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Stillwater River Flood Rehabilitation River Assessment Triage Team (RATT) 2023 Report - Executive Summary

Prepared for:

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The following document is an executive summary for the 2023 Stillwater Watershed RATT Report. It is intended to provide a brief summary of flood impacts and recommendations for addressing those impacts. It is primarily designed for local landowners on the Stillwater River, Rosebud Creek, and East and West Rosebud Creeks, although the recommendations for specific impacts may be useful to landowners on other streams in the watershed. For more information, please see the full report and accompanying appendices.

Note: Data for the flood are continuing to be analyzed by hydrologists. The numbers below reflect the best available data at the time of this work. Numbers related to flood magnitudes and frequencies may change as more hydrologic analysis is completed.

In mid-May of 2022, the Stillwater River at Absarokee was at an all-time low flow for that date (395 cfs on May 15). About a month later, an "atmospheric river" of moisture from the Pacific reached southern Montana, dropping 2-3 inches of rain on the mountain snowpack. This caused an estimated 4-9 inches of water to rapidly run off and reach the rivers draining the Beartooth Mountains. The river had been running at normal flows in early June, but then it rose rapidly to 6,400 cfs the night of June 11. Although this is a typical spring runoff peak, it was only the initial rise. By late morning on June 13, a massive runoff peak (measured indirectly) of 16,900 cfs reached Absarokee. Flows dropped within a day to 10,000 cfs, but the overall waning of the peak lasted 3 ½ days. After this event, there were three additional smaller magnitude flood peaks, all of which exceeded 6,000 cfs, that lasted into the first week of July. Our preliminary post-flood evaluation of West Rosebud Creek indicates that the peak flow of Rosebud Creek near Absarokee could have been 50 percent larger if Mystic Lake hadn't captured runoff from the upper West Rosebud drainage.

To document flood impacts and develop response strategies, the Stillwater Valley Watershed Council (SVWC) organized numerous local funders to assemble and support a ***River Assessment Triage Team*** (RATT). The team included a professional geomorphologist, hydrologist, fishery biologist, geographic information specialist and writer/community educator.

The RATT work was performed during the winter of 2022-2023. The team preformed scientific assessments of the flood, visited landowners in the river corridor, assessed flood impacts on each property, developed conceptual rehabilitation alternatives to address those impacts, and identified potential conservation opportunities. The goal of the RATT effort is to effectively document the nature and impacts of this flood, and to identify means of responding to the event that can support residents and the local economy while promoting the sustainability of both long-term land uses and ecological function of the Stillwater River, East Rosebud Creek, and West Rosebud Creek.

Some General Considerations for Landowners

General impressions and recommendations from the RAT Team regarding landowner approaches to managing these streams into the future are below.

1. The June 2022 flood was an "event of geologic scale", causing major changes both to the river channels and the valleys they occupy. These changes are long-term and thus will require sensible

adaptations. Riparian landowners now border a new river with new challenges. It is important to understand the profound geomorphic change in many sections of the river and to consider how to address those changes without unnecessarily impacting the natural character and associated ecological health of the river with “fixes” that might prove cost ineffective and detrimental.

2. When floods cause massive changes in a stream, there is typically a long period of adjustment as the river reworks flood sediment and vegetation begins to recover. Continued adjustments on the assessed streams should be expected for many years as the river re-establishes equilibrium conditions of width, slope, and riparian integrity. After major flooding, it is common for landowners to feel the need to “put things back how they were”, however, in other places in Montana that experienced similar flooding in 2011 (notably the Musselshell), those landowners that simply monitored areas of concern for the first few years ended up with the best outcome, both financially and in terms of river health. Sometimes a rapid response can backfire as the river continues to adjust.

3. There are places that warrant well-engineered erosion control treatments to protect infrastructure and high value property. This includes impacted transportation infrastructure (roads and bridges), residences under immediate threat of undermining or which are vulnerable to the next flood, and irrigation diversions.

