

## Memorandum

**DATE:** January 30, 2018

**TO:** James Bogusz and Stacey Lee, Victoria Airport Authority (VAA)

**FROM:** Chad Davey, Kerr Wood Leidal (KWL)

**RE: VICTORIA AIRPORT AUTHORITY  
2017 Reay Creek Hydrometric Monitoring Program – Summary Memorandum  
2083-030.300**

### 1. Introduction

Kerr Wood Leidal (KWL) was retained by the Victoria Airport Authority (VAA) to continue the hydrometric monitoring program that was initiated on Reay Creek in 2016. The goal of collecting water level and calculated discharge data is to better understand the hydrological response (i.e., water stage) of Reay Creek following precipitation events. This data could be used for future studies to validate the hydrological model developed for the Airport.

The following summary memorandum outlines the work that was conducted during the 2017 monitoring program and the data that was collected.

### 2. Hydrometric Program

#### 2.1 Station Installation

On January 29, 2016, Max Scruton and Chad Davey of KWL installed the Reay Creek hydrometric station to continuously monitor the water level in Reay Creek just upstream of Canora Road, immediately south of the Victoria International Airport (Figure 1).

A pressure transducer was installed at the hydrometric station to record water level every five minutes. Data is stored on a Solinst Edge datalogger (i.e. pressure transducer) and has the capacity to store ~4 months of data before it begins to overwrite previously collected data. The hydrometric monitoring station at Reay Creek consists of a 4" PVC pipe (i.e. stilling well) that houses the pressure transducer, benchmarks, and staff gauge (Photo 1). A Solinst barologger was also installed at the hydrometric station to measure barometric air pressure. Barometric data is needed for compensating barometric pressure changes when processing the information collected by the water level datalogger.



**Photo 1: Hydrometric Station at Reay Creek near Canora Road.**



On February 21, 2017, KWL staff performed a manual measurement of discharge and stage with the assistance of Stacey Lee from the Victoria Airport Authority. KWL provided Mr. Lee with instructions and necessary equipment to download the data from the hydrometric station. Mr. Lee carried out the downloading of data from the hydrometric station on subsequent field visits for the remainder of the 2017 program.

## 2.2 Stage-Discharge Relationship

The hydrometric station at Reay Creek continuously records water level (i.e. stage). Discharge is not measured directly by the pressure transducer. To obtain discharge from the water level data record, a stage-discharge relationship (SDR) needs to be developed. Stage-discharge relationships are created by measuring instantaneous discharge at different water levels and relating them to a fixed staff gauge. Measured flows are graphed with the associated stages, and a curve relating manual measurements of stage and discharge is created. Manual measurements collected at the Reay Creek hydrometric station is provided in Table 1. The SDR for the Reay Creek hydrometric station is provided in Figure 2.

**Table 1: Manual measurements of Discharge and Stage Collected**

Date	Staff Gauge (m)	Discharge (m <sup>3</sup> /s)
January 29, 2016	0.455	0.3133
March 10, 2016	0.515	0.483
April 1, 2016	0.240	0.008
June 23, 2016	0.335	0.066
October 13, 2016	0.405	0.168
February 21, 2017	0.300	0.027

The Manual of BC Hydrometric Standards recommends that a minimum of 10 discharge measurements, well-distributed throughout the range of station water levels, be used to develop a Class 'A' SDR<sup>1</sup>. Consequently, the Reay Creek SDR (Figure 2) and the discharges calculated using them remain preliminary until a well distributed minimum number of manual discharge measurements are collected.

The recommended upper limit of applicability for a SDR is a measure of how far the curve can be confidently extrapolated beyond the highest discharge measurement. An industry standard is to extrapolate to two times the highest discharge measurement. The Reay Creek SDR (Figure 2) shows the SDR upper limit of 0.96 m<sup>3</sup>/s, equivalent to a staff gauge reading of approximately 0.61 m, which is two times the highest flow measurement which was collected on March 10, 2016 (see Table 1).

