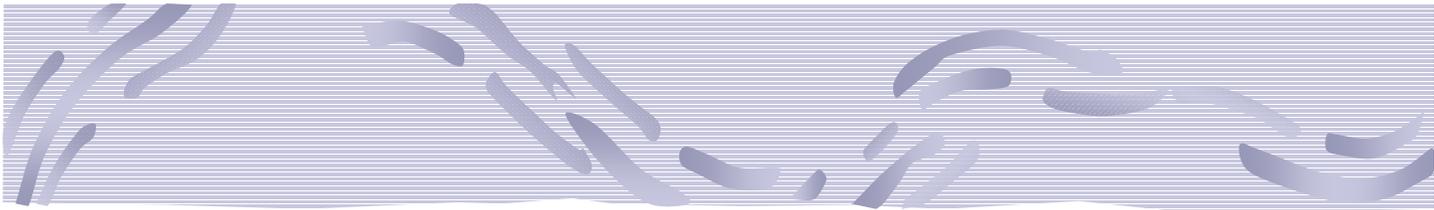


Section 11

HY8 Culvert Design Software





HY8

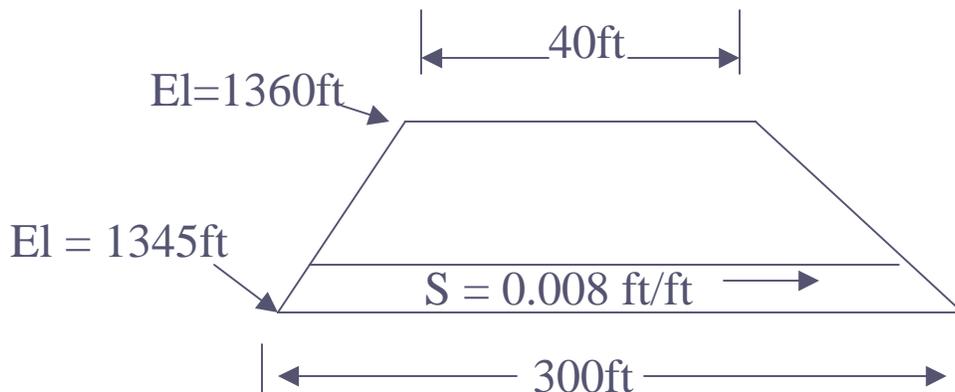
Culvert Analysis and Design Program

HY8 is a DOS interactive, menu driven program that allows the user to :

1. Design and analyze a culvert or a system of culvert
2. Consider and analyze roadway overtopping
3. Generate and route hydrographs through a culvert
4. Design and analyze energy dissipators



