

# Memo

**To:** Danielle Tetreau  
**From:** Nicholas Hartley  
**CC:** Charles Hebson, Andy Walsh, Eric Ham  
**Date:** 23 March 2018  
**Re:** WIN 23246.00 Waterville – Trafton Road Reconstruction

This memo describes the stream assessment information collected by MaineDOT and the proposed design of large culvert replacements associated with a highway reconstruction project in Waterville (WIN 23246.00). The project is located on Trafton Road between the interchange with Interstate 95 and the intersection with Route 104. Figure 1 below contains a location map showing the three crossings proposed to be replaced with this project. Longitudinal profile surveys of the stream channels were conducted by MaineDOT staff and the data used to develop a crossing design in accordance with Appendix B – Habitat Connectivity Design Protocol of the Maine ATS Programmatic Agreement (hereafter MAP).

### **Existing Structures**

The existing structures are all 48” corrugated metal pipes with 24” corrugated metal bypass pipes. Information on the structures can be found in the table below:

	Primary Structure		Bypass Structure	
	Length	Slope	Length	Slope
<b>Crossing 1</b>	41.8'	0.5%	41.8'	3.3%
<b>Crossing 2</b>	60.9'	1.2%	61.3'	2.0%
<b>Crossing 3</b>	60.8'	0.1%	62.0'	0.5%

### **Bankfull Width Determination**

MaineDOT used the measured bankfull width value to size the replacement culverts. The reference reach for crossings 1 and 3 were downstream of the existing structure. Crossing 2 used an upstream reference. The table below summarizes watershed characteristics as well as those of the proposed structure:

#### Structure 1:

Watershed Area	NWI wetlands	W <sub>bkf</sub> (calc)	W <sub>bkf</sub> (meas)	1.2 X W <sub>bkf</sub>	Proposed Structure Size	Proposed Material
1.1 mi <sup>2</sup>	17.76%	8.06 ft	7 ft	8.4 ft	95'L x 103"S x 71"R	Corrugated Metal

**Structure 2:**

<b>Watershed Area</b>	<b>NWI wetlands</b>	<b>W<sub>bkf</sub> (calc)</b>	<b>W<sub>bkf</sub> (meas)</b>	<b>1.2 X W<sub>bkf</sub></b>	<b>Proposed Structure Size</b>	<b>Proposed Material</b>
1.1 mi <sup>2</sup>	16.14%	8.06 ft	11 ft	13.2 ft	88'L x 14'S x 6'R	Precast Concrete

**Structure 3:**

<b>Watershed Area</b>	<b>NWI wetlands</b>	<b>W<sub>bkf</sub> (calc)</b>	<b>W<sub>bkf</sub> (meas)</b>	<b>1.2 X W<sub>bkf</sub></b>	<b>Proposed Structure Size</b>	<b>Proposed Material</b>
1.1 mi <sup>2</sup>	15.5%	8.06 ft	12 ft	14.4 ft	104'L x 15'S x 6'R	Precast Concrete

***Stream Horizontal Alignment***

The existing structures are roughly perpendicular to the centerline of the existing roadway. This results in sharp changes in the streams' horizontal alignments in the vicinity of the existing structures at crossings 1 and 3 that are not characteristic of natural alluvial channels. The stream at crossing 2 matches the alignment of the structure well. This creates the need to change the horizontal alignment of the proposed structure to better match the channel. Proposed skew angles relative to the proposed centerline at crossings 1, 2, and 3 are 22°, 8°, and 28°, respectively.

Crossing 1 will also require approximately 45' of stream realignment downstream of the proposed structure. This realignment is intended to match the sinuosity present in the downstream reach while also moving the channel away from the proposed inslope, allowing continuity of the channel without sharp breaks in the horizontal alignment that may result in stream discontinuity.

***Stream Channel Profile and Observations***

The stream profiles along the proposed horizontal alignments are shown in Figures 2-4. It should be noted that the existing structures shown on the profiles are projected horizontally onto the proposed alignment and therefore are not an accurate representation of the existing condition. The watersheds are shown in their respective hydrology reports in Appendix B. Stream photos are shown in Appendix A. In July 2017, MaineDOT's Survey Crew collected the data used to generate the streambed profiles. The profiles contain no vertical discontinuities and are therefore adequate for Habitat Connectivity Design. This section will detail the characteristics of each profile separately.

**Crossing 1**

Streambed profile data was collected approximately 245 and 220 feet up and downstream of the existing structure, respectively. This meets the minimum required distance of 140' required for HCD per the MAP. The stream gradient is approximately 1.2% upstream and flattens slightly to approximately 0.5% outside the influence of the structure downstream. The irregular appearance of the profile at approximately 1+50 is caused by the presence of a large tree, under which the channel flows.

The watershed has a generally moderate gradient, averaging approximately 4%. With a development percentage of approximately 15.8%, the majority of the watershed is rural in nature, roughly split between fields and forested areas. The unnamed stream continues with similar watershed characteristics until it meets the Kennebec River.

Elevations for the proposed structure were established using the downstream reference reach. This reach was chosen because it was the most defined channel in the reach with upstream being influence by exposed bedrock and encroachment of large trees.

The downstream reference reach exhibits plane-bed characteristics. Control points are generally large rocks that appear highly stable. Some control is also provided by encroachment of large trees.

#### Crossing 2

Streambed profile data was collected approximately 380 and 275 feet up and downstream of the existing structure, respectively. This meets the minimum required distance of 220' required for HCD per the MAP. The stream gradient upstream is relatively consistent at approximately 1.9%. Downstream is more inconsistent with significantly deeper pools relative to the upstream reach. The gradient is flatter, averaging approximately 1.0%.

The watershed for crossing 2 is immediately adjacent to the watershed for crossing 1. As such, it exhibits many similar characteristics. The average grade is also moderate at approximately 4%. It is, however, slightly more developed with 22.6% of the area being urban. The remaining contains more fields than the watershed for crossing 1, as well. These factors combine to result in a slightly higher peak flow statistics for this watershed. Similar to crossing 1, this watershed also proceeds until it flows into the Kennebec River.

The channel downstream exhibits characteristics typical of wetlands and therefore this reach is not appropriate for HCD design. The upstream channel has been used as the basis for establishing elevations for the proposed structure.

The selected reference reach is riffle-pool in nature. Control is provided by exposed bedrock outcrops. Downstream control at this location will be provided by large woody debris encroaching on the channel.

#### Crossing 3

Streambed profile data was collected approximately 330 and 415 feet up and downstream of the existing structure, respectively. This meets the minimum required distance of 240' required for HCD per the MAP. The gradient upstream is flat at approximately 0%. Downstream varies considerably with exposed bedrock and an ATV trail influencing the stream. Away from these influences, the gradient is approximately 1.7%.

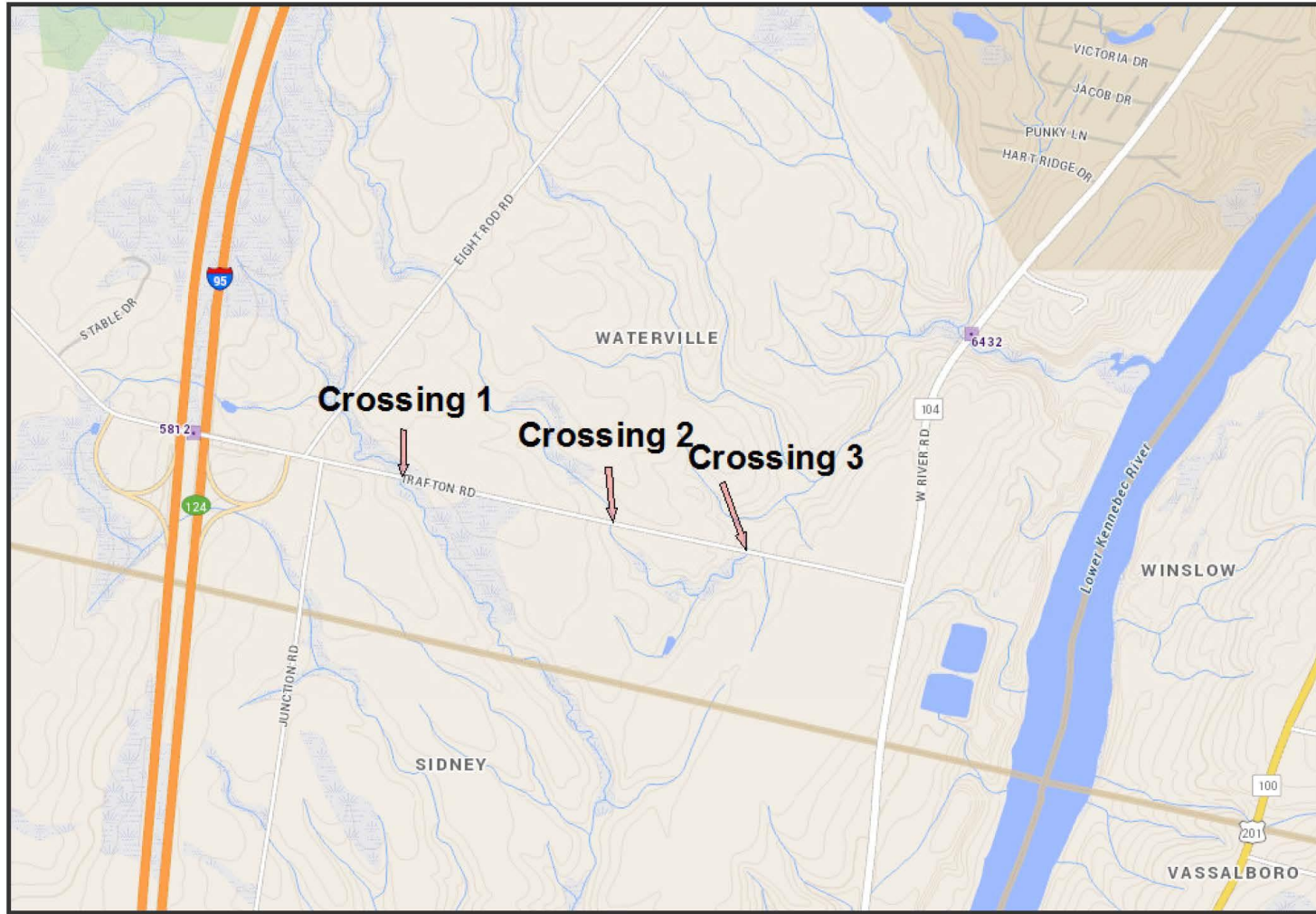
The watershed for crossing 3 is the same watershed as crossing 2. The wetland downstream of crossing 2 extends to the upstream reach of crossing 3, explaining the flatness seen in the profile. For general watershed characteristics, see the description for crossing 2.

As previously mentioned, the upstream reach is a wetland and therefore not applicable to HCD. The downstream reach is significantly steeper and use of this grade would result in discontinuities in the profile. For this reason, the proposed structure will be treated as a plane-bed transition between the upstream wetland and downstream defined channel.

Upstream grade control for this reference is provided by woody debris present in the wetland. Some large rocks also appear, include one immediately upstream that appears to be causing the wetland condition. There is no stable control immediately downstream because of the ATV trail crossing. The design will include a downstream control at the limits of stream construction that will stabilize a potential downcut caused by vehicles crossing the stream. Further downstream, grade control is provided by exposed bedrock.