## 2.3 Reay Creek Hydrograph

Data was collected at the Reay Creek hydrometric station from January 2016 to December 2017 and is presented in Figures 3 and 4. Figure 3 presents the hydrometric data collected at 5-minute intervals, whereas Figure 4 presents the Reay Creek hydrometric data as a daily mean discharge. The blue line on both Figures 3 and 4 represent the SDR upper limit, the flow values above the SDR upper limit are associated with a high uncertainty and should not be relied upon.

<sup>1</sup> Ministry of Environment. 2009. *Manual of British Columbia Hydrometric Standards*, Version 1.0 (Resources Information Standards Committee), 204p.



There are two data gaps in the hydrograph record: February 16 to March 14 and August 26 to September 3, 2017. This was due to the datalogger at the hydrometric station having exceeded its memory capacity and overwriting previously collected data.

The shape of the hydrograph for Reay Creek illustrates how reactive the discharge response is to precipitation events. The discharge and stage in Reay Creek rises and falls in a very short amount of time. The largest discharge event occurred on February 10, 2017. Table 2 shows the relationship between mean monthly discharge total monthly precipitation for 2016 and 2017. The higher precipitation during the fall and winter periods between October to March result in the highest discharges in Reay Creek (Table 2). In contrast, the drier spring and summer period between April and September results in Reay Creek having the lowest flows of the year.

**Table 2: Total precipitation (mm) and mean monthly discharge (Litres/s) for 2016 and 2017 at the Reay Creek Hydrometric Station.**

Month	2016		2017	
	Total Precipitation* (mm)	Mean Discharge (L/s)	Total Precipitation* (mm)	Mean Discharge (L/s)
Jan	138	59.2	52	18.3
Feb	116	89.5	130	113.7
Mar	119	75.2	138	126.7
Apr	10	7.9	75	68.2
May	13	2.3	48	18.2
Jun	21	3.9	28	8.9
Jul	14	1.4	0	0.5
Aug	3	0.2	3	0.6
Sep	31	4.5	20	2.9
Oct	234	35.0	92	34.6
Nov	176	65.3	193	144.2
Dec	135	47.8	131	130.7

\* Precipitation data is from the weather station at the Victoria Airport (ID#1018621)



### 3. Summary

It is recommended that the Reay Creek hydrometric program is continued into 2018 and that further manual measurements of discharge and stage are collected to ensure the current preliminary SDR is still valid.

KWL is available to provide assistance in continuing Reay Creek hydrometric program for 2018.

I trust that this letter memorandum meets your current needs. If you have any questions or concerns please do not hesitate to contact me.

