Spokane River Turbidity Report

Water Year 2022

A community driven water quality study coordinated by Spokane Riverkeeper and Spokane Falls Trout Unlimited

The Spokane River at the with sediment pollution from Hangman Creek on March 2nd, 2022.

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Abstract

The Spokane Riverkeeper partnered with Spokane Falls Trout Unlimited and local community scientists for the fifth year to measure and determine the effect of Hangman Creek's annual sediment plume on water clarity (turbidity) in the Spokane River. Turbidity is the measure of light refraction in the water and measured in nephelometric turbidity units (NTU). Total suspended solids (TSS) are the physical particles in the water column which create turbidity ("*Turbidity and Water*" 2001). Turbidity is also one of many ways used to measure water pollution in Washington. From December 2021 to June 2022, 21 community scientists performed 95 sampling events and collected 310 water samples from the Spokane River and Hangman Creek. These samples were analyzed for turbidity and compared against state standards. The reason for this study was to determine the effects (if any) on the Spokane River (primary Interest) from the polluted (turbid) water flowing in from Hangman creek. The results showed that 18 turbidity violations occurred over the course of the study in the Spokane River due to Hangman Creek. This means that Hangman Creek caused the Spokane River to exceed Washington State Water Quality Standards (WQS) 26% of the time (Table 1).

The turbid water is polluting the Spokane River to such a degree that fish habitat and other important qualities are degraded. Washington Department of Ecology (2006) states, high levels of turbidity cause fish and benthic macroinvertebrates to have reduced growth rates, reduced disease resistance, less successful or reduction of egg laying/rearing, modified migration, altered predator/prey relationships, and reduced ability to feed. Turbidity allows transmission of bacterial or viral particles that attach themselves to suspended particles in the water, which interferes with human health (*"Turbidity 2022"*).

Turbidity from Hangman Creek flows into the Spokane River

Introduction

There are three main tributaries to the Spokane River- Hangman Creek, Little Spokane River, and Chamokane Creek (Ashbrook, 2010). Hangman creek is one of the largest tributaries of the Spokane river and is also the first to enter the river. The watershed, originating in Idaho, covers 689 square miles and contributes approximately 10% of the Spokane River watershed flows (SCCD 2005). Hangman Creek enters the Spokane River at River Mile 72.3 at People's Park, south of downtown Spokane (SCCD 2005). Hangman Creek is listed as impaired because it does not meet state water quality standards (*"Hangman Creek multi-parameter TMDL"* 2006). Turbidity is designated as one of its impairments which means Hangman Creek frequently experiences, and therefore discharges, water with high turbidity. Berman and Quinn (1991) assert that changes in upstream riverbank soil structure and riparian corridor through human land use practices result in increased erosion, reduction in stream depth and increased turbidity. Throughout the Hangman Creek valley, much of the riparian land is cleared for commercial agriculture (Joy 2009).

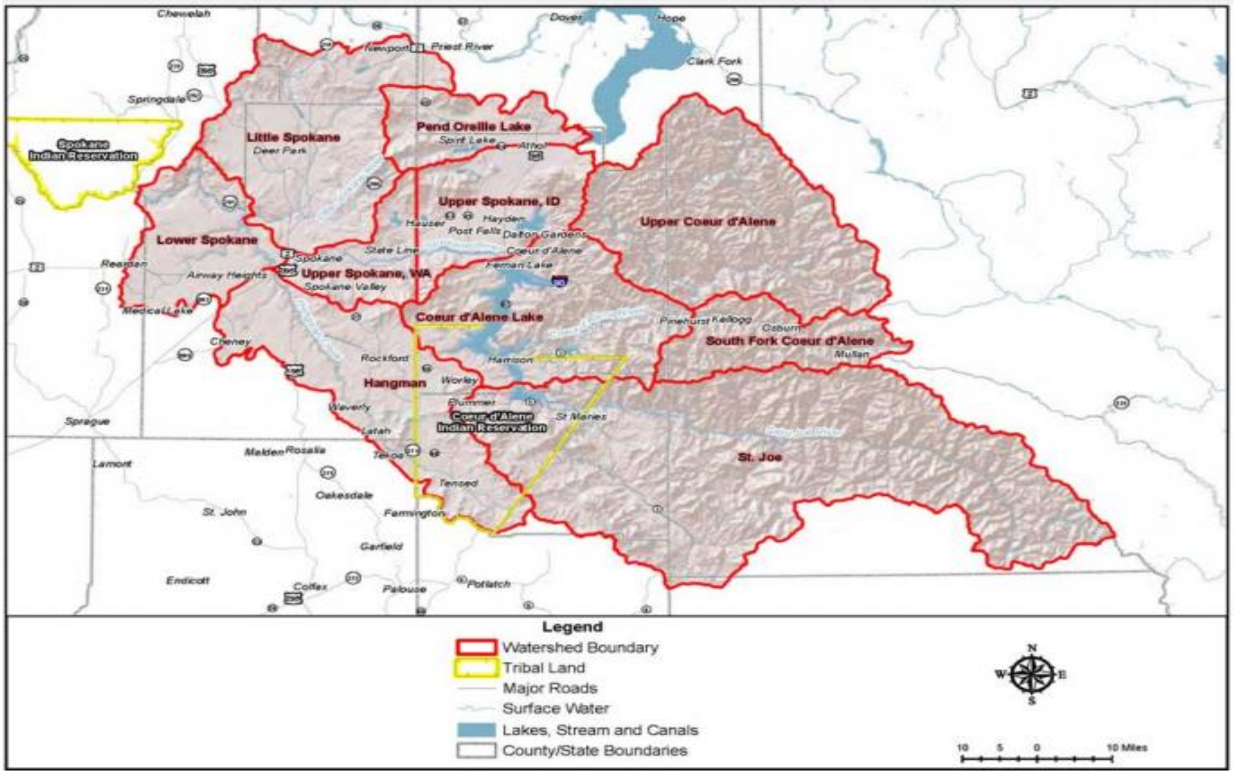

Figure 1 – Map of Spokane Watersheds (Spokane County 2011)

The Spokane River is approximately 111 miles long with headwaters that flow westward, from Lake Coeur d'Alene, Idaho, to meet the Columbia River (Spokane County 2021). The Spokane Valley-Rathdrum Prairie Aquifer, which flows east to west, is hydraulically connected to the Spokane River below Spokane Falls through a series of springs and seeps which keeps river temperatures cold year-round (Ashbrook, 2010). The majority of the river bed consists of large cobbles, boulders, gravel, and bedrock (Kahle et al., 2013). There are 7 hydroelectric dams on the Spokane river that impede fish passage.

