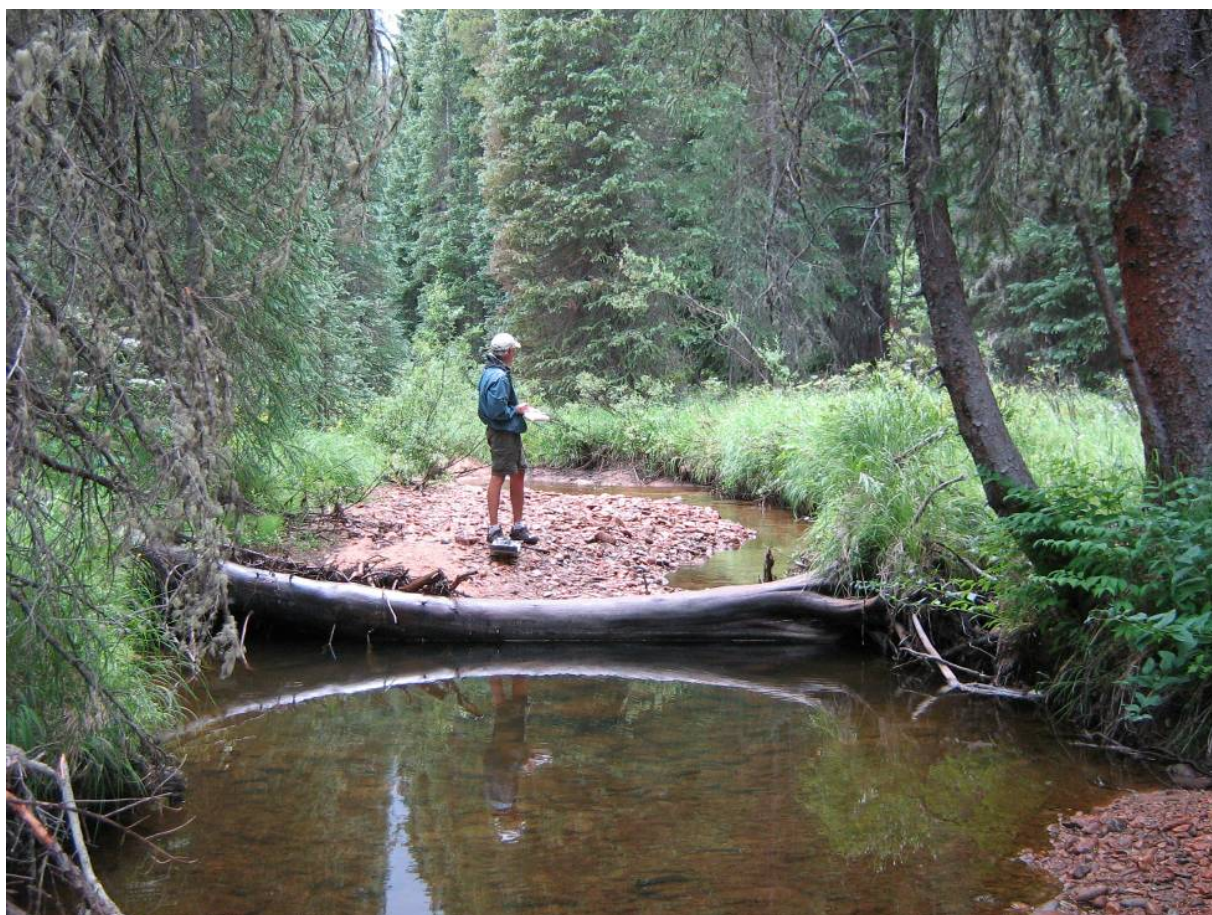


F2 Stream Reach Summary

Study Reach: F2, Fraser River - Denver Water Fraser River Diversion downstream to Winter Park Water and Sanitation District Wastewater Facility.

