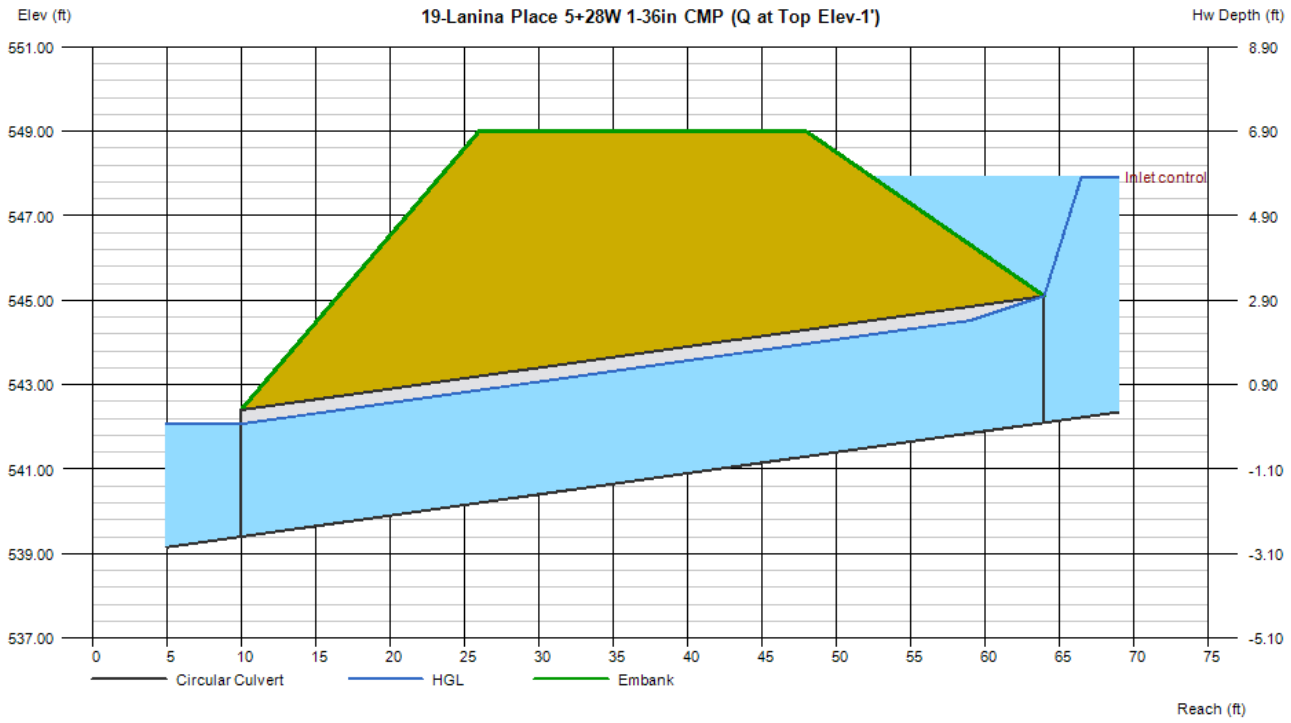
Top Elevation (ft)	=	549.00
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	71.00
Qmax (cfs)	=	71.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	71.00
Qpipe (cfs)	=	71.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.69
Veloc Up (ft/s)	=	10.69
HGL Dn (ft)	=	542.07
HGL Up (ft)	=	544.77
Hw Elev (ft)	=	547.92
Hw/D (ft)	=	1.94
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jan 29 2019

21-Hookpia Place 5+21.89 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	526.00
Pipe Length (ft)	=	62.00
Slope (%)	=	5.48
Invert Elev Up (ft)	=	529.40
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

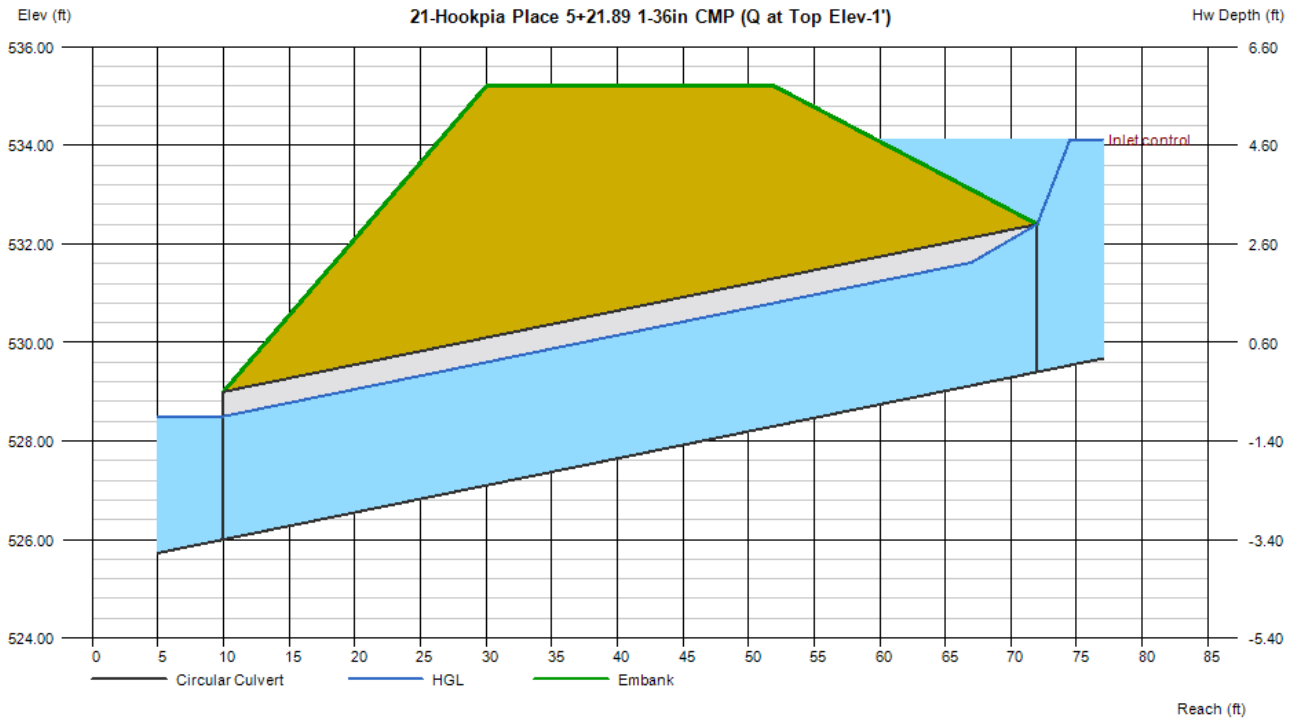
Top Elevation (ft)	=	535.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	60.00
Qmax (cfs)	=	60.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	60.00
Qpipe (cfs)	=	60.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.53
Veloc Up (ft/s)	=	9.53
HGL Dn (ft)	=	528.50
HGL Up (ft)	=	531.90
Hw Elev (ft)	=	534.12
Hw/D (ft)	=	1.57
Flow Regime	=	Inlet Control



Culvert Report

22-Hookpia Place 12+10 1-30in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	566.00
Pipe Length (ft)	=	60.00
Slope (%)	=	19.67
Invert Elev Up (ft)	=	577.80
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

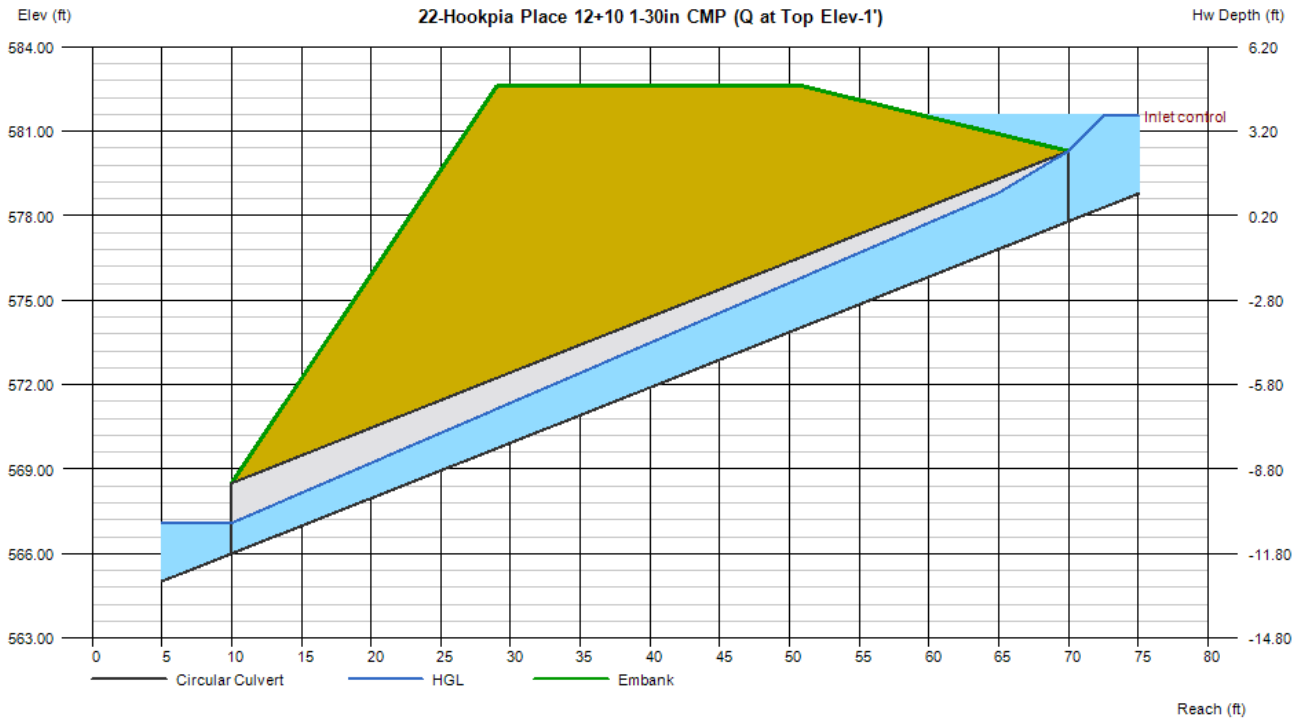
Top Elevation (ft)	=	582.60
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	38.00
Qmax (cfs)	=	38.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	38.00
Qpipe (cfs)	=	38.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	18.56
Veloc Up (ft/s)	=	8.70
HGL Dn (ft)	=	567.09
HGL Up (ft)	=	579.88
Hw Elev (ft)	=	581.55
Hw/D (ft)	=	1.50
Flow Regime	=	Inlet Control



Culvert Report

23-Waileia Place 6+08 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	443.70
Pipe Length (ft)	=	52.00
Slope (%)	=	5.77
Invert Elev Up (ft)	=	446.70
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

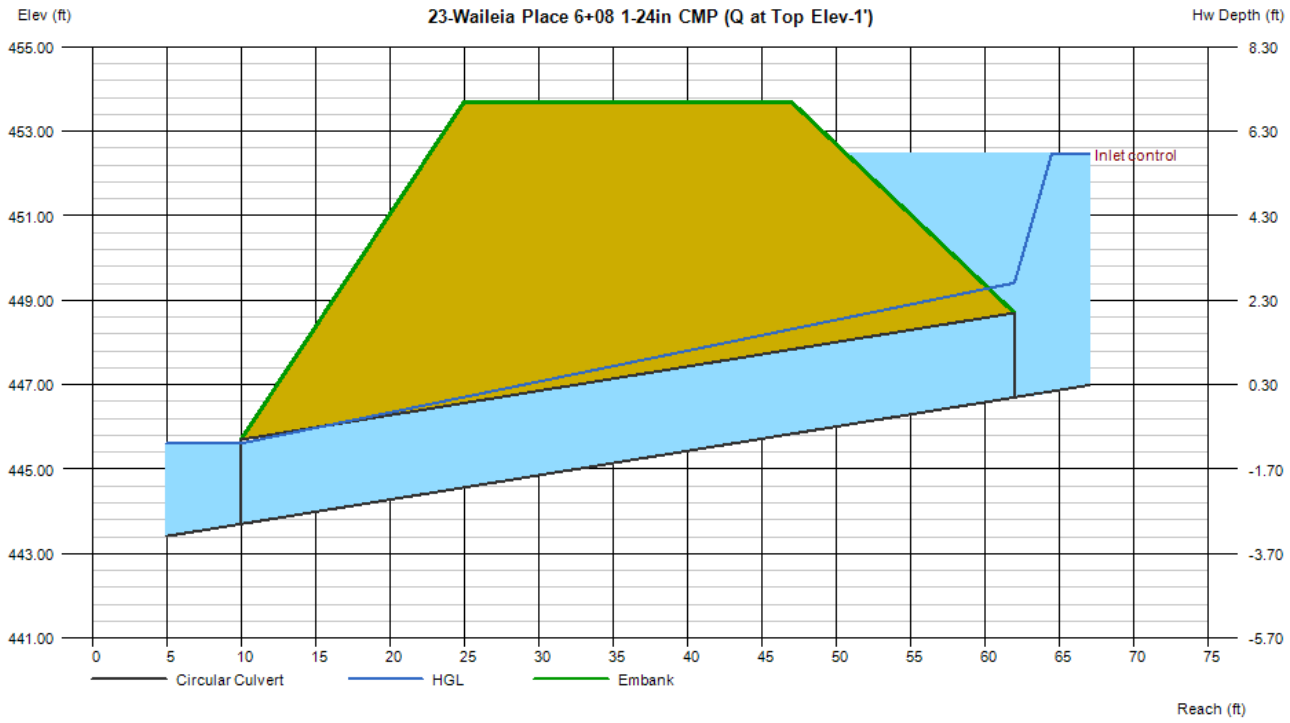
Top Elevation (ft)	=	453.70
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	34.00
Qmax (cfs)	=	34.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	34.00
Qpipe (cfs)	=	34.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	11.00
Veloc Up (ft/s)	=	10.82
HGL Dn (ft)	=	445.61
HGL Up (ft)	=	449.41
Hw Elev (ft)	=	452.46
Hw/D (ft)	=	2.88
Flow Regime	=	Inlet Control



Culvert Report

25-Kaapuni Place (Lot 218) 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	577.00
Pipe Length (ft)	=	24.00
Slope (%)	=	12.50
Invert Elev Up (ft)	=	580.00
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

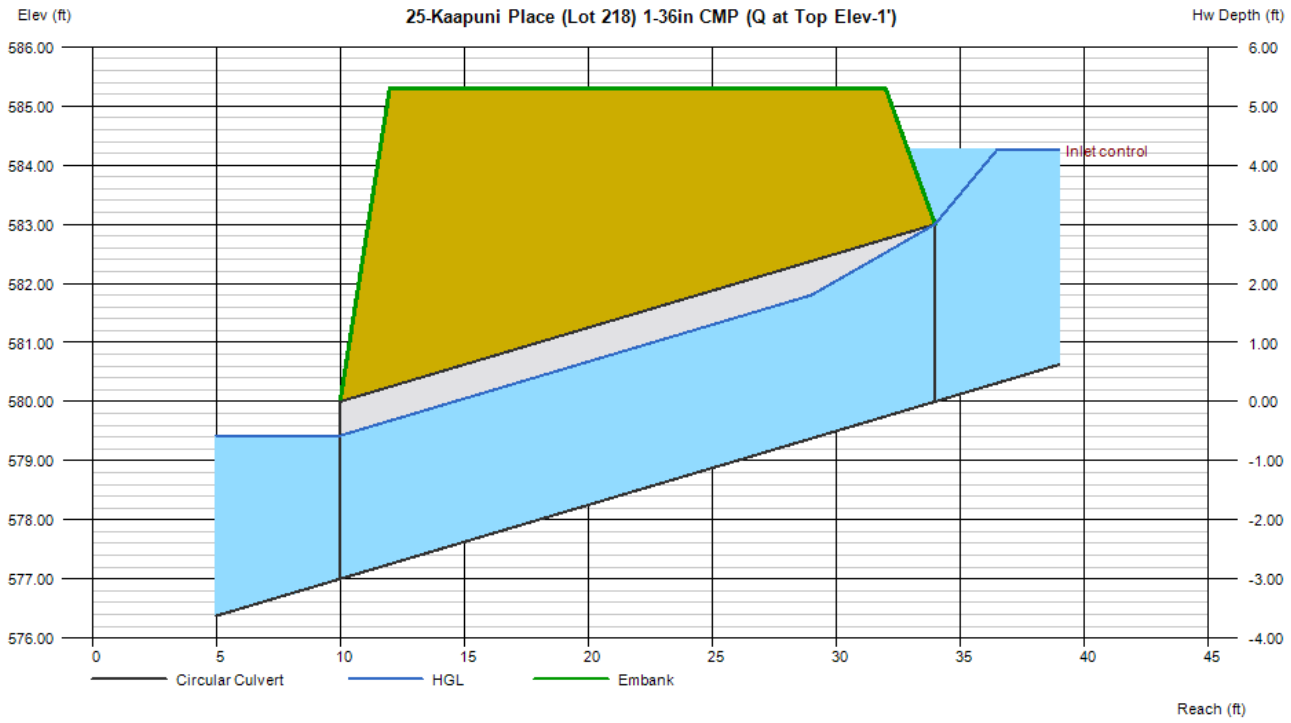
Top Elevation (ft)	=	585.30
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	56.00
Qmax (cfs)	=	56.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	56.00
Qpipe (cfs)	=	56.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.15
Veloc Up (ft/s)	=	9.15
HGL Dn (ft)	=	579.42
HGL Up (ft)	=	582.42
Hw Elev (ft)	=	584.26
Hw/D (ft)	=	1.42
Flow Regime	=	Inlet Control



Culvert Report

26-Mililani Place 16+91 3-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	415.70
Pipe Length (ft)	=	59.00
Slope (%)	=	3.05
Invert Elev Up (ft)	=	417.50
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	3
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

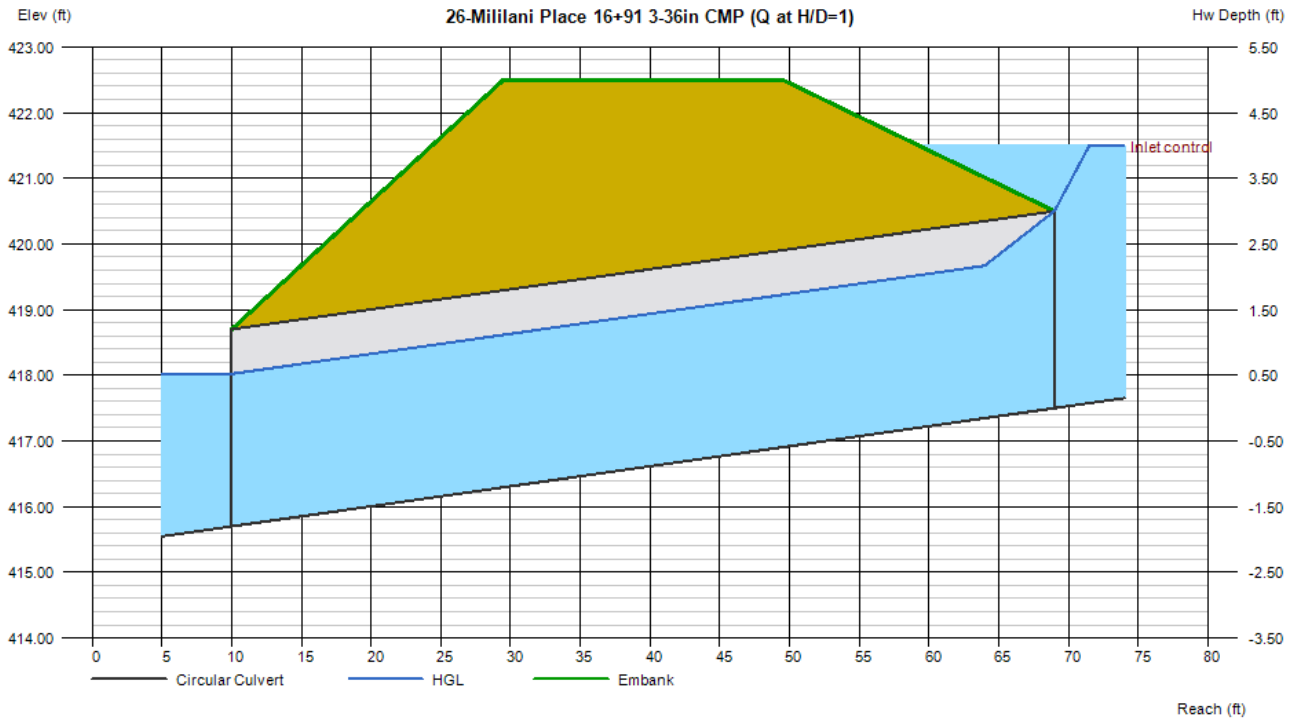
Top Elevation (ft)	=	422.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	153.00
Qmax (cfs)	=	153.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	153.00
Qpipe (cfs)	=	153.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.69
Veloc Up (ft/s)	=	8.69
HGL Dn (ft)	=	418.02
HGL Up (ft)	=	419.82
Hw Elev (ft)	=	421.50
Hw/D (ft)	=	1.33
Flow Regime	=	Inlet Control



Culvert Report

27-Kuaua Place 32+70.80 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	403.00
Pipe Length (ft)	=	57.00
Slope (%)	=	3.68
Invert Elev Up (ft)	=	405.10
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

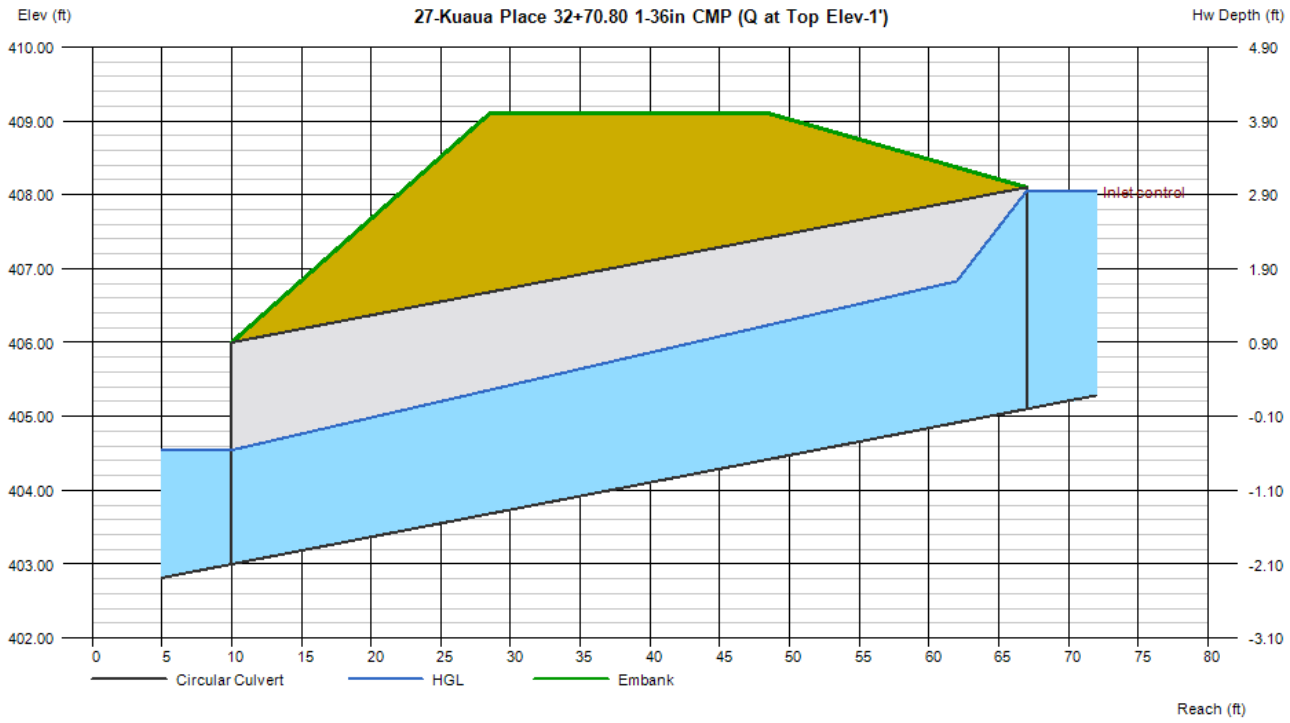
Top Elevation (ft)	=	409.10
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	36.00
Qmax (cfs)	=	36.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	36.00
Qpipe (cfs)	=	36.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.82
Veloc Up (ft/s)	=	7.41
HGL Dn (ft)	=	404.54
HGL Up (ft)	=	407.05
Hw Elev (ft)	=	408.05
Hw/D (ft)	=	0.98
Flow Regime	=	Inlet Control



Culvert Report

28-Malina Place 44+10+50 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	437.20
Pipe Length (ft)	=	58.00
Slope (%)	=	5.34
Invert Elev Up (ft)	=	440.30
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

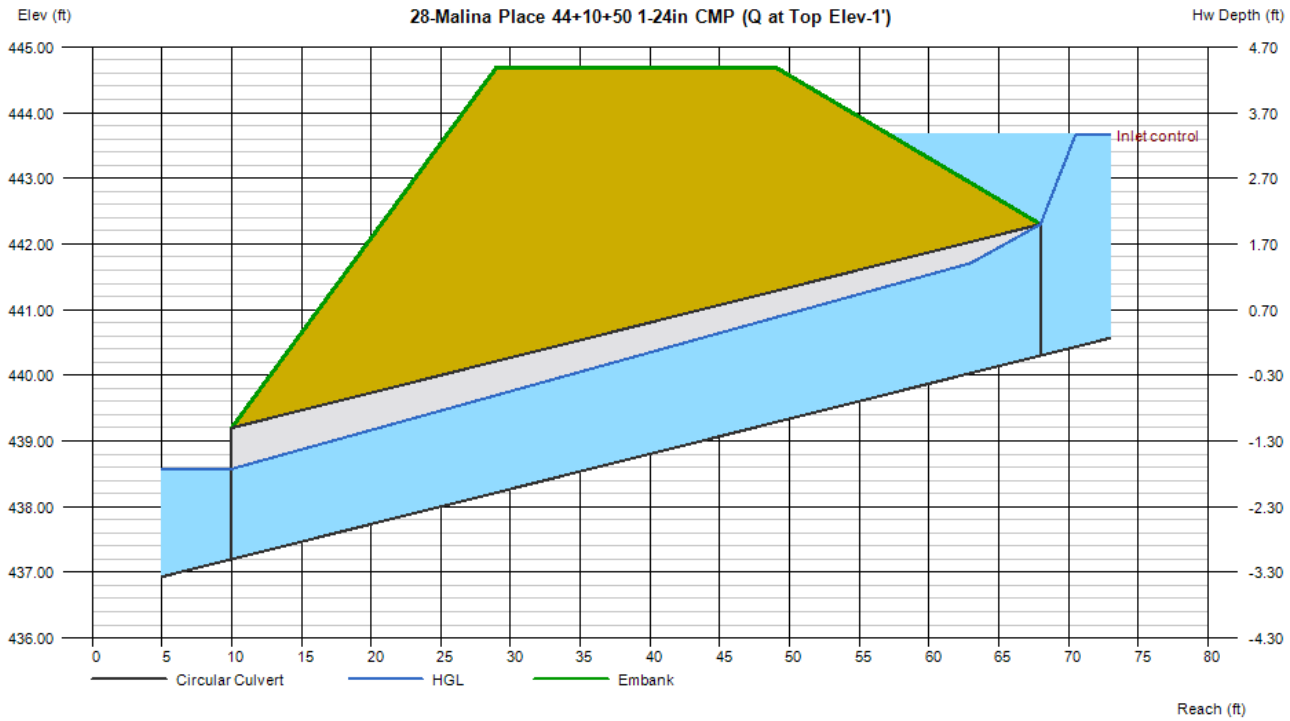
Top Elevation (ft)	=	444.69
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	23.00
Qmax (cfs)	=	23.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	23.00
Qpipe (cfs)	=	23.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.99
Veloc Up (ft/s)	=	8.06
HGL Dn (ft)	=	438.57
HGL Up (ft)	=	442.01
Hw Elev (ft)	=	443.66
Hw/D (ft)	=	1.68
Flow Regime	=	Inlet Control



Culvert Report

29-Malina Place 48+01 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	454.30
Pipe Length (ft)	=	51.50
Slope (%)	=	3.50
Invert Elev Up (ft)	=	456.10
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

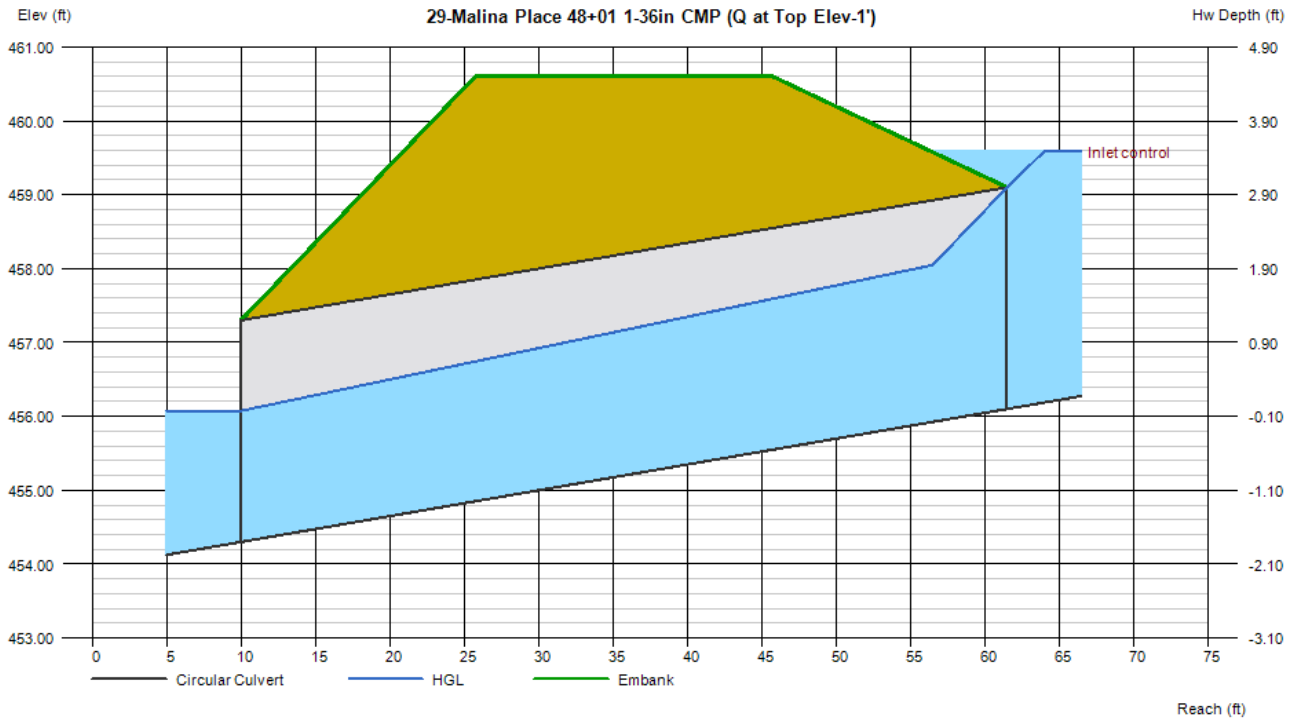
Top Elevation (ft)	=	460.60
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	44.00
Qmax (cfs)	=	44.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	44.00
Qpipe (cfs)	=	44.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.11
Veloc Up (ft/s)	=	8.08
HGL Dn (ft)	=	456.07
HGL Up (ft)	=	458.26
Hw Elev (ft)	=	459.59
Hw/D (ft)	=	1.16
Flow Regime	=	Inlet Control



Culvert Report

31-Mapu Place 12+99 1-48in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	292.40
Pipe Length (ft)	=	54.00
Slope (%)	=	3.15
Invert Elev Up (ft)	=	294.10
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

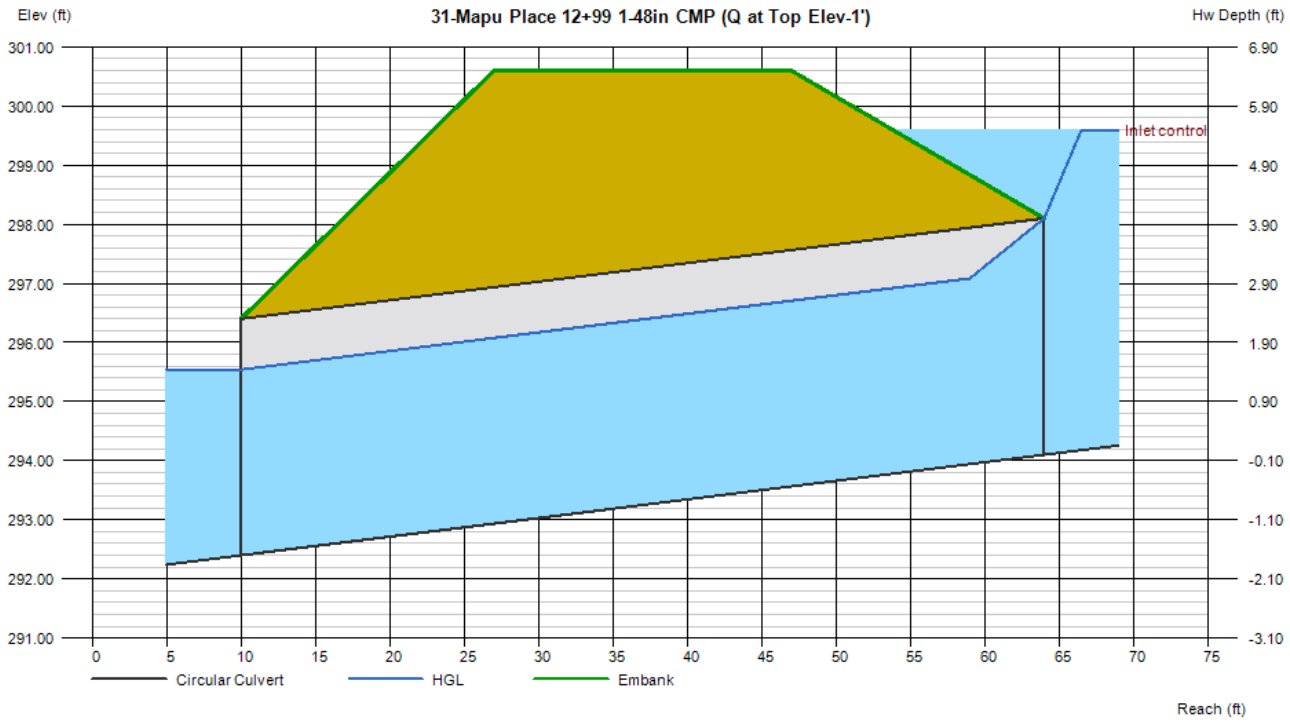
Top Elevation (ft)	=	300.60
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	108.00
Qmax (cfs)	=	108.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	108.00
Qpipe (cfs)	=	108.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.20
Veloc Up (ft/s)	=	10.20
HGL Dn (ft)	=	295.54
HGL Up (ft)	=	297.24
Hw Elev (ft)	=	299.60
Hw/D (ft)	=	1.37
Flow Regime	=	Inlet Control



Culvert Report

32-Mapu Place 20+64 3-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	318.50
Pipe Length (ft)	=	53.00
Slope (%)	=	4.72
Invert Elev Up (ft)	=	321.00
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	3
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

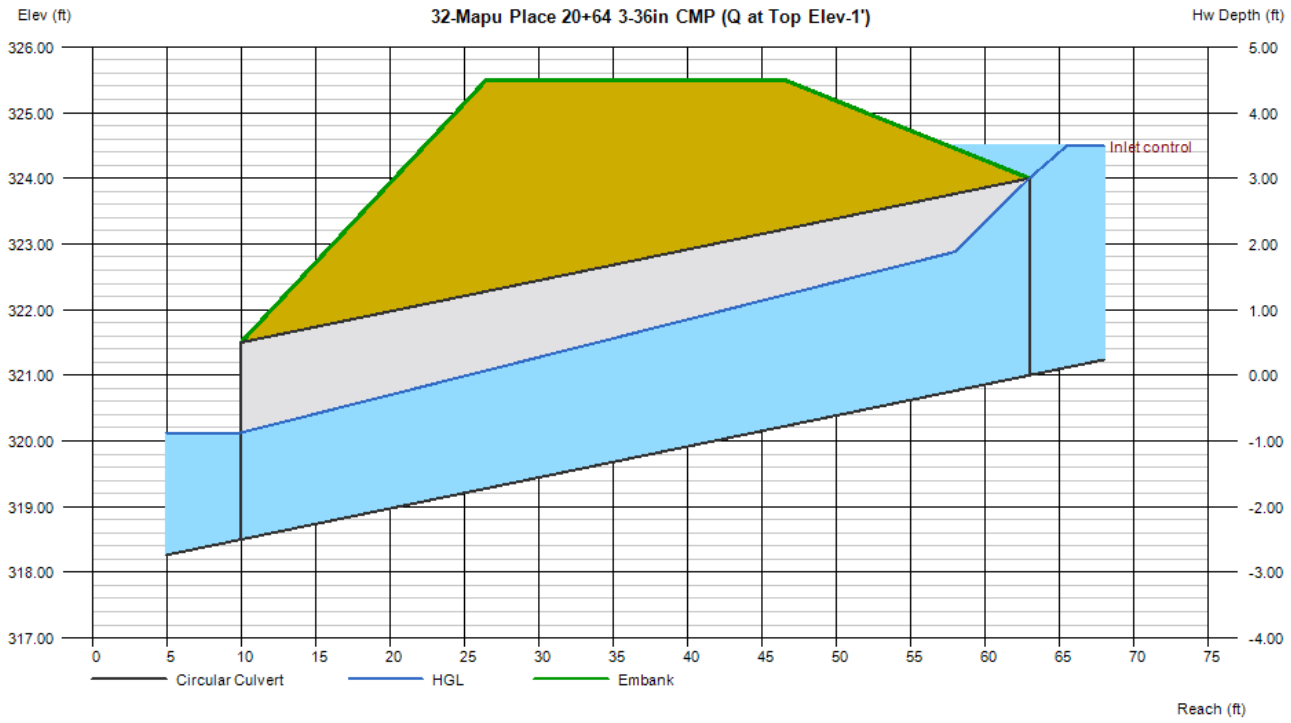
Top Elevation (ft)	=	325.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	133.00
Qmax (cfs)	=	133.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	133.00
Qpipe (cfs)	=	133.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	11.33
Veloc Up (ft/s)	=	8.11
HGL Dn (ft)	=	320.13
HGL Up (ft)	=	323.17
Hw Elev (ft)	=	324.49
Hw/D (ft)	=	1.16
Flow Regime	=	Inlet Control



Culvert Report

33-Akala Dr 7+82 1-48in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	263.00
Pipe Length (ft)	=	54.00
Slope (%)	=	5.19
Invert Elev Up (ft)	=	265.80
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

