



TEXAS DEPARTMENT OF TRANSPORTATION

# HYDRAULIC DESIGN MANUAL UPDATES

Stanley (Stan) Hopfe, P.E., CFM

Chief Hydraulics Engineer

October 12, 2016

---

# Hydraulic Design Manual Updates:

## Three critical updates:

- Sheet flow analysis is now required for storm sewer projects.
- Intensity Duration Frequency (IDF) Curves updated.
- Storm sewer and culvert maintenance velocities have increased (from 2 fps to 3 fps)

# Hydraulic Design Manual Release

- Hydraulic Design Manual Release Date:  
**July 1, 2016**
- Effective on all new projects with a Start Date:  
**August 1, 2016 or later**



TEXAS DEPARTMENT OF TRANSPORTATION

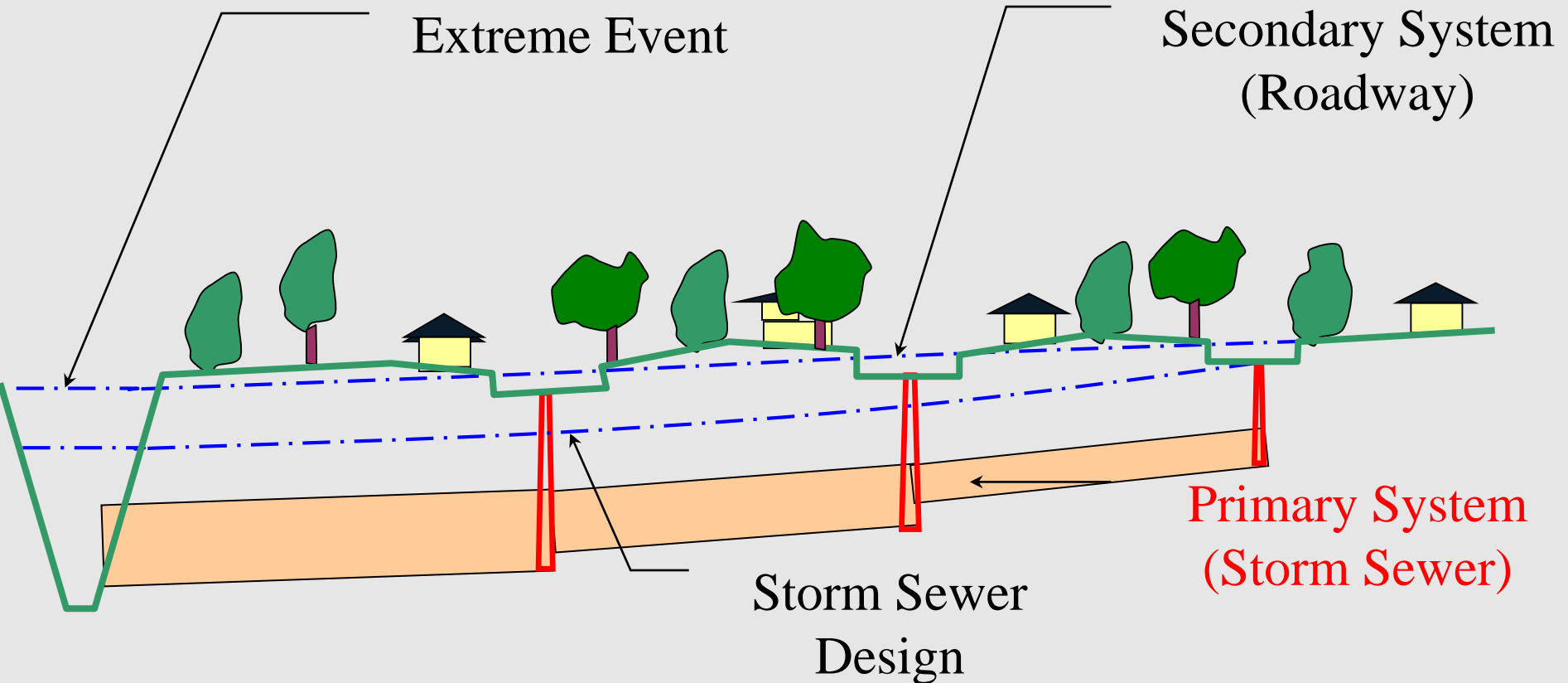
# **SHEET FLOW ANALYSIS REQUIRED FOR STORM SEWER PROJECTS**



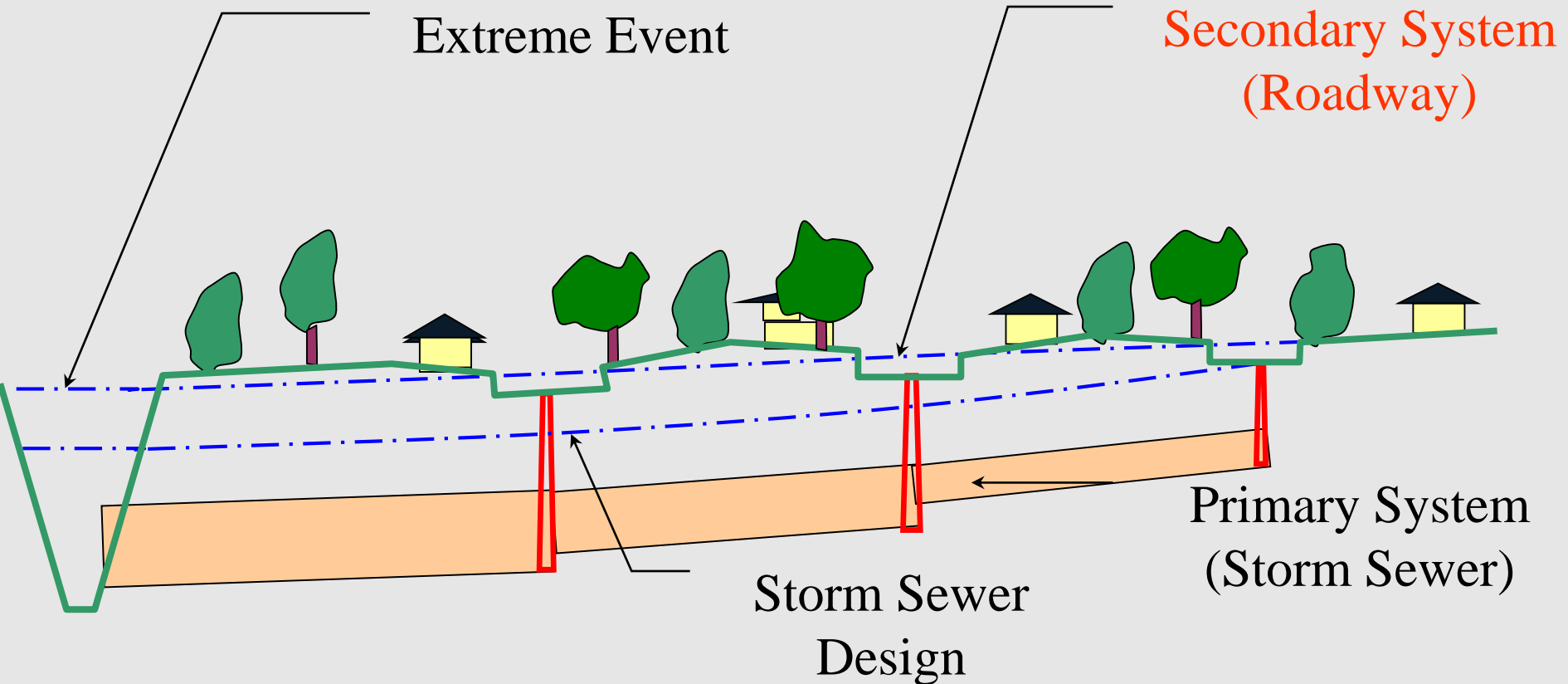
# Objective of the Sheet Flow Analysis

- Do not compromise existing sheet flow patterns.
- Insure the roadway provides storm conveyance for the extreme events without significant impacts to adjacent structures.