4. The most popular erosion control treatment used on private lands has often been quarried rock riprap. This approach is typically expensive, and often unnecessary. Rock riprap locks streams into place, and it is often detrimental for long-term river health, be it bankline conditions (no vegetation, shade, or undercutting) or long-term channel movement that supports riparian health. Professional engineering plans are often required by regulatory agencies for significant bank protection and restoration projects. Landowners should be aware that engineers will commonly design projects using conservative assumptions and factors of safety that usually produce more protective but more expensive projects. Landowners should have a detailed discussion with their engineer and contractor of the value of the property to be protected, the minimum acceptable design flood flow and water depth (10, 25, 50 or 100-year event), and the costs versus benefits of several options. There are plenty of options beyond traditional full-bank rock riprap such as brush matrices, root wads and other woody debris, or toe rock (quarried or native boulders) with a sloping planted upper bank. Less aggressive erosion control treatments can be applied as short-term, temporary protective measures; this can be an effective approach as problem areas shift in coming years as the river continues to change. These alternatives can be incorporated into engineering designs. We encourage all flood-affected property owners to review the wide variety of streambank restoration options described in Appendix A of the RATT report as well as the “Montana Stream Permitting Guide” available from the Montana Department of Natural Resources (2020). Landowners can also contact scientists and engineers in public agencies and in the private sector for assistance.

5. It is important to understand that erosion control will not stop flooding. Floodwater management tends to be most effective when it includes restoring/maintaining overflow channels,

preserving/restoring an intact riparian zone, and avoiding the construction of obstacles to flow or structures in the floodway. Building new floodplain barriers (e.g. berms/levees/dikes) can have unintended impacts, and thus aren't typically permittable.

6. Cost-benefit analysis is a key component of strategy development. Bank stabilization projects are expensive, typically costing at least $100 per cubic yard for placed riprap, which may need to be placed at a density of 1.5 cubic yards per yard of bank. Landowners should compare the cost of treatments (design, permitting, construction, and maintenance) to the value of the land.

7. Riparian landowners and local governments should consider setting structures back from the riverbanks for the best insurance against flood risk. Once residences (or other structures) are built on streambanks, the "die is cast", and most landowners will eventually employ aggressive erosion control measures that will cumulatively destroy key aspects of the river's ecological integrity such as riparian health, and fish and wildlife habitats. Our findings showed clearly that larger housing setbacks would have prevented costly damage and allowed the river to accommodate major flooding, which science indicates could become more common in coming decades. The bank erosion we observed against high terraces demonstrated how bank height alone will not protect landowners from the risk of damage.

Recommendations for Addressing Bank Erosion

Bank erosion was one of the most extensive and visible flood impacts. Digitized pre- and post-flood banklines indicate that just over 300 total acres of ground was eroded during the flood, with the vast majority on the Stillwater River and East Rosebud Creek. Figure 1 shows an example of the mapping, which is available for the Stillwater River (Sibanye-Stillwater Mine to Columbus) East Rosebud Creek (5.6 miles above the Forest Service Boundary to mouth), West Rosebud Creek (1.9 miles above Forest Service Boundary to mouth), and Rosebud Creek.

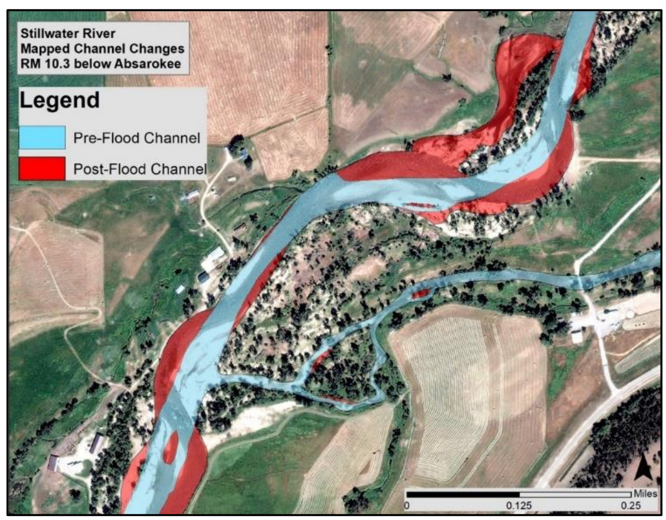

Figure 1. Example bankline mapping showing pre- and post-flood banklines capturing erosion location and extent, Stillwater River RM 10.3 below Absarokee

Where landowners decide to stabilize banklines, some RATT recommendations include:

1. Prioritize need, take a wait-and-see approach (NO ACTION) if possible.
2. Reduce bank angle to 3:1 if possible.
3. Consider alternatives to full-bank quarried rock riprap. Use wood/alluvium as treatment where infrastructure is not under immediate threat.