HY8 Example



Design Flow for Q25 = 100cfs

Check Flow for Q100 = 250cfs

Tailwater Data

Trapezoidal Channel

Side Slopes = 1.5:1

Bottom Width = 3.5ft

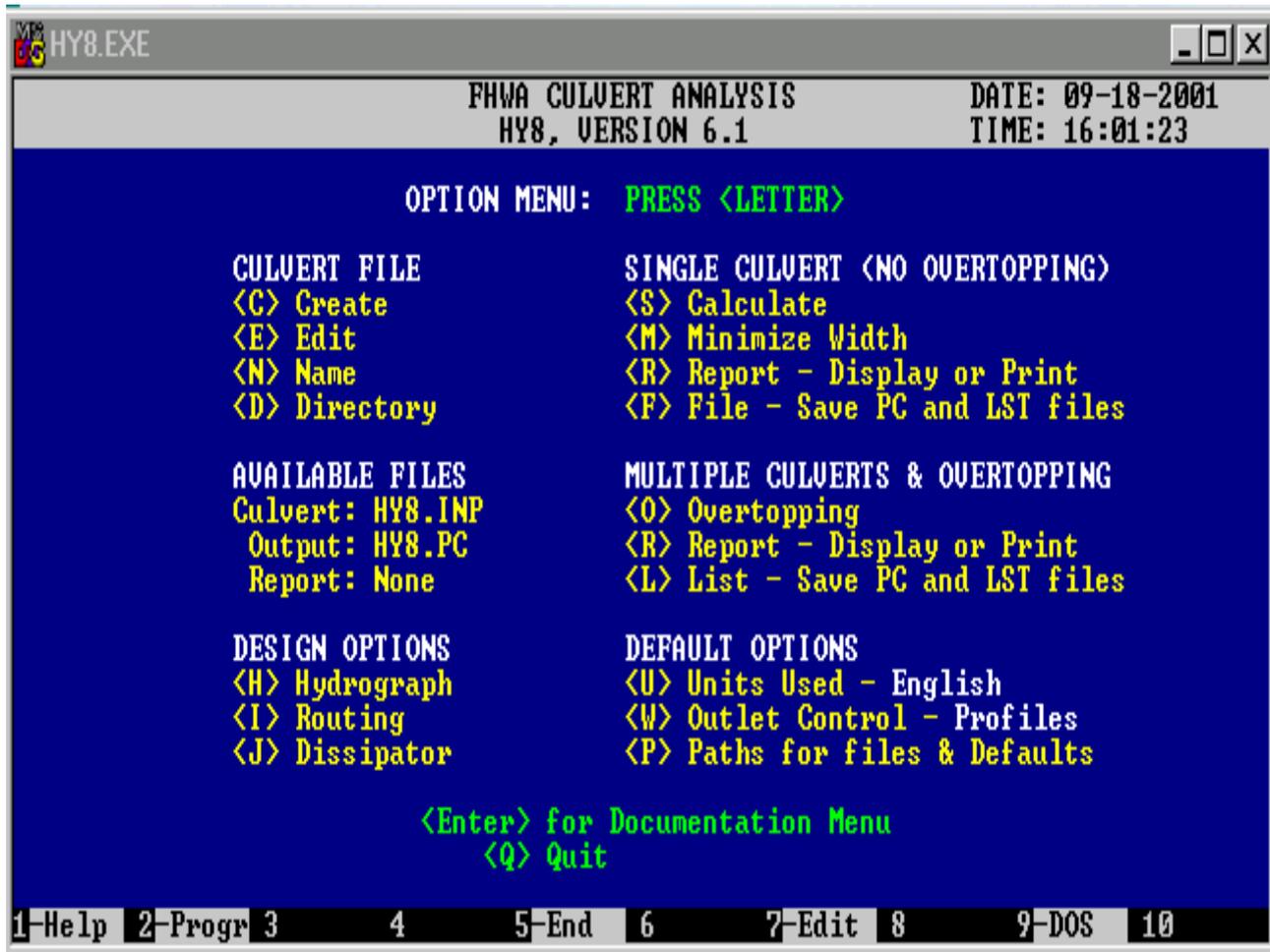
Channel Slope = 0.008ft/ft

Channel Invert Elevation = 1342.6ft

Manning's n value = 0.035

Natural stream channel with gravel, cobbles, few boulders

HY8 Example



The screenshot shows a DOS-style window titled "HY8.EXE". The window has a title bar with standard minimize, maximize, and close buttons. The main content area has a blue background with white and yellow text. At the top, it displays "FHWA CULVERT ANALYSIS" and "HY8, VERSION 6.1" on the left, and "DATE: 09-18-2001" and "TIME: 16:01:23" on the right. The main menu is titled "OPTION MENU: PRESS <LETTER>". It is divided into several sections: "CULVERT FILE" with options like Create, Edit, Name, and Directory; "SINGLE CULVERT (NO OVERTOPPING)" with options like Calculate, Minimize Width, Report, and File; "AVAILABLE FILES" showing "Culvert: HY8.INP", "Output: HY8.PC", and "Report: None"; "MULTIPLE CULVERTS & OVERTOPPING" with options like Overtopping, Report, and List; "DESIGN OPTIONS" with options like Hydrograph, Routing, and Dissipator; and "DEFAULT OPTIONS" with options like Units Used, Outlet Control, and Paths for files & Defaults. At the bottom of the menu, it says "<Enter> for Documentation Menu" and "<Q> Quit". A status bar at the very bottom contains a menu: "1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10".

```
HY8.EXE
FHWA CULVERT ANALYSIS          DATE: 09-18-2001
HY8, VERSION 6.1              TIME: 16:01:23

OPTION MENU:  PRESS <LETTER>

CULVERT FILE                SINGLE CULVERT (NO OVERTOPPING)
<C> Create                  <S> Calculate
<E> Edit                    <M> Minimize Width
<N> Name                    <R> Report - Display or Print
<D> Directory               <F> File - Save PC and LST files

AVAILABLE FILES             MULTIPLE CULVERTS & OVERTOPPING
Culvert: HY8.INP           <O> Overtopping
Output: HY8.PC             <R> Report - Display or Print
Report: None               <L> List - Save PC and LST files