The native fish community in the Spokane River is diverse and both recreationally and ecologically important. The interior redband trout (*Oncorhynchus mykiss gairdneri*), mountain whitefish *(Prosopium williamsoni)*, and suckerfish (*Catostomus columbianus)* are the primary fish that inhabit the River. Additionally, chinook salmon (*Oncorhynchus tshawytscha)* were reintroduced and have spawned (personal observation) in 2021 and 2022 as part of a cultural salmon reintroduction program led by the Coeur d'Alene and Spokane Tribes . The interior redband trout and chinook salmon are designated by the Washington State Department of Fish and Wildlife as a Species of Greatest Conservation Need (SGCN) under the Washington State Wildlife Action Plan (WDFW 2021). This designation enacts special protections for survival due to their population status, sensitivity to habitat alteration, or cultural importance (WDFW 2021). Washington State Administrative Code (WAC 173-201A-200, Aquatic life uses (e) Aquatic life turbidity criteria) states that water quality standards for Salmonid and specifically non-anadromous redband trout in areas that experience spawning, rearing, and migration should not exceed 5 NTU over background when the background is 50 NTU or less (*WACs -Title 173 - Chapter 173-201a - Section 173-201a-200*, 2003).

High turbidity for short periods of time or even moderately elevated turbidity for extended periods of time can permanently damage fish (especially salmonids) and benthic macroinvertebrate populations (Newcombe and Jensen, 1996)(Table 2). The physical impacts of turbidity are widespread. Suspended sediments ultimately settle from the water column and kill salmonid (trout and salmon) eggs by suffocation (Joy 2009). They also cover redds (current spawning beds), other future spawning areas, and smother macroinvertebrates (Joy 2009). Additionally, high turbidity results in reduction of depth in pool habitats, which allows temperatures to rise thereby making these pools less habitable (Joy 2009). In a survey conducted in 2003 by Parametrix, for Avista Corporation's Federal Energy Regulatory Commission (FERC) Permit #2545, researchers identified 130 redds in the lower study reach below Monroe Street Dam (Figure 2) with spawning occurring between April and June. Many of these redds are potentially impacted by the turbid water flowing from Hangman Creek.

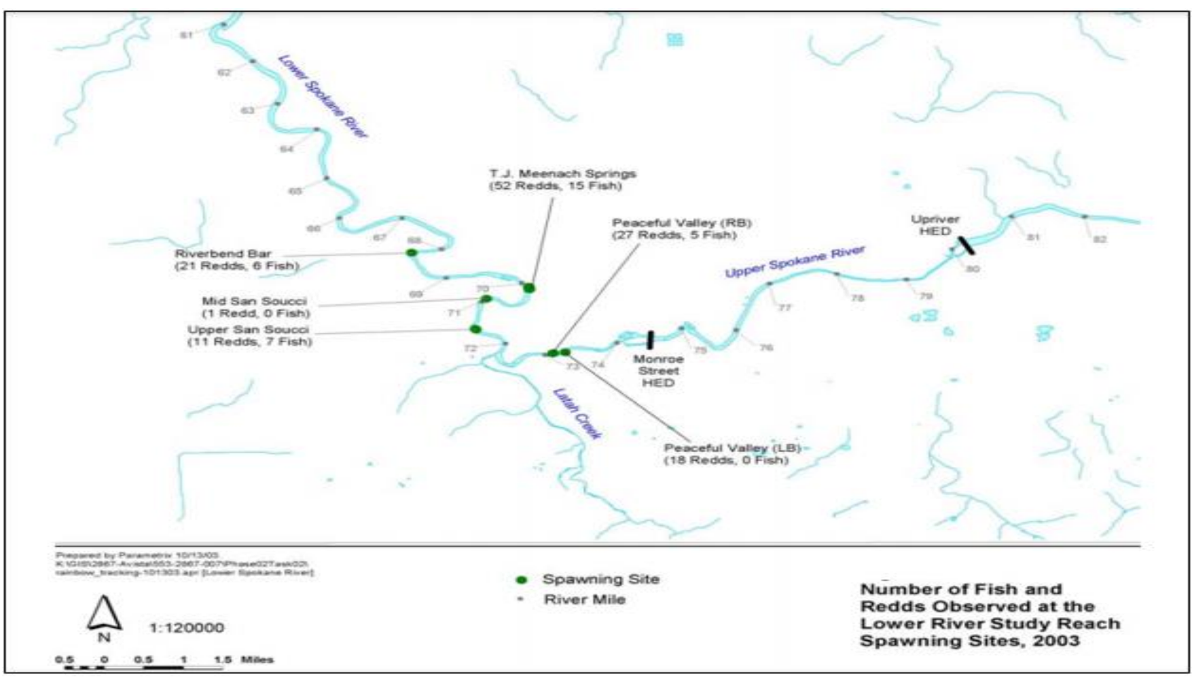

Figure 2 - (Parametrix 2003)

Methods

To follow the Quality Assurance Project Plan (QAPP), the Spokane Riverkeeper-Hangman Creek – Spokane River Turbidity Study for water year 2022 was conducted from December 2021 through June 2022. This included community science program volunteers who conducted 95 sampling sequences and collected 310 samples from 4 locations: Hangman Creek at the 11th Street Bridge, Spokane River at Sandifur Bridge, Hangman Creek confluence (Riverside) and Spokane River below the TJ Meenach Bridge (Appendix A).