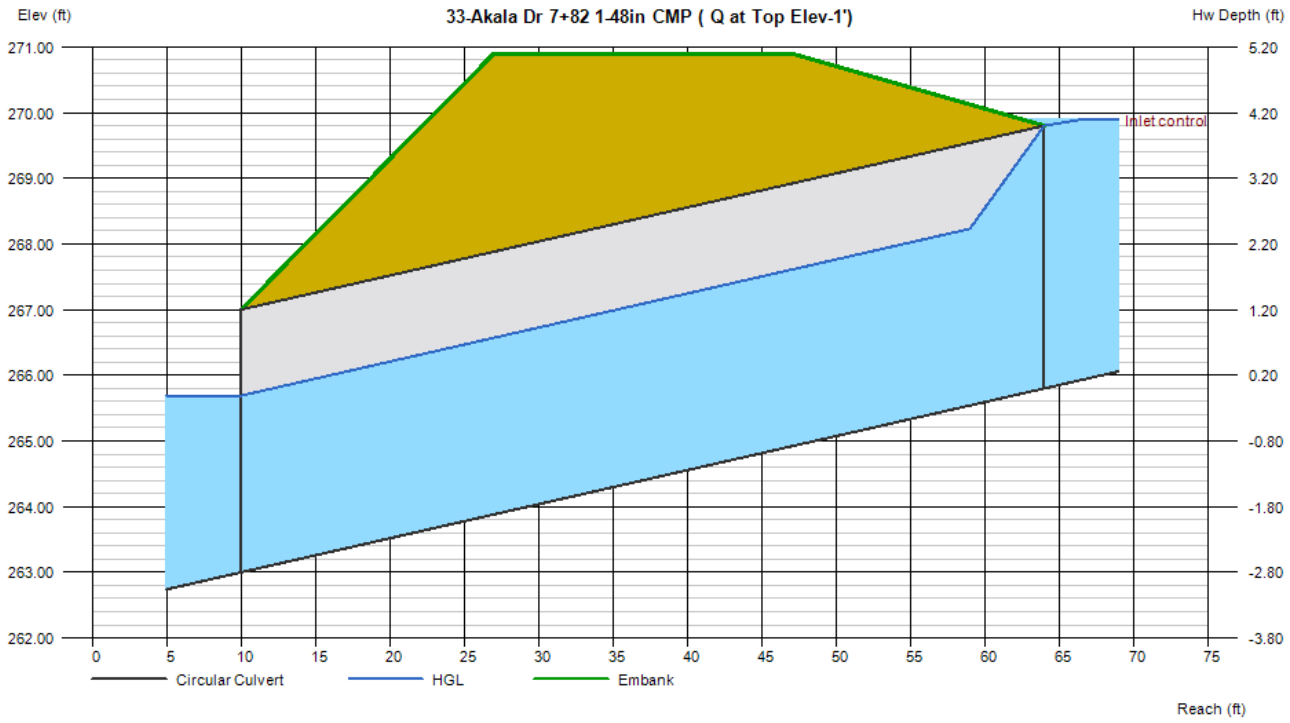
Top Elevation (ft)	=	270.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	79.00
Qmax (cfs)	=	79.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	79.00
Qpipe (cfs)	=	79.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.79
Veloc Up (ft/s)	=	8.79
HGL Dn (ft)	=	265.69
HGL Up (ft)	=	268.49
Hw Elev (ft)	=	269.90
Hw/D (ft)	=	1.02
Flow Regime	=	Inlet Control



Culvert Report

34-Akala Dr 9+96 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	264.00
Pipe Length (ft)	=	87.00
Slope (%)	=	5.17
Invert Elev Up (ft)	=	268.50
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

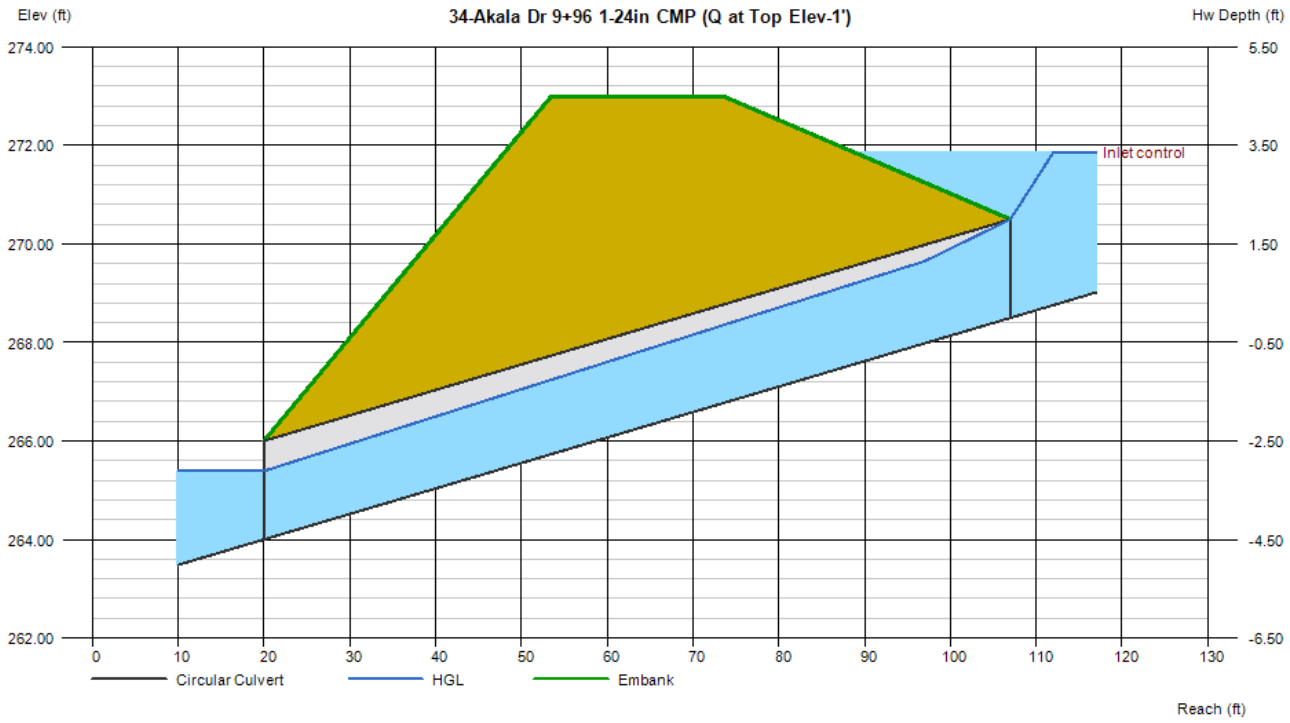
Top Elevation (ft)	=	273.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	23.00
Qmax (cfs)	=	23.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	23.00
Qpipe (cfs)	=	23.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.88
Veloc Up (ft/s)	=	8.06
HGL Dn (ft)	=	265.39
HGL Up (ft)	=	270.21
Hw Elev (ft)	=	271.86
Hw/D (ft)	=	1.68
Flow Regime	=	Inlet Control



Culvert Report

35-Akala Dr 14+94 3-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	285.00
Pipe Length (ft)	=	65.00
Slope (%)	=	10.46
Invert Elev Up (ft)	=	291.80
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	3
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

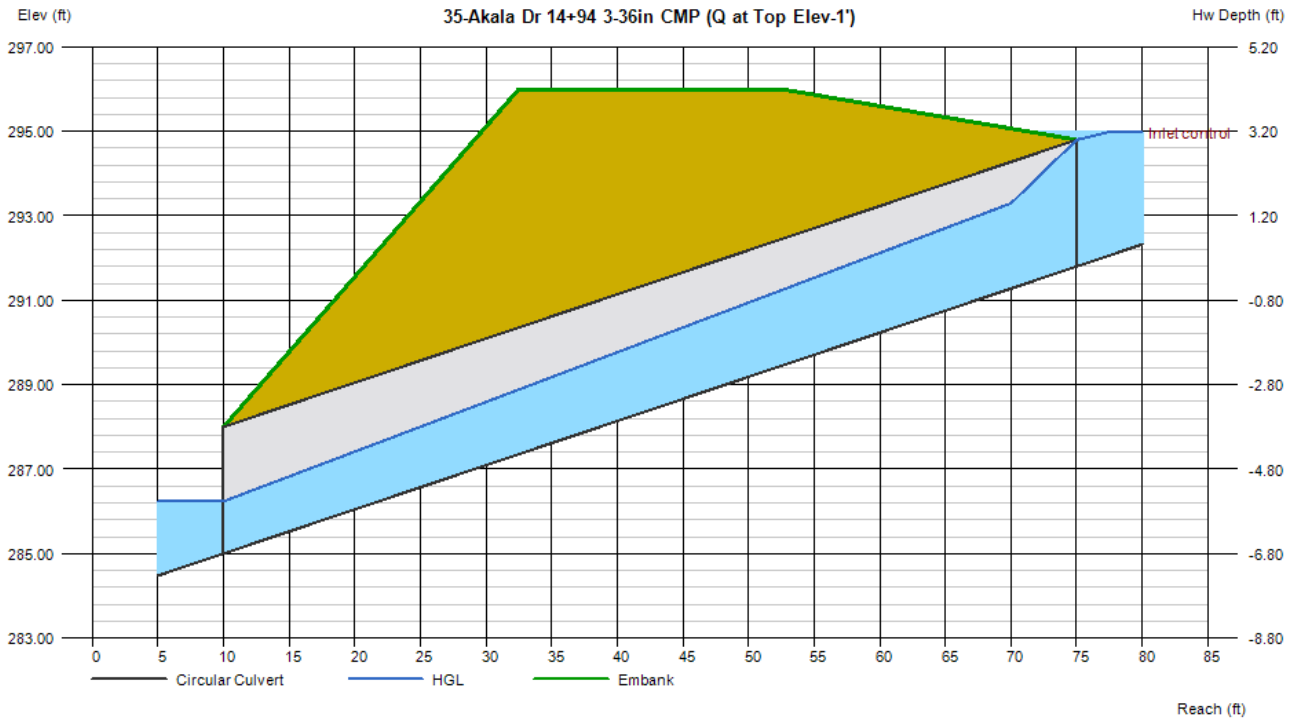
Top Elevation (ft)	=	296.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	123.00
Qmax (cfs)	=	123.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	123.00
Qpipe (cfs)	=	123.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	14.90
Veloc Up (ft/s)	=	7.82
HGL Dn (ft)	=	286.24
HGL Up (ft)	=	293.88
Hw Elev (ft)	=	294.99
Hw/D (ft)	=	1.06
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

37-Akala Dr 36+91 2-36in CMP

Invert Elev Dn (ft)	=	295.80
Pipe Length (ft)	=	50.00
Slope (%)	=	2.80
Invert Elev Up (ft)	=	297.20
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	2
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

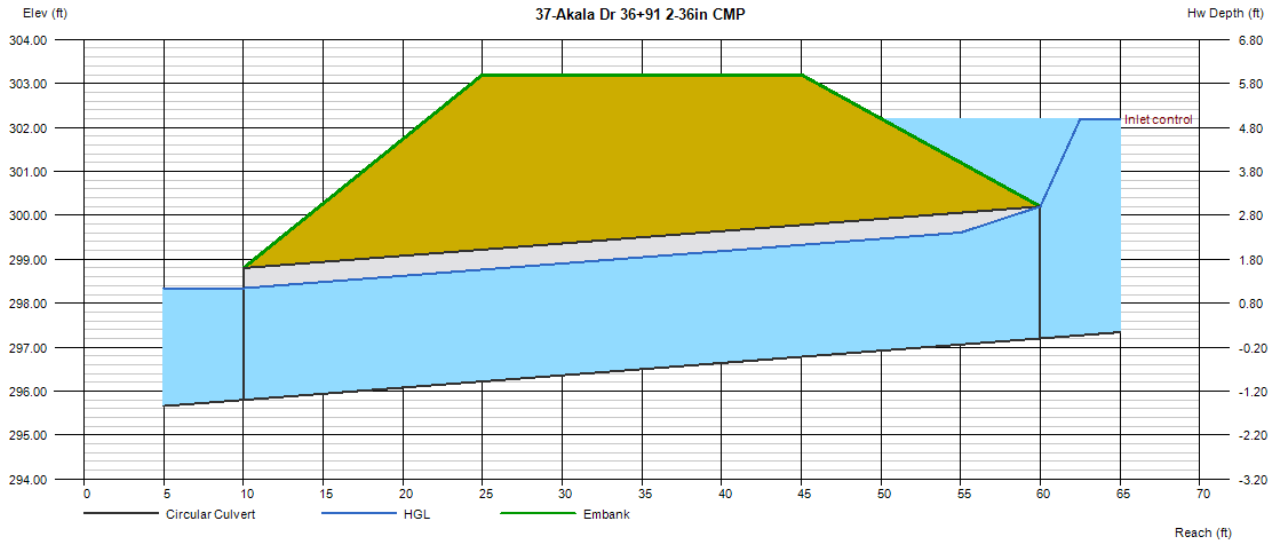
Top Elevation (ft)	=	303.20
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	125.00
Qmax (cfs)	=	125.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	125.00
Qpipe (cfs)	=	125.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.78
Veloc Up (ft/s)	=	9.77
HGL Dn (ft)	=	298.34
HGL Up (ft)	=	299.75
Hw Elev (ft)	=	302.19
Hw/D (ft)	=	1.66
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

38-Akala Dr 44+84 1-36in CMP

Invert Elev Dn (ft)	=	317.60
Pipe Length (ft)	=	51.00
Slope (%)	=	1.57
Invert Elev Up (ft)	=	318.40
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

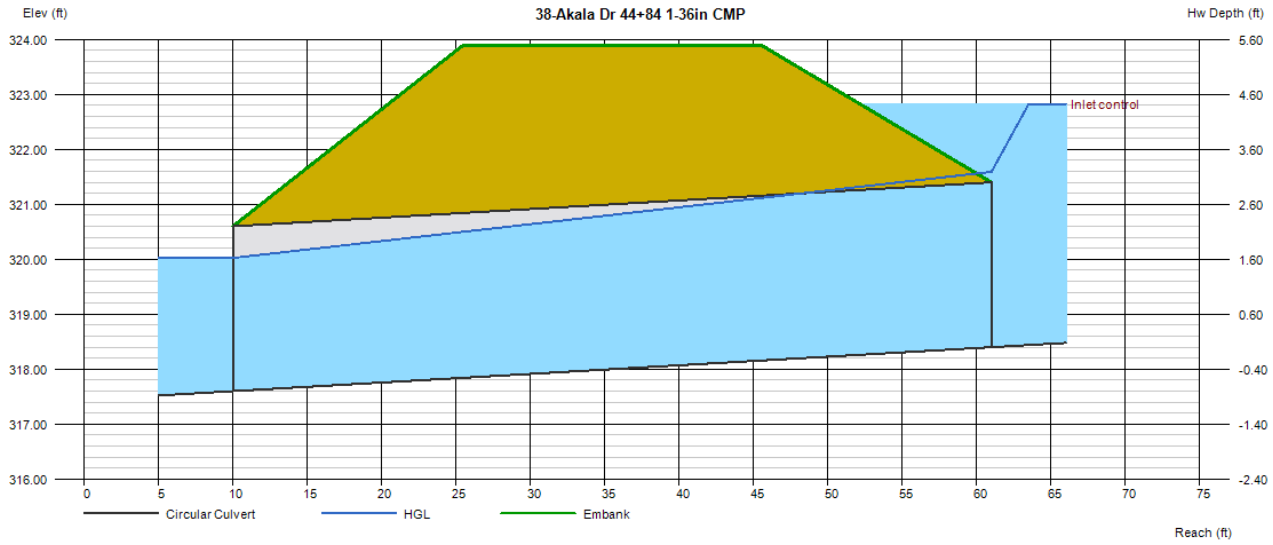
Top Elevation (ft)	=	323.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	56.00
Qmax (cfs)	=	56.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	56.00
Qpipe (cfs)	=	56.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.15
Veloc Up (ft/s)	=	7.92
HGL Dn (ft)	=	320.02
HGL Up (ft)	=	321.59
Hw Elev (ft)	=	322.83
Hw/D (ft)	=	1.48
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

39-Hoomua Dr 2+34 1-36in CMP

Invert Elev Dn (ft)	=	299.30
Pipe Length (ft)	=	43.50
Slope (%)	=	6.21
Invert Elev Up (ft)	=	302.00
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

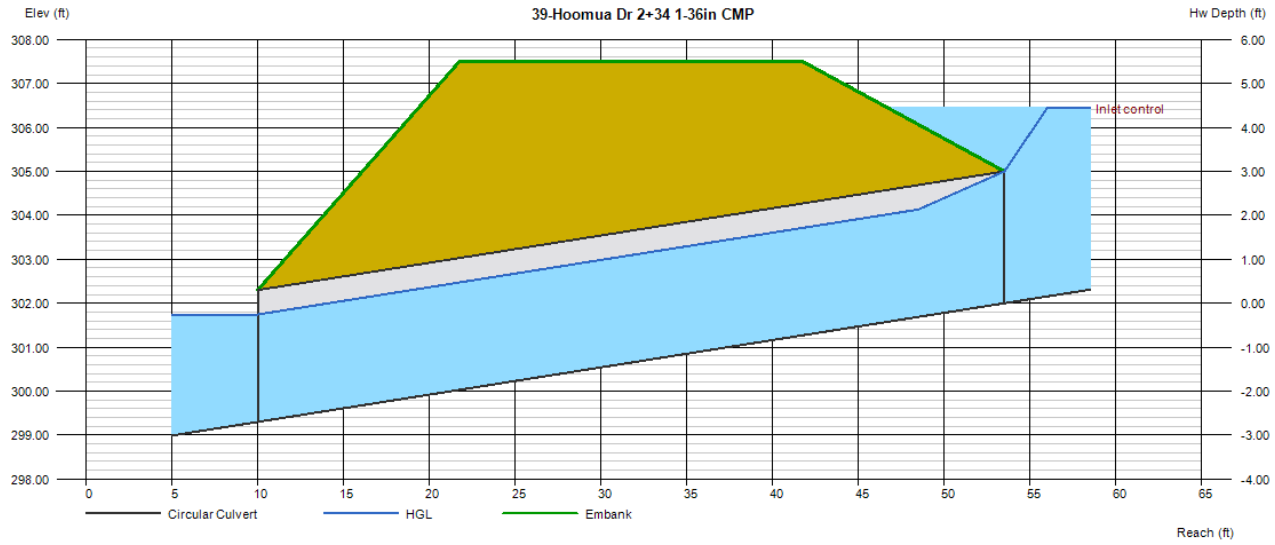
Top Elevation (ft)	=	307.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	57.00
Qmax (cfs)	=	57.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	57.00
Qpipe (cfs)	=	57.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.24
Veloc Up (ft/s)	=	9.24
HGL Dn (ft)	=	301.74
HGL Up (ft)	=	304.44
Hw Elev (ft)	=	306.44
Hw/D (ft)	=	1.48
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

40-Hoomua Dr 7+60 1-48in CMP

Invert Elev Dn (ft)	=	335.00
Pipe Length (ft)	=	56.00
Slope (%)	=	8.93
Invert Elev Up (ft)	=	340.00
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

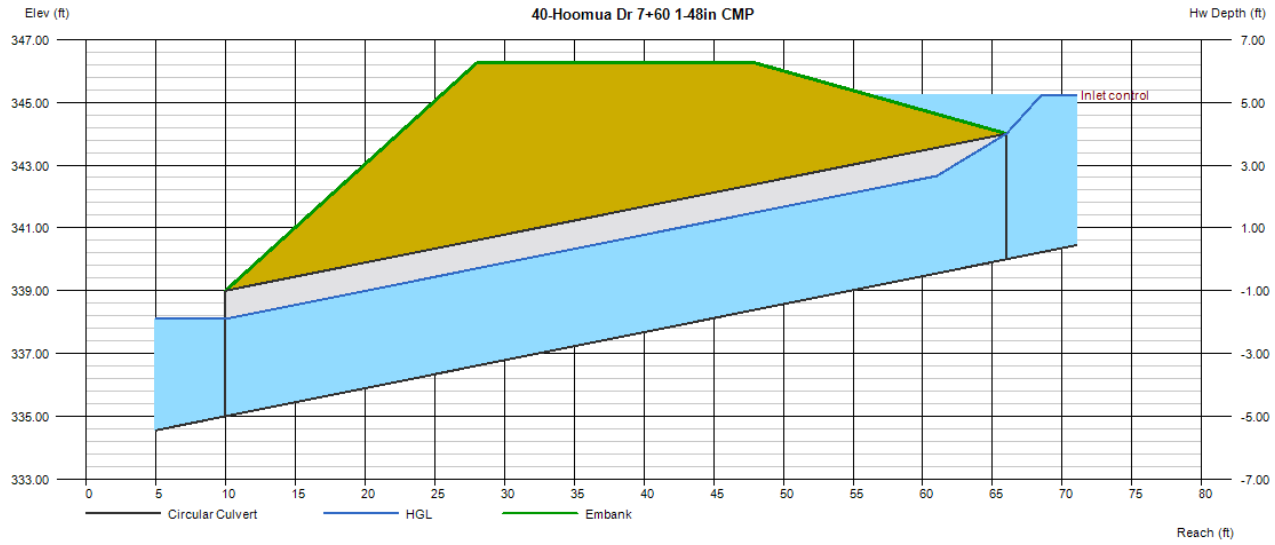
Top Elevation (ft)	=	346.25
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	105.00
Qmax (cfs)	=	105.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	105.00
Qpipe (cfs)	=	105.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.05
Veloc Up (ft/s)	=	10.05
HGL Dn (ft)	=	338.10
HGL Up (ft)	=	343.10
Hw Elev (ft)	=	345.23
Hw/D (ft)	=	1.31
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

42-Mikioi Place 43+07 1-42in CMP

Invert Elev Dn (ft)	=	325.30
Pipe Length (ft)	=	82.00
Slope (%)	=	10.12
Invert Elev Up (ft)	=	333.60
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

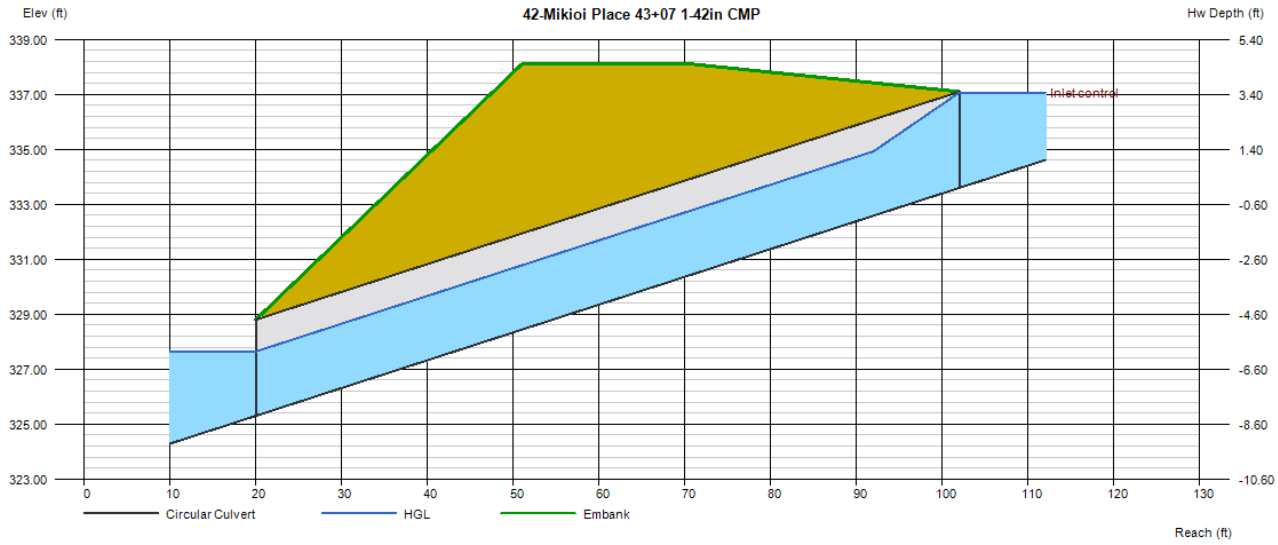
Top Elevation (ft)	=	338.10
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	56.00
Qmax (cfs)	=	56.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	56.00
Qpipe (cfs)	=	56.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.19
Veloc Up (ft/s)	=	8.19
HGL Dn (ft)	=	327.64
HGL Up (ft)	=	335.94
Hw Elev (ft)	=	337.07
Hw/D (ft)	=	0.99
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

44-Kehala Dr 38+35 1-36in CMP

Invert Elev Dn (ft)	=	355.50
Pipe Length (ft)	=	62.00
Slope (%)	=	6.45
Invert Elev Up (ft)	=	359.50
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

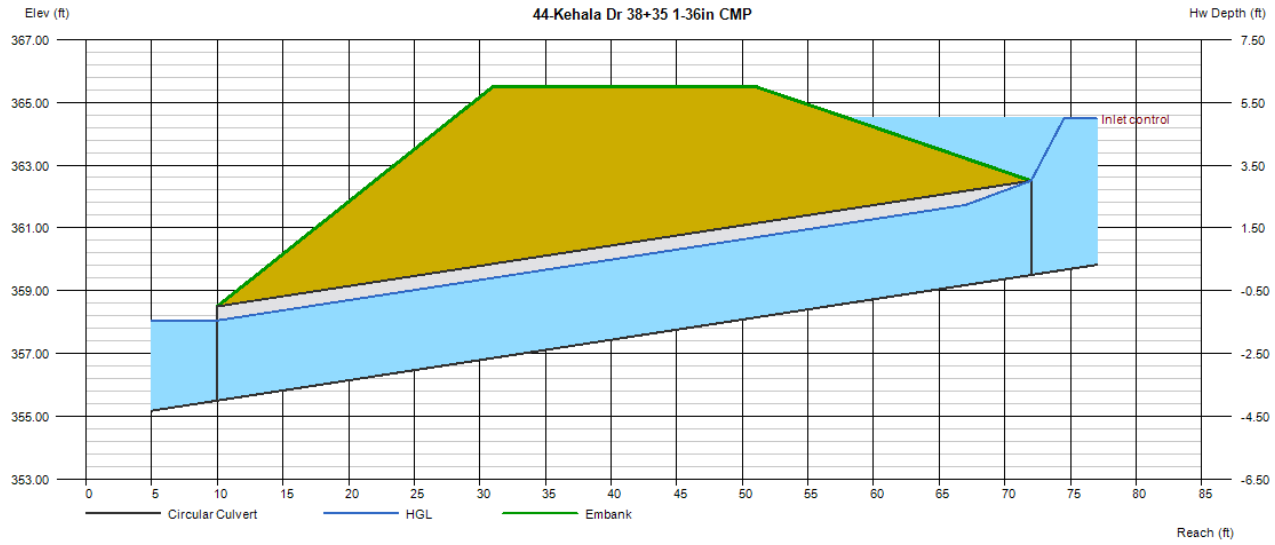
Top Elevation (ft)	=	365.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	63.00
Qmax (cfs)	=	63.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	63.00
Qpipe (cfs)	=	63.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.83
Veloc Up (ft/s)	=	9.83
HGL Dn (ft)	=	358.05
HGL Up (ft)	=	362.05
Hw Elev (ft)	=	364.48
Hw/D (ft)	=	1.66
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

45-Kehala Dr 45+37 1-42in CMP

Invert Elev Dn (ft)	=	381.00
Pipe Length (ft)	=	55.00
Slope (%)	=	7.09
Invert Elev Up (ft)	=	384.90
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

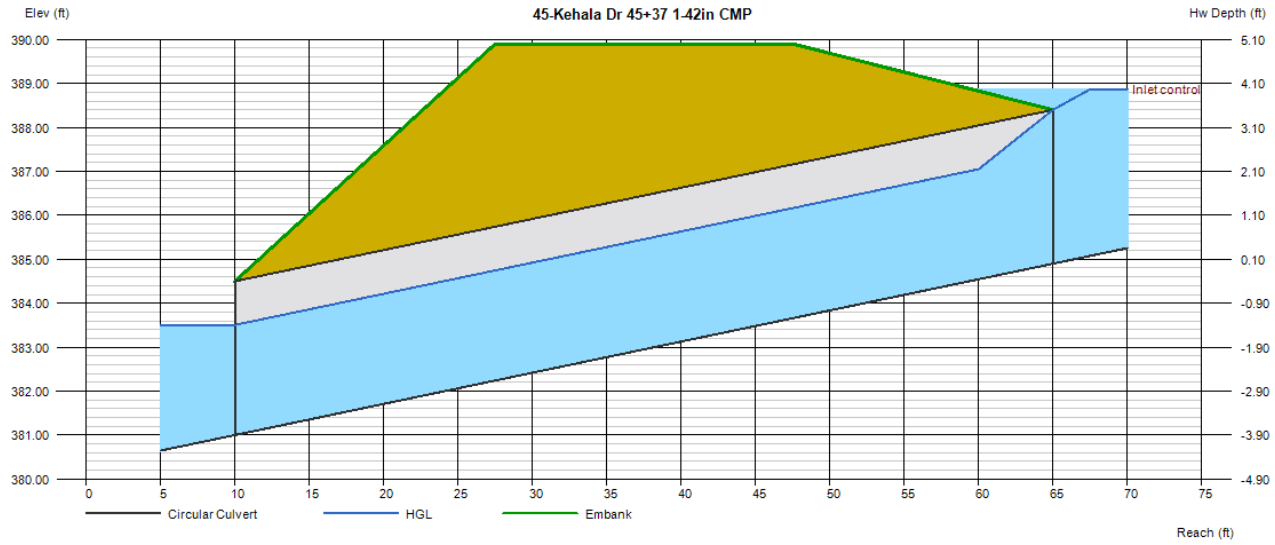
Top Elevation (ft)	=	389.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	64.00
Qmax (cfs)	=	64.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	64.00
Qpipe (cfs)	=	64.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.68
Veloc Up (ft/s)	=	8.69
HGL Dn (ft)	=	383.51
HGL Up (ft)	=	387.41
Hw Elev (ft)	=	388.87
Hw/D (ft)	=	1.13
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

46-Piilani Hwy 114+23 4-114in Circ Concrete

Invert Elev Dn (ft)	=	254.39
Pipe Length (ft)	=	184.00
Slope (%)	=	1.96
Invert Elev Up (ft)	=	258.00
Rise (in)	=	114.0
Shape	=	Circular
Span (in)	=	114.0
No. Barrels	=	4
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

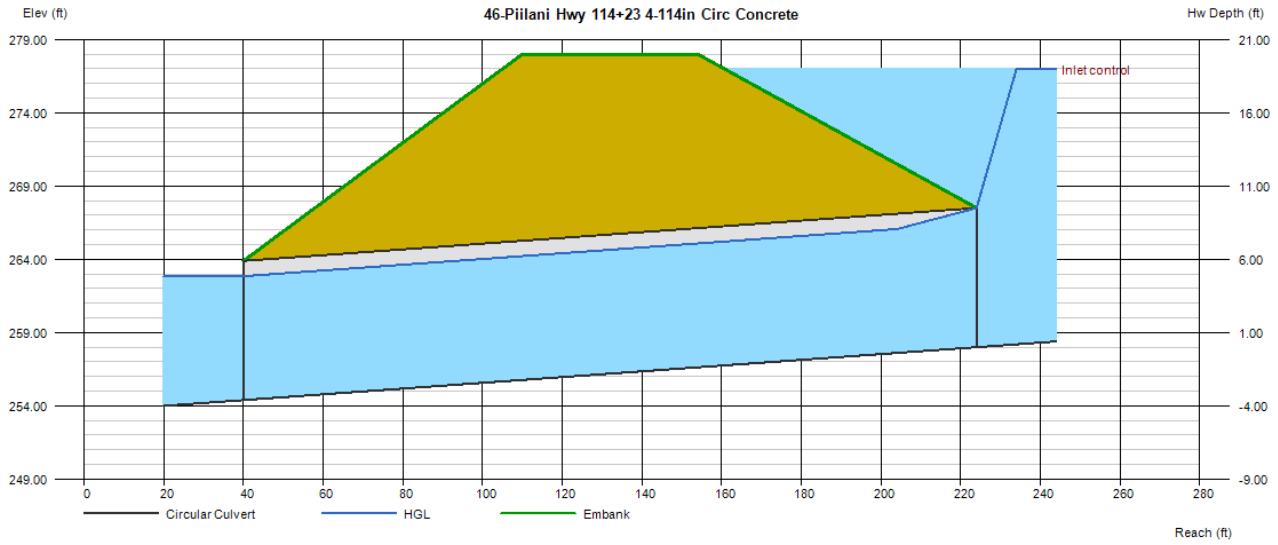
Top Elevation (ft)	=	278.00
Top Width (ft)	=	44.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	5069.00
Qmax (cfs)	=	5069.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	5069.00
Qpipe (cfs)	=	5069.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	19.02
Veloc Up (ft/s)	=	19.02
HGL Dn (ft)	=	262.84
HGL Up (ft)	=	266.45
Hw Elev (ft)	=	276.99
Hw/D (ft)	=	2.00
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

47-Piilani Hwy 116+86 1-120in Circ Concrete

Invert Elev Dn (ft)	=	258.82
Pipe Length (ft)	=	136.00
Slope (%)	=	1.98
Invert Elev Up (ft)	=	261.51
Rise (in)	=	120.0
Shape	=	Circular
Span (in)	=	120.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

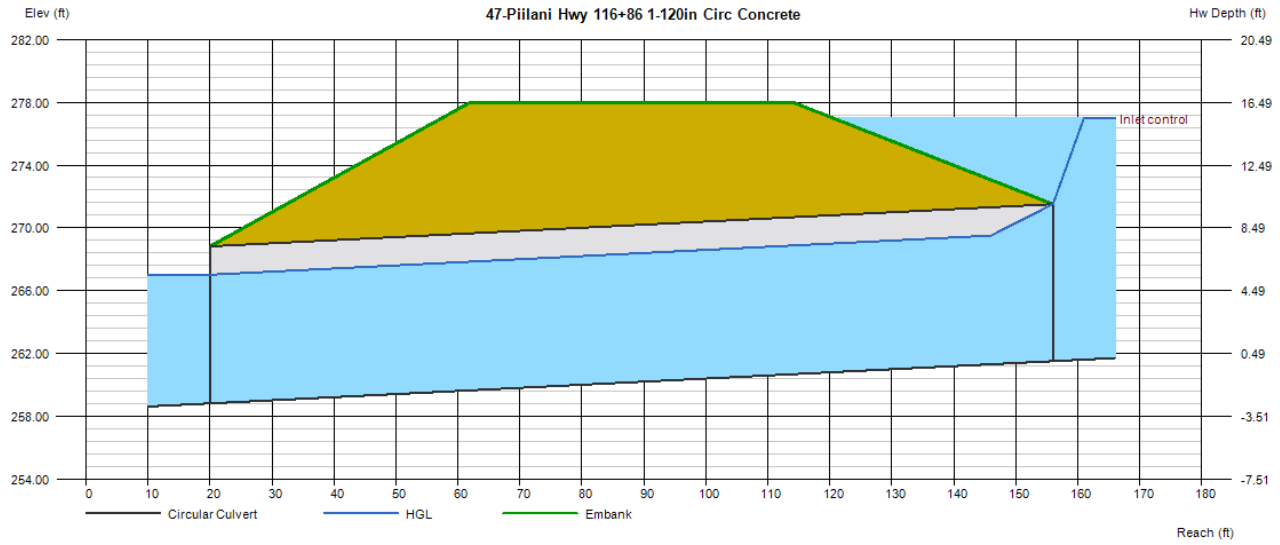
Top Elevation (ft)	=	278.00
Top Width (ft)	=	52.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1173.00
Qmax (cfs)	=	1173.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	1173.00
Qpipe (cfs)	=	1173.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	17.02
Veloc Up (ft/s)	=	17.02
HGL Dn (ft)	=	267.02
HGL Up (ft)	=	269.71
Hw Elev (ft)	=	276.99
Hw/D (ft)	=	1.55
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 5 2019

48-Piilani Hwy 124+50 3-48in Circ Concrete

Invert Elev Dn (ft)	=	277.73
Pipe Length (ft)	=	96.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	278.21
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	3
n-Value	=	0.024
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

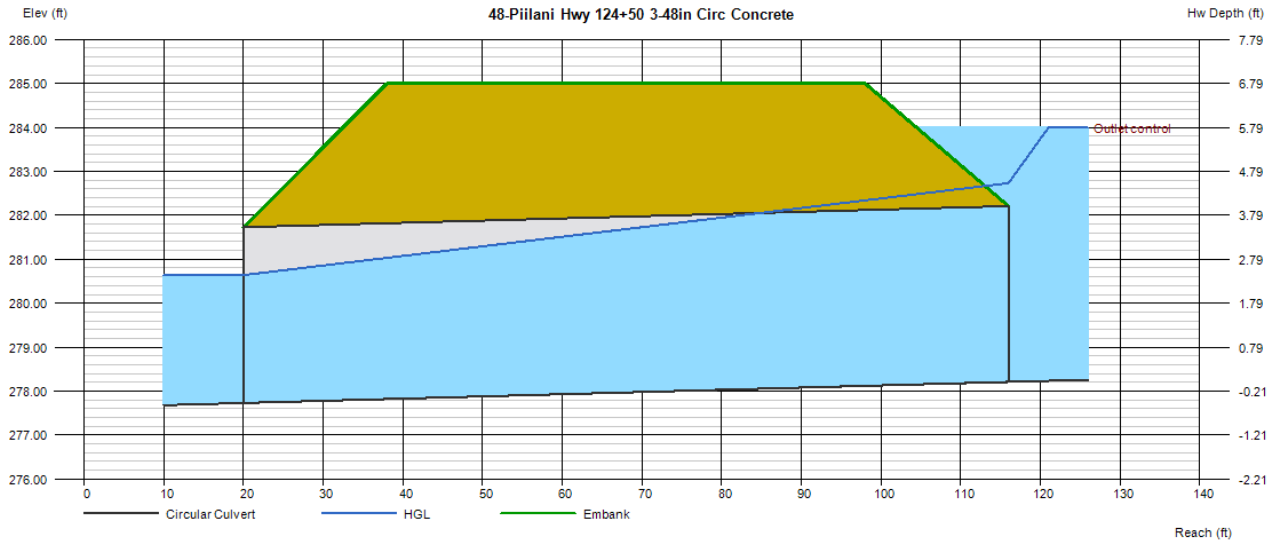
Top Elevation (ft)	=	285.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	277.00
Qmax (cfs)	=	277.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	277.00
Qpipe (cfs)	=	277.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.43
Veloc Up (ft/s)	=	7.35
HGL Dn (ft)	=	280.64
HGL Up (ft)	=	282.73
Hw Elev (ft)	=	283.99
Hw/D (ft)	=	1.45
Flow Regime	=	Outlet Control



Culvert Report

49-Piilani Hwy 143+55 2-120in Circ Concrete

Invert Elev Dn (ft)	=	275.65
Pipe Length (ft)	=	146.29
Slope (%)	=	4.41
Invert Elev Up (ft)	=	282.10
Rise (in)	=	120.0
Shape	=	Circular
Span (in)	=	120.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