DESIGN OPTIONS              DEFAULT OPTIONS
<H> Hydrograph             <U> Units Used - English
<I> Routing                <W> Outlet Control - Profiles
<J> Dissipator             <P> Paths for files & Defaults

<Enter> for Documentation Menu
<Q> Quit

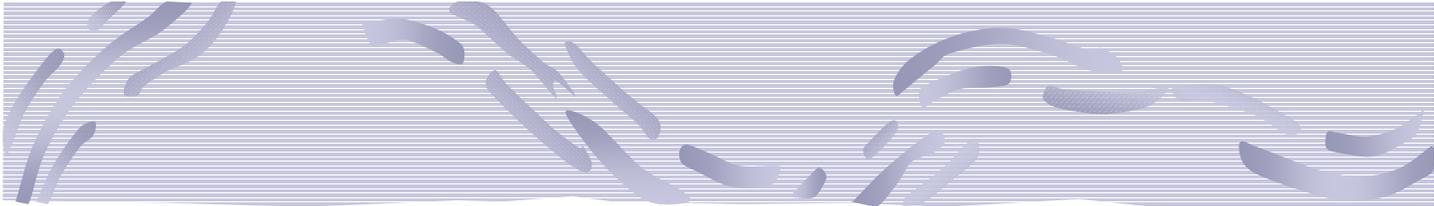
1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10
```

First Window, press <CREATE> to start a new file.

HY8 Example

For this culvert design, the information listed below will be entered onto the various screens in the data input section of the program. The data input screens will generally appear on the overhead in the order listed below:

1. Create a file
2. Enter the file name and date
3. Select “cfs” for units
4. Enter the discharge Design Q25 = 100cfs
 Maximum Q100= 250cfs
5. Select “Culvert Invert Data”
6. Enter the necessary data: Inlet Station = 100
 Inlet Elevation = 1345
 Outlet Station = 400
 Outlet Elevation = 1342.6
 # of Barrels = 1
7. Select a Culvert Shape: Choose “C” for circular
8. Enter the Culvert Diameter: Enter “4”
9. Select a Culvert Material: Choose “ 1 “ for concrete
10. Select an Inlet Type: Choose “1” for conventional
11. Select an Inlet Condition: Choose “4” Grooved end projected
 No Inlet depression
12. Check the summary table to be sure that all the information is correct. Make changes as this point if necessary.



HY8 Example

CONTINUATION:

13. Tailwater Rating Curve: Choose “2” for trapezoidal channel
14. Enter Tailwater Channel data: Bottom Width = 3.5ft
Side Slope = 1.5:1
Channel Slope = 0.008ft/ft
Manning’s n = 0.035
Channel Invert El = 1342.6ft
Culvert Invert El = 1342.6ft
15. Tailwater Rating Curve: This chart shows the elevation of the downstream of the culvert for a given flow
16. Roadway Profile Shape for Overtopping Analysis:
Choose “1” for constant roadway elevation
17. Enter Roadway Profile Data: Crest Length = 50ft
Crest Elevation = 1360ft
18. Weir Coefficient: Choose “1” for paved roadway surface
19. Select Roadway Crest: Go to “4” and enter the embankment top width of 40ft
20. Summary table will show with input.