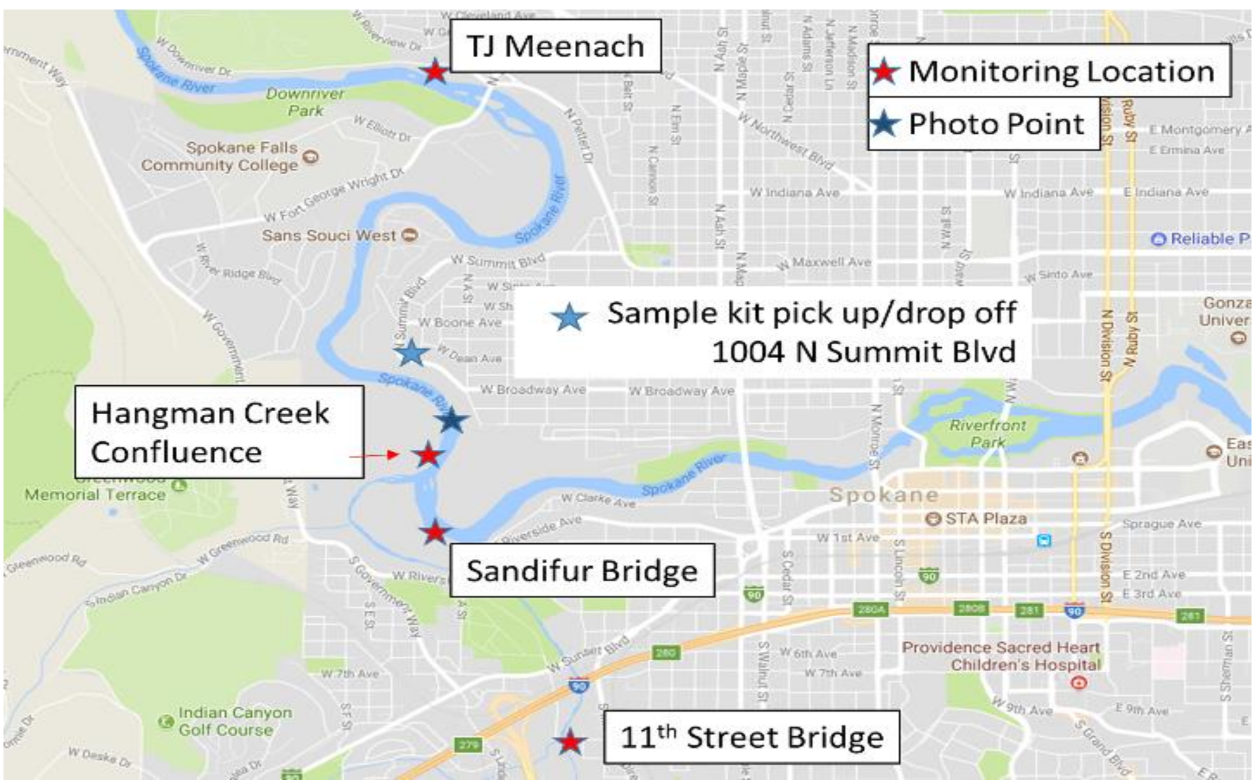

Figure 3 - Sample sites for Spokane Riverkeeper Hangman Creek - Spokane River Turbidity Study, wy 2022

Volunteer samplers were trained in all aspects of the study, including sample collection and storage, sample location, and safety. Quality control of data was addressed through duplicate measurements, field staff training, observing samplers, and weekly review of data. Sample measurements were duplicated in the field to analyze variability in readings. Any data identified as incorrectly collected, improperly stored, or held over 48 hours was discarded and not used in the analysis.

Samples were pulled directly from the stream surface at the shoreline. The sediment in Hangman Creek tends not to settle out due to the fine nature of the particles, so pulling samples from the shoreline is assumed to be representative of the entire river. At the "Hangman Creek Confluence" location, there is clear stratification of Spokane River and Hangman Creek waters, even though it is outside of the "mixing zone" of 300 feet designated by Ecology (WAC 173-201A-200). This location was chosen for monitoring due to its high importance for redband trout spawning, despite the poor mixing at this location. In locations where the river/creek was not accessible from the shoreline, a jar/bucket was lowered into the water from a bridge with a rope and transferred to Whirl-Pak bags for turbidity analysis. The sample site downstream from Hangman Creek in the Spokane River below TJ Meenach Bridge was located sufficiently downstream to ensure complete mixing. The sampling strategy required volunteers to sign up in advance, assuring that no storm events were targeted.

In the field, samplers determined and recorded water turbidity using a transparency tube. The transparency tube functions as a modified secchi disk, with a black and white disk located at the bottom of a clear tube. The sampler filled the 60 cm tube (marked in 0.2 cm increments) with water, looked into the opening of the tube from above, drained water by releasing the stopcock until the disk was visible, and recorded the height of water remaining in the tube in centimeters to the nearest 0.2 cm. Measurements were taken in the shade to reduce glare and improve accuracy. Dahlgren et al. (2004) concluded that transparency significantly correlates with turbidity. No specific calibration of the transparency tube is possible. In general, bias will be held to a 3-5% acceptable error. From an upland vantage point at the corner of Summit and College ("photo point" on Figure 4), samplers photographed the mouth of Hangman Creek to record visual evidence of sediment pollution. Location, time, date, weather conditions, and USGS streamflow information was recorded for each sample on a paper field data sheet with permanent ink as well as in an online field form (https://spokanefallstu.org/spokane-river-sediment-study/).