Figure 1: Location Map

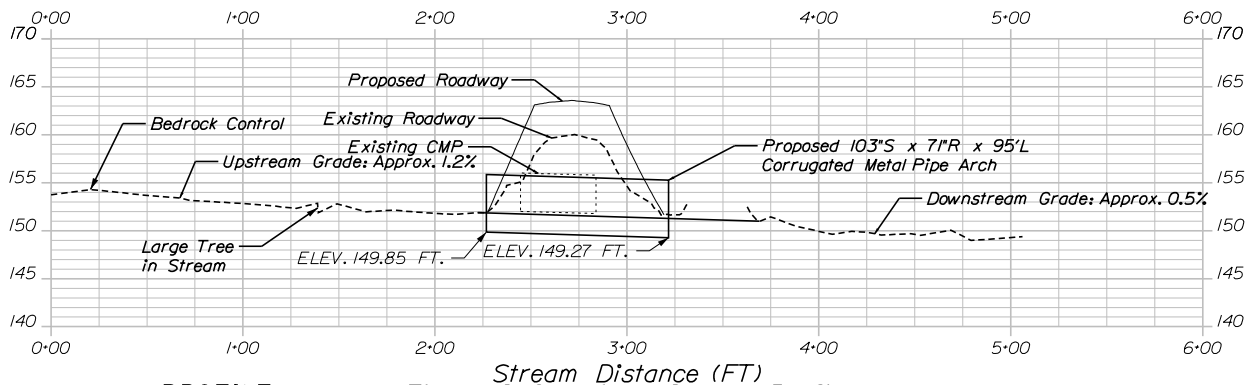
### WIN 23246.00 STRUCTURE LOCATIONS



The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch.

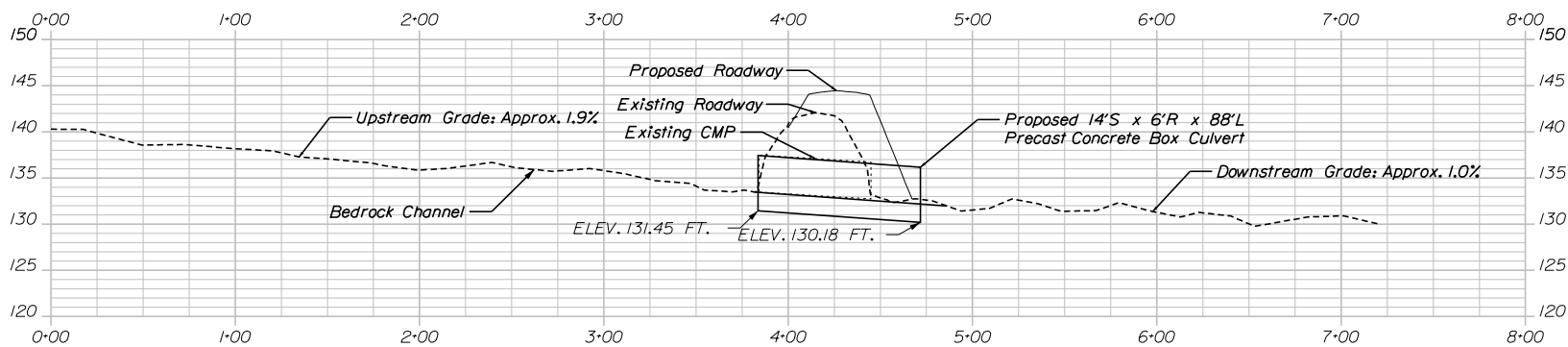
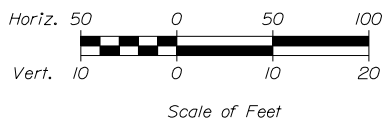
0.35 Miles  
1 inch = 0.27 miles

Date: 2/27/2018  
Time: 10:34:19 AM



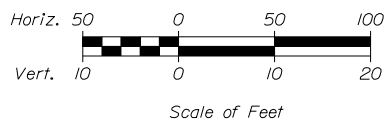
PROFILE

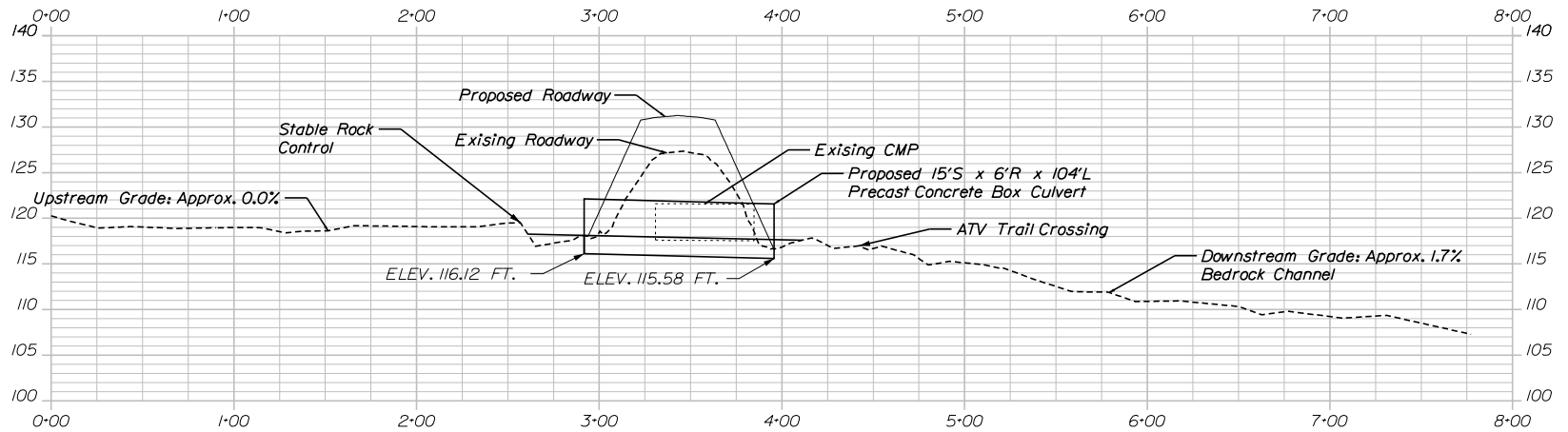
Figure 2: Crossing 1 Stream Profile



PROFILE

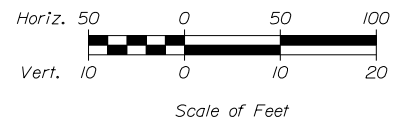
Figure 3: Crossing 2 Stream Profile





Stream Distance (FT)  
 Figure 4: Crossing 3 Stream Profile

PROFILE

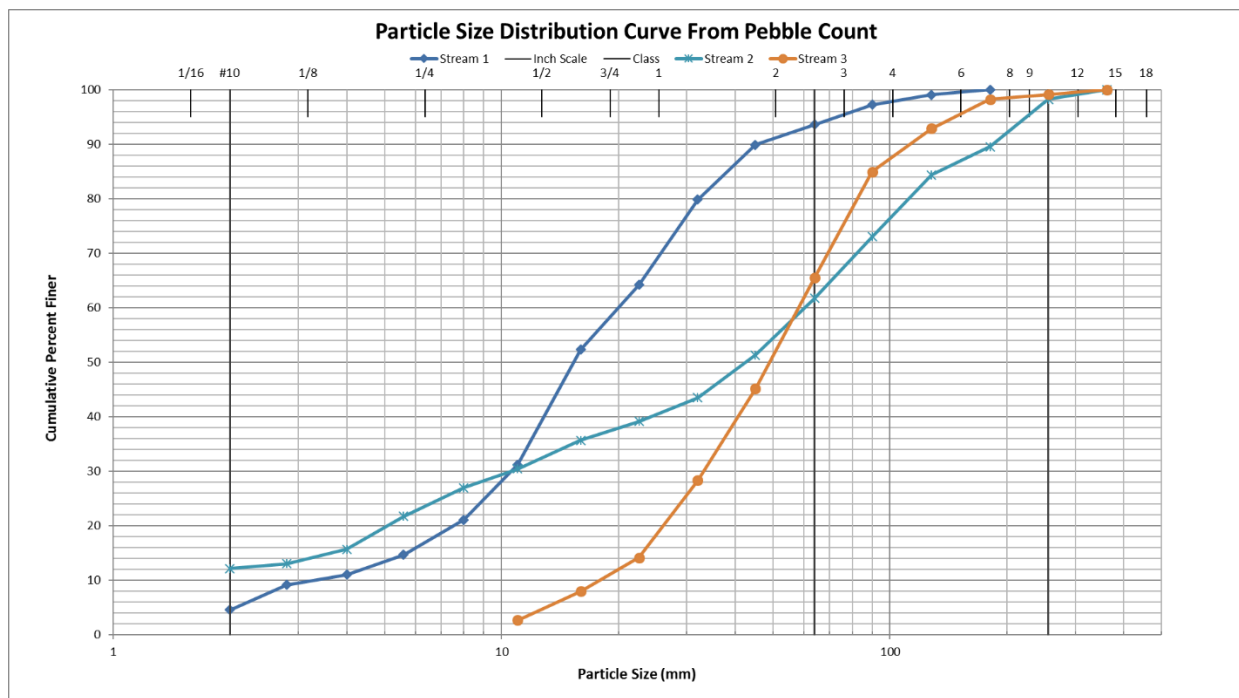


### ***Pebble Count and Streambed Description***

A pebble count and particle size analysis was conducted for each of the three streams crossings. The results are shown in Figure 5. The results of the pebble count are consistent with field observations, showing that the majority of the material in the channel is cobble and gravel. The table below summarizes the basic information for each of the counts for use in analysis:

<b>Crossing</b>	<b>Count Location</b>	<b>D50</b>	<b>D84</b>	<b>D95</b>
Crossing 1	Downstream	16 mm	36 mm	75 mm
Crossing 2	Upstream	42 mm	103 mm	205 mm
Crossing 3	Downstream	49 mm	87 mm	105 mm

**Figure 5: Pebble Count Results**



### ***Proposed Habitat Connectivity Design***

Based on the long profile survey and the geomorphic assessment, a Habitat Connectivity Design (HCD) approach is proposed for all three of these crossings. The proposed HCD replaces the existing 4'D CMP pipes with 2' overflow pipes at each crossing with new structures that will span the stream, allowing for stream and geomorphic conductivity. The longitudinal profile drives the determination of the project streambed elevations within the culverts. At crossing 1, the culvert is directly continuous with the low-gradient downstream reach and therefore the culvert HCD will be based on downstream channel conditions. The structure at crossing 2 will be set by carrying the upstream grade through the structure. Crossing 3 is intended to transition the upstream wetland condition into the defined channel downstream. The grades on these proposed structures are 0.6%, 1.4%, and 0.5%, respectively. In accordance with the preferred HCD approach under the MAP, the replacement culverts will all include a 24-inch thick layer of culvert streambed material (CSM) along the bottom; the CSM specification will be guided by the pebble counts. The cross-sectional design of the streambed in the culvert will provide for a low flow channel. Feature rocks and bank lines will be included to provide flow diversity and hydraulic roughness, emulating the riffle-run nature in the existing channels.