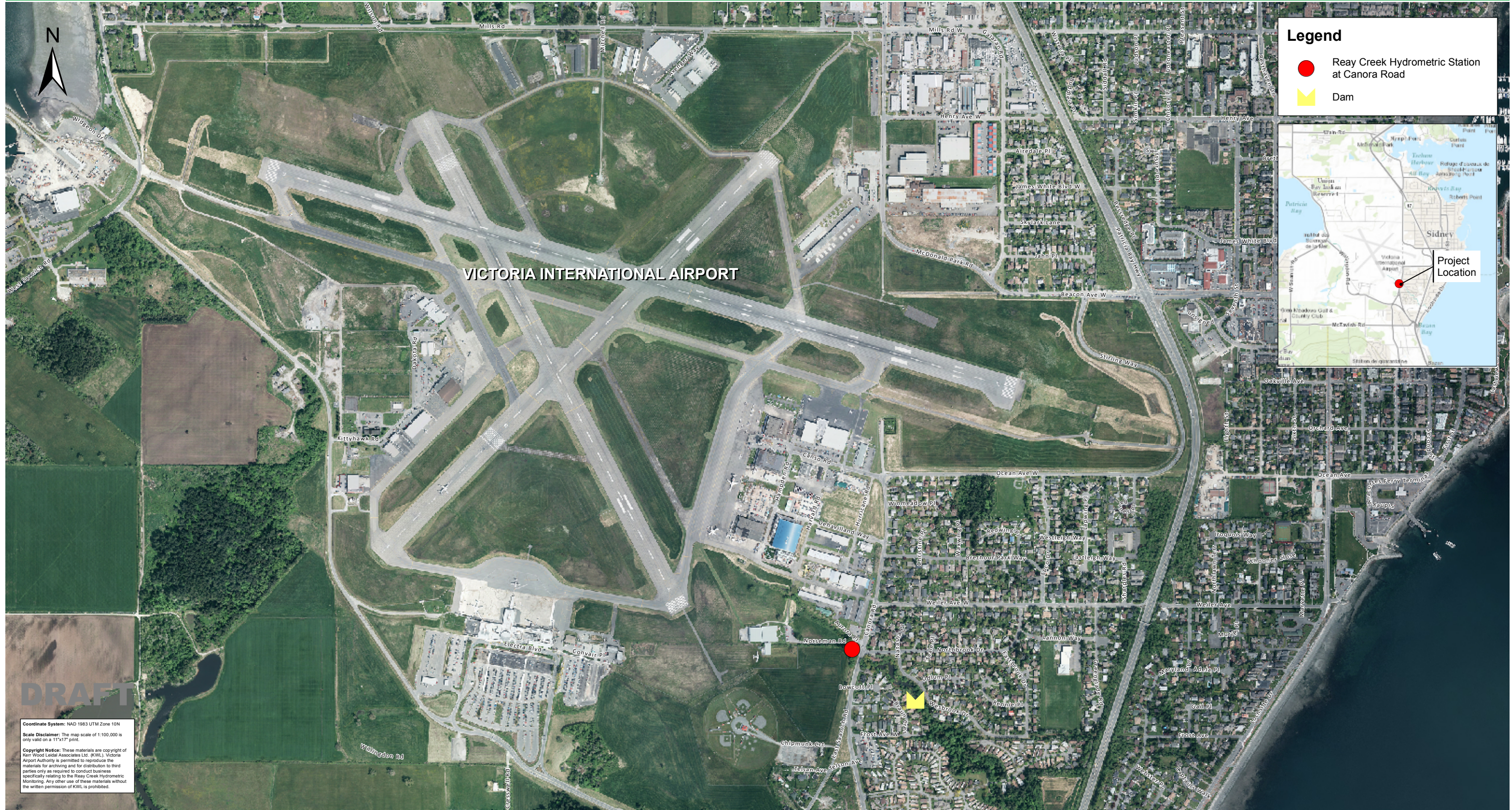
Yours truly,

**KERR WOOD LEIDAL ASSOCIATES LTD.**

A handwritten signature in black ink, appearing to read 'Chad Davey', is written over a light blue horizontal line.