Reach Description: Approximate channel length: 3 miles, approximate channel slope 2.8%.

The Fraser River in this reach is relatively steep with vegetated overbanks, varying between wetlands-type vegetation and pine forests. This reach of the Fraser traverses the base of Winter Park Ski area and includes discharge from the Moffat Tunnel. The channel bed is predominantly cobble with some areas heavily embedded with finer sediments as shown in the photograph below. Excessive deposition is likely exasperated by a combination of low springtime flows and winter sanding operations along U.S. Highway 40. Erosion along the cut slopes of the Highway, particularly along the switch backs in the upper basin, are also evident and likely to contribute to the sediment loading. A sediment removal project is proposed in F2 at the Denver Water intake structure, and is currently being implemented in a joint effort by the County, Denver Water, CDOT and the USFS.



Fraser River downstream of Denver Water diversion



Fraser River downstream of Denver Water diversion at driveway culvert crossing



Fraser River adjacent to Winter Park Ski Area at Moffat Tunnel crossing

Flow Recommendations:

Environmental Flow Methodology: A study site was not established within this reach. The U. S. Forest Service has developed instream flow recommendations for this reach.

Water Users:

- Irrigators, municipalities and industry flow-related issues: Flows in this reach are significantly controlled by transbasin diversions including Denver Water diversions on the Fraser River and Jim Creek. Base or minimal flows in F2 are mandated by the U.S. Forest Service, which requires a minimum of 10 cfs between May 15 and September 15 and 4 cfs between September 16 and May 14, measured at the Winter Park Gage, USGS 09024000, located in F3. These are referred to as by-pass flows and are imposed on Denver Water since they are being required to 'by-pass' diversions at a level that results in these minimum flows. When winter flows drop below the U.S. Forest Service requirements local diverters, including Winter Park Water and Sanitation District and Grand County have a difficult time extracting flows at their decreed amount (Wageck 2007).
- Recreational flows: Recreational stream use is relatively minimal with angling as the predominant use.

Summary of Flows:CWCB flows

- o none

USFS Flows (measured at the USGS Gage 09024000 located in F3)

- o 10 cfs summer (05/15 - 09/15)
- o 4 cfs winter (09/16 - 05/14)

Water User

- o Irrigators, municipalities and industry: The local diversions in this reach could potentially divert up to approximately 3 cfs at anytime.
- o Angling: none reported.

Stream Assessments: In August 2008, Tetra Tech conducted two stream assessments in F2. The assessments conducted were the Stream Reach Inventory /Channel Stability Evaluation (SRI/CSE), and the EPA Habitat Quality Assessment (HQA). The SRI/CSE evaluation scored in the fair” category and the EPA HQA evaluation scored in the “suboptimal” category. Relevant issues revealed in the stream assessments include excessive deposition, presence of fish passage barriers and general lack of flow and diversity in velocity/depth regimes. Results of both assessments are summarized in the following table. Details and methodology are presented in Appendix A.

Reach F2 Stream Assessments					
Stream Reach Inventory/Channel Stability Evaluation			EPA Habitat Quality Assessment		
Attribute			Attribute		Score
Upper Banks			Channel		
1	Landform Slope	2	1	Aquatic Habitat Barriers/ Diversion	5
2	Mass wasting hazard	3	2	Aquatic Structure as Cover	8
3	Debris Jam Potential	6	3	Velocity/ Depth Regimes	8
4	Vegetation Cover	3	4	Channel Flow Status	6
	Upper Bank Score:	14	5	Channel Alteration	13
Lower Banks			6	Frequency of Riffles	13
5	Channel Capacity	3	7	Channel Sinuosity	7
6	Bank Rock Content	5		Channel Score	60
7	Flow obstructors & Deflectors	6	Banks		
8	Cutting	6	8	Bank Stability	16
9	Deposition	12	9	Riparian Vegetation Cover and Disturbance	18
	Lower Bank Score:	32	10	Riparian Vegetation zone width	18
Channel Bottom				Bank Score	52
10	Rock Angularity	3		Total Score	112
11	Brightness	3	Notes		
12	Consolidation/Particle Packing	5			
13	Bottom size distribution	12			
14	Bed Scour and Deposition	18			
15	Clinging Aquatic Veg	3			
	Channel Bottom Score:	44			
	Total Score:	90			

Spawning Observations: No spawning survey was conducted in the reach.