# Drainage System (Storm Sewer and Roadway)

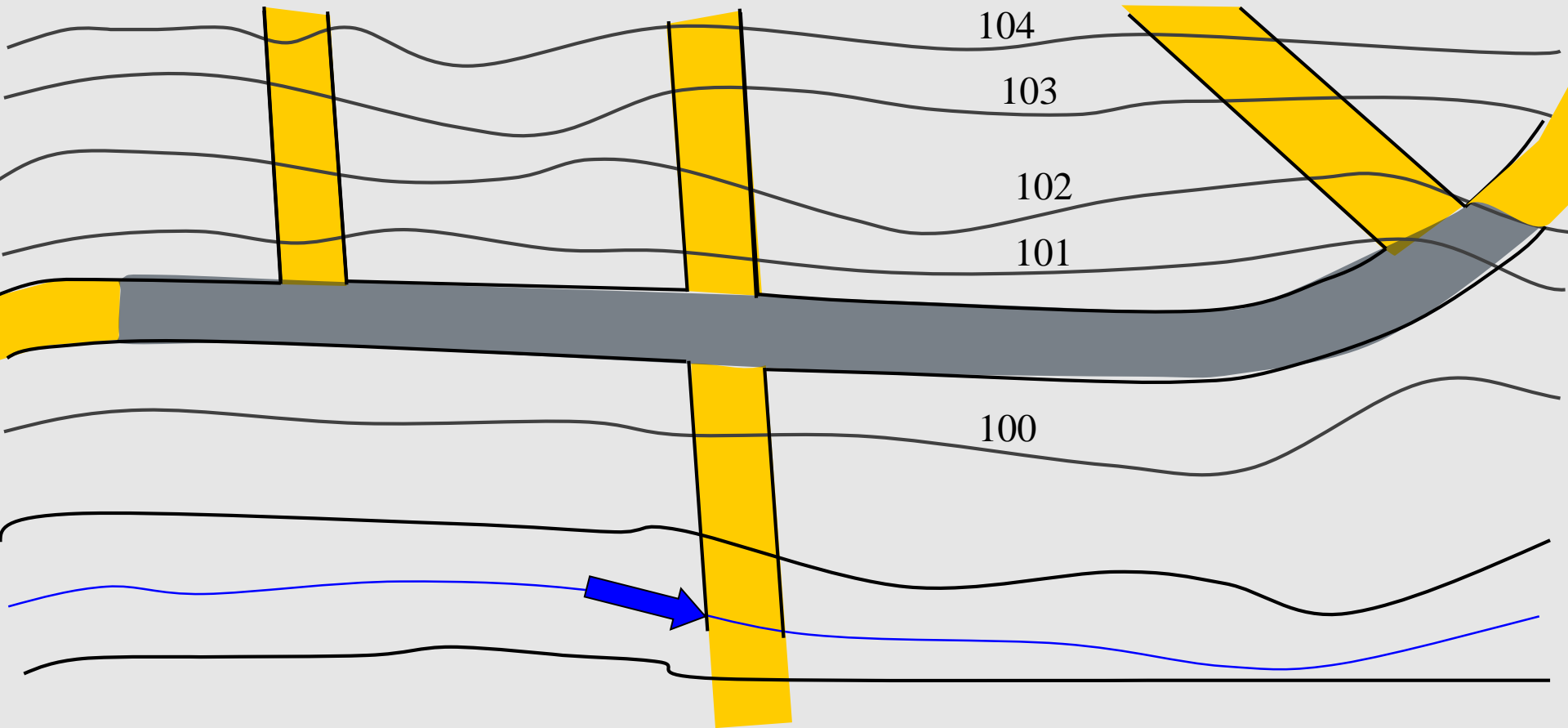


# Drainage System (Storm Sewer and Roadway)



# Contour Map

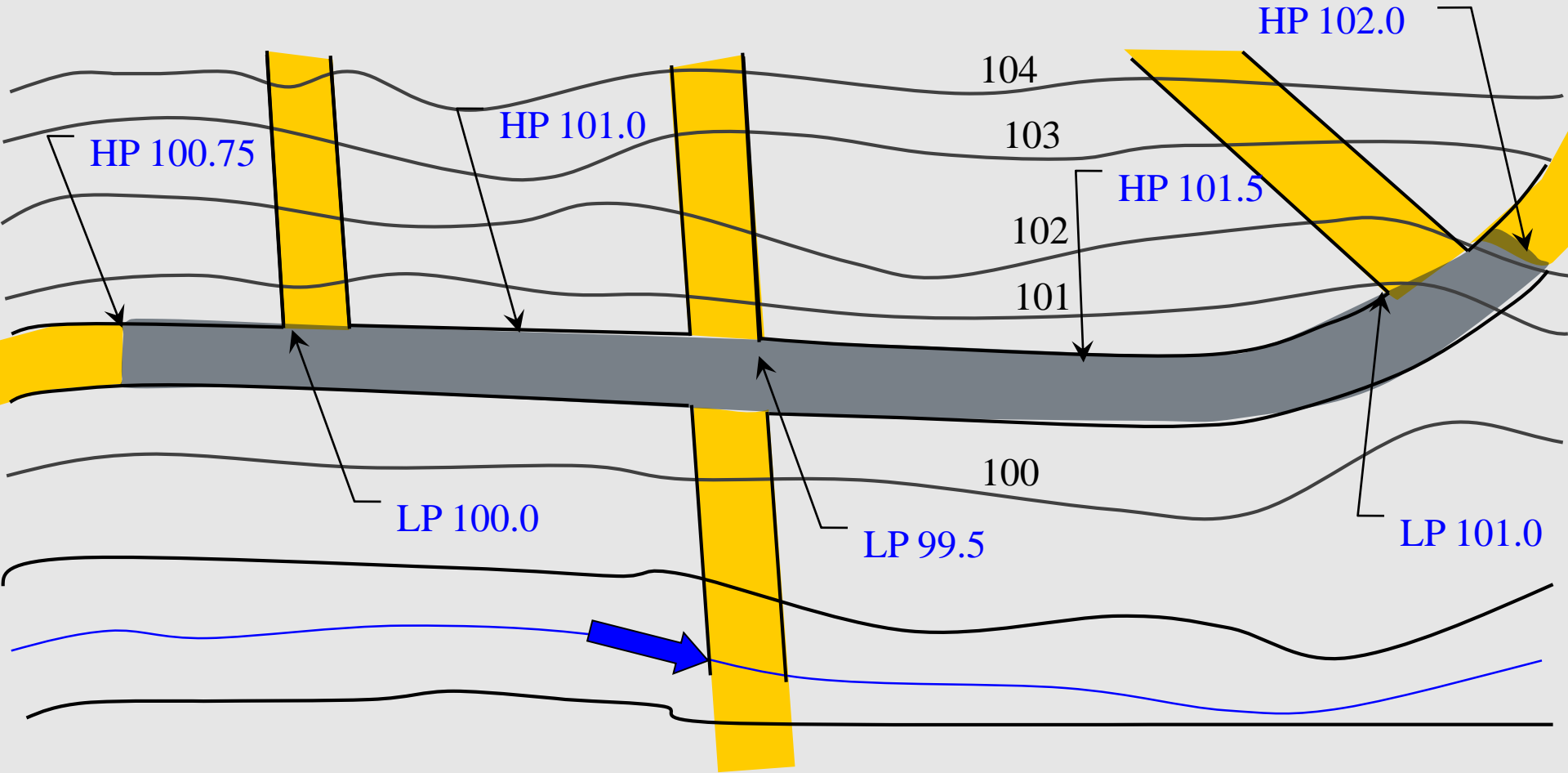
 Proposed Road