In addition to transparency tube readings, volunteers collected samples for Nephelometric Turbidity Units (NTU) analysis. Samplers labeled Whirl-Pak sample bags with location, date, and time. They filled the Whirl-Pak bags with sample water from each location and dropped them off in a cooler kept below 4°C. Sundays, Tuesdays, and Fridays. Spokane Riverkeeper staff collected and processed the samples within 48 hours of sampling. Whirl-Pak samples were analyzed with the Hach 2100P and Hach 2100Q mobile turbidimeters and recorded in NTU to the nearest 0.01 NTU. The turbidimeters were calibrated using manufacturer standards at the beginning of the sampling period using premixed calibration solutions. The turbidimeter unit has a stated accuracy of +/- 2%. Readings from Sandifur Bridge samples were considered a baseline reading (negative control) for the Spokane River above Hangman Creek influence and were compared to readings from the downstream TJ Meenach samples to determine the effect of Hangman Creek on the Spokane River. Turbidity data collected by Spokane Riverkeeper community science volunteers will be entered into the Washington State Department of Ecology Environmental Information Management System (EIM) database.

Results

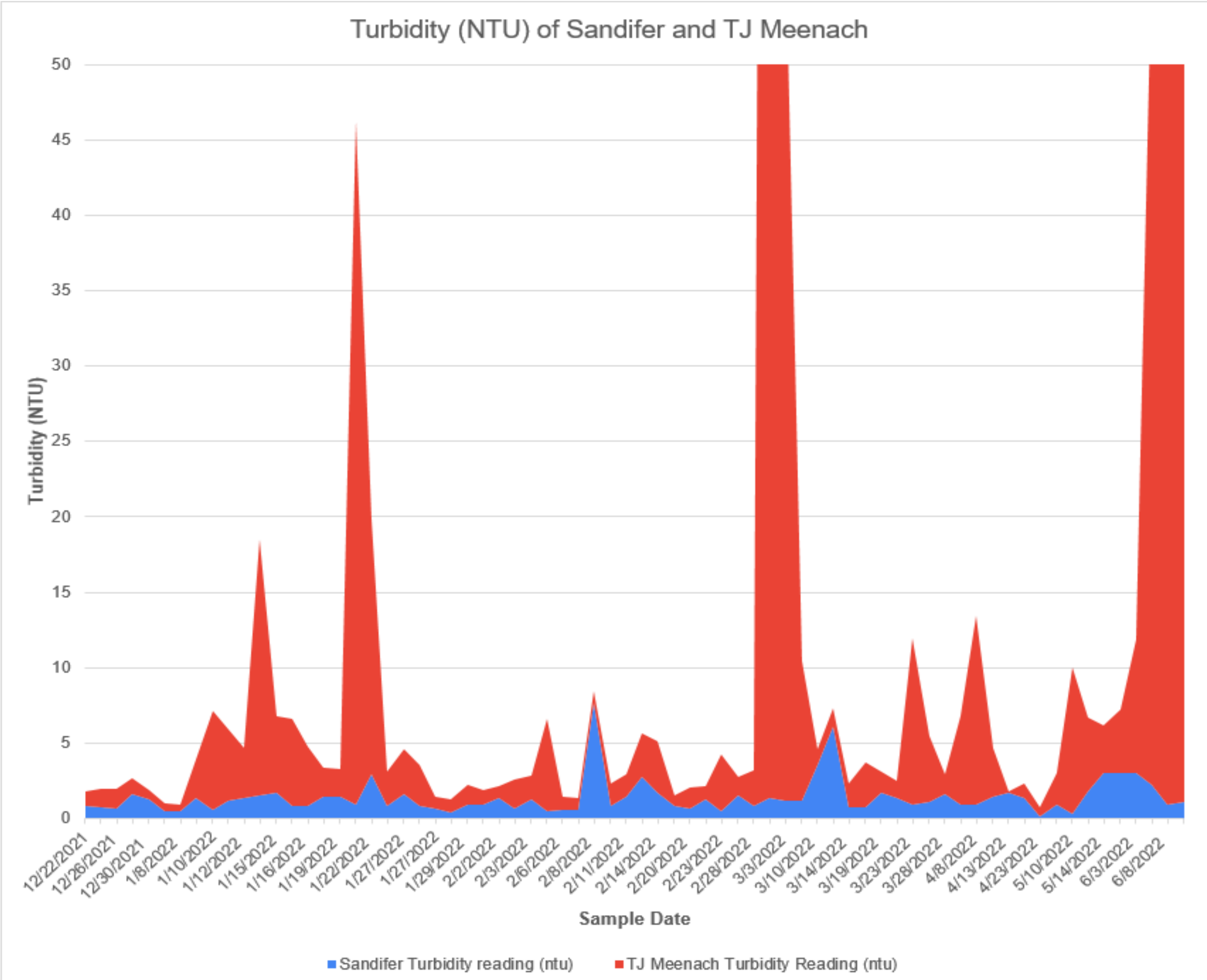

Figure 4 - Tj Meenach and Sandifer Site Turbidity Readings

Samples from Sandifur Bridge show the background turbidity in Spokane River upstream from the Hangman confluence. In Figure 4, the blue line shows NTU readings at Sandifur Bridge and the red line represents measurements at TJ Meenach Bridge. Most of the data for Sandifur bridge is below the 5 NTU limit that Washington Code has instituted while the data on TJ Meenach peaks over the state standard at least 11 times over the limit during the study period.