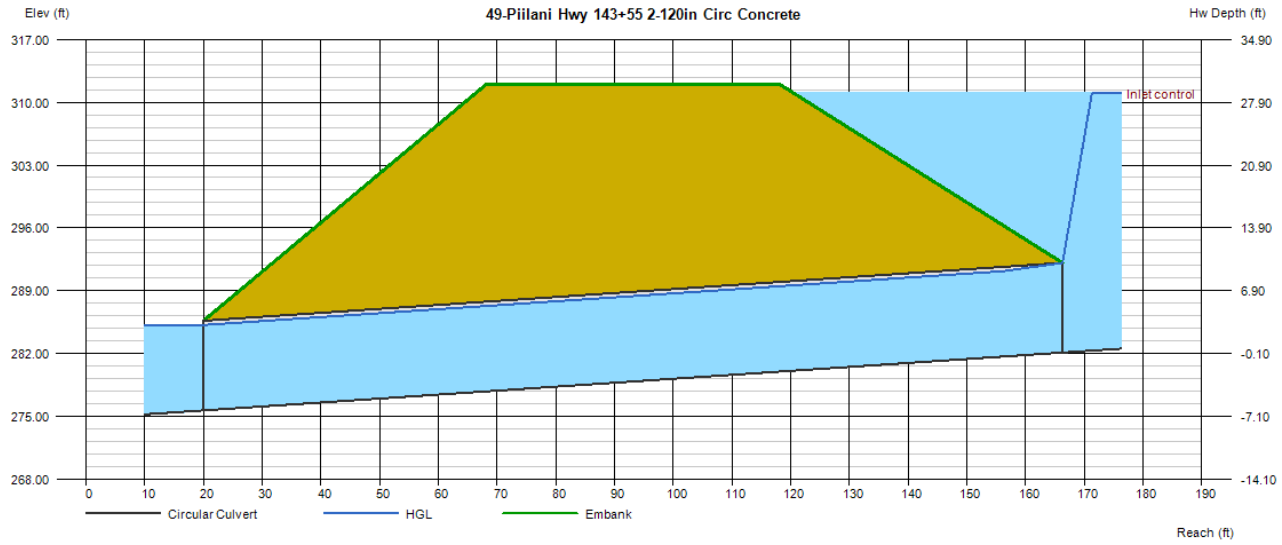
Top Elevation (ft)	=	312.00
Top Width (ft)	=	50.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	3727.00
Qmax (cfs)	=	3727.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	3727.00
Qpipe (cfs)	=	3727.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	24.15
Veloc Up (ft/s)	=	24.15
HGL Dn (ft)	=	285.17
HGL Up (ft)	=	291.62
Hw Elev (ft)	=	310.99
Hw/D (ft)	=	2.89
Flow Regime	=	Inlet Control



Culvert Report

4-Kupulau Dr 36+92 1-24in CMP (Q @ Top Elev - 1')

Invert Elev Dn (ft)	=	596.20
Pipe Length (ft)	=	54.00
Slope (%)	=	8.70
Invert Elev Up (ft)	=	600.90
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

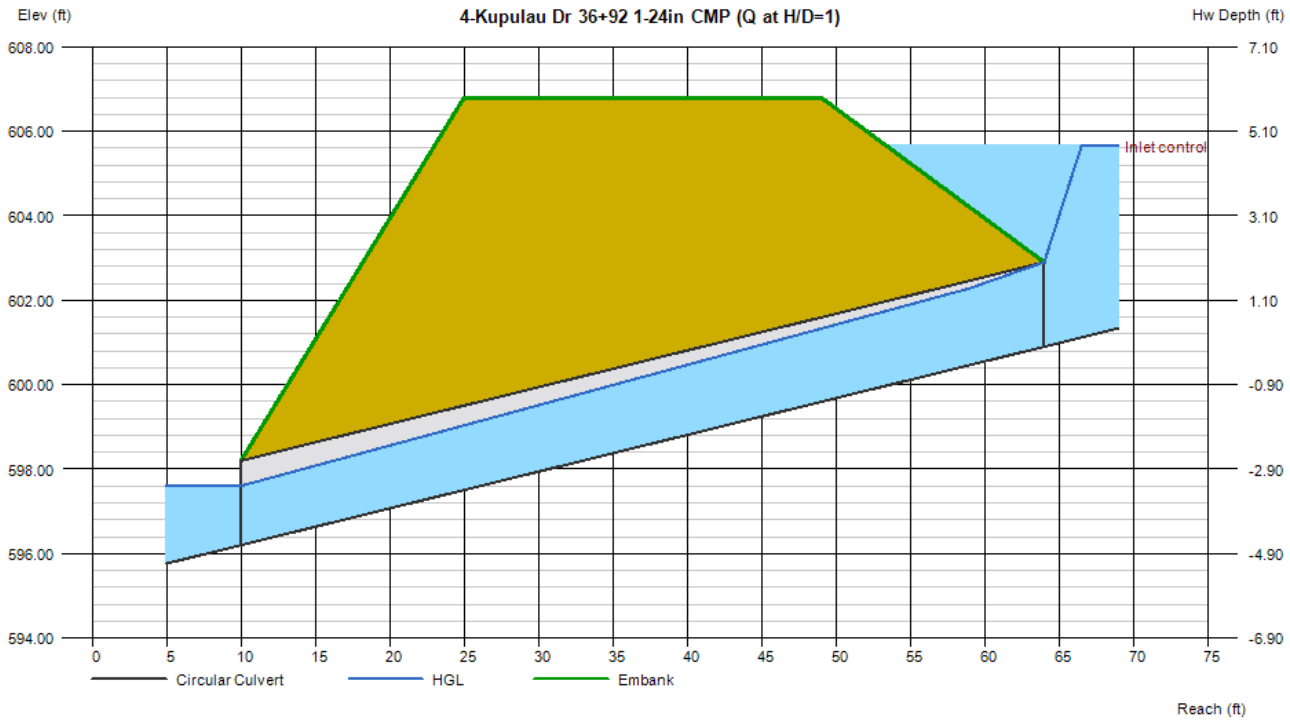
Top Elevation (ft)	=	606.80
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	30.00
Qmax (cfs)	=	30.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	30.00
Qpipe (cfs)	=	30.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	12.75
Veloc Up (ft/s)	=	9.85
HGL Dn (ft)	=	597.60
HGL Up (ft)	=	602.76
Hw Elev (ft)	=	605.65
Hw/D (ft)	=	2.37
Flow Regime	=	Inlet Control



Culvert Report

5-Kupulau Dr 41+87 1-24in CMP (Q @ Top Elev-1')

Invert Elev Dn (ft)	=	592.50
Pipe Length (ft)	=	56.00
Slope (%)	=	9.82
Invert Elev Up (ft)	=	598.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

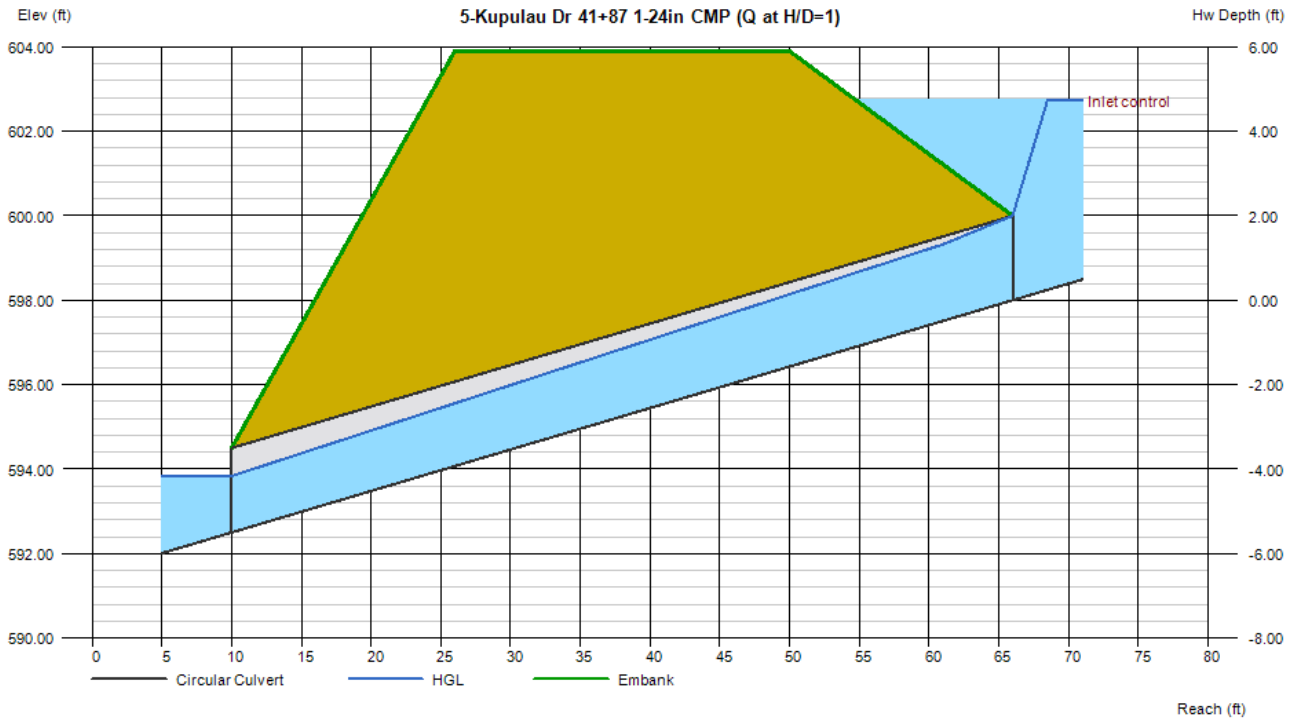
Top Elevation (ft)	=	603.90
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	30.00
Qmax (cfs)	=	30.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	30.00
Qpipe (cfs)	=	30.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	13.44
Veloc Up (ft/s)	=	9.85
HGL Dn (ft)	=	593.84
HGL Up (ft)	=	599.86
Hw Elev (ft)	=	602.74
Hw/D (ft)	=	2.37
Flow Regime	=	Inlet Control



Culvert Report

6-Kupulau Dr 48+62 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	618.80
Pipe Length (ft)	=	57.00
Slope (%)	=	9.12
Invert Elev Up (ft)	=	624.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

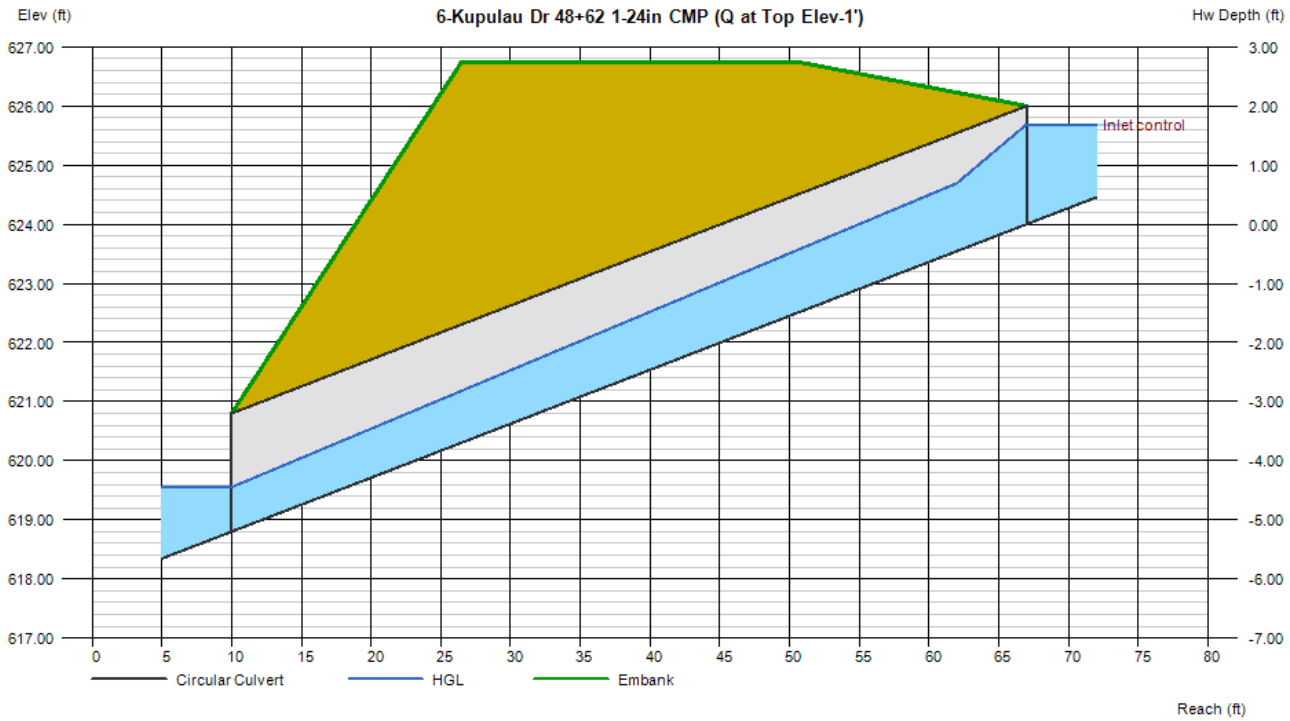
Top Elevation (ft)	=	626.75
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	11.00
Qmax (cfs)	=	11.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	11.00
Qpipe (cfs)	=	11.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.19
Veloc Up (ft/s)	=	5.66
HGL Dn (ft)	=	619.55
HGL Up (ft)	=	625.19
Hw Elev (ft)	=	625.69
Hw/D (ft)	=	0.84
Flow Regime	=	Inlet Control



Culvert Report

7-Kupulau Dr 52+47 1-36in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	610.20
Pipe Length (ft)	=	62.50
Slope (%)	=	4.48
Invert Elev Up (ft)	=	613.00
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

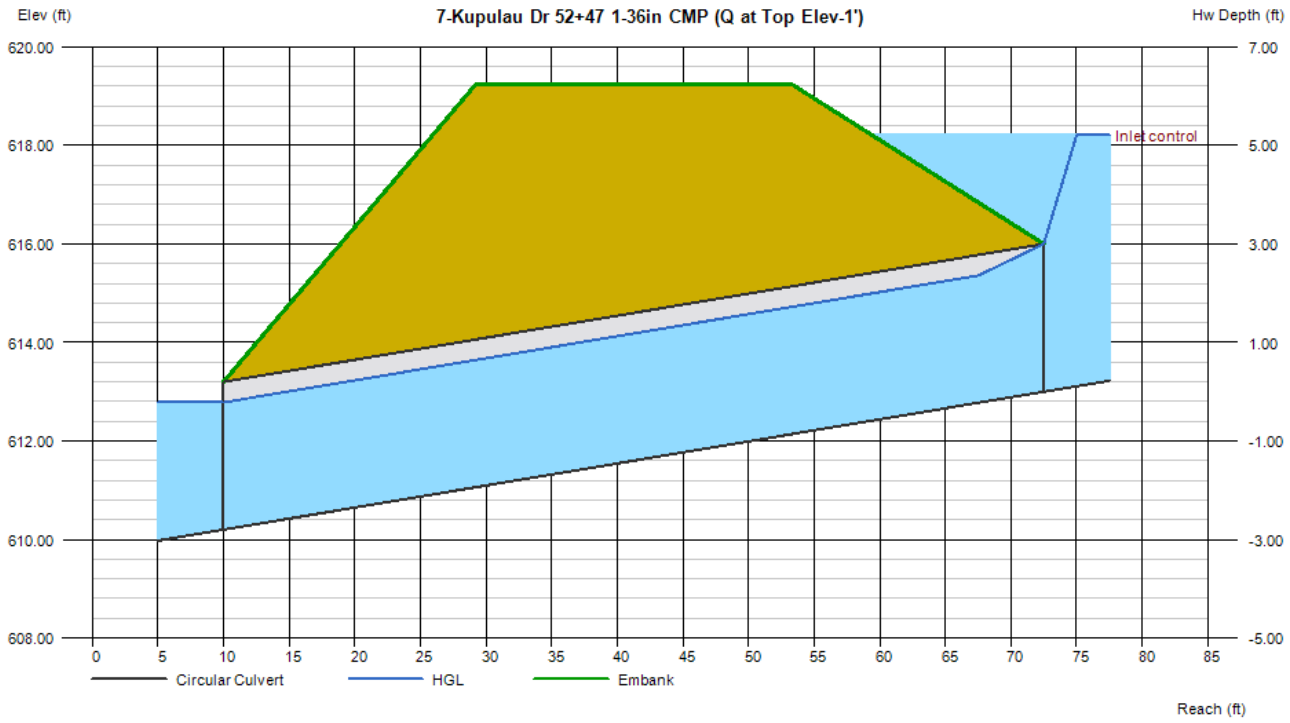
Top Elevation (ft)	=	619.25
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	65.00
Qmax (cfs)	=	65.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	65.00
Qpipe (cfs)	=	65.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.04
Veloc Up (ft/s)	=	10.04
HGL Dn (ft)	=	612.78
HGL Up (ft)	=	615.58
Hw Elev (ft)	=	618.21
Hw/D (ft)	=	1.74
Flow Regime	=	Inlet Control



Culvert Report

8-Kumulani Dr 4+97 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	639.90
Pipe Length (ft)	=	61.00
Slope (%)	=	7.05
Invert Elev Up (ft)	=	644.20
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

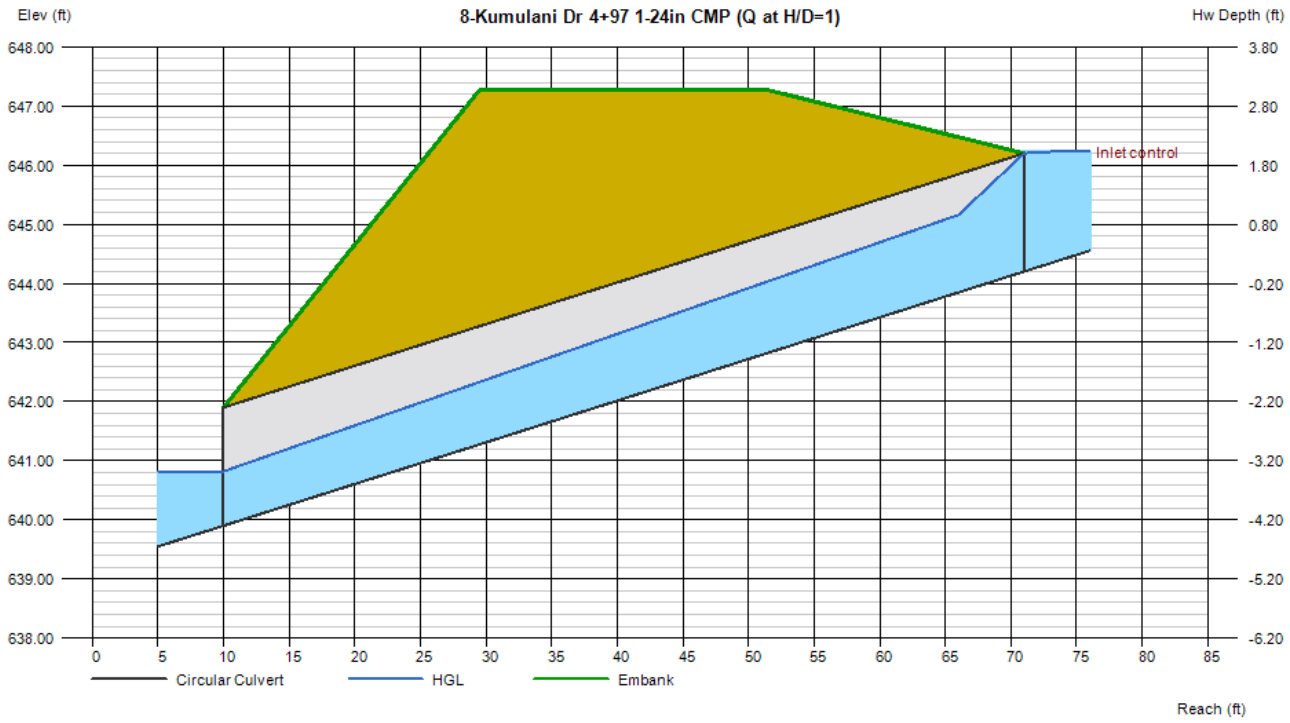
Top Elevation (ft)	=	647.27
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	14.00
Qmax (cfs)	=	14.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	14.00
Qpipe (cfs)	=	14.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.93
Veloc Up (ft/s)	=	6.22
HGL Dn (ft)	=	640.82
HGL Up (ft)	=	645.55
Hw Elev (ft)	=	646.23
Hw/D (ft)	=	1.02
Flow Regime	=	Inlet Control



Culvert Report

9-Kumulani Dr 7+36 1-24in CMP (Q at Top Elev-1')

Invert Elev Dn (ft)	=	644.60
Pipe Length (ft)	=	62.50
Slope (%)	=	7.52
Invert Elev Up (ft)	=	649.30
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Headwall
Coeff. K,M,c,Y,k	=	0.0078, 2, 0.0379, 0.69, 0.5

Embankment

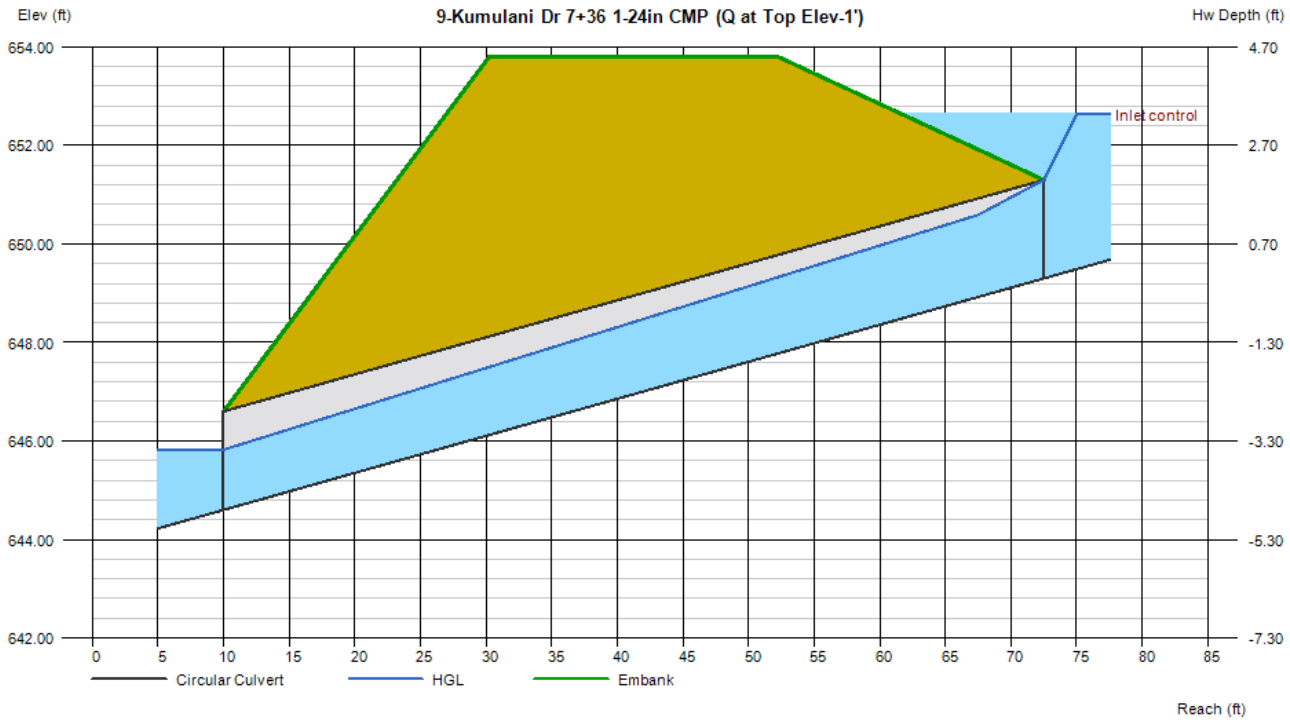
Top Elevation (ft)	=	653.80
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	23.00
Qmax (cfs)	=	23.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	23.00
Qpipe (cfs)	=	23.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	11.43
Veloc Up (ft/s)	=	8.06
HGL Dn (ft)	=	645.82
HGL Up (ft)	=	651.01
Hw Elev (ft)	=	652.64
Hw/D (ft)	=	1.67
Flow Regime	=	Inlet Control



OPTION 2 CULVERTS

Culvert Report

10-Kumulani Dr 11+41 Q50 1hr

Invert Elev Dn (ft)	=	649.70
Pipe Length (ft)	=	56.00
Slope (%)	=	5.89
Invert Elev Up (ft)	=	653.00
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

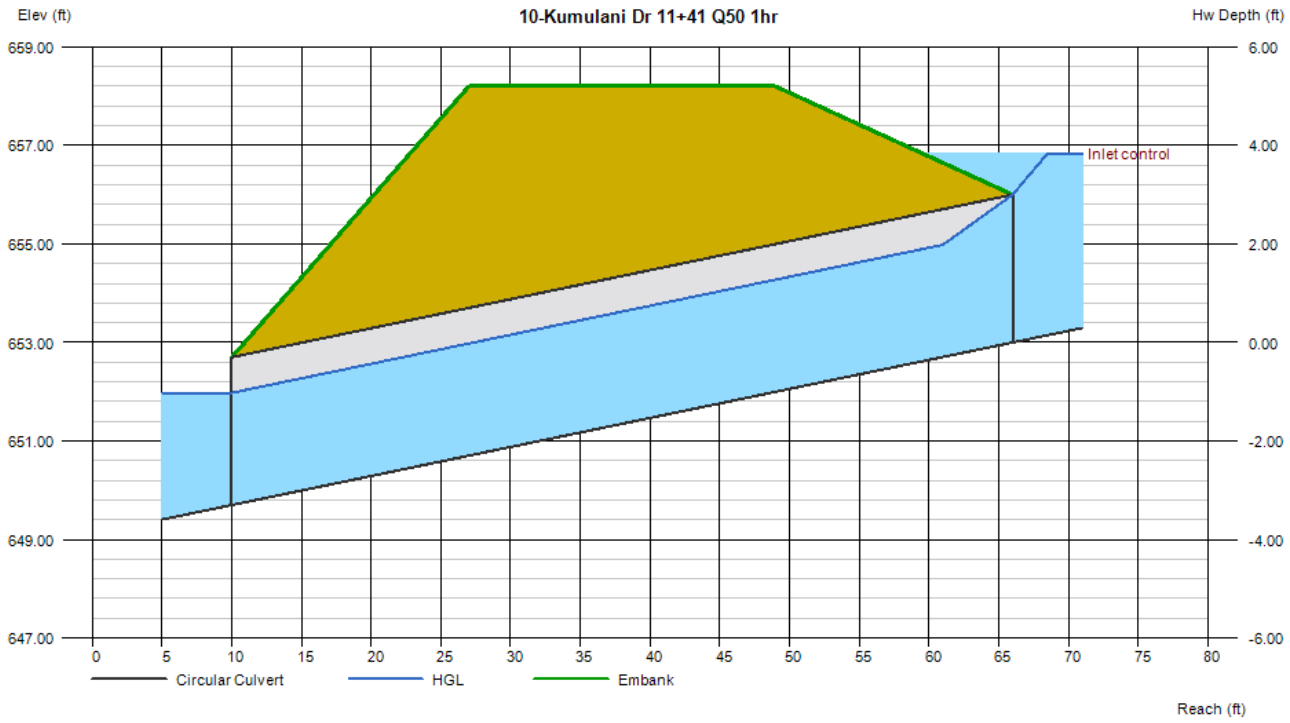
Top Elevation (ft)	=	658.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	49.00
Qmax (cfs)	=	49.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	49.00
Qpipe (cfs)	=	49.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.51
Veloc Up (ft/s)	=	8.51
HGL Dn (ft)	=	651.98
HGL Up (ft)	=	655.28
Hw Elev (ft)	=	656.83
Hw/D (ft)	=	1.28
Flow Regime	=	Inlet Control



Culvert Report

11-Kumulani Dr 17+46 Q100 24hr

Invert Elev Dn (ft)	=	640.00
Pipe Length (ft)	=	76.00
Slope (%)	=	0.26
Invert Elev Up (ft)	=	640.20
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	144.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

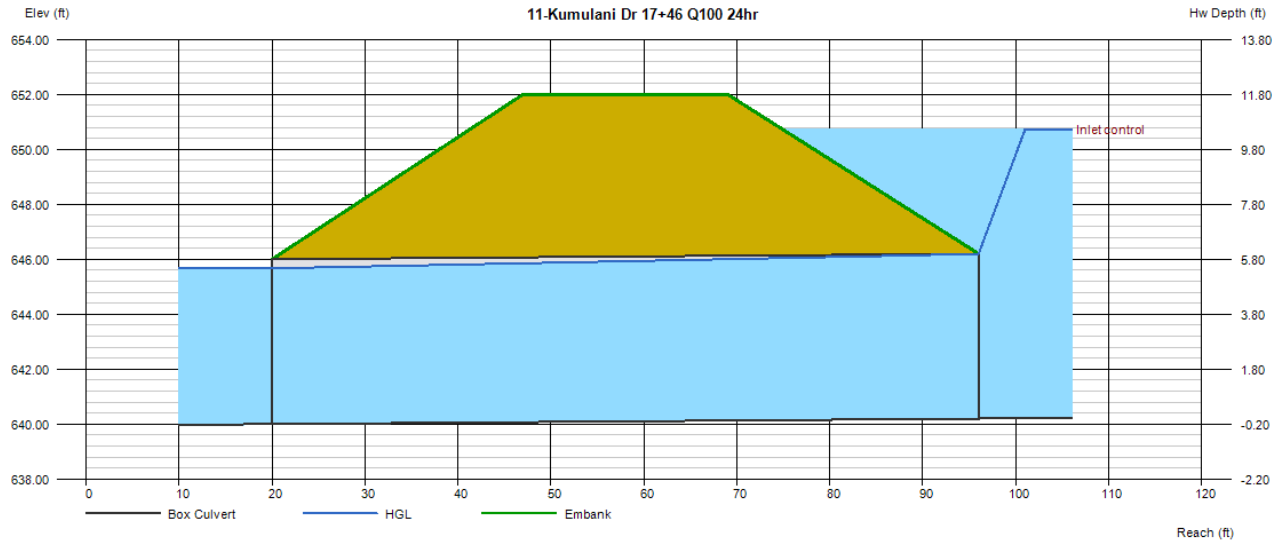
Top Elevation (ft)	=	652.00
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	921.00
Qmax (cfs)	=	921.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	921.00
Qpipe (cfs)	=	921.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	13.54
Veloc Up (ft/s)	=	12.81
HGL Dn (ft)	=	645.67
HGL Up (ft)	=	646.19
Hw Elev (ft)	=	650.73
Hw/D (ft)	=	1.75
Flow Regime	=	Inlet Control



Culvert Report

14-Nahenahe Pl 4+42 Q100 24hr

Invert Elev Dn (ft)	=	445.80
Pipe Length (ft)	=	75.00
Slope (%)	=	9.87
Invert Elev Up (ft)	=	453.20
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

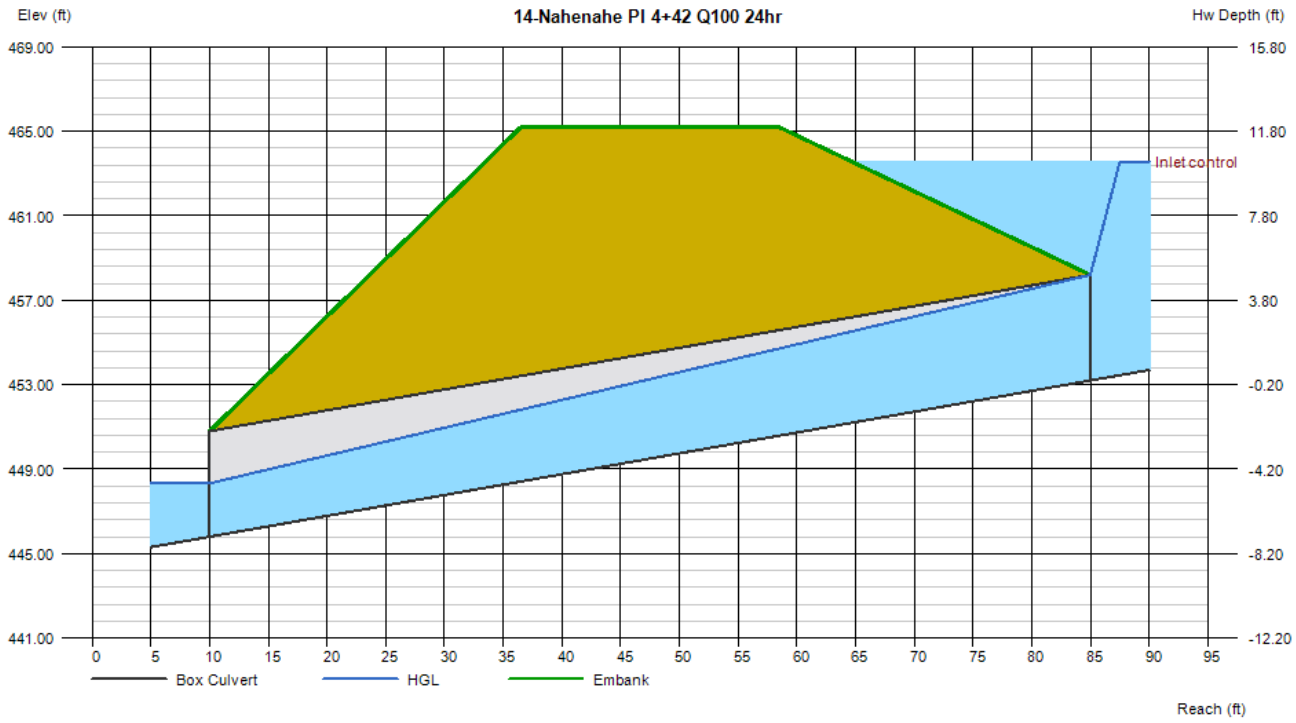
Top Elevation (ft)	=	465.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	687.00
Qmax (cfs)	=	687.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	687.00
Qpipe (cfs)	=	687.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	27.15
Veloc Up (ft/s)	=	13.74
HGL Dn (ft)	=	448.33
HGL Up (ft)	=	458.20
Hw Elev (ft)	=	463.55
Hw/D (ft)	=	2.07
Flow Regime	=	Inlet Control



Culvert Report

15-Keha Drive Q100 24hr

Invert Elev Dn (ft)	=	495.80
Pipe Length (ft)	=	52.00
Slope (%)	=	4.04
Invert Elev Up (ft)	=	497.90
Rise (in)	=	84.0
Shape	=	Box
Span (in)	=	276.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

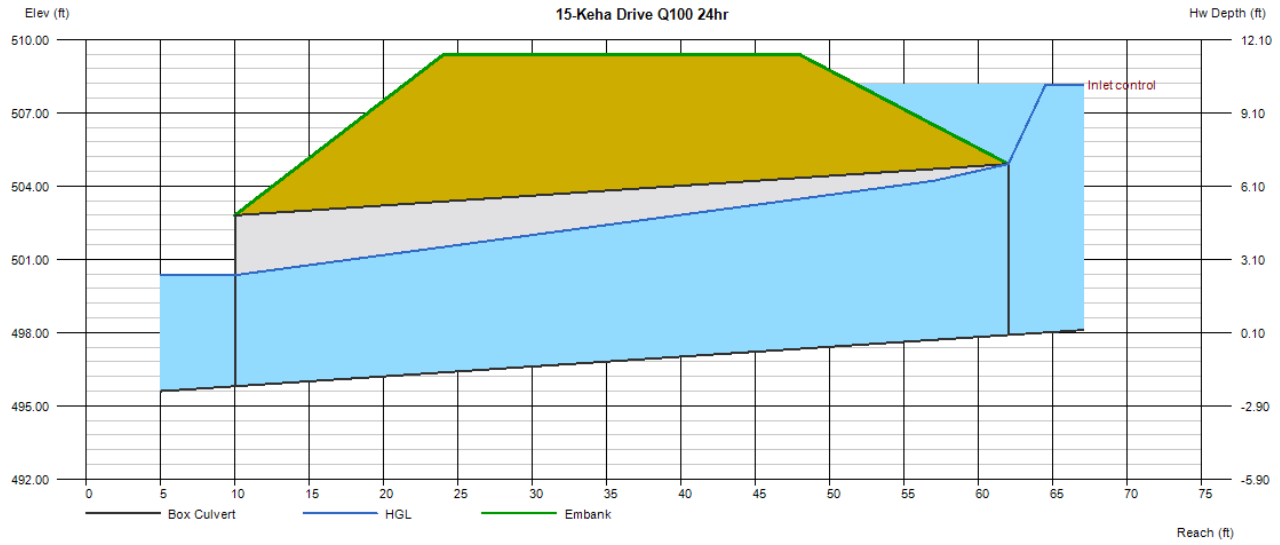
Top Elevation (ft)	=	509.37
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2282.00
Qmax (cfs)	=	2282.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	2282.00
Qpipe (cfs)	=	2282.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	21.81
Veloc Up (ft/s)	=	14.75
HGL Dn (ft)	=	500.35
HGL Up (ft)	=	504.63
Hw Elev (ft)	=	508.14
Hw/D (ft)	=	1.46
Flow Regime	=	Inlet Control



Culvert Report

17-Keha Dr 18+84 Q50 1hr

Invert Elev Dn (ft)	=	487.10
Pipe Length (ft)	=	68.00
Slope (%)	=	13.82
Invert Elev Up (ft)	=	496.50
Rise (in)	=	54.0
Shape	=	Circular
Span (in)	=	54.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

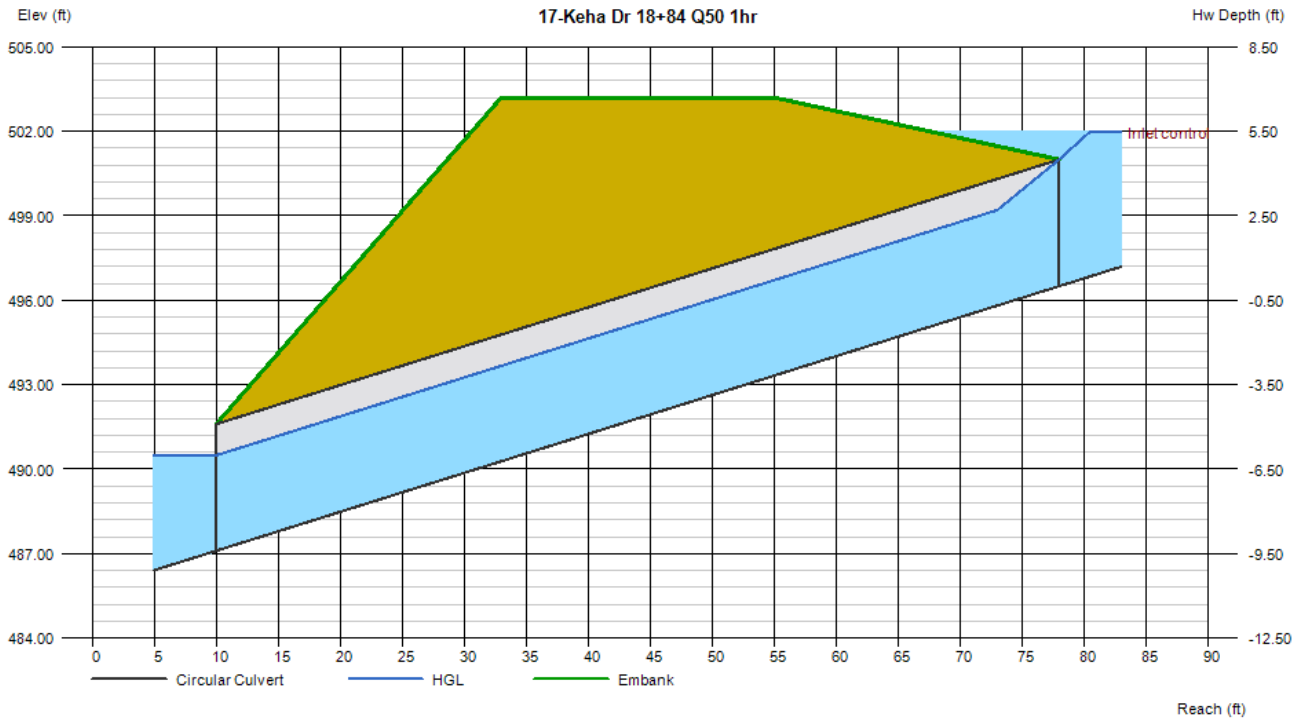
Top Elevation (ft)	=	503.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	133.00
Qmax (cfs)	=	133.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	133.00
Qpipe (cfs)	=	133.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.35
Veloc Up (ft/s)	=	10.35
HGL Dn (ft)	=	490.49
HGL Up (ft)	=	499.89
Hw Elev (ft)	=	501.99
Hw/D (ft)	=	1.22
Flow Regime	=	Inlet Control