**Hydraulic Capacity**

In accordance with the MAP, the hydraulic capacity of the proposed design was checked with HY-8 hydraulic analysis to confirm that it meets MaineDOT's headwater depth standard of  $H_w/R \leq 1$  (i.e., inlet headwater is at or below the top of the culvert;  $H_w$  is inlet water depth and  $R$  is culvert open rise above streambed) at the estimated  $Q_{100}$  peak flow. Hydraulic analysis has been summarized in the table below:

<b>Crossing</b>	<b><math>Q_{100}</math></b>	<b><math>H_w/R</math></b>
Crossing 1	116 CFS	0.93
Crossing 2	124 CFS	0.58
Crossing 3	128 CFS	0.67

All three of the proposed structures meet the design standard and the MAP target.

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## **Appendix A**

### **Photos**

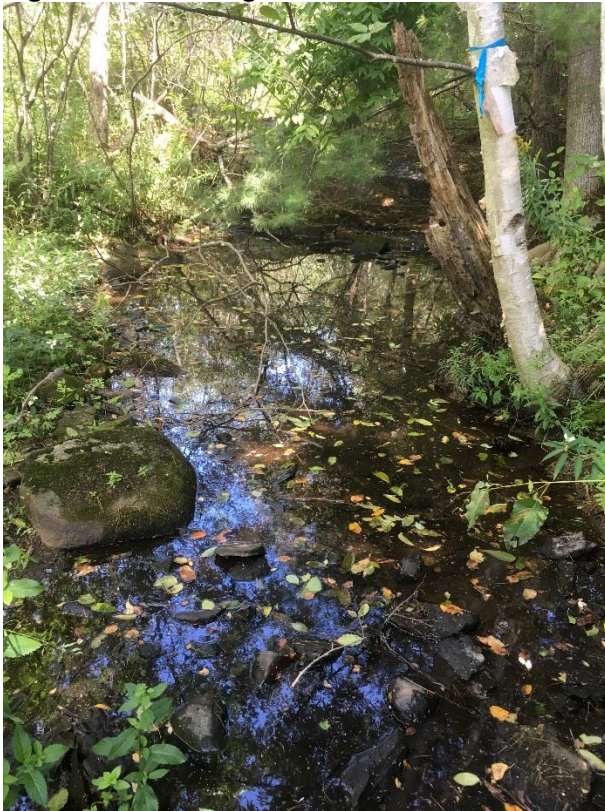
**Figure 6A: Crossing 1 Inlet**



**Figure 6B: Crossing 1 Outlet**



**Figure 6C: Crossing 1 US Reach**



**Figure 6D: Crossing 1 DS Reach**



**Figure 7A: Crossing 2 Inlet**



**Figure 7B: Crossing 2 Outlet**



**Figure 7C: Crossing 2 US Bedrock Channel**



**Figure 7D: Crossing 2 DS Reach**



**Figure 8A: Crossing 3 Inlet**



**Figure 8B: Crossing 3 Outlet**



**Figure 8C: Crossing 3 US Wetland**



**Figure 8D: Crossing 3 DS Reach**



**Figure 8E: Downstream ATV Crossing Showing Outlet**



**Figure 8F: Upstream Large Rock Control**



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**Appendix B**  
**Hydrology Report**

WIN:	23246.00
Town:	Waterville
Route No.:	Trafton Road
Asset ID:	
Lat:	44.5072
Long:	-69.69671

Project Name:	Waterville 23246 Trafton Rd Stream 1
Stream Name:	
Bridge Name:	
Analysis by:	DFB
Date:	11/2/2017

### Peak Flow Calculations by USGS Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015)

*Enter data in blue cells only!*

	km <sup>2</sup>	mi <sup>2</sup>	ac
A	2.85	1.10	704.0
W	0.51	0.2	125.0
P <sub>c</sub>	443657	4929972	
County	Kennebec		
pptA	41.7		
SG	0.00		
A (km <sup>2</sup> )	2.85		
W (%)	17.76		

*Enter data in [mi<sup>2</sup>]*

Watershed Area *DRNAREA*  
Wetlands area (by NWI)

watershed centroid (E, N; UTM 19N; meters)  
*choose county from drop-down menu*  
mean annual precipitation (inches; by look-up)  
sand & gravel aquifer as decimal fraction of watershed A

Conf Lvl 0.67

NWI Wetlands % *STORNWI*

**Worksheet prepared by:**

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*ver. 2017 Jun. 09*

**References:**

Hodgkins, G.A., 1999.  
Estimating the magnitude of peak flows for streams  
in Maine for selected recurrence intervals  
*WRIR 99-4008*, USGS Augusta, ME

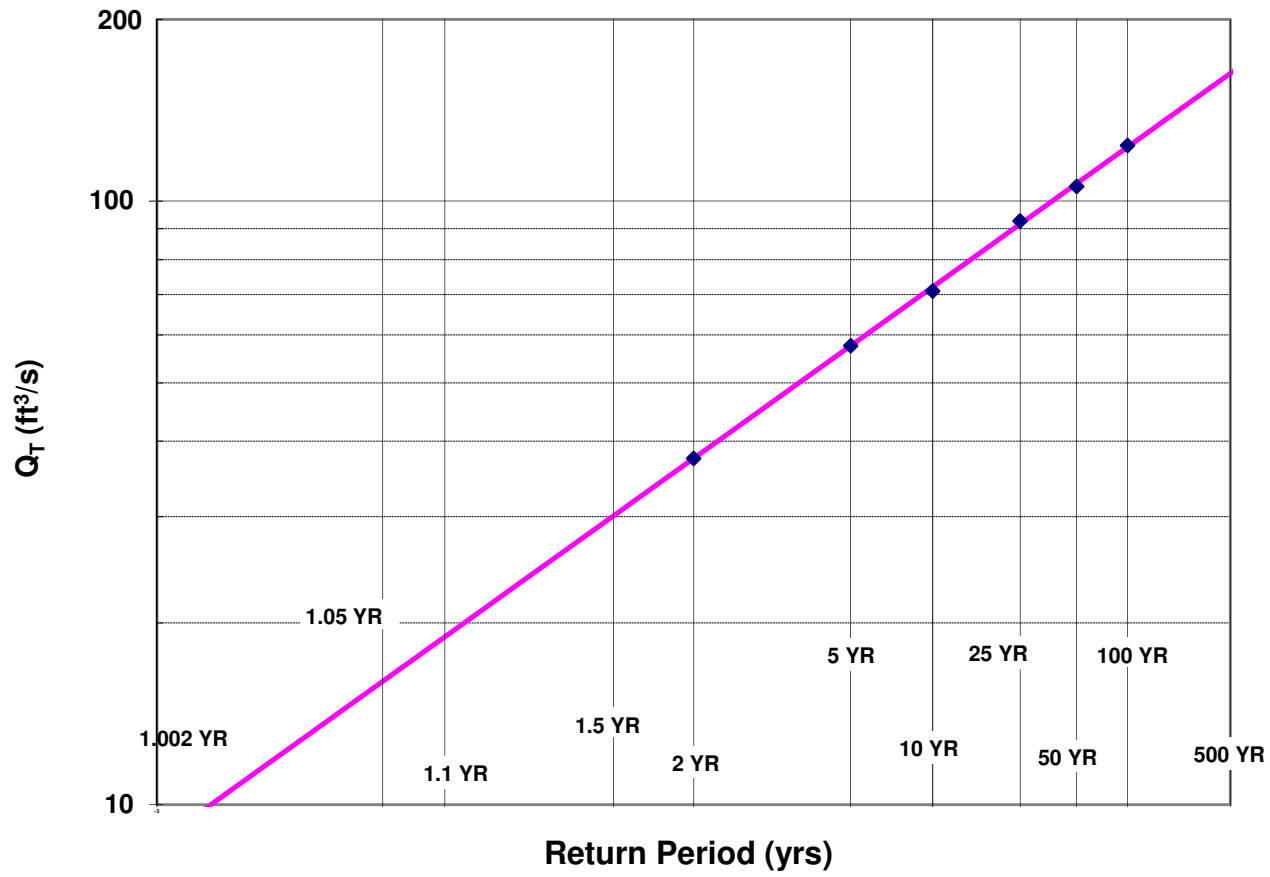
Lombard, P.J. & G.A. Hodgkins, 2015.  
Peak flow regression equations for small, ungaged streams in  
Maine - Comparing map-based to field-based variables  
*SIR 2015-4059*, USGS, Augusta, ME

$$Q_T = b \times A^a \times 10^{-wW}$$

Ret Pd	Peak Flow Estimate		
	T (yr)	Lower	Upper
1.1		0.54	
2		1.06	
5		1.63	
10		2.01	
25		2.63	
50		3.00	
100		3.50	
500		4.61	

Q <sub>T</sub> (ft <sup>3</sup> /s)
19.0
37.5
57.6
70.9
92.7
105.8
123.7
162.8

# Log-Normal Probability Plot



WIN:	23246.00
Town:	Waterville
Route No.:	Trafton Road
Asset ID:	0
Lat:	44.50719
Long:	-69.69671

Project Name:	Waterville 23246 Trafton Rd Stream 1
Stream Name:	0
Bridge Name:	0
Analysis by:	DFB
Date:	11/2/2017

**DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED**

**MAINE MONTHLY MEDIAN FLOWS and HYDRAULIC GEOMETRY BY USGS REGRESSION EQUATIONS (2004, 2013)**

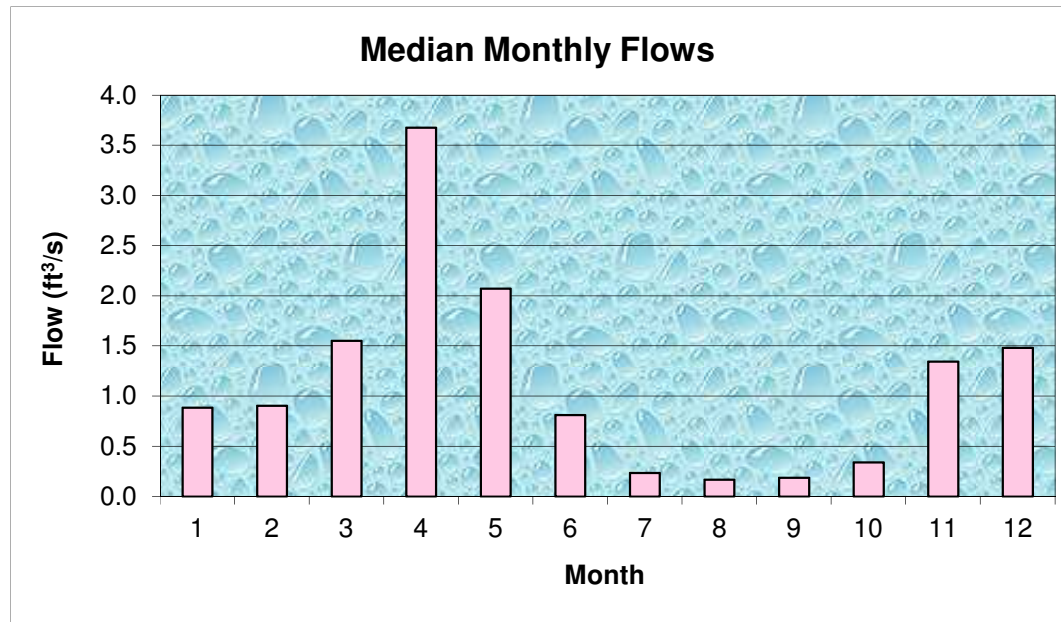
Value	Variable	Explanation
1.10	A	Area (mi <sup>2</sup> )
443656.6	P <sub>c</sub>	Watershed centroid (E,N; UTM; Zone 19; meters)
71.07	DIST	Distance from Coastal reference line (mi)
41.7	pptA	Mean Annual Precipitation (inches)
0.00	SG	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q <sub>median</sub> (ft <sup>3</sup> /s)	(m <sup>3</sup> /s)
Jan	0.89	0.0251
Feb	0.91	0.0257
Mar	1.55	0.0440
Apr	3.68	0.1042
May	2.07	0.0587
Jun	0.81	0.0230
Jul	0.23	0.0066
Aug	0.17	0.0048
Sep	0.19	0.0053
Oct	0.34	0.0096
Nov	1.34	0.0381
Dec	1.48	0.0420