Hydrologic Records: No streamflow records are available for this reach. The most applicable records will be those for reach F3 immediately downstream, which indicate USFS flow recommendations have been commonly equaled or exceeded throughout the entire period-of-record. .

Water Temperature: F2 is a Tier I stream reach as designated by CDPHE with a chronic temperature standard of 17°C MWAT and an acute temperature standard of 21.2°C DM. Although there is no water temperature data available for this reach, temperature data reviewed in the upper portion of reach F3, indicate stream temperatures for the Fraser River in this area are generally well below the MWAT and DM standards. Given the elevation of reach F2, and proximity to F3, the water temperature regime is likely supportive of a cold-water fishery and not a concern at this time.

Water Quality: The Moffat Tunnel, containing the train portal, has groundwater leakage that is collected, routed and discharged as a point source to both the east and west sides of the tunnel entrances. On the west side, the tunnel discharge is located on the Fraser River near the tunnel entrance across from the base of the ski area. Monthly monitoring data indicate that there may be exceedences of fine sediment, iron, mercury, copper and lead. Fines are 3 micron or smaller material, which is coarse to medium clay. Under turbulent flow conditions, these particles will stay in suspension and can add to the receiving stream's

turbidity. While in suspension, the material could affect trout in two ways. First, as trout are sight-feeders, their ability to find food could be impaired. Second, in high enough concentrations, gill damage could occur. The fine material may also add to substrate embeddedness and perhaps limit habitat for quality insects such as mayflies, stoneflies and caddisflies. Metals in the tunnel discharge could potentially impact the trout fishery in F2 through physiological stress, reduced condition, reproductive impairment/failure, and increased mortality. Sand transported from upstream and adjacent road maintenance operations appear to be accessing this reach of the Fraser, resulting in sand deposits in the flatter sloped sections throughout the reach.

Water Supply Issues (UPCO): Under current conditions, the water supplies in this reach are generally adequate with occasional shortages. Under future conditions shortages are predicted to increase significantly (large shortages) resulting in low and no-flow conditions affecting local water supply, waste water discharges and frequent times with flows falling below the CWCB ISF.

Summary of Results and Additional Remarks:

1. Flows recommended by the USFS are available.
2. The stream assessments indicate excessive deposition, presence of fish passage barriers and general lack of flow and diversity in velocity/depth regimes.
3. Water temperatures are supportive of the cold-water brook trout fishery which now predominates in F2.
4. When winter flows drop below the U.S. Forest Service requirements local diverters, including Winter Park Water and Sanitation District and Grand County have a difficult time extracting flows at their decreed amount.
5. The Moffat Tunnel discharge is a concern and could become problematic as diversions are increased and river flows are reduced, as predicted in the UPCO report (HRC 2003a). The County is proposing the Union Pacific Railroad construct a sedimentation/flocculation facility designed to treat the outfall on the West Portal side of the Moffat Tunnel utilizing the same standards as the County's wastewater treatment plant operators and other dischargers to the river and its tributaries.
6. Review of future flow conditions as depicted by Denver Water PACSM model indicate that the late summer flows, flushing flows and winter base flows, without flow enhancements or restoration, will be typically lower than target ranges recommended for F3.
7. Flow enhancements for F3 would require releases or reduced diversions at the Denver Water headgate located at the upstream end of F2. Thus flow enhancements for F3 would also be present in F2.