4. Concentrate on toe treatments along the base of the re-sloped bank; do not carry rock above the normal high water mark. Use vegetative treatments on upper bank slopes (See Appendix A for examples).
5. Consider using local boulders for a simple toe treatment. Make sure the bank slope is low and that the toe has the densest boulder placement. Toe rock sizing can be determined by an engineer for a given stream setting and level of protection.
6. Include a bankfull bench typically designed to the elevation of the bankfull discharge, composed of a reinforced toe, with compacted wood and alluvium behind it if the treatment encroaches into the channel; cap bench with alluvium/wood and plant perennial woody vegetation.
7. Where the channel widened dramatically, rearrange coarse bedload to keep thalweg off of bank. The thalweg is usually the portion of the stream cross-section carrying the deepest and fastest moving water.
8. Use wood treatments to deflect flows on upstream and/or downstream ends of eroding bank.
9. Rebuild fences anticipating a gentle layback of steep slopes (~3:1).
10. Encourage residential construction to incorporate a setback defined by a minimum interpolated slope angle of 4:1 from the low water's edge to the top bank.

Recommendations for Lost Channel Capacity

Channel infilling with coarse bedload sediment was a common flood impact. This included deposition of new point bars and deposition within/at the heads of existing side channels (Figure 2). An estimated 10.8 miles of channels have become isolated due to deposition, some of which have sediment concentrated at their entrances and others throughout their length.

Figure 2. Large point bar deposition and loss of side channel on Stillwater River, RM 10.5

Where landowners decide to work to improve channel capacity, some RATT recommendations include:

1. Reactivate side channels by excavating sediment/building apex log jams at heads of islands.
2. Skim tops of bars versus removing entire feature to maintain a low flow channel.
3. Retain wood jams and woody debris that aren't creating problems to improve habitat diversity.
4. Restore side channels that have aggraded to improve conveyance/habitat.

Recommendations for Managing Floodplain Wood

Debris accumulations were extensive on the river and included both man-made materials as well as large wood (Figure 3).

Figure 3. Example debris accumulation on upper Stillwater.

Where landowners decide to remove or relocate flood-sourced wood accumulations, some RATT recommendations include:

1. Rearrange floodplain wood and create openings along side channels and sloughs to better route overflows back to channel.
2. Concentrate wood at points of overflow to reduce overflow volumes.
3. Leave scattered wood in developing overflow channels to prevent their capture of the main thread.
4. Where possible, relocate wood to use as bank treatments; anchor with boulders to minimize risk of remobilization.
5. Creative incorporation of large woody debris such as root wads into restoration work can significantly improve fish habitat.

Recommendations for Repairing Damaged Roads

A total of 4,520 feet of road was mapped as having clear evidence of damage by bank erosion. Of that, approximately 0.5 miles of road was directly impacted by erosion on the Stillwater and 0.3 miles on the East Rosebud. Whereas some of the road damage has been repaired, some of the damage on the North Stillwater Road near Absarokee remains unrepaired or temporarily abated. The route was still closed as of June 2023. On the upper Stillwater above the mine, the road was still closed in March 2023; this road provides public access to Woodbine Campground and public land beyond. By June 2023, it was reopened to mine traffic but not public use. Approximately 0.3 miles of the access road to East Rosebud Lake on USFS property was eroded, isolating over a 5-mile stretch, rendering that area inaccessible.

Where landowners decide to rebuild roads, some RATT recommendations include:

1. If possible, relocate road back from stream to improve safety, reduce bank slope, and provide for bank habitat restoration.
2. Build strong rock toe; try to avoid extending rock into stream corridor.
3. Consider alternate treatments in upper bank (fabric lifts, woody/alluvial treatments)
4. Consider abandoning of or re-purposing roads for local use only where repair costs are prohibitive.