Q <sub>bf</sub>	5.7
ann avg	2.2
ann med	1.0
Q <sub>1.002</sub>	8.6
Q <sub>1.01</sub>	11.4
Q <sub>1.05</sub>	16.0
Q <sub>bf</sub>	27.1

assume v = 4ft/s

W <sub>bf</sub>	11.0	estimated bankfull width (ft)
d <sub>bf</sub>	0.6	estimated bankfull depth (ft)
A <sub>bf</sub>	4.9	estimated bankfull flow area (ft <sup>2</sup> )



**References**

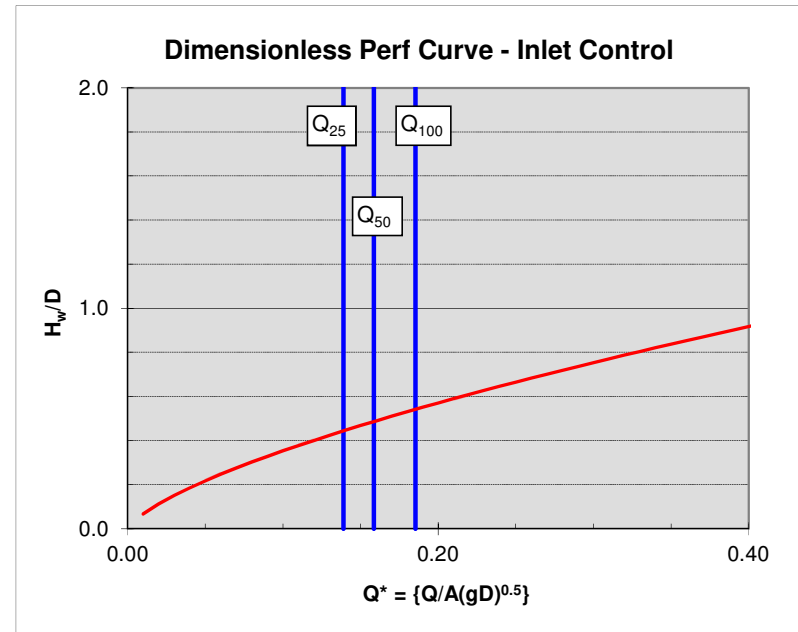
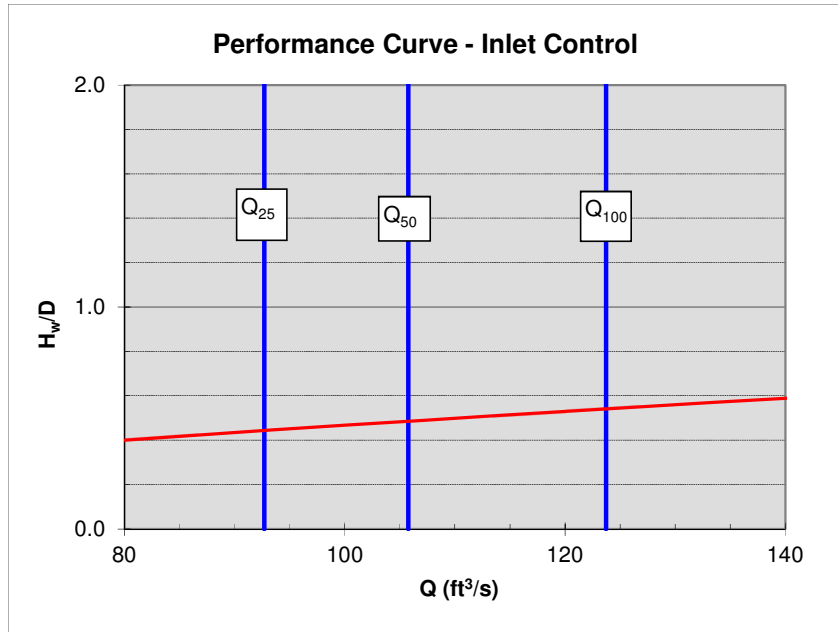
Dudley, R.W., 2013. FY2013 Progress Report - Phase 1 ..., USFWS QRP Project  
 Dudley, R.W., 2004. Estimating Monthly Streamflows ..., SIR 2004-5026

**NOTE:** This page is for preliminary sizing only.  
Final design should be done with HY8 or HDS-5

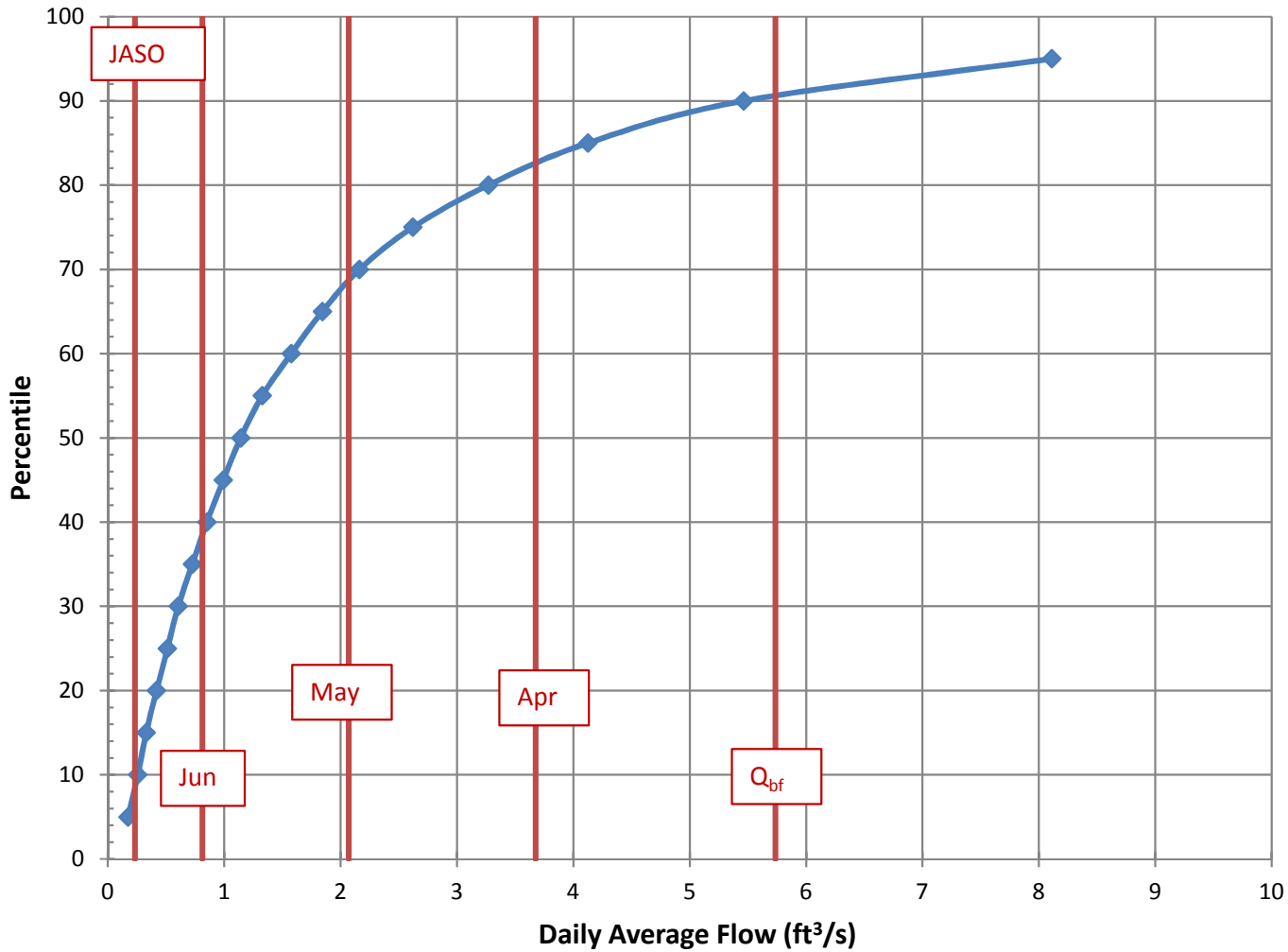
**Preliminary Culvert Sizing - Round & Box Culverts**

Shape:	Box			
Type:	Box 0 ww	Q <sub>25</sub>	92.7	
D or R (ft)	6	Q <sub>50</sub>	105.8	trial D / R = 5.3
w (ft)	8 box width	Q <sub>100</sub>	123.7	trial w: BFW = 11.0
Slope (ft/ft)	0.02			
A (ft <sup>2</sup> )	48.00			
g (ft/s <sup>2</sup> )	32.2			

**Note:**  
culvert dimensions are for open flow area; adjust for lost capacity due to embedding / backfilling (min {2' / 25% rise} embedment)



