ABSTRACT

The BNSF Forsyth Subdivision runs along the south side of the Yellowstone River for about 190 miles in eastern Montana. During the spring of 2011, the Yellowstone River reached historic flood levels forcing train operations to shut down. Flooding and saturated ground conditions caused damage at nearly 180 locations. BNSF and Shannon & Wilson, Inc. performed emergency site visits to assess the damage, evaluate risk, develop immediate repair plans, prioritize repairs, and initiate permitting. Priority repairs included riprap placement, slope and ditch grading, culvert repair and replacement, and subdrain construction.

The emergency repairs impacted a cumulative 18,635 lineal feet (3.5 miles) of water bodies designated as Waters of the United States. Regulators require environmental mitigation to offset adverse impacts of emergency repairs. Typical mitigation is often on-site, in-kind mitigation such as bank restoration and re-vegetation at damaged sites. Due to the scope of the emergency repairs, on-site and in-kind mitigation was both cost-prohibitive and logistically impossible in many locations. Therefore; off-site and out-of-kind mitigation was considered and actually is becoming more acceptable and in some cases preferred by regulatory agencies. Shannon & Wilson and BNSF developed an off-site, out-of-kind mitigation strategy that involves financially supporting a new in-lieu fee program that will implement environmental projects in the Yellowstone basin. This strategy, and others similar to it, is cost effective for BNSF, meets the needs of the
regulatory agencies, ecologically benefits the Yellowstone River, and may provide a framework for future mitigation alternatives in Montana and elsewhere.

**INTRODUCTION**

The BNSF Railway Company operates over 200 miles of mainline track along the Yellowstone River between the cities of Billings and Glendive in eastern Montana. An additional 296 miles of BNSF track runs along Yellowstone River tributary streams in eastern Montana. During the spring of 2011, historic rainfall and snowmelt events caused extensive flooding in the Yellowstone River watershed.

River bank erosion caused by the flooding, combined with saturated ground conditions in the railroad embankments and uplands, resulted in extensive damage to the railroad. Types of damage included erosion of railroad embankment slopes and shoulders, culvert failure, embankment washouts, and burial of the track in landslide debris. Track through much of eastern Montana was taken out of service until BNSF could perform emergency repairs. Repairs at many of the damage sites included rock riprap placement that triggered mitigation requirements as set forth in the Clean Water Act. This paper describes the flood damage, repairs to the railroad, and development of a unique compensatory mitigation plan to address the impacts of the emergency repairs.

**FLOODING IN THE YELLOWSTONE RIVER WATERSHED**

The Yellowstone River is the longest free-flowing river in the lower 48 states. It flows over 670 miles from Yellowstone National Park to its confluence with the Missouri River near Williston, North Dakota, as shown in Figure 1.
In May 2011, three storm systems moved across eastern Montana. Total rainfall in Miles City for the month was 9.5 inches; 7 inches above normal. Wet soil conditions from above-average precipitation in March and April 2011 contributed to the increased runoff that occurred after the May storms (1).

Record snowfall during the winter of 2010-2011 also contributed to the flooding. A Natural Resources Conservation Service (NRCS) report from June 2011 reported snowpack in the Upper and Lower Yellowstone River Basins at 222 to 305 percent above average, respectively (2).

As rain fell and snow melted, the Yellowstone and many other rivers in Montana swelled beyond their banks. The Yellowstone River crested at its third-highest level on record in Billings, Forsyth, and Miles City. On June 17, 2011, a presidential disaster was declared for 31 of Montana’s 56 counties (3).

Figure 2(a) show Yellowstone River data in Miles City during spring and summer of 2011. The plots show actual discharge measured at the Miles City stream gauge and median daily discharge based on an 85-year period of record. The maximum discharge of 85,400 cubic feet per second (cfs) occurred on May 24. This discharge is 365 percent above the median daily discharge of 23,400 cfs for May 24.

