Groundwater-Surface Water Interactions for Marshall Creek September 27th, 2023

Introduction

Marshall Creek, an important perennial tributary of Hangman (Latah) Creek, has been experiencing severe instream flow issues for the past 6-7 years. During the critical summer periods (June through August), the creek becomes observably dry for approximately 2.5 miles upstream from its confluence with Hangman Creek. The Spokane Conservation District (SCD) focused this investigation on the lower 7 river miles of Marshall Creek due to potential hydrological and land use changes that caused the 2017 flooding of a large agricultural field (approximately 42 ac.) now termed, "Marshall Lake". Other potential issues in this portion of the watershed included surface water rights, excessive in-channel vegetation, non-consumptive pond use, dams, and diversions. These factors have been observed and reported by residents in the watershed and by local and state governmental agencies. To better understand and quantify the current instream flow and potential impairments, the SCD completed 10 discharge measurements on September 27th, 2023, to evaluate and compare the ground water/surface water interactions along Marshall Creek (Figure 1.). The measurements, known as a seepage run or investigation, helped to provide estimations of ground water contributions/losses to the surface water and the ground water systems.

Methodology

The SCD contacted many residents within the targeted stream reaches on Marshall Creek to meet and gain permission to access preferred creek locations. All landowners contacted were very cooperative and interested in the measurement work. The SCD initially planned for nine discharge measurements along various sections of the creek. An additional site was added after a landowner requested to quantify the amount of water being diverted into their pond. The SCD worked with each landowner to prepare the discharge stations ahead of time. The discharge measurements were all taken on the same day by two teams of SCD staff. The SCD conducted streamflow discharge measurements according to the United States Geological Survey, Standard Operating Procedure for Wading Measurements (WSP 2175 (usgs.gov). The measurements were taken with FlowTracker Handheld ADV meters. The FlowTracker Handheld ADV is a single-point Doppler current meter designed for field velocity measurements. The FlowTracker measures the Doppler effect of flowing water to determine stream velocity which is then used to calculate discharge (SonTek FlowTracker Handheld-ADV – Pine Environmental (pine-environmental.com).

Results

The focus of these stream discharge measurements was to quantify stream flow in the lower portions of Marshall Creek and evaluate where the creek is losing or gaining water. The data collected from the seepage run is provided below in Table 1.

The most substantial finding of the stream discharge measurements was the difference between Stations 1 and 2. These locations were above and below the flooded field called "Marshall Lake". The instream flow diminished from 2.77 cubic feet per second (cfs) to 0.73 cfs. This is approximately a 74% loss of stream flow for Marshall Creek. The confluence for Minnie Creek was also between these stations. Minnie Creek had zero flow.