Culvert Report

18-Lanina Place Q100 24hr

Invert Elev Dn (ft)	=	522.80
Pipe Length (ft)	=	65.00
Slope (%)	=	3.85
Invert Elev Up (ft)	=	525.30
Rise (in)	=	84.0
Shape	=	Box
Span (in)	=	276.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

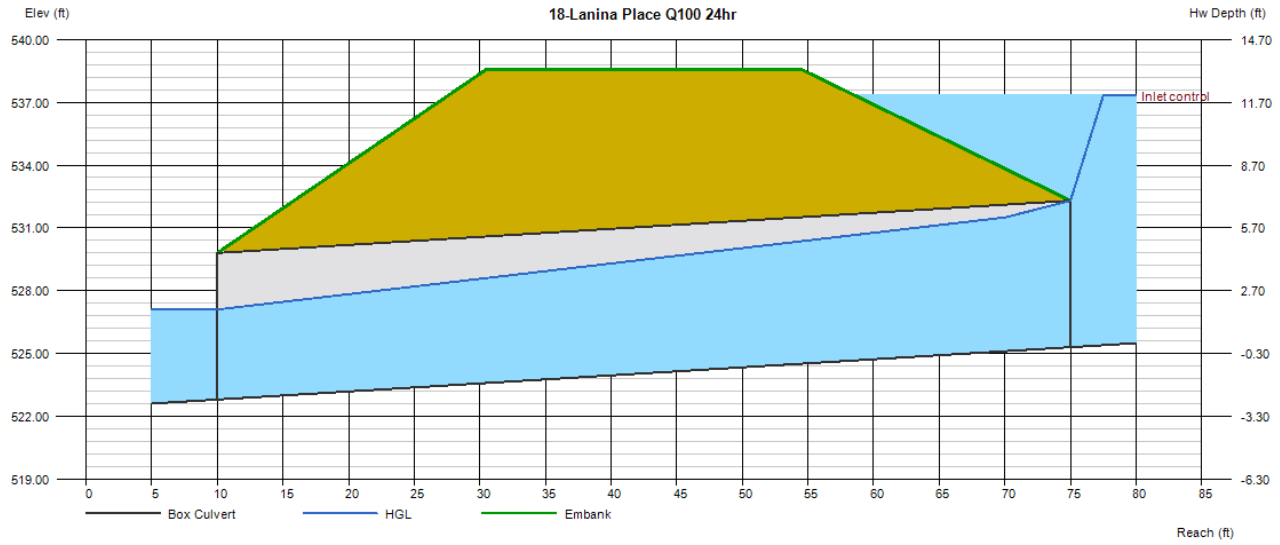
Top Elevation (ft)	=	538.57
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2201.00
Qmax (cfs)	=	2201.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	2201.00
Qpipe (cfs)	=	2201.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	22.25
Veloc Up (ft/s)	=	14.57
HGL Dn (ft)	=	527.10
HGL Up (ft)	=	531.87
Hw Elev (ft)	=	537.32
Hw/D (ft)	=	1.72
Flow Regime	=	Inlet Control



Culvert Report

19-Lanina Place 5+28W Q100 24hr

Invert Elev Dn (ft)	=	539.40
Pipe Length (ft)	=	54.00
Slope (%)	=	2.22
Invert Elev Up (ft)	=	540.60
Rise (in)	=	54.0
Shape	=	Circular
Span (in)	=	54.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

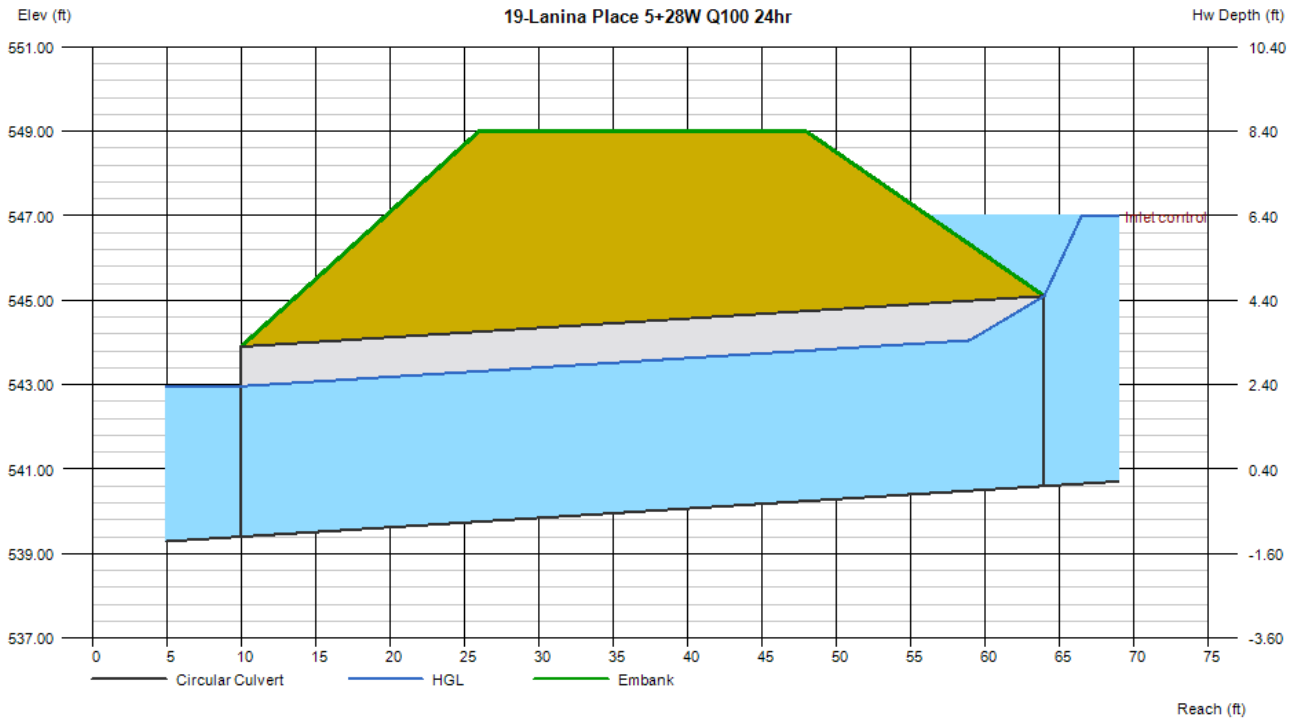
Top Elevation (ft)	=	549.00
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	295.00
Qmax (cfs)	=	295.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	295.00
Qpipe (cfs)	=	295.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.92
Veloc Up (ft/s)	=	10.92
HGL Dn (ft)	=	542.96
HGL Up (ft)	=	544.16
Hw Elev (ft)	=	546.99
Hw/D (ft)	=	1.42
Flow Regime	=	Inlet Control



Culvert Report

21-Hookpia Place 5+21.89 Q100 24hr

Invert Elev Dn (ft)	=	522.00
Pipe Length (ft)	=	62.00
Slope (%)	=	3.87
Invert Elev Up (ft)	=	524.40
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	156.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

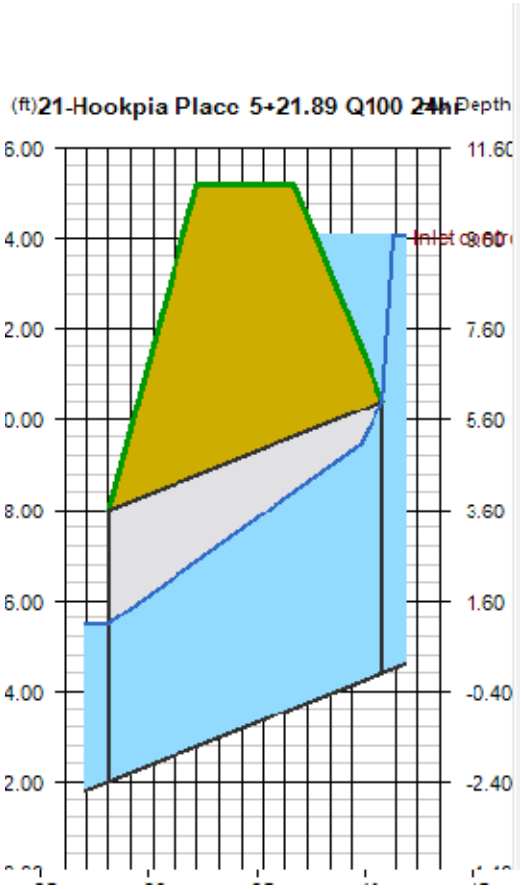
Top Elevation (ft)	=	535.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	928.00
Qmax (cfs)	=	928.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	928.00
Qpipe (cfs)	=	928.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	20.51
Veloc Up (ft/s)	=	13.21
HGL Dn (ft)	=	525.48
HGL Up (ft)	=	529.80
Hw Elev (ft)	=	534.06
Hw/D (ft)	=	1.61
Flow Regime	=	Inlet Control



Culvert Report

22-Hookpia Place 12+10 Q50 1hr

Invert Elev Dn (ft)	=	566.00
Pipe Length (ft)	=	60.00
Slope (%)	=	18.00
Invert Elev Up (ft)	=	576.80
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

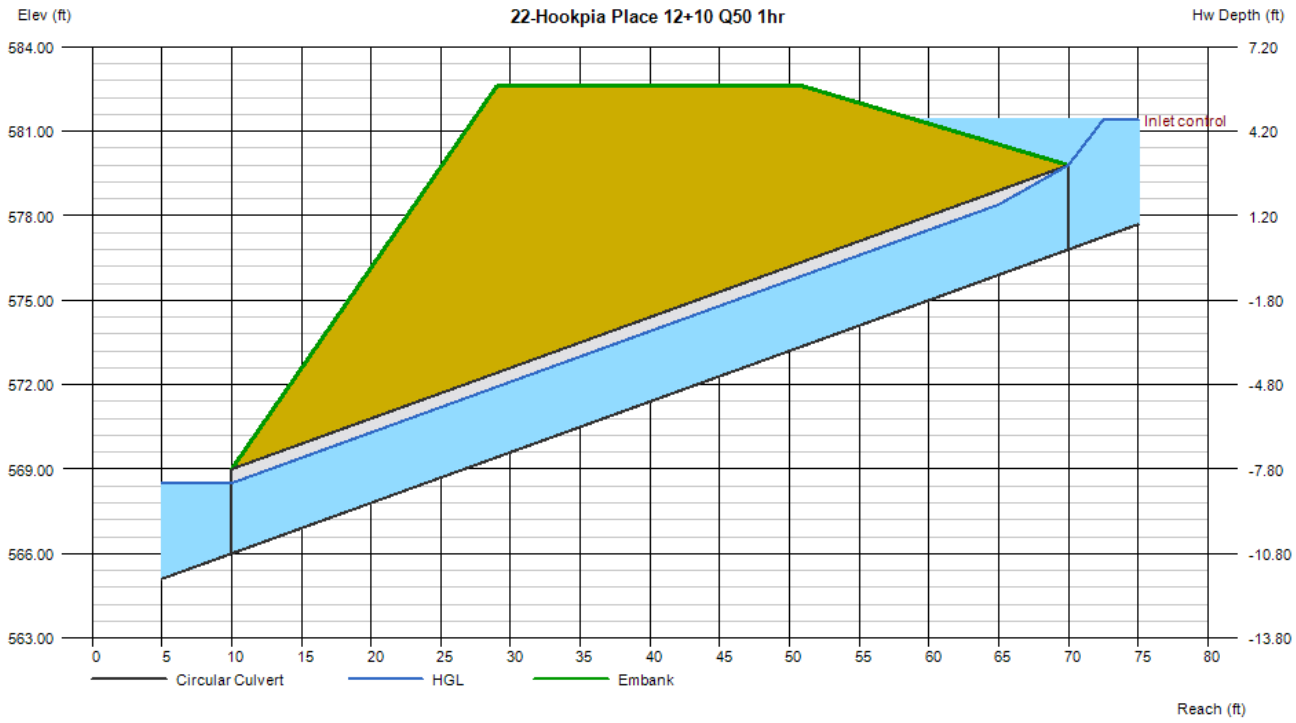
Top Elevation (ft)	=	582.60
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	60.00
Qmax (cfs)	=	60.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	60.00
Qpipe (cfs)	=	60.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.53
Veloc Up (ft/s)	=	9.53
HGL Dn (ft)	=	568.50
HGL Up (ft)	=	579.30
Hw Elev (ft)	=	581.41
Hw/D (ft)	=	1.54
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Apr 9 2019

P-24 Wailea Place Q100 24hr

Invert Elev Dn (ft)	=	449.00
Pipe Length (ft)	=	52.00
Slope (%)	=	9.42
Invert Elev Up (ft)	=	453.90
Rise (in)	=	84.0
Shape	=	Box
Span (in)	=	276.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

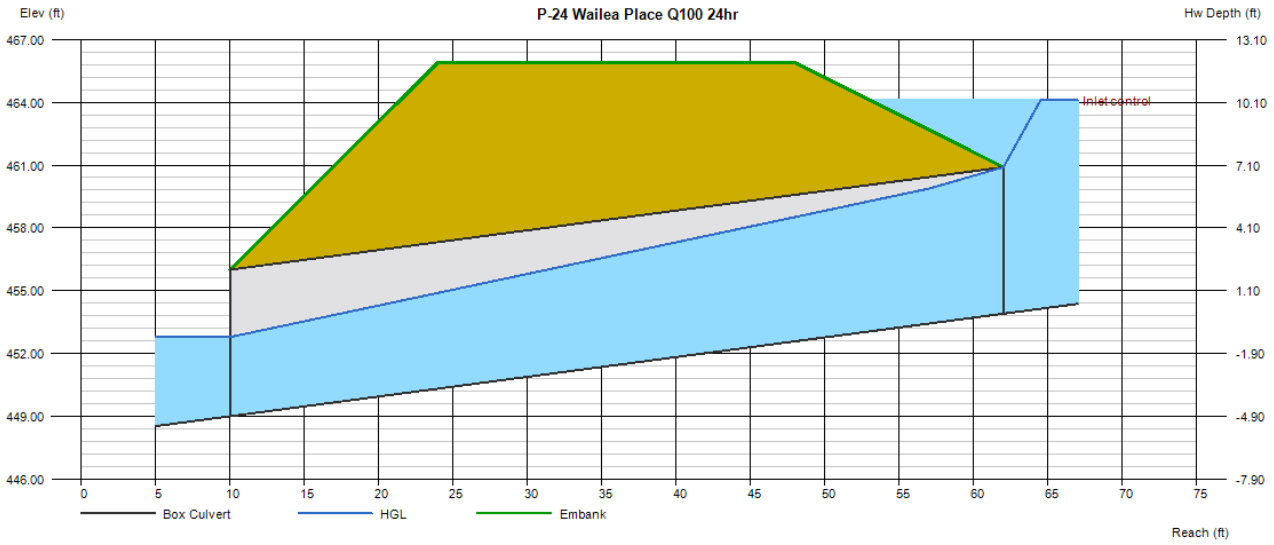
Top Elevation (ft)	=	465.90
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2285.00
Qmax (cfs)	=	2285.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	2285.00
Qpipe (cfs)	=	2285.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	26.28
Veloc Up (ft/s)	=	14.76
HGL Dn (ft)	=	452.78
HGL Up (ft)	=	460.63
Hw Elev (ft)	=	464.09
Hw/D (ft)	=	1.46
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 5 2019

25-Kaapuni Place (Lot 218) Q100 24hr

Invert Elev Dn (ft)	=	577.00
Pipe Length (ft)	=	24.00
Slope (%)	=	4.17
Invert Elev Up (ft)	=	578.00
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	84.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

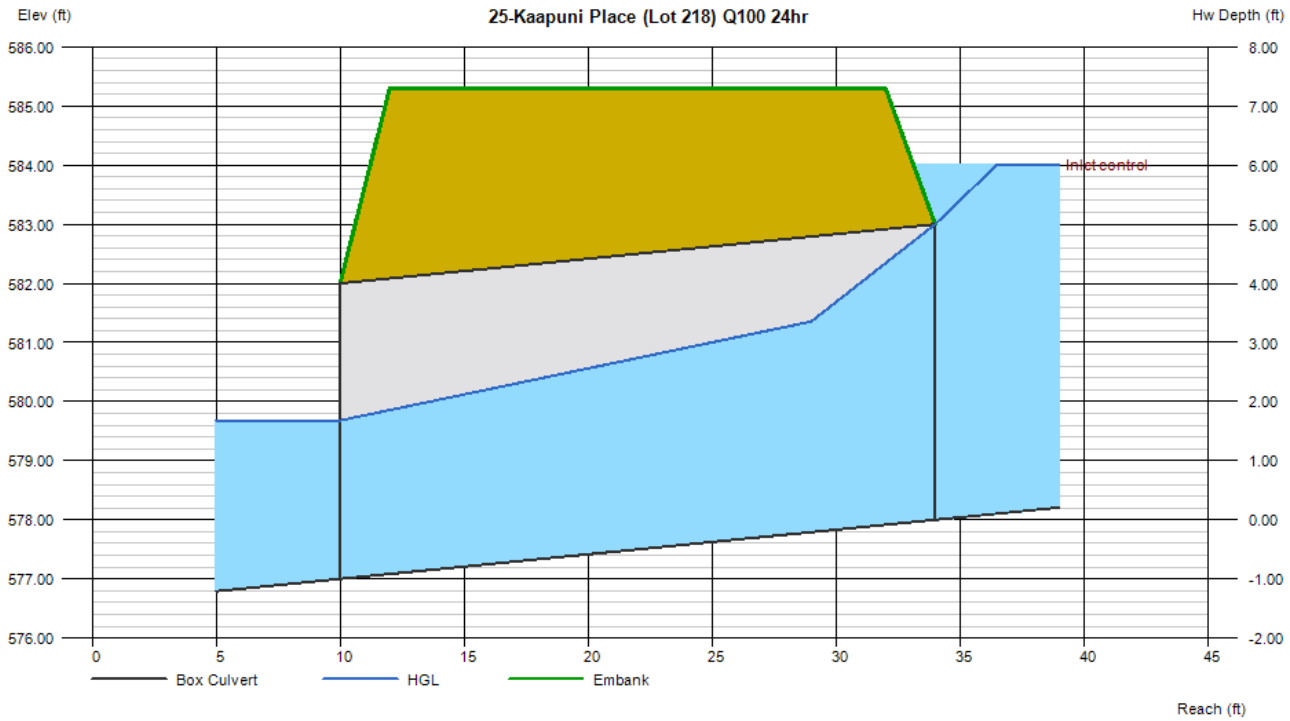
Top Elevation (ft)	=	585.30
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	294.00
Qmax (cfs)	=	294.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	294.00
Qpipe (cfs)	=	294.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	15.67
Veloc Up (ft/s)	=	11.07
HGL Dn (ft)	=	579.68
HGL Up (ft)	=	581.79
Hw Elev (ft)	=	584.01
Hw/D (ft)	=	1.20
Flow Regime	=	Inlet Control



Culvert Report

26-Mililani Place 16+91 Q100 24hr

Invert Elev Dn (ft)	=	412.20
Pipe Length (ft)	=	59.00
Slope (%)	=	1.36
Invert Elev Up (ft)	=	413.00
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

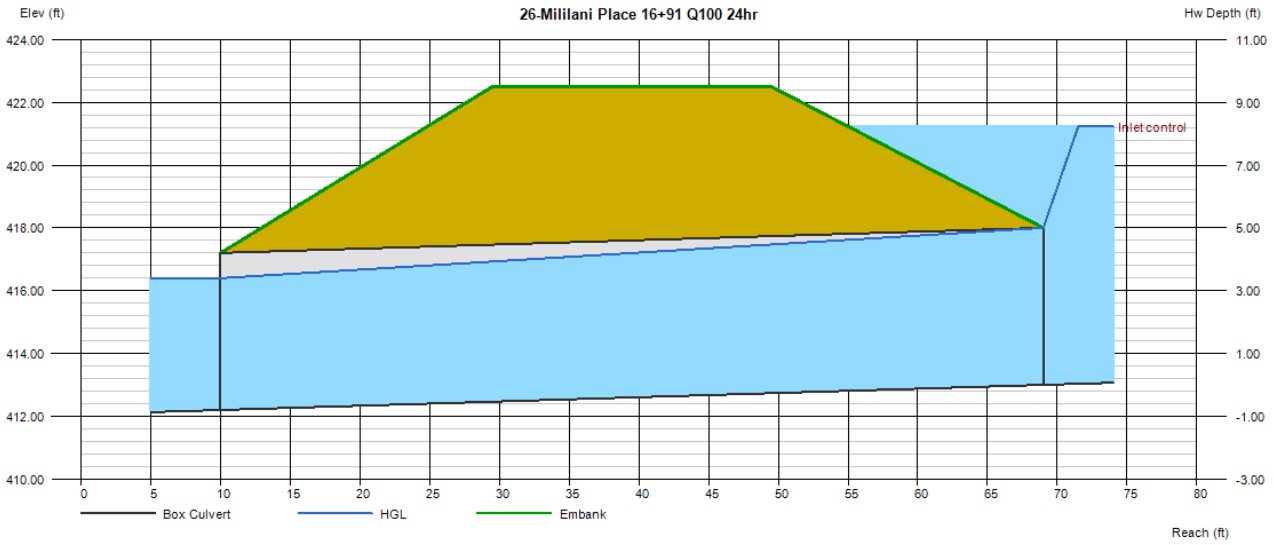
Top Elevation (ft)	=	422.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	690.00
Qmax (cfs)	=	690.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	690.00
Qpipe (cfs)	=	690.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	16.43
Veloc Up (ft/s)	=	13.80
HGL Dn (ft)	=	416.40
HGL Up (ft)	=	418.00
Hw Elev (ft)	=	421.23
Hw/D (ft)	=	1.64
Flow Regime	=	Inlet Control



Culvert Report

27-Kuaua Place 32+70.80 Q50 1hr

Invert Elev Dn (ft)	=	403.00
Pipe Length (ft)	=	57.00
Slope (%)	=	1.93
Invert Elev Up (ft)	=	404.10
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

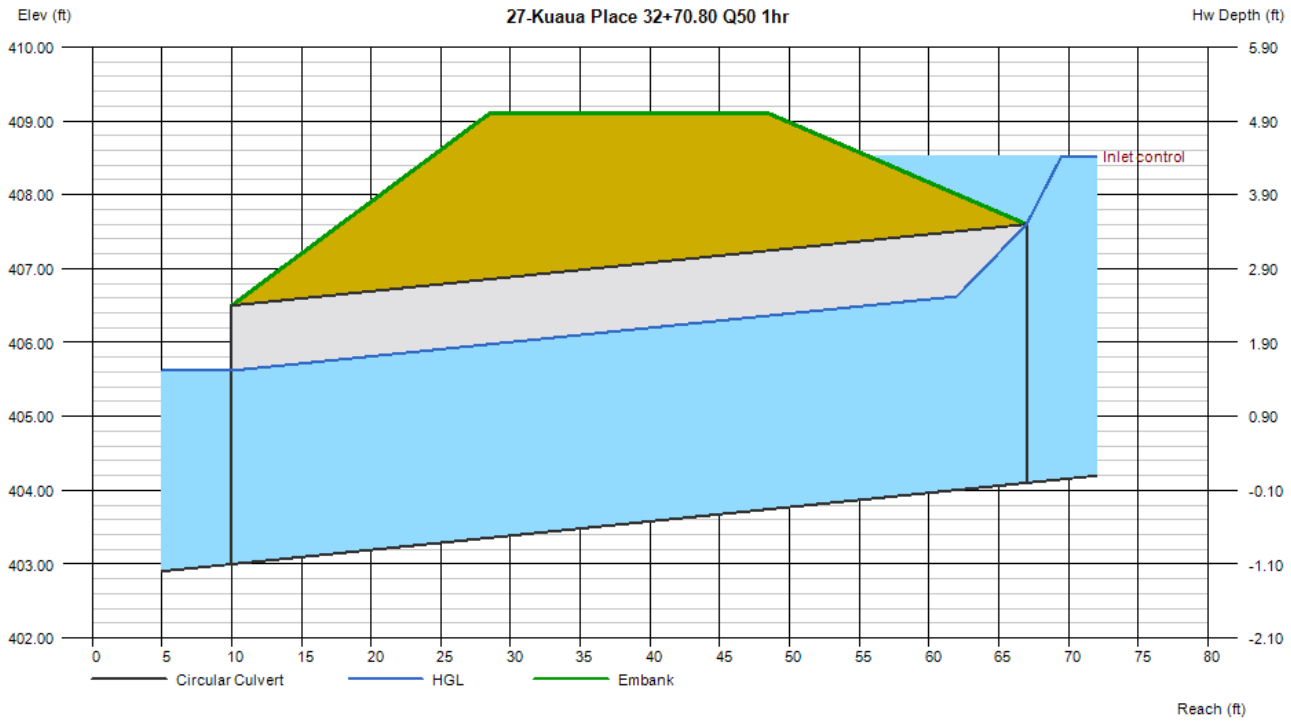
Top Elevation (ft)	=	409.10
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	70.00
Qmax (cfs)	=	70.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	70.00
Qpipe (cfs)	=	70.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.06
Veloc Up (ft/s)	=	9.06
HGL Dn (ft)	=	405.62
HGL Up (ft)	=	406.72
Hw Elev (ft)	=	408.52
Hw/D (ft)	=	1.26
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Apr 9 2019

29-Malina Place 48+01 Q100 24hr

Invert Elev Dn (ft)	=	448.30
Pipe Length (ft)	=	51.50
Slope (%)	=	2.52
Invert Elev Up (ft)	=	449.60
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	156.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

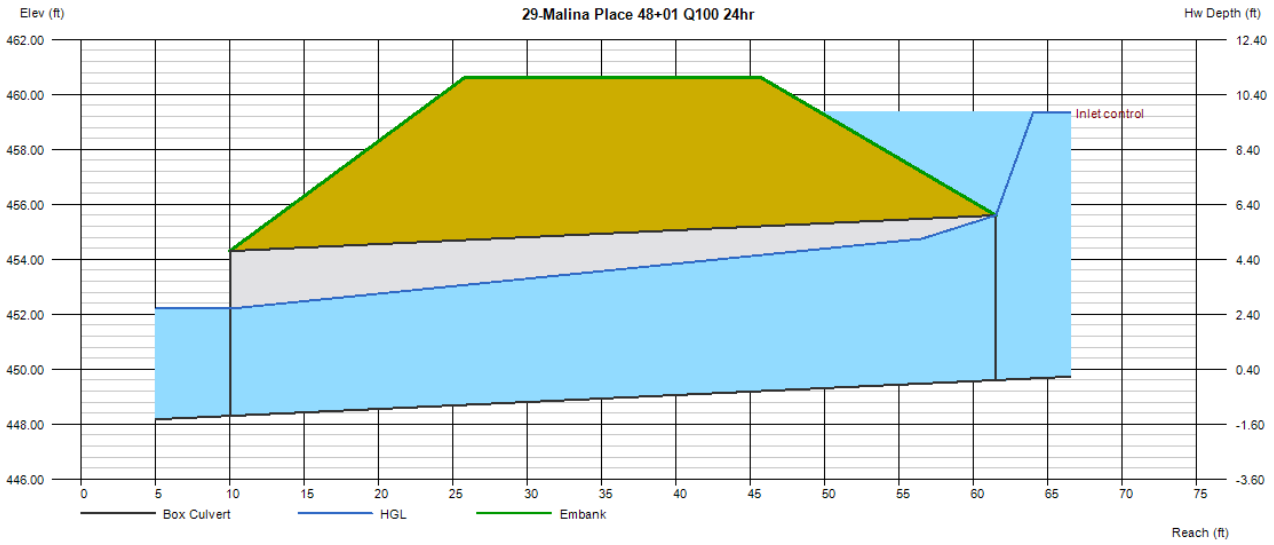
Top Elevation (ft)	=	460.60
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	932.00
Qmax (cfs)	=	932.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	932.00
Qpipe (cfs)	=	932.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	18.38
Veloc Up (ft/s)	=	13.23
HGL Dn (ft)	=	452.20
HGL Up (ft)	=	455.02
Hw Elev (ft)	=	459.34
Hw/D (ft)	=	1.62
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Apr 9 2019

3-Kupulau Drive Q100 24hr

Invert Elev Dn (ft)	=	585.40
Pipe Length (ft)	=	52.00
Slope (%)	=	8.08
Invert Elev Up (ft)	=	589.60
Rise (in)	=	84.0
Shape	=	Box
Span (in)	=	228.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

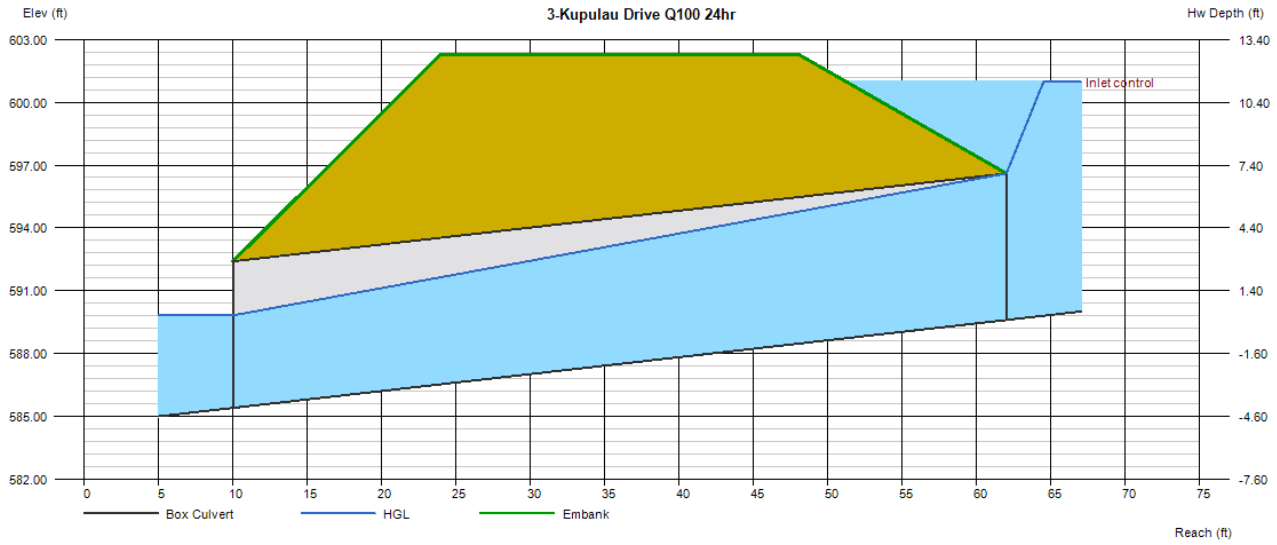
Top Elevation (ft)	=	602.30
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2194.00
Qmax (cfs)	=	2194.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	2194.00
Qpipe (cfs)	=	2194.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	26.13
Veloc Up (ft/s)	=	16.50
HGL Dn (ft)	=	589.82
HGL Up (ft)	=	596.60
Hw Elev (ft)	=	600.98
Hw/D (ft)	=	1.63
Flow Regime	=	Inlet Control



Culvert Report

31-Mapu Place 12+99 Q50 1hr

Invert Elev Dn (ft)	=	292.40
Pipe Length (ft)	=	54.00
Slope (%)	=	1.30
Invert Elev Up (ft)	=	293.10
Rise (in)	=	54.0
Shape	=	Circular
Span (in)	=	54.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

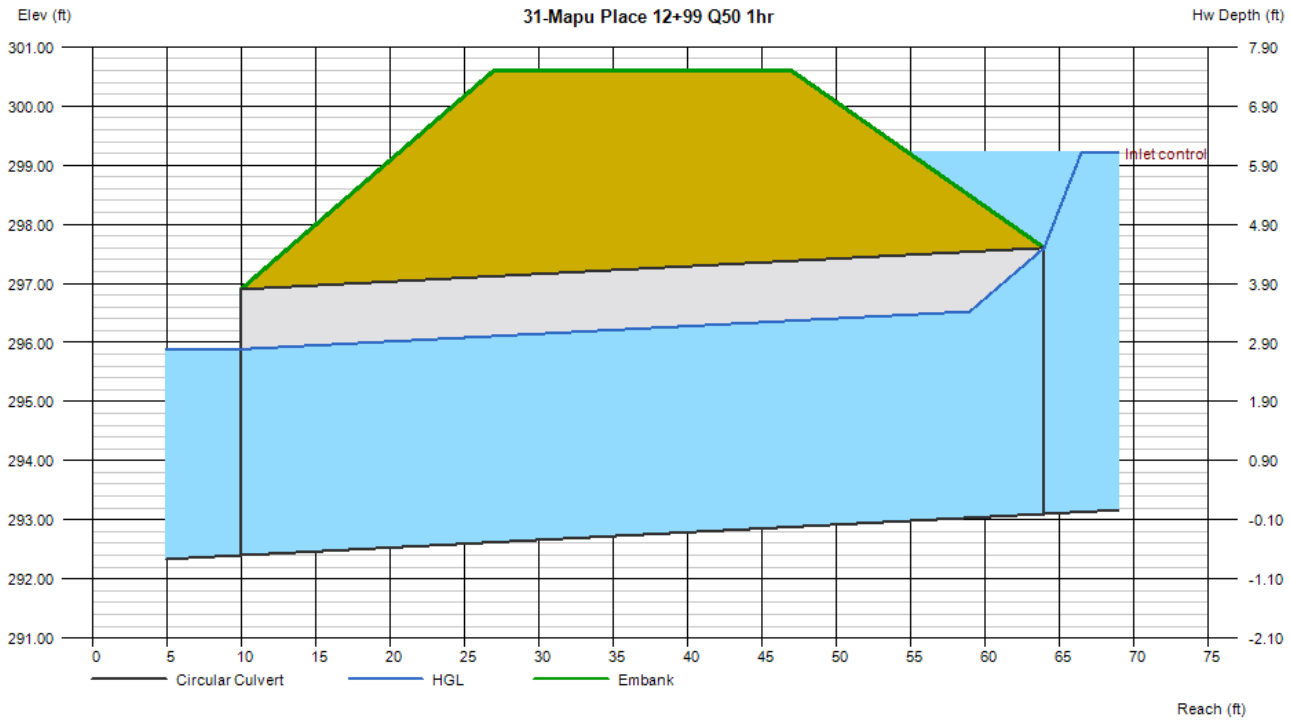
Top Elevation (ft)	=	300.60
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	141.00
Qmax (cfs)	=	141.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	141.00
Qpipe (cfs)	=	141.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.66
Veloc Up (ft/s)	=	10.66
HGL Dn (ft)	=	295.89
HGL Up (ft)	=	296.59
Hw Elev (ft)	=	299.21
Hw/D (ft)	=	1.36
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 12 2019

32-Mapu Place 20+64 Q100 24hr

Invert Elev Dn (ft)	=	315.50
Pipe Length (ft)	=	53.00
Slope (%)	=	0.94
Invert Elev Up (ft)	=	316.00
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

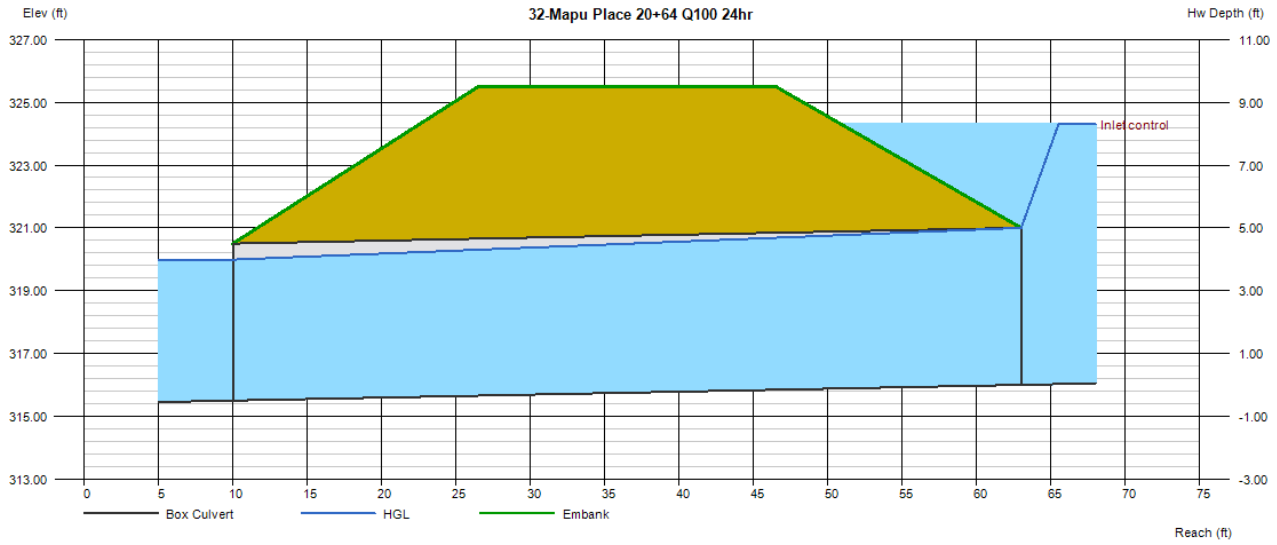
Top Elevation (ft)	=	325.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	696.00
Qmax (cfs)	=	696.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	696.00
Qpipe (cfs)	=	696.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	15.50
Veloc Up (ft/s)	=	13.92
HGL Dn (ft)	=	319.99
HGL Up (ft)	=	321.00
Hw Elev (ft)	=	324.29
Hw/D (ft)	=	1.66
Flow Regime	=	Inlet Control



Culvert Report

33-Akala Dr 7+82 Q100 24hr

Invert Elev Dn (ft)	=	263.00
Pipe Length (ft)	=	54.00
Slope (%)	=	3.33
Invert Elev Up (ft)	=	264.80
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

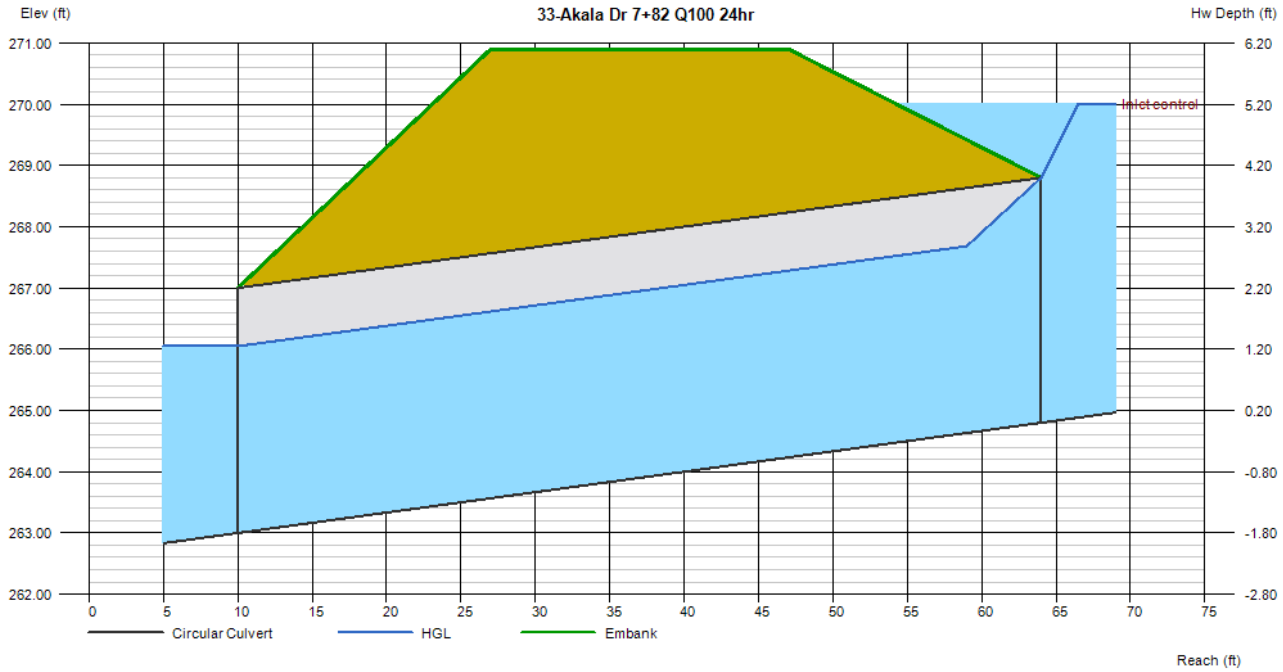
Top Elevation (ft)	=	270.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	203.00
Qmax (cfs)	=	203.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	203.00
Qpipe (cfs)	=	203.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.88
Veloc Up (ft/s)	=	9.88
HGL Dn (ft)	=	266.05
HGL Up (ft)	=	267.85
Hw Elev (ft)	=	270.01
Hw/D (ft)	=	1.30
Flow Regime	=	Inlet Control