Figure 2(a) shows river elevation at the United States Geological Survey (USGS) stream gage in Miles City. Flood stage corresponds to an elevation of 13.0 feet. Between May 22 and July 11, the river rose above flood stage on seven occasions.
On May 20, 2011, BNSF asked its geotechnical consultant Shannon & Wilson, Inc. (S&W) to evaluate embankment instability at Milepost (MP) 85 of the Forsyth Subdivision. In the following days and weeks, the number of damage locations would grow to nearly 180 on five Montana subdivisions in the Yellowstone River Basin. Damage included landslides, erosion of embankment slopes and track shoulders (Figure 3), culvert failure, and complete embankment washouts (Figure 4).
Figure 3 – Embankment Slope and Shoulder Erosion

Figure 4 - Embankment Washout on the Hettinger Subdivision
The number of locations spiked during the last week of May when the Yellowstone River crested above flood stage for the first time that season. The majority of the damage occurred in the Forsyth, Hettinger, and Dickinson Subdivisions. Figure 5 shows reported damage sites in these subdivisions.
Figure 5 - Damage Sites in the Forsyth, Hettinger, and Dickinson Subdivisions in Montana
To rapidly respond as the emergency conditions developed and progressed, BNSF established a command center in Billings. Damage assessments were carried out by teams consisting of BNSF engineering and maintenance-of-way personnel and S&W geotechnical engineers and geologists. At each damage location, the teams documented existing site conditions by taking photographs and sketching site plans and cross-sections. The teams ranked the sites as low to high priority for repair based on the impact of the damage to train operations. They developed emergency repair recommendations and estimated material quantities needed for the repairs. The immediate objectives of the emergency repairs were to restore train service and protect the railroad track and embankment from additional damage.

Repair work consisted of:

- Placing rock riprap to replace soil and previously-placed riprap fill that had washed away during the flooding and to buttress eroded slopes (Figures 6 and 7).
- Installing new culverts and riprap erosion protection at culvert inlets and outlets.
- Replacing, extending or cleaning existing culverts.
- Excavating landslide debris from the track, ditches, and shoulders.

Figure 6 – Embankment Slope Reconstruction and Bank Stabilization, Dickinson Subdivision
Figure 7 – Riprap Placement for Embankment Restoration, Forsyth Subdivision

Fill material used to restore and stabilize embankment slopes generally consisted of angular, quarried rock riprap. In some cases when riprap was not readily available, fill consisted of railroad ballast or soil. Riprap was purchased from commercial quarries and hauled by trucks to rail-yards in the subdivisions. At the yards, riprap was loaded onto side-dump railcars and hauled to repair locations. No equipment was operated in-water and, to the extent possible, construction was conducted from rail-mounted equipment to avoid disturbing adjacent land.

PERMITTING
The Clean Water Act

In 1972, Congress passed the Clean Water Act (CWA) “to restore and maintain the chemical, physical, and biological integrity of the Nation’s waters.” To achieve this goal, the CWA prohibits the discharge of fill material into wetlands, streams, and other waters of the United States unless a permit issued by the United States Army Corps of Engineers (Corps) or approved State agency under CWA Section 404 authorizes such a discharge (5).

When there is a planned discharge of fill into a waterway, the Corps requires that all practicable steps be taken to avoid and minimize impacts to aquatic resources. The
BNSF emergency response that resulted in placement of fill below the water line triggered the CWA Section 404 permit requirement. Unplanned discharges such as emergency riprap placement during flooding may have unavoidable impacts to aquatic resources. In these circumstances, the Corps may require compensatory mitigation to replace the loss of wetland, stream, or other aquatic resource functions. The Corps (or approved state authority) is responsible for determining the appropriate form and amount of compensatory mitigation required.

Pre-construction Notification of Agencies

The CWA requires pre-construction notification to the Corps of discharges into waters of the U.S., whether planned or unplanned. On May 23, 2011, the BNSF project team notified the Corps of the flood damage to the rail infrastructure and the need for immediate repairs. The Corps agreed that emergency repairs were necessary given the immediate and significant economic hardship to the railroad and national commerce. However, the Corps notified BNSF that best management practices must be implemented during the emergency repairs, efforts must be taken to avoid and minimize impacts where practical, and after-the-fact permitting would be required once the emergency response was complete.

Documentation of Impacts

To comply with the CWA Section 404 requirements, an S&W biologist visited damage locations between July 6 and 8, 2011. Emergency repairs were completed at most of the sites before the site visits. During the site visits, the biologist:

- Estimated the volume of riprap or other type of fill placed below the water line,
- Determined whether the eroded bank had been hardened with riprap before flooding occurred,
- Estimated whether the new fill had approximately the same area (have the same footprint) as the original embankment.