# Daily Average Flow Distribution



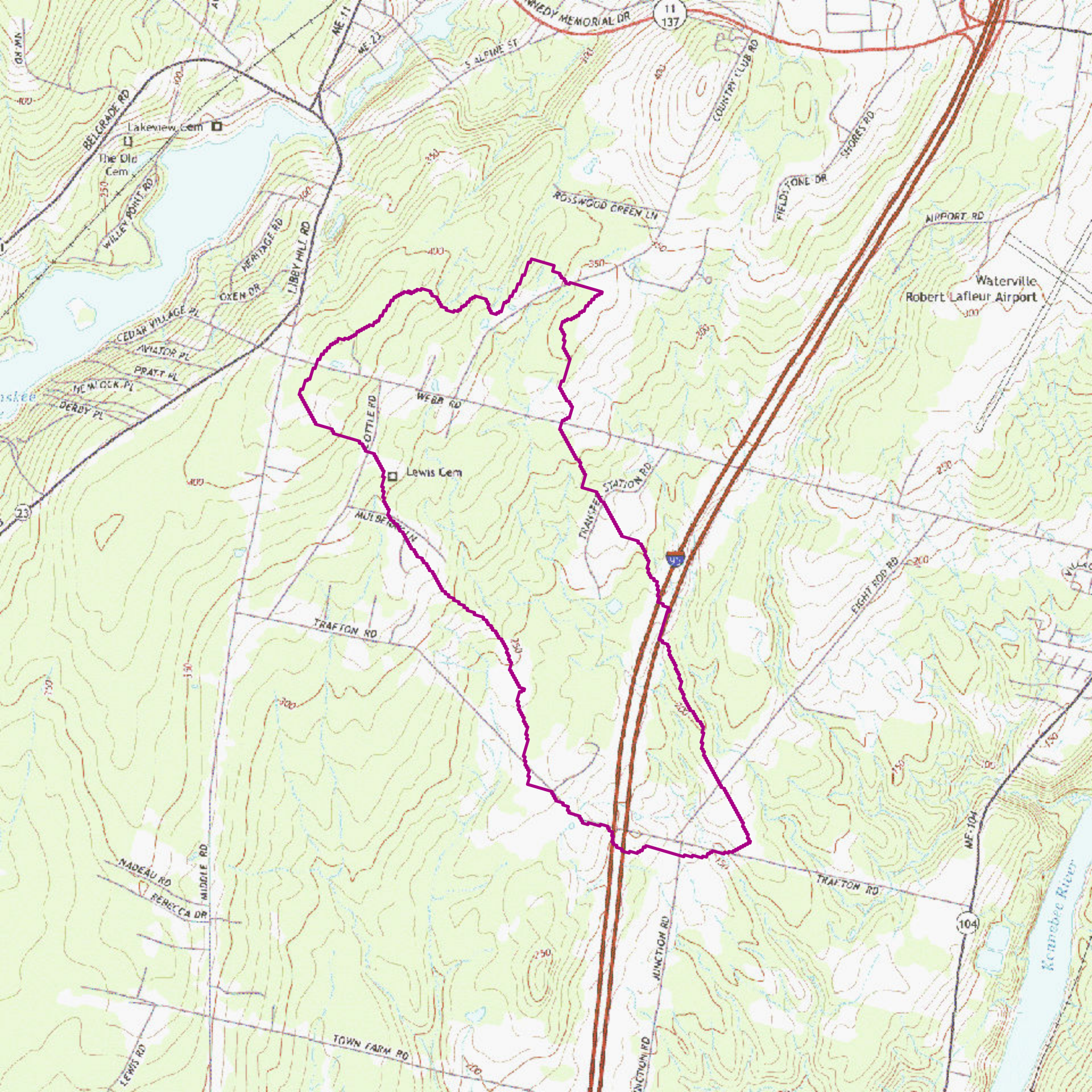
## Daily Avg Flow Dist

$A_{ws} = (mi^2)$  1.1

Q (ft³/s)

Pctl	Median	84 <sup>th</sup> pctl
5	0.17	0.28
10	0.26	0.39
15	0.33	0.48
20	0.42	0.59
25	0.51	0.69
30	0.61	0.78
35	0.73	0.89
40	0.85	1.03
45	0.99	1.16
50	1.14	1.37
55	1.33	1.60
60	1.58	1.87
65	1.84	2.18
70	2.16	2.55
75	2.62	3.06
80	3.27	3.66
85	4.13	4.69
90	5.46	6.29
95	8.11	9.79

Q <sub>bf</sub>	5.7
Q <sub>1.002</sub>	8.6
Q <sub>1.1</sub>	19.0
Q <sub>2</sub>	37.5



Waterville  
Robert Lafleur Airport

Lewis Cem

Lakeview Cem  
The Old Cem

Kennebec River

WIN:	23246.00	
Town:	Waterville	
Route No.:	Trafton Road	
Asset ID:		
Lat:	44.5062	Long: -69.69012

Project Name:	Waterville 23246 Trafton Rd Stream 2	
Stream Name:		
Bridge Name:		
Analysis by:	DFB	
Date:	11/2/2017	

### Peak Flow Calculations by USGS Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015)

*Enter data in blue cells only!*

	km <sup>2</sup>	mi <sup>2</sup>	ac
A	2.85	1.10	704.0
W	0.46	0.2	113.6

P <sub>c</sub>	444469	4930738
County	Kennebec	
pptA	41.7	
SG	0.00	

A (km <sup>2</sup> )	2.85
W (%)	16.14

Conf Lvl

*Enter data in [mi<sup>2</sup>]*

Watershed Area *DRNAREA*  
Wetlands area (by NWI)

watershed centroid (E, N; UTM 19N; meters)  
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NWI Wetlands % *STORNWI*

**Worksheet prepared by:**

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*ver. 2017 Jun. 09*

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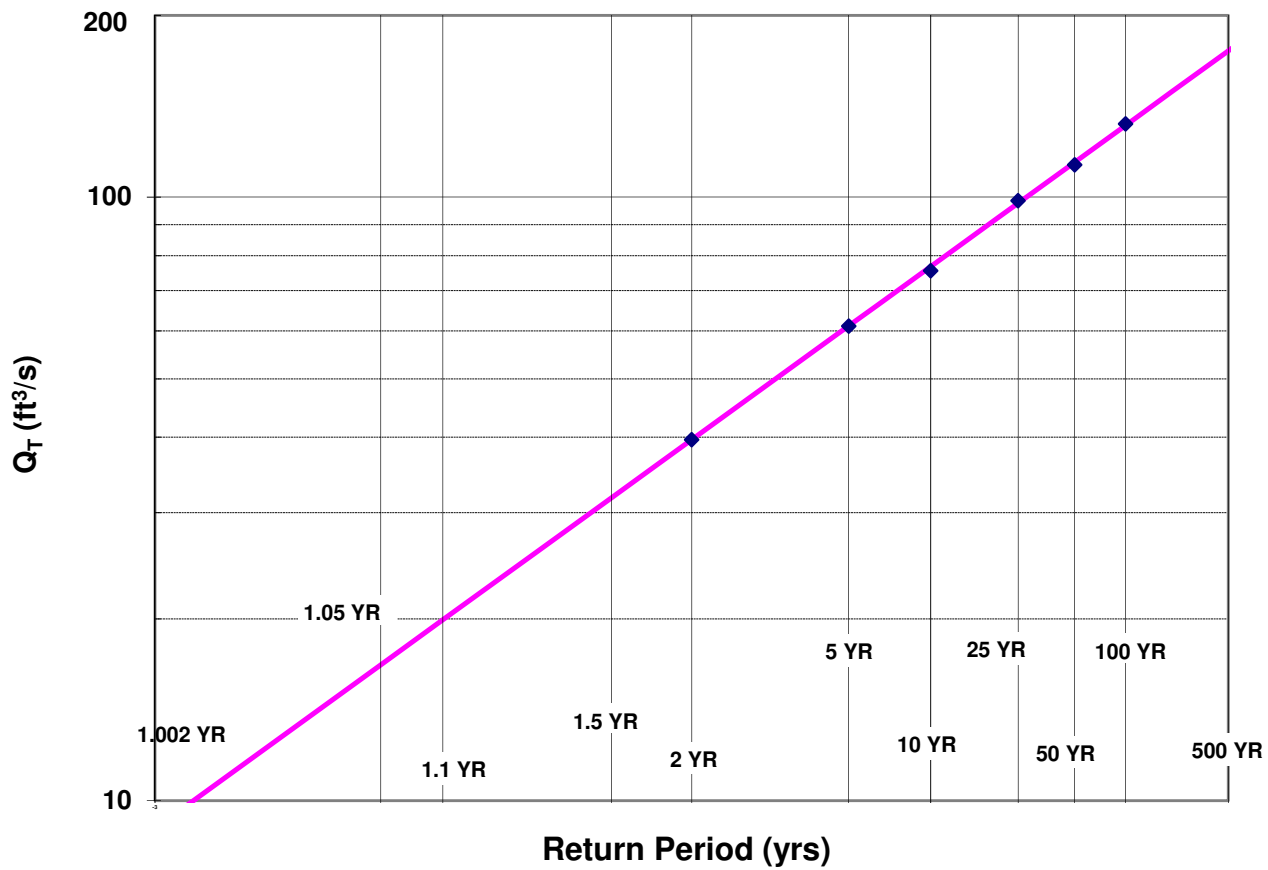
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Maine - Comparing map-based to field-based variables  
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$$Q_T = b \times A^a \times 10^{-ww}$$

Ret Pd	Peak Flow Estimate		
	T (yr)	Lower	Upper
1.1		0.56	
2		1.12	
5		1.73	
10		2.14	
25		2.80	
50		3.20	
100		3.75	
500		4.95	

Q <sub>T</sub> (ft <sup>3</sup> /s)
19.9
39.7
61.2
75.6
98.8
113.1
132.3
174.8

# Log-Normal Probability Plot



WIN:	23246.00
Town:	Waterville
Route No.:	Trafton Road
Asset ID:	0
Lat:	44.50621
Long:	-69.69012

Project Name:	Waterville 23246 Trafton Rd Stream 2
Stream Name:	0
Bridge Name:	0
Analysis by:	DFB
Date:	11/2/2017

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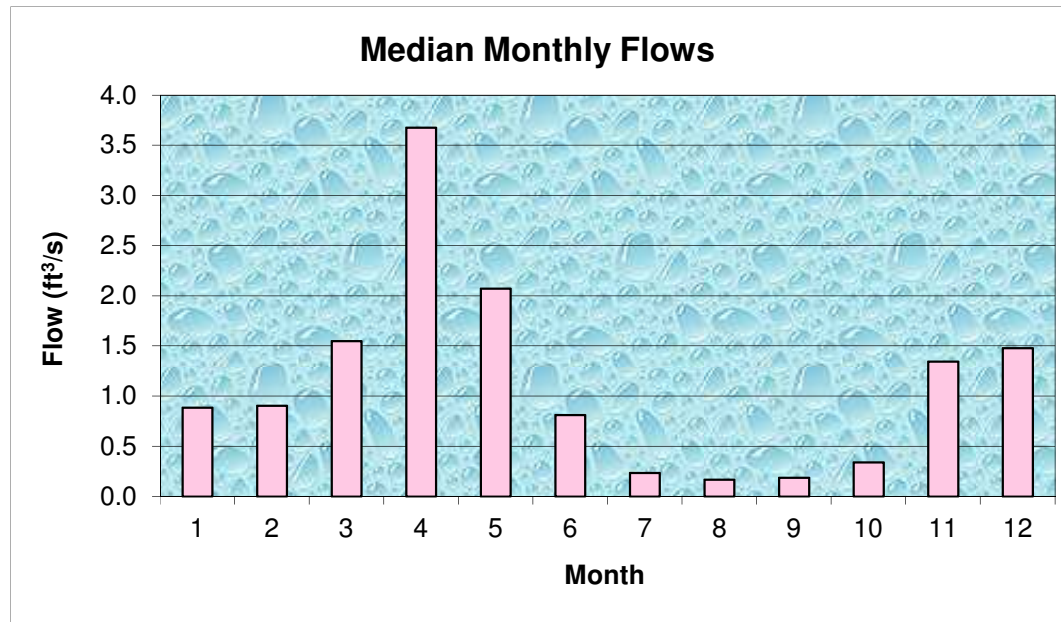
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Oct	0.34	0.0096
Nov	1.34	0.0381
Dec	1.48	0.0419

Q <sub>bf</sub>	5.7
ann avg	2.2
ann med	1.0
Q <sub>1.002</sub>	9.0
Q <sub>1.01</sub>	11.9
Q <sub>1.05</sub>	16.8
Q <sub>bf</sub>	27.1

assume v = 4ft/s

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d <sub>bf</sub>	0.6	estimated bankfull depth (ft)
A <sub>bf</sub>	4.9	estimated bankfull flow area (ft <sup>2</sup> )