Restoration Opportunities: Restoration opportunities presented for F2 are aimed at reducing the impacts from excessive sedimentation and frequent low flow conditions. In addition, there is an abundance of spawning gravels within F2 that, if separated from the fine sand material and mobilized to downstream portions of F2, F3 and F4, could provide benefits to the aquatic habitat in those reaches. As of March 2010 a sediment basin at the Denver Water intake is being proposed in a joint effort by the County, Denver Water, CDOT and the USFS. The purpose of the sediment basin is to collect excess sediment generated from the application of traction sand along U.S. Highway 40. Specific restoration opportunities include the following:

- ✓ Consider an alternative to the sediment basin whereby the traction sand is collected in a series of small sediment basins located within the highway right of way upstream of the Denver Water intake. This would provide several benefits: 1) the sand would be easy to access and remove, compared with removal from the sediment basin in the Fraser River, 2) roadside sediment basins will also provide benefit to F1 by reducing sediment loading directly to the river, 3) eliminating

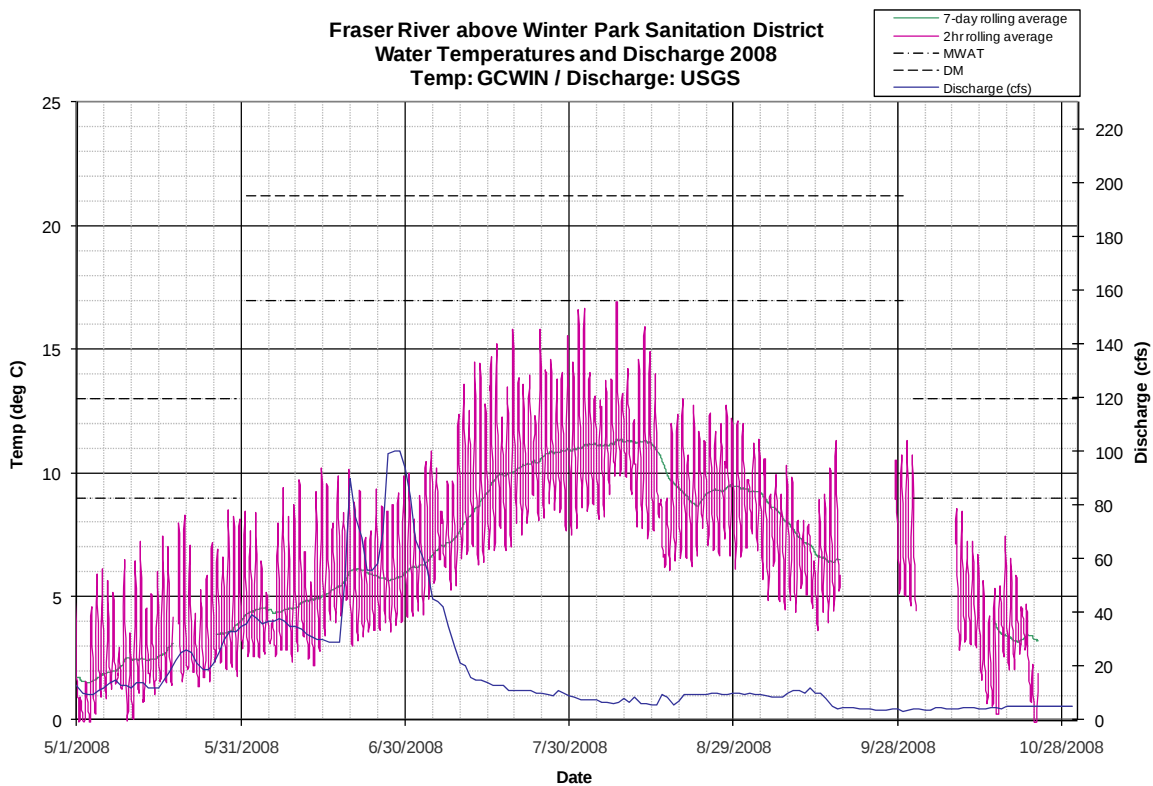
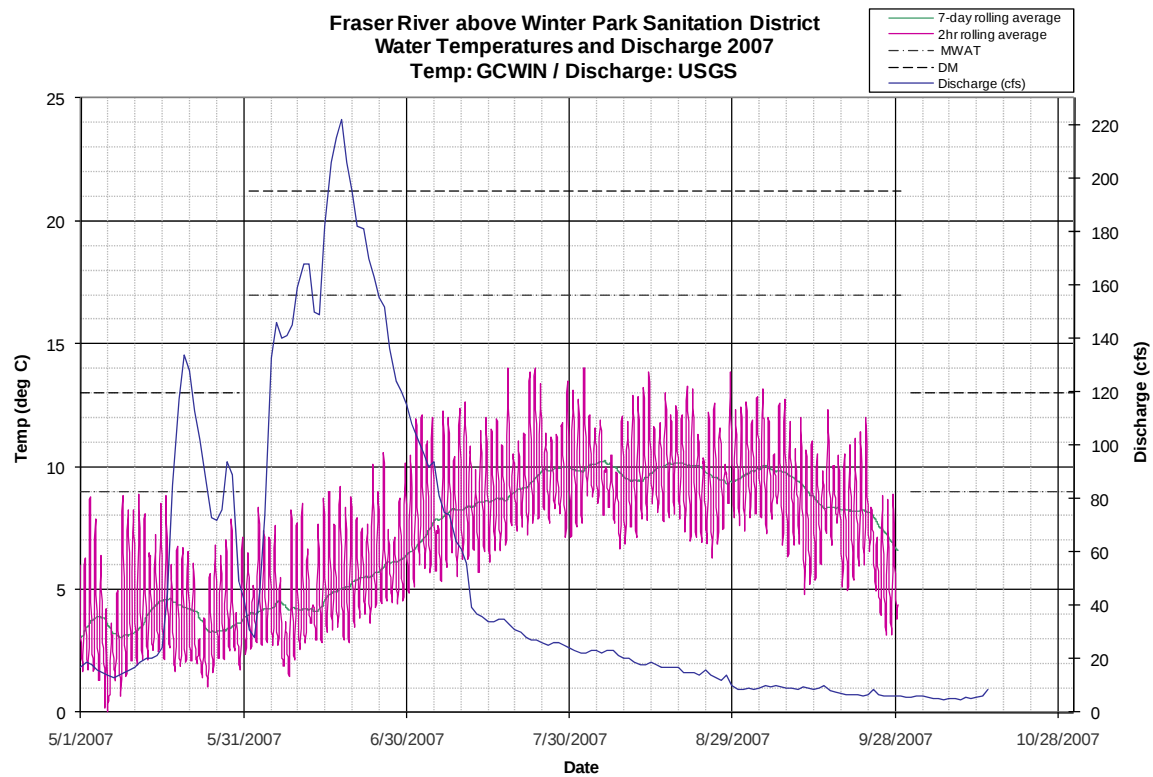
the sediment basin and presence of fine sediments from the Denver Water intake area will provide an opportunity to build a flushing channel at the headgate area that could be used in concert with a flushing flow, to push spawning gravels past the headgate area.