Culvert Report

34-Akala Dr 9+96 Q50 1hr

Invert Elev Dn (ft)	=	264.00
Pipe Length (ft)	=	87.00
Slope (%)	=	4.02
Invert Elev Up (ft)	=	267.50
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

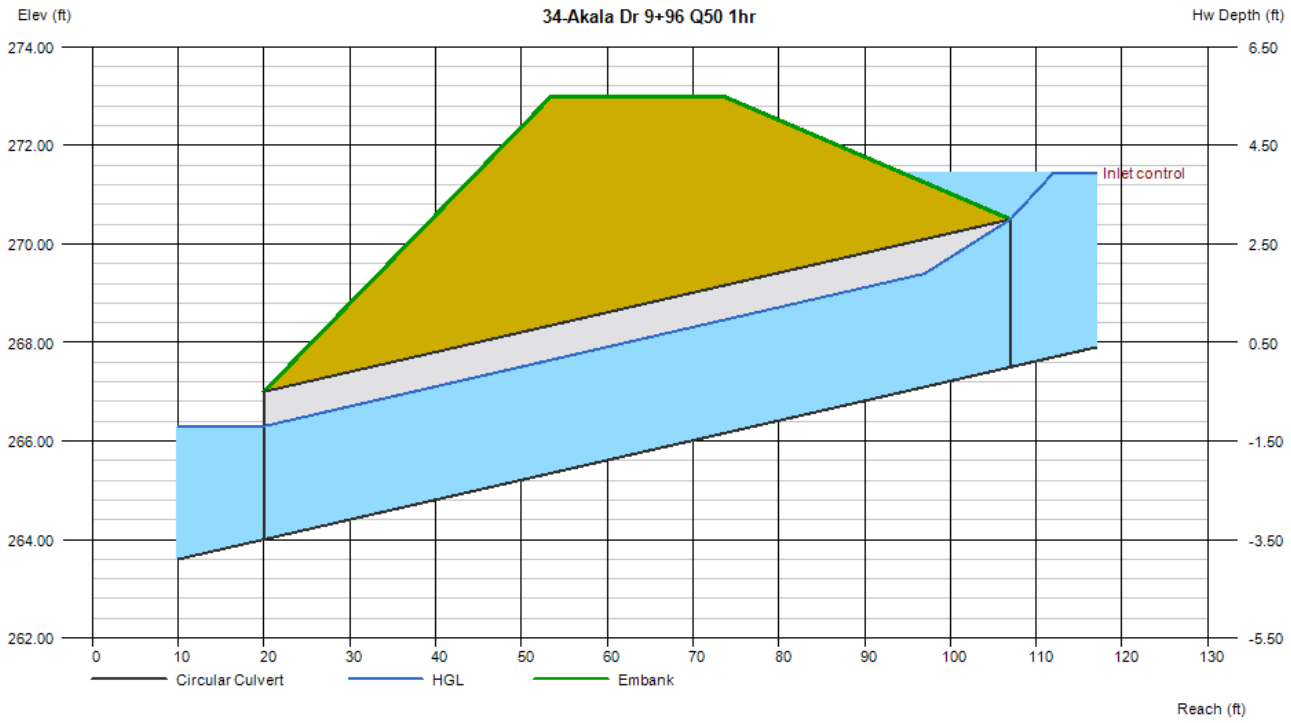
Top Elevation (ft)	=	273.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	50.00
Qmax (cfs)	=	50.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	50.00
Qpipe (cfs)	=	50.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.60
Veloc Up (ft/s)	=	8.60
HGL Dn (ft)	=	266.30
HGL Up (ft)	=	269.80
Hw Elev (ft)	=	271.44
Hw/D (ft)	=	1.31
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 12 2019

35-Akala Dr 14+94 Q100 24hr

Invert Elev Dn (ft)	=	285.00
Pipe Length (ft)	=	65.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	286.30
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

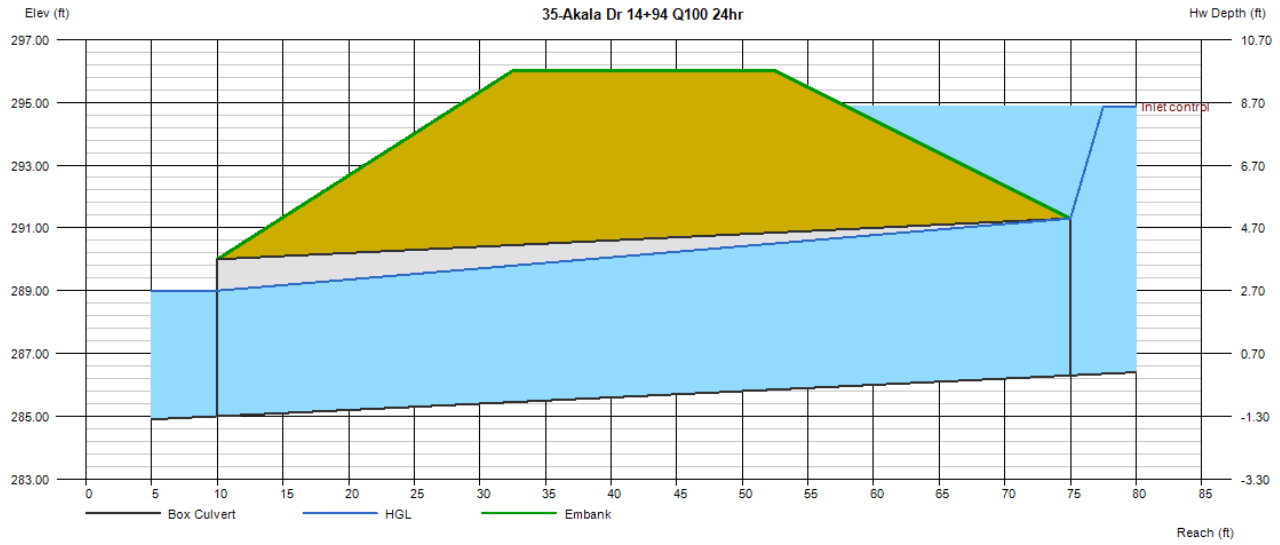
Top Elevation (ft)	=	296.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	725.00
Qmax (cfs)	=	725.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	725.00
Qpipe (cfs)	=	725.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	18.13
Veloc Up (ft/s)	=	14.50
HGL Dn (ft)	=	289.00
HGL Up (ft)	=	291.30
Hw Elev (ft)	=	294.86
Hw/D (ft)	=	1.71
Flow Regime	=	Inlet Control



Culvert Report

36- Akala Drive Q100 24hr

Invert Elev Dn (ft)	=	281.60
Pipe Length (ft)	=	59.00
Slope (%)	=	2.20
Invert Elev Up (ft)	=	282.90
Rise (in)	=	84.0
Shape	=	Box
Span (in)	=	276.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

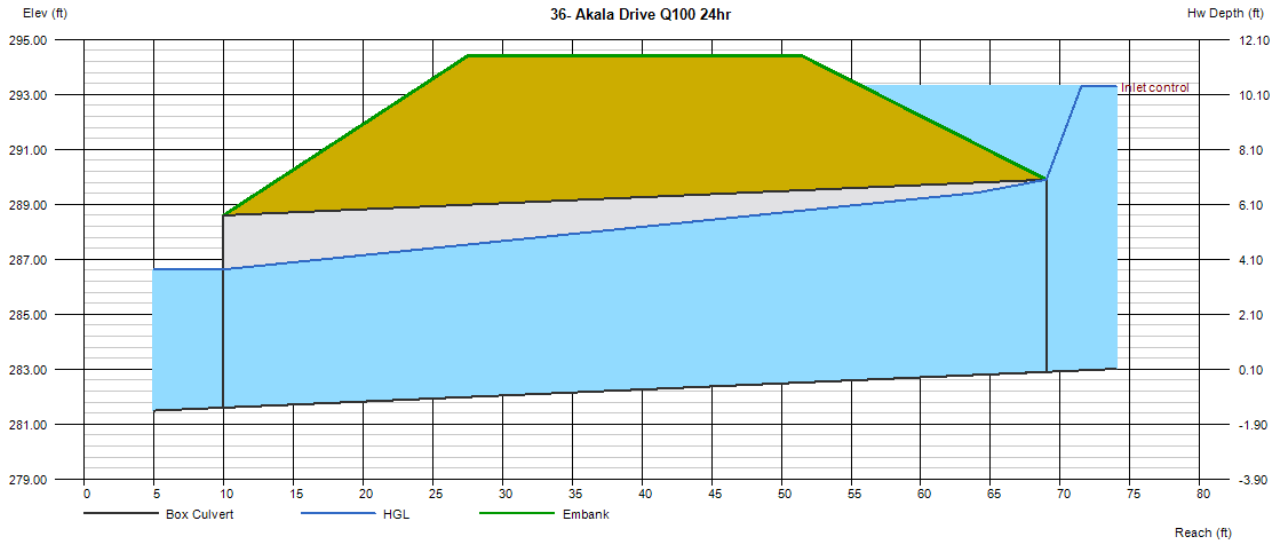
Top Elevation (ft)	=	294.40
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2308.00
Qmax (cfs)	=	2308.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	2308.00
Qpipe (cfs)	=	2308.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	19.95
Veloc Up (ft/s)	=	14.81
HGL Dn (ft)	=	286.63
HGL Up (ft)	=	289.68
Hw Elev (ft)	=	293.29
Hw/D (ft)	=	1.48
Flow Regime	=	Inlet Control



Culvert Report

37-Akala Dr 36+91 Q100 24hr

Invert Elev Dn (ft)	=	294.80
Pipe Length (ft)	=	50.00
Slope (%)	=	0.80
Invert Elev Up (ft)	=	295.20
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	60.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

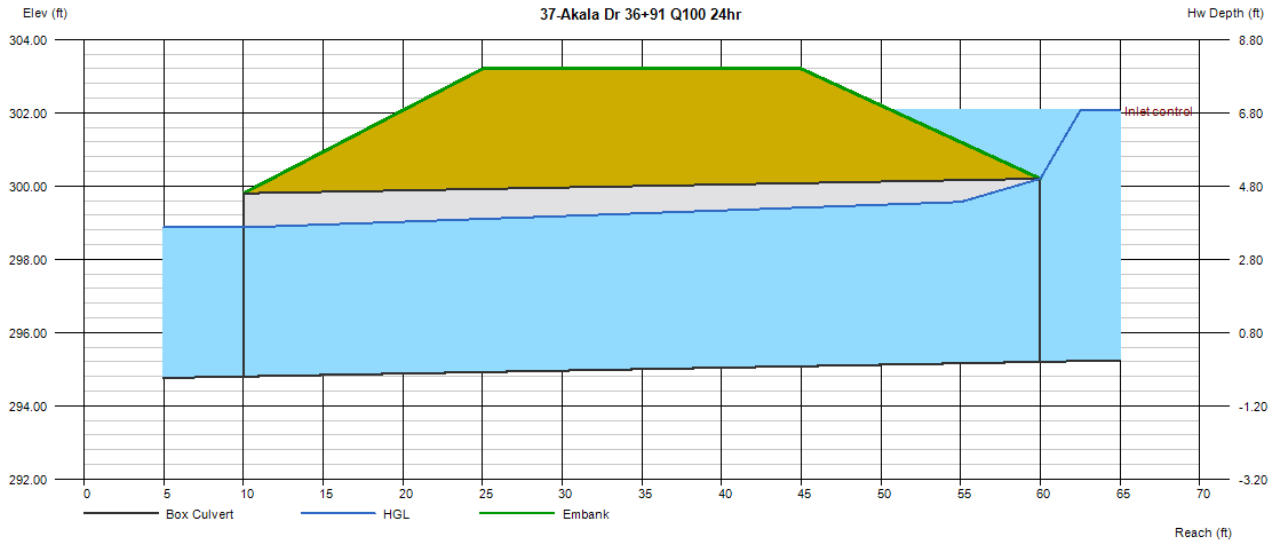
Top Elevation (ft)	=	303.20
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	266.00
Qmax (cfs)	=	266.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	266.00
Qpipe (cfs)	=	266.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	13.07
Veloc Up (ft/s)	=	11.98
HGL Dn (ft)	=	298.87
HGL Up (ft)	=	299.64
Hw Elev (ft)	=	302.06
Hw/D (ft)	=	1.37
Flow Regime	=	Inlet Control



Culvert Report

38-Akala Dr 44+84 Q100 24hr

Invert Elev Dn (ft)	=	311.60
Pipe Length (ft)	=	51.00
Slope (%)	=	2.55
Invert Elev Up (ft)	=	312.90
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	156.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

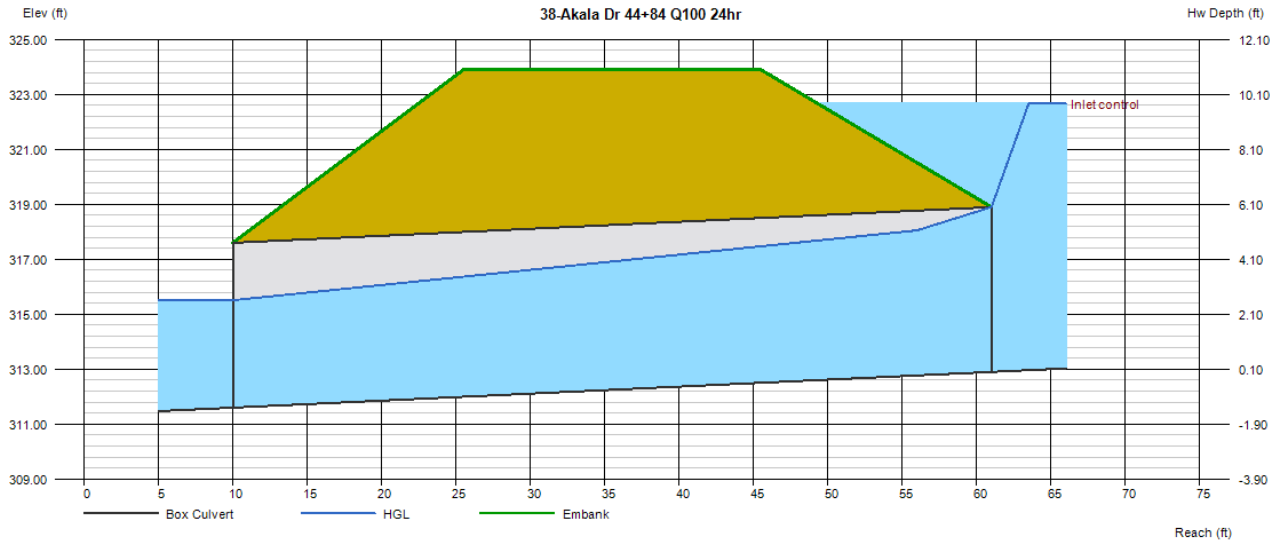
Top Elevation (ft)	=	323.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	935.00
Qmax (cfs)	=	935.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	935.00
Qpipe (cfs)	=	935.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	18.39
Veloc Up (ft/s)	=	13.25
HGL Dn (ft)	=	315.51
HGL Up (ft)	=	318.33
Hw Elev (ft)	=	322.67
Hw/D (ft)	=	1.63
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 5 2019

39-Hoomua Dr 2+34 Q50 1hr

Invert Elev Dn (ft)	=	299.30
Pipe Length (ft)	=	43.50
Slope (%)	=	3.91
Invert Elev Up (ft)	=	301.00
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

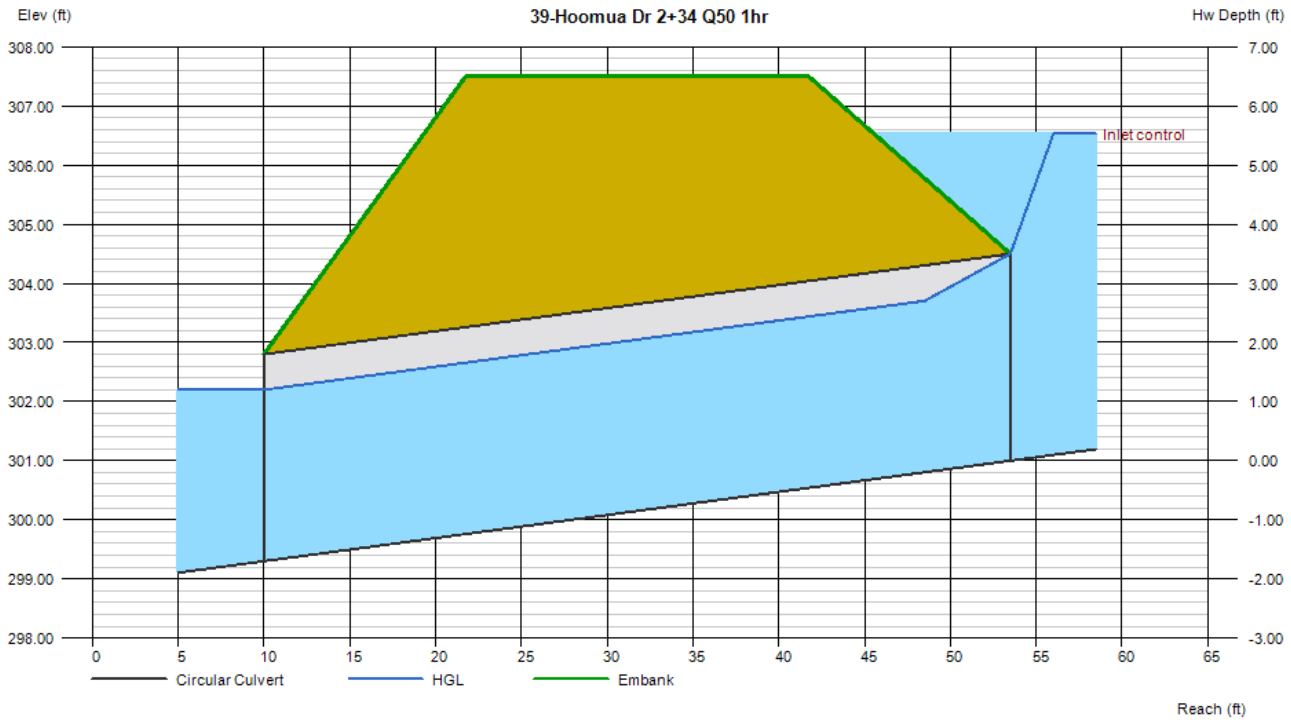
Top Elevation (ft)	=	307.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	87.00
Qmax (cfs)	=	87.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	87.00
Qpipe (cfs)	=	87.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.21
Veloc Up (ft/s)	=	10.21
HGL Dn (ft)	=	302.20
HGL Up (ft)	=	303.90
Hw Elev (ft)	=	306.53
Hw/D (ft)	=	1.58
Flow Regime	=	Inlet Control



Culvert Report

4-Kupulau Dr 36+92 Q100 24hr

Invert Elev Dn (ft)	=	596.20
Pipe Length (ft)	=	54.00
Slope (%)	=	3.15
Invert Elev Up (ft)	=	597.90
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

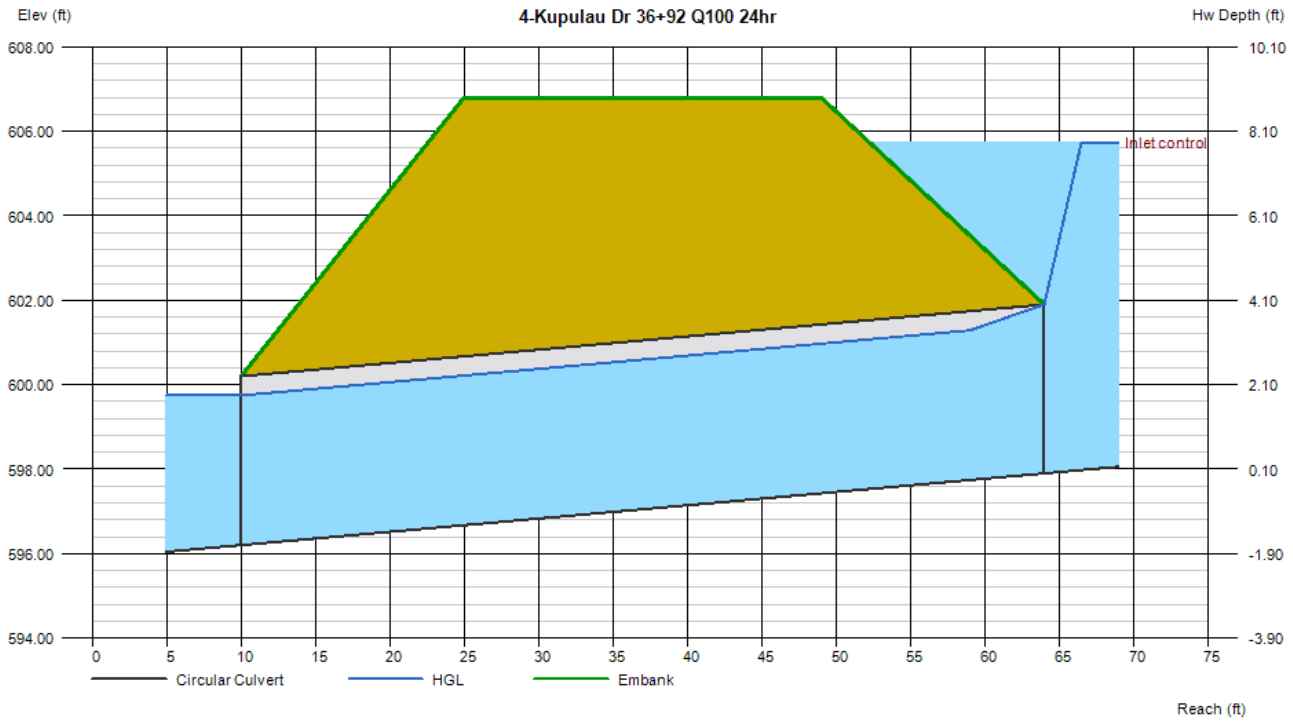
Top Elevation (ft)	=	606.80
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	288.00
Qmax (cfs)	=	288.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	288.00
Qpipe (cfs)	=	288.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	12.23
Veloc Up (ft/s)	=	12.23
HGL Dn (ft)	=	599.74
HGL Up (ft)	=	601.44
Hw Elev (ft)	=	605.74
Hw/D (ft)	=	1.96
Flow Regime	=	Inlet Control



Culvert Report

42-Mikioi Place 43+07 Q50 1hr

Invert Elev Dn (ft)	=	325.30
Pipe Length (ft)	=	82.00
Slope (%)	=	6.46
Invert Elev Up (ft)	=	330.60
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

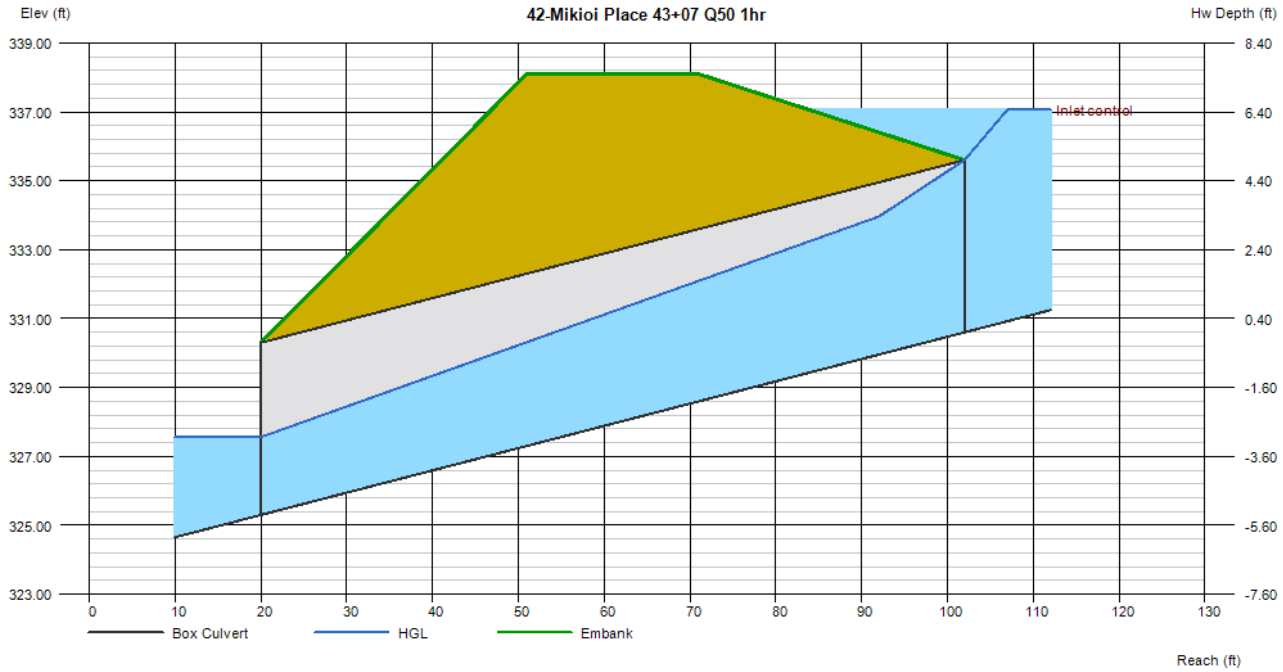
Top Elevation (ft)	=	338.10
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	199.00
Qmax (cfs)	=	199.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	199.00
Qpipe (cfs)	=	199.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	22.01
Veloc Up (ft/s)	=	11.71
HGL Dn (ft)	=	327.56
HGL Up (ft)	=	334.85
Hw Elev (ft)	=	337.06
Hw/D (ft)	=	1.29
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Jun 3 2019

43-Kehala Drive Q100 24hr

Invert Elev Dn (ft)	=	342.20
Pipe Length (ft)	=	63.00
Slope (%)	=	2.06
Invert Elev Up (ft)	=	343.50
Rise (in)	=	84.0
Shape	=	Box
Span (in)	=	276.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

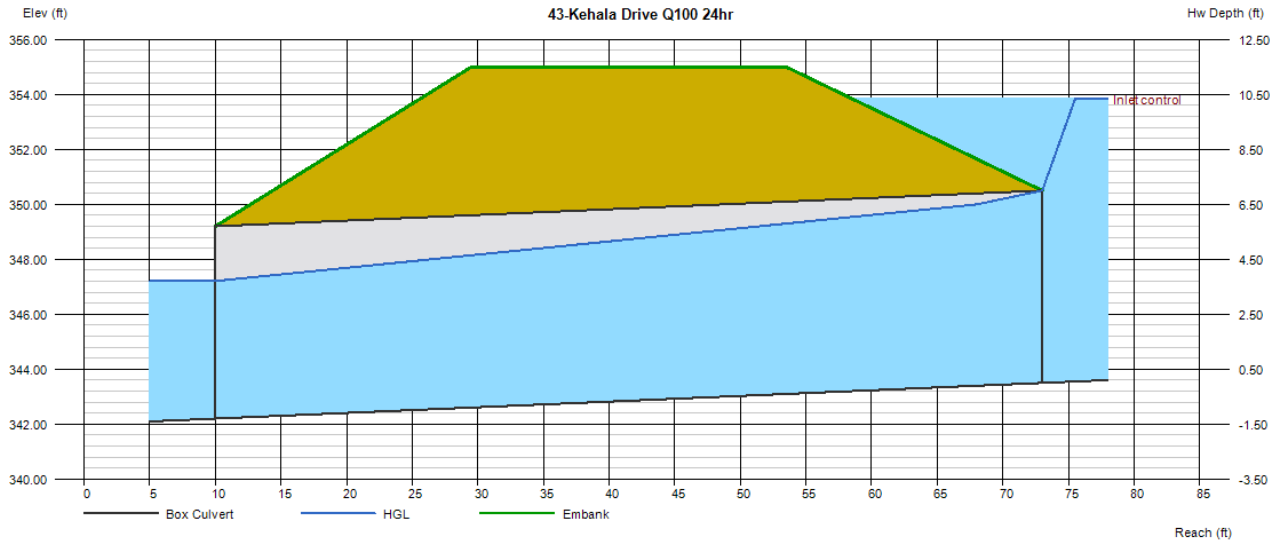
Top Elevation (ft)	=	355.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	2288.00
Qmax (cfs)	=	2288.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	2288.00
Qpipe (cfs)	=	2288.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	19.86
Veloc Up (ft/s)	=	14.76
HGL Dn (ft)	=	347.21
HGL Up (ft)	=	350.24
Hw Elev (ft)	=	353.83
Hw/D (ft)	=	1.48
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 5 2019

44-Kehala Dr 38+35 Q50 1hr

Invert Elev Dn (ft)	=	355.50
Pipe Length (ft)	=	62.00
Slope (%)	=	4.84
Invert Elev Up (ft)	=	358.50
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

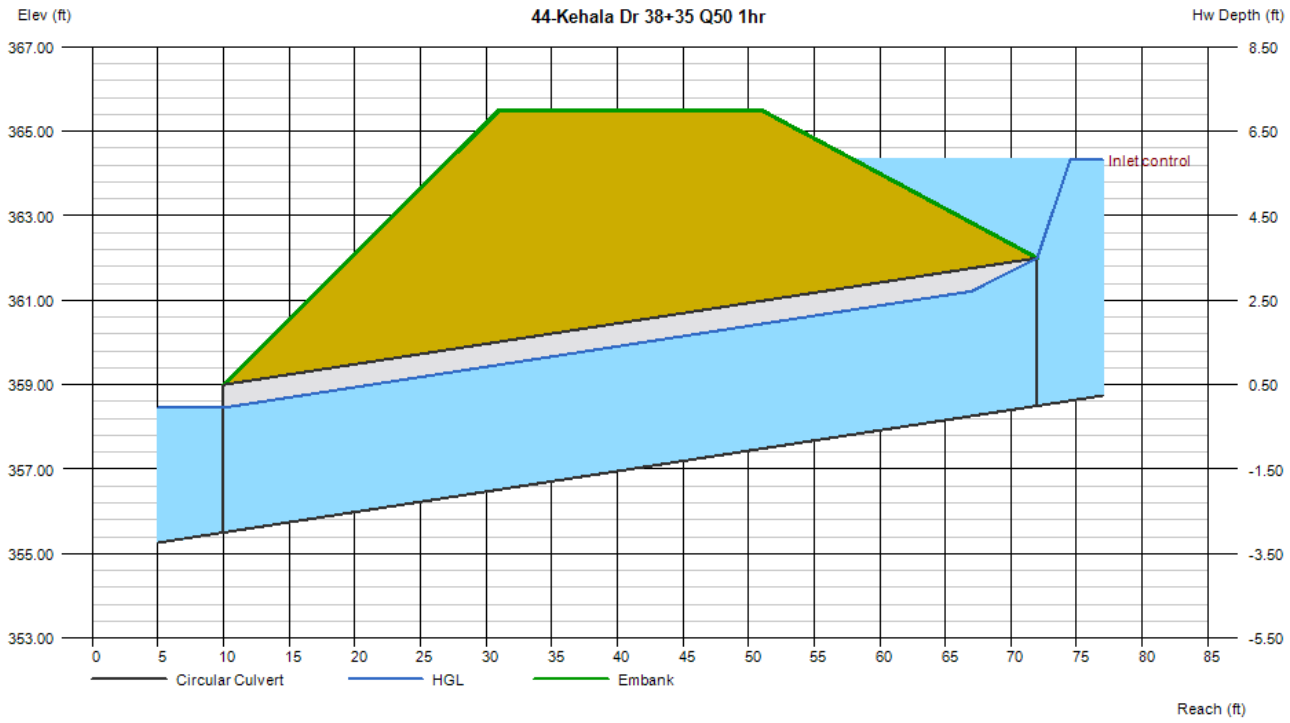
Top Elevation (ft)	=	365.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	91.00
Qmax (cfs)	=	91.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	91.00
Qpipe (cfs)	=	91.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.50
Veloc Up (ft/s)	=	10.50
HGL Dn (ft)	=	358.46
HGL Up (ft)	=	361.46
Hw Elev (ft)	=	364.32
Hw/D (ft)	=	1.66
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Mar 12 2019

45-Kehala Dr 45+37 Q50 1hr

Invert Elev Dn (ft)	=	380.00
Pipe Length (ft)	=	55.00
Slope (%)	=	3.45
Invert Elev Up (ft)	=	381.90
Rise (in)	=	60.0
Shape	=	Circular
Span (in)	=	60.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

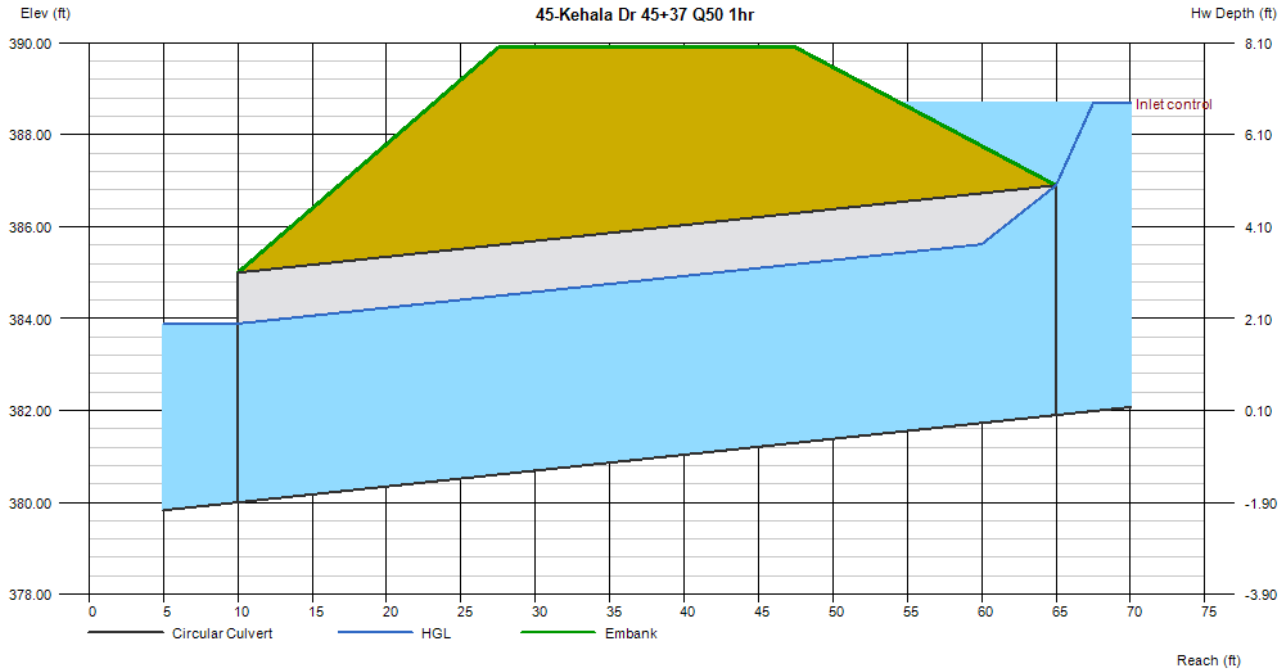
Top Elevation (ft)	=	389.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	185.00
Qmax (cfs)	=	185.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	185.00
Qpipe (cfs)	=	185.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	11.29
Veloc Up (ft/s)	=	11.29
HGL Dn (ft)	=	383.89
HGL Up (ft)	=	385.79
Hw Elev (ft)	=	388.70
Hw/D (ft)	=	1.36
Flow Regime	=	Inlet Control



Culvert Report

48-Piilani Hwy 124+50 Q50 24hr

Invert Elev Dn (ft)	=	275.73
Pipe Length (ft)	=	96.00
Slope (%)	=	0.50
Invert Elev Up (ft)	=	276.21
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	144.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

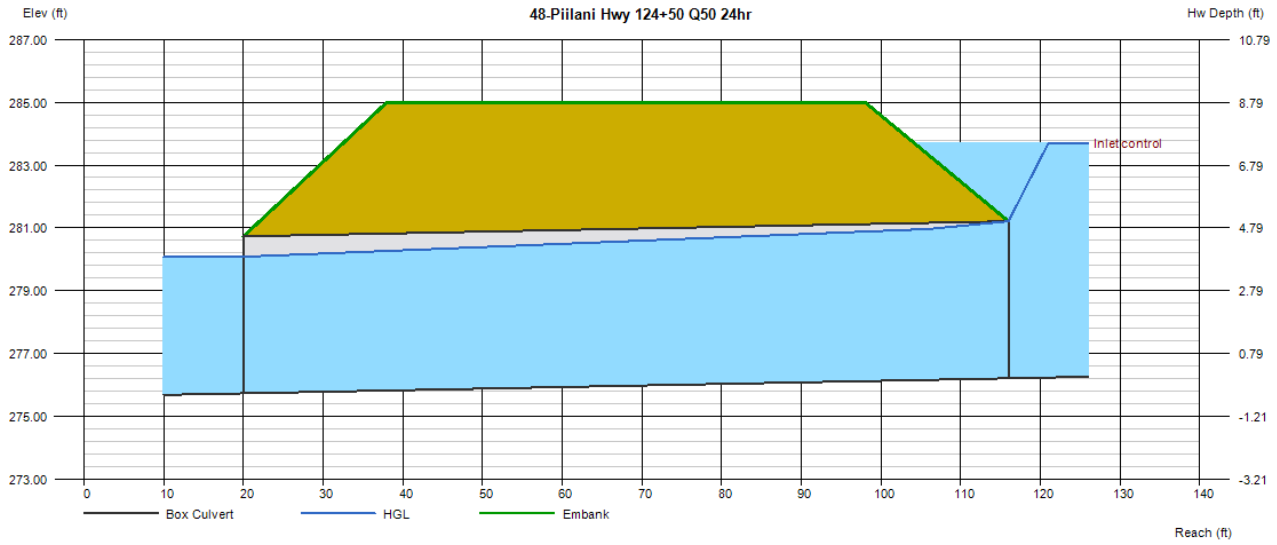
Top Elevation (ft)	=	285.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	730.00
Qmax (cfs)	=	730.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	730.00
Qpipe (cfs)	=	730.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	13.98
Veloc Up (ft/s)	=	12.53
HGL Dn (ft)	=	280.08
HGL Up (ft)	=	281.07
Hw Elev (ft)	=	283.70
Hw/D (ft)	=	1.50
Flow Regime	=	Inlet Control



Culvert Report

51-Piilani Hwy Q50 24hr

Invert Elev Dn (ft)	=	230.74
Pipe Length (ft)	=	82.14
Slope (%)	=	1.00
Invert Elev Up (ft)	=	231.56
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