Sites that had not previously been hardened with riprap, or had a larger footprint than what previously existed, require compensatory mitigation. Field data collected by the biologist were used to create individual site data sheets. An example is shown in Figure 8.
Based on the field reconnaissance, the emergency repairs disturbed about 10,450 lineal feet (lf) of stream bank. An estimated 2,425 lf of this total length resulted from maintenance activities. Maintenance activities consisted of culvert cleaning, replacement of existing culverts, and replacement of riprap where existing riprap had washed away during flooding. The remaining 8,025 lf of stream bank impacts resulted from new riprap on previously unhardened banks and new culvert installation.

**COMPENSATORY MITIGATION PLAN**

Emergency repairs that did not qualify as maintenance activities required compensatory mitigation. Compensatory mitigation is typically accomplished through one or a combination of the following methods:

**Permittee-Responsible Mitigation**

A permittee may be required to provide compensatory mitigation through an aquatic resource restoration, establishment, enhancement and/or preservation activity. This compensatory mitigation may be provided at or adjacent to the impact site (i.e., on-site mitigation) or at another location, usually within the same watershed as the permitted impact (i.e., off-site mitigation). The permittee retains responsibility for the implementation and success of the mitigation project.

**Mitigation Banks**

A permit applicant may obtain credits from a mitigation bank. A mitigation bank is a wetland, stream or other aquatic resource area that has been restored, established, enhanced, or preserved. This resource area is then set aside to compensate for future impacts to aquatic resources resulting from permitted activities. The value of a bank is determined by quantifying the aquatic resource functions restored, established, enhanced, and/or preserved in terms of “credits.” Permittees, upon approval of regulatory agencies, can acquire these credits to meet their requirements for compensatory mitigation.

**In-Lieu Fee Mitigation**

A permit applicant may make a payment to an in-lieu fee program that will conduct wetland, stream or other aquatic resource restoration, creation, enhancement, or preservation activities. In-lieu fee programs are generally administered by government agencies or non-profit organizations that have established an agreement with the regulatory agencies to use in-lieu fee payments collected from permit applicants. Mitigation banks and in-lieu fee mitigation are forms of “third-party” compensation because a third party, the bank or in-lieu fee sponsor assumes responsibility from the permittee for the implementation and success of the compensatory mitigation. Mitigation banks and in-lieu fee programs use a multi-resource agency process that brings more expertise and collaboration into the planning, approval, and oversight of wetland restoration and protection projects. For these reasons, compensatory mitigation rules were changed in 2008 to encourage the use of mitigation banks and in lieu fee programs.
Selection of Preferred Mitigation Alternative

The BNSF project team considered and then rejected permittee-responsible mitigation options. On-site and in-kind stream mitigation could have included stream bank restoration at the repair sites. The BNSF project team determined, however, that on-site and in-kind mitigation was not a practical alternative given the scale of mitigation, the number of individual sites, and the difficulty of bank restoration on steep slopes between the river and the railroad. Off-site and out-of-kind mitigation was proposed as a more practical mitigation approach.

S&W contacted several federal, state, local, and nonprofit groups working along the Yellowstone River to identify appropriate projects that would provide long-term ecological benefits to the Yellowstone River watershed. These agencies and groups suggested several mitigation projects for consideration. Of those projects reviewed, three were selected that provided geographic representation and offered significant, long-term ecological benefit. These three projects comprised the initial BNSF Compensatory Mitigation Proposal (CMP). The projects are described below.

Site 17
Site 17 is located along the Yellowstone River downstream of the Forsyth Subdivision near Sidney, Montana (see Figure 5). The site was used as a dump in the 1970s and 1980s when car bodies, riprap, and fly ash were placed to create a makeshift berm along the river bank for approximately 1,200 feet. The project proposed to remove this material, restore the site, reconnect the floodplain to the river, and contribute to flood relief through the rest of the Yellowstone River system. A cost estimate for the project had been developed previously by WWC Engineering of Helena Montana for the Richland County Conservation District. The first component of the BNSF CMP included paying for all or part of Site 17 restoration.