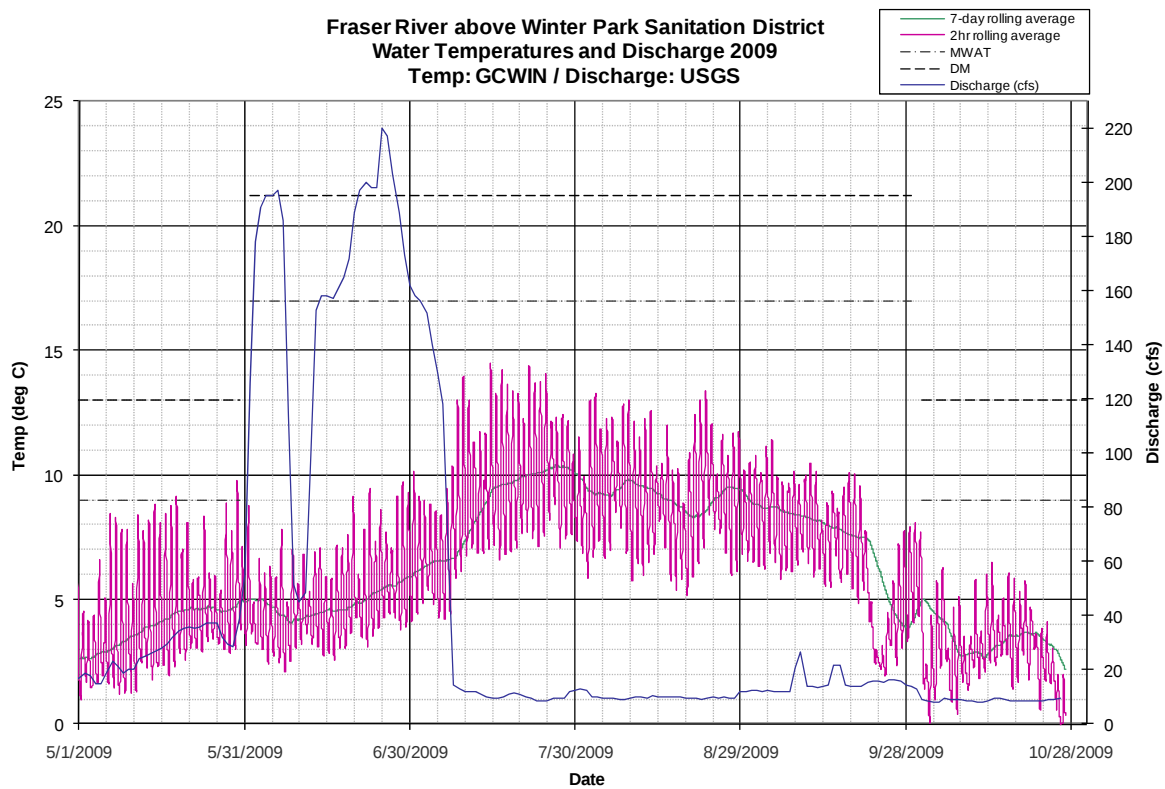
- ✓ Consider a reduction in winter diversions at the Denver Water intake to increase base flows to downstream water users, specifically for Winter Park Water and Sanitation District, and specifically during the peak tourist ski season (late December through mid-April).
- ✓ Develop maintenance requirements and schedule for sediment basin(s).
- ✓ Inventory downstream culverts, bridges and other stream crossings for capacity-related issues as they relate to gravel transport and flushing flow implementation.
- ✓ Continue to negotiate and implement the construction of a sedimentation/flocculation facility to treat the outfall on the West Portal side of the Moffat Tunnel.
- ✓ Practice and enforce effective Best Management Practices (BMPs) associated with local construction for the control of sediment runoff.
- ✓ Implement roadside BMPs along U.S Highway 40 to limit traction sand from entering the river directly along this reach.