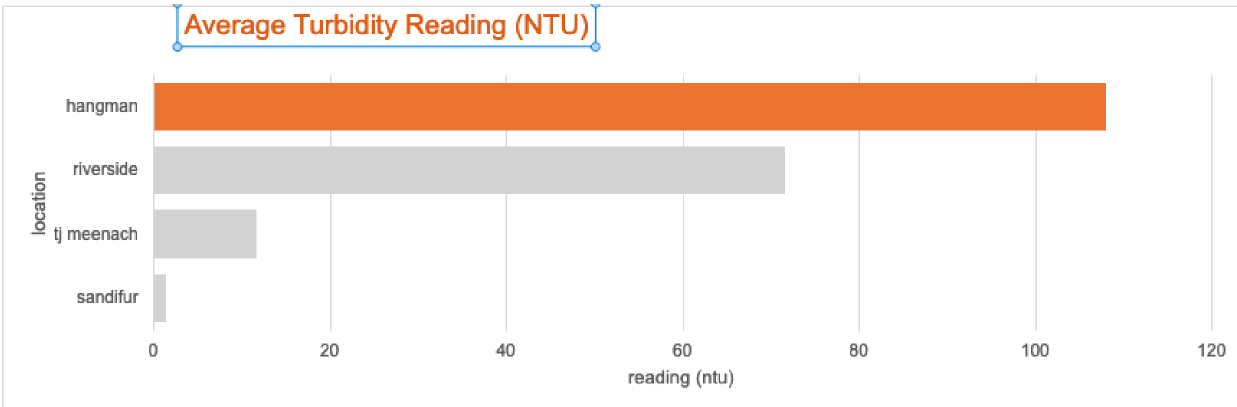

Figure 5 - Average Turbidity Reading over Study Period

Average turbidity readings for the Tj Meenach, Riverside, Sandifer and Hangman. Hangman, Riverside, and TJ Meenach sites lie above 5 NTU limit over the 6 month study period (Figure 5).

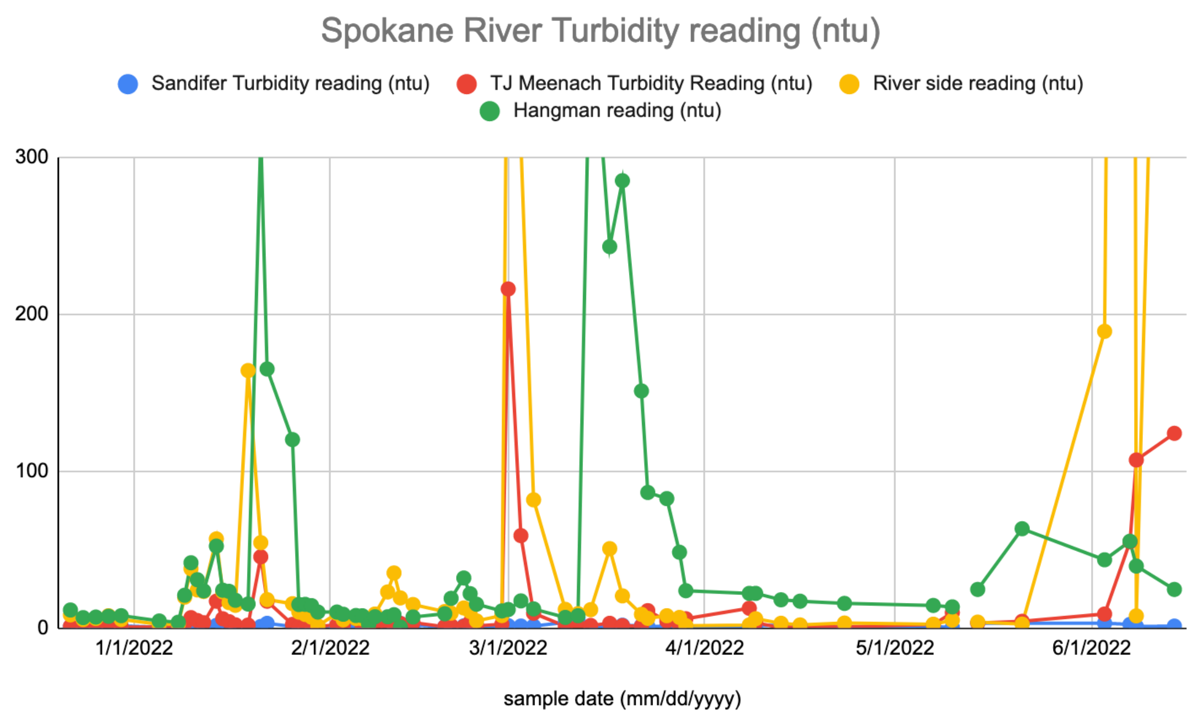

Figure 6 - Turbidity Readings for Hangman, Sandifer, and Tj Meenach sites

date	Sandifur NTU	plus 5 Sandifur NTU	TJ Meenach NTU in excess of 5 NTU over backgrou
1/10/2022	0.6	5.6	6.53
1/14/2022 0:00:00	1.54	6.54	17
1/15/2022 10:50:00	0.84	5.84	5.81
1/15/2022 14:45:00	1.7	6.7	5.1
1/21/2022 14:30:00	0.91	5.91	45.3
1/22/2022 14:32:00	2.89	7.89	17
2/5/2022 10:17:00	0.46	5.46	6.17
3/1/2022 11:35:00	1.16	6.16	216
3/5/2022 10:16:00	3.52	8.52	58.8
3/3/2022 16:08:00	6.07	11.07	9.33
3/23/2022 10:39:00	1.66	6.66	11
3/29/2022 10:24	1.42	6.42	5.82
4/8/2022 9:45:00	1.74	6.74	12.5
5/10/2022 9:39:00	4.9	9.9	9.75
6/3/2022 12:40:00	0.92	5.92	8.85
6/7/2022 11:15:00	1.13	6.13	54.9
6/8/2022 11:15:00	1.99	6.99	107
6/14/2022	3.8	8.8	124

Table 1 – Dates and NTU measurements at TJ Meenach that exceed 5 NTU over background measurements vs Sandifur Bridge on same day

Between December 21st, 2021 and June 14th, 2022, turbidity measurements at TJ Meenach, with influence from Hangman Creek, exceeded more than 5 NTU over background at Sandifur Bridge in 18 incidences and by as much as 216 NTU on January 30th, 2021 (Table 1).