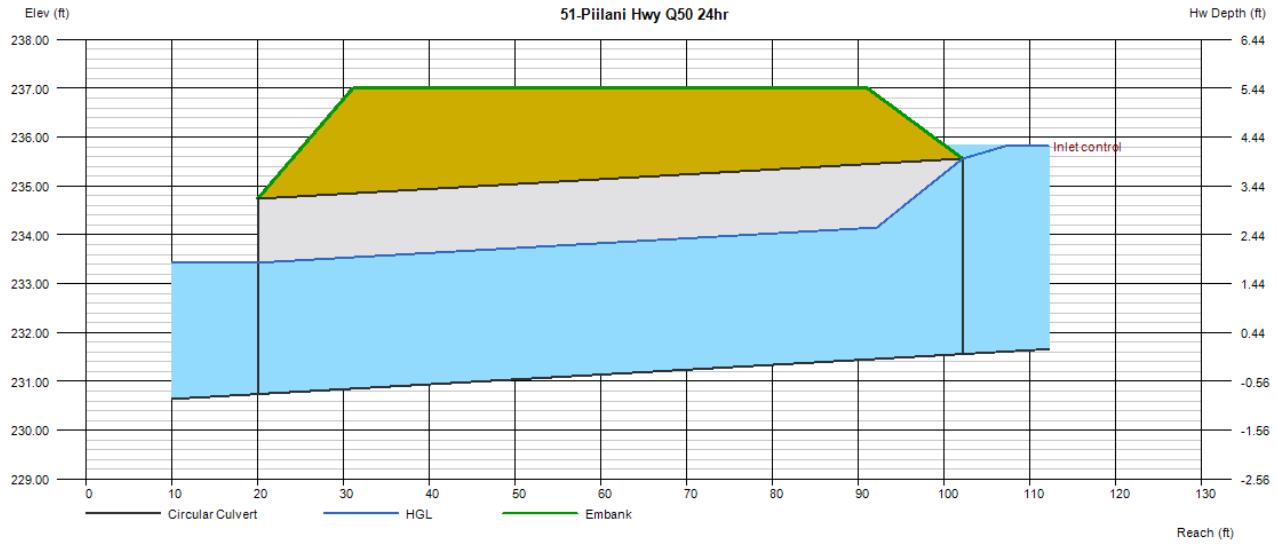
Top Elevation (ft)	=	237.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	158.00
Qmax (cfs)	=	158.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	158.00
Qpipe (cfs)	=	158.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.79
Veloc Up (ft/s)	=	8.79
HGL Dn (ft)	=	233.43
HGL Up (ft)	=	234.25
Hw Elev (ft)	=	235.82
Hw/D (ft)	=	1.06
Flow Regime	=	Inlet Control



Culvert Report

52-Piilani Hwy Q50 24hr

Invert Elev Dn (ft)	=	232.69
Pipe Length (ft)	=	102.07
Slope (%)	=	2.73
Invert Elev Up (ft)	=	235.48
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

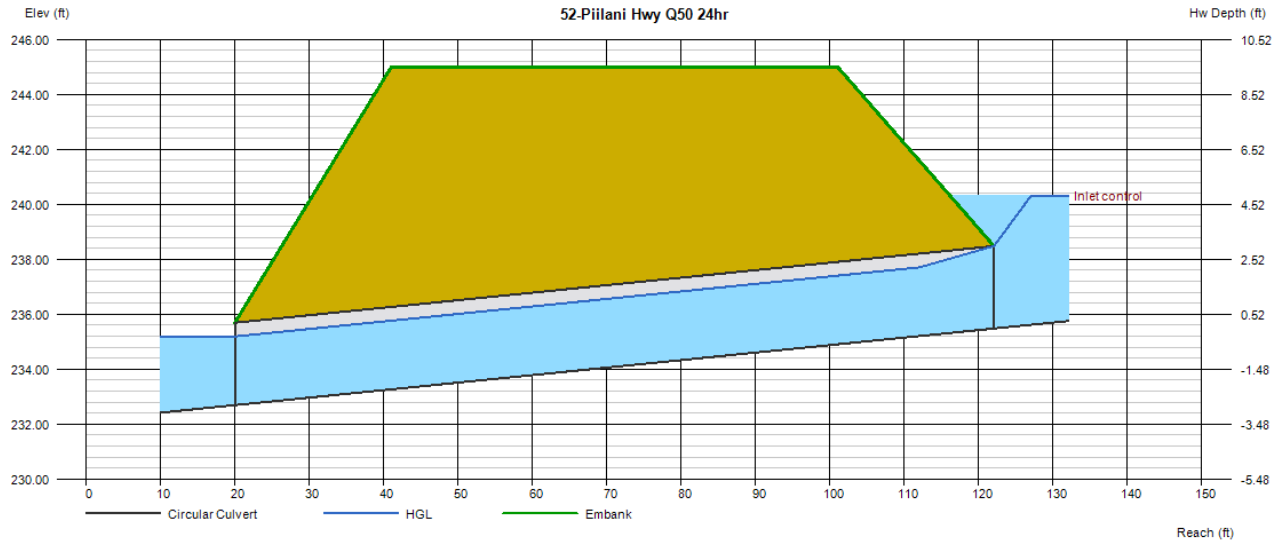
Top Elevation (ft)	=	245.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	60.00
Qmax (cfs)	=	60.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	60.00
Qpipe (cfs)	=	60.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.53
Veloc Up (ft/s)	=	9.53
HGL Dn (ft)	=	235.19
HGL Up (ft)	=	237.98
Hw Elev (ft)	=	240.32
Hw/D (ft)	=	1.61
Flow Regime	=	Inlet Control



Culvert Report

52-Piilani Hwy Q50 24hr

Invert Elev Dn (ft)	=	235.11
Pipe Length (ft)	=	184.23
Slope (%)	=	2.59
Invert Elev Up (ft)	=	239.88
Rise (in)	=	96.0
Shape	=	Circular
Span (in)	=	96.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

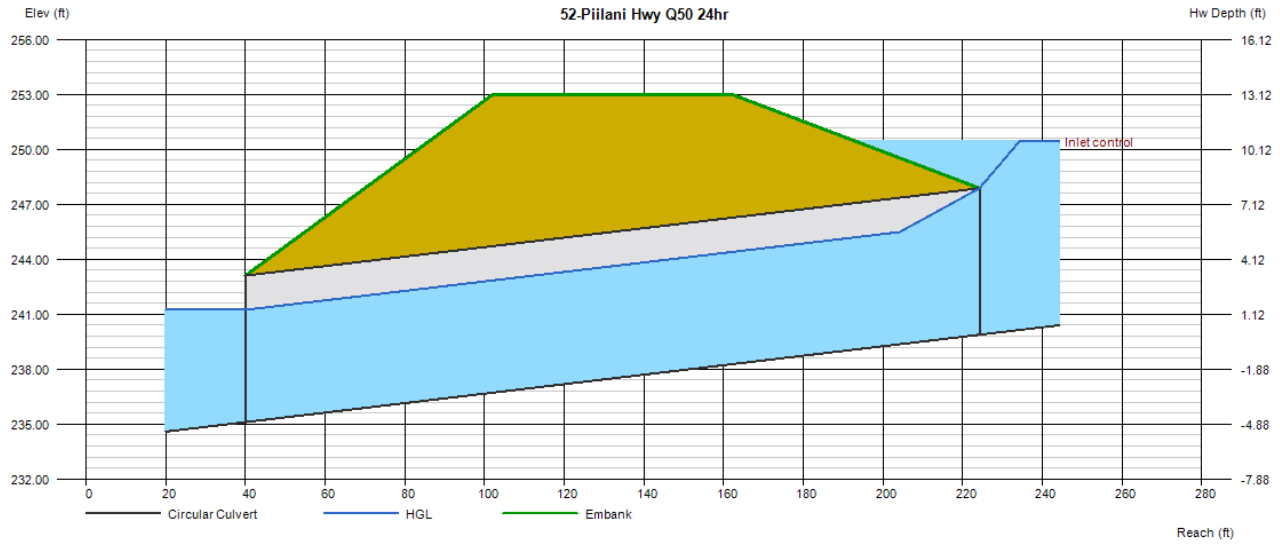
Top Elevation (ft)	=	253.00
Top Width (ft)	=	60.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	580.00
Qmax (cfs)	=	580.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	580.00
Qpipe (cfs)	=	580.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	14.04
Veloc Up (ft/s)	=	14.04
HGL Dn (ft)	=	241.24
HGL Up (ft)	=	246.01
Hw Elev (ft)	=	250.44
Hw/D (ft)	=	1.32
Flow Regime	=	Inlet Control



Culvert Report

5-Kupulau Dr 41+87 Q50 1hr

Invert Elev Dn (ft)	=	592.50
Pipe Length (ft)	=	56.00
Slope (%)	=	8.93
Invert Elev Up (ft)	=	597.50
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

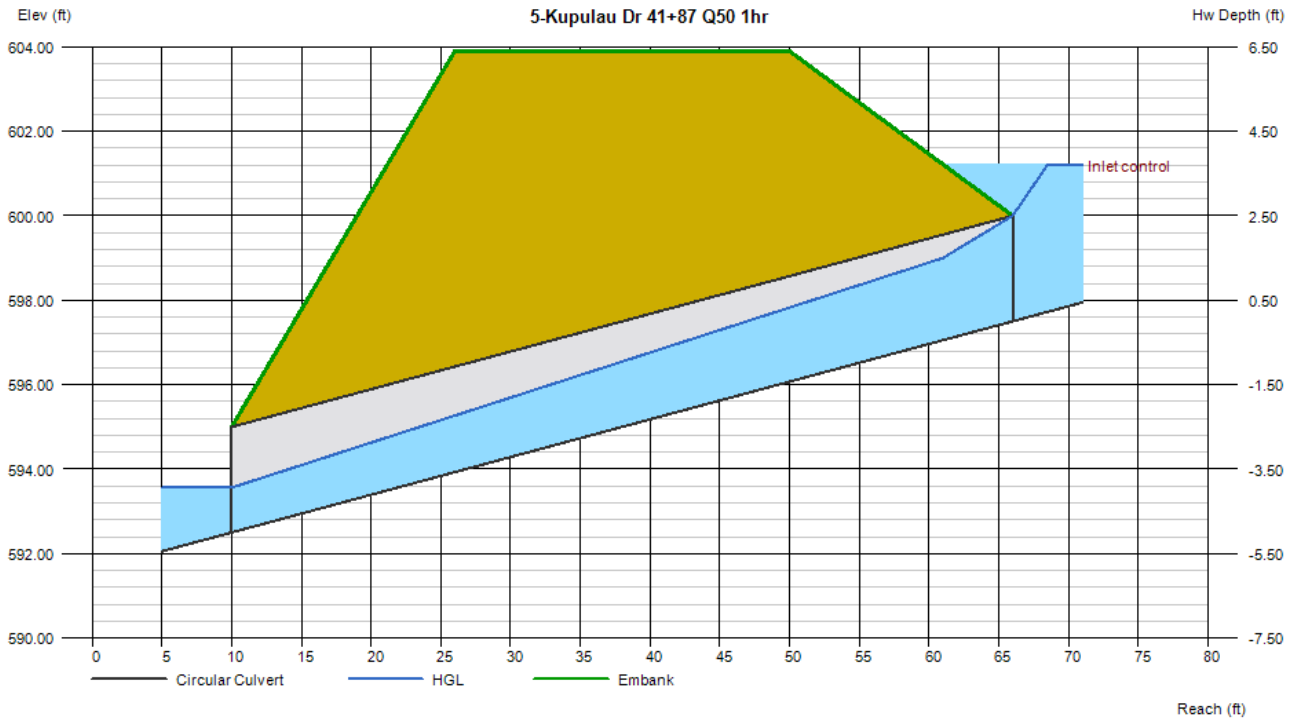
Top Elevation (ft)	=	603.90
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	36.00
Qmax (cfs)	=	36.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	36.00
Qpipe (cfs)	=	36.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	18.12
Veloc Up (ft/s)	=	8.42
HGL Dn (ft)	=	593.56
HGL Up (ft)	=	599.53
Hw Elev (ft)	=	601.20
Hw/D (ft)	=	1.48
Flow Regime	=	Inlet Control



Culvert Report

6-Kupulau Dr 48+62 Q50 1hr

Invert Elev Dn (ft)	=	618.80
Pipe Length (ft)	=	57.00
Slope (%)	=	4.74
Invert Elev Up (ft)	=	621.50
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

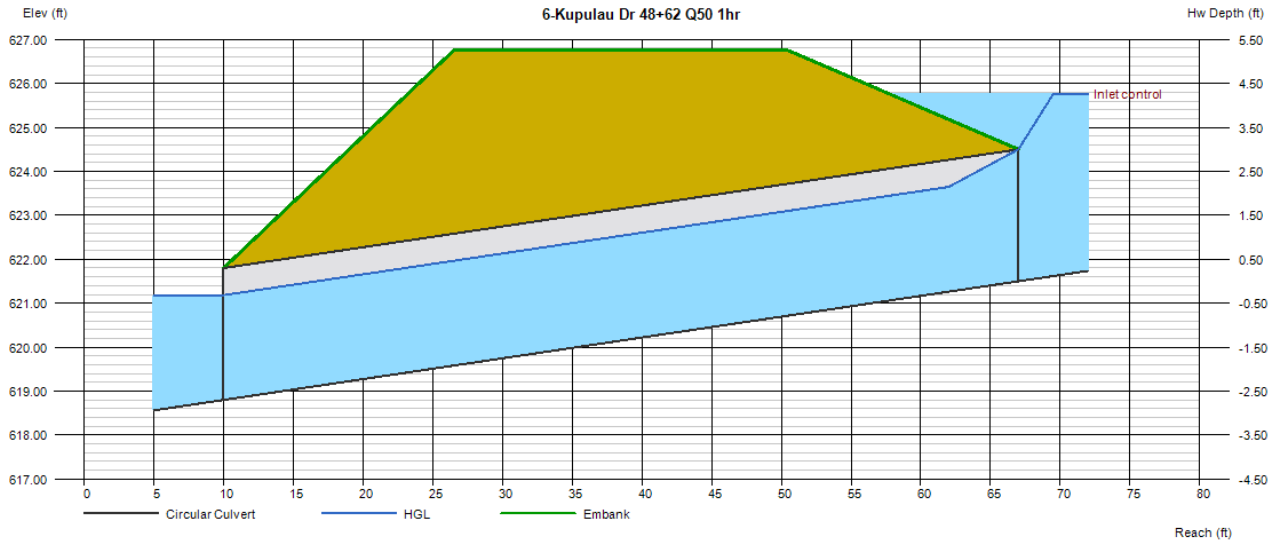
Top Elevation (ft)	=	626.75
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	54.00
Qmax (cfs)	=	54.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	54.00
Qpipe (cfs)	=	54.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.96
Veloc Up (ft/s)	=	8.96
HGL Dn (ft)	=	621.18
HGL Up (ft)	=	623.88
Hw Elev (ft)	=	625.76
Hw/D (ft)	=	1.42
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Apr 9 2019

7-Kupulau Dr 52+47 Q100 24hr

Invert Elev Dn (ft)	=	605.20
Pipe Length (ft)	=	62.50
Slope (%)	=	5.28
Invert Elev Up (ft)	=	608.50
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	156.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

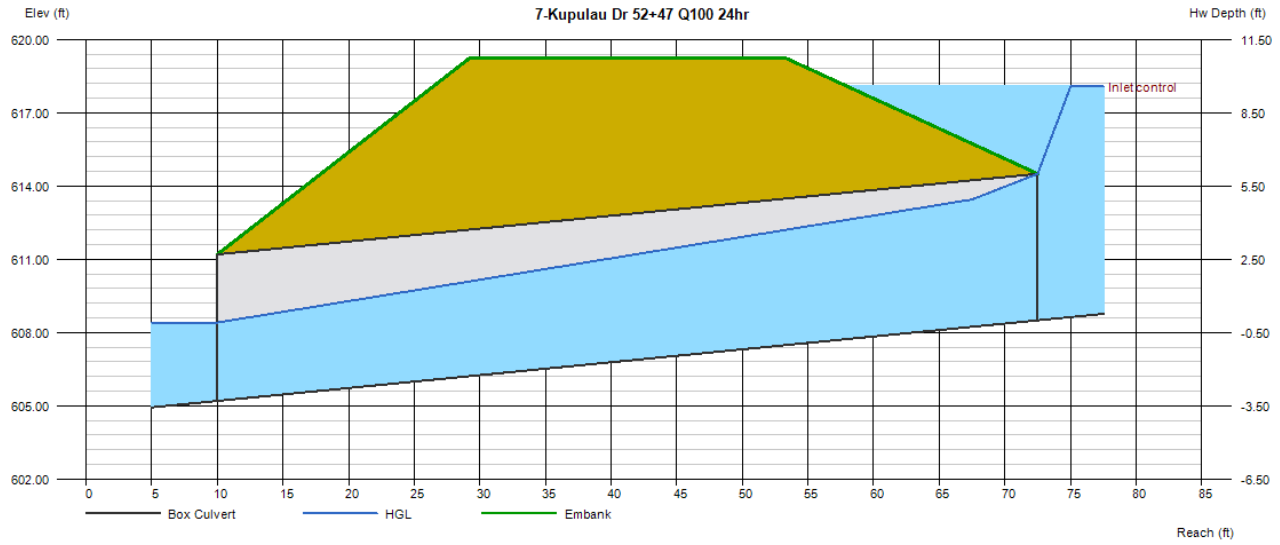
Top Elevation (ft)	=	619.25
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	924.00
Qmax (cfs)	=	924.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	924.00
Qpipe (cfs)	=	924.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	22.14
Veloc Up (ft/s)	=	13.20
HGL Dn (ft)	=	608.41
HGL Up (ft)	=	613.89
Hw Elev (ft)	=	618.07
Hw/D (ft)	=	1.60
Flow Regime	=	Inlet Control



Culvert Report

8-Kumulani Dr 4+97 Q50 1hr

Invert Elev Dn (ft)	=	639.90
Pipe Length (ft)	=	61.00
Slope (%)	=	2.13
Invert Elev Up (ft)	=	641.20
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

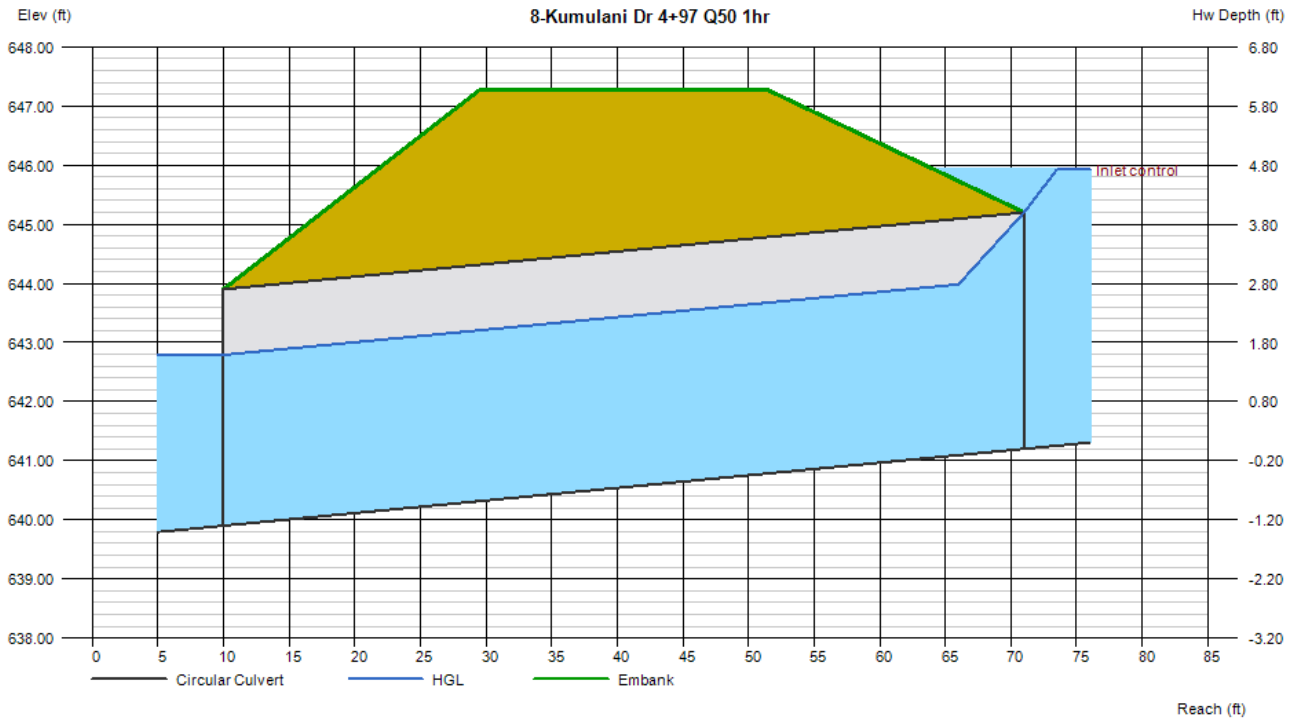
Top Elevation (ft)	=	647.27
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	91.00
Qmax (cfs)	=	91.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	91.00
Qpipe (cfs)	=	91.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.36
Veloc Up (ft/s)	=	9.36
HGL Dn (ft)	=	642.79
HGL Up (ft)	=	644.09
Hw Elev (ft)	=	645.92
Hw/D (ft)	=	1.18
Flow Regime	=	Inlet Control



OPTION 3 CULVERTS

Culvert Report

11-Kumulani Dr 17+46 Q50 24hr

Invert Elev Dn (ft)	=	640.00
Pipe Length (ft)	=	76.00
Slope (%)	=	1.45
Invert Elev Up (ft)	=	641.10
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	132.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

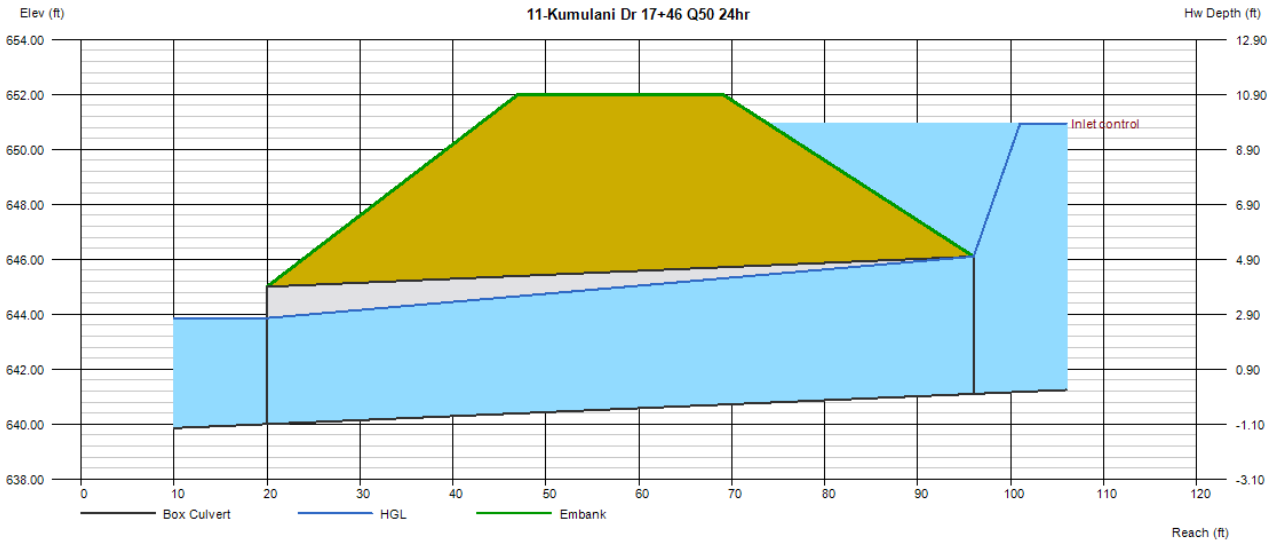
Top Elevation (ft)	=	652.00
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	713.00
Qmax (cfs)	=	713.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	713.00
Qpipe (cfs)	=	713.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	16.79
Veloc Up (ft/s)	=	12.96
HGL Dn (ft)	=	643.86
HGL Up (ft)	=	646.10
Hw Elev (ft)	=	650.95
Hw/D (ft)	=	1.97
Flow Regime	=	Inlet Control



Culvert Report

14-Nahenahe Pl 4+42 Q50 24hr

Invert Elev Dn (ft)	=	445.80
Pipe Length (ft)	=	75.00
Slope (%)	=	10.53
Invert Elev Up (ft)	=	453.70
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	96.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

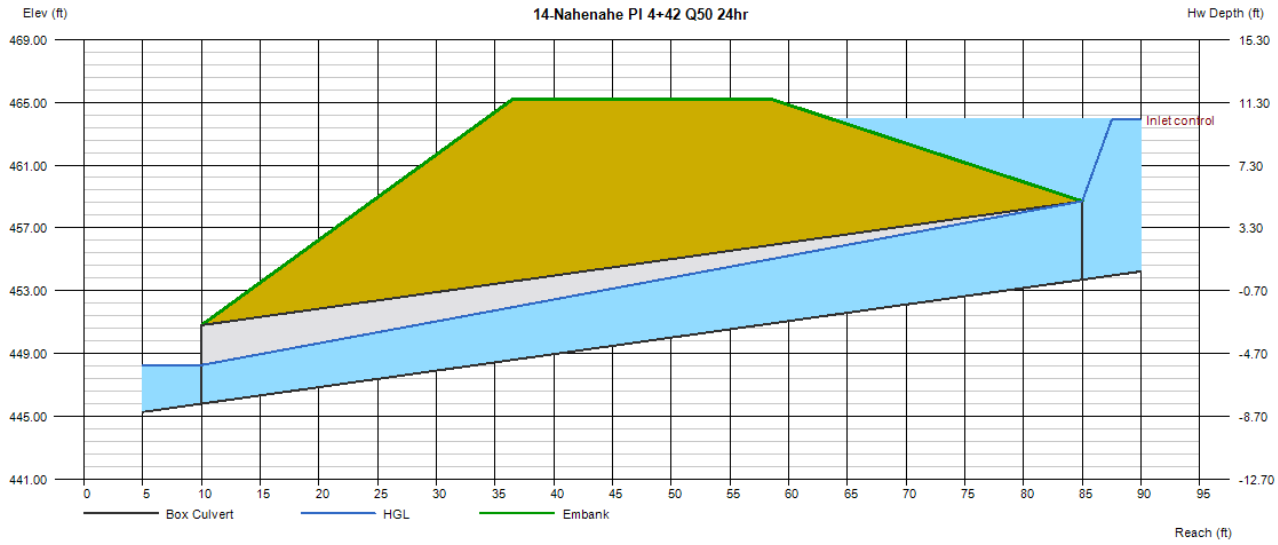
Top Elevation (ft)	=	465.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	543.00
Qmax (cfs)	=	543.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	543.00
Qpipe (cfs)	=	543.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	27.59
Veloc Up (ft/s)	=	13.58
HGL Dn (ft)	=	448.26
HGL Up (ft)	=	458.70
Hw Elev (ft)	=	463.88
Hw/D (ft)	=	2.04
Flow Regime	=	Inlet Control



Culvert Report

15-Keha Drive Q50 24hr

Invert Elev Dn (ft)	=	494.30
Pipe Length (ft)	=	52.00
Slope (%)	=	4.04
Invert Elev Up (ft)	=	496.40
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	192.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

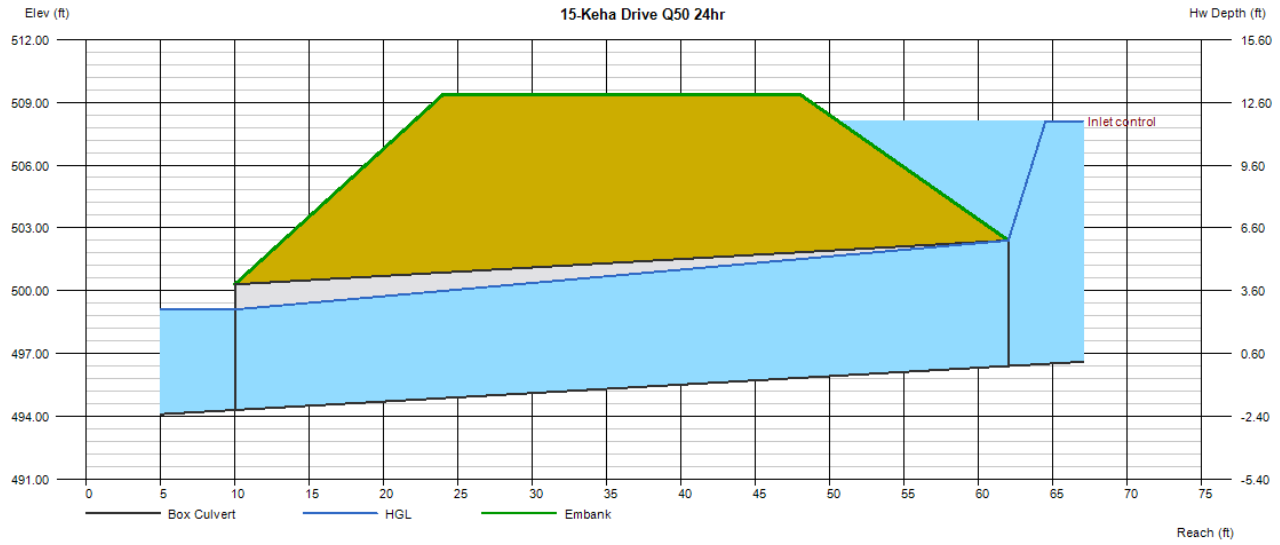
Top Elevation (ft)	=	509.37
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1758.00
Qmax (cfs)	=	1758.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	1758.00
Qpipe (cfs)	=	1758.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	22.89
Veloc Up (ft/s)	=	18.31
HGL Dn (ft)	=	499.10
HGL Up (ft)	=	502.40
Hw Elev (ft)	=	508.10
Hw/D (ft)	=	1.95
Flow Regime	=	Inlet Control



Culvert Report

18-Lanina Place Q50 24hr

Invert Elev Dn (ft)	=	523.30
Pipe Length (ft)	=	65.00
Slope (%)	=	3.08
Invert Elev Up (ft)	=	525.30
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	180.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

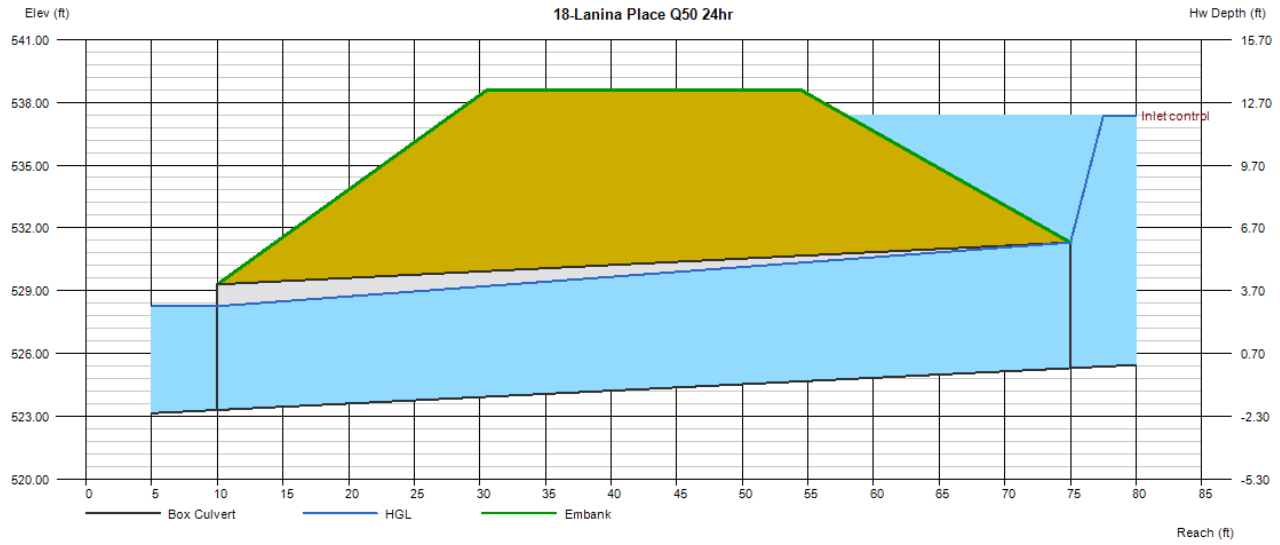
Top Elevation (ft)	=	538.57
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1693.00
Qmax (cfs)	=	1693.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	1693.00
Qpipe (cfs)	=	1693.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	22.76
Veloc Up (ft/s)	=	18.81
HGL Dn (ft)	=	528.26
HGL Up (ft)	=	531.30
Hw Elev (ft)	=	537.36
Hw/D (ft)	=	2.01
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 14 2019

19-Lanina Place 5+28 Q50 24hr

Invert Elev Dn (ft)	=	539.40
Pipe Length (ft)	=	54.00
Slope (%)	=	4.07
Invert Elev Up (ft)	=	541.60
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

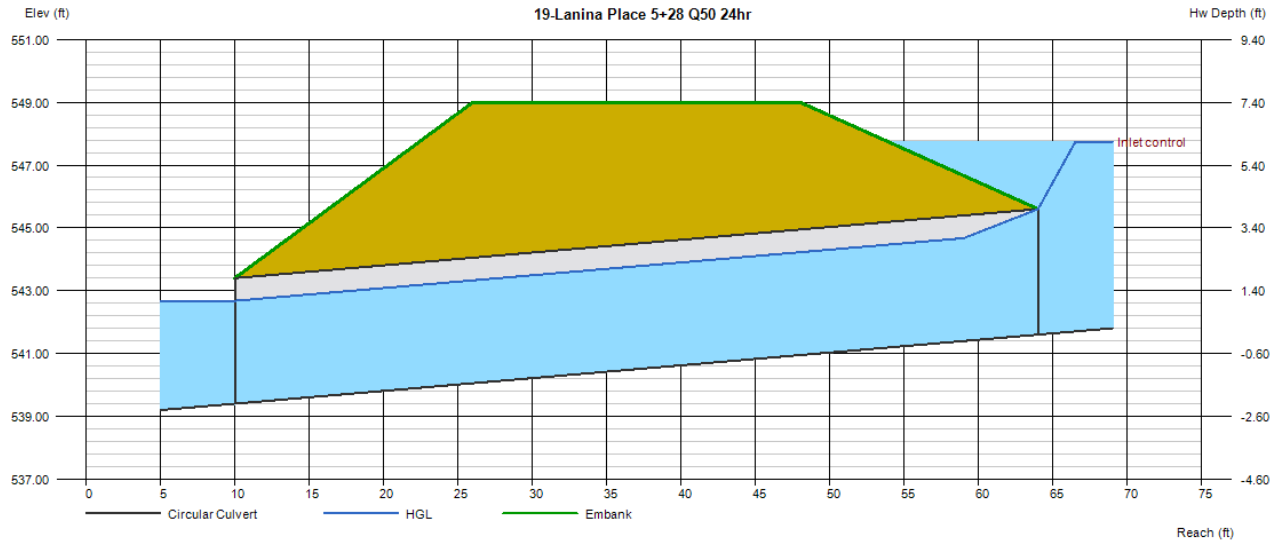
Top Elevation (ft)	=	549.00
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	237.00
Qmax (cfs)	=	237.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	237.00
Qpipe (cfs)	=	237.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	10.75
Veloc Up (ft/s)	=	10.75
HGL Dn (ft)	=	542.68
HGL Up (ft)	=	544.88
Hw Elev (ft)	=	547.74
Hw/D (ft)	=	1.53
Flow Regime	=	Inlet Control



Culvert Report

21-Hookpia Place 5+21.89 Q50 24hr

Invert Elev Dn (ft)	=	521.00
Pipe Length (ft)	=	62.00
Slope (%)	=	3.39
Invert Elev Up (ft)	=	523.10
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	108.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

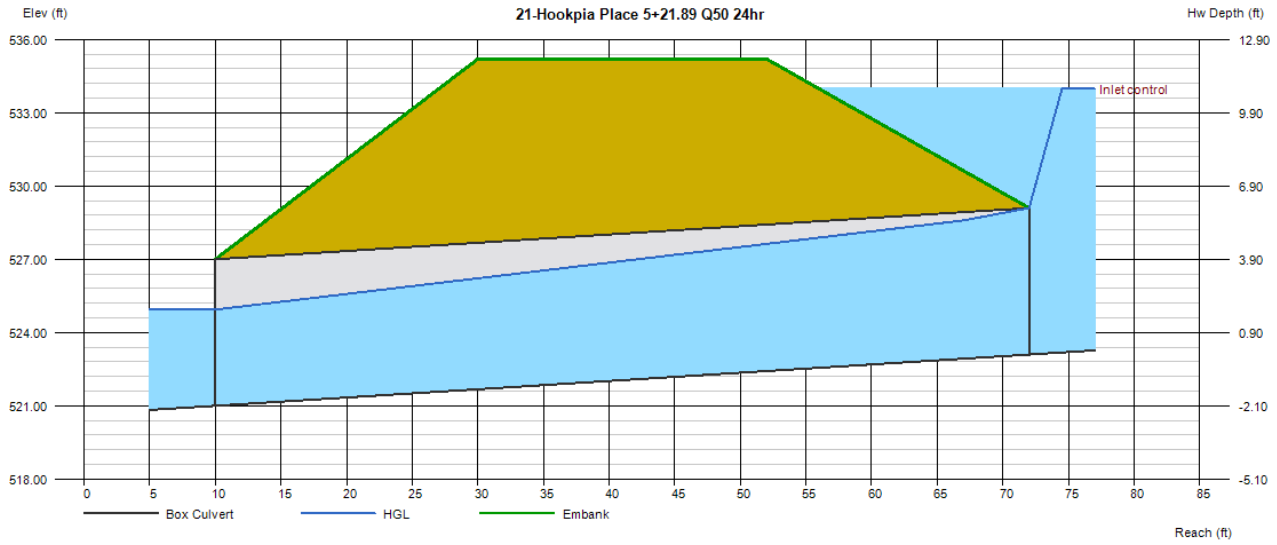
Top Elevation (ft)	=	535.20
Top Width (ft)	=	22.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	717.00
Qmax (cfs)	=	717.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	717.00
Qpipe (cfs)	=	717.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	20.22
Veloc Up (ft/s)	=	13.71
HGL Dn (ft)	=	524.94
HGL Up (ft)	=	528.91
Hw Elev (ft)	=	533.98
Hw/D (ft)	=	1.81
Flow Regime	=	Inlet Control



Culvert Report

P-24 Wailea Place Q50 24hr

Invert Elev Dn (ft)	=	447.00
Pipe Length (ft)	=	52.00
Slope (%)	=	11.35
Invert Elev Up (ft)	=	452.90
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	192.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