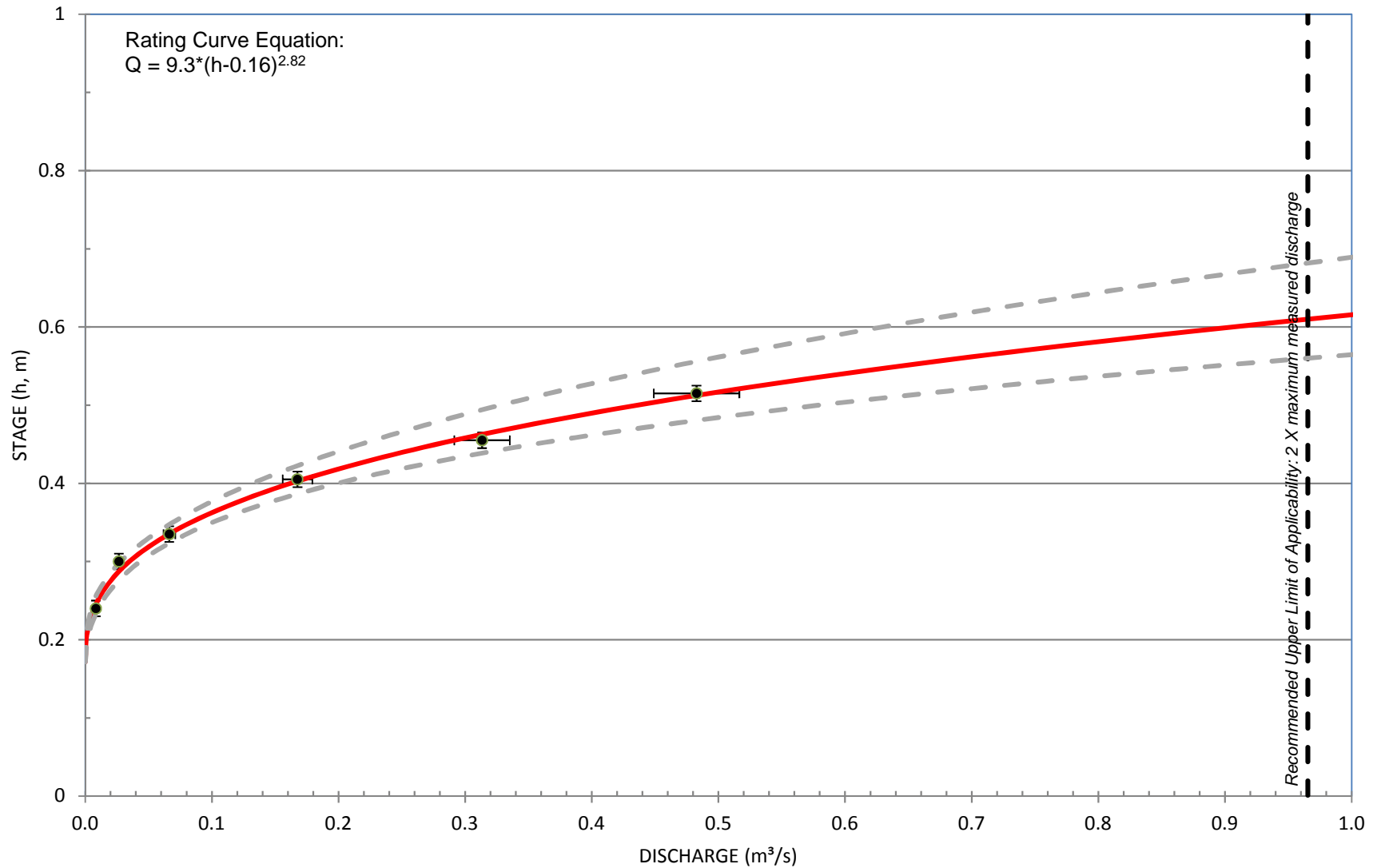
Chad Davey, M.Sc., R.P. Bio  
Fluvial Geomorphologist

- Encl: Figure 1: Location of Reay Creek Hydrometric Station  
Figure 2: SDR for Reay Creek Hydrometric Station  
Figure 3: Reay Creek Hydrograph (5 min Instantaneous)  
Figure 4: Reay Creek Hydrograph (Daily Mean Flow)



**2017 Preliminary Stage Discharge Relationship  
Reay Creek Hydrometric Station  
(Estimated by Method of Maximum Likelihood)**