**References**

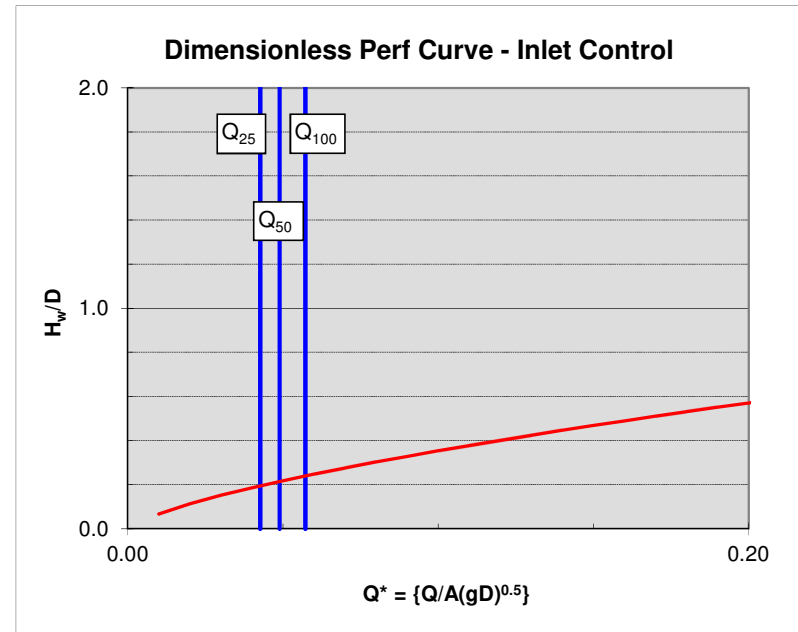
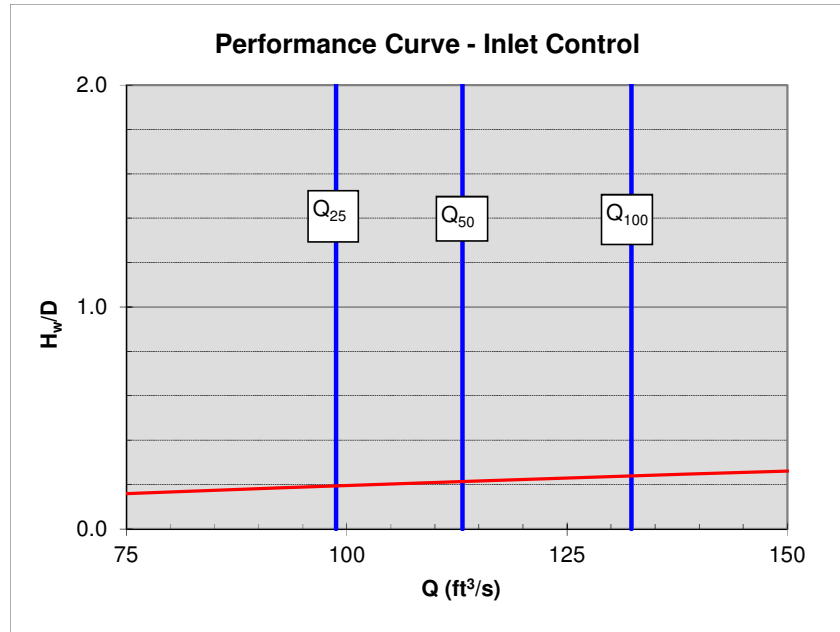
Dudley, R.W., 2013. FY2013 Progress Report - Phase 1 ..., USFWS QRP Project  
 Dudley, R.W., 2004. Estimating Monthly Streamflows ..., SIR 2004-5026

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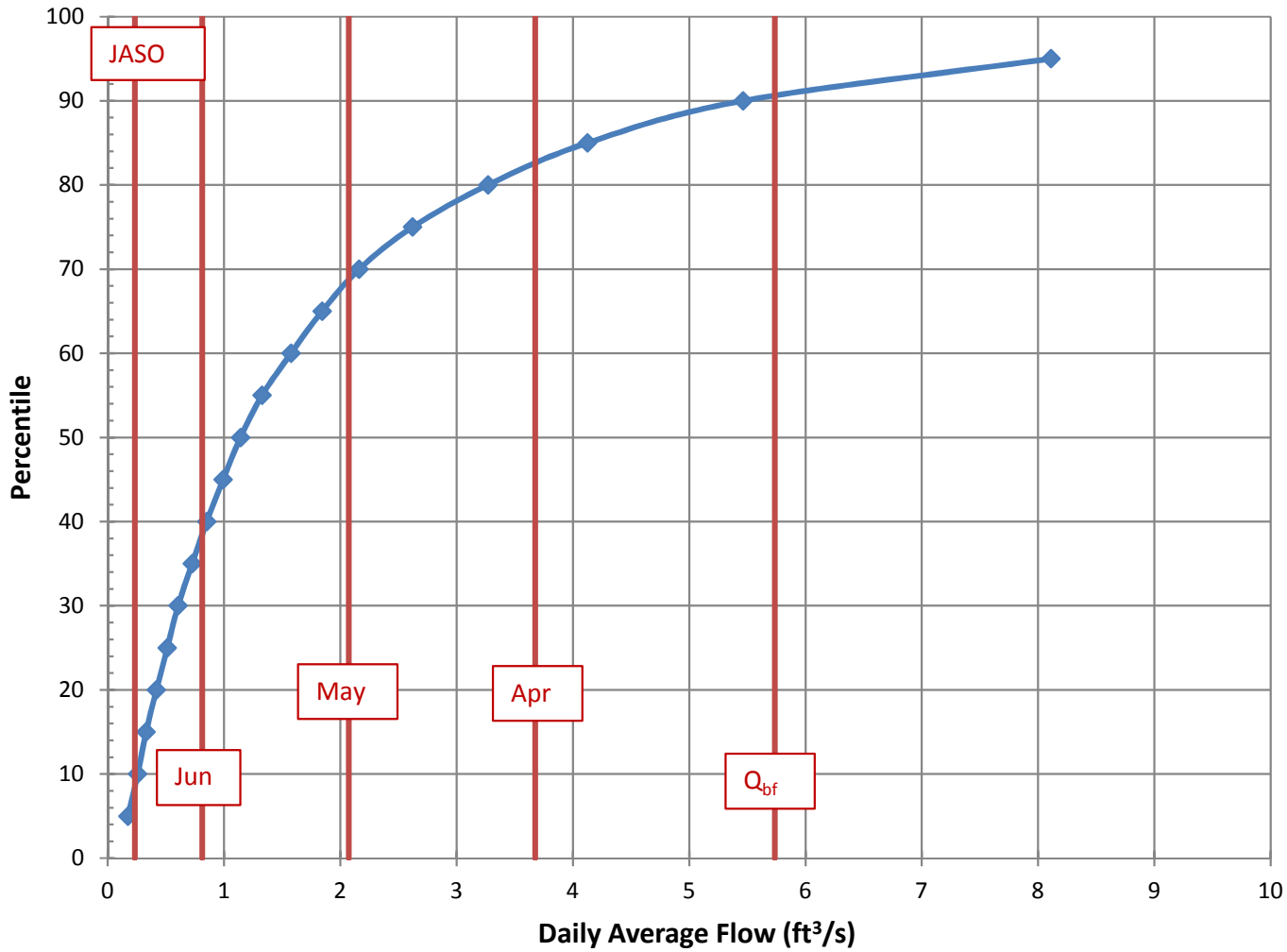
**Preliminary Culvert Sizing - Round & Box Culverts**

Shape:	Box			
Type:	Box 0 ww	Q <sub>25</sub>	98.8	
D or R (ft)	8	Q <sub>50</sub>	113.1	trial D / R = 5.5
w (ft)	18 box width	Q <sub>100</sub>	132.3	trial w: BFW = 11.0
Slope (ft/ft)	0.02			
A (ft <sup>2</sup> )	144.00			
g (ft/s <sup>2</sup> )	32.2			

**Note:**  
culvert dimensions are for open flow area; adjust for lost capacity due to embedding / backfilling (min {2' / 25% rise} embedment)



# Daily Average Flow Distribution



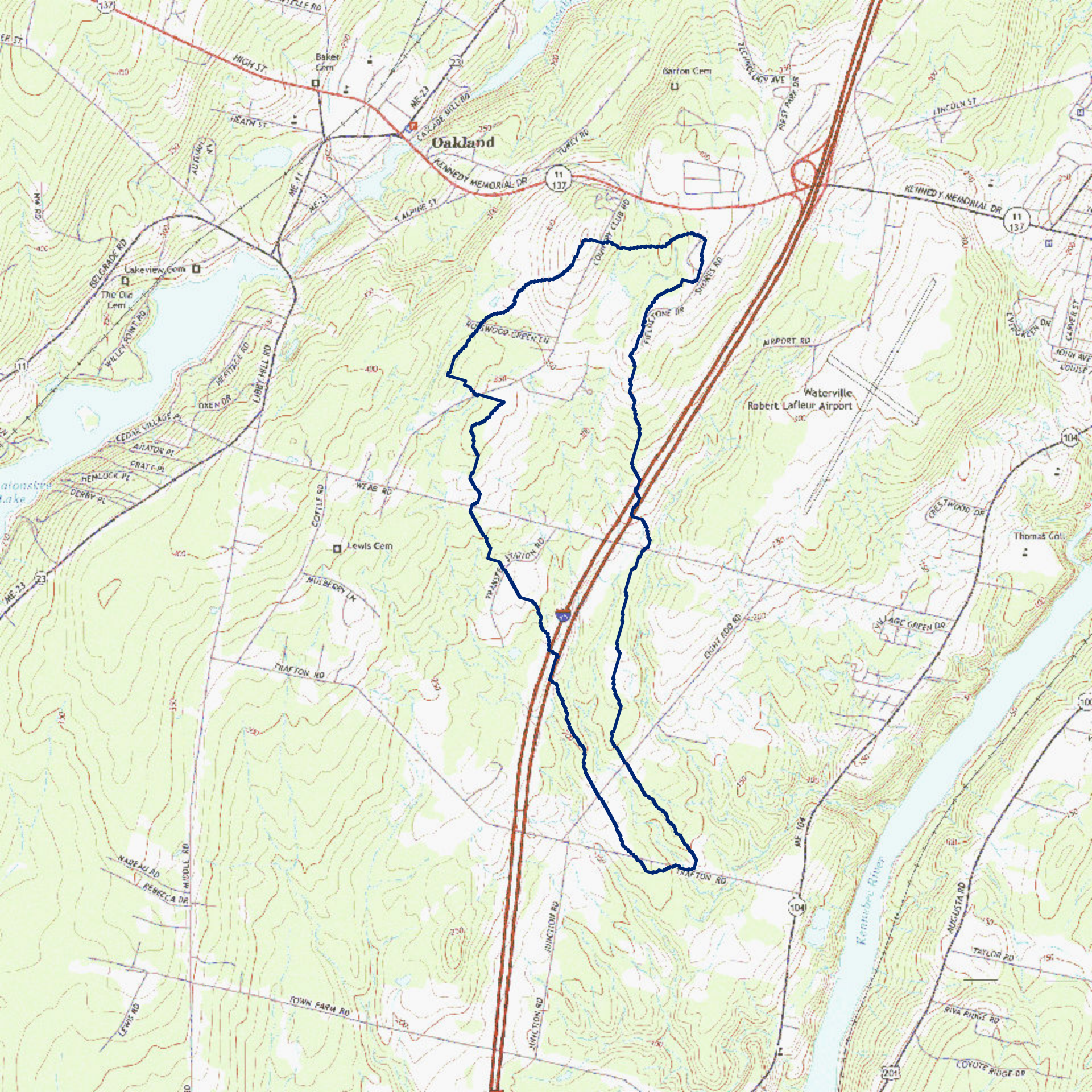
## Daily Avg Flow Dist

$A_{ws} = (mi^2)$  1.1

Q (ft³/s)