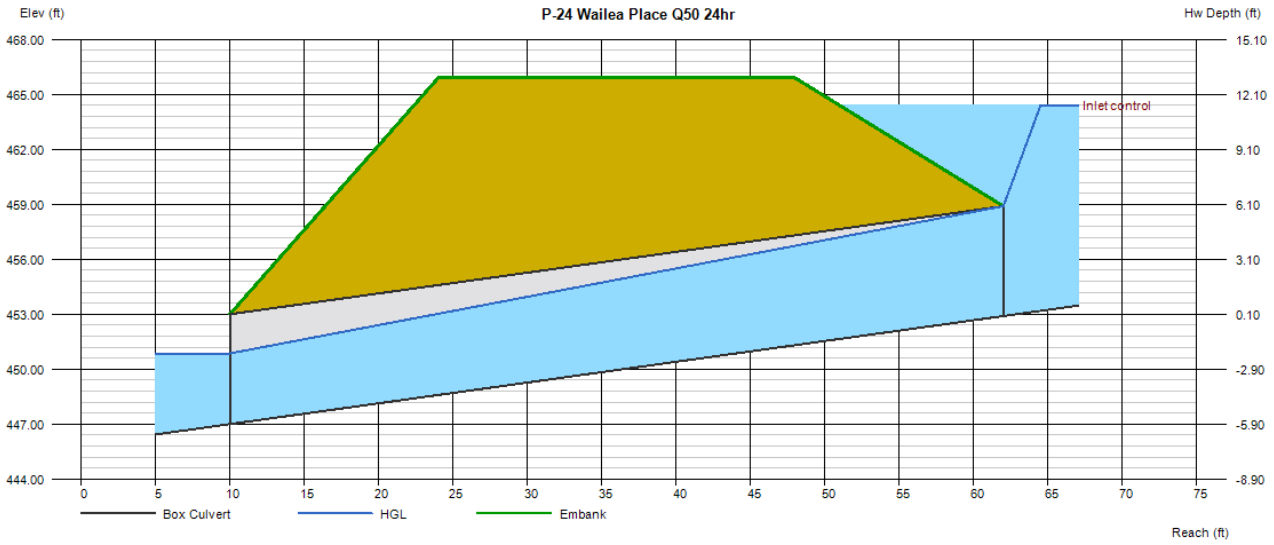
Top Elevation (ft)	=	465.90
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1761.00
Qmax (cfs)	=	1761.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	1761.00
Qpipe (cfs)	=	1761.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	28.51
Veloc Up (ft/s)	=	18.34
HGL Dn (ft)	=	450.86
HGL Up (ft)	=	458.90
Hw Elev (ft)	=	464.40
Hw/D (ft)	=	1.92
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Jun 3 2019

25-Kaapuni Place (Lot 218) Q50 24hr

Invert Elev Dn (ft)	=	577.00
Pipe Length (ft)	=	24.00
Slope (%)	=	6.25
Invert Elev Up (ft)	=	578.50
Rise (in)	=	48.0
Shape	=	Box
Span (in)	=	72.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

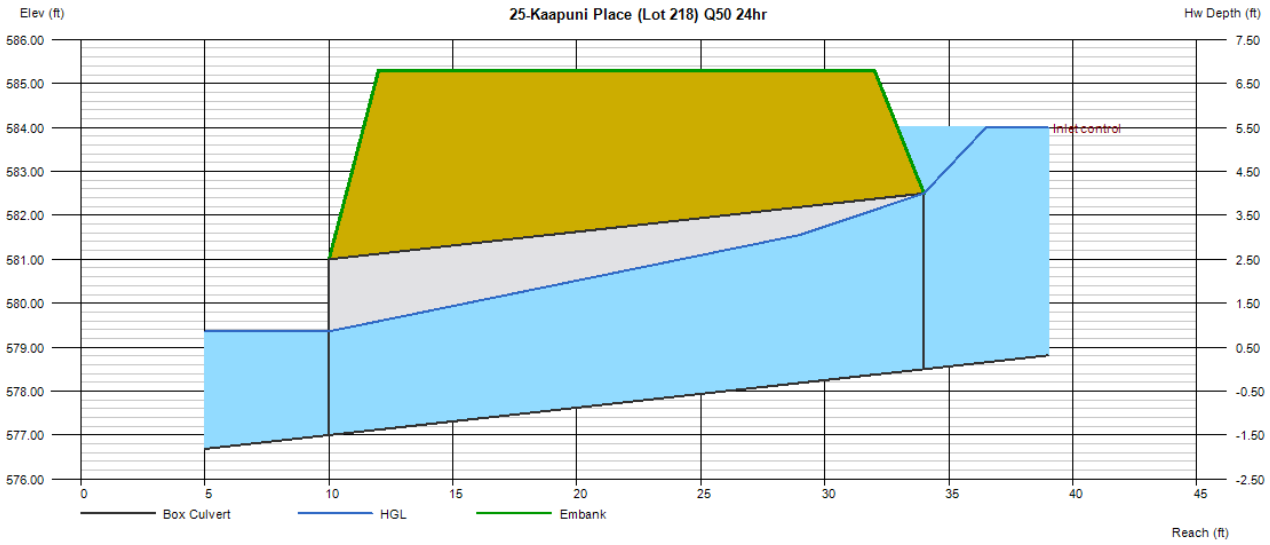
Top Elevation (ft)	=	585.30
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	236.00
Qmax (cfs)	=	236.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	236.00
Qpipe (cfs)	=	236.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	16.67
Veloc Up (ft/s)	=	10.83
HGL Dn (ft)	=	579.36
HGL Up (ft)	=	582.13
Hw Elev (ft)	=	584.00
Hw/D (ft)	=	1.37
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 14 2019

26-Mililani Place 16+91 Q50 24hr

Invert Elev Dn (ft)	=	412.20
Pipe Length (ft)	=	59.00
Slope (%)	=	1.36
Invert Elev Up (ft)	=	413.00
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	96.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

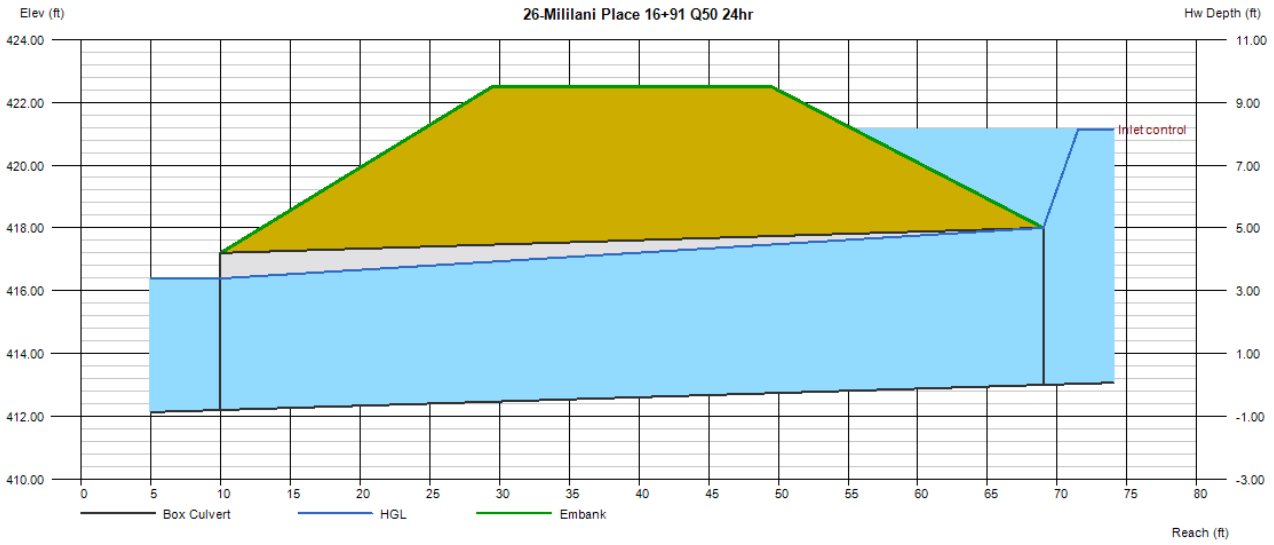
Top Elevation (ft)	=	422.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	545.00
Qmax (cfs)	=	545.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	545.00
Qpipe (cfs)	=	545.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	16.26
Veloc Up (ft/s)	=	13.63
HGL Dn (ft)	=	416.39
HGL Up (ft)	=	418.00
Hw Elev (ft)	=	421.14
Hw/D (ft)	=	1.63
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Jun 3 2019

29-Malina Place 48+01 Q50 24hr

Invert Elev Dn (ft)	=	448.30
Pipe Length (ft)	=	51.50
Slope (%)	=	2.52
Invert Elev Up (ft)	=	449.60
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

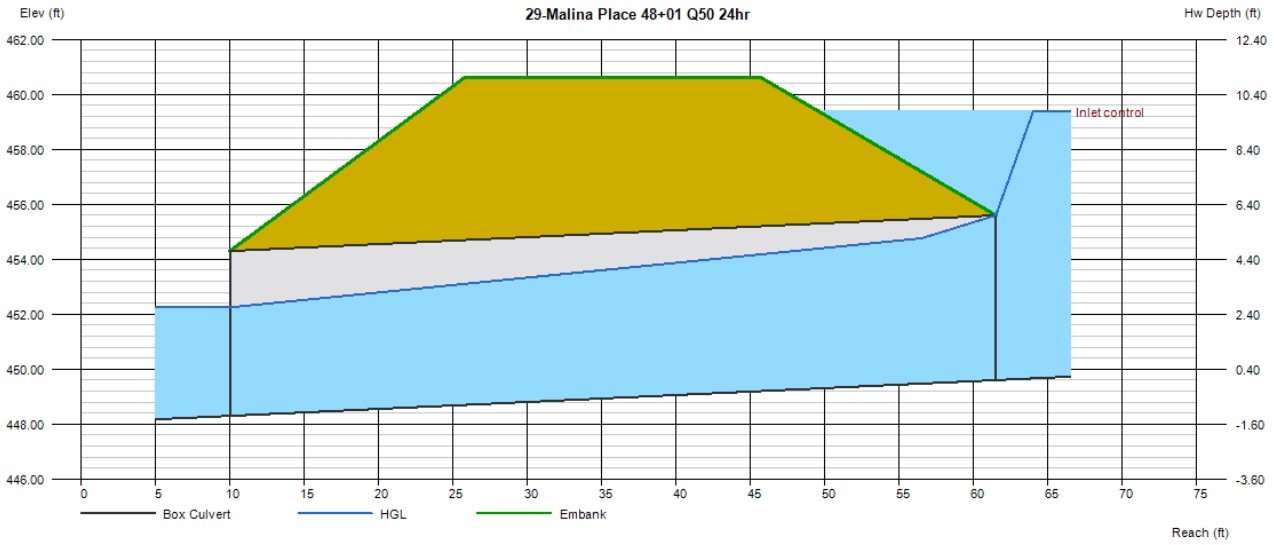
Top Elevation (ft)	=	460.60
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	720.00
Qmax (cfs)	=	720.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	720.00
Qpipe (cfs)	=	720.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	18.23
Veloc Up (ft/s)	=	13.25
HGL Dn (ft)	=	452.25
HGL Up (ft)	=	455.03
Hw Elev (ft)	=	459.38
Hw/D (ft)	=	1.63
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Apr 9 2019

3-Kupulau Drive Q50 24hr

Invert Elev Dn (ft)	=	585.40
Pipe Length (ft)	=	52.00
Slope (%)	=	7.12
Invert Elev Up (ft)	=	589.10
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	180.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

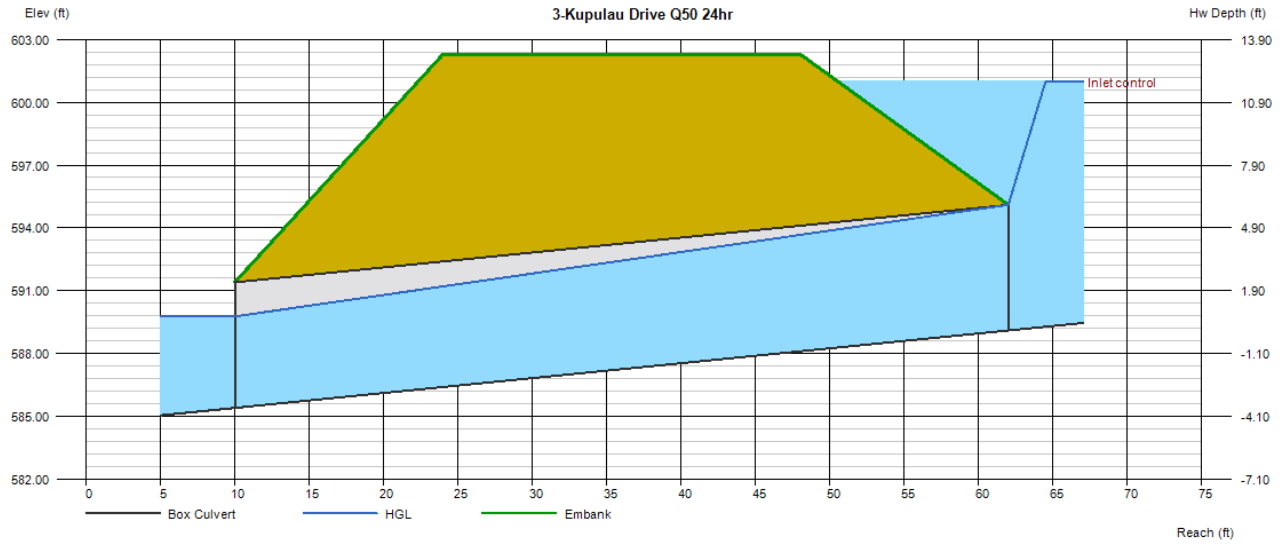
Top Elevation (ft)	=	602.30
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1687.00
Qmax (cfs)	=	1687.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	1687.00
Qpipe (cfs)	=	1687.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	25.74
Veloc Up (ft/s)	=	18.74
HGL Dn (ft)	=	589.77
HGL Up (ft)	=	595.10
Hw Elev (ft)	=	601.00
Hw/D (ft)	=	1.98
Flow Regime	=	Inlet Control



Culvert Report

32-Mapu Place 20+64 Q50 24hr

Invert Elev Dn (ft)	=	315.50
Pipe Length (ft)	=	53.00
Slope (%)	=	0.94
Invert Elev Up (ft)	=	316.00
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	96.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

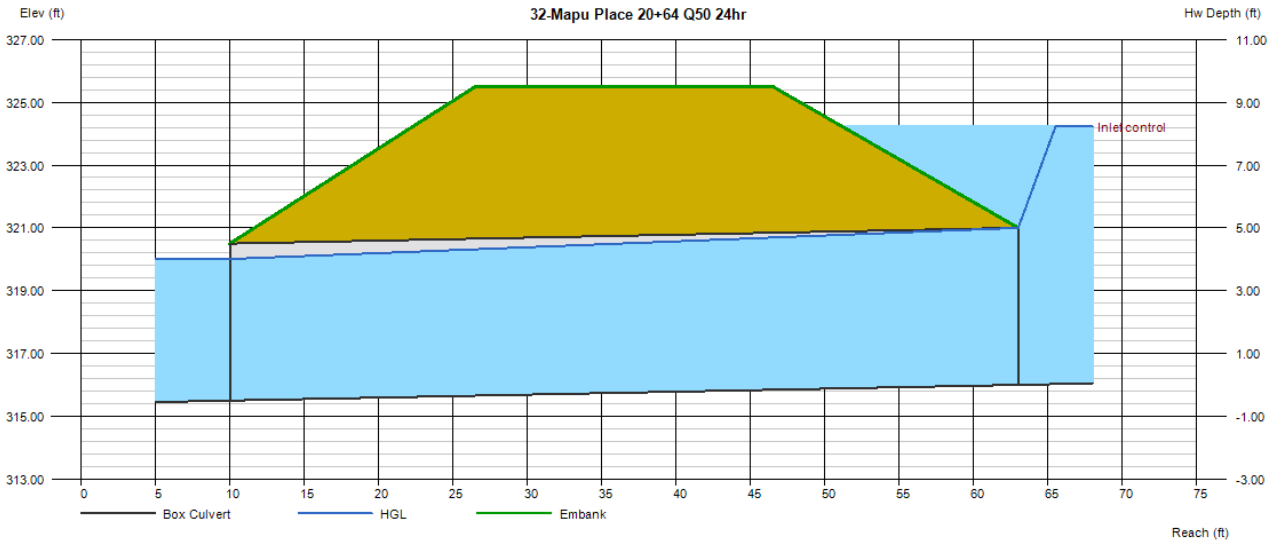
Top Elevation (ft)	=	325.50
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	551.00
Qmax (cfs)	=	551.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	551.00
Qpipe (cfs)	=	551.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	15.27
Veloc Up (ft/s)	=	13.78
HGL Dn (ft)	=	320.01
HGL Up (ft)	=	321.00
Hw Elev (ft)	=	324.22
Hw/D (ft)	=	1.64
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 14 2019

33-Akala Dr 7+82 Q50 24hr

Invert Elev Dn (ft)	=	263.00
Pipe Length (ft)	=	54.00
Slope (%)	=	3.33
Invert Elev Up (ft)	=	264.80
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

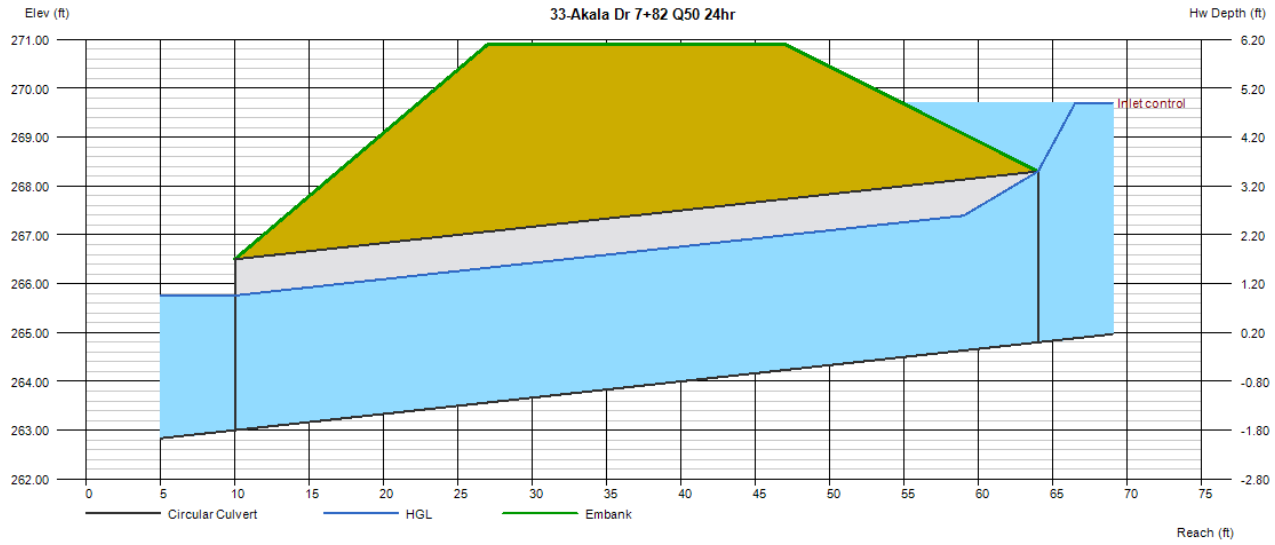
Top Elevation (ft)	=	270.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	156.00
Qmax (cfs)	=	156.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	156.00
Qpipe (cfs)	=	156.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	9.59
Veloc Up (ft/s)	=	9.59
HGL Dn (ft)	=	265.76
HGL Up (ft)	=	267.56
Hw Elev (ft)	=	269.70
Hw/D (ft)	=	1.40
Flow Regime	=	Inlet Control



Culvert Report

35-Akala Dr 14+94 Q50 24hr

Invert Elev Dn (ft)	=	285.00
Pipe Length (ft)	=	65.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	286.30
Rise (in)	=	60.0
Shape	=	Box
Span (in)	=	96.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

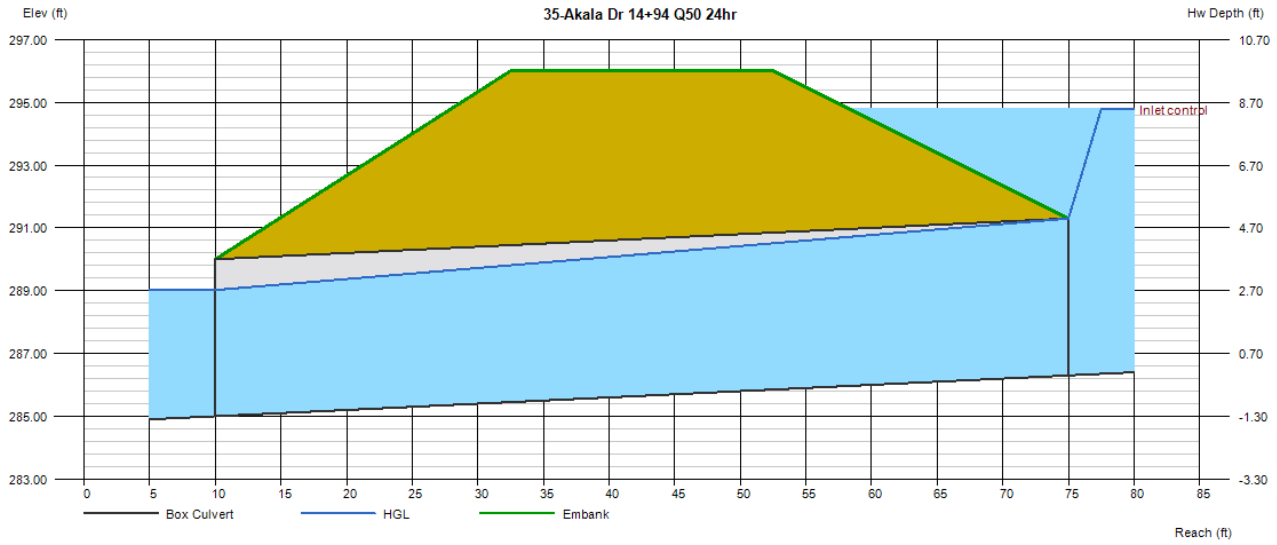
Top Elevation (ft)	=	296.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	574.00
Qmax (cfs)	=	574.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	574.00
Qpipe (cfs)	=	574.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	17.85
Veloc Up (ft/s)	=	14.35
HGL Dn (ft)	=	289.02
HGL Up (ft)	=	291.30
Hw Elev (ft)	=	294.79
Hw/D (ft)	=	1.70
Flow Regime	=	Inlet Control



Culvert Report

36- Akala Drive Q50 24hr

Invert Elev Dn (ft)	=	281.60
Pipe Length (ft)	=	59.00
Slope (%)	=	2.20
Invert Elev Up (ft)	=	282.90
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	228.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

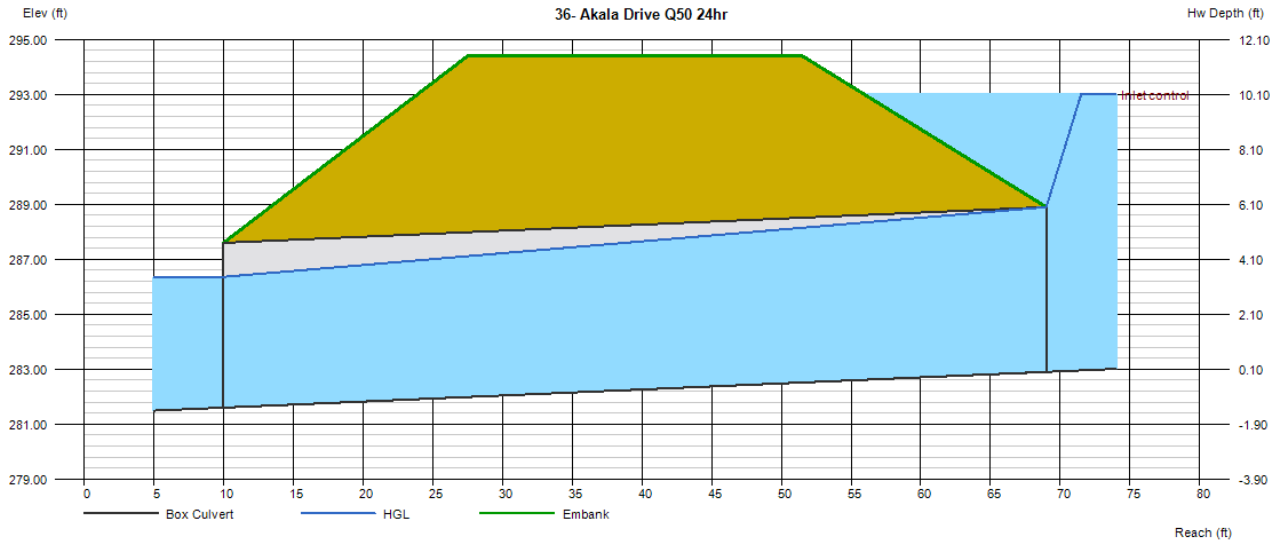
Top Elevation (ft)	=	294.40
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1779.00
Qmax (cfs)	=	1779.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	1779.00
Qpipe (cfs)	=	1779.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	19.67
Veloc Up (ft/s)	=	15.61
HGL Dn (ft)	=	286.36
HGL Up (ft)	=	288.90
Hw Elev (ft)	=	293.01
Hw/D (ft)	=	1.69
Flow Regime	=	Inlet Control



Culvert Report

37-Akala Dr 36+91 Q50 24hr

Invert Elev Dn (ft)	=	294.80
Pipe Length (ft)	=	50.00
Slope (%)	=	2.80
Invert Elev Up (ft)	=	296.20
Rise (in)	=	48.0
Shape	=	Box
Span (in)	=	60.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

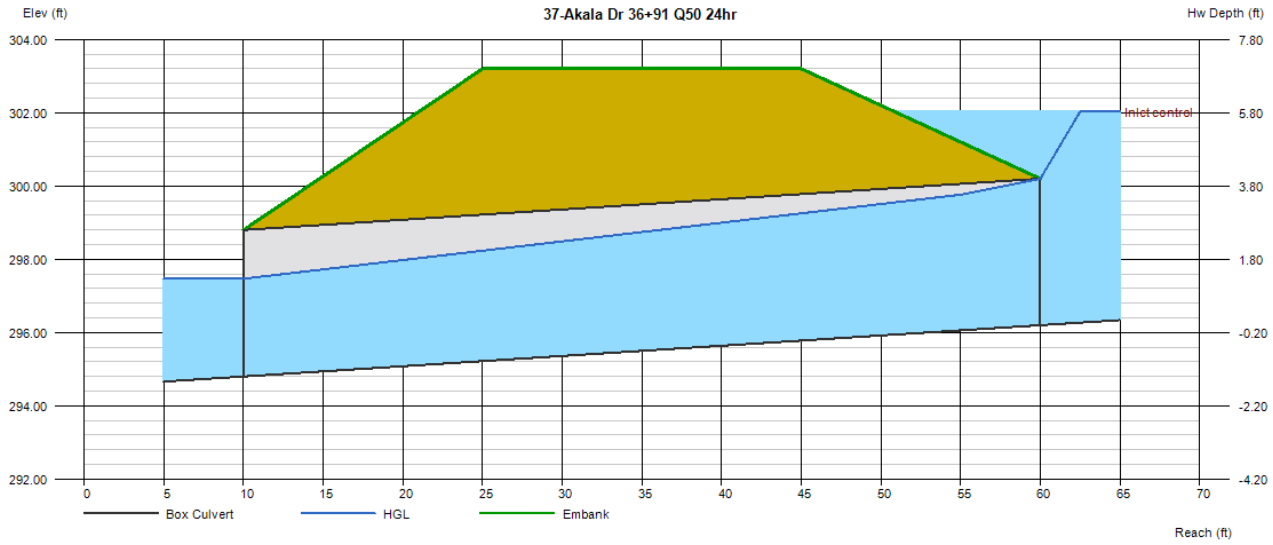
Top Elevation (ft)	=	303.20
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	212.00
Qmax (cfs)	=	212.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	212.00
Qpipe (cfs)	=	212.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	15.88
Veloc Up (ft/s)	=	11.10
HGL Dn (ft)	=	297.47
HGL Up (ft)	=	300.02
Hw Elev (ft)	=	302.04
Hw/D (ft)	=	1.46
Flow Regime	=	Inlet Control



Culvert Report

38-Akala Dr 44+84 Q50 24hr

Invert Elev Dn (ft)	=	309.60
Pipe Length (ft)	=	51.00
Slope (%)	=	6.47
Invert Elev Up (ft)	=	312.90
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	120.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

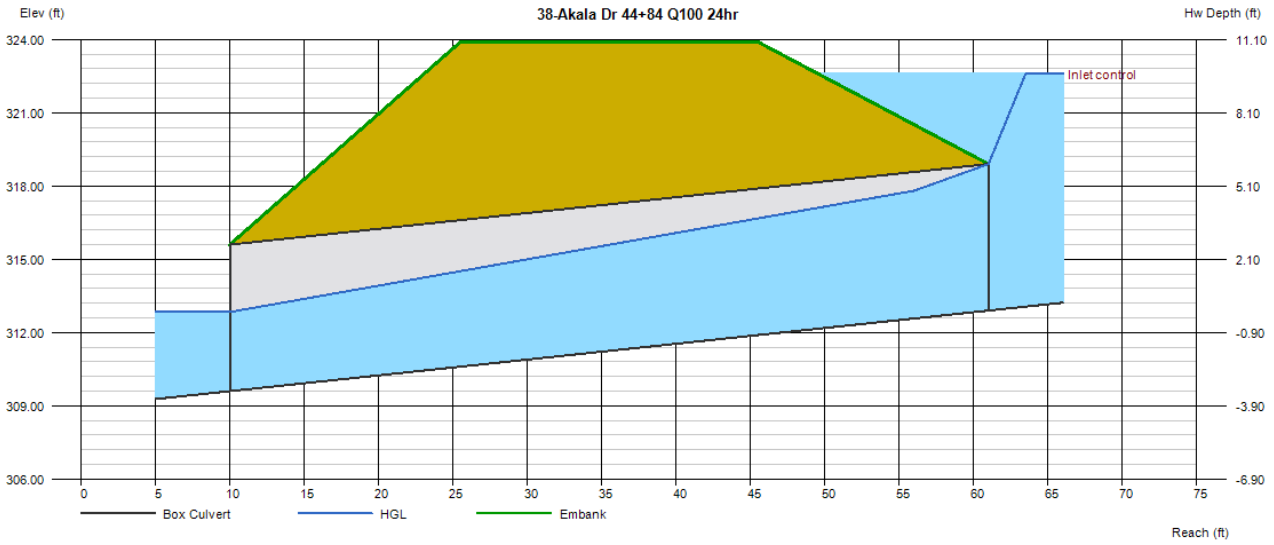
Top Elevation (ft)	=	323.90
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	723.00
Qmax (cfs)	=	723.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	723.00
Qpipe (cfs)	=	723.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	22.31
Veloc Up (ft/s)	=	13.27
HGL Dn (ft)	=	312.84
HGL Up (ft)	=	318.35
Hw Elev (ft)	=	322.60
Hw/D (ft)	=	1.62
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 14 2019

4-Kupulau Dr 36+92 Q50 24hr

Invert Elev Dn (ft)	=	596.20
Pipe Length (ft)	=	54.00
Slope (%)	=	2.78
Invert Elev Up (ft)	=	597.70
Rise (in)	=	42.0
Shape	=	Circular
Span (in)	=	42.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

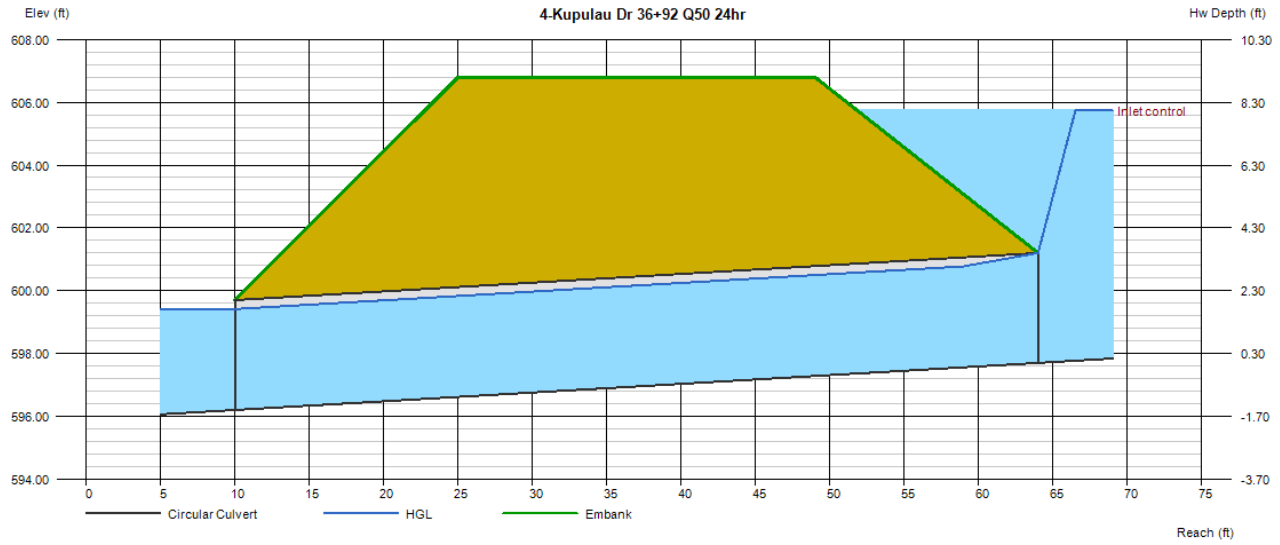
Top Elevation (ft)	=	606.80
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	231.00
Qmax (cfs)	=	231.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	231.00
Qpipe (cfs)	=	231.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	12.49
Veloc Up (ft/s)	=	12.49
HGL Dn (ft)	=	599.41
HGL Up (ft)	=	600.91
Hw Elev (ft)	=	605.73
Hw/D (ft)	=	2.29
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Jun 3 2019

43-Kehala Drive Q50 24hr

Invert Elev Dn (ft)	=	342.20
Pipe Length (ft)	=	63.00
Slope (%)	=	2.06
Invert Elev Up (ft)	=	343.50
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	216.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

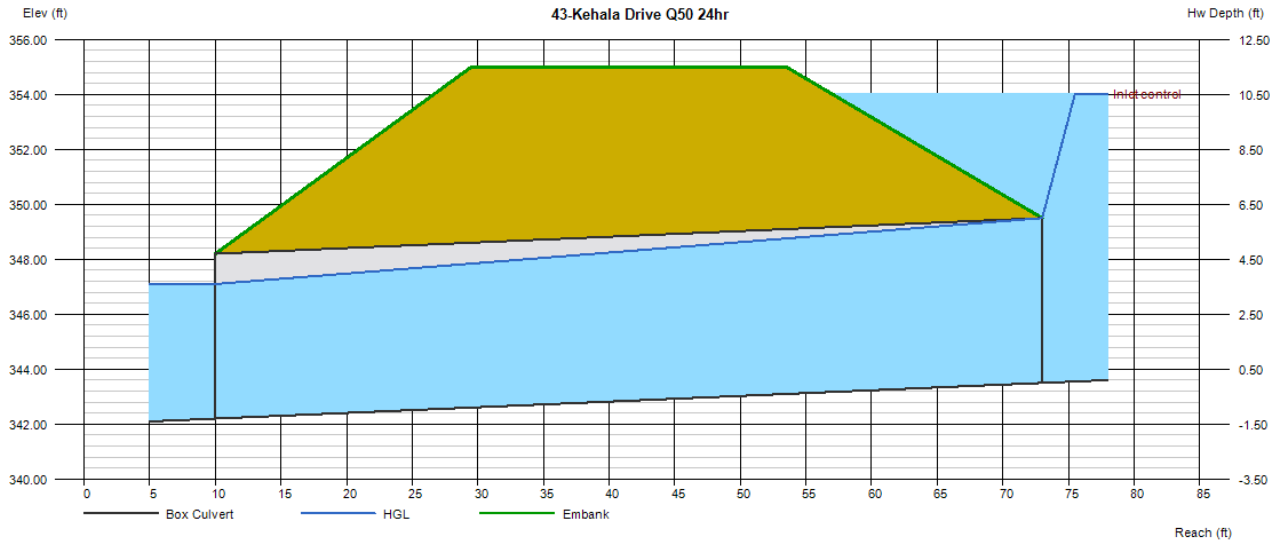
Top Elevation (ft)	=	355.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	1763.00
Qmax (cfs)	=	1763.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	1763.00
Qpipe (cfs)	=	1763.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	19.99
Veloc Up (ft/s)	=	16.32
HGL Dn (ft)	=	347.10
HGL Up (ft)	=	349.50
Hw Elev (ft)	=	354.03
Hw/D (ft)	=	1.75
Flow Regime	=	Inlet Control



Culvert Report

7-Kupulau Dr 52+47 Q50 24hr

Invert Elev Dn (ft)	=	604.20
Pipe Length (ft)	=	62.50
Slope (%)	=	4.48
Invert Elev Up (ft)	=	607.00
Rise (in)	=	72.0
Shape	=	Box
Span (in)	=	108.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Flared Wingwalls
Culvert Entrance	=	30D to 75D wingwall flares
Coeff. K,M,c,Y,k	=	0.026, 1, 0.0347, 0.81, 0.4

Embankment

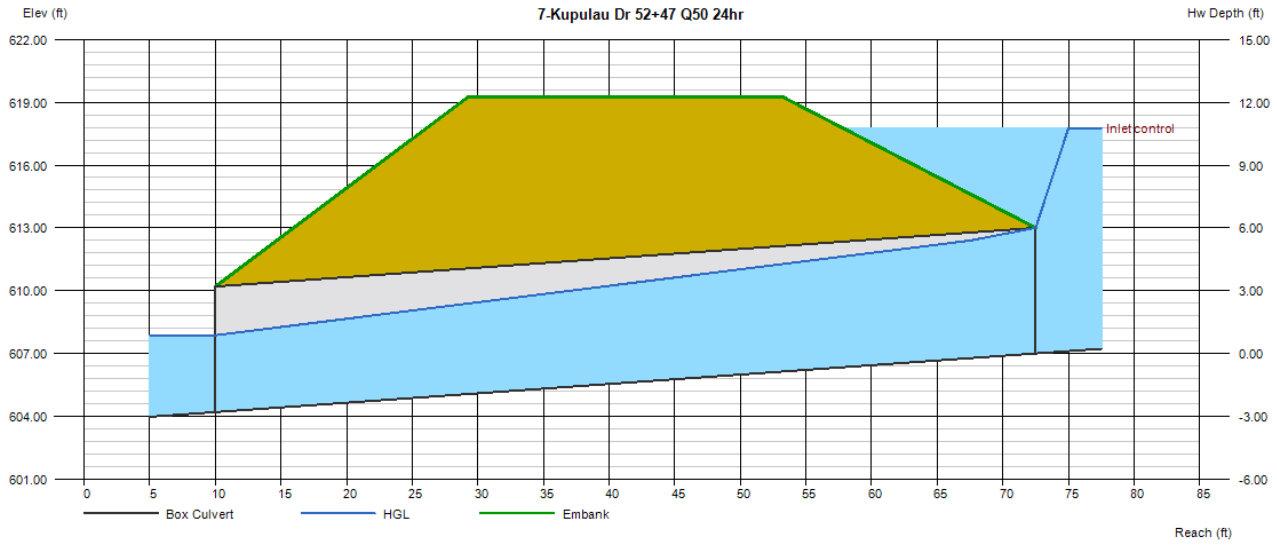
Top Elevation (ft)	=	619.25
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	713.00
Qmax (cfs)	=	713.00
Tailwater Elev (ft)	=	0.00

Highlighted

Qtotal (cfs)	=	713.00
Qpipe (cfs)	=	713.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	21.59
Veloc Up (ft/s)	=	13.68
HGL Dn (ft)	=	607.87
HGL Up (ft)	=	612.79
Hw Elev (ft)	=	617.78
Hw/D (ft)	=	1.80
Flow Regime	=	Inlet Control



APPENDIX C

FIELD PHOTOS

FLOODING ISSUE 1

FIELD PHOTOS

Photo 1: Upstream of Culvert 8 is not accessible (private property)

Photo 2: Downstream view of Culver 8 and roadside culvert (12”) outlets

Photo 3: Look toward roadside culvert inlet at TMK: 2-1-019: 062

Photo 4: Close-up view of roadside culvert inlet at TMK: 2-1-019: 062

FLOODING ISSUE 2

FIELD PHOTOS

Photo 1: Stand on Kupulau Dr, look toward upstream of Culvert 7

Photo 2: Stand on stream, look toward Culvert 7 inlet

Photo 3: Stand on right bank, look toward Culvert 7 outlet

Photo 4: Look toward downstream of Culvert 7

FLOODING ISSUE 3

FIELD PHOTOS

Photo 1: Stand on Kumulani Dr, look downstream toward Culvert 12 (Road side DI)

Photo 2: Close-up view of DI, filter sock was placed in front of DI

Photo 3: Existing DI across Culvert 12 at the opposite side of Kumulani Dr.