HY8 Example

CULVERT NO.		<S> SITE DATA			SUMMARY TABLE				<C> CULVERT SHAPE, MATERIAL, INLET			
INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE					
1345.00	1342.60	300.01	1 - RCP	4.00	4.00	.012	CONVENTIONAL					
2												
3												
4												
5												
6												

PRESS <C>	TO REVIEW Culvert Data	PRESS <E>	TO Edit Culvert Size
<D>	Discharge Data	<M>	Minimize Culvert Span
<R>	Roadway Data	<A>	Add or Delete Culverts
<S>	Site Data	<N>	Edit Number of Barrels
<T>	Tailwater Rating Curve	<F>	File - Save or Rename

<ENTER> To Save & Exit
 <ESC> For File Menu

1-Help 2-Progr 3 4 5-End 6 7-Edit 8 9-DOS 10

This screen summarizes all the data that has been entered. It is also a point to go back and change in the design. Once it has been determined that the correct data has been entered press <ENTER> to continue.

HY8 Example



```
HY8.EXE
FHWA CULVERT ANALYSIS          DATE: 09-18-2001
HY8, VERSION 6.1              TIME: 16:07:27

OPTION MENU:  PRESS <LETTER>

CULVERT FILE                  SINGLE CULVERT (NO OVERTOPPING)
<C> Create                    <S> Calculate
<E> Edit                      <M> Minimize Width
<N> Name                      <R> Report - Display or Print
<D> Directory                 <F> File - Save PC and LST files

AVAILABLE FILES               MULTIPLE CULVERTS & OVERTOPPING
Culvert: HY8.INP             <O> Overtopping
Output: None                 <R> Report - Display or Print
Report: None                 <L> List - Save PC and LST files

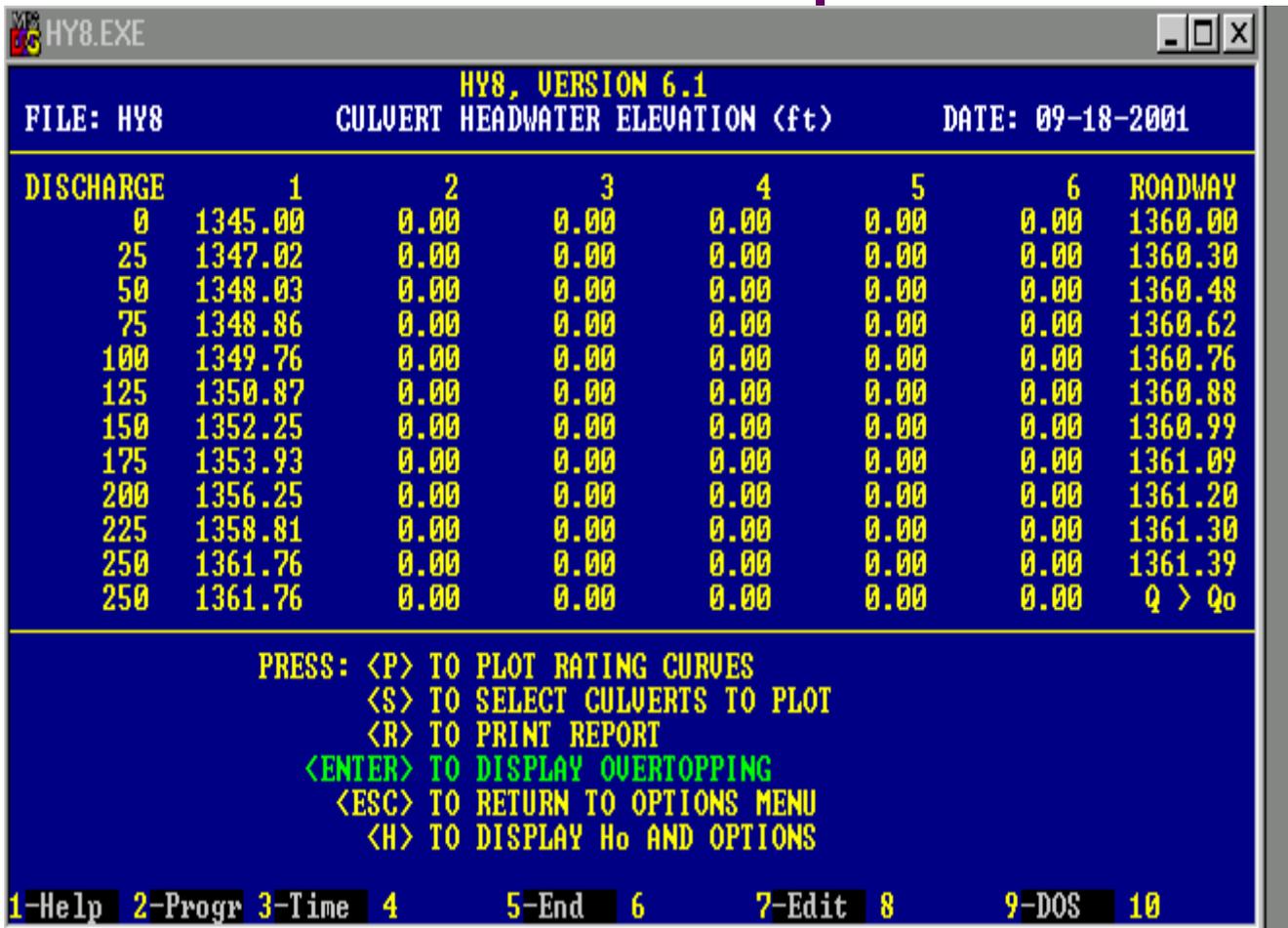
DESIGN OPTIONS                DEFAULT OPTIONS
<H> Hydrograph               <U> Units Used - English
<I> Routing                  <W> Outlet Control - Profiles
<J> Dissipator              <P> Paths for files & Defaults

<Enter> for Documentation Menu
<Q> Quit

1-Help  2-Progr  3          4          5-End  6          7-Edit  8          9-DOS  10
```