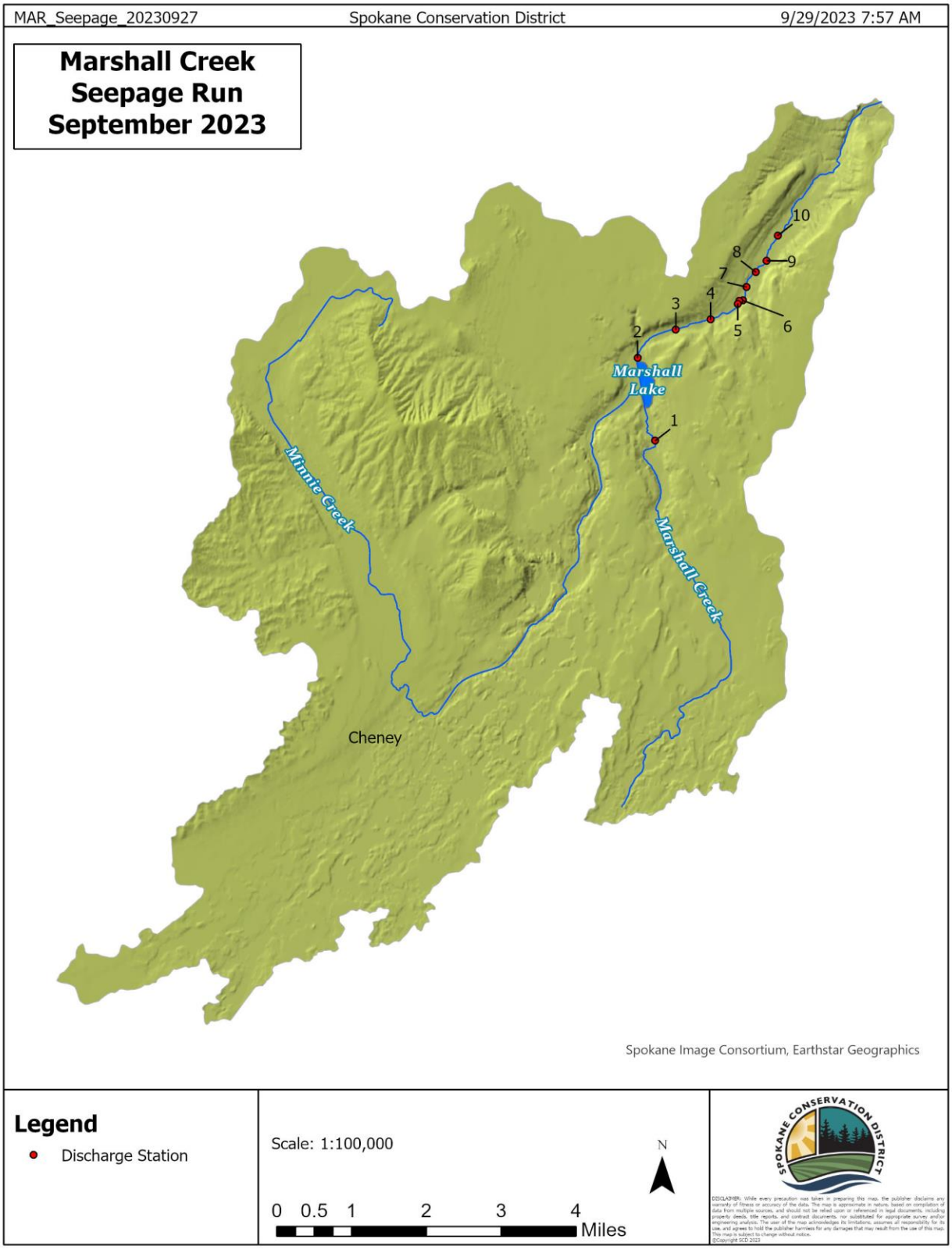

Figure 1. Marshall Creek Seepage Measurement Locations

Table 1. Marshall Creek Discharge Measurement Statistics for Seepage Run

Station Number	Description	River Mile	Water Temperature (°F)/(°C)	Discharge (cfs)	Change (±%)
1	Culvert – W. Marshall Creek Lane (Above Marshall Lake)	6.89	49.2/9.5	2.77	N/A
2	Culvert – S. McKenzie Rd. (Below Marshall Lake)	5.62	50.3/10.1	0.73	-74
3	9210 S. Cheney-Spokane Rd. Private Residence	4.87	51.4/10.8	0.53	-27
4	Culvert – S. Cheney-Spokane Rd.	4.37	50.8/10.4	0.57	+7
5	8513 S. Cheney-Spokane Rd. Private Residence. Above diversion/pond/outfall	3.76	49.1/9.5	0.44	-23
5a	8513 S. Cheney-Spokane Rd. Private Residence. Diversion channel to pond	3.71	50.2/10.1	0.37	N/A
6	8513 S. Cheney-Spokane Rd. Private Residence. Below diversion/pond/outfall	3.63	53.0/11.7	0.33	-25
7	Culvert – S. Cheney-Spokane Rd.	3.59	52.2/11.2	0.30	-9
8	7916 S. Cheney-Spokane Rd. Private Residence. Above diversion/pond/outfall	3.42	50.4/10.2	0.24	-20
9	7708 S. Cheney-Spokane Rd. Below diversion/pond/outfall	3.05	50.7/10.3	0.15	-37
10	7216 S. Cheney-Spokane Rd. Private Residence	2.67	NM	NM	-100