Pctl	Median	84 <sup>th</sup> pctl
5	0.17	0.28
10	0.26	0.39
15	0.33	0.48
20	0.42	0.59
25	0.51	0.69
30	0.61	0.78
35	0.73	0.89
40	0.85	1.03
45	0.99	1.16
50	1.14	1.37
55	1.33	1.60
60	1.58	1.87
65	1.84	2.18
70	2.16	2.55
75	2.62	3.06
80	3.27	3.66
85	4.13	4.69
90	5.46	6.29
95	8.11	9.79

$Q_{bf}$	5.7
$Q_{1.002}$	9.0
$Q_{1.1}$	19.9
$Q_2$	39.7



WIN:	23246.00
Town:	Waterville
Route No.:	Trafton Road
Asset ID:	
Lat:	44.5056
Long:	-69.68587

Project Name:	Waterville 23246 Trafton Rd Stream 3
Stream Name:	
Bridge Name:	
Analysis by:	DFB
Date:	11/2/2017

### Peak Flow Calculations by USGS Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015)

*Enter data in blue cells only!*

	km <sup>2</sup>	mi <sup>2</sup>	ac
A	2.85	1.10	704.0
W	0.44	0.2	109.1

P <sub>c</sub>	444513	4930586
County	Kennebec	
pptA	41.7	
SG	0.00	

A (km <sup>2</sup> )	2.85
W (%)	15.50

Conf Lvl

*Enter data in [mi<sup>2</sup>]*

Watershed Area *DRNAREA*  
Wetlands area (by NWI)

watershed centroid (E, N; UTM 19N; meters)

*choose county from drop-down menu*

mean annual precipitation (inches; by look-up)

sand & gravel aquifer as decimal fraction of watershed A

NWI Wetlands % *STORNWI*

**Worksheet prepared by:**

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Maine Dept. Transportation  
Augusta, ME 04333-0016  
207-557-1052

[Charles.Hebson@maine.gov](mailto:Charles.Hebson@maine.gov)  
*ver. 2017 Jun. 09*

**References:**

Hodgkins, G.A., 1999.  
Estimating the magnitude of peak flows for streams  
in Maine for selected recurrence intervals  
*WRIR 99-4008*, USGS Augusta, ME

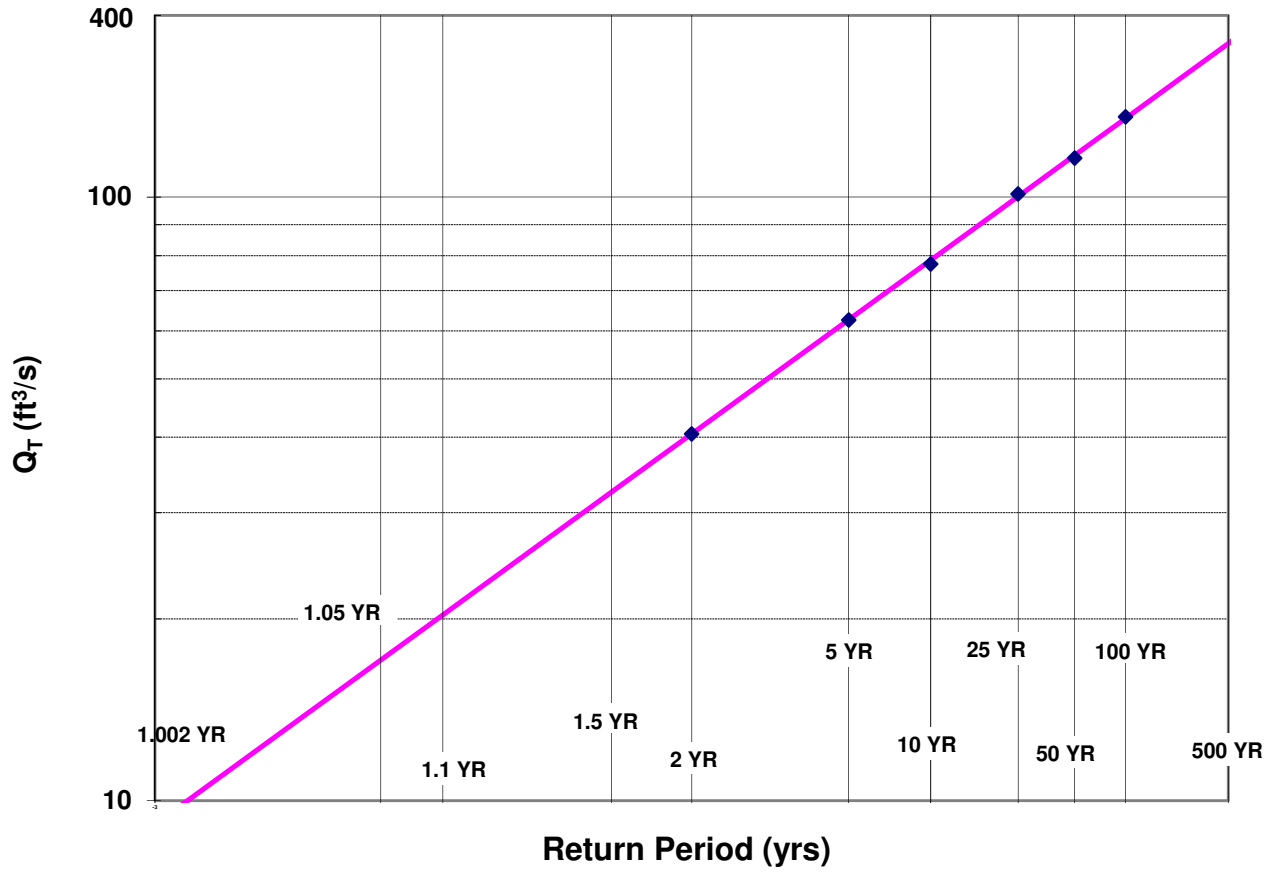
Lombard, P.J. & G.A. Hodgkins, 2015.  
Peak flow regression equations for small, ungaged streams in  
Maine - Comparing map-based to field-based variables  
*SIR 2015-4059*, USGS, Augusta, ME

$$Q_T = b \times A^a \times 10^{-wW}$$

Ret Pd	Peak Flow Estimate		
	T (yr)	Lower	Upper
1.1		0.58	
2		1.15	
5		1.77	
10		2.20	
25		2.87	
50		3.29	
100		3.85	
500		5.09	

Q <sub>T</sub> (ft <sup>3</sup> /s)
20.3
40.6
62.6
77.5
101.3
116.2
135.9
179.8

# Log-Normal Probability Plot



WIN:	23246.00
Town:	Waterville
Route No.:	Trafton Road
Asset ID:	0
Lat:	44.50560
Long:	-69.68587

Project Name:	Waterville 23246 Trafton Rd Stream 3
Stream Name:	0
Bridge Name:	0
Analysis by:	DFB
Date:	11/2/2017

**DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED**

**MAINE MONTHLY MEDIAN FLOWS and HYDRAULIC GEOMETRY BY USGS REGRESSION EQUATIONS (2004, 2013)**

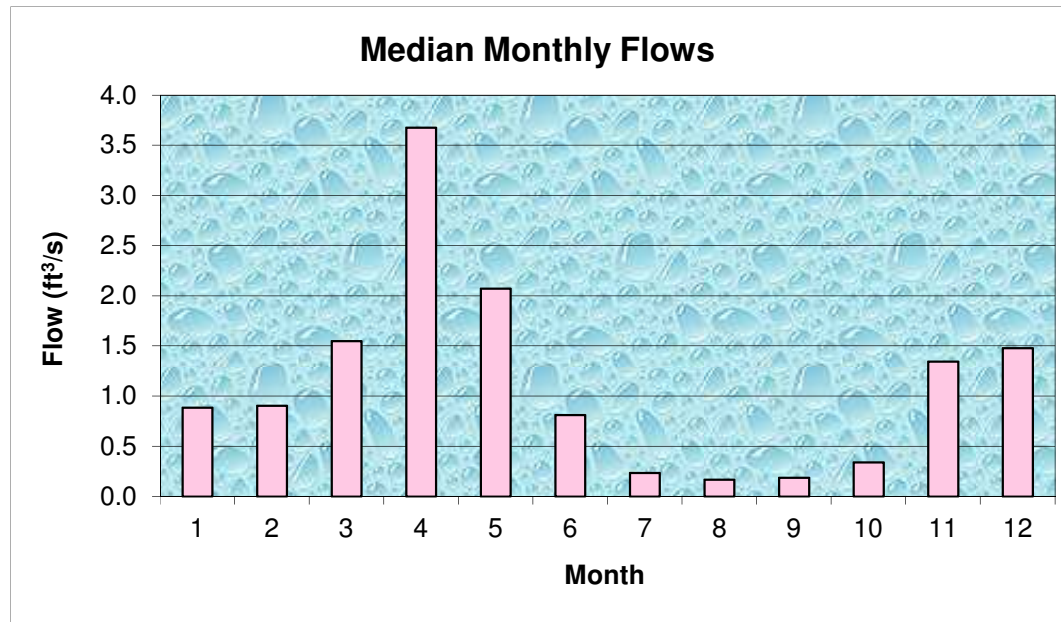
Value	Variable	Explanation
1.10	A	Area (mi <sup>2</sup> )
444513.2	P <sub>c</sub>	Watershed centroid (E,N; UTM; Zone 19; meters)
71.14	DIST	Distance from Coastal reference line (mi)
41.7	pptA	Mean Annual Precipitation (inches)
0.00	SG	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q <sub>median</sub> (ft <sup>3</sup> /s)	(m <sup>3</sup> /s)
Jan	0.89	0.0251
Feb	0.90	0.0256
Mar	1.55	0.0439
Apr	3.68	0.1042
May	2.07	0.0587
Jun	0.81	0.0230
Jul	0.23	0.0066
Aug	0.17	0.0048
Sep	0.19	0.0053
Oct	0.34	0.0096
Nov	1.34	0.0381
Dec	1.48	0.0420

Q <sub>bf</sub>	5.7
ann avg	2.2
ann med	1.0
Q <sub>1.002</sub>	9.1
Q <sub>1.01</sub>	12.1
Q <sub>1.05</sub>	17.1
Q <sub>bf</sub>	27.1

assume v = 4ft/s

W <sub>bf</sub>	11.0	estimated bankfull width (ft)
d <sub>bf</sub>	0.6	estimated bankfull depth (ft)
A <sub>bf</sub>	4.9	estimated bankfull flow area (ft <sup>2</sup> )