After you press ENTER, it takes you to the first window.
Here we want to select <O> for the Overtopping Analysis.

HY8 Example



The screenshot shows the HY8 software interface. The title bar reads 'HY8.EXE'. The main window title is 'HY8, VERSION 6.1'. Below the title, it says 'FILE: HY8', 'CULVERT HEADWATER ELEVATION (ft)', and 'DATE: 09-18-2001'. The main display area contains a table with columns for DISCHARGE, 1, 2, 3, 4, 5, 6, and ROADWAY. The data shows headwater elevations for discharges from 0 to 250. Below the table, there are instructions for navigating the menu. At the bottom, there is a menu bar with options 1-10.

DISCHARGE	1	2	3	4	5	6	ROADWAY
0	1345.00	0.00	0.00	0.00	0.00	0.00	1360.00
25	1347.02	0.00	0.00	0.00	0.00	0.00	1360.30
50	1348.03	0.00	0.00	0.00	0.00	0.00	1360.48
75	1348.86	0.00	0.00	0.00	0.00	0.00	1360.62
100	1349.76	0.00	0.00	0.00	0.00	0.00	1360.76
125	1350.87	0.00	0.00	0.00	0.00	0.00	1360.88
150	1352.25	0.00	0.00	0.00	0.00	0.00	1360.99
175	1353.93	0.00	0.00	0.00	0.00	0.00	1361.09
200	1356.25	0.00	0.00	0.00	0.00	0.00	1361.20
225	1358.81	0.00	0.00	0.00	0.00	0.00	1361.30
250	1361.76	0.00	0.00	0.00	0.00	0.00	1361.39
250	1361.76	0.00	0.00	0.00	0.00	0.00	Q > Qo

PRESS: <P> TO PLOT RATING CURVES
<S> TO SELECT CULVERTS TO PLOT
<R> TO PRINT REPORT
<ENTER> TO DISPLAY OVERTOPPING
<ESC> TO RETURN TO OPTIONS MENU
<H> TO DISPLAY Ho AND OPTIONS

1-Help 2-Progr 3-Time 4 5-End 6 7-Edit 8 9-DOS 10

Screen is displaying the Headwater Elevation at the inlet of the culvert for different discharges.