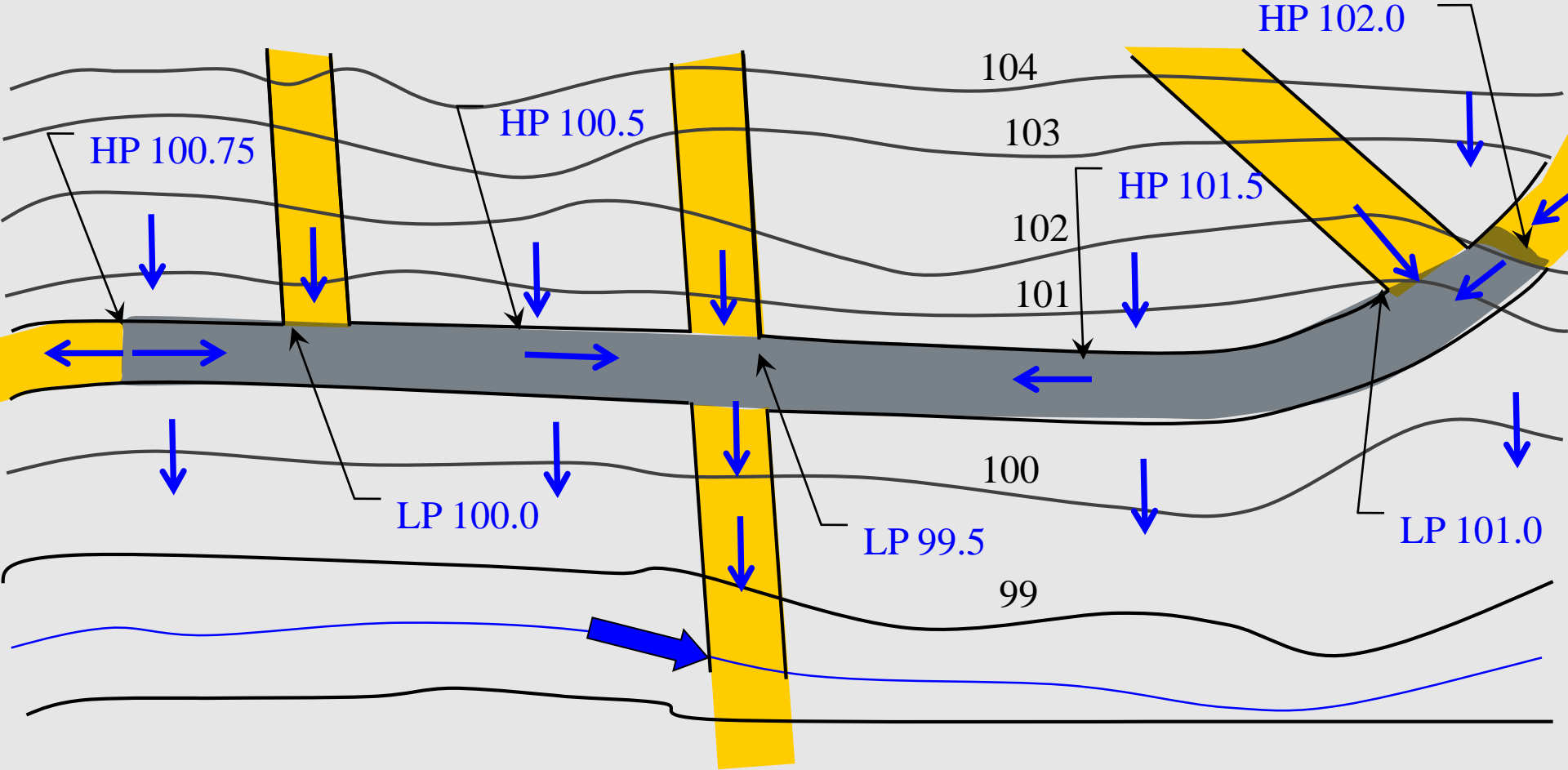
# Existing Sheet Flow Map

Proposed Road



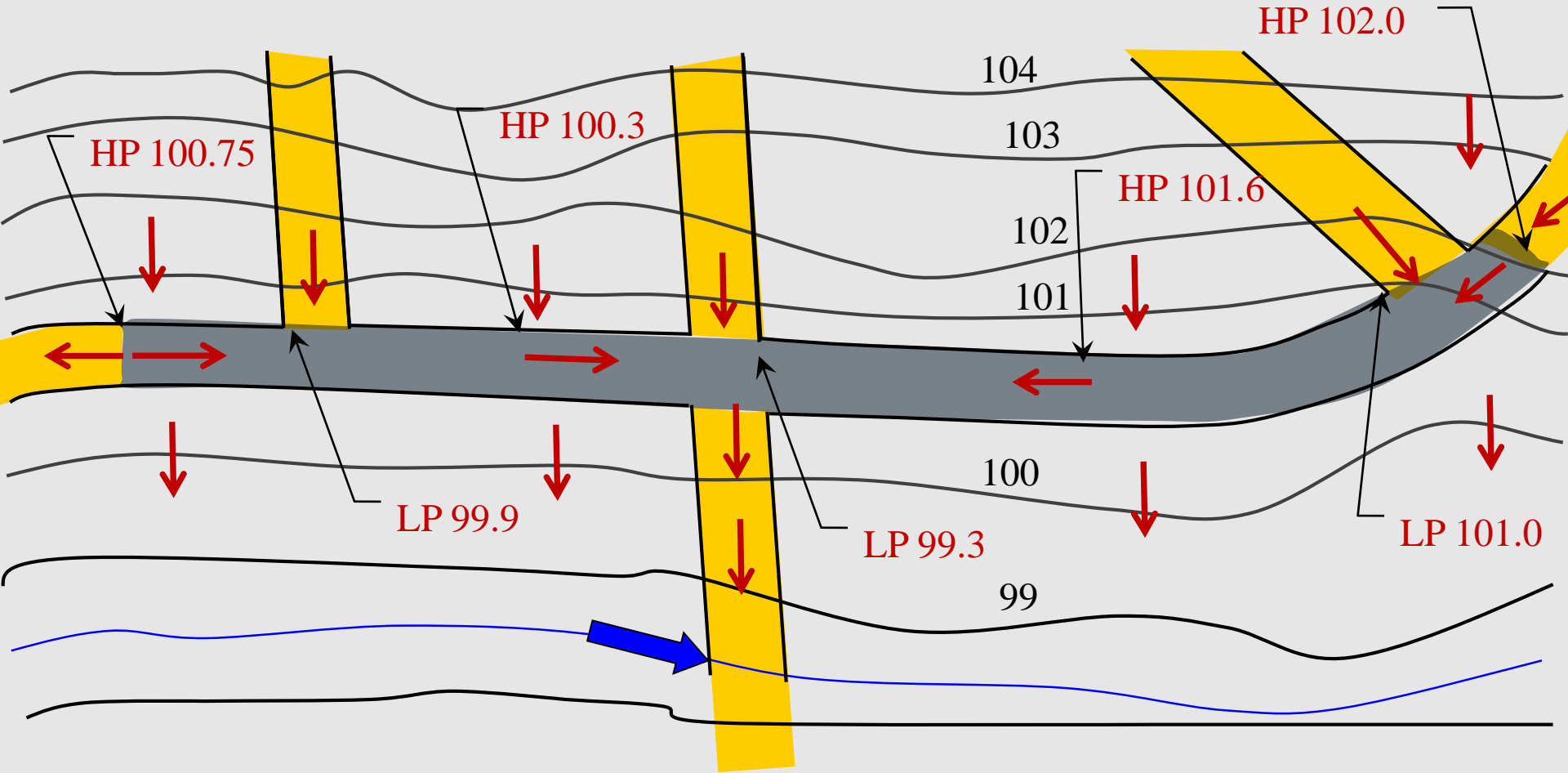
# Existing Sheet Flow Map

Proposed Road

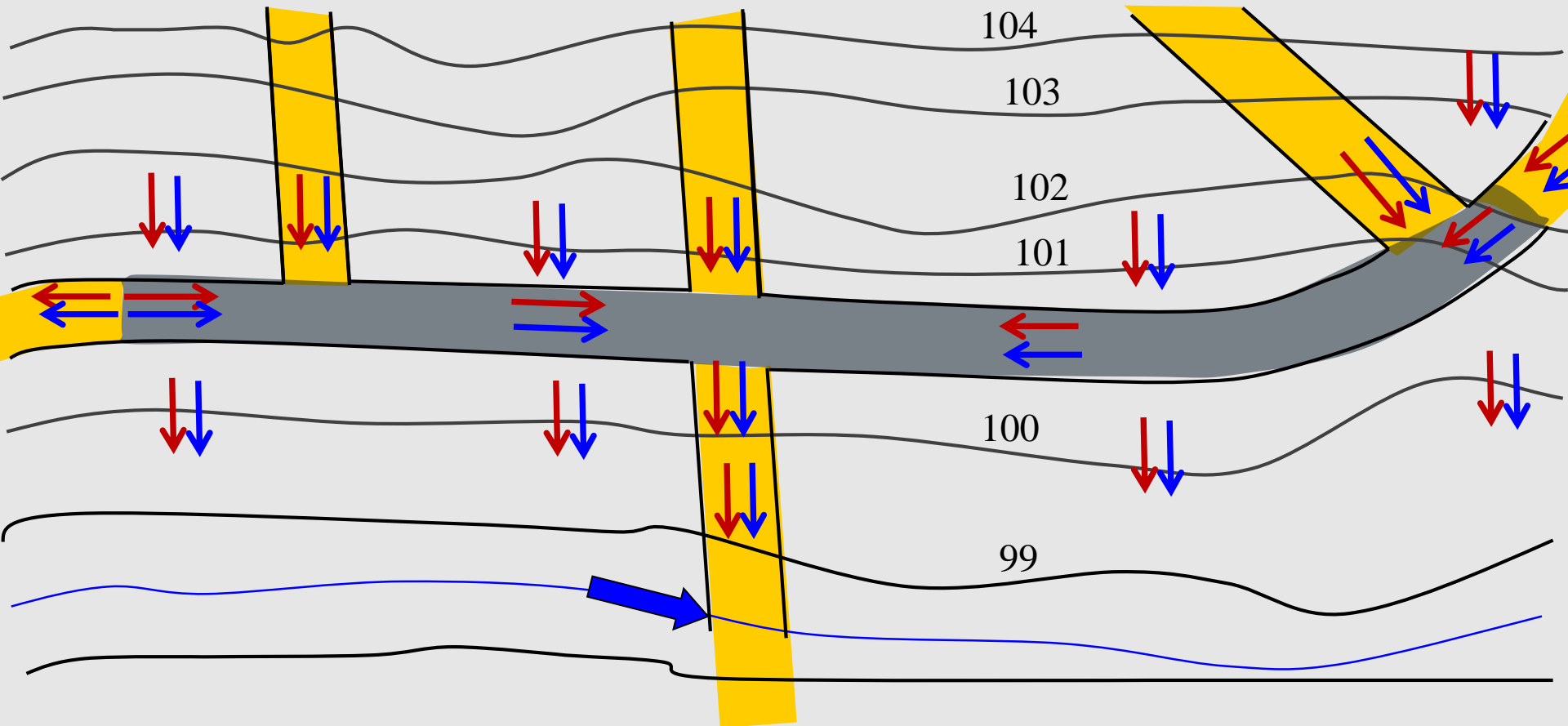
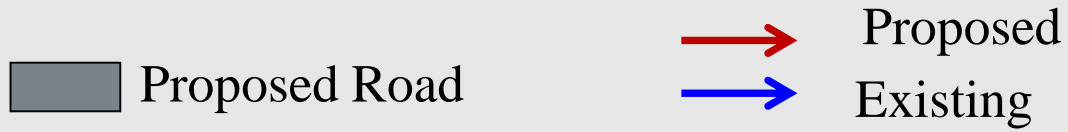