Recommendations for Repairing or Rebuilding Bridges

Figure 4. Upper Stillwater Bridge failure (RM 39.3); bridge provided the primary access route for the Rainbow Ranch Subdivision.

A total of 59 bridges were mapped in the assessment reaches, and 13 of those were completely destroyed by the flood. All the destroyed bridges were on either the Stillwater River or East Rosebud Creek. Several bridges provided primary access for residences such as the Rainbow Ranch Subdivision on the upper Stillwater (Figure 4). Other bridges visited in the field were substantially damaged but did not fail.

Where landowners decide to rebuild bridges, some RATT recommendations include:

1. Remove old or destroyed bridge piers, spans and remnants when replacing structure/restoring site.
2. Make sure bridge piers are designed to withstand bed scour.
3. Replace bridges with spans of sufficient length to avoid constricting the river which leads to excessive scour and greater flood stages.
4. Eliminate and do not create hazards for other river users floating the river or utilizing the zone below the ordinary high water marks.

Recommendations for Repairing Irrigation Infrastructure

As irrigation structures tend to be somewhat unique in terms of placement and construction, the impacts to them were widespread but variable. In general, damages consisted of the following:

- Destroyed or damaged headgates
- Erosion around headgates causing structure destabilization and loss of functionality
- Sediment/wood accumulations at headgates or in diversion channels to headgates damming off river access or affecting performance
- Overwhelming of headgates by floodwaters causing downstream ditch flooding

Where landowners decide to rehabilitate irrigation infrastructure, some RATT recommendations include:

1. Clean out debris in approach channel.
2. Ensure that there is a high flow release structure down ditch if headgate overtopped.
3. Repair flanked headgates as necessary with rock.
4. When making repairs, mitigate fish entrainment at the diversion (consult FWP).
5. Where rock diversions extend into river, maintain a low flow thread in river to support the fishery, pass sediment, and reduce risks to floaters.
6. To avoid rock weirs that cross the main channel, extend rock diversions further upstream but with a narrower opening that does not protrude excessively into the river mainstream.

Recommendations for Addressing Avulsions

An ***avulsion*** is the rapid carving of a new channel through a floodplain surface that captures flow of the main channel thread. A total of 29 avulsions were mapped in the assessment area, with the majority occurring throughout the riparian bottomlands along East Rosebud Creek below the USFS boundary. About 5.2 miles of new channel formed, with almost half of that total length on East Rosebud Creek. Some of these channels will decay with time, especially if they didn't erode deeply enough to carry typical flows. Some will persist as main channel threads. Although avulsions can create problems due to the dramatic channel change, they can also create beneficial habitat complexity and rejuvenation where infrastructure is not directly threatened.

Where landowners are concerned about channel avulsions, some RATT recommendations include:

1. If possible, maintain multithread channel connectivity for future flood relief, habitat, but with the main flow retained in the pre-flood channel.
2. Add large wood at the entrance to developing floodplain channels to dissuade their enlargement.
3. Monitor and, if a large avulsion is imminent and unacceptable, develop more aggressive alternatives to prevent wholesale channel relocation.

Permitting Considerations

Any proposed project should be evaluated early in the conceptual design process for permitting requirements. The most commonly required basic permits are a 310 and 404, administered by Conservation Districts and the US Army Corps of Engineers, respectively. Additionally, a floodplain permit from the County is generally required for any action in the mapped regulatory floodway or connected special hazard areas. There are FEMA mapped floodplains in Stillwater and Carbon County which may require substantial analysis of project impacts. In the construction process, a Short-Term Water Quality Standard for Turbidity (318 Authorization) may be required from the Montana Department of Environmental Quality. Montana Fish Wildlife and Parks administers 124 permits, which are required if the applicant is any agency or subdivision of state, county, or city government.

For more information on permitting in Montana, go to:

https://dnrc.mt.gov/licenses-and-permits/stream-permitting/