Press Enter to continue

HY8 Example

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITER
1345.00	0	0	0	0	0	0	0	0	1
1347.02	25	25	0	0	0	0	0	0	1
1348.03	50	50	0	0	0	0	0	0	1
1348.86	75	75	0	0	0	0	0	0	1
1349.76	100	100	0	0	0	0	0	0	1
1350.87	125	125	0	0	0	0	0	0	1
1352.25	150	150	0	0	0	0	0	0	1
1353.93	175	175	0	0	0	0	0	0	1
1356.25	200	200	0	0	0	0	0	0	1
1358.81	225	225	0	0	0	0	0	0	1
1360.19	250	237	0	0	0	0	0	13	7
1360.00	236	236	0	0	0	0	0	0 <---- Q = Qo	

PRESS: <P> TO PLOT TOTAL RATING CURVE
 <T> TO DISPLAY TABLE FOR EACH CULVERT
 <E> TO DISPLAY ERROR TABLE
 <R> TO PRINT REPORT Output stored in HY8.PC
 <H> TO RETURN TO HEADWATER TABLE
 <ENTER> TO RETURN TO OPTION MENU

1-Help 2-Progr 3-Time 4 5-End 6 7 8 9-DOS 10

Computation of flow through culverts is displayed for each iteration according to computed headwater elevation. Ten columns with information pertaining to performance are displayed:

- Column 1 - Computed headwater elevation
- Column 2 - Total discharge described from discharge range
- Column 3 to 8 – Calculated flows through each culvert
- Column 9 – Flow overtopping roadway
- Column 10 – Number of iterations program had to use to determine flow and headwater elevation (Max 30)

Press <T> to Display the summary table.

HY8 Example

HY8.EXE

FHWA CULVERT ANALYSIS
HY8, VERSION 6.1

DATE: 09-18-2001
TIME: 16:18:43

SUMMARY TABLE FOR FILE HY8

C U L V E R T N O.	<S> SITE DATA			<C> CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	1345.00	1342.60	300.01	1 - RCP	4.00	4.00	.012	CONVENTIONAL

PRESS: <ENTER> TO LIST ALL
<NUMBER> TO LIST A CULVERT
<ESC> TO RETURN

1-Help 2-Progr 3-Time 4 5-End 6 7 8 9-DOS 10

Brings up the summary table of the input information.

Press <ENTER> to list the results

HY8 Example

HY8.EXE

PERFORMANCE CURVE FOR CULVERT NO. 1 - 1(4.00 ft by 4.00 ft) RCP

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0	1345.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
25	1347.02	2.02	2.02	1-S2n	1.14	1.47	1.07	1.32	9.23	3.47
50	1348.03	3.03	3.03	1-S2n	1.65	2.11	1.66	1.89	10.11	4.19
75	1348.86	3.86	3.86	1-S2n	2.09	2.61	2.01	2.31	11.85	4.66
100	1349.76	4.76	4.76	5-S2n	2.51	3.02	2.42	2.66	12.59	5.02
125	1350.87	5.87	5.87	5-S2n	2.97	3.33	2.98	2.96	12.46	5.32
150	1352.25	7.25	4.60	2-M2c	4.00	3.59	3.59	3.23	12.61	5.57
175	1353.93	8.91	8.93	2-M2c	4.00	3.85	3.85	3.47	14.19	5.80
200	1356.25	10.82	11.25	6-PFc	4.00	4.00	4.00	3.69	15.92	6.00
225	1358.81	12.96	13.81	6-PFc	4.00	4.00	4.00	3.90	17.90	6.18
237	1360.19	14.02	15.19	4-PFt	4.00	4.00	4.00	4.09	18.83	6.35

INVERT ELEVATIONS--> Inlet - 1345.00 ft Crest - 0.00 ft
 FILE: HY8 Outlet - 1342.60 ft Throat - 0.00 ft

PRESS: <KEY> TO CONTINUE <W> FOR PROFILE TABLE
 <P> TO PLOT <I> FOR IMPROVED INLET TABLE

1-Help 2 3 4-Type 5-End 6 7 8 9-DOS 10

- Column 1: Q-Discharge describes from discharge range
- Column 2: HW-Computed headwater elevations at inlet
- Column 3: ICH-Inlet control headwater depth above inlet invert
- Column 4: OCH-Outlet control headwater depth above inlet invert
- Column 5: Flow Type-USGS flow types (press F4 to display)
- Column 6: dn-Normal depth computed in the culvert
- Column 7: dc-Critical depth computed in culvert
- Column 8: do-Depth assumed at culvert outlet
- Column 9: TW-Depth in downstream channel
- Column 10: Vo-Velocity computed at the culvert
- Column 11: TW-Velocity in downstream channel