Photo 4: Close-up view of DI shown in Photo 3

Photo 5: Stand on Kumulani Dr by the DI shown in Photos 3 and 4,
Look toward downstream of the DI.

FLOODING ISSUE 4

FIELD PHOTOS

Photo 1: Stand on Hookipa Pl, look toward upstream of Culvert 21

Photo 2: Stand on left bank, look toward Culvert 21 inlet

Photo 3: Stand Hookipa Pl, look toward downstream of Culvert 21

Photo 4: Stand on right bank, look toward downstream of Culvert 21

FLOODING ISSUE 5

FIELD PHOTOS

Photo 1: Stand on Mililani Pl, look toward upstream of Culvert 26

Photo 2: Stand on stream, look toward Culvert 26 inlet

Photo 3: Stand on left bank, look upstream toward Culvert 26 outlet

Photo 4: Stand on Mililani Pl, look toward downstream of Culvert 26

Photo5: Stand on Mililani Pl, look toward Kupulau Dr direction
private property TMK:2-1-015: 105 is the house at right side of the photo

FLOODING ISSUE 6

FIELD PHOTOS

Photo 1: Stand on Mapu Pl, look mauka toward the driveway at Private property 2-1-015: 048 (fading ac swale)

Photo 2: Close-up view at the private driveway

Photo 3: Flow path in the private property

Photo 4: Low point in the private property

FLOODING ISSUE 7

FIELD PHOTOS

Photo 1: Stand on Mapu Pl, look toward upstream of Culvert 32, dredged materials were left on site.

Photo 2: Further upstream of Photo 1, erosion was observed at the bank by the private property, TMK:2-1-015: 061.

Photo 3: Stand on stream, look downstream toward Culvert 32 inlet

Photo 4: Close-up view of Culvert 32 inlets

Photo 5: Stand on Mapu Pl, look toward downstream of Culvert 32 heavy vegetation was observed

Photo 6: Stand on right bank, look toward Culvert 32 outlet

FLOODING ISSUES 8 TO 11

FIELD PHOTOS

Photo 1: Stand on Stream, look toward Culvert 43 inlet

Photo 2: Stand on stream by Photo 1, look toward upstream channel of Culvert 43. Heavy vegetation was observed.

Photo 3: Stand on Kehala Dr, look downstream toward Culvert 43

Photo 4: Close-up view of downstream channel at Culvert 43 outlet. Heavy vegetation was observed.

Photo 5: Roadside swale and drain inlet by private property TMK: 2-1-014: 087

Photo 6: Existing swale appears to be created by flood water. Location is at north of DI shown in Photo 5.

Photo 7: Another roadside drain inlet by private property TMK: 2-1-014: 087

Photo 8: Private driveway at TMK 2-1-014: 060 fronting Mapu Pl.

Photo 9: Cement blocks were placed by private driveway at TMK: 2-1-014: 049

Photo 10: End of Mapu Pl, cul-de-sac

Photo 11: Mapu Pl Cul-de-sac, TMK: 2-1-014: 047 and 048

Photo 12: Earth swale at the end of cul-de-sac

Photo 13: Close-up view of the earth swale leading to stream

Photo 14: Another close-up view of the earth swale

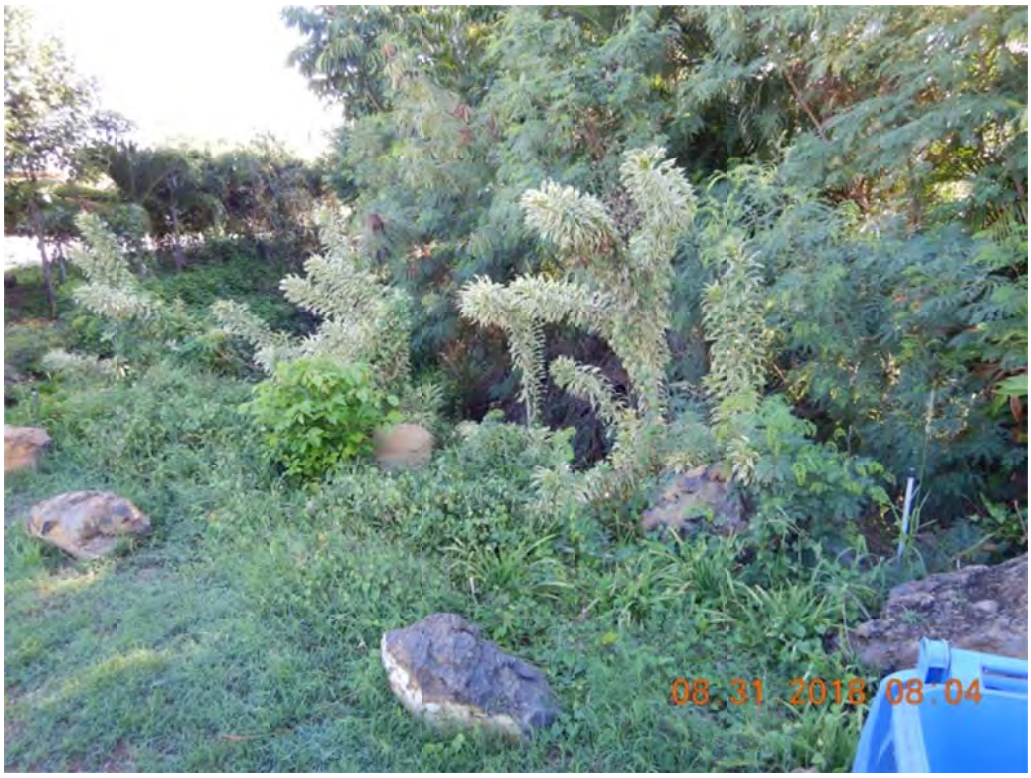


Photo 15: Stand on Akala Dr., look toward upstream of Culvert 36

Photo 16: Stand on stream, look toward Culvert 36 inlet

Photo 17: Stand on right bank, look toward Culvert 36 outlet

Photo 18: Stand on Akala Dr., look toward downstream channel of Culvert 36 outlet

FLOODING ISSUE 12

FIELD PHOTOS

Photo 1: Intersection view, look mauka toward Kumulani Dr.

Photo 2: Stand on south side of the intersection, look toward the intersection

Photo 3: Kumulani Dr. roadside swale (north side)

Photo 4: Kumulani Dr. roadside swale (south side)

Photo 5: Kumulani Dr. roadside swale (south side) continues to Hoala Dr.

Photo 6: Kumulani Dr. roadside swale (north side) continues to Hoala Dr.

APPENDIX D

CONCEPTUAL COST ESTIMATE

Maui Meadows Subdivision DMP
Option 1 - Mauka Diversion
Conceptual Cost Estimate

1 Mauka Diversion 1

Channel Characteristics:
Concrete/Trapezoidal

Bottom Width	50	feet
Min. Height	6	feet
Length	3,100	feet
Side Slope	2H: 1 V	
Assumed Lining Thickness	1.5	feet
Assumed Lining Height	6	feet

	Quantity	Unit	Unit Price	Total
Excavation for Channel	65,000	CY	$40	$2,600,000
Concrete Channel Lining	13,240	CY	$1,090	$14,431,600
Subtotal				$17,031,600
Contingency (20%)				$3,406,320
Total				$20,437,920
Say				**$20,438,000**

2 Mauka Diversion 2

Channel Characteristics:
Concrete/Trapezoidal

Bottom Width	50	feet
Min. Height	6	feet
Length	1,150	feet
Side Slope	2H: 1 V	
Assumed Lining Thickness	1.5	feet
Assumed Lining Height	6	feet

	Quantity	Unit	Unit Price	Total
Excavation for Channel	22,000	CY	$40	$880,000
Concrete Channel Lining	4,910	CY	$1,090	$5,351,900
Subtotal				$6,231,900
Contingency (20%)				$1,246,380
Total				$7,478,280
Say				**$7,479,000**

3 Mauka Diversion 3

Channel Characteristics:
Concrete/Trapezoidal

Bottom Width	50	feet
Min. Height	6	feet
Length	410	feet
Side Slope	2H: 1 V	
Assumed Lining Thickness	1.5	feet
Assumed Lining Height	6	feet

	Quantity	Unit	Unit Price	Total
Excavation for Channel	8,500	CY	$40	$340,000
Concrete Channel Lining	1,760	CY	$1,090	$1,918,400
Subtotal				$2,258,400
Contingency (20%)				$451,680
Total				$2,710,080
Say				**$2,711,000**

4 Access Road (non-paved) to the Three Mauka Diversions

Width	24	feet
Length	12,000	feet
Area = L x W =	6.7	acres
	32,000	sy

	Quantity	Unit	Unit Price	Total
Rough Grading for Access Road	32,000	sy	$90	$2,880,000
Contingency (20%)				$576,000
Total				$3,456,000
Say				**$3,456,000**

Option 1 Mauka Diversion Total Conceptual Costs **$34,084,000**

Notes:

1 Tipping fee for hauling excavated materials is not included.
2 Mobilization/Erosion Control/Permit costs are not included.
3 Land acquisition cost is not included.

1 Culvert 3 Improvements

	Quantity	Unit	Unit Price	Total
1-19'x7' Box	55	LF	$2,600	$143,000
Demolition of Exist. Culverts	1	LS	LS	$33,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$58,800	$117,600
Grading/Grouted Rip-Rap Lining	1	LS	LS	$83,300
Reconstruction of Roadway	150	SY	$95	$14,250
Subtotal				$391,150
Contingency (20%)				$78,230
Total				$469,380
Say				**$470,000**

2 Culvert 4 Improvements

	Quantity	Unit	Unit Price	Total
2-48" Conc. Pipe	110	LF	$395	$43,450
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$49,700
Reconstruction of Roadway	150	SY	$95	$14,250
Subtotal				$179,540
Contingency (20%)				$35,908
Total				$215,448
Say				**$216,000**

3 Culvert 5 Improvements

	Quantity	Unit	Unit Price	Total
1-30" Conc. Pipe	60	LF	$235	$14,100
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$17,640	$35,280
Grading/Grouted Rip-Rap Lining	1	LS	LS	$14,600
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$74,730
Contingency (20%)				$14,946
Total				$89,676
Say				**$90,000**

4 Culvert 6 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	60	LF	$280	$16,800
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$26,100
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$92,850
Contingency (20%)				$18,570
Total				$111,420
Say				**$112,000**

5 Culvert 7 Improvements

	Quantity	Unit	Unit Price	Total
1-13'x6' Box	65	LF	$2,110	$137,150
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$45,080	$90,160
Grading/Grouted Rip-Rap Lining	1	LS	LS	$88,100
Reconstruction of Roadway	130	SY	$95	$12,350
Subtotal				$334,260
Contingency (20%)				$66,852
Total				$401,112
Say				**$402,000**

6 Culvert 8 Improvements

	Quantity	Unit	Unit Price	Total
1-48" Conc. Pipe	65	LF	$395	$25,675
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$23,520	$47,040
Grading/Grouted Rip-Rap Lining	1	LS	LS	$33,100
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$118,015
Contingency (20%)				$23,603
Total				$141,618
Say				**$142,000**

7 Culvert 10 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	60	LF	$280	$16,800
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$85,650
Contingency (20%)				$17,130
Total				$102,780
Say				**$103,000**

8 Culvert 11 Improvements

	Quantity	Unit	Unit Price	Total
1-12'x6' Box	80	LF	$2,040	$163,200
Demolition of Exist. Culverts	1	LS	LS	$8,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$43,120	$86,240
Grading/Grouted Rip-Rap Lining	1	LS	LS	$65,000
Reconstruction of Roadway	150	SY	$95	$14,250
Subtotal				$336,690
Contingency (20%)				$67,338
Total				$404,028
Say				**$405,000**

9 Culvert 14 Improvements

	Quantity	Unit	Unit Price	Total
1-10'x5' Box	75	LF	$1,830	$137,250
Demolition of Exist. Culverts	1	LS	LS	$7,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$37,240	$74,480
Grading/Grouted Rip-Rap Lining	1	LS	LS	$46,300
Reconstruction of Roadway	120	SY	$95	$11,400
Subtotal				$276,930
Contingency (20%)				$55,386
Total				$332,316
Say				**$333,000**

10 Culvert 15 Improvements

	Quantity	Unit	Unit Price	Total
1-23'x7' Box	55	LF	$2,880	$158,400
Demolition of Exist. Culverts	1	LS	LS	$33,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$66,640	$133,280
Grading/Grouted Rip-Rap Lining	1	LS	LS	$107,000
Reconstruction of Roadway	170	SY	$95	$16,150
Subtotal				$447,830
Contingency (20%)				$89,566
Total				$537,396
Say				**$538,000**

11 Culvert 17 Improvements

	Quantity	Unit	Unit Price	Total
1-54" Conc. Pipe	70	LF	$448	$31,360
Demolition of Exist. Culverts	1	LS	LS	$7,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$25,480	$50,960
Grading/Grouted Rip-Rap Lining	1	LS	LS	$32,000
Reconstruction of Roadway	70	SY	$95	$6,650
Subtotal				$127,970
Contingency (20%)				$25,594
Total				$153,564
Say				**$154,000**

12 Culvert 18 Improvements

	Quantity	Unit	Unit Price	Total
1-23'x7' Box	65	LF	$2,880	$187,200
Demolition of Exist. Culverts	1	LS	LS	$39,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$66,640	$133,280
Grading/Grouted Rip-Rap Lining	1	LS	LS	$100,100
Reconstruction of Roadway	200	SY	$95	$19,000
Subtotal				$478,580
Contingency (20%)				$95,716
Total				$574,296
Say				**$575,000**

13 Culvert 19 Improvements

	Quantity	Unit	Unit Price	Total
2-54" Conc. Pipe	110	LF	$448	$49,280
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$36,260	$72,520
Grading/Grouted Rip-Rap Lining	1	LS	LS	$47,300
Reconstruction of Roadway	160	SY	$95	$15,200
Subtotal				$189,800
Contingency (20%)				$37,960
Total				$227,760
Say				**$228,000**

14 Culvert 21 Improvements

	Quantity	Unit	Unit Price	Total
1-13'x6' Box	65	LF	$2,110	$137,150
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$45,080	$90,160
Grading/Grouted Rip-Rap Lining	1	LS	LS	$87,000
Reconstruction of Roadway	130	SY	$95	$12,350
Subtotal				$333,160
Contingency (20%)				$66,632
Total				$399,792
Say				**$400,000**

15 Culvert 22 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	60	LF	$280	$16,800
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$85,650
Contingency (20%)				$17,130
Total				$102,780
Say				**$103,000**

16 Culvert 24 Improvements

	Quantity	Unit	Unit Price	Total
1-23'x7' Box	55	LF	$2,880	$158,400
Demolition of Exist. Culverts	1	LS	LS	$33,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$66,640	$133,280
Grading/Grouted Rip-Rap Lining	1	LS	LS	$58,800
Reconstruction of Roadway	170	SY	$95	$16,150
Subtotal				$399,630
Contingency (20%)				$79,926
Total				$479,556
Say				**$480,000**

17 Culvert 25 Improvements

	Quantity	Unit	Unit Price	Total
1-7'x5' Box	30	LF	$1,300	$39,000
Demolition of Exist. Culverts	1	LS	LS	$3,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$31,360	$62,720
Grading/Grouted Rip-Rap Lining	1	LS	LS	$34,600
Reconstruction of Roadway	40	SY	$95	$3,800
Subtotal				$143,120
Contingency (20%)				$28,624
Total				$171,744
Say				**$172,000**

18 Culvert 26 Improvements

	Quantity	Unit	Unit Price	Total
1-10'x5' Box	60	LF	$1,830	$109,800
Demolition of Exist. Culverts	1	LS	LS	$18,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$37,240	$74,480
Grading/Grouted Rip-Rap Lining	1	LS	LS	$77,200
Reconstruction of Roadway	100	SY	$95	$9,500
Subtotal				$288,980
Contingency (20%)				$57,796
Total				$346,776
Say				**$347,000**

19 Culvert 27 Improvements

	Quantity	Unit	Unit Price	Total
1-42" Conc. Pipe	60	LF	$340	$20,400
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$21,560	$43,120
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$93,170
Contingency (20%)				$18,634
Total				$111,804
Say				**$112,000**

20 Culvert 29 Improvements

	Quantity	Unit	Unit Price	Total
1-13'x6' Box	55	LF	$2,110	$116,050
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$45,080	$90,160
Grading/Grouted Rip-Rap Lining	1	LS	LS	$122,700
Reconstruction of Roadway	110	SY	$95	$10,450
Subtotal				$344,860
Contingency (20%)				$68,972
Total				$413,832
Say				**$414,000**

21 Culvert 31 Improvements

	Quantity	Unit	Unit Price	Total
1-54" Conc. Pipe	55	LF	$448	$24,640
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$25,480	$50,960
Grading/Grouted Rip-Rap Lining	1	LS	LS	$27,500
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$114,300
Contingency (20%)				$22,860
Total				$137,160
Say				**$138,000**

22 Culvert 32 Improvements

	Quantity	Unit	Unit Price	Total
1-10'x5' Box	55	LF	$1,830	$100,650
Demolition of Exist. Culverts	1	LS	LS	$16,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$37,240	$74,480
Grading/Grouted Rip-Rap Lining	1	LS	LS	$75,100
Reconstruction of Roadway	90	SY	$95	$8,550
Subtotal				$275,280
Contingency (20%)				$55,056
Total				$330,336
Say				**$331,000**

23 Culvert 33 Improvements

	Quantity	Unit	Unit Price	Total
2-48" Conc. Pipe	110	LF	$395	$43,450
Demolition of Exist. Culverts	1	LS	LS	$11,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$39,500
Reconstruction of Roadway	150	SY	$95	$14,250
Subtotal				$174,840
Contingency (20%)				$34,968
Total				$209,808
Say				**$210,000**

24 Culvert 34 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	90	LF	$280	$25,200
Demolition of Exist. Culverts	1	LS	LS	$9,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	70	SY	$95	$6,650
Subtotal				$98,950
Contingency (20%)				$19,790
Total				$118,740
Say				**$119,000**

25 Culvert 35 Improvements

	Quantity	Unit	Unit Price	Total
1-10'x5' Box	65	LF	$1,830	$118,950
Demolition of Exist. Culverts	1	LS	LS	$19,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$37,240	$74,480
Grading/Grouted Rip-Rap Lining	1	LS	LS	$60,900
Reconstruction of Roadway	110	SY	$95	$10,450
Subtotal				$284,280
Contingency (20%)				$56,856
Total				$341,136
Say				**$342,000**

26 Culvert 36 Improvements

	Quantity	Unit	Unit Price	Total
1-23'x7' Box	60	LF	$2,880	$172,800
Demolition of Exist. Culverts	1	LS	LS	$36,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$66,640	$133,280
Grading/Grouted Rip-Rap Lining	1	LS	LS	$149,400
Reconstruction of Roadway	180	SY	$95	$17,100
Subtotal				$508,580
Contingency (20%)				$101,716
Total				$610,296
Say				**$611,000**

27 Culvert 37 Improvements

	Quantity	Unit	Unit Price	Total
1-5'x5' Box	50	LF	$1,000	$50,000
Demolition of Exist. Culverts	1	LS	LS	$10,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$27,440	$54,880
Grading/Grouted Rip-Rap Lining	1	LS	LS	$34,400
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$154,030
Contingency (20%)				$30,806
Total				$184,836
Say				**$185,000**

28 Culvert 38 Improvements

	Quantity	Unit	Unit Price	Total
1-13'x6' Box	55	LF	$2,110	$116,050
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$45,080	$90,160
Grading/Grouted Rip-Rap Lining	1	LS	LS	$114,700
Reconstruction of Roadway	110	SY	$95	$10,450
Subtotal				$336,860
Contingency (20%)				$67,372
Total				$404,232
Say				**$405,000**

29 Culvert 39 Improvements (underground system in private property)

	Quantity	Unit	Unit Price	Total
1-42" Conc. Pipe	430	LF	$510	$219,300
Demolition of Exist. Culverts	1	LS	LS	$129,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$21,560	$43,120
Reconstruction of Roadway	360	SY	$95	$34,200
Subtotal				$425,620
Contingency (20%)				$85,124
Total				$510,744
Say				**$511,000**

30 Culvert 42 Improvements

	Quantity	Unit	Unit Price	Total
1-5'x4' Box	85	LF	$850	$72,250
Demolition of Exist. Culverts	1	LS	LS	$8,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$25,480	$50,960
Grading/Grouted Rip-Rap Lining	1	LS	LS	$40,900
Reconstruction of Roadway	90	SY	$95	$8,550
Subtotal				$181,160
Contingency (20%)				$36,232
Total				$217,392
Say				**$218,000**

31 Culvert 43 Improvements

	Quantity	Unit	Unit Price	Total
1-23'x7' Box	65	LF	$2,880	$187,200
Demolition of Exist. Culverts	1	LS	LS	$39,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$66,640	$133,280
Grading/Grouted Rip-Rap Lining	1	LS	LS	$146,600
Reconstruction of Roadway	200	SY	$95	$19,000
Subtotal				$525,080
Contingency (20%)				$105,016
Total				$630,096
Say				**$631,000**

32 Culvert 44 Improvements

	Quantity	Unit	Unit Price	Total
1-42" Conc. Pipe	65	LF	$340	$22,100
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$21,560	$43,120
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$96,320
Contingency (20%)				$19,264
Total				$115,584
Say				**$116,000**

33 Culvert 45 Improvements

	Quantity	Unit	Unit Price	Total
1-60" Conc. Pipe	55	LF	$500	$27,500
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$27,440	$54,880
Grading/Grouted Rip-Rap Lining	1	LS	LS	$38,500
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$132,080
Contingency (20%)				$26,416
Total				$158,496
Say				**$159,000**

34 Culvert 48 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
1-12'x5' Box	96	LF	$1,970	$189,120
Demolition of Exist. Culverts	1	LS	LS	$28,800
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$41,160	$82,320
Grading/Grouted Rip-Rap Lining	1	LS	LS	$62,200
Reconstruction of Roadway	180	SY	$95	$17,100
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$679,540
Contingency (20%)				$135,908
Total				$815,448
Say				**$816,000**

35 Culvert 51 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
2-48" Conc. Pipe	170	LF	$395	$67,150
Demolition of Exist. Culverts	1	LS	LS	$17,000
Inlet/Outlet Conc. Headwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$35,300
Reconstruction of Roadway	230	SY	$95	$21,850
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$507,940
Contingency (20%)				$101,588
Total				$609,528
Say				**$610,000**

36 Culvert 52 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	105	LF	$280	$29,400
Demolition of Exist. Culverts	1	LS	LS	$10,500
Inlet/Outlet Conc. Headwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$19,900
Reconstruction of Roadway	90	SY	$95	$8,550
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$407,550
Contingency (20%)				$81,510
Total				$489,060
Say				**$490,000**

37 Culvert 53 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
1-96" Conc. Pipe	185	LF	$927	$171,495
Demolition of Exist. Culverts	1	LS	LS	$37,000
Inlet/Outlet Conc. Headwall	2	EA	$39,200	$78,400
Grading/Grouted Rip-Rap Lining	1	LS	LS	$41,500
Reconstruction of Roadway	250	SY	$95	$23,750
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$652,145
Contingency (20%)				$130,429
Total				$782,574
Say				**$783,000**

Option 2 Culverts Improvements Conceptual Costs (Maui Meadows Subd.)	**$9,772,000**
Option 2 Culverts Improvements Conceptual Costs (Piilani Highway)	**$2,699,000**
Option 2 Culverts Improvements Total Conceptual Costs	**$12,471,000**

Notes:

1 Tipping fee for hauling excavated materials is not included.
2 Mobilization/Erosion Control/Permit/Traffic Control costs are not included.
3 Land acquisition cost is not included.

Maui Meadows Subdivision DMP
Option 3 - Culverts
Conceptual Cost Estimate

1 Culvert 3 Improvements

	Quantity	Unit	Unit Price	Total
1-15'x6' Box	55	LF	$2,250	$123,750
Demolition of Exist. Culverts	1	LS	LS	$33,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$49,000	$98,000
Grading/Grouted Rip-Rap Lining	1	LS	LS	$74,700
Reconstruction of Roadway	120	SY	$95	$11,400
Subtotal				$340,850
Contingency (20%)				$68,170
Total				$409,020
Say				**$410,000**

2 Culvert 4 Improvements

	Quantity	Unit	Unit Price	Total
2-42" Conc. Pipe	110	LF	$340	$37,400
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$30,380	$60,760
Grading/Grouted Rip-Rap Lining	1	LS	LS	$46,300
Reconstruction of Roadway	140	SY	$95	$13,300
Subtotal				$163,260
Contingency (20%)				$32,652
Total				$195,912
Say				**$196,000**

3 Culvert 5 Improvements

	Quantity	Unit	Unit Price	Total
1-30" Conc. Pipe	60	LF	$235	$14,100
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$17,640	$35,280
Grading/Grouted Rip-Rap Lining	1	LS	LS	$14,600
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$74,730
Contingency (20%)				$14,946
Total				$89,676
Say				**$90,000**

4 Culvert 6 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	60	LF	$280	$16,800
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$26,100
Reconstruction of Roadway	50	SY	$98	$4,900
Subtotal				$93,000
Contingency (20%)				$18,600
Total				$111,600
Say				**$112,000**

5 Culvert 7 Improvements

	Quantity	Unit	Unit Price	Total
1-9'x6' Box	65	LF	$1,830	$118,950
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$37,240	$74,480
Grading/Grouted Rip-Rap Lining	1	LS	LS	$63,000
Reconstruction of Roadway	100	SY	$95	$9,500
Subtotal				$272,430
Contingency (20%)				$54,486
Total				$326,916
Say				**$327,000**

6 Culvert 8 Improvements

	Quantity	Unit	Unit Price	Total
1-48" Conc. Pipe	65	LF	$395	$25,675
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$23,520	$47,040
Grading/Grouted Rip-Rap Lining	1	LS	LS	$33,100
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$118,015
Contingency (20%)				$23,603
Total				$141,618
Say				**$142,000**

7 Culvert 10 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	60	LF	$280	$16,800
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$85,650
Contingency (20%)				$17,130
Total				$102,780
Say				**$103,000**

8 Culvert 11 Improvements

	Quantity	Unit	Unit Price	Total
1-11'x5' Box	80	LF	$1,900	$152,000
Demolition of Exist. Culverts	1	LS	LS	$8,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$39,200	$78,400
Grading/Grouted Rip-Rap Lining	1	LS	LS	$55,600
Reconstruction of Roadway	140	SY	$95	$13,300
Subtotal				$307,300
Contingency (20%)				$61,460
Total				$368,760
Say				**$369,000**

9 Culvert 14 Improvements

	Quantity	Unit	Unit Price	Total
1-8'x5' Box	75	LF	$1,450	$108,750
Demolition of Exist. Culverts	1	LS	LS	$7,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$39,200
Reconstruction of Roadway	100	SY	$95	$9,500
Subtotal				$231,590
Contingency (20%)				$46,318
Total				$277,908
Say				**$278,000**

10 Culvert 15 Improvements

	Quantity	Unit	Unit Price	Total
1-16'x6' Box	55	LF	$2,320	$127,600
Demolition of Exist. Culverts	1	LS	LS	$33,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$50,960	$101,920
Grading/Grouted Rip-Rap Lining	1	LS	LS	$68,100
Reconstruction of Roadway	130	SY	$95	$12,350
Subtotal				$342,970
Contingency (20%)				$68,594
Total				$411,564
Say				**$412,000**

11 Culvert 17 Improvements

	Quantity	Unit	Unit Price	Total
1-54" Conc. Pipe	70	LF	$448	$31,360
Demolition of Exist. Culverts	1	LS	LS	$7,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$25,480	$50,960
Grading/Grouted Rip-Rap Lining	1	LS	LS	$32,000
Reconstruction of Roadway	70	SY	$95	$6,650
Subtotal				$127,970
Contingency (20%)				$25,594
Total				$153,564
Say				**$154,000**

12 Culvert 18 Improvements

	Quantity	Unit	Unit Price	Total
1-16'x6' Box	65	LF	$2,320	$150,800
Demolition of Exist. Culverts	1	LS	LS	$39,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$50,960	$101,920
Grading/Grouted Rip-Rap Lining	1	LS	LS	$77,100
Reconstruction of Roadway	150	SY	$95	$14,250
Subtotal				$383,070
Contingency (20%)				$76,614
Total				$459,684
Say				**$460,000**

13 Culvert 19 Improvements

	Quantity	Unit	Unit Price	Total
2-48" Conc. Pipe	110	LF	$395	$43,450
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$36,800
Reconstruction of Roadway	150	SY	$95	$14,250
Subtotal				$166,640
Contingency (20%)				$33,328
Total				$199,968
Say				**$200,000**

14 Culvert 21 Improvements

	Quantity	Unit	Unit Price	Total
1-9'x6' Box	65	LF	$1,830	$118,950
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$37,240	$74,480
Grading/Grouted Rip-Rap Lining	1	LS	LS	$62,100
Reconstruction of Roadway	100	SY	$95	$9,500
Subtotal				$271,530
Contingency (20%)				$54,306
Total				$325,836
Say				**$326,000**

15 Culvert 22 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	60	LF	$280	$16,800
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$85,650
Contingency (20%)				$17,130
Total				$102,780
Say				**$103,000**

16 Culvert 24 Improvements

	Quantity	Unit	Unit Price	Total
1-16'x6' Box	55	LF	$2,320	$127,600
Demolition of Exist. Culverts	1	LS	LS	$33,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$50,960	$101,920
Grading/Grouted Rip-Rap Lining	1	LS	LS	$43,500
Reconstruction of Roadway	130	SY	$95	$12,350
Subtotal				$318,370
Contingency (20%)				$63,674
Total				$382,044
Say				**$383,000**

17 Culvert 25 Improvements

	Quantity	Unit	Unit Price	Total
1-6'x4' Box	30	LF	$1,000	$30,000
Demolition of Exist. Culverts	1	LS	LS	$3,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$27,440	$54,880
Grading/Grouted Rip-Rap Lining	1	LS	LS	$27,600
Reconstruction of Roadway	40	SY	$95	$3,800
Subtotal				$119,280
Contingency (20%)				$23,856
Total				$143,136
Say				**$144,000**

18 Culvert 26 Improvements

	Quantity	Unit	Unit Price	Total
1-8'x5' Box	60	LF	$1,450	$87,000
Demolition of Exist. Culverts	1	LS	LS	$18,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$70,400
Reconstruction of Roadway	80	SY	$95	$7,600
Subtotal				$249,640
Contingency (20%)				$49,928
Total				$299,568
Say				**$300,000**

19 Culvert 27 Improvements

	Quantity	Unit	Unit Price	Total
1-42" Conc. Pipe	60	LF	$340	$20,400
Demolition of Exist. Culverts	1	LS	LS	$6,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$21,560	$43,120
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$93,170
Contingency (20%)				$18,634
Total				$111,804
Say				**$112,000**

20 Culvert 29 Improvements

	Quantity	Unit	Unit Price	Total
1-10'x6' Box	55	LF	$1,900	$104,500
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$39,200	$78,400
Grading/Grouted Rip-Rap Lining	1	LS	LS	$110,600
Reconstruction of Roadway	90	SY	$95	$8,550
Subtotal				$307,550
Contingency (20%)				$61,510
Total				$369,060
Say				**$370,000**

21 Culvert 31 Improvements

	Quantity	Unit	Unit Price	Total
1-54" Conc. Pipe	55	LF	$448	$24,640
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$25,480	$50,960
Grading/Grouted Rip-Rap Lining	1	LS	LS	$27,500
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$114,300
Contingency (20%)				$22,860
Total				$137,160
Say				**$138,000**

22 Culvert 32 Improvements

	Quantity	Unit	Unit Price	Total
1-8'x5' Box	55	LF	$1,450	$79,750
Demolition of Exist. Culverts	1	LS	LS	$16,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$68,600
Reconstruction of Roadway	80	SY	$95	$7,600
Subtotal				$239,090
Contingency (20%)				$47,818
Total				$286,908
Say				**$287,000**

23 Culvert 33 Improvements

	Quantity	Unit	Unit Price	Total
2-42" Conc. Pipe	110	LF	$340	$37,400
Demolition of Exist. Culverts	1	LS	LS	$11,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$30,380	$60,760
Grading/Grouted Rip-Rap Lining	1	LS	LS	$35,200
Reconstruction of Roadway	140	SY	$95	$13,300
Subtotal				$157,660
Contingency (20%)				$31,532
Total				$189,192
Say				**$190,000**

24 Culvert 34 Improvements

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	90	LF	$280	$25,200
Demolition of Exist. Culverts	1	LS	LS	$9,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	70	SY	$95	$6,650
Subtotal				$98,950
Contingency (20%)				$19,790
Total				$118,740
Say				**$119,000**

25 Culvert 35 Improvements

	Quantity	Unit	Unit Price	Total
1-8'x5' Box	65	LF	$1,450	$94,250
Demolition of Exist. Culverts	1	LS	LS	$19,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$54,600
Reconstruction of Roadway	90	SY	$95	$8,550
Subtotal				$243,540
Contingency (20%)				$48,708
Total				$292,248
Say				**$293,000**

26 Culvert 36 Improvements

	Quantity	Unit	Unit Price	Total
1-19'x6' Box	60	LF	$2,530	$151,800
Demolition of Exist. Culverts	1	LS	LS	$36,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$56,840	$113,680
Grading/Grouted Rip-Rap Lining	1	LS	LS	$131,800
Reconstruction of Roadway	160	SY	$95	$15,200
Subtotal				$448,480
Contingency (20%)				$89,696
Total				$538,176
Say				**$539,000**

27 Culvert 37 Improvements

	Quantity	Unit	Unit Price	Total
1-5'x4' Box	50	LF	$850	$42,500
Demolition of Exist. Culverts	1	LS	LS	$10,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$25,480	$50,960
Grading/Grouted Rip-Rap Lining	1	LS	LS	$26,500
Reconstruction of Roadway	50	SY	$95	$4,750
Subtotal				$134,710
Contingency (20%)				$26,942
Total				$161,652
Say				**$162,000**

28 Culvert 38 Improvements

	Quantity	Unit	Unit Price	Total
1-10'x6' Box	55	LF	$1,900	$104,500
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$39,200	$78,400
Grading/Grouted Rip-Rap Lining	1	LS	LS	$103,700
Reconstruction of Roadway	90	SY	$95	$8,550
Subtotal				$300,650
Contingency (20%)				$60,130
Total				$360,780
Say				**$361,000**

29 Culvert 39 Improvements (underground system in private property)

	Quantity	Unit	Unit Price	Total
1-42" Conc. Pipe	430	LF	$510	$219,300
Demolition of Exist. Culverts	1	LS	LS	$129,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$21,560	$43,120
Reconstruction of Roadway	360	SY	$95	$34,200
Subtotal				$425,620
Contingency (20%)				$85,124
Total				$510,744
Say				**$511,000**

30 Culvert 42 Improvements

	Quantity	Unit	Unit Price	Total
1-5'x4' Box	85	LF	$850	$72,250
Demolition of Exist. Culverts	1	LS	LS	$8,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$25,480	$50,960
Grading/Grouted Rip-Rap Lining	1	LS	LS	$40,900
Reconstruction of Roadway	90	SY	$95	$8,550
Subtotal				$181,160
Contingency (20%)				$36,232
Total				$217,392
Say				**$218,000**

31 Culvert 43 Improvements

	Quantity	Unit	Unit Price	Total
1-18'x6' Box	65	LF	$2,460	$159,900
Demolition of Exist. Culverts	1	LS	LS	$39,000
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$54,880	$109,760
Grading/Grouted Rip-Rap Lining	1	LS	LS	$126,100
Reconstruction of Roadway	160	SY	$95	$15,200
Subtotal				$449,960
Contingency (20%)				$89,992
Total				$539,952
Say				**$540,000**

32 Culvert 44 Improvements

	Quantity	Unit	Unit Price	Total
1-42" Conc. Pipe	65	LF	$340	$22,100
Demolition of Exist. Culverts	1	LS	LS	$6,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$21,560	$43,120
Grading/Grouted Rip-Rap Lining	1	LS	LS	$18,900
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$96,320
Contingency (20%)				$19,264
Total				$115,584
Say				**$116,000**

33 Culvert 45 Improvements

	Quantity	Unit	Unit Price	Total
1-60" Conc. Pipe	55	LF	$500	$27,500
Demolition of Exist. Culverts	1	LS	LS	$5,500
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$27,440	$54,880
Grading/Grouted Rip-Rap Lining	1	LS	LS	$38,500
Reconstruction of Roadway	60	SY	$95	$5,700
Subtotal				$132,080
Contingency (20%)				$26,416
Total				$158,496
Say				**$159,000**

34 Culvert 48 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
1-12'x5' Box	96	LF	$1,970	$189,120
Demolition of Exist. Culverts	1	LS	LS	$28,800
Inlet/Outlet Conc. Headwall/Wingwall	2	EA	$41,160	$82,320
Grading/Grouted Rip-Rap Lining	1	LS	LS	$62,200
Reconstruction of Roadway	180	SY	$98	$17,640
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$680,080
Contingency (20%)				$136,016
Total				$816,096
Say				**$817,000**

35 Culvert 51 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
2-48" Conc. Pipe	170	LF	$395	$67,150
Demolition of Exist. Culverts	1	LS	LS	$17,000
Inlet/Outlet Conc. Headwall	2	EA	$33,320	$66,640
Grading/Grouted Rip-Rap Lining	1	LS	LS	$35,300
Reconstruction of Roadway	230	SY	$95	$21,850
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$507,940
Contingency (20%)				$101,588
Total				$609,528
Say				**$610,000**

36 Culvert 52 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
1-36" Conc. Pipe	105	LF	$280	$29,400
Demolition of Exist. Culverts	1	LS	LS	$10,500
Inlet/Outlet Conc. Headwall	2	EA	$19,600	$39,200
Grading/Grouted Rip-Rap Lining	1	LS	LS	$19,900
Reconstruction of Roadway	90	SY	$95	$8,550
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$407,550
Contingency (20%)				$81,510
Total				$489,060
Say				**$490,000**

37 Culvert 53 Improvements, Piilani Highway

	Quantity	Unit	Unit Price	Total
1-96" Conc. Pipe	185	LF	$927	$171,495
Demolition of Exist. Culverts	1	LS	LS	$37,000
Inlet/Outlet Conc. Headwall	2	EA	$39,200	$78,400
Grading/Grouted Rip-Rap Lining	1	LS	LS	$41,500
Reconstruction of Roadway	250	SY	$95	$23,750
Piilani Highway Bypass	1	LS	LS	$300,000
Subtotal				$652,145
Contingency (20%)				$130,429
Total				$782,574
Say				**$783,000**

Option 3 Culverts Improvements Conceptual Costs (Maui Meadows Subd.)	**$8,624,000**
Option 3 Culverts Improvements Conceptual Costs (Piilani Highway)	**$2,700,000**
Option 3 Culverts Improvements Total Conceptual Costs	**$11,324,000**

Notes:

1 Tipping fee for hauling excavated materials is not included.
2 Mobilization/Erosion Control/Permit/Traffic Control costs are not included.
3 Land acquisition cost is not included.