# Proposed Sheet Flow Map

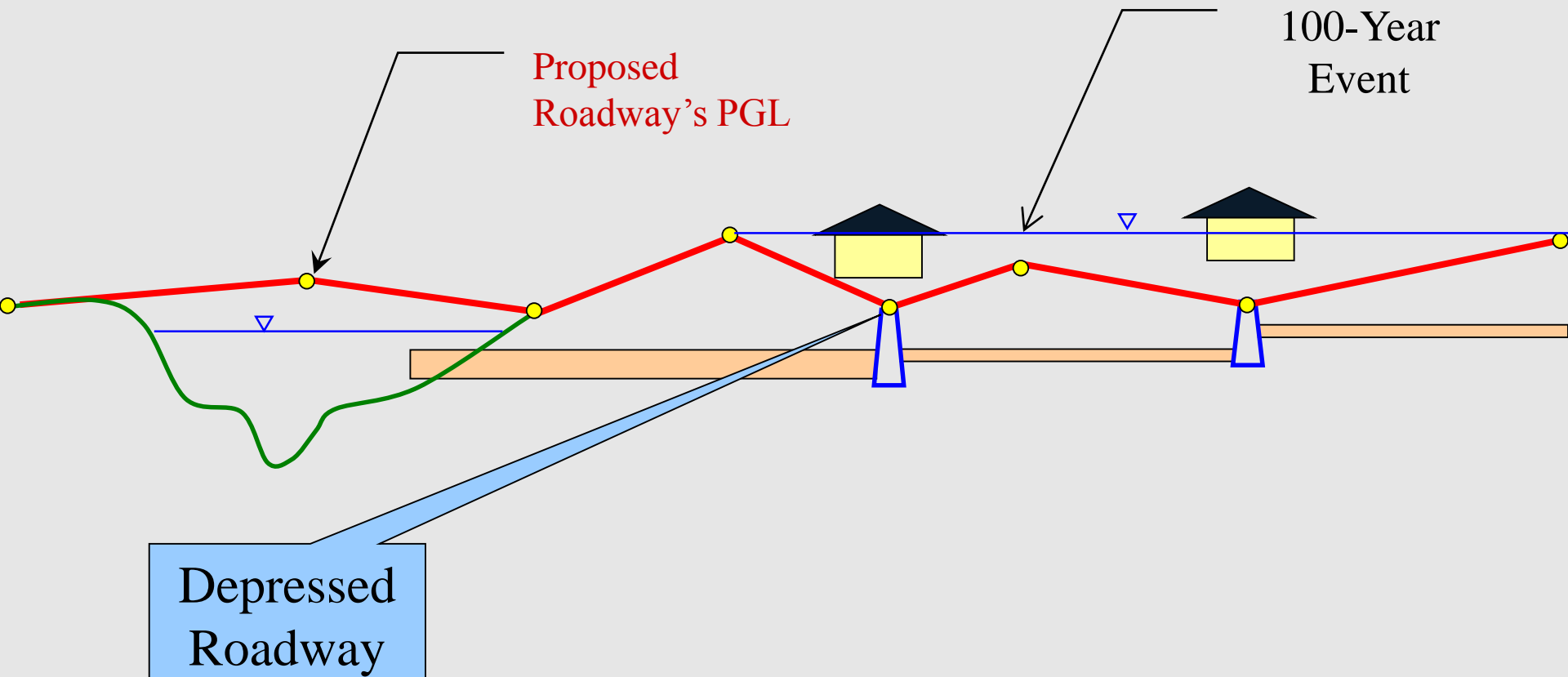
Proposed Road



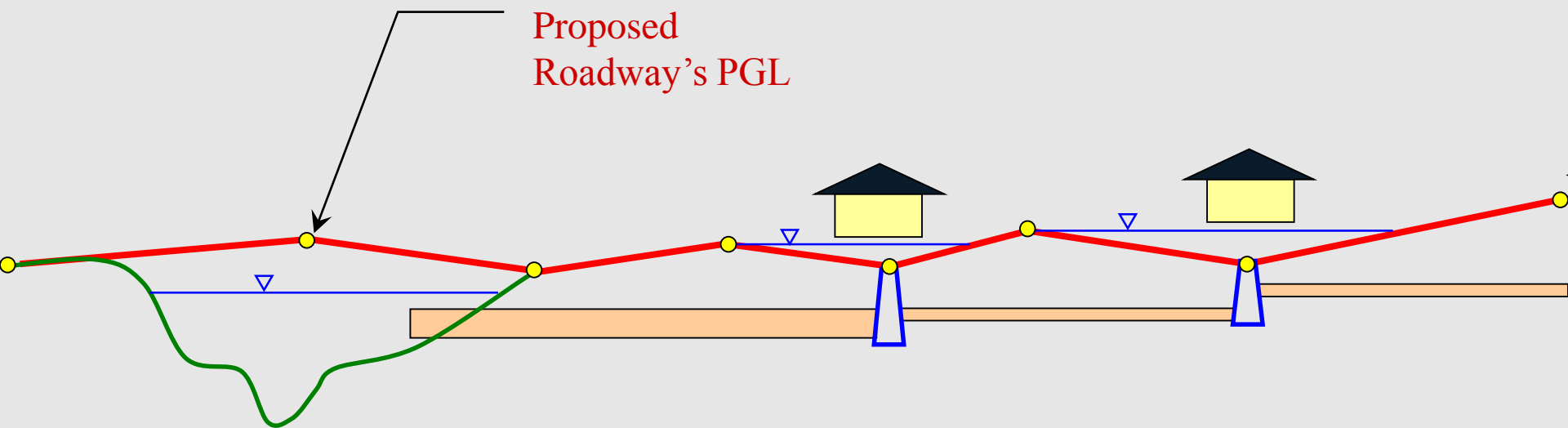
# Final Sheet Flow Map



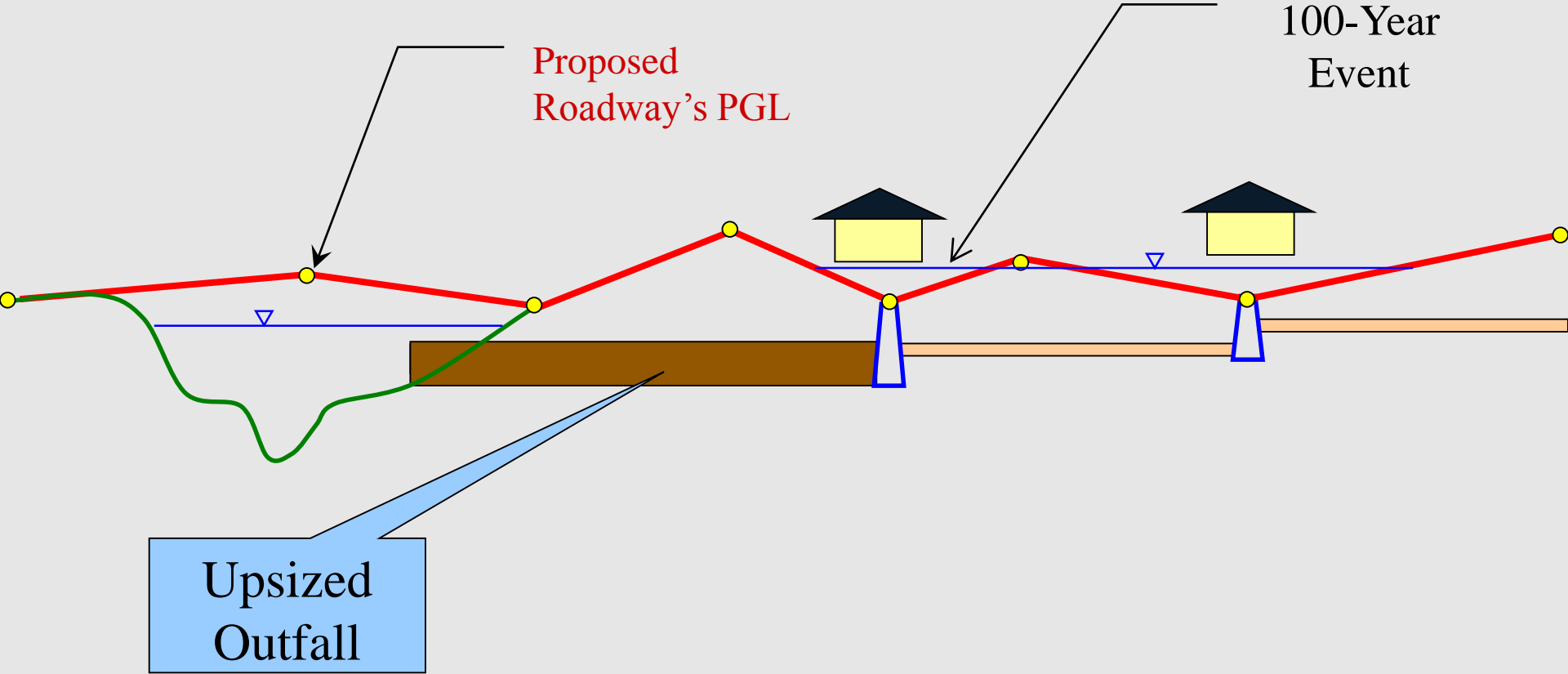
# Proposed Profile



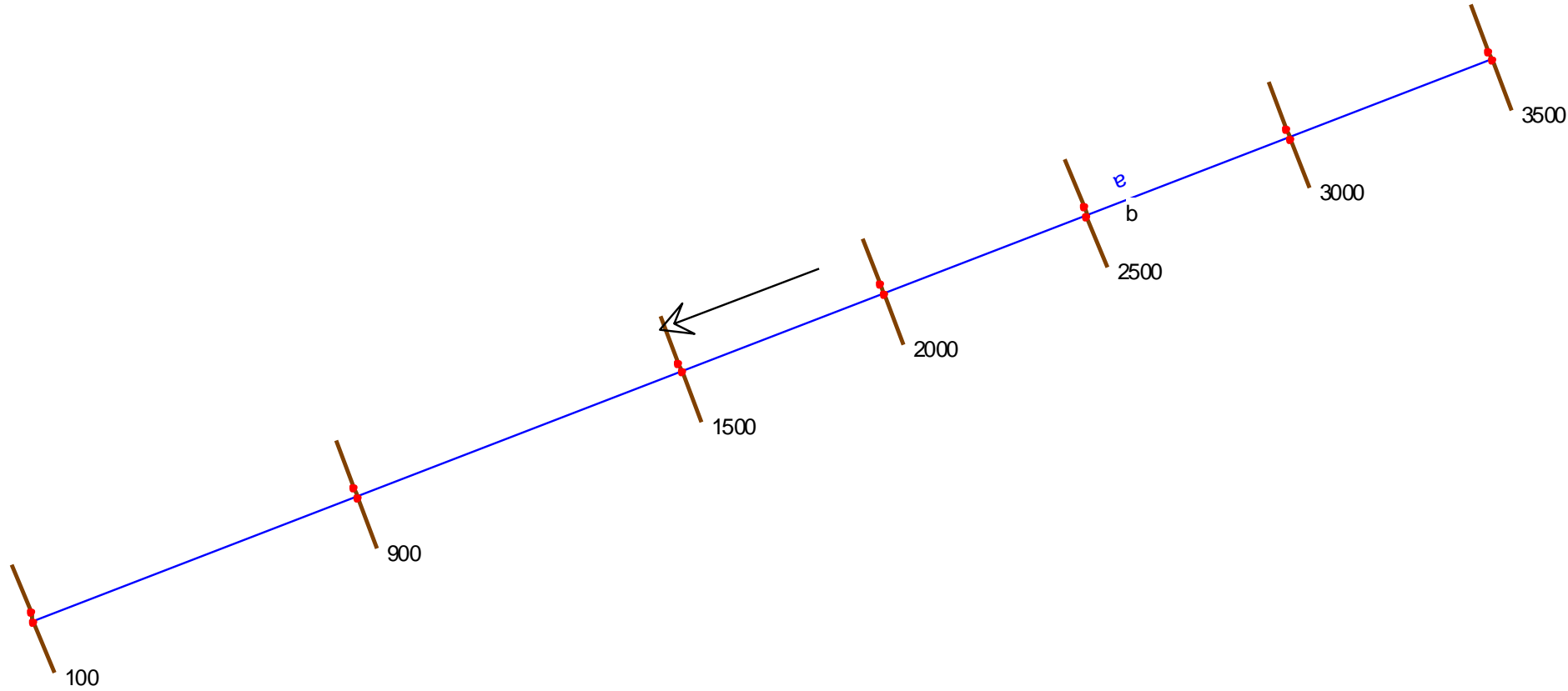
# Cascading Profile to Outfall



# Proposed Profile



# HEC-RAS for Roadway (100-Year Event)





River: a

Apply Data Plot Options

Keep Prev XS Plots

Reach: b River Sta.: 2500

Description

Del Row	Ins Row	Station	Elevation
		0	103
1		100	102
2		120	101.5
3		120	101
4		132	101.25
5		144	101
6		144	101.5
7		164	102
8		264	103
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28			
29			
30			
31			
32			
33			
34			