Water Use	Maximum Induced Turbidity – NTU or % of background	Maximum Induced Suspended Sediments –mg/l or % of background	Streambed Substrate Composition
Drinking Water – raw untreated	1 NTU when background is less than or equal to 5	No guideline	No guideline
Drinking Water – raw treated	5 NTU when background is less than or equal to 50	No guideline	No guideline
Recreation and Aesthetics	Maximum 50 NTU ….. secchi disc visible at 1.2 m	No guideline	No guideline
Aquatic Life -fresh- -marine- -estuarine-	8 NTU in 24 hours when background is less than or equal to 8 …. Mean of 2 NTU in 30 days when background is less than or equal to 8	25 mg/l in 24 hours when background is less than or equal to 25 …. Mean of 5 mg/l in 30 days when background is less than or equal to 25	Fines not to exceed -10% as less than 2mm- -19% as less than 3mm- -25% as less than 6.35mm- at salmonid spawning sites
Aquatic Life -fresh- -marine- -estuarine-	8 NTU when background is between 8 and 80 …. 10% when background is greater than or equal to 80	25 mg/l when background is between 25 and 250 …. 10% when background is greater than or equal to 250	Geometric mean diameter not less than 12 mm …. Fredle number not less than 5mm
Terrestrial Life -wildlife- -livestock water- Irrigation Industrial	10 NTU when background is less than or equal to 50 …. 20% when background is greater than or equal to 50	20 mg/l when background is less than or equal to 100 …. 20% when background is greater than or equal to 100	No guideline

Table 2 - Turbidity impact on Water Use-British Columbia Standards

Discussion

Our measurements for water year 2022 demonstrate that Hangman Creek turbidity influences AND increases Spokane River turbidity as evidenced by many increased turbidity samples (18 above 5 NTU) at TJ Meenach Bridge, which is downstream from the Hangman Creek confluence. Turbidity was not elevated (remained below 5 NTU on average) at Sandifur Bridge upstream (Figures 4-6, Table 1). Turbidity measurements from TJ Meenach Bridge exceeded 5 NTU over background at Sandifur Bridge in 18 observed incidences in water year 2022 which equates to impairment (polluted) 26% of the time. In the 2003 count from Avista, 64 of the 130 rainbow trout redds below Monroe Street Dam were found in the area that is most impacted by Hangman Creek turbidity (Parametrix 2003). The river downstream of the mouth of Hangman Creek are also imperative for the salmon life cycle, with observed redds from the August 2022 release (pers. Obs).

When a salmon egg is laid (and fertilized) in a redd, it is essential that the water quality parameters are correct in order for it to survive to hatch in the spring. The parameters include cold (between 41°F and 49°F) and flowing oxygenated water (Bash & Berman, 2001). In order for eggs to come in contact with oxygenated water, the gravel in which they sit must be free of sediment and turbid water so that the eggs can absorb the oxygen in sufficient amounts. The turbidity encountered downriver of Hangman Creek in the Spokane river may reduce egg survivial and hatching success. In the next part of the life-cycle, alevin (newly hatched salmon) hatch in the spring and live on their redds to feed and grow into fry ("*Chinook salmon*" n.d.). Bash and Berman (2001) concluded that high turbidity, during the alevin and fry life stage, can result in permanent damage to the fish's gills and reduces ability to locate food. Based on our results, turbidity was highest in the Spokane River from January-March (Appendix 1) which is also when the alevin and fry are most susceptible. As salmon fry start to out-migrate downstream, they imprint (memorize) their birthplace using a series of chemical and physiological senses ("*Chinook salmon*" n.d.). Again, turbidity negatively impacts this by delaying out-migration which can lead to increased risk of predation, high temperatures, or disease (Bash & Berman, 2001). After salmon leave their home river they will live in the ocean for 2-5 years and return when becoming physically mature. The same issues are encountered from turbidity as when they left their home river. When the salmon make their way back upstream to their imprinted (birthplace) location, they look for high quality locations to lay their eggs. When high turbidity is encountered during this time, salmon will avoid the area and find locations with clearer water which can reduce hatching success and cause unnecessary exposure to predation (Bash & Berman, 2001). Many studies have shown the negative effects of turbidity on salmonids and concur that physiological, behavioral, and habitat change are the foremost and most frequent. The turbid conditions in the Spokane River due to Hangman creek will lead to further destruction of the valuable salmonid populations.

The events encountered in the Spokane River below Hangman Creek indicate a violation of water quality standards for turbidity and warrant an evaluation of the data, that should lead to recognition and mitigation of the pollution effects. We hope these data will direct further resources to clean up the Hangman Creek watershed and limit the pollution damage that Hangman Creek has on the native fish, macroinvertebrates, and Spokane River water quality.

Conclusion

The Spokane Riverkeeper's Spokane River turbidity study for water year 2022 demonstrates turbidity pollution in the Spokane River originating from Hangman Creek. Turbidity measurements at TJ Meenach Bridge show a repeated Washington State water quality standard violation reading above 5 NTU over background measurements at Sandifur Bridge. Furthermore, the turbidity was measured in levels such that aquatic plants, fish, and macroinvertebrates could be negatively impacted by each of these turbidity events (Table 2). Suspended solids in turbidity are also known to transport toxic chemicals and nutrients downstream that have adverse environmental affects (Joy 2009). Sediment from Hangman Creek carries high levels of phosphorous that eventually is deposited in Lake Spokane, a water body with a Dissolved Oxygen TMDL (cleanup plan). Reductions in sediment loads from Hangman Creek could improve the low dissolved oxygen levels that plague the lake each year.

