MEMO

TO: Tim Blackburn, PEng

FROM: Adam Vaughan, EIT; Chris Coles, MASc, PEng

SUBJECT: **Construction Flows for Hwy 97 Cache Creek Replacement Bridge**

DATE: **September 20, 2023**

INTRODUCTION

WSP Canada Inc. (WSP) was retained by Urban Systems to estimate the flow rate associated with the requirements for worksite isolation and flow diversion during the anticipated culvert replacement activities at the crossing of Cache Creek and Hwy 97(the Site), in the Village of Cache Creek. It is understood that the construction period may span over a period of approximately one year. The BC Ministry of Transportation and Infrastructure (MoTI) defines the flow required for maintenance diversions in perennial natural watercourses as the 1:10-year monthly peak instantaneous flow during the period of construction (MoTI 2019). The analysis has been broken into discrete months to support the planning of flows diversion on a month by month basis. This memo summarizes the design flows for the selected months. These flows are estimated for present day conditions and do not include consideration for climate change.

HYDROLOGIC ASSESSMENT

An assessment of 1:10-year instantaneous peak flows at the Site during each month was performed using a single WSC hydrometric station: 08LF099 - Arrowstone Creek near the mouth. Arrowstone Creek is located within the watershed of the Site and is a tributary to Cache Creek. This station was chosen as it better represents the flood response of the watershed as compared to other regional stations. A series of maximum daily flows for each month were obtained from the station data.

Monthly peak flows were estimated using a peaking factor established between annual instantaneous peak and annual maximum daily flows at station 08LF099. The peaking factor was calculated as the average of the ratio of peak flow to maximum daily flow from the series of years where both values were present. The peaking factor was calculated to have a value of 1.25. The

Suite 1000
840 Howe Street
Vancouver, BC, Canada V6Z 2M1

T: +1 604 685-9381
F: +1 604 683-8655Suite 1000
840 Howe Street
Vancouver, BC, Canada V6Z 2M1

T: +1 604 685-9381
F: +1 604 683-8655
wsp.com

peaking factor was applied to maximum daily flows for each month throughout the dataset to produce a series of monthly peak flows.

A frequency analysis was performed on the monthly peak flow series from station 08LF099. 3 Parameter Log Normal, Extreme Value, Log Pearson III, and Weibull distributions were checked from the station data. Results were selected based on the individual statistical best fit distributions (using the Anderson-Darling goodness-of-fit test) for each month.

Estimated 1:10-year monthly instantaneous peak flows for each month are presented in Table 1:

Table 1: 1:10-year instantaneous peak flows on a monthly basis at station 08LF099

Month	1:10-year Monthly Peak Flow at Station 08FL099 (m^3/s)	Best Fit Statistical Distribution
January	0.1	Extreme Value
February	0.1	3 Parameter Log Normal
March	0.3	Log-Pearson III
April	2.0	Extreme Value
May	4.0	3 Parameter Log Normal
June	1.2	3 Parameter Log Normal
July	0.6	Log-Pearson III
August	0.2	Extreme Value
September	0.1	Extreme Value
October	0.2	Log-Pearson III
November	0.2	Extreme Value
December	0.1	Log-Pearson III

1:10-year monthly peak flows estimated at station 08LF099 were scaled to represent the drainage area reporting to the Site. The watershed area upstream of the Site was estimated to be 136 km^2, while the watershed area upstream of WSC station 08LF099 is 50.5 km^2. The area transfer method considered for establishing peak flows at Cache Creek was derived by Coulson (MOELP 1998). This method uses the ratio between the catchment areas of the subject site and a selected hydrometric station to scale flows:

$$Q_{site} = Q_{station}\left(\frac{A_{site}}{A_{station}}\right)^{0.785} \qquad \text{(Equation 1) (MOELP 1998)}$$

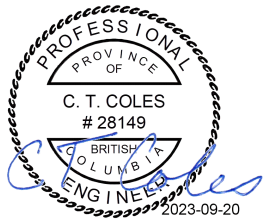
The estimated 1:10-year monthly peak flows at the Site are presented in Table 2 below.

Table 2: 1:10-year instantaneous peak flows on a monthly basis at the Site

Month	1:10-year Monthly Peak Flow at the Site (m^3/s)
January	0.2
February	0.2
March	0.7
April	4.5
May	8.7
June	2.7
July	1.2
August	0.5
September	0.3
October	0.4
November	0.4
December	0.2

CLOSURE

We trust that the information presented above is sufficient for your current requirements. Should you have any questions or comments regarding the above, please do not hesitate to contact us.



Adam Vaughan, EIT
Water Resources Engineer

Chris Coles, MASc, PEng
Senior Principal Water Resources Engineer

Engineers & Geoscientists BC Permit #1000200

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https://wsponlinecan.sharepoint.com/sites/CA-221-11730-003680/Shared Documents/06. Deliverables/3.0_ ISSUED/26939_ht_tm_Hwy 97 Cache Creek Construction Flows 20230920/26939_ht_tm_Hwy 97 Cache Creek Construction Flows 20230920.docx

REFERENCES

- MOELP (BC Ministry of Environment, Lands and Parks). 1998. British Columbia Streamflow Inventory. https://a100.gov.bc.ca/pub/acat/public/viewReport.do?reportId=2227
- MOTI (Ministry of Transportation and Infrastructure). 2019. BC Supplement to TAC Geometric Design Guide. 2019. 3rd Edition.