Downstream Reach Lengths		
LOB	Channel	ROB
500	500	500

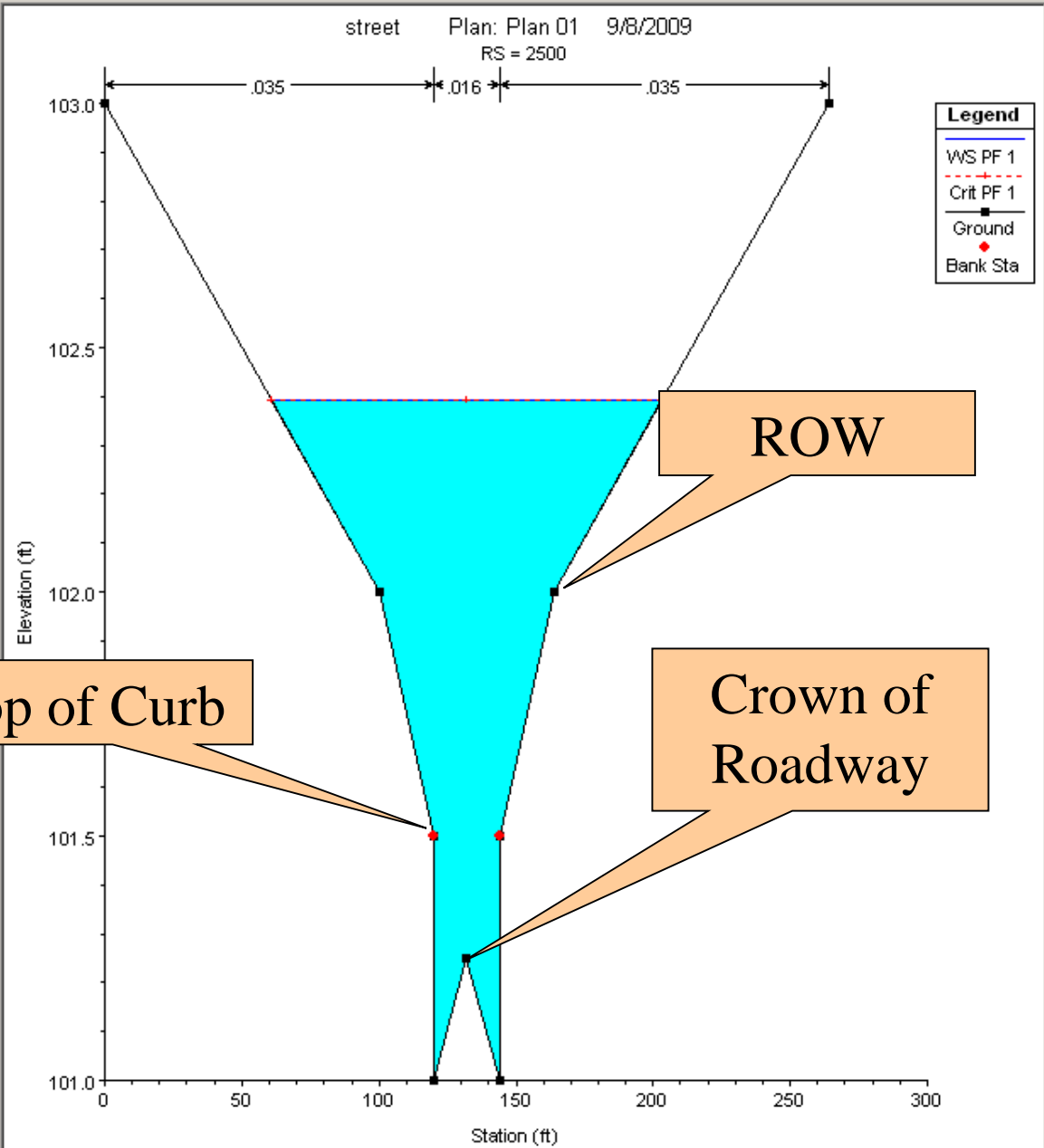
Manning's n Values		
LOB	Channel	ROB
0.035	0.016	0.035

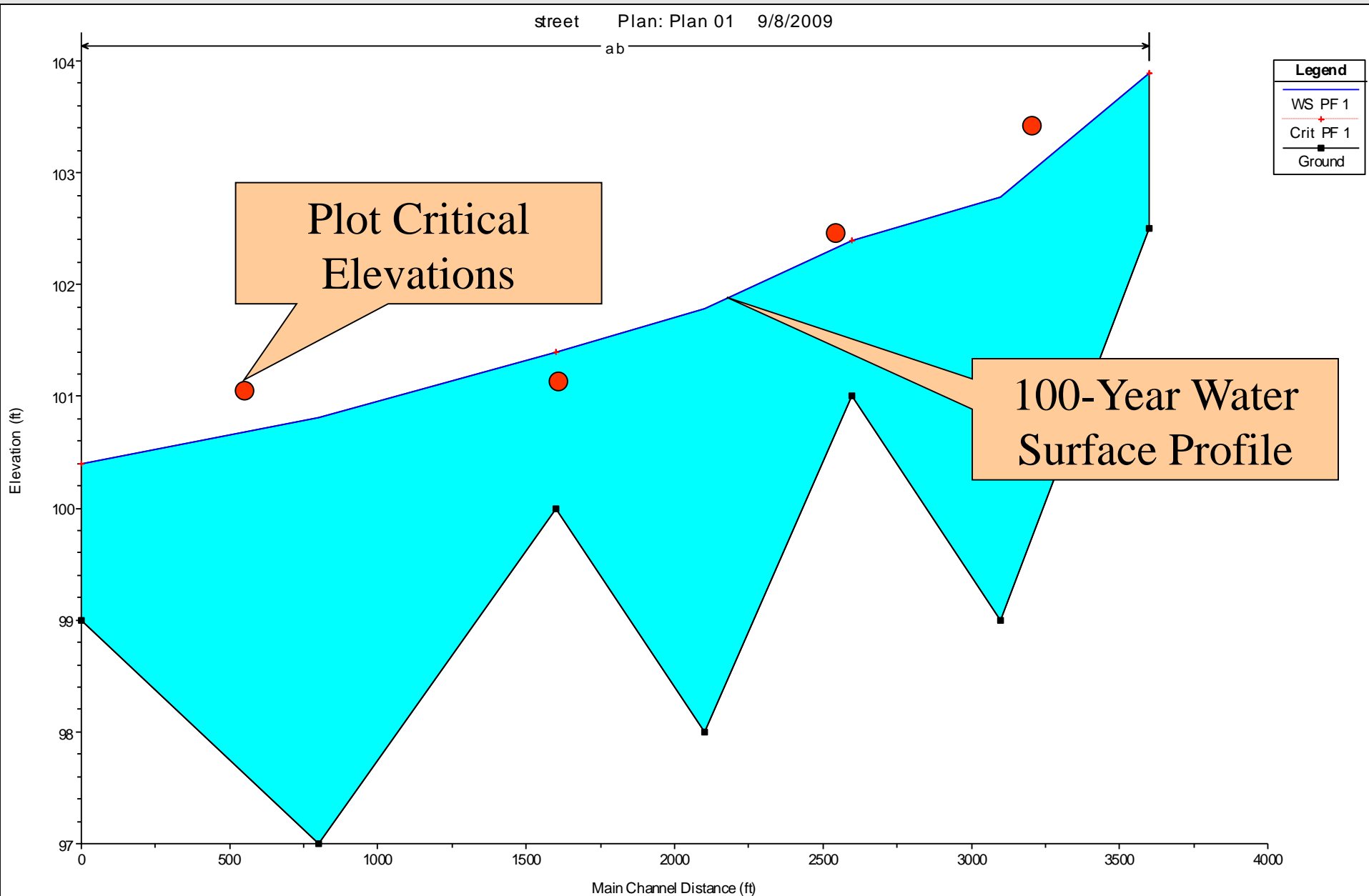
Main Channel Bank Stations	
Left Bank	Right Bank
120	144

Cont\Exp Coefficient (Steady Flow)	
Contraction	Expansion
0.1	0.3

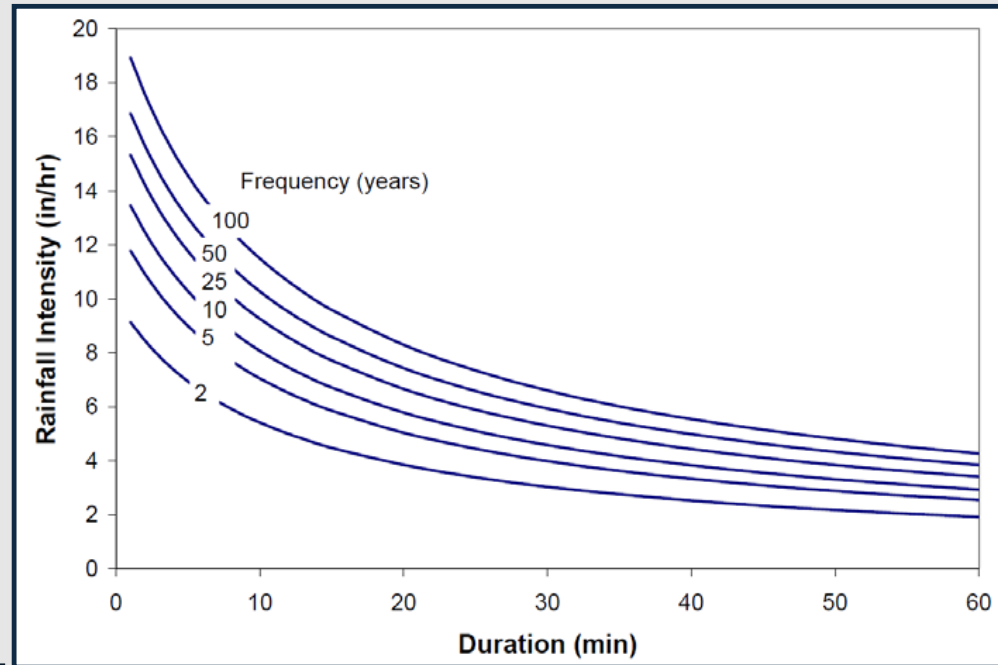


# HEC-RAS Profile of Roadway





# INTENSITY DURATION FREQUENCY CURVES (IDF CURVES)



2015 - E, B, & D coefficients

# Intensity-Duration-Frequency Curve (IDF Curves)

- Old IDF curves were based off TP-40 (1960s)
- Last IDF update occurred over 30 years ago (1985).
- The 2015, IDF curves will provide a stopgap measure until the NOAA Atlas 14 Precipitation Frequency data server comes online for Texas.