We believe that evaluation and recognition of turbidity impairment in the Spokane River by the Washington State Department of Ecology is necessary to further the cleanup or mitigate the effects of pollution from Hangman Creek. This pollution poses a threat to salmonid life cycles and interferes with recreation use or aesthetic enjoyment. As stated in the Hangman Creek TMDL (2009), implementation of agricultural best management practices (direct seed, etc), restoration of the floodplain, and the enhancement and improvement of riparian health could reduce turbidity and soil loss to erosion.

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Appendix

Row Labels	hangman	riverside	sandifur	tj meenach
12/22/2021 10:40				0.99
12/22/2021 11:25			0.84	
12/22/2021 11:30	11.4			
12/22/2021 11:56		8.28		
12/24/2021 9:31		5.35		
12/24/2021 9:33				1.24
12/24/2021 9:51			0.72	
12/24/2021 10:02	6.55			
12/26/2021 11:30				1.29
12/26/2021 11:45		6		
12/26/2021			0.67	

12:00				
12/26/2021 12:15	6.9			
12/28/2021 9:45				1.09
12/28/2021 10:05		7.75		
12/28/2021 10:20			1.58	
12/28/2021 10:30	7.39			
12/30/2021 14:25		5.39		0.65
12/30/2021 14:45			1.26	
12/30/2021 14:55	7.78			
1/5/2022 14:55				0.5
1/5/2022 15:10		2.3		
1/5/2022 15:25			0.49	
1/5/2022 15:40	4.41			

1/8/2022 14:30				0.51
1/8/2022 14:50		2.42		
1/8/2022 15:10			0.45	
1/8/2022 15:30	3.61			
1/9/2022 12:15	20.8			
1/9/2022 13:00			1.4	
1/9/2022 13:10		19.6		
1/9/2022 13:30				2.51
1/10/2022	41.5	37.7	0.6	6.53
1/11/2022 9:56				4.69
1/11/2022 10:14		24.2		
1/11/2022 10:33			1.22	
1/11/2022 10:53	30.7			
1/12/2022 10:33			1.36	
1/12/2022 11:50	23.6			
1/12/2022 12:15		23.2		
1/12/2022 13:00				3.3
1/14/2022 11:05				17

1/14/2022 11:37		56.7		
1/14/2022 12:00			1.54	
1/14/2022 12:20	52.1			
1/15/2022 10:50				5.81
1/15/2022 11:30			0.84	
1/15/2022 11:45	31.3			
1/15/2022 14:45				5.1
1/15/2022 15:05		23.9		
1/15/2022 15:30			1.7	
1/15/2022 15:55	24			
1/16/2022 8:58	23.3			
1/16/2022 9:30			0.8	
1/16/2022 9:50		23		
1/16/2022 10:20				3.98
1/17/2022 14:17		16.1		
1/17/2022 16:05				1.94
1/17/2022 16:34			1.45	
1/17/2022 16:42	17.6			

1/19/2022 9:36				1.78
1/19/2022 10:00		14.4		
1/19/2022 10:06			1.46	
1/19/2022 10:20	15.2			
1/21/2022 7:35	315			
1/21/2022 13:40	165			
1/21/2022 14:00			0.91	
1/21/2022 14:10		164		
1/21/2022 14:30				45.3
1/22/2022 10:00	120			
1/22/2022 14:32				17
1/22/2022 15:12		54.3		
1/22/2022 15:31			2.89	
1/22/2022 15:53	50.3			
1/23/2022 10:30	38.4			
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1/26/2022 11:00			0.86	
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1/27/2022 11:23			1.66	
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1/28/2022 16:45		10.5		
1/28/2022 17:08			0.4	
1/28/2022 17:30	10.5			
1/29/2022 10:55				1.29
1/29/2022 11:22		10.1		
1/29/2022 11:39	10.1		0.9	

1/30/2022 9:46				0.94
1/30/2022 10:00		8.56		
1/30/2022 10:20			0.93	
1/30/2022 10:30	8.7			
2/2/2022 11:34			1.37	
2/2/2022 11:48		6.82		
2/2/2022 11:58				0.8
2/2/2022 16:40				1.94
2/2/2022 16:55	7.91			
2/2/2022 17:10			0.65	
2/2/2022 17:25	7.76			
2/3/2022 10:20	2.3			
2/3/2022 10:40			1.23	
2/3/2022 11:00		1.23		
2/3/2022 11:20				1.6
2/3/2022 11:39		3.88		
2/5/2022 9:48		9.27		
2/5/2022 10:17			0.46	6.17

2/5/2022 10:29	7.1			
2/6/2022 14:26				0.84
2/6/2022 14:38		5.13		
2/6/2022 15:01			0.57	
2/6/2022 15:15	7.09			
2/7/2022 13:50				0.83
2/7/2022 14:05		5.97		
2/7/2022 14:15			0.57	
2/7/2022 14:25	8.38			
2/8/2022 9:56				0.76
2/8/2022 10:14		5.84		
2/8/2022 10:28	0.52			
2/8/2022 10:43			7.65	
2/10/2022 10:15				1.48
2/10/2022 10:45		5.52		
2/10/2022 11:01			0.85	
2/10/2022 11:10	6.95			
2/11/2022 9:30				1.54

2/11/2022 10:10		8.83		
2/11/2022 10:30			1.43	
2/11/2022 11:04	9			
2/12/2022 9:50				2.83
2/12/2022 10:10		22.9		
2/12/2022 10:30			2.8	
2/12/2022 10:45	18.83			
2/14/2022 10:04				3.34
2/14/2022 10:24		35		
2/14/2022 10:52			1.75	
2/14/2022 11:05	31.8			
2/18/2022 11:50	21.8			
2/18/2022 12:26		19.1		
2/18/2022 12:43			0.8	
2/19/2022 9:53				0.73
2/19/2022 10:11		14.9		
2/19/2022 10:27			0.62	
2/19/2022 10:43	15.1			