Pryor Creek Irrigation Siphon Project
Pryor Creek is a tributary to the Yellowstone River located near the town of Huntley, upstream of the Forsyth Subdivision (see Figure 5). An inverted irrigation siphon has blocked fish passage through Pryor Creek for over 100 years. A redesign of the siphon that allows fish passage has been completed, but the irrigation district lacks funding to construct the project. The second component of the BNSF CMP included partial funding of the Pryor Creek siphon reconstruction project.

Floodplain/Channel Migration Zone (CMZ) Acquisition
The third component of the BNSF CMP would contribute funds for the purchase of lands within the Yellowstone River channel migration zone (CMZ) and floodplain. The Montana Department of Fish, Wildlife, and Parks (FWP) currently manage funds it receives for Yellowstone River floodplain acquisition as part of an existing mitigation agreement with the Western Power Authority (WPA). The FWP however, has limited ability to acquire property with these funds. Therefore, the State of Montana is developing an agreement that will transfer these funds to Montana Aquatic Resources, Inc. (MARS). MARS is a nonprofit corporation established in 2011 to manage a statewide in-lieu fee program. When MARS obtains State approval, they will use these funds for floodplain and CMZ acquisition. The BNSF CMP included a financial contribution to the FWP land acquisition fund. The FWP would hold these funds with the WPA funds,
and subsequently transfer them to MARS to be used as part of their in-lieu fee program.

**Section 404 Permit**

The project team submitted the BNSF CMP consisting of the three projects described above to the Corps on June 8, 2012. The team also prepared a Joint Application for Proposed Work in Montana’s Streams, Wetlands, Floodplains, and other Water Bodies. The Corps used these documents to prepare a “Joint Public Notice for Permit Application Submitted to U.S. Army Corps of Engineers and Montana Department of Environmental Quality.” The Notice described BNSF’s application for after-the-fact Individual Permit approval of its CMP. The Corps issued the Notice for public review and comment on July 5, 2012.

**Outcomes of the Public Review and Comment**

The public review and comment period closed on August 15, 2012. The Corps received comments from the U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service (USFWS), and Montana FWP. The BNSF project team provided the Corps and the Montana Department of Environmental Quality (DEQ) with additional information to assist them with responding to public comments received for the 2011 Spring Flooding under Sections 401 and 404 of the federal Clean Water Act Emergency Repairs after-the-fact permitting.

Notable comments included the following:

1) The USFWS determined that four endangered, one threatened, and two candidate species may occur in the project area and required a Biological Assessment to determine the effects of the proposed action.

2) FWP did not support BNSF making a direct payment to a private irrigation district and therefore, objected to the Pryor Creek Siphon portion of the mitigation proposal.

Following the Public Review and Comment period, Montana DEQ issued a 401 Certification for the project on September 14, 2012. In addition to Section 404, the CWA includes a federal/state cooperative program referred to as a 401 Certification that increases the role of the state in decisions regarding the protection of natural resources. In Montana, the 401 Certification is issued by the DEQ. Conditions of the 401 certification may require the applicant to provide compensatory mitigation for the impacts or losses.

As a result of the Public comments, the Corps determined that BNSF should not fund the off-site projects at Pryor Creek and Site 17. The Corps instead indicated that they would require all mitigation credits to be in the form of a lump sum payment to the MARS in lieu fee program, which by the Fall of 2012, was nearly authorized by the State to begin collecting in lieu fees.

To calculate the number of mitigation credits BNSF would need to purchase through MARS, the Corps performed a cumulative impact analysis in January 2013 as part its Section 404 permit preparation. Using the 2010 version of the Montana Stream Mitigation Procedure, a spreadsheet program that evaluates impacts based on various
stream characteristics, the Corps determined that the emergency repairs resulted in approximately 47,000 debits. The corps does not set the price per credit. BNSF would need to negotiate with MARS to determine the cost of 47,000 credits. To obtain competitive pricing for mitigation credits, costs were obtained from MARS and a private mitigation bank (Eco Assets).