# USGS Atlas of Depth Duration Frequency of Precipitation Annual Maxim for Texas - 2004



In cooperation with the Texas Department of Transportation

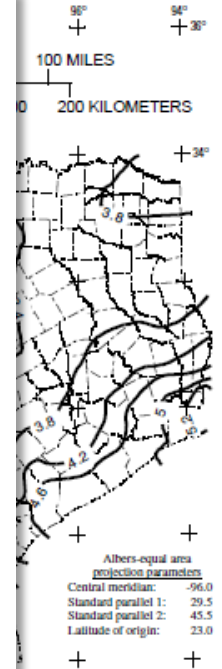
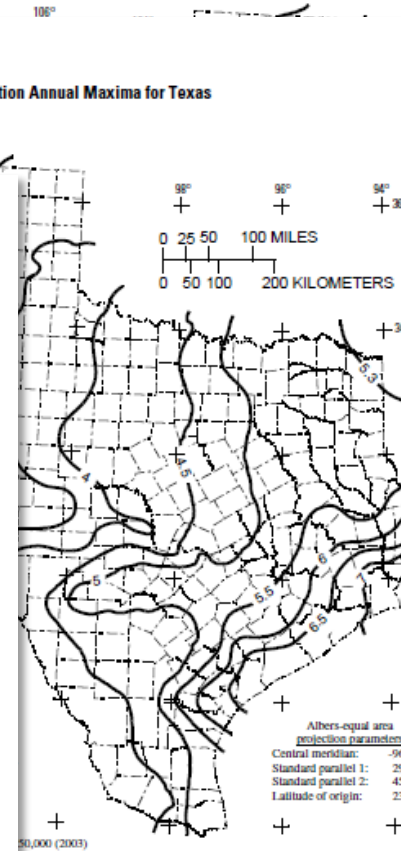
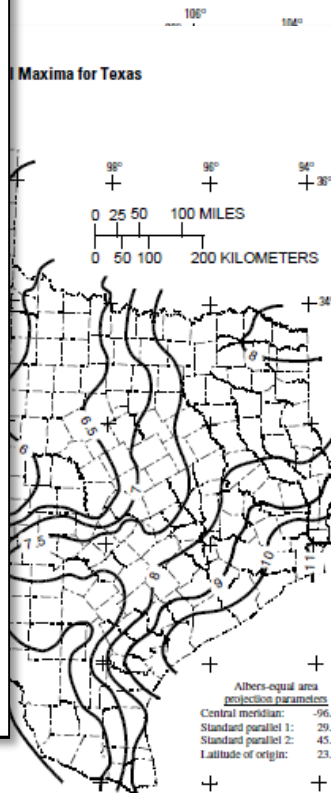
## Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas



Scientific Investigations Report 2004-5041  
(TxDOT Implementation Report 5-1301-01-1)

U.S. Department of the Interior  
U.S. Geological Survey

### 30 Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas



Base modified from U.S. Geological Survey digital data at 1:250,000 (2003)

Figure 47. Depth of precipitation for 25-year storm for 1-day duration in Texas.

# Intensity-Duration-Frequency (IDF) Curves

## Rainfall Intensity-Duration-Frequency Coefficients for Texas

Based on United States Geological Survey (USGS) Scientific Investigations Report 2004-5041  
"Atlas of Depth-Duration Frequency of Precipitation Annual Maxima for Texas"

### 1. Select English or SI Units

### 2. Select or Enter a County

### 3. Enter a Time of Conc. Select Units

Coefficient	50% (2-year)	20% (5-year)	10% (10-year)	4% (25-year)	2% (50-year)	1% (100-year)
<b>e</b>	0.8014	0.7898	0.7872	0.7828	0.7824	0.7779
<b>b (in.)</b>	48.63	58.72	68.67	79.33	90.90	101.22
<b>d (min)</b>	8.02	7.69	7.67	7.80	7.62	7.36
<b>Intensity (in./hr)</b>	3.94	4.99	5.89	6.86	7.92	9.03

(Spreadsheet Release Date: August 31, 2015; data table reshuffle by Asquith July 14, 2016)

**IDF Curves 2015 v2.1**

July 14, 2016



# MINIMUM MAINTENANCE VELOCITY

---

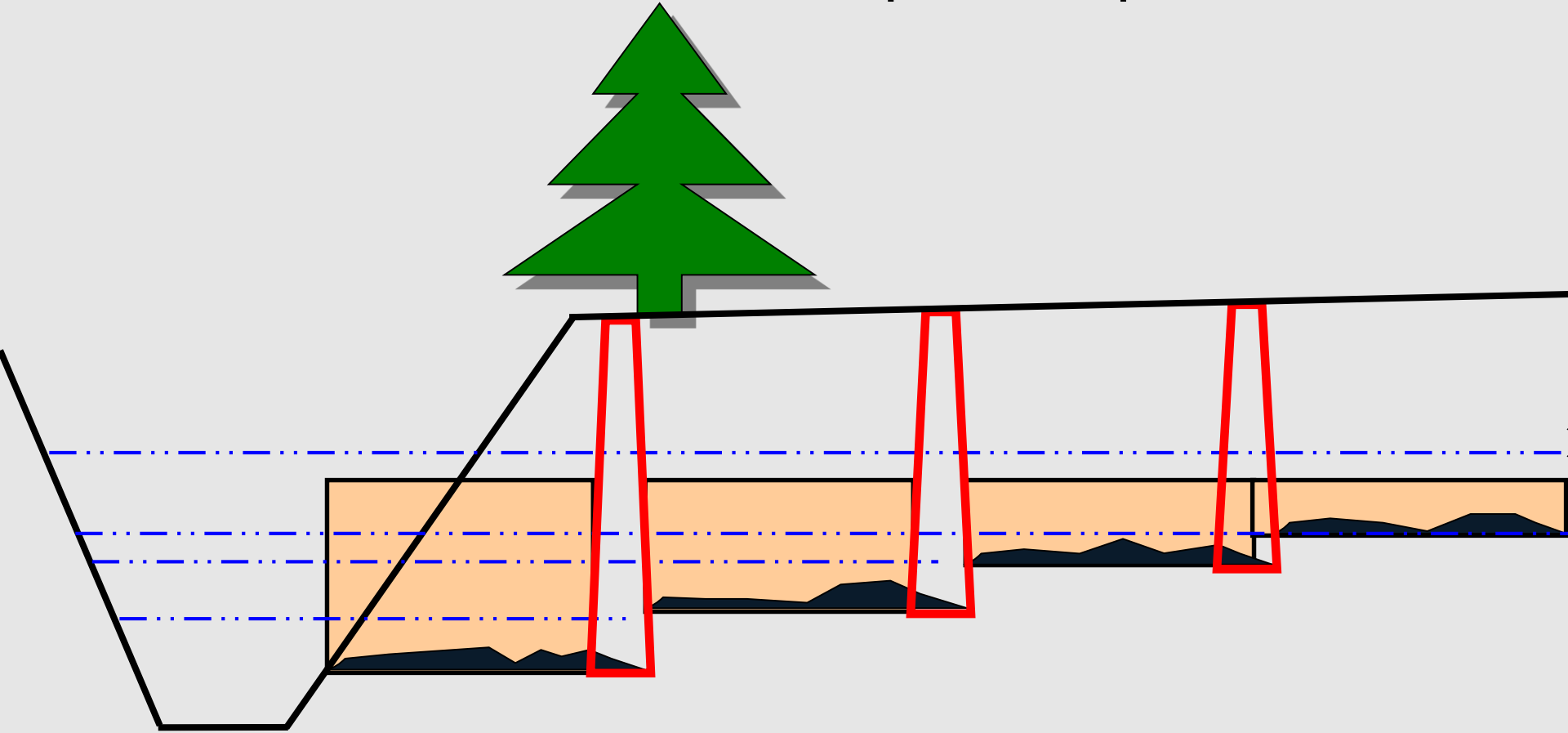
**Storm Sewer and Culverts**

**Increased from 2 fps to 3 fps**



# Maintenance Velocity

Storm Sewer and Culvert Minimum Maintenance Velocities Increased from 2 fps to 3 fps.





A black signpost stands against a blue sky with white clouds. It has four directional signs. The top-left sign is white with a black border and points left, containing the text 'THIS WAY'. The top-right sign is grey with a black border and points right, containing the text 'THAT WAY'. The bottom-left sign is white with a black border and points left, containing the text 'ANOTHER WAY'.

**THIS WAY**

**THAT WAY**

**ANOTHER WAY**

**WHAT**

**NEXT?**



TEXAS DEPARTMENT OF TRANSPORTATION

# HYDRAULIC DESIGN MANUAL

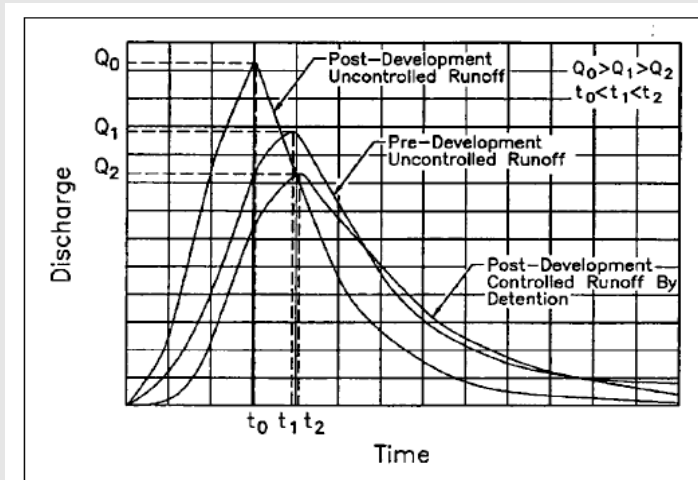


---

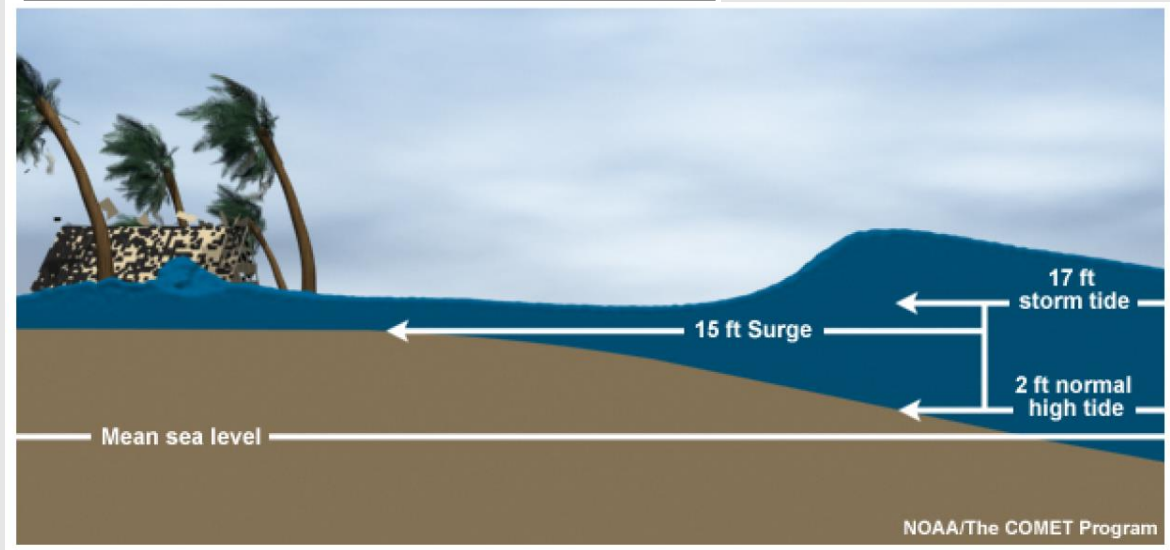
## Future Chapters

# Proposed New Chapters for 2017

## ■ Detention



## ■ Coastal





TEXAS DEPARTMENT OF TRANSPORTATION

NOAA ATLAS 14  
PRECIPITATION DATA FREQUENCY  
SERVER  
APRIL 2018

---

<http://hdsc.nws.noaa.gov/hdsc/pfds/>

# NOAA Atlas 14 Study Contributions

▪ Brazos River Authority	\$15,000
▪ City of Austin	\$50,000
▪ Harris County Flood Control District	\$200,000
▪ Texas Department of Transportation	\$740,000
	<b>\$1,005,000</b>