NOTES: cfs – cubic feet per second
N/A – not applicable.
NM – Not measured (no flow was present)
°F – Degrees in Fahrenheit
°C – Degrees in Celsius

Station 3 was located three quarters of a mile below Station 2. This reach lost another 0.20 cfs of stream flow (27%), but 0.04 cfs (7%) was gained back within the next half mile of stream at Station 4. Another 0.13 cfs of flow (23%) was lost between Station 4 and Station 5 (just over half a mile apart). Station 5 was positioned above the first in a series of established ponds on this section of Marshall Creek. The landowner requested that we also measure the inflow (diversion) channel to the pond. The inflow (diversion) discharge measurement to the pond was 0.37 cfs. This was approximately 83% of the current creek flow. The measurement at Station 6 was below the diversion, pond, and outfall. The measurement showed an approximate 0.11 cfs (25%) loss of flow after the pond.

Station 6 was also located above the next private diversion, pond, and outfall. Station 7 measurements indicated that there was a smaller flow loss of 0.03 cfs (9%) from this pond. The ponds between Station 5 and 7 had an overall stream flow loss of 0.14 cfs (34%) in a very short distance (900 feet). Station 8 was just under half a mile downstream of Station 7 and was also positioned above the last diversion, pond,

and outfall within the lower section of Marshall Creek. The measurement at Station 8 indicated a 0.06 cfs loss of stream flow (20%).

Station 9 was located below the last diversion, pond, and outfall. It was approximately a third of a mile below Station 8. The stream measurement (0.15 cfs) indicated a loss of stream flow (37%) from the upstream station. Station 10, approximately 2,000 feet downstream of Station 9, had water that entered the property, but it was too shallow to measure and went completely subsurface approximately halfway through the property. The SCD continued checking for stream flows down the channel to the confluence with Hangman Creek. No additional surface water was found.

Discussion

The discharge measurements that were taken on September 27th, 2023, confirmed that the single most significant impact to the section of Marshall Creek that was investigated by this seepage run was the flooding of the agricultural field known as "Marshall Lake". The flooded field began at river mile 6.28 and ended at river mile 5.68. The "lake" was over half of a mile long, reportedly 4'-5' in depth, and averaged approximately 600' in width. Approximately 74% (2.04 cfs) of the creek's instream flow was diverted and has been lost to flooding into this agricultural field.

Additional hydrological losses assumed to be due to seepage through the streambed were exacerbated by the presence of diversions and ponds (both total 0.61 cfs) that increase streambed area. This amount was only 22% of the stream flow above the "lake" but was 84% of the remaining flow after the "lake" losses. This indicated that the instream flow, without the formation of the "lake", would have potentially been approximately 2.16 cfs at river mile 3.05. In this case, the instream flow would have likely been adequate to reach the confluence of Hangman Creek. Natural flow losses have been documented by the SCD in past measurements, although historically, Marshall Creek has had enough perennial flow to reach its confluence with Hangman Creek (see Table 2. below).

Table 2. Marshall Creek Historic SCD Flow Measurements at Confluence to Hangman Creek

Date	Discharge (cfs)
September 6, 2001	0.60
July 18, 2002	0.98
September 4, 2002	1.74
September 30, 2009	2.81
September 22, 2015	0.52
September 15, 2021	NM
September 27, 2023	NM

NOTES: cfs – cubic feet per second
NM – not measured (no flow)

It should be further highlighted that although the measurements taken above and below ponds indicate potentially large losses (9-37%), the low flow conditions amplify the appearance of the loss. During higher stream flows, the same quantity loss would comprise a much smaller percent. Historic measurements indicate that the ponds, diversions, and outfalls did not severely impact the creek's instream flow.

The SCD collected stream temperature data with the Flowtracker measuring devices. The water temperatures were considered normal for the season, but there was a pattern noted at stations positioned after the flooded field and the ponded areas. All sites had an increase in temperature of one

to three degrees Fahrenheit. This was likely due to sunlight warming only the top portion of the water column which is removed by the pond outfalls. This may have a larger warming impact in the summer months.