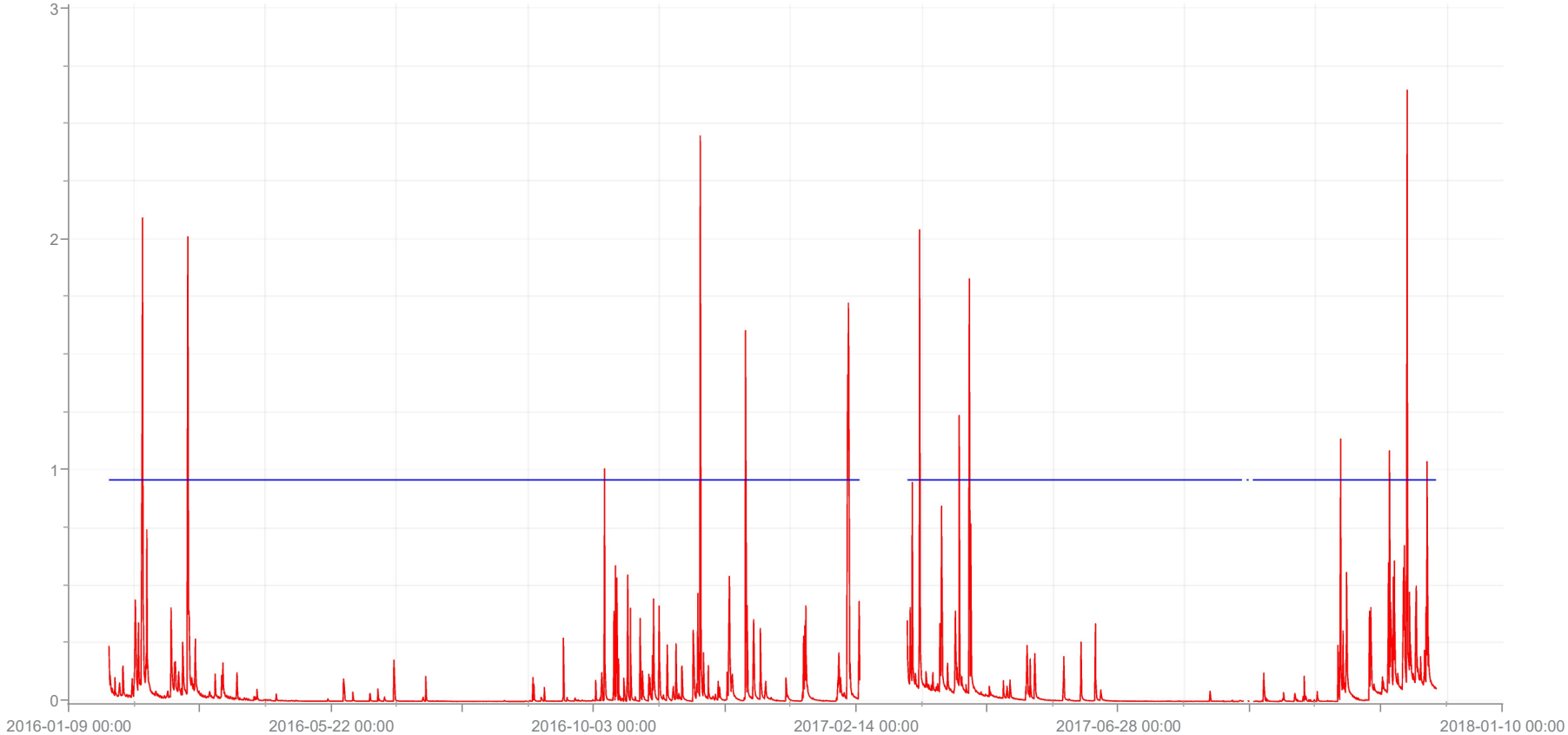
— Rating Curve    
 ● Points Used for Rating Curve    
 - - - Confidence Limits



Reay Creek at Canora Road

Start Date: 2016-01-09 00:00  
End Date: 2018-01-09 23:59

■ Preliminary Discharge (5 min Instantaneous) (m3/s) ■ SDR Upper Limit (m3/s)



Reay Creek at Canora Road

Start Date: 2016-01-09 00:00  
End Date: 2018-01-09 23:59