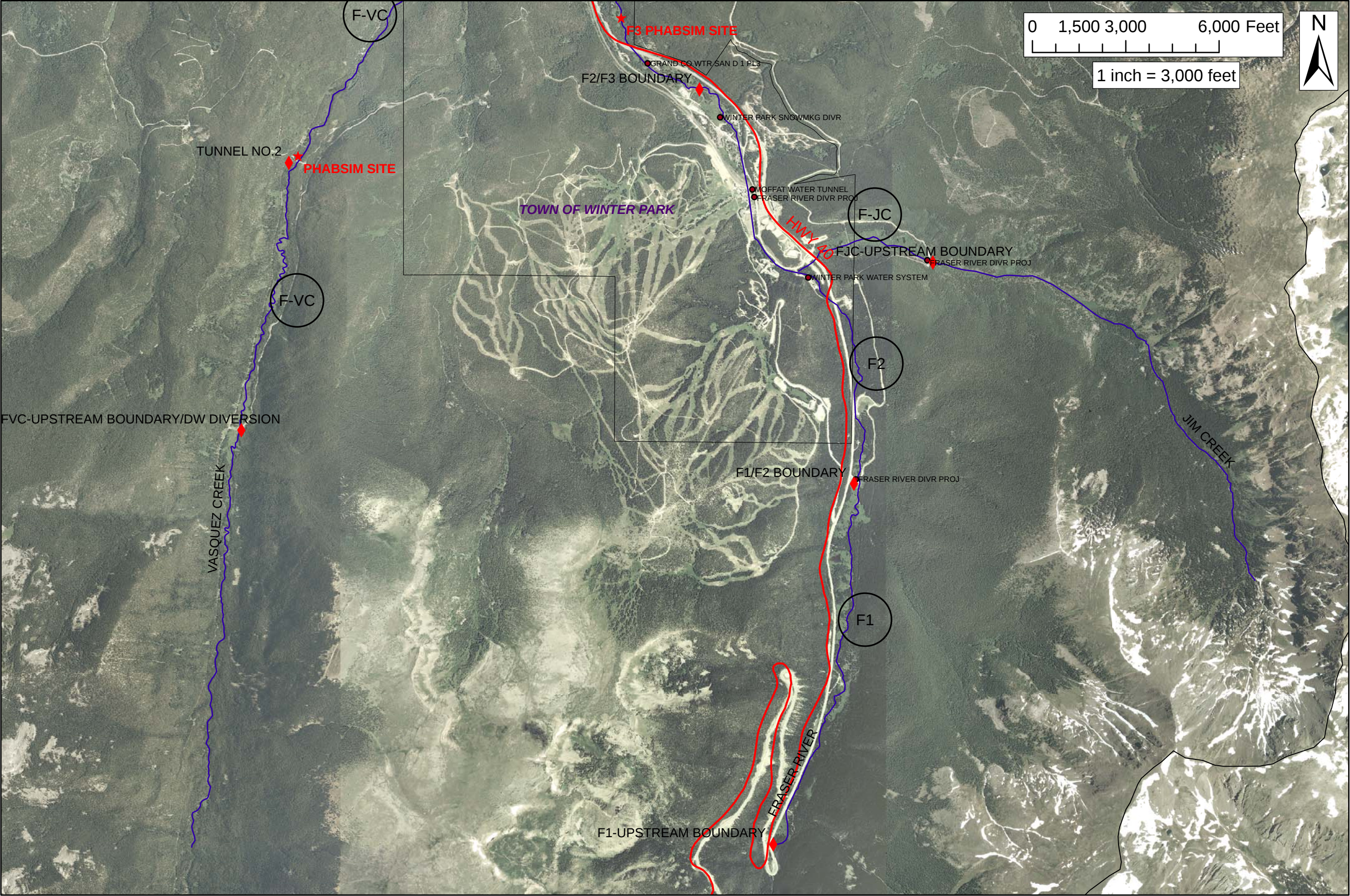
Monitoring: Establish and implement a monitoring program. Parameters should include monitoring of intergravel fine sediments and channel cross sections to monitor deposition and effectiveness of the sediment basin(s). Add a gage below Denver Water diversion structure to monitor streamflows.

Support Data

Surface Water Temperature Plots







GRAND COUNTY
STREAM MANAGEMENT PLAN
REACHES

Legend

- ◆ REACH BOUNDARY
- ★ PHABSIM SITES
- DIVERSIONS

REACH: F2
SHEET # :
1 OF 1