2/20/2022 13:45				1.42
2/20/2022 13:58		10.4		
2/20/2022 14:13			1.28	
2/20/2022 14:26	10.8			
2/22/2022 10:09				0.9
2/22/2022 10:35		9.41		
2/22/2022 10:57			0.5	
2/22/2022 11:07	11.7			
2/23/2022 14:00	17.2			
2/23/2022 14:20			1.52	
2/23/2022 14:38		12.7		
2/23/2022 14:40				3.72
2/24/2022 15:10				1.22
2/24/2022 15:30		10.4		
2/24/2022 15:54			0.83	
2/24/2022 16:03	12.1			
2/25/2022 10:26		4.46		
2/25/2022 10:48			1.39	

2/25/2022 11:15	6.67			
2/28/2022 17:19				2.38
2/28/2022 17:34		7.85		
2/28/2022 17:51			1.16	
2/28/2022 18:00	7.77			
3/1/2022 11:35				216
3/1/2022 11:55		482		
3/1/2022 12:08			1.16	
3/1/2022 12:20	406			
3/3/2022 7:15	243			
3/3/2022 16:08				58.8
3/3/2022 16:22		309		
3/3/2022 16:37			3.52	
3/3/2022 16:47	285			
3/4/2022 7:45	151			
3/5/2022 9:30	86.3			
3/5/2022 9:42				9.33
3/5/2022 9:58		81.6		

3/5/2022 10:16			6.07	
3/5/2022 10:26	82.4			
3/6/2022 11:45	48.2			
3/9/2022 15:00	23.7			
3/10/2022 15:50				1.06
3/10/2022 16:00	22			
3/10/2022 16:10		11.8		
3/10/2022 16:20			0.75	
3/10/2022 16:35	22			
3/11/2022 11:35	17.9			
3/12/2022 8:30	17			
3/12/2022 9:02			0.78	
3/12/2022 9:21		9.05		
3/12/2022 9:53				1.21
3/12/2022 17:00	15.6			
3/13/2022 16:35	14.3			
3/14/2022 12:25				1.54
3/14/2022 12:35		11.6		

3/14/2022 12:45			1.72	
3/14/2022 12:55	13.4			
3/14/2022 17:45	15			
3/15/2022 17:30	24.5			
3/16/2022 17:25	63.2			
3/17/2022 16:35				2.92
3/17/2022 16:50		50.5		
3/17/2022 16:58			1.37	
3/17/2022 17:15	43.4			
3/17/2022 17:20	55.2			
3/18/2022 15:40	39.4			
3/19/2022 8:40	24.5			
3/19/2022 9:10			0.93	
3/19/2022 9:20		20.4		
3/19/2022 9:50				1.42
3/19/2022 12:45	27.8			
3/20/2022 12:20	23.1			
3/21/2022 17:30	14.2			

3/22/2022 16:45	12.7			
3/22/2022 17:05				1.13
3/22/2022 17:20		8.62		
3/22/2022 17:30			1.1	
3/22/2022 17:40	11.8			
3/23/2022 10:10		6.07		
3/23/2022 10:39				11
3/23/2022 10:56			1.66	
3/23/2022 11:13	19.1			
3/24/2022 15:20	13.7			
3/26/2022 10:30		7.75		
3/26/2022 10:50			0.96	
3/26/2022 11:00	12.7			
3/26/2022 11:20				4.38
3/28/2022 13:55				1.3
3/28/2022 14:15		6.65		
3/28/2022 14:40	11.4			
3/28/2022 14:50			0.96	

3/29/2022 10:06		1.42		
3/29/2022 10:24				5.82
3/29/2022 10:45			1.42	
3/29/2022 11:05	5.86			
4/8/2022 8:30	24			
4/8/2022 8:57			1.74	
4/8/2022 9:20		1.83		
4/8/2022 9:45				12.5
4/9/2022 9:25				3.26
4/9/2022 9:40		5.82		
4/9/2022 9:55			1.35	
4/9/2022 10:05	11.8			
4/13/2022 13:00				0.092
4/13/2022 13:18		2.93		
4/13/2022 13:32			0.099	
4/13/2022 13:45	3.76			
4/16/2022 9:10	2.3			
4/16/2022 9:55			0.93	

4/16/2022 10:00		1.88		
4/16/2022 10:25				0.94
4/23/2022 14:01				0.62
4/23/2022 14:25		3.08		
4/23/2022 14:40			0.29	
4/23/2022 14:50	3.56			
5/7/2022 9:30				2.12
5/7/2022 9:45		2.32		
5/7/2022 10:00			1.83	
5/7/2022 10:15	3.21			
5/10/2022 9:12		4.9		
5/10/2022 9:39		9.75		9.75
5/10/2022 10:01			3	4.9
5/10/2022 10:15	26.1		3	
5/10/2022 16:50	29.5			
5/14/2022 10:15	8.62			
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5/14/2022 10:45				3.15

5/14/2022 11:00			3.01	
5/21/2022 8:15		2.42		
5/21/2022 8:30				4.19
5/21/2022 8:45			2.22	
5/21/2022 9:00	16.6			
6/3/2022 12:40				8.85
6/3/2022 12:55		189		
6/3/2022 13:10			0.92	
6/3/2022 13:20	#DIV/0!			
6/7/2022 11:15				54.9
6/7/2022 11:48		2070		
6/7/2022 12:13			1.13	
6/7/2022 12:45	2650			
6/7/2022 17:50	3264			
6/8/2022 11:15				107
6/8/2022 11:50			1.99	
6/8/2022 11:55		7.66		
6/8/2022 12:15	207			

6/14/2022 9:50				124
6/14/2022 10:36		936		
6/14/2022 11:00	892		3.8	