**References**

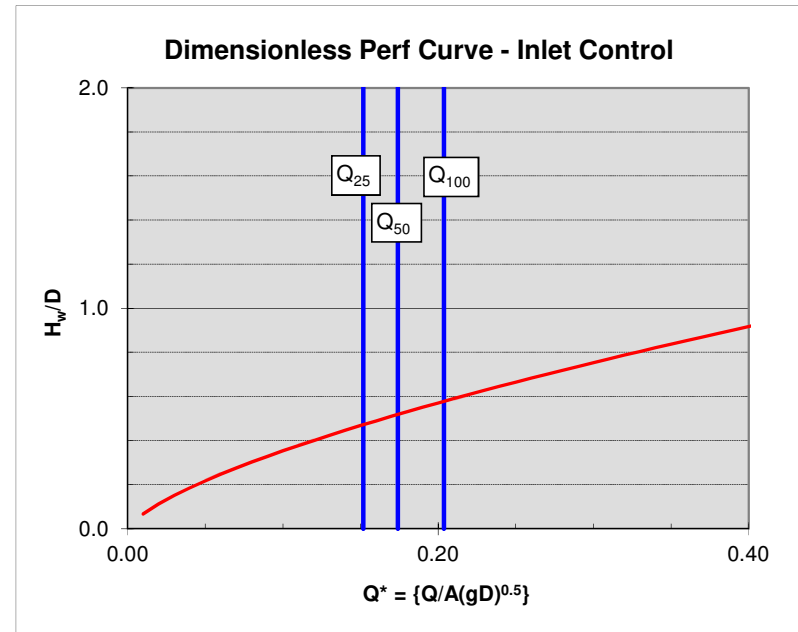
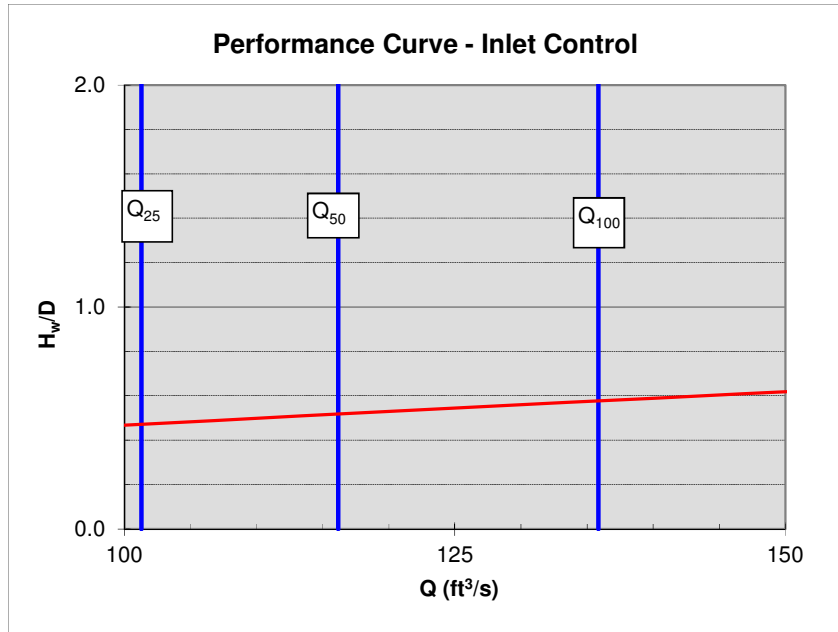
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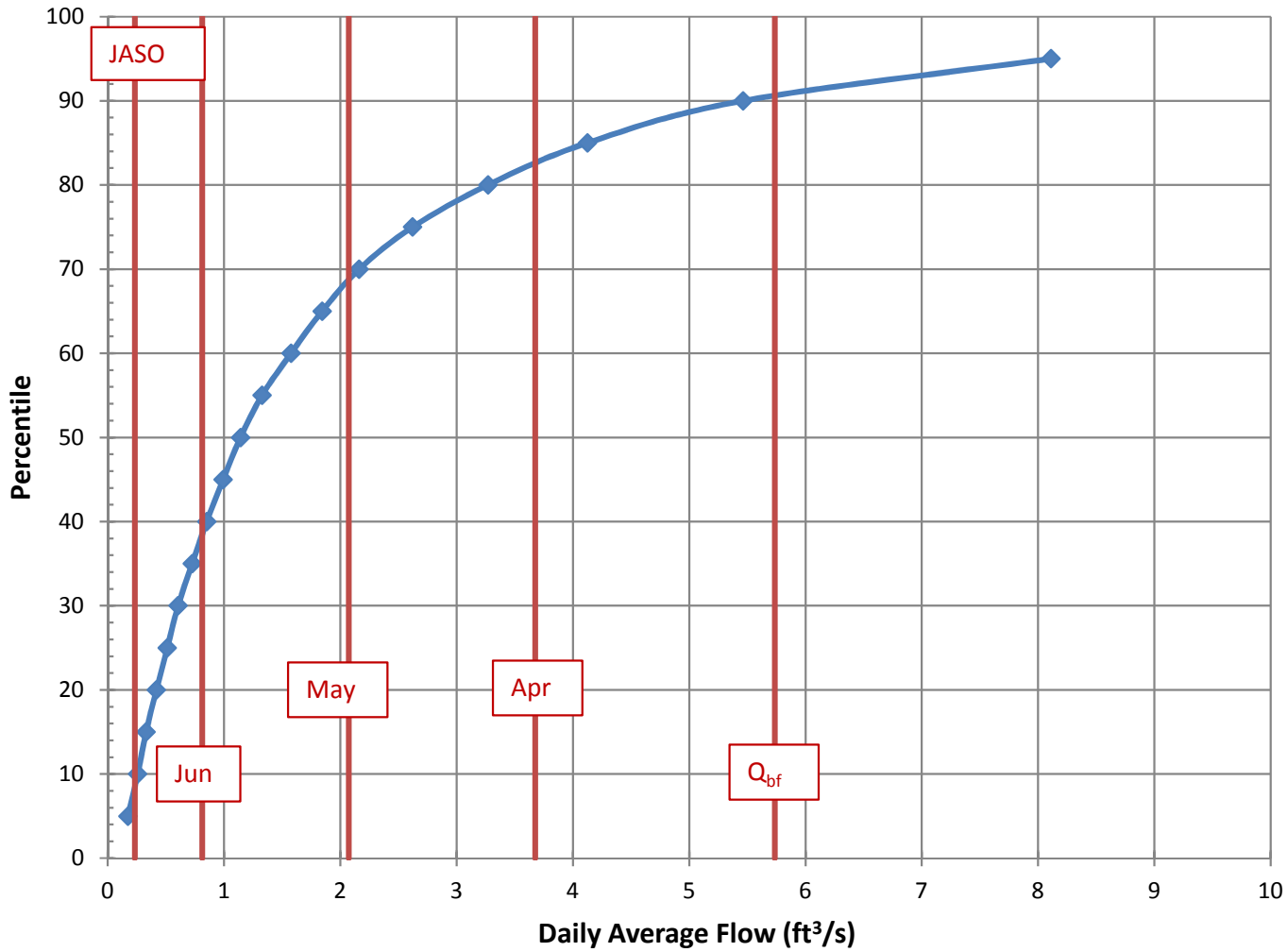
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Slope (ft/ft)	0.02			
A (ft <sup>2</sup> )	48.00			
g (ft/s <sup>2</sup> )	32.2			

**Note:**  
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# Daily Average Flow Distribution



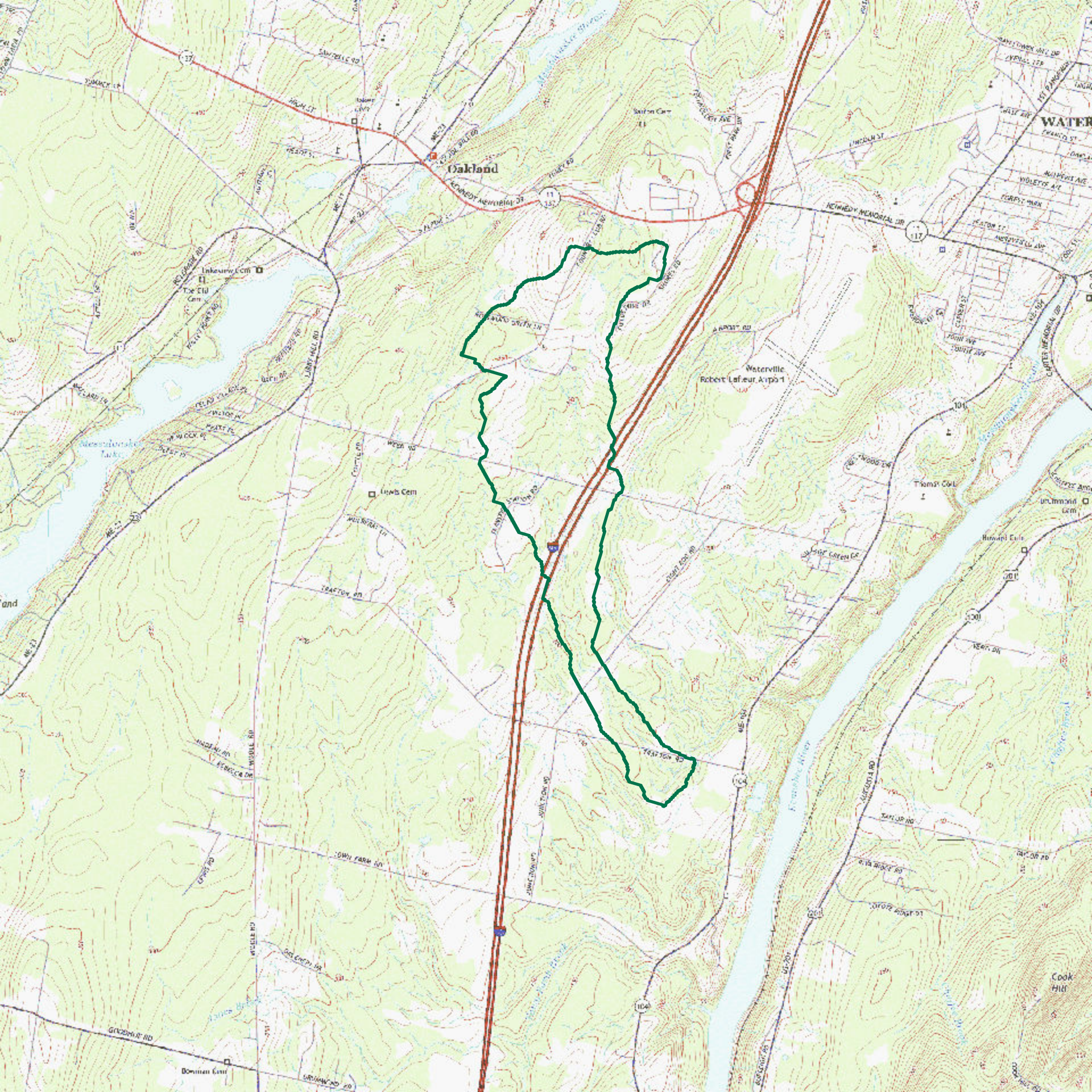
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$Q_2$	40.6



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