After receiving cost estimates, S&W asked the Corps to delay issuing the Individual Permit. The delay would allow BNSF to consider other options and develop a more cost-effective mitigation proposal. The Corps has agreed to a delay until March 2014. Work is currently underway to identify potential mitigation sites within the BNSF right-of-way. Sites where stabilization work is needed due to river encroachment, slope instability, or settlement are being reviewed for potential mitigation opportunities. Whether stabilization combined with mitigation at one or a few sites can be cost-competitive with a lump sum payment to MARS or a mitigation bank will be evaluated as the project progresses.

CONCLUSIONS

The BNSF project team completed a thorough analysis of the flood impacts and potential mitigation options. A compensatory mitigation proposal was submitted that included a bank restoration project, a fish passage project, and a financial contribution to a new in-lieu fee program. The Site 17 and Pryor Creek projects, while included in the proposal at the suggestion of regulatory agencies, were ultimately rejected due to objections by other agencies. The Corps is requiring mitigation of about 47,000 debits through a lump-sum payment to MARS or a mitigation bank. However, they have agreed to delay issuance of the permit to allow the BNSF project team to consider other, more cost-effective options for compensatory mitigation.

REFERENCES


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LIST OF FIGURES

Figure 1 – Yellowstone River Watershed Map showing BNSF Railway Subdivisions in the Middle and Lower Yellowstone Basins
Figure 2(a) – Yellowstone River Discharge in cubic feet per second at Miles City, Montana, April 1, 2011 – September 1, 2011
Figure 2(b) – Yellowstone River Gage Height in feet at Miles City, Montana, April 1, 2011 – September 1, 2011
Figure 3 – Embankment Slope and Shoulder Erosion
Figure 4 – Embankment Washout in the Hettinger Subdivision
Figure 5 – Damage Sites in the Forsyth, Hettinger, and Dickinson Subdivisions in Montana
Figure 6 – Embankment Slope Reconstruction and Bank Stabilization, Dickinson Subdivision
Figure 7 – Riprap Placement for Embankment Restoration, Forsyth Subdivision
Figure 8 – Data Sheet for In-water Work Location
YELLOWSTONE RIVER FLOOD IMPACTS AND ENVIRONMENTAL MITIGATION FOR THE BNSF RAILROAD IN EASTERN MONTANA

Katie Walter, PWS, and Steven McMullen, PE, Shannon & Wilson, Inc.
French Thompson III, BNSF Railway Co.

“...it didn't take long after floodwaters started receding in mid June to understand that the spring floods of 2011 would be among the costliest natural disasters ever to befall the state.” - Lorna Thackeray with the Billings Gazette (October 30, 2011)
### IMPACTS TO WATERS OF THE UNITED STATES FROM 2011 SPRING FLOODING

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### Typical On-Site and In-Kind Mitigation:

- **Stream Bank Restoration**
Off-Site and Out-of-Kind Mitigation

Due to the scope of the impacts, on-site and in-kind mitigation was not practical.

2008 Federal Rule sets preference for off-site mitigation.

Reached out to several stakeholders to identify a suite of potential projects and narrowed down the projects to 3: Site 17, Pryor Creek Inverted Siphon Project, and Statewide In-lieu fee program.

Site 17

Flooding destroyed irrigation canal that blocked fish passage for ~100 years.

Irrigation Canal supports 30,000 acres of crops.

$2.5 million dollar emergency repair completed to restore irrigation service.

Funding for permanent repair sought.

Pryor Creek Inverted Siphon Project
In-Lieu Fee and Mitigation Bank Programs

In Lieu Fee (ILF) Programs
- Administered by NGO or public agency
- Identify projects - watershed approach

Mitigation Banks
- For profit businesses
- Identify and create banks in areas with need - market approach

Benefits of ILF or Banks to Applicant
- Create or preserve aquatic habitats
- Provide long term management and permanent protection
- Credit sales and release to applicants
- Transfers risk and liability away from applicant

What is next?
- Corps to issue Individual permit identifying mitigation requirements
- Significant credits required to offset debits from repairs
- Costs for the Bank or ILF are high
- Comparing costs for self mitigation (acquisition, construction, 10 years of long-term maintenance and monitoring)
- Looking at long term needs and whether self mitigation can be beneficial for future needs

Questions?

Special Thanks to...
- BNSF Railway Company
- Corps of Engineers, Omaha District, Billings Regulatory Office