Source: <http://www.pooledfund.org/Details/Solicitation/1421>

# Select a State

NOAA's National Weather Service  
**Hydrometeorological Design Studies Center**  
Precipitation Frequency Data Server (PFDS)

Home Site Map News Organization

State:

Legend:  
■ Updated data available  
■ Data update in progress

Inset maps: HI, Selected Pacific Islands, AK, PR/VI

**Precipitation Frequency Data Server (PFDS)**

**General Info**  
Homepage  
Current Projects  
FAQ  
Glossary

**Precipitation Frequency (PF)**  
PF Data Server  
• PF in GIS Format  
• PF Maps  
• Temporal Distr.  
• Time Series Data  
• PFDS Perform.  
PF Documents

**Probable Maximum Precipitation (PMP)**  
PMP Documents

**Miscellaneous Publications**  
AEP Storm Analysis  
Record Precipitation

**Contact Us**  
Inquiries  
List-server

USA.gov  
Government Made Easy

# Drag & Drop Crosshair to Location

NOAA's National Weather Service  
Hydrometeorological Design Studies Center  
Precipitation Frequency Data Server (PFDS)

Home Site Map News Organization

## NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: LA

**DATA DESCRIPTION**  
Data type:  Units:  Time series type:

**SELECT LOCATION**

1. Manually:  
a) Enter location (decimal degrees, use "-" for S and W): latitude:  longitude:    
b) Select station (click here for a list of stations used in frequency analysis for LA):

2. Use map:

Map

a) Select location  
(move crosshair or double click)  
b) Click on station icon  
(  show stations on map)

**LOCATION INFORMATION:**  
Name: Vinton, Louisiana, US\*  
Latitude: 30.1530°  
Longitude: -93.6395°  
Elevation: 13 ft\*

Map data ©2016 Google 2 km   \* source: Google Maps

**POINT PRECIPITATION FREQUENCY (PF) ESTIMATES**  
WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION  
NOAA Atlas 14, Volume 9, Version 2

**General Info**  
Homepage  
Current Projects  
FAQ  
Glossary

**Precipitation Frequency (PF)**  
PF Data Server  
• PF in GIS Format  
• PF Maps  
• Temporal Distr.  
• Time Series Data  
• PFDS Perform.  
PF Documents

**Probable Maximum Precipitation (PMP)**  
PMP Documents

**Miscellaneous**  
Publications  
AEP Storm Analysis  
Record Precipitation

**Contact Us**  
Inquiries  
List-server

# Data Type:

NOAA's National Weather Service  
Hydrometeorological Design Studies Center  
Precipitation Frequency Data Server (PFDS)

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: MN

**DATA DESCRIPTION**

Data type: precipitation depth Units: english Time series type: partial duration

1. Metadata  
a) Draw location (decimal degree UTM for S&W): latitude longitude (CASE)  
b) Select station (click here for a list of stations used in frequency analysis for MN):

2. Data map:

3. Select location (hold mouse over map or double click)  
4. Click on station icon (1 = when station on map)

LOCATION INFORMATION:  
Name: Seward, Minnesota, US\*  
Latitude: 45.2427°  
Longitude: -94.2009°  
Datum: 1211 F

	10-yr	20-yr	30-yr	40-yr	50-yr	60-yr	70-yr	80-yr	90-yr	100-yr
15-min	0.222 (0.0088)	0.274 (0.0108)	0.311 (0.0121)	0.342 (0.0133)	0.369 (0.0143)	0.393 (0.0151)	0.415 (0.0158)	0.435 (0.0165)	0.453 (0.0171)	0.469 (0.0176)
30-min	0.444 (0.0176)	0.548 (0.0216)	0.622 (0.0242)	0.684 (0.0266)	0.738 (0.0288)	0.786 (0.0308)	0.828 (0.0326)	0.864 (0.0342)	0.894 (0.0356)	0.919 (0.0368)
1-hr	0.888 (0.0352)	1.096 (0.0432)	1.244 (0.0484)	1.368 (0.0532)	1.476 (0.0576)	1.572 (0.0616)	1.656 (0.0652)	1.728 (0.0684)	1.788 (0.0712)	1.838 (0.0736)
2-hr	1.376 (0.0528)	1.744 (0.0688)	1.966 (0.0772)	2.124 (0.0844)	2.244 (0.0896)	2.336 (0.0936)	2.412 (0.0968)	2.476 (0.0992)	2.528 (0.1012)	2.576 (0.1028)
3-hr	1.760 (0.0696)	2.256 (0.0896)	2.552 (0.1012)	2.772 (0.1096)	2.916 (0.1152)	3.000 (0.1188)	3.064 (0.1212)	3.116 (0.1232)	3.164 (0.1252)	3.208 (0.1272)
6-hr	2.608 (0.1032)	3.312 (0.1296)	3.704 (0.1452)	4.008 (0.1568)	4.224 (0.1656)	4.368 (0.1712)	4.440 (0.1744)	4.496 (0.1768)	4.544 (0.1788)	4.588 (0.1808)
12-hr	3.216 (0.1268)	4.032 (0.1584)	4.552 (0.1772)	4.944 (0.1912)	5.232 (0.2016)	5.436 (0.2108)	5.568 (0.2172)	5.632 (0.2208)	5.688 (0.2232)	5.736 (0.2252)
24-hr	3.920 (0.1536)	4.960 (0.1984)	5.600 (0.2208)	6.048 (0.2368)	6.384 (0.2496)	6.624 (0.2592)	6.784 (0.2656)	6.864 (0.2692)	6.928 (0.2712)	6.984 (0.2728)
3-day	5.728 (0.2252)	7.344 (0.2888)	8.256 (0.3208)	8.976 (0.3472)	9.456 (0.3624)	9.792 (0.3752)	10.000 (0.3848)	10.176 (0.3912)	10.320 (0.3968)	10.448 (0.4012)
6-day	7.616 (0.2928)	9.824 (0.3792)	11.104 (0.4272)	12.096 (0.4608)	12.768 (0.4832)	13.152 (0.5008)	13.408 (0.5136)	13.568 (0.5208)	13.728 (0.5272)	13.872 (0.5328)
10-day	9.472 (0.3668)	12.176 (0.4704)	13.872 (0.5328)	15.072 (0.5792)	15.840 (0.6096)	16.320 (0.6288)	16.608 (0.6408)	16.800 (0.6492)	16.944 (0.6552)	17.056 (0.6608)
30-day	13.104 (0.5048)	16.976 (0.6592)	19.296 (0.7488)	21.072 (0.8112)	22.272 (0.8576)	23.040 (0.8888)	23.520 (0.9092)	23.840 (0.9212)	24.048 (0.9272)	24.192 (0.9312)
60-day	16.432 (0.6372)	21.504 (0.8448)	24.384 (0.9456)	26.544 (1.0272)	27.936 (1.0736)	28.704 (1.1008)	29.136 (1.1168)	29.424 (1.1272)	29.616 (1.1328)	29.728 (1.1372)
100-day	19.760 (0.7704)	26.208 (1.0088)	29.696 (1.1472)	32.448 (1.2288)	33.936 (1.2736)	34.704 (1.2912)	35.136 (1.3032)	35.424 (1.3108)	35.616 (1.3152)	35.728 (1.3188)
15-yr	2.608 (0.1032)	3.312 (0.1296)	3.704 (0.1452)	4.008 (0.1568)	4.224 (0.1656)	4.368 (0.1712)	4.440 (0.1744)	4.496 (0.1768)	4.544 (0.1788)	4.588 (0.1808)
25-yr	3.216 (0.1268)	4.032 (0.1584)	4.552 (0.1772)	4.944 (0.1912)	5.232 (0.2016)	5.436 (0.2108)	5.568 (0.2172)	5.632 (0.2208)	5.688 (0.2232)	5.736 (0.2252)
50-yr	3.920 (0.1536)	4.960 (0.1984)	5.600 (0.2208)	6.048 (0.2368)	6.384 (0.2496)	6.624 (0.2592)	6.784 (0.2656)	6.864 (0.2692)	6.928 (0.2712)	6.984 (0.2728)
100-yr	4.624 (0.1808)	5.872 (0.2272)	6.640 (0.2568)	7.152 (0.2768)	7.512 (0.2904)	7.728 (0.2992)	7.896 (0.3056)	8.016 (0.3104)	8.096 (0.3136)	8.152 (0.3160)

1. Precipitation Frequency (PF) estimates are based on frequency analysis of partial duration series (PDS).  
2. Estimates are based on 100 years of data and are based on the 1971-2000 period. The probability of precipitation frequency estimates for a given duration and return period is based on the 1971-2000 period. Estimates of peak amounts are not provided for partial duration series (PDS) estimates and may not be accurate. See the PFDS User Guide for more information.  
3. Estimates are in 100.1 (100.1) units. Use the units for more information.

Get Data From PFDS by User Format: (PF) Precipitation Frequency estimates (CASE)

Start Link Categories:  
Home (0/0)

U.S. Department of Commerce  
National Oceanic and Atmospheric Administration  
National Weather Service  
Office of Hydrologic Engineering  
228 North First Avenue  
Silver Spring, Maryland 20910

Webmaster:  
Dennis  
Dennis

Privacy Policy  
Terms of Use  
Contact Us

## DATA DESCRIPTION

Data type: precipitation depth Units: english Time series type: partial duration

- precipitation depth
- precipitation depth
- precipitation intensity



# POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION  
NOAA Atlas 14, Volume 9, Version 2

PF tabular

PF graphical

Supplementary information

Print Page

## PDS-based precipitation frequency estimates with 90% confidence intervals (in inches/hour)<sup>1</sup>

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	7.03 (5.65-8.82)	7.97 (6.41-10.0)	9.50 (7.61-12.0)	10.8 (8.57-13.6)	12.5 (9.61-16.3)	13.8 (10.4-18.4)	15.1 (11.0-20.8)	16.4 (11.5-23.4)	18.1 (12.3-26.7)	19.4 (12.8-29.2)
10-min	5.15 (4.14-6.46)	5.84 (4.69-7.33)	6.95 (5.57-8.76)	7.87 (6.27-9.97)	9.13 (7.03-12.0)	10.1 (7.61-13.5)	11.0 (8.06-15.2)	12.0 (8.43-17.1)	13.3 (8.98-19.5)	14.2 (9.39-21.4)
15-min	4.19 (3.36-5.25)	4.74 (3.81-5.96)	5.66 (4.53-7.12)	6.40 (5.10-8.11)	7.42 (5.72-9.73)	8.20 (6.19-11.0)	8.98 (6.56-12.4)	9.76 (6.85-13.9)	10.8 (7.30-15.9)	11.6 (7.64-17.4)
30-min	3.11 (2.50-3.90)	3.51 (2.82-4.41)	4.18 (3.35-5.26)	4.75 (3.78-6.01)	5.54 (4.28-7.30)	6.17 (4.66-8.27)	6.81 (4.98-9.40)	7.47 (5.25-10.7)	8.36 (5.67-12.4)	9.05 (5.98-13.6)
60-min	2.09 (1.68-2.62)	2.35 (1.89-2.95)	2.81 (2.25-3.53)	3.21 (2.56-4.07)	3.82 (2.97-5.08)	4.32 (3.28-5.84)	4.86 (3.57-6.76)	5.43 (3.83-7.81)	6.24 (4.24-9.27)	6.89 (4.55-10.4)
2-hr	1.31 (1.06-1.64)	1.47 (1.19-1.84)	1.76 (1.42-2.20)	2.03 (1.62-2.55)	2.44 (1.91-3.23)	2.78 (2.13-3.75)	3.16 (2.34-4.38)	3.57 (2.54-5.11)	4.15 (2.85-6.14)	4.63 (3.08-6.93)
3-hr	0.986 (0.800-1.22)	1.11 (0.900-1.38)	1.34 (1.08-1.67)	1.56 (1.25-1.96)	1.90 (1.50-2.53)	2.20 (1.69-2.96)	2.52 (1.88-3.50)	2.88 (2.06-4.12)	3.39 (2.33-5.01)	3.81 (2.54-5.68)
6-hr	0.591 (0.482-0.729)	0.682 (0.555-0.842)	0.850 (0.690-1.05)	1.01 (0.815-1.26)	1.26 (0.998-1.66)	1.47 (1.14-1.97)	1.70 (1.27-2.35)	1.96 (1.41-2.79)	2.33 (1.61-3.42)	2.63 (1.77-3.90)
12-hr	0.343 (0.282-0.421)	0.409 (0.335-0.502)	0.529 (0.432-0.650)	0.639 (0.519-0.790)	0.807 (0.643-1.06)	0.949 (0.737-1.26)	1.10 (0.829-1.51)	1.27 (0.918-1.79)	1.51 (1.05-2.20)	1.70 (1.15-2.51)
24-hr	0.202 (0.167-0.246)	0.242 (0.199-0.295)	0.315 (0.259-0.385)	0.382 (0.312-0.469)	0.484 (0.388-0.632)	0.571 (0.446-0.754)	0.665 (0.503-0.904)	0.767 (0.558-1.08)	0.913 (0.640-1.32)	1.03 (0.702-1.51)
2-day	0.119 (0.098-0.143)	0.139 (0.115-0.168)	0.177 (0.146-0.215)	0.213 (0.175-0.260)	0.269 (0.218-0.349)	0.317 (0.250-0.417)	0.369 (0.282-0.500)	0.427 (0.313-0.596)	0.510 (0.360-0.735)	0.578 (0.396-0.840)
3-day	0.086 (0.071-0.103)	0.101 (0.084-0.122)	0.128 (0.107-0.155)	0.154 (0.127-0.188)	0.194 (0.157-0.250)	0.227 (0.179-0.297)	0.264 (0.202-0.355)	0.304 (0.223-0.422)	0.361 (0.256-0.517)	0.407 (0.280-0.589)
4-day	0.068	0.080	0.102	0.122	0.153	0.179	0.208	0.238	0.282	0.318
7-day	0.045 (0.038-0.054)	0.052 (0.044-0.062)	0.065 (0.054-0.078)	0.077 (0.064-0.093)	0.096 (0.078-0.122)	0.111 (0.089-0.144)	0.128 (0.099-0.171)	0.147 (0.109-0.203)	0.174 (0.124-0.247)	0.196 (0.136-0.281)
10-day	0.035 (0.029-0.042)	0.040 (0.034-0.048)	0.049 (0.041-0.059)	0.058 (0.048-0.070)	0.071 (0.058-0.091)	0.082 (0.066-0.106)	0.095 (0.073-0.126)	0.108 (0.080-0.148)	0.127 (0.091-0.179)	0.142 (0.099-0.203)
20-day	0.023 (0.019-0.027)	0.026 (0.022-0.030)	0.031 (0.026-0.037)	0.035 (0.030-0.042)	0.042 (0.034-0.053)	0.048 (0.038-0.061)	0.053 (0.041-0.070)	0.060 (0.044-0.081)	0.068 (0.049-0.095)	0.075 (0.053-0.107)
30-day	0.018 (0.015-0.021)	0.020 (0.017-0.024)	0.024 (0.020-0.028)	0.027 (0.023-0.033)	0.032 (0.026-0.040)	0.036 (0.028-0.045)	0.039 (0.031-0.051)	0.043 (0.032-0.058)	0.048 (0.035-0.067)	0.052 (0.037-0.074)
45-day	0.014 (0.012-0.017)	0.016 (0.014-0.019)	0.019 (0.016-0.022)	0.022 (0.018-0.025)	0.025 (0.020-0.030)	0.027 (0.022-0.034)	0.030 (0.023-0.038)	0.032 (0.024-0.043)	0.035 (0.026-0.049)	0.038 (0.027-0.053)
60-day	0.012 (0.010-0.014)	0.014 (0.012-0.016)	0.016 (0.014-0.019)	0.018 (0.015-0.022)	0.021 (0.017-0.025)	0.023 (0.018-0.028)	0.025 (0.019-0.032)	0.027 (0.020-0.035)	0.029 (0.021-0.040)	0.031 (0.022-0.043)

<sup>1</sup> Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.



# CLIMATE CHANGE GUIDANCE 2018 ±

---



# Presidential Executive Order 13690

## January 30, 2015

Establish Federal Flood Risk Management Standard (FFRMS) (amends EO 11988).

Describes 3 approaches to achieve “Future Flood” standards:

- Freeboard Value Approach (FVA).
- Use 500-year floodplain elevation and extent (0.2PFA).
- Climate-Informed Science Approach (CISA).

# Presidential Executive Order 13690

## January 30, 2015

Establish Federal Flood Risk Management Standard (amends EO 11988).

Describes 3 approaches to achieve “Future Flood” standards:

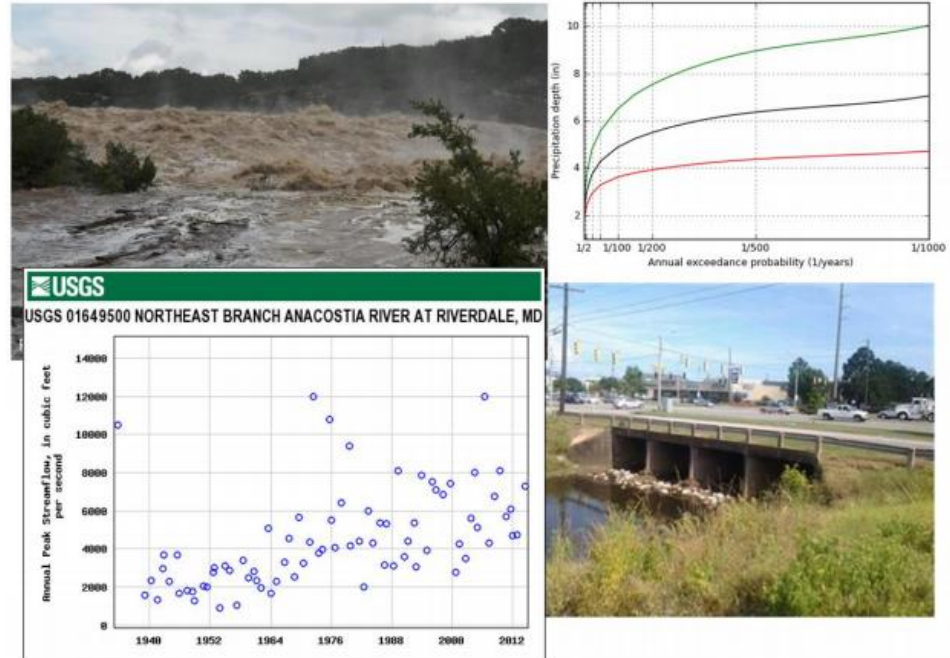
- Freeboard Value Approach (FVA).
- Use 500-year floodplain elevation and extent (0.2PFA).
- **Climate-Informed Science Approach (CISA).**



U.S. Department of  
Transportation  
Federal Highway  
Administration

Hydraulic Engineering Circular No. 17, 2<sup>nd</sup> Edition

# FHWA HEC-17 2<sup>nd</sup> Edition June 2016



**Highways in the River Environment-  
Floodplains, Extreme Events, Risk,  
and Resilience**

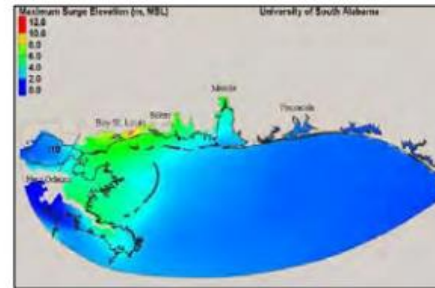
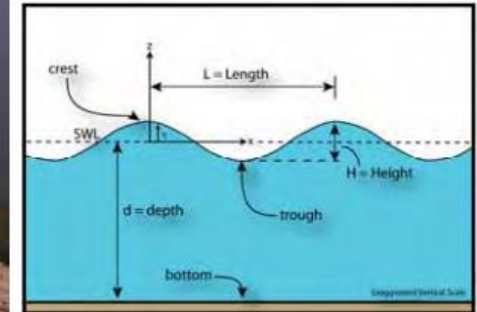
# FHWA HEC-25 Volume 2 October 2014



U.S. Department  
of Transportation  
Federal Highway  
Administration

Publication No. FHWA-NHI-07-096  
June 2008

Hydraulic Engineering Circular No. 25



## Highways in the Coastal Environment

Second Edition

# Question & Answers



Stanley (Stan) Hopfe, P.E., CFM  
Chief Hydraulics Engineer  
512 416-2219  
Stan.Hopfe@txdot.gov